National Aeronautics and Space Administration

FY 2008 Budget Estimates

How to Read NASA's Budget Tables

NASA Mission Directorate Budget Table

Budget Authority ($ in millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
FY 2008 President's Budget Request	Sep 2006 Op Plan	Budget numbers using new Theme structure and new method full cost simplification.					
Theme A							
Theme B							
Theme C							
FY 2007 President's Budget Request	Budget numbers using new Theme structure and old method full cost.						
Theme A							
Theme B							
Theme C							
Total Change from FY 2007 President's Budget Request	Top line changes						

The Mission Directorate budget tables provide the full FY 2008 President's Budget Request for each Mission Directorate and the Theme(s) under that Directorate. Each table provides comparative values from the FY 2007 President's Budget Request based on the Agency's previous full cost accounting method and converted to the new FY 2008 Theme structure. The bottom row displays the net change between these two line items.

NASA Theme / Program Budget Table

Budget Authority ($ in millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Theme X	Sep 2006 Op Plan	Budget numbers using new Theme structure and new method full cost simplification.					
Program A							
Program B							

The Theme and Program budget tables provide the FY 2008 President's Budget Request for each Theme or program line item. Each Theme and Program budget table displays information for the programs or projects included as part of that Theme or Program.

Highlights of Theme / Major Program Changes

	FY 2008		
Theme	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Program A			
Program B			
Program C			

FY 2008 column from FY 2007 President's Budget Request using new Theme structure and old method full cost.

FY 2008 budget request using new Theme structure and new method full cost simplification.

The Highlights of Theme/Major Program Changes table provides a comparison for FY 2008 that displays the difference between the FY 2007 President's Budget Request (with the Agency's previous full cost accounting method and the new Theme structure) and the FY 2008 President's Budget Request. In addition, short narratives are provided to explain the changes in each of program or project.

NOTE: The numbers in the budget tables may not add up due to rounding.

National Aeronautics and Space Administration
President's FY 2008 Budget Request

(Budget authority, $ in millions)						
By Appropriation Account						
By Mission Directorate	FY 2007	**FY 2008**	FY 2009	FY 20010	FY 2011	FY 2012
By Theme						
Science, Aeronautics and Exploration	**10,650.6**	**10,483.1**	**10,868.4**	**11,364.2**	**15,386.5**	**15,888.6**
Science	**5,466.8**	**5,516.1**	**5,555.3**	**5,600.6**	**5,656.9**	**5,802.7**
Earth Science	1,464.5	1,497.3	1,545.8	1,520.1	1,411.2	1,353.2
Heliophysics	1,028.1	1,057.2	1,028.4	1,091.3	1,241.2	1,307.5
Planetary Science	1,411.2	1,395.8	1,676.9	1,720.3	1,738.3	1,748.2
Astrophysics	1,563.0	1,565.8	1,304.2	1,268.9	1,266.2	1,393.8
Exploration Systems	**4,152.5**	**3,923.8**	**4,312.8**	**4,757.8**	**8,725.2**	**9,076.8**
Constellation Systems	3,232.5	3,068.0	3,451.2	3,784.9	7,666.0	7,993.0
Advanced Capabilities	920.0	855.8	861.6	973.0	1,059.1	1,083.9
Aeronautics Research	**529.3**	**554.0**	**546.7**	**545.3**	**549.8**	**554.7**
Aeronautics Technology	529.3	554.0	546.7	545.3	549.8	554.7
Cross-Agency Support Programs	**502.0**	**489.2**	**453.5**	**460.4**	**454.7**	**454.4**
Education	167.4	153.7	152.8	152.7	149.8	149.6
Advanced Business Systems	97.4	103.1	69.4	71.6	67.6	67.5
Innovative Partnerships Program	215.1	198.1	197.2	199.8	200.0	200.0
Shared Capability Assets Program	22.1	34.3	34.2	36.2	37.3	37.2
*Continuing Resolution Rate**	*(555.60)*					
Exploration Capabilities	**6,108.3**	**6,791.7**	**6,710.3**	**6,625.7**	**3,036.6**	**2,978.0**
Space Operations	**6,108.3**	**6,791.7**	**6,710.3**	**6,625.7**	**3,036.6**	**2,978.0**
Space Shuttle	4,017.6	4,007.5	3,650.9	3,634.4	116.2	0.0
International Space Station	1,762.6	2,238.6	2,515.1	2,609.2	2,547.5	2,600.8
Space and Flight Support	328.1	545.7	544.3	382.0	372.9	377.2
*Continuing Resolution Rate**	*(40.9)*					
Inspector General	**33.5**	**34.6**	**35.5**	**36.4**	**37.3**	**38.3**
*Continuing Resolution Rate**	*(2.0)*					
TOTAL	**16,792.3**	**17,309.4**	**17,614.2**	**18,026.3**	**18,460.4**	**18,905.0**
Year to Year Change		3.1%	1.8%	2.3%	2.4%	2.4%

FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

** Modification to FY 2007 if current continuing resolution is extended for entire year, and assuming $126.1M institutional mission support transfers from Exploration Capabilities to Science, Aeronautics and Exploration. Not included in totals.*

Totals may not add due to rounding.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FY 2008 Budget Request Summary

Message from the Administrator

The FY 2008 budget request addresses the balanced priorities for our Nation's civil space and aeronautics research goals as set forth by the NASA Authorization Act of 2005 and the Vision for Space Exploration. NASA's mission is to pioneer the future in space exploration, scientific discovery, and aeronautics research. We are doing that.

I believe that the assembly of the International Space Station is a more difficult engineering feat than was the Apollo program. Certainly, completing the International Space Station, retiring the Space Shuttle by 2010, and managing the effective transition from the Space Shuttle to new commercial cargo and crew transportation capabilities, the Orion Crew Exploration Vehicle, and Ares launch vehicles are the greatest management challenges facing NASA since the Apollo era. Science continues to be a high priority at NASA. At this time there are 58 operational NASA spacecraft advancing our scientific understanding of our home planet, the solar system, and the structure and evolution of the universe. Pursuant to the President's recent executive order for our Nation's aeronautics research and development policy, NASA is supporting innovative research leading to significant advances in aeronautical concepts, technologies, and capabilities to advance the United States' technological leadership in aeronautics and to facilitate the educational development of our aeronautics workforce.

NASA is on track in carrying out credible, affordable, and effective programs to meet the mandate set before us. This FY 2008 budget request has been carefully considered, and it balances many competing demands upon limited resources. However, Congress has not yet appropriated funds for NASA for FY 2007, and adjustments to NASA's plans contained herein may be necessary based on this appropriation. We're on track to carry out our mandate, but we have a lot of hard work ahead of us, with many difficult decisions remaining ahead. We have overcome great adversity, yet we continue forward. As President Bush observed in the wake of the Columbia tragedy, "The cause in which they died will continue. Mankind is led into the darkness beyond our world by the inspiration of discovery and the longing to understand. Our journey into space will go on."

Our only real resource is our people, and we have worked assiduously over the past year to deploy our workforce on the great task before us. The NASA management team is committed to maintaining and restoring the core technical capabilities within our Centers. I believe that maintaining ten healthy Centers, each an active contributor to some part of our mission, is essential, and we must maintain this goal as we work through the Space Shuttle transition. One step we have taken this year is to simplify our full cost accounting procedures in order to better utilize our facilities and people. This accounting change is neutral with respect to the program content of any of our missions, but will result in changes to the way our budget request is displayed. We will ensure that these changes are readily transparent to our stakeholders when comparing this budget to that of previous years.

We have a great deal of work to do. U.S. leadership in space exploration, scientific discovery, and aeronautics research is something for which we must strive every day. We must also invest our time, resources, and energy wisely. The President's FY 2008 budget request for NASA represents such an investment.

Michael D. Griffin
Administrator

FY 2006 Highlights

NASA completed another successful year of milestones and discoveries as the Agency pursues its Mission:

Science Mission Directorate

- NASA helped increase understanding of the dynamic interactions that take place between Earth's land, oceans, and atmosphere. As part of this effort, scientists obtained better measurements of ice sheets, ocean levels, and the ozone layer using the Gravity Recovery and Climate Experiment (GRACE), Ice, Cloud, and Land Elevation satellite (ICEsat), and other Earth-observing missions.
- The Mars Reconnaissance Orbiter (MRO) entered orbit around Mars and began testing its instruments. The MRO will return more data about Mars than all previous missions combined.
- NASA's suite of heliophysics missions provided scientists with the first direct measurement of magnetic reconnection on immense scales. Magnetic reconnection causes solar flares to erupt from the Sun's magnetic fields and creates aurora in Earth's magnetosphere. A better understanding of magnetic reconnection is fundamental to understanding explosive phenomena like solar flares and gamma ray bursts throughout the universe.
- NASA scientist John Mather was awarded the Nobel Prize in Physics, along with his colleague George Smoot, for their work leading to increased understanding of the Big Bang. Mather and Smoot used data from NASA's Cosmic Background Explorer (COBE) satellite to support their findings.

Exploration Systems Mission Directorate

- NASA selected the contractor that will build the Orion Crew Exploration Vehicle, NASA's first new human-rated space vehicle in more than 25 years.
- The Agency selected contractors to provide vehicles, systems, and operational capabilities needed to transport crew and cargo to and from the International Space Station (ISS).
- The Lunar Reconnaissance Orbiter (LRO) passed a Preliminary Design Review, allowing the project to proceed to the next phase of development and stay on track for a launch in 2008.

Aeronautics Research Mission Directorate

- NASA awarded the Agency's Software of the Year Award to The Future Air Traffic Management Concept Evaluation Tool team. This tool generates thousands of aircraft trajectories to enable efficient planning of traffic flows at the national level.
- The Agency initiated a comprehensive restructuring of NASA's aeronautics research programs in FY 2006 to ensure that NASA's aeronautics programs meet our Nation's needs by benefiting the broad aeronautics community including the Agency's partners in academia, industry, and other government agencies.

Cross-Agency Support Programs

- NASA reformulated the Agency's Education programs to maximize returns on education investments.
- NASA made improvements in business systems, processes, and procedures to improve financial management and accountability and to increase efficiency and cost savings across the Agency.
- Managers in NASA's Innovative Partnerships Program examined precedents and established protocols that will help the Agency partner with emerging space industry businesses.

Space Operations Mission Directorate

- NASA successfully completed STS-121, the second of two test flights to validate changes made in Shuttle operations since the loss of Shuttle Columbia in 2003. During the mission, crewmembers conducted tests and delivered several tons of supplies to the International Space Station (ISS).
- The Agency returned to sustained Shuttle operations and resumed ISS assembly during STS-115. The Shuttle crew delivered and attached the P3/P4 truss, which will provide power, data, and communications services for the ISS.
- Space Station crewmembers deployed the oxygen generation rack for testing and evaluation. This piece of the regenerative environmental control system will help NASA develop life-support technologies for future long-duration human space exploration.

Science Mission Directorate (SMD)

SMD conducts scientific exploration that is enabled by access to space or near-space in pursuit of a science plan with four major Themes: Earth Science, Heliophysics, Planetary Science, and Astrophysics. These Themes encompass questions as practical as next week's weather, as enticing as the prospect of life elsewhere in the solar system and beyond, and as profound as the origin of the universe. Together, they support the Agency's Mission: To pioneer the future in space exploration, scientific discovery, and aeronautics research and contribute to NASA's Strategic Goal 3: "Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration."

Fundamental research on profound science questions is the hallmark of the SMD portfolio. SMD pursues its science goals with the following: observatories in high-altitude aircraft, Earth orbit, and deep space; spacecraft visiting the Moon and other planetary bodies; and robotic landers, rovers, and sample return missions. Addressing NASA's science priorities requires comprehensive research programs that include scientific research and analysis, space missions, suborbital missions, field campaigns, data management, computational modeling, and advanced technology development.

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
FY 2008 President's Budget Request	5,244.6	5,466.8	5,516.1	5,555.3	5,600.6	5,656.9	5,802.7
Earth Science	1,325.6	1,464.5	1,497.3	1,545.8	1,520.1	1,411.2	1,353.2
Heliophysics	1,067.3	1,028.1	1,057.2	1,028.4	1,091.3	1,241.2	1,307.5
Planetary Science	1,298.9	1,411.2	1,395.8	1,676.9	1,720.3	1,738.3	1,748.2
Astrophysics	1,552.8	1,563.0	1,565.8	1,304.2	1,268.9	1,266.2	1,393.8
FY 2007 President's Budget Request	5,253.7	5,330.0	5,383.1	5,437.1	5,491.5	5,546.4	--
Earth Science	1,375.6	1,471.7	1,407.1	1,397.7	1,444.9	1,467.2	--
Heliophysics	1,042.4	985.8	1,133.5	1,156.4	1,141.3	1,193.6	--
Planetary Science	1,327.7	1,363.3	1,341.7	1,575.2	1,629.2	1,575.9	--
Astrophysics	1,507.9	1,509.2	1,500.9	1,307.9	1,276.1	1,309.7	--
Total Change from FY 2007 President's Budget Request	-9.1	136.8	132.9	118.2	109.0	110.5	5,802.7

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Exploration Systems Mission Directorate (ESMD)

The President and Congress committed the Nation to a journey of exploration: returning to the Moon in the next decade, then on to Mars and beyond. NASA's 2006 Strategic Plan laid out a framework to extend humankind's presence in space and promote international and commercial participation to further scientific, security and economic interests. ESMD will lead the way on this multi-generational journey by providing an organized focus for developing new capabilities and supporting technologies that enable sustained and affordable human space exploration.

ESMD has two closely integrated programmatic Themes to efficiently carry out its mission. The programs and projects in the Constellation Systems Theme are structured to develop, demonstrate, and deploy systems such as the Orion Crew Exploration Vehicle and the Ares launch vehicles that will enable sustained human exploration. The Advanced Capabilities Theme provides critical products to reduce operational and technical risks for Constellation Systems projects, including high-priority technology needs for lunar exploration; risk mitigation related to astronaut health and performance using the ISS, free-flyers, and ground-based laboratories; and lunar robotic missions to gather data relevant to future human missions.

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
FY 2008 President's Budget Request	3,050.1	4,152.5	3,923.8	4,312.8	4,757.8	8,725.2	9,076.8
Constellation Systems	1,733.5	3,232.5	3,068.0	3,451.2	3,784.9	7,666.0	7,993.0
Advanced Capabilities	1,316.6	920.0	855.8	861.6	973.0	1,059.1	1,083.9
FY 2007 President's Budget Request	3,050.10	3,978.30	3,981.60	4,499.80	5,055.90	8,775.10	--
Constellation Systems	1,733.50	3,057.60	3,067.60	3,612.90	4,083.80	7,698.40	--
Advanced Capabilities	1,316.60	920.7	914	886.9	972	1,076.70	--
Total Change from FY 2007 President's Budget Request	0.1	174.2	-57.8	-186.9	-298	-49.9	9,076.80

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Aeronautics Research Mission Directorate (ARMD)

NASA's Aeronautics Research Mission Directorate (ARMD) conducts high-quality, cutting-edge research that generates innovative concepts, tools, and technologies to enable revolutionary advances in our Nation's future aircraft as well as in the airspace in which they will fly. ARMD programs will facilitate a safer, more environmentally friendly, and more efficient national air transportation system. In addition, NASA's aeronautics research will continue to play a vital role in supporting NASA's human and robotic space exploration activities.

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
FY 2008 President's Budget Request	893.2	529.3	554.0	546.7	545.3	549.8	554.7
Aeronautics Technology	893.2	529.3	554.0	546.7	545.3	549.8	554.7
FY 2007 President's Budget Request	884.1	724.4	731.8	732.4	722.8	722.7	--
Aeronautics Technology	884.1	724.4	731.8	732.4	722.8	722.7	--
Total Change from FY 2007 President's Budget Request	9.1	-195.1	-177.7	-185.7	-177.4	-172.9	554.7

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Cross-Agency Support Programs (CASP)

CASP provides a focus to several ongoing activities and provides a strategic approach to managing some of NASA's unique facilities. This budget area consists of four programs:

- Education contributes to the development of the Nation's science, technology, engineering, and mathematics workforce through a diverse portfolio of Education initiatives;
- Advanced Business Systems develops and integrates systems for financial, procurement, asset management and human capital performance;
- The Innovative Partnerships Program leverages technology and capabilities for NASA through joint partnerships with industry academia, other government agencies, and national laboratories; and
- The Shared Capability Assets Program helps NASA prioritize critical capabilities and make strategic investment decisions to replace, modify, or disposition assets.

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
FY 2008 President's Budget Request	533.4	502.0	489.2	453.5	460.4	454.7	454.4
Education Theme	162.4	167.4	153.7	152.8	152.7	149.8	149.6
Advanced Business Systems	156.3	97.4	103.1	69.4	71.6	67.6	67.5
Innovative Partnership Programs	214.8	215.1	198.1	197.2	199.8	200.0	200.0
Shared Capability Assets Program	--	22.1	34.3	34.2	36.2	37.3	37.2
FY 2007 President's Budget Request	533.5	491.7	497.9	467.1	476.8	482.2	--
Education Theme	162.4	153.3	152.4	153.1	154.0	153.3	--
Advanced Business Systems	156.3	108.2	106.9	73.8	78.5	80.6	--
Innovative Partnership Programs	214.8	197.9	205.5	206.2	209.7	212.9	--
Shared Capability Assets Program	--	32.2	33.1	33.9	34.7	35.5	--
Total Change from FY 2007 President's Budget Request	0.0	10.3	-8.7	-13.6	-16.4	-27.5	454.4

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Space Operations Mission Directorate (SOMD)

SOMD provides mission-critical space exploration services to both NASA customers and to other partners within the United States and throughout the world. At the heart of SOMD is the nearly half-century of experience in safely and reliably building, flying, and maintaining some of the world's most advanced and complex aerospace systems, year in and year out. Two of these systems, the Space Shuttle and the International Space Station, continue to enable current and future human space exploration. The lessons learned during the construction and operation of the International Space Station will be directly applicable to the challenges that will face future explorers on the lunar and Martian surfaces.

In addition to these high-profile programs, SOMD is responsible for ensuring that the critical infrastructure needed for space access and space communications is available to meet the needs of NASA's scientific customers. The Launch Services Program facilitates access to space for all NASA space science missions. The Rocket Propulsion Test Program maintains NASA's wide variety of test facilities for use by both the Space Shuttle and Constellation Systems' programs. The Crew Health and Safety Program ensures that NASA's astronauts are fully prepared for their missions. Finally, Space Communications operates NASA's extensive network of terrestrial and orbiting communications nodes, which includes the associated hardware and software needed to pull down the terabytes of data being generated by NASA's far-flung fleet of crewed vehicles and robotic spacecraft from Earth orbit out to the edges of the solar system.

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
FY 2008 President's Budget Request	6,904.7	6,108.3	6,791.7	6,710.3	6,625.7	3,036.6	2,978.0
Space Shuttle	4,812.5	4,017.6	4,007.5	3,650.9	3,634.4	116.2	--
International Space Station	1,753.4	1,762.6	2,238.6	2,515.1	2,609.2	2,547.5	2,600.8
Space and Flight Support (SFS)	338.8	328.1	545.7	544.3	382.0	372.9	377.2
FY 2007 President's Budget Request	6,869.7	6,234.4	6,680.4	6,442.3	6,242.9	2,896.7	--
Space Shuttle	4,777.5	4,056.7	4,087.3	3,794.8	3,651.1	146.7	--
International Space Station	1,753.4	1,811.3	2,200.3	2,255.6	2,197.1	2,360.8	--
Space and Flight Support (SFS)	338.8	366.5	392.8	392.0	394.7	389.2	--
Total Change from FY 2007 President's Budget Request	35.0	-126.2	111.3	268.0	382.8	139.9	2,978.0

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Inspector General

The NASA Office of Inspector General's (OIG's) mission is to prevent and detect crime, fraud, waste, abuse, and mismanagement while promoting economy, effectiveness, and efficiency within the Agency:

- The OIG Office of Audits (OA) conducts independent, objective audits and reviews of NASA and NASA contractor programs and projects to improve NASA operations as well as a broad range of professional audit and advisory services. It also comments on NASA policies and is responsible for the oversight of audits performed under contract. The OA helps NASA accomplish Agency objectives by bringing a systematic, disciplined approach to evaluate and improve the economy, efficiency and effectiveness of NASA operations.
- The OIG Office of Investigations (OI) identifies, investigates, and refers for prosecution cases of crime, waste, fraud, and abuse in NASA programs and operations. The OIG's Federal law enforcement officers investigate false claims and statements, conspiracy, theft, computer crimes, mail fraud, and violations of Federal laws, such as the Procurement Integrity Act and the Anti-Kickback Act. Through its investigations, the OI also seeks to prevent and deter crime at NASA.

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
FY 2008 President's Budget Request	32.0	33.5	34.6	35.5	36.4	37.3	38.3
Inspector General	32.0	33.5	34.6	35.5	36.4	37.3	38.3
FY 2007 President's Budget Request	32.0	33.5	34.6	35.5	36.4	37.3	--
Inspector General	32.0	33.5	34.6	35.5	36.4	37.3	--
Total Change from FY 2007 President's Budget Request	0.0	0.0	0.0	0.0	0.0	0.0	38.3

Mission Support

To implement NASA's Mission, the Agency requires the workforce, facilities, and operational support of its Centers and NASA Headquarters. These necessary mission support costs are included in the Mission Program Budgets as Center Management and Operations, Corporate General and Administrative, and Institutional Investment accounts.

Center Management and Operations (CM&O) includes the basic costs to manage and operate each of the 10 NASA Centers and to maintain the technical capability required to support the Agency's Mission. These costs cannot be directly identified or tied to a specific program or project requirement, but are necessary for efficient and effective administration and operation of the NASA Centers. The CM&O budget combines activities previously budgeted as Center General and Administrative (G&A) and Service Pool costs.

Corporate G&A provides for the management and oversight of Agency missions, functions, and Centers, and the performance of some Agency-wide administrative activities. The responsibilities include the following: the determination of programs and projects; establishment of management policies, procedures, and performance criteria; evaluation of progress; and the coordination and integration of all phases of the Agency's Mission.

Institutional Investments includes design and execution of non-programmatic Discrete and Minor Revitalization Construction of Facility projects, Facility Demolition projects, and Environmental Compliance and Restoration activities.

($ in millions)	FY 2007 Current	FY 2008 Estimate
Center Management and Operations	1733.0	2013.0
Corporate G&A	741.1	678.7
Institutional Investments	211.0	319.7

Management and Performance Overview

The Agency’s integrated planning and performance management system provides NASA decision-makers with appropriate data and information to accomplish the following: plan strategy and implementation; monitor progress toward performance commitments; identify issues (including the status of resources); and gauge the organization's overall health. Through this system, NASA identifies the Agency's long-term Strategic Goals, near-term Outcomes, and other key performance measures and continuously measures the Agency’s progress toward those goals. NASA managers use this performance data as a basis for key investment decisions, as well as programmatic and institutional decision-making.

NASA’s performance system is built and managed to align with the Agency's internally and externally imposed performance measurement and reporting requirements, tools, and practices including the Government Performance and Results Act, the President's Management Agenda (PMA), and the Office of Management and Budget’s Program Assessment Rating Tool (PART). NASA uses the PMA initiatives and PART reviews as guides to navigate and improve NASA’s performance management. Through these activities, NASA programs are reviewed with recommendations that influence investment decisions. NASA also commits to a series of follow-up actions in response to PMA and PART findings.

NASA continues to find new ways to use program performance information to support Agency strategy and budget decisions. In the coming year NASA will focus on improving the policy, metrics, and analysis processes for life cycle cost and schedule performance monitoring and reporting as part of the Major Program Annual Reports (MPAR) effort which strives to link NASA’s projects with the Agency’s high-level Strategic Goals and Sub-goals.

Details on NASA's plans to improve both program and management performance in the coming year to increase PMA scores, address PART review results and the MPAR can be found in the Management and Performance section of this document. This section also provides a summary of the Agency's performance commitments for the requested budget.

How to Read NASA's Budget Tables

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NOTE: The numbers in the budget tables may not add up due to rounding.

Appropriation Summary: Science, Aeronautics, and Exploration

(Millions of Dollars)	FY 2006 Actual	FY 2007	FY 2008 Budget Request
SCIENCE	**5,244.6**	**5,466.8**	**5,516.1**
Earth Science	1,325.6	1,464.5	1,497.3
Heliophysics	1,067.3	1,028.1	1,057.2
Planetary Sciences	1,298.9	1,411.2	1,395.8
Astrophysics	1,552.8	1,563.0	1,565.8
EXPLORATION SYSTEMS	**3,050.1**	**4,152.5**	**3,923.8**
Constellation Systems	1,733.5	3,232.5	3,068.0
Advanced Capabilities	1,316.6	920.0	855.8
AERONAUTICS RESEARCH	**893.2**	**529.3**	**554.0**
Aeronautics Technology	893.2	529.3	554.0
CROSS-AGENCY SUPPORT PROGRAMS	**533.4**	**502.0**	**489.2**
Education	162.4	167.4	153.7
Advanced Business Systems	156.3	97.4	103.1
Innovative Partnerships Program	214.8	215.1	198.1
Shared Capability Assets Program	0.0	22.1	34.3
TOTAL APPROPRIATION	**9,721.3**	**10,650.6**	**10,483.1**

FY 2006 represents September 2006 operating plan.

FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Totals may not add due to rounding.

Science

NASA's Science Mission Directorate conducts scientific exploration that is enabled by access to space or near-space in pursuit of a science plan with four broad goals:
- Earth Science: Study Earth from space to advance scientific understanding and meet societal needs;
- Planetary Science: Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space;
- Heliophysics: Understand the Sun and its effects on Earth and the solar system; and
- Astrophysics: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.

These goals encompass questions as practical as next week's weather, as enticing as the prospect of life elsewhere in the solar system and beyond, and as profound as the origin of the universe. Together, they support the Agency's Mission: To pioneer the future in space exploration, scientific discovery, and aeronautics research" and contribute to NASA's Strategic Goal 3: "Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration."

Structure. Fundamental research on profound science questions is the hallmark of NASA's Science portfolio. The Science Mission Directorate (SMD) pursues its science goals with: observatories in high -altitude aircraft, Earth orbit, and deep space; spacecraft visiting the Moon and other planetary bodies; and robotic landers, rovers, and sample return missions. Responsibility for defining, planning and overseeing NASA's space and Earth science programs is assigned by the NASA Administrator to SMD and is organized into four divisions, each of which is responsible for the pursuit of one of NASA's four science goals.

Balanced Investment Portfolio. The FY 2008 budget is the result of a planning process that starts with NASA's strategic science plan and science community priorities and utilizes a defined process for creating a balanced portfolio of science investments. In planning its science portfolio, NASA begins with the broad consensus science priorities defined by the National Research Council (NRC) in its decadal surveys and other reports. Under the auspices of the NASA Advisory Council (NAC), NASA engages the science community in developing triennial roadmaps for implementing these priorities.

Addressing these science priorities requires comprehensive research programs that include scientific research and analysis, space missions, suborbital missions, field campaigns, data management, computational modeling, and advanced technology development. NASA balances the mix of investments in science areas and program elements based on the following considerations:

- A commitment is made to reasonable progress on each of the long-term Outcomes in the NASA Strategic Plan, though the pace of progress can be influenced by other NASA and federal programs, such as human exploration timelines in the case of Mars exploration. These Outcomes are science-based, not mission-based, and progress is assessed against the decadal surveys and roadmaps laid out for each science area.
- Investment choices are based on scientific merit. At the same time, it is recognized that sustained progress in advancing U.S. space- and Earth-science interests requires investments across a broad range of activities.
- Partnerships are essential to achieving NASA's science objectives.
- Scientific discovery is fueled by prompt, broad, and easy access to research data. Therefore, data will be made publicly available as soon as possible after scientific validation.
- Active participation by the research community outside NASA is critical to success; therefore, NASA will endeavor to sustain the health of necessary scientific disciplines.
- NASA will also maintain the essential technical capabilities at the NASA Centers.

Mission Directorate Budget Distribution

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
FY 2008 President's Budget Request	**5,244.6**	**5,466.8**	**5,516.1**	**5,555.3**	**5,600.6**	**5,656.9**	**5,802.7**
Earth Science	1,325.6	1,464.5	1,497.3	1,545.8	1,520.1	1,411.2	1,353.2
Heliophysics	1,067.3	1,028.1	1,057.2	1,028.4	1,091.3	1,241.2	1,307.5
Planetary Science	1,298.9	1,411.2	1,395.8	1,676.9	1,720.3	1,738.3	1,748.2
Astrophysics	1,552.8	1,563.0	1,565.8	1,304.2	1,268.9	1,266.2	1,393.8
FY 2007 President's Budget Request	**5,253.7**	**5,330.0**	**5,383.1**	**5,437.1**	**5,491.5**	**5,546.4**	**--**
Earth Science	1,375.6	1,471.7	1,407.1	1,397.7	1,444.9	1,467.2	--
Heliophysics	1,042.4	985.8	1,133.5	1,156.4	1,141.3	1,193.6	--
Planetary Science	1,327.7	1,363.3	1,341.7	1,575.2	1,629.2	1,575.9	--
Astrophysics	1,507.9	1,509.2	1,500.9	1,307.9	1,276.1	1,309.7	--
Total Change from FY 2007 President's Budget Request	**-9.1**	**136.8**	**132.9**	**118.2**	**109.0**	**110.5**	**5,802.7**

Note: FY 2008 PB Request -- FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.
FY 2007 PB Request -- represents the FY 2007 P.B. request in the new Theme structure.

Mission Directorate Budget Changes

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Total Changes	**-9.1**	**136.8**	**132.9**	**118.2**	**109.0**	**110.5**	**5,802.7**
Programmatic Content	**-9.1**	**--**	**--**	**12.5**	**22.2**	**38.7**	**5,802.7**
Earth Science	-50.1	--	89.2	149.3	94.6	-3.7	1,353.2
Heliophysics	24.9	--	-104.6	-127.7	-52.3	28.0	1,307.5
Planetary Science	-28.8	--	9.6	34.3	24.1	92.1	1,748.2
Astrophysics	44.9	--	5.8	-43.4	-44.2	-77.7	1,393.8
Programmatic Transfers	**--**	**--**	**14.4**	**14.9**	**15.5**	**15.9**	**--**
Earth Science	--	--	18.5	18.6	19.3	19.7	--
Planetary Science	--	--	-4.1	-3.7	-3.8	-3.8	--
Institutional Adjustments	**--**	**136.8**	**118.5**	**90.8**	**71.3**	**55.9**	**--**
Earth Science	--	-7.2	-17.4	-19.7	-38.7	-72.0	--
Heliophysics	--	42.3	28.3	-0.3	2.3	19.6	--
Planetary Science	--	47.9	48.6	71.1	70.8	74.1	--
Astrophysics	--	53.8	59.0	39.7	37.0	34.2	--

Mission Directorate Highlights of Programmatic Changes

<u>Science</u>

Earth Science

Programmatic Content:

Increases funding for Global Precipitation Measurement, Landsat Data Continuity Mission, Glory missions and NPOESS Preparatory Project (NPP) to maintain current schedule.

Programmatic Transfers:

Transfers High End Computing Capability funding from Shared Capability Assets Program.

Institutional Adjustments:

Full Cost Simplification.

Heliophysics

Programmatic Content:

Delays New Millennium ST-9 and follow on missions by roughly two years; schedules will be assessed for the FY 2009 budget.
Defers funding for Magnetospheric Multiscale mission, consistent with extension of Phase A study by six months for resolution of cost issues.

Institutional Adjustments:

Full Cost Simplification.

Planetary Science

Programmatic Content:

New Lunar Science project will enable studies of existing lunar data; enhance scientific return from the 2008 Lunar Reconnaisance Orbiter; and provide for the development of scientific instruments for future NASA and non-NASA lunar missions. Adds funding for studies of potential Outer Planets missions.

Programmatic Transfers:

Transfers funding for studies of Near-Earth Objects to the Exploration Systems Mission Directorate.

Institutional Adjustments:

Full Cost Simplification.

Astrophysics

Programmatic Content:

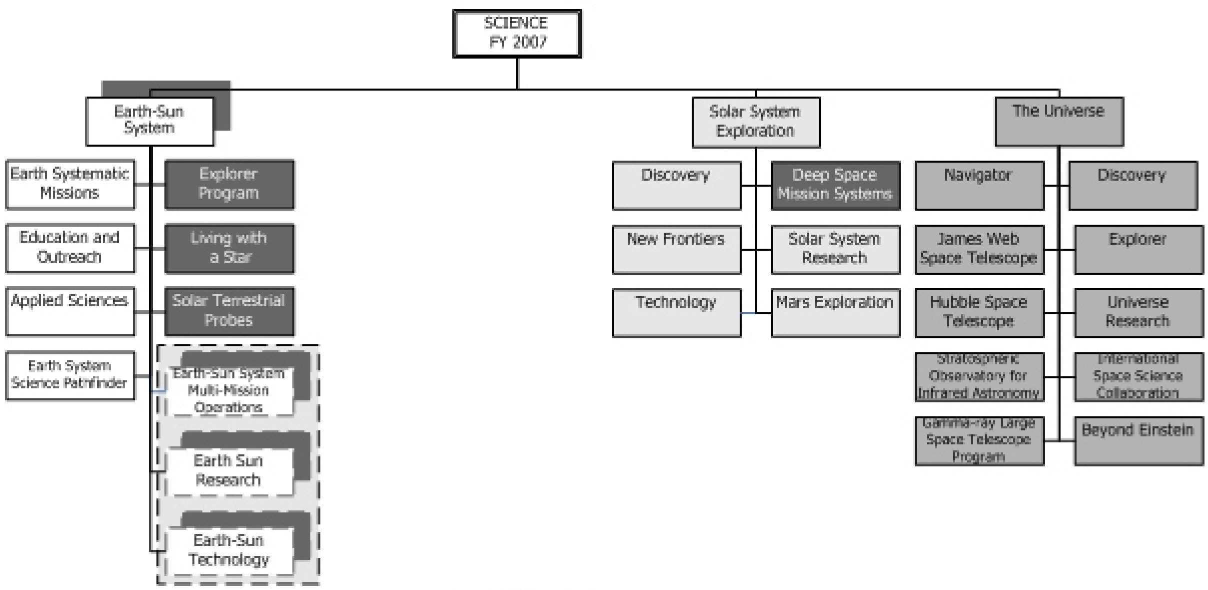
Restores SOFIA program; increases level of reserves in JWST; refocuses the Navigator Program to fund core interferometry and planet-finding research and technology; provides new Astrophysics future mission funding.

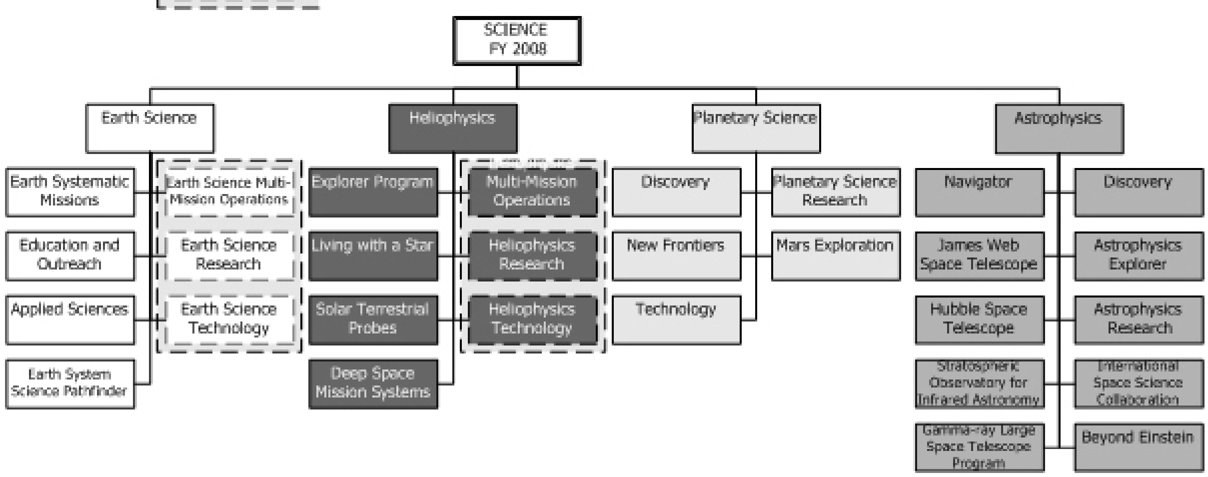
Institutional Adjustments:

Full Cost Simplification.

Mission Directorate Budget Structure Adjustments

For FY 2008, the Science Mission Directorate separated the Earth-Sun System theme into two new themes: Earth Science and Heliophysics. Four programs -- Earth Systematic Missions, Education and Outreach, Applied Sciences, and Earth System Science Pathfinder -- will move to the Earth Science theme. Three programs -- Explorer Program, Living with a Star, and Solar Terrestrial Probes -- will move to the Heliophysics theme. Three programs -- Earth-Sun System Multi-Mission Operations, Earth-Sun Research, and Earth-Sun Technology -- will be divided between Earth Science and Heliophysics. The Heliophysics theme will also acquire the Deep Space Mission Systems program from the Solar System Exploration theme.





Mission Directorate:	Science
Theme:	Earth Science

Theme Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Earth Science	1,325.6	1,464.5	1,497.3	1,545.8	1,520.1	1,411.2	1,353.2
Earth Science Research	460.8	453.4	428.5	453.0	453.8	469.1	481.4
Applied Sciences	94.8	46.8	40.3	41.3	41.1	38.0	38.9
Earth Science Multi-Mission Operations	190.4	192.9	204.4	181.3	191.3	185.8	194.2
Earth Systematic Missions	356.1	523.8	608.0	693.0	576.0	387.9	387.9
Earth System Science Pathfinder	133.4	165.2	135.7	94.9	171.6	242.3	161.2
Education and Outreach	20.2	25.9	23.5	23.6	23.7	23.9	24.1
Earth Science Technology	69.9	56.6	57.0	58.7	62.6	64.2	65.5

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Theme Changes

	FY 2008		
Earth Science	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Earth Science Research	**481.9**	**428.5**	**-53.4**
Operating Spacecraft moved to Earth Systematic Missions. *HECC (High End Computing) transferred from Shared Capability Assets Program to Earth Science Research.*			
Applied Sciences	**50.3**	**40.3**	**-10.0**
No significant change.			
Earth Science Multi-Mission Operations	**214.7**	**204.4**	**-10.3**
No significant change.			
Earth Systematic Missions	**464.5**	**608.0**	**143.5**
Increases funding for Landsat Data Continuity Mission (LDCM), Glory mission, NPOESS Preparatory Project (NPP), and Global Precipitation Measurement (GPM) mission to maintain current schedule.			
Earth System Science Pathfinder	**111.5**	**135.7**	**24.2**
Increases funding for OCO and Aquarius to maintain development schedule; Aquarius launch delay by the mission partner providing the spacecraft.			
Education and Outreach	**23.7**	**23.5**	**-0.2**
Earth Science Technology	**60.6**	**57.0**	**-3.5**
No significant change.			

Theme Purpose

The Earth Science Theme addresses the following Goal and Sub-goal in the 2006 NASA Strategic Plan:

Goal 3: Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.

Sub-goal 3A: Study Earth from space to advance scientific understanding and meet societal needs.

Mission Directorate:	Science
Theme:	Earth Science

Theme Overview

Earth is a complex, dynamic system not yet fully understood. The Earth system, like the human body, is comprised of diverse components that interact in complex ways. We need to understand the Earth's atmosphere, lithosphere, hydrosphere, cryosphere, and biosphere as a single connected system.

From space the Earth can be viewed as a planet, with evident interconnectedness of the oceans, atmosphere, continents, ice sheets, and life itself. Global-scale changes are observed and tracked, and regional changes can be studied in their global context. The role that human civilization increasingly plays as a force of change can be observed. NASA studies this dynamic planet to trace effect to cause, connect variability and forcing with response, and vastly improve national capabilities to predict climate, weather, natural hazards, and conditions in the space environment.
NASA's Earth science portfolio addresses six focus areas:
(1) Climate Variability and change;
(2) Atmospheric composition;
(3) Carbon cycle, ecosystems, and biogeochemistry;
(4) Water and energy cycles;
(5) Weather; and
(6) Earth surface and interior.
In each of these areas, NASA seeks the input of the Earth science community in universities and elsewhere to identify the scientific questions to be addressed and to define effective strategies to pursue the answers to those questions.

NASA answers these questions by: (1) conducting selected Earth science missions which extend our knowledge of Earth systems; (2) managing mission observation data so that it is widely available to the broader scientific community; (3) conducting and sponsoring research to answer fundamental science questions about observed changes in climate, weather, and natural hazards; (4) enabling partner organizations to apply NASA's science results to help improve the Nation's observational and forecasting systems; and (5) developing technologies that will improve future Earth measurement capabilities.

The Earth Science Division (ESD) consists of seven programs: Earth Systematic Missions, Earth Science Pathfinder, Research, Applied Sciences, Multi-Mission Operations, Technology and Education and Outreach. ESD has 14 operational missions on orbit, 5 missions in implementation, and 2 missions in formulation.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

The Earth Science Theme contributes to four Presidential initiatives: Climate Change Research, Global Earth Observation, the Oceans Action Plan, and the Vision for Space Exploration. NASA delivers sound science that helps decision-makers make informed decisions to improve quality of life, enhance economic stewardship, and enhance U.S. Industry's competitiveness in the global marketplace.

NASA is developing predictive capabilities that will enable advanced assessments of the causes and consequences of global change. These improvements will enhance scientists' ability to manage coastal environments, agriculture, water resources, and aviation safety; monitor air quality, forest fires, and impacts of infectious diseases and invasive species; and conduct hurricane forecasting and disaster relief efforts.

ESD provides support for the application of key earth science measurements to operational systems maintained by other agencies. On a reimbursable basis, NASA built the NOAA Geostationary Operational Environmental Satellite (GEOS) and Polar Orbiting Environmental Satellites (POES) series of satellites.

Over the coming months, NASA will be evaluating opportunities for implementing the recommendations of the National Research Council's Earth Science Decadal Survey.

Relevance to the NASA Mission:

The Earth Science Division supports NASA's mission to pioneer scientific discovery by increasing our understanding and enabling prediction of global change. It also supports exploration of the universe and search for life through our improved understand of Earth's system dynamics.

Relevance to education and public benefits:

The Earth Science Division increases public awareness and understanding of the global change and enables the use of science information in teaching and learning at all levels of education. Through the Earth Science Division, NASA seeks to increase science literacy and focus attention on the dynamic Earth, thereby making new scientific knowledge available for use in everyday decisions by the public, businesses, and governments in those areas influenced by environmental changes. NASA's partnership with educational and service-provider organizations shares the discoveries and knowledge from Earth Science missions and research programs to make this new knowledge available to the Nation. The Earth Science Theme has significant science results to share with the public. The public is informed through news releases highlighting Earth Science events, dynamic media delivery bringing the excitement of Earth science and research to the public, documentaries, innovative planetarium shows, exhibits at museums and science centers, and content-rich Web sites. ESD seeks to inspire the next generation of explorers by providing opportunities for learners of all ages to investigate the Earth system using unique NASA resources. These research efforts strengthen science, technology, engineering and mathematics education nationwide. This is a fundamental part of NASA's mission as the leaders and citizens who will meet the Earth science challenges of tomorrow are the students of today.

Mission Directorate:	Science
Theme:	Earth Science

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
Strategic Goal 3	**Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.**	
Sub Goal 3A	**Study Earth from space to advance scientific understanding and meet societal needs.**	
Outcome 3A.1	**Progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition.**	
APG 8ES01	Demonstrate progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition, based on measurements from presently orbiting NASA and non-NASA assets. Progress will be evaluated by external expert review.	Multiple Programs
Outcome 3A.2	**Progress in enabling improved predictive capability for weather and extreme weather events.**	
APG 8ES02	Demonstrate progress in enabling improved predictive capability for weather and extreme weather events. Progress will be evaluated by external expert review.	Multiple Programs
Outcome 3A.3	**Progress in quantifying global land cover change and terrestrial and marine productivity, and in improving carbon cycle and ecosystem models.**	
APG 8ES03	Demonstrate progress in quantifying global land cover change and terrestrial and marine productivity, and in improving carbon cycle and ecosystem models. Progress will be evaluated by external expert review.	Multiple Programs
APG 8ES04	Complete the Orbiting Carbon Observatory (OCO) Operational Readiness Review.	Earth System Science Pathfinder
Outcome 3A.4	**Progress in quantifying the key reservoirs and fluxes in the global water cycle and in improving models of water cycle change and fresh water availability.**	
APG 8ES05	Demonstrate progress in quantifying the key reservoirs and fluxes in the global water cycle and in improving models of water cycle change and fresh water availability. Progress will be evaluated by external expert review.	Multiple Programs
APG 8ES06	Complete Global Precipitation Measurement (GPM) Mission Spacecraft Preliminary Design Review (PDR).	Earth Systematic Missions
Outcome 3A.5	**Progress in understanding the role of oceans, atmosphere, and ice in the climate system and in improving predictive capability for its future evolution.**	
APG 8ES07	Demonstrate progress in understanding the role of oceans, atmosphere, and ice in the climate system and in improving predictive capability for its future evolution. Progress will be evaluated by external expert review.	Multiple Programs
APG 8ES08	Launch the Ocean Surface Topography Mission (OSTM).	Earth Systematic Missions
APG 8ES09	Complete the Glory mission Operational Readiness Review (ORR).	Earth Systematic Missions
APG 8ES10	Complete the Aquarius Instrument Pre-ship Review.	Earth System Science Pathfinder

Mission Directorate:	Science
Theme:	Earth Science

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
Outcome 3A.6	**Progress in characterizing and understanding Earth surface changes and variability of Earth's gravitational and magnetic fields.**	
APG 8ES11	Demonstrate progress in characterizing and understanding Earth surface changes and variability of Earth's gravitational and magnetic fields. Progress will be evaluated by external expert review.	Multiple Programs
Outcome 3A.7	**Progress in expanding and accelerating the realization of societal benefits from Earth system science.**	
APG 8ES12	Issue twelve reports with partnering organizations that validate using NASA research capabilities (e.g., observations and/or forecast products) could improve their operational decision support systems.	Applied Sciences
APG 8ES13	Increase the number of distinct users of NASA data and services.	Earth Science Research
APG 8ES14	Maintain a high level of customer satisfaction, as measured by exceeding the most recently available federal government average rating of the Customer Satisfaction Index.	Earth Science Research

Performance Achievement Highlights

Earth System Science Pathfinder
NASA successfully launched and began operations of the CloudSat and Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellites.
Earth Science Research
The Earth Science Program successfully participated in an interagency/international effort (N-AMMA) to monitor the development and evolution of hurricanes. The program also conducted research leading to the discovery of arctic winter sea ice decline in 2005 and 2006. NASA's Columbia supercomputer was cited as playing a key role in the trend towards increased resolution in global atmospheric models, specifically increasing accuracy of hurricane models.

Quality

Performance Measure #	Description
Earth Science Theme	
APG 8ES15	Complete all development projects within 110% of the cost and schedule baseline.
APG 8ES16	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 8ES17	Peer-review and competitively award at least 90%, by budget, of research projects.
APG 8ES18	Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 130 days.

Mission Directorate:	Science
Theme:	Earth Science

Program Assessment Rating Tool (PART):

The Earth-Sun System Theme was subject to a PART review in 2005 and received a "moderately effective" rating (score of 84%). The assessment found that this program is well-defined, has a clear objective, and has an effective strategic planning process. A key opportunity to increase effectiveness lies in continuing to improve efficiencies in mission operations, in reducing science data validation periods and in making NASA research available to a broader community.

To ensure that performance continues to improve, the theme will:
1) Report on estimated mission life-cycle cost (LCC) and key schedule milestones associated with each mission phase for those missions formally approved for formulation, the mission's cost and schedule progress and any plans to re-baseline life-cycle cost and/or schedule.
2) Assess obstacles to improving the hand-off of NASA's R&D to other federal agencies and implement organizational and system fixes to ensure results.
3) Assure that priorities developed in the NRC Earth Science decadal survey are reflected in the program's portfolio to the extent feasible.

To date the LCC and key milestones were reported on a quarterly basis to OMB for projects that are in development. This has also been provided annually to the Congress as the Major Program Annual Report. In the coming year, projects that are still in formulation will be included as a part of the quarterly reporting. The scope and duration of the NRC's Earth Science decadal survey have been extended to include a follow-on analysis of the impact of changes to the NPOESS program and development of strategies for mitigation and recovery of lost or at-risk capabilities. Reports are expected to be issued early 2007 and mid-2007, respectively. NASA adjusted its FY07 budget request and factored NRC's interim recommendations into the FY08 request, and will ensure that the priorities identified in the forthcoming reports are reflected to the extent feasible in the program's portfolio.

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IRT	Varies	Each project has a independent review team (IRT) for review, at each major milestone, to evaluate project performance and readiness to proceed to the next phase. These reviews occur throughout the year.	Varies
Relevance	NASA Advisory Council (NAC)	09/2006	NASA Advisory Council (NAC) - Review science strategy and implementation strategy for the Earth Science programs	05/2007
Relevance	National Research Council (NRC	01/2007	National Research Council - Decadal survey of effectiveness and quality of the Earth Science programs. First time a Decadal survey developed for Earth Science.	2016

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Science Research

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Earth Science Research	460.8	453.4	428.5	453.0	453.8	469.1	481.4

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	FY 2007 PB Request	FY 2008 PB Request	Change
Earth Science Research	**481.9**	**428.5**	**-53.4**

The decrease is due to the transfer of the following operating missions to Earth Systematic Missions: Total Ozone Mapping Spectrometer; Tropical Rainfall Measuring Mission; Ocean Winds; Landsat Science Project Office; Terra; Aqua; Aura; Ice, Cloud and land Elevation Satellite, Active Cavity Radiometer Irradiance Monitor Satellite; Solar Radiation and Climate Experiment; and Jason.

Program Overview

The Earth Science Research Program improves the capability to document the global distribution of a range of important environmental parameters related to the Earth's atmosphere, hydrosphere, biosphere, cryosphere, and land surface; to understand the processes that drive and connect them; and to improve our capability to predict the future evolution of the Earth system, including climate, weather, and natural hazards.

Earth Science Research funds basic research and modeling efforts, the Suborbital Science Project (which conducts research using airplanes and Uninhabited Air Systems), and supercomputing efforts that support a variety of agencies. Earth Science operating spacecraft previously included in Earth Science Research have been moved under the Earth Systematic Missions Program in the FY08 budget.

For more information, please see http://science.hq.nasa.gov/earth-sun/index.html.

Program Relevance

The Earth Science Research Program contributes to the Outcomes under Strategic Plan Sub-goal 3A: Study Earth from space to advance scientific understanding and meet societal needs.

This research is an important component of the U.S. Global Change Research Program (GCRP) and Climate Change Research Initiative (CCRI), both of which are components fo the Climate Change Science Program (CCSP). Earth Science Research also contributes to the U.S. Weather Research Program, the Earthscope Program, and the Ocean Action Plan. Research plans and objectives for much of NASA's FY 2008 activities are described in the Climate Change Science Program (CCSP) Strategic Plan, and are reported by the program and the subcommittee on Global Change Research to Congress annually in the "Our Changing Planet" report. Some components of NASA's Earth Science Research Program (e.g., Earth surface and interior research) are not reported through the CCSP.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Science Research

Plans For FY 2008

The Science Mission Directorate will issue Research Opportunities in Space and Earth Science 2007 (ROSES-07), a research announcement covering all of the planned research solicitations in Earth Science Research for FY 2007; the FY 2008 budget will fund the competitively selected activities. Many of the research activities carried out in FY2008 will be tasks initiated in FY 2006 and FY 2007 based on solicitations included in ROSES-05 and ROSES-06, respectively.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Science Research

Project Descriptions

The Earth Science Research Program includes Research and Analysis (R&A) and Earth Observing System Science (EOS Science), both of which support researchers via grants, contracts, or tasks funded in response to successful proposals to announcements in NASA's Research Opportunities in Space and Earth Science (ROSES) Program. EOS Science conducts spacecraft calibration/validation activities and supports interdisciplinary science teams, while R&A funds discipline-specific science across six focus areas.

The program also includes two supercomputing efforts, as well as, the Suborbital Science Project, the Carbon Cycle Science Team, the Data Assimilation Office, Satellite Laser Ranging, and the Mission Science Guest Investigator Project.

Earth Science Research and Analysis (R&A)

Earth Science R&A funds research in all six Earth science focus areas:

(1) Climate variability and change;
(2) Atmospheric composition;
(3) Carbon cycle, ecosystems, and biogeochemistry;
(4) Water and energy cycles;
(5) Weather; and
(6) Earth surface and interior.

The R&A Project addresses the Earth system and the interactions of its components, characterizing them on a broad range of spatial and temporal scales to understand the naturally occurring and human-induced processes that drive the overall system. The new content of the R&A Project for FY 2008 will be outlined in the ROSES-07 announcement and selected from among the resulting proposals; the remainder of the program was defined in response to the ROSES-05 and ROSES-06 solicitations. Project elements not included in ROSES-07 may be solicited in future years.

Funding for Seastar and a portion of Radarsat have been moved into the R&A line in the FY 2008 budget.

EOS Science

EOS Science funds interdisciplinary science teams, as well as calibration and validation activities that ensure the utility of spaceborne measurements.

In addition, funding for the AVIRIS/AirSAR/TIMS instruments, a portion of Radarsat, and the National Institute of Standards and Technology Calibration activity has been moved into the EOS Science line in the FY 2008 budget.

Suborbital Science

Suborbital Science funds NASA's airplane- and Uninhabited Air Systems (UAS)-based Earth Science efforts. The project supports the operation of a catalogue of NASA-owned and leased aircraft, including the ER-2, DC-8, WB-57, P-3, Twin Otter, B-200, Aerosonde, Ikhana, and other UAS aircraft. These assets are deployed in campaigns conducted around the world to monitor extreme weather events (e.g., hurricanes), capture data for Earth Science modeling activities, and calibrate the instruments flying aboard Earth Science spacecraft (e.g., Aura). Suborbital Science also funds technology development efforts designed to provide Earth Science researchers with improved instruments and datalinks to these aircraft.

Scientific Computing

Scientific Computing funds NASA's Earth Science supercomputing assets and projects at Goddard Space Flight Center. The Scientific Computing Project's primary purpose is to support Earth Science modeling activities based on data collected by Earth Science spacecraft.

High-End Computing Columbia (HECC)

The HECC Project at Ames Research Center (ARC) is focused around the Columbia supercomputer. HECC is part of NASA's Shared Capability Assets Program (SCAP); as such, HECC serves the supercomputing needs of all of NASA's Mission Directorates, as well as external users. The Science Mission Directorate is managing HECC's resources for NASA; HECC funding supports the operation, maintenance, and upgrade of supercomputing capability at ARC.

Carbon Cycle Science Team

The Carbon Cycle Science Team conducts research using measurements from a variety of assets; the team will be significant users of data from the upcoming Orbiting Carbon Observatory and NPOESS Preparatory Project missions, expanding their existing utilization of data from currently operating missions (e.g., Terra, Landsat, EO-1).

Data Assimilation Office

The Data Assimilation Office, also known as the Global Modeling and Assimilation Office (GMAO), located at Goddard Space Flight Center, creates global climate and environmental models using data from Earth Science satellites and aircraft. These products can then be used by investigators to further their research.

Satellite Laser Ranging

The Satellite Laser Ranging (SLR) Project provides highly accurate altitude data for the operation of Earth Science spacecraft and the calibration of their instruments. This is particularly important for missions such as Jason and the Gravity Recovery and Climate Experiment (GRACE), which require very precise positioning information for their measurements.

Mission Science Guest Investigator Program

The Mission Science Guest Investigator Program supports researchers using data from Earth Science spacecraft, but who are not formally part of the Mission Science Teams themselves.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Science Research

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Issue competed, peer-reviewed research awards.	Research and Analysis; Suborbital Science (flight opportunities)	None	Annual
Maximize resource utilization (i.e., computing cycles) in supercomputer projects.	Scientific Computing; HECC	None	Percent of available cycles used by programs.
Issue competed, peer-reviewed Guest Observer awards.	Guest Investigator	None	Annual

Implementation Schedule

Project	Schedule by Fiscal Year: Prior, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20	Phase	Beg	End	Mile-stone
R&A, EOS Science, Carbon Cycle Science Team, Data Assimilation Office, Satellite Laser Ranging, and Mission Science Guest Investigator Program (all ongoing research efforts)		Tech			
		Form			
		Dev			
		Ops			
		Res	Jan-90	Dec-20	
Suborbital Science		Tech			
		Form			
		Dev			
		Ops	Jan-90	Dec-20	
		Res			
Scientific Computing		Tech			
		Form			
		Dev			
		Ops	Jan-95	Dec-20	
		Res			
HECC		Tech			
		Form			
		Dev	Jan-05	Aug-05	
		Ops	Sep-05	Dec-20	
		Res			

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Science Research

Program Management

The Earth Science Theme manages the Research Program. GSFC implements Scientific Computing; ARC implements HECC.

Project	Oversight	Lead Performer	Partners
R&A, EOS Science, Carbon Cycle Science Team, Mission Science Guest Investigators Program	Science Mission Directorate	Earth Science Theme	Partners include, but are not limited to: the National Oceanic and Atmospheric Administration (Department of Commerce); the National Science Foundation; the Department of Defense; and the U.S. Geological Survey (Department of the Interior). In addition, international entities engaged in Earth Science research participate in NASA's efforts.
Suborbital Science	Earth Science Theme, Science Mission Directorate	GSFC/Wallops Flight Facility, DFRC, and ARC are the primary Centers involved in this project.	The Federal Aviation Administration, the Department of Defense, the Department of Energy, the National Science Foundation, and the National Oceanic and Atmospheric Administration (Department of Commerce).
Scientific Computing	Earth Science Theme, Science Mission Directorate	NASA Center for Computational Sciences, Goddard Space Flight Center	Department of Energy and the Department of Defense.
High-End Computing Capability	Earth Science Theme, Science Mission Directorate	NASA Advanced Supercomputing, Ames Research Center	Department of Energy and the Department of Defense.
Data Assimilation Office (Global Modeling and Assimilation Office)	Earth Science Theme, Science Mission Directorate	Goddard Space Flight Center	None.
Satellite Laser Ranging	Earth Science Theme, Science Mission Directorate	Goddard Space Flight Center	None.

Acquisition Strategy

The Earth Science Research Program is based on full and open competition. Grants are peer reviewed and selected based on NASA Research Announcements and other related announcements.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Relevance	NAC Earth Science Subcommittee	New	The NASA Advisory Council Science Subcommittee reviews content and progress towards Earth Science sub-goal in the NASA Strategic Plan of at least one Science Focus Area per year.	2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Programmatic Risk	No significant risk at this time.	N/A

Mission Directorate:	Science
Theme:	Earth Science
Program:	Applied Sciences

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Applied Sciences	94.8	46.8	40.3	41.3	41.1	38.0	38.9

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Applied Sciences	**50.3**	**40.3**	**-10.0**
Budgetary changes are due to full cost simplification.			

Program Overview

The Applied Sciences Program is focused on working with Federal agencies and national organizations to extend the use of technology and data associated with NASA's constellation of Earth system observing spacecraft. These spacecraft, which routinely make measurements using dozens of research instruments, are used by a community of Earth system scientists in laboratories, universities, and research institutions throughout the country, and around the world, to model the Earth system and improve predictions, projections, and forecasts.

Through its partnerships with operational agencies such as NOAA, Department of Agriculture, and other agencies and organizations, the Applied Sciences Program extends the benefits of NASA Earth system science to improve decision making and policy formulation. Outcomes from these partnerships have demonstrated the value of NASA's observations from research spacecraft and predictive capability from scientific models in areas such as improving public health tracking systems for deadly diseases, providing advanced weather predictive capability for aviation turbulence and icing, and improving severe storm predictions for disaster warnings. As we move forward, the NASA Applied Sciences Program will continue the incorporation of NASA research results into policy and management decision-support tools that are vital for the Nation's safety, security, and economic enterprises. For more information, please see http://science.hq.nasa.gov/earthsun/applications/index.html.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Applied Sciences

Program Relevance

Together with operational partners, the Applied Sciences Program employs a systematic approach to turn NASA research and development results into decision-support tools for areas of national priority, including aviation, agricultural efficiency, public health, homeland security, ecological forecasting; air quality, carbon management, coastal management, disaster management, energy management, invasive species and water management. NASA emphasizes collaboration with NOAA and other Federal agencies to systematically transition Earth system science research results for operational utilization. NASA provides Earth system scientists with verification of the performance of commercial remote sensing data products for use in Earth science research, thereby optimizing the value to the government of private sector investments in space.

The Applied Sciences Program supports Strategic Plan Sub-goal 3A: Study Earth from space to advance scientific understanding and meet societal needs.

More specifically, the program contributes to Outcome 3A.7: Progress in expanding and accelerating the realization of societal benefits from Earth system science.

Plans For FY 2008

For 2008, the Applied Sciences Program will work with Federal agencies, such as EPA, NOAA, USDA, FAA, DOE, and CDC, and other regional, national, and international organizations, such as the Western Governor's Association, Southern Governor's Growth Policy Board, American Water Resources Association, Coastal States Organization, Group on Earth Observations, and UNESCO. The Program will use formulation studies and rapid prototyping activities to further optimize the evaluation and selection of NASA research results for integration into decision support systems.

Applied Sciences will support the Commercial Remote Sensing Space Policy by providing funded Earth system scientists with the opportunity to verify the performance of commercial remote sensing data products for research purposes.

Applied Sciences will also conduct interoperability activities to support improved access to NASA research results, including the Federal Enterprise Architecture and standards and protocols established by national and international data standards organizations.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Applied Sciences

Project Descriptions

The Applied Sciences Program is focused on working with Federal agencies and national organizations to extend the use of technology and data associated with NASA's constellation of Earth system observing spacecraft. These spacecraft, which routinely make measurements using dozens of research instruments, are used by a community of Earth system scientists in laboratories, universities, and research institutions throughout the country, and around the world, to model the Earth system and improve predictions, projections, and forecasts.

Pathways - National Applications

The Project conducts R&D activities with partnering organizations to validate the use of NASA research capabilities (e.g., observations and/or forecast products) in improving operational decision support systems. National Applications focuses on twelve areas of national priority: Agricultural Efficiency, Air Quality, Aviation, Carbon Management, Coastal Management, Disaster Management, Ecological Forecasting, Energy Management, Homeland Security, Invasive Species, Public Health, and Water Management.

Pathways - Crosscutting Solutions

The Project conducts systems integration, engineering, interoperability, and prototyping activities to support the National Applications and improve use of Earth science results in decision support systems. Crosscutting Solutions includes four elements: Geosciences Interoperability, DEVELOP, Solutions Networks, and Integrated Benchmarked Systems.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Work with partners to verify, validate, benchmark, and extend use of Earth science technology & data	Applied Sciences	N/A	Annual

Program Management

Applied Sciences Program responsibility resides within the Earth Science Division of the Science Mission Directorate.

Project	Oversight	Lead Performer	Partners
Pathways - National Applications and Pathways - Crosscutting Solutions	NASA HQ	GSFC, LaRC, SSC, JPL, MSFC, and ARC	EPA, NOAA, USDA, FAA, DOE, and CDC; regional, national , and international organizations (e.g., the Western Governor's Association, Southern Governor's Growth Policy Board, American Water Resources Association, Coastal States Organization, Group on Earth Observations, and UNESCO); Academic institutions; and, Corporate entities.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Applied Sciences

Acquisition Strategy

The Applied Sciences Program will use the annual Science Mission Directorate Research Opportunities in Space and Earth Science (ROSES) competitive solicitations as the primary method to acquire projects to integrate NASA Earth science research results into decision support tools. The Applied Sciences Program will continue to develop and nurture partnerships with Federal agencies and national organizations to identify key topics for the competitive solicitations.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Relevance	National Research Council	05/2002	Reviewed and validated implementation of the related NASA Strategic Goals.	05/2009

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Partner Interest	NASA Earth science measurements and models may present types of information that the partners have limited experience using, and they may be reluctant to consider unfamiliar data product types.	The program addresses this risk through strong partnerships, systems engineering approaches, and involvement with interagency working groups.
Partner Commitment	Partners may be reluctant to invest resources and personnel to adopt data from research satellites, especially satellites that do not have a planned successor for long-term data availability. In addition, partners' funding may change.	To address this risk, the program encourages partners to focus on types of measurements (e.g., sea surface temperature) rather than data from a specific satellite. The program focuses on documenting the performance of the NASA products in the decision support systems to communicate the value to the partners' decision making and budget priorities. The program also works with partners before some

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Science Multi-Mission Operations

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Earth Science Multi-Mission Operations	190.4	192.9	204.4	181.3	191.3	185.8	194.2

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Earth Science Multi-Mission Operations	**214.7**	**204.4**	**-10.3**
Changes due to full cost simplification.			

Program Overview

The Earth Science Multi-Mission Operations Program acquires, preserves, and distributes observational data to support Earth Science focus areas in conformance with national science objectives. Facilities involved in this undertaking include data-handling, data processing, and archiving systems.

NASA's principal Earth Science information system is the Earth Observing System Data and Information System (EOSDIS), which has been operational since August 1994. EOSDIS acquires, processes, archives, and distributes Earth Science data and information products created from satellite data, which arrive at the rate of more than four trillion bytes (4 Terabytes) per day. Having successfully created this system, NASA is utilizing advances in information technology to expand capabilities while providing continuous service to the user community.

The Evolution of EOSDIS Elements (EEE) effort is: increasing efficiency and operability; increasing data usability by the research, application, and modeling communities; providing services and tools needed to enable use of NASA's Earth Science data in next-decadal models, research results, and decision support system benchmarking; and improving support for end users. The evolved system is being phased in -- a process that began in FY2006 -- with milestones developed through 2008. The budget request for FY2009 and beyond incorporates cost savings that will result from this effort. A plan for 2015 will guide further improvements.

NASA Earth Science information is archived at eight Distributed Active Archive Centers (DAACs) located across the United States. The DAACs specialize by topic area, and make their data available to researchers around the world.

Research opportunities related to EOSDIS are available through the Advanced Collaborative Connections for Earth System Science (ACCESS) and Research, Education and Applications, Solutions Network (REASoN) programs.

For more information, please see http://eos.nasa.gov/eosdis.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Science Multi-Mission Operations

Program Relevance

The Earth Science Multi-Mission Operations Program supports Strategic Plan Sub-goal 3A: Study Earth from space to advance scientific understanding and meet societal needs.

Plans For FY 2008

The Earth Science Multi-Mission Operations Program will continue the operation of EOSDIS, the DAACs and its accompanying functions, as well as Core System Science Data Processing Systems. The maintenance of these systems is important to the collection of data from Earth Science satellites in orbit, as well as to the continuity of Earth Science research efforts.

The first steps of the Evolution of EOSDIS Elements (EEE) effort are underway, and the FY2008 budget will show the first operational benefits associated with EEE. Support of the EEE will enable a smooth transition to the new architecture between now and 2015.

The FY2008 budget will also support REASoN and ACCESS selections made in the 2007 and 2008 Research Opportunities in Space and Earth Science (ROSES) announcements. These Cooperative Agreements are important for keeping the research and modeling communities actively involved with the EOSDIS architecture.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Science Multi-Mission Operations

Project Descriptions

The Earth Science Multi-Mission Operations Program includes the EOSDIS and Multi-Mission Operations projects. EOSDIS is the central data handling system for NASA's Earth Science efforts; Multi-Mission Operations includes funding for the Distributed Active Archive Centers (DAACs), specialized facilities located across the country that process, archive, and distribute data to the research and modeling communities. The Multi-Mission Operations project line also funds the Elements of EOSDIS Evolution effort.

EOSDIS

EOSDIS is the central data handling system for NASA's Earth Science efforts. EOSDIS components funded in the project include: A) Product Generation for the research community, using algorithms and software developed by EOS investigators; B) Data Archive, Management, and Distribution, ensuring the preservation of data, products, related algorithms, and system-configuration history; C) Information Management, enabling researchers to rapidly locate and retrieve data critical to their work; and D) User Support for research scientists, educators, students, and users in public agencies responsible for operational applications of the data, as well as for the general public. EOSDIS development ends in FY07, and in FY08 and beyond, all improvements to the system will be developed through REASoN and ACCESS solicitations.

Multi-Mission Operations

This project funds the Elements of EOSDIS Evolution, aimed at improving the efficiency and effectiveness of EOSDIS while reducing the cost, and the Distributed Active Archive Centers, which collect, disseminate, and archive Earth Science data at eight centers across the Nation:

1) The Alaska SAR Facility, which collects Synthetic Aperture Radar data, and information on sea ice, polar processes, and geophysics;
2) The GSFC Earth Sciences Data and Information Services Center, which collects information on atmospheric composition, atmospheric dynamics, global precipitation, ocean biology, ocean dynamics, and solar irradiance;
3) The Langley Research Center DAAC, which collects data on Earth's radiation budget, clouds, aerosols, and tropospheric chemistry;
4) The Land Processes DAAC, which collects land processes data;
5) The National Snow and Ice Data Center, which collects snow and ice data, as well as information about the cryosphere and climate;
6) The Oak Ridge National Laboratory DAAC, which collects data on biogeochemical dynamics, and ecological data for studying environmental processes;
7) The Physical Oceanography DAAC, which collects information on oceanic processes and air-sea interactions; and
8) The Socioeconomic Data and Applications Center, covering population, sustainability, geospatial data, multilateral environmental agreements, natural hazards, and poverty.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Complete Evolution of EOSDIS Elements (EEE) Step 1 in December 2007	EOSDIS and DAACs	No Change	No Change

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Science Multi-Mission Operations

Implementation Schedule

Project	Schedule by Fiscal Year																Phase Dates			
	Prior	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20		Beg	End	Mile-stone
EOSDIS and Multi-Mission Operations (including DAACs)																	Tech			
																	Form			
																	Dev			
																	Ops	Aug-94	Dec-15	
																	Res			
Elements of EOSDIS Evolution (phased start-up beginning in FY 2008)																	Tech			
																	Form	Nov-04	Nov-05	
																	Dev	Dec-05	Mar-08	
																	Ops	Apr-08	Dec-20	
																	Res			

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

The Science Mission Directorate and the Program Management Council have oversight responsibility for this program. The Earth Science Data and Information System Project Office at GSFC has primary responsibility for the program.

Project	Oversight	Lead Performer	Partners
EOSDIS (development of EOSDIS systems)	GSFC	Earth Science Data and Information Systems Project Office, GSFC (EOSDIS development)	Key participants in EOSDIS include the space agencies of Europe, Canada, Germany, France, and Japan. Other U.S. agency partners include the National Oceanic and Atmospheric Administration (Department of Commerce), U.S. Geological Survey (Department of the Interior), and the Department of Defense.
EOSDIS (peer-reviewed data research opportunities)	SMD	NASA Headquarters	None.
Multi-Mission Operations (operations and maintenance of Core EOSDIS systems; DAACs)	GSFC	Earth Science Data and Information Systems Office, Goddard Space Flight Center	Key participants in the Multi-Mission Operations project include the space agencies of Europe, Canada, Germany, France, and Japan. Other U.S. agency partners include the National Oceanic and Atmospheric Administration (Department of Commerce), U.S. Geological Survey (Department of the Interior), and the Department of Defense.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Science Multi-Mission Operations

Acquisition Strategy

The Science Mission Directorate's Senior Review process serves as one basis for Earth Science Multi-Mission Operations acquisition priorities; the Senior Review process helps to determine priorities for extending the operations of Earth Science spacecraft beyond their primary missions. In addition, science information system support for new missions is developed in concert with Earth Science mission development, reusing, as appropriate, existing system elements and infrastructure. NASA Centers and DAACs can execute sub-contracts for operational activities.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Relevance	Earth Science Steering Com.	11/2005	Review of EOSDIS Evolution to approve "Step 1" plans for Evolution of EOSDIS Elements.	11/2008
Quality	Independent Senior Review Brd.	N/A	Peer review of DAACs, modeled on Space Science Data Centers' Senior Review.	05/2008

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
None at this time.	n/a	n/a

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Earth Systematic Missions	356.1	523.8	608.0	693.0	576.0	387.9	387.9
NPOESS Preparatory Project (NPP)	21.2	80.1	91.0	93.6	20.2	6.8	7.6
Glory Mission	56.6	60.0	42.7	32.7	11.1	11.3	1.9
Global Precipitation Measurement (GPM)	23.4	28.1	90.2	182.4	208.8	158.7	163.7
Landsat Data Continuity Mission (LDCM)	8.5	113.5	160.2	192.6	154.5	38.7	4.0
Other	28.8	47.0	33.4	10.9	57.9	130.2	168.3

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Earth Systematic Missions	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
NPOESS Preparatory Project (NPP)	**72.9**	**91.0**	**18.1**
Due to the late delivery of sensors from the NPOESS Integrated Program Office (IPO), the launch date has slipped, increasing mission cost. The latest delivery date currently planned leads to a September 2009 launch of NPP. This represents a 17-month slip from the FY 2007 submit.			
Glory Mission	**34.0**	**42.7**	**8.7**
Budget increase reflects cost growth in the Aerosol Polarimetry Sensor (APS) instrument, as well as increased workforce requirements.			
Global Precipitation Measurement (GPM)	**25.4**	**90.2**	**64.8**
The GPM Project has been replanned with the funding required for a no later than 2013 launch.			
Landsat Data Continuity Mission (LDCM)	**109.8**	**160.2**	**50.4**
The changes in the budget request are primarily due to an increase in launch vehicle costs, an increased estimate for the mission level procurements, and contractor incentives for early delivery in order to minimize any gap in data coverage.			
Other	**47.2**	**33.4**	**-13.8**
No major programmatic changes.			

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions

Program Overview

The Earth Systematic Missions Program provides Earth-observing satellites--including LDCM, Glory, GPM, NPP, OSTM, Terra, Aqua, Aura, EP/TOMS, TRMM, ACRIMSat, QuikSCAT, EO-1, Jason, ICESat, and SORCE--that contribute to the provision of long-term environmental data sets that can be used to study the evolution of the Earth system on a range of temporal scales. This information is used to analyze, model, and improve understanding of the Earth system. Data gathered by these spacecraft will enable improved predictions of climate, weather, and natural hazards. NASA works with the science community to identify science questions on the frontiers of science that have profound societal importance, and to which on-going remote sensing of the Earth can make a defining contribution. These science questions become the foundation of a research strategy, which defines requirements for scientific observations through the vantage point of space. Each of the six Earth science focus areas has an implementation roadmap that shows what role space-based observations play in meeting overall science objectives. This effort also provides techniques and technologies that can be employed to predict climate, weather and natural hazards on planets we plan to explore.

For more information, please see http://science.hq.nasa.gov/missions/earth/earth-sun.htm.

Program Relevance

The Earth Systematic Missions Program develops, demonstrates, and initiates the satellite capability necessary for systematic science measurements from space in order to develop an understanding of the Earth's system and its response to natural or human-induced changes and to improve prediction of climate, weather, and natural hazards. This satellite-based Earth science measurement capability is an important tool for NASA scientists and the science community at large in their efforts to support three important Presidential initiatives: the Climate Change Research Initiative, Global Earth Observation, and the Oceans Action Plan.

This program contributes to the Outcomes under Strategic Plan Sub-goal 3A: Study Earth from space to advance scientific understanding and meet societal needs. Specifically the Earth Systematic Missions Program supports Outcomes 3A.3, 3A.4, and 3A.5.

Plans For FY 2008

The following activities will be undertaken in FY 2008:

- The NPP mission will complete its Mission Operations Review (MOR);
- The Glory Mission will have an APS instrument Pre Ship Review (PSR);
- LDCM will complete its instrument Preliminary Design Review (PDR) and award of spacecraft and Mission Operations Element contracts; and
- OSTM will have its Operational Readiness Review (ORR) followed by launch of the OSTM mission.

Ten of the eleven operating spacecraft in the Earth Systematic Missions Program will undergo a Senior Review in 2007 to determine whether their missions will be extended (Aura, in its prime mission through July 2010, is the exception). Most of these spacecraft are already in their extended mission phase, and are slated to operate through the end of 2009; Aqua, TOMS, EO-1, and SORCE currently have earlier decommissioning dates, but these are subject to revision via the Senior Review process.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions

Project Descriptions

The missions are required to achieve the following critical threshold requirements: a mission profile (measurements, orbit parameters, lifetime, altitude, etc.); the successful launch of the satellite and/or instrument into the proper orbit by the prescribed launch date; and the provision for instrument control, data processing, distribution, and archiving capability for each mission.

Global Precipitation Measurement (GPM) Mission

Extending precipitation measurement beyond the current TRMM mission, GPM will provide: near-global measurement of precipitation, its distribution, and physical processes; rain rates and latent heating measurement; and more frequent and complete sampling of Earth's precipitation. The science focus areas served by GPM will include: climate variability and change; water and energy cycles; and weather.

Glory

Glory will provide measurements of global distribution of natural and anthropogenic aerosols from varying angles, in numerous spectral bands with multiple polarizations, as well as total solar irradiance measurements. The science focus areas served by Glory will include: atmospheric composition; carbon cycle, ecosystems, and biogeochemistry; climate variability and change; and water and energy Cycles.

Landsat Data Continuity Mission (LDCM)

LDCM will provide visible and near-infrared images of the Earth surface in approximately nine frequency bands, with 30-meter resolution. LDCM will enable cross-sensor comparison of data from within the Landsat series. The science focus areas served by LDCM will include: carbon cycle, ecosystems, and biogeochemistry; and earth surface and interior. LDCM is being undertaken by NASA as a stand-alone ('free-flyer') mission planned for launch as soon as possible to provide continuity of Landsat data.

Ocean Surface Topography Mission (OSTM)

OSTM will measure sea surface height to an accuracy of less than 4 centimeters every 10 days. The science focus areas served by OSTM will include: climate variability and change, and water and energy cycles. This mission is a follow-on to Jason.

NPOESS Preparatory Project (NPP)

NPP is a preparatory mission for the National Polar-orbiting Operational Environmental Satellite System (NPOESS) and will provide global imagery in a number of visible and infrared frequency bands, collect ozone data, and provide improved measurements of temperature and moisture profiles in the atmosphere. The science focus areas served by NPP will include: atmospheric composition; climate variability and change; carbon cycle, ecosystems, and biogeochemistry; water and energy cycles; and weather.

Future Missions

This project supports missions that begin formulation in the near future to implement systematic measurements in response to priorities suggested by the National Research Council's Earth Science Decadal Survey.

Terra

Terra collects global data on the state of the atmosphere, land, and oceans, as well as their interactions with solar radiation and with one another. The science focus areas served by Terra include: atmospheric composition; carbon cycle, ecosystems, and biogeochemistry; climate variability and change; earth surface and interior; water and energy cycles; and weather. Terra is a joint mission with Japan and Canada.

Aqua

Aqua monitors atmospheric, land, ocean, and ice variables for improved understanding of the Earth's water cycle and improved understanding of the intricacies of the climate system. The science focus areas served by Aqua include: atmospheric composition; carbon cycle, ecosystems, and biogeochemistry; climate variability and change; water and energy cycles; and weather. Aqua is a joint mission with Brazil and Japan.

Aura

Aura measures atmospheric chemical composition, tropospheric/stratospheric exchange of energy and chemicals, chemistry-climate interactions, and air quality. The science focus areas served by Aura include: atmospheric composition; climate variability and change; and weather. Aura is a joint mission with the Netherlands, Finland, and the United Kingdom.

Earth Probe/Total Ozone Mapping Spectrometer (EP/TOMS)

TOMS monitors and maps atmospheric ozone. Together with earlier TOMS instruments aboard Nimbus-7 (launched in 1978) and Meteor-3 (launched in 1991), the EP/TOMS provides a data set of daily ozone measurements going back more than two decades. The science focus area served by TOMS is atmospheric composition.

Tropical Rainfall Measuring Mission (TRMM)

TRMM measures precipitation, clouds, lightning, and radiation processes over tropical regions. TRMM is one of several spacecraft currently extending the long-term radiation budget record begun in the mid-1980s. The science focus areas served by TRMM include climate variability and change; water and energy cycles; and weather. TRMM is a joint mission with Japan.

Active Cavity Radiometer Irradiance Monitor Satellite (ACRIMSat)

ACRIMSat monitors total solar irradiance. The science focus areas served by ACRIMSat include: climate variability and change, and water and energy cycles.

Quick Scatterometer (QuikSCAT)

QuickSCAT measures ocean surface wind vectors using the SeaWinds instrument. The science focus areas served by QuikSCAT include: climate variability and change, and weather.

Earth Observing-1 (EO-1)

The EO-1 spacecraft collects data to allow paired scene comparisons between the EO-1 Advanced Land Imager (ALI) and the Landsat-7 Enhanced Thematic Mapper Plus (ETM+). The science focus areas served by EO-1 include: carbon cycle, ecosystems, and biogeochemistry; and earth surface and interior.

Jason

Jason monitors ocean height to support the study of ocean circulation. The science focus areas served by Jason include: climate variability and change; and water and energy cycles. Jason is a joint mission with France.

Ice, Clouds, and Land Elevation Satellite (ICESat)

ICESat measures elements of ice-sheet mass balance, cloud-top and land-surface topography, and vertical profiles of aerosol and cloud properties. The science focus areas served by ICESat include: climate variability and change: earth surface and interior; and water and energy cycles.

Solar Radiation and Climate Experiment (SORCE)

SORCE measures the total and spectral solar irradiance incident at the top of Earth's atmosphere. The science focus areas served by SORCE include: atmospheric composition; climate variability and change; and water and energy cycles.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Complete planned operations of currently operating missions.	Operating missions	Through 2010	Through 2010
Data collection.	EO-1	TBD: Annual Amount of Data	TBD: Annual Amount of Data
Extend measurement of precipitation to global coverage every 3 hours.	GPM	Confirmation Review in TBD-year	Confirmation Review in TBD-year
Launch 4 additional Earth Systematic Mission (ESM) missions.	GPM, Glory, LDCM, NPP, OSTM	by 2014	by 2014

Mission Directorate: Science
Theme: Earth Science
Program: Earth Systematic Missions

Implementation Schedule

Project	Phase	Beg	End	Mile-stone
Global Precipitation Measurement Mission (GPM)	Tech			
	Form	Jul-02	Oct-08	
	Dev	Nov-08	Jun-13	
	Ops	Jul-13	Jul-16	
	Res			
Glory	Tech			
	Form	Oct-03	Nov-03	
	Dev	Dec-03	Dec-08	
	Ops	Jan-09	Jan-12	
	Res			
Landsat Data Continuity Mission (LDCM)	Tech			
	Form	Oct-03	Feb-05	
	Dev	Mar-07	Jan-11	
	Ops	Feb-11	Feb-16	
	Res			
Ocean Surface Topography Mission (OSTM)	Tech			
	Form	Dec-02	Mar-06	
	Dev	Mar-06	Jun-08	
	Ops	Jul-08	Jul-11	
	Res			
NPOESS Preparatory Project (NPP)	Tech			
	Form	Mar-00	Nov-03	
	Dev	Dec-03	Sep-09	
	Ops	Oct-09	Oct-14	
	Res			
Terra	Tech			
	Form			
	Dev			
	Ops	Dec-99	Sep-09	
	Res		Sep-11	
Aqua	Tech			
	Form			
	Dev			
	Ops	May-02	May-08	
	Res		May-10	
Aura	Tech			
	Form			
	Dev			
	Ops	Jul-04	Jul-10	
	Res		Jul-12	
Total Ozone Mapping Spectrometer (TOMS)	Tech			
	Form			
	Dev			
	Ops	Jul-96	Sep-08	
	Res		Sep-10	
Tropical Rainfall Measuring Mission (TRMM)	Tech			
	Form			
	Dev			
	Ops	Nov-97	Nov-09	
	Res		Nov-11	
Active Cavity Radiometer Irradiance Monitor Satellite (ACRIMSat)	Tech			
	Form			
	Dev			
	Ops	Dec-99	Sep-09	
	Res		Sep-11	
Quick Scatterometer (QuikSCAT)	Tech			
	Form			
	Dev			
	Ops	Jun-99	Sep-09	
	Res		Sep-11	
Earth Observing-1 (EO-1)	Tech			
	Form			
	Dev			
	Ops	Nov-00	Nov-07	
	Res		Nov-09	

Mission Directorate: Science
Theme: Earth Science
Program: Earth Systematic Missions

Jason	Tech		
	Form		
	Dev		
	Ops	Dec-01	Sep-09
	Res		Sep-11
Ice, Clouds, and Land Elevation Satellite (ICESat)	Tech		
	Form		
	Dev		
	Ops	Jan-03	Sep-09
	Res		Sep-11
Solar Radiation and Climate Experiment (SORCE)	Tech		
	Form		
	Dev		
	Ops	Jan-03	Mar-08
	Res		Mar-10

- Tech & Adv Concepts (Tech)
- Formulation (Form)
- Development (Dev)
- Operations (Ops)
- Research (Res)
- Represents a period of no activity for the Project

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions

Program Management

GSFC manages NPP, LDCM, Glory, GPM, Terra, Aqua, Aura, EP/TOMS, TRMM, EO-1, and ICESat. JPL manages OSTM, ACRIMSat, QuikSCAT, Jason, and SORCE.

Project	Oversight	Lead Performer	Partners
GPM	GSFC	GSFC	JAXA - provides dual frequency precipitation radar and launch vehicle for GPM.
Glory	GSFC	GSFC	None.
LDCM	GSFC	GSFC	USGS - provides data processing/distribution and on-orbit operations for LDCM.
OSTM	JPL	JPL	CNES - provides spacecraft and 2 instruments for OSTM.
NPP	GSFC	GSFC	NOAA/IPO - provides 3 of 4 instruments and ground system for NPP.
Terra	GSFC	GSFC	Japan's Ministry of Economy, Trade and Industry (METI) provided the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER). The Canadian Space Agency provided the Measurements of Pollution in The Troposphere (MOPITT) instrument.
Aqua	GSFC	GSFC	The National Space Development Agency (NASDA, now part of the Japan Aerospace Exploration Agency, or JAXA) provided the Advanced Microwave Scanning Radiometer for the Earth Observing System (AMSR-E) instrument. Brazil's Instituto Nacional de Pesquisas Espaciais (INPE, the Brazilian Institute for Space Research) provided the Humidity Sounder for Brazil (HSB) instrument.

Project	Oversight	Lead Performer	Partners
Aura	GSFC	GSFC	The National Environmental Research Council of the United Kingdom funded the High Resolution Dynamics Limb Sounder (HIRDLS); the instrument was designed by universities and laboratories in the U.K. and the U.S., including the University of Colorado, Oxford University, the National Center for Atmospheric Research (U.S.), and the Rutherford Appleton Laboratory (U.K.). The University of Edinburgh (U.K.) contributed to data processing algorithms and validation for the Microwave Limb Sounder (MLS). The Ozone Monitoring Instrument (OMI) was built by Dutch Space and TNO TPD in the Netherlands in cooperation with Finnish VTT and Patria Advanced Solutions Ltd. KNMI (Royal Netherlands Meteorological Institute) is the Principal Investigator Institute. Overall responsibility for OMI lies with the Netherlands Agency for Aerospace Programmes (NIVR), with the participation of the Finnish Meteorological Institute (FMI).
EP/TOMS	GSFC	GSFC	None.
TRMM	GSFC	GSFC	The Japan Aerospace Exploration Agency (JAXA) provided the Precipitation Radar (PR) instrument and the launch vehicle (an H-II F6).
ACRIMSat	JPL	JPL	None.
QuikSCAT	JPL	JPL	None.
EO-1	GSFC	GSFC	None.
Jason	JPL	JPL	The French Centre National d'Etudes Spatiales (CNES, the National Center for Space Studies) is responsible for the Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) instrument; THALES built the instrument, and SMP provided the ground beacons. The CNES is also responsible for the Poseidon-2 nadir-viewing radar altimeter; Alcatel Space Industries was prime contractor for the instrument.
ICESat	GSFC	GSFC	None.
SORCE	NASA HQ	GSFC	None.

Acquisition Strategy

LDCM: The LDCM instrument will be selected by full and open competition in early FY 2007. LDCM spacecraft will be a Rapid Spacecraft Development Office selection.

GPM: The GPM instruments and ground system will be selected via full and open competition; the spacecraft is an in-house development at GSFC with avionics to be selected by full and open competition.

Senior Reviews are held every two years to assess the relative science value of missions in operation. In FY 2007, all operating Earth Systematic Missions other than Aura will go through the competitive Senior Review process to determine whether they should enter an extended mission phase after their current missions have been completed (many of these missions are already in the extended phase).

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Quality	Senior Review Panel	04/2005	2007 Senior Review - All operating Earth Systematic Missions except for Aura will undergo this review to determine whether their missions should be extended beyond current plans.	02/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Operational measurements	Delays in planned transfers of responsibility for operational measurements increase the costs of the ESM Program and limited the resources available to undertake planned new measurements.	NASA is working with NOAA to standardize the transfer of operational measurements.
Data gap	Gaps in Earth measurements can result if planned follow-on missions are not completed as scheduled.	NASA works with partner agencies to identify measurements that might be at risk of a potential gap and to develop options to minimize the length and science impact of the gap. For example, NASA has developed improvements in mission operations that often allow existing mission life to be extended.
Partnership uncertainties	Earth observations, global and multifunctional in nature, are frequently undertaken in partnership with other agencies and countries. While this increases the breadth of observations, it adds risk to individual projects with respect to partner funding and schedule.	The Earth Systematic Missions Program increasing utilizes a portfolio approach to selecting missions, including joint missions, so that science results are less dependent on the outcome of individual missions than they are on the achieved suite of missions in operation at any given time.
Operating mission engineering risk	Earth Science operating missions, especially those in their extended mission phase, face the normal array of engineering risks that could impact the mission. As spacecraft and their systems age, instruments and spacecraft systems (e.g., solar arrays, batteries, gyroscopes) degrade, increasing the risk to the mission.	NASA Centers involved with operating missions (primarily GSFC and JPL) routinely monitor spacecraft and instrument health and develop mitigation strategies in coordination with SMD to deal with technical challenges, as needed. A variety of options are available, including reducing instrument usage time, making corrections via software uploads, and accepting higher levels of risk.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Development:	NPOESS Preparatory Project (NPP)

Budget / Life Cycle Cost

Budget Authority ($ millions)	**Prior**	**FY06**	**FY07**	**FY08**	**FY09**	**FY10**	**FY11**	**FY12**	**BTC**	**LCC TOTAL**
FY 2008 President's Budget Request	**492.1**	**21.2**	**80.1**	**91.0**	**93.6**	**20.2**	**6.8**	**7.6**	**13.8**	**826.4**
Formulation	47.7	--	--	--	--	--	--	--	--	--
Development	444.4	21.2	80.1	91.0	93.6	13.3	--	--	--	--
Operations	--	--	--	--	--	6.9	6.8	7.6	13.8	--
Other	--	--	--	--	--	--	--	--	--	--
FY 2007 President's Budget Request	**489.4**	**31.7**	**70.1**	**72.9**	**6.2**	**6.2**	**6.4**	**--**	**6.6**	**689.5**
Formulation	44.3	--	--	--	--	--	--	--	--	--
Development	445.1	28.0	64.2	66.9	--	--	--	--	--	--
Operations	--	3.7	5.9	6.0	6.2	6.2	6.4	--	6.6	41.0
Other	--	--	--	--	--	--	--	--	--	--
Changes	**2.7**	**-10.5**	**10.0**	**18.1**	**87.4**	**14.0**	**0.4**	**7.6**	**7.2**	**136.9**
Formulation	3.4	--	--	--	--	--	--	--	--	3.4
Development	-0.7	-6.8	15.9	24.1	93.6	13.3	--	--	--	139.4
Operations	--	-3.7	-5.9	-6.0	-6.2	0.7	0.4	7.6	7.2	-5.9
Other	--	--	--	--	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Project Changes

Project	*NPOESS Preparatory Project (NPP)*
The launch date change and cost increase for NPP are due to the late delivery of sensors from the NPOESS Integrated Program Office (IPO). The Visible Infrared Imaging Radiometer Suite (VIIRS) is on the critical path for the launch of NPP. The latest delivery date based on the recent Nunn-McCurdy review of the NPOESS program leads to a September 2009 launch of NPP. This represents a 17-month slip from the FY 2007 submit.	

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Development:	NPOESS Preparatory Project (NPP)

Project Purpose

The NPOESS Preparatory Project (NPP) is a joint mission with National Oceanic and Atmospheric Administration (NOAA) and the US Air Force (USAF) to extend key environmental measurements. The satellite will provide atmospheric and sea surface temperatures, humidity sounding, land and ocean biological productivity, and cloud and aerosol properties.

The NPP mission has two objectives: First, NPP will provide a continuation of global change observations following the Earth Observing System (EOS) missions Terra and Aqua; specifically, atmospheric and sea surface temperatures, humidity sounding, land and ocean biological productivity, and cloud and aerosol properties. Second, NPP will provide the National Polar-orbiting Operational Environmental Satellite System (NPOESS) with risk- reduction demonstration and validation for the critical NPOESS sensors, algorithms, and processing.

Project Parameters

The NPP spacecraft is based on a modified Ball Commercial Platform (BCP) 2000 bus with a 5-year design life. The NPP orbit is a polar, sun-synchronous orbit at a nominal altitude of 824km. The four instruments are newly developed sensors based on heritage NASA sensors. The Advanced Technology Microwave Sounder (ATMS) is being developed by NASA, and the other three instruments are being developed by the NOAA/DoD Integrated Program Office.

Project Commitments

NPP will launch in September 2009 and undertake the following scientific measurements over its five-year operating life: atmospheric and sea surface temperatures, humidity soundings, land and ocean biological productivity, and cloud and aerosol properties.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Visible Infrared Imaging Radiometer Suite (VIIRS)	Raytheon SBRS	Provide global imagery in visible and infrared frequency bands: .3 to 14 microns / 400m resolution	Same	Same
Ozone Mapping and Profiler Suite (OMPS)	Ball Aerospace	Collection of total column and vertical profile ozone data with 300-380nm / LIMB 290-1000nm	Same	Same
Cross-Track Infrared Sounder (CrIS)	ITT Aerospace	Temperature and moisture profiles at 3.9-15.4 microns	Same	Same
Advanced Technology Microwave Sounder (ATMS)	NG Electronic Systems	Temperature and moisture profiles at 22 channels / 23-183 ghz	Same	Same
Spacecraft	Ball Aerospace	5-year design life, Weight 2228 kg, Power 1400 watts	Same	Same
Launch vehicle	Boeing	Delta II 7920	Same	Same
Ground system	Raytheon	Command, Control, and Communication Segment (C3S) and Interface Data Processing Segment (IDPS)	Same	Same

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Development:	NPOESS Preparatory Project (NPP)

Schedule Commitments

The NPP mission completed Mission Confirmation Review (MCR) in November 2003.

Milestone Name	Confirmation Baseline	FY 2007 PB Request	FY 2008 PB Request
Development			
CrIS Flight Model Delivery	Oct 2005	June 2006	Jan 2007
ATMS Flight Model Delivery	Apr 2005	Oct 2005	Oct 2005
OMPS Flight Model Delivery	Sep 2005	Oct 2006	Mar 2008
VIIRS Flight Model Delivery	Nov 2005	Mar 2007	Jul 2008
Operations Readiness Review	Jun 2006	Nov 2007	Apr 2009
Launch	Oct 2006	April 2008	Sep 2009

Development Cost Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
NPOESS Preparatory Project (NPP)	2006	604.2	2007	732.4	21	Launch Readiness	4/30/2008	9/30/2009	17

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**604.2**	**732.4**	**128.2**
Technology Development	0.0	0.0	0.0
Aircraft/Spacecraft	160.0	156.0	-4.0
Payload(s)	194.2	171.0	-23.2
System Integration and Testing	0.0	0.0	0.0
Launch Vehicle/Services	72.9	86.0	13.1
Ground Systems	48.2	41.5	-6.7
Science/Technology	0.0	31.6	31.6
Other (In-house labor is reflected under other in FY08)	128.9	246.3	117.4

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Development:	NPOESS Preparatory Project (NPP)

Project Management

GSFC is responsible for NPP project management. NASA Agency PMC has program oversight responsibility. NOAA/DOD IPO is responsible for managing development of OMPS, CrIS and VIIRS instruments. Responsible official for this project is Michael Freilich.

Project Element	Element Oversight	Lead Performer	Partners
Spacecraft	GSFC	Ball Aerospace	
ATMS Development	GSFC	NG Electronic Systems	
OMPS Development	GSFC	Ball Aerospace	NOAA / DoD (NPOESS-IPO)
CrIS Development	GSFC	ITT Aerospace	NOAA / DoD (NPOESS-IPO)
VIIRS Development	GSFC	Raytheon SBRS	NOAA / DoD (NPOESS-IPO)
Data archive and storage	GSFC	NOAA	DoD
Ground Systems and Ops	GSFC	Raytheon	NOAA / DoD (NPOESS-IPO)

Acquisition Strategy

Spacecraft and ATMS were procured competitively. The VIIRS, OMPS, and CrIS were procured competitively via the NPOESS IPO.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	NPP IRT	08/2005	Mission Operations Review/Successfully completed.	03/2008

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Instrument Delivery Delay	Additional delays in the delivery of instruments are very likely. This would result in observatory integration delays, test delays, cost increases, schedule slip, and possible gaps in data continuity.	NASA and NOAA/IPO team working together to identify further work-arounds to minimize impacts.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Development:	Glory Mission

Budget / Life Cycle Cost

Budget Authority ($ millions)	Prior	FY06	FY07	FY08	FY09	FY10	FY11	FY12	BTC	LCC TOTAL
FY 2008 President's Budget Request	**70.8**	**56.6**	**60.0**	**42.7**	**32.7**	**11.1**	**11.3**	**1.9**	**--**	**287.0**
Formulation	70.8	--	--	--	--	--	--	--	--	--
Development	--	56.6	60.0	42.7	24.9	--	--	--	--	--
Operations	--	--	--	--	7.8	11.1	11.3	1.9	--	--
Other	--	--	--	--	--	--	--	--	--	--
FY 2007 President's Budget Request	**63.1**	**52.6**	**52.0**	**34.0**	**12.1**	**7.8**	**7.3**	**--**	**1.8**	**230.7**
Formulation	63.1	--	--	--	--	--	--	--	--	--
Development	--	52.6	52.0	34.0	--	--	--	--	--	--
Operations	--	--	--	--	12.1	7.8	7.3	--	1.8	--
Other	--	--	--	--	--	--	--	--	--	--
Changes	**7.7**	**4.0**	**8.0**	**8.7**	**20.6**	**3.3**	**4.0**	**1.9**	**-1.8**	**56.3**
Formulation	7.7	--	--	--	--	--	--	--	--	7.7
Development	--	4.0	8.0	8.7	24.9	--	--	--	--	45.6
Operations	--	--	--	--	-4.3	3.3	4.0	1.9	-1.8	3.1
Other	--	--	--	--	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Project Changes

Project	*Glory Mission*
The acquisition cost for the Aerosol Polarimetry Sensor (APS) instrument has grown. Additional workforce needs to address APS issues and maintain schedule have also contributed to the increased funding requirements. A cost and schedule review will be completed in Feb 2007.	

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Development:	Glory Mission

Project Purpose

Glory's science objectives are to (1) determine the global distribution, microphysical properties, and chemical composition of natural and anthropogenic aerosols and clouds with accuracy and coverage sufficient for a reliable quantification of the aerosol direct and indirect effects on climate; and, (2) continue measurement of the total solar irradiance to determine the Sun's direct and indirect effect on the Earth's climate.

The Glory mission will contribute to NASA's research regarding the atmospheric conditions that influence climate and improve understanding of the natural and man-made factors that contribute to climate change. It will also enable a greater understanding of the seasonal variability of aerosol properties. Both advances are essential components of predicting climate change. Solar radiation is the dominant, direct energy input into the terrestrial ecosystem, affecting all physical, chemical, and biological processes. Aerosols interact with atmospheric conditions in complex ways that can have large effects on climate.

For more on the scientific questions addressed by Glory, visit http://glory.gsfc.nasa.gov/.

Project Parameters

The Glory mission will operate two scientific instruments aboard an existing NASA spacecraft asset requiring minor modification. The Glory satellite will fly in the low Earth orbit A-Train constellation (five spacecraft flying in close proximity to provide detailed observations of the Earth system) to assess the effectiveness of combining data from multiple instruments, a mode required in the NPOESS era.

The two instruments aboard Glory are the Aerosol Polarimetry Sensor (APS) which is an advanced polarimeter used for measurements that increase our understanding of black carbon soot and other aerosols as causes of climate change. The APS will provide unprecedented measurements of the global distribution of natural and anthropogenic aerosols and clouds with accuracy and coverage sufficient for a reliable quantification of the aerosol direct and indirect effects on climate. The second Glory instrument is the solar Total Irradiance Monitor (TIM), which provides measurements to maintain an uninterrupted solar irradiance data record by bridging the gap between the NASA's Solar Radiation and Climate Experiment (SORCE) and the National Polar Orbiting Operational Environmental Satellite System (NPOESS) missions.

Glory will launch on a Taurus XL from Vandenberg AFB, California.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Development:	Glory Mission

Project Commitments

Glory will launch in December 2008 to begin a 3-year prime mission (with a 5 year goal) to gather scientific measurements of atmospheric aerosols and solar irradiance.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Aerosol Polarimetry Sensor (APS)	Raytheon	Provide unprecedented measurements of the global distribution of natural and anthropogenic aerosols	Same	Same
Total Irradiance Monitor (TIM)	U of Colorado LASP	Maintain an uninterrupted solar irradiance data record	Same	Same
Spacecraft	Orbital	Refurb of VCL mission bus	Same	Same
Launch vehicle	Orbital	Taurus XL	Same	Same
Ground System Ops, TIM Science Ops, APS Science Ops	Orbital / Colorado University-Boulder LASP /GSFC Institute for Space Studies	Combination of the commercial ground stations, MOC, APS SOC, TIM SOC, GES DAAC, and networks that connect them	Same	Same
Mission Ops	Orbital	Operations of the spacecraft and the generation of command uplink	Same	Same
Data Archive	GSFC Earth Science Distributed Active Archive Center (GES DAAC)	Archival and distribution of mission data	Same	Same

Schedule Commitments

Glory was confirmed for development on December 13, 2005.

Milestone Name	Confirmation Baseline	FY 2007 PB Request	FY 2008 PB Request
Development			
Mission Confirmation Review	11/2005	11/2005	12/2005
Mission Pre-ship review	8/2008	not included	8/2008
Launch	12/2008	12/2008	12/2008

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Development:	Glory Mission

Development Cost Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Glory Mission	2007	192.9	2007	192.9	0	Launch Readiness	12/31/2008	12/31/2008	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**192.9**	**192.9**	**0.0**
Aircraft/Spacecraft	13.1	13.1	0.0
Payload(s)	48.0	48.0	0.0
System Integration and Testing	3.6	3.6	0.0
Launch Vehicle/Services	54.5	54.5	0.0
Ground Systems	1.1	1.1	0.0
Science/Technology	13.4	13.4	0.0
Other	59.2	59.2	0.0

Project Management

GSFC has Project Management responsibility. The Science Mission Directorate Program Management Council has program oversight responsibility.

The responsible official for this project is Michael Freilich, Director of the Earth Science Division.

Project Element	Element Oversight	Lead Performer	Partners
APS	GSFC	Raytheon	
TIM	GSFC	U of Colorado LASP	

Acquisition Strategy

There are no remaining major procurements, as all instrument and spacecraft contracts are in place.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Development:	Glory Mission

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	GSFC	08/2006	Detailed cost and schedule review/ Required delta Integrated Baseline Review (IBR). The IBR is used to understand the project's performance measurement baseline (PMB) and project objectives.	02/2007

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
APS Instrument	Instrument contractor poor performance will cause increased cost and possible impact to launch readiness date.	HQ and GSFC are carrying out a cost and schedule review. The project is monitoring contractor trends and conducting a delta Integrated Baseline Review (IBR).

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Formulation:	Global Precipitation Measurement (GPM)

Budget / Life Cycle Cost

Budget Authority ($ millions)	FY06	FY07	FY08
FY 2008 President's Budget Request	23.4	28.1	90.2
FY 2007 President's Budget Request	23.2	24.2	25.4
Total Change from FY 2007 President's Budget Request	0.1	3.8	64.8

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Formulation:	Global Precipitation Measurement (GPM)

Project Purpose

The Global Precipitation Measurement (GPM) mission will initiate the measurement of global precipitation, making possible high spatial resolution precipitation measurements available at a 3-hour or less refresh rate over much of the globe. A joint mission with the Japan Aerospace Exploration Agency (JAXA), GPM will provide the first opportunity to calibrate measurements of global precipitation--including the distribution, amount, rate, and associated heat released--across tropic, mid-latitude, and polar regions.

The GPM mission has the following scientific objectives:

(1) Advance precipitation measurement capability from space through combined use of active and passive remote-sensing techniques. These advanced measurements will be used to calibrate dedicated and operational passive microwave sensors with the goal of achieving global sampling.

(2) Advance understanding of global water/energy cycle variability and fresh water availability. Improved measurements of the space-time variability of global precipitation will substantially close the water/energy budget and elucidate the interactions between precipitation and other climate parameters.

(3) Improve climate prediction by providing the foundation for better understanding of surface water fluxes, soil moisture storage, cloud/precipitation microphysics and latent heat release in the Earth's atmosphere.

(4) Advance Numerical Weather Prediction (NWP) skills through more accurate and frequent measurements of instantaneous rain rates with better error characterizations, and the development of improved assimilation methods.

(5) Improve flood-hazard and fresh-water-resource prediction capabilities through better temporal sampling and wider spatial coverage of high-resolution precipitation measurements, and innovative designs in hydro-meteorological modeling.

For more information see http://science.hq.nasa.gov/missions/earth.html.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Formulation:	Global Precipitation Measurement (GPM)

Project Parameters

The GPM project includes a core spacecraft and an additional NASA-provided passive microwave (constellation) spacecraft, both of which will measure precipitation across two latitudes. The real power of this mission, however, is in the ability of the core spacecraft to leverage, for the first time, passive microwave measurements from other operating and planned 'satellites of opportunity' by calibrating their measurements to its own. The exact sampling rate over different areas of the globe will depend on the number and orbits of satellites of opportunity, but given the prevalence of passive microwave instruments on operational satellite systems, the global sampling will be robust.

The NASA Core Spacecraft will fly in a 65 degree inclined orbit at an altitude of 407 km; the 65 deg orbit provides better latitude coverage than TRMM (which is 35 deg). The Core Spacecraft includes two scientific instruments which will provide active and passive microwave measurements of precipitation:

The JAXA-supplied Dual-frequency Precipitation Radar (DPR) is characterized by cross-track swath widths of 245 km and 120 km, for the Ku precipitation radar (KuPR) and Ka-band precipitation radar (KaPR), respectively, providing a 3-dimensional observation of rain and an accurate estimation of rainfall rate. The KuPR (13.6 GHz) is an updated version of the highly successful unit flown on the TRMM mission. The KuPR and the KaPR will be co-aligned on the GPM core spacecraft bus such that that the 5 km footprint location on the earth will be the same.

The GPM Microwave Imager (GMI) is a conically-scanning radiometer which will provide significantly improved spatial resolution over the TRMM Microwave Imager (TMI).

NASA's passive microwave spacecraft will fly in a 40 degree inclined orbit; this orbit covers the destructive hurricane region; the constellation-of-opportunity spacecraft will fly at multiple altitudes and inclines.

The Core Spacecraft will be launched from Tanegashima Island, Japan on an H-IIA launch vehicle and NASA's constellation satellite will be launched from the Kennedy Space Center on a Taurua-XL. The collection of the DPR data will be transmitted to the ground using the TDRSS multiple access (MA) and single access (SA) service

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Formulation:	Global Precipitation Measurement (GPM)

Project ROM Estimate

The GPM Core Spacecraft is planned for a launch in June 2013 to begin a 3-year prime mission (5-year goal), followed by a launch in June 2014 of the NASA passive microwave (constellation) spacecraft. When calibrated with existing and planned passive microwave measurements, GPM will provide global measurements of precipitation with a sampling frequency of three hours or less over much of the globe.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Core Spacecraft	GSFC	Provides platform for the GMI and JAXA-supplied DPR instruments	Same	Same
Constellation Spacecraft	GSFC	Provides platform for the second GMI instrument	Same	Same
Dual-frequency Precipitation Radar (DPR)	JAXA	Provides a cross-track swath widths of 245 km and 120 km, for the Ku precipitation radar (KuPR) and Ka-band precipitation radar (KaPR).		
GPM Microwave Imager (GMI)	GSFC	Provides 13 microwave channels ranging in frequency from 10 GHz to 183 GHz; four high frequency, millimeter-wave, channels about 166 GHz and 183 GHz. 1.2 m diameter antenna	Same	Same
Launch Vehicle	JAXA	H-IIA		

Schedule ROM Estimate

GPM entered formulation in July 2002. Milestone dates beyond the formulation phase are preliminary estimates pending completion of formulation.

Milestone Name	Formulation Estimate	FY 2007 PB Request	FY 2008 PB Request
Formulation			
KDP-C	Dec 2003	Oct 2008	
Core Spacecraft launch readiness date (LRD)	Nov 2010	Dec 2012	Jun 2013
Constellation Spacecraft launch readiness date (LRD)		not included	Jun 2014

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Formulation:	Global Precipitation Measurement (GPM)

Project Management

GSFC has project management responsibility. The Agency Program Management Council has program oversight responsibility.

The responsible official for this project is Michael Freilich, Director of the Earth Sciences Division.

Project Element	Element Oversight	Lead Performer	Partners
Core Spacecraft	GSFC	GSFC	
Core Spacecraft: GMI	GSFC	Ball Aerospace	
Core Spacecraft: DPR	GSFC		JAXA
Constellation Spacecraft	GSFC	To Be Determined	
Constellation Spacecraft: GMI	GSFC	Ball Aerospace	
Launch vehicle and services			JAXA

Acquisition Strategy

DPR instrument and launch vehicle for core spacecraft will be provided by foreign partner (JAXA), subject to inter-agency coordination. The Constellation Spacecraft and Launch Vehicle will be selected by full and open competition. The Core Spacecraft will be an in-house development at GSFC with avionics to be selected by full and open competition via Goddard's Rapid Spacecraft Development Office (RSDO). The GMI instrument contract is in place, resulting from a competitive selection.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO	12/2005	Non-Advocate Review	04/2008

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Constellation elements	Exact global sampling depends on operations of 'spacecraft of opportunity' that are not part of this project.	NASA is developing data algorithms that allow GPM to make the broadest possible use of microwave instruments on other spacecraft; NASA participates in inter-agency and international planning processes for operational Earth observation measurements to maximize the leverage opportunities for GPM.
JAXA	Delay threatens partnership	Rebaseline NASA development schedule and harmonize with JAXA's

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Formulation:	Landsat Data Continuity Mission (LDCM)

Budget / Life Cycle Cost

Budget Authority ($ millions)	FY06	FY07	FY08
FY 2008 President's Budget Request	**8.5**	**113.5**	**160.2**
FY 2007 President's Budget Request	**27.1**	**98.1**	**109.8**
Total Change from FY 2007 President's Budget Request	**-18.6**	**15.4**	**50.4**

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure. The changes in the budget request are primarily due to an increase in launch vehicle costs, an increased estimate for the mission level procurements, and added contractor incentives for early delivery.

Project Purpose

Unprecedented changes in land cover and use are having profound consequences for weather and climate change, ecosystem function and services, carbon cycling and sequestration, resource management, the national and global economy, human health, and society. The Landsat data series, begun in 1972, is the longest continuous record of changes in the Earth's surface as seen from space and the only satellite system designed and operated to repeatedly observe the global land surface at moderate resolution. Landsat data are available at an affordable cost, providing a unique resource for people who work in agriculture, geology, forestry, regional planning, education, mapping, and global change research.

The purpose of the Landsat Data Continuity Mission (LDCM) is to extend the record of multi-spectral, moderate resolution Landsat-quality data, and to meet US Government operational and scientific requirements for observing land use and land change.

Project Parameters

LDCM is being formulated for a Launch Readiness Date (LRD) that will minimize a potential data gap in the archive due to the fuel-limited life of Landsat-7. The Landsat-7 end-of-life is currently estimated to be October 2010, while the LDCM is currently estimated for launch in January 2011.

LDCM consists of a single science instrument (the Operational Land Imager), a spacecraft, and a mission operations ground system. The LDCM is in formulation and system level requirements are in development to provide the following system-level performance parameters:

Earth Spatial-Temporal Coverage: 16-day repeat coverage of the global land mass

Spatial Resolution: 30 meters

Radiometric Performance: Accuracy, dynamic range, and precision sufficient to detect land cover change using historic Landsat data

Data: 185-km-cross-track-by-180-km-along-track multi-spectral image of the earth surface

Mission Life: 5 Years

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Formulation:	Landsat Data Continuity Mission (LDCM)

Project ROM Estimate

LDCM will launch in 2011 and operate for 5 years.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Operational Land Imager (OLI)	TBD	Provide Landsat-equivalant data to extend the Landsat data of Earth's land surface for 5 years	Same	Same
Spacecraft	TBD	Provide performance and reliability commensurate with OLI data requirements.	Same	Same
Launch Vehicle	TBD	Provide medium class launch service access to space.	Same	Same
Mission operations ground system	TBD	Provide capability for command and control, mission scheduling, long-term trending and analysis, and flight dynamics analysis.	Same	Same

Schedule ROM Estimate

In FY 2007, the LDCM Project will award the Operational Land Imager (OLI) contract, the spacecraft interface study contract(s) and formulate the Mission Operations Element (MOE) system development in coordination with the USGS. Following the initial formulation of the LDCM procurement strategy, in FY 2008, the LDCM project will award the MOE, complete the preliminary design on OLI, select the spacecraft bus vendor, as well as conduct the Mission Confirmation review in preparation for entry into development. In FY 2008 preliminary design will comprise the majority of the technical effort with critical design and fabrication completion in FY 2009 and 2010. System integration and test will begin in FY 2010-FY 2011. Observatory integration and testing, as well as environmental testing will be in FY 2010 for launch vehicle integration in early FY 2011.

Milestone Name	Formulation Estimate	FY 2007 PB Request	FY 2008 PB Request
Formulation			
Award OLI contract	June 2007	Not included	June 2007
Confirmation Review	Jan 2008	Feb 2007	Jan 2008
Critical Design Review (CDR)	Feb 2009	Not included	Feb 2009
PSR	May 2011	Not included	May 2011
Launch	Jan 2011	Jan 2011	Jan 2011

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Formulation:	Landsat Data Continuity Mission (LDCM)

Project Management

GSFC is responsible for LDCM project management. The Science Mission Directorate Program Management Council has program oversight responsibility. The responsible official for this project is Michael Freilich, Director of the Earth Science Division.

Project Element	Element Oversight	Lead Performer	Partners
Operational Land Imager	GSFC	To be determined	
Spacecraft	GSFC	To be determined	
Ground System	GSFC	To be determined	DOI-USGS
Mission Operations	GSFC	TO be determined	DOI-USGS

Acquisition Strategy

NASA plans to issue an openly competed Request for Proposals (RFP) for the Operational Land Imager instrument in the beginning of 2007 that will result in a cost-reimbursable contract award in 2007.

NASA plans to use the Rapid Spacecraft Development Office (RSDO) contract to acquire the LDCM spacecraft. An RSDO "On-Ramp" solicitation will be issued to permit all qualified spacecraft vendors to be added to the current RSDO catalog. We anticipate that the LDCM RSDO spacecraft will be awarded in the 4th quarter of 2007.

NASA in coordination with the US Geological Survey (USGS) plans to issue a separate RFP for the LDCM mission operations ground system that is anticipated to be awarded in the 4th quarter of 2007. NASA plans to issue all the solicitations with 5 one-year options for extended sustaining engineering support.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	HQ and GSFC	11/2007	NAR (Follow-on from PNAR)	06/2008

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
Project In Formulation:	Landsat Data Continuity Mission (LDCM)

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Focal Plane Array (FPA) Development Risk	The technical risk in LDCM is low to moderate. The system component with the greatest associated risk is the Focal Plane Array (FPA). The FPA has proven flight heritage, but intrinsic development risk which could impact the LDCM schedule.	Risk mitigation strategies are based upon proven NASA methodologies that include the required instrument manufacturer risk mitigation strategy implementation and correlated Government expert oversight, enhanced FPA deliverables and test scenarios, and in-plant expert representation.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth System Science Pathfinder

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Earth System Science Pathfinder	133.4	165.2	135.7	94.9	171.6	242.3	161.2
Aquarius	51.7	73.4	60.6	33.5	6.7	4.8	3.4
Orbiting Carbon Observatory (OCO)	40.8	75.7	40.9	12.6	6.4	--	--
Other	40.9	16.0	34.1	48.8	158.4	237.5	157.8

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Earth System Science Pathfinder	FY 2007 PB Request	FY 2008 PB Request	Change
Aquarius	**55.6**	**60.6**	**5.0**
OCO and Aquarius schedule, cost phasing, and total cost were adjusted to the Confirmation baselines that were approved in May 2005 and September 2005, respectively.			
Orbiting Carbon Observatory (OCO)	**34.1**	**40.9**	**6.9**
Other	**21.8**	**34.1**	**12.3**
The CloudSat/CALIPSO launch was delayed from May 2005 to April 2006 due to technical issues and the unavailability of the planned launch opportunity.			

Program Overview

The Earth System Science Pathfinder Program (ESSP) addresses unique, specific, highly focused mission requirements in Earth science research. ESSP includes a series of relatively low-to-moderate cost, small-to-medium sized, competitively selected, Principal Investigator-led missions that are built, tested and launched in a short time interval. These missions, which complement the larger Earth Systematic Missions (ESM), are capable of supporting a variety of scientific objectives related to Earth science, including studies of the atmosphere, oceans, land surface, polar ice regions, and solid Earth. Investigations include development and operation of remote-sensing instruments and the conduct of investigations utilizing data from these instruments.

ESSP currently has two missions in development (OCO and Aquarius) and three operating missions (the Gravity Recovery and Climate Experiment [GRACE], CloudSat, and the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations [CALIPSO] mission). Future ESSP missions will be selected from proposals submitted in response to Announcements of Opportunity (AOs). These AOs will be released approximately once every two years, subject to funding availability.

ESSP supports missions that complement those of the larger Earth Systematic Missions which are designed to facilitate on-going or operational measurements.

For more information see http://earth.nasa.gov/essp/index.html/.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth System Science Pathfinder

Program Relevance

Earth System Science Pathfinder missions provide science data, techniques, and technologies that can be employed to predict climate, weather, and natural hazards on Earth and other planets we plan to explore.

ESSP contributes to the Outcomes under Strategic Plan Sub-goal 3A: Study Earth from space to advance scientific understanding and meet societal needs.

Plans For FY 2008

1) OCO mission observatory Pre-Ship Review and Operations Readiness Review.

2) Aquarius mission observatory Pre-Ship Review and Mission Operations Review.

3) GRACE and CloudSat will undergo a Senior Review in 2007 to determine whether their missions will be extended. GRACE is already in its extended mission phase, and is currently slated to operate through the end of FY09. CloudSat currently has an earlier planned mission completion date, but these dates are subject to revision via the Senior Review process.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth System Science Pathfinder

Project Descriptions

Earth System Science Pathfinder (ESSP) projects provide specific measurements with a limited mission development lead time.

Orbiting Carbon Observatory (OCO)

Improve understanding of atmospheric carbon dioxide sources and sinks, a critical element in making more reliable climate predictions. The science focus areas served by OCO will include: atmospheric composition; and carbon cycle, ecosystems, and biogeochemistry.

Aquarius

Aquarius will observe and model seasonal and year-to-year variations of sea-surface salinity and how these variations relate to changes in the water cycle and ocean circulation. The science focus areas served by Aquarius will include: climate variability and change; and water and energy cycles.

Earth Explorer Future Missions

Future ESSP projects will implement unique, specific, highly focused missions in response to priorities suggested by the National Research Council's Earth Science Decadal Survey.

Gravity Recovery and Climate Experiment (GRACE)

The Gravity Recovery and Climate Experiment (GRACE), launched in 2002, was the first ESSP mission. GRACE measures Earth's gravity field and its variations with time. Science Focus Areas served by GRACE include: Climate Variability and Change; Earth Surface and Interior; and Water and Energy Cycles.

CloudSat

CloudSat measures cloud characteristics to increase understanding of the role of optically thick clouds in Earth's radiation budget. The science focus areas served by CloudSat include: climate variability and change and weather.

Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO)

CALIPSO measures the vertical distribution of clouds and aerosols. The science focus areas served by CALIPSO include: atmospheric composition, climate variability and change, water and energy cycles, and weather.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Senior Review (SR) to make recommendations on mission extensions	GRACE and CloudSat	SR to take place in 2007	SR to take place in 2007
Launch spacecraft	Orbiting Carbon Observatory	September 2008	September 2008
Launch spacecraft	Aquarius	March 2009	July 2009

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth System Science Pathfinder

Implementation Schedule

Project	Schedule by Fiscal Year															Phase Dates			
	Prior	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20		Beg	End	Mile-stone
OCO																	Tech			
																	Form	Oct-03	Apr-05	
																	Dev	May-05	Sep-08	
																	Ops	Oct-08	Oct-10	
																	Res			
Aquarius																	Tech			
																	Form	Oct-03	Sep-05	
																	Dev	Oct-05	Jul-09	
																	Ops	Jul-09	Jul-12	
																	Res			
Gravity Recovery and Climate Experiment (GRACE)																	Tech			
																	Form			
																	Dev			
																	Ops	Mar-02	Sep-09	
																	Res		Sep-11	
CloudSat																	Tech			
																	Form			
																	Dev			
																	Ops	Apr-06	Feb-08	
																	Res		Feb-10	
Cloud-Aerosol Lidar and Infrared Pathfinder Satellite (CALIPSO)																	Tech			
																	Form			
																	Dev			
																	Ops	Apr-06	Apr-09	
																	Res		Apr-11	

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth System Science Pathfinder

Program Management

The Agency Program Management Council has program oversight responsibility.

Project	Oversight	Lead Performer	Partners
Aquarius	JPL	JPL	Argentina's Comision Nacional De Actividades Espaciales (CONAE), NOAA, NRL, NCAR
Orbiting Carbon Observatory (OCO)	JPL	JPL	Laboratoire des Sciences du Climat ed de l'Environment (LSCE), France; Universitat Bremen, Germany; National Institute of Water & Atmospheric Research, New Zealand; Climate Monitoring & Diagnostic Laboratory, NOAA; Space Research Organization Netherlands, The Netherlands; Institut fur Umweltphysik, Bremen, Germany
Gravity Recovery and Climate Experiment (GRACE)	Earth Science Division	JPL	Deutches Zentrum fur Luft- und Raumfahrt (DLR, the German Aerospace Center); Office National d'Etudes et de Recherches Aerospatiale (ONERA) of France; GeoForschungsZentrum (German National Research Centre for Geosciences); NOAA; NGA;
CloudSat	Earth Science Division	JPL	The Canadian Space Agency (CSA); The U.S. Air Force (USAF); The U.S. Department of Energy's (DOE)
Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO)	Earth Science Division	GSFC	The French Centre National d'Etudes Spatiales (CNES, the National Center for Space Studies) and Alcatel; SODERN; Institut Pierre Simon Laplace, France;

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth System Science Pathfinder

Acquisition Strategy

Future ESSP missions will be selected competitively via announcements of opportunity (AO). The AO process utilizes peer review of the science content of the proposed missions, as well as thorough independent review of their technical, management, and cost elements.

In FY 2007, GRACE and CloudSat will go through the competitive Senior Review process to determine whether they should enter an extended mission phase after their current missions have been completed.

Grace Project team: Amarillo Independent School District. Applied Physics Laboratory, Johns Hopkins Univ. Llano Independent School District. Messalonskee School System. GSFC. Center for Space Research, Univ. of Texas at Austin. Analytical Mechanics Associates. Elizabeth Board of Education, Killeen Independent School District; MIT, Dept of Earth, Atmospheric & Planetary Sciences; Mid-Prairie Community School District; KSC; LaRC; Space Systems Loral; Sunray Independent School District; Texas Space Grant Consortium; Univ. of Colorado, Physics Department; Ohio State Univ., Civil & Environmental Engineering and Geodetic Science; Stanford Telecon; TRW; DJO, DASA, Jena-Optronik, Gm.
CloudSat Project team: Colorado State Univ. PI and team, E&PO effort; Ball Aerospace ; Cooperative Institute for Research in the Atmosphere (CIRA; Colorado State Univ.) operates Data Processing Center. LaRC Atmospheric Sciences Data Center delivers data products to CIRA. GSFC delivers data products to CIRA. European Centre for Medium-Range Weather Forecasts met forecast data to CIRA. GLOBE program (Boulder, Colorado) prime education partner.

CALIPSO Project team: LaRC systems engineering, payload mission ops, science data validation, data processing and archiving. Ball Aerospace CALIOP and wide-field camera, payload integration, LV support, science data downlink. Hampton Univ. manages quid pro quo validation effort, E&PO effort, and leads International Science Advisory Panel.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Quality	Senior Review Panel	04/2005	GRACE was included in the 2005 senior review / ranked high enough to be extended.	02/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Operating Mission Risk	Earth Science operating missions, especially those in their extended mission phase, face the normal array of engineering risks that could impact the mission. As spacecraft and their systems age, instruments and spacecraft systems (e.g., solar arrays, batteries, gyroscopes) degrade, increasing the risk to the mission.	NASA Centers involved with operating missions (primarily GSFC and JPL) routinely monitor spacecraft and instrument health and develop mitigation strategies in coordination with NASA HQ to deal with technical challenges, as needed. A variety of options is available, including reducing instrument usage time, making corrections via software uploads, and accepting higher levels of risk.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth System Science Pathfinder
Project In Development:	Aquarius

Budget / Life Cycle Cost

Budget Authority ($ millions)	Prior	FY06	FY07	FY08	FY09	FY10	FY11	FY12	BTC	LCC TOTAL
FY 2008 President's Budget Request	**35.6**	**51.7**	**73.4**	**60.6**	**33.5**	**6.7**	**4.8**	**3.4**	**--**	**269.7**
Formulation	35.6	--	--	--	--	--	--	--	--	--
Development	--	51.7	73.4	60.6	32.4	--	--	--	--	--
Operations	--	--	--	--	1.1	6.7	4.8	3.4	--	--
Other	--	--	--	--	--	--	--	--	--	--
FY 2007 President's Budget Request	**33.8**	**51.7**	**65.5**	**55.6**	**26.9**	**5.9**	**4.6**	**--**	**2.2**	**246.2**
Formulation	33.8	--	--	--	--	--	--	--	--	--
Development	--	51.7	65.5	55.6	26.9	--	--	--	--	--
Operations	--	--	--	--	--	5.9	4.6	--	2.2	--
Other	--	--	--	--	--	--	--	--	--	--
Changes	**1.8**	**--**	**7.8**	**5.0**	**6.6**	**0.8**	**0.2**	**3.4**	**-2.2**	**23.5**
Formulation	1.8	--	--	--	--	--	--	--	--	1.8
Development	--	--	7.9	5.0	5.5	--	--	--	--	18.4
Operations	--	--	--	--	1.1	0.8	0.2	3.4	-2.2	3.3
Other	--	--	--	--	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Project Changes

Project	*Aquarius*
Budget request reflects a 4 month launch delay by Budget request reflects a 4 month launch delay by CONAE, the mission partner providing the spacecraft.	

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth System Science Pathfinder
Project In Development:	Aquarius

Project Purpose

The Aquarius mission will investigate the links between the global water cycle, ocean circulation and climate. It will observe and model variations of sea surface salinity, and how these relate to changes in the water cycle and ocean circulation. This will yield an unprecedented view of the oceans' role in climate and weather.

Project Parameters

Aquarius is an instrument on the Argentine Comisión Nacional de Actividades Espaciales (CONAE) spacecraft, SAC-D. The combined NASA and CONAE instruments and spacecraft form the Aquarius/SAC-D observatory. This observatory will be launched into a polar, sun synchronous orbit that allows global coverage of ice-free ocean surfaces consistent with Aquarius/SAC-D science observational targets. The Aquarius instrument includes an L-band microwave radiometer (1.413 GHz) and scatterometer (1.26 GHz). The radiometer will measure the surface brightness temperature, which is related to the surface emissivity and physical temperature of the seawater. The surface emissivity is determined by the dielectric constant of seawater, which is related to salinity. The scatterometer is required to provide coincident information of sea surface roughness, a critical correction term for retrieval of sea surface salinity.

Project Commitments

Aquarius will launch in July 2009 to begin a 3-year prime mission to measure Sea Surface Salinity (SSS) with the precision, resolution, and coverage needed to characterize salinity variations and investigate the linkage between ocean circulation, the Earth's water cycle, and climate variability.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Aquarius Instrument (integrated radiometer/ scatterometer)	JPL	L-band microwave radiometer at 1.413 GHz; scatterometer at 1.26 GHz; SSS measurements with root-mean-sq random errors and systematic biases <= 0.2 psu on 150 km sq scales over ice-free oceans.	Same	Same
Spacecraft	CONAE	SAC-D	Same	Same
Launch Vehicle	Boeing	Delta II	Same	Same
Data Management	GSFC	N/A	Same	Same
Operations	CONAE	Command and telemetry	Same	Same

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth System Science Pathfinder
Project In Development:	Aquarius

Schedule Commitments

The Aquarius Mission entered a Risk Mitigation Phase (RMP) in July 2002. Following the RMP, the project was authorized to proceed to a formulation phase in December 2003. The Aquarius mission was authorized by the NASA Science Mission Directorate to proceed to Development (Implementation) on October 12, 2005. Aquarius is scheduled to launch in July 2009.

Milestone Name	Confirmation Baseline	FY 2007 PB Request	FY 2008 PB Request
Development			
Mission Confirmation Review	Septembr 2005	September 2005	September 2005
CDR	August 2007	August 2007	August 2007
Aquarius Instrument Pre-ship Review [FY08 APG]	May 2008	May 2008	May 2008
Launch	March 2009	March 2009	July 2009

Development Cost Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Aquarius	2007	215.9	2007	215.9	0	Launch Readiness	3/31/2009	3/31/2009	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**215.9**	**215.9**	**0.0**
Payload(s)	59.1	59.1	0.0
Launch Vehicle/Services	75.9	75.9	0.0
Ground Systems	5.4	5.4	0.0
Science/technology	10.8	10.8	0.0
Other	64.7	64.7	0.0

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth System Science Pathfinder
Project In Development:	Aquarius

Project Management

Project management responsibility resides at JPL. The SMD Program Management Council has program oversight responsibility.

The responsible official for this project is Michael Freilich, Director of the Earth Science Division.

Project Element	Element Oversight	Lead Performer	Partners
Launch Vehicle	KSC	Boeing	
Ground System	JPL	GSFC	
Aquarius Instrument	JPL	JPL	
Spacecraft	CONAE	CONAE	CONAE
Radiometer	JPL	GSFC	
Data management	GSFC	GSFC/JPL	
Mission operations	CONAE	CONAE	CONAE

Acquisition Strategy

Aquarius was competitively selected from proposals submitted in response to ESSP Announcement of Opportunity 3. All elements of the project were included in that selection, and there are no other planned major procurements.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	Aquarius Indep. Review Team	09/2006	Review technical, cost, schedule status.	08/2007

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
CONAE Delays	Further Delays at CONAE could impact launch date.	Monitor CONAE Progress and confirm commitments; reassess available schedule reserves.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth System Science Pathfinder
Project In Development:	Orbiting Carbon Observatory (OCO)

Budget / Life Cycle Cost

Budget Authority ($ millions)	Prior	FY06	FY07	FY08	FY09	FY10	FY11	FY12	BTC	LCC TOTAL
FY 2008 President's Budget Request	**72.8**	**40.8**	**75.7**	**40.9**	**12.6**	**6.4**	**--**	**--**	**--**	**249.2**
Formulation	30.9	--	--	--	--	--	--	--	--	--
Development	41.9	40.8	75.7	40.9	--	--	--	--	--	--
Operations	--	--	--	--	12.6	6.4	--	--	--	--
Other	--	--	--	--	--	--	--	--	--	--
FY 2007 President's Budget Request	**64.5**	**40.7**	**68.2**	**34.1**	**12.3**	**6.7**	**--**	**--**	**--**	**226.5**
Formulation	31.8	--	--	--	--	--	--	--	--	--
Development	32.7	40.7	68.2	34.1	--	--	--	--	--	--
Operations	--	--	--	--	12.3	6.7	--	--	--	--
Other	--	--	--	--	--	--	--	--	--	--
Changes	**8.2**	**0.1**	**7.6**	**6.9**	**0.3**	**-0.3**	**--**	**--**	**--**	**22.8**
Formulation	-0.9	--	--	--	--	--	--	--	--	-0.9
Development	9.2	0.1	7.5	6.8	--	--	--	--	--	23.6
Operations	--	--	--	--	0.3	-0.3	--	--	--	--
Other	--	--	--	--	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Project Changes

Project	*Orbiting Carbon Observatory (OCO)*
No major programmatic changes.	

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth System Science Pathfinder
Project In Development:	Orbiting Carbon Observatory (OCO)

Project Purpose

The data received from OCO will provide an improved understanding of CO2 sinks, a critical element in making reliable climate predictions. Two important Earth Science questions OCO will help address are: 1) What human and natural processes are controlling atmospheric CO2; and 2) What are the relative roles of the oceans and land ecosystems in absorbing CO2.

Project Parameters

The Orbiting Carbon Observatory (OCO) is a two-year mission, which will fly in a Sun-synchronous polar orbit that provides near global coverage of the sunlit portion of the Earth with a 16-day repeat cycle. The orbit's early afternoon equator crossing time maximizes the available signal and minimizes diurnal biases in CO2 measurements associated with photosynthesis. The OCO flight system uses hardware components, software and processes with heritage. OCO's three-axis stabilized bus design is derived from the LEOStar 2 spacecraft class currently in production at OSC. The design and architecture of the OCO spacecraft bus is based on the successful Solar Radiation and Climate Experiment (SORCE) and (Galaxy Explorer) GALEX missions. The spacecraft structure is made of honeycomb panels that form a hexagonal shape. This structure houses the instrument and the spacecraft bus components. Panels with solar cells are attached and stowed such that the whole structure fits inside the small fairing of the Taurus launch vehicle. For the OCO Mission, the spacecraft has been elongated to accommodate the instrument and the instrument has been embedded into the structure of the spacecraft. The instrument consists of a single telescope feeding three high-resolution grating spectrometers. The optics will be cooled to approximately 270 Kelvin and the Focal Plane Arrays (FPAs) to approximately 120 Kelvin. The instrument is designed to measure CO2 and O2 near-infrared absorptions from reflected sunlight. Remote sensing retrieval algorithms will process these data to yield estimates of the column-averaged CO2 dry air mole fraction, XCO2. The total weight of the Observatory is about 530kg (1170 lb).

Project Commitments

OCO will launch in September 2008 to begin a 2-year prime mission.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
OCO Mission	JPL	Provide the first space-based measurements of atmospheric CO2 with the precision, resolution, and co	Same	Same

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth System Science Pathfinder
Project In Development:	Orbiting Carbon Observatory (OCO)

Schedule Commitments

The Orbiting Carbon Observatory (OCO) will provide the first space-based measurements of atmospheric carbon dioxide (CO2) with the precision, resolution, and coverage needed to characterize its sources and sinks on regional scales and quantify their variability over the seasonal cycle. OCO was competitively selected from proposals submitted in response to ESSP Announcement of Opportunity 3 to enter a Risk Mitigation Phase (RMP) in July 2002. Following the RMP, the project was authorized to proceed to a formulation phase in December 2003. The OCO mission was authorized by the NASA SMD to proceed to Development (Implementation) on May 12, 2005. OCO is scheduled to launch in September 2008.

Milestone Name	Confirmation Baseline	FY 2007 PB Request	FY 2008 PB Request
Development			
Mission Confirmation Review	April 2005	April 2005	April 2005
CDR	August 2006	August 2006	August 2006
Launch Readiness	September 2008	September 2008	September 2008

Development Cost Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Orbiting Carbon Observatory (OCO)	2007	199.3	2007	199.3	0	Launch Readiness	9/30/2008	9/30/2008	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**199.3**	**199.3**	**0.0**
Spacecraft	49.1	49.1	0.0
Payload(s)	24.4	24.4	0.0
Launch Vehicle/Services	48.2	48.2	0.0
Ground Systems	9.9	9.9	0.0
Science/technology	9.8	9.8	0.0
Other	57.9	57.9	0.0

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth System Science Pathfinder
Project In Development:	Orbiting Carbon Observatory (OCO)

Project Management

Project management responsibility resides at JPL. The NASA and JPL Program Management Councils have program oversight responsibility.

The responsible official for this project is Michael Freilich, Director of the Earth Science Division.

Project Element	Element Oversight	Lead Performer	Partners
Spacecraft	JPL	OSC	
Instrument	JPL	HS	
Ground System	JPL	JPL	
Launch Vehicle	JPL	KSC	

Acquisition Strategy

The OCO mission is part of the Earth System Science Pathfinder (ESSP) Program in NASA's Science Mission Directorate (SMD). All mission elements were included in the proposal that was selected competitively as part of ESSP Opportunity 3.

There are no planned major procurements, as all instrument and spacecraft contracts are in place.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	OCO Indep. Review Team	08/2006	Review technical, cost, and schedule status of the project prior to major milestones.	04/2007

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Instrument Cost	Instrument Cost Overuns may impact total mission cost.	Assess cost impacts and project approach to minimize these costs. Confirm technical approach. Update budget request as needed.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Education and Outreach

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Education and Outreach	20.2	25.9	23.5	23.6	23.7	23.9	24.1

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Education and Outreach	**23.7**	**23.5**	**-0.2**
There are no major programmatic changes from FY 2007 to FY 2008.			

Program Overview

The Earth Science Education and Outreach Program seeks to make the discoveries and knowledge generated from NASA's Earth-observing satellites and scientific research (including applied science) accessible to students, teachers, and the public. It addresses workforce preparation and the education pipeline, and engages the public in better understanding NASA Earth Science research results from space.

The Earth Science Education and Outreach Program consists of two projects: Fellowships and New Investigators, and the Earth Science Education and Outreach Activity.

In addition to supporting the science, technology, engineering, and mathematics (STEM) carriers which support Earth Science objectives, this Program supports NASA's three major education outcomes:
-Strengthen NASA and the Nation's future workforce
-Attract and retain students in STEM disciplines
-Engage Americans in NASA's mission

Program Relevance

The Earth Science Education and Outreach Program strongly supports NASA's three major education Outcomes:
- ED-1: Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals, through a portfolio of programs.
- ED-2: Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.
- ED-3: Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Education and Outreach

Plans For FY 2008

The Earth Science Education and Outreach Program will continue to support teachers, students, scientists, and engineers in FY 2008, but the program will place particular emphasis on activities related to the International Polar Year (IPY).

Project Descriptions

The Earth Science Education and Outreach Program uses the results of NASA's studies of the Earth system to enhance the teaching and learning about Earth and the environmental sciences through partnerships with educational institutions and organizations. In coordination with the NASA Office of Education, the program makes the discoveries and knowledge generated by Earth Science research accessible to students, teachers, and the public by enabling dynamic and engaging learning environments.

New Investigator Program in Earth Science

Support research and education related to current projects and solicit new applications every two years (in odd years) as part of the Research Opportunities for Space and Earth Sciences (ROSES) effort.

GLOBE

Continue worldwide implementation and U.S. coordination, in partnership with the National Science Foundation.

K-16/Informal Education

Integrate and coordinate education activities selected as part of the REASoN (Research, Education, Applications Solutions Network), Earth Explorers, and the International Polar Year, which are work funded in other Earth Science programs.

NASA Earth System Science Fellowship

Support graduate students pursuing masters or Ph.D. degrees in Earth system Science as an element of the NASA Earth and Space Science Fellowship Program. This program provides new fellowships annually.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Provide research awards to new scientists and engineers.	New Investigators Program (NIP)	Approximately 30 awards per year	Approximately 30 awards per year
Provide fellowships to graduates for advanced degrees in Earth system science and related areas.	NASA Earth and Space Science Fellowship (NESSF)	Approximately 135 graduate fellowship awards per year	Approximately 135 graduate fellowship awards per year
Provide awards to educators for curriculum development.	K-16/Informal Education	Approximately 20 competitive awards	Approximately 20 competitive awards
Continue to support GLOBE Program.	GLOBE	same	same

Program Management

This program is managed by the Science Mission Directorate (SMD). Performing organizations include academic and/or educational institutions, research and/or non-profit organizations, and state and local governments.

Project	Oversight	Lead Performer	Partners
New Investigator Program	Science Mission Directorate	N/A	None.
GLOBE Program	Science Mission Directorate	N/A	NSF
K-16/Informal Education Program	Science Mission Directorate	N/A	None.
ESS Science Fellowship Program	Science Mission Directorate	N/A	None.

Acquisition Strategy

The acquisition strategy is primarily peer review, competitive sourcing, and/or Space Act agreements. Non-NASA performer acquisitions are primarily grants or cooperative agreements.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Science Technology

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Earth Science Technology	69.9	56.6	57.0	58.7	62.6	64.2	65.5

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Earth Science Technology	**60.6**	**57.0**	**-3.5**
No major program changes.			

Program Overview

Advanced technology plays a major role in enabling the Earth research and applications programs of the future that will provide an improved understanding of the total Earth system and the effects of natural and human-induced changes on the global environment. The Earth Science Technology Program (ESTP) provides the Earth Science Division with new capabilities, enabling previously unforeseen or infeasible science investigations, enhancing existing measurement capabilities, and reducing the cost, risk, and development times of Earth science measurements.

The Earth Science Technology Office (ESTO) provides strategic, science-driven technology assessments and requirements development. The program implements a science focused technology program by pursuing promising scientific and engineering concepts through open competition solicitations.

For more information, please see: http://esto.nasa.gov.

Program Relevance

Advanced technologies enable space-based measurements that look at how the Earth system works. They contribute to applications that serve national interests. Technology advancements are crucial to enabling previously unforeseen or unfeasible science investigations and adding to existing measurement capabilities by reducing cost, risk, or development time.

The Earth Science Technology Program contributes to the Outcomes under Strategic Plan Sub-goal 3A: Study Earth from space to advance scientific understanding and meet societal needs.

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Science Technology

Plans For FY 2008

ESTP will plan and implement development of new remote-sensing and information systems technologies for infusion into future science missions in order to enable, or dramatically enhance, measurements and data system capabilities. Planning will start with measurement priorities established by the science community, leading to systematically developed technology requirements and priorities that will be captured in a Web-accessible database. Studies will be conducted to assess measurement options for meeting technology performance requirements. Implementation will be performed through solicitations in three elements: Instrument Incubator, Advanced Information Systems Technology, and Advanced Technology Initiatives.

Instrument Incubator

This project develops new and innovative instruments and measurement techniques at the system level, including laboratory development and airborne validation.

Advanced Information Systems Technology

This project develops end-to-end information technologies that enable new Earth-observation measurements and information products.

Advanced Technology Initiatives

This project implements a broad array of technology developments for state-of-the-art components for instruments and Earth- and space-based platforms.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Annually advance a portion of funded technology developments by one.	ESTP	25%	25%
Annually mature several technologies to the point of readiness for demonstration.	ESTP	At least 2	At least 2
Annually enable or improve one new science measurement capability.	ESTP	No Change	No Change

Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Science Technology

Program Management

The Science Mission Directorate has oversight responsibility of the program office. The project elements below each contain a portfolio of tasks that vary with new selections.

Project	Oversight	Lead Performer	Partners
Instrument Incubator	ESTO	NASA Centers/industry/academia	None.
Advanced Info Systems	ESTO	NASA Centers/industry/academia	None.
Advanced Tech Initiatives	ESTO	NASA Centers/industry/academia	None.

Acquisition Strategy

Tasks are procured primarily through full and open competition.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Relevance	NAC - Earth-Sun System	03/2004	Radar/Radiometry Technology Needs. Validated current mission.	03/2009

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Technology Infusion	Selecting only those technologies that are certain to mature and be infused precludes the pursuit of promising and needed technologies that are innovative but risky.	ESTP will pursue a portfolio of technologies that balance innovation and risk with requirements that are clearly traceable to the strategic objectives of the Earth Science Theme.

Theme Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Heliophysics	1,067.3	1,028.1	1,057.2	1,028.4	1,091.3	1,241.2	1,307.5
Heliophysics Research	196.9	221.2	206.1	188.0	201.5	192.8	207.5
Deep Space Mission Systems (DSMS)	254.6	254.2	263.0	272.1	277.7	276.5	282.4
Living with a Star	259.1	232.5	253.0	269.2	261.4	266.1	286.7
Solar Terrestrial Probes	102.6	88.7	126.8	125.3	114.4	181.3	181.5
Heliophysics Explorer Program	125.1	78.3	76.1	75.6	133.1	166.8	186.5
Near Earth Networks	71.4	63.7	66.0	65.2	67.2	65.6	66.9
New Millennium	57.6	89.6	66.2	33.0	36.0	92.1	95.9

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Theme Changes

	FY 2008		
Heliophysics	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Heliophysics Research	**192.3**	**206.1**	**13.8**
Changes reflect programmatic adjustments; increase planned funding for Heliophysics Research Program.			
Deep Space Mission Systems (DSMS)	**256.9**	**263.0**	**6.1**
No significant changes.			
Living with a Star	**264.2**	**253.0**	**-11.2**
No significant changes.			
Solar Terrestrial Probes	**182.4**	**126.8**	**-55.6**
Changes reflect MMS project de-scope that is underway.			
Heliophysics Explorer Program	**73.3**	**76.1**	**2.8**
Launch delays for AIM and THEMIS due to technical and launch vehicle issues.			
Near Earth Networks	**72.4**	**66.0**	**-6.4**
No significant changes.			
New Millennium	**92.1**	**66.2**	**-25.9**
Delays ST-9 and follow-on missions by roughly two years; schedules will be assessed for the FY 2009 budget cycle.			

Mission Directorate:	Science
Theme:	Heliophysics

Theme Purpose

The Heliophysics Theme studies the science of the Sun-Solar System Connection to (1) understand the Sun and its effects on Earth, the solar system, and the space environmental conditions that will be experienced by explorers, and to (2) demonstrate technologies that can improve future operational systems.

In this pursuit, the Heliophysics Theme supports the following Goal and Sub-goal in the 2006 NASA Strategic Plan:

Goal 3: Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.

Sub-goal 3B: Understand the Sun and its effects on Earth and the solar system.

Theme Overview

The Sun is a magnetic star at the center of our solar system with daily-to-several day variations in magnetic activity that occur within a 22-year cycle of activity. The short-term variations are called space weather and the long-term variability is analogous to the Earth's climate. Products from its activity -- particles, radiation, and fields -- extend throughout the volume of space of our solar system, the heliosphere. They can interact with planetary atmospheres and magnetic fields such as those found on the Earth and Mars and change the solar activity products inside the atmospheres. They also affect human technology including spacecraft and humans in space. The science that addresses the production and propagation of solar activity and its interactions with planets in our solar system is called heliophysics and is in its infancy compared to Earth science.

Just as we depend upon a terrestrial weather report and knowledge of the Earth's climate to plan our days on Earth, we will need space weather reports to safely and successfully explore beyond Earth. The Heliophysics Theme's three objectives strive to increase the scientific foundation leading to a reliable space weather predictive capability: (1) to understand the fundamental physical processes of the space environment; (2) to understand how humans, technology, and habitability of planetary exploration are affected by solar variability; and, (3) to maximize the safety and productivity of explorers by developing the capability to predict space weather.

The Heliophysics theme makes progress on achieving its objectives as follows. It collects and analyzes data from a network of heliophysics spacecraft in extended operations. It conducts prime operations for the Solar Terrestrial Relations Observatory (STEREO) and Hinode (Solar B) missions from the Solar Terrestrial Probes (STP) Program to obtain new information about the physical processes of the Sun. It develops new missions such as Solar Dynamics Observatory (SDO) and Time History of Events and Macroscale Interactions during Substorms (THEMIS) that will improve the data detail in areas of heliophysics that surfaced as important in prior investigations/missions. It plans for the future in technology and science by funding technology flight validation missions from the NMP and conducting future mission pre-concept studies.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

The capability for space weather prediction and knowledge of space weather effects on humans and microelectronics improves the ability to maintain telecommunications containing satellite links, to operate intelligence-gathering spacecraft, and to retain the safety of the airplanes and airline crews.

Relevance to the NASA Mission:

Success in future exploration missions can only be achieved when we understand and either accommodate or mitigate the effects of space weather on the health and safety of astronauts and technological systems in the heliosphere and planetary environments.

Relevance to education and public benefits:

The ability to predict and then accommodate or mitigate space weather effects on increasingly more complex technological systems will facilitate their use for health, safety, and leisure applications.

Mission Directorate:	Science
Theme:	Heliophysics

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
Strategic Goal 3	**Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.**	
Sub Goal 3B	**Understand the Sun and its effects on Earth and the solar system.**	
Outcome 3B.1	**Progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium.**	
APG 8HE01	Demonstrate progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium. Progress will be evaluated by external expert review.	Multiple Programs
APG 8HE02	Complete Magnetospheric Multiscale (MMS) System Design Review (SDR).	Solar Terrestrial Probes
Outcome 3B.2	**Progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields.**	
APG 8HE03	Demonstrate progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields. Progress will be evaluated by external expert review.	Multiple Programs
APG 8HE04	Complete Phase A for the Geospace Radiation Belt Storm Probes mission.	Living with a Star
Outcome 3B.3	**Progress in developing the capability to predict the extreme and dynamic conditions in space in order to maximize the safety and productivity of human and robotic explorers.**	
APG 8HE05	Demonstrate progress in developing the capability to predict the extreme and dynamic conditions in space in order to maximize the safety and productivity of human and robotic explorers. Progress will be evaluated by external expert review.	Multiple Programs
APG 8HE06	Complete Solar Dynamics Observatory (SDO) Integrated Observatory Performance Test.	Living with a Star

Performance Achievement Highlights

New Millennium
Space Technology 5 launched successfully in March 2006.
Solar Terrestrial Probes
Solar B launched successfully in September 2006 and STEREO launched successfully in October 2006.
Deep Space Mission Systems (DSMS)
The DSN exceeded its performance goals for telemetry, command and control, and tracking by successfully transmitting more than 99% of this information.
Living with a Star
SDO spacecraft structure was completed; science investigations for the Radiation Belt Storm Probes mission were awarded; Space Environment Testbeds (SET-1) completed its Critical Design Review; the Science and Technology Definition Team report for Solar Sentinels mission was published.
Near Earth Networks
The program maintained expected performance metrics. Innovative solutions to manufacturing defects and new business strategies enabled this positive outcome.

Mission Directorate:	Science
Theme:	Heliophysics

Performance Achievement Highlights

Heliophysics Explorer Program
Two Wide-angle Imaging Neutral-atom Spectrometers (TWINS-A) launched in June 2006.
Heliophysics Research
The research program led by the scientists associated with the Heliospheric Operating Missions are credited with twenty five significant advances and discoveries reported in the GPRA assessment.

Quality

Performance Measure #	Description
Heliophysics Theme	
APG 8HE07	Complete all development projects within 110% of the cost and schedule baseline.
APG 8HE08	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 8HE09	Peer-review and competitively award at least 90%, by budget, of research projects.
APG 8HE10	Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 130 days.

Program Assessment Rating Tool (PART):

The 2006 PART was used to assess the risk of the Heliophysics Theme to achieving strategic Sub-goal 3B, "Understand the Sun and its effects on Earth and the solar system." Three outcomes are associated with the sub-goal, and a total of twelve annual performance goals are associated with the outcomes. The Heliophysics Theme met eleven of twelve of its 2006 annual performance goals. The unmet goal, the launch of the STEREO mission, was delayed beyond FY 2006 due to problems with the Delta II launch vehicle second-stage tanks; after resolution of the tank problem, STEREO had a successful launch in October 2006.

To address these areas, the Heliophysics Theme will pursue the following performance improvement action: Report for major missions on: estimated mission lifecycle cost upon entering development; key schedule milestones associated with each mission phase for those missions formally approved for formulation; mission cost and schedule progress achieved in each phase before entering the next; and any plans to re-baseline lifecycle cost and schedule.

To date the life cycle cost and schedule numbers have been reported on a quarterly basis for projects that have authority to proceed into development. This has been provided as a quarterly submission to the Office of Management and Budget, and annually to the Congress as the Major Program Annual Report. In the coming year, projects that are still in formulation will be included as a part of the quarterly reporting.

The Theme will also work with Space Operations Mission Directorate to define requirements, approach, projected schedule, and budget profile for Deep Space Network upgrades, in time for the FY 2009 budget submit to OMB.

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Relevance	NASA Advisory Council (NAC)	11/2006	Review science and program implementation strategies and relevance to the NASA strategies and goals/Effective.	11/2007
Relevance	ESSAC	09/2005	The Earth and Space Sciences Advisory Committee (ESSAC), now part of NAC, review science and program implementation strategies and relevance to the NASA Strategies and goals/Effective.	11/2007
Relevance	National Research Council	12/2003	Decadal review of science content/Effective.	TBD

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Research

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Heliophysics Research	196.9	221.2	206.1	188.0	201.5	192.8	207.5

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Heliophysics Research	**192.3**	**206.1**	**13.8**
Changes reflect programmatic adjustments; including an increase in planned funding for Heliophysics Research Program.			

Program Overview

The Heliophysics Research Program undertakes scientific investigations utilizing operational space-based and suborbital platforms (surface, balloon, aircraft, and rocket). The Program also funds basic research and modeling utilizing the results of the full array of NASA's missions. The Program has four major components: (1) Research and Analysis (R&A), (2) Heliophysics Operating Missions, (3) Sounding Rockets, and (4) Science Data and Computing Technology.

Research and Analysis aims to solicit basic and applied research in support of the Heliophysics Division's objectives. The Heliophysics Operating Missions are a fleet of satellites that are making systematic measurements of the solar structure and phenomena, the solar wind and solar energetic particles, and the Sun's extensive electromagnetic fields. Sounding Rockets provide low-cost platforms to have direct access to the Earth's mesosphere and lower thermosphere, so the researchers can observe the Sun's impact on those regions. The Science Data and Computing Technology component supports the Science Mission Directorate (SMD) science endeavors in two ways, first by assuring the permanent archiving and preservation of space science data obtained from past missions, and secondly by soliciting applications of advance information science and technology to enhance science productivity.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Research

Program Relevance

The Heliophysics Research Program supports the three main goals of the Heliophysics Science: (1) Open the Frontier to Space Environment Prediction: Understand the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium, (2) Understand the Nature of Our Home in Space: Understand how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields, and (3) Safeguard the Journey of Exploration: Maximize the safety and productivity of human and robotic explorers by developing the capability to predict the extreme and dynamic conditions in space.

Research into the nature of solar activity and its effects on the solar system will help safeguard the journeys of robotic and human explorers. As society becomes increasingly dependent on space-based technologies, humankind's vulnerability to space weather becomes more apparent, and the need to understand and mitigate these effects becomes more important. NASA's objective is to understand and predict the causes of space weather by studying the Sun, the heliopshere, and planetary environments as a single, connected system.

Heliophysics Research Program supports each of the Outcomes under Strategic Plan Sub-goal 3B: Understand the Sun and its effects on Earth and the Solar System. Additionally, this program supports the following Strategic Plan Outcomes:

3B.1: Progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium.
3B.2: Progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields.
3B.3: Progress in developing the capability to predict the extreme and dynamic conditions in space in order to maximize the safety and productivity of human and robotic explorers.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Research

Plans For FY 2008

The Research and Analysis program will hold its annual competition for new research awards: approximately $12 million will be available for the competition resulting in approximately 70 new awards.

NASA will continue to execute space-based solar and space physics investigations and will hold its annual guest investigator competition. After ceasing operations in the spring of 2007, Polar will complete the research phase of its mission in FY 2008. Ulysses will cease operations at the conclusion of its 3rd solar pass in March 2008. After an appropriate overlap with the Solar Dynamics Observatory (SDO) Project, the Transition Region and Coronal Explorer (TRACE) Project will cease operations at the end of FY 2008 or early in FY 2009. In the FY 2007 PB, Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) was fully funded through the 5-year budget. In December 2005, this mission failed; the science research phase will wind down in FY 2007. All other missions will participate in a Senior Review in April 2008 to determine their status and funding profiles in FY 2009 and beyond.

The Sounding Rockets program will launch approximately 10 missions, from domestic and international locations.

Science Data and Computing Technology will continue to sustain the NASA Space Science Data Center and hold its annual competition for the Advanced Information Systems Research where approximately $4 million will be available for new research awards.

In this single budget year the Heliophysics Research Program will contribute to the annual performance goals: 8HELI1, 8HELI5 and 8HELI6.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Research

Project Descriptions

The Heliophysics Research Program funds heliophysics research and analysis; the mission operations and data analysis for multiple heliophysics missions in operation; sounding rockets; and scientific computing.

Research and Analysis

Research and Analysis comprises an ever-evolving suite of individual PI-proposed investigations that cover the complete range of science disciplines and techniques essential to achieve the Heliophysics Division's objectives.

Research and Analysis covers four elements: (1) Geospace Science, (2) Low-Cost Access to Space, (3) Solar and Heliospheric Physics, and (4) the Heliophysics Theory.

Geospace Science studies the physics of magnetospheres, including their formation and fundamental interactions with plasmas, fields, and particles (the Earth's magnetosphere is emphasized, but studies of the magnetospheres of planets, comets, and other primordial bodies are also supported). Geospace Science also deals with the physics of the mesosphere, thermosphere, ionosphere, and aurorae of the Earth, including the coupling of these phenomena to the lower atmosphere and magnetosphere.

Low-Cost Access to Space funds science investigations that may be completed through suborbital rocket or balloon flight of experimental instrumentation, as well as proof-tests of new concepts in experimental techniques that may ultimately find application in free-flying Heliophysics space missions.

Solar and Heliospheric Physics treats the Sun as a typical star, as the dominant, time-varying source of energy, plasma, and energetic particles in the solar system (especially concerning its influence on the Earth). This project investigates the origin and behavior of the solar wind, energetic particles, and magnetic fields in the heliosphere and their interaction with the interstellar medium.

The Heliophysics Theory Program supports efforts to attack problems concerning phenomena relating to the Heliophysics program using relatively large "critical mass" groups of investigators that are beyond the scope of the nominally smaller Supporting Research and Technology programs.

Heliophysics Operating Missions

The evolving Heliophysics Operating Missions have impressive capabilities for studying the solar structure and phenomena (the SOHO, TRACE, and RHESSI missions), the resulting solar energetic particles and solar wind at 1 AU (Wind, ACE, and SOHO missions) and in other regions of the heliosphere (Ulysses and Voyager), the terrestrial magnetospheric which responds to solar drivers (Cluster, Geotail, FAST, Polar, geosynchronous measurements), and the upper terrestrial atmosphere (TIMED, and ground-based optical and magnetometer networks). It is this collective asset that provides the data, expertise, and research results that contribute directly to the national goals of real time space weather predictions as well as contributing to fundamental research on solar and space plasma physics.

The Guest Investigator (GI) program is a critical component of the Heliophysics Operating Missions. The GI program enables the broadest community of researchers in universities and institutions across the country to use Operating Missions data in innovative scientific research.

Sounding Rockets

The Sounding Rockets effort funds the launch activities that support science investigations funded in other parts of the research program, including both in the Heliophysics R&A Low-Cost Access to Space activity, and in the Astrophysics research program.

Sounding Rockets present unique low cost platforms that provide direct access to the Earth's mesosphere and lower thermosphere (40 - 120 km), and to precipitation regions of the Earth's magnetosphere. They also allow researchers to reach above the Earth's atmosphere to observe the Sun. Rockets offer the ability to gather in-situ data in specific geophysical targets (e.g. the aurora and noctilucent clouds), to fly calibration underflights of orbiting missions, and to recover and re-fly instrumentation.

Science Data and Computing

Science Data and Computing includes two elements, the National Space Science Data Center (NSSDC) and administration of the Applied Information Systems Research (AISR) investigations selected under the Research Opportunities in Space and Earth Science (ROSES) NASA Research Announcements (NRA). Both are SMD-wide support activities. The NSSDC is responsible for assuring the permanent archiving and preservation of space science data from past missions, and works in federation with other distributed science data centers to provide multidiscipline data and information services to the science community. The AISR program exploits advances in information science and technology to enhance the science productivity from SMD-sponsored missions.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Complete planned research and analysis activities and disseminate results.	Research and Analysis, Science Data and Computing	Annual	Annual
Continue ops & science delivery through end of prime mission & any approved extended mission.	Operational Missions	Annual	Annual
Provide Sounding Rockets flights for high-altitude science experiments.	Sounding Rockets	12 per year	12 per year

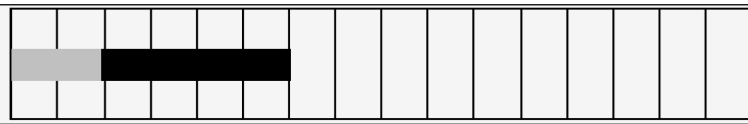
Mission Directorate: Science
Theme: Heliophysics
Program: Heliophysics Research

Implementation Schedule

Project	Schedule by Fiscal Year (Prior, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20)	Phase Dates	Beg	End	Milestone
Voyager		Tech			
		Form			
		Dev			
		Ops	Aug-77	Aug-11	
		Res		Aug-12	
Ulysses		Tech			
		Form			
		Dev			
		Ops	Oct-90	Apr-08	
		Res		Oct-09	
Geotail		Tech			
		Form			
		Dev			
		Ops	Jul-92	Jul-08	
		Res		Jul-09	
Wind		Tech			
		Form			
		Dev			
		Ops	Nov-94	Nov-11	
		Res		Nov-12	
Solar and Heliospheric Observatory (SOHO)		Tech			
		Form			
		Dev			
		Ops	Dec-95	Dec-11	
		Res		Dec-12	
Polar		Tech			
		Form			
		Dev			
		Ops	Feb-96	Mar-07	
		Res		Mar-08	
Fast Auroral Snapshot Explorer (FAST)		Tech			
		Form			
		Dev			
		Ops	Aug-96	Feb-08	
		Res		Feb-09	
Advanced Composition Explorer (ACE)		Tech			
		Form			
		Dev			
		Ops	Aug-97	Aug-11	
		Res		Aug-12	
Transition Region and Coronal Explorer (TRACE)		Tech			
		Form			
		Dev			
		Ops	Apr-98	Nov-08	
		Res		Nov-09	
Cluster-II		Tech			
		Form			
		Dev			
		Ops	Jul-00	Jul-10	
		Res		Jul-11	
Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics (TIMED)		Tech			
		Form			
		Dev			
		Ops	Dec-01	Dec-11	
		Res		Dec-12	
RHESSI		Tech			
		Form			
		Dev			
		Ops	Feb-02	Feb-11	
		Res		Feb-12	
STEREO		Tech			
		Form	May-01	Mar-02	
		Dev	Mar-02	Oct-06	
		Ops	Jan-07	Jan-10	
		Res			

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Research

Solar-B (Hinode)



Tech		
Form	Dec-98	Nov-00
Dev	Nov-00	Sep-06
Ops	Oct-06	Oct-10
Res		

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

Project	Oversight	Lead Performer	Partners
Research and Analysis	SMD	All NASA Centers	
Heliophysics Operating Missions	SMD	GSFC and JPL	European Space Agency, and the Japan Aerospace Exploration Agency.
Sounding Rockets	SMD	GSFC	
Science Data and Computing	SMD	ARC and GSFC	

Acquisition Strategy

The acquisition in the Heliophysics Research and Analysis component are based on full and open competition. Proposals are peer reviewed and selected based on the NASA research announcement -- Research Opportunities in Space and Earth Sciences (ROSES). Universities, government research labs, and industry throughout the U.S. participate in R&A research projects.

The Heliophysics Operating Missions and instrument teams were previously selected from NASA Announcements of Opportunity. This project sponsors two annual competitions in ROSES: Heliophysics Guest Investigators and Virtual Observatories for Heliophysics Data.

The prime contract for the Sounding Rockets Project will be re-competed in 2008. Individual payloads for the rocket campaigns are chosen from the annual competitions held under several of the Science Mission Directorate Research and Analysis components.

The Science Data and Computing component holds a competition where proposals are peer reviewed and selected based on ROSES research announcement. Universities, government research labs, and industry throughout the U.S. participate in Science Data and Computing Technology research projects.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Research

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Quality	Senior Review Panel	01/2001	The Research and Analysis project and the Advanced Information Systems Research element of Scientific Data and Computing were reviewed in a special Senior Review of the Space Science Research Programs in 2001. SMD is in the early steps of organizing the next Senior Review for these research elements. All projects received satisfactory remarks to proceed with planned activities.	01/2007
Quality	Senior Review Panel	11/2005	The missions of the Heliophysics Operating Missions had their last Senior Review in November 2005. The next Senior Review is scheduled for April 2008. The Heliophysics data centers along with the NSSDC went before a Senior Review panel in May 2006. All projects received satisfactory or excellent remarks to proceed with planned activities.	04/2008

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Heliophysics Research Program	There is no significant risk at this time.	No mitigation is necessary.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Deep Space Mission Systems (DSMS)

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Deep Space Mission Systems (DSMS)	254.6	254.2	263.0	272.1	277.7	276.5	282.4

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Deep Space Mission Systems (DSMS)	**256.9**	**263.0**	**6.1**
No significant changes.			

Program Overview

The Deep Space Mission System (DSMS) program enables human and robotic exploration of the solar system and beyond by providing reliable, high-performance, and cost-effective telecommunications and navigation services. Project elements within DSMS include the Deep Space Network (DSN) and the Advanced Multi-Mission Operations System (AMMOS).

The DSN is a global network of antennas that supports interplanetary spacecraft missions plus radio and radar astronomy observations for the exploration of the solar system and the universe. DSN also supports selected Earth-orbiting missions. The AMMOS project provides planetary science missions with a set of navigation and design software tools and services for flight mission training, space communications resource allocation, and improved communication and navigation.

The management of all NASA Space Communications Activities was centralized October 2, 2006 within the Space Operations Mission Directorate Space Communications Program Office. The Centralization includes existing networks and supporting functions: Deep Space Network (DSN), Space Network (SN), Ground Network (GN) and NASA Integrated Service Network (NISN), and Exploration Communications and Navigation Systems (ECANS).

For more information, see http://deepspace.jpl.nasa.gov/dsn/

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Deep Space Mission Systems (DSMS)

Program Relevance

The Program primarily supports NASA's Strategic Goal 3, Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration. In particular, DSMS contributes significantly to Sub-goal 3C: Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere and the hazards and resources present as humans explore space. DSMS also contributes to Subgoal 3D: Discover the origin, structure, evolution and destiny of the universe, and search for Earth-like planets. DSMS is also rapidly evolving to support the eventual human exploration of Earth's moon and Mars.

DSMS is rapidly evolving to support the eventual human exploration of Earth's moon and Mars. This program also inspires and motivates students to pursue careers in science, technology, engineering, and mathematics. Furthermore, DSMS engages the public in shaping and sharing the experience of exploration and discovery.

Plans For FY 2008

In 2007, NASA is performing an Analysis of Alternatives to determine the form of the next generation Deep Space Network which will begin with the replacement of the 70-meter antennas. In FY 2008, NASA will begin to formulate an implementation plan based on the results of the Analysis of Alternatives.

The DSN will continue to acquire telemetry data from spacecraft, transmit commands to spacecraft, and track spacecraft position & velocity in support of about 35 missions currently operating: New Horizons, Dawn, Image, TOMSEP, Deep Impact, Ulysses, GOES-13 (for NOAA), Genesis, RadarSat (Canadian mission), Spirit and Opportunity (the 2003 Mars Exploration Rovers), Voyagers 1 and 2, ISTP (Cluster, Geotail, Polar, Wind), Cassini, SOHO, ACE, Mars Express, Integral (ESA mission), Muses-C (Japanese), Chandra, MESSENGER, MAP, Stardust, 2001 Mars Odyssey, Rosetta, MRO, Spitzer, GSSR, STEREO and Space Geodesy. DSN anticipates support of, Phoenix, Mars Science Laboratory, future Discovery, New Frontiers, and Explorer missions, as well as support for Exploration missions including Constellation and SELENE (Japanese).

AMMOS will continue to develop multi-mission software tools for spacecraft navigation and mission planning, efficient spacecraft communication and data handling.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Deep Space Mission Systems (DSMS)

Project Descriptions

Deep Space Network

NASA's scientific investigation of the Solar System is accomplished mainly through the use of unmanned automated spacecraft. The DSN provides the vital two-way communications link that guides and controls these planetary explorers, and brings back the images and new scientific information they collect. All DSN antennas are steerable, high-gain, parabolic reflector antennas. In addition, the Solar System Radar (SSR), currently installed only on the 70-meter antenna at the Goldstone Deep Space Communications Complex, is also a part of the DSN. The SSR is a unique NASA facility for high-resolution ranging and imaging of planetary and small-body targets. It provides a wide variety of information about asteroids, comets, meteors, orbital debris and other Near Earth Objects (NEOs), including simultaneous, co-registered radar images and topography (even in lunar areas not illuminated by the Sun), and data regarding surface characteristics, structure, composition, orbits, rotations, and spin axes.

The DSN consists of three deep space communications complexes placed at longitudes approximately 120 degrees apart around the world: Goldstone, California; Madrid, Spain; and Canberra, Australia. These facilities provide communications and spacecraft navigation for all of NASA's deep-space missions and most of the rest of the world's deep space missions.

Advanced Multi-Mission Operating Systems (AMMOS)

AMMOS, provides multi-mission navigation, design, and training tools to flight missions, and undertakes technology investments for improved communications and navigation technologies.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Infusion of new technologies to improve capabilities	DSN	Not included	Every 3 to 5 years
Provide standard interfaces in order to enable interoperability among missions and DSMS	DSN & AMMOS	Not included	On-going
Provide all standard services to missions at 95% availability; provide 99% for critical events	DSN	Not included	95% and 98%

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Deep Space Mission Systems (DSMS)

Implementation Schedule

Project	Schedule by Fiscal Year																Phase Dates			
	Prior	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20		Beg	End	Mile-stone
DSN																	Tech Form Dev Ops Res		Jan-20	
AMMOS																	Tech Form Dev Ops Res		Jan-20	

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

The Space Operations Mission Directorate is responsible for overall oversight of the Deep Space Mission System (DSMS) program. JPL is responsible for program management and oversight.

Project	Oversight	Lead Performer	Partners
DSN	SOMD	JPL	Spain, Australia
AMMOS	SOMD	JPL	

Acquisition Strategy

No major acquisitions planned for FY 2008.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Quality	Internal panel	06/2006	The review identified the potential impacts of a 3 year phase out of AMMOS activities. The best means of implementing the findings of the AMMOS review are under study within the Science Mission Directorate and will be reflected in future budget submissions.	06/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
DSN reliability	Aging infrastructure is reliable but fragile. There are several single points of failure in the current system that add a degree of risk to critical event support.	The Analysis of Alternatives being undertaken in 2007 will provide the basis for evaluating the best means of replacing the aging assets.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Living with a Star	259.1	232.5	253.0	269.2	261.4	266.1	286.7
Solar Dynamics Observatory (SDO)	183.1	182.9	110.4	25.6	16.7	15.3	20.5
Radiation Belt Storm Probes (RBSP)	17.0	4.9	95.3	188.6	174.7	123.1	28.9
Other	59.0	44.6	47.3	55.0	70.0	127.7	237.3

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Living with a Star	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Solar Dynamics Observatory (SDO)	**101.8**	**110.4**	**8.6**
No significant changes.			
Radiation Belt Storm Probes (RBSP)	**86.0**	**95.3**	**9.3**
RBSP investigators work with JHU-APL-lead project to develop and complete Phase A.			
Other	**76.4**	**47.3**	**-29.1**
No significant changes.			

Program Overview

The LWS program seeks to improve our understanding of how and why the Sun varies, how the Earth and solar system respond, and how the variability and response affect humanity. This improved understanding of solar variability (i.e., space weather) and its effects will lead to a reliable predictive capability for space weather that is essential to safe and successful future space exploration as well as increased use of complex technological systems to improve the safety and quality of life on the ground. LWS accomplishes its goals with a combination of new science missions and yearly science research grant opportunities to improve scientific understanding. Its first mission, the Solar Dynamics Observatory (SDO), will replace and improve upon the science of the Solar and Heliospheric Observatory (SOHO). If selected for development, the second mission, the Radiation Belt Storm Probes (RBSP), will address the processes that accelerate and transport radiation particles by having two spacecraft make identical measurements while transiting through the Earth's radiation belts in elliptical orbits on a two-year mission. The RBSP results will enable the development of models for the Earth's radiation belts and for under-sampled planetary environments (such as Mars). Spacecraft and aeronautics engineers will use the models to reduce the design margins for radiation effects and to alert operators or pilots of predicted storms and ionizing radiation that could impact crew health or vehicle operations.

For more information, please see http://lws.gsfc.nasa.gov/

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star

Program Relevance

Understanding and either accommodating or mitigating the effects of space weather on the health and safety of astronauts and technological systems in the heliosphere and planetary environments will enhance opportunities for human exploration. LWS provides the capability for space weather prediction and knowledge of space weather effects on humans and microelectronics; and it improves the ability to maintain telecommunications containing satellite links, to operate intelligence-gathering spacecraft, and to improve aircraft safety.

In this pursuit, LWS supports NASA Strategic Sub-goal 3B: Understand the Sun and its effects on Earth and the solar system. The program contributes primarily to the following Outcomes:

3B.2: Progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields.

3B.3: Progress in developing the capability to predict the extreme and dynamic conditions in space in order to maximize the safety and productivity of human and robotic explorers.

Plans For FY 2008

Complete SDO development activities including comprehensive observatory performance test (APG 8HE06). Complete Phase A for the RBSP Project (APG 8HE04).

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star

Project Descriptions

LWS projects address one or mor of the LWS objectives to improve our understanding of how and why the Sun varies, how the Earth and solar system respond, and how the variability and response affect humanity.

Solar Dynamics Observatory (SDO)

SDO will investigate how the Sun's magnetic field is structured and how its energy is converted and released into the heliosphere in the forms of solar wind, energetic particles, and variations in solar irradiance. Additional detail can be found in the SDO Project section of this document.

Radiation Belt Storm Probes (RBSP)

If selected for development, RBSP will improve the understanding of how solar storms interact with and change the particles, fields, and radiation in the Earth's Van Allen radiation belts and atmosphere. This knowledge could be applicable to any planet in our solar system with a magnetic core (such as Mars). Additional detail can be found in the G-RBSP Project section of this document.

Space Environment Testbeds (SET)

SET is a technology development effort that will improve the engineering approach to accommodate and/or mitigate the effects of solar variability on spacecraft design and operations. It has a space flight component comprised of a testbed that will be delivered for a piggyback ride on the USAF DSX mission, and a data mining component that fund analyses of existing data to improve engineering design and operations models.

Geospace Mission of Opportunity (G-MOO)

Three G-MOOs were selected for a competitive Phase A study from the same Announcement of Opportunity used to select the G-RBSP science investigations. Two G-MOO studies are for science instruments that would ride on non-LWS spacecraft, and the other G-MOO is a series of science instruments that would ride on balloons. The Phase A studies will conclude in FY 2008, however it is anticipated that no investigation will be selected for Phase B in FY 2008.

LWS Science

LWS science funds competitively-selected proposals that improve the understanding of the physics of the integrated system that links the Sun and its activity to the heliosphere and planetary atmospheres. The integrated physics understanding will be achieved through data analysis to support the development of new or revised theories and models and is the precursor to a predictive space weather capability.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Launch SDO for a five-year mission.	SDO	August 2008	August 2008
Determine whether to proceed with implementation of RBSP.	RBSP	Not included	January 2009

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star

Implementation Schedule

Project	Schedule by Fiscal Year (Prior, 06–20)	Phase	Beg	End	Milestone
SDO		Tech			
		Form	Aug-02	Jul-04	
		Dev	Jul-04	Aug-08	
		Ops	Oct-08	Jul-13	
		Res			
Radiation Belt Storm Probes		Tech			
		Form	Nov-06	Jan-09	
		Dev	Jan-09	Mar-11	
		Ops	Apr-11	Apr-14	
		Res			

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

The NASA Agency Program Management Council has overall program oversight for LWS. GSFC is the managing center for the program; individual missions are implemented by GSFC or Johns Hopkins University-Applied Physics Lab (JHU-APL).

Project	Oversight	Lead Performer	Partners
RBSP	GSFC	JHU-APL	
SDO	GSFC	GSFC	

Acquisition Strategy

LWS spacecraft will be either developed in-house at GSFC or procured from JHU-APL. Mission payloads will be procured competitively except when it is clearly in the benefit of the government to do a sole-source procurement or partnership with an external provider. The SDO launch vehicle and two instruments were selected through full and open competitions and one instrument is being provided sole-source from Lockheed-Martin. The spacecraft is an in-house build at GSFC.

Four RBSP instruments were selected through full and open competition and one instrument was obtained by partnering with the National Reconnaissance Office. The launch vehicle will be selected through full and open competition and the spacecraft is an in-house build at JHU-APL.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	LWS Independent Review Team	09/2006	Assess project status/acceptable to proceed.	08/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Launch vehicle cost and availability	Availability and cost for launch vehicles may reduce content of science in missions.	Maintain knowledge of launch vehicle availability and cost; use knowledge in any rebaselining or planning of follow-on missions.
Uncertainty in mission environments	Uncertainties in the definitions of the mission environments introduce uncertainties in the mission lifetimes and reliabilities.	Add design margin, redundancy, testing, and error detection and correction techniques to reduce uncertainties in lifetime and increase reliabilities.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Development:	Solar Dynamics Observatory (SDO)

Budget / Life Cycle Cost

Budget Authority ($ millions)	Prior	FY06	FY07	FY08	FY09	FY10	FY11	FY12	BTC	LCC TOTAL
FY 2008 President's Budget Request	**291.7**	**183.1**	**182.9**	**110.4**	**25.6**	**16.7**	**15.3**	**20.5**	**30.7**	**876.9**
Formulation	85.8	--	--	--	--	--	--	--	--	--
Development	205.9	183.1	182.9	110.4	--	--	--	--	--	--
Operations	--	--	--	--	25.6	16.7	15.3	20.5	30.7	--
Other	--	--	--	--	--	--	--	--	--	--
FY 2007 President's Budget Request	**284.9**	**178.1**	**166.0**	**101.8**	**23.4**	**16.0**	**12.1**	**--**	**44.0**	**826.3**
Formulation	85.3	--	--	--	--	--	--	--	--	--
Development	199.6	178.1	166.0	101.8	--	--	--	--	--	--
Operations	--	--	--	--	23.4	16.0	12.1	--	44.0	--
Other	--	--	--	--	--	--	--	--	--	--
Changes	**6.8**	**5.0**	**16.9**	**8.6**	**2.2**	**0.7**	**3.1**	**20.5**	**-13.3**	**50.6**
Formulation	0.5	--	--	--	--	--	--	--	--	0.5
Development	6.3	5.0	16.9	8.6	--	--	--	--	--	36.8
Operations	--	--	--	--	2.2	0.7	3.2	20.5	-13.3	13.3
Other	--	--	--	--	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Project Changes

Project	*Solar Dynamics Observatory (SDO)*
No significant changes.	

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Development:	Solar Dynamics Observatory (SDO)

Project Purpose

The Solar Dynamics Observatory (SDO) is the Living With a Star (LWS) Program's first mission. It will investigate how the Sun's magnetic field is structured and how its energy is converted and released into the heliosphere in the forms of solar wind, energetic particles, and variations in solar irradiance. Scientists will analyze SDO data to improve the science needed to enable space weather predictions. The five-year prime life is designed to provide measurements over a substantial portion of the solar cycle.

Project Parameters

The SDO satellite will be placed into an inclined geosynchronous orbit to allow for a nearly-continuous observation of the Sun, a high science data downlink rate, and contact with a single, dedicated, ground station. The combined data from the satellite and the three science instruments--the Helioseismic and Magnetic Imager (HMI), the Extreme Ultraviolet Variability Experiment (EVE), and the Atmospheric Imaging Assembly (AIA)--will require a downlink rate of 1.4 Terabytes per day.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Development:	Solar Dynamics Observatory (SDO)

Project Commitments

SDO will launch in August 2008 to begin a five-year prime mission in geosynchronous Earth orbit.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Helioseismic and Magnetic Imager (HMI)	Stanford University	Resolution of 1 arc-second, with noise level <= 40 meters per second and 25 Gauss respectively: obtain full-disk photospheric velocity and longitudinal magnetic field measurements every 60 seconds.	Same	Same
Atlas V Evolved Expendable Launch Vehicle (EELV)Vehicle	KSC and Lockheed Martin	Deliver a 3,200 kg spacecraft to geosynchronous transfer orbit at about 2,500 km altitude.	Same	Same
Spacecraft	GSFC	Deliver high-rate data from instrument to ground station with a high accuracy for 5 years.	Same	Same
Atmospheric Imaging Assembly (AIA)	Lockheed Martin Solar Astrophysics Laboratory	Field-of-view of 40 arc-minutes in 1 chromospheric, 3 coronal wavelength bands with 1.2 arc-second resolution, and a cadence of 4 images every 10s: obtain full-disk images of the solar atmosphere.	Same	Same
Extreme Ultraviolet Variability Experiment (EVE)	University of Colorado	Make hourly solar spectral irradiance measurements in 6 emission lines at resolution of 0.2 nanometers, and measure Helium II emission line with resolution of 5 nanometers.	Same	Same
Ground System	GSFC	Transmit 1.3 MB/sec of Ka-band science data to the scientists and have 30-day backup ground storage.	Same	Same

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Development:	Solar Dynamics Observatory (SDO)

Schedule Commitments

The SDO Project was authorized to begin Formulation in August 2002. It was initially confirmed to begin Phase B in October 2003. After an independent review coincident with the project's Preliminary Design Review, the NASA Program Management Council confirmed the SDO Project to begin development in July 2004.

Milestone Name	Confirmation Baseline	FY 2007 PB Request	FY 2008 PB Request
Development			
Begin Implementation	July 2004	Same	Same
Critical Design Review	February 2005	April 2005	April 2005
Complete Spacecraft Structure	January 2006	March 2006	March 2006
Deliver Science Instruments to Spacecraft	February 2007	Same	Same
Launch Readiness	April 2008	August 2008	August 2008

Development Cost Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Solar Dynamics Observatory (SDO)	2006	652.7	2007	672.6	3	Launch Readiness	8/30/2008	8/30/2008	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**652.7**	**672.6**	**19.9**
Other (In-house labor is reflected under other in FY08)	46.5	224.5	178.0
Ground Systems	69.7	42.4	-27.3
Launch Vehicle/Services	120.6	120.6	0.0
Payload	181.8	139.8	-42.0
Spacecraft	234.1	140.2	-93.9
System I&T	0.0	5.1	5.1

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Development:	Solar Dynamics Observatory (SDO)

Project Management

The spacecraft will be built in-house at GSFC. GSFC is also responsible for management, design, integration, test, and operations. The responsible official for this project is Richard Fisher, Director of the Heliophysics Division.

Project Element	Element Oversight	Lead Performer	Partners
Mission Operations	GSFC	GSFC	n/a
Spacecraft design, integration, and test	GSFC	GSFC	n/a
Helioseimic and Magnetic Imager (HMI)	GSFC	Stanford University	n/a
EELV	KSC	Lockheed Martin	n/a
Atmospheric Imaging Assembly (AIA)	GSFC	Lockheed Martin	n/a
Extreme Ultraviolet Variability Experiment (EVE)	GSFC	University of Colorado	n/a

Acquisition Strategy

The SDO spacecraft and ground system is being designed, developed, and tested in-house at GSFC using a combination of GSFC civil servants and local task contractors. The acquisition of sub-contracted spacecraft sub-assemblies, components, and parts is through procurement contracts issued by the SDO Procurement Office. The ground system components include a dedicated ground station antenna/facility and science data distribution system at White Sands, New Mexico, and a mission operations center at GSFC. The EVE and HMI science investigations were procured through the Announcement of Opportunity (AO) process. The AIA was obtained through a Justification for Other Than Full and Open Competition using unusual and compelling urgency after one investigation that was initially selected from the AO was not confirmed to begin Phase B.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	LWS Independent Review Team	09/2006	Assess project status/acceptable to proceed.	08/2007

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Operations in Radiation Environment (new)	Mission lifetime and reliability may be limited due to the severe ionizing radiation environment in geosynchronous Earth orbit (GEO).	Develop and verify requirements for operation in GEO that begin at the materials and component levels and continue through the level of the entire observatory.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Formulation:	Radiation Belt Storm Probes (RBSP)

Budget / Life Cycle Cost

Budget Authority ($ millions)	FY06	FY07	FY08
FY 2008 President's Budget Request	17.0	4.9	95.3
FY 2007 President's Budget Request	1.1	5.8	86.0
Total Change from FY 2007 President's Budget Request	15.9	-0.9	9.3

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Project Purpose

The Radiation Belt Storm Probes (RBSP) mission will improve our understanding of how solar storms interact with and change the particles, fields, and radiation in the Earth's Van Allen radiation belts and atmosphere. The mission results will be applicable to any planet in our solar system, such as Mars, with a magnetic core.

The solar wind, produced by the Sun's activity, transports heat, electric and magnetic fields, and high energy ions and electrons throughout the solar system; the energy is high enough to be categorized as ionizing radiation. The heat, fields, ions, and electrons in the solar wind are drawn into the Earth's magnetic field at the Earth's poles, and they interact with the Earth's magnetosphere. When a solar flare or storm (i.e., space weather) occurs, the solar wind and hence the magnetosphere can change very quickly if the flare is directed toward the Earth. This space weather can affect the operations of technological systems with sensitive microelectronics (such as elecommunications with satellite links, spacecraft, and aircraft) and humans in space. Understanding the science associated with the solar wind and the planet's fields and atmosphere is a necessary precursor to developing a predictive space weather capability.

Project Parameters

The RBSP mission is comprised of two identical spacecraft in elliptical, low-inclination orbits that travel independently through the Earth's radiation belts to distinguish time and space variations in the measured ions, electrons, and fields. The mission design lifetime of two years is a design challenge due to the high radiation environment approximately 100 kilorads behind 220 mils of aluminum. The two spacecraft are in close proximity at times and are operated separately. Each spacecraft's data must be distinguished from the other spacecraft's data to achieve the science success distinguishing; between spatial and temporal variations in measurements.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Formulation:	Radiation Belt Storm Probes (RBSP)

Project ROM Estimate

RBSP will launch two identical spacecraft in 2011 to begin a 2-year prime mission in geosynchronous transfer Earth orbit.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
EELV	KSC	Deliver a spacecraft to geosynchronous transfer orbit	Not Applicable	New
Energetic Particle, Composition and Thermal Plasma (ECT)	Boston University	Measure the electron & ion spectra & composition to understand the electron & ion changes	Not Applicable	New
Radiation Belt Science of Protons, Ion Composition and Electrons (RBSPICE)	New Jersey Institute of Technology	Measure the ring current in the magnetosphere during geomagnetic storms	Not Applicable	New
Electric and Magnetic Field Instrument Suite and Integrated Science (EMFISIS)	University of Iowa	Measure the magnetic fields & plasma waves	Not Applicable	New
Electric Field and Search Coil (EFASC)	University of Minnesota	Measure the electric fields for particles in the radiation belts	Not Applicable	New
Relativistic Proton Spectrometer (RPS)	National Reconnaissance Office	Measure the inner Van Allen belt protons	Not Applicable	New
Spacecraft	JHU-APL	Operate science instruments in high radiation; transmit science data to ground	Not Applicable	New
Ground System	JHU-APL	Receive science data from two spacecraft; distribute to investigators	Not Applicable	New

Schedule ROM Estimate

The RBSP project was authorized to begin formulation in September 2006 when the selections for science investigations were announced. It is scheduled to be initially confirmed to begin Phase B in Fiscal Year 2008. The ATP Baseline will be established when the Science Mission Directorate's Program Management Council reviews the findings from the second Non-Advocate Review (NAR) and approves the project to begin development.

Milestone Name	Formulation Estimate	FY 2007 PB Request	FY 2008 PB Request
Formulation			
Begin Formulation	Sept. 2006	Same	Same
Initial Confirmation Review	Jan. 2008	Same	Same
Begin Implementation	Jan. 2009 (Prelminary)	N/A	N/A

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Formulation:	Radiation Belt Storm Probes (RBSP)

Project Management

GSFC will provide oversight and the science management of data analysis through Phase E.

Project Element	Element Oversight	Lead Performer	Partners
Ground Systems	GSFC	JHU-APL	
Data Analysis	GSFC	GSFC	National Reconnaissance Office, Czech Republic
Instrument Development	GSFC	JHU-APL	National Reconnaissance Office
Spacecraft design, integration with instrument, and test	GSFC	JHU-APL	National Reconnaissance Office, Czech Republic
Mission Operations	GSFC	JHU-APL	
Expendable Launch Vehicle	KSC	TBD	

Acquisition Strategy

The RBSP spacecraft and ground system is being designed, developed, and tested at the JHU-APL. The acquisition of sub-contracted spacecraft sub-assemblies, components, and parts is through procurement contracts issued by the JHU-APL Procurement Office. Instrument development participants include the University of Iowa, University of Minnesota, New Jersey Institute of Technology, and Boston University, as well as contributions from the National Reconnaissance Office and the Czech Republic. The ground system components will be defined during the definition phases (Phases A and B) and will include a mission operations center at the JHU-APL. The ECT, EMFISIS, EFASC, and RBSPICE science investigations were procured through the Announcement of Opportunity (AO) process, and the operations phase (Phase E) contracts will be managed by GSFC. The RPS instrument is being obtained through the NASA/Air Force Space Command/National Reconnaissance Office Partnership Council.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	LWS Standing Review Board	N/A	Assess project status.	09/2007

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Operations in Radiation Environment	Mission lifetime and reliability may be limited due to the severe ionizing radiation environment of the Geosynchronous Transfer Orbit (GTO)	Develop and verify requirements for operation in GTO that being at the materials and component levels and continue through the level of the entire spacecraft observatories.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Solar Terrestrial Probes	102.6	88.7	126.8	125.3	114.4	181.3	181.5
Magnetospheric Multiscale (MMS)	16.0	45.2	84.5	91.1	100.9	176.4	172.0
Other	86.6	43.5	42.3	34.2	13.5	4.9	9.5

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Solar Terrestrial Probes	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Magnetospheric Multiscale (MMS)	**121.4**	**84.5**	**-36.9**
Changes reflect MMS Project de-scope that is underway.			
Other	**61.0**	**42.3**	**-18.7**
No significant changes.			

Program Overview

The primary goal of the Solar Terrestrial Probes (STP) Program is to explore the Sun-Solar System connection to understand the sun and its effects on Earth, the solar system, and on the space environment conditions that will be experienced by explorers. To accomplish this overarching goal, STP investigations focus on specific scientific areas required to advance our fundamental understanding of the Sun-Solar System connection. Successive STP missions target the "weakest links" in the chain of understanding how plasma processes operate from the Sun to the Earth's space environment. STP missions will address processes such as the variability of the Sun, the responses of the planets to these variations, and the interaction of the Sun and solar system. STP missions are strategically defined and investigations are competitively selected. Strategic mission lines afford the space physics community the opportunity to plan specific missions to address one or more of the research focus areas and thus make significant progress in elucidating the fundamental processes of the coupled Sun-solar system connection.

For more information please see: http://stp.gsfc.nasa.gov/Solar Terrestrial Probes Program

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes

Program Relevance

The Solar Terrestrial Probes missions study the Sun, the heliosphere, and planetary environments as elements of a single interconnected system. Each STP mission responds to at least one of the three Heliophysics Division science and exploration objectives: (1) to understand the fundamental physical processes of the space environment; (2) to understand how humans, technology, and habitability of planetary exploration are affected by solar variability; and, (3) to maximize the safety and productivity of explorers by developing the capability to predict space weather. Understanding our space environment to the point of prediction also contributes to developing future operational systems that support the needs of our increasingly technological society. The Strategic Plan Outcomes supported by the Solar Terrestrial Probes Program correspond to the objectives above, and are as follows:

3B.1: Progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium.
3B.2: Progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields.
3B.3: Progress in developing the capability to predict the extreme and dynamic conditions in space in order to maximize the safety and productivity of human and robotic explorers.

Plans For FY 2008

Complete MMS formulation activities.

In this single budget year STP will meet the annual performance goal (APG 8HELI3) of "Complete Magnetospheric Multiscale (MMS) System Design Review". This program will also contribute to the annual performance goals: 8HELI1, 8HELI5 and 8HELI6.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes

Project Descriptions

The first STP mission, TIMED, was launched in 2001 to study the influences of the Sun and of humans on the mesosphere and lower thermosphere/ionosphere. This mission is now joined by two missions newly in operation STEREO and Solar-B. MMS, if approved for development, will be the next STP mission in space.

Solar Terrestrial Relations Observatory (STEREO)

Launched on October 25, 2006, the Solar TErrestrial RElations Observatory (STEREO) is a 2-year mission employing two nearly identical observatories to provide 3-D measurements of the Sun to study the nature of coronal mass ejections. These powerful eruptions are a major source of the magnetic disruptions on Earth and a key component of space weather, which can greatly affect satellite operations, communications, power systems, the lives of humans in space, and global climate.

Magnetospheric Multiscale (MMS)

A four-spacecraft mission launch planned for 2013 with a 2-year mission life, MMS is designed to study magnetic reconnection in key boundary regions of the Earth's magnetosphere. The best laboratory for understanding reconnection is the Earth's magnetosphere where reconnection powers storms and substorms. The spacecraft will probe the regions of geospace most critical to measuring reconnection. The results will enable a predictive science of space weather.

Additional detail can be found in the Magnetospheric Multiscale Project section of this document.

Solar B (Hinode)

Hinode launched on September 22, 2006 from Japan's Uchinoura Space Center to begin its three year mission is to explore the magnetic fields of the Sun. A follow-on to the highly successful Japan/US/UK Yohkoh (Solar-A) satellite that operated between 1991 and 2001, Hinode consists of a coordinated set of optical, EUV, and X-ray instruments that will investigate the interaction between the Sun's magnetic field and its corona. The result will be an improved understanding of the mechanisms that power the solar atmosphere and drive solar eruptions. NASA developed three science instrument components: the Focal Plane Package (FPP), the X-Ray Telescope (XRT), and the Extreme Ultraviolet Imaging Spectrometer (EIS) and will share operations support for science planning and instrument command generation activities.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Observe ~ 50 CME and 24 inter-planetary events over a 2 year period.	STEREO	Launch May 2006	Launched Oct. 2006
Complete MMS Formulation	MMS	June 2007	Same
Measure Sun's magnetic field and ultraviolet/x-ray radiation over a 3 year period.	Solar B (Hinode)	Launch Sept 2006	Launched Sept. 2006

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes

Implementation Schedule

Project	Schedule by Fiscal Year															Phase Dates			
	Prior	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20		Beg	End	Mile-stone
Magnetospheric Multiscale (MMS)																	Tech			
																	Form	May-02	Jun-08	
																	Dev	Jun-08	Jan-14	
																	Ops	Jan-14	Jan-17	
																	Res			

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

Program management responsibility for the STP Program is assigned to GSFC.

Project	Oversight	Lead Performer	Partners
STEREO	GSFC	APL	United Kingdom
MMS	GSFC	GSFC	
Solar B (Hinode)	MSFC	MSFC	JAXA

Acquisition Strategy

STP utilizes full and open competitions to the greatest extent possible for the acquisition of scientific instruments, spacecraft, and science investigations (including research and analysis). Certain instruments, missions or mission systems may be acquired without competitions (e.g., through international partnerships), provided there is a clear scientific or technological benefit to NASA. Missions may be implemented in the "out-of-house," or "PI-mode," where the entire mission is acquired through full and open competition. This strategy varies by project.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO	07/2006	Overall assessment of life cycle cost, schedule and deliverables of the STP Program. Outcome was favorable and no programmatic changes were recommended.	07/2008

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes
Project In Formulation:	Magnetospheric Multiscale (MMS)

Budget / Life Cycle Cost

Budget Authority ($ millions)	FY06	FY07	FY08
FY 2008 President's Budget Request	16.0	45.2	84.5
FY 2007 President's Budget Request	7.8	40.9	121.4
Total Change from FY 2007 President's Budget Request	8.2	4.2	-36.9

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Project Purpose

The Magnetospheric Multiscale (MMS) Project will use four identically instrumented spacecraft to perform the first definitive study of magnetic reconnection in space. Reconnection occurs in all astrophysical plasma systems but can be studied in situ only in the solar system and most efficiently only in Earth's magnetosphere. It is the primary process by which energy is transferred from the solar wind to Earth's magnetosphere and plays an important role in the processes known as "space weather." Magnetic reconnection between the interplanetary and terrestrial magnetic fields is the critical physical process determining the size of a geomagnetic storm. The reconnection process is thought to be of great importance for energy transfer throughout the universe.

MMS will observe the physics at work within targeted small-scale diffusion regions where reconnection occurs. MMS's scientific objective is to explore and understand the fundamental plasma physics processes of reconnection, particle acceleration, and turbulence on the micro- and mesoscale in Earth's magnetosphere. Because these processes occur throughout the universe, understanding them is fundamental to understanding astrophysical and solar system plasmas.

For more information please see: http://stp.gsfc.nasa.gov/missions/mms/mms.htm

Project Parameters

The MMS instrument payload will make high-time-resolution measurements of plasmas, electric fields, and magnetic fields. High-temporal and -spatial resolution will permit direct observation of the microphysical processes occurring in diffusion regions.

The mission design life is two years after spacecraft checkout and full commissioning of the instruments. The four spacecraft and instrument suites have identical design requirements. A two-phase, low-inclination orbit will probe the most likely reconnection sites on both the dayside magnetopause and in the magnetotail. The primary target of Phase 1 is the dayside magnetopause reconnection region. Phase 2 will focus on the near-Earth neutral line. The four spacecraft will fly in a tetrahedron formation and the separation between the observatories will be adjustable over a range of 10 to 400 kilometers during science operations and within the area of interest.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes
Project In Formulation:	Magnetospheric Multiscale (MMS)

Project ROM Estimate

NASA plans to launch four identical-instrumented spacecraft on a Evolved Expendable Launch Vehicle (EELV) into a highly elliptical Earth orbit in October 2013 and begin two years of scientific measurements that will enable an understanding of fundamental plasma physics processes associated with magnetic reconnection.

A project descope exercise was initiated in November 2006, to assure the project stays within available funding profile, with expected completion in early 2007.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
EELV	TBD	Deliver ~4,000-kg payload consisting of 4 observatories to a highly elliptical Earth orbit.	Same	Same
Ground Systems	GSFC	Provide during operations minimum science data payback of ~4 Gbits of data per observatory each day.	Same	Same
Spacecraft	GSFC	Deliver high-rate data from instruments to ground station with a high accuracy for 2 years	Same	Same
Electic Field Instruments	South West Research Institute	Provide measurements of electric fields (time resolution 1 ms).	Same	Same
Plasma Wave Instruments	South West Research Institute	Provide plasma wave measurements (electric vector to 100 KHz).	Same	Same
Energetic Particle Instruments	South West Research Institute	Provide high-resolution measurement of energetic particles	Same	Same
Electron and Ion Plasma Spectrometer Instruments	South West Research Institute	Three-dimensional measurements of hot plasma composition (time resolution 10s).	Same	Same
Magnetic Field Instruments	South West Research Institute	Provide measurements of magnetic fields (time resolution 10 ms)	Same	Same

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes
Project In Formulation:	Magnetospheric Multiscale (MMS)

Schedule ROM Estimate

MMS began formulation in 2002 and the project's Initial Confirmation Review is scheduled for early 2007. The Non-Advocate and Confirmation Reviews are planned for 2008. Schedules will be revised pending completion of a mission descope exercise in early 2007.

Milestone Name	Formulation Estimate	FY 2007 PB Request	FY 2008 PB Request
Formulation			
Mission Design Review	N/A	March 2006	March 2006
Initial Confirmation Review (Preliminary Date)	January 2004	(Not included)	TBD
Confirmation Review (Preliminary Date)	January 2005	June 2007	TBD
Launch (Preliminary Date)	June 2008	July 2013	TBD

Project Management

GSFC has Program Management responsibility for the Solar Terrestrial Probes Program and the Project Management responsibility for the MMS Project.

Project Element	Element Oversight	Lead Performer	Partners
Four Instrument Suites	GSFC	Southwest Research Institute	Japan, Germany (DLR), Austrian Space Agency, Sweden (SNSB), CNES and PPARC
EELV	KSC	TBD	
Four Spacecraft	GSFC	GSFC	
Mission Operations	GSFC	GSFC	

Acquisition Strategy

The instrument suite was acquired via a competitive Announcement of Opportunity process. A cost plus-fixed fee contract was awarded to the instrument suite team led by the Principal Investigator at Southwest Research Institute to work with GSFC in mission formulation.

GSFC is building the four spacecraft in-house. GSFC is also responsible for operating the MMS observatories and managing the Mission Operations Center.

The EELV (Atlas V or Delta IV) will be acquired via competitive process by KSC.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes
Project In Formulation:	Magnetospheric Multiscale (MMS)

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO	09/2006	To assess MMS readiness to proceed into Phase B / recommended to descope the project.	05/2007

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
	No significant risks known at this time.	

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Explorer Program

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Heliophysics Explorer Program	125.1	78.3	76.1	75.6	133.1	166.8	186.5

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	FY 2007 PB Request	FY 2008 PB Request	Change
Heliophysics Explorer Program	**73.3**	**76.1**	**2.8**
Launch delays for AIM and THEMIS due to technical and launch vehicle issues.			

Program Overview

The mission of the Heliophysics Explorer program is designed to provide frequent flight opportunities for world-class astrophysics and space physics investigations, utilizing innovative, streamlined and efficient management approaches to spacecraft development and operations. The Heliophysics Explorer program is composed of an on-going series of space science missions that are independent, but share a common funding and management structure. The program emphasizes missions that can be accomplished under the control of the scientific research community and seeks to control total mission life-cycle costs. The program also seeks to enhance public awareness of, and appreciation for, space science and to incorporate educational and public outreach activities. The Medium-Class Explorers (MIDEX) project provides flight opportunities for focused science missions. The Small Explorer (SMEX) project provides frequent flight opportunities for highly focused and relatively inexpensive missions. Mission of Opportunity (MO) space science investigations are flown as part of a non-NASA space mission. MOs are conducted on a no- exchange-of-funds basis with the organization sponsoring the mission.

The Heliophysics Explorer program currently has several missions in development within the Heliophysics Division. One explorer mission, WISE, is incorporated into the Astrophysics Division budget and details can be found there. Link to the Explorers program homepage for information is http://explorers.gsfc.nasa.gov/missions.html

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Explorer Program

Program Relevance

Numerous U.S. and cooperative international scientific space Explorer missions have made impressive discoveries; from Earth's magnetosphere gamma ray astronomy; some Explorer spacecraft have even traveled to other planets, and some have monitored the Sun.

The Heliophysics Explorer Program contributes to the outcomes under Strategic Plan Sub-goal 3B: Understand the Sun and its effects on Earth and the solar system. Specifically, the Strategic Plan Outcomes supported by the Heliophysics Explorer Program correspond to the objectives above, and are as follows:

3B.1: Progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium.

This program also seeks to enhance public awareness of, and appreciation for, space science and to incorporate educational and public outreach activities as integral parts of space science investigations.

Plans For FY 2008

The program will continue the development of the Small Explorer project, IBEX, in preparation for a launch on June 15, 2008, along with two Mission of Opportunity (AO) space science investigations, CINDI (June 2008) and TWINS-B (2nd qtr 2007). The MIDEX Announcement of Opportunity (AO) 7/8 will be released and the down select will be conducted towards the end of the fiscal year. Heliophysics Explorer Program will contribute to the Annual Performance Goals: 8HELI1, 8HELI5 and 8HELI6.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Explorer Program

Project Descriptions

The Explorer Program currently has five missions in formulation, development or operations, as well as planned future Explorer project opportunities.

Aeronomy of Ice in Mesophere (AIM)

The primary objective of the AIM mission is to understand why polar mesospheric clouds (PMCs) form and why they vary. AIM will study the microphysics of polar mesospheric clouds as well as the environment in which they form. AIM will also determine the causes of Earth's highest-altitude clouds, which form in the coldest part of the atmosphere about 50 miles above the polar regions every summer. AIM will launch on a Pegasus XL from Vanderberg Air Force Base into a sun synchronous orbit at 600 km. Prime operations will continue for two years.

Interstellar Boundary Explorer (IBEX)

Interstellar Boundary Explorer (IBEX) will detect for the first time the edge of the Solar System, study galactic cosmic rays, and energetic particles from beyond the solar system that pose health and safety hazards for humans exploring beyond Earth orbit. As the solar wind from the Sun flows out beyond Pluto, it collides with the material between the stars, forming a shock front. IBEX contains two neutral atom imagers that are designed to detect particles from the termination shock at the boundary between the Solar System and interstellar space. IBEX will make these observations from a highly elliptical orbit that takes it beyond the interference of the Earth's magnetosphere.

IBEX will be launched on Pegasus XL from Kwajalein in June 2008. Southwest Research Institute will maintain operations for two years.

Time History of Events and Macroscale Interactions during Substorms (THEMIS)

The THEMIS project will lead to the understanding of the onset and evolution of magnetospheric substorms. NASA's THEMIS mission will use five identical microspacecraft (probes) to answer fundamental outstanding questions regarding magnetospheric substorm instability, a dominant mechanism of transport and explosive release of solar wind energy within Geospace.

THEMIS will also employ a dense network of ground observatories to time known plasma particles and fields signatures in Earth's magnetotail, relative to substorm onset. In addition to addressing its primary objective, THEMIS answers critical questions in radiation belt physics and solar wind-magnetosphere energy coupling. THEMIS is a Medium-Class Explorers (MIDEX) mission with a target launch in February, 2007.

Coupled Ion-Neutral Dynamics Investigation (CINDI)

CINDI is a NASA-sponsored Mission of Opportunity (MO) conducted by the University of Texas at Dallas (UTD). CINDI will discover the role of ion-neutral interactions in the generation of small and large-scale electric fields in the Earth's upper atmosphere. Ion-neutral interactions are a key process in controlling the dynamics of all planetary atmospheres and their understanding is important to describing the electrodynamic connections between the Sun and the Upper Atmosphere.

The CINDI investigation is carried out as an enhancement to the science objectives of the Communication/Navigation Outage Forecast System (C/NOFS) undertaken by the Air Force Research Laboratory (AFRL) and the Space and Missile Command Test and Evaluation Directorate (SMC/TEL).

In addition the CINDI instruments will provide measurements of the 3-D neutral winds and ion drifts. The instrument will be operated for at least two years. During that time the CINDI science investigations will be undertaken and will provide essential input to real-time specification and prediction models being developed by C/NOFS. This synergistic relationship optimizes the productivity and resources for the CINDI mission.

Two Wide-angle Imaging Neutral-atom Spectrometers (TWINS-B)

TWINS-B will provide the second half of the stereo imaging of the Earth's magnetosphere, the region surrounding the planet controlled by its magnetic field and containing the Van Allen radiation belts and other energetic charged particles. TWINS-B will enable three-dimensional global visualization of this region, which will lead to greatly enhanced understanding of the connections between different regions of the magnetosphere and their relation to the solar wind. TWINS-B will fly as a NASA-sponsored Mission of Opportunity (MO) in the 2nd quarter of 2007.

Explorer Program Management and Future Missions

The project funds future Explorer project selections for the Medium-Class Explorers (MIDEX), the Small Explorer (SMEX), and Mission of Opportunity (MO).

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Launching 2 missions by the end of FY 2008	IBEX and CINDI	Same	Same

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Explorer Program

Implementation Schedule

Project	Schedule by Fiscal Year																Phase Dates			
	Prior	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20		Beg	End	Mile-stone
AIM																	Tech			
																	Form	Jul-02	Apr-04	
																	Dev	Apr-04	Sep-06	
																	Ops	Oct-06	Aug-08	
																	Res			
IBEX																	Tech			
																	Form	Jan-05	Mar-06	
																	Dev	Mar-06	Jun-08	
																	Ops	Jul-08	Jul-10	
																	Res			
THEMIS																	Tech			
																	Form	Apr-02	Apr-04	
																	Dev	Apr-04	Feb-07	
																	Ops	Mar-07	Mar-09	
																	Res			
CINDI																	Tech			
																	Form	Sep-00	Nov-01	
																	Dev	Nov-01	Jun-08	
																	Ops	Jun-08	Jun-10	
																	Res			
TWINS-B																	Tech			
																	Form			
																	Dev	Apr-99	Jun-07	
																	Ops	Jun-07	Jun-09	
																	Res			

- Tech & Adv Concepts (Tech)
- Formulation (Form)
- Development (Dev)
- Operations (Ops)
- Research (Res)
- Represents a period of no activity for the Project

Program Management

Goddard Space Flight Center (GSFC) has Program Management responsibility for all Heliophysics Explorer Programs.

Project	Oversight	Lead Performer	Partners
AIM	GSFC	Hampton University	Laboratory for Atmospheric and Space Physics (LASP) Orbital Science Corp
IBEX	GSFC	Southwest Research Insitute (SWRI)	Orbital Science Corporation Los Alamos National Laboratory Lockheed Martin Advance Technology Center
THEMIS	GSFC	University of California Berkeley	Swales Aerospace, France, Germany and Canada
TWINS-B	GSFC	Southwest Research Institute	Los Alamos National Laboratory and Aerospace Corporation
CINDI	GSFC	University of Texas at Dallas	U.S. Air Force

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Explorer Program

Acquisition Strategy

Explorer program has established an acquisition strategy that contracts for the whole mission (concept through delivery of science data/analysis), with emphasis on performance incentives and a cost cap for each mission.

Investigations are selected through the AO process, where multiple investigations are selected competitively for initial concept studies with a competitive down-select to proceed to the next stage of formulation.

Investigations are selected to proceed from one phase to the next through execution of contract options, based on successful technical, cost, and schedule performance in the previous phases.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO	03/2003	Review and make recommendations on Announcements of Opportunity selections. Selected IBEX and Nuclear Spectroscopic Telescope Array (NuSTAR).	06/2008

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Increased cost of launch vehicle	The increasing cost of the Delta Launch vehicle threaten the maintainability and viability of the Explorers Program and future missions	Work to create viable launch options for the next AO release
Extended time between release Announcement of Opportunity (AO).	A MIDEX AO release in FY 2008 would be approximately 3 years since the last AO release, which is beyond the Program's 24 month cycle, thus creating an imbalance in the Explorer program. The Explorer Program is vital for emerging science opportunities. The reduced number of missions also creates a lack of flight opportunities for scientists.	Work to get the Program back on track with a MIDEX AO release every 24 months.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Near Earth Networks

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Near Earth Networks	71.4	63.7	66.0	65.2	67.2	65.6	66.9

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure. No changes in procured program content.

Highlights of Major Program Changes

	FY 2008		
<u>**Program Title:**</u>	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Near Earth Networks	**72.4**	**66.0**	**-6.4**
No significant changes.			

Program Overview

The NASA Near Earth Networks (NEN) program provides multi-mission driven space flight tracking, telemetry & command (TT&C), meteorological and photo-optical services and associated activities of customer interface, network and range scheduling, cross-cutting maintenance and systems engineering, facilities, safety, and security. These services are intended for near-Earth (<2 million Km) spaceflight missions, including human space flight (Space Shuttle Program and Constellation), sounding rocket, and near-Earth orbital flight as a part of NASA Space Communications in support of Science Missions, Space Operations, Exploration Systems, and Aeronautics. Services are also intended for flight missions, including unmanned aerial vehicle, aircraft and rockets in support of Upper Atmospheric Research, Space Operations, and Aeronautics. The Program encompasses Ground Network (GN) for orbital support and Research Range Services for sub-orbital flight. The NEN are comprised of a mix of NASA assets, commercial services, and cooperating agencies. The global nature of space communications requires that tracking facilities are frequently dependent upon inter-Agency and international host-tenant agreements. Virtual networks may be constituted to meet unique mission needs such as spacecraft launch, early orbit operations, and remote range operations. The NEN program includes network integration, test, and scheduling functions. Supporting functions include systems engineering and development to address systems obsolescence replacement and transition to new capabilities.

For more information, please see: http://scp.gsfc.nasa.gov/gn/index.htm

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Near Earth Networks

Program Relevance

NEN not only provides the ability to communicate with orbiting spacecraft, which is fundamental to science data acquisition, but addresses the technical challenges involved in improving telecommunications capability in the federal, private and academic sectors. This results in higher data rates, efficient spectrum usage and a higher quality of life.

The NEN space communication program enables space operations and science data acquisition from 30 orbiting spacecraft. In doing so, the NEN program directly supports the following NASA Strategic Outcome 1.1: Assure the safety and integrity of the Space Shuttle workforce, systems, and processes, while flying the manifest; and Strategic Sub-goals 3A: Study Earth from space to advance scientific understanding and meet societal needs; 3B: Understand the Sun and its effects on Earth and the solar system.

Plans For FY 2008

Begin development of the Launch Head space communications facility and systems in support of the Constellation program.

The GN Project is managing the development of three 18 meter Ka-band receive antenna systems at the TDRSS White Sands Complex in support of the Lunar Reconnaissance Orbiter (LRO) and the Solar Dynamics Observatory (SDO). Significant systems development and installation will occur during FY 2008. This activity is jointly funded by LRO, SDO and NEN.

Project Descriptions

The NEN program is composed of two projects which include Ground Network and Research Range which provide space communication support across NASA Directorates.

Ground Network

The NEN space communications program receives science data from Earth-orbiting robotic spacecraft, and from the Space Shuttle during launch and ascent. The Ground Network space communications capacity is adjusted to meet projected mission workload. The current capacity is sized for 4.5 terabytes per day and 40,000 data acquisition tracking passes per year. The capacity is adjusted to meet projected mission workload. Multi-antenna S and X band stations at key geographic locations support a largely polar-orbiting mission set. There is heavy reliance upon commercial service providers and increasingly on cooperative mutual aid agreements with nearby facilities of other agencies.

Research Range

The Research Range Services supports the capacity to provide launch instrumentation for NASA suborbital programs and projects, to simultaneously enable a major remote campaign to Poker Flat or Kwajalein and local Wallops missions involving a launch site and a single downrange deployed tracking/command site.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Near Earth Networks

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Operationalize Launch Head space communications facility for use by Constellation Program.	Ground Networks	By 2012	By 2012
Operationalize two meter RF systems.	Ground Networks	By 2008	By 2008

Implementation Schedule

Project	Schedule by Fiscal Year (Prior, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20)	Phase Dates	Beg	End	Mile-stone
SDO 18M Antenna		Tech			
		Form			
		Dev	Jan-06	Jan-08	
		Ops	Jan-08	Sep-13	
		Res			
Launch Head		Tech			
		Form			
		Dev	Mar-06	Jan-11	
		Ops	Jan-11	Jan-20	
		Res			

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

GSFC has overall responsibility for the management of the Near-Earth Network.

Project	Oversight	Lead Performer	Partners
Research Range Services	GSFC	GSFC Services Contract	
Ground Network	GSFC	GSFC Services Contract	NSF

Acquisition Strategy

All work is accomplished using task orders under the competitively awarded Indefinite Delivery/Indefinite Quantity (IDIQ) Near Earth Network Services (NENS) contract. The University of Alaska provides services for the Research Range Project.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	SOMD	10/2004	To assess whether the NEN Program is meeting its objectives. Outcome was favorable and no programmatic changes were recommended.	10/2008

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Remote Operations	The NEN operates in extreme and remote environments (Alaska, Norway, and Antarctica), which may have limited access and attendant risk of service loss due to equipment failures, loss of commercial power, damage from severe storms, etc.	The NEN includes a scheduled preventative maintenance program and system architecture including system redundancy and alternatives. Mutual aid cooperative agreements have been established with nearby facilities of other agencies.
Aging and Fragile Systems	NEN systems are aging and fragile. There have been numerous antenna failures, due to apparent metal fatigue. The NEN is recovering from an earlier attempt to achieve a cost recovery operation based upon commercial services.	The systems have been examined by failure review boards and both corrective and preventative measures are being undertaken with the allocated resources.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	New Millennium

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
New Millennium	57.6	89.6	66.2	33.0	36.0	92.1	95.9

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
New Millennium	**92.1**	**66.2**	**-25.9**
Delays ST-9 and follow on missions by roughly two years; schedules will be assessed for the FY 2009 budget cycle.			

Program Overview

The New Millennium Program (NMP) is a technology flight validation program designed to retire risk of key emerging and breakthrough technologies to enable future NASA science missions. The objectives of the Program are to capitalize on investments being made in U.S. technological capabilities and accelerate the incorporation of payoff, advanced technologies into future NASA Science Missions by conducting in-space validation missions, when the technologies must be tested in space in order to be validated. NMP allows NASA to conduct technology maturation and validation in low cost NMP projects, rather than during science mission development. The needs for specific new technology capabilities are identified through the Science Mission Directorate (SMD) science planning process. Technology solutions to meet those needs are solicited by SMD and selected for NMP through an open competitive process. NMP pursues partnerships for access to space in order to maximize the available resources invested in advanced technologies. The focus of the NMP projects is on new capabilities for science missions planned in the 5 to 15 year time frame.

For more information, please see: http://nmp.jpl.nasa.gov

Mission Directorate:	Science
Theme:	Heliophysics
Program:	New Millennium

Program Relevance

The goal of the New Millennium Program (NMP) is to reduce the risks to, as well as the costs of, future NASA science missions. In that capacity, the NMP supports NASA Strategic Goal 3: develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration. NMP contributes to the following Sub-goals through the demonstration of technologies that enable or enhance missions in each Science Theme:

3A: Study Earth from space to advance scientific understanding and meet societal needs.
3B: Understand the Sun and its Effects on the Earth and the Solar System.
3C: Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere and the hazards and resources present as the humans explore space.
3D: Discover the origin, structure, evolution and destiny of the universe, and search for Earth-like planets.

NMP also contributes to NASA Strategic Goal 5: Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.

Plans For FY 2008

Plans for FY 2008 include completion of the Space Technology 6, Inertial Stellar Compass technology validation; continued development for Space Technology 7, Disturbance Reduction System; and continued development of the Space Technology 8 (Subsystem Validation Mission). Space Technology 9 and follow on missions will be delayed by roughly two years; schedules will be assessed for the FY 2009 budget cycle.

No specific APGs are supported by this program in fiscal year 2008.

Space Technology 5 Micro-Satellites

The Space Technology 5 mission, launched March 22, 2006 and completed June 20, 2006, focused on the design, development, integration and operation of three full service 25-kilogram-class spacecraft that implemented multiple new technologies and, functioning as a single constellation, achieved accurate research-quality scientific measurements.

Space Technology 6 -- Inertial Stellar Compass

The Inertial Stellar Compass (ISC) enables a spacecraft to continuously determine its attitude (the direction in which it is pointing). It also enables a spacecraft to recover its orientation (direction and pointing) after a temporary malfunction or power loss. This is done by the "marriage" of a miniaturized star camera and gyro system. ISC technology uses an active pixel sensor in a star-tracking camera and a three-axis system of microelectromechanical gyros. ISC was successfully launched on the TacSat -2 (Air Force Research Laboratory (AFRL)) satellite in December 2006.

Space Technology 7 -- Disturbance Reduction System

Space Technology 7's Disturbance Reduction System (DRS) incorporates enhanced micro-Newton thruster technology, which works with enhanced sensor technology provided by the European Space Agency. Together, these technologies will demonstrate precision spacecraft control, validating position-measurement of objects in weightlessness with 100-times greater accuracy than ever before. During the Space Technology 7 test flight, the DRS is expected to achieve close to the ultimate in weightlessness.

Space Technology 8

Space Technology 8 (ST 8) is a mission to validate four new subsystem-level technologies never before tried in space. The ST 8 technologies are:

1. Dependable Multiprocessor: A fault-tolerant software architecture running on a cluster of commercial-off-the-shelf (COTS)-based computers that enhances the immunity of a high-performance onboard processing system to the error-causing radiation environment of space provided by Honeywell International.
2. Ultraflex 175: A deployable solar array system that is a highly efficient, lightweight power producer for both orbiting and landed spacecraft provided by ATK Space Systems.
3. SAILMAST Ultra Lightweight Boom: A technology for strong, deployable ultra-lightweight structures that can be used to support huge, deployable solar sails and other large structures like space telescopes sunshades provided by ATK Space Systems.
4. Thermal Loop: A miniature thermal management system for small spacecraft that tightly controls the operating temperatures of the spacecraft and instruments while using little power provided by the Goddard Space Flight Center.

Space Technology 9

Space Technology 9 (ST 9) consists of five system validation concepts selected for Formulation in 2005. NASA's plans to select one concept to continue into Formulation Refinement are delayed by roughly two years; schedules will be assessed for the FY 2009 budget cycle. The five competing concepts are: (1) Precision Formation Flying, (2) Solar Sail System, (3) Aerocapture, (4) Terrain Relative Guidance System, and (5) Large Space Telescope Technologies.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	New Millennium

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Validate Disturbance Reduction System (DRS) by Operating in space for 240 hours.	Space Technology 7 (On European Space Agency's LISA Path Finder)	N/A	Before end of 1st Quarter FY 2008
Validate Inertial Stellar Compass by operating in space environment for 48 hours over 30 days.	Space Technology 6 (on TacSat 2)	N/A	Launched Dec 2006

Implementation Schedule

Project	Schedule by Fiscal Year: Prior, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20	Phase	Beg	End	Mile-stone
Space Technology 5		Tech	Jan-99	Jun-01	
		Form	Jun-01	Dec-01	
		Dev	Dec-01	Mar-06	
		Ops	Mar-06	Jun-06	
		Res			
Space Technology 6		Tech	Nov-01	May-02	
		Form	May-02	Aug-02	
		Dev	Aug-02	Nov-06	
		Ops	Nov-06	Apr-07	
		Res			
Space Technology 7		Tech	Apr-01	Apr-03	
		Form	Apr-03	Jul-03	
		Dev	Jul-03	Oct-09	
		Ops	Oct-09	Sep-10	
		Res			
Space Technology 8		Tech	Sep-03	Aug-06	
		Form	Aug-06	Oct-06	
		Dev	Oct-06	Feb-09	
		Ops	Feb-09	Sep-09	
		Res			

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Mission Directorate:	Science
Theme:	Heliophysics
Program:	New Millennium

Program Management

The New Millennium Program is managed by Jet Propulsion Laboratory, with oversight from NASA Headquarters.

Project	Oversight	Lead Performer	Partners
Space Technology 6	JPL	JPL	
Space Technology 7	JPL	JPL	European Space Agency
Space Technology 8	JPL	JPL	Busek Corporation
Space Technology 9	JPL	JPL	

Acquisition Strategy

The Science Mission Directorate (SMD) acquires advanced technology concepts through an open competitive process, such as the NASA Research Announcement (NRA) process, to ensure participation by the broadest community, and to solicit advanced technology proposals appropriate to satisfy SMD-established requirements for either a system or subsystem flight validation opportunity. Open competitions for acquisitions to implement each flight validation experiment are required unless an alternative procurement approach is approved by the SMD Associate Administrator.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO	01/2007	Program, alignment and management. Review -- Program Implementation Review (PIR) for the New Millennium Program. Results of the review have not yet been released.	TBD
Performance	IPAO-IRT	08/2006	Non-Advocate Review (NAR) for Space Technology 8. Recommended to proceed to the next phase.	N/A
Performance	SRB/IRT	N/A	Critical Design Review for Space Technology 8.	06/2007

Mission Directorate:	Science
Theme:	Planetary Science

Theme Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Planetary Science	1,298.9	1,411.2	1,395.8	1,676.9	1,720.3	1,738.3	1,748.2
Mars Exploration	662.2	721.1	625.7	594.8	592.5	624.0	665.5
Discovery	131.8	179.9	184.9	320.7	370.2	355.2	341.1
New Frontiers	118.1	158.1	147.3	296.0	277.5	267.9	274.5
Technology	56.7	73.4	67.6	62.6	63.9	62.7	64.2
Planetary Science Research	330.0	278.8	370.5	402.9	416.2	428.5	402.9

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Theme Changes

	FY 2008		
Planetary Science	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Mars Exploration	**630.9**	**625.7**	**-5.3**
Minor adjustments.			
Discovery	**196.7**	**184.9**	**-11.9**
The Discovery budget profile has been adjusted to reflect the Dawn replan and change of launch date to June 2007 and the selection of concept studies for 3 full missions and 3 Missions of Opportunity for the Discovery 2006 Announcement of Opportunity (AO).			
New Frontiers	**160.6**	**147.3**	**-13.3**
Aligns Juno funding with 2011 launch date; New Frontiers 3 Announcement of Opportunity (AO) to be released in late 2008.			
Technology	**63.4**	**67.6**	**4.1**
Minor adjustments.			
Planetary Science Research	**290.1**	**370.5**	**80.5**
Provides additional funding for planetary Research and Analysis (R&A); supported Hayabusa (Muses-C) later Earth return (2010); adds Outer Planets Missions studies to the R&A portfolio, and Lunar Science.			

Theme Purpose

The purpose of the Planetary Science Theme is to advance scientific knowledge of the origin and history of the solar system, including the history of life and whether it evolved beyond Earth. Equally important is finding resources, evaluating, and mitigating the risks to humans that will be encountered as we conduct an overall balanced program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.

In this pursuit, the Planetary Science Theme supports the following Goal and Sub-goal in the 2006 NASA Strategic Plan:

Goal 3: Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.

Sub-goal 3C: Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space.

Mission Directorate:	Science
Theme:	Planetary Science

Theme Overview

Planetary Science is a grand human enterprise that seeks to discover the nature and origin of the celestial bodies among which we live and to explore whether life exists beyond Earth. The scientific imperative for Planetary Science, the quest to understand our origins, is universal. How did we get here? Are we alone? What does the future hold? These overarching questions lead to more focused, fundamental science questions about our solar system: How did the Sun's family of planets and minor bodies originate? How did the Solar System evolve to its current diverse state? What are the characteristics of the Solar System that led to the origin of life? How did life begin and evolve on Earth and has it evolved elsewhere in the Solar System? What are the hazards and resources in the Solar System environment that will affect the extension of human presence into space?

To achieve progress in addressing these five fundamental science questions, NASA relies on a balanced program. There are five programs within the Planetary Science Theme: Discovery, New Frontiers, Research, Technology, and Mars Exploration. Discovery has one operating spacecraft (MESSENGER), one radar instrument operating on an ESA Mars Express mission, one mission in development phase (Dawn), and a Mission of Opportunity with ISRO (M3). New Frontiers has one operating spacecraft (New Horizons) and one mission currently in the formulation phase (Juno). Research supports one operating spacecraft (Cassini) and two missions with international partners (Rosetta and Hayabusa), as well as Research and Analysis, Sample and Data Curation, data Dissemination and Analysis. The Mars program has two spacecrafts (Odyssey and MRO) and two rovers (Spirit and Opportunity) in operation, one instrument (MEX) operating on an ESA Mars Express mission, two missions in development (Phoenix, and MSL), technology, next decade missions, and research. Finally, Planetary Science includes a Technology Program that includes advanced In-Space propulsion systems (ISP) and Advanced power generation and storage (RPS).

Relevance

Relevance to national priorities, relevant fields, and customer needs:

Planets and satellites of the solar system and the ancient icy bodies far from the Sun are "Rosetta stones" that can tell unique stories about the evolution of the solar system. As researchers learn more about the origins of living organisms on Earth and about the solar system's planets and moons, they may learn that life has arisen in places beyond Earth.

This robotic exploration will generate knowledge about or solar system needed to identify the most promising human exploration missions. This knowledge will also help enable safe human exploration in the forbidding environments they will encounter.

Relevance to the NASA Mission:

The Planetary Science Theme Supports the NASA Mission, "To pioneer the future in space exploration, scientific discovery, and aeronautics research," and NASA "Strategic Goal 3: "Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration."

Robotic exploration is an integral part of an overall strategy to extend human presence throughout the solar system.

Relevance to education and public benefits:

The Planetary Science Theme uses its missions, research programs, and the human resources of the space science community to enhance the quality of American science, mathematics, and technology education, particularly at the pre-college level. The Planetary theme is dedicated to sharing the excitement of discoveries and knowledge generated by space science missions and research, with the public, and thus contributing to educating and inspiring the next generation of scientists and technical workers needed for the 21st century.

Public benefits from Planetary Science include a growing understanding of the solar system and Earth's significance within it. Planetary Science's Discovery, Mars, and Research programs were among the first at NASA to require a plan for education and public outreach, as NASA recognized the importance of communicating the excitement of space exploration to the public.

Mission Directorate:	Science
Theme:	Planetary Science

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
Strategic Goal 3	**Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.**	
Sub Goal 3C	**Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space.**	
Outcome 3C.1	**Progress in learning how the Sun's family of planets and minor bodies originated and evolved.**	
APG 8PS01	Demonstrate progress in learning how the Sun's family of planets and minor bodies originated and evolved. Progress will be evaluated by external expert review.	Multiple Programs
APG 8PS02	Complete the Mercury Surface, Space Environment, Geochemisry and Ranging (MESSENGER) Mercury Flyby 1.	Discovery
APG 8PS03	Begin Juno instruments detailed design.	New Frontiers
Outcome 3C.2	**Progress in understanding the processes that determine the history and future of habitability in the solar system, including the origin and evolution of Earth's biosphere and the character and extent of prebiotic chemistry on Mars and other worlds.**	
APG 8PS04	Demonstrate progress in understanding the processes that determine the history and future of habitability in the solar system, including the origin and evolution of Earth's biosphere and the character and extent of prebiotic chemistry on Mars and other worlds. Progress will be evaluated by external expert review.	Multiple Programs
APG 8PS05	Begin 2009 Mars Science Laboratory (MSL) Assembly, Test, Launch Operations (ATLO).	Mars Exploration
Outcome 3C.3	**Progress in identifying and investigating past or present habitable environments on Mars and other worlds, and determining if there is or ever has been life elsewhere in the solar system.**	
APG 8PS06	Demonstrate progress in identifying and investigating past or present habitable environments on Mars and other worlds, and determining if there is or ever has been life elsewhere in the solar system. Progress will be evaluated by external expert review.	Multiple Programs
APG 8PS07	Land the Phoenix spacecraft on the Martian surface and begin science operations.	Mars Exploration
Outcome 3C.4	**Progress in exploring the space environment to discover potential hazards to humans and to search for resources that would enable human presence.**	
APG 8PS08	Demonstrate progress in exploring the space environment to discover potential hazards to humans and to search for resources that would enable human presence. Progress will be evaluated by external expert review.	Multiple Programs

Performance Achievement Highlights

Planetary Science Research

Cassini used its large suite of instruments to study Saturn's moon Enceladus and found geyser-like water vapor spurts from its surface. The Huygens probe was released from the Cassini spacecraft and successfully descended through the murky atmosphere of Saturn's largest moon, Titan. Huygens discovered that Titan's surface has been shaped by flowing liquid and blowing winds.

Mission Directorate:	Science
Theme:	Planetary Science

Performance Achievement Highlights

Discovery

An initial analysis of the Stardust successful returned cometary and interstellar dust samples to Earth (January 16, 2006) indicates that the samples returned exceed all expectations and may alter view of comet formation. Deep Impact reported a finding of a small area of water ice on the surface of Temple 1, which marks the first evidence of water ice on the surface of a comet. Three full missions, with science objectives that include asteroid sample return, Venus atmospheric analysis, and gravity field mapping of the Moon, were selected for further study in response to the 2006 Discovery AO. In addition, three missions of opportunity that utilize the Deep Impact and Stardust spacecraft for addtional cometary and planetary investigations were selected for study. The Dawn project, a mission to the two largest and most massive asteroids in our solar system (Ceres and Vesta), successfully completed spacecraft integration in preparation a June 2007 launch. MESSENGER, currently enroute to Mercury, successfully completed the last of the rotation maneuvers required to control the spacecraft thermal environment during cruise and a final trajectory correction maneuver in preparation for a flyby of Venus in October 2007.

Mars Exploration

Mars Reconnaissance Orbiter (MRO) began its two-year science phase in November 2006. New high-resolution data are flowing back from Mars at an unprecedented rate. In a first for any spacecraft, MRO has returned spectacular images of earlier NASA landers - the rover Spirit that landed on the surface in 2004, Opportunity on the edge of Victoria Crater, and the two Viking landers that set down in 1976. These images show meter-scale rocks that could destroy a lander. The new MRO images of the earlier landers and their surroundings combined with the observations made from ground level allow us to confidently plan safe landing sites for future missions. New mysteries of the Red Planet are being revealed. MRO has taken pictures of unusually persistent patches of frozen water, and spotted tracks of massive landslides that, curiously, have left no visible debris behind. The images and other data have already demonstrated their enormous value to any future missions to the surface of Mars. During its surprising 10 year life span, Mars Global Surveyor found new deposits in two gullies, the compelling evidence that water still flows occasionally on the surface of Mars.

New Frontiers

New Horizons launched successfully on January 19, 2006, and is currently in the operation phase. Juno replanned to support the August 2011 launch date.

Technology

The Radioisotope Power Conversion Technology (RPCT) has resulted in breakthrough technology to advance the development of future radioisotope power systems by reducing the Pu-238 fuel requirement through increased efficiency and enabling high specific power. During the second phase of the effort led by Sunpower (Athens, OH), a free-piston Stirling convertor demonstrated 38% efficiency. With the earlier than anticipated success of the Sunpower Stirling convertors in the demonstration of high efficiency at low mass, the NASA/DOE Advanced Stirling Radioisotope Generator (ASRG) will achieve >7 W/kg, a factor of 2 greater than that previously planned for the previous SRG-110 project. In-Space Propulsion (ISP) delivered and tested a flight-like electric propulsion thruster that was developed under the "NASA's Evolutionary Xenon Thruster" (NEXT) project. The ISP also successfully delivered and has begun testing a Hall thruster designed specifically to lower cost and increase reliability / manufacturability while also increasing performance over other propulsion options.

Quality

Performance Measure #	Description
Planetary Science Theme	
APG 8PS09	Complete all development projects within 110% of the cost and schedule baseline.
APG 8PS10	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 8PS11	Peer-review and competitively award at least 90%, by budget, of research projects.
APG 8PS12	Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 130 days.

Program Assessment Rating Tool (PART):

The Planetary Science Theme was subject to a PART review in 2006 and received an "effective" rating. The assessment found that this program is well-defined and well-managed, with a clear purpose and direct ties to NASA's mission.

Areas identified for performance improvement included the achievement of program goals within budgeted costs and established schedules. To address this, the theme will report for major missions on: estimated mission life cycle cost (LCC) upon entering development; key schedule milestones associated with each mission phase for those missions formally approved for formulation; mission cost and schedule progress achieved in each phase before entering the next; and any plans to re-baseline LCC and schedule. To date the LCC and key milestones were reported on a quarterly basis to OMB for projects that are in development. This has also been provided annually to the Congress as the Major Program Annual Report. In the coming year, projects that are still in formulation will be included as a part of the quarterly reporting.

Another area of focus will be the portfolio mix of missions. In the coming year the Theme will also explore options for modifying the current approach to its competed programs to allow for a healthy mix of missions of various size and scope, potentially including missions to the outer planets.

Further, NASA is defining its requirements, approach, and projected schedule for Deep Space Network upgrades, and will provide this information to OMB and Congress in early 2007. The budget profiles for the upgrades will be reflected in the Agency's FY 2009 budget submit to OMB.

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Relevance	NASA Advisory Council	05/2006	Reviews science and program implementation strategies and relevancies to the NASA strategies and goals. Recommendations include rebalance the program, with R&A restoration; development of science plan; and better cost and risk management for missions.	02/2007
Relevance	National Research Council	12/2003	Decadal Survey of Planetary Science priorties/Published Decadal Report entitled "New Frontiers and the Solar System: An Integrated Exploration Strategy".	09/2013
Relevance	COMPLEX, MEPAG, OPAG, VExAG	12/2003	2003 Solar System Exploration Roadmap/Outcome include publicaiton of the 2006 Solar System Exploration Roadmap and the 2006 Mars Architecture.	12/2007
Relevance	National Research Council	12/2003	Assess NASA/Planetary Science performance against the NRC Decadal Survey recommendations.	2/2007

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Mars Exploration	662.2	721.1	625.7	594.8	592.5	624.0	665.5
Phoenix (Scouts 07)	141.5	99.8	11.4	1.2	--	--	--
2009 Mars Science Lab	253.4	378.4	345.0	238.2	73.6	58.2	40.1
Other	267.3	242.8	269.3	355.4	518.9	565.8	625.4

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Mars Exploration	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Phoenix (Scouts 07)	**28.6**	**11.4**	**-17.2**
Reduction in FY 2008 reflects a rephase of funding to FY 2006.			
2009 Mars Science Lab	**285.6**	**345.0**	**59.4**
Budget request reflects the revised budget profile approved at confirmation review.			
Other	**316.7**	**269.3**	**-47.5**

Program Overview

Mars is the most Earth-like planet in our solar system, with land mass approximately equivalent to the Earth's and what appear to be familiar features such as riverbeds, past river deltas, and volcanoes. Mars holds valuable scientific clues to the development of the solar system, planets, and maybe life itself. The Mars Program has been developed to conduct a rigorous, incremental, discovery-driven exploration of Mars to determine the planet's physical, dynamic, and geological characteristics.

The Mars Rovers, Spirit & Opportunity, continue to provide amazing science data & images to the science community and the public. They have exceeded their original design life by more than a factor of 10 and traversed a combined distance of over 10 miles on the Martian surface. A more benign ancient Mars has been revealed, in which salty acidic waters indicate a planet with the potential for life. Mars Global Surveyor ceased functioning in November, 2006; however Mars Odyssey has continued to operate exceedingly well, providing new data on a dynamic planet that has undergone episodes of relative wet and dry periods throughout its history. Mars Reconnaissance Orbiter arrived in March 2006 and just started its primary science phase. Initial images from early tests show that MRO will undoubtedly change our view of the Red Planet and greatly expand scientific knowledge.

For more information, see http://mars.jpl.nasa.gov

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration

Program Relevance

The activities within the Mars program gather data that will enable NASA to search for evidence of life on Mars, to understand the history of the solar system, and to prepare for future human exploration by making measurements and discoveries that will characterize the hazards for humans and identify useable resources.

The program contributes primarily to the following outcomes, each of which supports Strategic Plan Sub-goal 3C, "Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space:"
3C.2: Progress in understanding the processes that determine the history and future of habitability in the solar system, including the origin and evolution of Earth's biosphere and the character and extent of prebiotic chemistry on Mars and other worlds.
3C.3: Progress in identifying and investigating past or present habitable environments on Mars and other worlds, and determining if there is or ever has been life elsewhere in the solar system.
3C.4: Progress in exploring the space environment to discover potential hazards to humans and to search for resources that would enable human presence.

Plans For FY 2008

- Mars Scout (Phoenix) will launch in August 2007 and will begin its primary mission in 2008 on the surface of Mars.
- Mars Science Laboratory (MSL) will begin Assembly, Test and Launch Operations activities in February, 2008, in preparation for its launch readiness date in September 2009.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration

Project Descriptions

The Mars Exploration Program (MEP) is composed of a number of synergistic projects that achieve the programmatic and scientific goals of the program. The technology program supports future missions through competitive selection of base, focused, and instrument-specific development. Science research is fostered through competitive, peer-reviewed selections for scientific research, and missions are developed through largely competitive processes, including core MEP missions and community-driven competitive Scout missions. MEP is currently operating Odyssey, the Mars Exploration Rovers, and the Mars Reconnaissance Orbiter at Mars. Missions in formulation or development include: Phoenix (2007), MSL (2009), and the second Mars Scout (2011 launch).

Mars Odyssey

In its extended mission phase, the primary scientific objectives of Odyssey include monitoring of inter-annual variations of Mars climate and surface processes, new and improved elemental maps, extended monitoring of charged-particle radiation for human hazard assessment, acquiring future mission landing site data, and continuing as a key telecommunications asset at Mars. Funding to extend mission operations may be available pending on the outcomes of the mission review each year.

Mars Exploration Rovers (Spirit and Opportunity)

The rovers will continue to explore geological settings on the surface of Mars using a suite of remote sensing and in-situ instruments. The objective is to expand our understanding of the history and the geological processes that shaped Mars, particularly those involving water. Funding to extend mission operations may be available pending on the outcomes of the mission review each year.

Mars Reconnaissance Orbiter

MRO, which began its science mapping phase at the beginning of FY 2007, has three general objectives: 1)provide high-resolution spectral maps and images for interpretation of the geology of the Martian crust; 2)use ground-penetrating radar to map compositional discontinuation and layering under the surface; and 3)create planetary-scale maps of critical atmospheric properties. MRO is also the key telecommunications asset for the first half of the next decade at Mars.

Mars 2007 Scout (Phoenix)

The Phoenix lander is the first Mars Scout mission and is led by a Principal Investigator from University of Arizona. Phoenix will characterize the chemistry, mineralogy and isotopic composition of evolved gases in surface and subsurface soils and ices at a landing site in the high latitudes of the northern hemisphere. Additional detail can be found in the Phoenix Project section of this document.

Mars Science Laboratory

MSL takes a major step forward in Mars exploration, both technically and scientifically, utilizing a new entry, descent, and landing system, a long-duration rover, and ten payload elements for definitive mineralogical and organics measurements. The primary scientific objective is to explore and quantitatively assess a local region on Mars as a potential habitat for life. MSL will lay the ground work for future scientific missions, and provide key information for human exploration. Additional detail can be found in the MSL Project section of this document.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
MEP will provide continual operational presence on Mars	Mars Exploration	No change	No change
At least one Mars mission will be launched at every opportunity (every 26 months)	Mars Exploration	No change	No change

Implementation Schedule

Schedule by Fiscal Year: Prior, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Project	Phase	Beg	End	Milestone
Mars Odyssey	Tech			
	Form	Apr-97	Apr-99	
	Dev	Apr-99	Apr-01	
	Ops	Apr-01	Sep-08	
	Res			
Mars Express	Tech			
	Form	Jan-00	Sep-00	
	Dev	Sep-00	Jun-03	
	Ops	Jun-03	Dec-05	
	Res	Dec-05	Oct-08	
Mars Exploration Rovers (Spirit & Opportunity)	Tech			
	Form	May-00	Aug-01	
	Dev	Aug-01	Jun-03	
	Ops	Jun-03	Sep-08	
	Res			
Mars Reconnaissance Orbiter (MRO)	Tech			
	Form	Jan-01	Jul-02	
	Dev	Jul-02	Aug-05	
	Ops	Aug-05	Dec-10	
	Res	Dec-10	Sep-14	
Mars Scout (Phoenix)	Tech			
	Form	Aug-03	Mar-05	
	Dev	Mar-05	Aug-07	
	Ops	Aug-07	Aug-08	
	Res	Aug-08	Oct-09	
Mars Science Laboratory (MSL)	Tech			
	Form	Nov-03	Aug-06	
	Dev	Aug-06	Sep-09	
	Ops	Sep-09	Oct-12	
	Res	Oct-12	Oct-15	

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration

Program Management

The Agency Program Management Council has oversight responsibility for the Mars Exploration Program. Responsibility for implementation of the Mars Exploration Program is assigned to the MEP program office at JPL.

Project	Oversight	Lead Performer	Partners
MRO	NASA HQ	JPL	
Mars Exploration Rovers	NASA HQ	JPL	
Phoenix	NASA HQ, JPL	University of Arizona	
MSL	NASA HQ	JPL	Department of Energy; International partners include Canada, Spain, and Russia.

Acquisition Strategy

The Mars Exploration Program has set a goal of open competition for all missions. All major acquisitions for MRO, Phoenix, and MSL are in place; Ball Aerospace developed the primary optical instrument for MRO, while Lockheed Martin was the spacecraft design/systems integrator. Lockheed Martin Aerospace and Boeing are providing support for Phoenix. Malin Space Systems and Honeybee Robotics are providing support for MSL.

A major competitive acquisition for the second Mars Scout is underway. All research and technology is procured through the ROSES announcement and a competitive, peer-review selection process.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO	10/2006	A Program Implementation Review was conducted in late FY 2006. Results have not yet been released.	10/2008
Performance	IPAO	08/2006	MSL Non-Advocate Review confirmed that MSL was ready to proceed into implementation.	08/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Program flexibility	Flight windows for Mars missions occur only once every ~ 26 months. As a result, schedule delays can result in missing the launch opportunity altogether.	A sufficient amount of program-level reserves are held to deal with unanticipated program issues.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration
Project In Development:	Phoenix (Scouts 07)

Budget / Life Cycle Cost

Budget Authority ($ millions)	Prior	FY06	FY07	FY08	FY09	FY10	FY11	FY12	BTC	LCC TOTAL
FY 2008 President's Budget Request	**146.5**	**141.5**	**99.8**	**11.4**	**1.2**	**--**	**--**	**--**	**--**	**400.4**
Formulation	85.7	--	--	--	--	--	--	--	--	--
Development	60.8	141.5	99.8	--	--	--	--	--	--	--
Operations	--	--	--	11.4	1.2	--	--	--	--	--
Other	--	--	--	--	--	--	--	--	--	--
FY 2007 President's Budget Request	**139.6**	**125.6**	**90.5**	**28.6**	**1.0**	**--**	**--**	**--**	**--**	**385.3**
Formulation	83.2	--	--	--	--	--	--	--	--	--
Development	56.4	125.6	90.5	--	--	--	--	--	--	--
Operations	--	--	--	28.6	1.0	--	--	--	--	--
Other	--	--	--	--	--	--	--	--	--	--
Changes	**7.0**	**15.9**	**9.3**	**-17.2**	**0.2**	**--**	**--**	**--**	**--**	**15.1**
Formulation	2.5	--	--	--	--	--	--	--	--	2.5
Development	4.4	15.9	9.3	--	--	--	--	--	--	29.6
Operations	--	--	--	-17.2	0.2	--	--	--	--	-17.0
Other	--	--	--	--	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Project Changes

Project	*Phoenix (Scouts 07)*
Additional funds have been added to cover unanticipated cost growth. NASA is undertaking a Directorate-level review to assess whether the project has taken appropriate steps to control cost and schedule that are required to meet the August 2007 launch date.	

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration
Project In Development:	Phoenix (Scouts 07)

Project Purpose

The Phoenix Project will uncover clues about the geologic history and biological potential of Martian arctic regions. In the continuing pursuit of water on Mars, the poles are a good place to probe, as water ice is found there. Phoenix will be the first surface mission to return data from either polar region, providing an important contribution to the Mars science strategy of "follow the water." The Phoenix Project has two objectives: 1) study the history of water on Mars in all its phases; and 2) search for evidence of a habitable zone to assess the biological potential of the ice-soil boundary. For more information on the Phoenix mission, visit http://phoenix.lpl.arizona.edu.

Project Parameters

Phoenix will land on the icy northern pole of Mars between 65 degrees and 75 degrees North latitude. During the course of the 90 Martian day primary mission (with potential extended operations of 60 days), Phoenix will deploy its robotic arm and dig trenches up to half a meter (1.6 feet) into the layers of water ice. These layers, thought to be affected by seasonal climate variations, could contain organic compounds that are necessary for life. To analyze soil samples collected by the robotic arm, Phoenix will carry an "oven" and a "portable laboratory." Selected samples will be heated to release volatiles that can be examined for their chemical composition and other characteristics.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration
Project In Development:	Phoenix (Scouts 07)

Project Commitments

Phoenix will launch in 2007 and land on the surface of Mars in 2008 to complete a series of scientific measurements over a 90 day period, as described below.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Surface Stereo Imager	University of Arizona	Acquire a panoramic picture of the landing site in at least a 120 degree radius around the Lander.	No change	No change
Mars Descent Imager (MARDI)	Malin Space Science Systems	Provide images at an 8 meter scale.		
Robotic arm	JPL	Provide surface soil samples to either the TEGA or MECA chemistry instruments.	No change	No change
Thermal and Evolved Gas Analyzer (TEGA)	University of Arizona and University of Texas, Dallas	Analyze at least 2 soil samples for water and minerals near the surface.	No change	No change
Microscopy, Electrochemistry, and Conductivity Analyzer (MECA)	JPL	MECA will analyze the wet chemistry of at least 2 soil samples for organics.	No change	No change
TEGA mass spectrometer.	University of Arizona and University of Texas, Dallas	TEGA will analyze an atmospheric sample.	No change	No change
Robotic Arm Camera (RAC)	University of Arizona and Max Planck Institute, Germany	Document all non-atmospheric samples and their collection locations with images.	No change	No change
Meteorology package (MET)	Canadian Space Agency	Record the daily weather of the Martian northern plains and provide information on the current state of the polar atmosphere.	No change	No change
Spacecraft	Lockheed Martin	Will deliver Phoenix science instrument to the Martian surface.	No change	No change
Launch vehicle	Boeing	Delta 2925 launch vehicle	No change	No change
Mission operations and data analysis	University of Arizona	Mission control for the Phoenix lander on the Martian surface.	No change	No change
Mission science	University of Arizona	Serves as Principle Investigator for the project.	No change	No change

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration
Project In Development:	Phoenix (Scouts 07)

Schedule Commitments

Phoenix began formulation in August 2003. The mission was approved to proceed into the development phase in May 2005.

Milestone Name	Confirmation Baseline	FY 2007 PB Request	FY 2008 PB Request
Development			
Start Assemble Test & Launch Operations (ATLO)	April 2006	April 2006	April 2006
Launch Readiness	August 2007	August 2007	August 2007
Target arrival	May 2008	May 2008	May 2008
End of prime mission	August 2008	August 2008	August 2008

Development Cost Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Phoenix (Scouts 07)	2006	273.6	2007	303.8	11	Launch Readiness	8/30/2007	8/30/2007	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**273.6**	**303.8**	**30.2**
Spacecraft	92.2	103.8	11.6
Payloads	21.9	29.5	7.6
Systems I&T	6.5	10.9	4.4
Launch Vehicle/Services	77.1	86.2	9.1
Ground Systems	1.3	5.8	4.5
Science/Technology	2.9	10.0	7.1
Other	71.7	57.6	-14.1

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration
Project In Development:	Phoenix (Scouts 07)

Project Management

Program Management responsibility provided by JPL. The responsible official for this project is James Green, Acting Director of the Planetary Science Division.

Project Element	Element Oversight	Lead Performer	Partners
Principal Investigator	JPL	University of Arizona, Lunar and Planetary Laboratory	
Spacecraft manufacturing and integration	JPL	Lockheed Martin Aerospace	
Systems engineering and management	JPL	JPL	
Launch vehicle	JPL	Boeing	
TEGA instrument	JPL	University of Arizona with University of Texas, Dallas	
MECA instrument	JPL	JPL	
Surface Stereo Imager	JPL	University of Arizona	
Robotic Arm Camera	JPL	University of Arizona	Max Planck Institute, Germany

Acquisition Strategy

NASA competitively selected the entire Phoenix Project as the first Mars Scout mission in 2003. Participants, including JPL, were selected as a team. All major acquisitions are in place.

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Radar performance issues and test anomalies (element of Entry, Descent and Landing [EDL] System.)	Initial test resulted in a significant number of anomalies as well as a significant concern over the capability to meet system performance needs.	A NASA independent evaluation team will access radar performance and recommend a mitigation process.
Entry, Descent and Landing System	This is a new landing system that has not yet been proven at Mars. If Entry-Descent-Landing (EDL) process and margins (e.g., mass, thermal, loads, parachute opening, thruster performance, landing location, etc.) are inadequate, the mission could be lost.	Technical improvements to Phoenix systems from the Mars Exploration Rovers, together with an intensive testing program, are major mitigation steps being taken. Special risk and work-to-go reviews are being conducted, and multiple independent review teams continually monitor EDL progress and plans.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration
Project In Development:	2009 Mars Science Lab

Budget / Life Cycle Cost

Budget Authority ($ millions)	Prior	FY06	FY07	FY08	FY09	FY10	FY11	FY12	BTC	LCC TOTAL
FY 2008 President's Budget Request	**299.1**	**253.4**	**378.4**	**345.0**	**238.2**	**73.6**	**58.2**	**40.1**	**--**	**1,686.0**
Formulation	299.1	216.0	--	--	--	--	--	--	--	--
Development	--	37.4	378.4	345.0	234.9	5.8	--	--	--	--
Operations	--	--	--	--	3.3	67.8	58.2	40.1	--	--
Other	--	--	--	--	--	--	--	--	--	--
FY 2007 President's Budget Request	**294.7**	**253.4**	**347.9**	**285.6**	**231.0**	**50.4**	**41.2**	**--**	**--**	**1,504.1**
Formulation	294.7	216.0	--	--	--	--	--	--	--	--
Development	--	37.4	347.9	285.6	231.0	--	--	--	--	--
Operations	--	--	--	--	--	50.4	41.2	--	--	--
Other	--	--	--	--	--	--	--	--	--	--
Changes	**4.4**	**--**	**30.5**	**59.4**	**7.2**	**23.2**	**17.1**	**40.1**	**--**	**181.9**
Formulation	4.4	--	--	--	--	--	--	--	--	4.4
Development	--	--	30.5	59.4	3.9	5.8	--	--	--	99.6
Operations	--	--	--	--	3.3	17.4	17.0	40.1	--	77.8
Other	--	--	--	--	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Project Changes

Project	*2009 Mars Science Lab*
NASA confirmed the Mars Science Lab (MSL) Project to proceed into the development phase in August 2006. The FY 2008 budget represents the approved MSL baseline established at confirmation, whereas the FY 2007 budget was a formulation estimate.	

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration
Project In Development:	2009 Mars Science Lab

Project Purpose

The MSL Project will make detailed measurements of element composition, elemental isotopes and abundance, mineralogy, and organic compounds to determine if Mars has, or ever had, an environment capable of supporting life.

MSL has four science objectives: (1) assess the biological potential of at least one selected site on Mars; (2) characterize the geology and geochemistry of the landing region at all appropriate spatial scales; (3) identify planetary processes relevant to past habitability; and (4) characterize the broad spectrum of the Martian surface radiation environment.

For more information, see the MSL homepage at http://marsprogram.jpl.nasa.gov/missions/future/msl.html.

Project Parameters

The Mars Science Laboratory is a surface rover which will collect Martian soil samples and rock cores and analyze them for organic compounds and environmental conditions that could have supported microbial life now or in the past. MSL will be a long-duration (two years) roving science laboratory that will be twice as long and three times as heavy (800-850 kilograms) as the Mars Exploration Rovers, Spirit and Opportunity.

Key technologies developed for MSL include throttle-controlled, high-thrust engines (required during Martian entry, descent, and landing [EDL]); rock acquisition and processing equipment used to acquire and distribute samples to the analytic instrument suite; and long-life, high reliability, thermal cycle resistant electronics for use in the rover.

The EDL system will accommodate a wide range of possible latitude and altitude locations on Mars in order to be discovery-responsive and to have the capability to reach very promising, but difficult-to-reach scientific sites.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration
Project In Development:	2009 Mars Science Lab

Project Commitments

MSL will be ready to launch in September 2009 and will arrive at Mars after 12 months of flight time. MSL will operate for two Earth years on the surface of Mars and will travel approximately 20 kilometers.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Rover		Travel 20 kilometers over the Martian surface.	No change	No change
Stereoscopic and microscopic cameras	Malin Space Systems	Acquire color, stereo images with resolutions up to 0.2 mm/pixel at 2 m range.	N/A	No change
Robotic arm tools	Honeybee Robotics	Acquire, process and deliver 75 rock and soil samples to analytic instruments.	N/A	No change
Chemistry camera (ChemCam)	Department of Energy/Los Alamos National Laboratory; France	Remotely measure elemental composition of rocks and soil up to 9m from rover.	N/A	No change
Alpha Particle X-ray Spectrometer	JPL	Measure with high precision the elemental composition of in situ rocks and soil.	N/A	No change
Rover Environmental Monitoring System (REMS)	JPL	Monitor key atmospheric measurements including temperature, pressure, wind speed/direction and humidity.	N/A	No change
Dynamic Albedo of Neutrons (DAN)	JPL	Measure hydrogen content in subsurface deposits.	N/A	No change
Cruise stage and entry system	Lockheed Martin	Transport rover to Martian surface and land with impact speed below 1 m/s	N/A	No change
Mission operations and data archive	JPL	Conduct one-year cruise and two-year rover primary mission with remotely located science team.	N/A	No change

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration
Project In Development:	2009 Mars Science Lab

Schedule Commitments

The MSL Project entered formulation in November 2004 and proceeded into the development phase in August 2006.

Milestone Name	Confirmation Baseline	FY 2007 PB Request	FY 2008 PB Request
Development			
Critical Design Review	June 2007	N/A	Same
Start Assembly, Test, and Launch Operations (ATLO)	February 2008	N/A	Same
Launch Readiness Review	September 2009	N/A	Same

Development Cost Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
2009 Mars Science Lab	2007	1,068.5	2007	1,068.5	0	Launch Readiness	9/30/2007	9/30/2007	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**1,068.5**	**1,068.5**	**0.0**
Technology development	0.0	0.0	0.0
Spacecraft, rover, & carrier	424.8	424.8	0.0
Payload	64.9	64.9	0.0
Systems I&T	46.5	46.5	0.0
Launch vehicle/services	182.6	182.6	0.0
Ground systems	45.5	45.5	0.0
Science/technology	11.4	11.4	0.0
Other	292.8	292.8	0.0

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration
Project In Development:	2009 Mars Science Lab

Project Management

2009 MSL is a JPL-managed project. Instrument implementation has been assigned to JPL. The responsible official for this project is James Green, Acting Director of the Planetary Science Division.

Project Element	Element Oversight	Lead Performer	Partners
Stereoscopic and microscopic cameras	JPL	Malin Space Systems	N/A
Robotic arm tools	JPL	Honeybee Robotics	N/A
Chemistry camera (ChemCam)	JPL	Los Alamos National Laboratory, Department of Energy and France	Los Alamos National Laboratory, Department of Energy and France
Alpha Particle X-ray Spectrometer	JPL	Canada	Canada
Rover Environmental Monitoring System (REMS)	JPL	Spain	Spain
Dynamic Albedo of Neutrons (DAN)	JPL	Russia	Russia
Rover	JPL	JPL	N/A
Cruise stage and entry system	JPL	Lockheed Martin	N/A
Spacecraft	JPL	JPL	N/A

Acquisition Strategy

All major acquisitions are in place. All major instruments were competitively selected.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO/IRT	06/2006	Assess MSL readiness for implementation; Project was confirmed to proceed into implementation.	06/2007

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
MSL Rover mass growth	Estimated Rover mass has grown and the spacecraft is approaching its mass limit.	Project will continuously perform reviews, through its launch window period, of the entire flight system to validate changes and identify mass reduction opportunities. Several savings opportunities have already been identified.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Discovery

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Discovery	131.8	179.9	184.9	320.7	370.2	355.2	341.1
Dawn	59.6	66.7	7.8	7.6	8.1	11.9	13.5
Other	72.2	113.2	177.0	313.0	362.0	343.4	327.6

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Discovery	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Dawn	**5.7**	**7.8**	**2.1**
DAWN re-plan has been completed; budget reflects a June 2007 launch.			
Other	**191.0**	**177.0**	**-14.0**
Budget profile reflects the three full class Discovery mission concept studies, and three Mission of Opportunity (MoO) concept studies selected in the 2006 Discovery Announcement of Opportunity (AO).			

Program Overview

Robotic space exploration holds tremendous opportunity for exploration and discovery. Even with the vast amount of knowledge gained since exploration of the solar system began, there are many unanswered questions. NASA's Discovery Program gives scientists the opportunity to find innovative ways to unlock the mysteries of the solar system. It provides lower-cost, highly focused planetary science investigations designed to enhance our understanding of the solar system. The Discovery Program offers the scientific community the opportunity to assemble a team and design exciting, focused science investigations that complement NASA's larger planetary science explorations.
All completed Discovery missions (NEAR, Mars Pathfinder, Lunar Prospector, Deep Impact, Stardust, and Genesis) have achieved groundbreaking science, with each taking a unique approach to space exploration. Current Discovery missions include: ASPERA-3, MESSENGER, Dawn*, Kepler*, and Moon Mineralogy Mapper (M3). ASPERA-3 is an instrument aboard ESA's Mars Express spacecraft that has been in operations since 2004. MESSENGER, a mission to Mercury, will provide the first images of the entire planet and collect detailed information on the composition and structure of Mercury's crust, its geologic history, the nature of its thin atmosphere and active magnetosphere, and the makeup of its core and polar materials. M3 was selected as a Mission of Opportunity in February 2005. It will be part of the scientific payload for the Indian Space Research Organization (ISRO) Chandrayaan-1 mission to the Moon.

*Additional information regarding the Dawn Discovery mission follows; additional information regarding the Kepler Discovery mission is included under the Astrophsyics Discovery Program. For more information regarding the Discovery Program, see http:/discovery.nasa.gov.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Discovery

Program Relevance

Supports NASA mission "To pioneer the future in space exploration, scientific discovery, and aeronautics research", by enhancing our understanding of the solar system as it is today as well as solar system's formation and evolution, and by protecting the public, our workforce, and our environment while achieving our science.

Supports NASA Strategic Goal 3, "Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration," by providing frequent flight opportunities for solar system exploration with high quality, high-value scientific investigations that can be accomplished under a not-to-exceed cost cap.

The program primarily supports the Outcomes under Strategic Plan Sub-goal 3C: Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space. However, the Kepler mission will contribute to Sub-goal 3D: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets. More specifically, it will support Outcome 3D.4: Progress in creating a census of extra-solar planets and measuring their properties.

Plans For FY 2008

MESSENGER spacecraft will complete the first of three flybys of Mercury in January of 2008, and will complete the second flyby in October of 2008. (APG 8PS02)

Having been launched in 2007, the Dawn spacecraft will be cruising toward a Mars gravity assist which will occur in March 2009.

ASPERA-3 will be continuing to collect data as it orbits Mars on Mars Express.

The Moon Mineralogy Mapper (M3) will launch as a part of ISROs Chandrayaan-1 mission in March 2008.

A Discovery 11 mission will have been selected and, if approved, have entered into Phase B design in 2008.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Discovery

Project Descriptions

Since the program's inception, 10 missions (NEAR, Mars Pathfinder, Lunar Prospector, Stardust, CONTOUR, Genesis, MESSENGER, Deep Impact, Dawn, and Kepler) and 2 Missions of Opportunity (Aspera-3 and M3) have been, or are in the process of being, implemented. NEAR, Mars Pathfinder and Lunar Prospector exceeded their science goals. CONTOUR was lost due to excess heating during the embedded solid-rocket motor burn. Genesis and Stardust successfully returned abundant science samples of the solar wind, comets and interstellar dust particles back to Earth. Deep Impact successfully excavated and observed interior comet material by creating a crater on the comet Temple 1 on July 4, 2005. MESSENGER and Aspera-3 both launched successfully, and are currently in the operations & data analysis phase. Dawn and M3 are in development phase for launch before the end of 2008.

In October, 2006, three full-class missions were selected for concept studies, as well as three missions of opportunity. Decisions about which mission(s) will proceed to implementation phase is expected in 2007

MESSENGER

MESSENGER, a mission to Mercury, launched on August 3, 2004, to provide the first images of the entire planet and collect detailed information on the composition and structure of Mercury's crust, its geologic history, the nature of its thin atmosphere and active magnetosphere, and the makeup of its core and polar materials. MESSENGER flew past the Earth for a gravity assist in August 2005, and will fly past Venus twice to use the planet's gravity to move the spacecraft's trajectory closer to Mercury.

Aspera-3

Aspera-3, a Mission of Opportunity, is one of seven instruments aboard the ESA Mars Express spacecraft in orbit around Mars, with a goal to study the interaction of the solar wind and Martian atmosphere. The measurements taken by this instrument will help answer the question of how strongly the interplanetary plasma and electromagnetic fields affect the Martian atmosphere.

Dawn

The Dawn mission will undertake a journey to the two largest and most massive asteroids in our solar system, Vesta and Ceres. Launching from Cape Canaveral in June 2007, the Dawn spacecraft will encounter and orbit Vesta four years later, then travel an additional three years to reach and orbit Ceres. Additional detail can be found in the Dawn Project section of this document.

Moon Mineralology Mapper (M3)

The Moon Mineralogy Mapper (M3) instrument will be part of the scientific payload for India's Chandrayaan-1 mission to the Moon. The primary objectives of the M3 are: 1) to assess the mineral resources of the Moon, and 2) to characterize and map the composition of the surface at high spatial resolution. It will launch via a Polar Satellite Launch Vehicle from Satish Dhawan Space Center (SDSC), India, on March 2008. The M3 payload will cruise 5.5 days, reach its final polar orbit of the Moon at an altitude of 100 km and operate for 2 years (four 2-month periods with optimal imaging geometry and global access).

Discovery Future (2006 Missions of Opportunity)

The three full-class missions selected for concept study are:
- Origins Spectral Interpretation, Resource Identification and Security (OSIRIS) would survey an asteroid and provide the first return of asteroid surface material samples to Earth.
- Vesper is a Venus chemistry and dynamics orbiter that would advance our knowledge of the planet's atmospheric composition and dynamics.
- Gravity Recovery and Interior Laboratory (GRAIL) would use high-quality gravity field mapping of the moon to determine the moon's interior structure.

The three missions of opportunity selected for concept studies are
- Deep Impact eXtended Investigation of Comets (DIXI) would use the existing Deep Impact spacecraft for an extended flyby mission to a second comet to take pictures of its nucleus to increase our understanding of the diversity of comets.
- Extrasolar Planet Observations and Characterization (Epoch) would use the high-resolution camera on the Deep Impact spacecraft to search for the first Earth-sized planets detected around other stars.
- Stardust NExT would use the existing Stardust spacecraft to flyby comet Tempel 1 and observe changes since the Deep Impact mission visited it in 2005. In 2005, Tempel 1 has made its closest approach to the sun, possibly changing the surface of the comet.

These proposals were among approximately two dozen submitted in response to NASA's Discovery Program 2006 Announcement of Opportunity in April. NASA plans to select one or more investigations to continue into a development effort after detailed review of the concept studies.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Launch an average of one mission per 24 months	Discovery Program	Same	Same
Complete current prime and funded extended operating missions	MESSENGER, Aspera-3	Mar. 2012 and Dec. 2006	Sept. 2012 and Sept. 2008

Implementation Schedule

Project	Schedule by Fiscal Year (Prior, 06–20)	Phase	Beg	End	Milestone
MESSENGER		Tech			
		Form	Jul-99	Jun-01	
		Dev	Jun-01	Aug-04	
		Ops	Aug-04	Sep-12	
		Res			
Dawn		Tech			
		Form	Dec-01		
		Dev	Feb-04	Jun-07	
		Ops	Jun-07	Nov-15	
		Res			
Moon Mineralogy Mapper (M3)		Tech			
		Form	Mar-05	Feb-06	
		Dev	Mar-06	Mar-08	
		Ops	Mar-08	Sep-10	
		Res			
ASPERA-3		Tech			
		Form			
		Dev	Sep-00	Jun-03	
		Ops	Jun-03	Sep-08	
		Res			

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

MSFC is responsible for Discovery program management. Scientific mission priorities and assignment responsibilities reside with the Science Mission Directorate.

Project	Oversight	Lead Performer	Partners
Aspera-3	MSFC	Southwest Research Institute	Sweden; European Space Agency (ESA).
Dawn	MSFC	JPL	German Aerospace Center (DLR); Los Alamos National Labs (LANL).
Moon Mineralogy Mapper (M3)	MSFC	JPL	Indian Space Research Organization (ISRO), spacecraft provider. USGS.
MESSENGER	MSFC	APL	

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Discovery

Acquisition Strategy

With the exception of future NASA Announcement of Opportunities, all major acquisitions are in place. The Southwest Research Institute is the Principal Investigator and Lead Scientist,for Aspera-3. The University of California at Los Angeles is the Principal Investigator and Lead Scientist for the Dawn mission. Brown University is the Principal Investigator and Lead Scientist for M3; SAIC, U of Hawaii, and U. of Tennessee are also participants. Department of Terrestrial Magnetism at the Carnegie Institution of Washington is the Principal Investigator and Lead Scientist for MESSENGER.

The Discovery Program solicits proposals for entire missions and missions of opportunity. The proposals are put together by teams led by a PI which may include firms, small business, government and universities. The initial phase of each competitive selection is a concept study, and several missions and missions of opportunity will generally be selected for this phase. At the completion of the study phase, one or more concepts may be selected for development, based on their continued scientific merit, technical, management and cost viability, and the availability of funding.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO	04/2005	Verified compliance with Agency requirements for program documentation.	04/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Future launch vehicle cost and availability	As launch vehicle costs continue to grow, they place additional pressure on cost-capped Discovery programs.	Consider requesting an increase in the Discovery cost cap to specifically cover increases in launch costs that are beyond project control.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Discovery
Project In Development:	Dawn

Budget / Life Cycle Cost

Budget Authority ($ millions)	Prior	FY06	FY07	FY08	FY09	FY10	FY11	FY12	BTC	LCC TOTAL
FY 2008 President's Budget Request	**256.9**	**59.6**	**66.7**	**7.8**	**7.6**	**8.1**	**11.9**	**13.5**	**31.7**	**463.8**
Formulation	106.6	--	--	--	--	--	--	--	--	--
Development	150.3	59.6	64.4	--	--	--	--	--	--	--
Operations	--	--	2.3	7.8	7.6	8.1	11.9	13.5	31.7	--
Other	--	--	--	--	--	--	--	--	--	--
FY 2007 President's Budget Request	**251.5**	**63.6**	**56.1**	**5.7**	**6.0**	**7.0**	**9.3**	**--**	**59.3**	**458.4**
Formulation	103.5	--	--	--	--	--	--	--	--	--
Development	148.0	63.6	56.1	--	--	--	--	--	--	--
Operations	--	--	--	5.7	6.0	7.0	9.3	--	59.3	--
Other	--	--	--	--	--	--	--	--	--	--
Changes	**5.4**	**-3.9**	**10.6**	**2.1**	**1.7**	**1.1**	**2.6**	**13.5**	**-27.6**	**5.4**
Formulation	3.1	--	--	--	--	--	--	--	--	3.1
Development	2.3	-4.0	8.3	--	--	--	--	--	--	6.6
Operations	--	--	2.3	2.1	1.6	1.1	2.6	13.5	-27.6	-4.4
Other	--	--	--	--	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Project Changes

Project	*Dawn*
NASA re-planned the Dawn Project for a June 2007 launch date due to unresolved technical and schedule issues driven by hardware deliveries that compromised the 2006 launch opportunity.	

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Discovery
Project In Development:	Dawn

Project Purpose

The Dawn Project's primary objective is to significantly increase understanding of the conditions and processes present during the solar system's earliest history by investigating in detail two of the largest protoplanets remaining intact since their formation. Specifically, Dawn will examine the geophysical and geochemical properties of 1 Ceres and 4 Vesta, main belt asteroids that reside between Mars and Jupiter.

For more information, see the Dawn homepage at http://dawn.jpl.nasa.gov.

Project Parameters

The Dawn spacecraft will use solar-electric (ion) propulsion to reach and orbit Vesta (for seven months) and Ceres (for five months), while performing science investigations at various altitudes and lighting conditions.

Dawn will use imaging, spectroscopy, and gravity measurements to characterize the two asteroids. Dawn will determine their mass, gravity fields, principal axes, rotational axes and moments of inertia.

Full surface imagery of Vesta and Ceres will be provided in at least three colors.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Discovery
Project In Development:	Dawn

Project Commitments

Dawn is scheduled to launch in June 2007. The total mission duration is nine years. Dawn will orbit Vista for at least seven months at 700 and 120 km altitudes, and will orbit Ceres for at least five months at 890 and 140 km altitudes.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Gamma Ray and Neutron Detector (GRaND)	Los Alamos National Labs (LANL)	Produce maps of surface elements; Measure hydrogen, thorium, uranium, and potassium to ±20% precision at spatial resolution of 1.5 times the mapping altitude.	No change	No change
Framing Camera (FC)	Deutsches Zentrum fur Luft-und Raumfarht and Max-Planck-Institut für Sonnensystemforschung	Image >80% of Vesta at <100m/pixel (and 80% of Ceres at <200m/pixel).	No change	No change
Visible and Infrared Mapping Spectrometer (VIR)	Agenzia Spaziale	Obtain >10,000 frames of Vesta (>8,000 of Ceres) full surface imagery in three bands addressing wavelengths between 0.25-5 microns.	No change	No change
Spacecraft	Orbital Sciences Corporation	With onboard ion propulsion.	No change	No change
Launch vehicle	KSC	Delta 2925H	No change	No change
Mission operations	JPL, UCLA	4.3 years interplanetary cruise to Vesta.	No change	No change

Schedule Commitments

Dawn formulation started December 21, 2001. Dawn implementation started February 11, 2004. Dawn was replanned in 2006 and is not scheduled for launch in June 2007. The arrival dates remain unchanged due the use of a different flight path. Dawn will arrive at Vesta in October 2011 and at Ceres in February 2015.

Milestone Name	Confirmation Baseline	FY 2007 PB Request	FY 2008 PB Request
Development			
Critical Design Review	June 2004	June 2004	June 2004
Launch Readiness	June 2006	TBD	June 2007
Vesta arrival	Oct. 2011	TBD	Oct. 2011
Ceres arrival	Feb. 2015	TBD	Feb.2015

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Discovery
Project In Development:	Dawn

Development Cost Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Dawn	2006	273.5	2007	263.4	-4	Launch Readiness	9/30/2007	9/30/2007	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**273.5**	**263.4**	**-10.1**
Aircraft/Spacecraft	143.7	117.3	-26.4
ELV	87.5	65.0	-22.5
Mision Operations	12.7	14.6	1.9
Other	20.4	55.2	34.8
Payload	8.7	7.3	-1.4
Science/Technology	0.5	4.0	3.5

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Discovery
Project In Development:	Dawn

Project Management

Principal Investigator is responsible for all aspects of the mission. JPL provides the day-to-day management of project. Project oversight is provided by the MSFC. Responsible official for this project is James Green, Acting Director of Planetary.

Project Element	Element Oversight	Lead Performer	Partners
Mission science	University of California Los Angeles (UCLA)	University of California Los Angeles (UCLA)	
Visible and Infrared mapping spectrometer (VIR)	JPL	Italian Space Agency (ASI)	Italian Space Agency (ASI)
Framing Camera (FC)	JPL	Deutsches Zentrum fur Luft-und Raumfarht (DLR); Max-Planck-Institut für Sonnensystemforschung (MPS)	Deutsches Zentrum fur Luft-und Raumfarht (DLR); Max-Planck-Institut für Sonnensystemforschung(MPS)
Gamma Ray and Neutron Detector (GRaND)	JPL	Los Alamos National Laboratory (LANL)	Los Alamos National Laboratory (LANL)
Project management, mission design, system engineering, navigation, safety, mission assurance	MSFC/Discovery Program Office	JPL	
Spacecraft bus and system integration and testing.	JPL	Orbital Sciences Corporation (Orbital)	Naval Research Laboratory (NRL)
Ion Propulsion System	JPL	JPL	
Mission Operations Implementation	JPL	JPL	
Launch Vehicle	KSC	Boeing	

Acquisition Strategy

All major acquisitions are in place. Dawn mission was competitively selected as part of the Discovery program.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	Independent Assess. Team	06/2006	Schedule and cost assessment/Outcome indicated the cost and schedule are achievable and consistent with the Dawn Project's plan.	03/2007

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Discovery
Project In Development:	Dawn

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Launch vehicle readiness	The ability of Boeing to correct the Delta-II Heavy anomalous behavior during transonic flight in time to support the June 2007 launch date.	Continue to work with the KSC Launch Vehicle Office and vehicle provider to ensure a successful launch.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	New Frontiers

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
New Frontiers	118.1	158.1	147.3	296.0	277.5	267.9	274.5
Juno	40.4	124.1	120.2	272.9	242.6	190.9	16.0
Other	77.8	34.0	27.0	23.1	35.0	76.9	258.5

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
New Frontiers	FY 2007 PB Request	FY 2008 PB Request	Change
Juno	**127.9**	**120.2**	**-7.7**
Funding profile is adjusted to fully reflect the August 2011 launch estimate established last year.			
Other	**32.7**	**27.0**	**-5.7**

Program Overview

The New Frontiers program, provides the opportunity for medium-sized, PI-led missions, providing an efficient means to undertake high-quality planetary science investigations.

The Program's prime objective is to enhance our understanding of the solar system as it is today and of solar system's formation and evolution. New Horizons and Juno are New Frontiers selected flight missions. New Horizons will conduct reconnaissance of Pluto and its moon Charon. Juno's overarching scientific goal is to understand the origin and evolution of Jupiter.

For more information, see http://newfrontiers.msfc.nasa.gov

Program Relevance

Supports NASA's Mission "To pioneer the future in space exploration, scientific discovery, and aeronautics research," by enhancing our understanding of the solar system as it is today and of solar system's formation and evolution, and by protecting the public, our workforce, and our environment while achieving our science.

Supports NASA "Strategic Goal 3: Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration," by providing frequent flight opportunities for high-quality, high-value scientific investigations that can be accomplished under a not-to-exceed cost cap. More specifically, contributes to Outcomes under Strategic Sub-goal 3C: Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	New Frontiers

Plans For FY 2008

In FY 2008, the Juno Mission will complete the Preliminary Design Review (PDR)/Non-Advocate Review (NAR) and Key Decision Point Review (KDP).

By FY 2008, The New Horizons will have begun an approximate 8-year cruise to Pluto. The cruise period will include periodic spacecraft and instrument checkouts.

The third New Frontiers AO is to be released late in 2008.

Project Descriptions

There are currently two flight missions selected in the New Frontiers Program; New Horizons and Juno.

New Horizons

On 19 January 2006, New Horizons launched aboard an Atlas V launch vehicle. It is presently en route to swing past Jupiter for a gravity boost & scientific studies in February 2007; and will reach Pluto and its moon, Charon, in July 2015. New Horizons will conduct a reconnaissance of the Pluto-Charon system, mapping the surface composition and surface temperatures of Pluto and Charon, characterizing the geology of Pluto and Charon, characterizing the atmosphere of Pluto, searching for an atmosphere around Charon and searching for rings and additional satellites around Pluto.

Juno

The Juno mission to Jupiter science goals are to 1) Determine the Oxygen to Hydrogen ratio to determine water abundance and constrain core mass in order to decide among alternative theories of planetary origin 2) Understand Jupiter's interior structure and dynamical properties, including internal convection and the size and mass of its core, through mapping of its gravitational and magnetic fields; 3) Map variations in atmospheric composition, temperature, cloud opacity and dynamics to depths greater than 100 bars at all latitudes; 4) Characterize and explore the three-dimensional structure of Jupiter's polar magnetosphere and auroras.

Juno uses a simple, spin-stabilized spacecraft in an elliptical polar orbit that minimizes radiation exposure by flying under Jupiter's radiation belts. Juno's baseline orbit remains continuously in sunlight, resulting in benign and stable thermal conditions. Max-spin stability eliminates complex, power-hungry attitude control components such as reaction wheels. Additional detail can be found in the Juno Project section of this document.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Launch an average of one mission per 52 months	New Frontiers Program	Same	Same

Mission Directorate:	Science
Theme:	Planetary Science
Program:	New Frontiers

Implementation Schedule

Project	Schedule by Fiscal Year																Phase Dates			
	Prior	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20		Beg	End	Mile-stone
New Horizons																	Tech			
																	Form	Nov-01	Mar-03	
																	Dev	Mar-03	Jan-06	
																	Ops	Jan-06	Sep-17	
																	Res			
Juno																	Tech			
																	Form	Jul-04	Aug-08	
																	Dev	Aug-08	Aug-11	
																	Ops	Aug-11	Aug-18	
																	Res			

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

Scientific mission priorities and assignment responsibilities reside with SMD. MSFC has New Frontiers program management responsibility.

Project	Oversight	Lead Performer	Partners
Juno	MSFC	JPL	
New Horizons	MSFC	APL	

Acquisition Strategy

Major acquisitions for the New Horizons (APL) and Juno (JPL) projects are in place. Future major acquisitions are to be defined upon mission selection. The New Frontiers program will solicit proposals for an entire mission, put together by teams led by PIs and comprised of people from industry, small businesses, government and universities. The Juno Principal Investigator is from the SouthWest Research Institute; Jet Propulsion Laboratory will provide mission project management; Lockheed Martin Space Systems will build the spacecraft. The Principal Investigator for New Horizons is from the Southwest Research Institute; Johns Hopkins University/Applied Physics Laboratory has project management responsibility.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO	05/2006	Verify compliance with NASA program documentation requirements. / Results were favorable.	05/2008

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
	No significant risk known at this time.	

Mission Directorate:	Science
Theme:	Planetary Science
Program:	New Frontiers
Project In Formulation:	Juno

Budget / Life Cycle Cost

Budget Authority ($ millions)	FY06	FY07	FY08
FY 2008 President's Budget Request	40.4	124.1	120.2
FY 2007 President's Budget Request	52.3	117.2	127.9
Total Change from FY 2007 President's Budget Request	-11.9	6.9	-7.7

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Project Purpose

Juno was selected on July 15, 2005 under the New Frontiers Announcement of Opportunity (AO). The overarching scientific goal of the Juno mission is to improve our understanding of the origin and evolution of Jupiter. As the archetype of giant planets, Jupiter can provide knowledge that will improve our understanding of both the origin of our solar system and the planetary systems being discovered around other stars. The investigation focuses on the four science objectives requested in the New Frontiers Announcement of Opportunity (AO) for a medium class mission to Jupiter:

1 - Origin: Determine the Oxygen to Hydrogen ratio to determine water abundance and constrain core mass to decide among alternative theories of planetary origin.
2 - Interior: Understand Jupiter's interior structure and dynamical properties through mapping of its gravitational and magnetic fields, including internal convection and the size and mass of its core.
3 - Atmosphere: Map variations in atmospheric composition, temperature, cloud opacity and dynamics to depths greater than 100 bars at all latitudes.
4 - Magnetosphere: Characterize and explore the three- dimensional structure of Jupiter's polar magnetosphere and auroras.

These objectives have been rated very highly in the National Academies' Solar System Exploration Decadal Survey and Sun- Earth Connections Decadal Survey. The Astrophysics Decadal Survey identified the study of star formation, their planetary systems, as well as giant and terrestrial planet birth and evolution as high priority. Juno fulfills key goals outlined in recent NASA and NRC studies and is relevant to NASA's Vision for Space Exploration.

Project Parameters

Juno achieves the science objectives by using a simple spinning, solar-powered spacecraft to make global maps of the gravity, magnetic fields, and atmospheric composition of Jupiter from a unique elliptical polar orbit with a close perijove. The spacecraft carries precise, high-sensitivity radiometers, magnetometers, and gravity science systems. Juno's 32 orbits extensively sample Jupiter's full range of latitudes and longitudes. From its polar perspective Juno combines in situ and remote sensing observations to explore the polar magnetosphere and determine what drives Jupiter's remarkable auroras.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	New Frontiers
Project In Formulation:	Juno

Project ROM Estimate

Juno launch date is August 2011, and after a five-year cruise to Jupiter, Jupiter Orbit Insertion (JOI)is scheduled for October 2016. Juno will perform one-year of science operations.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Waves	University of Iowa	Measures radio and plasma emissions; 4 m elec. dipole and search coil	Same	Same
Jupiter Energetic particle Detector Instrument (JEDI)	John Hopkins Applied Physics Lab (APL)	Measures auroral distributions of electrons and ions; TOF vs. energy, ion & electron sensors	Same	Same
Gravity Science	Jet Propulsion Lab (JPL)	Maps Jupiter's gravitational field to determine structure of core; X & Ka-band precision Doppler	Same	Same
Flux-Gate Magnetometer (FGM)	GSFC	Maps Jupiter's Magnetic Field (Vector)	Same	Same
Scalar Helium Magnetometer (SHM)	Jet Propulsion Lab (JPL)	Maps Jupiter's Magnetic Field (Magnitude)	Same	Same
Launch Vehicle	KSC	C3 = 32.0 km2/s2, Capability=3545 kg	Same	Same
UV Spectrometer (UVS)	Southwest Research Institute (SwRI)	FUV spectral imager for auroral emissions	Same	Same
Microwave Radiometer (MWR)	Jet Propulsion Lab (JPL)	6 wavelengths (1.3-50 cm); sounds atmosphere to determine water and ammonia abundances	Same	Same
Spacecraft	Lockheed Martin	Solar-powered, spin-stabilized spacecraft in an elliptical polar orbit that min radiation expoosure	Same	Same
Jovian Auroral Distributions Experiment (JADE)	Southwest Research Institute (SwRI)	Ion mass spec. & electron analyzers; measures auroral distributions of electrons and ions	Same	Same

Mission Directorate:	Science
Theme:	Planetary Science
Program:	New Frontiers
Project In Formulation:	Juno

Schedule ROM Estimate

Formulation started at selection, May 2005. With approval to proceed, the project would enter implementation in June 2008.

Milestone Name	Formulation Estimate	FY 2007 PB Request	FY 2008 PB Request
Formulation			
PDR	5/2008	Not included.	Same
CDR	3/2009	Not included.	Same
ATLO Readiness	3/2010	Not included	Same
Launch	8/2011	Same	Same

Project Management

The Juno project is part of the New Frontiers Program managed by MSFC. The Principal Investigator from Southwest Research Institute (SwRI) has delegated day-to-day project management to JPL.

Project Element	Element Oversight	Lead Performer	Partners
Vector Fluxgate Magnetometer (FGM)	Jet Propulsion Lab (JPL)	Goddard Space Flight Center (GSFC)	
Flight System, Integration and Test	Jet Propulsion Lab (JPL)	Lockheed Martin	
Management; Microwave radiometer, Scalar Helium Magnetometer, and Gravity Science Experiment	MSFC/New Frontiers Program Office	Jet Propulsion Lab (JPL)	
Plasma Waves Experiment (WAVE)	Jet Propulsion Lab (JPL)	University of Iowa (UI)	
Jupiter energetic particle instrument (JEDI)	Jet Propulsion Lab (JPL)	Applied Physics Lab (APL)	
UVS and JADE instruments	MSFC/New Frontiers Program Office	Southwest Research Institute (SwRI)	
Overall responsibility for the development, implementation, operation, and success of the mission	MSFC/New Frontiers Program Office	PI/Southwest Research Institute (SwRI)	
JunoCam	Jet Propulsion Lab (JPL)	Malin Space Science Systems	

Acquisition Strategy

All major acquisitions are in place. Juno was selected competitively in July 15, 2005 under a New Frontiers Program Announcement of Opportunity (AO-03-OSS-03).

Mission Directorate:	Science
Theme:	Planetary Science
Program:	New Frontiers
Project In Formulation:	Juno

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO	10/2006	Assess cost, schedule, and risk status of project/Findings for the review showed that cost and schedule for the 2011 launch are consistent with the project's plans.	05/2008

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Solar Array Performance	Solar array performance could potentially be less than expected in the low-intensity, low-temperature and high-radiation environment of Jupiter	Performing early radiation tests on solar cells; conservative estimates of performance.
Stellar Reference Unit (SRU) performance	Possible degraded SRU performance on a spinning spacecraft in a high-radiation environment	Initiated competitive study contracts and radiation testing to select SRU with best performance to meet project needs

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Technology

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Technology	56.7	73.4	67.6	62.6	63.9	62.7	64.2

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Technology	**63.4**	**67.6**	**4.1**
No significant changes.			

Program Overview

Planetary Science is a challenging endeavor. Future Planetary Science missions will demand advances in both power and propulsion systems to enable successful trips to harsh environments, far from the sun, with highly challenging trajectories. To meet these needs, the Planetary Science Technology Program includes the Radioisotope Power Systems (RPS) and In-Space Propulsion (ISP) projects.

The ISP project develops in-space propulsion technologies that can enable or benefit near and mid-term NASA missions. These technologies will enhance the performance of planetary science missions by allowing increased science payload mass, minimized launch cost and decreased mission trip times. Furthermore, ISP will enable access to more challenging and interesting science destinations.

The RPS project advances the capabilities of spacecraft power systems, thereby making it possible for missions to travel to more distant destinations. RPS activities focus on advanced Radioisotope Thermal Generation (RTG) technologies and Stirling Radioisotope Generators (SRG), which will be essential for future science missions to the outer planets, small bodies, and other solar system destinations.

Program Relevance

The Planetary Science Technology program is designed to support the Outcomes under Strategic Sub-goal 3C, "Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space," by enabling future planetary science missions.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Technology

Plans For FY 2008

The In-Space Propulsion (ISP) project will:
-Complete development and infusion to flight of NASA's Evolutionary Xenon Thruster (NEXT) electric propulsion system.
-Initiate a system development effort around the Hall thruster if further testing shows it is warranted.
-Complete development of a high-performance bipropellant chemical propulsion system.

Radioisotope Power Systems (RPS) Project will:
-Integrate the first-generation Stirling converters into an engineering model generator assembly, which will then undergo lifetesting to provide reliability data.
-Demonstrate 1500-hour lifetime RTG couples and validate 4-couple module power output.

Project Descriptions

The Planetary Science Technology program includes the In-Space Propulsion, Radioisotope Power Systems, and Technology Planning projects.

ISP

The ISP portfolio invests in high priority technology areas such as Solar Electric Propulsion (Next-Generation Electric Propulsion), Solar Sail Propulsion, Aerocapture Technology and Advanced Chemical propulsion.

RPS

The RPS project works toward the demonstration of a Stirling Radioisotope Generator (SRG) and supports the development of the Multi-Mission Radioisotopic Thermoelectric Generator (MMRTG) system. System and mission trade studies are performed to evaluate the benefits of advanced RPS technologies for future science missions and to define technology needs.

Technology Planning

Investments in technology planning allow for strategic studies of focused technology areas that are necessary for the achievement of Planetary Science Division missions.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Next Generation Ion Thruster will demonstrate a >4,000-second specific impulse xenon thruster	ISP	January 2008	No change
Stirling convertor will work towards a qualified engineering model	RPS	September 2008	No change
Radioisotope Thermoelectric Generator (RTG) will demonstrate an 8 Watts (electric)/kg system	RPS	September 2009	No change

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Technology

Program Management

SMD provides overall oversight of the technology program. GRC is responsible for ISP. SMD is responsible for the RPS project.

Project	Oversight	Lead Performer	Partners
ISP	GRC	GRC	
RPS	Science Mission Directorate	JPL, GRC	Department of Energy

Acquisition Strategy

Technology activities are solicited using the NASA Research Opportunities in Space and Earth Sciences (ROSES) announcement, and selections are made using a competitive, peer-reviewed process. Lockheed Martin and Sunpower are providing support for the RPS project.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Planetary Science Research

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Planetary Science Research	330.0	278.8	370.5	402.9	416.2	428.5	402.9

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	FY 2007 PB Request	FY 2008 PB Request	Change
Planetary Science Research	**290.1**	**370.5**	**80.5**
Provides additional funding for Planetary Research and Analysis (R&A); supports extension of Hayabusa (Muses-C) Earth return to 2010; adds $5M per year in FY 2008 and FY 2009 to fund outer planets mission concept studies; adds Lunar Science Research to enhance opportunity for lunar scientific discovery.			

Program Overview

The Planetary Research Program develops theoretical tools and laboratory data needed to analyze flight data, makes possible new and better instruments to fly on future missions, and analyzes the data returned. These capabilities allow planetary science to answer specific questions posed and develop an overall understanding of the origin and evolution of the solar system. This program represents an essential complement to flight missions, providing the scientific research and the theoretical foundation to allow the Nation to fully utilize the unique data sets returned from the missions exploring the solar system. It is also the primary interface with NASA for university faculty and graduate students in this field.

Program Relevance

Supports NASA's Mission "To pioneer the future in space exploration, scientific discovery, and aeronautics research."

Supports NASA "Strategic Goal 3: Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration." More specifically, supports Sub-goal 3C: "Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space."

In addition, this program provides key support in training the next generation of mission team members, principal investigators, and project scientists, as well as educates the general public.

Plans For FY 2008

Release Research Announcements soliciting R&A proposals and make selections.

Continue planetary science data archiving and releasing of this data to the science community in a timely manner.

Continue curation and distribution of solar system samples (Astromaterials) returned by NASA planetary missions.

Start the Cassini three-year extended science mission.

Perform the Rosetta fly-by of Asteroid Steins (September 2008).

Continue to provide for Hayabusa (Muses-C) navigation & DSN Tracking and coordinating Science Analysis to support an Earth Return in 2010.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Planetary Science Research

Project Descriptions

There are five major project elements within the Research Program: (1) Research and Analysis (R&A); (2) Lunar Science; (3) the operations & analysis of data for Cassini-Huygens; (4) participation in two international missions (Rosetta, and Hayabusa [Muses-C]); and (5) data archiving and sample curation. These elements provide the foundation for science theories, analysis, data archive, facilities and infrastructures for new theories and instrumentations that enable the next generation of flight missions.

Research & Analysis (R&A)

The scope of Research and Analysis (R&A) is wide because the effort must provide the new theories and instrumentation that enable the next generation of flight missions. R&A also provides the foundation for the formulation of new scientific questions and strategies. Discoveries and concepts developed in the R&A Program are the genesis of scientific priorities, missions, instrumentation, and investigations. R&A supports research tasks in areas such as: Astrobiology and cosmochemistry; the origins and evolution of planetary systems; and the atmospheres, geology, and chemistry of the solar system's planets (other than Earth). Additionally, it provides for instrument and measurement concepts, and supports the initial definition and development of instruments for future Discovery, New Frontiers, or Mars missions. A new and fully competed Outer Planets Missions studies effort will identify a range of outer planets science targets and mission options that could be achieved at various budget levels, creating a "menu" of mission options that NASA could pursue in the future.

Lunar Science

The Lunar Science Project will provide for 1) receipt and archiving of LPRP data into the Planetary Data System, 2) competed missions of opportunity for scientific payloads to fly on both international and LPRP missions, 3) competed opportunities to analyze scientifically data from LPRP missions and accompanying scientific payloads, 4) competed opportunities to develop technology and instruments to support lunar science studies, and 5) competed basic lunar science investigation.

Cassini

Cassini-Huygens is an outer planets flagship mission to Saturn that has helped us better understand that planet, its famous rings, magnetosphere, icy satellites, and particularly the moon Titan. Cassini-Huygens is an international collaborative effort to Saturn, with a four year obiter prime mission. It is the first spacecraft to explore the Saturn system including all its rings and moons. A major focus is Saturn's largest moon Titan, with its dense atmosphere, methane-based meteorology, and geologically active surface. Cassini was launched in October 1997, arrived at Saturn in July 2004, and will continue to investigate Saturn and its major moon through September 2012.

Rosetta & Hayabusa (Muses-C)

Rosetta, an ESA/NASA comet rendezvous mission, launched in March 2004 and will arrive at comet Churyumov-Gerasimenko in 2014. The prime scientific objective of the Rosetta mission is to study the origin of comets, the relationship between cometary and interstellar material and the implications of comets with regard to the origin of the Solar System. Hayabusa (Muses-C), a joint Japanese/NASA mission to study asteroid Itokawa and return a sample, it is currently planning for an Earth Return in 2010.

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Planetary Science Research

Planetary Data Systems (PDS) & Astromaterials Curation

Planetary Data System and Astromaterials Curation projects provides funds for data archives, sample-holding facilities, and analysis tools needed to perform research. The Planetary Data System (PDS) is the active data archive for NASA's Planetary Science Division. Astromaterials Curation Facility, at JSC, provides services for all returned planetary materials that do not require planetary protection laboratories.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Deliver science data to PDS consistent with science archive plan (within 6 months)	Cassini	Same	Same
Meeting commitments to the International Partners as agreed to in the MOU	Rosetta and Hayabusa	Same	Same
Archive and release mission data to the science community within 6 months of downlink	Planetary Data System (PDS)	Same	Same
Release of Research Announcements soliciting R&A proposals (annual selections)	Research & Analysis (R&A)	Same	Same
Release a Lunar Advanced Science and Exploration Research opportunity and make selections	Lunar Science Research	N/A	New
Store new samples of Astromaterials and distribute them as requests are approved by CAPTEM	Astromaterials Curations	Same	Same

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Planetary Science Research

Implementation Schedule

Project	Schedule by Fiscal Year																Phase Dates			
	Prior	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20		Beg	End	Mile-stone
Cassini																	Tech			
																	Form		Sep-89	
																	Dev	Oct-89	Oct-97	
																	Ops	Oct-97	Sep-12	
																	Res	Jul-04	Sep-12	
Rosetta																	Tech			
																	Form			
																	Dev		Mar-04	
																	Ops	Mar-04	Sep-17	
																	Res	Sep-08	Sep-17	
Hayabusa																	Tech			
																	Form			
																	Dev		May-03	
																	Ops	May-03	Sep-11	
																	Res	Jun-10	Sep-11	
R&A, PDS, Curation																	Tech			
																	Form			
																	Dev			
																	Ops			
																	Res	Oct-70	Sep-20	
Lunar Science Reserach																	Tech			
																	Form			
																	Dev			
																	Ops			
																	Res	Oct-07	Sep-12	

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Planetary Science Research

Program Management

NASA Headquarters is responsible for R&A, Lunar Research Science, and Outer Planets Mission Studies program management; Jet Propulsion Lab (JPL) has operations responsibility for Cassini, Rosetta, and Hayabusa (Muses-C).

Project	Oversight	Lead Performer	Partners
Cassini	JPL	JPL	The Italian Space Agency provided Cassini's high-gain communication antenna and the Huygens probe was built by the European Space Agency (ESA).
Rosetta	JPL	JPL	The European Space Agency (ESA) built the spacecraft, provided the launch vehicle, and operates the spacecraft.
Hayabusa (Muses -C)	JPL	JPL	Japan Aerospace Exploration Agency (JAXA) responsibilities include the spacecraft, launch vehicle, and operations.
Research & Analysis	HQ	Multiple (NASA Centers, Universities, industries, etc)	
Planetary Data System (PDS)	GSFC	JPL and other Discipline Nodes	
Astromaterials Curation	JSC	JSC	NSF and Smithsonian Institution for Antarctic meteorites

Acquisition Strategy

The R&A and Lunar Science Research FY 2008 budget will fund competitively selected activities from the ROSES-07 (Research Opportunities in Space and Earth Science) Omnibus NRA.

All major acquisitions for Cassini (JPL), Rosetta (JPL), Hayabusa (JPL), Planetary Data System (PDS [JPL, GSFC, and other]), and Astromaterial Curation (JSC) are in place. The following institutions operate the PDS nodes: Atmospheres Node (NMSU; Geosciences Node (Wash U St. Louis); HiRISE Data Node (UAZ); Imaging Node (USGS Flagstaff); Planetary Plasma Interactions Node (UCLA); Radio Science (SETI); Rings Node (SETI); Small Bodies Node (U of MD); JPL and ARC.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Quality	Panel of scientists	10/2006	Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM) reviews recent curation activities and future plans/Curation of Genesis, Stardust, and Apollo lunar samples are on track and meeting distribution requests; the Curation Project performing well overall.	03/2007
Quality	Senior Review Panel	New	Cassini senior review for an extended mission.	02/2007

Mission Directorate:	Science
Theme:	Planetary Science
Program:	Planetary Science Research

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Research Program Risk -	There are no significant programmatic risks within the Research Program	N/A

Theme Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Astrophysics	1,552.8	1,563.0	1,565.8	1,304.2	1,268.9	1,266.2	1,393.8
Astrophysics Research	308.6	319.8	315.2	306.1	331.9	378.5	491.4
Gamma-ray Large Space Telescope (GLAST) Program	120.2	90.7	42.2	28.3	28.3	29.3	30.2
Discovery	147.5	105.0	93.0	25.7	16.3	16.2	17.6
James Webb Space Telescope	364.0	468.5	545.4	452.1	376.9	321.1	285.9
Hubble Space Telescope	277.2	343.0	277.7	165.2	152.8	151.4	151.3
Navigator	145.5	124.7	57.1	58.4	59.5	61.0	62.5
Stratospheric Observatory for Infrared Astronomy (SOFIA)	90.8	--	77.3	89.1	88.6	89.9	92.1
Astrophysics Explorer	71.1	69.4	99.1	88.8	28.2	11.7	5.7
International Space Science Collaboration	13.0	19.8	26.5	39.1	38.7	36.5	35.2
Beyond Einstein	14.9	22.1	32.3	51.5	147.6	170.6	222.1

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Theme Changes

Astrophysics	FY 2008		
	FY 2007 PB Request	FY 2008 PB Request	Change
Astrophysics Research	**309.2**	**315.2**	**6.0**
No significant changes.			
Gamma-ray Large Space Telescope (GLAST) Program	**25.2**	**42.2**	**16.9**
GLAST has completed a replan and is now scheduled for launch in November 2007.			
Discovery	**69.9**	**93.0**	**23.1**
Kepler has completed a replan and is now scheduled for launch in November 2008.			
James Webb Space Telescope	**492.6**	**545.4**	**52.8**
JWST completed a replan in 2006, with reserves added to the program in 2008 and 2009.			
Hubble Space Telescope	**302.2**	**277.7**	**-24.5**
Supports a 2008 Servicing Mission.			
Navigator	**170.6**	**57.1**	**-113.5**
The Navigator Program has been refocused to fund core interferometry and planet-finding research and technology.			
Stratospheric Observatory for Infrared Astronomy (SOFIA)	**0.0**	**77.3**	**77.3**
The SOFIA Program has been restored and is being replanned with a schedule and budget that reflect remaining technical work and the change in aircraft management to DFRC.			
Astrophysics Explorer	**86.1**	**99.1**	**12.9**
WISE entered development in October 2006, and is scheduled for launch in October 2009.			
International Space Science Collaboration	**23.6**	**26.5**	**2.9**
No significant changes.			

Beyond Einstein	**21.4**	**32.3**	**11.0**
Additional funding for Beyond Einstein Future Missions; results of the Beyond Einstein Program Assessment Committee (BEPAC) will be incorporated in the FY 2009 President's Budget.			

Theme Purpose

The Astrophysics Theme supports the following Goal and Sub-goal in the 2006 NASA Strategic Plan:

Goal 3: Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.

Sub-goal 3D: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.

Theme Overview

How did the universe begin? How will it end? Does time have a beginning and an end? The universe is a dynamic, evolving place, governed by cycles of matter and energy. In an intricate series of physical processes, chemical elements are formed and destroyed, passed between stars and diffuse clouds. Through the Astrophysics Theme, NASA seeks to understand these cycles and how they created the unique conditions that support life. Where are we from? Are we alone? NASA searches for answers to these questions looking far away, towards the beginning of time, to see galaxies forming, and close to home, in search of planetary systems like Earth around nearby stars.

The Astrophysics suite of operating missions includes three Great Observatories, which have helped astronomers unravel the mysteries of the cosmos by allowing contemporaneous observations of objects at different electromagnetic wavelengths. The best known is the Hubble Space Telescope, which has rewritten astronomy textbooks since its launch in 1990. Hubble was joined by the Chandra X-Ray Observatory in 1999 and the Spitzer Space Telescope in 2003. In the years to come, new technologies and more powerful instruments will allow the Astrophysics Theme to look deeper into the cosmos, to the edge of black holes and nearly to the beginning of time. In the search for origins, NASA will peer at tens of thousands of stars, inventory their planets, and search for solar systems resembling Earth.

The Astrophysics portfolio has been rebalanced to reflect the reinstatement of the SOFIA Program after an external independent review.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

The Astrophysics Theme seeks to answer questions that humankind has been pondering for millennia: How did the universe begin? How will it end? What are the limits of matter and energy, of space and time? How did the universe come to be, and what are the laws of nature that have permitted life to arise in the universe? Throughout history, these questions have served as cornerstones of mythology and philosophy: thought-provoking, but unanswerable. Now, with the aid of cutting-edge science and technology, the answers are within reach.

Knowing whether Earth alone supports life in the cosmos depends upon NASA's search for life-sustaining planets or moons, and researchers' understanding of the diversity of life here on Earth. Programs within the Astrophysics Theme are aimed at developing the new technologies, building the instruments to make crucial observations, and performing the science that will bring answers to these questions.

Relevance to education and public benefits:

Over the last decade, few scientific endeavors have contributed more to the rewriting of science textbooks, or generated more public interest and excitement, than the Astrophysics Theme's Great Observatories: the Hubble Space Telescope, the Chandra X-Ray Observatory, the Spitzer Space Telescope, and the Compton Gamma Ray Observatory (1991-1999). As more sophisticated instruments have been added through the years, the world has witnessed the birth of stars, begun to unravel the mysteries of black holes, and looked billions of years into the past. This flood of knowledge and questions has spread across the globe via front-page press, television, Web sites, and school curricula at all levels. Programs within the Astrophysics Theme will continue to make significant contributions toward meeting national goals for the reform of science, mathematics, and technology education, as well as elevating scientific and technological literacy throughout the country.

Mission Directorate:	Science
Theme:	Astrophysics

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
Strategic Goal 3	**Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.**	
Sub Goal 3D	**Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.**	
Outcome 3D.1	**Progress in understanding the origin and destiny of the universe, phenomena near black holes, and the nature of gravity.**	
APG 8AS01	Demonstrate progress in understanding the origin and destiny of the universe, phenomena near black holes, and the nature of gravity. Progress will be evaluated by external expert review.	Multiple Programs
APG 8AS02	Launch the Gamma-ray Large Area Space Telescope (GLAST).	Gamma-ray Large Space Telescope (GLAST) Program
Outcome 3D.2	**Progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects recognized in the present universe.**	
APG 8AS03	Demonstrate progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects we recognize in the present universe. Progress will be evaluated by external expert review.	Multiple Programs
APG 8AS04	Complete James Webb Space Telescope (JWST) Preliminary Design Review (PDR).	James Webb Space Telescope
APG 8AS05	Complete Hubble Space Telescope Servicing Mission 4 (HST SM4) Pre-ship Review.	Hubble Space Telescope
Outcome 3D.3	**Progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems.**	
APG 8AS04	Complete James Webb Space Telescope (JWST) Preliminary Design Review (PDR).	James Webb Space Telescope
APG 8AS05	Complete Hubble Space Telescope Servicing Mission 4 (HST SM4) Pre-ship Review.	Hubble Space Telescope
APG 8AS06	Demonstrate progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems. Progress will be evaluated by external expert review.	Multiple Programs
Outcome 3D.4	**Progress in creating a census of extra-solar planets and measuring their properties.**	
APG 8AS07	Demonstrate progress in creating a census of extra-solar planets and measuring their properties. Progress will be evaluated by external expert review.	Multiple Programs
APG 8AS08	Complete the Kepler spacecraft Integration and Test (I&T) phase.	Discovery

Performance Achievement Highlights

Hubble Space Telescope

Hubble detected 16 Jupiter-sized planet candidates orbiting stars toward the center of the Milky Way. This means, upon extrapolation, that there are probably at least six billion Jupiters in this galaxy alone.

James Webb Space Telescope

JWST successfully completed a replan of the program in 2006. Steady progress on primary mirror manufacturing and successful completion of many subsystem Preliminary Design Reviews also took place.

Mission Directorate:	Science
Theme:	Astrophysics

Performance Achievement Highlights

Astrophysics Research
Scientists using NASA's Far Ultraviolet Spectroscopic Explorer (FUSE) solved a 35-year-old mystery about the whereabouts of deuterium, an isotope of hydrogen often called "heavy hydrogen." Because deuterium is a tracer of star and galaxy evolution, this discovery could radically alter theories about how stars and galaxy form.
Stratospheric Observatory for Infrared Astronomy (SOFIA)
Following engine checkout in August 2006, the SOFIA aircraft taxied onto the runway under its own power for the first time since modification of the aircraft began in 1998.
Navigator
The Navigator Program has been refocused and funds core interferometry and planet-finding research and technology via remaining Space Interferometry Mission (SIM) funding, limited Terrestrial Planet Finder (TPF) funding, and ground-based projects (Keck and Large Binocular Telescope Interferometer [LBTI]).
Astrophysics Explorer
The Wide-field Infrared Survey Explorer (WISE) Project began its implementation phase in October 2006. WISE will conduct a survey of the entire sky in the infrared, studying more than 100,000 asteroids, the coolest and closest stars to the Sun, and the most luminous galaxies in the universe.
Beyond Einstein
The National Research Council (NRC) began reviewing the Beyond Einstein Program in order to determine which mission will proceed first.
Gamma-ray Large Space Telescope (GLAST) Program
The environmental tests of the Large Area Telescope (LAT) at the Naval Research Laboratory were completed successfully, and the instrument was shipped to General Dynamics in Scottsdale, AZ, and mounted onto the spacecraft.
Discovery
The largest optical mirror ever built for a mission (Kepler) beyond Earth's orbit was delivered to Ball Aerospace & Technologies Corp., where it will go through environmental testing and spacecraft integration.

Quality

Performance Measure #	Description
Astrophysics Theme	
APG 8AS09	Complete all development projects within 110% of the cost and schedule baseline.
APG 8AS10	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 8AS11	Peer-review and competitively award at least 90%, by budget, of research projects.
APG 8AS12	Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 130 days.

Program Assessment Rating Tool (PART):

The Astrophysics Theme received a PART rating of "effective" in 2004. The assessment found that this program is well-defined, has a clear objective, and has an effective strategic planning process, embracing the research priorities of astronomers and astrophysicists. This theme will receive an update to this review in FY 2007.

Areas identified for performance improvement included financial management practices and cost effectiveness in achieving program goals. This Theme will pursue the following performance improvement actions: report on the estimated lifecycle cost before entering development, the anticipated cost and schedule associated with each mission phase, the mission's cost and schedule progress achieved in each phase before entering the next, and any plans to re-baseline lifecycle cost and/or schedule.

To date the life cycle cost and schedule numbers have been reported on a quarterly basis for projects that have authority to proceed into development. This has been provided as a quarterly submission to the Office of Management and Budget, and annually to the Congress as the Major Program Annual Report. In the coming year, projects that are still in formulation will be included as a part of the quarterly reporting.

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Relevance	National Research Council	N/A	The Beyond Einstein Program Assessment Committee (BEPAC) determine which mission proceeds first will be due.	09/2007
Relevance	National Research Council	07/2006	Mid-decadal NASA Astrophysics Performance Assessment report will be due.	05/2007
Relevance	National Research Council	N/A	Review of NASA Great Observatory Science Centers on lessons learned for future science centers was is almost complete. Report due April 2007.	N/A
Relevance	AAAC	N/A	Exo-planet task force of Astronomy and Astrophysics Advisory Committee (AAAC) convened to look at future of NASA and NSF planet-finding.	01/2007
Relevance	National Research Council	05/2001	Decadal Survey will start some time in the 2008 time frame. Last Decadal was published in 2001 which prioritized science objectives.	TBD

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Astrophysics Research

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Astrophysics Research	308.6	319.8	315.2	306.1	331.9	378.5	491.4

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	FY 2007 PB Request	FY 2008 PB Request	Change
Astrophysics Research	**309.2**	**315.2**	**6.0**

The Astrophysics Theme held a comparative independent peer review of missions in operation in April 2006. Following this review, the gamma-ray burst-chasing satellite Swift and the all-sky ultraviolet survey mission GALEX received mission extensions and funding augmentations, and several other missions received extensions at reduced levels of funding.

Program Overview

For thousands of years, people have gazed at the stars, given them names, and observed their changes. Though NASA has only recently joined the ancient pursuit of knowledge of the cosmos, 40 years of space science has yielded such astronomical advances as full-sky mapping of the oldest light in the universe.

The Astrophysics Theme's Astrophysics Research Program translates universe missions into science advances by: managing missions in operation; collecting, processing, and storing mission data; making mission data available to scientists; and funding grants for basic research, technology development, and data analysis from past and current missions. All data collected by missions are archived in data centers located at universities and NASA Centers throughout the country and are readily available to all researchers and the general public.

For more information on current operating missions, go to:
http://science.hq.nasa.gov/missions/universe.html.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Astrophysics Research

Program Relevance

The Astrophysics Research Program contributes to achieving subgoal 3D in the NASA strategic plan: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.

The Outcomes to which the program contributes include:
3D.1. Progress in understanding the origin and destiny of the universe, phenomena near black holes, and the nature of gravity.
3D.2. Progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects recognized in the present universe.
3D.3. Progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems.

Plans For FY 2008

The Astrophysics Research Program will continue to conduct and enable a high-quality astrophysical research consistent with NASA's goals and science programs as described in the 2006 NASA Strategic Plan.

RXTE

Rossi X-Ray Timing Explorer (RXTE) observes the high-energy worlds of black holes, neutron stars, X-ray pulsars, and bursts. RXTE studies variability over time in the emission of X-ray sources, with moderate spectral resolution. This time behavior is a source of important information about processes and structures in white-dwarf stars, X-ray binaries, neutron stars, pulsars, and black holes.

FUSE

The Far Ultraviolet Spectroscopic Explorer (FUSE) studies the wavelength range of 90 to 120 nanometers from high orbit. This range provides an opportunity to answer important questions about many types of astrophysical objects, such as the nuclear regions of active galaxies and quasars, massive stars, supernovae, planetary nebulae, and the outer atmospheres of cool stars and planets. FUSE enables study of the physical processes governing the evolution of galaxies, as well as the origin and evolution of stars and planetary systems.

Chandra

The Chandra X-ray Observatory explores the hot, turbulent regions in space in the X-ray part of the spectrum. Chandra's mirrors allow the sharpest X-ray imaging ever achieved, 25-times sharper than previous X-ray observations.

XMM

The XMM-Newton Observatory is an X-ray astrophysics observatory developed by the European Space Agency, with U.S. participation. This facility-class observatory, with an anticipated lifetime through 2009, enables astronomers to conduct sensitive X-ray spectroscopic observations of a wide variety of cosmic sources.

WMAP

The Wilkinson Microwave Anisotropy Probe (WMAP) studies the early universe by measuring the cosmic microwave background radiation over the full sky. WMAP produced the earliest "baby picture" of the universe, showing temperature variation of microwave light 379,000 years after the Big Bang, over 13 billion years ago.

INTEGRAL

The International Gamma-Ray Astrophysics Laboratory (INTEGRAL) seeks to unravel the secrets of the highest-energy--and therefore the most violent--phenomena in the universe.

GP-B

Gravity Probe-B (GP-B) is testing two extraordinary, unverified predictions of Albert Einstein's general theory of relativity. It will measure how space and time are warped by the presence of the Earth, and, more profoundly, how Earth's rotation drags space-time around with it.

Astrophysics Research and Analysis (R&A)

All R&A grants selected for funding by the Astrophysics Theme are broadly competed through NASA's Research Opportunities in Space and Earth Sciences (ROSES). Grant proposals must relate directly to both Agency and Theme goals and objectives, and all proposals are peer-reviewed by a mix of scientific disciplines and are selected based upon merit.

Balloons

Balloons have been used for decades to conduct scientific studies. While the basics of ballooning have not changed, balloon size and capabilities have increased and their dependability has improved greatly. The Wallops Flight Facility manages the NASA Balloon Program. The program offers inexpensive, high-altitude flight opportunities for scientists to test new research technologies prior to spaceflight application.

GALEX

The Galaxy Evolution Explorer (GALEX) is exploring the origin and evolution of galaxies and the origins of stars and heavy elements, and is also conducting an all-sky ultraviolet survey.

Spitzer

The Spitzer Space Telescope is an infrared cryogenic telescope equipped with three instruments to study--via spectroscopy, high-sensitivity photometry, and imaging-clouds of gas and dust characteristic of star forming regions, centers of galaxies, and newly forming planetary systems. Spitzer has proactively managed the on-board cryogen so that it is anticipated that the science operations will last two years longer than the level-1 requirement.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Complete prime and approved extended missions.	RXTE, FUSE, Chandra, XMM, WMAP, INTEGRAL, GALEX, Spitzer, Swift, Suzaku	Through 2011	Through 2011
Undertake an annual, peer-reviewed competition for research grants.	Astrophysics R&A	Annual	Annual
Provide balloon flights for high-altitude science experiments.	Balloons	14-19 flights per year	14-19 flights per year

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Astrophysics Research

Implementation Schedule

Project	Phase	Beg	End	Mile-stone
RXTE	Tech			
	Form			
	Dev			
	Ops	Dec-95	Sep-09	
	Res			
FUSE	Tech			
	Form			
	Dev			
	Ops	Jun-99	Sep-09	
	Res			
Chandra	Tech			
	Form			
	Dev			
	Ops	Jul-99	Jul-11	
	Res			
XMM	Tech			
	Form			
	Dev			
	Ops	Dec-99	Sep-09	
	Res			
WMAP	Tech			
	Form			
	Dev			
	Ops	Jun-01	Sep-10	
	Res			
INTEGRAL	Tech			
	Form			
	Dev			
	Ops	Oct-02	Sep-11	
	Res			
GALEX	Tech			
	Form			
	Dev			
	Ops	Apr-03	Sep-11	
	Res			
Spitzer	Tech			
	Form			
	Dev			
	Ops	Aug-03	Sep-09	
	Res			
GP-B	Tech			
	Form			
	Dev			
	Ops	Apr-04	Sep-05	
	Res	Sep-05	Apr-07	
Swift	Tech			
	Form			
	Dev			
	Ops	Nov-04	Sep-11	
	Res			
Suzaku	Tech			
	Form			
	Dev			
	Ops	May-05	Sep-11	
	Res			

Schedule by Fiscal Year: Prior, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Astrophysics Research

Program Management

The Agency Program Management Council has program oversight responsibility. SMD provides program management, with individual projects managed at GSFC, JPL, and MSFC.

Project	Oversight	Lead Performer	Partners
Spitzer	JPL	California Institute of Technology	None
Chandra	MSFC	Harvard-Smithsonian Center for Astrophysics.	Low Energy Transmission Grating Spectrometer (LETGS) instrument, in collaboration with the Max-Planck-Institüt für Extraterrestriche Physik (MPE) in Germany.
Gravity Probe-B	MSFC	Stanford University	None
GALEX and FUSE		Orbital Sciences	None

Acquisition Strategy

Hubble: Lockheed Martin in Bethesda, MD, maintains the servicing contract for Hubble Space Telescope.

Spitzer: California Institute of Technology, Pasadena, CA, hosts the institution for the science center, which archives the Spitzer data. Ball Aerospace and Technologies Corporation, Boulder, CO, integrated the science instruments for the principal investigator teams. Lockheed Martin Space System Company, Bethesda, MD, integrated the spacecraft and the instruments to the bus and provides some mission operation servicing. Smithsonian Astrophysical Observatory, Cambridge, MA, hosts the principal investigator institution for the Infrared Array Camera (primary camera). Cornell University, Ithaca, NY, hosts the principal investigator institution for the Infrared Spectrometer: Spitzer's spectrograph. University of Arizona, Tucson AZ, hosts the principal investigator institution for the Multiband Imaging Photometer for Spitzer, the long wavelength imager and photometer on Spitzer.

Chandra: The prime contractor for Chandra operations is the Smithsonian Astrophysical Observatory (SAO) in Cambridge, MA. The contract for Chandra was renewed in 2003 for a period of five years. Northrop Grumman provides technical support for Chandra, TRW was the prime contractor for developing the Chandra spacecraft. The Smithsonian Astrophysical Observatory developed the High Resolution Camera (HRC) instrument. Pennsylvania State University and MIT assembled the Advanced CCD Imaging Spectrometer (ACIS) instrument. MIT assembled the High Energy Transmission Grating (HETG) instrument. SRON, The Netherlands, constructed the Low Energy Transmission Grating (LETG) instrument, in collaboration with the Max-Planck-Institut fur Extraterrestriche Physik (MPE) in Germany.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Quality	Senior Review Panel	04/2006	2006: Senior Review - Comparative review of operating missions / Ranked missions in terms of science return.	4/2008

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Pointing and Control Malfunctions	RISK: There are low to moderate risks of malfunctions in the pointing and control features of operating spacecraft.	MITIGATION: NASA maintains a rigorous personnel training program for early detection and recovery from operational anomalies.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Gamma-ray Large Space Telescope (GLAST) Program

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Gamma-ray Large Space Telescope (GLAST) Program	120.2	90.7	42.2	28.3	28.3	29.3	30.2
Gamma-ray Large Space Telescope (GLAST) Project	113.2	90.7	42.2	28.3	28.3	29.3	30.2
Other	7.0	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Gamma-ray Large Space Telescope (GLAST) Program	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Gamma-ray Large Space Telescope (GLAST) Project	**23.8**	**42.2**	**18.4**
The GLAST Project has been rebaselined due to schedule delays in avionics and the Large Area Telescope (LAT) instrument, and increased cost risk associated with the spacecraft development; launch is November, 2007.			
Other	**1.4**	**0.0**	**-1.4**
No major program changes.			

Program Overview

A collaboration with the Department of Energy, France, Italy, Sweden, Japan, and Germany, the Gamma-ray Large Area Space Telescope (GLAST) will improve researchers' understanding of the structure of the universe, from its earliest beginnings to its ultimate fate. By measuring the direction, energy, and arrival time of celestial high-energy gamma rays, GLAST will map the sky with 50 times the sensitivity of previous missions, with corresponding improvements in resolution and coverage. Yielding new insights into the sources of high-energy cosmic gamma rays, GLAST will reveal the nature of astrophysical jets and relativistic flows and study the sources of gamma-ray bursts.

GLAST is a next-generation, high-energy gamma-ray observatory designed for making observations of celestial gamma-ray sources. GLAST is a follow-on mission to the Compton Gamma Ray Observatory - Energetic Gamma Ray Experiment Telescope (CGRO-EGRET) mission in the 1990s. It will achieve comparable sensitivity five times faster than previous space-based instruments, monitor a region of the sky four times larger, and locate objects with up to ten-fold better precision.

For more information, please see http://glast.gsfc.nasa.gov/.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Gamma-ray Large Space Telescope (GLAST) Program

Program Relevance

By mapping the gamma-ray sky and analyzing gamma-ray bursts, GLAST will provide a new tool for studying how black holes, notorious for pulling matter in, can accelerate jets of gas outward at fantastic speeds. Physicists will be able to observe the effects of subatomic particles at energies far greater than those seen in ground-based particle accelerators and will also gain insights into the puzzling question of how energetic gamma rays are produced in the magnetosphere of spinning neutron stars. Perhaps the biggest science return will come from understanding the nature of the high -energy gamma-ray sources that have escaped correlation at other wavelengths and constitute the unidentified bulk of nearly 300 known high-energy sources.

GLAST will contribute to NASA Strategic Plan Sub-Goal 3D: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets. More specifically, GLAST will contribute to Outcome 3D.1: Progress in understanding the origin and destiny of the universe, phenomena near black holes, and the nature of gravity.

Plans For FY 2008

GLAST is scheduled to launch in November 2007. After two months of in-orbit checkout, research will begin in January 2008.

Project Descriptions

GLAST is a single program/project.

GLAST

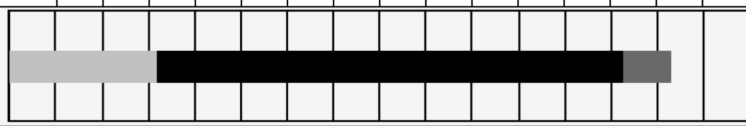
The GLAST mission will operate for five years (with a goal of operating for ten years)to measure the direction, energy, and arrival time of celestial gamma rays. Mission objectives include: (1) understanding the mechanisms of particle acceleration in astrophysical environments such as active galactic nuclei; (2) determining the high-energy behavior of gamma-ray bursts; (3) resolving and identifying point sources with known objects; and (4) probing dark matter and the extra-galactic background light in the early universe.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Launch GLAST; Create an all-sky gamma-ray map; Complete 4 years of observing gamma-ray bursts	GLAST	September 2007	November 2007

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Gamma-ray Large Space Telescope (GLAST) Program

Implementation Schedule

Project	Schedule by Fiscal Year (Prior, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20)	Phase Dates			
			Beg	End	Mile-stone
GLAST		Tech	Jun-98	Dec-99	
		Form	Dec-99	Dec-03	
		Dev	Dec-03	Nov-07	
		Ops	Nov-07	Jan-18	
		Res	Jan-18	Jan-19	

- Tech & Adv Concepts (Tech)
- Formulation (Form)
- Development (Dev)
- Operations (Ops)
- Research (Res)
- Represents a period of no activity for the Project

Program Management

GSFC is responsible for GLAST Program Management. The NASA Program Management Council has program oversight responsibility.

Project	Oversight	Lead Performer	Partners
GLAST	GSFC	GSFC	International partners: Japan, Italy, France, Sweden, and Germany. Domestic partner: Naval Research Laboratory (NRL), Washington, DC:
GLAST Large Area Telescope (LAT) Principal Investigator and Science Support	GSFC	Stanford University	NRL (Washington, DC), Japan, Italy, and France will all provide science support.
Spacecraft	GSFC	General Dynamics/Spectrum Astro	
GLAST Burst Monitor	GSFC	MSFC	Germany: Detectors and electronics.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Gamma-ray Large Space Telescope (GLAST) Program

Acquisition Strategy

The spacecraft contract with General Dynamics/Spectrum Astro (Gilbert, AZ), was acquired via a blanket procurement through GSFC's Rapid Spacecraft Development Office.

The acquisition of the primary instrument (LAT) at the Stanford Linear Accelerator Center, Stanford University, and the secondary instrument (GBM) at MSFC were selected through an Announcement of Opportunity competitive selection in 2000. Japan and Italy supplied a portion of LAT silicon strip detectors while Italy assembled the LAT tracker towers, which form the track imaging system, as well as additional hardware used in the towers. France supplied the Calorimeter structures and Sweden the Calorimeter detector crystals for the LAT. The Naval Research Laboratory (NRL), Washington, DC: assembled the Calorimeter for the LAT and environmentally tested the integrated instrument. Germany is providing the detectors and electronics for the GRB instrument.

The GSFC Science Support Center will support Guest Observers (GO) and manage annual solicitation for GOs. GSFC Mission Operations Center personnel are provided by a contractor set-aside procurement. Japan, Italy, and France will all provide science support.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	Independent Review Team (IRT)	03/2006	Review project cost, schedule, and performance / Mission Operations Review; Program past Mission Operations Review. The reviews were successfully completed.	04/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
GLAST schedule.	The replanned GLAST schedule includes 1 month of funded schedule reserve, which my not be sufficient to address remaining Command and Data Handling (C&DH) or solar array tasks.	The Contractor has added additional engineering personnel and GSFC has sent a C&DH specialist team to assist the contractor in closeout. NASA is working with contractor to advance scheduled delivery of solar arrays.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Gamma-ray Large Space Telescope (GLAST) Program
Project In Development:	Gamma-ray Large Space Telescope (GLAST) Project

Budget / Life Cycle Cost

Budget Authority ($ millions)	Prior	FY06	FY07	FY08	FY09	FY10	FY11	FY12	BTC	LCC TOTAL
FY 2008 President's Budget Request	**312.8**	**113.2**	**90.7**	**42.2**	**28.3**	**28.3**	**29.3**	**30.2**	**180.1**	**855.0**
Formulation	98.7	--	--	--	--	--	--	--	--	--
Development	214.1	113.2	90.7	--	--	--	--	--	--	--
Operations	--	--	--	42.2	28.3	28.3	29.3	30.2	180.1	--
Other	--	--	--	--	--	--	--	--	--	--
FY 2007 President's Budget Request	**311.8**	**118.9**	**80.7**	**23.8**	**27.1**	**27.6**	**28.7**	**--**	**157.3**	**775.9**
Formulation	103.1	--	--	--	--	--	--	--	--	--
Development	208.7	118.9	80.7	--	--	--	--	--	--	--
Operations	--	--	--	23.8	27.1	27.6	28.7	--	157.3	--
Other	--	--	--	--	--	--	--	--	--	--
Changes	**1.0**	**-5.6**	**9.9**	**18.4**	**1.1**	**0.7**	**0.6**	**30.2**	**22.8**	**79.1**
Formulation	-4.4	--	--	--	--	--	--	--	--	-4.4
Development	5.4	-5.7	10.0	--	--	--	--	--	--	9.7
Operations	--	--	--	18.4	1.2	0.7	0.6	30.2	22.8	73.9
Other	--	--	--	--	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Project Changes

Project	*Gamma-ray Large Space Telescope (GLAST) Project*

The GLAST Project has been rebaselined due to schedule slips in the Command and Data Handling sub-system and the Large Area Telescope (LAT) instrument, as well as increased cost risk associated with the spacecraft contractor. Launch is now planned for November 2007.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Gamma-ray Large Space Telescope (GLAST) Program
Project In Development:	Gamma-ray Large Space Telescope (GLAST) Project

Project Purpose

GLAST will study cosmic gamma rays, the most energetic form of radiation. Billions of times more energetic than visible light and capable of generating prodigious amounts of energy, cosmic gamma rays are generated by distant objects such as supermassive black holes, merging neutron stars, and streams of hot gas moving close to the speed of light.

Mission objectives include: (1) understanding the mechanisms of particle acceleration in astrophysical environments such as active galactic nuclei; (2) determining the high-energy behavior of gamma-ray bursts; (3) resolving and identifying point sources with known objects; and (4) probing dark matter and the extra-galactic background light in the early universe.

Project Parameters

The GLAST primary instrument is the Large Area Telescope (LAT), which will provide an all-sky gamma-ray map as well as provide follow-up observations of gamma-ray bursts. LAT is a high-energy pair conversion telescope with a mass of 3,000 kilograms. It utilizes a silicon strip detector to detect gamma rays in the energy range of 20 MeV to 300 GeV. LAT will achieve comparable sensitivity five-times faster than previous space-based instruments, monitor a region of the sky four-times larger, and locate objects with up to tenfold better precision.

The GLAST secondary instrument is the Gamma Ray Burst Monitor (GBM), which will detect and immediately transmit the data regarding gamma-ray bursts over the two-thirds of the sky that is unocculted by the Earth. GBM includes a series of 12 low-energy Sodium Iodide (NaI) and two high-energy Bismuth Germanate (BGO) detectors. GBM's mass is 70 kilograms and its energy range is 10 KeV to 25 MeV. GBM's energy range extends nearly three times as far as previous instruments, thereby permitting LAT burst detections to be tied to lower-energy measurements.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Gamma-ray Large Space Telescope (GLAST) Program
Project In Development:	Gamma-ray Large Space Telescope (GLAST) Project

Project Commitments

GLAST will launch in 2007 to complete five-years of mission operations (with a goal of 10 years of operations) to: measure the direction, energy, and arrival time of celestial gamma rays; create an all-sky gamma-ray map during the first year of operations; and detect and provide follow-up observations of gamma-ray bursts.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Large Area Telescope	Stanfor Linear Accelerator Center	GLAST will identify gamma rays in 20 MeV to 300 GeV energy range with a sensitivity 50 times that of EGRET at 100 MeV. GLAST will have a positional accuracy of 30 arcsec to 5 arcmin.	No change	No change
GLAST Burst Monitor	MSFC	GLAST will detect gamma-ray bursts at 10 keV to 25 MeV energy range, with a positional accuracy of 15 degress for burst alerts, 3 degrees after final processing.	No change	No change
Spacecraft			No change	No change
Launch vehicle	Boeing	Delta 2920 (H)		
Ground System:	Goldbelt Orca/Omitron		No change	No change
Mission Ops	Goldbelt Orca/Omitron	mission operations development	No change	No change
Data management	GSFC	Science Support Center/Archive at GSFC. Science data production at Stanford Linear Accelerator Center (LAT) and MSFC (GBM).	No change	No change

Schedule Commitments

GLAST entered implementation in December 2003. In 2006, the GLAST Project was rebaselined due to technical, cost, and schedule issues. However, both the primary (LAT) and secondary (GBM) instruments have been completed, integrated, and tested, and in 2007 they will be integrated with the spacecraft. Launch is now scheduled for November 2007.

Milestone Name	Confirmation Baseline	FY 2007 PB Request	FY 2008 PB Request
Development			
Operational Readiness Review	February 2007	May 2007	April 2007
Launch Readiness	May 2007	September 2007	November 2007

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Gamma-ray Large Space Telescope (GLAST) Program
Project In Development:	Gamma-ray Large Space Telescope (GLAST) Project

Development Cost Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Gamma-ray Large Space Telescope (GLAST) Project	2006	414.0	2007	439.8	6	Launch Readiness	9/30/2007	11/30/2007	2

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**414.0**	**439.8**	**25.8**
Science/Technology	10.0	10.7	0.7
Payload	113.0	108.8	-4.2
Aircraft/Spacecraft	97.0	95.2	-1.8
Launch Vehicle/Services	87.0	84.9	-2.1
Ground Systems	14.0	17.2	3.2
Other (In-house labor is reflected under other in FY08)	93.0	123.0	30.0

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Gamma-ray Large Space Telescope (GLAST) Program
Project In Development:	Gamma-ray Large Space Telescope (GLAST) Project

Project Management

GSFC is responsible for GLAST Project management. The NASA Program Management Council and GSFC Center Management Council have program oversight responsibility. The responsible official for this project is Richard Howard.

Project Element	Element Oversight	Lead Performer	Partners
Spacecraft	GSFC	General Dynamics/Spectrum Astro, Gilbert, AZ	N/A
LAT	GSFC	Stanford Linear Accelerator Center, a Department of Energy-funded laboratory, Stanford University	Naval Research Lab (Washington, DC), Italy, Japan, France and Sweden.
GBM	GSFC	MSFC	Germany
Mission Operations and Data Analysis	GSFC	MSFC Mission Operations Center	Naval Research Laboratory, Italy, Japan, France, and Germany.
Launch Vehicle	GSFC	KSC	N/A
Science	GSFC	GSFC Science Support Center	Japan, Italy, and France will provide science support.

Acquisition Strategy

The spacecraft contractor, General Dynamics/Spectrum Astro (Gilbert, AZ), was chosen via a blanket procurement through GSFC's Rapid Spacecraft Development Office.

The primary instrument (LAT) at the Stanford Linear Accelerator Center, Stanford University, and the secondary instrument (GBM) at MSFC were selected through a competitive Announcement of Opportunity selection in 2000.

Italy assembled the LAT tracker towers, which form the track imaging system, as well as additional hardware used in the towers. Japan and Italy supplied a portion of the LAT silicon strip detectors. France supplied calorimeter structures and Sweden provided the calorimeter detector crystals. Germany supplied the detectors and electronics for GBM.

The Naval Research Laboratory (NRL), Washington, DC, assembled the calorimeter for the LAT and environmentally tested the integrated instrument.

The GSFC Science Support Center will support guest observers (GO) and manage annual solicitation for GOs. Goldbelt Orca/Omitron will provide the ground system via a mission operations development contract. Mission Operations Center personnel will be provided by a contractor set-aside procurement.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Gamma-ray Large Space Telescope (GLAST) Program
Project In Development:	Gamma-ray Large Space Telescope (GLAST) Project

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	Independent Review Team	03/2006	Cost, schedule, performance review / Mission Operations Review was successful.	04/2007

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Command and Data Handling	Command and Data Handling (C&DH) hardware remain a risk to schedule launch window.	The contractor has added additional engineering personnel and GSFC has sent a C&DH specialist team to assist the contractor in closeout.
Solar Arrays	Solar array delivery, wing assembly, and qualification testing remains a risk to the schedule launch window.	NASA is working with the contractor to deliver solar arrays in advance of scheduled delivery date.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Discovery

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Discovery	147.5	105.0	93.0	25.7	16.3	16.2	17.6
Kepler	139.9	105.0	93.0	25.7	16.3	16.2	17.6
Other	7.6	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure. Kepler replan budget increase in FY08 in response to contractor overruns.

Highlights of Major Program Changes

	FY 2008		
Discovery	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Kepler	**65.9**	**93.0**	**27.1**
The Kepler Project completed a replan in 2007 and is now scheduled for launch in November 2008.			
Other	**4.0**	**0.0**	**-4.0**
No major program changes.			

Program Overview

In space exploration, the possibilities for discovery are without limits. Even with the vast amount of knowledge gained since space exploration began, there are still more questions than answers.

The Discovery Program provides planetary and planet-searching communities frequent access to space for modest but scientifically meritorious and focused missions led by a Principal Investigator. The goal is to launch smaller missions with fast development times, each for a fraction of the cost of NASA's larger Planetary Science and Astrophysics science exploration missions. Through the Discovery Program, the scientific community can develop innovative investigations of scientific issues that often have fundamental human relevance and interest, such as determining if Earth is unique among planets in its ability to generate and sustain life.

Kepler is the only Discovery project currently supporting the Astrophysics Theme.

Please refer to the Discovery Program, under the Planetary Science Theme, for information regarding other NASA Discovery missions with Planetary science objectives.

Program Relevance

Within the Astrophysics Theme, Discovery supports NASA Strategic Goal 3, "Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration," and Sub-goal 3D, "Discover the origin, structure, evolution and destiny of the universe, and search for Earth-like planets. The program provides frequent flight opportunities for high-quality, high-value scientific planet-searching investigations that can be accomplished under a not-to-exceed cost cap.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Discovery

Plans For FY 2008

In FY 2008, the primary instrument, the photometer, will be finished and spacecraft integration and testing will be completed.

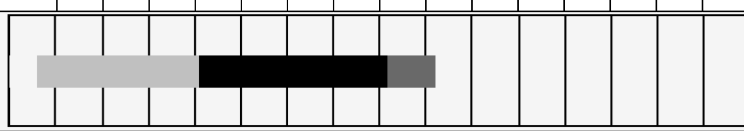
Kepler

Kepler will detect and characterize terrestrial-sized planets around other stars, measuring the reduction in starlight as a planet orbits and occults its parent star. It will measure the sizes, masses, and densities of both gas and ice giant planets. Kepler is the only planned observation system that will survey Earth's region of the Milky Way galaxy to detect and characterize hundreds of Earth-size planets in or near the habitable zone, and thousands in shorter period planets. The mission will provide key information for future planet-finding and characterization missions. Kepler is in development.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Over four years, determine the frequency of terrestrial and larger planets in the habitable zone.	Kepler	Launch June 2008	Launch November 2008

Implementation Schedule

Project	Schedule by Fiscal Year														Phase Dates			
	Prior	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20		Beg	End	Mile-stone
Kepler																Tech			
																Form	Dec-01	May-05	
																Dev	May-05	Nov-08	
																Ops	Nov-08	Dec-12	
																Res	Dec-12	Dec-13	

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

MSFC is responsible for Discovery Program management. The NASA Program Management Council has program oversight responsibility.

Project	Oversight	Lead Performer	Partners
Kepler	JPL	Ball Aerospace & Technologies, Corp., Boulder, CO	None

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Discovery

Acquisition Strategy

Discovery projects are selected through competitive Announcements of Opportunity, the program solicits proposals for entire missions. Proposals are submitted by a principal investigator (PI)-led team and may include industry, small businesses, government, and university participants. The Kepler acquisitions are in place. There are no currently planned Astrophysics Explorer projects requiring future acquisitions.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	Standing Review Board (SRB)	10/2006	Kepler Critical Design Review (CDR). CDR was successful	08/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Cost cap	The Discovery Program funds mid-sized projects which, in order to keep projects within their cost caps, have less risk mitigation built into the project design. Rising launch vehicle costs increase the cost-pressure on mission design.	Technical, management, and cost risks for each investigation are carefully examined as part of the selection process, and acceptable risks are documented in individual project appendices attached to the Discovery Program plan. All technical and programmatic risks are further reviewed as part of the project confirmation review during the PDR timeframe to ensure risks have been mitigated.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Discovery
Project In Development:	Kepler

Budget / Life Cycle Cost

Budget Authority ($ millions)	Prior	FY06	FY07	FY08	FY09	FY10	FY11	FY12	BTC	LCC TOTAL
FY 2008 President's Budget Request	**174.8**	**139.9**	**105.0**	**93.0**	**25.7**	**16.3**	**16.2**	**17.6**	**24.2**	**612.6**
Formulation	142.8	--	--	--	--	--	--	--	--	--
Development	32.0	139.9	105.0	93.0	12.1	--	--	--	--	--
Operations	--	--	--	--	13.6	16.3	16.2	17.6	24.2	--
Other	--	--	--	--	--	--	--	--	--	--
FY 2007 President's Budget Request	**170.3**	**129.8**	**95.2**	**65.9**	**13.0**	**12.7**	**12.3**	**--**	**19.6**	**518.8**
Formulation	147.2	--	--	--	--	--	--	--	--	--
Development	23.1	129.8	95.2	62.9	--	--	--	--	--	--
Operations	--	--	--	3.0	13.0	12.7	12.3	--	19.6	--
Other	--	--	--	--	--	--	--	--	--	--
Changes	**4.4**	**10.1**	**9.7**	**27.1**	**12.7**	**3.7**	**3.9**	**17.6**	**4.6**	**93.8**
Formulation	-4.4	--	--	--	--	--	--	--	--	-4.4
Development	8.9	10.1	9.8	30.1	12.1	--	--	--	--	71.0
Operations	--	--	--	-3.0	0.6	3.6	3.9	17.6	4.6	27.3
Other	--	--	--	--	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Project Changes

Project	*Kepler*
Due to contractor workforce and cost overruns, Kepler underwent a major restructuring and replan during FY 2006. A new management team is in place, the organizational structure has been changed, and new cost and schedule plans are complete. Project technical requirements remain unchanged, but the launch date has moved from June, 2008 to November, 2008.	

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Discovery
Project In Development:	Kepler

Project Purpose

The centuries-old search for other Earth-like worlds has been re-energized by the intense excitement and popular interest surrounding the discovery of Jupiter-like, gas-giant planets orbiting stars beyond our solar system. With the exception of the pulsar planets, a large majority of the extrasolar planets detected thus far are gas giants.

The Kepler mission is designed to survey a portion of the extended solar neighborhood. The goal is to detect and characterize hundreds of potentially habitable planets that are up to 600 times less massive than Jupiter. Transits by planets produce a fractional change in stellar brightness. From measurements of the period, change in brightness and known stellar type, the planetary size, orbital size and characteristic temperature are determined. From these properties, the question of whether or not the planet might be habitable (not necessarily inhabited) can be answered.

Kepler's specific objectives include: 1) determine the frequency of terrestrial and larger planets in or near the habitable zones of a wide variety of spectral types of stars; 2) determine the distribution of planet sizes and their orbital semi-major axes (half the longest diameter of the orbit); 3) estimate the frequency and orbital distribution of planets in multiple-stellar systems; and (4) determine the distributions of semi-major axis, albedo, size, mass, and density of short-period giant planets.

For more information please see http://www.kepler.nasa.gov

Project Parameters

Flight System Characteristics:
-Spacebased Photometer: 0.95-m aperture
-Primary mirror: 1 meter diameter, 85% weighted
-Detectors: 95 mega pixels (42 CCDs with 2200x1024 pixels)
-Fine guidance sensors: 4 CCDs located on science focal plane
-Uplink X-band; Downlink Ka-band
-Spacecraft and instrument mass: 1039 kg, maximum expected
-Spacecraft and instrument power: 651 W, maximum expected

Mission Characteristics:
-Continuously point at a single star field in Cygnus-Lyra region except during Ka-band downlink
-Roll the spacecraft 90 degrees about the line-of-sight every 3 months to maintain the sun on the solar arrays and the radiator pointed to deep space
-Monitor 100,000 solar class and cooler stars for planets
-Mission lifetime of 4 years
-D2925-10L (Delta II) launch into an Earth-trailing heliocentric orbit
-Scientific Operations Center at NASA Ames Research Center
-Mission Operations Center at University of Colorado Laboratory for Atmospheric and Space Physics
-Data Management Center at Space Telescope Science Institute
-Deep Space Network for telemetry
-Routine contact: X-band contact twice a week for commanding, health and status and Ka-band contact once a month for science data downlink

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Discovery
Project In Development:	Kepler

Project Commitments

Following a 30-day characterization period, Kepler will begin acquiring its scientific data by continuously and simultaneously observing over 100,000 target stars. During the first year, terrestrial planets with orbital periods shorter than that of Mercury - as well as a wide range of larger planets with similar periods - should be detected. Finally, the anticipated identification of Earth-size planets in the habitable zones of other star systems will begin during the third year.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Flight System	Ball Aerospace Technologies, Boulder, Colorado	Provides on-orbit capability to detect Earth-like planet transits	April 2008	September 2008
Launch Vehicle	Boeing	D2925-10L (Delta II)	Same	Same
Mission Operations	Univ. of Colorado Laboratory for Atmospheric and Space Physics	Use of existing facility to operate the mission	Same	Same
Data Management	Space Telescope Science Institute	Use of existing facility to pre-process data and manage the archives	Same	Same
Mission Science	ARC Science Operations Center	Use of existing facility for data reduction and analysis	Same	Same

Schedule Commitments

Kepler was selected as a Discovery class mission in January 2001 and entered implementation in May of 2005. The project underwent a replan in 2006 and has since successfully completed its Critical Design Review (CDR) milestone in October of 2006. In FY 2008, the primary instrument, the photometer, is scheduled to be finished, and spacecraft integration and testing will be complete. Launch is now scheduled for November 2008 and mission operations will cease in December of 2012, with an additional year of funded research.

Milestone Name	Confirmation Baseline	FY 2007 PB Request	FY 2008 PB Request
Development			
CDR	March 2006	March 2006	October 2006
Assemby, Test, and Launch Operations (ATLO) start	December 2006	December 2006	July 2007
Launch Readiness	June 2008	June 2008	November 2008

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Discovery
Project In Development:	Kepler

Development Cost Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Kepler	2006	322.0	2007	418.4	30	Launch Readiness	6/30/2008	11/30/2008	5

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**322.0**	**418.4**	**96.4**
Science/ Technology	16.0	7.0	-9.0
Payload (Photometer)	65.0	117.1	52.1
Aircraft/Spacecraft	52.0	68.0	16.0
Launch Vehicle/Services	82.0	82.0	0.0
Ground Systems	29.0	16.0	-13.0
Systems Integration & Testing	7.0	14.8	7.8
Other	71.0	113.5	42.5

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Discovery
Project In Development:	Kepler

Project Management

JPL is responsible for Kepler development project management. The Science Mission Directorate Program Management Council has program oversight responsibility. The responsible official for this project is Richard Howard.

Project Element	Element Oversight	Lead Performer	Partners
Flight System	JPL	Ball Aerospace & Technologies Corp., Boulder, CO	ARC
ELV	KSC	Boeing Company, Chicago, IL	
Mission Operations & Data Analysis	ARC	Laboratory for Atmospheric and Space Physics (LASP), University of Colorado, Boulder, CO	- Space Telescope Science Institute, Baltimore, MD - Ball Aerospace & Technologies Corp., Boulder, CO

Acquisition Strategy

All major acquisitions are in place; the Ames Research Center & Ball Aerospace & Technologies, Corp. Kepler team was selected via a competative NASA Discovery Program Announcement of Opportunity.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	SRB, JPL & ARC	10/2006	Critical Design Review (CDR) was completed successfully.	N/A
Performance	SRB, JPL & ARC	N/A	Assembly, Test & Launch Operations (ATLO) Readiness Review	08/2007
Performance	SRB, JPL & ARC	N/A	Operational Readiness Review	04/2008
Performance	SRB, JPL & ARC	N/A	Launch Readiness Review	10/2008

Mission Directorate: Science
Theme: Astrophysics
Program: Discovery
Project In Development: Kepler

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Contractor Performance	Ball Aerospace and Technology Corp. and many of its sub-contractors have not been able to execute planned activities within the cost and schedule they proposed. This has put the overall schedule and total cost for the project at risk.	New management personnel and structures have been put in place at JPL and BATC. Increased emphasis on use of the EVM system has shown improved visibility into the project at all levels. Forward-looking metrics have been put in place to provide early warning of issues prior to the normal reporting cycle. Active on-site government involvement has also been instituted.
Focal Plane Array Integration	The Focal plane on Kepler, with 42 large CCD's, is the largest ever flown in space and has stringent requirements on science performance. That together with the high density of elements and electrical and thermal attachments makes the assembly and test of this element a key challenge for the project.	The project has added resources in personnel and test equipment to provide robustness in the assembly and test of this element. Additional schedule reserves have been added to the project in this area. Management attention to this element extends to the NASA HQ level.
Communication System	Kepler is the first mission to use Ka band communications as its primary data link. Elements in the flight transponder have been unreliable in flight.	Teams are working to resolve reliability issues. Kepler has chosen modifications in at least one of the transponders to add reliability to elements thought to be the cause of the problem. Additional design improvements to allow more communications link redundancy are under study. Planning that will allow science operations with the reduced capacity engineering data link is well advanced.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	James Webb Space Telescope

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
James Webb Space Telescope	364.0	468.5	545.4	452.1	376.9	321.1	285.9
James Webb Space Telescope	343.8	468.5	545.4	452.1	376.9	321.1	285.9
Other	20.2	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
James Webb Space Telescope	FY 2007 PB Request	FY 2008 PB Request	Change
James Webb Space Telescope	**464.0**	**545.4**	**81.4**
JWST completed a replan in 2006, with reserves added to the program in 2008 and 2009. Launch is planned for 2013.			
Other	**28.7**	**0.0**	**-28.7**
Full cost accounting simplification.			

Program Overview

The James Webb Space Telescope (JWST)--identified by the National Research Council as a top priority new initiative for astronomy and physics for the current decade--is a large, deployable, space-based, infrared astronomical observatory. One of the largest and most complex unmanned missions NASA has ever undertaken, JWST is a logical successor to the Hubble Space Telescope (HST). JWST will extend beyond Hubble's discoveries into the infrared where the highly redshifted early universe must be observed, cool objects like protostars and protoplanetary disks emit strongly, and dust obscures shorter wavelengths.

During its five-year science mission, JWST will address the question: "How did we get here?" by exploring the mysterious epoch when the first luminous objects in the universe came into being after the Big Bang. The focus of scientific study will include detection of the first light in the universe, emergence of galaxies, origins of stars and planetary systems, and origins of elements necessary for life.

JWST completed a replan in 2006, with launch planned for 2013. For more information, please see: http://www.jwst.nasa.gov/.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	James Webb Space Telescope

Program Relevance

The James Webb Space Telescope will support Strategic Plan Goal 3D: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.

The Outcomes to which the program will contribute include:

- 3D.2. Progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects recognized in the present universe.
- 3D.3. Progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems.

Plans For FY 2008

The JWST Non-Advocate Review (NAR)/Preliminary Design Review (PDR) is scheduled for March of 2008; if successful, the program will be allowed to proceed into development [APG 84504].

Project Descriptions

JWST is a single program/project.

JWST

JWST will have a large mirror, 6.5 meters (21.3 feet) in diameter and a sunshield the size of a tennis court. Neither the mirror nor the sunshade fit onto the rocket fully open, so both will fold up and open only after JWST is in outer space. JWST will reside in an orbit about 1.5 million kilometers (1 million miles) from the Earth.

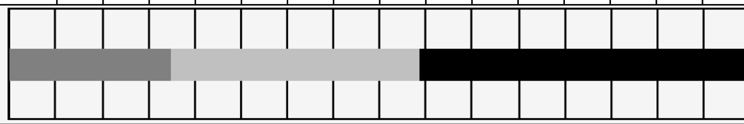
The telescope and instruments will operate at cryogenic temperature in order to achieve infrared performance. Launch is scheduled for 2013, on an ESA-supplied Ariane-5 rocket to Sun-Earth L2 for a five-year science mission (10-year goal) to study the origin and evolution of galaxies, stars, and planetary systems.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Operate mid & near infrared cameras & a near infrared spectrograph using a 6m-mirror for 5 years	JWST	Schedule was under review	Launch June 2013

Mission Directorate:	Science
Theme:	Astrophysics
Program:	James Webb Space Telescope

Implementation Schedule

Project	Schedule by Fiscal Year																Phase Dates			
	Prior	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20		Beg	End	Mile-stone
JWST																	Tech	Apr-96	Apr-99	
																	Form	Apr-99	Mar-08	
																	Dev	Mar-08	Jul-13	
																	Ops	Jul-13	Oct-23	
																	Res	Oct-23	Oct-24	

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

GSFC is responsible for JWST project management. NASA and GSFC Program Management Councils have program oversight responsibility.

Project	Oversight	Lead Performer	Partners
JWST	GSFC	Northrup Grumman Space Technologies, Redondo Beach, CA	European Space Agency (ESA) Canadian Space Agency (CSA)

Acquisition Strategy

JWST is being built by Northrop Grumman Space Technology (Redondo Beach, CA), teamed with Ball (Boulder, CO), ITT (Rochester, NY) and Alliant Techsystems (Edina, MN). Selections were made via a competitive NASA Request For Proposal.

The Space Telescope Science Institute (STScI), in Baltimore, MD, is developing the Science and Operations Center and associated services. STScI was selected by the NASA Administrator.

The Integrated Science Instrument Module (ISIM) is being provided by GSFC.

The University of Arizona, Tucson, is providing the near-infrared science camera. The selection was made via a competitive NASA Announcement of Opportunity.

The European Space Agency is providing the Mid-Infrared Instrument, with management and technical participation by JPL, selected for this role after an internal NASA competition. The Europeans are also providing the Near-Infrared Spectrometer and an Ariane-5 launch vehicle.

The Canadian Space Agency is providing the Fine Guidance Sensor.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	James Webb Space Telescope

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Relevance	Science Assessment Team	08/2005	Review project science. Validated JWST Science for rebaseline	N/A
Performance	IPAO/Special Review Team	04/2006	Review project cost & schedule. Validated the JWST rebaseline.	N/A
Performance	IPAO	N/A	Technical Non-Advocate Review (T-NAR) (forthcoming)	01/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Project Complexity	JWST is a complicated system with unprecedented design features; therefore, cost and schedule estimates contain additional uncertainty during formulation. Further cost growth and schedule extension is possible.	JWST completed a replan in FY 2006 which includes additional funding reserves over the next few years to reduce the risk of schedule extensions and associated cost growth.
Technology Level	JWST requires advances in several technologies, which could present cost and schedule problems.	To ensure these technologies are ready when needed, NASA is aggressively developing large, lightweight cryogenic optics, wavefront sensing and control algorithms, and high-performance detectors. All technologies for JWST will be mature enough by 2007 to reduce risk to an acceptable level for mission confirmation; Technology Readiness Review (T-NAR) in Jan 2007 will proceed full project NAR.
International Partners	Because JWST is an international collaboration, NASA may incur schedule and cost impacts caused by challenges in Europe and Canada that are outside of NASA's control.	NASA has written clearly-defined interfaces and is actively managing and complying with export controls International Traffic in Arms Regulations (ITAR).

Mission Directorate:	Science
Theme:	Astrophysics
Program:	James Webb Space Telescope
Project In Formulation:	James Webb Space Telescope

Budget / Life Cycle Cost

Budget Authority ($ millions)	FY06	FY07	FY08
FY 2008 President's Budget Request	343.8	468.5	545.4
FY 2007 President's Budget Request	343.6	418.3	464.0
Total Change from FY 2007 President's Budget Request	0.2	50.2	81.4

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure. As a result of the recent replan, reserves were added to JWST in FY2008 and FY2009.

Project Purpose

The James Webb Space Telescope (JWST)--identified by the National Research Council as a top priority new initiative for astronomy and physics for the decade--is a large, deployable, space-based infrared astronomical observatory. JWST conducted a replan in 2006 and is scheduled for launch no-earlier-than 2013. The mission is a logical successor to the Hubble Space Telescope (HST), extending beyond Hubble's discoveries into the infrared, where the highly redshifted early universe must be observed, where cool objects like protostars and protoplanetary disks emit strongly, and where dust obscures shorter wavelengths.

During its five-year science mission, JWST will address the question: "Are we alone?" by exploring the mysterious epoch when the first luminous objects in the universe came into being after the Big Bang. The focus of scientific study will include first light, assembly of galaxies, origins of stars and planetary systems, and origins of the elements necessary for life.

For more information, please see: http://www.jwst.nasa.gov/.

Project Parameters

JWST will be optimized for infrared astronomy, with some capability in the visible range. It will be sensitive to light from 0.6 to 27 micrometers in wavelength. JWST's instruments are: Near Infrared Camera (NIRCam), Mid Infrared Instrument (MIRI), Near Infrared Spectrograph (NIRSpec) and Fine Guidance Sensor (FGS). The telescope is scheduled to launch in 2013 from Kourou, French Guiana, on an ESA-supplied Ariane 5 rocket . Its operational location is the L2 Lagrange point. The JWST Ground Operations, Science Support Center and archives will be at STScI.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	James Webb Space Telescope
Project In Formulation:	James Webb Space Telescope

Project ROM Estimate

JWST is scheduled to launch in 2013 on a 5-year (10-year goal) mission. The four main science goals are:
- Search for the first galaxies or luminous objects formed after the Big Bang.
- Determine how galaxies evolved from their formation until now.
- Observe the formation of stars from the first stages to the formation of planetary systems.
-Measure the physical and chemical properties of planetary systems and investigate the potential for life in those systems.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Primary Mirror	Ball Aerospace; Tinsley Laboratories; Axsys Technologies; and Brush Wellman Inc.	Un-obscured light collecting area of no less than 25 square meters	Same	Same
Sunshield	Northrop Grumman Space Technology, Redondo Beach, California	Enable Zodiacal-light-background-limited observations over the wavelength range 1.7-10 micrometers	Same	Same
Near-Infrared Camera (NIRCam) instrument	University of Arizona; Lockheed Martin	Optimized for finding first light sources, and operating over the wavelength range 0.6-5 microns	Same	Same
Near-Infrared Spectrometer (NIRSpec)	European Space Agency (ESA)	Operating over the wavelength range 0.6-5 microns with three observing modes	Same	Same
Mid-Infrared Instrument (MIRI)	ESA, University of Arizona, Jet Propulsion Lab	Operating over the wavelength range 5-27 microns, providing imaging, coronagraphy, and spectroscopy	Same	Same
Fine Guidance Sensor	Canadian Space Agency (CSA)	Provides scientific target pointing information to the observatory's attitude control sub-system	Same	Same

Mission Directorate:	Science
Theme:	Astrophysics
Program:	James Webb Space Telescope
Project In Formulation:	James Webb Space Telescope

Schedule ROM Estimate

The JWST schedule rebaseline has been completed. JWST is in late mission formulation, although some long-lead flight items are already in production per instructions from NASA Headquarters when the program entered the preliminary design phase (i.e., Phase B). JWST was authorized to start formulation in March of 1999 and mission confirmation is scheduled to occur in mid to late FY 2008.

Milestone Name	Formulation Estimate	FY 2007 PB Request	FY 2008 PB Request
Formulation			
Technology Non-Advocate Review (T-NAR)		Under Review	January 2007
Non-Advocate Review/Preliminary Design Review		Under Review	March 2008
Critical Designe Review		Under Review	July 2009
Launch		Under Review	June 2013

Mission Directorate:	Science
Theme:	Astrophysics
Program:	James Webb Space Telescope
Project In Formulation:	James Webb Space Telescope

Project Management

GSFC is responsible for JWST project management. NASA and GSFC Program Management Councils have program oversight responsibility.

Project Element	Element Oversight	Lead Performer	Partners
Observatory	GSFC	NGST	Ball, ITT, ATK
Mission management and System Engineering	GSFC	GSFC	NGST
Integrated Science Instrument Module (ISIM)	GSFC	GSFC	ATK, Swales
NIRCam	University of Arizona	Lockheed Martin	Teledyne (formerly Rockwell), GSFC
NIRSpec	ESA	Astrium	GSFC
MIRI	JPL	European Consortium	JPL, NGST, Teledyne (formerly Rockwell)
FGS-TF	CSA	COM DEV	Teledyne (formerly Rockwell), NASA-GSFC
Ariane 5 ECA launch vehicle and launch operations	ESA	Arianespace	
Ground control systems and science operations and control center NASA-GSFC, JPL-DSN	STScI	STScI	GSFC, JPL (DSN)

Acquisition Strategy

JWST is being built by Northrop Grumman Space Technology (Redondo Beach, CA), teamed with Ball (Boulder, CO), ITT (Rochester, NY) and Alliant Techsystems (Edina, MN). Selections were made via NASA Request For Proposal.

The Space Telescope Science Institute (STScI), in Baltimore, MD, is developing the Science and Operations Center and associated services.

The Integrated Science Instrument Module (ISIM) is being provided by GSFC.

The University of Arizona, Tucson, is providing the near-infrared science camera. The selection was made via a NASA Announcement of Opportunity.

The European Space Agency is providing the Mid-Infrared Instrument, with management and technical participation by JPL, which was selected for this role after an internal NASA competition. The Europeans are also providing the Near-Infrared Spectrometer and an Ariane 5 launch vehicle.

The Canadian Space Agency is providing the Fine Guidance Sensor.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	James Webb Space Telescope
Project In Formulation:	James Webb Space Telescope

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Relevance	Science Assessment Team	08/2005	Validated JWST science for rebaseline	N/A
Performance	Special Review Team & IPAO	04/2006	Approved revised cost & schedule estimates. JWST rebaselined	N/A
Performance	IPAO & GSFC	N/A	Technical Non-Advocate Review (T-NAR)	01/2007
Performance	IPAO & GSFC	N/A	Non-Advocate Review (NAR)/Preliminary Design Review (PDR)	03/2008

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
JWST Planning Risks	JWST is a complicated system with unprecedented design features; therefore, cost and schedule estimates contain additional uncertainty during formulation. Further cost growth and schedule extension is possible.	JWST completed a replan in FY06, as well as special review by NASA's Program Assessment and Evaluation (PA&E) office. Independent review and scrutiny of the program continue through the remainder of mission formulation and into implementation (See "Independant Reviews" Section).
JWST Advanced Technology Develompent Risk	JWST requires advances in several technologies, which could present cost and schedule problems.	To ensure these technologies are developed and are ready when needed, NASA is aggressively developing large, lightweight cryogenic optics, wavefront sensing and control algorithms, and high-performance detectors. All technologies for JWST will be mature enough in 2007 to reduce risk to an acceptable level for mission confirmation; Technology Non-Advocate Review (T-NAR) to be held in January 2007.
JWST Partnership Risk	Because JWST is an international collaboration, NASA may incur schedule and cost impacts caused by challenges in Europe and Canada that are outside of NASA's control. Experience with similar collaborations indicates that this is likely to occur.	NASA has written clearly-defined interfaces and is actively managing and complying with export controls (ITAR).

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Hubble Space Telescope

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Hubble Space Telescope	277.2	343.0	277.7	165.2	152.8	151.4	151.3

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	FY 2007 PB Request	FY 2008 PB Request	Change
Hubble Space Telescope	**302.2**	**277.7**	**-24.5**
Operations profile adjusted to better match current plans.			

Program Overview

Since 1990, the Hubble Space Telescope has used its pointing precision, powerful optics, and state-of-the-art instruments to explore the visible, ultraviolet, and near-infrared regions of the electromagnetic spectrum. When Hubble is no longer able to carry out its scientific mission, the observatory will continue to investigate the formation, structure, and evolution of stars and galaxies; study the history of the universe; and provide a space-based research facility for optical astronomy.

Planning is underway to carry out the final servicing mission (SM4), scheduled for as early as May 2008. SM4 will not only restore capabilities but improve performance with new instruments. Hubble operations and development funding also supports a suite of life extension activities in order to maximize science return as the telescope's capabilities degrade over time.

For more information, please see:
http://hubble.gsfc.nasa.gov/index.php.

Program Relevance

The Hubble Space Telescope provides the means to investigate the formation, structure, and evolution of stars and galaxies, and studies the history of the universe in visible, ultraviolet, and near-infrared regions of the electromagnetic spectrum.

The Hubble Space Telescope (HST) contributes to Strategic Plan Goal 3D: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets. More specifically, HST contributes primarily to the following Outcomes:

- 3D.2 Progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects recognized in the present universe; and
- 3D.3 Progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems.

Plans For FY 2008

The HST Program will continue operations and observatory life extension efforts. Service Mission 4 will be undertaken.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Hubble Space Telescope

Project Descriptions

The Hubble Space Telescope orbits Earth every 97 minutes, inclined 28.5 degrees to the equator (low Earth orbit), 575 kilometers (360 miles) above the Earth's surface. Equipped with a 2.4 meter primary mirror, Hubble operates in wavelengths from the near-ultraviolet to the near-infrared. The observatory was designed to be serviced and upgraded by astronauts, and four servicing missions have been carried out since its launch in 1990. In 2002, the Shuttle crew installed the Advanced Camera for Surveys (ACS) and a cryo-cooler that brought the ailing Near Infrared Camera and Multi-Object Spectrometer (NICMOS) back to life. New instruments scheduled for installation on SM4 include the Cosmic Origins Spectrograph (COS) and Wide Field Camera-3 (WFC3).

HST Operations

Operations support includes Hubble's Space Telescope Operations Control Center (STOCC), the Space Telescope Science Institute (STScI), and the HST data analysis program.

The STOCC at Goddard Space Flight Center, in Greenbelt Maryland, is "Hubble Mission Control": they 'drive' the telescope 24 hours a day, seven days a week; integrate, validate, and update flight software; and support life-extension activities and upcoming servicing missions.

STScI, in Baltimore, Maryland, is responsible for the Hubble Science Program that includes the following: a Guest Observer Program in which scientists propose for observation time; HST data archives; life-extension and operations of the telescope; as well as outreach to the community (including all the amazing images taken from the observatory).

HST Development

Development efforts are currently focused primarily on Servicing Mission-4 (SM4). In order to continue operating Hubble, new engineering hardware will need to be installed, specifically batteries, gyroscopes, and a refurbished Fine Guidance Sensor (FGS). A soft capture mechanism is also scheduled to be added for future deorbit of the telescope.

In order to expand the scientific power of the telescope, two new scientific instruments are planned for installation during SM4: the Cosmic Origins Spectrograph (COS) and the Wide Field Camera-3 (WFC3). Each instrument contains advanced technology sensors which surpass what has been available on Hubble to-date, and improvement factors of 10 times or greater are expected in certain key performance areas. An attempt will also be made to repair the failed Space Telescope Imaging Spectrograph (STIS) instrument.

There is also an operations support component within Hubble development which provides the technical expertise required for day-to-day spacecraft operations, performance monitoring, anomaly identification, failure work-around implementation, and operational life extension initiatives.

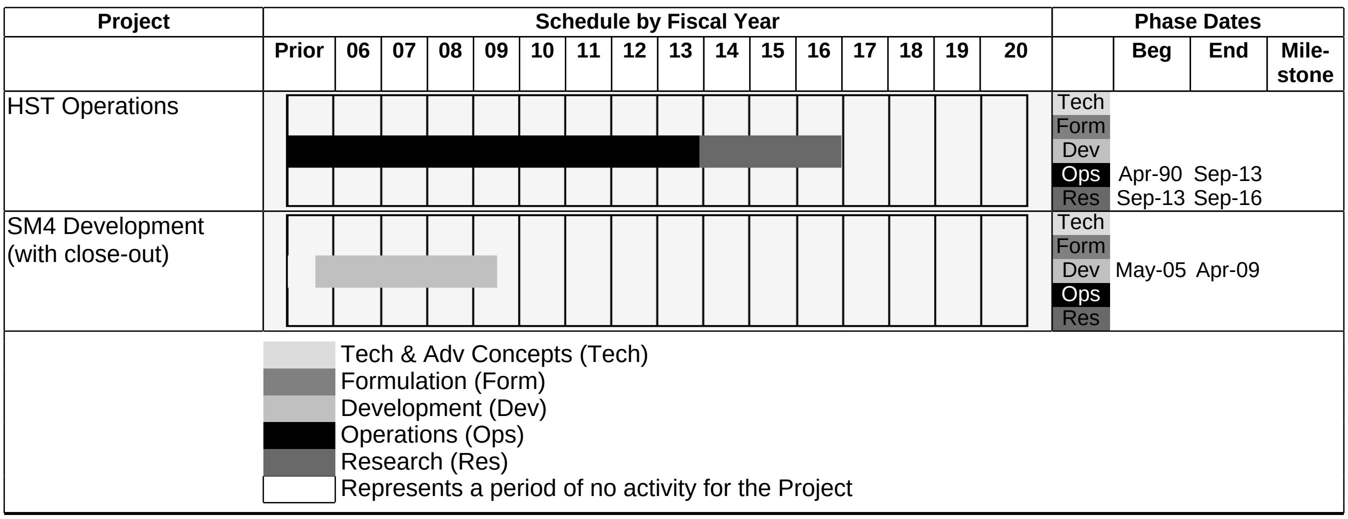
After SM4, the servicing mission development function will disappear, and the staffing associated with it will be eliminated. However, the need for the technical expertise to assure the efficient, productive, and safe operations of the Hubble Observatory, and to maximize its remaining science output following the SM4 investment will remain.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Hubble Space Telescope

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Extend HST science operations.	HST	N/A	To 20xx
COS Instrument will provide more than 10 times gain in sensitivity over previous HST instruments.	HST Development	N/A	Installed May 2008
Wide Field Camera 3's UVIS will have 10x better spatial resolution (equivalent to a 16.8 megapixel).	HST Development	N/A	Installed May 2008

Implementation Schedule



Program Management

GSFC is responsible for HST project management. The NASA Program Management Council and GSFC Center Management Council have program oversight responsibility.

Project	Oversight	Lead Performer	Partners
Operations	GSFC	Space Telescope Science Institute, Baltimore, MD	N/A
SM4	GSFC	GSFC	N/A
Hubble European Space Agency Information Center	N/A	N/A	European Space Agency

Acquisition Strategy

All major acquisitions are in place for operations and servicing. Space Telescope Science Institute, Baltimore, MD; Ball Aerospace and Technologies Corp., Boulder, CO; Johnson Space Center, Houston, TX are providing support for SM4. The Space Telescope Science institute is providing support for the Hubble European Space Agency Information Center.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Hubble Space Telescope

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	SRB & GSFC	09/2002	Critical Design Review & Technical Readiness Review (Development and Operations)	05/2007
Other	National Research Council	07/2004	Assessed the viability of a shuttle servicing mission, evaluated robotic and ground operations to extend the life of the telescope as a valuable scientific tool, assessed telescope component failures and their impact, and provided an overall risk-benefit assessment of servicing options.	N/A

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Spacecraft Hardware Performance	Degradation or failure of critical spacecraft hardware could result in loss of science program or mission.	Continue to identify and develop life-extension initiatives: -One gyro science, zero gyro safemode and hybrid instrument operations; -Battery management improvements; and -Forward looking science observations.
Servicing Mission	Selected SM4 mission dates become later than prudent for telescope survivability.	Develop alternate means of energy management for more aggressive rendezvous and docking concepts.
Shuttle schedule	If additional shuttle inspection/repair requirements are identified, there may be a loss of shuttle resources available for HST servicing.	Preliminary shuttle timeline shows full 5 HST Extra Vehicular Activities (EVAs), with early and late shuttle inspections. Continue integrated planning with shuttle program and develop shortened-mission priorities and associated flight rules, if necessary.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Navigator

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Navigator	145.5	124.7	57.1	58.4	59.5	61.0	62.5
Space Interferometer (SIM) - PlanetQuest	115.0	100.6	21.6	22.1	23.4	23.8	24.0
Other	30.4	24.1	35.5	36.3	36.1	37.2	38.5

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure. The Navigator Program has been refocused. Development of SIM is deferred beyond the current budget horizon. TPF technology work has been restored, and Keck Interferometer and LBTI will continue forward in development.

Highlights of Major Program Changes

	FY 2008		
Navigator	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Space Interferometer (SIM) - PlanetQuest	**139.0**	**21.6**	**-117.3**
SIM will be funded at a level that supports engineering risk reduction, additional work on mission design and core expertise in interferometry and related research and technology.			
Other	**31.6**	**35.5**	**3.8**
TPF technology development activities are re-established for a subset of starlight suppression technology for coronograph and interferometer development.			

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Navigator

Program Overview

Are humans alone? For centuries, humankind has pondered this question. Within the past few decades, advances in science and technology have brought humans to the threshold of finding an answer to this timeless question.

Recent discovery of planets around stars other than the Sun confirms that the solar system is not unique. Indeed, these extrasolar planets appear to be common in the galactic neighborhood. Although the giant, Jupiter-like planets discovered thus far are unlikely to support life, some may be in systems that also contain smaller, terrestrial planets like Mars and Earth.

Against the backdrop of these discoveries, the Navigator Program addresses the following science objectives: (1) Learn how galaxies, stars, and planets form, interact, and evolve by focusing on observing the formation of planetary systems and characterizing their properties. (2) Look for signs of life in other planetary systems by focusing on: (a) discovering planetary systems of other stars and their physical characteristics and (b) searching for worlds that could or do harbor life.

The Navigator Program consists of a coherent series of increasingly challenging projects, each complementary to the others and all missions building on the results and capabilities of those that preceded them as NASA searches for habitable planets outside of the solar system. The Keck Interferometer will characterize the inner dust environments around other star systems, while the Large Binocular Telescope Interferometer will characterize outer dust environments and observe giant planets. SIM will completely characterize masses and orbits of planets in nearby star systems and identify candidate terrestrial planets for further study. Each mission measures unique properties of exoplanets. Together the missions build a synergistic picture of exoplanets. No single mission can do this.

For more information, please visit: http://planetquest.jpl.nasa.gov/index.cfm.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Navigator

Program Relevance

The understanding of planetary systems has undergone a profound shift since 1995 when the first exoplanets were discovered. The field has been transformed from one in which extrapolation from the solar system has been replaced by the empirical wealth of over 200 exoplanets. The sheer variety of giant planets and planetary systems--including planets orbiting very close to stars or on highly elliptical orbits, and resonance-locked pairs of planets--has come as a surprise. Yet these discoveries just reveal the "tip of the iceberg." If the solar system is typical, then these giant planets may be accompanied by many sibling terrestrial planets.

The Navigator Program is the focus of NASA's efforts to enable advanced telescope searches for Earth-like planets, as called for by the Vision for Space Exploration. The objectives of the program are:

- Search for and detect terrestrial planets that might exist in the habitable zones of nearby stars.
- Characterize the atmospheres of all detected planets.
- Search for indicators of the presence of life on terrestrial planets.
- Study each planetary system (planets plus zodiacal dust) as a whole.

The Navigator Program contributes to achieving Subgoal 3D in the NASA Strategic Plan: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.

The program contributes to the following outcome:
3D.4. Progress in creating a census of extra-solar planets and measuring their properties.

Plans For FY 2008

Keck Interferometer will offer new nulling modes of operation for competitive scientific access. In 2008, the Large Binocular Telescope (LBT) Interferometer instrument will hold a pre-ship review (before being delivered to the LBT Observatory). The SIM, TPF, and Michelson Science Center project plans for FY 2008 are under revision at this time.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Navigator

Project Descriptions

The Navigator Program consists of a coherent series of increasingly challenging projects, each complementary to the others and all missions building on the results and capabilities of those that preceded them as NASA searches for habitable planets outside of the solar system. The Keck Interferometer will characterize the inner dust environments around other star systems, while the Large Binocular Telescope Interferometer will characterize outer dust environments and observe giant planets. SIM will completely characterize masses and orbits of planets in nearby star systems and will identify candidate terrestrial planets for further study. Each mission measures unique properties of exoplanets. Together the missions build a synergistic picture of exoplanets. No single mission can do this.

Space Interferometry Mission (SIM)

In NASA's search for Earth-like planets, the most essential questions concern the number and variety of planet sizes and orbits. SIM will carry out a census of nearby planetary systems, returning this fundamental information as well as the location and masses of specific targets for further detailed study. SIM will also study the evolution of planet systems, and a wide variety of other general astrophysics questions. SIM is in an extended formulation.

Keck Interferometer (KI)

Keck Interferometer will carry-out a broad range of measurements of dust and gas around stars, particularly including the inner region of the disks where planets similar to Earth might form. These measurements, coupled with complementary data from LBTI, will help to characterize the processes of planet formation and evolution, and will help to determine the telescope size needed to enable a future Terrestrial Planet Finder mission. The Keck Interferometer is in development.

Terrestrial Planet Finder (TPF)

TPF will detect Earth-like planets in the habitable zone of nearby stars and will measure the colors and spectra of these planets, in the visible and infrared respectively, to characterize them and look for signs of life. TPF will also study the evolution of planet systems, and a wide variety of other general astrophysics questions. TPF is in pre-formulation phase, and is undertaking technology risk reduction activities.

Large Binocular Telescope Interferometer (LBTI)

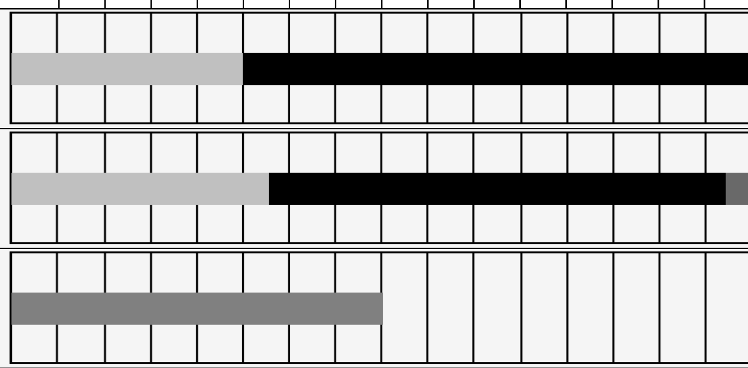
LBTI will carry-out a broad range of measurements of dust and gas around stars, including the outer region of the disks where planets similar to Jupiter might form. These measurements, coupled with complementary data from Keck Interferometer, will help to characterize the processes of planet formation and evolution, and will help to determine the telescope size needed to enable a future Terrestrial Planet Finder mission. LBTI is in development.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Complete assessment of exoplanet science capability and strategies.	All Navigator Projects	N/A	2007
Keck's two telescopes linked as an interferometer with an 85-meter baseline.	Keck Interferometer	9/2009	9/2009

Implementation Schedule

Schedule by Fiscal Year: Prior, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20



Project	Phase	Beg	End	Mile-stone
Keck Interferometer	Tech			
	Form			
	Dev	Feb-03	Sep-09	
	Ops	Oct-09	Oct-24	
	Res			
Large Binocular Telescope Interferometer	Tech			
	Form	Jan-01	Nov-02	
	Dev	Nov-02	May-10	
	Ops	May-10	Mar-20	
	Res	Mar-20	Mar-23	
SIM	Tech			
	Form	Oct-98	Oct-12	
	Dev			
	Ops			
	Res			

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

JPL is responsible for Navigator program management; Agency Program Management Council has program oversight responsibility.

Project	Oversight	Lead Performer	Partners
Large Binocular Telescope Interferometer (LBTI)	JPL	Univesity of Arizona	None
Space Interferometer Mission (SIM)	JPL	JPL	None
Keck Interferometer (KI)	JPL	JPL	California Association for Research and Astronomy.
Terrestrial Planet Finder (TPF)	JPL	JPL	None

Acquisition Strategy

Major acquisitions are already completed for the Keck Interferometer.

Northrop Grumman Space Technology (NGST) was competitively selected via a Request for Proposal issued for the spacecraft assembly, test and launch operations (ATLO), and spacecraft operations support. Science Team Members were competitively selected through an Announcement of Opportunity; The SIM science team is comprised of Principal Investigators from institutions in California, Ohio, Maryland, Washington, New Hampshire, Virginia, and the U.S. Naval Observatory. Northrop Grumman Space Technology is responsible for the spacecraft ATLO and spacecraft operations support. California Institute of Technology was selected for science operations and science center.

W.M. Keck Observatory, California Association for Research in Astronomy (CARA) operates the twin Keck 10 meter telescopes. SAIC (Science Applications International Corporation, headquartered in San Diego, CA) and Tetra Tech (Pasadena, CA) have supported NASA in the Environmental Impact Statement process. CalTech manages the project, provides technical expertise in interferometry, and develops key hardware and software components. The University of Hawaii holds the lease for the Mauna Kea Science Reserve.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	EIRB/SRB	09/2006	Review of Navigator Program Science Plan was completed successfully and the plan published.	09/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Exo-planet Science Capability	Extended technology and formulation phases may make it difficult to retain expertise on exo-planet science.	An exo-planet task force has been formed to assess current planet-finding research and technology, and suggest a research strategy leading up to the next decadal survey.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Navigator
Project In Formulation:	Space Interferometer (SIM) - PlanetQuest

Budget / Life Cycle Cost

Budget Authority ($ millions)	FY06	FY07	FY08
FY 2008 President's Budget Request	115.0	100.6	21.6
FY 2007 President's Budget Request	117.0	98.5	139.0
Total Change from FY 2007 President's Budget Request	-2.0	2.1	-117.3

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Project Purpose

SIM will implement breakthroughs in precision control technology to measure the positions and distances of stars with unprecedented precision. By measuring small reflex motions of nearby stars, SIM will conduct a census of planetary systems around 2000 nearby stars, detecting and measuring the masses of planets as small as Earth around the nearest stars. SIM will show which small, rocky planets are in the habitable zones. SIM will address the important topic of solar system evolution by studying giant planets around young stars, revealing their location and distribution shortly after formation.

With precision measurements of star positions and motions throughout the Milky Way and in nearby galaxies, SIM will enable a revolutionary gain in our understanding of the processes whereby our galaxy was assembled from smaller components and how it continues to evolve. Precise distance measurements for stars will permit studies of the dynamics and evolution of stars and star clusters, determine sizes and masses of rare objects such as x-ray binaries, and definitively calibrate the luminosities of virtually all stellar types, enabling improved precision of distance measurements throughout the Universe.

Project Parameters

SIM combines the light from two telescopes separated by approximately 9 meters. By measurement and control of light phase, with new precision measurement technology developed for this mission, SIM will measure the relative positions of stars with errors of less than 1 microarcsecond. With accurate position measurements, SIM will measure the distances to stars throughout the Milky Way galaxy and in nearby galaxies.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Navigator
Project In Formulation:	Space Interferometer (SIM) - PlanetQuest

Project ROM Estimate

SIM development has been deferred beyond the budget horizon. SIM is funded at a level that supports engineering risk reduction, additional work on mission design and core expertise in interferometry and related science.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Spacecraft	Northrop Grumman Space Technology (NGST)	Build, Assemble Test and Launch an optical interferometer with a 9m baseline & provide	operations support	N/A
Science Team	Institutions in California, Ohio, Maryland, Washington, New Hampshire and Virginia, Georgia and DC	Preparatory science (ground observations to ID target stars; develop observing scenarios)	N/A	N/A

Schedule ROM Estimate

SIM began formulation in October of 1998, and entered phase B in August of 2003. Due to budgetary constraints, SIM is funded at a level that supports engineering risk reduction, and additional work on mission design and core expertise in interferometry and related science.

Milestone Name	Formulation Estimate	FY 2007 PB Request	FY 2008 PB Request
Formulation			
LRD	N/A	2015-2016	N/A

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Navigator
Project In Formulation:	Space Interferometer (SIM) - PlanetQuest

Project Management

JPL is responsible for SIM project management; NASA Program Management Council and JPL Center Management Council have program oversight responsibility.

Project Element	Element Oversight	Lead Performer	Partners
Interferometer	JPL	JPL	
Spacecraft and Spacecraft Operations	JPL	Northrup Grumman Space Technology	
Mission Management and System Engineering	JPL	JPL	
Science Operations	JPL	California Institute of Technology	

Acquisition Strategy

Northrop Grumman Space Technology (NGST) was selected via a competitive Request for Proposal issued for spacecraft Assembly, Test and Launch Operations (ATLO), and spacecraft operations support.

Science Team Members (Principal Investigators) were selected through an Announcement of Opportunity; scientists were selected from universities (in California, Maryland, Ohio, Virginia, New Hampshire, Georgia and DC), other government agencies (U.S. Naval Observatory) and the Netherlands.

California Institute of Technology was selected for science operations and science center.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	EIRB	6/2006	Closed engineering milestone 1 & 3: reduce engineering risk of lack of flight heritage for external beam launcher; address power level and reliability of the metrology source flight hardware.	N/A
Performance	EIRB	09/2006	Completed Engineering Milestone #2: reduce engineering risks for building internal beam launcher flight hardware.	N/A
Performance	EIRB	N/A	Close engineering milestone #5: demonstrate instrument communication hardware and software architecture.	7/2007

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Navigator
Project In Formulation:	Space Interferometer (SIM) - PlanetQuest

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Interferometry Expertise	Budget constraints threaten the loss of interferometry expertise developed in the last decade.	Maintain core interferometry expertise at JPL.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Stratospheric Observatory for Infrared Astronomy (SOFIA)

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Stratospheric Observatory for Infrared Astronomy (SOFIA)	90.8	--	77.3	89.1	88.6	89.9	92.1
Stratospheric Observatory for Infrared Astronomy (SOFIA)	88.2	--	77.3	89.1	88.6	89.9	92.1
Other	2.7	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
<u>Stratospheric Observatory for Infrared Astronomy (SOFIA)</u>	FY 2007 PB Request	FY 2008 PB Request	Change
Stratospheric Observatory for Infrared Astronomy (SOFIA)	**0.0**	**77.3**	**77.3**
The SOFIA project is reinstated. Project replanning is under way.			
Other	**0.0**	**0.0**	**0.0**

Program Overview

SOFIA is under development as an astronomical observatory consisting of a 2.5 meter aperture telescope permanently installed in a specially modified Boeing 747 aircraft. The aircraft, with an open-port telescope provided through a partnership with the German Aerospace Center (DLR), was designed to provide routine access to the visual, infrared, far-infrared, and sub-millimeter parts of the spectrum.

Mission objectives include studying many different kinds of astronomical objects and phenomena: (1) star birth and death, (2) formation of new solar systems, (3) identification of complex molecules in space, (4) planets, comets and asteroids in our solar system, (5) nebulae and dust in galaxies (or, Ecosystems of galaxies), (6) black holes at the center of galaxies.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Stratospheric Observatory for Infrared Astronomy (SOFIA)

Program Relevance

SOFIA will contribute to Strategic Plan Goal 3: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.

More specifically, the program will contribute primarily to the following Outcome:
3D.3. Progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems.

SOFIA offers a unique world-class facility for infrared astronomy covering parts of the spectrum that cannot be covered from the ground. As a result, SOFIA will provide unique insights into scientific questions regarding energetics of luminous galaxies, the origin of stars and planetary systems, gas and grain chemistry of the interstellar medium, and the structure of the solar system.

SOFIA also offers operational and technological flexibility that no spacecraft can offer, because it can be deployed to multiple locations and the observatory and its instrument suite can be changed and upgraded over its planned 20-year life.

Plans For FY 2008

- Complete flight testing with the telescope aperture door closed to validate the basic aircraft safety and performance following the extensive structural modifications;
- Flight testing with the telescope aperture door open, to validate the safety and performance characteristics of the aircraft, aperture door system, and telescope assembly in that operational mode; and
- Continue development of critical observatory sub-systems and instruments.

Project Descriptions

The SOFIA observatory was designed as a highly-modified 747SP aircraft with a large open-port cavity aft of the wings, housing a 2.5 meter telescope optimized for infrared/sub-millimeter wavelength astronomy. In addition, the SOFIA Program includes facility-class science instruments, principal investigator labs, data archives, science/mission planning systems, the hangar, and supporting equipment to provide sustained operations for engineering and science flights.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Provide initial science operations with three available instruments.	SOFIA	N/A	Beginning in 2010
Provide remaining five science instruments for use in SOFIA operations.	SOFIA	N/A	N/A
Provide scheduled operations for 20 years.	SOFIA	N/A	hours/year under review
Provide full science operational capability with 4 available instruments.	SOFIA	N/A	Beginning in 2013

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Stratospheric Observatory for Infrared Astronomy (SOFIA)

Implementation Schedule

Project	Schedule by Fiscal Year																Phase Dates			
	Prior	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20		Beg	End	Mile-stone
SOFIA																	Tech			
																	Form			
																	Dev	Dec-96	Sep-10	
																	Ops	Sep-13	Sep-33	
																	Res			

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

Program management, aircraft observatory development, & flight testing have been moved to Dryden Flight Research Center. Science operations & management are at Ames Research Center pending review in 2007.

Project	Oversight	Lead Performer	Partners
SOFIA Observatory Aircraft and Operations	DFRC	L3	German Space Agency (DLR)
SOFIA Science	ARC	USRA	German Space Agency (DLR)

Acquisition Strategy

The project has been restructured with DFRC directly responsible for aircraft management. Contracts are being negotiated to support completion of the development, integration, and test of the airborne platform system, including maintenance, flight operations, and related support.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	ICSMR	11/2004	To review the cost, schedule, and management elements of the SOFIA Program.	N/A
Performance	SOFIA Options Review Team	04/2006	Review and document the status of the program. Develop options for alternative paths forward for the program, and assess the cost and science impacts of the options.	N/A
Performance	Science Mgt. and Ops. Review	new	Review science and operations management's completed results. Scheduled to be completed by 06/2007	N/A

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Stratospheric Observatory for Infrared Astronomy (SOFIA)

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Contract restructuring	The project cannot finalize its replan until the major contractual changes are in place.	ARC and DFRC are working together closely to maintain program continuity and develop a fully integrated schedule to the initial operating capability milestone while completing contract arrangements.
Under-developed operations plan	SOFIA does not yet have a comprehensive operations plan. Costs associated with the operations phase are not yet fully understood.	NASA is conducting a comprehensive independent operations review in the spring of 2007 in order to fully understand the cost and plan the budget accordingly.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Stratospheric Observatory for Infrared Astronomy (SOFIA)
Project In Development:	Stratospheric Observatory for Infrared Astronomy (SOFIA)

Budget / Life Cycle Cost

Budget Authority ($ millions)	Prior	FY06	FY07	FY08	FY09	FY10	FY11	FY12	BTC	LCC TOTAL
FY 2008 President's Budget Request	**468.5**	**88.2**	**--**	**77.3**	**89.1**	**88.6**	**89.9**	**92.1**	**2,425.4**	**3,419.0**
Formulation	35.0	--	--	--	--	--	--	--	--	--
Development	433.5	88.2	46.8	77.3	89.1	88.6	89.9	92.1	2,425.4	3,430.9
Operations	--	--	--	--	--	--	--	--	--	--
Other	--	--	-46.8	--	--	--	--	--	--	-46.8
FY 2007 President's Budget Request	**139.2**	**45.3**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**184.5**
Formulation	--	--	--	--	--	--	--	--	--	--
Development	139.2	45.3	--	--	--	--	--	--	--	--
Operations	--	--	--	--	--	--	--	--	--	--
Other	--	--	--	--	--	--	--	--	--	--
Changes	**329.3**	**42.8**	**--**	**77.3**	**89.1**	**88.6**	**89.9**	**92.1**	**2,425.4**	**3,234.5**
Formulation	35.0	--	--	--	--	--	--	--	--	35.0
Development	294.3	42.9	46.8	77.3	89.1	88.6	89.9	92.1	2,425.4	3,246.4
Operations	--	--	--	--	--	--	--	--	--	--
Other	--	--	-46.8	--	--	--	--	--	--	-46.8

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Project Changes

Project	*Stratospheric Observatory for Infrared Astronomy (SOFIA)*
The SOFIA project is reinstated. Project replanning is under way.	

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Stratospheric Observatory for Infrared Astronomy (SOFIA)
Project In Development:	Stratospheric Observatory for Infrared Astronomy (SOFIA)

Project Purpose

Mission objectives include studying many different kinds of astronomical objects and phenomena, but some of the most interesting are: (1) star birth and death, (2) formation of new solar systems, (3) identification of complex molecules in space, (4) planets, comets and asteroids in our solar system, (5) nebulae and dust in galaxies (or, Ecosystems of galaxies), (6) black holes at the center of galaxies.

Project Parameters

Initial operational capability in January 2010, full operational capability in January 2013. The instruments currently planned to be available at initial operational capabiity are: FLITECAM - First Light Infrared Test Experiment CAMera and HIPO - High-speed Imaging Photometer for Occultation. Operational altitude will be above 41,000 feet, higher than most of the moisture in the atmosphere.

Project Commitments

SOFIA will have initial operational capability in September, 2010 and will begin 20 years of operation as an airborn observatory.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
First Light Infrared Test Experiment CAMera (FLITECAM)	UCLA	Near Infrared Test Camera 1-5 microns	No change	No change
High-speed Imaging Photometer for Occultation (HIPO)	Lowell Observatory	High-speed imaging photometer for Occultations 0.3 - 1.1 microns	No change	No change
Airborne Observatory	NASA, L3, MPC, DLR	Modified 747SP aircraft with 2.5 meter telescope installed	No change	No change

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Stratospheric Observatory for Infrared Astronomy (SOFIA)
Project In Development:	Stratospheric Observatory for Infrared Astronomy (SOFIA)

Schedule Commitments

The development and test plan has been modified to enable earlier science observations by the science community concurrent with the late phases of aircraft flight testing. Previously, the milestone Operational Readiness Review (ORR, FY2011) denoted the time when all instruments were completed and initial science observations would commence, and refinement of telescope performance (such as pointing and stability) were to be performed in the three years following ORR in order to reach full system performance capability. The modified plan provides for initial science observations with a subset of science instruments at a new milestone denoted as Initial Operational Capability (IOC, FY2010), followed by completion of the remaining science instruments and refinement of telescope performance, at which point Full Operational Capability (FOC, FY2013) is reached.

Milestone Name	Confirmation Baseline	FY 2007 PB Request	FY 2008 PB Request
Development			
Full Operational Capability (FOC)	N/A	N/A	2013
Operations Readiness Review (ORR)	2001	N/A	2001
Initial Operational Capability (IOC)	N/A	N/A	2010

Development Cost Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Stratospheric Observatory for Infrared Astronomy (SOFIA)	2007	1,005.5	2007	1,005.5	0	Full Operation (FOC)	1/1/2013	1/1/2013	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**1,005.5**	**1,005.5**	**0.0**
Aircraft/Spacecraft	657.7	657.7	0.0
Science/Technology	199.6	199.6	0.0
Other Project Costs	148.2	148.2	0.0

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Stratospheric Observatory for Infrared Astronomy (SOFIA)
Project In Development:	Stratospheric Observatory for Infrared Astronomy (SOFIA)

Project Management

The current replan places responsibility for SOFIA program management, aircraft observatory development, and flight testing at DFRC, and science management at ARC (pending review in 2007). The responsible official for this project is Richard Howard.

Project Element	Element Oversight	Lead Performer	Partners
SOFIA Science	NASA Program Management Council	ARC, USRA, and DLR	German Space Agency (DLR)
SOFIA Observatory Aircraft and Operations	NASA Program Management Council	DFRC, L3, MPC, and CSC/DyneCorp	German Space Agency (DLR)

Acquisition Strategy

The Project has been restructured with a NASA in-house integrated product team. Contracts are being negotiated to (1) support completion of the development, integration and test of the airborne platform system and (2) maintenance, flight operations, and related support.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	SOFIA Options Review Team	04/2006	Reviewed and documented the status of the program. Developed options for alternative paths forward for the program, and assessed the cost and science impacts of the options. Results used to formulate SOFIA program rebaseline.	N/A
Performance	SOFIA Science Management Team	New	Review science and operations management. To be completed by 06/2007.	N/A
Performance	ICSMR	11/2004	To review the cost, schedule, and management elements of the SOFIA program.	N/A

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Stratospheric Observatory for Infrared Astronomy (SOFIA)
Project In Development:	Stratospheric Observatory for Infrared Astronomy (SOFIA)

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
CDDS Failure	If the Cavity Door Drive System fails, it could result in the door locking in the open position, forcing the aircraft to land with the door open possibly resulting in significant damage to the observatory.	NASA will conduct a review of this subsystem, with DLR support. We will adjust the CDDS plan and requirements based on the review.
MCCS Development	Mission Communication and Control System DevelopmentThe MCCS is a complex system linking the aircraft flight controls, telescope assembly controls and mission communications systems. Development is relatively immature, and if problems arise, the development schedule could slip.	NASA will conduct a review of this subsystem to determine whether portions can be descoped.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Astrophysics Explorer

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Astrophysics Explorer	71.1	69.4	99.1	88.8	28.2	11.7	5.7
Wide-Field Infrared Survey Explorer	54.5	58.4	83.0	74.9	14.0	5.5	1.7
Other	16.6	11.0	16.1	13.9	14.2	6.2	3.9

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Astrophysics Explorer	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Wide-Field Infrared Survey Explorer	**71.7**	**83.0**	**11.3**
Budget profile adjusted to reflect WISE Delta Confirmation Review held in October 2006.			
Other	**14.4**	**16.1**	**1.6**
No major program changes.			

Program Overview

The Explorer Program provides frequent flight opportunities for world-class astrophysics and space physics investigations, utilizing an innovative and efficient approach to spacecraft development and operations. The program is composed of a series of independent space science missions that share a common funding and management structure. The program emphasizes missions that can be accomplished under the control of the scientific research community within specified lifecycle cost requirements. The program provides access to space and launch vehicle funding. These funds are part of the total cost cap for each mission. For each mission class, launch will take place within the following number of months after implementation starts: Small Explorer (SMEX), 33 months; medium-class Explorer (MIDEX), 40 months.

The Wide-field Infrared Survey Explorer (WISE) is the only Explorer project in development currently supporting the Astrophysics Theme. Please refer to the Heliophysics Theme for information on additional Explorer projects. For more information, see the Explorer Program homepage for information: http://explorers.gsfc.nasa.gov/missions.

Program Relevance

WISE will contribute to Strategic Sub-goal 3D: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.

More specifically, the program will contribute to the following Outcomes:

3D.2. Progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects recognized in the present universe.

3D.3. Progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems.

Plans For FY 2008

Spacecraft and payload integration and testing will begin.

Suzaku

Suzaku, launched in July 2005, is Japan's fifth X-ray astronomy mission, and was developed at the Institute of Space and Astronautical Science of Japan Aerospace Exploration Agency (ISAS/JAXA) in collaboration with U.S. (NASA/GSFC, MIT) and Japanese institutions. Suzaku will study black holes, neutron stars and quasars to unravel the physics high-energy processes and the behavior of matter under extreme conditions. Suzaku has also been formerly referred to as Astro-E2.

Swift

Swift launched in November, 2004. Swift studies the position, brightness, and physical properties of gamma ray bursts. With Swift, a NASA mission with international participation, scientists now have a tool dedicated to answering these questions and solving the gamma-ray burst mystery. Its three instruments give scientists the ability to scrutinize gamma-ray bursts like never before. Within seconds of detecting a burst, Swift relays a burst's location to ground stations, allowing both ground-based and space-based telescopes around the world the opportunity to observe the burst's afterglow.

WISE

Planned for launch in 2009, WISE will provide a storehouse of knowledge about the solar system, the Milky Way, and the universe. During its six-month mission, WISE will map the sky in infrared light, searching for the nearest and coolest stars, the origins of stellar and planetary systems, and the most luminous galaxies in the universe. WISE's infrared survey will provide an essential catalog for the James Webb Space Telescope (JWST). Solar panels will provide WISE with electricity as it orbits several hundred miles above the dividing line between night and day on Earth, looking out at right angles to the Sun and always pointing away from the planet. As the telescope orbits from the North Pole to the South Pole and then back up to the North Pole, it will sweep out a circle in the sky. As Earth moves around the Sun, this circle will shift, until WISE has observed the entire sky. WISE is in development.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Begin a 6 month survey of the infrared sky.	WISE	2009	2009

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Astrophysics Explorer

Implementation Schedule

Project	Schedule by Fiscal Year (Prior, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20)	Phase Dates	Beg	End	Mile-stone
WISE		Tech			
		Form	Apr-02	Oct-06	
		Dev	Oct-06	Oct-09	
		Ops	Oct-09	May-10	
		Res	May-10	May-12	
Swift		Tech			
		Form			
		Dev			
		Ops	Apr-04	Sep-11	
		Res			
Suzaku		Tech			
		Form			
		Dev			
		Ops	May-05	Sep-11	
		Res			

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

The Explorer Program is a multiple-project program with program responsibility assigned to GSFC.

Project	Oversight	Lead Performer	Partners
WISE	GSFC	JPL	

Acquisition Strategy

Explorer projects are selected through competitive Announcements of Opportunity, from which multiple investigations are selected for initial concept studies, followed by a competitive down-select to proceed to the next stage of formulation. Investigations are selected to proceed from one phase to the next through execution of contract options, based on successful technical, cost, and schedule performance in the previous phases.

The WISE acquisitions are in place. There are no currently planned Astrophysics Explorer projects requiring future acquisitions.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	WISE IIRT	01/2006	Review the progress and status of the WISE mission. The Integrated Independent Review Team (IIRT) recommended confirmation.	N/A

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Astrophysics Explorer

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Cost cap	The Explorer Program funds smaller projects which, in order to keep projects within their cost caps, have less risk mitigation built into the project design. Rising launch vehicle costs increase the cost-pressure on mission design.	Technical, management, & cost risks for each investigation are carefully examined as part of the selection process; acceptable risks are documented in individual project appendices to the Explorer Program plan. All technical & programmatic risks are further reviewed as part of the preliminary design review (PDR)and project confirmation review to ensure risks have been mitigated.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Astrophysics Explorer
Project In Development:	Wide-Field Infrared Survey Explorer

Budget / Life Cycle Cost

Budget Authority ($ millions)	Prior	FY06	FY07	FY08	FY09	FY10	FY11	FY12	BTC	LCC TOTAL
FY 2008 President's Budget Request	**45.1**	**54.5**	**58.4**	**83.0**	**74.9**	**14.0**	**5.5**	**1.7**	**--**	**337.1**
Formulation	45.1	54.5	--	--	--	--	--	--	--	--
Development	--	--	58.4	83.0	74.9	--	--	--	--	--
Operations	--	--	--	--	--	14.0	5.5	1.7	--	--
Other	--	--	--	--	--	--	--	--	--	--
FY 2007 President's Budget Request	**42.1**	**69.7**	**53.9**	**71.7**	**44.8**	**8.8**	**4.3**	**--**	**--**	**295.3**
Formulation	42.1	69.7	--	--	--	--	--	--	--	--
Development	--	--	53.9	71.7	44.8	--	--	--	--	--
Operations	--	--	--	--	--	8.8	4.3	--	--	--
Other	--	--	--	--	--	--	--	--	--	--
Changes	**3.0**	**-15.2**	**4.5**	**11.3**	**30.1**	**5.2**	**1.2**	**1.7**	**--**	**41.9**
Formulation	3.0	-15.2	--	--	--	--	--	--	--	-12.2
Development	--	--	4.5	11.3	30.1	--	--	--	--	45.9
Operations	--	--	--	--	--	5.2	1.2	1.7	--	8.1
Other	--	--	--	--	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Project Changes

Project	*Wide-Field Infrared Survey Explorer*
The WISE Delta Confirmation Review was held in October 2006. WISE has entered the development phase.	

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Astrophysics Explorer
Project In Development:	Wide-Field Infrared Survey Explorer

Project Purpose

The Wide-Field Infrared Survey Explorer (WISE) Mission has six objectives: (1) finding the most luminous galaxies in the universe; (2) finding the closest stars to the Sun; (3) detecting most main-belt asteroids larger than three kilometers; (4) extending the 2MASS Project survey into the thermal infrared; (5) enabling a wide variety of studies ranging from the evolution of protoplanetary debris disks to the history of star formation in normal galaxies; and (6) providing a catalog for the James Webb Space Telescope (JWST).

Project Parameters

The single WISE instrument is a four-channel imager that will take overlapping snapshots of the sky. WISE includes: a two-stage, solid-hydrogen cryostat to cool detectors and optics; a 40-centimeter telescope and reimaging optics; and a scan mirror to stabilize the line-of-sight while the spacecraft scans the sky.

Project Commitments

WISE will launch in October 2009 on a six-month mission (with a one-month checkout) to provide an all-sky survey in the wavelengths from 3.5 to 23 microns--up to 1000 times more sensitive than the Infrared Astronomical Satellite (IRAS) survey.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Spacecraft	Ball Aerospace & Technologies Corporation	40-centimeter telescope	N/A	Same
Launch Vehicle	Boeing	Delta 2	N/A	Same
Science Payload	Space Dynamics Laboratory	Instrument integration and launch support	N/A	Same
Mission Operations and Data Management	UCLA			

Schedule Commitments

WISE entered development in October 2006 after an extended formulation phase.

Milestone Name	Confirmation Baseline	FY 2007 PB Request	FY 2008 PB Request
Development			
Begin Development	October 2006	N/A	October 2006
Assembly, Test & Launch Operations	April 2008	April 2008	NA
Launch Readiness	June 2009	N/A	October 2009

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Astrophysics Explorer
Project In Development:	Wide-Field Infrared Survey Explorer

Development Cost Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Wide-Field Infrared Survey Explorer	2007	217.9	2007	217.9	0	Launch Readiness	10/31/2009	10/31/2009	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**217.9**	**217.9**	**0.0**
Science/Technology	4.4	4.4	0.0
Payload	20.4	20.4	0.0
Aircraf/Spacecraft	33.4	33.4	0.0
Launch Vehicle	76.9	76.9	0.0
Ground Systems	11.9	11.9	0.0
Other	70.9	70.9	0.0

Project Management

JPL is responsible for WISE Project Management. The GSFC Program Management Council has program oversight responsibility. The responsible official for this project is Richard Howard.

Project Element	Element Oversight	Lead Performer	Partners
Spacecraft	JPL	Ball Aerospace & Technologies Corporation	N/A
Mission operations and data analysis	JPL	JPL	N/A
Payload	JPL	Space Dynamics Laboratory	N/A

Acquisition Strategy

WISE was selected competitively as part of the Explorer Announcement of Opportunity in 2002. All elements of the project were included in the competitive proposal. The cryogenic instrument is being built by Space Dynamics Laboratory; Ball Aerospace and Technologies Corporation in Colorado is building the spacecraft.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Astrophysics Explorer
Project In Development:	Wide-Field Infrared Survey Explorer

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IIRT	N/A	Assembly, Test, Launch, and Operations (ATLO) Readiness Review	03/2009
Performance	IIRT	01/2006	Review the progress and status of the WISE mission / Integrated Independent Review Team (IIRT) recommended confirmation.	N/A

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Inadvertent Cover Deployment	If the cover deploys other than when commanded, or doesn't deploy when commanded, the mission will not be operable.	Use of flight-proven actuators and pyro firing circuitry. Utilize the lessons learned from SPIRIT III and WIRE anomalies.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	International Space Science Collaboration

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
International Space Science Collaboration	13.0	19.8	26.5	39.1	38.7	36.5	35.2
Herschel	5.9	12.5	17.1	29.0	29.3	29.5	29.3
Other	7.1	7.3	9.5	10.1	9.4	7.0	5.9

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
International Space Science Collaboration	FY 2007 PB Request	FY 2008 PB Request	Change
Herschel	**13.4**	**17.1**	**3.6**
Delay in ESA launch date.			
Other	**10.2**	**9.5**	**-0.7**
No significant changes.			

Mission Directorate:	Science
Theme:	Astrophysics
Program:	International Space Science Collaboration

Program Overview

The International Space Science Collaboration Program supports U.S. participation in large missions led by international partners. As part of this program, NASA funds particular elements or subsystems for each mission, generally scientific instruments. In this way, U.S. scientists participate in the international missions, which cost less than the United States performing the missions itself and provide access to mission data that is otherwise inaccessible.

Herschel and Planck, two projects in the International Space Science Collaboration (SSC) Program, are ESA-led missions. NASA is making significant contributions to these ESA missions, funding critical elements of several science instruments and subsystems, and supporting U.S. investigators. Herschel and Planck will be launched together on an Ariane-5 and then separate while being injected into their transfer orbits. The spacecraft will then proceed independently to their operational orbits. Herschel has been designed to unveil a face of the early universe that has remained hidden until now. Thanks to its ability to detect radiation at far-infrared and sub-millimeter wavelengths, Herschel will observe dust-obscured and cold objects that are invisible to other telescopes. Targets for Herschel will include clouds of gas and dust where new stars are being born, disks out of which planets may form, and comet atmospheres packed with complex organic molecules. Herschel will provide insight into how the first galaxies formed and how they evolved to give rise to present day galaxies. NASA is contributing to two of the three instruments. Planck will help provide answers to one of the most important sets of questions asked in modern science: how did the universe begin, how did it evolve to the state observed today, and how will it continue to evolve in the future? Planck's objective is to analyze, with the highest accuracy ever achieved, the remnants of the radiation that filled the universe immediately after the Big Bang, which is observed today as the cosmic microwave background (CMB). NASA is contributing to both instruments. Herschel and Planck are scheduled to launch in 2008. NASA has delivered the instruments and components it is providing for these two projects and is currently working with ESA on the their final testing and integration onto the spacecraft.

For more information go to http://sci.esa.int/science- e/www/area/index.cfm?fareaid=16.

Program Relevance

ISSC will contribute to Stategic Plan Goal 3: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets. More specifically, the program will contribute to the following Annual Performance Goals:

- 3D.1. Progress in understanding the origin and destiny of the universe, phenomena near black holes, and the nature of gravity;
- 3D.2. Progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects recognized in the present universe; and
- 3D.3. Progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems.

Plans For FY 2008

Final stages of testing and integration of the Herschel and Planck instruments with the European Space Agency will take place.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	International Space Science Collaboration

Program Overview

The International Space Science Collaboration Program supports U.S. participation in large missions led by international partners. As part of this program, NASA funds particular elements or subsystems for each mission, generally scientific instruments. In this way, U.S. scientists participate in the international missions, which cost less than the United States performing the missions itself and provide access to mission data that is otherwise inaccessible.

Herschel and Planck, two projects in the International Space Science Collaboration (SSC) Program, are ESA-led missions. NASA is making significant contributions to these ESA missions, funding critical elements of several science instruments and subsystems, and supporting U.S. investigators. Herschel and Planck will be launched together on an Ariane-5 and then separate while being injected into their transfer orbits. The spacecraft will then proceed independently to their operational orbits. Herschel has been designed to unveil a face of the early universe that has remained hidden until now. Thanks to its ability to detect radiation at far-infrared and sub-millimeter wavelengths, Herschel will observe dust-obscured and cold objects that are invisible to other telescopes. Targets for Herschel will include clouds of gas and dust where new stars are being born, disks out of which planets may form, and comet atmospheres packed with complex organic molecules. Herschel will provide insight into how the first galaxies formed and how they evolved to give rise to present day galaxies. NASA is contributing to two of the three instruments. Planck will help provide answers to one of the most important sets of questions asked in modern science: how did the universe begin, how did it evolve to the state observed today, and how will it continue to evolve in the future? Planck's objective is to analyze, with the highest accuracy ever achieved, the remnants of the radiation that filled the universe immediately after the Big Bang, which is observed today as the cosmic microwave background (CMB). NASA is contributing to both instruments. Herschel and Planck are scheduled to launch in 2008. NASA has delivered the instruments and components it is providing for these two projects and is currently working with ESA on the their final testing and integration onto the spacecraft.

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- 3D.2. Progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects recognized in the present universe; and
- 3D.3. Progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems.

Plans For FY 2008

Final stages of testing and integration of the Herschel and Planck instruments with the European Space Agency will take place.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	International Space Science Collaboration

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Provide roughly 7000 hours of science data per year from NASA-provided instrumentation for x years.	Herschel	Launch 2007	Launch 2008
Provide 3 years of science data from NASA-provided instrumentation.	Planck	Launch 2007	Launch 2008

Implementation Schedule

Project	Schedule by Fiscal Year: Prior, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20	Phase Dates	Beg	End	Mile-stone
Herschel		Tech			
		Form	Sep-97	Sep-01	
		Dev	Oct-01	Jul-08	
		Ops			
		Res	Feb-09	Apr-14	
Planck		Tech			
		Form	Sep-97	Sep-01	
		Dev	Oct-01	Jul-08	
		Ops			
		Res	Feb-09	Feb-10	

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

JPL is responsible for Herschel and Planck project management. NASA's Program Management Council and JPL's Center Management Council have program oversight responsibility.

Project	Oversight	Lead Performer	Partners
Herschel	JPL - Herschel project management, including mission and science operations.	JPL	ESA
Planck	JPL is responsible for Planck project management.	JPL	ESA

Acquisition Strategy

U.S. elements for the Herschel and Planck missions have been delivered to ESA. The ISSC Program has no pending project acquisitions. ISSC Program acquisition strategy varies by project, given the differing international partnerships involved in each project.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	International Space Science Collaboration

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IRT	09/2001	Critical Design Review completed successfully	N/A

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
System Configuration	International partnerships entail additional challenges in integrating components and system engineering.	Provide on-site integration and system engineering support as needed.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	International Space Science Collaboration
Project In Development:	Herschel

Budget / Life Cycle Cost

Budget Authority ($ millions)	Prior	FY06	FY07	FY08	FY09	FY10	FY11	FY12	BTC	LCC TOTAL
FY 2008 President's Budget Request	**109.8**	**5.9**	**12.5**	**17.1**	**29.0**	**29.3**	**29.5**	**29.3**	**79.2**	**341.5**
Formulation	10.4	--	--	--	--	--	--	--	--	--
Development	99.4	5.9	12.5	17.1	--	--	--	--	--	--
Operations	--	--	--	--	29.0	29.3	29.5	29.3	79.2	--
Other	--	--	--	--	--	--	--	--	--	--
FY 2007 President's Budget Request	**99.4**	**5.9**	**11.7**	**13.4**	**27.2**	**27.4**	**27.6**	**--**	**102.3**	**315.1**
Formulation	11.0	--	--	--	--	--	--	--	--	--
Development	88.4	5.9	11.7	--	--	--	--	--	--	--
Operations	--	--	--	13.4	27.2	27.4	27.6	--	102.3	--
Other	--	--	--	--	--	--	--	--	--	--
Changes	**10.4**	**0.0**	**0.8**	**3.6**	**1.9**	**1.8**	**1.8**	**29.3**	**-23.1**	**26.5**
Formulation	-0.6	--	--	--	--	--	--	--	--	-0.6
Development	11.0	--	0.8	17.1	--	--	--	--	--	28.9
Operations	--	--	--	-13.4	1.8	1.9	1.9	29.3	-23.1	-1.6
Other	--	--	--	--	--	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Project Changes

Project	*Herschel*
All hardware deliverables have been delivered to the Principal Investigators. ESA has delayed the planned launch.	

Mission Directorate:	Science
Theme:	Astrophysics
Program:	International Space Science Collaboration
Project In Development:	Herschel

Project Purpose

The Herschel project is an astrophysics mission in the International Space Science Collaboration Program. The mission supports NASA Strategic Sub-Goal 3D: "Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets."

The mission objectives are to (1) study the formation of galaxies in the early universe and their subsequent evolution, (2) investigate the creation of stars and their interaction with the interstellar medium, (3) observe the chemical composition of the atmospheres and surfaces of comets, planets and satellites, (4) examine the molecular chemistry of the universe.

Project Parameters

The Herschel Space observatory is a collaboration between NASA and the European Space Agency (ESA). It will be the first space observatory covering the full far-infrared and sub-millimeter waveband, and its telescope will have the largest mirror deployed in space to date.

The observatory will operate for 700 hours a year at the second Lagrange point of the Earth-sun system. Herschel will perform high special and spectral resolution imaging in the 85-900 micron wavelength region with subperb sensitivity for both photometry and spectroscopy. Herschel's 3.5 meter mirror will collect the light from distant and poorly known objects, such as newborn galaxies thousands of milssions of light-years away, and will focus that light onto three instruments whose detectors will be kept at temperatures close to absolute zero.

ESA is the lead agency for the mission. NASA is providing the first two of the following three science instruments, as well as mission and science operations:

Heterodyne Instrument for the Far Infrared (HIFI) is a very high resolution heterodyne spectrometer.

Spectral and Photometric Imaging Receiver (SPIRE) is an imaging photometer and an imaging Fourier transform spectrometer

Photodetector Array Camera and Spectrometer (PACS) - is an imaging photometer and medium resolution grating spectrometer.

Herschel will launch aboard an Ariane-5.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	International Space Science Collaboration
Project In Development:	Herschel

Project Commitments

Herschel will launch in July, 2008 on a 3-year prime mission (5-year goal) as a multipurpose observatory with data provided to the entire astronomical community, Mission objectives include (1) study the formation of galaxies in the early universe and their subsequent evolution, (2) investigate the creation of stars and their interaction with the interstellar medium, (3) observe the chemical composition of the atmospheres and surfaces of comets, planets and satellites, (4) examine the molecular chemistry of the universe.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
HIFI	JPL	A very high resolution heterodyne spectrometer operating continuously in 7 bands from 480 to 1250 GHz and portions of 1410-1910 GHz range.	No change	No change
SPIRE	JPL	The photometer images the sky in three bands simultaneously. Provides broadband photometry & medium resolution spectroscopy in wavelengths from 200 to 670 microns.	No change	No change
Science Operations	JPL	JPL manages the US portion of the science operations	No Change	No Change

Schedule Commitments

Herschel entered implementation in October 2001. NASA delivered all instrument hardware in FY06. Herschel was scheduled to launch in August 2007 as determined by ESA. ESA has now extended the launch date to July 2008.

Milestone Name	Confirmation Baseline	FY 2007 PB Request	FY 2008 PB Request
Development			
Launch Readiness	N/A European Launch	August 2007	July 2008

Mission Directorate:	Science
Theme:	Astrophysics
Program:	International Space Science Collaboration
Project In Development:	Herschel

Development Cost Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Herschel	2006	117.0	2007	134.9	15	Launch Readiness	8/30/2007	7/31/2008	11

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**117.0**	**134.9**	**17.9**
Science/Technology	19.3	30.7	11.4
Payload	56.7	58.0	1.3
Systems Integration & Test	2.4	2.4	0.0
Other	38.6	43.8	5.2

Project Management

JPL has management of the US portion of the mission, including mission and science operations. NASA Program Management Council has program oversight responsibility. The responsible official for this project is Richard Howard.

Project Element	Element Oversight	Lead Performer	Partners
Herschel HIFI	JPL	Netherlands Institute for Space Research	ESA
Herschel SPIRE	JPL	Cardiff University - Department of Physics and Astronomy	ESA

Acquisition Strategy

Completed major acquisitions.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	JPL IRT	09/2001	Critical Design Review was successful	N/A

Mission Directorate:	Science
Theme:	Astrophysics
Program:	International Space Science Collaboration
Project In Development:	Herschel

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Potential performance anomalies	Unexpected performance issues that only arise in system configuration.	NASA has personnel on-site during integration and testing.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Beyond Einstein

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Beyond Einstein	14.9	22.1	32.3	51.5	147.6	170.6	222.1

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Beyond Einstein	**21.4**	**32.3**	**11.0**
Additional funding for Beyond Einstein Future Missions; results of the Beyond Einstein Program Assessment Committee (BEPAC) will be incorporated in the FY 2009 President's Budget.			

Program Overview

In attempting to understand and explain the universe, Albert Einstein devised several theories along with his theory of general relativity. Some fantastic predictions flow from these theories: the Big Bang, black holes, and existence of "dark energy." However, Einstein's theories only predict, they do not really explain the phenomena. To find answers, scientists must move beyond Einstein's theory; they must employ new techniques and launch missions to observe the universe in new and advanced ways. They must test and validate these new theories and enjoin heretofore separate fields like astronomy and particle physics.

NASA commissioned the National Research Council Beyond Einstein Program Assessment Committee (BEPAC) to conduct an independent study to assess the five proposed missions in the Beyond Einstein Program and recommend which of these should be developed and launched first. The BEPAC report is due in September 2007. Beyond Einstein (BE) is currently undergoing a program-level review.

For more information, please see: http://universe.nasa.gov/.

Program Relevance

Beyond Einstein will contribute to Strategic Plan goal 3D: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets. More specifically, the program will contribute to the following Outcomes: 3D.1. Progress in understanding the origin and destiny of the universe, phenomena near black holes, and the nature of gravity. 3D.2. Progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects recognized in the present universe.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Beyond Einstein

Plans For FY 2008

NASA will have received the results of the National Research Council's BEPAC study to assess the five proposed missions in the Beyond Einstein Program and recommend which one should be developed and launched first. NASA will restructure the program based upon the report in order to reflect the selection of one mission to proceed forward while the other missions remain in technology development.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Beyond Einstein

Project Descriptions

The Beyond Einstein program has the following four projects:

Laser Interferometer Infrared Antenna (LISA)

The Laser Interferometry Space Antenna (LISA) would be the first dedicated space-based gravitational wave observatory. LISA would use an advanced system of laser interferometry and the most delicate measuring instruments ever made to directly detect gravitational waves. LISA is in mission formulation.

Constellation-X (Con-X)

The Constellation-X Observatory would be a combination of several X-ray telescopes working in unison to generate the observing power of one giant telescope. With the observatory, scientists will investigate black holes, Einstein's Theory of General Relativity, galaxy formation, the evolution of the universe on the largest scales, the recycling of matter and energy, and the nature of dark matter and dark energy. Con-X is in a pre-formulation.

Joint Dark Energy Mission (JDEM)

The Joint Dark Energy Mission (JDEM) would be an Einstein Probe to study the nature of dark energy that dominates the universe. More specifically, it will be a wide-field telescope in space to determine the expansion history of the universe and fully probe the nature of dark energy. Inflation Probe--Immediately after the Big Bang, the universe appears to have undergone a period of "inflation," when it expanded so rapidly that parts of it separated from the other parts faster than the speed of light. This rapid expansion enabled slight density differences in an incredibly dense, young universe to ultimately grow into the stars, galaxies, and vast voids we see today.

Beyond Einstein Future Missions

This project includes funding for the first full Beyond Einstein mission. In addition to LISA, Con-X, and JDEM, two other potential Beyond Einstein projects are being evaulated.

Inflation Probe--Immediately after the Big Bang, the universe appears to have undergone a period of "inflation," when it expanded so rapidly that parts of it separated from the other parts faster than the speed of light. This rapid expansion enabled slight density differences in an incredibly dense, young universe to ultimately grow into the stars, galaxies, and vast voids we see today. The Inflation Probe would attempt to investigate what propelled this inflation, and try and determine if it is the same force that is accelerating the expansion of the universe.

Black Hole Finder Probe--Scientists have identified two main classes of black holes: smaller, stellar-sized black holes that form from the collapse of massive stars; and supermassive black holes in the core of most galaxies. The latter can contain the mass of millions to billions of suns and grow by swallowing stars and gas that venture too close. This consumption releases great amounts of energy. But there is an accounting problem: not enough light is coming from supermassive black holes to explain their growth. There are hints that much of the growth occurs behind a shroud of dust. The Black Hole Finder Probe would conduct a census of hidden black holes, revealing where, when, and how they form. This would also allow scientists to study the cosmic evolution of black holes.

Mission Directorate:	Science
Theme:	Astrophysics
Program:	Beyond Einstein

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Identify an initial Beyond Einstein mission to proceed to development.	Beyond Einstein	NA	2008

Program Management

GSFC has responsibility for Beyond Einstein Program. The NASA Program Management Council and GSFC Center Management Council have program oversight responsibility.

Project	Oversight	Lead Performer	Partners
LISA	GSFC	GSFC/JPL	ESA
Con-X	GSFC	GSFC	
JDEM	TBD	TBD	
Future Missions	GSFC	GSFC	

Acquisition Strategy

The acquisition strategy will depend on which mission is selected to move forward. However, NASA will seek to maximize the amount of competition to ensure that the best concepts and science are supported.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Relevance	NRC/BEPAC	None	Assess the five proposed missions in the Beyond Einstein Program and recommend which of these should be developed and launched first. Report should be completed in 09/2007	N/A

Exploration Systems

The President and Congress committed the Nation to a journey of exploration: returning to the Moon in the next decade, then on to Mars and beyond. In its Strategic Plan, NASA laid out an organizational framework that more fully utilizes agency resources to extend humankind's presence in space and promote international and commercial participation to further scientific, security, and economic interests. The Exploration Systems Mission Directorate (ESMD) will lead the way on this multi generational journey by providing an organizational focus for developing new capabilities and supporting technologies that enable sustained and affordable human space exploration.

An endeavor of this significance and magnitude cannot be undertaken by a single organization, or even a single nation. During 2006, NASA initiated and coordinated a worldwide effort to establish a Global Exploration Strategy, including participants from 13 other international space agencies, academia, and private industry, totalling more than a thousand stakeholders from around the world. This group drafted a set of exploration themes and objectives to facilitate discussion as we plan our return to the Moon. Future forums will address the roles and contributions of international partners toward realizing common objectives.

NASA is also pursuing partnerships that will encourage the commercial space sector while supporting the exploration effort. In 2006, ESMD selected two emerging aerospace companies (Space Exploration Technologies and Rocketplane-Kistler) to demonstrate cargo transportation capabilities for potential commercial servicing of the International Space Station (ISS).

Since the Vision for Space Exploration (VSE) was announced in 2004, NASA has developed the organization and processes that will enable an expanded human presence in space. The 2005 Exploration Systems Architecture Study (ESAS) provided the baseline design: an Apollo-derived crew capsule and Shuttle-based launch vehicle. Since then, the design has matured with each design cycle. A Lunar Architecture Team (LAT) is currently engaged in studies that will influence future development. This iterative formulation process will continue until the program is baselined at the Preliminary Design Review (PDR) in 2008.

ESMD has organized into two closely integrated programmatic themes to efficiently carry out its mission. Projects in the Constellation Theme are structured to develop, demonstrate, and deploy systems that will enable sustained human exploration. These include Orion, which will carry and support crews traveling to low Earth orbit and beyond, the Ares launch vehicles to transport both crew and cargo elements, as well as ground and in-space support infrastructure.

Driven by Constellation requirements, activities within the Advanced Capabilities Theme are structured into three major programs that provide critical products to reduce operational and technical risk for Constellation projects. Exploration and Technology Development Program (ETDP) activity addresses high priority technology needs for lunar exploration as identified by ESAS and further refined by the LAT. The Human Research Program (HRP) carries out investigation and risk mitigation related to astronaut health and performance. In 2008 the Lunar Precursor Robotic Program (LPRP) will launch the Lunar Reconnaissance Orbiter (LRO)--the first lunar robotic mission.

NASA continues to look for ways to reduce life cycle cost. Recently ESMD partnered with the Air Force to develop a common engine for the heavy lift launch vehicle (Ares V), and within NASA, ESMD has engaged in collaborative efforts with the Space Operations, Science, and Aeronautics Mission Directorates across all 10 field Centers in support of the Exploration mission.

The ESMD budget distribution is identified below, along with an explanation of changes. The following sections identify performance and budget for ESMD themes, programs, and projects.

Mission Directorate Budget Distribution

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
FY 2008 President's Budget Request	**3,050.1**	**4,152.5**	**3,923.8**	**4,312.8**	**4,757.8**	**8,725.2**	**9,076.8**
Constellation Systems	1,733.5	3,232.5	3,068.0	3,451.2	3,784.9	7,666.0	7,993.0
Advanced Capabilities	1,316.6	920.0	855.8	861.6	973.0	1,059.1	1,083.9
FY 2007 President's Budget Request	**3,050.1**	**3,978.3**	**3,981.6**	**4,499.8**	**5,055.9**	**8,775.1**	**--**
Constellation Systems	1,733.5	3,057.6	3,067.6	3,612.9	4,083.8	7,698.4	--
Advanced Capabilities	1,316.6	920.7	914.0	886.9	972.0	1,076.7	--
Total Change from FY 2007 President's Budget Request	**0.1**	**174.2**	**-57.8**	**-186.9**	**-298.0**	**-49.9**	**9,076.8**

Note: FY 2008 PB Request -- FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.
FY 2007 PB Request -- represents the FY 2007 P.B. request in the new Theme structure.

Mission Directorate Budget Changes

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Total Changes	**0.1**	**174.2**	**-57.8**	**-186.9**	**-298.0**	**-49.9**	**9,076.8**
Programmatic Content	**--**	**--**	**105.1**	**57.5**	**47.2**	**47.6**	**7,490.6**
Constellation Systems	--	--	--	--	--	--	6,593.6
Advanced Capabilities	--	--	105.1	57.5	47.2	47.6	897.0
Programmatic Transfers	**--**	**--**	**-340.1**	**-407.1**	**-471.2**	**-413.4**	**--**
Constellation Systems	--	--	-153.0	-304.8	-395.8	-333.2	--
Advanced Capabilities	--	--	-187.1	-102.3	-75.4	-80.2	--
Institutional Adjustments	**0.1**	**174.2**	**177.2**	**162.7**	**126.0**	**315.9**	**1,586.2**
Constellation Systems	0.1	174.9	153.4	143.1	96.8	300.9	1,399.4
Advanced Capabilities	--	-0.7	23.8	19.6	29.2	15.0	186.8

Note: Changes in Programmatic Content reflect the increases or decreases made directly to a program or project in response to cost increases, schedule or technical changes, or a change in Agency priorities.

A Programmatic Transfer is the movement of funding and content to another part of the Agency to reflect either a change in program management or to support Agency-wide capabilities.

Institutional Adjustments are changes in the allocation of Agency-wide costs to a given program.

Mission Directorate Highlights of Programmatic Changes

Exploration Systems

Constellation Systems

Programmatic Transfers:

Content transfers include:
Transfer to SOMD of funding and responsibility for the purchase of ISS Cargo Crew Services.

Institutional Adjustments:

An Institutional Adjustment to the allocation of agency costs to Constellation Systems.

Advanced Capabilities

Programmatic Content:

Lunar Precursor Robotic Program:
An increase of $45 million in Programmatic Content to support an increase in costs for the Lunar Reconnaissance Orbiter

Exploration Technology Development Program:
An increase of $59.4 million for Programmatic Content to support technology development to increase the capabilities and reduce the costs of future exploration missions.

Human Research Program:
An increase of $0.4 million to support Advanced Food Technology, and an additional $0.3 million transfer to support radiation research.

Programmatic Transfers:

Lunar Precursor Robotic Program:
The transfer of funding from future missions to support critical agency assets (-$168.8 million).

Exploration Technology Development:
The FY 2008 budget involves a number of Programmatic Transfers, including: a) Alpha Magnetic Spectrometer (AMS) to the Space Operations Mission Directorate (-$3.5 million); b) the Microgravity Science Glovebox and Material Science Research Rack to the Space Operations Mission Directorate (-$4.3); and c) the transfer of the Near Earth Object Observation (NEOO) from the Science Mission Directorate to ESMD (+4.1 million).

Institutional Adjustments:

Lunar Precursor Robotics Program:
An Institutional Adjustment to the allocation of agency costs to the program (+$35.0 million).

Exploration Technology Development Program:
An Institutional Adjustment to the allocation of agency costs to the program (-$18.9 million).

Human Research Program:
An Institutional Adjustment to the allocation of agency costs to the program (+$7.8 million).

Mission Directorate Budget Structure Adjustments

For FY 2008, the Exploration Systems Mission Directorate (ESMD) has consolidated programs and reorganized into two Themes: Constellation Systems and Advanced Capabilities.

Within the Constellation Theme, Launch and Mission Systems (LMS) has been divided into separate Ground and Mission Operations projects. This will allow greater focus on mission and more efficient utilization of existing personnel and facilities.

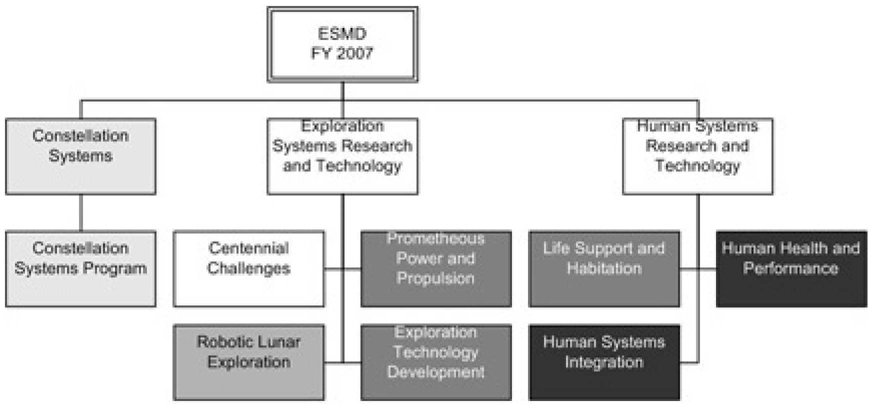
The two remaining Themes from the FY 2007 Budget, Exploration Systems Research and Technology (ESRT) and Human Systems Research and Technology (HSRT), have been combined into a single new theme called Advanced Capabilities. This new Theme consists of three programs: the Lunar Precursor Robotic Program (LPRP), Exploration Technology Development Program (ETDP), and Human Research Program (HRP).

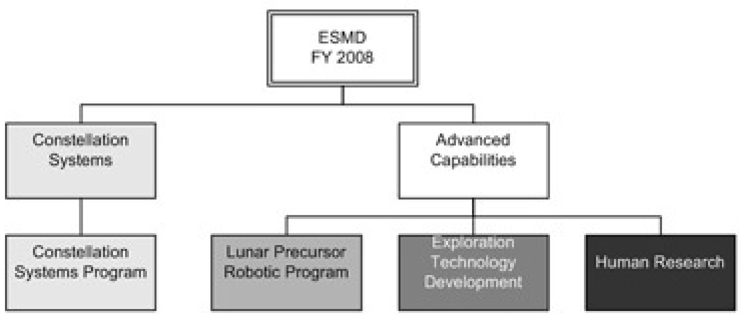
LPRP is similar in content to the Robotic Lunar Exploration Program (RLEP) and includes the Lunar Reconnaissance Orbiter (LRO) and Lunar Crater Observation Sensing Satellite (LCROSS), as well as future lunar missions that are under consideration.

ETDP incorporates projects from the former Exploration Technology Development, Prometheus Power and Propulsion, and Life Support and Habitation Programs. HRP combines projects from Human Health and Performance with elements of Human Systems Integration. These changes are consistent with the 12 technology maturation priorities identified in the Exploration System Architecture Study (ESAS).

Centennial Challenges is transfered to IPP; it is now managed by the Innovative Partnership Program (IPP) Office.

The budget for purchasing future ISS Cargo and Crew Services has been transferred to International Space Station Program in the Space Operations Mission Directorate. Retained within ESMD is the responsibility to demonstrate a Commercial Cargo Crew Capability. This project is executed out of the Commercial Orbital Transportation Services Project Office at the Johnson Space Center.


ESMD
FY 2007
Constellation Systems
Exploration Systems Research and Technology
Human Systems Research and Technology
Constellation Systems Program
Centennial Challenges
Prometheous Power and Propulsion
Life Support and Habitation
Human Health and Performance
Robotic Lunar Exploration
Exploration Technology Development
Human Systems Integration


ESMD
FY 2008
Constellation Systems
Advanced Capabilities
Constellation Systems Program
Lunar Precursor Robotic Program
Exploration Technology Development
Human Research

Theme Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Constellation Systems	1,733.5	3,232.5	3,068.0	3,451.2	3,784.9	7,666.0	7,993.0
Constellation Systems Program	1,733.5	3,232.5	3,068.0	3,451.2	3,784.9	7,666.0	7,993.0

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Theme Changes

	FY 2008		
Constellation Systems	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Constellation Systems Program	**3,067.6**	**3,068.0**	**0.4**

BUDGET ADJUSTMENTS: Constellation programmatic content changes include zero-sum transfers between ESMD themes; realignment of Technical Excellence effort, support for Agency assets and uncovered workforce, transfer of Exploration Communications and Navigation Systems (ECANS) management responsibility to the Space Operations Mission Directorate (SOMD), transfer of International Partner purchases management and budget execution responsibility to SOMD (beginning in FY 2008), and internal program adjustments. Institutional Adjustments reflect Agency-wide overhead realignment across Directorates.

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems

Theme Purpose

Currently, the Nation's space transportation systems are unsuitable for human exploration beyond low Earth orbit. NASA's Exploration Systems Mission Directorate (ESMD) has been tasked with developing the capability to return humans to the Moon and eventually destinations beyond. Efforts within the Constellation System Theme are focused on providing a new exploration infrastructure, which include a crew vehicle (Orion), an expendable launch vehicle (Ares I), a heavy-lift cargo launch vehicle (Ares V), spacesuits and tools required by the flight crews, and associated ground and mission operations systems.

Orion will carry four crew members to the Moon, and serve as the primary exploration vehicle for future missions. It will also be capable of ferrying up to six astronauts (plus additional cargo) to and from the International Space Station (ISS), should commercial transport services be unavailable. The Ares I will consist of a solid rocket booster and an upper stage that can carry Orion into low Earth orbit. Consistent with the Agency's Strategic Plan, Constellation Systems is working to bring these systems into service as soon as possible after retirement of the Space Shuttle, consistent with NASA's commitment to strong science and aeronautics programs.

NASA is pursuing partnerships with the emerging private space sector to provide Commercial Orbital Transportation Services (COTS) to the ISS. Currently, this capability is not available within the United States or NASA. ESMD is working with commercial partners to demonstrate delivery and return capabilities to support ISS cargo resupply through funded Space Act Agreements. Partner demonstrations are on track to provide operational cargo services to the ISS beginning in 2010. If industry can successfully demonstrate this transportation capability, NASA will acquire ISS services competitively using domestic vendors.

The Constellation Systems Theme supports the following Goals in the 2006 NASA Strategic Plan:

Goal 4: Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.

Goal 5: Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.

Goal 6: Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.

Theme Overview

The Constellation Systems Theme consists of a single program: Constellation Systems, which includes exploration activity across all NASA Centers.

The projects supporting initial Constellation capabilities phase include Orion and Ares I (crew exploration and launch vehicles), space suits and tools, as well as the ground and mission operations infrastructure needed to support low-Earth orbit missions. Orion and Ares I are currently targeted for operation no later than 2014.

Following the initial phase, Constellation will develop crew and cargo capabilities for a mission to the lunar surface, no later than 2020. As currently planned, this system will include the Ares V Cargo Launch Vehicle, Earth Departure Stage (EDS), Lunar Surface Access Module (LSAM), and associated support capabilities. Further development will provide crew, cargo, and infrastructure to support human exploration of Mars and beyond.

The preliminary technical definition of these systems was originally outlined in the 2005 Exploration Systems Architecture Study (ESAS). During FY 2006, Constellation conducted a Systems Requirements Review (SRR) to baseline the technical requirements and operational dates for all program elements, in preparation for Preliminary Design Review (PDR) in FY08 and Critical Design Review (CDR) in FY10.

A major endeavor in the Constellation Program, is the COTS effort to spur parallel development of a cost-effective, commercial capability to carry cargo to the ISS, with future options for transporting crew. While the projects funded in the COTS budget are high risk, they represent NASA's preferred servicing approach. Should these systems prove to be unreliable or too costly, NASA will rely on Orion and purchase of space transportation services from International Partners to meet obligations to the ISS.

Constellation set aside $81.1M of FY 2008 budget authority for the design, construction and modification of Constellation Systems facilities. Details of the program direct Construction of Facilities (CoF) projects are included in the Supporting Data: CoF section of the IBPD.

Additional Constellation program detail can be found in the Constellation Systems Program section.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

The Constellation Systems Theme supports the Nation's Vision for Space Exploration by developing the transportation and infrastructure necessary to enable a sustained and affordable human program to explore the Moon in preparation for missions to destinations beyond.

NASA's effort in this area contributes to implementation of the emerging Global Exploration Strategy, which includes participants from 13 other international space agencies, and more than a thousand individuals around the world from academia, the private sector, and the general public.

Relevance to the NASA Mission:

The Constellation System Theme supports NASA's mission to pioneer the future of space exploration and scientific discovery by developing the systems needed to enable scientific activities and discoveries not obtainable with robotic explorers alone. By creating the capability for human presence beyond low Earth orbit, Constellation Systems provides the opportunity to conduct fundamental science, such as astronomy, physics, astrobiology, historical geology, and exobiology.

Relevance to education and public benefits:

As with past and current human exploration programs, NASA's efforts to develop Orion and the Ares systems will accelerate the development of technologies that are important for the economy and national security. The advanced systems and capabilities required for space travel include power generation and storage, communications and navigation, networking, robotics, and improved materials, all of which could be used on Earth to meet commercial and other national needs. As Shuttle activities begin to wind down, NASA will transition needed Shuttle personnel to new, challenging positions working on Constellation Systems development efforts. Constellation Systems also will provide a training ground for the next generation of scientists and engineers who will realize the Nation's space exploration dreams.

Furthermore, Orion will serve as a public symbol of the Nation's continued commitment to space exploration, much as the Shuttle has over the past 25 years. NASA anticipates that the exploration initiatives will spark the public's imagination and inspire the Nation's youth to pursue careers in science, technology, engineering, and mathematics as a result of their renewed interest in space.

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
Strategic Goal 4	**Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.**	
Outcome 4.1	**No later than 2014, and as early as 2010, transport three crewmembers to the International Space Station and return them safely to earth, demonstrating an operational capability to support human exploration missions.**	
APG 8CS01	Complete the Preliminary Design Review (PDR) for the Orion/Crew Exploration Vehicle (CEV).	Constellation Systems Program
APG 8CS02	Complete Critical Design Review (CDR) for the Ares I-1 flight demonstration test.	Constellation Systems Program
APG 8CS03	Complete the Preliminary Design Review (PDR) for Ares-I/Crew Launch Vehicle.	Constellation Systems Program
APG 8CS04	Complete the Critical Design Review (CDR) for the ground infrastructure/systems at the launch site.	Constellation Systems Program
APG 8CS05	Complete the System Design Review (SDR) for mission operations infrastructure and systems.	Constellation Systems Program
APG 8CS06	Complete the Preliminary Design Review (PDR) for the Extravehicular Activity (EVA) Systems.	Constellation Systems Program
Outcome 4.2	**By 2010, successfully transition applicable Shuttle components, infrastructure, and workforce to the Constellation Systems program.**	
APG 8CS07	Demonstrate progress towards the transition of Space Shuttle and International Space Station Infrastructure for utilization in Constellation Systems, including transfer of Mobile Launch Platform 1.	Constellation Systems Program
Strategic Goal 5	**Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.**	
Outcome 5.2	**By 2010, demonstrate one or more commercial space services for ISS cargo and/or crew transport.**	
APG 8CS08	Complete the Flight Demonstration 1 Readiness Review leading up to demonstration flights in FY2009.	Constellation Systems Program
APG 8CS09	Complete the Flight Demonstration 2 Preliminary Design Review (PDR) leading up to demonstration flights in FY2009.	Constellation Systems Program
APG 8CS10	Complete the Flight Demonstration 3 System Requirements Review (SRR) leading up to demonstration flights in FY2009.	Constellation Systems Program
Strategic Goal 6	**Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.**	
Outcome 6.4	**Implement the space communications and navigation architecture responsive to science and exploration mission requirements.**	
APG 8CS11	Provide the Command, Control, Communication and Information (C3I) standards, validation processes and test systems designs, and demonstrate life cycle feasibility at the Ground Operations and Mission Operations Preliminary Design Reviews (PDRs).	Constellation Systems Program
Outcome 6.5	**No later than 2020, demonstrate the capability to conduct an extended human expedition to the lunar surface and lay the foundation for extending human presence across the solar system.**	
APG 8CS12	Develop and annually refine a lunar return architecture that has the maximum possible utility for later missions to Mars and other destinations.	Extended Lunar Stay Capability
APG 8CS13	Demonstrate progress towards the refinement of initial cargo launch vehicle conceptual designs to establish preliminary cargo launch vehicle system requirements.	Extended Lunar Stay Capability

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems

Performance Achievement Highlights

Constellation Systems Program

In January 2006, NASA competitively awarded Orion Phase I contracts to Lockheed Martin and Northrop Grumman/Boeing for concept refinement and trade studies, then issued an RFP for DDT&E, production and sustainment. In August 2006, NASA completed Phase II down selection and awarded the Orion contract to Lockheed Martin.

In March 2006, NASA engineers at Glenn Research Center (GRC) studied a scale model of the CEV under blue light in preparation for testing in the Ames Research Center's (ARC) Unitary Wind Tunnel Complex. This test demonstrated the aerodynamic properties of the heat shield design using a model painted with special, pressure-sensitive paint. Additional tests conducted in the Ames arc-jet facility, which resembles a room-size blowtorch, evaluated potential heat shield materials.

In May 2006, NASA selected the RS-68 engine to power the core stage of the heavy-lift cargo launch vehicle, Ares V, superseding NASA's initial decision to use a derivative of the Shuttle main engine. Life cycle cost studies demonstrated that the RS-68, which is the most powerful liquid oxygen/liquid hydrogen booster in existence, was a better choice for the Agency. The RS-68 is currently used in the Delta IV launcher, the largest of the Delta rocket family.

Engineers at Marshall Space Flight Center conducted a hot-fire test of a scaled-down model of engine main injector hardware in July 2006. This device will inject and mix liquid hydrogen and liquid oxygen propellants in the main combustion chamber of the upper-stage rocket engine that will be used in the Ares I crew launch vehicle and the Ares V cargo launch vehicle. These hot-fire tests were performed on the J-2X upper stage engine--an updated version of the powerful J-2 engine used to launch the Saturn V rocket upper stages during Apollo Program. The injector was fired horizontally with varying fuel temperatures and different propellant mixtures for 10 to 20 seconds at a thrust of approximately 20,000 pounds. Data collected during these tests will help engineers investigate design options for, and maximize performance of the J-2X upper stage engine.

In 2006, the program conducted a Systems Requirements Review (SRR) to define detailed interface requirements at the Constellation program level, as well as the project level for Orion, Ares I, and supporting ground and in-space systems. NASA also established an intra-agency CEV Smart Buyer Team to perform trade studies and design analysis to help the CEV Project Office understand and verify the appropriateness of the requirements incorporated into the CEV Phase II solicitation.

NASA has continued preliminary design work and systems testing through FY 2006, including recovery parachute and first stage drop tests at the Yuma Proving Ground, and vertical crew module drop tests at Langley Research Center (LaRC). Johnson Space Center (JSC) engineers built a full-scale mock-up of the command module, which will be used to test systems in situ.

Also in FY 2006, ESMD established the Commercial Crew and Cargo Project Office at JSC and assigned the office responsibility for managing NASA's Commercial Orbital Transportation Services (COTS) Projects. The Office released a final COTS demonstration announcement soliciting proposals for the initial commercial ISS transportation demonstration phase, and on August 18, 2006, NASA entered into funded Space Act agreements with Space Exploration and Technologies (SpaceX) and Rocketplane-Kistler (RpK).

Quality

Performance Measure #	Description
Constellation Systems Theme	
APG 8CS14	Complete all development projects within 110% of the cost and schedule baseline.
APG 8CS15	Reduction in ground operations cost (through 2012) of the Constellation Systems based on comparison with the Space Shuttle Program.

Program Assessment Rating Tool (PART):

The Constellation Systems Theme received a FY 2006 PART rating of "Adequate." The rating reflected a strong ability to convey the program's purpose and design, combined with a low rating in program accountability due to a lack of independent review planning at that time, as well as an inability to demonstrate cost effectiveness, and a lack of strong financial management practices within the Agency.

Several performance improvement areas were identified. Specifically, the Constellation Program is to:
1) Conduct planned internal reviews.
2) Plan and conduct a comprehensive external program review.
3) Develop and baseline metrics for the transition of activities and assets from the Space Operations Mission Directorate programs to Constellation Systems.

Constellation Systems is making plans to conduct an independent review of the program in FY 2007. NASA has also scheduled a Preliminary Non-Advocate Review (PNAR) for July 2007. In addition, Constellation projects will be assessed by independent reviewers from the Independent Program Assessment Office (IPAO) during regularly scheduled milestone reviews. Measures and refined plans for transition from the Space Shuttle Program to Constellation are undergoing development and are planned to be completed in FY 2007 to factor into the FY 2009 budget request development process.

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Other	IPAO standing review board	New	Preliminary Program Acceptance Review (PPAR). Per a pending revision to NASA 7120 guidelines, independent reviews of NASA programs will not be conducted as separate reviews. Instead, members of the IPAO will participate as non-voting members of program and project reviews and submit an independent report. The purpose of the PPAR is to review the systems engineering best practices, evaluate the architecture and its consistency with available budget, schedule, and risk management.	07/2007
Other	IPAO standing review board	New	Program Acceptance Review (PAR). Per a pending revision to NASA 7120 guidelines, independent reviews of NASA programs will not be conducted as separate reviews. Instead, members of the IPAO will participate as non-voting members of program and project reviews and submit an independent report. The purpose of the PAR is to review the systems engineering best practices, evaluate the architecture and its consistency with available budget, schedule, and risk management.	05/2008

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Constellation Systems Program	1,733.5	3,232.5	3,068.0	3,451.2	3,784.9	7,666.0	7,993.0
Crew Exploration Vehicle	839.2	1,001.1	950.8	1,425.0	1,211.7	1,551.0	1,125.1
Crew Launch Vehicle	384.2	916.1	1,175.2	1,077.8	1,220.0	1,817.2	1,334.9
Ground Operations	--	--	356.8	301.9	326.8	983.2	1,172.6
Mission Operations	--	--	47.4	111.3	158.2	258.6	282.8
Commercial Cargo Crew Capability	--	--	236.0	158.8	41.3	--	--
Other	510.1	1,315.3	301.9	376.5	826.9	3,056.0	4,077.6

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Constellation Systems Program	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Crew Exploration Vehicle	**875.5**	**950.8**	**75.3**
Project delta reflects institutional adjustments made regarding an Agency-wide overhead realignment across NASA's Mission Directorates.			
Crew Launch Vehicle	**827.4**	**1,175.2**	**347.8**
Changed architecture from a 4-segment Reusable Solid Rocket Booster (RSRB) system to a 5-segment, as well as selected the J-2X for the Upper Stage Engine over the Space Shuttle Main Engine. Constellation Program Office also increased Ares I budget from Program Reserves for an Ascent Development Flight Test (ADFT) scheduled for April 2009. *Delta also reflects institutional adjustments which reflect an Agency-wide overhead realignment across NASA's Mission Directorates.*			
Ground Operations	**0.0**	**356.8**	**356.8**
Starting in FY 2007, Launch & Mission Systems (LMS) has been divided into two distinct projects: Mission Operations and Ground Operations. *Project delta also reflects institutional adjustments made regarding an Agency-wide overhead realignment across NASA's Mission Directorates. FY 2007 funding is contained in the Other budget line.*			
Mission Operations	**0.0**	**47.4**	**47.4**
Starting in FY 2007, Launch & Mission Systems (LMS) has been divided into two distinct projects: Mission Operations and Ground Operations. *Project delta also reflects institutional adjustments made regarding an Agency-wide overhead realignment across NASA's Mission Directorates. FY 2007 funding is contained in the Other budget line.*			
Commercial Cargo Crew Capability	**0.0**	**236.0**	**236.0**
Project delta reflects programmatic adjustments for the transfer of International Partner purchases management and budget execution responsibility to SOMD. FY 2007 funding is contained in the Other budget line. *Delta also reflects institutional adjustments made regarding an Agency-wide overhead realignment across NASA's Mission Directorates.*			

Other	**1,364.8**	**301.9**	**-1,062.9**

This budget includes Ares V, Program Integration, Exploration Communication and Navigation System (ECANS), Advanced Development, Extra Vehicular Activity (EVA), and Advanced Projects.

Programmatic and Institutional changes have combined to account for the significant changes in this line item. In FY 07 this line accounted for many of the uncertainties in the definition of the program and projects. Since then clarification of project schedules and requirements have increased the needs of CEV and CLV as well as other projects. The centralization of communication and navigation responsibilities to SOMD reduced the ECANS project requirements and funds. This area also includes FY 2007 LM&S (Ground Ops and Mission Ops) and Commercial Cargo Crew Capability funds not displayed in the table.

Management of all NASA Space Communications activities was centralized within the SOMD Space Communications Program Office in October 2006. This centralization effort included existing networks and supporting functions: Deep Space Network (DSN), Space Network (SN), Ground Network (GN), NASA Integrated Network Services (NISN), and Exploration Communications and Navigation Systems (ECANS).

The Constellation Program Office has also selected the RS-68 engine for the core stage engine for the Ares V launch vehicle. NASA is engaged in a collaborative effort with the USAF to improve the existing commercially-developed rocket engine to meet future requirements of both agencies, as well as the U.S. commercial fleet. With the proposed joint upgrades, the RS-68 will deliver more thrust and be safer, more reliable, and more efficient than the current RS-68, while maintaining low manufacturing and operating costs. Cooperation between agencies will include sharing assets and resources to develop and certify the RS-68B engine, certified for use on both NASA's Ares V and the Air Force Delta IV EELV fleet. Development activity will incorporate NASA-required upgrades with existing AATS upgrades, making use of existing USAF hardware to provide a new launch capability at a considerable cost savings over separate development efforts. Merging requirements will enable the government to purchase a common engine in greater numbers, thereby increasing buying power.

Project delta reflects institutional adjustments made regarding an Agency-wide overhead realignment across NASA's Mission Directorates.

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program

Program Overview

The Vision for Space Exploration calls for a human return to the Moon by the end of the next decade, paving the way for eventual journeys to Mars and beyond. NASA's space exploration activity is now in a period of transition, as NASA works to complete the International Space Station (ISS) and retire the shuttle fleet by 2010.

Already, the Constellation Systems Program is focused on the next generation of human spacecraft. The Ares I and Ares V launch vehicles will propel the Orion crew vehicle to low Earth orbit and beyond. Both Ares and Orion draw on the best elements of the Apollo and Shuttle programs to create safe, reliable, and affordable systems. These vehicle designs were conceived during the FY 2005 Exploration Systems Architecture Study (ESAS), and have continued to undergo refinement as plans for a new space exploration infrastructure take shape. In addition to Orion and Ares, work is underway to develop the extravehicular activity (EVA) suits and tools required by flight crews, as well as associated ground and mission operations systems.

Orion is currently targeted for operation no later than 2014, and the first sortie mission to the Moon is planned for no later than 2020. Future development will provide crew and cargo transportation as well as support capabilities required for human exploration of Mars and other destinations. In their initial phase, Constellation systems will be capable of supporting crew and cargo transportation to the ISS, as a backup to commercial services.

In the near term, it is necessary to purchase space transportation services from International Partners to resupply the ISS. Beyond that NASA would prefer to purchase these services from domestic commercial providers. The Commercial Orbital Transportation Services (COTS) Projects are being developed for that specific purpose, and also to stimulate growth of the commercial space sector.

Constellation supports NASA Objectives 4.1, 4.2, 5.1, 5.2, 6.4, and 6.5; it also supports APGs 6SFS4, 6ISS2, 8CS1 to 8CS3, and 8CS4 to 8CS7.

For more information, please see: http://www.nasa.gov/mission_pages/constellation/main/index.html

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program

Program Relevance

The Vision for Space Exploration calls for humans to return to the moon by the end of the next decade, paving the way for eventual journeys to Mars and beyond. After completing the International Space Station and retiring the shuttle fleet by 2010, the Vision calls for human and robotic missions to explore destinations beyond low Earth orbit.

The NASA Authorization Act of 2005 mandates the establishment of a program to develop a sustained human presence on the Moon, including a robust precursor program to promote exploration, science, commerce and U.S. preeminence in space, and as a stepping stone to future exploration of Mars and other destinations.

The Constellation Systems Program is responsible for providing the capabilities essential to achieving NASA's Mission to pioneer the future in space exploration by first re-establishing a U.S. presence on the Moon. Doing so will enable significant national aspirations such as extending operational experience in a hostile planetary environment, developing capabilities needed for opening the space frontier, preparing for human exploration of Mars, providing for science operations and discovery, and enabling national, commercial and scientific goals for the development and use of the Moon.

Orion and Ares I are the first elements of this bold, new direction, and are key to carrying out the low Earth orbit and lunar missions described in the NASA Strategic Plan. The support systems currently in under development are also critical components of the Constellation Systems Program.

Support of ISS operations through International Partner purchases and Commercial Orbital Transportation Services (COTS) is also crucial to accomplishing NASA's Strategic Goals, by encouraging partnerships with the emerging commercial space sector.

Plans For FY 2008

FY 2008 will be a key year for the Constellation Systems Program as it transitions from program planning to development of the major program elements. Transition activity will be marked by such events as the Orion and the Ares I Preliminary Design Review (PDR) in the third Quarter FY 2008. Upon successful completion of these reviews, the Constellation Systems Program will be granted the authority to develop and produce these elements consistent with the approved architecture and design.

Also in the third Quarter FY 2008, the Mission Operations Systems Definition Review (SDR) will be conducted. Successful completion will enable the program to begin development of updated processes and facilities necessary to support the next era of human space exploration. The Ground Operations Project is tasked with reconfiguring a launch pad previously used for the Space Shuttle in order to accommodate Orion and Ares I. To ensure that NASA has a technically appropriate design to begin development, a Critical Design Review (CDR) is planned for third Quarter FY 2008. This activity will enable operations and supportability factors to be incorporated into flight hardware designs, allowing the valuable lessons learned from past spacecraft programs to drive lower life cycle costs as we prepare for a series of missions, beginning with the first Orion flight in 2009.

EVA System Configuration 1 SDR is planned for the first Quarter FY 2008. Completion and approval of this review by the Constellation Systems Program Office will enable the EVA project to proceed with source selections in the 2nd Quarter FY 2008. The elements of this project include the technology development for spacesuits and surface suits, air-lock outfitting equipment, Orion interface hardware, umbilicals, and space helmets. A successful configuration that integrates these elements will maximize capability, reuseability, and commonality.

After the U.S. Air Force CDR for the RS-68A engine in December 2007, the Ares V project will complete its configuration confirmation and design analysis for the RS-68B in fourth Quarter FY 2008, which will include all of the upgrades necessary for NASA's requirements for the Ares V.

The Constellation Systems Program FY08 SE&I effort will complete the project-level SDRs which are intended to ensure all Constellation Systems technical requirements are allocated to the projects and to the subsystem level.

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program

Project Descriptions

The projects that comprise Constellation's initial capabilities phase include Orion (Crew Exploration Vehicle) and Ares I (Crew Launch Vehicle), EVA suits and tools, as well as the ground and mission operations infrastructure needed to support low Earth orbit missions to ISS as a replacement to the Space Shuttle. Orion and Ares I are targeted for operations no later than 2014.

As currently planned, this system will include the Ares V Cargo Launch Vehicle, Earth Departure Stage (EDS), Lunar Surface Access Module (LSAM), and associated support capabilities, which will support lunar missions starting no later than 2020. Further development will support human space exploration to other destinations.

Orion (Crew Exploration Vehicle)

Orion is NASA's next generation piloted spacecraft. For missions to the Moon, Orion will carry up to four astronauts to low Earth orbit, then link up with a lunar surface access module for the trip to lunar orbit. The access module will descend to the Moon's surface for up to a week for sortie missions and up to six months for outpost missions, while Orion orbits, awaiting its return. The two vehicles will rendezvous at the end of the surface mission, and the crew will return to Earth in Orion. The capsule will re-enter the atmosphere and descend on parachutes back to Earth.

Additional detail can be found in the Crew Exploration Vehicle Project section of this document.

Ares I (Crew Launch Vehicle)

The mission of the Ares I project is to deliver a safe, reliable launch system that expands America's scientific reach through space exploration. Ares I is dedicated to enabling human trips to the Moon and Mars. It is also capable of flying to low earth orbit. A cornerstone of NASA's future human space flight activity, it is an integral part of the Vision for Space Exploration. Orion and Ares I are currently targeted for operation no later than 2014.

Additional detail can be found in the Crew Launch Vehicle Project section of this document.

Ground Operations

Ground Operations consists of the launch site infrastructure necessary to receive, inspect, assemble, integrate, test, simulate, monitor and perform launch processing operations and landing/recovery of the flight hardware.

Additional detail can be found in the Ground Operations Project section of this document.

Mission Operations

Mission Operations includes the systems and infrastructure necessary for the Constellation command and control during ascent/descent and mission operation execution for abort test, uncrewed and crewed flights. It also supports the interoperability of the control center facilities with other control centers and test sites.

Additional detail can be found in the Mission Operations Project section of this document.

EVA

The Extravehicular Activity (EVA) Systems Project encompasses the elements necessary to protect crewmembers and allow them to work effectively in the pressure and thermal environments which exceed the human capability during all mission phases. The EVA system includes pressure suits, EVA life support systems, umbilicals, EVA tools and mobility aids, EVA-specific vehicle interfaces, EVA servicing equipment, suit avionics, individual crew survival equipment (i.e., integral to the pressure suit), and ground support systems.

Ares V

Late next decade, the Ares V Earth Departure Stage (EDS) will carry larger payloads such as the lunar lander into orbit. In addition, Orion will dock with Ares V for missions to the Moon, where astronauts will explore new territories and conduct science and technology experiments. Both the Ares I and Ares V systems are being designed to support longer future trips to Mars.

Commercial Cargo Crew Capabilities

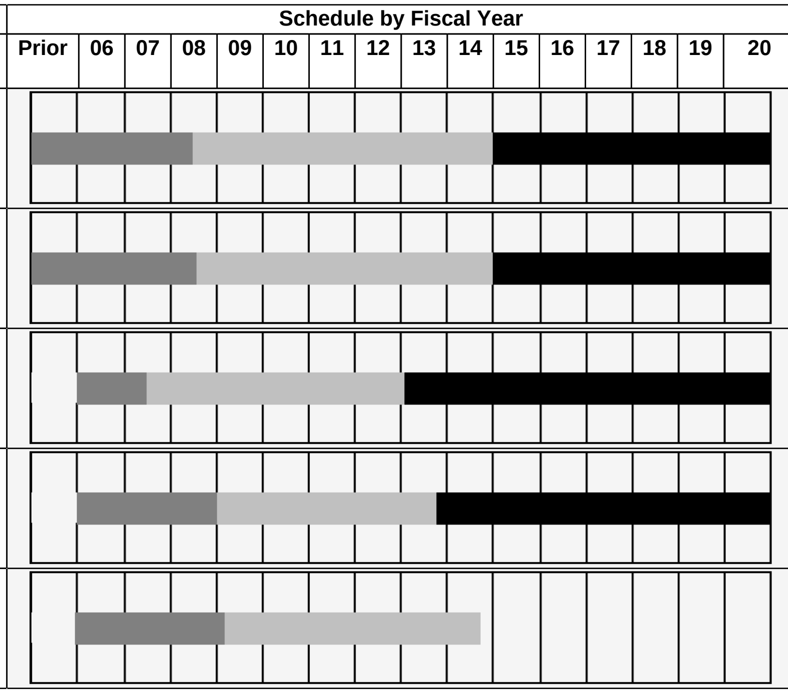
The Commercial Cargo Crew Capability Project (C4P) supports demonstration of Commercial Space Transportation Services from domestic companies. NASA's Commercial Orbital Transportation Services (COTS) Projects are designed to facilitate U.S. private industry demonstration of cargo and crew space transportation capabilities with the goal of achieving reliable, cost effective access to low-Earth orbit. Beginning in FY 2008, the management and budget execution responsibility for International Partner purchases has been transferred to SOMD. For details concerning project management and schedule, please refer to the Project in Development: Commercial Cargo Crew Capabilities Project area of this document.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
2 Flights per year for lunar sortie missions starting in 2020	Constellation	2 Flights per year for lunar sortie missions	2 Flights per year for lunar sortie missions
First Lunar Mission Test Flight in September 2018	Ares V	First Lunar Mission Test Flight in September 2018	First Lunar Mission Test Flight in September 2018

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program

Implementation Schedule



Project	Phase	Beg	End	Milestone
Orion	Tech			
	Form	Nov-04	Apr-08	Mar-08
	Dev	Apr-08	Sep-14	Apr-09
	Ops	Sep-14	Sep-20	Oct-14
	Res			Oct-14
Ares I	Tech			
	Form	Nov-04	Apr-08	Apr-08
	Dev	May-08	Sep-14	Sep-09
	Ops	Oct-14	Sep-20	Oct-14
	Res			Oct-14
Ground Operations	Tech			
	Form	Oct-05	Apr-07	Mar-07
	Dev	Apr-07	Oct-12	Oct-12
	Ops	Oct-12	Oct-20	Oct-20
	Res			Oct-20
Mission Operations	Tech			
	Form	Oct-05	Oct-08	Sep-08
	Dev	Oct-08	Jul-13	Jun-13
	Ops	Aug-13	Sep-20	Aug-13
	Res			Aug-13
Extravehicular Activity	Tech	Feb-05	Aug-05	Aug-05
	Form	Sep-05	Nov-08	Dec-07
	Dev	Dec-08	May-14	Oct-13
	Ops	Jun-14		Sep-14
	Res			Sep-14

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

Johnson Space Flight Center in Houston, Texas, has program management responsibility for the Constellation Program.

Constellation Systems projects will be assessed by independent reviewers from IPAO during regularly scheduled milestone reviews.

Project	Oversight	Lead Performer	Partners
Orion	Johnson Space Center	Lockheed Martin	None
Ares I	Marshall Space Flight Center	Marshall Space Flight Center	ATK-Thiokol, Pratt & Whitney Rocketdyne
Ground Operations	Kennedy Space Center	Kennedy Space Center	None
Mission Operations	Johnson Space Center	Johnson Space Center	None
Commercial Cargo Crew Capabilities	Johnson Space Center	SpaceX, and Rocketplane-Kistler	None

Acquisition Strategy

In general, Constellation Systems acquisitions are performance and outcome-based, with appropriate risk-sharing in current and planned procurements. Contracts are Cost plus Award Fee "End Item" DDT&E, with incentives tied to cost, schedule and performance outcomes. They are focused on the entire Constellation Systems Program lifecycle, not just near term milestones.

The procurement strategy for all projects under Constellation Systems will maximize competition whenever possible. However, there have been several exceptions to this strategy in instances where it was more appropriate either from an economic or technical standpoint to contract through sole-source selection.

The first example of this necessary deviation is the sole-source selection of ATK-Thiokol for the Ares I first Stage. ATK-Thiokol is the current provider of Space Shuttle reusable solid rocket boosters (RSRB) and given their experience and expertise with this component, selecting ATK-Thiokol to continue RSRB work for Ares I was most appropriate to ensure continuity of operations so as to not jeopardize the schedule of Constellation or introduce an unnecessary increase in risk by introducing a new provider for this work.

Another example of a necessary non-competitive selection is the J-2X Upper Stage Engine for Ares I. The decision by the Constellation Program Office to select the J-2X engine for the Upper Stage in effect selected Pratt & Whitney Rocketdyne (PWR) because the J-2S engine is a heritage engine that has proven performance and reliability to meet Constellation Systems needs.

The Constellation Systems Program is currently in the process of developing its acquisition strategies for Ground and Mission Operations.

Commercial Cargo Crew Capability: in FY 2008, the COTS Projects will continue to execute the Space Act Agreements signed in August 2006 with SpaceX and RpK for Phase I.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Other	IPAO Membership	New	Preliminary Program Acceptance Review (PPAR). Per a pending revision to NASA 7120 guidelines, independent reviews of NASA programs will not be conducted as separate reviews. Instead, members of the IPAO will participate as non-voting members of program and project reviews and submit an independent report. The purpose of the PPAR is to review the systems engineering best practices, evaluate the architecture and its consistency with available budget, schedule, and risk management.	07/2007
Other	IPAO membership	New	Program Acceptance Review (PAR). Per a pending revision to NASA 7120 guidelines, independent reviews of NASA programs will not be conducted as separate reviews. Instead, members of the IPAO will participate as non-voting members of program and project reviews and submit an independent report. The purpose of the PAR is to review the systems engineering best practices, evaluate the architecture and its consistency with available budget, schedule, and risk management.	05/2008

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
1102 - Ability to operate the CEV by 2014.	Risks to: Schedule and Cost. The current Constellation Systems Program phasing is not optimal to support an Orion/Ares I development and launch timeline by the President's 2014 deadline.	The program is on a path to complete DDT&E for high risk hardware by 2012 in order to not preclude operations in 2014. Options are in work to review test flights and content of crew launch and crew exploration vehicles to align technical and budget targets to narrow the gap from 2014 to an earlier operational date.
1154 - Launch vehicle operability	Risks to: Performance. Given the conventional developmental process does not include operability as a requirement, there is a possibility that the Ares I design will not result in adequate reduction of life cycle costs to an affordable level.	Launch vehicle operability mitigation plan in review.
1119 - Orion weight	Risks to: Performance, Schedule and Cost. There is a possibility that excessive growth in spacecraft mass will lead to reductions in mission performance and/or functionality.	Establish mass properties group to: * Make design decisions affecting weight allocation * Analyze designs and estimate current weights * Identify effects of changes on current and target weights Weight control meetings with management and design groups will assess weight status, define action items, and communicate risks. "Graybeard" external weight reviews will occur prior to PDR and CDR.
1118 - Ability for Ares I to meet performance requirements	Risks to: Performance and Cost. Given the history of vehicle and payload weight growth, there is a possibility that there will be an inability to maintain the performance and margins needed to meet performance requirements.	Mitigation plan in review. Mitigate ability for Ares I to meet performance requirements.
1087 - Lack of lunar sortie suit technology development	Risks to: Performance and Cost. Given that the funding for lunar sortie EVA technology development is not defined, there is a possibility that the suit system will have major impacts on the overall Constellation architecture, including logistics (weight, volume, consumables), performance and operational limitations and increased operational overhead.	Determine if funding for lunar suit technology development can be made available from the Constellation Systems program or from other sources, such as the Exploration Technology Development program.

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Formulation:	Crew Exploration Vehicle

Budget / Life Cycle Cost

Budget Authority ($ millions)	FY06	FY07	FY08
FY 2008 President's Budget Request	**839.2**	**1,001.1**	**950.8**
FY 2007 President's Budget Request	**839.2**	**894.7**	**875.5**
Total Change from FY 2007 President's Budget Request	**0.0**	**106.4**	**75.3**

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure. Changes are largely due to a Constellation Systems Program decision to retire development risks as early as possible and rephase funding profiles across Constellation to better manage the peak spending years of FY 2009 through FY 2011.

Project Purpose

Orion is NASA's next-generation piloted spacecraft. For missions to the Moon, Orion will carry up to four astronauts to low Earth orbit and, once there, link up with a lunar surface access module for the trip to lunar orbit. The access module will descend to the Moon's surface for up to a week for sortie missions, and up to six months for outpost missions, while Orion orbits, awaiting its return. The two vehicles will rendezvous again at the end of the surface mission, and the astronauts will ride back to Earth in Orion. The capsule will re-enter the atmosphere and descend on parachutes back to Earth.

Orion will also have the capability to service the International Space Station (ISS) as a backup to commercial crew and cargo delivery services now in development for the ISS. The vehicle will be capable of transporting six crew to and from the ISS, and remain docked for six months as a rescue return vehicle.

The Orion project relies heavily on technology risk reduction efforts funded by the Exploration Technology Development Program (ETDP), such as the Thermal Protection System (TPS) activities based at Ames Research Center (ARC).

Project Parameters

Orion will be a five-meter diameter vehicle, capable of transporting six astronauts to the ISS or four astronauts to the Moon, Mars, and other destinations, then returning them safely to Earth. The combined crew and service modules will provide power, life support, and propulsion for rendezvous, orbit correction, and de-orbit. In the event of a launch mishap, a Launch Abort System (LAS) will separate the crew module from the launch vehicle. A thermal protection system will protect the crew during re-entry, and the landing attenuation system will provide safe impact loads landing on dry ground.

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Formulation:	Crew Exploration Vehicle

Project ROM Estimate

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Crew Module	Lockheed-Martin	Piloted vehicle	n/a	Prime Contractor selected August 2006
Service Module	Lockheed-Martin	Provides power, propulsion, and other support services for Crew Module	n/a	Prime Contractor selected August 2006
Launch Abort System	Lockheed-Martin	Separates Crew Module from launch vehicle in event of launch accident	n/a	Prime Contractor selected August 2006

Schedule ROM Estimate

Award of the Orion prime contract was delayed several months, to August 2006. As a result, the milestone reviews (SRR, SDR, PDR, and CDR) were delayed as well. Orion will still be operational no later than 2014.

Milestone Name	Formulation Estimate	FY 2007 PB Request	FY 2008 PB Request
Formulation			
System Requirements Review	n/a	May 2006	January 2007
System Design Review	n/a	October 2006	April 2007
Preliminary Design Review	n/a	October 2007	March 2008
Critical Design Review	n/a	January 2009	April 2009

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Formulation:	Crew Exploration Vehicle

Project Management

Orion is managed by the Orion Project Office at JSC, with support from LaRC and GRC.

Orion will be assessed by independent reviewers such as the Independent Program Assessment Office during regularly scheduled milestone reviews.

Project Element	Element Oversight	Lead Performer	Partners
Crew Module	Orion Project Office and Crew Module Office, JSC	Lockheed-Martin	
Service Module	Orion Project Office, JSC; Service Module Office, GRC	Lockheed-Martin	
Launch Abort System	Orion Project Office, JSC; Launch Abort System Office, LaRC	Lockheed-Martin	

Acquisition Strategy

The contract for Schedule A Orion Design, Development, Test, and Evaluation (DDT&E) was awarded to Lockheed Martin in August 2006. Optional Schedules B and C, for additional production and sustaining engineering, must be exercised by July 2009, following the Critical Design Review (CDR). Lockheed Martin's subcontractors include Aerojet, Hamilton Sundstrand, Honeywell, Orbital Sciences Corporation, and United Space Alliance.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO Standing Review Board	N/A	The System Requirements Review is the first independent review for Orion project. The results will be documented in a formal report.	04/2007

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Formulation:	Crew Exploration Vehicle

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Orion Weight	Risks to: Performance, Schedule and Cost. It is possible that excessive growth in spacecraft mass will lead to reductions in mission performance and/or functionality.	Establish mass properties group to make design decisions affecting weight allocations, analyze designs and estimate current weights, identify effects of changes on current and target weights. Conduct meetings with management and design groups to assess weight status, define action items, and communicate risks. "Greybeard" external weight reviews will occur prior to PDR and CDR.
Launch Abort System	Risks to: Performance, Schedule, and Cost. LAS system development and flight test schedule of less than 30 months is challenging.	Risk management plan includes extensive wind tunnel testing and high fidelity computational fluid dynamics for analysis & control motor testing; also tight review of incremental milestones and performance. A fallback option is available, with sufficient performance and budget to meet requirements.

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Formulation:	Crew Launch Vehicle

Budget / Life Cycle Cost

Budget Authority ($ millions)	FY06	FY07	FY08
FY 2008 President's Budget Request	384.2	916.1	1,175.2
FY 2007 President's Budget Request	384.2	836.7	827.4
Total Change from FY 2007 President's Budget Request	0.0	79.4	347.8

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure. Changes to the CLV budget in FY 2007 through FY 2010 reflect NASA's desire to not preclude completion of Ares I development prior to 2014.

Project Purpose

The mission of the Ares I project is to deliver a safe, reliable launch system that expands America's scientific reach through space exploration. Ares I is dedicated to enabling human trips to the Moon and Mars. An integral part of the Vision for Space Exploration, Ares I is currently scheduled to be operational no later than 2014.

Ares I as defined by the Exploration Systems Architecture Study (ESAS) was a shuttle-derived launch vehicle, with a first stage based on the Shuttle solid rocket motors. Since that time, the design has evolved, and Constellation Systems has identified the J-2X as the Ares I (Crew Launch Vehicle) upper stage engine and Ares V (Cargo Launch Vehicle) upper stage, which also functions as the Earth Departure Stage (EDS). The J-2X is a derivative of the J-2 (Saturn) engine and its advanced development engine successor, J-2S, which improved performance and gave throttle capability to the engine.

For more information, please visit: http://www.nasa.gov/mission_pages/constellation/ares/index.html.

Project Parameters

The Ares I project is tasked to design, develop, test, and evaluate a human-rated crew launch vehicle comprised of a five-segment Shuttle-derived Reusable Solid Rocket Booster (RSRB), and a new J-2X upper stage engine. Ares I will feature a 24.5-metric ton lift capability, and will serve as a versatile transportation system that will carry crew to low Earth orbit (LEO) for exploration missions to the Moon and destinations beyond. In its initial phases, the project will also have the capability to deliver crew and cargo to the ISS.

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Formulation:	Crew Launch Vehicle

Project ROM Estimate

As currently planned, Ares I will conduct two Ascent Development Flight Tests (ADFT) and two certification flights prior to operations in September 2014. The first ADFT, Ares I-1, will fly in April 2009, and the second, Ares I-2, will fly in August 2012. Two of the certification flights will be Orbital Flight Tests (OFT), which will occur in September 2013 and June 2014. The first operational flight will take place in September 2014. Beginning no later than 2020, two flights per year are planned for lunar sortie missions.

The Ares I architecture has been changed from a four-segment to a five-segment RSRB in order to be cost effective and minimize the development schedule by optimizing one first stage design for both Ares I and Ares V instead of two separate designs. The same cost and schedule philosophy was exercised in the decision to use the J-2X engine for the Upper Stage instead of the SSME, as the Ares V Core Stage Engine was to be an SSME. The J-2X was also selected over the SSME because of its airborne start capability, which the SSME did not possess and would have to be developed, resulting in an increase of risk, cost, and required schedule. The combination of these decisions to streamline the design for various elements of both launch vehicles has resulted in a savings in Design Development Test and Evaluation of approximately $1 billion over the life cycle of the project.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
First Stage	ATK-Thiokol	Initial phase of the launch ascent configuration	4-segment RSRBs with 24.5-metric ton lift capability	5-segment RSRBs with 24.5-metric ton lift capability
Upper Stage Engine	Pratt & Whitney Rocketdyne	Propulsion source for second phase of the launch ascent configuration	1 RS-25e (current Space Shuttle Main Engine)	1 J-2X Engine
Upper Stage	TBD	EDS of the launch ascent configuration	Powered by a liquid oxygen/liquid hydrogen (LOX/LH2) SSME engine	Powered by a liquid oxygen/liquid hydrogen (LOX/LH2) J-2X engine
Ares I-1	Marshall Space Flight Center	First unmanned test article for flight controllability and environment characterization	Not included	Scheduled for April 2009

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Formulation:	Crew Launch Vehicle

Schedule ROM Estimate

Ares I received the Authority To Proceed (ATP) in September 2005, with a total development budget of $14.4 billion. This includes $4.6 billion for Design, Development, Test, and Evaluation (DDT&E), and $9.2 billion for production. The one-month change to the estimated PDR and CDR dates are due to refinement of the Ares I schedule during an internal review in March 2006.

Milestone Name	Formulation Estimate	FY 2007 PB Request	FY 2008 PB Request
Formulation			
Preliminary Design Review (PDR)	March 2008	March 2008	April 2008
Critical Design Review (CDR)	August 2009	August 2009	September 2009
Ares I First Flight (Full Functional Configuration)	September 2012	September 2012	September 2012
Ares I First Operational Flight	September 2014	September 2014	September 2014

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Formulation:	Crew Launch Vehicle

Project Management

Marshall Space Flight Center (MSFC) in Huntsville, Alabama, has project management responsibility for Ares I.

Ares I will be assessed by independent reviewers from IPAO during regularly scheduled milestone reviews.

Project Element	Element Oversight	Lead Performer	Partners
First Stage	Marshall Space Flight Center	ATK-Thiokol	None
Upper Stage Production	Marshall Space Flight Center	TBD	TBD
Upper Stage Main Engine	Marshall Space Flight Center	Pratt & Whitney Rocketdyne	None
Ares I-1	Marshall Space Flight Center	Marshall Space Flight Center	None

Acquisition Strategy

The Ares I First Stage was selected as a sole source acquisition, performer is ATK-Thiokol. Rationale: the Ares I and preliminary Ares V five-segment RSRB design work will be considered a contract within a contract. Ares I and Ares V work for Exploration will be accomplished under Schedule B of the Space Shuttle contract in place with ATK; Schedule A is the current Space Shuttle program contract effort, which will terminate in 2010. This approach is being used to capture the benefit of utilizing Shuttle assets for the Ares I effort that will lower technical, cost and schedule risk.

J-2X Upper Stage Engine was selected as a non-competitive acquisition, performed by Pratt & Whitney Rocketdyne (PWR). Rationale: J-2X predecessor (J-2S) from which the J-2X is derived is the exclusive property of PWR. The decision to select the J-2X engine in effect selected the contractor as well.

The Instrument Unit will be selected via full and open competition as a purchase acquisition, performers TBD.

Upper Stage Production will be selected via full and open competition as a purchase acquisition, performers TBD.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO Standing Review Board	N/A	System Requirements Review. Final report due out in Late January 2007.	01/2007

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Launch vehicle operability	Risks to: Performance. Given that the conventional developmental process does not include operability as a requirement, there is a possibility that the Ares I design will not result in adequate reduction of life cycle costs to an affordable level.	Launch vehicle operability mitigation plan in review.
Ability for Ares I to meet performance requirements	Risks to: Performance and Cost. Given the history of vehicle and payload growth, there is a possibility of being unable to maintain the performance and margins needed to meet performance requirements.	Mitigation plan in review. Mitigate ability for Ares I to meet performance requirements.
J-2X development schedule	Risks to: Schedule. Given the aggressive schedule from ATP through DCR for J-2X, there is a possibility that this project will not meet the 2012 operational flight test dates.	Conduct Preliminary Requirements Review (PRR) early and baseline schedule and utilize Earned Value Management.

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Formulation:	Ground Operations

Budget / Life Cycle Cost

Budget Authority ($ millions)	FY06	FY07	FY08
FY 2008 President's Budget Request	--	--	356.8
Total Change from FY 2007 President's Budget Request	0.0	0.0	356.8

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Project Purpose

The Ground Operations Project, previously part of the Constellation Systems Launch & Mission Systems (L&MS) Project, will provide all launch and recovery capabilities needed during the Design, Development, Test and Evaluation (DDT&E) phases of Exploration missions. These capabilities include personnel, launch control centers, vertical integration buildings, launch pads, fueling systems, transporters, mobile launch platforms, recovery ships and landing site equipment, command/control software and hardware. Project activity includes development of operational processes and documentation necessary for Agency operational organizations to perform pre-launch and launch processing, and recovery after landing.

As Constellation Systems projects and programs mature during DDT&E, the project will transition selected Space Shuttle and ISS ground support equipment, infrastructure and key contractor functions from those programs.

Project Parameters

The Ground Operations Project is currently engaged in defining the complete processing system at the launch site. Characteristics of a launch site system include numbers of integration cells/launch pads, launch rate capability, and the associated life cycle costs.

Project ROM Estimate

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Ground Operations Project	Multiple Architectural and Engineering (A&E) Contracts	Facilities, ground equipment, control systems and networks to develop, plan and execute DDT&E.	Multiple Architecture & Engineering (A&E) Contracts.	Multiple Contracts for Operations Integration at KSC.

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Formulation:	Ground Operations

Schedule ROM Estimate

Ground Operations received Authority to Proceed (ATP) in September 2006.

Milestone Name	Formulation Estimate	FY 2007 PB Request	FY 2008 PB Request
Formulation			
Launch Facilities	Mobile Launch Platform (MLP)		12/08
Launch Control Rooms	Launch Control Center LCC-1		4/08
CLV Processing	PAD 39B		12/08

Project Management

The Kennedy Space Center (KSC) in Florida has key responsibility for management of the Ground Operations Project.

Ground Operations will be assessed by independent reviewers from IPAO during regularly scheduled milestone reviews.

Project Element	Element Oversight	Lead Performer	Partners
Ground Operations Project	Johnson Space Center (JSC) has Constellation Program leadership.	Kennedy Space Center (KSC) will manage the Government effort.	None

Acquisition Strategy

Ground Operations will rely on a combination of in-house government as well as existing and competed contracts with architectural and engineering firms to perform the necessary analyses and designs for ground infrastructure and systems. Additionally, due to the highly coupled nature of using existing Space Shuttle Program (SSP) and ISS facilities, the project is actively seeking operational expertise of civil servants and contractors to facilitate improved processing designs and lessons-learned to ensure lowest life cycle costs and safer processing.

Further acquisition planning is still ongoing to incorporate Agency planning for SSP transition.

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Formulation:	Ground Operations

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO Standing Review Board	N/A	The System Requirements Review is the first independent review for the Ground Operations project. The results will be documented in a formal report.	04/2007
Other	PA&E GO Infrastructure Review	06/2006	Sought insight into global launch systems best practices for application to Constellation Systems ground operations (GO) systems. Reviews are on-going.	N/A
Other	National Academy, Public Admin	06/2006	Sought understanding of the government/contractor mix in preparation for workforce planning across SSP/Constellation transition.	N/A

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Backlog of Maintenance	SSP/ISS Backlog of Maintenance and Repair (BMAR): deferred maintenance for facilities and Ground Support Equipment (GSE) that will be used by Constellation and recommend funding levels post FY 2010.	Reviewing current SSP/ISS BMAR/deferred maintenance for facilities/GSE that will be used by Constellation and recommend funding levels post FY 2010.
GO support to program level Requirements Documentation for SRR.	Support to Level 2 products while resources are required for Level 3 development.	Develop resource loaded schedule with matrix ISS and SSP support to identify shortfalls and address program level 2, 3 and 4 resources and schedule impact.

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Formulation:	Mission Operations

Budget / Life Cycle Cost

Budget Authority ($ millions)	FY06	FY07	FY08
FY 2008 President's Budget Request	--	--	47.4
Total Change from FY 2007 President's Budget Request	0.0	0.0	47.4

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Project Purpose

The Constellation Systems Mission Operations Project, previously part of the Constellation Systems Launch and Mission Systems (L&MS) Project, will provide all mission operations capabilities needed to execute the Constellation missions. This includes the personnel, mission control centers, training systems, planning systems, mission command/control software and hardware necessary to plan missions, prepare personnel, train and execute mission operations across the ISS, Lunar and Mars Design, Development, Test and Evaluation (DDT&E) phases of Exploration. Project funding supports development of processes and documentation necessary for Agency operational organizations to perform mission strategic planning, flight manifesting, astronaut and flight controller training, as well as mission control for ascent, mission and return/landing. Mission Operations will utilize significant Space Shuttle Program (SSP) and International Space Station (ISS) facilities and systems expertise as the Constellation Systems Projects and programs mature in DDT&E.

Project Parameters

The Mission Operations Project is currently engaged in defining the requirements of the Exploration Mission System. Characteristics of such a system include a number of control rooms, mission planning timeline, training timeline and associated life cycle costs.

Project ROM Estimate

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
Mission Operations	Mission Operations Div, Shuttle Program contractors, internal Constellation Systems personnel	Mission control centers, training and planning systems, mission/command control software and hardware.		Single Contract for Mission Operations Integration at JSC.

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Formulation:	Mission Operations

Schedule ROM Estimate

Mission Operations received authority to proceed (ATP) in September 2006.

Milestone Name	Formulation Estimate	FY 2007 PB Request	FY 2008 PB Request
Formulation			
Training Systems System Requirements Review	Exploration Training Facility Preliminary Design Review		5/07
Mission Operation Contract for Constellation	N/A		1/11
Mission Operations System Requirements Review	N/A		3/07

Project Management

JSC manages the Mission Operations effort, relying on matrix support from the Mission Operations Directorate (MOD) at JSC.

Mission Operations will be assessed by independent reviewers from IPAO during regularly scheduled milestone reviews.

Project Element	Element Oversight	Lead Performer	Partners
Mission Operations Project	Johnson Space Center (JSC) has Constellation Program leadership	JSC will manage the MO effort under the Constellation Program leadership	None

Acquisition Strategy

This effort will rely on a combination of Mission Operation Project as well as matrixed MOD government and support contractor personnel to perform necessary analysis and planning for Mission Systems. Additionally, due to the highly coupled nature of using existing Space Shuttle and International Space Station Programs, flight hardware interfaces and some legacy infrastructure, Mission Operations is actively seeking operational expertise of these government and contractors to facilitate improved planning timelines, training capabilities and lessons-learned to ensure lowest life cycle costs and efficient mission execution.

Future acquisition planning is still ongoing to incorporate Agency planning for SSP transition.

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Formulation:	Mission Operations

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO Standing Review Board	N/A	The System Requirements Review is the first independent review for the Mission Operations project. The results will be documented in a formal report.	04/2007
Other	IV&V Evaluation	N\A	Mission Control Center software development Independent Verification and Validation evaluation which may include hardware develoment practices. Performed at request of Constellation Program Office.	06/2007

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Mission Operations Contract for Constellation	Mission Operations will require existing SSP/ISS flight operations contractor to perform infrastructure trades analysis, maintenance and upgrade planning, flight controller/astronaut training planning and operational systems analysis for Constellation. There is no contract vehicle to perform this immediate work.	Assess and develop Justification for other than Full and Open Competition (JFOC) to utilize existing United Space Alliance (USA) contractor to perform study tasks for Constellation. JFOC approved 10/9/2006. Space Processing Operations Contract (SPOC) awarded 2006 which included additional Decision Packages to authorize USA to perform support tasks and studies for Constellation.
Life Cycle Cost Impact	Utilizing traditional approaches toward developing a human space flight mission system may result in a new system which exceeds available budgets or requires excessive mission support personnel to be cost effective across the life cycle and will not allow funding for future lunar missions.	Implement a Flight Operations Improvement Team to validate, eliminate or replace current system approaches with alternative technologies, processes or cultural shifts to reduce mission system resources or improve efficiency. Incorporate, track and validate improvements showing improvements to Life Cycle Cost from mission systems development decisions.

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Development:	Commercial Cargo Crew Capability

Budget / Life Cycle Cost

Budget Authority ($ millions)	Prior	FY06	FY07	FY08	FY09	FY10	FY11	FY12	BTC	LCC TOTAL
FY 2008 President's Budget Request	--	--	--	236.0	158.8	41.3	--	--	--	436.0
FY 2007 President's Budget Request	--	--	--	--	--	--	--	--	--	--
Changes	--	--	--	236.0	158.8	41.3	--	--	--	436.0

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Project Changes

Project	*Commercial Cargo Crew Capability*

The International Space Station (ISS) Cargo Crew Services Project supported both International Partner purchases to service the International Space Station (ISS) in the near term, and a two phased effort to obtain commercial transportation services from Earth to the ISS and back. Beginning in FY 2008, the management and budget execution responsibility for the International Partner purchases area of this project has been transferred to the Space Operations Mission Directorate (SOMD). The Commercial Orbital Transportation Service development effort has been retained in this project.

Project Purpose

The Commercial Cargo Crew Capability Project (C4P) supports demonstration of Commercial Space Transportation Services from domestic companies. NASA's Commercial Orbital Transportation Services (COTS) Projects are designed to facilitate U.S. private industry demonstration of cargo and crew space transportation capabilities with the goal of achieving reliable, cost effective access to low-Earth orbit.

In the near-term, International Partner Purchases are necessary because the U.S. currently has no alternative to the Space Shuttle. In the long-term, NASA would prefer to utilize domestic commercial space transportation providers, both to ensure availability of U.S. sources and to expend taxpayer dollars at home. The Commercial Cargo Crew Capability Projects are designed to enable procurement of domestic orbital transportation services to resupply the International Space Station in the future and to stimulate the commercial space sector.

Project Parameters

Phase I of the Commercial Cargo Crew COTS Projects include Capability A: Unpressurized cargo to ISS; Capability B: Pressurized cargo to ISS; Capability C: Pressurized cargo to and from ISS. Contractors are required to demonstrate ability to transport cargo to and from the ISS.

Upon completion of successful flight demonstrations, the project will move into Phase II, the Operations Phase. NASA will use a Request for Proposals (RFP) to solicit transportation and resupply services to the ISS. Companies responding to this RFP could provide similar space transportation services to non-NASA customers.

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Development:	Commercial Cargo Crew Capability

Project Commitments

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
COTS	SpaceX and Rocketplane Kistler	Successful demonstration of 3 flights per vendor for unpressurized cargo and pressurized cargo.		Space Act Agreements Define Request.

Schedule Commitments

Milestone Name	Confirmation Baseline	FY 2007 PB Request	FY 2008 PB Request
Development			
COTS Project: SpaceX - Demo 1 Systems COTS Project: SpaceX - Demo 1 Systems	November 2006	N/A	November 2006
COTS Project: SpaceX - Demo 1 Preliminary Design Review (PDR)	January 2007	N/A	January 2007
COTS Project: SpaceX - Demo 1 System Critical Design Review (CDR)	August 2007	N/A	August 2007
COTS Project: SpaceX - Demo 1 Readiness Review (RR)	February 2008	N/A	February 2008
COTS Project: SpaceX - Demo 1 Mission	September 2008	N/A	September 2008
COTS Project: SpaceX - Demo 2 Mission	June 2009	N/A	June 2009
COTS Project: SpaceX - Demo 3 Mission	September 2009	N/A	September 2009
COTS Project: RpK - SRR	February 2007	N/A	February 2007
COTS Project: RpK - Pressurized Cargo Module (PCM) CDR	August 2007	N/A	August 2007
COTS Project: RpK - Unpressurized Cargo Module (UCM) CDR	September 2007	N/A	September 2007
COTS Project: RpK - ISS Test Readiness Review (TRR)	October 2007	N/A	October 2007
COTS Project: RpK - Risk Reduction Flight	November 2008	N/A	November 2008
COTS Project: RpK - 1st Demo Flight with Pressurized Cargo	January 2009	N/A	January 2009
COTS Project: RpK - 2nd Demo Flight with Unpressurized Cargo	March 2009	N/A	March 2009

Mission Directorate:	Exploration Systems
Theme:	Constellation Systems
Program:	Constellation Systems Program
Project In Development:	Commercial Cargo Crew Capability

Project Management

The Commercial Cargo Crew Capability Project is managed at Johnson Space Center.

Project Element	Element Oversight	Lead Performer	Partners
Commercial Cargo Crew COTS Projects Phase 1 Capabilites A-C	Johnson Spacce Center	SpaceX and Rocketplane-Kistler	

Acquisition Strategy

Commercial Cargo Crew Capability: in FY 2008, the COTS Projects will continue to execute the Space Act Agreements signed in August 2006 with SpaceX and RpK for Phase I. Currently, there is no acquisition strategy for COTS Projects Phase I Capability D, crew transportation and for the Operational Phase (Phase II). However, NASA will begin developing those plans for the FY 2009 budget submit.

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
COTS Projects Demonstrations	Risks to: Performance. The entire COTS program and projects are high risk. As each partner completes negotiated milestones, project risks are retired. Failure to meet these milestones will result in the inability to demonstrate cargo transportation to and from the ISS.	The Commercial Cargo Crew Capability Project Office (C4PO) will independently identify risks unique to each COTS partner and review them internally on a regular basis. Risks unique to each COTS partner will be treated as company proprietary. CEV/CLV projects and foreign purchases of space transportation capabilities are NASA's path to meeting service obligations to ISS, if COTS is unsuccessful.

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities

Theme Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Advanced Capabilities	1,316.6	920.0	855.8	861.6	973.0	1,059.1	1,083.9
Lunar Precursor Robotic Program	149.5	284.6	278.1	331.6	381.5	372.9	385.7
Exploration Technology Development	696.0	439.3	394.3	344.5	405.7	500.4	505.7
Human Research Program	414.6	178.5	183.3	185.5	185.7	185.9	192.4
Centennial Challenges	--	12.1	--	--	--	--	--
Prometheus Power and Propulsion	56.5	5.5	--	--	--	--	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Theme Changes

	FY 2008		
Advanced Capabilities	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Lunar Precursor Robotic Program	**366.9**	**278.1**	**-88.8**

The Lunar Precursor Robotic Program (LPRP) replaces the former Robotic Lunar Exploration Program (RLEP).

The FY 2008 budget includes the transfer of funding from future missions to support critical agency assets (-$168.8 million).

The FY 2008 budget also includes an increase of $45 million in Programmatic Content to support an increase in costs for the Lunar Reconnaissance Orbiter, as well as an Institutional Adjustment to the allocation of agency costs to the program (+$35.0 million).

Exploration Technology Development	**357.3**	**394.3**	**37.0**

This program encompasses a technology budget structure modified to reflect tasks defined in the Exploration System Architecture Study (ESAS). The reformulation of the Advanced Space Technology and Technology Maturation programs of the former Exploration Systems Research and Technology Theme were combined to initiate the ETDP Program in FY 2007. The Life Support and Habitation (LSH) program of the former Human Systems Research and Technology Theme have been added to round out the program's portfolio. LSH includes the non-Exploration portion of the ISS-based research budget that was developed as a result of the NASA Authorization Act of 2005.

The FY 2008 budget involves a number of Programmatic Transfers, including: a) Alpha Magnetic Spectrometer (AMS) to the Space Operations Mission Directorate (-$3.5 million); b) the Microgravity Science Glovebox and Material Science Research Rack to the Space Operations Mission Directorate (-$4.3); and c) the transfer of the Near Earth Object Observation (NEOO) from the Science Mission Directorate to ESMD (+4.1 million).

The FY 2008 budget also includes an increase of $59.4 million for Programmatic Content to to increase the capabilities and reduce the costs of future exploration missions, and an Institutional Adjustment to the allocation of agency costs to the program (-$18.9 million).

Human Research Program	**174.9**	**183.3**	**8.4**

The Human Research Program (HRP) was formed after the Exploration Systems Architecture Study to focus its research investment on investigating and mitigating the highest risk to human health and performance in support of exploration missions. This newly structured program is a combination of the content within the Human Health and Performance Program and the Human Systems Integration Program, under the former Human Systems Research and Technology Theme. The focus of HRP is research that addresses exploration gaps in characterizing space environment effects on humans, and developing standards and countermeasures.

The FY 2008 budget includes $0.4 million increase in Programmatic Content to support Advanced Food Technology, and an additional $0.3 million transfer to support radiation research. The FY 2008 budget also includes an Institutional Adjustment to the allocation of agency costs to the program (+$7.8 million).

Centennial Challenges	**10.0**	**0.0**	**-10.0**
The Centennial Challenges Program has been transferred to the Innovative Partnerships Program (IPP) beginning in FY 2007.			
Prometheus Power and Propulsion	**4.9**	**0.0**	**-4.9**
This program is now a project under Exploration Technology Development Program (ETDP) for the FY 2008 budget, in order to capture all technology development projects under one program. Funds for Prometheus Power and Propulsion are transferred into the Exploration Technology Development Program. Prometheus will focus on development of nuclear power and propulsion systems in support of long-duration stays on the Moon and Mars.			

Theme Purpose

The Advanced Capabilities (AC) Theme provides knowledge, technology and innovation that will enable current and future exploration missions, as outlined in NASA's Strategic Plan. The AC Theme is composed of three major programs: the Lunar Precursor Robotic Program, Human Research Program, and the Exploration Technology Development Program. These programs and their associated projects provide knowledge as a result of ground based research, research conducted in space, and by observations by robotic flight missions. The AC Theme also develops and matures advanced technology, integrates that technology into prototype systems, and transitions technology to Constellation Systems. Through its activities, AC provides operational and technical risk mitigation for Constellation Systems.

When astronauts journey to the Moon and beyond, they will be exposed to the microgravity, radiation, and isolation to explore for long periods of time. Keeping crews physically and mentally healthy and productive during such long-duration missions will require new technologies and capabilities. NASA is studying how the space environment, close quarters, heavy workloads, and long periods of time away from home contribute to physical and psychological stresses and is developing technologies that can prevent or mitigate these effects. NASA is also pursuing innovative ways to meet the basic needs of oxygen, water, food, and shelter with systems that can operate dependably, first for weeks and eventually for months on the Moon, and eventually for months on Mars as well.

Maturing relevant new technologies will allow NASA to place Orion into service as soon as possible after Shuttle retirement. These include structures, thermal protection systems, propulsion, life support systems, capabilities for in-situ resource utilization, and many others that will enable future human and robotic exploration missions using both ground-based and ISS-based research.

In support of the lunar return effort, NASA has established the Lunar Precursor and Robotic Program (LPRP) Office at Marshall Space Flight Center. The program office will examine mission concepts that can provide information useful to the lunar exploration effort or demonstrate technology needed by further human explorers to reduce mission risk.

The first lunar robotic mission is the Lunar Reconnaissance Orbiter (LRO), which will provide detailed mapping for human landing site selection. A secondary payload, the Lunar Crater Observation and Sensing Satellite (LCROSS), will provide additional data on lunar resources.

The AC Theme supports multiple Goals and Sub-goals in the 2006 NASA Strategic Plan.

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities

Theme Overview

The Exploration Technology Development Program (ETDP) provides new technologies that will enable NASA to conduct future human and robotic exploration missions, and to reduce risk and life cycle cost. The Program's primary customers are the designers and developers of flight systems in the Constellation Systems and Lunar Precursor Robotic Programs. ETDP activity reduces the risk of infusing new technologies into flight projects by maturing them to the level of demonstration in a relevant environment in time to support the Preliminary Design Review of the target flight system. Projects include: Structures, Materials and Mechanisms; Protection Systems; Non-Toxic Propulsion; Energy Storage; Thermal Control; Avionics and Software; Environmental Control and Life Support; Crew Support and Accommodation; ISS Research and Operations; In-Situ Resource Utilization; Robotics, Operations and Supportability; Fission Surface Power Systems; and Near Earth Objects Observation.

The Human Research Program (HRP) investigates and mitigates the highest risks to astronaut health and performance in support of NASA exploration missions. The program's primary goal is to develop and provide human health and performance countermeasures, knowledge, technologies, and tools to enable safe, reliable, and productive human space exploration. Projects include: the ISS Medical Project; Behavioral Health and Performance; Space Human Factors and Habitability; Human Health Countermeasures; Space Radiation; and Exploration Medical Capability.

The Lunar Precursor Robotic Program (LPRP) is planning and executing lunar robotic missions to conduct research and prepare for future human exploration. Precursor activities include topographic mapping, mineral identification and mapping, and radiation and dust characterization. Data from LPRP missions is critical to Constellation Systems' efforts to return humans to the moon by 2020. Data from LPRP will support astronaut safety, landing site selection, and engineering requirements for lunar surface hardware. The first mission, Lunar Reconnaissance Orbiter (LRO), will launch in late 2008.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

The Advanced Capabilities Theme supports the Vision for Space Exploration (VSE) by developing innovative technologies and gathering scientific data needed to implement a sustained and affordable human and robotic program to explore the solar system and beyond.

NASA's effort in this area contributes to implementation of the Global Exploration Strategy, which includes participation from thirteen other international space agencies, as well as more than a thousand individuals around the world from academia, the private sector, and the general public. Activity at the global level is focused on answering such questions as, "Why should we return to the Moon?" and "What will we accomplish there?"

Relevance to the NASA Mission:

Advanced Capabilities activity supports NASA's mission to pioneer the future in space exploration and scientific discovery by acquiring new and vital knowledge and by identifying, developing, and transitioning new technologies that enable the systems concepts and capabilities needed to expand and sustain human presence in space.

Relevance to education and public benefits:

Advanced Capabilities programs support educational outreach activity at the K-12, undergraduate, and graduate levels. By providing ideas for the Space Grant and Graduate Student Research Programs, NASA promotes educational opportunities for students at colleges and universities across the Nation.

In implementing these programs, NASA plans to leverage the expertise of academia, government agencies, and industry to carry out research and development efforts. By advancing diverse, novel technologies through projects with non-traditional NASA research partners, small businesses and others, public benefits will include new technologies such as power generation, communications, computing, robotics, and improved materials from space exploration research and execution for use by industry and the general public.

In addition, exploration will further advance the medical knowledge and diagnostic and treatment technologies NASA uses to keep humans healthy and productive in space, improving the medical treatment and health of humans on Earth. Research into human adaptation to microgravity has helped scientists better understand changes that come with aging, such as bone loss, muscle atrophy, and loss of balance. NASA-developed telemedicine technologies that help doctors on Earth monitor and treat astronauts in space through computer-assisted imaging and diagnostics, video, and telecommunications, help doctors deliver quality medical care to people in underserved areas of the world.

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
Strategic Goal 2	**Complete the International Space Station in a manner consistent with NASA's International partner commitments and the needs of human exploration.**	
Outcome 2.3	**Conduct basic and applied biological and physical research to advance and sustain U.S. scientific expertise.**	
APG 8AC01	Design, build, and deliver for flight two ISS experiments.	Exploration Technology Development
APG 8AC02	Design, build, and deliver for flight two Foton M3 experiments.	Exploration Technology Development
APG 8AC03	Conduct 30 ground-based investigations in the physical and biological sciences that promote the development of related microgravity research capabilities.	Exploration Technology Development
Strategic Goal 3	**Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.**	
Sub Goal 3C	**Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space.**	
Outcome 3C.4	**Progress in exploring the space environment to discover potential hazards to humans and to search for resources that would enable human presence.**	
APG 8AC04	Develop and deliver the Radiation Assessment Detector (RAD) for the Mars Science Laboratory, scheduled to fly in 2009.	Human Research Program
Sub Goal 3F	**Understand the effects of the space environment on human performance, and test new technologies and countermeasures for long-duration human space exploration.**	
Outcome 3F.1	**By 2008, develop and test candidate countermeasures to ensure the health of humans traveling in space.**	
APG 8AC05	Publish results of renal stone countermeasure experiments and evaluate for operational use.	Human Research Program
APG 8AC06	Complete study of a non-pharmacological countermeasure for bone loss in a spaceflight analog environment.	Human Research Program
APG 8AC07	Characterize the size distribution of lunar dust (from Apollo samples) in the inhalable size range (<10 micrometers), and begin toxicity testing with simulated lunar dust.	Human Research Program
APG 8AC08	Determine the stability of a controlled set of food/nutritional items and common medications, representative of the types and classes typically provided on space missions, after six months exposure to the space flight environment.	Human Research Program
Outcome 3F.2	**By 2010, identify and test technologies to reduce total mission resource requirements for life support systems.**	
APG 8AC09	Deliver two prototype life support systems: the Carbon Dioxide and Moisture Removal Amine System (CAMRAS); and the Sorbent Based Air Revitalization (SBAR) System.	Human Research Program
Outcome 3F.3	**By 2010, develop reliable spacecraft technologies for advanced environmental monitoring and control and fire safety.**	
APG 8AC10	Deliver the Vehicle Cabin Atmosphere Monitoring (VCAM) flight hardware in preparation for launch to ISS.	Exploration Technology Development
APG 8AC11	Deliver the Electronic Nose (E-Nose) flight hardware in preparation for launch to ISS	Exploration Technology Development

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
APG 8AC12	Launch the Smoke Aerosol Measurement Experiment (SAME) to ISS and initiate testing.	Exploration Technology Development
APG 8AC13	Deliver the Combustion Integrated Rack (CIR) and its insert, the Flame Extinguishment Experiment in preparation for launch to ISS.	Exploration Technology Development
Strategic Goal 6	**Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.**	
Outcome 6.1	**By 2008, launch a Lunar Reconnaissance Orbiter (LRO) that will provide information about potential human exploration sites.**	
APG 8AC14	Complete the Critical Design Review (CDR), Mission Readiness Review (MRR), and Payload Engineering Review (PER) for the Lunar Reconnaissance Orbiter.	Lunar Precursor Robotic Program
APG 8AC15	Complete the Critical Design Review (CDR) and Mission Readiness Review (MRR) for the Lunar Crater Observation and Sensing Satellite.	Lunar Precursor Robotic Program
Outcome 6.2	**By 2012, develop and test technologies for in situ resource utilization, power generation, and autonomous systems that reduce consumables launched from Earth and moderate mission risk.**	
APG 8AC16	Achieve authority to proceed for a medium lander mission to be launched in the 2010-2011 timeframe that would characterize the lunar surface environment.	Lunar Precursor Robotic Program
Outcome 6.3	**By 2013, sufficiently develop and test technologies for nuclear power systems to enable an informed selection of systems for flight development to provide power to a lunar outpost.**	
APG 8AC17	By 2008, demonstrate high efficiency power conversion systems in the laboratory at power levels in excess of 10 kilowatts that are relevant to future fission surface power systems.	Exploration Technology Development

Performance Achievement Highlights

Exploration Technology Development

In August 2006, crew onboard the ISS successfully completed the Dust and Aerosol Measurement Feasibility Test (DAFT), an experiment to characterize the distribution and size of dust particles floating in the air aboard the ISS. DAFT tested the effectiveness of fire safety technology in detecting greater-than-normal amounts of particles in the air, a difficult task in a near-weightless environment where air circulates differently and heavier particles are not pulled toward the ground.

The Exploration Life Support project made progress in developing new concepts and technologies for removing carbon dioxide and humidity from spacecraft environments. These technologies are lighter and smaller than those currently used on the ISS, freeing up valuable mass on future exploration vehicles.

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities

Performance Achievement Highlights

Human Research Program

During FY 2006, HRP initiated an exhaustive review of the program's focus areas (bone and muscle, cardiology, pharmacology, neurological sciences, nutrition, immunology, behavioral health and performance disciplines) to assess the program's research, data, and knowledge completed to date and its significance to current exploration missions, and to determine what work still needs to be done to implement the Vision for Space Exploration.

The Program also refocused its International Space Station utilization approach to better coordinate research and maximize use of facilities aboard the International Space Station and other space-based research platforms. HRP initiated the Stability of Pharmacotherapeutic and Nutritional Compounds flight experiment aboard ISS to document how the radiation environment in space affects the stability of vitamins and compounds in foods and medication for long-duration human missions. The Program also conducted "walk back" tests to determine if a crewmember could walk 10 kilometers in a space suit from a failed lunar rover back to home base. The test monitored the crewmember's exertion and the results will be used to improve space suit designs.

Lunar Precursor Robotic Program

In 2006, the Lunar Reconnaissance Orbiter (LRO) mission passed the Preliminary Design and Confirmation Reviews, where an external team reviewed plans for systems, software, and vehicle configuration and determined that the project should progress forward to the development stage. The Critical Design Review (CDR) was successfully completed early in FY 2007. LRO continues preparation for launch in October 2008.

NASA selected the Lunar Crater Observation and Sensing Satellite (LCROSS), to launch as a secondary payload with LRO, taking advantage of additional mass capability on the launch vehicle.

Quality

Performance Measure #	Description
Advanced Capabilities Theme	
APG 8AC18	Complete all development projects within 110% of the cost and schedule baseline.
APG 8AC19	Increase the relative amount technology products transferred to Constellation Systems developers for mission application compared to the total budget.
APG 8AC20	Reduce time within which NRA research grants are awarded, from proposal due date to selection, by 2.5% per year, with a goal of 135 days.

Program Assessment Rating Tool (PART):

The Advanced Capabilities Theme has not been PART reviewed in its entirety and will be in FY 2007. Several predecessors programs to the current programs have been reviewed. Most recently, in FY 2005, the former Human Systems Research and Technology Theme (HSRT) received a PART rating of "Moderately Effective." HSRT demonstrated a clear program purpose and design, as well as effective strategic planning. However, it was determined that the overall progress towards key goals was not sufficiently demonstrated, because continued strategic revisions to the program made it difficult to ascertain progress towards key goals. Additionally, while regular independent evaluations previously conducted by the National Research Council confirm the importance and appropriateness of the HSRT research agenda, these reviews tended not to focus on effectiveness or results.

Several performance improvement areas were identified. Specifically, elements of the former HSRT continue to pursue the following actions:
1) establish a risk mitigation process for the Bioastronautics Roadmap deliverables for Human Space Exploration,
2) ensure independent peer review for directed research, and
3) streamline NASA Research Announcements (NRAs).

In FY 2006, progress was made in all the performance improvement areas. The Human Research Program is developing an integrated research plan that identifies schedules, priorities, and resources required to mitigate high-priority risks. This plan will be completed in mid-FY 2007. New strategies employed in FY 2006 for NRAs will be leveraged in FY 2007. Further, a metric was established that 100% of directed research projects will undergo a non-advocate review (NAR). Out of the six directed review projects a NAR was performed on four, the remaining two will be completed in FY2007.

The performance improvement progress made by HSRT and the other program predecessors will be factored into the FY 2007 Advanced Capabilities review.

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Quality	National Research Council	New	Congressionally mandated assessment of program effectiveness and technical quality.	03/2007

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Lunar Precursor Robotic Program

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Lunar Precursor Robotic Program	149.5	284.6	278.1	331.6	381.5	372.9	385.7
Lunar Reconnaissance Orbiter	117.4	120.7	159.4	29.1	4.8	--	--
Other	32.0	163.8	118.7	302.5	376.7	372.9	385.7

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

Lunar Precursor Robotic Program	FY 2008		
	FY 2007 PB Request	FY 2008 PB Request	Change
Lunar Reconnaissance Orbiter	**91.0**	**159.4**	**68.4**
The launch vehicle for LRO changed from a Delta II to an Atlas V to solve a technical problem known as nutation, which is the off-axis spinning and tumbling of a satellite. This added $15 million. The Lunar Crater Observing and Sensing Satellite (LCROSS) was added as a secondary payload to take advantage of Atlas V's increased launch mass capability. This added $24 million. Given the fast-paced schedule for LRO development, one month of contingency funding was added in case of a launch delay. This added $6 million. Lastly, an institutional adjustment to the allocation of agency costs added $23.4 million.			
Other	**275.9**	**118.7**	**-157.2**
The Future Missions budget of the Lunar Precursor Robotics Program was adjusted in several ways for the FY 2008 budget. These include: *1) Programmatic Transfers to support critical agency assets (-$168.8 million).* *2) An Institutional Adjustment to the allocation of agency costs to the program (+$11.6 million).*			

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Lunar Precursor Robotic Program

Program Overview

The Lunar Precursor and Robotic Program (LPRP) supports America's return to the Moon by executing lunar robotic missions to conduct research and prepare for future human exploration.

LPRP missions will gather data important for reducing the risks of returning humans to the Moon by 2020, such as examining the lunar radiation environment, which has implications for astronaut safety. Surface imaging and mapping will assist landing site selection by identifying terrain hazards (slope, roughness, obstacles) as well as areas of scientific and operational interest. Temperature and lighting conditions over an annual cycle, along with a good characterization of dust, environmental conditions, and radiation are needed for mission and hardware design. Resource identification and mapping will inform decisions about possible future use of in-situ resources. Future LPRP missions may also demonstrate prototype technologies such as precision landing and in-situ resource utilization.

Specific LPRP activities will include topographic mapping, resource and mineral identification and mapping, identifying permanently lighted and permanently shadowed areas near the lunar poles, and characterizing the radiation and dust environment and landing site hazards. LPRP is considering a mix of orbiters, landers, and impactors to obtain required data.

LPRP's first mission, the Lunar Reconnaissance Orbiter (LRO), is in development, with launch planned late in October 2008. LRO will provide critical information about the Moon to enable selection of safe landing sites with compelling exploration and scientific features. Using a robust suite of instruments to measure the topography of the moon's surface, LRO will take high-resolution images of sites of interest, globally assess thermal and radiation environments, and assay potential resources.

Launching with LRO is the Lunar Crater Observation and Sensing Satellite (LCROSS). This low-cost secondary payload will investigate the presence of lunar volatiles in a permanently shadowed region of the lunar surface. The Lunar Architecture Team (LAT) study is examining lunar exploration requirements needed to support a human lunar sortie by 2020. The LAT is scheduled to conclude Phase 2 architecture refinements in July 2007, and will assist in determining future missions and instruments to follow LRO and LCROSS.

LPRP missions will advance scientific understanding of and facilitate human return to the Moon by producing high-quality maps of lunar terrain, illumination, and resources; high-resolution images of large areas of the lunar surface; a lunar geographic coordinate system resulting from the mapping and imaging; and information on the lunar radiation environment.

LPRP supports Outcomes 6.1 and 6.2 and APGs 8AC14 (successfully complete LRO reviews) and 8AC15 (successfully complete LCROSS reviews).

Program Relevance

LPRP executes the projects that will achieve Outcomes 6.1 ("by 2008, launch a Lunar Reconnaissance Orbiter (LRO) that will provide information about potential human exploration sites") and 6.2 ("By 2012, develop and test technologies for in-situ resource utilization, power generation, and autonomous systems that reduce consumables launched from Earth and moderate mission risk.").

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Lunar Precursor Robotic Program

Plans For FY 2008

Instrument and subsystem design and fabrication for LRO and LCROSS are the primary FY 2007 activities, while spacecraft integration and testing will begin early in FY 2008. The spacecraft are preparing for launch in October 2008 (FY 2009).

LPRP also plans to develop an integrated lunar data set, which will combine data from previous NASA and international lunar missions with data from LRO and follow-on missions to meet the needs of human lunar return and provide engineering, technical, and safety standards for a human lunar sortie by 2020.

Lunar Reconnaissance Orbiter

The Lunar Reconnaissance Orbiter project is a lunar-orbiting satellite with six instruments and a technology demonstration payload to conduct an initial reconnaissance of the Moon. The orbiter will map and image the Moon's surface, take high-resolution images of areas of interest, assess light, thermal, and radiation environments, and map resources. The LCROSS impactor and Shepherding Spacecraft, which are co-manifested with LRO, will attempt to identify water in a permanently shadowed crater.

Future Missions

The Future Missions budget line carries outyear funding for LPRP missions that may be selected to follow LRO and LCROSS. Currently, NASA is considering a lander to gather data on surface conditions that cannot be obtained from an orbiter and to validate orbital remote sensing data with ground truth. Future missions also under study include small orbiters, as demonstrators of required technologies or to gather specific data sets.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Prepare to launch LRO/LCROSS mission early in FY 2009.	LRO	Launch early FY 2009	No Change
Select and begin formulating future missions.	Missions to be determined as outcome of LAT and other studies.	n/a	Select and begin formulation.

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Lunar Precursor Robotic Program

Implementation Schedule

Project	Schedule by Fiscal Year															Phase Dates			
	Prior	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20		Beg	End	Mile-stone
LRO (includes LCROSS)																	Tech			
																	Form	May-04	Mar-06	
																	Dev	May-06	Nov-08	
																	Ops	Dec-08	Nov-09	
																	Res	Dec-09	Dec-20	

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

The Lunar Precursor and Robotic Program Office at Marshall Space Flight Center manages LPRP. The LRO spacecraft is managed by Goddard Space Flight Center, and LCROSS is managed by Ames Research Center.

Acquisition Strategy

Acquisition strategy for missions beyond LRO and LCROSS has not yet been determined. Once the various architecture and small satellite studies result in concepts for the next missions, appropriate acquisition strategies will be determined.

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Program Architecture Definition	Immaturity of Lunar Robotic Requirements leads to lack of program architecture definition.	LPRP requirements needed to support the Constellation Systems program's first lunar sortie and resulting architecture are being defined by several studies. The most important of these is the LAT, which will complete its Phase 2 definition by July 2007. The resulting requirements and architecture will allow NASA to select the LPRP missions and instruments that will follow LRO and LCROSS.

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Lunar Precursor Robotic Program
Project In Development:	Lunar Reconnaissance Orbiter

Budget / Life Cycle Cost

Budget Authority ($ millions)	Prior	FY06	FY07	FY08	FY09	FY10	FY11	FY12	BTC	LCC TOTAL
FY 2008 President's Budget Request	**65.4**	**117.4**	**120.7**	**159.4**	**29.1**	**4.8**	**--**	**--**	**--**	**496.8**
Formulation	58.1	35.2	--	--	--	--	--	--	--	--
Development	7.3	82.3	120.7	130.1	2.0	--	--	--	--	--
Operations	--	--	--	--	22.0	3.9	--	--	--	--
Other	--	-0.1	--	29.3	5.1	0.9	--	--	--	35.2
FY 2007 President's Budget Request	**65.4**	**102.2**	**119.4**	**91.0**	**27.9**	**5.3**	**1.7**	**--**	**--**	**412.8**
Changes	**--**	**15.2**	**1.3**	**68.4**	**1.2**	**-0.5**	**-1.7**	**--**	**--**	**84.0**

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Project Changes

Project *Lunar Reconnaissance Orbiter*

In FY 2006, the launch vehicle for the Lunar Robotics Orbiter (LRO) was changed from a Delta II to an Atlas V to solve a possible nutation problem with LRO. Nutation is an attitude stability problem that could cause spacecraft pointing errors or even result in tumbling and loss of spacecraft. The Delta II's upper stage is spin-stabilized, which could initiate a nutation problem with LRO. The Atlas V's upper stage does not spin and will not initiate the nutation problem. The change to Atlas V increased the LRO budget by $15 million in FY08 (incomparison to estimates made during project formulation). The change allowed LRO to use a simpler spacecraft design incorporating previously flown components, such as a TDRSS fuel tank.

Also in 2006, the Lunar Crater Observation and Sensing Satellite (LCROSS) was competitively selected as a secondary payload to take advantage of the Atlas V's increased launch mass capability. LCROSS is a cost-capped spacecraft development project and increases LRO's lifecycle costs in comparison to estimates made during project formulation. The selection of the LRO spacecraft added $24 million to the FY 2008 budget for LRO.

In addition, funding for one month of schedule contingency was added in case of a launch delay (+$6 million), and an institutional adjustment to the allocation of agency costs added $23.4 million to LRO budget in FY 2008.

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Lunar Precursor Robotic Program
Project In Development:	Lunar Reconnaissance Orbiter

Project Purpose

The Lunar Reconnaissance Orbiter (LRO) is the first mission in NASA's return to the Moon and the implementation of the Vision for Space Exploration. LRO will orbit the Moon for one year, carrying out extensive measurements of lunar topography, resources, and thermal and radiation environments. This data about the lunar surface is critical for site selection, safe landing, and astronaut safety of the first human lunar sortie by 2020.

LRO will orbit the Moon in a circular, 50 kilometer polar orbit. During its mission, it will:

-Precisely measure lunar terrain, with altitude resolution of 10 centimeter locally and one meter absolute from the Moon's center of mass, at an average data grid density of 0.001 degrees latitude and 0.04 degrees longitude;

-Assess meter-scale surface features to enable safety analysis of potential lunar landing sites;

-Characterize illumination and thermal environments over a full year;

-Characterize lunar mineralogy, and investigate the presence of water and other volatiles in permanently shadowed regions;

-Measure the radiation environment to assess the potential biological impacts to human explorers; and

-Demonstrate the technical performance of a synthetic aperture radar for communication and scientific investigation of the lunar surface.

The Lunar Crater Observation and Sensing Satellite (LCROSS) will launch with LRO as a secondary payload to investigate lunar surface volatiles, primarily water, in a permanently shadowed site. The LCROSS Shepherding Spacecraft will separate from the Atlas V's upper stage. The upper stage will impact the lunar surface in a permanently shadowed region near a lunar pole, creating a cloud of about 200 metric tons of ejecta. The Shepherding Spacecraft will observe the impact and ejecta to detect and characterize the possible presence of water. The impact and ejecta will also be observed by ground and other space-based telescopes.

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Lunar Precursor Robotic Program
Project In Development:	Lunar Reconnaissance Orbiter

Project Parameters

LRO has a dry mass of about 1,000 kilograms. To achieve the required high resolution, LRO will use a 50 kilometer polar orbit. LRO will be stabilized in three axes to about one arc-minute of pointing accuracy. Data downlink capability will be up to 900 gigabits per day.

LRO contains a suite of six competitively selected instruments, plus a technology demonstration payload offering additional measurements. The project will integrate the results from all six instruments to provide high fidelity information to advise future exploration activities. The instruments are:

* Lunar Orbiter Laser Altimeter (LOLA) for precise topographical measurements;
* LRO Camera (LROC) for high resolution imaging of the lunar surface;
* Lunar Exploration Neutron Detector (LEND) to search for evidence of water ice;
* Diviner Lunar Radiometer to map the temperature of the lunar surface;
* Lyman-Alpha Mapping Project (LAMP) sensor to observe the lunar surface in the far ultraviolet; and
* Cosmic Ray Telescope for the Effects of Radiation CRaTER) to measure the Moon's radiation environment and assess the equivalent radiation dose to human tissue.

LRO includes the Mini-RF (Radio Frequency) technology demonstration payload, which will collect radar data to complement the other LRO measurements.

LCROSS consists of a 900 kilogram, 480 watt Shepherding Spacecraft and the spent upper stage of the Atlas V launch vehicle. After LRO separates from the launch vehicle, LCROSS will use a lunar gravity assist to achieve a highly inclined lunar orbit, returning towards a lunar pole about 80 days later. As LCROSS approaches the Moon, the Shepherding Spacecraft will release the 2,000 kilogram upper stage. The upper stage will impact in a permanently shadowed crater near the pole, excavating about 200 metric tons of material from the surface. The Shepherding Spacecraft will observe the impact and resulting cloud of ejecta with visible and near-infrared cameras and spectrometers and a photometer. LCROSS will be able to detect the presence of water ice in the excavated regolith to concentrations as low as 0.5%.

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Lunar Precursor Robotic Program
Project In Development:	Lunar Reconnaissance Orbiter

Project Commitments

LRO will launch in October 2008 for a one-year mission. Information from LRO is critical to hardware design, mission planning, and landing site selection for the first human lunar sortie by 2020. This information will:

* Aid navigation and landing safety
  - High resolution visible imagery
  - High resolution mapping and altimetry
  - Rock abundance

* Locate and identify resources
  - Map surface temperatures at various times of the lunar day over a full year
  - Detect and map surface materials and minerals
  - Identify and map surface and subsurface water ice
  - Map solar illumination at various times of day over a full year

* Characterize the enviroment for life in lunar orbit and on the surface
  - High-energy radiation
  - Neutron radiation
  - Radiation effects on human tissue

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
LCROSS Shepherding Spacecraft	Northrup-Grumman	Volatiles investigation	n/a	New
LCROSS Payload Suite	NASA/ARC	Instruments on the Shepherding Spacecraft	n/a	New
CRaTER	Boston University	Radiation instrument	no change	no change
DIVINER	UCLA	Surface temperature mapping instrument	no change	no change
LAMP	Southwest Research Institute	Far-ultraviolet imager	no change	no change
LEND	Russian Institute for Space Research	Neutron detector to search for evidence of water ice	no change	no change
LOLA	NASA/GSFC	Laser altimeter	no change	no change
LROC	Arizona State University	High-resolution imager	no change	no change
Mini-RF	Naval Air Warfare Center	Radar technology demonstrator	no change	no change
Launch Vehicle Integration	NASA/KSC	Integrate LRO and LCROSS to Atlas V launch vehicle	no change	no change

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Lunar Precursor Robotic Program
Project In Development:	Lunar Reconnaissance Orbiter

Schedule Commitments

LRO received confirmation to proceed from formulation to implementation in May 2006, and Critical Design Review took place in November 2006. Launch Readiness Review will occur in August 2008, in preparation for an October 2008 (FY 2009) launch.

Milestone Name	Confirmation Baseline	FY 2007 PB Request	FY 2008 PB Request
Development			
LRO Authority to Proceed	May 2004	May 2004	May 2004
LCROSS Authority to Proceed	April 2006	n/a	April 2006
LRO Critical Design Review	November 2006	November 2006	November 2006
LCROSS Confirmation Review	December 2006	n/a	December 2006
LCROSS Critical Design Review	February 2007	February 2007	February 2007
LRO/LCROSS Launch Readiness Review (LRR)	August 2008	August 2008	August 2008
LRO/LCROSS Launch	October 2008 (FY 2009)	October 2008	October 2008

Development Cost Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Lunar Reconnaissance Orbiter	2007	420.8	2007	420.8	0	Launch Readiness	10/30/2008	10/30/2008	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**420.8**	**420.8**	**0.0**
LRO Spacecraft	90.8	90.8	0.0
LRO Instruments and Payload	38.2	38.2	0.0
LCROSS Spacecraft and Instruments	59.1	59.1	0.0
Systems I&T	8.5	8.5	0.0
Ground Systems	11.3	11.3	0.0
Program Management and Other Direct Costs	33.7	33.7	0.0
Project Reserve	56.9	56.9	0.0
Launch Vehicle for LRO/LCROSS	122.3	122.3	0.0

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Lunar Precursor Robotic Program
Project In Development:	Lunar Reconnaissance Orbiter

Project Management

The LRO Project Office at GSFC has overall responsibility for LRO. The LCROSS Project Office at ARC has responsibility for LCROSS.

Project Element	Element Oversight	Lead Performer	Partners
LRO Spacecraft	LRO Project Office, GSFC	GSFC in-house	Boston University, UCLA, Russian Space Research Institute, Southwest Research Institute, Arizona State University, Naval Air Warfare Center
LCROSS spacecraft	LCROSS Project Office, ARC	Northrup-Grumman	

Acquisition Strategy

NASA/GSFC is building the LRO spacecraft in-house, with instrument providers as noted in the Project Commitments section. Northrup-Grumman is building the LCROSS sensing satellite, with payload suite procurement and integration performed by NASA/ARC. All major procurements have been let.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	NASA IPAO	04/2006	Authority to Proceed / The LRO project underwent a review for Authority to Proceed in April, 2006. The review determined that an alternative launch vehicle was required to avoid the nutation problem. The review also determined that a secondary spacecraft should be competitively selected to take advantage of the increased capacity of the new launch vehicle.	11/2006
Performance	Independent Review Team	11/2006	LRO spacecraft Critical Design Review (CDR) / The LRO spacecraft passed CDR and was given authorization to proceed on its development path in preparation for launch in October, 2008. The Project's cost were baselined for reporting to Congress. The LCROSS Spacecraft will undergo CDR in February 2007. Luanch Readiness Review for LRO/LCROSS is scheduled for August, 2008.	02/2007

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Lunar Precursor Robotic Program
Project In Development:	Lunar Reconnaissance Orbiter

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Aggressive Schedule	Planned launch in October 2008 forces a challenging and aggressive development schedule. LCROSS has several schedule dependencies on LRO development outputs. Although the launch window for LRO/LCROSS is not defined by orbital mechanics, the schedule is driven by the need to inform Constellation Systems hardware design and mission planning efforts to enable a human lunar sortie by 2020.	LRO and LCROSS are applying program management best practices to identify and correct any issues before they result in schedule slips.

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Exploration Technology Development

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Exploration Technology Development	696.0	439.3	394.3	344.5	405.7	500.4	505.7

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Exploration Technology Development	**357.3**	**394.3**	**37.0**

This program encompasses a technology budget structure modified to reflect tasks defined in the Exploration System Architecture Study (ESAS). The reformulation of the Advanced Space Technology and Technology Maturation programs of the former Exploration Systems Research and Technology Theme were combined to initiate the ETDP Program in FY 2007. The Life Support and Habitation (LSH) program of the former Human Systems Research and Technology Theme have been added to round out the program's portfolio. LSH includes the non-Exploration portion of the ISS-based research budget that was developed as a result of the NASA Authorization Act of 2005.

The FY 2008 budget involves a number of Programmatic Transfers, including: a) Alpha Magnetic Spectrometer (AMS) to the Space Operations Mission Directorate (-$3.5 million); b) the Microgravity Science Glovebox and Material Science Research Rack to the Space Operations Mission Directorate (-$4.3); and c) the transfer of the Near Earth Object Observation (NEOO) from the Science Mission Directorate to ESMD (+4.1 million).

The FY 2008 budget also includes an increase of $59.4 million for Programmatic Content to support technology development to increase the capabilities and reduce the costs of future exploration missions, and an Institutional Adjustment to the allocation of agency costs to the program (-$18.9 million).

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Exploration Technology Development

Program Overview

The Exploration Technology Development Program (ETDP) develops new technologies that will enable NASA to conduct future human and robotic exploration missions, while reducing mission risk and cost. The primary customers of the ETDP are the designers of flight systems in both the Constellation Systems and Lunar Precursor Robotic (LPRP) programs. By maturing new technologies to the level of demonstration in a relevant environment early enough to support a flight system's Preliminary Design Review (PDR), NASA can significantly reduce both cost and risk. ETDP is currently maturing near-term technologies to enable first flight of the Orion in 2014, and developing long-lead technologies needed for the lunar exploration missions no later than 2020.

The projects in the ETDP were formulated to address the high priority technology needs for lunar exploration identified by the Exploration Systems Architecture Study (ESAS), with further refinement by the Lunar Architecture Team (LAT). They are: Structures, Materials, and Mechanisms; Protection Systems; Non-Toxic Propulsion; Energy Storage; Thermal Control; Avionics and Software; Environmental Control & Life Support; Crew Support and Accommodation; In-Situ Resource Utilization; Robotics, Operations and Supportability; and Fission Surface Power Systems. All technology projects are managed at NASA Centers.

The ISS Research and Operations Project within ETDP includes ISS flight experiments, free-flyer experiments, and ground-based research that investigate the effects of microgravity on fluid physics, combustion, and fundamental biology for both exploration and non-exploration research.

ETDP also includes the Near Earth Objects Observation (NEOO) Project which detects, tracks, and characterizes asteroids and comets that have the potential to impact Earth.

EDTP Supports Objective(s) 2.3, 3.F.2, 3.F.3 and 6.3 and APG(s) 8AC1 to 8AC3, 8AC9 to 8AC13, and 8AC17.

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Exploration Technology Development

Program Relevance

Activities carried out in the ETDP are crucial to bringing Constellation Systems into service in a safe and cost-effective manner. Technology development is also key to the lunar return effort, as we prepare for human exploration of the Moon and later missions to Mars and other destinations.

ETDP is developing near-term technologies to reduce mission risk and cost for Orion, such as a prototype ablative heat shield, the parachute and landing attenuation system, a low-impact docking system, and environmental monitoring and life support systems.

The program is also developing long-lead technologies to enable future lunar exploration, such as components for advanced space suits, precision landing and propulsion systems for the lunar lander, structural concepts for crew habitats, robotics for assembly and maintenance of the lunar outpost, insitu resource utilization systems to enable sustainable operations, energy storage for solar power systems, and fission surface power systems for long duration and productive stays at lunar outposts and exploration of Mars.

The ETDP will support physical science research on ISS by preparing for flight a facility for combustion and fluid physics research. Two experiments that support biological research are being prepared for the Russian Foton M3 free flyer. These research experiments are part of the ISS Research and Operations Project.

In addition, the Environmental Control and Life Support Project is developing two environmental monitoring instruments that detect atmospheric contaminants in crew habitats. These instruments will be demonstrated on ISS, and if successful, will be used operationally to protect crews on long-duration exploration missions.

Plans For FY 2008

The Protection Systems Project will test and deliver for Constellation Systems a prototype ablative heat shield for the Orion CEV.

The Environmental Control and Life Support Project will complete laboratory testing of technologies for carbon dioxide and humidity removal, water disinfection, and solid waste volume compaction for potential use on Orion. This project will prepare the Electronic Nose (E-Nose) and Vehicle Cabin Atmosphere Monitor (VCAM) flight hardware for launch and testing on the ISS.

The Avionics and Software Project will complete autonomous precision landing system architecture definition, procure sensor hardware, and complete software development and integration.

The Structures, Materials, and Mechanisms Project will develop a prototype low-impact docking mechanism and a landing attenuation system for the Orion CEV. This project will also develop a sub-scale structural test article of the Orion command module, fabricated from lightweight composite materials.

The Crew Support & Accommodations Project will complete definition of thermal management, life support, energy storage, and dust mitigation technology capability needs for an advanced EVA surface suit.

The Robotics, Operations, and Supportability Project will demonstrate robotic mobility systems concept for transporting human and payloads supporting lunar operations and outpost assembly.

The Non-Toxic Propulsion Project will demonstrate prototype techniques for zero boil-off cryogenic propellant storage to enable long-duration lunar missions.

The In-Situ Resource Utilization (ISRU) Project will develop and test laboratory concepts for regolith excavation systems for site preparation and to provide raw materials for oxygen production.

The ISS Research & Operations Project will prepare the Combustion Integrated Rack (CIR) and its insert, the Flame Extinguishment Experiment (fire suppression) for launch to the ISS.

The Energy Storage Project will develop regenerative fuel cells for storing energy in a solar surface power system.

The Fission Surface Power Systems Project will develop preliminary concepts for affordable nuclear power systems to enable long duration stays at lunar outposts, and that are extensible to the exploration of Mars.

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Exploration Technology Development

Project Descriptions

The ETDP projects were formulated in FY 2006 to address high priority technology needs identified by the Exploration Systems Architecture Study (ESAS). Program content has evolved since ESAS to reflect better definition of system requirements in the Constellation Systems Program, and to incorporate new technology needs for the lunar outpost identified by the Lunar Architecture Team in FY 2007. To insure that technology development is meeting mission requirements, technical performance goals have been established for all projects with the Constellation Systems Program. Once technology products have reached the required level of maturity, the Constellation Systems Program assumes management responsibility for inserting them into the design of its flight projects.

Structures, Materials and Mechanisms

This project is developing the prototype docking mechanism, parachute, and landing attenuation system for the Orion Crew Exploration Vehicle. It will also develop structural concepts for a lightweight composite command module in order to reduce launch mass and cost. The structural test facilities at Langley Research Center will support this project.

Protection Systems

This project is developing a prototype human-rated ablative heat shield for the CEV to dissipate heat during reentry, advanced thermal protection system materials for future missions that will enter the atmosphere of Mars, and technologies for protecting lunar surface systems from the adverse effects of lunar dust. The arcjet test facilities at Ames Research Center will support this project.

Non-Toxic Propulsion

This project is developing cryogenic propulsion systems for the CEV and the LSAM, and technologies for long-term storage of non-toxic cryogenic propellants such as liquid hydrogen, oxygen, and methane. Cryogenic propellants have higher performance than propellants that are storable at room temperature such as hydrazine. Hydrazine produces toxic vapors, and requires ground operations personnel to use specialized handling procedures and protective gear to insure their safety. Non-toxic cryogenic propulsion systems will reduce ground operations costs associated with handling hazardous propellants by eliminating the need for specialized procedures. Cryogenic propellant storage will minimize the boiloff of propellants in the ascent stage of the LSAM during long stays on the surface. Rocket engine test facilities at Glenn Research Center and Marshall Space Flight Center will support this project.

Energy Storage

This project is developing advanced lithium-ion batteries and regenerative fuel cells for energy storage. These technologies will enable a solar power system to store energy for use by the outpost during the lunar night, and they will provide power for mobile systems such as EVA suits and rovers. The goals of this project are to double the energy density of state-of-the-art batteries and fuel cells, and develop new materials that will enable these devices to function at low temperatures on the Moon. The battery and fuel cell test facilities at Glenn Research Center and the Jet Propulsion Laboratory will support this project.

Thermal Control

This project is developing heat pumps, evaporators, and radiators for thermal control of the CEV and lunar surface systems such as habitats, power systems, and EVA suits. Thermal control systems dissipatae waste heat and maintain a comfortable working environment in crew habitats. Thermal test facilities and Johnson Space Center and Glenn Research Center will support this project.

Avionics and Software

This project is developing autonomous precision landing and hazard avoidance systems that will enable missions to land in close proximity to the lunar outpost. This technology may be demonstrated on future Lunar Precursor Robotic Program missions to reduce risk for crewed lunar landings.

Environmental Control and Life Support

This project is developing technologies for atmospheric management, environmental monitoring and control, advanced air and water recovery systems, and waste disposal for use inside crew habitats. These technologies will enable sustainable life support systems for long-duration missions and protect crew health from hazardous contaminants. Existing life support systems are open-loop, which means that consumables such as water and oxygen must be resupplied from Earth. The goal is to develop closed-loop systems in which essential elements are recycled. Life support test facilities at Johnson Space Center will support this project. Environmental monitoring instruments will be demonstrated on ISS, and are planned for infusion into the CEV and the lunar outpost.

Crew Support and Accommodation

This project is developing component technologies for an advanced Extra Vehicular Activity (EVA) suit. The current spacesuit used on the Shuttle and ISS cannot be used for walking on the Moon due to limited mobility and high mass. Advanced EVA surface suits with improved mobility will be tested in JSC neutral buoyancy and thermal vacuum facilities, and in annual desert field tests that simulate lunar surface operations.

ISS Research and Operations

This project is performing Exploration and Non-Exploration Research using facilities on the International Space Station (ISS) and Free Flyers. Exploration Research directly addresses exploration mission needs in human health and countermeasures; applied physical sciences for fire prevention, detection, and suppression; multiphase fluid flow; life support; and thermal control applications. An example is the Fluids and Combustion Facility that is being developed for flight on the ISS in 2008. This facility will investigate the physics of fluid flow and combustion in microgravity that has potential application for propellant handling, thermal control, and fire suppression on future exploration systems.

Non-Exploration Research was created as a result of the NASA Authorization Act of 2005, which requires NASA to carry out basic, applied, and commercial research on the ISS, Free Flyers and ground based laboratories, which is not directly linked to the Vision for Space Exploration. This research focuses on reduced gravity investigations in the life and physical sciences in fields such as microbial, cellular and animal research, materials science, fluid physics and combustion science. The motivation for this research is to sustain the existing United States scientific expertise and capabilities in microgravity research. The knowledge gained from these investigations has the potential of uncovering information that may lead to novel applications both on Earth and in space. Biological experiments will also be conducted on the Russian Foton M3 free flyer.

In-Situ Resource Utilization

This project is developing chemical processing and robotics technologies for regolith (lunar soil) excavation and handling, for producing oxygen from regolith, and for collecting and processing lunar ice and other volatiles. The utilization of in-situ resources will enable a sustainable lunar outpost by reducing the mass of consumables that must be resupplied from Earth such as water, oxygen, and rocket propellants. In-situ resource utilization (ISRU) has not been demonstrated. The goal of this project is to develop proof-of-concept ISRU systems that could demonstrated on future Lunar Precursor Robotics Program missions. Test facilities at Johnson Space Center will support this project.

Robotics, Operations, and Supportability

This project is developing technologies for surface mobility and equipment handling, human-system interaction, and lunar surface supportability. Dexterous robots and autonomous rovers capable of traversing rough terrain will assist the crew in exploring and in assembling and maintaining the lunar outpost. Robotics laboratories at Ames Research Center, Johnson Space Center, and the Jet Propulsion Laboratory will support this project. Prototype robots will be demonstrated in annual desert field tests that simulate lunar surface operations.

Fission Surface Power Systems

This project is developing concepts and technologies for affordable nuclear fission surface power systems for long duration stays on the moon and exploration of Mars. NASA is collaborating with DOE on development of fission surface power system concepts. Power conversion test facilities at Glenn Research Center and nuclear test facilities at DOE will support this project.

Near Earth Objects Observation

This project is detecting, tracking, and characterizing Near Earth Objects (NEOs) such as asteroids and comets that come within 1.3 Astronomical Units of the sun and that have potential to collide with Earth. A network of ground-based telescopes and space-based sensors will support this project.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Prototype heat shield for CEV (Constellation Systems Program)	Protection Systems	2008	No Change
Lunar Lander descent engine (Constellation Systems Program)	Non-Toxic Propulsion	2012	No Change
Carbon dioxide and moisture removal system (Constellation Systems Program)	Environmental Control and Life Support	2008	No Change
ENose and VCAM atmospheric contaminant monitoring instruments (ISS Program)	Environmental Control and Life Support	2008	No Change
Prototype Thermal Radiator for CEV (Constellation Systems Program)	Thermal Control	2008	No Change
Fluids and Combustion Facility (ISS Program)	ISS Research and Operations	2008	No Change
Precision Landing and Hazard Avoidance System Demonstration (Lunar Precursor Robotic Program)	Avionics and Software	2009	No Change
Advanced EVA Suit components - life support, thermal control, power (Constellation Systems Program)	Crew Support and Accommodation	n/a	2012
Detect 90% of Near Earth Objects greater than 140 meters in size	Near Earth Objects Observation	n/a	2020
Prototype low-impact docking system for CEV (Constellation Systems Program)	Structures, Materials and Mechanisms	n/a	2008
Prototype Parachute for CEV (Constellation Systems Program)	Structures, Materials and Mechanisms	n/a	2008
Prototype landing attenuation system for CEV (Constellation Systems Program)	Structures, Materials and Mechanisms	n/a	2008
Composite structure for future human spacecraft (Constellation Systems Program)	Structures, Materals and Mechanisms	n/a	2009

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Exploration Technology Development

Program Management

The Exploration Technology Development Program Office is located at NASA Langley Research Center.

Project	Oversight	Lead Performer	Partners
Structures, Materials, and Mechanisms	ETD Program Office - Langley Research Center	Langley Research Center	Jacobs Engineering, University of Alabama Huntsville, Sierra Lobo, ATK, ILC Dover, Lockheed Martin, Swales, National Institute of Aerospace, University of Toledo, Bigelow Aerospace.
Protection Systems	ETD Program Office - Langley Research Center	Ames Research Center (Thermal Protection); Glenn Research Center (Dust Mitigation)	Boeing; for Dust: ASRC Aerospace Corporation/Sierra Lobo, HRP, NESC, Colorado School of Mines, Smithsonian Institute, Lunar Planetary Institute.
Non-Toxic Propulsion	ETD Program Office - Langley Research Center	Glenn Research Center	ATK, KT Engineering, Northrup Grumman, Aerojet, Pratt & Whitney Rocketdyne, ATG.
Energy Storage	ETD Program Office - Langley Research Center	Glenn Research Center	TJ Technologies, Naval Surface Warfare Center, Lawrence Berkeley (DOE), University of Akron, Teledyne Energy Systems, Infinity Technologies, ElectroChem, Texas A&M, Lockheed Martin
Thermal Control	ETD Program Office - Langley Research Center	Johnson Space Center	GRC, JPL, Hamilton Sundstrand, Mainstream, Paragon Space Development Corporation
Avionics and Software	ETD Program Office - Langley Research Center	Marshall Space Flight Center (Rad Hard Electronics); Johnson Space Center (Precision Landing)	Georgia Institute of Technology, Auburn University, BAE Systems, Boeing, IBM, Lynquent Corporation, University of Arkansas, University of Maryland, University of Tennessee, Vanderbilt University, AFRL, Sandia National Lab, University of Idaho, Draper Laboratory, LaRC, JPL, FastMetrix, SAIC, University of Texas, Utah State, Jacobs Engineering, APL.
Environmental Control and Life Support	ETD Program Office - Langley Research Center	Jet Propulsion Laboratory (Environmental Control); Johnson Space Center (Life Support)	MSFC, GRC, ARC, KSC, George Washington University
Crew Support and Accommodation	ETD Program Office - Langley Research Center	Johnson Space Center	Hamilton Sundstrand, ILC Dover
ISS Research and Operations	NASA Headquarters	Glenn Research Center	European Space Agency, Russian Space Agency

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Exploration Technology Development

Project	Oversight	Lead Performer	Partners
In-Situ Resource Utilization	ETD Program Office - Langley Research Center	Johnson Space Center	US Army, Caterpillar, Canadian Space Agency, JAXA, ESA, DOE, Lockheed Martin, Orbitec, Pioneer Astronautics, NCSER, Arctic Slope Regional Corp., Case Western Reserve Univ., ANALEX, Corp., ZIN, Corp., TFOME Corp, Seimens Corp., Parker Hanifin Corp., National Instruments Corp., Teledyne Brown Engineering, Battelle-PNNL, Lunar Geotechnical Institute, University of Hawaii, University of Tennessee, Colorado School of Mines, Case Western Reserve, Mass. Institute of Tech., Florida Institute of Tech, Sverdrup, University on New Brunswick, and NORCAT
Robotics, Operations, and Supportability	ETD Program Office - Langley Research Center	Johnson Space Center	QSS Group Inc./Carnegie Mellon University West, Cal Tech (JPL), Jacobs Sverdrup, Metrica, SKT, MIT/Univ of Massachusetts, Alliance Space Systems, NIA, Swales/Lockheed, Northrop-Grumman, Carnegie Mellon University, Case Western Reserve Univ., Mars Technology Program, in planning: DOD, DARPA; for Supportability: National Center for Space Exploration Research, Zin Technologies, Bioastronautics, UMR, ASRC, Sierra Lobo, Creare, Inc., ASRC Aerospace Corporation/Sierra Lobo
Fission Surface Power Systems	ETD Program Office - Langley Research Center	Glenn Research Center	Department of Energy
Near Earth Objects Observation	NASA Headquarters	Jet Propulsion Laboratory	

Acquisition Strategy

No major program-level acquisitions or competitive research announcements are planned. All projects are managed by NASA Centers which issue contracts for R&D support. These contracts are listed in the table above under Partners.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Quality	National Research Council	New	Assessment of program effectiveness and technical quality	03/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Technology Requirements	Technologies may not meet system requirements defined by the Constellation Program and the Lunar Precursor Robotics Program after they are developed.	Conduct architecture studies to identify probable capabilities required. Customers endorse technical performance goals.
Technology Progress	On time delivery of mature technologies.	Progress towards technical milestones will be key decision criterion for project continuation.
Technology Transition	Lack of commitment from customers to incorporate technologies into system designs.	Develop a technology insertion plan with program agreement for each technology.
Technology Pull vs. Technology Push	Over emphasis on high-maturity, near-term technologies required by a mission (technology pull) versus low-maturity, far-term technologies without immediate mission application (technology push) may reduce opportunities for innovation.	Require projects to pursue some high risk technologies. Work with customers to align push technologies with gaps.

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Human Research Program

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Human Research Program	414.6	178.5	183.3	185.5	185.7	185.9	192.4

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification and shown in the new Theme structure.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Human Research Program	**174.9**	**183.3**	**8.4**

The Human Research Program (HRP) was formed after the Exploration Systems Architecture Study to focus its research investment on investigating and mitigating the highest risk to human health and performance in support of exploration missions. This newly structured program is a combination of the content within the Human Health and Performance Program and the Human Systems Integration Program, under the former Human Systems Research and Technology Theme. The focus of HRP is research that addresses exploration gaps in characterizing space environment effects on humans, and developing standards and countermeasures. The Human Research Program contains six projects that manage the biomedical deliverables in support of the exploration architecture: Space Radiation, Behavioral Health and Performance,
Exploration Medical Capability, Space Human Factors and Habitability, Human Health Countermeasures, and the ISS Medical Project.

The FY 2008 budget includes $0.4 million increase in Programmatic Content to support Advanced Food Technology, and an additional $0.3 million transfer to support radiation research. The FY 2008 budget also includes an Institutional Adjustment to the allocation of agency costs to the program (+$7.8 million).

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Human Research Program

Program Overview

The Human Research Program (HRP) is focused on investigating and mitigating the highest risks to human health and performance in support of NASA exploration missions. ESMD and Constellation Systems documents provide the mission architecture definitions, mission concepts of operations, vehicle, habitat, and space suit performance requirements, and other technical information needed to focus the HRP efforts for specific exploration missions. HRP conducts research, develops countermeasures, and undertakes technology development to inform and support compliance with NASA's health, medical, human performance, and environmental standards. The goal of the HRP is to develop and provide human health and performance countermeasures, knowledge, technologies, and tools to enable safe, reliable, and productive human space exploration. The specific objectives of the HRP are:

1. Develop capabilities, necessary countermeasures, and technologies in support of human space exploration, focusing on mitigating the highest risks to crew health and performance.

2. Define and improve human spaceflight medical, environmental and human factors standards.

3. Develop technologies that serve to reduce medical and environmental risks, to reduce human systems resource requirements (mass, volume, power, data, etc.) and to ensure effective human-system integration across exploration systems.

4. Ensure maintenance of Agency core competencies necessary to enable risk reduction in the following areas:
a. Space medicine;
b. Physiological and behavioral effects of long duration spaceflight on the human body;
c. Space environmental effects, including radiation, on human health and performance;
d. Space human factors.

To enable the program to accomplish these objectives, HRP contains six projects that manage the biomedical deliverables in support of the exploration architecture: 1) Space Radiation, 2) Behavioral Health and Performance, 3) Exploration Medical Capability, 4) Space Human Factors and Habitability, 5) Human Health Countermeasures, and 6) ISS Medical Project.

This program supports Objective(s) 3.C.4, 3.F.1, and APG(s) 8AC4 to 8AC8, which will publish results of the Renal Stone Countermeasure study and evaluate for operational use; complete study of a non-pharmacological countermeasure for bone loss in a spaceflight analog environment; characterize the size distribution of lunar dust in the inhalable size range and begin toxicity testing with simulated lunar dust; and, determine the stability of a controlled set of food/nutritional items and common medications, after six months exposure to the space flight environment.

Program Relevance

The research and technology produced by the Human Research Program (HRP) enables human exploration missions. Risk reductions made possible by this program can be employed in the design of exploration vehicles and habitats, in the selection and training of flight crews, and in the planning and execution of mission operations. Each program element includes related projects and research tasks focused on developing products that reduce risks to the crew. The HRP, in consultation with customers and stakeholders, shall determine areas of specific focus and shall be responsive to customer needs, goals, and objectives for maintaining crew health and performance during exploration missions. The three primary customers for HRP outcomes and products are: (1) ESMD's Constellation Program, (2) Office of the Chief Health and Medical Officer, and (3) Space Operations Mission Directorate. The major stakeholders of HRP products are the Chief Health and Medical Officer, Flight Surgeons, the Astronaut Office, Flight Control Teams, Constellation Program, and spacecraft development project offices. Frequent communications with customers will ensure the projects remain relevant to Exploration needs and goals. Customers and stakeholders will provide inputs to the projects by reviewing the proposed standards, requirements, countermeasures, and systems solutions to ensure that products are usable, crew health is maintained, operating efficiency is improved, and vehicle and habitat designs are conducive to safe and efficient crew performance.

Plans For FY 2008

The Space Radiation Project will primarily use ground based facilities (such as the NASA Space Radiation Laboratory at Brookhaven National Lab) to evaluate the increased risk of cancer as a function of age, age at exposure, radiation quality, latency, and gender. The project will also initiate new studies aimed at understanding the effect of radiation dose rate on cancer risk. These efforts will support more accurate prediction of risks and facilitate longer stays in space.

Exploration Medical Capability will build, validate, and use the ISS as a test-bed for technology prototypes that will allow NASA to meet the required level of care standards for long-duration space exploration missions including: rapidly-deployed EVA sensors, medical-grade water production system, ventilation system that uses cabin oxygen instead of stored oxygen, and capability to analyze blood and saliva-borne biomarkers. EMC will also mature the tools needed for medical decision-making during exploration missions.

Space Human Factors and Habitability will primarily use ground based analog models to optimize human systems performance in the design of the Orion CEV and other exploration vehicles. SHFH will also evaluate human toxicity of long-term exposure to lunar dust and develop food-packaging systems to ensure safe storage and delivery of food on long-term missions.

Behavioral Health and Performance will undertake ground based analog and ISS flight based studies to evaluate contributing factors to health or performance degradation, errors, and/or failures during critical mission operations. These studies will evaluate sleep loss and circadian rhythm, medication side effects, fatigue, team cohesion, and training protocols.

Health and Human Countermeasures will undertake ground based analog and ISS flight based studies to reduce both the crew health risks during exploration missions and long-term health risks afterward. These studies will include cardiac structure and function, stability of pharmaceuticals and nutrients in a space environment, development of a food system that meets all nutrition requirements for long-duration missions, and bone demineralization monitoring techniques.

Project Descriptions

HRP contains six projects that manage the biomedical deliverables in support of the exploration architecture. The Space Radiation project includes research on human health effects to enable accurate prediction of risks associated with exposure to space radiation, establishment of requirements for radiation protection, and development of radiation monitoring technologies. The Behavioral Health and Performance project includes identification and characterization of the behavioral and performance risks associated with training, living and working in space, and the development of strategies, tools, and technologies to mitigate these risks. The Exploration Medical Capability project includes research to support establishment of space medical standards and policy, development of next-generation medical care and crew health maintenance technologies, and development of an integrated medical model for probabilistic risk assessment. The Space Human Factors and Habitability project includes research and development activities in space human factors engineering that are fundamental to design and development of next generation crewed space vehicles, inform environmental health standards and requirements for spacecraft and habitats, and aid the development of extended shelf life foods with reduced packaging mass. The Human Health Countermeasures project includes exercise devices and exercise prescriptions, research on how the body reacts in space, as well as requirements for the use of drugs, nutrition, and exercise as effective countermeasures to the potentially harmful effects of space on the human body. The ISS Medical Project includes current ISS biomedical research capabilities and on-orbit validation of next generation on-orbit equipment, medical operations, procedures, and crew training concepts.

ISS Medical Project (ISSMP)

The ISSMP provides planning, integration, and implementation services for HRP research tasks and evaluation activities requiring access to space or related flight resources on the ISS, Shuttle, Soyuz, Progress, or other spaceflight vehicles and platforms. This includes support to related pre-flight and post-flight activities.

ISSMP services include operations and sustaining engineering for all HRP ISS flight hardware; experiment integration and operation, including individual research tasks and on-orbit validation of next generation on-orbit equipment; medical operations; procedures; and crew training concepts, as well as operation and sustaining engineering for the Telescience Support Center located at the Johnson Space Center (JSC), which provides real-time operations and data services to all HRP flight experiments. This project integrates HRP-approved flight activity, and complements and interfaces with external implementing organizations, such as the ISS Payloads Office and International Partners, to accomplish the HRP's objectives.

This effort is led by JSC with Baseline Data Collection support from the Kennedy Space Center (KSC).

Exploration Medical Capability (EMC)

The EMC project is responsible for defining requirements for crew health maintenance during exploration missions, developing treatment scenarios, extrapolating from the scenarios to health management modalities and evaluating the feasibility of those modalities for use during Exploration missions. The EMC project is also responsible for the evolution of Exploration health care options based on past experience, anticipated needs, and input from flight surgeon and crew offices.

The Vision for Space Exploration objectives present significant new challenges to crew health care capabilities. These challenges include the hazards created by the terrain of lunar or planetary surfaces that may be difficult to traverse during exploration, the effects of gravity transitions, low gravity environments, and limited communications with ground-based personnel for diagnosis and consultation. Each challenge has associated medical implications and medical requirements and technologies to ensure safety and success. The major deliverables for the EMC project consist of input to the following standards and requirements:
o medical standards of care;
o crew selection and retention criteria;
o fitness for duty criteria;
o requirements for medical equipment, clinical care capabilities, medical equipment;
o technology development;
o medical informatics; and
o integrated medical requirements for each mission.

This effort is led by JSC. GRC and ARC contribute technology development and clinical care expertise to the EMC project.

Behavioral Health & Performance (BHP)

The BHP project identifies and characterizes the behavioral and performance risks associated with training, living and working in space, and return to Earth. The BHP project develops strategies, tools, and technologies to mitigate these risks. One set of deliverables for the BHP project consists of input to the BHP health and medical standards, requirements, and operational tools for exploration. A second set of deliverables consists of knowledge, tools, and technology to prevent performance degradation, human errors or failures during critical operations resulting from sleep loss, circadian de-synchronization, fatigue or work overload; deterioration of morale and motivation; interpersonal conflicts or lack of team cohesion, coordination, and communication; team and individual decision-making, performance readiness factors (fatigue, cognition, and emotional readiness); behavioral health disorders; and individual selection and crew assignments.

The lead center for this work is JSC in close collaboration with the Ames Research Center (ARC). ARC provides special expertise in the following areas: a) sleep and fatigue, cognition, team performance and decision-making, and technology for assessing these factors, b) development and validation of biomarkers (e.g., non-intrusive physiological measures) for predicting performance and behavioral health degradations, and c) tests of assessment and mitigation strategies in operational analog spaceflight environments.

The BHP Element also works in close collaboration with its National Space Biomedical Research Institute (NSBRI) partners. The Neurobehavioral and Psychosocial Adaptation Team and the Sleep and Chronobiology Team have expertise in predictive modeling, and the development and testing of BHP related countermeasures and technologies for monitoring and assessing crew performance and health status.

Space Human Factors & Habitability (SHFH)

The Space Human Factors and Habitability project consists of three main focus areas: Space Human Factors Engineering, Advanced Environmental Health, and Advanced Food Technology.

The major deliverables for the space human factors engineering projects are validated models for predicting the effects of interface designs on human performance; methods for measuring human and human-system performance; design concepts for and evaluations of advanced crew interfaces and habitability systems; and requirements for spacecraft and space missions. The lead center for this work is JSC, in close collaboration with ARC. ARC provides special expertise in perception, cognition, automation and display design and evaluation, and individual and team performance, complementing JSC's expertise in habitability and ergonomics.

The major deliverables for the advanced environmental health projects are inputs to environmental health standards and requirements for Exploration spacecraft and habitats. Advanced Environmental Health research assesses the acute and long-term health impacts of targeted pollutants in the environment, including lunar dust, microorganisms, and atmospheric contaminants. The lead Center for this work is JSC in close collaboration with ARC. ARC provides special expertise in pulmonary diseases and selected aspects of dust activation.

The deliverables for the advanced food technology projects are extended shelf life foods with improved nutritional content and quality and reduced packaging mass to provide easier trash management. The advanced food research effort provides a safe, nutritious, and acceptable food system to maintain crew health and performance. Technology development addresses nutritional, psychological, safety, and acceptability requirements while minimizing mass, volume, waste, power, and trace gas emissions. The lead center for this work is JSC.

Human Health Countermeasures (HHC)

The HHC project provides the biomedical expertise for the development and assessment of medical standards, vehicle and spacesuit requirements dictated by human physiological needs and develops a validated and integrated suite of countermeasures for exploration missions that ensure the maintenance of crew health during all phases of the mission. Countermeasures target human physiology and performance capabilities at risk from space flight missions at each stage of mission performance. Pre-flight countermeasures involve crew selection, physical fitness and exercise, physiological adaptation training, and health stabilization. In-flight countermeasures cover physiological and nutritional health, physical fitness, and mission performance. Post-flight countermeasures target rehabilitation strategies.

The major deliverables for the HHC project are input for the refinement of health and medical standards, validated human health prescriptions, validated exercise system requirements, extravehicular activity (EVA) pre-breathe protocols, integrated physiological countermeasures, partial gravity human performance predictions and requirements, and criteria for the agency fitness for duty and crew selection/retention standards. Core biomedical capabilities provide the biomedical expertise that enables the development of medical standards, the assessment of the risks to crew health and performance, and the validation of countermeasures.

This effort is led by JSC. Other participants in this work include ARC and Glenn Research Center (GRC). ARC provides the animal models capability, and GRC provides advanced technology capability. International agencies currently cooperate on joint flight proposals, reduced gravity studies, and collaborative bedrest studies. It is anticipated that such collaborations will continue in the future.

Space Radiation

The Space Radiation project performs investigations to assure the crews can safely live and work in the space radiation environment without exceeding the acceptable radiation safety limits as set by Office of the Chief Health and Medical Officer. The major deliverables for the Space Radiation project include inputs to standards for radiation health, habitability, and environments; requirements for radiation protection, early technology development for monitoring equipment, caution and warning, models and tools to assess and predict risks due to space radiation exposure, and strategies to mitigate exposure effects.

Although information exists to recommend crew exposure limits and spacecraft design requirements for missions in low earth orbit, there is insufficient knowledge of the health effects of radiation, the space radiation environment, and countermeasure efficacy to provide recommendations on crew exposure limits and design requirements for extended lunar and Mars missions. Therefore, a major focus of the Space Radiation Project will be basic and fundamental research to expand the knowledge base and reduce the uncertainty inherent in current exposure limits and design requirements.

The Space Radiation Project is a multi-center project led by JSC, and includes work at the Langley Research Center (LaRC) and ARC. LaRC provides computational modeling capability, and ARC provides biomolecular mechanisms capability. The intramural and extramural groups use national laboratories to conduct research using accelerator-based simulation of space radiation.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Launch 60-72 ISS Research payloads from 2007 through 2012	HRP/ISSMP	Launch 10-12 ISS Research payloads per year	No Change
National Space Biomedical Research Institute (NSBRI)	HRP/PSM	12 consortium institutions develop countermeasures for long duration space missions.	No Change
NASA Space Radiation Laboratory, Brookhaven National Laboratory (DOE)	HRP/SR	Provides critical data on understanding the effects of space radiation to ensure crew safety.	No Change
University of Texas, Medical Branch at Galveston (UTMB) Bed Rest Facility	HRP/HHC	Spaceflight-analog facility that is critical to understanding the health impacts to astronauts.	No Change
Exploration Medical Capability (EMC)	HRP/EMC	Medical care & crew health maintenance technologies; medical data mgt; probabalistic risk assessment	No Change
Behavioral Health & Performance (BHP)	HRP/BHP	Investigates & mitigates behavioral performance risks in support of exploration missions.	No Change
Space Human Factors & Habitability (SHFH)	HRP/SHFH	Supports Advanced Environmental Health, Advanced Food Technology & Space Human Factors Engineering.	No Change
Human Health Countermeasures (HHC)	HRP/HHC	Develops physiological, pharmacological, & nutritional countermeasures.	No Change
Program Science Management/NSBRI	HRP/PSM	HRP management, integration, and NSBRI.	No Change
ISS Medical Project (ISSMP)	HRP/ISSMP	Supports flight research integration & operations for ISS & Shuttle.	No Change
Space Radiation (SR)	HRP/SR	Focuses on human health effects, vehicle design requirements, and crew exposure limits.	No Change

Mission Directorate:	Exploration Systems
Theme:	Advanced Capabilities
Program:	Human Research Program

Program Management

The Human Research Program Office is located at Johnson Space Center.

Project	Oversight	Lead Performer	Partners
Space Radiation	Johnson Space Center	Johnson Space Center (Supporting Centers: LaRC and ARC)	National Space Biomedical Research Institute, Department of Energy, Brookhaven National Laboratories, Numerous National Universities; contractors include Wyle Laboratories and USRA.
Behavioral Health & Performance	Johnson Space Center	Johnson Space Center (Supporting Center: ARC)	National Space Biomedical Research Institute, Numerous National Universities; contractors include Wyle Laboratories and USRA.
Human Health Countermeasures	Johnson Space Center	Johnson Space Center (Supporting Centers: ARC and GRC)	National Space Biomedical Research Institute, National Institutes of Health, University of Texas Medical Branch, Numerous National Universities; contractors include Wyle Laboratories and USRA.
Space Human Factors & Habitability	Johnson Space Center	Johnson Space Center (Supporting Center: ARC)	National Space Biomedical Research Institute, Numerous National Universities; contractors include Wyle Laboratories and USRA.
Exploration Medical Capability	Johnson Space Center	Johnson Space Center (Supporting Centers: GRC and ARC)	National Space Biomedical Research Institute, Numerous National Universities; contractors include Wyle Laboratories and USRA.
ISS Medical Project	Johnson Space Center	Johnson Space Center (Supporting Center: KSC)	European Space Agency, Japanese Aerospace Exploration Agency, German Aerospace Center (DLR), Canadian Space Agency, Numerous National Universities; contractors include Wyle Laboratories.

Acquisition Strategy

FY 2007: Joint NASA/NSBRI Space Radiation NASA Research Announcement, which will investigate Individual Radiation Sensitivity, and Radiation Monitoring Technologies.
FY 2007: Joint NASA/NSBRI NASA Research Announcement, which will focus on the following research areas: Bone Loss; Cardiovascular Alterations; Human Performance Factors, Sleep, and Chronobiology; Muscle Alterations and Atrophy; Neurobehavioral and Psychosocial Factors; Nutrition, Physical Fitness, and Rehabilitation; Sensorimotor Adaptation; Smart Medical Systems; and, Technology Development.
FY 2007: Directed Research Projects which will focus on Exercise, Musculoskeletal, and Cardiovascular countermeasures; Behavioral Health; Immunology; Nutrition; Extravehicular Activity Physiology; Food and Drug Stability; and Space Radiation Health.
FY 2008: Joint NASA/NSBRI Space Radiation NASA Research Announcement (radiation research areas will be determined by future iterative gap analysis)
FY 2008: Joint NASA/NSBRI NASA Research Announcement (research areas will be determined by future iterative gap analysis)
FY 2008: Directed Research Projects (research areas will be determined by future iterative gap analysis)

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Quality	External Independent Reviews	03/2006	Independent Formulation Review of Directed Research Projects	03/2007
Quality	External Independent Reviews	05/2006	Program Implementation Review	06/2008
Quality	Peer Review Panels	05/2006	Peer Review of NASA Research Announcements	05/2007
Quality	National Research Council	05/2006	Lunar Radiation Study	09/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Data Accessibility for HRP Researchers	HRP researchers do not have access to the multiple biomedical data sets that could be used to characterize and mitigate certain health effects of space flight. These data sets are not integrated and the processes for accessing the existing data sets are restricted due to privacy policies of both by the United States and the International Partners.	Develop process for identifying and vetting proposed investigations involving HRP data mining research activities and providing required data access. Define and implement the technical architecture for enabling HRP researchers to access approved data sets. Develop appropriate process for sharing data with International Partners based on legal constraints.
Lack of Sufficient ISS Flight Resources for Critical HRP Investigations	Given that ISS flight resources are very limited by available launch/return vehicles and by the number of ISS crewmembers, there is a possibility that HRP cannot complete all critical flight investigations in all areas where there are gaps in current capability (at Countermeasure Readiness Level 7-to-8 or Technology Readiness Level 6) to meet both Agency standards and Constellation needs.	Communicate the risk of not achieving HRP goals to the Constellation Systems Program. HRP will refine its baseline of critical flight investigations, work with the ISS Program to maximize flight resources, look for additional efficiencies by restructuring flight investigations to be more suitable for current ISS resources, and look for synergy with Medical Operations and International Partners.
Development of HRP Processes	Given that HRP is a newly formed program, there is a possibility that certain processes may not be formulated or well-documented at the time of the initial need for them, resulting in just-in-time management decision making and guidance.	Develop and baseline the HRP Program Requirements Document. Develop and baseline the schedule for HRP process document(s). Develop and baseline the HRP Science Management Plan. Develop and baseline an HRP document tree.

Aeronautics Research

Advances in fundamental aeronautics research have driven the first two waves of aeronautics growth over the last century (first in propeller aircraft, then in jets). These revolutions have led to today's National Airspace System (NAS), the hub-and-spoke commercial air carrier industry, as well as innumerable military, public service, and business aviation capabilities. Technological advances in aviation have directly benefited the American public by improving the quality of life and creating economic prosperity for the Nation.

The current needs of the Nation have transcended the limited solutions that aviation currently offers, requiring dramatic improvements in safety, capacity, environmental compatibility, robustness, and freedom of mobility throughout the U.S. and across the globe. Now, a third wave of aeronautical advances offers solutions to these challenges. This third wave is not merely an extrapolation of the existing aviation capabilities, but a radical technology shift that will enable revolutionary enhancements of both the airspace system and the aircraft that fly in it.

NASA has significantly restructured its aeronautics program to ensure that it is positioned better than ever to provide meaningful and relevant research aligned with national priorities. NASA's Aeronautics Research Mission Directorate (ARMD) expands the boundaries of aeronautical knowledge for the benefit of the Nation and the broad aeronautics community, which includes the Agency's partners in academia, industry, and other government agencies. ARMD is conducting high-quality, cutting-edge research that will lead to revolutionary concepts, technologies, and capabilities that enable radical change to both the airspace system and the aircraft that fly within it, facilitating a safer, more environmentally friendly, and more efficient air transportation system. At the same time, we are ensuring that aeronautics research and critical core competencies continue to play a vital role in support of the Vision for Space Exploration.

Mission Directorate Budget Distribution

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
FY 2008 President's Budget Request	**893.2**	**529.3**	**554.0**	**546.7**	**545.3**	**549.8**	**554.7**
Aeronautics Technology	893.2	529.3	554.0	546.7	545.3	549.8	554.7
FY 2007 President's Budget Request	**884.1**	**724.4**	**731.8**	**732.4**	**722.8**	**722.7**	**--**
Aeronautics Technology	884.1	724.4	731.8	732.4	722.8	722.7	--
Total Change from FY 2007 President's Budget Request	**9.1**	**-195.1**	**-177.7**	**-185.7**	**-177.4**	**-172.9**	**554.7**

Note: FY 2008 PB Request -- FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Mission Directorate Budget Changes

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Total Changes	**9.1**	**-195.1**	**-177.7**	**-185.7**	**-177.4**	**-172.9**	**554.7**
Programmatic Content	**--**	**--**	**53.3**	**45.7**	**58.5**	**64.6**	**554.7**
Aeronautics Technology	--	--	53.3	45.7	58.5	64.6	554.7
Institutional Adjustments	**9.1**	**-195.1**	**-231.0**	**-231.4**	**-235.9**	**-237.5**	**--**
Aeronautics Technology	9.1	-195.1	-231.0	-231.4	-235.9	-237.5	--

Mission Directorate Highlights of Programmatic Changes

Aeronautics Research

Aeronautics Technology

Programmatic Content:

The Aeronautics Budget is augmented to enhance program executability in priority research areas by (a) increasing program/project procurement budget levels and (b) enabling further skill mix rebalancing that ensures critical core competencies are preserved as staffing adjustments are implemented.

The portion of DRFC's infrastructure costs that are fixed and necessary to maintain flight research test capabilities at NASA have been added to the SCAP Aeronautics Test Program. This provides a limited but stable source of funding for the DFRC fixed costs allowing managers to stabilize rates and charge customers with the specific operational costs.

Institutional Adjustments:

Full Cost Simplification does not impact the program content.

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology

Theme Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Aeronautics Technology	893.2	529.3	554.0	546.7	545.3	549.8	554.7
Aviation Safety	148.4	76.9	74.1	76.5	80.2	78.9	78.3
Airspace Systems	173.9	92.6	98.1	91.1	90.3	91.4	92.7
Fundamental Aeronautics	570.9	305.7	293.4	289.0	285.7	290.1	294.2
Aeronautics Test Program	--	54.1	88.4	90.2	89.2	89.4	89.5

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Theme Changes

	FY 2008		
Aeronautics Technology	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Aviation Safety	**102.1**	**74.1**	**-28.0**
+10.8M augmentation will enhance program executability in priority research areas by enabling further skill mix rebalancing that ensures critical competencies are preserved. The priority research areas include icing research for the Integrated Vehicle Health Management project, adaptive flight control for the Integrated Resilient Aircraft Control project, and computer and human factors research for the Integrated Intelligent Flight Deck project. *-$0.7M reduction to service pool overhead.* *-$38.1M Full Cost Simplification adjustments. This transfer does not impact the program content.*			
Airspace Systems	**124.0**	**98.1**	**-25.9**
+2.8M augmentation will enhance program executability in priority research areas by increasing project procurement levels as well as enabling further skill mix rebalancing that ensures critical core competencies are preserved. The priority research is in operational concepts and human-in-the-loop simulation modeling that supports research in automated separation assurance. *-$0.8M reduction to service pool overhead.* *-$27.9M Full Cost Simplification adjustments. This transfer does not impact the program content.*			
Fundamental Aeronautics	**449.3**	**293.4**	**-155.8**
+16.2M augmentation will enhance program executability in priority research areas by increasing project procurement levels as well as enabling further skill mix rebalancing that ensures critical core competencies are preserved. The key research areas include: combustion foundational research and aerothermodynamics system integration for the Subsonic Fixed Wing project; advanced control methods and cabin noise modeling and reduction for the Subsonic Rotary Wing project; high-temperature sensors, advanced inlet/nozzle concepts, aero-propulsive-servo-elasticity and lightweight multifunctional materials for the Supersonics project; and advanced structural concepts, durability technologies, and non-destructive evaluation methods for the Hypersonics project. *-$3.0M reduction to service pool overhead.* *-$169.0M Full Cost Simplification adjustments. This transfer does not impact the program content.*			
Aeronautics Test Program	**56.4**	**88.4**	**32.0**
+23.3M transfer Dryden Flight Research Center fixed infrastructure costs for test bed aircraft, support aircraft maintenance and support, and test range (flight communication and data acquisition) support to ATP. *+$0.2M augmentation to enhance program executability in priority research areas by enabling further skill mix rebalancing that ensures critical core competencies are preserved.* *+$8.5M Full Cost Simplification adjustments. This transfer does not impact the program content.*			

Theme Purpose

NASA's Aeronautics Research Mission Directorate (ARMD) supports the Agency's goal (Goal 3) of developing a balanced overall program of science, exploration, and aeronautics, consistent with the redirection of the human spaceflight program to focus on exploration. Specifically, ARMD advances knowledge in the fundamental disciplines of aeronautics and develops technology for safer aircraft and higher capacity airspace systems. The ARMD research plans directly support the National Aeronautics Research and Development Policy and accompanying Executive Order signed by the President on December 20, 2006.

ARMD conducts cutting-edge research that produces concepts, tools, and technologies that enable the design of vehicles that fly safely through any atmosphere at any speed. A key focus of ARMD will be the development of physics-based Multidisciplinary Design Analysis and Optimization (MDAO) tools that will provide the ability to evaluate radically new vehicle designs. In addition, ARMD is directly addressing fundamental research challenges that must be overcome in order to implement the Next Generation Air Transportation System (NGATS) This research will yield revolutionary concepts, capabilities, and technologies that will enable significant increases in the capacity, efficiency and flexibility of the National Air Space. In conjunction with expanding air traffic management capabilities, research is being conducted to help address substantial noise, emissions, efficiency, performance, and safety challenges that are required to ensure vehicles can support the NGATS vision.

Aeronautics research and space exploration have always been and will continue to be inextricably linked. Advances in our fundamental knowledge and understanding in aerodynamics, aerothermodynamics, flight dynamics and control, materials, structures, and human interface technologies like integrated cockpit panels have been critical to the success of NASA's space program over the past several decades. As we look to the future challenges in space exploration, we recognize the need to greatly advance our fundamental understanding in key aeronautics disciplines across all flight regimes in order to advance our capabilities for safe flight through any atmosphere, be it our own, or that of another planet.

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology

Theme Overview

ARMD conducts high-quality, innovative research that will lead to revolutionary concepts, technologies, and capabilities that enable radical change to both the airspace system and the aircraft that fly within it. At the same time, ARMD ensures that its research continues to play a vital role in support of the Agency's space exploration missions.

The Aviation Safety Program builds upon the unique safety-related research capabilities of NASA to develop tools, methods, and technologies that will improve the intrinsic safety attributes of current and future aircraft, and to overcome aircraft safety technological barriers that would otherwise constrain the full realization of the Next Generation Air Transportation System (NGATS).

The Airspace Systems Program (ASP) conducts cutting-edge air traffic management research that will enable the NGATS. In partnership with the Joint Planning and Development Office, ASP will help develop the concepts, capabilities, and technologies that will lead to the significant enhancements in capacity, efficiency, and flexibility needed to meet the Nation's airspace and airportal requirements for decades to come.

The Fundamental Aeronautics program conducts cutting-edge research that will enable the design of vehicles that fly through any atmosphere at any speed. Because aircraft of the future will need to address multiple and often conflicting design challenges such as noise, emissions, and performance, a key focus will be the development of physics-based, multidisciplinary design, analysis, and optimization (MDAO) tools. Such tools will make it possible to evaluate radically new vehicle designs and to assess, with known uncertainties, the potential impact of innovative concepts and technologies on a vehicle's overall performance.

The Aeronautics Test Program ensures the strategic availability and accessibility of a critical suite of aeronautics test facilities that are deemed necessary to meet aeronautics, agency, and national needs. Strategic utilization, operations, maintenance, and investment decisions are made for major wind tunnel/ground test facilities at Ames, Glenn, and Langley Research Centers, and for the Western Aeronautical Test Range, support aircraft and test bed aircraft at Dryden Flight Research Center.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

The Office of Science and Technology Policy (OSTP) National Science and Technology Council (NSTC) Committee on Technology chartered an Aeronautics Science and Technology (AS&T) Subcommittee in September 2005. The AS&T Subcommittee is co-chaired by NASA's Associate Administrator for Aeronautics Research and OSTP's Transportation and Aeronautics Representative and was responsible for drafting a National Aeronautics Research and Development Policy, which was released by the White House in December 2006. The policy establishes a set of specific U.S. aeronautics research objectives, defines the appropriate role of the federal Government in aeronautics research and development (R&D), defines the roles and responsibilities of the various departments and agencies in aeronautics R&D, addresses R&D test and evaluation infrastructure, and addresses the coordination of aeronautics research across the federal Government. NASA's ARMD will align its efforts with the Policy.

In addition, NASA's new aeronautics research portfolio aligns very well with the recommendations of the 2006 National Research Council Decadal Survey, which was conducted independently of ARMD's restructuring. All five of the Common Themes identified in the Decadal Survey are present across ARMD's research programs, and 47 of the 51 Technical Challenges are also well represented in the portfolio.

Relevance to the NASA Mission:

ARMD's focus on long-term, cutting-edge research that expands the boundaries of aeronautical knowledge for the benefit of the broad aeronautics community directly supports NASA's mission to pioneer the future in space exploration, scientific discovery, and aeronautics research. NASA's return to fundamental aeronautics research will have far-reaching effects on both civilian aviation and space exploration.

Relevance to education and public benefits:

NASA's restructured program ensures long-term focus in fundamental research in both traditional aeronautical disciplines and relevant emerging fields that can be integrated into multidisciplinary system-level capabilities that can be broadly applied. This approach will enable revolutionary change to both the airspace system and the aircraft that fly within it, leading to a safer, more environmentally friendly, and more efficient national air transportation system. Furthermore, ARMD will disseminate all of its research results to the widest practicable extent.

ARMD is establishing strong partnerships with academia through our NASA Research Announcement (NRA) process, which through full and open competition, is fostering close working relationships among NASA researchers and academia. In addition, ARMD has focused a number of its educational activities to better align with ongoing activities within universities, industry, and outside organizations. ARMD is partnering with these outside organizations by providing technical expertise to help train and educate the future aerospace workforce. These partnering activities include a series of case studies on aeronautical topics; expansion of ARMD's Web-based learning modules; support of design competitions; and better methods for communicating NASA's educational and research opportunities to stakeholders.

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
Strategic Goal 3	**Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.**	
Sub Goal 3E	**Advance knowledge in the fundamental disciplines of aeronautics, and develop technologies for safer aircraft and higher capacity airspace systems.**	
Outcome 3E.1	**By 2016, identify and develop tools, methods, and technologies for improving overall aircraft safety of new and legacy vehicles operating in the Next Generation Air Transportation System (projected for the year 2025).**	
APG 8AT01	Provide definition of an Integrated Resilient Aircraft Control (IRAC) architecture and capabilities, and identify technology implementation barriers for full IRAC capability.	Aviation Safety
APG 8AT02	Complete a feasibility study for assessment of active operator assistance in approach and landing task, including active attention management.	Aviation Safety
APG 8AT03	Develop a framework that integrates Aging Aircraft and Durability technologies to detect, predict, and mitigate aging/durability related hazards and insert current state-of-the-art methods in framework to establish a baseline.	Aviation Safety
APG 8AT04	Using aircraft landing gear system as a testbed, develop and validate Integrated Vehicle Health Management sensor fusion, fault detection, and isolation methods.	Aviation Safety
Outcome 3E.2	**By 2016, develop and demonstrate future concepts, capabilities, and technologies that will enable major increases in air traffic management effectiveness, flexibility, and efficiency, while maintaining safety, to meet capacity and mobility requirements of the Next Generation Air Transportation System.**	
APG 8AT05	Conduct service-provider-based automated separation assurance simulation.	Airspace Systems
APG 8AT06	Demonstrate trajectory analysis technology for automated separation assurance.	Airspace Systems
Outcome 3E.3	**By 2016, develop multidisciplinary analysis and design tools and new technologies, enabling better vehicle performance (e.g., efficiency, environmental, civil competitiveness, productivity, and reliability) in multiple flight regimes and within a variety of transportation system architectures.**	
APG 8AT07	Develop and test component technology concepts used in conventional aircraft configurations that establish the feasibility of achieving Stage 3 -42 EPNdb (cumulative) noise reduction.	Fundamental Aeronautics
APG 8AT08	Develop and test component technology concepts for unconventional aircraft configurations that establish the feasibility of achieving short take-off and landings on runways less than 3000 feet.	Fundamental Aeronautics
APG 8AT09	Validate model engine stall control concepts using component test data obtained in test cell CE18 in order to extend rotorcraft engine operability range.	Fundamental Aeronautics
APG 8AT10	Develop a rotorcraft model, validated with data from gear noise and vibration testing, to predict reductions in gear vibration transmission.	Fundamental Aeronautics
APG 8AT11	Demonstrate a composite supersonic engine fan blade containment system that is 20 percent lighter than the High Speed Research Program metallic containment system and validate through laboratory tests.	Fundamental Aeronautics

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
APG 8AT12	Demonstrate a high fidelity analysis technique for assessing the impact of nozzle plume effects on the off body flow field of a supersonic aircraft and validate predicted results within 5 percent of flight data.	Fundamental Aeronautics
APG 8AT13	Characterize multi-functional advanced ablator systems in arcjet facilities to provide a database for material degradation models for hypersonic vehicles.	Fundamental Aeronautics
APG 8AT14	Evaluate state-of-the-art hypersonic flight simulation tools, ablator systems, and GNC technologies using data from sub-orbital SOAREX flight 1.	Fundamental Aeronautics
Outcome 3E.4	**Ensure the continuous availability of a portfolio of NASA-owned wind tunnels/ground test facilities, which are strategically important to meeting national aerospace program goals and requirements.**	
APG 8AT15	Develop a maintenance and investment strategy for NASA owned wind tunnels/ground test facilities to ensure their long-term health and operational availability.	Aeronautics Test Program
APG 8AT16	Develop a long-term, flight operations/test infrastructure vision and funded plan working with all the appropriate stakeholders, to assure that the plan reflects the priorities of the long-term needs of the Nation.	Aeronautics Test Program

Performance Achievement Highlights

Aviation Safety

The Integrated Vehicle Health Management project has made key advances in sensor technologies, analytical tools, and construction of simulation and test-bed capabilities to include sensory particles that were successfully embedded in aluminum and when strained undergo a process to inherently improve damage detection. Structural anomaly detection methods were also developed and demonstrated using laboratory fatigue-cycle data from lap-splice panels instrumented with the NASA-developed Fiber Optic Strain System (FOSS).

The Aircraft Aging and Durability project advanced methods for predicting crack growth and the use of advanced composites for engine fan blade failure containment. A multi-scale analysis methodology was developed to model damage processes. This work is critical to both developing better criteria for crack growth propagation and designing more damage tolerant and durable structural materials. Proof of concept demonstrations for an improved lightweight composite engine casing capable of fan blade failure containment was also completed.

The Integrated Intelligent Flight Deck project made major advancements in data mining for information sharing, new crew-vehicle interfaces for managing workload and maintaining situational awareness, and assessments of forward looking sensor technologies for hazard detection. Research included an assessment of head-worn display media for safe and efficient surface operations in low-visibility conditions, and multiple studies addressing the optimal fusion of "synthetic" and enhanced vision system display concepts.

The Integrated Resilient Aircraft Control project developed a new test capability for simulating upset flight conditions and a refined ability to characterize the in-flight effect of vehicle damage. The Airborne Subscale Transport Aircraft Research test bed that supports research in upset modeling, and prevention and recovery of transport category aircraft was completed. Preliminary structural damage computational models were also developed for a transport airframe under discrete source damage.

Performance Achievement Highlights

Airspace Systems

NASA restructured the Airspace Systems Program to align research efforts with the Joint Planning and Development Office's Next Generation Air Transportation System (NGATS) goals for 2025. (The Joint Planning and Development Office is a collaboration among government agencies, industry, and the public sector to plan and enable NGATS.) NASA identified major research thrust areas: the NGATS Air Traffic Management Airspace Project and the NGATS Air Traffic Management Airportal Project. The program focuses on finding technological solutions for automated air traffic management as a step toward creating a safe, efficient, high-capacity, and integrated NGATS.

NASA successfully completed the Small Aircraft Transportation System (SATS) Project in FY 2006. The project focused on improving four operating capabilities: higher-volume operations at airports without traffic-control towers or radar; lower landing minimums at minimally equipped airfields; increased single pilot performance; and en-route procedures for integrated fleet operations. SATS conducted final assessments and evaluations, and published the project's successes in the Air Traffic Control Association's Journal of Air Traffic Control.

The Virtual Airspace Modeling and Simulation (VAMS) Project successfully developed its system-wide operational concept, which provides a detailed description of a future capacity-enhancing concept for the National Airspace System and an assessment of its potential capacity benefits. The assessment was performed using the VAMS-developed Airspace Concepts Evaluation System (ACES) assessment tool that models gate-to-gate operations of the National Airspace System. Using ACES, VAMS demonstrated that the system-wide concept could accommodate the targeted doubling of capacity (relative to 1997 throughput).

The Future Air Traffic Management Concepts Evaluation (FACET) Tool won NASA's Software of the Year Award for 2006. FACET is a flexible software tool that models the National Airspace System. Its powerful simulation capabilities can rapidly generate thousands of aircraft trajectories to enable efficient planning of traffic flows at the national level.

Performance Achievement Highlights

Fundamental Aeronautics

Within the Rotary Wing Project, a helicopter flight test was conducted to provide data for rotorcraft acoustic analysis validation and to develop low noise flight profiles. The test was jointly executed by NASA, the US Army, the Center for Rotorcraft Innovation, Bell Helicopter, and the University of Maryland.

Within the Fixed Wing Project, design of the geared turbofan components has been completed by Pratt & Whitney. Studies conducted by NASA and Pratt & Whitney identified a low fan pressure ratio geared turbofan with a lightweight Variable Area Fan Nozzle as an attractive approach to reduce both noise and emissions relative to current engines. The design for a geared turbofan demonstrator was completed, expected testing of a model fan test in GRC's 9-foot by 15-foot wind tunnel in September 2006. Also, two scale Blended Wing Body (BWB) models were tested. A BWB 8.5% model was tested in the LaRC full scale tunnel and a 2% model was tested in the national transonic facility to validate the aerodynamic and control characteristics in preparation for flight tests at Dryden in early 2007. This work supports X48B validation opportunities planned in FY 2007.

Under an interagency agreement with the FAA, the Supersonics Project began a study of material and structural concepts for advanced fan containment systems, applicable to subsonic and supersonic aircraft. Initial material procurement and test article manufacturing is underway, with testing to be completed in 2007. Also in Supersonics, an initial study of the impact of atmospheric turbulence on very low noise sonic boom waveforms was completed. NASA F-18 aircraft, flying a specially designed flight profile, were used to generate the booms. Indoor and outdoor waveform shapes, noise levels and building vibration data were recorded for use in model validation studies.

The Hypersonics Project completed Mach 5 testing of the Ground Demonstration Engine - 2 in the NASA 8-Foot High Temperature Tunnel. NASA teamed with the Air Force Research Laboratory and Pratt & Whitney Rocketdyne to complete the tests. The NASA tests marked the first time a hydrocarbon-fueled, fuel-cooled scramjet was tested at closed-loop hypersonic conditions. Also, a Preliminary Design Review for the Hypersonic Boundary Layer Transition Flight Experiment (Hy-BoLT) was completed. This flight test, which is a partnership between NASA and ATK, will acquire data for the effects of protuberances and cavities on aerodynamic heating to support the Space Shuttle. The Hy-BoLT experiment will be launched atop the ATK ALV-X1 launch vehicle from the NASA Wallops Flight Facility. Additionally, a NASA design for a SiC/SiC composite micro-structure and heat exchanger panel was developed based on operating conditions simulating a scramjet thermal environment. A novel fiber architecture was developed in collaboration with Albany International and General Electric, and the panel will be tested in the upcoming year. An engineering study was completed to define the effort and associated cost to upgrade NASA's Propulsion System Laboratory to span an important gap in hypersonic research, covering the transition of combined cycle systems between "low" and high speed operations. The proposed facility enhancements have generated significant interest in the high speed community, including the possibility that other government agencies may use this facility to perform Mach 2-4+ testing.

Aeronautics Test Program

Examples of FY 2006 accomplishments include exceeding the projected utilization of Aeronuatics Test Program (ATP) ground test facilities, reducing the backlog of overdue maintenance activities in the ATP facilities, initiating test technology investments including standardizing wind tunnel measurement systems across all NASA Research Centers and developing test facility control system simulators.

Both the Constellation Program Test and Verification Office and the ATP have critical responsibilities in accomplishing the Agency's exploration mission. To ensure the successful fulfillment of each organization's responsibilities, they have entered into a Strategic Alliance Agreement.

The ATP is working with the Department of Defense (DoD) to develop the National Partnership for Aeronautic Testing to better integrate the operations and planning of the Nation's aeronautics testing assets. In addition, ATP is working with DoD to develop an interagency charging policy for aeronautics test facilities as part of a plan to strengthen the co-reliance of the two agencies on each others aeronautics ground test facilities.

Quality

Performance Measure #	Description
Aeronautics Technology Theme	
APG 8AT17	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 8AT18	Increase the annual percentage of research funding awarded to Aeronautics University Partnerships.

Program Assessment Rating Tool (PART):

In FY 2005, Aeronautics received a PART rating of "Moderately Effective". The reason for the rating was because ARMD was in the process of significantly restructuring its programs at that time. There were six performance improvement areas identified, five of which were successfully completed this year.

- Continue performing regular program reviews to ensure funding of projects that are relevant and effective;
- Strengthen priority research areas identified by NASA, in consultation with the National Research Council and external partners;
- Restructure the program to better focus on projects that have a federal role;
- Develop technical metrics and demonstrate quantitative progress against those metrics; and
- Preserve the Wind Tunnel infrastructure at the Research Centers that are deemed either mission critical and/or a unique national asset.

Aeronautics has made significant progress in the last performance improvement area, which is to define the new Aeronautics performance measures. This action, as well as the Re-PART assessment, is scheduled for completion in FY 2007.

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	ARMD	New	Now that Aeronautics restructuring has been completed, ARMD will initiate quarterly performance reviews starting in fiscal year 2007. Semi-annual Agency Program Management Reviews will also be initiated in fiscal year 2007	02/2007

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology
Program:	Aviation Safety

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Aviation Safety	148.4	76.9	74.1	76.5	80.2	78.9	78.3

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Aviation Safety	**102.1**	**74.1**	**-28.0**

+10.8M augmentation will enhance program executability in priority research areas by enabling further skill mix rebalancing that ensures critical competencies are preserved. The priority research areas include icing research for the Integrated Vehicle Health Management project, adaptive flight control for the Integrated Resilient Aircraft Control project, and computer and human factors research for the Integrated Intelligent Flight Deck project.

-$0.7M reduction to service pool overhead.

-$38.1M Full Cost Simplification adjustments. This transfer does not impact the program content.

Program Overview

The Aviation Safety Program is dedicated to the mastery and intellectual stewardship of the core competencies of aircraft safety in aeronautics for the Nation. Furthermore, the program builds upon the unique safety-related research capabilities of NASA to improve aircraft safety for current and future aircraft, and to overcome aircraft safety technological barriers that would otherwise constrain the full realization of the Next Generation Air Transportation System (NGATS). Currently the U.S. Air Transportation System is widely recognized as among the safest in the world, which can be credited to the vigilance of industry and government working together. However, looking at the projected increases in air traffic and future system capabilities, this vigilance must continue in order for the U.S. to meet both the public expectations for safety and the full realization of the NGATS. To meet these challenges, the Aviation Safety Program will focus on developing cutting-edge technologies to improve the intrinsic safety attributes of current and future aircraft that will operate in the NGATS. Concurrently, these technologies can be leveraged to support space exploration activities, such as enabling self-reliant and intelligent systems necessary for the long-duration travel requirements of future space vehicles.

This program supports NASA Outcome 3E.1 and APGs 8AT1 through 8AT4.

For more information, please see http://www.aeronautics.nasa.gov/programs_avsp.htm.

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology
Program:	Aviation Safety

Program Relevance

The Aviation Safety Program will provide aircraft safety related concepts, tools, and technologies that will help ensure the safety of the U.S. Air Transportation System as it transitions to meet the future needs of the NGATS. These needs include: the anticipated significant increases in air traffic; increased reliance on automation; increased diversity of vehicles; and increased complexity in the system. The long range goals of the research include: reduced occurrence of in-flight failures; onboard systems capable of self-correcting anomalies; improved crew workload allocation and situation awareness; and advanced flight controls to ensure flight safety during adverse flight conditions. In addition, the Aviation Safety Program technologies can be leveraged to improve the resilience of future space vehicles against the hazards of long duration space travel as well as operations in harsh and/or remote environments. These technology developments are aligned with NASA's Strategic Goals and with the National Aeronautics Research and Development Policy.

Plans For FY 2008

Each of the Aviation Safety Projects developed 10-year roadmaps and key milestones. Based on the technical roadmaps, each project developed a research project plan that implements key aspects of the roadmap in concert with industry and other government agency needs and university and research institution capabilities. Each project, while pursuing several research lines, has highlighted a key performance deliverable for FY 2008.

Researchers in the Integrated Vehicle Health Management Project will conduct in-flight tests, in high ice-water content conditions, to increase the accuracy of measured total water content by 50 percent over the existing instrumentation.

Researchers in the Aircraft Aging and Durability Project will develop a framework that integrates current and future detection, prediction, and mitigation methods to prevent aircraft aging-related hazards. The effectiveness of this newly developed framework will be assessed against current methods used by the safety community.

Researchers in the Integrated Intelligent Flight Deck Project will develop automation technologies to improve workload responsibilities and crew awareness of critical decision points during the approach and landing phase of flight.

Researchers in the Integrated Resilient Aircraft Control Project will develop computational aeroservoelasticity modeling methods that will lay the framework to enable the capability to predict the effects that an aircraft structural component in off-nominal conditions will have on the aerodynamic stability and control characteristics of an aircraft in flight.

Project Descriptions

The Aviation Safety Program supports research that will develop technologies, tools, and guidelines to improve the inherent safety attributes of aircraft vehicles. Physics-based, multidisciplinary design, analysis, and optimization (MDAO) tools will be developed to enable aircraft designers to incorporate more resilient features to mitigate off-nominal conditions. Robust modeling, sensing, and information processing techniques will enable operators and regulators to more pro-actively detect and correct potential problems before an unsafe condition occurs. The Aviation Safety Program also supports the Agency's human and robotic exploration missions by advancing knowledge in areas relevant to sustaining long endurance and remote operations in harsh environments.

The Aviation Safety Program has four projects. The Integrated Vehicle Health Management Project addresses the challenge of integrating, processing, and effectively using large amounts of information across highly integrated and complex flight critical systems. The Aircraft Aging and Durability Project addresses the challenge of improving the operational resiliency of future structures and advanced materials. The Integrated Intelligent Flight Deck Project addresses the future challenges to ensure the proper integration of the human operator in a highly automated and complex operational environment. The Integrated Resilient Aircraft Control Project addresses the challenge of preventing the loss-of-control of an aircraft in the event of an upset or off-nominal condition.

Integrated Vehicle Health Management

The Integrated Vehicle Health Management (IVHM) Project will conduct research to advance the state of highly integrated and complex flight-critical health management technologies and systems. These technologies will enable nearly continuous onboard situational awareness of the vehicle health state for use by the flight crew, ground crew, and maintenance depot. Improved safety and reliability will be achieved by onboard systems capable of performing self-diagnostics and self-correcting of anomalies that could otherwise go unattended until a critical failure occurs. A key enabling technology will be the ability for sharing and processing large amounts of information between the various vehicle subsystems to more accurately diagnose the system health state and execute the logic to self-correct any critical anomalies detected. Because of the potential broad applications for the IVHM products to include commercial, military, and space vehicles we will be working with the FAA, DOD, and the NASA space directorates to develop these technologies.

Aircraft Aging and Durability

The Aircraft Aging and Durability (AAD) Project will develop advanced diagnostic and prognostic capabilities for detection and mitigation of aging-related hazards. The research and technologies to be pursued will decrease the susceptibility of current and next generation aircraft and onboard systems to premature deterioration, thus greatly improving vehicle safety and mission success. Emerging civilian and military aircraft are introducing advanced material systems, fabrication techniques, and structural configurations for which there is limited service history. There will be an emphasis in the AAD project on new material systems/fabrication techniques and the potential hazards associated with aging-related degradation. The intent is to take a proactive approach to identifying aging-related hazards before they become critical, and to develop technology and processes to incorporate aging mitigation into the design of future aircraft. Foundational research in aging science will ultimately yield Multidisciplinary Design, Analysis, and Optimization (MDAO) capabilities that will enable system-level integrated methods for detection, prediction, and mitigation/management of aging-related hazards for future civilian and military aircraft. Because of the potential broad applications for the AAD products to include commercial, military, and space vehicles, NASA will be working with the FAA, DOD, and the NASA space directorates to develop these technologies.

Integrated Intelligent Flight Deck

The Integrated Intelligent Flight Deck (IIFD) Project will pursue flight deck related technologies that will ensure crew workload and situation awareness are both safely optimized and adapted to the future operational environment as envisioned by the NGATS. A key component of this research will be investigating methods to automatically monitor, measure, and assess the state of the crew awareness to their assigned task. The scope of IIFD includes the following: development of crew/vehicle interface technologies that reduce the risk of pilot error; development of monitoring technologies to enable detection of unsafe behaviors; development of fail-safe methods for changing the operator/automation roles in the presence of detected disability states; and development of a comprehensive surveillance system design that enables robust detection of external hazards with sufficient time-to-alarm for safe maneuvering to avoid the hazards. The products of the IIFD Project should enable system designers to eliminate the safety risk of unintended consequences when introducing new and advanced systems into an operational environment. Because of the potential broad applications for the IIFD products to include commercial, military, and space vehicles we will be working with the FAA, DOD, and the NASA space directorates to develop these technologies.

Integrated Resilient Aircraft Control

The Integrated Resilient Aircraft Control (IRAC) Project will conduct research to advance the state of aircraft flight control automation and autonomy in order to prevent loss-of-control in flight. Taking into account the advanced automation and autonomy capabilities as envisioned by the NGATS, the research will pursue methodologies to enable an aircraft to automatically detect, mitigate, and safely recover from an off-nominal condition that could lead to a loss of control. A key component of the research will be to develop technologies that would enable an aircraft control system to automatically adapt or reconfigure itself in the event of a failed or damaged component. These adaptive control concepts will likely have applications to future space exploration missions where vehicles will be required to operate and adapt to unknown flight environments. Because of the potential broad applications for the IRAC products to include commercial, military, and space vehicles NASA ARMD will be working with the FAA, DoD, and the NASA space directorates to develop these technologies.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Demonstration of integrated gas path sensing and diagnostics for aircraft engine health by FY 2009.	IVHM	The project was in formulation during FY 2007.	Milestone was established based on internal and external peer reviews of the proposals.
Demonstrate self-healing material system concepts for in-situ mitigation of damage by FY 2011.	IVHM	The Project was in formulation during FY 2007.	Milestone was established based on internal and external peer reviews of the proposals.
Demonstrate prognostic methodologies to forecast aircraft engine operability margins by FY 2013.	IVHM	The project was in formulation during FY 2007.	Milestone was established based on internal and external peer reviews of the proposals.
Verify (in certain scenarios) ability to identify & correct impending in-flight failures by FY 2016.	IVHM	The project was in formulation during FY 2007.	Milestone was established based on internal and external peer reviews of the proposals.
Validate Generation 1 methodologies for durability by FY 2010.	AAD	The Project was in formulation during FY 2007.	Milestone was established based on internal and external peer reviews of the proposals.
Validate residual life prediction methods by FY 2014.	AAD	The project was in formulation during FY 2007.	Milestone was established based on internal and external peer reviews of the proposals.
Demonstrate validated predictive capability and extended life methods by FY 2016.	AAD	The project was in formulation during FY 2007.	Milestone was established based on internal and external peer reviews of the proposals.
Deliver validated flight deck guidelines, information, and display requirements by FY 2010.	IIFD	The project was in formulation during FY 2007.	Milestone established based on internal and external peer reviews of the proposals.
Complete an evaluation of multi-spectral image fusion, extraction, and culling algorithms by FY2013	IIFD	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.
Deliver a validated assessment of tools, Adaptive Flight Display Concepts & technologies by FY 2016.	IIFD	The project was in formulation during FY2007.	Milestone was based on internal and external peer reviews of proposals.
By FY 2007 end, baseline evaluation criteria for new technologies intended to reduce LoC accidents.	IRAC	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.
By FY 2011, evaluate new methods for recovery of unimpaired aircraft from upset conditions.	IRAC	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.
By FY 2014, evaluate new methods for aircraft upset recovery under icing conditions.	IRAC	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.
By FY 2016, evaluate new methods for upset recovery of aircraft in a damaged condition.	IRAC	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.

Program Management

The ARMD Associate Administrator is responsible for portfolio approval. The Headquarters Program Director oversees portfolio formulation, implementation, evaluation, and integration of results with other ARMD/NASA programs.

Project	Oversight	Lead Performer	Partners
Integrated Vehicle Health Management (IVHM)	Principle Investigator and Project Manager who report to the Program Director	LARC, GRC, ARC, DFRC	FAA, JPDO, CAST, NOAA, DoD, and Industry working groups
Aircraft Aging and Durability (AAD)	Principle Investigator and Project Manager who report to Program Director	LARC, GRC, ARC	FAA, CAST, DoD, AFRL, and Industry working groups
Integrated Intelligent Flight Deck (IIFD)	Principle Investigator and Project Manager who report to Program Director	LARC, ARC, GRC	FAA, JPDO, CAST, and Industry working groups
Integrated Resilient Aircraft Control (IRAC)	Principle Investigator and Project Manager who report to Program Director	LARC, DRFC, GRC, ARC	FAA, JPDO, CAST, AFRL, and Industry working groups

Acquisition Strategy

A full and open NASA Research Announcement (NRA) was used as the means to solicit innovative proposals in key research areas that compliment NASA expertise. One of the main objectives of the NRA investment is to stimulate close collaboration among NASA researchers and NRA award recipients to ensure effective knowledge transfer. The Aviation Safety Program will award approximately $8 million annually in grants and cooperative agreements, primarily with academic institutions or consortia. These awards will also help to strengthen the research capabilities that are of interest to NASA within the recipient organizations and institutions.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Relevance	Expert Review	04/2006	For each of the Aviation Safety projects, an expert panel was convened to assess the research relevance, scope, quality, balance, and management plans proposed by the Principle Investigator and Project Manager. After the key issues and concerns were addressed through improved project proposals, recommendations for approval were submitted by the review panel to the ARMD AA.	N/A
Performance	Expert Review	New	Each of the Aviation Safety projects will be evaluated by a panel of internal and external technical experts on an annual basis to evaluate the projects' performance and progress. These reviews will be chaired by the ARMD AA.	09/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Research Risk	Given that fundamental research is highly dynamic, there is the possibility that milestones may not be met because of things learned along the way (e.g., the milestone may not be possible to achieve or may require more effort).	Aviation Safety Program will mitigate by conducting yearly assessments of all research elements and will update the 10-year working plan as required.
Cost/Schedule Risk	Given significant change to cost and/or schedule in a technical deliverable, there is the possibility that the lower priority activities may be descoped or eliminated.	Aviation Safety will use the peer review rating of its technical proposals during portfolio formulation, in concert with portfolio evaluations to assess the technical merit of its work to rebalance the portfolio investment to meet the changed requirement.
Dependency Risk	Given that technologies from other programs (both external and internal to NASA) do not meet expected technical performance and timeliness, there is the possibility that this program's cost and schedule may slip. In addition, NGATS safety related requirements/needs may change.	Aviation Safety will monitor and track technology development progress in other programs under prior agreement, and maintain contingency plans as part of the agreement with the other programs. In addition, NGATS requirements will be monitored through active participation with the JPDO and will modify the Aviation Safey Program 10 -year roadmap as required.

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology
Program:	Airspace Systems

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Airspace Systems	173.9	92.6	98.1	91.1	90.3	91.4	92.7

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Airspace Systems	**124.0**	**98.1**	**-25.9**

+2.8M augmentation will enhance program executability in priority research areas by increasing project procurement levels as well as enabling further skill mix rebalancing that ensures critical core competencies are preserved. The priority research is in operational concepts and human-in-the-loop simulation modeling that supports research in automated separation assurance.

-$0.8M reduction to service pool overhead.

-$27.9M Full Cost Simplification adjustments. This transfer does not impact the program content.

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology
Program:	Airspace Systems

Program Overview

The Airspace Systems Program (ASP) is dedicated to the mastery and intellectual stewardship of the core competencies of Aeronautics relative to air traffic management for our Nation's airspace. The primary goal of the ASP is to develop innovative R&D solutions for a safe, efficient, high-capacity airspace system on the ground and in the air. In pursuit of this goal, the ASP is aligning its R&D portfolio to address the future air traffic management research needs through the Next Generation Air Transportation System (NGATS) Initiative as defined by the Joint Planning and Development Office (JPDO).

Consistent with NGATS capabilities, ASP will focus on two major NGATS Air Traffic Management (ATM) projects: Airspace and Airportal. ASP will perform foundational research to enable revolutionary capabilities in multi-aircraft flow and airspace optimization, trajectory design and conformance, and adaptive systems management. Research in the two projects will be integrated for gate-to-gate solutions.

ASP has a four-level approach to technology development: (1) conduct foundational research to further our understanding of the underlying physics and the ability to model that physics, (2) leverage the foundational research to develop technologies and analytical tools focused on discipline-based solutions, (3) integrate multi-disciplinary methods and technologies to create sub-system level capabilities, and (4) integrate capabilities developed in (3) to provide solutions for a safe, efficient, and high-capacity airspace system.

Continuing in FY 2008, ASP will be conducting activities that are in strong alignment with the NGATS initiative.

This program supports NASA Outcome 3E.2 and APGs 8AT5 and 8AT6.

For more information, please see http://www.aeronautics.nasa.gov/programs_asp.htm.

Program Relevance

The ASP was realigned in FY 2006 to directly address the needs of the NGATS initiative as defined by the multi-federal agency JPDO. The objective of the program is to develop revolutionary concepts, capabilities, and technologies that will enable significant increases in the capacity, efficiency and flexibility of our National Airspace System (NAS)--an objective that is clearly aligned with the JPDO's vision of the NGATS. The ATM research conducted in the ASP is a vital component of the fundamental research conducted in support of the NGATS vision. However, increasing the capacity of the NAS by factors of two to three will not be sufficiently effective unless coupled with technology advances produced in areas of Fundamental Aeronautics and Aviation Safety. The relevance of the ASP research portfolio to national needs will be enhanced by close coordination and integration with developments in all ARMD programs.

Plans For FY 2008

The NGATS ATM Airspace Project will focus on developing capabilities in traffic flow management, dynamic airspace configuration, separation assurance, and airspace super density operations, which are supported by cross cutting technical areas of trajectory synthesis, prediction, and uncertainty, performance based services, and system-level design, analysis and simulation tools.

The NGATS ATM Airportal Project will focus on developing airportal and terminal capabilities in three areas: safe and efficient surface operations, coordinated arrival/departure operations, and airportal transition and integration management.

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology
Program:	Airspace Systems

Project Descriptions

The Airspace Systems Program (ASP) conducts cutting-edge research that will enable the Next Generation Air Transportation System (NGATS). In partnership with the Joint Planning and Development Office (JPDO), the ASP will conduct the research to enable the high capacity, efficient, and safe airspace and airportal systems required to meet the Nation's requirements for decades to come.

NGATS ATM-Airspace Project will develop a plan to integrate solutions for a safe, efficient and high-capacity airspace system through joint research efforts and partnerships with other government agencies. In addition to core research and development to be conducted by NASA, Space Act Agreements will be established with U.S. industry to address research partnerships at the system-wide level including systems integration and operational applications. The project leverages in-house foundational research with academic institutions, non-profit organizations, and industry performing foundational research to address technology gaps.

The NGATS ATM-Airportal Project will focus on achieving the highest possible efficiency in the use of such airportal resources as gates, taxiways, runways, and final approach airspace. In pursuit of that goal, the project will research, develop, demonstrate, and validate advanced operational concepts, proof-of-concept systems, algorithms, technologies, tools, and operational procedures for use in maximizing capacity and throughput in the airportal environment while enabling associated elements of the NGATS.

The fundamental capabilities developed in either of the two projects will be leveraged for the benefit of the other to make efficient use of available resources.

NGATS ATM Airspace

The NGATS ATM-Airspace Project will develop and explore fundamental concepts and integrated solutions that address the optimal allocation of ground and air automation technologies necessary for the NGATS. The project will focus NASA's technical expertise and world-class facilities to address the question of where, when, how, and the extent to which automation can be applied to moving aircraft safely and efficiently through the NAS. Research in this project will address Four-Dimensional Trajectory Operations, including advances in the science and applications of multi-aircraft trajectory optimization that solves the demand/capacity imbalance problem while taking into account weather information and forecast uncertainties and keeping aircraft safely separated. The project's research will develop and test concepts for advanced traffic flow management to provide trajectory planning and execution across the spectrum of time horizons from "strategic planning" to "separation assurance." The project will also conduct research to explore dynamic airspace configuration that addresses the technical challenges of migrating from the current structured, static homogenous airspace to a dynamic, heterogeneous airspace that adapts to user demand and meets changing constraints of weather, traffic congestion, and a highly diverse aircraft fleet. Ultimately, the roles and responsibilities of humans and automation influence every technical area and will be addressed thoroughly.

NGATS ATM Airportal

The NGATS ATM-Airportal Project will develop and validate algorithms, concepts, and technologies to increase throughput of the runway complex and achieve high efficiency in the use of airportal resources such as gates, taxiways, runways, and final approach airspace. Currently, the growth of air traffic demand and fleet diversity is causing the operational volume at hub airports to rapidly approach their maximum capacity. NASA research in this project will lead to development of solutions that safely integrate surface and terminal area air traffic optimization tools and systems with Four-Dimensional trajectory operations. To support super-density and equivalent visual operations, NASA will also conduct research in wake hazard sensing and prediction.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Complete trajectory analysis for service-provider-based automated separation assurance by FY 2009.	Airpsace Project	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of the proposals.
Create safety assurance software models via formal methods analyses and simulation by FY 2010.	Airspace Project	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of the proposals.
Conduct analysis for tactical weather and traffic complexity avoidance by FY 2010.	Airspace Project	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of the proposals.
Expand human-in-the-loop simulation of service-provider-based automated separation assurance FY2010.	Airspace Project	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of the proposals.
Complete simulation analysis of automated separation assurance in complex scenarios by FY 2011.	Airspace Project	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of the proposals.
Demonstrate integrated systems for optimizing automated surface operations by FY 2009.	Airportal Project	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of the proposals.
Validate initial super-density concept by FY 2011.	Airportal Project	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of the proposals.

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology
Program:	Airspace Systems

Program Management

The ARMD Associate Administrator is responsible for portfolio approval. The Headquarters Program Director oversees portfolio formulation, implementation, evaluation, and integration of results with other ARMD and NASA programs.

Project	Oversight	Lead Performer	Partners
NGATS ATM Airspace	Principal Investigator and Project Management, who report to the Program Director.	ARC, LARC	FAA, JPDO, DOT, Air Force, Flight Dimensions International, Inc., Lockheed, Air Services Australia
NGATS ATM Airportal	Principal Investigator and Project Management, who report to the Program Director.	LARC, ARC	FAA, JPDO

Acquisition Strategy

A full and open NASA Research Announcement (NRA) was used as the means to solicit innovative proposals in key research areas that complement NASA expertise. One of the main objectives of the NRA investment is to stimulate close collaboration among NASA researchers and NRA award recipients to ensure effective knowledge transfer. The Airspace Systems Program will award $9.6 million in FY 2008 in grants and cooperative agreements, primarily with academic institutions or consortia. These awards will also help to strengthen the research capabilities that are of interest to NASA within the recipient organizations and institution.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Relevance	Expert Review	04/2006	For each of the Airspace System Program projects, an expert panel was convened to assess the research relevance, scope, quality, balance, and management plans proposed by the Principal Investigator and Project Manager. After the key issues and concerns were addressed through improved project proposals, the expert review panel submitted the recommendations to the ARMD AA.	N/A
Performance	Expert Review	New	Each of the Airspace Systems Program projects will be evaluated by a panel of internal and external experts on an annual basis to assess the project's performance and progress. These reviews will be chaired by the ARMD AA.	11/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Research Risk	Given that cutting-edge research is highly dynamic, there is the possibility that planned milestones may not be met due to knowledge gained along the way (e.g., the milestones may not be possible to achieve or may require more time and effort).	ASP will conduct yearly assessments of all research elements at all four levels and will update the 10-year roadmap as required.
Cost/Schedule Risk	Given significant change to cost and/or schedule in a technical deliverable, there is the possibility that lower priority activities may be descoped or eliminated.	ASP will use the peer review rating of its technical proposals during portfolio formulation, in concert with portfolio evaluations, to assess the technical merit of its work to rebalance the portfolio investment to meet the changed requirement. This includes monitoring and tracking progress, maintaining descope prioritization for the program, and leveraging potential external opportunities.
Dependency Risk	Given that the NGATS requirements/needs may change, there is a possibility that the strategic roadmap and milestones will require modification.	ASP will monitor NGATS requirements through active participation with the JPDO and will modify the ASP 10-year roadmap as required.

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology
Program:	Fundamental Aeronautics

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Fundamental Aeronautics	570.9	305.7	293.4	289.0	285.7	290.1	294.2

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Fundamental Aeronautics	**449.3**	**293.4**	**-155.8**

+16.2M augmentation will enhance program executability in priority research areas by increasing project procurement levels as well as enabling further skill mix rebalancing that ensures critical core competencies are preserved. The key research areas include: combustion foundational research and aerothermodynamics system integration for the Subsonic Fixed Wing project; advanced control methods and cabin noise modeling and reduction for the Subsonic Rotary Wing project; high-temperature sensors, advanced inlet/nozzle concepts, aero-propulsive-servo-elasticity and lightweight multifunctional materials for the Supersonics project; and advanced structural concepts, durability technologies, and non-destructive evaluation methods for the Hypersonics project.

-$3.0M reduction to service pool overhead.

-$169.0M Full Cost Simplification adjustments. This transfer does not impact the program content.

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology
Program:	Fundamental Aeronautics

Program Overview

The Fundamental Aeronautics Program is dedicated to the mastery and intellectual stewardship of the core competencies of aeronautics for the Nation across all flight regimes. The corresponding long -term research that the program performs is both focused and integrated across disciplines. Using this research, the program provides feasible solutions to the performance and environmental challenges of current and future air vehicles. The results of NASA's pre-competitive research are widely disseminated and available to support the Nation's aerospace industry.

The program had significant accomplishments in FY 2006 including flight tests, subsonic and supersonic wind tunnel testing, materials studies, preliminary design reviews, and hardware development for all flight regimes. Of particular significance are the development of fundamental concepts and experiments in hypersonics that will be used to validate state-of-the-art predictive capabilities. Significant progress has also been achieved in the reduction of noise for both rotorcraft and subsonic aircraft through the use of intelligent path planning and advanced concepts for modern variable-cycle turbofan engines.

The work in the Fundamental Aeronautics Program directly benefits the public through the development of techniques and concepts for both subsonic and supersonic vehicles that are cleaner and quieter. Aircraft efficiency is addressed through revolutionary configurations, lighter and stiffer materials, improved propulsion systems, and advanced concepts for drag reduction. The program also helps the country develop and maintain excellence in the aeronautics workforce by providing significant research opportunities in all of its projects. Research work in planetary entry, descent, and landing will be used to advance the Nation's Vision for Space Exploration.

This program supports NASA Outcome 3E.3 and APGs 8AT7 through 8AT14.

For more information, please see http://www.aeronautics.nasa.gov.

Program Relevance

The long-term goals of the Fundamental Aeronautics Program (FA) are to significantly advance the state-of-the-art in fundamental technologies critical to reducing noise, emissions and fuel consumption and increasing the performance of future vehicles in all speed regimes. In addition, the FA Program contributes to the development of fundamental ideas and models to aid in the Entry, Descent, and Landing (EDL) phase of re-entry vehicles. These two major goals are directly relevant to NASA's Strategic Goals.

In order to provide support for the Agency's Strategic Goals, the four projects within the FA Program will carry out a number of new research activities during FY 2008 to extend our capabilities beyond current boundaries. Two key areas of emphasis will be weight reduction and internal/external flow control. Weight reduction leads directly to higher performance, and indirectly to reduced noise, emissions, and fuel consumption. Understanding and controlling internal and external aerodynamics are fundamental to all aspects of aircraft environmental compatibility, efficiency, and increased performance. Analytical methods will be pursued that are faster and more accurate to enable better, more reliable designs. They will also guide the analysis and evaluation of new technology concepts. In parallel, new concepts and component technologies will be explored to guide out-year research and technology development. In addition, a host of research areas relevant to NASA's mission will be pursued including hypersonic propulsion, high-temperature materials and flow physics, supersonic structural concepts and sonic boom minimization ideas, and advanced rotorcraft concepts to improve the speed and range of rotary wing vehicles.

The FA Program supports the goals of the NGATS and the JPDO by providing foundational research, prediction tools, and advanced technologies that can be used to both assess and reduce the noise and emission levels of current and future aircraft. Together with significant advances in aircraft performance (to reduce overall fuel consumption), these contributions can enable significant growth in the national air transportation system while meeting stringent environmental constraints.

Plans For FY 2008

The Subsonic Fixed Wing Project will develop and test component technology concepts used in conventional aircraft configurations that establish the feasibility of achieving significant noise reduction (Stage 3-42 EPN decibals cumulative). For unconventional aircraft configurations the project will develop and test component technology that establishes the feasibility of achieving short take-off and landings on runways less than 3000ft. The project will flight test scale models of the X-48 Blended Wing-Body concept to evaluate this advanced configuration.

The Subsonic Rotary Wing Project will validate model engine stall control concepts using component test data obtained in GRC's CE18 facility to improve the operability range of rotorcraft engines and further improve their range and efficiency. Wake characterization, interior noise, and tip-path plane measurement studies will also be pursued during FY 2008.

The Supersonics Project will use laboratory tests to validate a composite containment system for supersonic engine fan blades that is 20 percent lighter than the metallic containment system developed by the High Speed Research Program in the late 1990s, demonstrating advancement in new concepts for high efficiency propulsion and airframes for supersonic aircraft. The project will validate a high-fidelity analysis technique for assessing the impact of nozzle plume effects on the off-body flow field of a supersonic aircraft to aid in the development of predictive noise propagation modeling.

The Hypersonics Project will establish technology baselines through the evaluation of hypersonic flight simulation tools, Guidance, Navigation and Control (GNC) technologies, and ablator systems using data from flight one of the Sub-Orbital Aerodynamic Re-entry Experiments (SOAREX). They also will use NASA's arc-jet facilities to characterize the behavior of advanced heat shield systems to provide a database for material degradation models for hypersonic vehicles. The Hypersonic Boundary Layer Transition (HyBoLT) and SOAREX experiments are scheduled to fly in July of 2007 atop the ATK Launch Vehicle X-1.

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology
Program:	Fundamental Aeronautics

Project Descriptions

The Fundamental Aeronautics (FA) Program supports research in tools and technologies that enable the design of vehicles that fly through any atmosphere at any speed. Physics-based, multidisciplinary design, analysis, and optimization (MDAO) tools will be developed and will make it possible to evaluate radically new vehicle designs and to assess, with known uncertainties, the potential impact of innovative technologies and concepts on a vehicle's overall performance. Advanced component technologies will be developed to realize revolutionary improvements in noise, emissions, and performance. The FA Program also supports the Agency's human and robotic exploration missions by advancing knowledge in areas relevant to EDL.

The FA Program has four projects. The Fixed Wing Project addresses the challenge that future aircraft need to be quieter and cleaner to meet stringent noise and emissions regulations. These aircraft must also meet challenging performance requirements to make them economically viable alternatives to the existing fleet. The Rotary Wing Project will address the technical barriers that constrain rotorcraft from reaching widespread use in civil aviation. These barriers include range, speed, payload capacity, fuel efficiency, and environmental acceptance. The Supersonics Project will: conduct research to support the elimination of the efficiency, environmental and performance barriers to practical supersonic cruise; and, to address the critical issue of supersonic deceleration to enable safe, precision planetary entry, descent, and landing of human and large science missions in any atmosphere. Because all access to space and all entry from space through any planetary atmosphere require hypersonic flight, the Hypersonics Project will tackle all of the key fundamental research issues required to make hypersonic flight and re-entry feasible.

Subsonic Fixed Wing

The project focus is to develop improved prediction methods and technologies for lower noise, lower emissions, and higher performance for subsonic aircraft. Higher performance includes energy efficiency and operability technologies that enable advanced airframe and engine systems. Estimates for weight reduction, enhanced lift, lower drag, higher thermal efficiency, noise reduction, NOx reduction, particulate/soot reduction, and alternative fuels efficiency will be used in system studies to determine the best return on investment. Initial studies will concentrate on existing state-of-the-art aircraft/engine systems such as the Boeing 777 with GE-90 engines, and similar systems that are feasibly sized to 150-passenger and regional jet vehicle classes.

While there are no specific system level goals for noise, emissions, and performance, technologies will be evaluated using best available trade studies for existing engines/aircraft. It is expected that the selected aircraft/engine systems and advanced technologies evaluated in the studies will be general enough to have broad benefits across a range of vehicle classes. Initially, the project will concentrate on evaluating the best "tube and wing" configurations using podded engines. Validation opportunities have been identified with industry partners that are expected to meet nearer term noise/emissions/performance targets. Improvements will be made to prediction methods using this validation data. This will provide the foundation for evaluating advanced vehicle concepts such as hybrid wing/engines where current prediction methods are unreliable. The ten-year strategy is to provide validated prediction tools that can be used to perform system trade studies aimed at evaluating advanced concepts capable of meeting longer term noise, emissions, and performance targets.

The Fixed Wing Project has identified the following key technical challenges that are combined into higher level multi-disciplinary challenges: material science and mechanics of materials and structures; reacting flow physics; control methods and strategies; dynamic modeling and simulation; acoustics physics, aeroelasticity; computational methods; fluid dynamics and heat transfer; and new experimental approaches.

Subsonic Rotary Wing

The Subsonic Rotary Wing project will focus its research in the most persistent technical challenge areas in order to produce advances in prediction tool capability and technology. The overarching objective of the project is to advance the capability of rotorcraft system, subsystem, and component prediction tools by advancing the knowledge base of fundamental and discipline physics. Advances in physics-based prediction capability will ultimately lead to a more robust industry ability to develop rotorcraft vehicles that fly as designed.

The specific objectives of the research in fundamental physics are driven by five key technical challenges: power transmission and generation; control theory and information processing and modeling; fluid mechanics, dynamics, and aero-structural coupling; acoustics physics; and solid mechanics and advanced materials. These technical challenges are relevant to a broad range of industry and government programs, inherently force the integration of multiple disciplines, and involve technical issues that are beyond the reach of current prediction tools. Each of the technical challenges brings together the analytical methods and experimental validation data that are required to advance the state-of-the-art in a multi-discipline environment. Innovative solutions to these technical challenges, coupled with the increased ability to predict with certainty the solutions, will drive breakthrough technology for the rotorcraft industry.

Supersonics

The Supersonics Project supports the FA Program strategy of developing systems level multi-disciplinary capabilities for supersonic civilian and military supersonic applications. In addition, one of the components of the project is the development of ideas, concepts, and fundamental tools to aid in the development of safe, accurate, and reliable supersonic deceleration systems for planetary entry and re-entry. The Supersonics Project is closely aligned with the ARMD principles of maintaining intellectual stewardship of aeronautical core competencies for the Nation in the supersonic flight regime and of focusing research in areas that are appropriate to NASA's unique capabilities.

A broad-based research plan has been defined that addresses the challenges through development of knowledge, capabilities, and technologies at the foundational, discipline, multidiscipline and systems levels. A set of major technical challenges has been identified for the two vehicle classes that will be addressed by the Supersonics Project, practical supersonic cruise vehicles and high-mass Mars entry systems. The Supersonics Project will partner appropriately with both the Hypersonics and Subsonic Fixed Wing projects in developing integrated approaches and technologies.

The Supersonics project is organized along the following major technical challenges that have been identified for the two vehicle classes: efficiency (supersonic cruise, light weight and durability at high temperature); environmental challenges (airport noise, sonic boom, high altitude emissions); performance challenges (aero-propulso-servo-elastic analysis and design); entry descent and landing challenges (supersonic deceleration); and multidisciplinary design, analysis and optimization challenges.

Hypersonics

NASA Aeronautics Hypersonic Project is based on the fact that all access to Earth or planetary orbit, and all entry from orbit into Earth's atmosphere or any planet with an atmosphere requires flight through the hypersonic regime. In fact, the hypersonic flight regime often proves to be the design driver for most of the vehicle's systems, subsystems, and components due to the critical effects of aerodynamic heating and the demands for close integration between the airframe and propulsion systems.

The goal of the Hypersonics Project is to conduct long-term, cutting-edge research in the core competencies of the hypersonic regime thereby producing knowledge, data, capabilities, and design tools that are applicable to a broad range of hypersonic vehicles. Project resources are focused on two high payoff NASA-unique missions, Highly Reliable Reusable Launch Systems and High Mass Mars Entry Systems. This research will be performed primarily at NASA Aeronautics Centers, but will also include partnerships with other government agencies, universities, and industry, as appropriate.

Foundational hypersonics research on Highly Reliable Reusable Launch Systems will enable sustained hypersonic flight through the atmosphere and can help the Department of Defense achieve its goal of reaching targets from the air with global reach, quick reaction, persistence, and significant payload. The research on High Mass Mars Entry Systems conducted by the Hypersonics Project is focused on the development of technologies and concepts that can enable the safe and accurate delivery of large payloads to the surface of Mars. This effort will facilitate the Entry, Descent, and Landing phase of both human and robotic planetary missions and is closely aligned with the long-term goals of NASA's Vision for Space Exploration.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
In 2009, develop a database for alternative hydrocarbon fuels and characterize compared to Jet-A.	Subsonics Fixed Wing	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.
In 2010, conduct wind tunnel test of reduced noise model w/o performance or weight penalties.	Subsonics Fixed Wing	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.
In 2011, conduct tests to validate low-speed maximum lift improvement due to active flow control.	Subsonics Fixed Wing	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.
In 2011, develop and validate aircraft noise and propagation predictions within 3dB of flight data.	Subsonics Fixed Wing	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.
In 2011, validate ability to predict the effects of active flow control systems.	Subsonics Rotary Wing	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.
In 2012, integrate and demonstrate technologies to reduce rotor speed by 50% without penalties.	Subsonics Rotary Wing	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.
In 2009, demonstrate and adjoint-based design for configuation shaping.	Supersonics	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.
In 2011, demonstrate innovative light weight materials and processes with 10% weight savings.	Supersonics	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.
In 2011, define a propulsion system concept that achieves target takeoff noise limits.	Supersonics	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.
In 2011, evaluate the accuracy of phenomenological turbulence and sub-grid scale models.	Hypersonics	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.
In 2012, predict the mass and performance of Mars decelerators and low-high L/D entry systems.	Hypersonics	The project was in formulation during FY 2007.	Milestone was based on internal and external peer reviews of proposals.

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology
Program:	Fundamental Aeronautics

Program Management

The ARMD Associate Administrator is responsible for portfolio approval. The Headquarters Program Director oversees portfolio formulation, implementation, evaluation, and integration of results with other ARMD/NASA Programs.

Project	Oversight	Lead Performer	Partners
Subsonics Fixed Wing	Principal Investigator and Project Management who report to the Program Director	ARC, DFRC, GRC, LaRC	Air Force Research Lab (AFRL), Boeing, Pratt & Whitney, Lockheed Martin, Northrop Grumman
Subsonics Rotary Wing	Principal Investigator and Project Management who report to the Program Director	ARC, GRC, LaRC	Army, Center for Rotorcraft Innovation (CRI), Bell Helicopter, Sikorsky, ZFL, Helowerks, Inc
Supersonics	Principal Investigator and Project Management who report to the Program Director	ARC, DFRC, GRC, LaRC	Gulfstream Aerospace, Lockheed Martin, AFRL, DARPA Oblique Flying Wing Program
Hypersonics	Principal Investigator and Project Management who report to the Program Director	ARC, DFRC, GRC, LaRC	AFRL, DARPA Falcon Program, ATK

Acquisition Strategy

During the summer of 2006, Fundamental Aeronautics (FA) used a NASA Research Announcement (NRA) vehicle as the means to solicit research proposals in several key areas of interest to the FA Program. During the process ARMD ensured that competition for the NRA awards was full and open. One of the key objectives of the NRA investment is to stimulate close collaboration among NASA researchers and NRA award recipients, to ensure effective knowledge transfer. ARMD received 507 proposals for the FA Program from universities and industry and intends to complete the award phase by the end of January 2007. A second phase of the NRA solicitation will follow during the first months of calendar year 2007.

In addition to soliciting research proposals, ARMD is actively building collaborations with industrial partners through Space Act Agreements (SAAs). Although these SAAs do not include transfers of funds or acquisitions to/from industrial partners, they do involve NASA investments and acquisitions for testing equipment, tunnel time, etc.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	Expert Review	New	Each of the Fundamental Aeronautics projects will be evaluated by a panel of internal and external technical experts on an annual basis to evaluate the projects' performance and progress. These reviews will be chaired by the ARMD AA.	11/2007
Relevance	Expert Review	04/2006	For each of the Fundamental Aeronautics projects, an expert panel was convened to assess the research relevance, scope, quality, balance and management plans proposed by the Principal Investigator and Project Manager. After the key issues and concerns were addressed through improved project proposals, recommendations for approval were submitted by the review panel to the ARMD AA.	N/A

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Cost/Schedule Risk	Given significant change to cost and/or schedule in a technical deliverable, there is the possibility that lower priority activities may be descoped or eliminated.	Fundamental Aeronautics will use the peer review rating of its technical proposals during portfolio formulation, in concert with portfolio evaluations to assess the technical merit of its work to rebalance the portfolio investment to meet the changed requirement.
Dependency Risk	Given that technologies from other programs (both external and internal to NASA) do not meet expected technical performance and timeliness, there is the possibility that this program's cost and schedule may slip.	Fundamental Aeronautics will monitor and track technology development progress in other programs under prior agreement and maintain contingency plans as part of the agreement with the other programs.
Research Risk	Given that fundamental research is highly dynamic, there is the possibility that milestones may not be met because of things learned along the way (e.g., the milestone may not be possible to achieve or may require more time or effort).	Fundamental Aeronautics will mitigate by conducting yearly assessments of all research elements and will update the 10-year working plan as required.

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology
Program:	Aeronautics Test Program

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Aeronautics Test Program	--	54.1	88.4	90.2	89.2	89.4	89.5

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Aeronautics Test Program	**56.4**	**88.4**	**32.0**

+23.3M transfer Dryden Flight Research Center fixed infrastructure costs for test bed aircraft, support aircraft maintenance and support, and test range (flight communicaiton and data acquisition) support to ATP.

+$.2M augmentation to enhance program executability in priority research areas by enabling further skill mix rebalancing that ensures critical core competencies are preserved.

+$8.5M Full Cost Simplification adjustments. This transfer does not impact the program content.

Program Overview

The Aeronautics Test Program (ATP) is an ARMD program as well as a component of NASA's Shared Capability Assets Program (SCAP). ATP is dedicated to the mastery and intellectual stewardship of the core competencies of Aeronautics testing, both on the ground and in the air. ATP's purpose is to ensure the strategic availability of a minimum, critical suite of aeronautical test facilities which are necessary to meet the long-term needs and requirements of the nation. ATP is responsible for the strategic and business management of the major wind tunnels/ground test facilities at Ames, Glenn and Langley Research Centers and the Western Aeronautical Test Range (WATR), Support Aircraft and Test Bed Aircraft at Dryden Flight Research Center. ATP ensures funding levels allow for continuous operations at ATP facilities and for the appropriate levels of maintenance and investments in test technology/test techniques. A major benefit of this program is that it establishes stable user pricing at its facilities. ATP is responsible for related alliances with the Department of Defense. This program supports the objective to ensure the continuous availability of a portfolio of NASA owned wind tunnels/ground test facilities and flight operations/test infrastructure which are strategically important to meeting national aerospace program goals and requirements and the following Annual Performance Goals: 1) assess and modify as needed the investment strategy for NASA-owned wind tunnels/ground test facilities by working with all the appropriate stakeholders, to assure that the plan reflects the priorities of the long-term needs of the Nation; and 2) develop a long-term, flight operations/test infrastructure vision and funded plan working with all the appropriate stakeholders, to assure that the plan reflects the priorities of the long-term needs of the Nation.

This program supports NASA Outcome 3E.4 and APGs 8AT15 and 8AT16.

For more information, please see http://www.aero.nasa.gov/programs_atp.htm.

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology
Program:	Aeronautics Test Program

Program Relevance

Aeronautics Test Program facilities are required to support many of NASA's programs across the Agency as well as other government agencies and U.S. Industry.

ARMD's Fundamental Aeronautics program requires ATP wind tunnel and aeropropulsion testing capabilities and flight research testing capabilities to execute many of the projects in the Fundamental Aeronautic Program. The Icing Research Tunnel provides an essential testing capability for the Aviation Safety Program.

Exploration Sciences Mission Directorate relies on many of the ATP facilities, both ground test and flight test, to develop the new vehicles required for space exploration.

Space Operations Mission Directorate requires ATP facilities to support the Shuttle in developing understanding of unexpected events and developing fixes for those events. Dryden's WATR provides range information for the Shuttle and Dryden provides the backup landing site for the Shuttle.

The Science Mission Directorate utilizes the ATP facilities, both ground test and flight test, to carry out many of its science projects.

The Department of Defense (DoD) and the U.S. industry are reliant on many of the ATP facilities to develop fighter aircraft, missiles, transport aircraft, and on occasion submarine vehicles.

Plans For FY 2008

The program will provide for partial funding of the fixed costs for those ATP facilities that have significant projected NASA program usage, and/or that are considered to be national assets for which NASA accepts stewardship responsibilities, and/or for which there are present or future requirements by other government agencies or the U.S. aerospace industry. This will achieve user price and utilization stability for both major wind tunnels/ground test facilities and flight operations/test infrastructure. In addition, for those assets that are considered to be unique but for which there is no projected current or future usage, the ATP will provide funds to mothball these facilities. Significant maintenance activities, beyond routine maintenance, will be performed to improve productivity and reduce operational cost. An investment in test technology and facility upgrades (new capability) will be made. The wind tunnel/ground test facilities effort will be coordinated with the Defense Test Resource Management Center of the Office of the Secretary of Defense (OSD). This will enable the DoD and NASA to leverage their resources for investments in this area. A university grant/contract effort is planned wherein the use of one or more ATP assets for development of advanced aerospace technologies will be realized.

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology
Program:	Aeronautics Test Program

Project Descriptions

The ATP is a long-term, funded commitment by NASA to retain and invest in test capabilities that are considered to be important to the Nation and the Agency. Through the ATP, the Agency will adopt consistent management processes and procedures across the NASA Research Centers as it relates to the operations and maintenance of the ATP major wind tunnels/ground test facilities and flight operations/test infrastructure. The ATP will review the status of its assets annually. In doing so, NASA is ensured that near-term decisions, such as that to close a facility, have financial gains relative to long-term capability risks. The ATP will cooperate with the DoD to coordinate investments.

There are four projects in the ATP:

- Facility Operations Support: Provide 60% to 100% of the facility fixed costs for ground test facilities and up to 100% of the facility fixed costs for flight facilties to ensure facility and staff availability and user price stability.

- Facility Maintenance: Provide significant maintenance activities that cannot be addressed as routine maintenance such as repair facility thermal insulation to improve facility productivity and reduce cost of operation, repair facility drive motor cooling water pump, replace worn out facility control equipment, and replace worn out and outdated data acquisition equipment.

- Facility Upgrades and Test Technology: Develop and implement new technologies that increase test capability, improve productivity and efficiency, and improve data quality.

- Facility Related Research: Activities in this project will be competed openly with a strong desire to involve universities with experimental work in major facilities.

The ATP is working closely with the DoD to develop the National Partnership for Aeronautic Testing (NPAT) which is designed to strengthen the reliance of NASA and DoD on each other

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Deliver at least 92% of scheduled operating hours for all operations and research facilities by FY09	Facility Operations Support Project	No Change	No Change
Develop a new generation of highly skilled aero test engineers and scientists via FY08-12 NRA awards	Facility Related Research Project	In Formulation	NRA in place
Improve Facility Condition Index for ATP facilities by reducing Backlog Maintenance by 10% by FY12	Facility Maintenance Project	No Change	No Change
Implement centralized force balance capability by FY09	Facility Upgrades and Test Technology Project	In Formulation	Ready for Implementation in fiscal year 07

Mission Directorate:	Aeronautics Research
Theme:	Aeronautics Technology
Program:	Aeronautics Test Program

Program Management

The ARMD AA is responsible for portfolio approval. The ATP Director (who is located at LaRC but reports directly to the ARMD AA) oversees portfolio formulation, implementation, evaluation, and integration of results with other ARMD/NASA Programs.

Project	Oversight	Lead Performer	Partners
Facility Maintenance Project	Senior managers of ATP facilities at ARC, DFRC, LaRC, & GRC have key implementation responsibilities	ARC, GRC, LaRC, and DFRC	DoD, Industry, and Univerisities
Facility Upgrades and Test Technology Project	Senior managers of ATP facilities at ARC, DFRC, LaRC, & GRC have key implementation responsibilities	ARC, GRC, LaRC, and DFRC	DoD, Industry, and Universities
Facility Related Research Project	Senior managers of ATP facilities at ARC, DFRC, LaRC, & GRC have key implementation responsibilities	ARC, GRC, LaRC, and DFRC	DoD, Industry, and Universities
Facility Operations Support Project	Senior managers of ATP facilities at ARC, DFRC, LaRC, & GRC have key implementation responsibilities	ARC, GRC, LaRC, and DFRC	DOD, Industry, and Universities

Acquisition Strategy

Acquisitions that support ATP facilities maintenance and repair are usually less than the Construction of Facilities (CoF) threshold of $0.5M and are initiated as early in the fiscal year as possible. Larger ATP acquisitions (significant facility repairs) that exceed CoF thresholds require that ATP funds are converted to CoF funds.

The anticipated NRA commitment is $1.0M for this Program.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Relevance	NAC and ATP Users	07/2006	Periodic reviews are carried out by the NASA Advisory Council (NAC) and the U.S. users of ATP facilities. The last ATP review was carried out by the Aeronautics Subcommittee of the NAC in July 2006; no major findings were reported. The next major programmatic review is planned for February 2007 with DoD and U.S. aerospace industry users invited to participate.	02/2007
Performance	Review Panel	New	Each of the ATP projects will be reviewed on an annual basis to evaluate the projects' performance and progress. These reviews will be chaired by the ARMD AA.	09/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
ATP Risk Management	ATP assets are prioritized based upon national and Agency program relevance, uniqueness, and capabilities. The assets ranked highest receive increased funding. Given significant change in program needs or national priorities, there is a risk that lower priority facilities will not being readily available. Both operational/maintenance activities could be descoped/eliminated.	The Agency will review the facility prioritization on an annual basis and realign the ATP budget profile in order to ensure that facilities which are critical to NASA programs, other government agency programs and to the U.S. aerospace industry are available when required at reasonable pricing levels. ATP will work closely with DoD through NPAT.

Cross-Agency Support Programs

Cross-Agency Support Programs provides a focus to several ongoing activities and provides a strategic approach to managing some of NASA's unique research facilities. This budget area consists of four Themes: Education, Advanced Business Systems, Innovative Partnerships Program, and Shared Capabilities Assets Program.

Budget Distribution

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
FY 2008 President's Budget Request	**533.4**	**502.0**	**489.2**	**453.5**	**460.4**	**454.7**	**454.4**
Education Theme	162.4	167.4	153.7	152.8	152.7	149.8	149.6
Advanced Business Systems (IEMP)	156.3	97.4	103.1	69.4	71.6	67.6	67.5
Innovative Partnerships Program	214.8	215.1	198.1	197.2	199.8	200.0	200.0
Shared Capability Assets Program	--	22.1	34.3	34.2	36.2	37.3	37.2
FY 2007 President's Budget Request	**533.5**	**491.7**	**497.9**	**467.1**	**476.8**	**482.2**	**--**
Education Theme	162.4	153.3	152.4	153.1	154.0	153.3	--
Advanced Business Systems (IEMP)	156.3	108.2	106.9	73.8	78.5	80.6	--
Innovative Partnerships Program	214.8	197.9	205.5	206.2	209.7	212.9	--
Shared Capability Assets Program	--	32.2	33.1	33.9	34.7	35.5	--
Total Change from FY 2007 President's Budget Request	**0.0**	**10.3**	**-8.7**	**-13.6**	**-16.4**	**-27.5**	**454.4**

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Budget Changes

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Total Changes	**--**	**10.3**	**-8.7**	**-13.6**	**-16.4**	**-27.5**	**454.4**
Programmatic Content	**--**	**--**	**-34.4**	**-34.1**	**-34.1**	**-34.0**	**454.4**
Education Theme	--	--	-11.4	-11.4	-11.3	-11.3	149.6
Advanced Business Systems (IEMP)	--	--	-0.9	-0.6	-0.6	-0.6	67.6
Innovative Partnerships Program	--	--	-22.1	-22.1	-22.2	-22.1	200.0
Shared Capability Assets Program	--	--	--	--	--	--	37.2
Programmatic Transfers	**--**	**--**	**9.6**	**9.5**	**10.6**	**11.1**	**--**
Shared Capability Assets Program	--	--	9.6	9.5	10.6	11.1	--
Institutional Adjustments	**--**	**10.3**	**16.1**	**11.0**	**7.1**	**-4.6**	**--**
Education Theme	--	14.1	12.6	11.1	10.1	7.9	--
Advanced Business Systems (IEMP)	--	-10.8	-2.8	-3.9	-6.3	-12.5	--
Innovative Partnerships Program	--	17.2	14.6	13.0	12.3	9.3	--
Shared Capability Assets Program	--	-10.2	-8.3	-9.2	-9.0	-9.3	--

Note: Changes in Programmatic Content reflect the increases or decreases made directly to a program or project in response to cost increases, schedule or technical changes, or a change in Agency priorities.

A Programmatic Transfer is the movement of funding and content to another part of the Agency to reflect either a change in program management or to support Agency-wide capabilities.

Institutional Adjustments are changes in the allocation of Agency-wide costs to a given program.

Highlights of Programmatic Changes

<u>**Cross-Agency Support Programs**</u>
Education Theme
Programmatic Content:
Redirected funds from Education to address higher priority NASA mission requirements.
Institutional Adjustments:
Full Cost Simplification.
Advanced Business Systems (IEMP)
Programmatic Content:
Redirected funds to address higher priority NASA mission requirements.
Institutional Adjustments:
Full Cost Simplification.
Innovative Partnerships Program
Programmatic Content:
Red Planet Capital eliminated for higher Agency priorities. *Reduction to Technology Transfer.*
Programmatic Transfers:
Centennial Challenges from Exploration Systems Mission Directorate. No net funding change.
Institutional Adjustments:
Full Cost Simplification.
Shared Capability Assets Program
Programmatic Transfers:
HECC Budget transfered to SMD, but HECC multi-discipline Agency management support still part of the SCAP program. *New SCAP Facility/Capability investments for: Thermal Vacuum Chambers (TVC); Simulators; and Arc-Jets.* *Flight Operations, and Test Infrastructure was also transferred to SCAP, but the budget remains in Aeronautics Research Mission Directorate's Aeronautics Test Program.*
Institutional Adjustments:
Full Cost Simplification.

Theme Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Education Theme	162.4	167.4	153.7	152.8	152.7	149.8	149.6
Education	162.4	167.4	153.7	152.8	152.7	149.8	149.6

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Theme Changes

	FY 2008		
Education Theme	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Education	**152.4**	**153.7**	**1.3**
Change reflects net impact of full-cost simplification and redirecting funding from Education to address higher priority NASA mission requirements.			

Theme Purpose

The Education Theme supports multiple Goals and Sub-goals in the 2006 NASA Strategic Plan. Specifically, the Education Theme has the responsibility to deliver on the following outcomes: Outcome ED-1: Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals through a portfolio of programs. Outcome ED-2: Attract students and retain them in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty. Outcome ED-3: Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission.

The NASA Strategic Plan Education outcomes are mapped onto the Education Strategic Portfolio Framework and are embedded in four categories of involvement: inspire, engage, educate and employ. The strategic framework will guide the planning, implementation, assessment and validation of the portfolio of programs: E-Education, Elementary and Secondary Education, Higher Education, Informal Education and Minority University Research and Education Program, toward achievement of the Outcomes.

Mission Directorate:	Cross-Agency Support Programs
Theme:	Education Theme

Theme Overview

NASA's journeys into air and space deepen the understanding of the universe, advance technology breakthroughs, enhance air travel safety and security, and expand frontiers of scientific research. These achievements share a common genesis: Education. NASA will continue the tradition of investing in Education programs and supporting Educators who play a key role in preparing, inspiring, exciting, encouraging, and nurturing the youth who will manage and lead the laboratories and research centers of tomorrow. NASA will pursue three major goals: 1) Strengthen the Nation's future workforce--NASA will identify and develop the critical skills and capabilities needed to achieve the Vision for Space Exploration. To meet this demand, NASA will contribute to the development of the Nation's science, technology, engineering, and mathematics (STEM) workforce through a diverse portfolio of Education initiatives for America's students at all levels, especially those in traditionally underserved and underrepresented communities. 2) Attract students and retain them in STEM disciplines--To compete effectively for the minds, imaginations and career ambitions of America's young people, NASA will focus on engaging and retaining students in STEM Education programs and encourage pursuit of educational disciplines critical to the NASA engineering, scientific, and technical missions. 3) Engage Americans in NASA's mission--NASA will build strategic partnerships and linkages between STEM formal and informal education providers. Through hands-on, interactive, educational activities, NASA will engage students, educators, families, the general public, and all Agency stakeholders to increase Americans' science and technology literacy. As the United States begins the second century of flight, NASA will maintain its commitment to excellence in STEM Education to ensure the next generation of Americans accept the full measure of their role and responsibility for shaping the future.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

The Nation maintains its commitment to excellence in science, technology, engineering, and mathematics (STEM) education to ensure the next generation of explorers and innovators is fully prepared to join the workforce while contributing to national needs. The May 2005 National Academies report, "Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future," proposes four broad recommendations to enhance the science and technology enterprise so that the United States can successfully compete, prosper, and be secure in the global community of the 21st century: 1) increase America's talent pool by vastly improving K-12 science and mathematics education; 2) sustain and strengthen the Nation's traditional commitment to long-term basic research; 3) make the United States the most attractive setting in which to study and perform research; and 4) ensure that the United States is the premiere place in the world to innovate. NASA is taking a leading role to inspire interest in STEM, as few other organizations can through its unique mission, workforce, facilities, research and innovations. The Agency is also taking a leading role to make significant impacts in engaging underserved and underrepresented communities in STEM.

Relevance to the NASA Mission:

The NASA Education Strategic Coordination Framework was approved by the Strategic Management Council on February 23, 2006. It was adopted as the framework for NASA education programs, projects, products and activities by the Education Coordinating Committee on February 24, 2006. The Framework assures that all education investments are aligned with the NASA Strategic Plan.

Relevance to education and public benefits:

As NASA implements the Vision of Space Exploration, which will carry humans back to the Moon, on to Mars, and beyond, NASA Education is working to lay the groundwork that will make this ongoing journey possible. The Vision calls for a program of exploration that will continue for decades, requiring the dedication and ingenuity not only of the scientists and engineers of today but of generations to come. To ensure those future explorers will be ready to continue the journey, NASA is working with one of its most vital partners--educators. The Office of Education will promote education as an integral component of every major NASA research and development mission. NASA along with industry and university engineers and scientists, will share knowledge and experience with students and educators as they study Earth and the universe using the latest aerospace research methods.

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
Strategic Goal	**Supports Multiple Agency Goals**	
Outcome ED-1	**Contribute to the development of the Science, Technology, Engineering and Math (STEM) workforce in disciplines needed to achieve NASA's strategic goals, through a portfolio of programs.**	
APG 8ED01	Provide 100 NASA-supported courses offered at institutions of higher education targeted at the STEM skills needed by NASA.	Education
APG 8ED02	Serve 250 students, 150 faculty, and 40 institutions in designated EPSCoR states.	Education
APG 8ED03	Support 125 Minority Institutions and 4,500 underserved students in STEM education programs.	Education
Outcome ED-2	**Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers and faculty.**	
APG 8ED04	Increase by 5 percent the number of elementary and secondary student participants in NASA instructional and enrichment activities.	Education
APG 8ED05	Increase by 5 percent elementary and secondary educators' use of NASA resources in their classroom instruction.	Education
Outcome ED-3	**Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission.**	
APG 8ED06	Provide support to 100 museums and science centers across the country to actively engage the public in NASA events and activities.	Education

Performance Achievement Highlights

E-Education

NASA unveiled its new Kids' Club web site that features animated educational activities for children in grades K-4. Twelve visually impaired/blind high school students participated in an innovative program called Rocket On! made possible through a partnership between NASA & the National Federation of the Blind. The students developed & built sensors to measure acceleration, temperature, pressure & roll rate for a payload on a rocket to be launched. They calculated rocket performance & trajectory using MathTrax, an accessible math tool developed by the NASA Learning Technologies Project.

This year, NASA broadened its use of sports figures in NASA Brain Bites to draw analogies between the world of sports & physics or operations of space flight, including a series of educational videos hosted by Olympic athletes.

Elementary & Secondary Education

The NASA Explorer Schools Program added 33 schools to the existing 218 schools and was recognized as one of the Top 50 Government Innovations for 2006 by the Ash Institute. Recently selected new schools include Cottonwood Day School and Sanders Middle School, located on the Arizona Navajo Reservation.

The Science, Engineering, Mathematics Aerospace Academy (SEMAA) project continued pioneering the development of aerospace-themed schools to actively inspire, engage and education students through hands-on activities and materials that encompass the research and technology of the NASA Mission Directorates. Eight schools (4 high schools, 2 middle schools & 2 elementary schools) were designated as NASA aerospace-themed academies. Educator Astronaut Program graduated 3 astronaut candidates from the 2004 class.

Performance Achievement Highlights

Higher Education

NASA JPL hosted 11 students representing seven Space Grant Consortia for 10 weeks as they developed an initial mission design for "Inspiration," a small Lander that will travel to Mars with the Astrobiology Field Laboratory. Higher Education program conducted NASA Pre-Service Teacher Institutes which sponsor workshops, field trips and tours of NASA Field Centers designed to provide college students who are preparing to become K-8 educators with in-depth and intensive learning experiences that raise comprehension of and interest in STEM-related topics.

The Reduced Gravity Student Flight Program allows teams of undergraduate science and engineering students to propose, design and fly a reduced-gravity experiment. Teams are investigating the effect of microgravity on the human body, fluids, inflatable structures, metals, and lasers. The teams included more than 2,000 undergraduate students from 146 universities, 81 students from 9 community colleges and 446 high school students from 73 schools.

Informal Education

NASA and Honeywell launched the 2006 tour of the award-winning FMA Live! (Force=Mass x Acceleration) the innovative, traveling hip-hop science concert reached nearly 20,000 students in 45 schools during its 14-week, 27-city tour across the United States.

NASA and the Girl Scouts of America are partners in groundbreaking efforts to inspire young women to pursue STEM careers. This summer, Girl Scouts across the Nation were invited to participate in STS-115 launch-day activities on site at NASA Field Centers and at the launch site at NASA Kennedy Space Center.

In July 2006, sixth-through-eighth graders successfully completed the 2-week Bernard Harris Summer Science Camp, which was made available in partnership with NASA and Exxon Mobile (Bernard Harris is the first African-American astronaut to walk in space).

Minority University Research and Education Program (MUREP)

NASA hosted faculty/student research teams from 14 of the Nation's 35 Tribal Colleges & Universities (TCU) assigning participants to research and engineering teams working on robotics, 3-D design, geospatial data analysis and astrobiology. Fifty-seven TCU faculty/students performed research at seven NASA Field Centers.

The Harriett G. Jenkins Predoctoral Fellowship Program produced 21 Ph.D and 33 M.S. Degree recipients in a STEM discipline. From this pool, NASA added five of the former JPFP participants to its workforce. The aerospace industry hired eight Jenkins Fellows graduates.

NASA selected a consortium of three organizations to administer the Motivating Undergraduates in Science and Technology (MUST) Project: Hispanic College Fund, United Negro College Fund Special Program Corporation, and Society of Hispanic Professional Engineers. MUST will identify and develop critical skills and capabilities needed to achieve future missions.

Quality

Performance Measure #	Description
Education Theme Theme	
APG 8ED07	Reduce turn around time by 10% from submission of supplementary curriculum products for formal review to online distribution.
APG 8ED08	Reduce the cost per program participant by 5%.

Program Assessment Rating Tool (PART):

NASA's Education Program received a FY2004 PART rating of "Adequate". Many positive attributes were cited and it was concluded that the program attracts students to science & technology careers at NASA. On the other hand, it was cited that NASA lacked complete data on the effectiveness of its education programs. The program was unaware of the degree to which participants had taken jobs with NASA or related fields. The program did not report on a complete set of performance measures that reflected the desired program outcomes. Specifically, the Office of Education was assigned several program improvements actions:

1) Perform regular program reviews to ensure that only effective, relevant programs are funded.
2) Report accomplishments annually and make the data available to the public.
3) Perform self-evaluations, including solicitation of student feedback and collections of longitudinal data on student career paths.
4) Fill NASA´s workforce needs by a stronger effort to consider eligible program participants and facilitate their job entry.
5) Develop appropriate performance measures, baselines, and targets.

Education increased attention to strategic planning and performance measurement to better define expected results; identify appropriate measures to document achievements; and ensure that reliable, valid, and comprehensive performance data are collected, analyzed, and reported. Regular reviews are conducted to determine the effectiveness of program components and to eliminate, enhance existing or add missing components to achieving its goals. Effort is being made to link program participation to NASA's workforce requirements and to implement a process to track students.

A new Education Framework was developed, with an implementation plan to support the strategic direction and the Vision for Space Exploration. Outcomes, objectives and measures were developed to support the framework. This will be factored into a PART reassessment in FY2007.

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	Space Grant Program Management	06/2003	Insure each 52 Space Grant consortia conduct a balanced program of research, education & public service in compliance with legislation, regulations, and NASA program guidance/Outcome of the merit review determines if the grant is continued for 5 years; outcome of the last evaluation (1998-2002): 33 consortia passed; 14 consortia placed on probation with requirement for corrective action plan, 5 consortia did not pass and these 5 consortia were re-established based on a competitive solicitation.	06/2008
All	ECC	02/2006	The Education Coordinating Committee (ECC) conducted a portfolio review of all NASA education investments. The review resulted in an inventory of investments, with projects categorized by type to enable further analysis. The review also developed a refined set of program objectives and corresponding measures.	TBD
Quality	National Research Council	06/2006	In FY 06 the NRC Board on Science Education began work under a contract with NASA to conduct an evaluation of NASA's pre-college education program. An expert panel was convened and the first committee meeting was held Nov. 15-17, 2006. Three additional committee meetings will be held prior to the submission of the NRC's report, scheduled for November, 2007. The NRC does not release preliminary results prior to submission of their report.	02/2008
All	NEPER and Westat	08/2001	OMB directed an external evaluation of NASA Education Program. The NASA Education Program Evaluation Review (NEPER) Panel concluded that NASA possesses a unique opportunity to use its facilities and personnel to enrich the education pipeline, K-12 through the Ph.D degree, in order to contribute to ameliorating the Nation's projected workforce shortage in science and engineering. The panel believes it takes a community to build a strong and effective national STEM program.	TBD

Mission Directorate:	Cross-Agency Support Programs
Theme:	Education Theme
Program:	Education

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Education	162.4	167.4	153.7	152.8	152.7	149.8	149.6

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Education	**152.4**	**153.7**	**1.3**

Change reflects net impact of full-cost simplification and redirecting funding from Education to address higher priority NASA mission requirements.

Program Overview

NASA's journeys into air and space deepen the understanding of the universe, advance technology breakthroughs, enhance air travel safety and security, and expand frontiers of scientific research. These achievements share a common genesis: Education. NASA will continue the tradition of investing in education and supporting educators who play a key role in preparing, inspiring, exciting, encouraging, and nurturing the youth who will manage and lead the laboratories and research centers of tomorrow. NASA will pursue three major goals: 1) Strengthen the Nation's future workforce--NASA will identify and develop the critical skills and capabilities needed to achieve the Vision for Space Exploration. To meet this demand, NASA will contribute to the development of the Nation's science, technology, engineering, and mathematics (STEM) workforce through a diverse portfolio of education initiatives for America's students at all levels, especially those in traditionally underserved and underrepresented communities. 2) Attract students and retain them in STEM disciplines--To compete effectively for the minds, imaginations and career ambitions of America's young people, NASA will focus on engaging and retaining students in STEM education and encourage pursuit of educational disciplines critical to the NASA engineering, scientific, and technical missions. 3) Engage Americans in NASA's mission--NASA will build strategic partnerships and linkages between STEM formal and informal education providers. Through hands-on, interactive, educational activities, NASA will engage students, educators, families, the general public, and all Agency stakeholders to increase Americans' science and technology literacy. As the United States begins the second century of flight, NASA will maintain its commitment to excellence in STEM education to ensure the next generation of Americans accept the full measure of their role and responsibility for shaping the future.

Mission Directorate:	Cross-Agency Support Programs
Theme:	Education Theme
Program:	Education

Program Relevance

The Education Program supports NASA Strategic Plan Outcomes ED-1, ED-2, & ED-3.

Higher Education (HE) & Minority Undergraduate Research and Education Project (MUREP) investments are mapped directly to NASA Education Outcomes ED-1 and ED-2 through the "employ" and "educate" categories of involvement and make contributions to the "engage" involvement category. The project will develop the necessary interfaces and strategies with other projects to ensure effective continuity and contribution to the performance measures.

The Elementary and Secondary (E&S) Education Project investments map to NASA Strategic Plan Outcome ED-2 via efforts that use content, people, or facilities. These efforts address the "engage" and "educate" categories of the Education Framework. The E&S Project, in conjunction with the other major NASA Education programs, tries to "push and pull" students through the STEM pipeline.

The NASA E-Education Project serves a cross-cutting function across the other four Education projects and effectively addresses all four levels of involvement. Serving to provide guidance and continuity across the E-Education Project is a roadmap and research strategy. This roadmap and strategy is intended to embrace other interested NASA and external entities into this effort and are allowed to contribute to key E-Education research questions.

The Informal Education Project's investments map to NASA Strategic Plan Education Outcome ED-3 via efforts that use NASA content, people, or facilities. Informal Education supports the "inspire" and "engage" categories of the Education Framework.

Plans For FY 2008

The Education Program will use re-aligned and restructured projects to focus and accelerate products and services to meet NASA Strategic Goals ED-1, ED-2, & ED-3.

The Higher Education and MUREP Projects will continue to facilitate these efforts through competitive NASA Research Announcements (NRA), Cooperative Agreement Notices (CANs), and other procurement vehicles, and multi-year grants awarded to institutions, faculty, and students in Agency-relevant research. These projects will continue to focus on strengthening the academic and research infrastructure of Minority Institutions (MI) and attracting and preparing students in STEM disciplines, and support their completion of undergraduate and graduate degrees with the ultimate goal of providing access to careers in NASA and the Nation's scientific and technical workforce.

NASA Elementary and Secondary Education Project will continue to implement a systemic restructuring of budgets to realize efficiencies, cost savings and reallocation. A business model that includes cost-sharing, sunrise-sunset provisions to funded projects, and insertion of standard processes, tools, and reporting will continue to be implemented. The realignment of projects to the Centers beginning late FY 2006 will necessitate adjustments to management processes and interface mechanisms throughout FY 2007 and FY 2008.

The E-Education Project will sustain the following efforts in FY 2008: implementation of studies to address key E-Education research questions & technical requirements and the chronology of the R&D roadmap for the next 3-5 years; pursue partnerships; leverage technology infrastructures to deliver exploration related content; implement a meta-tagging process for the Education Program to enhance access to NASA multi-media content; identify assessment results that prove benefit to targeted audiences.

The Informal Education Project will focus on its priority initiative, NASA Explorer Institutes (NEI). Four categories of NEI projects will be considered for funding in FY 2008 including: Professional Development Workshop Opportunities; STEM Teaching Tools and Products; Infrastructure Development Projects; and Partnerships for Sustainability.

Mission Directorate:	Cross-Agency Support Programs
Theme:	Education Theme
Program:	Education

Project Descriptions

There are 5 projects in the Education Program:

Higher Education Project focuses on supporting institutions of higher education in strengthening their research capabilities and providing opportunities that attract and prepare increasing numbers of students for NASA-related careers. The research conducted by the institutions will contribute to the research needs of NASA's Mission Directorates. The student projects serve as a major link in the student pipeline helping to "build, sustain, and effectively deploy the skilled, knowledgeable, diverse, and high performing workforce needed to meet the current and emerging needs of government and its citizens."

Minority University Research and Education Project engages under-represented populations through a wide variety of initiatives. Multi-year grants are awarded to engage minority institutions, faculty and students in research pertinent to NASA missions. The project focuses on retaining underrepresented and underserved students in a STEM discipline through completion of undergraduate or graduate degrees and entry into the scientific and technical workforce.

Elementary and Secondary Education Project provides K-12 educators with tools, experiences, and opportunities to further their education and participate in unique NASA learning experiences to enhance their knowledge of STEM and inspire pursuit of STEM careers. The project supports the role of educational institutions, which provide the framework to unite students, families, and educators for educational improvement.

The E-Education Project sustains the research and development of technology applications, products, services and implementation of technology-enriched infrastructure in facilitating the appropriate and effective technology-based applications to enhance the educational process for formal and informal education.

Informal Education Project intends to increase learning, to educate students, educators and the general public on specific science, technology, engineering or math (STEM) content areas, and to expand the nation's future STEM workforce. The project provides supplemental educational materials/handouts that are standards based, support staff/facilitators, trained or qualified in STEM/education fields, actively working with participants to further enhance their understanding, and develop content based on educational standards and/or learning objectives to supplement and enrich an experience, visual, or activity.

Mission Directorate:	Cross-Agency Support Programs
Theme:	Education Theme
Program:	Education

Higher Education Project

The Higher Education Project has the following four subprojects:

The Experimental Program to Stimulate Competitive Research (EPSCOR) effort aims to strengthen the long-term self sustainability of academic research enterprises by supporting states with modest research infrastructure to become more competitive in attracting research funding. Funding is awarded to lead academic institutions in 25 jurisdictions to foster a STEM relationship with NASA and industry for research and development opportunities.

Space Grant, a national network of colleges and universities, works to expand opportunities for students and faculty to understand and participate in NASA's aeronautics and space programs by supporting and enhancing engineering and science education, research, and workforce development and informal education through student scholarships, graduate fellowships, and hands-on experiences at NASA Centers and academic institutions.

The Undergraduate Student Researchers Project (USRP) attracts undergraduate students from the widest array of backgrounds, who are fully representative of America's racial, ethnic, and cultural diversity; and provides them with hands-on, challenging research experiences that stimulate continued student interest in the fields/disciplines aligned with NASA's Mission.

The Graduate Student Researchers Project (GSRP) cultivates research ties to the academic community to help meet the continuing needs of the Nation's aeronautics and space effort by increasing the number of highly trained scientists and engineers in aeronautics and space-related disciplines, and broadening the base of students pursuing advanced degrees in science, mathematics, and engineering. NASA awards fellowships for graduate study leading to masters or doctoral degrees in the fields of science, mathematics, and engineering related to NASA research and development.

Minority University Research & Education Project (MUREP)

MUREP subprojects address the following federal mandates: Executive Orders 13256, 13230, and 13270.

University Research Centers (URCs) provide a broad-based, competitive NASA-related research capability among the Nation's Minority Institutions (MI) that foster new aerospace science and technology concepts; expand the Nation's base for aerospace research and development; develop mechanisms for increased participation by faculty and students in mainstream research; and increase the production of US citizens who have historically been underrepresented and in obtaining advanced degrees in STEM disciplines.

Tribal Colleges & Universities (TCUs) increase student and faculty involvement in the excitement of space exploration and cutting-edge technologies. Partnerships with NASA enhance the capacity of TCUs to compete for federal grants and other resources, and provides high-quality educational opportunities to Native American students and faculty.

Motivating Undergraduates in Science & Technology (MUST) provides one-year scholarships and internships at a NASA center to rising freshmen, sophomores, juniors, or transfer students. Open to all eligible students, the overall purpose is to provide outreach to underrepresented and underserved US citizens, enrolled in STEM disciplines.

Curriculum Improvement Partnership Award for Integration of Research (CIPAIR) is a workforce development three-year undergraduate curriculum improvement effort to strengthen the educational experience by integrating cutting-edge NASA-related research into the undergraduate STEM curriculum and to strengthen teaching and research strategies and collaboration across academic programs.

NASA Science & Technology Institute - Minority Institutions (NSTI-MI) is a joint venture which brings together the expertise of MIs and the NASA centers to provide research opportunities and improve transfer of information, ideas, and technology.

Jenkins Postdoctoral Fellowship Project (JPFP) provides support for underrepresented and underserved students in STEM disciplines, including women, minorities, and those with disabilities who seek advanced degrees and opportunities for NASA-related research.

Faculty Awards for Research (FAR) provides faculty at MIs with an opportunity early in their academic careers, to integrate the research & education components with unique mission requirements of NASA centers.

The NASA Administrator's Fellowship Project (NAFP) seeks to increase the ability of MIs to respond to NASA's overall research and development mission. NASA employees spend a year as visiting faculty/administrators at MIs and members of MI STEM faculty spend a year conducting research at a NASA center.

Small Projects support opportunities for students, teachers, faculty, and researchers in NASA related STEM fields.

Mission Directorate:	Cross-Agency Support Programs
Theme:	Education Theme
Program:	Education

Elementary & Secondary (E&S) Education Project

E&S Education Project integrates new components with existing NASA assets into a structure that supports local education efforts to encourage student involvement in STEM. There are six subprojects:

Interdisciplinary National Science Program Incorporating Research & Education (INSPIRE) effort is intended to become a multi-tiered pipeline program designed to bridge students' STEM education experiences for pre-college and post-secondary students.

NASA Explorer Schools (NES) establishes a three-year partnership between NASA and school teams, consisting of teachers and education administrators from diverse communities across the country. The project is designed for education communities at the fourth through nineth grade levels.

Science Engineering, Mathematics & Aerospace Academy (SEMAA) is a national project designed specifically to reach K-12 minority students that are traditionally underrepresented in careers involving STEM. Students meet during school, after school or on Saturday mornings, and during the summer to engage in hands-on, interactive learning sessions that are specifically designed for each grade level.

Aerospace Education Services Project (AESP) is a professional development program that serves the elementary and secondary education community by providing classroom demonstrations, faculty workshops, parent training, in-service training for teachers, and identification of appropriate classroom resources.

Education Flight Projects provide opportunities for K-12 students to gain hands-on experience as payload investigators using NASA flight platforms such as the Space Shuttle, the International Space Station (ISS), sounding rockets, and scientific balloons.

E-Education Project

E-Education has the following four sub-projects:

NASA Learning Technologies (NLT) develops and refines leading-edge or cutting-edge technologies that are in use within NASA missions and/or projects to enhance the teaching and learning of scientific concepts. Technologies funded under NTP are incubated and developed, evaluated, and leveraged with strategic partners to extend reach into educational and commercial applications.

Classroom of the Future (COTF) conducts empirical educational research then develops and tests off-the-shelf and new or evolving educational technologies that incorporate research findings on cognition and effective application of technology to educational settings. The educational technologies tested and/or developed use NASA research, datasets, or subject

NASA Educational Technology Services (NETS) support the publishing and is responsible for maintaining the educational content on the NASA Portal and managing the operation of the Office of Education Web site and other electronic-based dissemination networks. Additional Web support is provided in the identification and linkage of multimedia resources to support the education video file (education programming) on the NASA TV Public Services channel and NASA TV Education Services channel.

E-Education Small Projects develop infrastructure and deploy research-based technology applications, products, and services to enhance the educational process for formal and informal education. An emphasis is implementation of educational product development, review, and metatagging processes and final distribution through approved media, electronic, and/or site-based channels.

Informal Education Project

NASA's Office of Education, Office of Public Affairs, Mission Directorates, and the Centers all work together to develop partnerships and activities that enhance the capabilities of Informal Education community to inspire the next generation of explorers by providing access to NASA staff, research, technology, information, and facilities. Informal Education activities are on-going and are structured to leverage targets of opportunity.

The Informal Education project currently has one subproject, the NASA Explorer Institutes (NEI). The goal of the NASA Explorer Institutes effort is to encourage and support activities that do the following: improve public understanding and appreciation of STEM disciplines to enhance their scientific and technological literacy, mathematical competence, problem-solving skills, and desire to learn; establish linkages that promote new relationships between providers of informal and formal education resulting in improved and creative STEM education in all learning environments; excite youth, particularly those who are underrepresented and underserved about STEM disciplines; expand STEM informal education programs and activities to communities/locations that have been traditionally underserved by such opportunities; stimulate parents and others to support their children's learning endeavors in formal and informal settings and become informed proponents for high-quality, universally available STEM education in the home and elsewhere; and encourage and implement innovative strategies that support development of a socially responsible and informed public who can make responsible decisions about STEM policy issues affecting their everyday lives.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Enable eligible jurisdictions to compete successfully for NASA research & technology opportunities	Experimental Project to Stimulate Competitive Research (EPSCoR)	$10.0M	$10.0M
Promote a network of state-based consortia to promote NASA's interests throughout the country	National Space Grant College and Fellowship Project (Space Grant)	$28.8M	$29.0M
Place undergraduate students at NASA centers for 10-week internship or 15-week semester internship	Undergraduate Student Research Project (USRP)	$3.7M	$3.7M
Support graduate students pursuing master or doctoral degrees in disciplines relevant to NASA	Graduate Student Researchers Project (GSRP)	$8.7M	$7.0M
Achieve broad-based competitive aerospace research capability among the Nation's minority instit.	University Research Centers (URCs)	$18.2M	$14.7M
Produce leadership for building capacity at MIs and prepare students to compete in STEM workforce	NASA Science and Technology Institute for Minority Institutions (NSTI-MI)	$1.2M	$1.1M
Respond to need of 2 & 4 year minority institutions to strengthen STEM curricula related to NASA	Curriculum Improvement Partnership Award for Integration of Research (CIPAIR)	$2.5M	$2.5M
Enhance professional development of NASA employees and STEM faculty of minority service institutions	NASA Administrator's Fellowship Project (NAFP)	$2.5M	$2.5M
Train students with disabilities and underrepresented/underserved 6-16 students through MSI	Small Projects	$0.2M	$1.5M
Create opportunity for minority, women, & individuals with disabilities to pursue graduate education	Harriet G. Jenkins Predoctoral Fellowship Project (JPFP)	$2.6M	$2.6M
Enhance the education infrastructure at the Nation's 35 Tribal Colleges and Universities	Tribal Colleges (TCUs)	$1.9M	$1.7M
Plan for 100 undergraduates across nine centers and JPL	Motivating Undergraduates in Science & Technology (MUST)	$0.0	$1.9M
Provide faculty of minority institutions opportunity to engage in research pertinent to NASA mission	Faculty Awards for Research (FAR)	$1.8M	$4.4M
Technical direction for 24 SEMAA sites, host student tours/presentations, and national conference	Science, Engineering, Mathematics & Aerospace Academy (SEMAA)	$4.2M	$4.0M

Nationwide infrastructure for customized professional development	Aerospace Education Services Project (AESP)	$6.3M	$5.3M
National education efforts tied to space exploration activities	NASA Educator Astronaut (NEA)	$2.9M	$2.7M
STEM pathways for eligible U.S. citizens with emphasis on underrepresented & underserved groups	Interdisciplinary National Science Project Incorporating Research & Education Experience (INSPIRE)	$3.9M	$3.7M
Adjustment of management processes and interface mechanisms to complete project realignment effort	Education Flight Projects	$2.0M	$1.1M
Serve schools in every state and add up to 50 new teams	NASA Explorer Schools (NES)	$14.1M	$12.3M
Advance technologies that support well-educated and highly skilled workforce	NASA Learning Technologies (NLT)	$2.9M	$1.9M
Implement additional options for accessing Web-based learning services from the Education Portal	NASA Educational Technology Services (NETS)	$1.9M	$1.4M
Finalize tasks to extend reach of NASA education products and delivery to targeted NASA staff	E-Education Small Projects	$1.7M	$0.6M
Evaluate new technologies available commercially for applications in educational environments	NASA-sponsored Classroom of the Future (COTF)	$2.0M	$2.1M
Partnerships/alliances for students/citizens to become participants in NASA R&T and Space Exploratio	NASA Explorer Institutes (NEI)	$2.4M	$1.7M

Mission Directorate:	Cross-Agency Support Programs
Theme:	Education Theme
Program:	Education

Program Management

Program Management is the responsibility of the Assistant Administrator for Education and is conducted in accordance with NASA policies and procedures.

Project	Oversight	Lead Performer	Partners
Higher Education Project	NASA HQ Office of Education	NASA HQ, NASA Centers, External Grant Awardees	Fifty-two university-based Space Grant Consortia in all 50 states, Puerto Rico and District of Columbia require 100 percent matching funds on non-fellowship awards. Twenty-five selected juristictions and a total of seven federal agencies.
Minority University Research and Education Project	NASA HQ Office of Education	NASA Centers, External Grant Awardees	
Elementary & Secondary Education Project	NASA HQ Office of Education	NASA Centers, NASSMC, NSTA, U.S. Space & Rocket Cntr, OSU, STEM Stakeholders, External Grant Awardee	Educational organizations and institutions provide professional development opportunities and in-kind contributions to NES schools; OSU; Network of Educator Astronaut Teachers, AOL, Univ CA-San Diego, AMSAT, ARISS International Team
E-Education Project	NASA HQ Office of Education	NASA Centers, External Grant Awardees, UNITeS Contract	NSF, Dept. of Education, DoD, Dept. of Energy, Office Max, Lorain, County Joint Vocational School
Informal Education Project	NASA HQ Office of Education	JPL, NASA Centers, external grant awardee	Arizona State University and ArtReach International, AMES-The Navajo Nation; National Park Service, University of California -Berkeley, and Ideum, GSFC; College of Charleston, S.C., U.S. Space and Rocket Center, Ala.; Girl Scouts U.S.A.; Houston Museum of Natural Science, Rice University and Starlight Productions, JSC; Denver Museum of Nature and Science; Morehead Planetarium and Science Center; University of Alabama-Huntsville, National Association of Rocketry, and 4-H; Lunar Planetary Institute, Texas, Haltom City Public Library, Texas, and Librarians from Pennsylvania, Delaware and Maryland; and American Musueum of National History, Over 200 Museums.

Acquisition Strategy

The Education Program will continue to facilitate its programs and projects through competitive NASA research announcements, cooperative agreement notices and other procurement vehicles, and multi-year competitive grant awards to institutions, faculty and students in Agency-relevant research.

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Affiliation Risk	The primary risk is loss of affiliation with students, teachers, faculty, education administrators, and institutions at all educational levels resulting in an inability to meet NASA and the Nation's future workforce needs in scientific and technical disciplines.	Education Program will monitor and mitigate program & project risks through continual evaluation of program & project performance and relevance, adjusting the portfolio to ensure an appropriate mix.

Mission Directorate:	Cross-Agency Support Programs
Theme:	Advanced Business Systems (IEMP)

Theme Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Advanced Business Systems (IEMP)	156.3	97.4	103.1	69.4	71.6	67.6	67.5
Integrated Enterprise Management Program	156.3	97.4	103.1	69.4	71.6	67.6	67.5

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Theme Changes

	FY 2008		
Advanced Business Systems (IEMP)	FY 2007 PB Request	FY 2008 PB Request	Change
Integrated Enterprise Management Program	**106.9**	**103.1**	**-3.8**
-Content reduction to redirect funds to address higher priority NASA mission requirements. *-Full cost simplification.*			

Theme Purpose

Within NASA's Strategic Plan, this Theme is aligned with NASA's Cross Cutting Management Strategies, hence, supports multiple NASA Goals and Sub-goals. NASA's vision for integrated financial management pairs information with accountability and links the Agency's financial, programmatic, and institutional communities for mission success. Therefore, NASA will develop a culture that integrates financial decision-making with scientific and technical leadership by providing Agency leaders with timely, accurate, and useful information about where initiatives are and are not succeeding. To achieve this objective, NASA is continuing to implement Agency-wide initiatives to improve the Agency's financial, procurement, asset management and human capital performance.

Theme Overview

Advanced Business Systems (IEMP) was established in FY 2006 to reflect the implementation of Agency-wide business systems as a direct program.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

NASA is consolidating all Agency-wide Advanced Business Systems implementation activities under one Theme to ensure integration of disparate systems in order to improve efficiencies, reduce redundant systems, and improve business information available to the program/project management community and mission support organizations

Relevance to the NASA Mission:

Advanced Business Systems supports NASA's Mission by achieving management and institutional excellence comparable to NASA's technical excellence through improvements to the financial, physical, and human resources management processes throughout the Agency.

Relevance to education and public benefits:

Integrated business systems will result in improved financial management of appropriated funds and financial confidence in NASA from the taxpayers.

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
Strategic Goal	**Supports Multiple Agency Goals**	
Outcome IEM-1	**By 2009, implement Agency business systems that provide timely, consistent and reliable business information for management decisions.**	
APG 8IEM01	Implement the Property, Plant and Equipment (PP&E) module of the Integrated Asset Management Project to provide integration between functional and financial processes for accountable personal property.	Integrated Enterprise Management Program
APG 8IEM02	Implement the Human Capital Information Environment to strategically plan and manage NASA's Human Capital resulting in the elimination of redundant systems and integrating the remaining Human Capital processes and systems.	Integrated Enterprise Management Program
APG 8IEM03	Implement Phase 2 of the Aircraft Management Module, including the Aircraft Logistics System, Aircraft Financial System Interface to NASA's Core Financial system and the Maintenance Management module to ensure safety of ground and flight operations and improve visibility into aircraft operations processes.	Integrated Enterprise Management Program
Outcome IEM-2	**By 2009, increase efficiency by implementing new business systems and reengineering Agency business processes.**	
APG 8IEM04	Reduce the number of quarterly corrective adjustments to financial statements from the 2006 baseline of 5948 steps to the 2008 goal of 3345 steps (a 44 percent reduction).	Integrated Enterprise Management Program
APG 8IEM05	Increase percentage of total travel booking completed on-line, from the 2006 baseline of 1.8 percent to the 2008 goal of 50 percent.	Integrated Enterprise Management Program

Quality

Performance Measure #	Description
Advanced Business Systems (IEMP) Theme	
APG 8IEM06	Complete all development projects within 110% of the cost and schedule baseline.
APG 8IEM07	Reduce the number of financial processing steps/time to perform year end closing from the 2005 baseline of 120 steps to the 2008 goal of 20 steps (an 83% reduction).

Program Assessment Rating Tool (PART):

The Integrated Enterprise Management Program received a FY 2006 PART rating of "Moderately Effective." The rating reflects that the program addresses clear and existing needs of the Agency. The implementation of business systems across NASA allows timely access to standardized, agency-wide data. The program had achieved progress towards long-term goals but has remaining work. For example, at the time of the review, the program had implemented several software modules to improve financial management but the software did not provide adequate functionality, specifically in regards to compliance with the Federal Financial Management Improvement Act. Also, in 2006, NASA had yet to formulate a complete, concrete, and realistic plan for a clean audit.

As a result of this assessment, several performance improvement actions have been agreed on by IEMP:
1) Complete the upgrade of the financial management software to improve compliance with the Federal Financial Management Improvement Act.
2) Support the Office of the Chief Financial Officer in obtaining a clean audit.
3) Clarify and prioritizing requirements for future systems that allow access to timely, standardized and Agency-wide data.

Since the review, the upgrade to NASA's core financial system was put into production at the end of FY 2006, and was in full use by mid-November. In FY 2007, IEMP will work with the OCFO to assess and ensure NASA's compliance with the Federal Financial Management Improvement Act. Further, IEMP will work with OCFO to identify areas where IEMP can make system improvements to assist with trouble areas as identified by the auditors.

To continue to serve the needs of the Agency and to best prioritize the investment to meet those needs, IEMP has formed the Management/Business Systems Integration Group. The work of this group will continue into FY 2007.

Mission Directorate:	Cross-Agency Support Programs
Theme:	Advanced Business Systems (IEMP)
Program:	Integrated Enterprise Management Program

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Integrated Enterprise Management Program	156.3	97.4	103.1	69.4	71.6	67.6	67.5

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Integrated Enterprise Management Program	**106.9**	**103.1**	**-3.8**
-Content reduction to redirect funds to address higher priority NASA mission requirements. *-Full cost simplification.*			

Program Overview

The Integrated Enterprise Management Program (IEMP) is an important Agency initiative that is changing the way financial, physical, and business management is performed throughout NASA. Center- and/or Mission Directorate-unique approaches are being replaced with a single set of standard integrated business processes. Each and every NASA employee will be impacted by these changes. New IEMP systems are improving business processes by minimizing data redundancy, standardizing information and electronic data exchanges, processing and recording financial events effectively and efficiently, and ensuring consistent information throughout the Agency. IEMP consists of projects that effect business process changes through the acquisition and implementation of information technology tools.

Program Relevance

The Integrated Enterprise Management Program will ensure integration of disparate systems in order to improve efficiencies, reduce redundant systems, and improve business information available to the program/project management community and mission support organizations.

Plans For FY 2008

-Complete the Human Capital Information Environment (HCIE) full operational capability at all Centers by the end of FY08.

-Complete the Integrated Asset Management (IAM) Property, Plant and Equipment (PP&E) Module implementation at all Centers in early FY08.

-Continue the Aircraft Management Module (AMM) Phase 2 implementation.

Mission Directorate:	Cross-Agency Support Programs
Theme:	Advanced Business Systems (IEMP)
Program:	Integrated Enterprise Management Program

Project Descriptions

The Integrated Enterprise Management Program is a multi-year, Agency-wide effort to transform NASA's business and financial systems and processes through the implementation of "best of class" software solutions. The goal of IEMP is to implement systems to improve the management and accountability of NASA's financial, procurement, human resources, and asset management areas. In addition to current development projects listed below, the following projects have been completed and are being operated by IEMP: Resume Management, Position Description, Travel Management, Core Financials, Program Management Information Improvement, Agency Labor Distribution, Recruitment One Stop, E-Payroll, Webtads, SAP Version Update, and Contract Management Module (CMM).

Aircraft Management Module

The Aircraft Management Module will extend the existing system used at Johnson Space Center to other NASA Centers, providing standard Agency processes, data, and reporting of aircraft, flight and flight crew information, and general aircraft operations.

Integrated Asset Management

The Asset Management Project will extend NASA's use of its SAP software to support life cycle visibility, tracking, control, and capitalization of plant, property and equipment.

Human Capital Information Environment

The Human Capital Information Environment will integrate NASA's Human Capital data, providing a single location for employees and managers to access human capital information.

Mission Directorate:	Cross-Agency Support Programs
Theme:	Advanced Business Systems (IEMP)
Program:	Integrated Enterprise Management Program

Implementation Schedule

Project	Schedule by Fiscal Year (Prior, 06–20)	Phase	Beg	End	Milestone
Contract Management Module		Tech			
		Form	Apr-04	Nov-04	
		Dev	Dec-04	Nov-06	
		Ops	Nov-06	Mar-07	
		Res			
Aircraft Management Module Phase 1		Tech			
		Form	Aug-05	Sep-06	
		Dev	Sep-06	Mar-07	
		Ops	Apr-07	Jun-07	
		Res			
Aircraft Management Module Phase 2		Tech			
		Form	Oct-06	Mar-07	
		Dev	Mar-07	Apr-09	
		Ops	Apr-09	Jun-09	
		Res			
Integrated Asset Management Property, Plant & Equipment Module		Tech			
		Form	Jul-06	Feb-07	
		Dev	Feb-07	Oct-07	
		Ops	Oct-07	Dec-07	
		Res			
SAP Version Update (SVU)		Tech			
		Form	Nov-05	Mar-06	
		Dev	Mar-06	Nov-06	
		Ops	Nov-06	Mar-07	
		Res			
Human Capital Information Environment - IOC		Tech			
		Form	May-06	Jan-07	
		Dev	Jan-07	Jul-07	
		Ops	Jul-07	Nov-07	
		Res			
Human Capital Information Environment - FOC		Tech			
		Form	Apr-07	Oct-07	
		Dev	Oct-07	Apr-08	
		Ops	Apr-08	Sep-08	
		Res			

- Tech & Adv Concepts (Tech)
- Formulation (Form)
- Development (Dev)
- Operations (Ops)
- Research (Res)
- Represents a period of no activity for the Project

Program Management

IEMP Projects are managed at Marshall Space Flight Center, Johnson Space Center, and the NASA Shared Services Center.

Project	Oversight	Lead Performer	Partners
SAP Version Update	Headquarters Program Office	Marshall Space Flight Center	All Centers
Integrated Asset Management Property, Plant and Equipment Module	Headquarters Program Office	Marshall Space Flight Center	All Centers
Human Capital Information Environment	Headquarters Program Office	NASA Shared Services Center	All Centers
Aircraft Management Module (AMM)	Headquarters Program Office	Johnson Space Flight Center	ARC, DFRC, GRC, GSFC, KSC, LaRC, and MSFC

Acquisition Strategy

No major acquisitions are planned for FY 2008.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	Center Systems Mgt. Office	06/2006	Independent Standing Review Board formed by the Program Director in mid FY06. This team attends and prepares assessments of major project milestone review materials and completion of review entry and exit criteria.	01/2007
Quality	Fairmont IV&V Facility	09/2006	Independent Assessment by a third party contractor is in place on the program. Independent Assessment Team has been assigned by the Program to review all project requirements for completeness and testability, and to verify that requirements traceability into the project test effort is clear and complete.	02/2007
Performance	IPAO	03/2006	The Program Implementation Review assesses continued consistency with baseline commitments (performance, safety, cost, risk, and schedule) and strategic alignment, as defined in a Program Commitment Agreement (PCA) and program plan. The results of this review are reported to the Agency Program Management Council.	03/2008
Performance	Center Systems Mgt. Office	N/A	A Non-Advocate Review (NAR) is an independent assessment of projects conducted at the end of NPR 7120.5's formulation phase. It provides Agency management with an assessment of the readiness of the project to proceed into the implementation phase. Upon successful completion of this review process, a recommended project baseline is established.	N/A

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Concept of Operations	Lack of an Agency Concept of Operations for NASA's business environment may result in the implementation of requirements that are not optimally integrated or prioritized.	1) Conduct Data Gap Analysis to identify a more complete business requirements set; 2) Utilize a cross-organization group to help prioritize and validate requirements; and 3) Develop a Concept of Operations based on the complete requirements set. 4) Develop a prioritization roadmap for achieving the desired operations state.
Human Capital Information Environment	Implementation of the current Human Capital Information Environment (HCIE) requirements scope may exceed available budget, resulting in delays in project implementation and/or reduction in scope that could impact benefits expected.	IEMP will perform additional analysis of the requirements set, clearly defining additional categories related to cost, complexity to develop and implement, Agency need, regulatory requirements, and employee needs. Each requirement will be reviewed against these categories, and prioritized accordingly.
Integrated Asset Management (IAM)	Adaptation of the Department of Energy's (DOE's) asset management solution for NASA may not be possible due to the high level of customization. This may result in unexpected development, costs, and schedule delays to NASA's IAM implementation.	1) Work with DOE to determine which components, if any, can be utilized as a part of the NASA asset management solution; and 2) Investigate alternative methods for developing IAM components that will mitigate impacts to cost and schedule.
SAP Version Update and Contract Management Module	If training deployment and plans are not property executed, then acceptance and use of the upgraded financial system and new contract management module may be inefficient and could result in process and data integrity issues.	1) Engage key stakeholders at Centers to require attendance at training events; 2) Conduct training overview briefings to ensure stakeholders and end users are aware of training events, and communicate training information Agency wide; and 3) Task the Center Implementation Teams to identify end-users who must have training sooner in the training schedule.

Theme Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Innovative Partnerships Program	214.8	215.1	198.1	197.2	199.8	200.0	200.0
Innovative Partnerships Program	214.8	215.1	198.1	197.2	199.8	200.0	200.0

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Theme Changes

	FY 2008		
Innovative Partnerships Program	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Innovative Partnerships Program	**205.5**	**198.1**	**-7.4**
- Centennial Challenges transferred from ESMD to IPP. *- Red Planet Capital eliminated by Administration policy and funds redirected toward higher Agency priorities.* *- Full cost simplification.*			

Theme Purpose

NASA's Innovative Partnerships Program (IPP) is focused on adding value to NASA through partnerships. The mission of IPP is to provide leveraged technology and capabilities for NASA's mission directorates, programs, and projects through joint partnerships with industry academia, other government agencies, and national laboratories.

In this pursuit, the Innovative Partnership Program supports multiple Strategic Goals and Sub-goals in the 2006 NASA Strategic Plan.

Theme Overview

Innovative Partnerships Program (IPP) provides leveraged technology investments, dual-use technology-related partnerships, and technology solutions for NASA. In addition, IPP enables cost avoidance and accelerates technology maturation. IPP consists of the following program elements: Technology Infusion which includes the Small Business Innovative Research (SBIR)/Small Business Technology Transfer(STTR) Programs and the IPP Seed Fund; Innovation Incubator which includes Centennial Challenges and new efforts to encourage partnerships and facilitate purchasing services from the emerging commercial space sector; and Partnership Development which includes Intellectual Property management, Technology Transfer (T2), and new innovative partnerships. Together these program elements increase NASA's connection to emerging technologies in the external communities, enable targeted positioning of NASA's technology portfolio in selected areas, and secure NASA's intellectual property to provide fair access and to support NASA's strategic goals. Dual-use partnerships and licensing also create socio-economic benefits within the broader community.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

IPP facilitates transfer of technology out of NASA for commercial or other socio-economic benefit to the Nation. In addition, IPP provides protection of the government's rights in NASA's inventions, as mandated by legislation. IPP implements NASA's SBIR and STTR programs in accordance with the primary objective of providing the high-technology small business sector with an opportunity to develop technology for NASA.

Relevance to the NASA Mission:

IPP provides technology alternatives for NASA programs and projects through technology development and joint partnerships with industry, academia, federal agencies, and labs. By broadening NASA's connection to emerging technologies, IPP provides a greater range of technological solutions for programs. IPP has also established a Seed Fund to contribute to the development of technology to support NASA programs and priorities at the Centers. This effort will benefit multiple Mission Directorates.

Relevance to education and public benefits:

A key function of IPP is the transfer of scientific knowledge through intellectual property and technology licensing, resulting in public benefit through commercial application. IPP invites and facilitates partnerships with companies of all sizes from many sectors, as well as by academic research institutions and other entities nationwide. Many of our innovative partnerships, such as Centennial Challenges, provide educational benefits and excite the public.

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
Strategic Goal	**Supports Multiple Agency Goals**	
Outcome IPP-1	**Promote and develop innovative technology partnerships among NASA, U.S. industry, and other sectors for the benefit of Agency programs and projects.**	
APG 8IPP01	Develop 20 technology-related significant partnerships that create value for NASA's programs and projects. Track both quantitative dollar value and qualitative benefits to NASA (e.g., reduced volume or mass, improved safety).	Innovative Partnerships Program
APG 8IPP02	Complete 50 technology transfer agreements with the commercial and academic community through mechanisms like licenses, software use agreements, facility use agreements, and Space Act Agreements.	Innovative Partnerships Program
APG 8IPP03	Fully implement an annual portfolio licensing approach that targets licensing goals of greatest value/benefit to NASA. Examples include licensing royalties and new technology products available to NASA. Royalties should be $4 million per year or greater.	Innovative Partnerships Program
APG 8IPP04	Complete and institutionalize an enhanced Intellectual Property (IP) management process that enables stronger use of NASA's IP to support NASA's strategies. Implement such IP management together with at least two significant NASA programs or projects.	Innovative Partnerships Program
Strategic Goal 5	**Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.**	
Outcome 5.1	**Develop and demonstrate a means for NASA to purchase launch services from emerging launch providers.**	
APG 8IPP05	Demonstrate purchase of services from the emerging commercial space sector for microgravity research and training.	Innovative Partnerships Program
Outcome 5.3	**By 2012, complete one or more prize competitions for independently designed, developed, launched, and operated missions related to space science or space exploration.**	
APG 8IPP06	Demonstrate benefits of prize competitions by awarding at least one prize and communicating the resulting technology advancements.	Innovative Partnerships Program

Performance Achievement Highlights

Innovative Partnerships Program

In FY 2008, IPP plans to promote and develop innovative technology partnerships between NASA, U.S. industry, and other sectors for the benefit of NASA programs and projects. IPP will also encourage the pursuit of appropriate partnerships with the emerging commercial space sector. Specifically, IPP will develop at least 20 technology-related significant partnerships that create value for NASA programs and projects; complete at least 50 technology transfer agreements with the commercial and academic community through licensing, software use agreements, facility use agreements, and Space Act Agreements; implement a portfolio licensing approach that targets licensing goals of greatest value/benefit to NASA; and complete as well as institutionalize an enhanced Intellectual Property (IP) management process. IPP also plans to develop and demonstrate a means for NASA to purchase services from emerging parabolic aircraft flight and suborbital launch providers for microgravity research and training. Finally, IPP will continue prize competitions, awarding one or more prizes to further encourage partnerships with innovative technology providers including the emerging commercial space sector.

Quality

Program Assessment Rating Tool (PART):

OMB has not yet conducted a PART review of the Innovative Partnerships Program Theme.

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Quality	NAPA	09/2004	Review of Technology Transfer Program; completed 4th QTR FY 2004.	09/2007
Performance	National Research Council	09/2006	Review of SBIR/STTR Program. Review currently in Phase II of a 2-phase study; each study phase to be completed within a 3-year period. Phase I results are available. Phase II planned to be completed in FY 2008.	09/2008
Quality	Booz Allen Hamilton	05/2004	Review of Space Product Development; completed 2nd QTR FY 2004.	N/A

Mission Directorate:	Cross-Agency Support Programs
Theme:	Innovative Partnerships Program
Program:	Innovative Partnerships Program

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Innovative Partnerships Program	214.8	215.1	198.1	197.2	199.8	200.0	200.0

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Innovative Partnerships Program	**205.5**	**198.1**	**-7.4**

- Centenial Challenges transferred from ESMD to IPP.
- Red Planet Capital eliminated by Administration policy and funds redirected toward higher Agency priorities.
- Full cost simplification.

Program Overview

IPP's primary mission is to provide leveraged technology and capabilities for Mission Directorate programs and projects through partnerships with industry, academia, government agencies, and national laboratories. Accordingly, IPP integrates the following program elements so that they complement each other to achieve the program's mission objectives: Technology Transfer, Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR), and Centennial Challenges.

Technology Transfer, SBIR/STTR, and Centennial Challenges are based upon leveraging NASA's resources with private or other external resources for the primary purpose of developing new technologies for NASA mission use, with the technologies also having strong potential for commercial application. Therefore, all of IPP's functions primarily serve NASA's mission interests, both in the near term and long term, and with respect to a broad range of technologies and technology readiness levels. Similarly, IPP's functions target and invite a broad spectrum of U.S. industrial and non-profit interests. IPP, by virtue of all of its program elements, provides the opportunity for grass-roots direct involvement, nationwide, in NASA's exploration and other missions.

Mission Directorate:	Cross-Agency Support Programs
Theme:	Innovative Partnerships Program
Program:	Innovative Partnerships Program

Program Relevance

IPP provides technology transfer out of NASA for commercial or other socio-economic benefit to the Nation. In addition, IPP facilitates protection of the government's rights in NASA's inventions, as mandated by legislation. IPP implements NASA's SBIR and STTR programs in accordance with the primary objective of providing the high-technology small business sector with an opportunity to develop technology for NASA. IPP has also established a Seed Fund to contribute to the development of technology to support NASA programs and priorities at the Centers. This effort is expected to benefit multiple Mission Directorates.

IPP provides technology alternatives for NASA programs and projects through dual-use technology development and joint partnerships with industry, academia, federal agencies, and labs. By broadening NASA's connection to emerging technologies, IPP provides increased range of technological solutions for programs and cost savings.

Plans For FY 2008

In FY 2008, IPP plans to promote and develop innovative technology partnerships between NASA, U.S. industry, and other sectors for the benefit of NASA programs and projects. IPP will also encourage the pursuit of appropriate partnerships with the emerging commercial space sector. Specifically, IPP will develop at least 20 technology-related significant partnerships that create value for NASA programs and projects; complete at least 50 technology transfer agreements with the commercial and academic community through licensing, software use agreements, facility use agreements, and Space Act Agreements; implement a portfolio licensing approach that targets licensing goals of greatest value/benefit to NASA; and complete as well as institutionalize an enhanced Intellectual Property (IP) management process. IPP also plans to develop and demonstrate a means for NASA to purchase services from emerging parabolic aircraft flight and suborbital launch providers for microgravity research and training. Finally, IPP will continue prize competitions, awarding one or more prizes to further encourage partnerships with innovative technology providers including the emerging commercial space sector.

Mission Directorate:	Cross-Agency Support Programs
Theme:	Innovative Partnerships Program
Program:	Innovative Partnerships Program

Project Descriptions

IPP consists of the following program elements: Technology Infusion which includes the Small Business Innovative Research (SBIR)/ Small Business Technology Transfer (STTR) Programs and the IPP seed Fund; Innovation Incubator which includes Centennial Challenges and new efforts to facilitate purchasing services from the emerging commercial space sector; and Partnership development which includes Intellectual Property management, Technology Transfer (T2), and new innovative partnerships.

The purposes of the SBIR/STTR programs, as established by law, are to: stimulate technological innovation in the private sector; strengthen the role of small business concerns in meeting federal research and development needs; increase the commercial application of these research results; and encourage participation of socially and economically disadvantaged persons and women-owned small businesses.

Technological innovation is vital to the performance of the NASA Mission and to the Nation's prosperity and security. To be eligibile for selection, a proposal must present an innovation that fulfills one or more NASA needs as described in the 2006 NASA SBIR/STTR Program Solicitation and has significant potential for successful commercialization. Commercialization encompasses the infusion of technology into products and services for NASA Mission programs, other government agencies, and non-government markets.

Small Business Innovative Research (SBIR)

The Small Business Innovation Research (SBIR) Program was established by Congress in 1982 to provide increased opportunities for small businesses to participate in R&D, to increase employment, and to improve U.S. competitiveness. The program's specific objectives are to stimulate U.S. technological innovation, use small businesses to meet federal research and development needs, increase private-sector commercialization of innovations derived from federal R&D, and foster and encourage participation by socially disadvantaged businesses. Legislation enacted in 2000 extended and strengthened the SBIR program and increased its emphasis on pursuing commercial applications of SBIR project results.

The Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs provide an opportunity for small, high technology companies and research institutions (RI) to participate in Government sponsored research and development (R&D) efforts in key technology areas.

The SBIR program is for small businesses with 500 or fewer employees and non-profit RI, such as a university or a research laboratory with ties to an SBC. NASA encourages these organizations to learn more about these programs as a significant source of seed funding for the development of innovations. The SBIR Phase 1 contracts last for 6 months with a maximum funding of $100,000, and Phase 2 contracts last for 24 months with a maximum funding of $600,000. The STTR Phase 1 contracts last for 12 months with a maximum funding of $100,000, and Phase 2 contracts last for 24 months with the maximum contract value of $600,000. Historically, the ratio of the number of Phase 1 proposals to awards for SBIR is 8:1 and for STTR is 5:1. About 40 percent of the completed Phase 1 projects receive funding for Phase 2 development.

Small Technology Transfer Research (STTR)

The Small Business Technology Transfer (STTR) Program awards contracts to small business concerns for cooperative research and development with a non-profit research institution, such as a university. The goal of the STTR Program is to facilitate the transfer of technology developed by a research institute through the entrepreneurship of a small business. The small business and its partnering institution are required to sign an agreement on how intellectual property will be shared between them. Modeled after the SBIR Program, with the same basic requirements and phased funding structure described above, STTR is a separate activity and is separately funded. It differs from SBIR in several important aspects:

STTR is a smaller program. The funding set-aside is 0.30 percent of the extramural research and development budget, approximately one-twentieth of the amount for SBIR. The small company must take the research and intellectual property of the research institution and convert it into a useful product. In comparison to SBIR, twice as much time is allowed for performance of Phase 1. The Phase 2 activity is two years. While the proposal is still submitted by small business concerns, at least 30 percent of the funding and work must originate with the research institution, while only a minimum of 40 percent must come from the small business concerns. Phase 1 STTR projects receive up to $100,000 in funds for a one-year effort. The maximum contract value for STTR Phase 2 is $600,000.

The STTR Program Solicitation research areas correspond to the central underlying technological competencies of each participating NASA Center. The Jet Propulsion Laboratory (JPL) participates in the management of the STTR Program.

Technology Transfer Partnerships (T2)

The T2 program element facilitates the transfer of new or improved technology alternatives into NASA mission planning and use; and as required by law, T2 transfers out of NASA technology for commercial or other benefit to the Nation. In addition, T2 facilitates protection of NASA's intellectual property rights in its inventions, as also mandated by law. The T2 program element encourages participation by all firms, ranging from small to Fortune 500 companies, and particularly targets companies from the non-aerospace (i.e., "non-traditional") sectors that otherwise might not recognize the opportunity to partner with NASA. T2 partnerships often involve state and other federal agencies, academic institutions, and other non-profit entities.

Centennial Challenges

The Centennial Challenges program conducts prize competitions for revolutionary, breakthrough accomplishments that advance the Vision for Space Exploration and other NASA priorities. Some of NASA's most difficult technical challenges may require novel solutions from non-traditional sources of innovations. By making awards based on actual achievements, instead of proposals, NASA is tapping innovators in academia, industry and the public. This effort is modeled on successful past prize competitions, including an 18th century navigation prize, early 20th century aviation prizes, and more recent prizes offered by the US government and in the private sector.

Despite the fact that none of the competitions held to date have resulted in the award of a cash purse to a winning team, the amount of team diversity (representing small and large businesses, high school and university students, and enthusiastic hobbyists and garage mechanics) and the variety of technologies implemented exceeded all expectations.

As the prize purses increase, the amount of participation and level of technical maturity and ingenuity will also increase. In the past competitions with prize purses on the order of $300K each, it is estimated that the 10-15 participating teams represented an investment of $50-100K each. Teams invested on the order of $250-500K each in the competition with the $2M prize purse.

With the FY 2008-2012 funding request of $4M/year for Centennial Challenges, new prize competitions will be initiated to support NASA's science (e.g., the Station-Keeping Solar Sail Challenge), aeronautic (e.g., the Micro Reentry Vehicle Challenge), and space exploration (e.g., the Human Lunar All Terrain Vehicle Challenge) goals. Centennial Challenges is continually working with each of the NASA Mission Directorates to ensure that competitions selected are addressing the current set of NASA's technology priorities.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Integrate SBIR/STTR technology into Agency science and technology plans.	Small Business Innovative Research (SBIR)	$122.3M	$127.1M
Integrate SBIR/STTR technology into Agency science and technology plans.	Small Technology Transfer Research (STTR)	$14.7M	$15.3M
20 partnerships, 50 tech transfer agreements, portfolio licensing, intellectual property management	Technology Transfer Partnerships	$39.7M	$33.3M
Hold 3 Centennial Challenges competitions	Centennial Challenges	$10.0M	$4.0M

Mission Directorate:	Cross-Agency Support Programs
Theme:	Innovative Partnerships Program
Program:	Innovative Partnerships Program

Program Management

Project	Oversight	Lead Performer	Partners
Technology Transfer Partnerships	NASA HQ IPP Office	NASA HQ IPP Office	All NASA Centers
Small Business Innovative Research (SBIR)	NASA HQ IPP Office	NASA HQ IPP Office	All NASA Centers
Small Technology Transfer Research (STTR)	NASA HQ IPP Office	NASA HQ IPP Office	All NASA Centers
Centennial Challenges	NASA HQ IPP Office	5 allied organizations	NASA HQ and 5 allied organizations.

Acquisition Strategy

No significant acquisitions are planned for FY 2008.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Quality	NAPA	09/2004	Review of Technology Transfer Program: completed 4th quarter FY 2004.	09/2007
Performance	National Research Council	09/2006	Review of SBIR/STTR Program: Review is currently in Phase II of a 2-phase study; each study phase to be completed within a 3-year period. Phase I results are available. Phase II planned to be completed in FY 2008.	09/2008
Quality	Booz Allen Hamilton	05/2004	Review of Space Product Development: completed 2nd quarter FY 2004.	N/A

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Technology Transfer Partnerships	Insufficient resources to support & protect the Government's rights in its inventions and transfer technology out of the Agency for national economic and quality of life benefits.	To further support this obligation, implement a performance based budget with a customer focused organization which includes metrics and oversight.
SBIR/STTR	Temporary inefficiencies may arise due to the consolidation of SBIR/STTR program to 4 (from 10) primary Centers.	Engage SBIR/STTR Mission Directorate representatives to determine satisfaction and needs. Establish a web-based system, with Level II COTR oversight, to execute compilation of technology topics/subtopics, distribution of SBIR/STTR Solicitation, and proposal evaluation. Move financial management oversight of SBIR/STTR to HQ-IPP.
Centennial Challenges	If critical mass is not maintained for Centennial Challenges competitions are at risk of losing the number and quality of competitors that makes the program so successful. Without the number and high quality of competitors, expanding the scope of competitions will become difficult.	Continue to develop excellent Centennial Challenges competitions, as well as develop and maintain interest in Centennial Challenges by providing information to the taxpayers, Congress, academic institutions, and industry about the technological benefits of these competitions.

Mission Directorate:	Cross-Agency Support Programs
Theme:	Shared Capability Assets Program

Theme Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Shared Capability Assets Program	--	22.1	34.3	34.2	36.2	37.3	37.2
Shared Capability Assets Program	--	22.1	34.3	34.2	36.2	37.3	37.2

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Theme Changes

	FY 2008		
Shared Capability Assets Program	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Shared Capability Assets Program	**33.1**	**34.3**	**1.3**

The FY 2008 HECC funding ($33.1M) included in the FY 2007 budget has been transferred to the SMD budget. The FY 2008 budget for SCAP consists of three new capabilities that include thermal vacuum chambers, simulators, and arc-jets as well as institutional full cost simplification for a total of 34.3M. Also, transferred into the SCAP program is the Flight Operations & Test Infrastructure funded by the Aeronautics Test Program (ATP) in the Aeronautics Research Mission Directorate (ARMD).

Theme Purpose

The Shared Capability Assets Program (SCAP) supports multiple NASA Strategic Goals and Sub-goals by sustaining capabilities for future requirements while dispositioning under-utilized capabilities to form an overall balanced complement of assets for NASA.

Theme Overview

The Shared Capability Assets Theme is a single-program theme: the Shared Capability Assets Program (SCAP). SCAP was established to ensure key capabilities and assets are available for future missions, and will help NASA prioritize critical capabilities and make strategic investment decisions to replace, modify, or disposition assets. It is managed at the Agency level, with funding and day-to-day management responsibilities generally resident in the Mission Directorates and in the office of Institutional Management (IMD). Seven specific key capability/asset classes have been identified to ensure that NASA retains specialized assets and skills required for missions:
Baseline Capabilities included:
1. Wind Tunnels in the Aeronautics Test Program (ATP)
2. Rocket Propulsion Testing (RPT)
3. High End Computing Columbia

New Capabilities added in FY07 include:

4. Thermal Vacuum Acoustic Test Capability
5. Arc-Jets Test Capability
6. Flight Simulation Capability
7. Flight Operations and Test Infrastructure Capability

SCAP may add additional capabilities the agency may need to sustain in support of future NASA missions.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

NASA has many unique and world-class test facilities and engineering capabilities which must be retained to meet current & future needs of the agency.

NASA, other government agencies, industry and academia routinely use the SCAP facilities to push the state-of-the-art in meeting mission requirements. The resulting advanced technologies often have dual-use capabilities that allow the Nation to compete on favorable terms in the global market place as well as to help insure our Nation's defense.

Relevance to the NASA Mission:

SCAP facilities and workforce allow NASA programs to model, design, and test concepts, prototypes, and flight systems in order to reduce mission risks, minimize operational costs, and optimize exploration & science capabilities.

Relevance to education and public benefits:

SCAP facilities provide unique opportunities to investigate, test, and establish new scientific and engineering theories, principles, and methods.

These advances in core sciences and engineering become the basis for new and advanced technologies that revise our understanding of the world and enable us to improve our living standards both nationally & globally.

Mission Directorate:	Cross-Agency Support Programs
Theme:	Shared Capability Assets Program

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
Strategic Goal	**Supports Multiple Agency Goals**	
Outcome SC-1	**Establish and maintain selected Agency level shared capabilities, across multiple classes of assets (e.g., wind tunnels, vacuum chambers, etc.), to ensure that they will continue to be available to support the missions that require them.**	
APG 8SC01	Prioritize funding requirements and select classes of assets for inclusion in the Shared Capability Assets Program.	Shared Capability Assets Program
APG 8SC02	Identify re-investment/re-capitalization opportunities within and among classes of assets and execute the approved changes (e.g., reallocate funds, upgrade facilities, etc.).	Shared Capability Assets Program
APG 8SC03	Assets identified in FY2007 that no longer have requirements for use by NASA will be dispositioned (decision made on whether to place on standby, be mothballed, be demolished, etc).	Shared Capability Assets Program

Performance Achievement Highlights

Shared Capability Assets Program

- SCAP conducted in depth assessment of costs and requirements on new capability proposals and selected new capabilities (thermal vacuum chambers, flight ops and test infrastructure, simulators and arc-jets) for inclusion into SCAP.
- SCAP has proposed a Program Plan and a Disposition Plan which are currently being reviewed by senior management.
- SCAP has identified assets/capabilities that are not needed in the near future; senior management has approved their disposition to standby, mothball, abandon, or demolish.

Quality

Program Assessment Rating Tool (PART):

OMB has not yet conducted a PART review of the Shared Capability Assets Program Theme.

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
All	RAND Corporation	01/2003	An independent assessment was conducted by the RAND Corporation in 2003 titled "Wind Tunnel and Propulsion Test Facilities: An Assessment of NASA's Capabilities to Serve National Needs".	NA

Mission Directorate:	Cross-Agency Support Programs
Theme:	Shared Capability Assets Program
Program:	Shared Capability Assets Program

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Shared Capability Assets Program	--	22.1	34.3	34.2	36.2	37.3	37.2

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Major Program Changes

Program Title:	FY 2008		
	FY 2007 PB Request	FY 2008 PB Request	Change
Shared Capability Assets Program	**33.1**	**34.3**	**1.3**

The FY 2008 HECC funding ($33.1M) included in the FY 2007 budget has been transferred to the SMD budget. The FY 2008 budget for SCAP consists of three new capabilities that include thermal vacuum chambers, simulators, and arc-jets as well as institutional full cost simplification for a total of 34.3M. Also, transferred into the SCAP program is the Flight Operations & Test Infrastructure funded by the Aeronautics Test Program (ATP) in the Aeronautics Research Mission Directorate (ARMD).

Program Overview

The Shared Capability Assets Program (SCAP) is managing the capabilties under its purview by: establishing an alliance between all centers with like assets; making decisions on disposition of capabilities no longer required; identifying re-investments/re-capitalization opportunities within and among classes of assets; and executing changes. SCAP reviews these capabilities each year to ensure the requirements are still valid.

These facility capabilities are being sustained to ensure they are available when needed to support NASA missions.

New capabilities will be assessed upon request for funding during the budget formulation process and added as deemed necessary to support Agency programs.

Program Relevance

NASA has many unique and world class test facilities and engineering capabilities which must be retained to meet current & future needs of the agency.

SCAP facilities and workforce allow NASA programs to model, design, and test concepts, prototypes, and flight systems in order to reduce mission risks, minimize operational costs, and optimize exploration & science capabilities.

Plans For FY 2008

In this current year of FY 2007, SCAP will concentrate on building an infrastructure within asset classes and between centers. We will institute consistency in reimbursable pricing policies, initiate quarterly program reviews for better management insight into the capabilities and provide a forum for cooperation between all the centers within asset classes.

SCAP will continue the management of capabilities added in FY 2007 and will begin to broaden it's alliances outside of the agency for such capabilities as thermal vacuum chambers. Organizations such as the Space Environments Simulation Facilities Alliance (SESFA) will help to strengthen these alliances. SCAP will examine and scrutinize new proposals for additional capabilities submitted as part of the FY 2009 budget process.

The SCAP has recommended capabilities the agency no longer requires and has developed a disposition plan for these assets. SCAP will complete disposition of some assets such as the 757 at Langley Research Center and the Hypersonic Test Facility (HTF) at Glenn Research Center during this fiscal year. A few other assets are undergoing the disposition approval process, but action will be taken on them when final decisions are made.

Mission Directorate:	Cross-Agency Support Programs
Theme:	Shared Capability Assets Program
Program:	Shared Capability Assets Program

Project Descriptions

SCAP has the following baseline assets/capabilities:
1. Wind tunnels in the Aeronautics Test Program (ATP) in the Aeronautics Research Mission Directorate.
2. Rocket Propulsion Testing (RPT) in the Space Operations Mission Directorate.
3. High End Computing Columbia

New assets/capabilities added in for FY07 include:
1. Thermal Vacuum Acoustic Test Capability
2. Arc-Jets Test Capability
3. Flight Simulation Capability
4. Flight Operations and Test Infrastructure Capability

Aeronautics Test Program (ATP) - Wind Tunnels in the Aeronautics Research Mission Directorate

ATP's purpose is to ensure the strategic availability of a minimum, critical suite of aeronautical test facilities necessary to meet the long-term needs and requirements of the Nation. ATP is responsible for the strategic and business management of the major wind tunnels/ground test facilities at Ames, Glenn, and Langley Research Centers and the Western Aeronautical Test Range (WATR), Support Aircraft and Test Bed Aircraft at Dryden Flight Research Center. ATP ensures funding levels allow for continuous operations at ATP facilities and for the appropriate levels of maintenance and investments. A major benefit of this program is that it establishes stable user pricing at its facilities. ATP is responsible for related alliances with the Department of Defense. This program supports the objective to ensure the continuous availability of a portfolio of NASA owned wind tunnels/ground test facilities and flight operations/test infrastructure that are strategically important to meeting national aerospace program goals and requirements.

Rocket Propulsion Testing (RPT) in the Space Operations Mission Directorate

As the principal implementing authority for NASA's Rocket Propulsion Testing, the Rocket Propulsion Test (RPT) Program reviews, approves, and provides direction on rocket propulsion test assignments, capital asset improvements, test facility modernizations and refurbishments, integration for multi-site test activities, identification and protection of core capabilities, and the advancement and development of test technologies.

RPT employs a collaborative approach to ensure rocket propulsion test activities are conducted in a manner that minimizes cost, ensures safety, provides credible schedules, achieves all technical objectives, and leverages the lessons learned. RPT reduces propulsion test costs through the safe and efficient utilization of rocket propulsion test facilities in support of NASA programs, commercial partners, and the Department of Defense, while eliminating unwarranted duplication. RPT sustains and improves Agency-wide rocket propulsion test core capabilities (both infrastructure and critical skills) and ensures appropriate levels of capability and competency are maintained.

RPT supports several Agency Strategic Goals: Fly the Shuttle as safely as possible until its retirement; Bring a new Crew Exploration Vehicle (Ares and Orion) into service as soon as possible after Shuttle retirement; and Establish a lunar return program having the maximum possible utility for later mission to Mars and other destinations.

Thermal Vacuum Acoustic Test Capability

This capability includes thermal-vacuum, vacuum and acoustic chambers at NASA facilities (Glenn Research Center, Goddard Space Flight Center, Jet Propulsion Laboratory, Johnson Space Center, Kennedy Space Center, Marshall Space Flight Center and Plum Brook Station) that are large enough to accommodate at least a four foot cube (spacecraft/flight hardware) with adequate space surrounding the structure for safe, easy access while inside the chamber. Chambers with minimum dimensions on the order of 10 ft. and 10 ft. will generally meet this provision. Space environmental chambers should have the capability of pressures of 1 X 10-2 torr or lower and thermal shrouds capable of LN2 temperatures or lower. Acoustic chambers should be capable of approximately 150 dB at frequencies in the range of 25 to 1000 Hertz.

Arc-Jets Test Capability

Project Manager is George Madzsar at Headquarters SCAP
An arc-jets facility provides ground-based high-enthalpy environments that support the nation's DDT&E activities in Thermal Protection materials, vehicle structures, aerothermodynamics, and hypersonics. A gas (typically air) is heated and accelerated to supersonic/hypersonic speeds by a continuous electrical arc. This high-enthalpy gas passes over a test sample, producing an approximation of the surface temperature and pressure found in environments such as that experienced by a vehicle on atmospheric entry.

Flight Simulation Capability

Project Manager is Robert Soltess at Headquarters SCAP
This capability includes an array of flight simulator assets at the Ames Research Center (ARC) and the Langley Research Center (LaRC). Principal assets include the Vertical Motion Simulator (the world's largest motion system) and its supporting cabs, labs, and equipment at ARC and the Cockpit Motion Facility and its supporting suite of simulators (the Differential Maneuvering Simulator, the Visual Motion Simulator) and other central support facilities at LaRC.

Flight Operations and Test Infrastructure Capability

Includes the following Dryden Flight Research Center Infrastructure and Capabilities:
1. Test Range Support: This collection of facilities provides radar, telemetry, video, communications, data acquisition and management, mission control, and range safety support for all Dryden flight missions. It is a fundamental capability utilized by all four Mission Directorates.
2. Support Aircraft Maintenance and Operations: This capability supports the maintenance and operations of support aircraft (3 F-18s, T-38, T-34, B-200) required for mission preparation, safety chase, and pilot proficiency. This is an essential capability required to ensure Dryden's flight crew (10 test pilots, 6 other flight crew) retain proficiency and meet aviation safety standards. Access to the EAFB airfields and emergency response services are also covered here.
3. Testbed Aircraft: This capability supports uniquely configured, highly instrumented research aircraft testbeds at Dryden that are utilized to support key flight experiments in support of all four Mission Directorates. Current testbed aircraft include the F-15B, ER-2, and C-20 aircraft.

Mission Directorate:	Cross-Agency Support Programs
Theme:	Shared Capability Assets Program
Program:	Shared Capability Assets Program

High End Computing Columbia

The HECC provides scientists and engineers with the supercomputing resources (10,240 processors) and simulation tools needed to carry out critical NASA missions and make new scientific discoveries for the benefit of humankind. The HECC Project is continuously improving system performance and supports all four Mission Directorates. Recent simulation support activities included: simulating Space Shuttle launches for future space missions; projecting the impact of human activity on weather patterns; simulating dark matter halo surrounding the Milky Way; and designing safe, efficient space exploration vehicles and aircraft.

Program Management

The Shared Capabilities Theme Director is Steve Miley at NASA Headquarters. Extensive liaisons will be used to coordinate & monitor mission directorate and center management of the SCAP supported facilities.

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Facility Condition Status	SCAP Program Management must make strategic decisions on dispositioning of facilities (operational, mothball, close) under large uncertainties of demand and performance requirements. The consequences can result in a facility not being ready or available to support a critical capability or test for the Agency.	Perform annual review of mission directorate/program/project requirements, facility status, and state-of-the-art so that NASA missions are supported with minimum delays and start-up/operations costs.

How to Read NASA's Budget Tables

NASA Mission Directorate Budget Table

Budget Authority ($ in millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
FY 2008 President's Budget Request	Sep 2006 Op Plan	Budget numbers using new Theme structure and new method full cost simplification.					
Theme A							
Theme B							
Theme C							
FY 2007 President's Budget Request	Budget numbers using new Theme structure and old method full cost.						
Theme A							
Theme B							
Theme C							
Total Change from FY 2007 President's Budget Request	Top line changes						

The Mission Directorate budget tables provide the full FY 2008 President's Budget Request for each Mission Directorate and the Theme(s) under that Directorate. Each table provides comparative values from the FY 2007 President's Budget Request based on the Agency's previous full cost accounting method and converted to the new FY 2008 Theme structure. The bottom row displays the net change between these two line items.

NASA Theme / Program Budget Table

Budget Authority ($ in millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Theme X	Sep 2006 Op Plan	Budget numbers using new Theme structure and new method full cost simplification.					
Program A							
Program B							

The Theme and Program budget tables provide the FY 2008 President's Budget Request for each Theme or program line item. Each Theme and Program budget table displays information for the programs or projects included as part of that Theme or Program.

Highlights of Theme / Major Program Changes

	FY 2008		
Theme	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Program A			
Program B			
Program C			

FY 2008 column from FY 2007 President's Budget Request using new Theme structure and old method full cost.

FY 2008 budget request using new Theme structure and new method full cost simplification.

The Highlights of Theme/Major Program Changes table provides a comparison for FY 2008 that displays the difference between the FY 2007 President's Budget Request (with the Agency's previous full cost accounting method and the new Theme structure) and the FY 2008 President's Budget Request. In addition, short narratives are provided to explain the changes in each of program or project.

NOTE: The numbers in the budget tables may not add up due to rounding.

Appropriation Summary: Exploration Capabilities

(Millions of Dollars)	FY 2006 Actual	FY 2007	FY 2008 Budget Request
SPACE OPERATIONS	**6,904.7**	**6,108.3**	**6,791.7**
Space Shuttle	4,812.5	4,017.6	4,007.5
International Space Station	1,753.4	1,762.6	2,238.6
Space and Flight Support	338.8	328.1	545.7
TOTAL APPROPRIATION	**6,904.7**	**6,108.3**	**6,791.7**

FY 2006 represents September 2006 operating plan.

FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Totals may not add due to rounding.

Space Operations

The Space Operations Mission Directorate (SOMD) is responsible for providing mission critical space exploration services to both NASA customers and to other partners within the United States and throughout the world: flying the Space Shuttle to assemble the International Space Station; ensuring safe and reliable access to space; maintaining secure and dependable communications between platforms across the solar system; and ensuring the health and safety of our Nation's astronauts.

At the heart of SOMD is nearly half a century of experience at safely and reliably building, flying, and maintaining some of the world's most advanced and complex aerospace systems. Two of these systems, the Space Shuttle and the International Space Station, continue to be the cornerstone of human space exploration. The Vision for Space Exploration and the NASA Strategic Plan recognize the central role of the International Space Station as a unique orbital outpost for carrying out the scientific and engineering research needed for prolonged stays on the Moon and Mars. The lessons being learned during the construction and operation of the International Space Station are directly applicable to the challenges that may be faced by explorers on the lunar and Martian surfaces.

Getting the full use out of the International Space Station means completing assembly of the orbiting facility in a manner consistent with the plans and agreements that have been made between the United States and its 15 international partners. As the only vehicle that can launch the remaining elements of the International Space Station, support teams of orbiting astronauts, and serve as a platform for joint human and robotic assembly operations at both the International Space Station and the Hubble Space Telescope, the Space Shuttle is critical to the success of the Vision for Space Exploration. SOMD is responsible for ensuring the safety and continued success of the Space Shuttle Program. Though the fleet of Space Shuttle orbiters will be retired once International Space Station assembly is complete in FY 2010, the Space Shuttle's legacy (including manufacturing facilities, ground operations equipment, launch pads, flight hardware, workforce skills, and experience) will be the foundation for the next series of exploration vehicles being developed by the NASA Exploration Systems Mission Directorate (ESMD). From the shop floor to the Headquarters level, SOMD and ESMD are working to ensure that these transition and retirement activities take maximum advantage of potential efficiencies between current and planned systems.

In addition to these high-profile programs, SOMD is also responsible for ensuring that the critical infrastructure needed for space access and space communications is available to meet the needs of NASA's customers. The Launch Services Program facilitates access to space for all NASA space science missions. The Rocket Propulsion Test Program maintains NASA's wide variety of test facilities for use by both the Space Shuttle and Constellation Systems Programs. The Crew Health and Safety Program ensures that NASA's astronauts are fully prepared for their missions both now and in the future. Finally, the Space Communications Program operates NASA's extensive network of terrestrial and orbiting communications nodes, as well as all of the associated hardware and software needed to pull down the terabytes of data generated by NASA's fleet of crewed vehicles and robotic spacecraft from Earth orbit out to the very edges of the solar system.

The budget distribution between SOMD Themes is identified below, along with an explanation of changes. The sections that follow identify Performance and Budget for SOMD Themes and programs.

Mission Directorate Budget Distribution

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
FY 2008 President's Budget Request	**6,904.7**	**6,108.3**	**6,791.7**	**6,710.3**	**6,625.7**	**3,036.6**	**2,978.0**
Space Shuttle	4,812.5	4,017.6	4,007.5	3,650.9	3,634.4	116.2	--
International Space Station	1,753.4	1,762.6	2,238.6	2,515.1	2,609.2	2,547.5	2,600.8
Space and Flight Support (SFS)	338.8	328.1	545.7	544.3	382.0	372.9	377.2
FY 2007 President's Budget Request	**6,869.7**	**6,234.4**	**6,680.4**	**6,442.3**	**6,242.9**	**2,896.7**	**--**
Space Shuttle	4,777.5	4,056.7	4,087.3	3,794.8	3,651.1	146.7	--
International Space Station	1,753.4	1,811.3	2,200.3	2,255.6	2,197.1	2,360.8	--
Space and Flight Support (SFS)	338.8	366.5	392.8	392.0	394.7	389.2	--
Total Change from FY 2007 President's Budget Request	**35.0**	**-126.2**	**111.3**	**268.0**	**382.8**	**139.9**	**2,978.0**

Note: FY 2008 PB Request -- FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Mission Directorate Budget Changes

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Total Changes	**35.0**	**-126.2**	**111.3**	**268.0**	**382.8**	**139.9**	**2,978.0**
Programmatic Content	**35.0**	**--**	**35.0**	**27.0**	**-21.3**	**26.3**	**2,978.0**
Space Shuttle	35.0	--	-33.6	-30.8	-30.7	-1.0	--
International Space Station	--	--	-78.4	-96.8	-19.0	-37.4	2,600.8
Space and Flight Support (SFS)	--	--	147.0	154.6	28.4	64.7	377.2
Programmatic Transfers	**--**	**--**	**111.9**	**313.1**	**407.8**	**345.9**	**--**
Space Shuttle	--	--	-5.0	-5.0	--	--	--
International Space Station	--	--	104.3	307.6	397.1	334.3	--
Space and Flight Support (SFS)	--	--	12.6	10.5	10.7	11.6	--
Institutional Adjustments	**--**	**-126.2**	**-35.6**	**-72.1**	**-3.7**	**-232.3**	**--**
Space Shuttle	--	-39.1	-41.2	-108.1	14.0	-29.5	--
International Space Station	--	-48.7	12.4	48.7	34.0	-110.2	--
Space and Flight Support (SFS)	--	-38.4	-6.8	-12.7	-51.7	-92.6	--

Mission Directorate Highlights of Programmatic Changes

Space Operations
Space Shuttle
Programmatic Content:
Redirected funds from reserves to accommodate funding for two TDRS replenishment satellites within the Mission Directorate budget.
Programmatic Transfers:
Funds no longer required by Shuttle for SSME testing are transferred to the Rocket Propulsion Test Program to protect capability required for later development of Constellation Systems Programs.
Institutional Adjustments:
Institutional adjustments reflect the transfer of Technical Excellence to Center Management and Operations.
International Space Station
Programmatic Content:
Redirected funds from reserves and reduced budget for Shuttle Transition and Retirement to accommodate funding for two TDRS replenishment satellites within the Mission Directorate budget.
Programmatic Transfers:
The majority of the increase is due to the transfer from ESMD of the ISS Crew and Cargo Purchases budget, and an additional transfer from ESMD of less than $5 million per year is due to the transfer of the Material Science Research Rack / Microgravity Science Glovebox to ISS Multi-User Support and Systems.
Institutional Adjustments:
Institutional adjustments reflect the transfer of Technical Excellence to Center Management and Operations.
Space and Flight Support (SFS)
Programmatic Content:
The Space Communications Program recognized an increase to fund two Tracking Data Relay Satellite System (TDRSS) replenishment satellites to ensure capability through FY 2016.
Programmatic Transfers:
Consistent with the Agency strategy to protect certain enabling cababilities, this budget maintains base funding by reallocating test funds from Shuttle due to retirement, and adding funding to maintain B-2 Test Chamber capability at NASA's Plum Brook Station in Sandusky, Ohio. The transfer also includes $2-3 million per year for moving the Alpha Magnetic Spectrometer (AMS) to Launch Services.
Institutional Adjustments:
Institutional adjustments reflect the transfer of Technical Excellence to Center Management and Operations.

Theme Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Space Shuttle	4,812.5	4,017.6	4,007.5	3,650.9	3,634.4	116.2	--
Space Shuttle Program	4,812.5	4,017.6	4,007.5	3,650.9	3,634.4	116.2	--

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Theme Changes

	FY 2008		
Space Shuttle	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Space Shuttle Program	**4,087.3**	**4,007.5**	**-79.9**
A net reduction to the Space Shuttle Program reflects changes to overhead, a transfer of Technical Excellence to Center Management and Operations, and a $5M transfer of RPT test funds.			

Theme Purpose

The purpose of the Space Shuttle Theme is to operate and maintain NASA's three Space Shuttles. In accordance with the Vision for Space Exploration, NASA will use the Space Shuttle to complete assembly of the International Space Station (ISS) by FY 2010, at which time the Shuttles will be retired. NASA will also use the Space Shuttle to conduct a fifth servicing mission to the Hubble Space Telescope. In both cases, the Space Shuttle is the only vehicle capable of carrying both crew and heavy cargo to low-Earth orbit, serving as a platform for joint crewed and robotic extravehicular activity. Because of its unique capabilities and the importance of its missions, the Space Shuttle remains essential for advancing U.S. national scientific, security, political, and economic interests.

Specifically, the Space Shuttle Theme supports the following Goal in the 2006 NASA Strategic Plan:

Goal 1: Fly the Shuttle as safely as possible until its retirement, not later than 2010.

Theme Overview

The Space Shuttle Theme ensures that the Space Shuttle is prepared to safely complete those missions that require the Shuttle's unique ability to carry crews and heavy payloads to low Earth orbit and, once there, to execute extremely complex and intricate assembly and servicing operations. All Space Shuttle missions will be completed by the end of FY 2010 and the Space Shuttle will be retired after nearly 30 years of service. At that time, many of the people, skills, facilities, hardware, and hard-won experience from the Space Shuttle Program will be transitioned to a new generation of vehicles currently being developed by the Constellation Systems Program, ensuring both continuity of operations to the greatest extent possible and the continued success of NASA's program of space exploration.

The Space Shuttle Program's highest priority is to safely complete the mission manifest by the end of FY 2010 using as few flights as possible. Working through project, program, Directorate, and Agency-level processes, the Space Shuttle Program will also play a key role in coordinating the smooth transition of Space Shuttle assets and capabilities to the next generation of space exploration systems without compromising the safety of ongoing flight operations.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

NASA's primary objective is to advance U.S. national scientific, security, and economic interests by ensuring the success of the Nation's exploration goals as enunciated in the Vision for Space Exploration. The next step in the Vision for Space Exploration is to complete assembly of the ISS in a manner that meets NASA's exploration research needs and international commitments. Ensuring that the Hubble Space Telescope continues to return world-class science is also a high priority for the nation's science community. The Space Shuttle is uniquely qualified to carry out both of these missions. While accomplishing these missions, Space Shuttle transition activities will be undertaken in a manner that safeguards the long-term viability of U.S. technical capabilities in anticipation of future challenges and opportunities.

Relevance to the NASA Mission:

The Space Shuttle supports NASA's mission by providing a unique capability for critical missions in support of the Vision for Space Exploration.

Relevance to education and public benefits:

The Space Shuttle provides long-term benefits to the public by enabling the completion of the ISS, serving as a platform for servicing the Hubble Space Telescope, and maintaining those capabilities needed for long-term U.S. exploration objectives. The Space Shuttle Program also remains a highly visible activity that promotes education in math, science, and engineering-careers that are critical to U.S. national security and the future of U.S. economic competitiveness.

Mission Directorate:	Space Operations
Theme:	Space Shuttle

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
Strategic Goal 1	**Fly the Shuttle as safely as possible until its retirement, not later than 2010.**	
Outcome 1.1	**Assure the safety and integrity of the Space Shuttle workforce, systems and processes, while flying the manifest.**	
APG 8SSP01	Achieve zero Type-A (damage to property at least $1 million or death) or Type-B (damage to property at least $250 thousand or permanent disability or hospitalization of three or more persons) mishaps in FY2008.	Space Shuttle Program
APG 8SSP02	Complete 100 percent of all mission objectives for all Space Shuttle missions in FY2008 as specified in the Flight Requirements Document for each mission.	Space Shuttle Program
Outcome 1.2	**By September 30, 2010, retire the Space Shuttle.**	
APG 8SSP03	Develop a detailed schedule of last-need dates for all significant Space Shuttle program element capabilities.	Space Shuttle Program
APG 8SSP04	A 9 percent reduction (over FY2007 values) in the annual value of Shuttle production contracts for Orbiter, External Tank, Solid Rocket Boosters, Reusable Solid Rocket Motor, Space Shuttle Main Engine and Launch & Landing, while maintaining safe flight.	Space Shuttle Program

Performance Achievement Highlights

Space Shuttle Program

STS-121 in July 2006 marked the completion of NASA's planned Return to Flight test sequence and set the stage for the Space Shuttle's return to recurring mission operations. In September 2006, STS-115 restarted the ISS assembly sequence by bringing the nearly 36,000 pound P3/P4 truss segment and solar arrays to the orbiting research facility. In December 2006, STS-116 rerouted electrical systems for P3/P4 and delivered vital equipment and supplies to the ISS.

Quality

Performance Measure #	Description
Space Shuttle Theme	
APG 8SSP05	Annually reduce the Space Shuttle sustaining engineering workforce for flight hardware and software, while maintaining safe flight.
APG 8SSP06	Deliver at least 90% of scheduled operating hours for all operations and research facilities.

Program Assessment Rating Tool (PART):

The Space Shuttle Theme received FY 2006 PART update to its original FY 2005 rating of "Adequate". The reasons for the rating include a well-defined purpose and system design, benefiting from strong strategic planning. To perform beyond an "Adequate" rating, improvements are required in the areas of program management and program results. The Space Shuttle Program is taking steps to improve programmatic and financial management, and identify the program benefits from several successful missions, including return to ISS assembly in September 2006.

Since the Program's review, NASA completed three actions required to improve the performance status of the program:

1) Returned the Space Shuttle safely to flight and restarted its assembly of the ISS.
2) Completed plans to retire the Shuttle by 2010, when it has finished its role in assembling the ISS.
3) Developed outcome-oriented short and long-term measures for the Space Shuttle Program.

NASA has begun, but has not completed, the following actions to improve the performance status of the program:

1) Developing outcome-oriented measures to assess the effectiveness of the transition between the Space Shuttle and Constellation programs.
2) Taking steps to improve programmatic and financial management to better measure and improve program performance.

These performance improvement areas were added in FY 2006 to continue to stretch the program to greater levels of results. In FY 2007, the Program will work with the Constellation Systems Program to complete measures and plan for transition from the SSP to Constellation.

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Other	ASAP	10/2006	Provides independent assessments of safety to the NASA Administrator.	10/2007
Other	NASA Advisory Council	10/2006	Provides independent guidance for the NASA Administrator.	02/2007

Mission Directorate:	Space Operations
Theme:	Space Shuttle
Program:	Space Shuttle Program

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
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Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
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Program Overview

The FY 2008 budget reflects the continuation of International Space Station (ISS) assembly flights and the decision to proceed with a fifth Space Shuttle servicing mission to the Hubble Space Telescope. The budget also takes into account the accelerating pace at which Space Shuttle Program assets (such as launch facilities at the Kennedy Space Center) are no longer needed for mission execution. Those assets that are needed to support the development or operation of future exploration systems like the Ares I Crew Launch Vehicle are being preserved. Wherever feasible, existing processes and institutional structures are being employed or slightly modified to support the transition effort.

This program supports Outcomes 1.1 and 1.2, Annual Performance Goals (APGs) 8SSP1 through 8SSP4, and Efficiency Measures 8SSP5 and 8SSP6.

For more information, please see http://www.nasa.gov/mission_pages/shuttle/main/index.html.

Program Relevance

For FY 2008, the Space Shuttle Program manifest calls for completing four ISS assembly flights as well as the SM4 servicing mission to the Hubble Space Telescope. The ISS assembly flights include the launch of major research facility modules from the European Space Agency and Japan. These flights are a major step towards fulfilling U.S. commitments to NASA's international partners as specified in the ISS agreements and the Vision for Space Exploration. After the SM4 servicing mission, the Hubble Space Telescope will once again have six fully operational instruments (including a suite of cameras and spectrographs that will have about 10 times the capability of older instruments) as well as new hardware capable of supporting at least another five years of world-class space science.

Mission Directorate:	Space Operations
Theme:	Space Shuttle
Program:	Space Shuttle Program

Plans For FY 2008

There are a number of significant activities planned for the Space Shuttle Program in FY 2008. The Space Shuttle is manifested to fly a total of five missions, including four assembly and logistics flights to the ISS and a fifth servicing mission to the Hubble Space Telescope. At the same time, the Space Shuttle has a number of major transition milestones set for FY 2008. Among these are the transition of major facilities at the Kennedy Space Center to the Constellation Systems Program, including two of the four high bays in the Vehicle Assembly Building and Launch Pad 39B.

Mission Directorate:	Space Operations
Theme:	Space Shuttle
Program:	Space Shuttle Program

Project Descriptions

The Space Shuttle Program is organized into three functional areas: Program Integration, Flight and Ground Operations, and Flight Hardware.

Program Integration

The Program Integration budget includes the following: funds for flight software; system engineering, flight operations, and management integration; safety and mission assurance; business management; propulsion system integration; construction of facilities; safety and sustainability; and all Space Shuttle support accounts for the Space Shuttle Program. Program Integration includes payload integration into the Space Shuttle and systems integration of the flight hardware elements through all phases of flight. It provides for the engineering analysis needed to ensure that payloads are safe and meet Space Shuttle interface requirements. Finally, Program Integration includes the necessary mechanical, aerodynamic and avionics engineering tasks to ensure that the launch vehicle can be safely launched, fly a safe ascent trajectory, achieve planned performance, and descend to a safe landing.

Flight and Ground Operations

Flight Operations assures the successful accomplishment of pre-flight planning, crew training, operations control activities, flight crew operations support, aircraft maintenance and operations, and life sciences operations support for each mission to efficiently and effectively meet NASA's customer requirements. Flight Operations funding also provides for the maintenance and operation of critical mission support facilities including the Mission Control Center (MCC), Integrated Training Facility (ITF), Integrated Planning System (IPS) the Software Production Facility (SPF), and the aircraft fleet used for training.

Ground Operations provides final integration and checkout of all hardware elements for launch. It also includes coordination with other government agencies and foreign entities for Space Shuttle landing capabilities. The major launch site operational facilities at the Kennedy Space Center (KSC) include three Orbiter Processing Facilities (OPFs), two launch pads, the Vehicle Assembly Building (VAB), the Launch Control Center (LCC) and three Mobile Launcher Platforms (MLPs). Ground Operations support capability includes launch countdown and landing for Space Shuttle missions. Ground support for Space Shuttle landing includes both the KSC and Edwards Air Force Base runways and multiple contingency landing sites in the United States and other countries. Ground Operations also includes the maintenance and operations of ground infrastructure to support launch and landing. The Orbiters are normally in the hardware processing flow along with External Tanks, Space Shuttle Main Engines, and Solid Rocket Booster components to support several missions.

Flight Hardware

Space Shuttle Flight Hardware assures the vehicle hardware and software are designed, developed, manufactured, and tested to enable safe and reliable transportation. Five major flight elements make up the Space Shuttle system: the Orbiter, the Space Shuttle Main Engines (SSME), the External Tank (ET), the Reusable Solid Rocket Motors (RSRM), and the Solid Rocket Boosters (SRB).

Orbiter

The Orbiter, the winged vehicle that carries the payload and a crew of up to seven astronauts, is the principal element of the Space Shuttle system. Each orbiter measures 122 feet long, 57 feet high, with a wingspan of 78 feet, and can carry approximately 35,000 to 41,000 pounds of payload to the ISS depending on the configuration of the Space Shuttle, rendezvous altitude, and other mission-specific requirements. There are three reusable orbiters in the fleet: Discovery OV-103, Atlantis OV-104, and Endeavour OV-105. The flight schedule continues to support the ISS assembly sequence as well as the Hubble Space Telescope servicing mission scheduled to fly in FY 2008.

SSME

The Space Shuttle Main Engines (SSME) were developed in the 1970s and are the most efficient liquid-fueled rocket engines ever built. Each Block II main engine can produce 418,000 pounds of thrust at sea level. The main engines are throttleable, reusable, and have a high degree of redundancy. Three main engines are mounted in a triangular configuration at the aft end of the orbiter and provide about 29 percent of the total thrust at liftoff. Critical SSME engineering skills are being maintained to ensure safe mission flyout and sufficient SSME component spares are being stockpiled to support the program through FY 2010.

ET

The External Tank (ET) is the largest and heaviest (approximately 1.7 million pounds when fully loaded with liquid oxygen and liquid hydrogen) element of the Space Shuttle system. The external tank serves two functions: to carry the fuel and oxidizer that feeds the main engines during ascent, and to act as the structural "backbone" to which the orbiter and solid rocket boosters are attached. Because the liquid hydrogen and liquid oxygen need to be stored at temperatures of hundreds of degrees below zero, the external tank is covered with foam insulation to keep the propellants cold on the launch pad and during ascent and prevent formation of ice from atmospheric condensation. After the main engines are shut down at an altitude of about 70 miles above Earth, the external tank is jettisoned, reenters the atmosphere at high velocity, and breaks up harmlessly over a remote ocean area.

There are sufficient stocks of both aluminum lithium for the main structural elements and most components to complete assembly of these tanks through FY 2010. Meanwhile, the ET project office continues to work closely with the Constellation program to ensure a smooth transition of materials, tooling, critical skills, and shop floor space at the Michoud Assembly Facility in Mississippi from ET production to Orion and Ares I development.

RSRM and SRB

Two Solid Rocket Boosters (SRB's) provide the main thrust that lifts the Space Shuttle off the launch pad up to an altitude of about 150,000 feet. Each SRB is made of three major subassemblies: a forward nose cone, a four-segment Reusable Solid Rocket Motor (RSRM), and an aft nozzle. The SRBs for the Space Shuttle are the largest ever flown, and are designed for reuse. Each is 149 feet long, 12 feet in diameter, and weighs approximately 1.3 million pounds when loaded with fuel. The sea-level thrust of each booster is approximately 3.3 million pounds. They are fired after the thrust level of the three main engines is verified during the first few seconds of the ignition sequence. Together, the two SRBs provide about 71 percent of the total thrust at liftoff.

Each Ares I crew launch vehicle will have a first stage powered by five RSRM segments derived from those currently used by the Space Shuttle, while the heavy-lift Ares V will use two five-segment boosters mounted alongside a core stage similar to the way the SRBs are attached to the ET on the Space Shuttle. Using Shuttle-derived booster technology in Constellation program vehicles promotes continuity and cost savings in both hardware production and operations.

Transition and Retirement

NASA continues to ensure a smooth transition from the Space Shuttle to the next generation of Constellation Systems Program vehicles, including the Orion Crew Exploration Vehicle (CEV) and Ares I Crew Launch Vehicle. Appropriate Space Shuttle flight and ground hardware, technology, people, and practices are being identified for transfer, retirement, or reassignment.

NASA's Human Space Flight Transition Plan is guided by four fundamental principles: (a) the Space Shuttle fleet will be retired by the end of FY 2010; (b) the Space Shuttle Program will emphasize safety and mission success; (c) Space Shuttle transition will support Constellation Systems Program development objectives without interfering with Space Shuttle safety and mission success; and (d) the Space Shuttle will complete assembly of the ISS and conduct a fifth servicing mission to the Hubble Space Telescope by the end of FY 2010 using as few flights as possible. The goals of Human Space Flight Transition are to: (1) evolve from current operations to future operations; (2) evolve the workforce, ensuring that NASA has the right mix of skills for both Shuttle/ISS Programs and Constellation; (3) achieve multi-program objectives at the best value to the Agency, and (4) conduct an efficient and safe closeout of the Space Shuttle Program through the transfer of assets needed for follow-on programs and decommissioning and disposal of the rest.

NASA has already taken a number of important steps to ensure a smooth transition. In addition to developing the Transition Plan, NASA has identified Space Shuttle assets that are no longer needed for mission execution and that can be used in Exploration Systems development. These include the transfer of the A-1 Test Stand at the Stennis Space Center in Mississippi for use in Ares I and Ares V engine development; transfer of the Kennedy Space Center Firing Room One to the Constellation Systems Program; and the transfer of excess aluminum-lithium metal used to make the high performance External Tank of the Space Shuttle to the Constellation Systems Program for use in the Orion and Ares I projects.

Mission Directorate:	Space Operations
Theme:	Space Shuttle
Program:	Space Shuttle Program

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Safely complete manifest and retire by FY 2010.	The Space Shuttle Program	Flight schedule was subject to resumption of Shuttle flights.	The manifest has five launches planned in FY 2008.

Implementation Schedule

Project	Prior	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	Phase	Beg	End	Mile-stone
Program Integration																	Tech			
																	Form			
																	Dev			
																	Ops	Dec-04	Sep-10	
																	Res			
Flight and Ground Operations																	Tech			
																	Form			
																	Dev			
																	Ops	Dec-04	Sep-10	
																	Res			
Flight Hardware																	Tech			
																	Form			
																	Dev			
																	Ops	Dec-04	Sep-10	
																	Res			

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

The Space Shuttle Program Manager reports to the Associate Administrator for Space Operations at NASA Headquarters.

Project	Oversight	Lead Performer	Partners
Program Integration	Johnson Space Center	Johnson Space Center	n/a
Flight and Ground Operations	Kennedy Space Center	United Space Alliance	n/a
Flight Hardware	Johnson Space Center and Marshall Space Center	ATK Thiokol, Pratt & Whitney Rocketdyne, and Lockheed Martin	n/a

Acquisition Strategy

The Space Program Operations Contract (SPOC) prime contractor is United Space Alliance. Other prime contractors providing flight hardware are ATK Thiokol (Reusable Solid Rocket Motor), Lockheed Martin (External Tank), and Pratt & Whitney Rocketdyne (Space Shuttle Main Engines).

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Other	ASAP	10/2006	Provides independent assessments of safety to the NASA Administrator.	10/2007
Other	NASA Advisory Council	10/2006	Provides independent guidance for the NASA Administrator.	02/2007

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Safely complete manifest by FY 2010	Assembly and full utilization of the ISS are critically dependent on the Space Shuttle, which will be retired by 2010.	Shuttle hardware could support two contingency flights if those flights are essential to continue ISS operations and can be safely flown before the end of FY 2010.

Mission Directorate:	Space Operations
Theme:	International Space Station

Theme Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
International Space Station	1,753.4	1,762.6	2,238.6	2,515.1	2,609.2	2,547.5	2,600.8
International Space Station Program	1,753.4	1,762.6	2,238.6	2,515.1	2,609.2	2,547.5	2,600.8

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Theme Changes

	FY 2008		
International Space Station	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
International Space Station Program	**2,200.3**	**2,238.6**	**38.3**

Budget changes reflect reductions to ISS Reserves and Shuttle Transition and Retirement (STaR) and increases due to the transfer of Crew and Cargo Purchases, and the Material Science Research Rack (MSRR)/Microgravity Science Glovebox (MSG) from Exploration to ISS Multi-User Support and Systems (MUSS).

Theme Purpose

The International Space Station (ISS) is a complex of research laboratories in low Earth orbit (LEO) in which U.S. and International Partner astronauts conduct scientific and technological investigations in a space environment. The objective of the ISS is to support scientific research for human space exploration and other activities requiring the unique attributes of humans in space. Consistent with the Vision for Space Exploration, ISS research is focused on science and technology development that will prepare human explorers to travel beyond LEO.

Three crew members are currently onboard the ISS. ISS crews are supported by resupply and crew rotation using the Space Shuttle, and Russian Progress and Soyuz vehicles.

This Theme supports Strategic Goal 2 of NASA's Strategic Plan: Complete the International Space Station in a manner consistent with NASA's International Partner commitments and the needs of human exploration.

Mission Directorate:	Space Operations
Theme:	International Space Station

Theme Overview

Missions to the International Space Station are yielding much information about the human impacts of long-duration space exploration. NASA and the International Partners are using this information to set the standards for longer missions to the Moon and Mars. Techniques demonstrated in robotics, assembly, and maintainability on the ISS will guide development of next-generation space vehicles that will fly farther, faster, and for longer duration.

The FY 2008 budget request provides funding for ISS launch processing activities, vehicle on-orbit assembly with a crew of three, and continuation of research payload and experiment deliveries to orbit. The FY 2008 budget includes funding for development of habitability modifications, the purchasing of additional spares to be stowed on ISS for use during the post-Shuttle period, and development of the ExPRESS Logistics Carriers (ELC) to transport and stow critical ISS components and spares on-orbit. NASA's plan to complete the ISS will meet the commitment to the International Partners and utilize the ISS as a vital part of the Vision for Space Exploration. A key element in the future of the ISS Program is the purchase of alternate cargo and crew transportation services for the post-Shuttle era. Funding for the development of the Commercial Orbital Transportation Services (COTS) Project is in the Constellation Systems Theme to better exploit potential synergies with exploration systems. Funding for the purchase of crew and cargo transportation services, either from international partners or preferably from commercial providers, is transferred from the Exploration Systems Mission Directorate to ISS.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

The International Space Station serves as a platform for research activities that will prepare human explorers to travel beyond LEO. Research aboard the ISS is critical to:

- understanding the effects of space environments on the human body;
- developing techniques for mitigating these hazards;
- minimizing the logistical burden of supporting humans far from Earth;
- addressing remote medical emergencies; and
- demonstrating enabling technologies for human exploration.

The ISS program represents an unprecedented level of international cooperation. The ISS International Partnership is composed of NASA, the Russian Federal Space Agency (Roskosmos), the Canadian Space Agency (CSA), the European Space Agency (ESA), and the Japan Aerospace Exploration Agency (JAXA). International participation in the program has significantly enhanced the capabilities of the ISS.

Relevance to the NASA Mission:

The International Space Station Theme supports the fundamental goal of the Vision for Space Exploration "to advance U.S. scientific, security, and economic interest through a robust space exploration program": by completing assembly of the ISS by the end of the decade, focusing U.S. research and use of the ISS on supporting space exploration goals, and conducting ISS activities in a manner consistent with international commitments.

Relevance to education and public benefits:

The benefits of ISS research cross all areas of American life, including health, medicine, economics, entrepreneurship, quality of life, research/knowledge gathering, education, and bridging cultural differences. Specific examples include new uses of ultrasound technology, embedded web technology to allow remote monitoring and control of devices through a computer and Web browser, and work to help researchers understand and mitigate muscle, balance, and bone problems. Research performed on the ISS will contribute to a broader understanding of injury and disease in support of Earth-based medical applications. The ISS, an exploration research and technology test bed, will be used to develop and demonstrate, among other things, closed loop life support systems and remote medical care capabilities. Both technologies can be used to benefit people here on Earth; for example, water recycling technology is being used to provide potable water to places devastated by natural disasters. NASA will also demonstrate technologies on the ISS necessary for future space systems such as thermal control, environmental control, and power generation.

Mission Directorate:	Space Operations
Theme:	International Space Station

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
Strategic Goal 2	**Complete the International Space Station in a manner consistent with NASA's International partner commitments and the needs of human exploration.**	
Outcome 2.1	**By 2010, complete assembly of the U.S. On-orbit Segment; launch International Partner elements and sparing items required to be launched by the Shuttle; and provide on-orbit resources for research to support U.S. human space exploration.**	
APG 8ISS01	Based on the actual Space Shuttle flight rate, number of remaining Shuttle flights, and the discussions with the International Partners, update the agreed-to ISS assembly sequence and transportation plan as necessary.	International Space Station Program
APG 8ISS02	Accomplish a minimum of 90 percent of the on-orbit research objectives as established one month prior to a given increment.	International Space Station Program
APG 8ISS03	Per the final configuration agreed to by the International Partners, fly the ISS elements and logistics baselined for FY2008.	International Space Station Program
APG 8ISS04	Provide increased power capability by assembling the remaining Truss element as baselined in FY2008.	International Space Station Program
Outcome 2.2	**By 2009, provide the on-orbit capability to support an ISS crew of six crewmembers.**	
APG 8ISS05	Establish flight-ready status for the Water Recovery System (part of the U.S. Regenerative Environmental Control Life Support System).	International Space Station Program
APG 8ISS06	In concert with the International Partners, assure a continuous crew presence on the ISS.	International Space Station Program

Performance Achievement Highlights

International Space Station Program

The Shuttle's successful Return to Flight on STS-121/ULF1.1 led to resumption of ISS assembly on STS-115/12A and STS-116/12A.1. The STS-121 mission in July 2006 delivered the oxygen generation system rack, which is part of the regenerative environmental control and life support system. This rack eventually will allow the ISS to accommodate six crewmembers and will help NASA develop and validate life support technology for use during long-duration human space missions. In September 2006, STS-115 crew members attached the newly delivered P3/P4 truss, doubling the ISS's power capability. In December 2006, STS-116 crew members attached a smaller truss, P5, that will enable the next truss segment with additional solar arrays to be attached on a future mission; and reconfigured the International Space Station's power and cooling systems from a temporary setup to a permanent mode. Continued successful Space Shuttle and ISS missions will allow completion of ISS assembly by FY 2010.

Quality

Performance Measure #	Description
International Space Station Theme	
APG 8ISS07	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 8ISS08	Achieve an Annual Cost Performance Index (CPI), the ratio of the value of the work accomplished versus the actual cost of the work accomplished, of greater than or equal to one.

Program Assessment Rating Tool (PART):

The International Space Station received an FY 2004 PART rating of "Moderately Effective". The assessment found that the program had greatly improved its management, particularly in the area of cost control and had effectively managed its budget reserves. Further concern was expressed that the ISS was extremely dependent on the Space Shuttle.

NASA is taking the following actions to improve the performance of the program:
1) Developing alternatives to the Space Shuttle for resupplying the International Space Station
2) Holding program managers accountable for meeting cost, schedule, and performance goals.

In FY2006, NASA made progress in both of these areas for improvement. The Commercial Orbital Transportation Services (COTS) Project was initiated with the intent of funding demonstrations of resupply and crew rotation capabilities, and to purchase these capabilities from U.S. companies. This is intended to be the primary source of resupplying the ISS. As another alternative, the European Space Agency is developing the Automated Transfer Vehicle, and the Japan Aerospace Exploration Agency is developing the H-II Transfer Vehicle for resupply to ISS, which are expected to be available before Shuttle retirement. In FY 2007, work will continue in both of these performance improvement areas. The ISS has set processes in place to review and monitor performance on cost, schedule, and technical goals.

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Other	NASA Advisory Council	10/2006	Provides independent guidance for the NASA Administrator.	02/2007
Other	ASAP	10/2006	Provides independent assessments of safety to the NASA Administrator.	10/2007
Other	Independent Safety Task Force	12/2006	Discover and assess possible ISS vulnerabilities that may impact vehicle health, compromise crew health, or necessitate premature abandonment. Final report will be released by 1st quarter of CY 2007.	none
Other	ISS Advisory Committee	03/2006	Assess ISS operational readiness to support new crew, assess Russian flight team preparednesss to accommodate the Expedition 15 mission, and assess health and flight readiness of Expedition 15 crew.	02/2007

Mission Directorate:	Space Operations
Theme:	International Space Station
Program:	International Space Station Program

Program Budget

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Budget changes reflect reductions to ISS Reserves and Shuttle Transition and Retirement (STaR) and increases due to the transfer of Crew and Cargo Purchases, and the Material Science Research Rack (MSRR)/Microgravity Science Glovebox (MSG) from Exploration to ISS Multi-User Support and Systems (MUSS).

Program Overview

The International Space Station (ISS) is a complex of research laboratories in low Earth orbit (LEO) in which U.S. and international astronauts conduct scientific and technological investigations in a space environment. The objective of the ISS is to support scientific research for human space exploration and other activities requiring the unique attributes of humans in space. Consistent with the Vision for Space Exploration, ISS research is focused on science and technology development that will prepare human explorers to travel beyond LEO. This program supports Outcomes 2.1 and 2.2 and Annual Performance Goals 8ISS1 through 8ISS6.

In July 2006, ISS returned to a complement of three crew members on Flight ULF1.1 (Shuttle mission STS-121). ISS crews are supported by resupply and crew rotation using the Space Shuttle, and Russian Progress and Soyuz vehicles. More detailed information may be found at http://www.nasa.gov/mission_pages/station/main/index.html. In September and December 2006, ISS returned to assembly with the attachment of the P3/P4 (Flight 12A) and P5 (Flight 12A.1) Trusses, respectively. Assembly will continue through the remainder of FY 2007 with the addition of the S3/S4 (Flight 13A) and S5 (Flight 13A.1) Trusses as well as the launch of Node 2 (Flight 10A).

Mission Directorate:	Space Operations
Theme:	International Space Station
Program:	International Space Station Program

Program Relevance

The ISS is an exploration research and technology test bed. NASA will use the ISS to develop and demonstrate, among other things, closed loop life support systems, and remote medical care capabilities. Both of these technologies can be used to benefit people here on Earth; for example, water recycling technology used on the ISS is being used to provide potable water to places devastated by natural disasters. NASA will also demonstrate technologies on the ISS necessary for future space systems such as thermal control, environmental control, and power generation.

This Program supports Outcomes 2.1, "By 2010, complete assembly of the U.S. On-orbit Segment; launch international partner elements and sparing items required to be launched by the Shuttle; and provide on-orbit resources for research to support U.S. human space exploration," and Outcome 2.2, "By 2009, provide the on-orbit capability to support an ISS crew of six crewmembers." This program also supports all FY 2008 Annual Performance Goals, APG 8ISS1 through 8ISS6.

Plans For FY 2008

In FY 2008, NASA will continue ISS assembly and complete the truss and solar array assembly with delivery of the S6 truss structure on Flight 15A. With the addition of Node 2 in FY 2007, the ISS will be ready to receive delivery of International Partner elements Columbus and JEM on Space Shuttle Flights 1E, 1J, and 1J/A. Also on Flight 1J/A, increased ISS robotic capability will arrive with the addition of the Canadian Special Purpose Dexterous Manipulator (SPDM). ISS will continue processing activities, ground testing, and integration of flight hardware for future missions, while operating and monitoring the health of the vehicle systems full time, and conducting operations on 25 to 30 research experiments. Ground training is ongoing for future flight crews, and ISS will continue to conduct ISS-based EVAs for ISS maintenance, science, and assembly.

Mission Directorate:	Space Operations
Theme:	International Space Station
Program:	International Space Station Program

Project Descriptions

In FY 2008 NASA will continue launch, assembly, on-orbit operations, ground processing and development of ISS hardware to support increased ISS capabilities.

Operations

In October 2007, NASA will launch the European Space Agency's (ESA's) Columbus module on Flight 1E. In December, NASA will launch both the Japan Aerospace Exploration Agency's (JAXA's) Experiment Logistics Module Pressurized Section (ELM-PS) and the Canadian Space Agency's (CSA's) Special Purpose Dexterous Manipulator (SPDM), or "Dextre," on Flight 1J/A. Another JAXA element on Flight 1J, the Japanese Experiment Module Pressurized Module (JEM PM), will follow in February 2008. These International Partner elements will expand capabilities to conduct ISS's research in life sciences, materials sciences, fluid physics, and other topics in a weightless environment. In July 2008 the launch of the S6 Truss on Flight 15A will complete truss assembly and provide full power generating capability to the ISS.

Prior to launch, NASA and the International Partners will complete building, conduct testing, and perform integration of each international element into the Shuttle. NASA will perform those activities for the S6 Truss and the Multi-Purpose Logistics Module (MPLM) on Flight ULF2, scheduled for launch in October 2008.

Development

At the end of FY 2007, all ISS development is complete except Habitability Upgrades and ExPRESS Logistics Carrier (ELC) improvements.

Node 3

Node 3 is being built in Italy by the European Space Agency, but is owned by NASA. It will provide an additional 3470 cubic feet of volume for Advanced Regenerative Environmental Control and Life Support System (ECLSS) and waste management. Node 3 is scheduled for delivery to KSC in FY 2007. Ground processing will occur at KSC to support launch in FY 2010.

Regenerative Environmental Control and Life Support System (ECLSS)

Regenerative Environmental Control and Life Support System (ECLSS) Water Recovery System (WRS) development will be complete in FY 2007 and is manifested on Flight ULF-2. The Oxygen Generation System (OGS) was launched on Flight 12A in September 2006. Early checkout was successful. Activation will occur in FY 2007 following lab integration and vent installation. Regenerative ECLSS will allow operations with a crew size of six to be established in FY 2009 and provide a critical test bed for exploration.

Habitability Upgrades

Habitability Upgrades (modification for crew quarters, galley, waste collection/hygiene compartment, organic constituent analyses, and exercise facilities) will continue in FY 2008. Scheduled for launch on Flight 17A, Habitability Upgrades provide critical hardware enabling six person crew operations to be established in FY 2009. These upgrades will be completed by CY 2008.

ExPRESS Logistics Carrier

The final remaining flight hardware is the ExPRESS Logistics Carrier (ELC). ELC will support launch and external stowage of critical ISS components and spares necessary for post-Shuttle ISS maintenance and support. The ELC will also provide accommodations for external research payloads. Goddard Space Flight Center (GSFC) is responsible for ELC implementation to design, build, test, and deliver five full-sized unpressurized carriers. Kennedy Space Center (KSC) is responsible for ELC outfitting.

Major Program Annual Report

Pursuant to the requirements of section 103 of the NASA Authorization Space Act of 2005, (Pub. Law 109-155; 42 U.S.C. 16613; Act) each major development program with an estimated lifecycle cost of $250 million or more, that has been approved to proceed to implementation, is required to submit a Major Program Annual Report. To date, the ISS was one of the major development programs within NASA fitting these criteria. ISS submitted its Major Program Annual Report in FY 2007. It provided an estimate of the life-cycle cost for the program, development milestones, program risks, and detailed breakout of the development cost. At the end of FY 2006, approximately 97.5 percent of ISS development was complete, and by the end of FY 2007 all ISS development will be complete except Habitability Upgrades and ExPRESS Logistics Carrier (ELC) improvements. ISS will not continue to submit yearly reports as all development is essentially complete.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Assembly	ISS	Specific flight dates subject to resumption of Shuttle flights.	ISS Assembly complete by 2010.

Implementation Schedule

Project	Schedule by Fiscal Year																Phase Dates			
	Prior	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20		Beg	End	Mile-stone
ISS																	Tech			
																	Form			
																	Dev	Oct-93	Sep-07	
																	Ops	Oct-07	Sep-16	
																	Res			

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Mission Directorate:	Space Operations
Theme:	International Space Station
Program:	International Space Station Program

Program Management

The ISS Program Manager reports to the Associate Administrator for Space Operations at NASA Headquarters.

Project	Oversight	Lead Performer	Partners
On-orbit assembly and operations	NASA Johnson Space Center	The Boeing Company	Russian Federal Space Agency, European Space Agency, Japan Aerospace Exploration Agency, Canadian Space Agency, and Agenzia Spaziale Italiana (ASI).

Acquisition Strategy

As the Shuttle nears its retirement, the ISS Program intends to use alternative cargo and crew transportation services from commercial industry. In August 2006, NASA selected Space Exploration Technologies Corporation of El Segundo, California, and Rocketplane-Kistler of Oklahoma City, Oklahoma, to develop and demonstrate Commercial Orbital Transportation Services (COTS) that could open new markets and pave the way for contracts to launch and deliver crew and cargo to the International Space Station. NASA and the two companies signed Space Act Agreements that establish milestones and objective criteria to assess their progress throughout Phase 1 of the competition. Once a capability is demonstrated, NASA plans to purchase crew and cargo delivery services competitively in Phase 2. In December 2006, NASA issued a Request For Information (RFI) to obtain industry data on ISS commercial resupply opportunities in the interim period before implementation of COTS Phase 2. This RFI is for gathering industry data only in support of ISS cargo requirements in FY 2009 (Reference solicitation number: NNJ07ISSBG.) Funding for COTS is in the Constellation Systems Theme to better exploit potential synergies with exploration systems.

The ISS Program is developing an acquisition strategy that addresses completion of assembly and sustaining of the United States Orbital Segment (USOS). The current NAS 15-10000 contract has been extended, through exercising planned options, to run through September 30, 2008. This will ensure a stable contract environment through completion of assembly and Shuttle retirement.

Mission Directorate:	Space Operations
Theme:	International Space Station
Program:	International Space Station Program

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Other	NASA Advisory Council	10/2006	Provides independent guidance for the NASA Administrator.	02/2007
Other	ASAP	10/2006	Provides independent assessments of safety to the NASA Administrator.	10/2007
Other	Independent Safety Task Force	12/2006	Discover and assess possible ISS vulnerabilities that may impact vehicle health, compromise crew health, or necessitate premature abandonment. Final report will be released by 1st quarter of CY 2007.	none
Other	ISS Advisory Committee	03/2006	Assess ISS operational readiness to support new crew, assess Russian flight team preparedness to accomplish the Expedition 15 mission, and assess health and flight readiness of Expedition 15 crew.	02/2007

Mission Directorate:	Space Operations
Theme:	International Space Station
Program:	International Space Station Program

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Russian Segment capability to provide adequate Micrometeroid/Orbital Debris (MMOD) protection	Inadequate Micro-Meteoroid/Orbital Debris (MMOD) shielding on the Russian Segment can lead to greater potential for MMOD penetration and depress contingencies.	To mitigate the risk for Russian Segment MMOD, the International Space Station Program has launched and installed the Service Module (SM) conformal panels. The SM deployable shields are expected to be launched and installed in CY 2009. The program is working with Roscosmos on the plan to develop, launch, and install shielding enhancements for the Progress, Soyuz and Docking Compartment-1.
USOS Cargo Transportation Shortfall - 2007 through 2009	Given United States Orbital Segment (USOS) ISS assembly and logistics requirements, there is a 13 metric ton USOS cargo transportation shortfall from 2007 through 2009.	ISS Program Manager is negotiating with Russian Partners on mitigation options for the near-term cargo transportation shortfall. Additional options to mitigate the risk are addressed in a December 2006 NASA Request For Information (RFI) to obtain industry data on ISS commercial resupply opportunities in the interim period before implementation of COTS Phase 2.
USOS Cargo Transportation Shortfall - 2010 through 2015	Given Shuttle retirement in 2010 and current ISS transportation requirements, there is approximately 62.4 metric ton USOS cargo transportation shortfall from 2010 through 2015.	ISS requirements and capabilities are under review with assessments due by January 2007.
Non-Procurement & External Impacts on ISS Budget Implementation	Given that new and/or increased non-procurement charges continue to be levied on the ISS Program, the possibility exists that program reserves will be exhausted or major content will have to be deleted.	Technical Excellence funding issues have been resolved and service pool unwinding has been accomplished. Minor Service Pool issues for FY08 will be addressed in the upcoming PPBE. The impact of a year-long CR is being evaluated. JSC FTE ceiling impacts have been resolved for FY07. ISS will participate in the forward work starting in January to resolve the FY08 and subsequent challenges.
Export Control Issues (ATV/HTV and Columbus)	NASA contractors are required to obtain a Technical Assistance Agreements (TAA) from the Department of State if the contractor determines that they are required to provide technical information to foreign nationals. Certain international partners have expressed reservations in signing these TAAs, hindering progress on certification of the ATV and HTV for flight readiness.	NASA has discussed these issues with the Department of State and is pursuing an amendment to Section 126.6 of the International Traffic in Arms Regulations (ITAR). The amendment would extend to NASA the same exemption authority that is currently available to the Department of Defense and its contractors for foreign military sales activities.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)

Theme Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Space and Flight Support (SFS)	338.8	328.1	545.7	544.3	382.0	372.9	377.2
Space Communications	155.9	170.5	371.4	373.4	215.5	206.2	210.4
Launch Services	109.0	101.5	112.3	109.4	102.3	102.1	102.4
Rocket Propulsion Testing	64.0	46.2	51.3	51.0	53.8	54.2	54.1
Crew Health & Safety	10.0	9.9	10.6	10.5	10.4	10.4	10.4

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Theme Changes

	FY 2008		
Space and Flight Support (SFS)	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Space Communications	**193.7**	**371.4**	**177.7**
The current constellation of Tracking and Data Relay Satellite System (TDRSS) satellites are degrading such that the system capacity to meet all user requirements will likely be below that required by 2011 (50% confidence level). To ensure that capacity is sufficient for the full complement of users through 2016, NASA will procure two new satellites for deployment in 2012 and 2013.			
Launch Services	**120.6**	**112.3**	**-8.3**
Transferred Alpha Magnetic Spectrometer (AMS) from Exploration Systems Mission Directorate. The transfer was offset by overhead changes that resulted in a net reduction to the budget.			
Rocket Propulsion Testing	**67.0**	**51.3**	**-15.7**
Consistent with the Agency strategy to protect certain enabling cababilities, this budget maintains base funding by reallocating test funds from Shuttle due to retirement, and adding funding to maintain B-2 Test Chamber capability at NASA's Plum Brook Station in Sandusky, Ohio. Overhead changes resulted in a net reduction to the budget.			
Crew Health & Safety	**11.5**	**10.6**	**-0.8**
Changes in overhead resutled in a net decrease to the budget.			

Theme Purpose

Space and Flight Support (SFS), managed by the Space Operations Mission Directorate, is comprised of several distinct programs providing Agency-level services. These programs include Space Communications, Launch Services, Rocket Propulsion Testing (RPT), and Crew Health and Safety (CHS). These services are critical for enabling the conduct of space exploration, aeronautical research, and biological and physical research. These services are provided to a wide range of customers, including NASA scientists and engineers, other federal agencies, universities, foreign governments, and industry interests.

The Space and Flight Support Theme supports the following Goals in the 2006 NASA Strategic Plan:

Goal 5: Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.

Goal 6: Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)

Theme Overview

NASA's flight missions must be linked to Earth to accomplish their mission objectives. NASA uses a common infrastructure to provide these essential links. This infrastructure is managed by the Space Operations Mission Directorate's Space Communications Program.

NASA has assigned responsibility for understanding the full range of civil space launch needs to the Space Operations Mission Directorate Launch Services organization. The Launch Services Program, which works closely with other government agencies and the launch industry, seeks to ensure that the most safe, reliable, on-time, and cost-effective launch opportunities are available on a wide range of launch systems. These efforts help to achieve the national goals for leadership in understanding Earth and exploring the universe.

As the principal implementing authority for NASA's Rocket Propulsion Testing (RPT), the RPT Program reviews, approves, and provides direction on rocket propulsion test assignments, capital asset improvements, test facility modernizations and refurbishments, integration for multi-site test activities, identification and protection of core capabilities, and the advancement and development of test technologies.

The health care of the NASA Astronaut Corps is the responsibility of space medical operations at the Johnson Space Center. A portion of the responsibilities for that care is managed within the Crew Health and Safety program (CHS). CHS enables: 1) healthy and productive crew during all phases of spaceflight missions; 2) implementation of a comprehensive health care program for astronauts; and 3) the prevention and mitigation of negative long-term health consequences of space flight.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

SFS provides the enabling capabilities required to advance space exploration and expand scientific knowledge of Earth and the universe. Without these capabilities NASA could not perform many of its missions.

Relevance to the NASA Mission:

The Space and Flight Support Theme supports NASA's Vision for Space Exploration to conduct NASA robotic and human exploration missions by providing unique operational capabilities for spacecraft communications, launch services, and rocket tests, as well as managing the health care of the Astronaut Corps.

Relevance to education and public benefits:

The benefits of SFS include: the relay of scientific data from space to Earth; the safe launching of expendable launch vehicles necessary for research; the assurance that rocket systems have been adequately tested; and the testing and implementation of various human health and illness prevention measures. A space program properly supported by this Theme will produce research data that can be used to generate new scientific knowledge through the study of heliophysics, astrophyisics, solar system exploration, Earth science, biological and physical research, and more. These activities benefit both the general public and the education community.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)

Performance Commitment

Performance Measure #	Description	Contributing Program (s)
Strategic Goal 5	**Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.**	
Outcome 5.1	**Develop and demonstrate a means for NASA to purchase launch services from emerging launch providers.**	
APG 8SFS01	Realize competitive rates from emerging U.S. launch providers and open the bidding process to a larger number of launch providers.	Launch Services
Strategic Goal 6	**Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.**	
Outcome 6.4	**Implement the space communications and navigation architecture responsive to science and exploration mission requirements.**	
APG 8SFS02	Implement technology initiatives consistent with approved baseline space communications and navigation architecture.	Space Communications
APG 8SFS03	Complete the Exploration Communications and Navigation System (ECANS) Preliminary Design Review (PDR).	Space Communications

Performance Achievement Highlights

Space Communications

The Space Communications Architecture Report and supporting documents to establish the Space Communications architecture was released and presented to the Strategic Management Council (March 2006).

SFS achieved above 95 percent Space Network data delivery to the International Space Station, each Space Shuttle mission, and all low Earth orbiting missions.

SFS achieved less than 3 percent lost operating time on NASA's Integrated Services Network (NISN) available services.

Launch Services

NASA's Launch Services Program achieved 100 percent success for FY 2006 launches: Pluto New Horizons was launched successfully on an Atlas V in January 2006; ST5 was launched successfully on a Pegasus XL in March 2006; and CALIPSO and Cloudsat were launched successfully on Delta II in April 2006.

Rocket Propulsion Testing

The Rocket Propulsion Test (RPT) Program implemented Integrated Propulsion Test Facility Utilization Schedules for Space Shuttle Main Engine, Integrated Powerhead Demonstrator (IPD), Orbital Maneuvering System, Vernier Reaction Control System, Reusable Solid Rocket Motor, and DoD Customers RS-68, AFRL Injector Coatings, and NGLT Auxiliary Propulsion Systems. Fourteen Test Assignments were made: 8 NASA/ 2 DoD/ 4 Industry. RPT signed a Strategic Alliance Agreement with the Constellation Systems Program to assure readiness of facilities and infrastructure. RPT savings/cost avoidance achieved = $3.2M in 2006.

Crew Health & Safety

Crew Health and Safety implemented the responsibility for evaluating the effects of space on pharmacological agents.

Quality

Performance Measure #	Description
Space and Flight Support (SFS) Theme	
APG 8SFS04	Achieve at least 98% Space Network proficiency for delivery of Space Communications services.
APG 8SFS05	Achieve less than 3% of lost operating time on the NASA Integrated Services Network (NISN) available services.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)

Performance Measure #	Description
APG 8SFS06	Complete all development projects within 110% of the cost and schedule baseline.

Program Assessment Rating Tool (PART):

The Space and Flight Support (SFS) Theme received an FY 2004 PART rating of "Adequate," and updates in FY 2005 and FY 2006 have confirmed improvement. The original assessment found that the program elements within this theme were generally effective in providing services to NASA and other customers, but needed better plans to improve those services in the future.

Several performance improvement areas were identified that NASA is taking action toward:
1) While maintaining a flat program funding profile, strive to improve the programs results by increasing efficiency.
2)Develop a plan to independently review all of the major program elements to support improvements and evaluate effectiveness and relevance.
3) Develop better measures that will help to drive program improvement.

Program funding has been relatively flat with the exception of adding funds for new TDRSS spacecraft; improvements are driven by increasing efficiency. New efficiency measures are under development. For example, the Space Network target for percent of planned data delivery achieved has increased from 95 percent to 98 percent and the actuals are meeting or exceeding the target. Improvements are also being identified through independent review of all the major program elements to evaluate effectiveness and relevance. The Launch Services and Space Communications Programs have contracted with the National Academy of Public Administration to perform these independent reviews. Progress toward completing these areas that needed improvement will continue, and the theme is planned for an updated review in FY 2007 that will assess how successful this progress has been.

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	National Research Council	01/2006	Independent Evaluation by National Research Council (NRC) was completed in September 2006 with final report due by 1st quarter of CY 2007.	n/a

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Space Communications

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Space Communications	155.9	170.5	371.4	373.4	215.5	206.2	210.4
TDRS Continuation	1.0	--	182.5	186.2	29.7	21.0	25.7
Other	154.9	170.5	188.9	187.2	185.8	185.2	184.7

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.
DSN, GN and ECANS budgets are not included here.

Highlights of Major Program Changes

	FY 2008		
Space Communications	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
TDRS Continuation	**0.0**	**182.5**	**182.5**
Provides funding for an additional two TDRS in conjunction with funding from partners.			
Other	**193.7**	**188.9**	**-4.9**
Changes in Technical Excellence and overhead resutled in a net increase to the budget.			

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Space Communications

Program Overview

Over its history, NASA has operated hundreds of robotic space missions, thousands of suborbital missions and flight tests, and placed humans in space. These flight missions must be linked to Earth to accomplish their mission objectives. NASA uses a common infrastructure to provide these essential links. The responsibility for this infrastructure is with the Space Operations Mission Directorate's Space Communications Program (SCP). NASA's backbone of communications capabilities reliably transmit data between the ground control centers and the flight missions. These capabilities keep the missions operating safely and return volumes of science and technology data that has led to innumerable discoveries about Earth, the solar system, and the universe.

The management of all NASA Space Communications activities was centralized October 2, 2006, within the Space Operations Mission Directorate. The centralization includes several existing networks: Deep Space Network (DSN), Space Network (SN), Ground Network (GN) and NASA Integrated Services Network (NISN), and Exploration Communications and Navigation Systems (ECANS) and supporting functions. The budget for DSN, GN, and ECANS will be reflected in the Science Mission Directorate and the Exploration Mission Directorate budgets.

The Space Communications Program serves NASA Mission Directorates, the managers of their approved space flight missions (both NASA-only and partnerships), NASA institutional facilities, and non-NASA organizations requiring services from the NASA SC assets. Non-NASA organizations include the Department of Defense, other U.S. government agencies, commercial companies, and foreign space agencies.

The Space Communications Program supports the Agency's goal to improve access to space for the Nation by making it increasingly safe, reliable, and affordable. This program supports Outcome 6.4 and Annual Performance Goals (APGs) 8SFS1 and 8SFS2.

For more information, please see https://www.spacecomm.nasa.gov/spacecomm/.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Space Communications

Program Relevance

The Space Communications Program supports the Agency's goal to improve the provision of access to space for the Nation by making access to space increasingly safe, reliable, and affordable. Reliability on all SCP networks is high, achieving 97 percent of the data delivery planned. It also supports the Agency's goal to establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations. It accomplished this by implementing the space communications and navigation architecture responsive to science and exploration mission requirements and implementing technology initiatives consistent with approved baseline space communications and navigations architecture.

The centrally managed SCP supports NASA Mission Directorates and external organizations with space communications and data systems services that are responsive to the mission needs, within the allocated resources of the program. This includes the utilization of commercial providers to the extent feasible and where cost effective. SCP also conducts space communications technology and standards development to provide mission-enabling, efficient, and effective services.

The SCP goals are derived from the NASA Strategic Plan and the subordinate tactical plans of the NASA Mission Directorates. Program goals are:
1. Mission Safety: Acquire, maintain, and operate SCP systems to achieve NASA and flight program objectives in a safe and reliable manner.
2. Mission Assurance: Provide SCP services to flight missions, as agreed and documented, in Service Level Agreements.
3. Mission Commitment: Work to avoid or resolve service problems.
4. Institutional Communication Assurance: Acquire, operate, and maintain NISN systems to meet Agency networking and video teleconferencing needs.
5. SC Planning: Evolve the SCP services consistent with the architecture framework and mission requirements.
6. Program Management: Manage SCP to best value, consistent with goals above.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Space Communications

Plans For FY 2008

In FY 2008, the SCP plans include continuing support of Earth and space science missions such as Hubble Space Telescope, Mars Reconnaissance Orbiter (MRO), and Galileo. SCP will support the human space flight missions of the Space Shuttle Program and the International Space Station. SCP plans to maintain its level of proficiency in support of all mission operations. The Space Communications Plan will be completed and submitted as required by the NASA Authorization Act of 2005. A Request for Proposal for Tracking and Data Relay Satellite - K/L (TDRS-K/L) acquisition will be released, a prime contractor selected, and the Preliminary Design Review completed. Upgrades to the NASA Integrated Services Network (NISN) mission network will be completed and services will migrate to the new infrastructure.

The Exploration Communications and Navigation Systems (ECANS) System Requirements Review and Preliminary Design Review will be completed. SCP will represent and advocate NASA spectrum positions at the World Radio Conference. The upgrade of the Deep Space Network (DSN) and alternate assets for operational Ka band to support Kepler, Mars Reconnaissance Orbiter, and other mission will begin. The plan for the DSN 70 meter replacement project will be completed and implementation will begin. Installation of 18 meter Ka-band systems at White Sands for the Solar Dynamics Observatory and the Lunar Reconnaissance Orbiter missions will be completed and the Distress Alerting Satellite System / Search and Rescue ground station technology demonstration will be completed and transitioned to other government agencies for operations.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Space Communications

Project Descriptions

SCP is responsible for providing communications services to flight missions and supplying NASA's terrestrial communications needs. SCP is comprised of several elements:

- Near Earth Network (NEN): globally distributed terrestrial tracking stations supporting launching, landing, and Earth orbiting spacecraft, primarily polar and equatorial orbiting spacecraft in low Earth orbit.

- Space Network (SN): Tracking and Data Relay Satellite System (TDRSS) in geosynchronous orbit and accompanying ground stations in White Sands, New Mexico, and Guam; SN provides LEO missions with continuous coverage. TDRSS provides five operational satellites to satisfy customer communications requirements, providing in-flight ommunications with spacecraft operating in low-Earth orbit. To minimize the loss of capacity for the full complement of users, NASA will procure two new communications satellites for deployment in 2012 and 2013.

- Deep Space Network (DSN): globally distributed terrestrial tracking stations predominantly supporting missions beyond Earth orbit.

- NASA Integrated Services Network (NISN): provides point-to-point terrestrial signal transport services and routing network services among facilities such as NASA flight support networks, mission control centers, and science facilities, and administrative communications among NASA Centers utilizing commercial service backbones.

- SCP Crosscutting Functions: spectrum, standards, technology, external coordination, resources, and systems planning functions that enable NASA's SCP networks.

Other activities include initiating and managing communications and navigation technology initiatives to reduce cost; developing an architecture to support exploration and science missions; managing access to communications frequencies in order to conduct space/ground based transmissions; and conducting proof-of-concept analysis for space-based search and rescue system to improve distress alert and location capabability.

Both TDRSS and NISN provide service to non-NASA missions on a reimbursable basis.

The SCP supporting functions include the following:

- Spectrum: Management of spectrum and orbital slot resources for all NASA organizations. The Spectrum Manager ensures proper Agency representation in national and international spectrum regulatory forums, and shall advise the Deputy AA for Space Communications regarding spectrum issues and policy, as described in NPD 2570.5D.

- Standards Management: The Standards Manager is responsible for management and coordination of communications and data standards for all NASA organizations. The Standards Manager ensures proper Agency representation, including the Office of the Chief Engineer (OCE), in national and international standards regulatory forums, and advises the Deputy AA for Space Communications regarding standards issues. A Standards Management Plan guides the activities in this domain.

- Technology Management: The Technology Manager is responsible for management and coordination of communications technology, research, and prototyping activities for NASA. The Technology Manager advises the Deputy AA for Space Communications regarding technology activities and investments, including those deemed necessary to fulfill Agency goals for space exploration. A Technology Management Plan guides the activities in this domain.

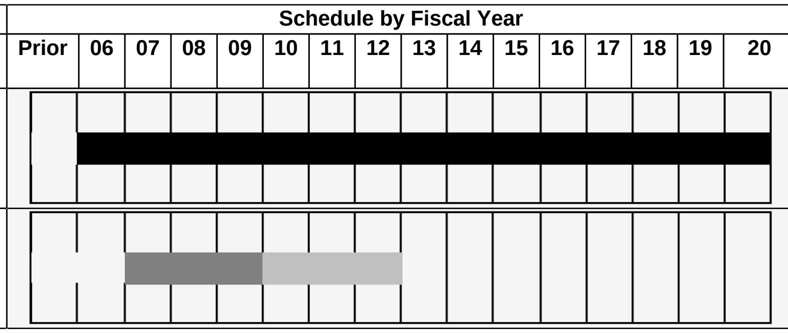
- External Coordination: Under direction of the Deputy AA for Space Communications, the External Coordination Manager conducts and coordinates all space communications interfaces with organizations external to NASA, including inter-agency and international efforts.

- Requirements Management: The Requirements Manager is responsible for managing the requirements that enable NASA to fulfill its space communications needs for future missions and is the SCP entry point for new missions. The SCP receives advice and input from the Requirements Working Group, which is chaired by a representative from the SCP.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Achieve less than 3% of lost operating time on NISN available services.	NISN	Less than 3% data loss.	Less than 3% data loss.
Achieve at least 98% Space Network proficiency for delivery of Space Communications services.	SN	98% proficiency.	98% proficiency.

Implementation Schedule



Project	Phase	Beg	End	Milestone
Other - Space Communications	Tech			
	Form			
	Dev			
	Ops	Oct-05	Oct-20	
	Res			
TDRS	Tech			
	Form	Oct-06	Sep-09	
	Dev	Oct-09	Sep-12	
	Ops			
	Res			

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

The Deputy AA for Space Communications reports to the Associate Administrator for Space Operations at NASA Headquarters.

Project	Oversight	Lead Performer	Partners
Other - Space Communications	Space Communications Program Office - NASA Headquarters	Headquarters	Goddard Space Flight Center, Marshall Space Flight Center
TDRS	Space Communications Program Office - NASA Headquarters	Headquarters	Goddard Space Flight Center, Marshall Space Flight Center and Kennedy Space Center.

Acquisition Strategy

The TDRS Continuation Project is a joint partnership between NASA and several outside partners. A cost sharing arrangement with outside partner users is in negotiation. To meet the 2011 need date, it is essential that pre-formulation activities begin in FY 2007 and that the contract for spacecraft development be in place by the end of FY 2007.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	National Research Council	01/2006	SOMD Space Communications Independent Evaluation by National Research Council (NRC) was completed in September 2006 with final report due by 1st quarter of CY 2007.	n/a

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
TDRS K and L Schedule Risk Management	Schedule - aggressive plan for acquision which supports procurement in FY 2007 and launch TDRS K in 2012 and TDRS L in 2013.	Failure to meet the current schedule requirement will cause the schedule to slip and the 2011 launch date may not occur. Should this happen, the project schedule would be re-evaluated and possibly re-negotiated with the partner users.
TDRS K and L Funding Risk Management	Funds Availability - due to a Continuing Resolution, appropriated funding may not be available until quarter 3 of the fiscal year.	There is a high probability that the issuance of appropriated funding will occur late in FY07. If the Fixed Price Procurement can be awarded in two phases, then NASA could award with its funds and add other customer funds as a modification to the contract.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Space Communications
Project In Formulation:	TDRS Continuation

Budget / Life Cycle Cost

Budget Authority ($ millions)	FY06	FY07	FY08
FY 2008 President's Budget Request	**1.0**	**--**	**182.5**
FY 2007 President's Budget Request	**1.0**	**--**	**--**
Total Change from FY 2007 President's Budget Request	**0.0**	**0.0**	**182.5**

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.
Budget represents NASA's portion of the TDRS effort.

Project Purpose

Tracking and Data Relay Satellite (TDRS) Continuation Project supports the Agency's goal to establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations. It accomplishes this by implementing the space communications and navigation architecture responsive to Science and Exploration mission requirements and implementing technology initiatives consistent with approved baseline space communications and navigations architecture.

The existing fleet is aging and reliability analysis predict a shortage of flight assets to support NASA missions and the user community by 2011. As a result, NASA will proceed in FY 2007 with the acquisition of two additional spacecraft, TDRS-K&L to be launched in 2012 and 2013. By adding these two spacecraft to the fleet, TDRS-K&L will extend reliable support until approximately 2016 with current loading estimates. An option to procure two more spacecraft will be included as part of the procurement.

Project Parameters

The current system is responsible for the management of the procurement, design, development, test, launch, on-orbit evaluation and anomaly resolution of TDRS spacecraft. The TDRS spacecraft include the basic program (TDRS 1-6), the replacement program (TDRS 7), and the TDRS H, I, and J replenishment program or TDRS 9-10. The TDRS system consists of in-orbit telecommunications satellites stationed at geosynchronous altitude and associated ground stations located at White Sands, New Mexico and Guam Naval Station. This system of satellites and ground stations comprises the Space Network that provides mission services for near Earth user satellites and orbiting resources, with many near-Earth spacecraft being totally dependent upon it for performance. The anticipated procurement of TDRS K and L will be used to replenish the present TDRSS.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Space Communications
Project In Formulation:	TDRS Continuation

Project ROM Estimate

The TDRS K and L spacecraft will be fully compatible with and capable of functioning as part of the TDRS System, as implemented and operated by the White Sands Complex (WSC) and Guam Naval Station. Requirements will include: design, development, fabrication, integration, test, on-orbit delivery, and launch services. Launch dates for TDRS K and L will be in 2012 and 2013 respectively. The spacecraft are required to have an operational life of eleven years. Expendables and wear out items should be designed for a mission life of fifteen years. The basic requirement will also include modification of a subset of the WSC Space-to-Ground Link Terminals to provide compatibility with the new spacecraft, while preserving backwards compatibility with the existing TDRS spacecraft.

Project Element	Provider	Description	FY 2007 PB Request	FY 2008 PB Request
TDRS Continuation	NASA	Aging hardware replacement	Commitment was not yet requested.	NASA will be commiting to $450M through FY 2013.

Schedule ROM Estimate

Qtr 2 2007 - Release RFP for TDRS-K/L acquisition
Qtr 4 2007 - Select Prime Contractor
FY 2008 - Complet Preliminary Design Review (PDR)

Milestone Name	Formulation Estimate	FY 2007 PB Request	FY 2008 PB Request
Formulation			
Complete Preliminary Design Review for two TDRS compatable satellites	FY 2008	n/a	FY 2008

Project Management

The Deputy AA for Space Communications reports to the Associate Administrator for Space Operations at NASA Headquarters.

Project Element	Element Oversight	Lead Performer	Partners
TDRS	Space Communications and Navigation (SCAN) Office	SCAN	GSFC, MSFC, and KSC.

Acquisition Strategy

An Acquisition Strategy for this procurement is under evaluation and being considered by the Program Office.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Space Communications
Project In Formulation:	TDRS Continuation

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
TDRS K and L Schedule Risk Management	Schedule - aggressive plan for acquision which supports procurement in FY 2007 and launch TDRS K in 2012 and TDRS L in 2013.	Failure to meet the current schedule requirement will cause the schedule to slip and the 2011 launch date may not occur. Should this happen, the project schedule would be re-evaluated and possibly re-negotiated with the partner users.
TDRS K and L Funding Risk Management	Funds Availability - due to a Continuing Resolution, appropriated funding may not be available until quarter 3 of the fiscal year.	There is a high probability that the issuance of appropriated funding will occur late in FY07. If the Fixed Price Procurement can be awarded in two phases, then NASA could award with its funds and add other customer funds as a modification to the contract.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Launch Services

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Launch Services	109.0	101.5	112.3	109.4	102.3	102.1	102.4

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Launch Services	**120.6**	**112.3**	**-8.3**
Transferred Alpha Magnetic Spectrometer (AMS) from Exploration Systems Mission Directorate. The transfer was offset by overhead changes that resulted in a net reduction to the budget.			

Program Overview

Assuring reliable and cost-effective access to space for missions is critical to achieving the Vision for Space Exploration. NASA has assigned responsibility for understanding the full range of civil space launch needs to the Space Operations Mission Directorate Launch Services Program. The Launch Services Program, which works closely with other government agencies and the launch industry, seeks to ensure that the most safe, reliable, on-time, cost-effective launch opportunities are available on a wide range of launch systems. A key challenge of the program is understanding the launch needs of the different civil government customers. These customers seek to: understand Earth processes, including the use of weather satellites; explore the universe with planetary probes, Mars rovers, and orbiters; and enhance life on Earth by understanding the universe using various scientific missions. The program purchases fixed-price launch services from domestic suppliers and provides oversight to ensure that these valuable, one-of-a-kind missions safely leave Earth to explore the universe beyond. The program works with customers from universities, industry, government agencies, and international partners from the earliest phase of a mission. The funding provides the capability for NASA to maintain critical skills that provide technical management of launch services on the full fleet of existing and new launch systems. For more information, please see http://www.nasa.gov/centers/kennedy/launchingrockets/index.html.

Program Relevance

The Launch Services Program (LSP) is responsible for enabling access to space for NASA and other select government missions. LSP is responsible for a wide range of activities critical to fulfilling the Vision for Space Exploration. LSP provides safe, reliable, cost-effective and on-time launch services for NASA and NASA-sponsored payloads using expendable launch vehicles (ELVs). The program increases the opportunity for mission success by reducing launch risk through a technical oversight approach that includes a combination of specified approvals and targeted insight. The LSP is also responsible for NASA oversight of launch operations and countdown management and provides added quality and mission assurance in lieu of the requirement for the launch service provider to obtain a commercial launch license.

Plans For FY 2008

There are several planned launches for FY 2008: Space Tracking and Surveillance System (STSS), Gamma-ray Large Area Space Telescope (GLAST), National Oceanic and Atmospheric Administration-N Prime (NOAA-N'), Interstellar Boundary Explorer (IBEX), Ocean Surface Topography Mission (OSTM), Orbiting Carbon Observatory (OCO), and Solar Dynamics Observatory (SDO). STSS, GLAST, NOAA-N', and OSTM will be launched on Delta II rockets and SDO will be on an Atlas V. IBEX and OCO will launch on a Pegasus XL and Taurus XL, respectively. In addition to the processing, mission analysis, and spacecraft integration and launch services of the above missions, LSP plans the continued advanced planning and trade studies for launching future missions that will extend scientific knowledge and exploration capabilities, such as a mission to Jupiter, a wide-field infrared telescope, the next-generation Mars rover, lunar reconnaissance, and a mission to study the ocean's role in climate and weather. LSP plans continue advanced planning to support the evolving launch requirements for Moon and Mars exploration, and will complete certification of the Taurus XL launch system planned for use on NASA missions.

Project Descriptions

The Launch Service Program (LSP) provides the acquisition of commercial services using primarily domestic Launch Vehicles and associated standard services, non-standard services (mission unique options), and engineering and analysis. These services are contracted through LSP at the Kennedy Space Center (KSC). LSP provides a launch vehicle selection process and engineering and analysis for launch vehicle certification at levels of detail commensurate with the mission risk tolerance. LSP also provides technical management of the launch service; technical insight into the launch vehicle production/test; coordination and approval of mission-specific integration activities; coordination and approval of mission-unique launch vehicle hardware/software development; provision of payload-processing accommodations; and management of the launch campaign/countdown. The program maximizes mission success of commercially developed expendable launch services by employing a technical oversight approach that includes a combination of specified approvals and targeted insight. Manifesting and scheduling of payload launches are accomplished on a routine basis through the auspices of the Flight Planning Board. Through this process all space access requirements and priorities are assessed to develop flight planning manifests that best meet the requirements and capabilities of the Agency. LSP acquires launch services to meet the full range of customer requirements. These requirements range from finding space for small payloads to the launch of dedicated payloads on a range of launch vehicles. LSP mission support capability assures NASA retains the technical, management, and acquisition skills necessary to meet customer demand. This capability provides the staffing and facilities required to meet the Agency's various launch service needs.

LSP Projects

LSP provides planning, execution, and support for flight project customer requirements. The functions provided include acquisition and management of all program-related services; and program -level financial management including the integration and insight of the launch services projects across multiple Centers and management of all program resource requirements. LSP provides implementation of the Contracting Officer Technical Representative (COTR) function for Expendable Launch Vehicle Integrated Support (ELVIS), all of the NASA launch service contracts, and contracts for commercial Payload Processing Facilities' (PPFs), ensuring consistency and best practices are followed among the various contracts.

LSP has partnered with Stennis Space Center (SSC) to provide engine assembly oversight through the monitoring of RS-68 engine test schedules and operations. SSC participates in RS-68 engine test firings, pedigree and hardware acceptance reviews, and provides performance results to LSP.

LSP is responsible for managing the launch service, planning and implementation of technical schedules, budget and integration efforts, and launch site processing of spacecraft missions. The Fleet Systems Project is responsible for coordinating mission-specific and fleet-wide launch vehicle analyses, hardware changes, and production oversight, assessments, and out-of-family anomaly resolution. They also provide leadership, expertise in launch vehicle fleet integration, and assurance of expendable launch vehicle readiness to achieve a safe and successful launch per NPD 8610.23, and launch vehicle certification per NPD 8610.7.

LSP has partnered with Marshall Space Flight Center (MSFC) to manage and maintain a resident office at Boeing's Delta Launch Vehicle Factory in Decatur, Alabama. MSFC provides specific engineering discipline support to the launch vehicle certification processes for risk category 2 and 3 certification and technical support as required.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Launch Services

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
The Launch Services Program is planning for 29 missions by 2012.	SMD - 23 Missions, ESMD - 4 Missions, and DOD - 2 Mission	The Launch Services Program planned six launches in FY08.	The Launch Services Program is planning seven launches in FY08.

Program Management

The Launch Services Program Manager reports to the Associate Administrator for Space Operations at NASA Headquarters.

Project	Oversight	Lead Performer	Partners
Launch Services Acquisition and Management	Launch Services Program, Kennedy Space Center	Kennedy Space Center	Air Force, National Reconnaissance Office
Engine Assembly and Test	Launch Services Program, Kennedy Space Center	Stennis Space Center	Air Force, National Reconnaissance Office
Mission Planning and Integration	Launch Services Program, Kennedy Space Center	Kennedy Space Center	Science Mission Directorate, Exploration Systems Mission Directorate, Missile Defense Agency, NOAA
Vehicle Production Insight	Launch Services Program, Kennedy Space Center	Marshall Space Flight Center	Air Force, National Reconnaissance Office

Acquisition Strategy

Under the NASA Launch Services (NLS) contracts with Boeing, Lockheed Martin, and Orbital Sciences, the program acquires services associated with launches of Delta, Atlas, Pegasus, and Taurus launch vehicles. Services are provided on a Firm-Fixed-Price/IDIQ basis, and missions can be ordered under these contracts through June 2010. Missions not presently under contract are competed among existing NLS contractors through use of a Launch Service Task Order mechanism. In addition to the NLS contracts, four active missions remain under the Small Expendable Launch Vehicle Services contract with Orbital Sciences.

The NLS solicitation contains an On-Ramp provision that permits technology infusion or improvements. New offerors may seek an NLS contract during On-Ramp open seasons that occur each year in February and August. The NLS contracts enable ordering of standard and non-standard services, as well as special studies and mission-unique modifications.

Integrated launch services are provided by the Analex Corp. through a hybrid fixed-price/cost contract which contains options to continue performance through September 2011. Payload processing for East Coast missions is provided by Astrotech Space Operations; a competitive procurement is in process for payload processing for West Coast missions.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Launch Services

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO Assessment	10/2006	Non-Advocate Review (NAR) of LSP to present information to Agency decision-making councils.	2008
Performance	National Academy of Public Adm	9/2006	Independent assessment on LSP performance.	none
Performance	NASA Human Capital Study	10/2006	Independent assessment on KSC implementations of NASA's full cost and workforce planning.	none

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Delta II Production Line	RISK: The future of Delta II production line is unknown at this time.	NASA should continue flying the Delta II beyond 2009 using existing vehicle inventories. NASA will compete the contract award against viable options. Fund launch site infrastructure as an Agency capability for one pad (SLC-17B) on the east coast. No additional missions will be manifested on Delta II at Vendenburg Air Force Base (SLC-2W).
Limited number of domestic providers of services to support scheduled launch missions.	RISK: There are a very limited number of domestic providers to support scheduled missions.	Through acquisition strategy, the program will maximize the number of bidders for the various missions supported by the Launch Services Program.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Rocket Propulsion Testing

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Rocket Propulsion Testing	64.0	46.2	51.3	51.0	53.8	54.2	54.1

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Major Program Changes

Program Title:	FY 2008		
	FY 2007 PB Request	FY 2008 PB Request	Change
Rocket Propulsion Testing	**67.0**	**51.3**	**-15.7**
Consistent with the Agency strategy to protect certain enabling cababilities, this budget maintains test capability by reallocating test funds from Shuttle due to retirement, and adding funding to maintain B-2 Test Chamber capability at NASA's Plum Brook Station in Sandusky, Ohio. Overhead changes resulted in a net reduction to the budget.			

Program Overview

As the principal implementing authority for NASA's rocket propulsion testing, the Rocket Propulsion Test (RPT) Program reviews, approves, and provides direction on rocket propulsion test assignments, capital asset improvements, test facility modernizations and refurbishments, integration for multi-site test activities, identification and protection of core capabilities, and the advancement and development of test technologies.

RPT employs a collaborative approach to ensure rocket propulsion test activities are conducted in a manner that minimizes cost, ensures safety, provides credible schedules, achieves all technical objectives, and leverages the lessons learned. RPT reduces propulsion test costs through the safe and efficient utilization of rocket propulsion test facilities in support of NASA programs, commercial partners, and the Department of Defense, while eliminating unwarranted duplication. RPT sustains and improves Agency-wide rocket propulsion test core capabilities (both infrastructure and critical skills) and ensures appropriate levels of capability and competency are maintained.

The program strategy is to fund and maintain a core competency of skilled test and engineering crews and test stand facilities; consolidate and streamline NASA's rocket test infrastructure; establish and maintain world-class test facilities; modernize test facility equipment; provide non-project specific equipment and supplies; and develop effective facility/infrastructure maintenance strategies and performance. RPT supports several Agency Strategic Goals: Strategic Goal 1, Fly the Shuttle as safely as possible until its retirement, not later than 2010; Strategic Goal 4, Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement; and Strategic Goal 6, Establish a lunar return program having the maximum possible utility for later mission to Mars and other destinations.

Further information on the RPT Program can be found at: https://rockettest.ssc.nasa.gov/.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Rocket Propulsion Testing

Program Relevance

Test capabilities will continue to support safe operation of the Space Shuttle, implementation of the Vision for Space Exploration, and use by other DoD and commercial programs. Capabilities include rocket propulsion test facilities, associated infrastructure and systems, and the core skilled workforce necessary to operate and maintain these assets. These capabilities are critical for the testing of existing and new rocket propulsion systems used by the Shuttle, Constellation Systems, and other programs for their safe and successful operation, and in general, for the Nation's access to space.

Plans For FY 2008

Test facility management, maintenance, sustaining engineering, operations, and facility modernization projects required to keep the test-related facilities in the appropriate state of operational readiness will continue to be funded. Established testing requirements for the exploration program will be used to identify excess and "at-risk" test facilities and will support decisions relative to test asset consolidation initiatives. The RPT's inventory of 32 test stands, ranging from active to mothballed facilities, will continue to be maintained at various states of operational readiness as required. Propulsion test technology development will also be continued.

The RPT Program will also continue to assist in the rocket propulsion testing requirements definition for low Earth orbit and in-space propulsion systems and related technologies.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Rocket Propulsion Testing

Project Descriptions

The RPT represents the single point interface for NASA's rocket propulsion test facilities located at: Stennis Space Center (SSC); Marshall Space Flight Center (MSFC); Johnson Space Center-White Sands Test Facility (JSC-WSTF); and Glenn Research Center-Plum Brook Station (GRC-PBS). These facilities have a replacement value of greater than two billion dollars. The RPT provides for enabling support of test facilities at the performing Centers, conducting test facility management, maintenance, sustaining engineering, operations, and facility modernization required to keep test-related facilities in a state of operational readiness.

The RPT sustains and improves Agency-wide rocket propulsion test core competencies (both infrastructure and critical skills), ensures appropriate levels of capability and competency are maintained, and eliminates unwarranted duplication. The program strategy is to fund and maintain core competencies of skilled test and engineering crews and test stand facilities; consolidate and streamline NASA's rocket test infrastructure; establish and maintain world-class test facilities; modernize test facility equipment; provide non-project specific equipment and supplies; and develop effective facility/infrastructure maintenance strategies and performance.

The RPT budget does not include resources to support the marginal costs of testing (e.g., direct labor, propellants, materials, program-unique facility modifications, etc.) since these activities are to be funded by programs as a direct cost when they occupy the RPT test stands. When NASA, DoD, and commercial partners occupy periods at the RPT-supported test stands, they are responsible for program-specific facility modifications in addition to the active testing of the program-specific test article.

Rocket Propulsion Testing Capabilities

To effectively maintain the Agency's rocket propulsion test capabilities, the RPT Program sustains the rocket propulsion testing core competencies, which includes both enabling infrastructure and skilled workforce, while eliminating unwarranted duplication. The RPT works with other projects and programs to identify and develop future testing needs and approaches. These testing needs are used to assure the resources at NASA's RPT centers will be available when needed while excess capability is reduced. During the transition period between the Space Shuttle and the Constellation Systems Program, the RPT program must ensure that all future requirements are accounted for and test capabilities are available.

Much of the Agency's rocket test infrastructure is approximately 40 years old and close attention is being paid to identify and address technical risks so test stands can continue supporting propulsion testing. Identification, prioritization, and accomplishment of facility maintenance projects are major components in assuring these facilities and systems continue safe and reliable operation through the life of future Constellation Systems Program requirements. The focus of the majority of these projects is on large scale systems that are common among multiple test facilities.

Development of rocket propulsion test technology is another objective of the RPT. This is accomplished through specific technology tasks for potential benefit to rocket propulsion testing in the areas of safety, technology, or operational efficiency.

The RPT collaborates with the DoD in developing efficiencies and cost savings through the National Rocket Propulsion Alliance (NRPTA). This forum facilitates sharing of equipment and operations knowledge, and acts as a central interface for potential test customers to contact both NASA and DoD facilities. The NRPTA includes POC's from six NASA centers and four DoD centers, all of whom offer test expertise.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Support continued commercial testing of RS-68 engine.	Pratt Whitney Rocketdyne/Air Force	Support all rocket propulsion test operations.	Support all rocket propulsion test operations.
Support continued testing of SSME, Shuttle Reaction Control System, and SRB Technology testing.	Space Shuttle Program	Support all rocket propulsion test operations.	Support all rocket propulsion test operations.
Support Advanced Propulsion System Test Bed, J-2X, and ESMD Propulsion System tech development.	Constellation Program	Support all rocket propulsion test operations.	Support all rocket propulsion test operations.

Program Management

The Rocket Propulsion Testing Program Manager reports to the Associate Administrator for Space Operations at NASA Headquarters.

Project	Oversight	Lead Performer	Partners
Technical Services and Support	Stennis Space Center	Jacobs-Sverdrup, Mississippi Space Services, Plum Brook Operations Support Group	Rocket Propulsion Test Management Board Members: Stennis Space Center, Marshall Space Flight Center, Johnson Space Center, White Sands Test Facility, Glenn Research Center's Plum Brook Station, Kennedy Space Center (associate member), and Glenn Research Center (associate member). National Rocket Propulsion Test Management Board Department of Defense Members: Air Force Research Lab, Arnold Engineering Development Center, Redstone Technical Test Center, and Naval Air Warfare Center.

Acquisition Strategy

The Test Operations Contract (TOC) will be completing the second year of its first two-year option contract period which began in September 2006.

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Facility infrastructure	The RPT's 40 year old facilities require extensive maintenance to extend their functional performance life for several decades.	The RPT is strategically investing limited maintenance funding for critical projects on the facilities required by test projects. The RPT will employ an approach that includes multi-year phasing of significant projects and funding project design packages to develop improved cost and schedule data. The RPT will determine and undertake the most vulnerable system issues in priority order.
Uncertainty of Exploration Systems requirements for RPT test facilities	Since the Exploration Program is still early in the design, development, test, and evaluation process, testing requirements for RPT facilities are evolving, most specifically those requirements associated with the Crew Exploration Vehicle.	RPT will continue evaluating ESMD's requirements, assessing impacts, and identifying resources to achieve test schedules. RPT formed an alliance with the Constellation Systems Program Propulsion Test Integration Group to provide review of test schedules, and to make appropriate test assignments. RPT will coordinate with multiple stakeholders across NASA to make test facility investments.
Critical skills	The RPT must retain the critical test facility engineering and operations skills held by the test site workforce during the transition period between the Space Shuttle phase-out and the Constellation Program phase-in.	RPT will monitor Constellation's developing requirements, and continue to monitor the effects of Shuttle's plans on the RPT workforce. The information derived from this analysis will be used to identify the specific propulsion test skills needed to perform the Agency's requirements. The RPT will create plans to shift NASA's present resources, as needed, to maintain the core competencies.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Crew Health & Safety

Program Budget

Budget Authority ($ millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Crew Health & Safety	10.0	9.9	10.6	10.5	10.4	10.4	10.4

Note: FY 2007 column represents the 2007 President's Budget in full-cost simplification.

Highlights of Major Program Changes

	FY 2008		
Program Title:	**FY 2007 PB Request**	**FY 2008 PB Request**	**Change**
Crew Health & Safety	**11.5**	**10.6**	**-0.8**
Changes in overhead resutled in a net decrease to the budget.			

Program Overview

The health care of the NASA Astronaut Corps is the responsibility of space medical operations at the Johnson Space Center. A portion of the responsibilities for that care is managed within the Crew Health and Safety program (CHS). CHS enables the following: 1) healthy and productive crew during all phases of spaceflight missions; 2) implementation of a comprehensive health care program for astronauts; and 3) the prevention and mitigation of negative long-term health consequences of space flight. The program works towards these goals by providing the means to capture and analyze the evidence base essential to identify health risks and apply this information to operational medicine. CHS also develops, assesses, and refines standards for clinical and physiological testing, in-flight health and performance, and environmental monitoring. Requirements for the medical care system are continually assessed and refined, modifications and enhancements identified, and development of capabilities undertaken when needed.

Program Relevance

CHS provide enhancements to the health care provision environment both in space and on the ground. The program manages health care for the Astronaut Corps, both while in space and during ground-based training. CHS certifies the medical health of astronauts before flight and provides them with care throughout their careers. CHS also medically supports the ISS, Shuttle, and Orion activities, including planning, training, and medical operations support.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Crew Health & Safety

Plans For FY 2008

CHS will continue to help develop and refine a standardized battery of clinical and physiological tests for all crewmembers. Workshops are planned to refine evidence-based information with the intent of applying this information to operational medicine. Crew Health Surveillance special projects will focus on developing and refining medical standards. This is critical to meet the needs of exploration timelines. Similarly, real-time mission evaluation will help define and deliver medical operations hardware for current programs and meet the needs of known architectures. The Longitudinal Study of Astronaut Health will be enhanced with respect to data archiving and mining. This is crucial to being able to provide health information for current and future operational medical response, as well as for countermeasures development. Remote Medical Diagnostic and Informatics will design, implement, and maintain a comprehensive data management infrastructure. Modules for real-time collection of medically relevant mission data will continue to be added to the Mission Medical Information System this year. Additional tools will be implemented as operational needs and priorities are identified. NASA will continue adding all forms of clinical data to the Computerized Medical Information System, which is an electronic medical record used for real-time documentation of clinical care at the point of care. Finally, CHS will continue to develop and maintain environmental standards for all space exploration platforms.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Crew Health & Safety

Project Descriptions

The CHS Office is responsible for supporting a program of comprehensive health care necessary to enable a healthy and productive crew during all phases of spaceflight missions, and to prevent and mitigate long-term negative health consequences as a result of spaceflight. The CHS Office raises awareness and accountability for the total scope of health and safety of NASA's Astronaut Corps. The major functions of Crew Health and Safety are to provide headquarters leadership, advocacy and support for the following: design, implement, and manage a comprehensive healthcare program for spaceflight; provide mission support on operational health-related issues and tasks; conduct astronaut medical selection certification and health maintenance; collect, archive, and manage biomedical data pertinent to the prevention and/or remediation of adverse medical events; and conduct technology development and clinical operational efforts required to support long-duration spaceflight missions.

Clinical Status Evaluation

Clinical Status Evaluation develops a standardized battery of clinical and physiological tests performed on all long-duration crewmembers for use in health-risk and operations-impact analysis.

Crew Health Surveillance

Crew Health Surveillance supports development and interpretation of operational health-related data from space flight. It also provides clinical team support for implementation and evaluation of medical requirements and for rapid response to clinical contingencies.

Real-Time Mission Evaluation

Real-Time Mission Evaluation supports the definition and implementation of medical care system requirements for all mission types in conjunction with medical operations efforts.

Longitudinal Study of Astronaut Health

Longitudinal Study of Astronaut Health archives astronaut medical record information in database form and performs data analyses to support clinical care and long-term health assessments of the Astronaut Corps using evidence-based medicine methodology.

Remote Medical Diagnostic and Informatics

Remote Medical Diagnostic and Informatics designs, implements, and maintains a comprehensive data management infrastructure to support the objectives of the Space Medicine Program.

Computerized Medical Information System

Computerized Medical Information System develops electronic medical records for real-time documentation of clinical care at the point of care and provides a foundation for the long-term goal of delivering medical information electronically to flight surgeons.

Clinical Care Capability Development Project

Clinical Care Capability Development Project designs, develops, and implements a comprehensive health-care system for space flight to include health monitoring, prevention, and intervention for all mission phases commensurate with medical operations guidelines.

Environmental Monitoring

Environmental Monitoring develops and maintains environment standards. It prepares and defends documents presented to the NRC during committee meetings; surveys all available literature on the compounds in question; and determines recommended exposure levels based upon NRC recommended methods. It also supports JSC's environmental laboratories.

Information Technology/ODIN Seats

Information Technology/ODIN Seats manages the costs of maintenance and replacement of contractor computers, phones, etc.

Program Commitments

Commitment/Output	Program/Project	FY 2007 PB Request	FY 2008 PB Request
Analysis of Fitness-for-Duty Standards	Clinical Status Evaluation	Analysis of current standards	Analysis of current standards
Data Reports	LSAH	90 Reports	90 Reports
Database for Medical Requirements Data	Remote Medical Diagnostic & informatics	10 MRIDs in DB	Additional 20 MRIDs in DB
Medical Hardware Certification Process Revision	Clinical Care Capability Development	AED pilot for process revision	Generic hardware certification process for medical COTS hardware
Electronic Medical Record System	Computerized medical Information System	Ongoing support	Ongoing support
Environmental Standards	Environmental Monitoring	Ongoing support	Ongoing support

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Crew Health & Safety

Program Management

The Crew Health and Safety Program Manager reports to the Deputy Associate Administrator for Program Integration within Space Operations at NASA Headquarters.

Project	Oversight	Lead Performer	Partners
Clinical Status Evaluation	JSC	JSC/Wyle	N/A
Crew Health Surveillance	JSC	JSC/Wyle	N/A
Real-Time Mission Evaluation	JSC	JSC/Wyle	N/A
Longitudinal Study of Astronaut Health	JSC	JSC/Wyle	N/A
Remote Medical Diagnostic & Informatics	JSC	JSC/Wyle	N/A
Computerized Medical Information System	JSC	JSC/Wyle	N/A
Clinical Care Capability Development Project	JSC	JSC/Wyle	N/A
Environmental Monitoring	JSC	JSC/Wyle	N/A

Acquisition Strategy

No major acquisitions planned.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Other	Institute of Medicine (IOM)	01/2003	NASA requested help from IOM in "assessing the [Longitudinal Study of Astronaut Health] study and making any necessary midcourse corrections." Outcome: IOM's report, Review of NASA's LSAH Study, makes recommendations for improving the validity of the LSAH as a database for monitoring the health of astronauts and for research on the effects of space on humans.	TBD
Other	CPHS	01/2006	Review the LSAH study for compliance with Human Subjects Study rules. Outcome: Approval renewed.	03/2007
Other	Booz-Allen-Hamilton	01/2005	Review security implementation of electronic medical database systems. Outcome: Space Medicine Division was evaluated and reviewed as a Moderate security system. The review team has deemed the system rating appropriate in accordance with the FIPS 199, Standards for Security Categorization of Federal Information and Information Systems, rating criteria.	TBD

Program Risk Management

Title	Risk Statement	Risk Management Approach and Plan
JSC Watch Item 1043/Resource Availability for Space Medicine Systems Information Tech Enhancements	Given the constrained resources for space medicine IT, there is a possibility that the improvement of medical capabilities will be impacted. The process must become more efficient by creating new databases and systems tools that solve deficiencies and to enable management, review, analysis, and reporting of all crew member medical data.	The plan is to incrementally implement improvements as funding allows with a target resolution date of FY11. Leveraging with the ESMD Human Research Program has begun to improve this timeline.
JSC IRMA 1044 Resource availability for implementing IOM recommendations for LSAH	The Institute of Medicine (IOM) recommendations, as part of the National Academies, conducted a review of the Longitudinal Study of Astronaut Health (LSAH) project at the direction of NASA/HQ. Their findings recommend improving the quality of data collection.	The plan is to incrementally implement improvements as funding allows. Some enhancements to surveillance have already been implemented (equalization of testing between astronaut subjects and comparison subjects).

Inspector General

The NASA Office of Inspector General (OIG) budget request for Fiscal Year 2008 is $34.6 million. The NASA OIG consists of 207 auditors, analysts, specialists, investigators, and support staff at NASA Headquarters in Washington, D.C., and NASA Centers throughout the United States. The FY 2008 request supports our mission to prevent and detect crime, fraud, waste, abuse, and mismanagement while promoting economy, effectiveness, and efficiency within the Agency. Recognizing that the number of identified audits, investigations, and other activities significantly exceed the available resources, continuous adjustments of priorities will be necessary to ensure that a balanced coverage of NASA's programs and operations is maintained, critical and sensitive matters are promptly evaluated and investigated, and OIG customers receive timely, accurate, and complete responses.

The OIG, Office of Audits (OA) conducts independent, objective audits and reviews of NASA and NASA contractor programs and projects to improve NASA operations as well as a broad range of professional audit and advisory services. It also comments on NASA policies and is responsible for the oversight of audits performed under contract. The OA helps NASA accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the economy, efficiency and effectiveness of NASA operations.

The OIG Office of Investigations (OI) identifies, investigates, and refers for prosecution cases of crime, waste, fraud, and abuse in NASA programs and operations. The OIG's Federal law enforcement officers investigate false claims, false statements, conspiracy, theft, computer crimes, mail fraud, and violations of Federal laws, such as the Procurement Integrity Act and the Anti-Kickback Act. Through its investigations, the OI also seeks to prevent and deter crime at NASA. NASA's OIG FY 2008 request is broken out as follows:

- 82 percent of the proposed budget is dedicated to personnel and related costs, including salaries, benefits, training, monetary awards, worker's compensation, permanent change of station costs, metro subsidies, as well as the Government's contributions for Social Security, Medicare, health and life insurance, retirement accounts, and matching contributions to Thrift Savings Plan accounts. Salaries include the required additional 25 percent law enforcement availability pay for criminal investigators.

- 4 percent of the proposed budget is dedicated to travel, per diem at current rates, and related expenses. The OIG staff is located at 14 offices on or near NASA installations and contractor facilities.

- 14 percent of the proposed budget is dedicated to operations and equipment primarily funding for the Agency's annual financial audit and also includes funding for government vehicles, special equipment for criminal investigators, and information technology equipment unique to the OIG.

Inspector General

Budget Distribution

Budget Authority ($ millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
FY 2008 President's Budget Request	**32.0**	**33.5**	**34.6**	**35.5**	**36.4**	**37.3**	**38.3**
Inspector General	32.0	33.5	34.6	35.5	36.4	37.3	38.3
FY 2007 President's Budget Request	**32.0**	**33.5**	**34.6**	**35.5**	**36.4**	**37.3**	**--**
Inspector General	32.0	33.5	34.6	35.5	36.4	37.3	--
Total Change from FY 2007 President's Budget Request	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**38.3**

Highlights of Programmatic Changes

Inspector General

Inspector General

Programmatic Content:

There have been no changes

The FY 2008 budget estimates are
Personnel and related costs - $28.3 million
Travel - $1.3 million
Operations and Equipment - $5.0 million

Overview

This supporting data section provides information on the following areas:

- Distribution of Funds by Installation;
- Workforce;
- Center Management and Operations;
- Corporate G&A;
- Institutional Investments;
- Construction of Facilities;
- Reimbursable Estimates by Appropriation;
- Summary of Consulting Services;
- Obligations by Object Class Code;
- National Institute of Aerospace; and
- Other Government Reporting Requirements.

NASA's Organization

NASA is comprised of NASA Headquarters in Washington, D.C., nine Centers located around the country, and the Jet Propulsion Laboratory, a Federally Funded Research and Development Center operated under a contract with the California Institute of Technology. In addition, NASA partners with academia, the private sector, state and local governments, other federal agencies, and a number of international organizations to create an extended NASA family of civil servants, allied partners, and stakeholders. Together, this skilled, diverse group of scientists, engineers, managers, and support personnel share the Mission, Vision, and Values that are NASA.

To achieve NASA's Mission, NASA Headquarters is organized into four Mission Directorates:

• The Science Mission Directorate;

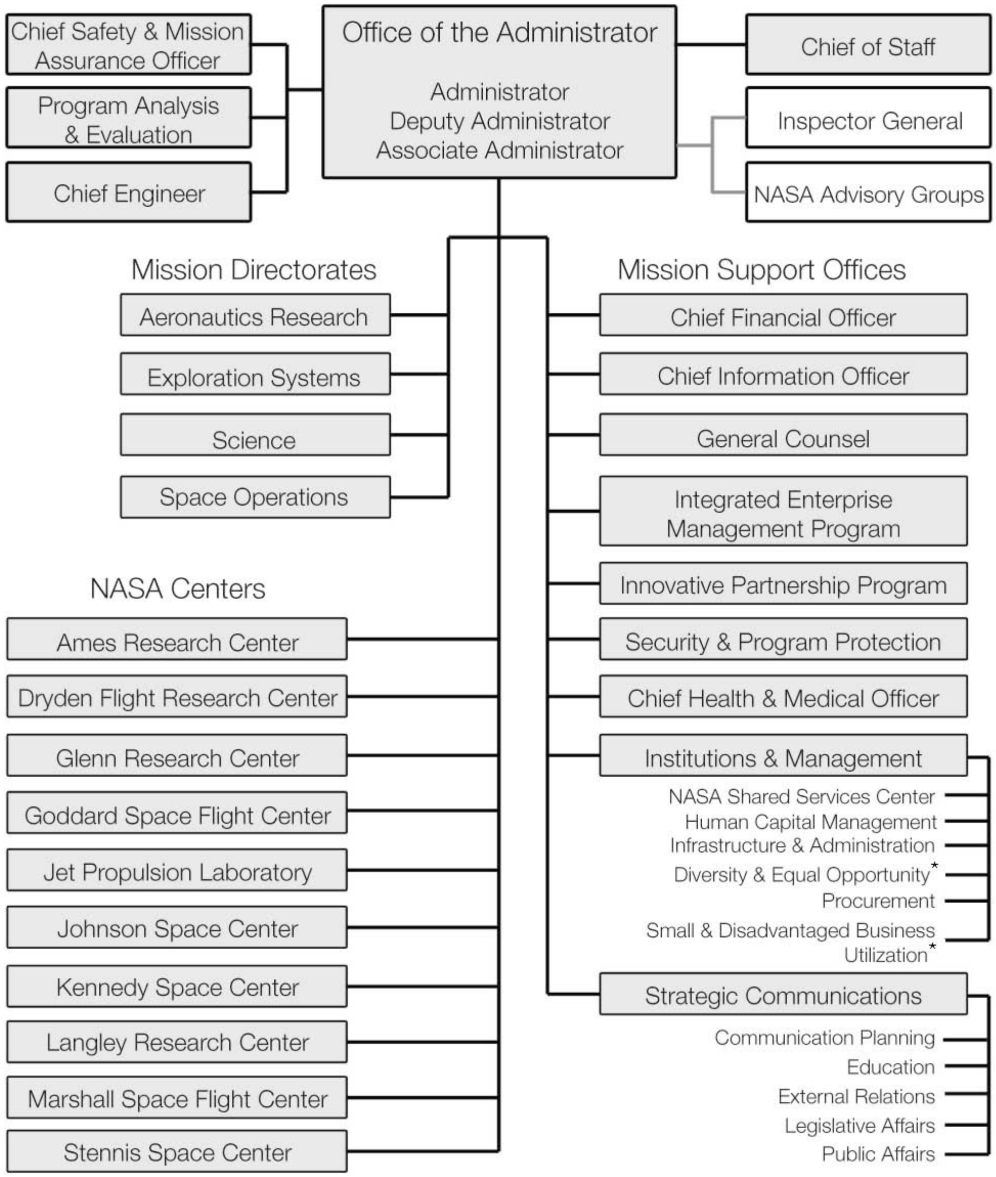
• The Exploration Systems Mission Directorate;

• The Aeronautics Research Mission Directorate; and

• The Space Operations Mission Directorate.

Functional support for NASA initiatives comes from the Agency's Mission Support Offices. These offices focus on reducing risks to missions by implementing efficient management operations Agency-wide: adopting standard business and management tools to improve the effectiveness of cross-Agency operations; implementing innovative practices in human capital management that encourage increased teamwork, Agency-wide perspectives, and capability development; and reducing long-term operations costs by decreasing environmental liability costs.

National Aeronautics and Space Administration Organization Chart



In accordance with law, the offices of Diversity and Equal Opportunity and Small and Disadvantaged Business Utilization maintain reporting relationships to the Deputy Administrator and Administrator.

Mission Support Budget

To implement NASA's Mission, the Agency requires the workforce, facilities, and operational support of its Centers and NASA Headquarters. These necessary mission support costs are included in the Mission Program Budgets as Center Management and Operations, Corporate General and Administrative, and Institutional Investment accounts.

Center Management and Operations (CM&O) includes the basic costs to manage and operate each of the 10 NASA Centers and to maintain the technical capability required to support the Agency's Mission. These costs cannot be directly identified or tied to a specific program or project requirement, but are necessary for efficient and effective administration and operation of the NASA Centers. The CM&O budget combines activities previously budgeted as Center General and Administrative (G&A) and Service Pool costs.

Corporate G&A provides for the management and oversight of Agency missions, functions, and Centers, and the performance of some Agency-wide administrative activities. The responsibilities include the following: the determination of programs and projects; establishment of management policies, procedures, and performance criteria; evaluation of progress; and the coordination and integration of all phases of the Agency's Mission.

Institutional Investments includes design and execution of non-programmatic Discrete and Minor Revitalization Construction of Facility projects, Facility Demolition projects, and Environmental Compliance and Restoration activities.

The table below documents the resources provided for these activities.

($ in millions)	FY 2007 Current	FY 2008 Estimate
Center Management and Operations	1733.0	2013.0
Corporate G&A	741.1	678.7
Institutional Investments	211.0	319.7

Note: Does not include Service Pool Costs.

Full Cost Simplification

NASA implemented full cost management, to include appropriation, budgeting and costing, in FY 2004. This strengthened the Agency's understanding of the true costs of projects and provided NASA management with better insight into maximizing the efficient use of resources. After three years of full cost implementation, NASA conducted a review of the implementation and effects of full cost management on Agency operations. The primary finding from that review was that the overhead allocations were more complex than necessary, and that the overhead allocation approach created disadvantages for NASA's smaller research Centers.

The original full cost approach allocates the cost to run each Center to projects based upon their workforce at the Center. Since costs to operate a Center are not solely a function of the size of the workforce, the overhead costs for the smaller Centers were significantly higher than for the larger Centers. To eliminate the cost advantages/disadvantages between Centers, beginning in fiscal year 2007, NASA is managing Center overhead costs with a single rate for all nine Federal centers. (The overhead for NASA's Jet Propulsion Laboratory is included in its contract rates as a Federally-Funded Research and Development Center). A single Agency-wide rate for Center Management and Operations (CM&O) will be allocated to each of the Agency's non-JPL projects and programs based on each project's direct budget.

The other change implemented for FY 2007 was to re-balance the allocation of responsibilities between the Centers and Mission Directorates. Management of the technical capabilities of the Center, primarily for Engineering and Safety and Mission Assurance, was moved to the Center Director, with associated budgets transferred to CM&O.

This re-allocation of overhead costs was content neutral for the Mission Directorate projects. Those projects based at the smaller Centers will see a net reduction in allocated overhead, and thus full cost budget. Projects at the larger Centers will receive additional overhead allocations, increasing their total full cost budget, but their direct content remains unchanged. The total budget for each Center, both for Center operations and for conducting projects, remains unchanged.

Within this document, budget tables showing the current request will show the FY 2007 and subsequent budget estimates with the simplified full cost overheads. FY 2007 will be equivalent to the President's FY 2007 request. Within selected tables, the original FY 2007 request is also shown with the original full cost allocations.

Distribution of Funds by Installation

($ in millions)	FY 2008 Estimate	FY 2009	FY 2010	FY 2011	FY 2012
Ames Research Center	592	508.1	495.3	470	475.1
Center Management & Operations	148.2	134.1	137.9	145	149.9
Corporate G&A	11.8	10.2	10.2	10.4	10.6
Institutional Investments	23.2	18.6	12.1	11.4	10.4
Mission Programs	408.8	345.2	335.1	303.2	304.3
Dryden Flight Research Center	217.6	214.8	199.4	154.2	152.7
Center Management & Operations	57.3	56.6	59.9	61.7	65.8
Corporate G&A	2.1	2.2	2.2	2.2	2.2
Institutional Investments	10.5	11.1	4.4	5.1	5.1
Mission Programs	147.7	144.9	132.9	85.1	79.7
Glenn Research Center	556.1	543.9	521.4	525.3	501
Center Management & Operations	178.1	176.7	182	189.1	197.3
Corporate G&A	15.1	15.1	15.1	15.2	15.2
Institutional Investments	39.6	38.4	30.1	24.7	9.7
Mission Programs	323.4	313.8	294.2	296.2	278.8
Goddard Space Flight Center	2422.1	2267.0	2093.1	1978.2	2058.1
Center Management & Operations	358.6	368.6	378.7	391.3	405.2
Corporate G&A	58.4	55.4	55.4	56.2	56.6
Institutional Investments	16.8	20.1	14.6	14.7	16.7
Mission Programs	1988.3	1822.9	1644.4	1516.0	1579.6
Jet Propulsion Laboratory	1368.1	1,368.3	1,323.3	1,266.3	1,185.6
Center Management & Operations	--	--	--	--	--
Corporate G&A	15.9	15.7	14.3	14	8.8
Institutional Investments	15.9	16.8	23	17.2	12.2
Mission Programs	1,337.0	1,335.8	1,285.9	1,235.1	1,164.6
Johnson Space Center	5,084.20	5,646.30	5,904.70	5,863.60	5,852.60
Center Management & Operations	370	368.8	356.1	356.7	364.1
Corporate G&A	12.4	13.4	12.6	13.3	12.6
Institutional Investments	42.9	32.2	48.3	42.9	43.8
Mission Programs	4,658.90	5,231.90	5,487.60	5,450.70	5,432.00
Kennedy Space Center	1,454.50	1,320.20	1,214.40	1,548.20	1,599.10
Center Management & Operations	324.9	336.6	342.5	347	354.9
Corporate G&A	8.8	8.7	8.8	8.8	8.8
Institutional Investments	44.8	38.6	44.9	48.9	44.9
Mission Programs	1,076.00	936.2	818.2	1,143.50	1,190.40

Supporting Data: Distribution of Funds by Installation

($ in millions)	FY 2008 Estimate	FY 2009	FY 2010	FY 2011	FY 2012
Langley Research Center	674.9	592	584.1	588.8	600.9
Center Management & Operations	220.8	213.5	218.1	224.5	231.5
Corporate G&A	59.3	59.9	57.8	59	59.4
Institutional Investments	50	14.9	12.7	10.5	13.5
Mission Programs	344.8	303.6	295.5	294.8	296.5
Marshall Space Flight Center	2,724.6	2,517.7	2,341.0	2,615.0	2,913.3
Center Management & Operations	304.2	308	304.3	309	317.5
Corporate G&A	35	34	34.8	35	30.8
Institutional Investments	60.4	30.5	25.7	26	26
Mission Programs	2,325.0	2,145.2	1,976.1	2,245.0	2,539.0
NASA Headquarters (includes IG)	1988.7	2400.8	3129.2	3256.6	3406.2
Center Management & Operations	--	--	--	--	--
Corporate G&A	458.1	462.8	460.9	464.1	488.9
Institutional Investments	6.0	83.7	106.7	123.6	139.1
Mission Programs	1524.6	1854.3	2561.6	2668.9	2778.2
Stennis Space Center	225.8	235.0	220.5	194.3	160.5
Center Management & Operations	50.9	51.8	52.0	53.9	55.2
Corporate G&A	1.7	1.8	1.7	1.8	1.9
Institutional Investments	9.7	18.3	9.2	10.9	8.9
Mission Programs	163.5	163.2	157.6	127.7	94.4
Total	**17,309.4**	**17,614.2**	**18,026.3**	**18,460.4**	**18,905.0**

NASA Workforce

As an institution, NASA is only as good as the quality of its scientists, engineers, and program managers. The retirement of the Space Shuttle and development of the Orion Crew Exploration Vehicle and launch systems as well as sustaining ISS operations post-assembly translates into a dramatic shift in NASA's workforce needs over the next five years. This transition needs to be carefully considered in accordance with the projected budget for the Agency. The workforce levels as proposed are goals until this analysis is completed. A more thorough analysis of NASA's workforce needs in the outyears is planned to be conducted as part of NASA's FY 2009 planning this year.

The Agency has also developed strategies for recruiting and retaining critical personnel. These strategies are intended to make good use of the flexibilities granted to the Agency in the NASA Flexibility Act of 2004.

Finally, NASA is implementing near-term actions to facilitate the transition of the workforce including employee buyouts in surplus skill areas and hiring restrictions at the Centers. The restrictions are designed to reduce the risk of uncovered capacity in future years and to ensure that no Center could grow while other Centers had workforce available for new assignments. Continued and aggressive analysis is required to appropriately match the workforce to the Agency's mission. The workforce estimates below will continue to be updated until this analysis is completed.

Workforce Estimates by Installation

	FTE Estimates						
Center	**FY 2006**	**FY 2007**	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**	**FY 2012**
Ames Research Center	1240	1210	1136	1085	1085	1085	1082
Dryden Flight Research Center	477	515	535	520	501	488	487
Glenn Research Center	1667	1646	1620	1595	1595	1595	1590
Goddard Space Flight Center	3284	3193	3100	3100	3100	3100	3091
Johnson Space Center	3235	3265	3265	3258	3255	2899	2890
Kennedy Space Center	2066	2100	2107	2107	2107	1902	1894
Langley Research Center	1934	1920	1854	1800	1800	1800	1794
Marshall Space Flight Center	2527	2569	2569	2550	2500	2500	2492
Stennis Space Center	269	282	282	280	280	280	279
Headquarters	1318	1280	1292	1300	1300	1300	1242
NSSC	64	120	140	156	159	159	159
NASA	**18,081**	**18,100**	**17,900**	**17,751**	**17,682**	**17,108**	**17,000**

Note: Distribution of Center FTE by Mission Directorate not available.

Center Management and Operations Overview

Center Management and Operations (CM&O) includes the basic costs to manage and operate a Center and to maintain the technical capability required to support the Agency's Mission. These costs cannot be directly identified or tied to a specific program or project requirement, but are necessary for efficient and effective administration and operation of the NASA Centers. The CM&O budget combines activities previously budgeted as Center General and Administrative (G&A) and Service Pool costs.

Functions include:

Basic Operations and Management

- **Institutional Administration**—Activities to support the basic operation and management of the Center.
- **Environmental Management**—Activities to comply with federal, state, and local laws, regulations, and executive orders associated with operational environmental management.
- **Facility Services**—Activities to support facilities and infrastructure operation and maintenance.
- **Information Technology Services**—Activities to support information technology; data gathering, processing and distribution.
- **Security Program**—Activities associated with providing basic protective services for the Center.
- **Safety & Mission Assurance**— Institutional operational safety activities that support the development, implementation, and oversight of Center safety, reliability, maintainability, and quality assurance policies and procedures.
- **Other Personnel Costs**—Center personnel costs that are not salary and benefit costs including awards, training, Permanent Change of Station, Household Goods, security investigations, lump sum payments and worker's compensation.

Technical Capability

- **Technical Excellence**—Activities related to the independent judgment and decision-making on matters related to the application and adjudication of technical requirements for projects and program work.
- **Center Investment Accounts**—Activities associated with maintaining and developing the core competencies at the Center.
- **Science and Engineering**—Science and Engineering support which cannot be directly charged to a program and includes management, design and analytic tools, contract management and administrative support.
- **Fabrication**—Fabrication services support which cannot be directly charged to a program and includes management, contract management, administrative support, equipment and supplies.
- **Testing Services**—Test facility support which cannot be directly charged to a program and includes management, contract management, administrative support, test operations, equipment and supplies.
- **Safety and Mission Assurance Technical Authority**—Salary and travel for S&MA supervisors, branch chiefs or above and designated deputies to render independent authoritative decisions on safety and mission assurance requirements relating to the design or operation of a program or project.

Center Management & Operations by Function

($ in millions)	FY 2007 Current	FY 2008 Estimate	FY 2009	FY 2010	FY 2011	FY 2012
Institutional Administration	579.3	599.6	595.9	592.6	614.9	633.3
Environmental Management	20.1	20.7	21.3	21.6	22.4	22.7
Facility Services	446.8	468	466.9	465.6	477.9	490.6
Information Services	231.3	226.1	228.9	235.1	240.1	245.5
Technical Excellence	111.6	117.2	119.8	124.6	128.9	133.2
Security Program	94	90.2	88.4	91	93.8	96.5
Safety & Mission Assurance (S&MA)	28.1	48.5	51.8	53.3	55.2	57.1
Center Investment Accounts	143.0	148.2	142.7	141.1	137.6	145.6
Other Personnel Costs	65	59	58.7	62.2	57	57.5
Science & Engineering	0	207.1	214.2	220.4	227.9	236.1
Fabrication	0	8.4	5.4	3	3.5	3.6
Testing Services	0	9.4	9.7	9.7	9.8	10.2
S&MA Technical Authority	13.9	10.6	11	11.3	9.2	9.5
Total	**1733.0**	**2,013.0**	**2,014.7**	**2,031.5**	**2,078.2**	**2,141.4**

Note: CM&O began in FY 2007; Service Pools will be transferred to CM&O beginning in FY 2008.

Technical Excellence by Center (Previously Independent Technical Authority)

($ in millions)	FY 2007 Current	FY 2008 Estimate	FY 2009	FY 2010	FY 2011	FY 2012
Ames Research Center	2.5	2.6	2.6	2.7	2.8	2.9
Dryden Flight Research Center	6.1	6.3	6.6	6.8	7	7.3
Glenn Research Center	12.9	13.3	13.7	14.3	14.7	15.3
Goddard Space Flight Center	10.3	10.6	11	11.3	11.7	12
Johnson Space Center	19.1	19.9	20.5	21.2	22	22.7
Kennedy Space Center	10.7	10.8	11.2	11.6	11.9	12.3
Langley Research Center	15	15.5	16	16.6	17.2	17.7
Marshall Space Flight Center	32.2	35.3	35.2	37.1	38.4	39.7
Stennis Space Center	2.8	2.9	3	3	3.2	3.3
Total	**111.6**	**117.2**	**119.8**	**124.6**	**128.9**	**133.2**

Corporate General and Administrative (Corporate G&A)

Corporate G&A provides for the management and oversight of Agency missions, functions, and centers, and the performance of some Agency-wide administrative activities. The responsibilities include the determination of programs and projects; establishment of management policies, procedures, and performance criteria; evaluation of progress; and the coordination and integration of all phases of the Agency's mission.

The majority of the Corporate G&A budget funds Headquarters Operations, including Headquarters personnel salaries, travel, rent, Information Technology, and other support. The remainder of the Corporate G&A budget provides for agency-wide activities and services to support projects performed at the NASA Centers.

Functions include:

Headquarters Operations

- Corporate Management and Operations - Headquarters personnel salaries, benefits, and travel; and operational costs such as rents, IT support, and facility services.

Agency-Wide Activities and Services

- **Office of Chief Financial Officer** – Financial management and operations.
- **Agency Operations** – Agency-wide support including, training, awards, and payroll information services.
- **Chief Information Officer** – Agency-wide tools and systems for efficient operations, IT security, and E-Government Initiatives.
- **Office of the Chief Engineer** – Engineering standards and system engineering.
- **Office of Safety and Mission Assurance** – Safety, reliability, maintainability, and quality mission assurance, risk management, and probabilistic risk assessments.
- **Office of the Chief Health and Medical Officer** - Agency occupational health; and research of subject protection and medicine of extreme environments.
- **Corporate Security** – Headquarters physical security, and Agency-wide security initiatives and counterintelligence.
- **Independent Verification & Validation** – Independent verification and validation for software and systems.
- **Program Analysis and Evaluation** – Independent assessment of Agency programs, strategic planning, and the performance evaluation and analyses of programs, operational readiness and strategic investments.

Corporate G&A by Function

($ in millions)	FY 2006 Actual	FY 2007 Current	FY 2008 Estimate	FY 2009	FY 2010	FY 2011	FY 2012
Corporate Management & Operations	331.9	342.4	341.7	344.7	348.5	351.5	357.7
Office of Ch Financial Officer (OCFO)	24.8	16.0	10.5	10.3	8.7	8.5	9.8
Agency Operations	27.3	45.1	32.9	33.5	33.9	34.8	35.7
Chief Information Officer	95.2	73.8	76.2	75.2	75.5	77.0	79.1
Office of Chief Engineer *	44.7	109.6	109.7	108.3	102.5	102.6	104.3
Office of S&MA	51.5	46.7	45.8	45.4	44.9	45.5	46.9
Office of Chief Health & Medical Officer	4.6	4.7	4.7	4.7	4.6	4.7	4.8
Corporate Security	9.1	12.6	11.7	11.7	11.8	11.9	12.2
Independent Verification &Validation	31.8	26.0	25.6	25.9	25.5	25.8	26.2
Program Analysis & Evaluation	24.0	23.4	19.9	19.4	18.0	17.8	19.0
Center Workforce Planning	0	40.8	0	0	0	0	0
Total	**644.8**	**741.1**	**678.7**	**679.1**	**673.9**	**680.1**	**695.7**

** Includes NASA Engineering & Safety Center beginning in FY 2007.*

Headquarters Corporate G&A Budget

The Corporate Management & Operations budget within Corporate G&A includes all Headquarters Operations costs. These include labor and travel for the NASA Headquarters Mission Directorates and Mission Support Offices in the performance of their duties, and the facilities and services to enable them. The tables below provide additional details about the Headquarters Operations Corporate G&A budget, including information on travel budgets and workforce.

Headquarters Corporate G&A Budget by Office

Headquarters Operations Budget by Office ($ in millions)	FY 2006 Actual	FY 2007 Current	FY 2008 Estimated
Total Headquarters Operations	320.9	342.4	341.7
Office of the Administrator	4.8	3.9	4
Office of Safety and Mission Assurance	6.8	7.8	7.3
Office of the Program Analysis and Evaluation	10.2	12.0	11.3
Office of the Chief Engineer	3.7	4.2	3.7
Office of Program and Institutional Integration	5.4	5.6	6.1
Aeronautics Research Mission Directorate	7	7.0	6.5
Exploration Systems Mission Directorate	16	17.2	17.9
Science Mission Directorate	24.1	27.4	27.7
Space Operations Mission Directorate	16.3	16.8	16.7
Office of the Chief Financial Officer	14.9	24.4	17.9
Office of the Chief Information Officer	2.8	3.6	3.8
Office of the General Counsel	7.5	8.9	9.3
Office of Integrated Enterprise Management Program	1.2	1.6	1.9
Office of Innovative Partnership Program	1.3	1.6	1.6
Office of Security and Program Protection	4.3	4.5	5.2
Office of Chief Health & Medical Officer	1.6	1.6	1.5
Office of Institutions and Management (includes all HQ Operations costs)	159.4	166.4	167.9
Office of the Chief of Strategic Communications	33.6	17.0	19.1
Office of External Relations *	N/A	11.0	12.3

Note: FY06 included in Strategic Communications.

Headquarters Corporate G&A Travel Budget

NASA Headquarters Travel Budget ($ in millions)	FY 2006 Actual	FY 2007 Current	FY 2008 Estimated
Total Travel	11.6	11.0	10.7
Office of the Administrator	0.5	0.5	0.5
Office of Safety and Mission Assurance	0.6	0.6	0.4
Office of the Program Analysis and Evaluation	0.3	0.3	0.3
Office of the Chief Engineer	0.3	0.1	0.1
Office of Program and Institutional Integration *	-		-
Aeronautics Research Mission Directorate	0.5	0.5	0.5
Exploration Systems Mission Directorate	2	1.9	1.9
Science Mission Directorate	1.7	1.6	1.6
Space Operations Mission Directorate	1.8	1.6	1.6
Office of the Chief Financial Officer	0.6	0.6	0.6
Office of the Chief Information Officer	0.2	0.1	0.1
Office of the General Counsel	0.2	0.2	0.1
Office of Integrated Enterprise Management Program	0.2	0.2	0.2
Office of Innovative Partnership Program *	-	0.0	-
Office of Security and Program Protection	0.2	0.1	0.1
Office of Chief Health & Medical Officer	0.1	0.1	0.1
Office of Institutions and Management	1.1	1.3	1.2
Office of the Chief of Strategic Communications	1.4	0.6	0.6
Office of External Relations	N/A	0.7	0.8

** Less than 0.1M*

Headquarters FTE Assignments per Office

NASA Headquarters Civil Service (FTE)	FY 2006*	FY 2007*	FY 2008*	FY 2008 SES Only
Total Civil Service FTE	1318	1300	1280	152
Office of the Administrator	30	23	22	7
Office of Safety and Mission Assurance	44	43	44	5
Office of the Program Analysis and Evaluation	70	74	70	10
Office of the Chief Engineer	24	24	23	9
Office of Program Institutional Integration	38	39	39	2
Aeronautics Research Mission Directorate	46	41	38	8
Exploration Systems Mission Directorate	99	101	102	11
Science Mission Directorate	158	162	166	19
Space Operations Mission Directorate	103	97	96	9
Office of the Chief Financial Officer	101	115	110	12
Office of the Chief Information Officer	19	21	23	4
Office of the General Counsel	43	47	48	6
Office of Integrated Enterprise Management Program	7	9	11	1
Office of Innovative Partnership Program	9	10	10	1
Office of Security and Program Protection	29	31	32	2
Office of Chief Health & Medical Officer	11	10	9	1
Office of Institutions and Management	310	288	280	25
Office of the Chief of Strategic Communications	177	110	103	12
Office of External Relations	N/A	55	54	8

*Note: * Number includes non SES and SES.*

Institutional Investments by Function

Institutional Investments includes design and execution of non-programmatic Discrete and Minor Revitalization Construction of Facility projects, Facility Demolition projects, and Environmental Compliance and Restoration activities.

($ in millions)	FY 2006 Actual	FY 2007 Current	FY 2008 Estimate	FY 2009	FY 2010	FY 2011	FY 2012
Environmental Compliance and Restoration	53.5	50.6	76.5	71.5	71.3	66.4	51.3
Institutional CoF/Strategic Investments	200.5	160.4	243.2	251.7	260.4	269.5	279.1
Total	**254.0**	**211.0**	**319.7**	**323.2**	**331.7**	**335.9**	**330.4**

Environmental Compliance and Restoration (ECR)

ECR Program funding primarily provides for all personnel, services, and activities necessary to complete the cleanup of hazardous materials and wastes that have been released to the surface or groundwater at NASA installations, NASA-owned industrial plants supporting NASA activities, and other current or former NASA sites where NASA operations have contributed to environmental problems and where the Agency is obligated to contribute to cleanup costs. The majority of these cleanups are mandated under a variety of federal and state environmental laws and regulations as well as legally enforceable orders and agreements. Program activities include projects, studies, assessments, investigations, plans, designs, related engineering, program support, sampling, monitoring, regulatory agency oversight costs, and any land necessary to acquire to ensure operation of remedial treatment processes and sites as part of the remediation and cleanup measures. Additionally, program resources are used to address compliance with environmental management system initiatives as outlined under Executive Order 13148 and to promote focused investment in environmental areas that would be of direct benefit to NASA missions and the Agency as a whole.

The FY 2008 funding request represents a phased approach in relation to a total Agency environmental cleanup liability approaching one billion dollars that must be addressed within the next several years, as well as for the strategic environmental management initiatives detailed above. Based on relative urgency and potential health hazards and safety, these activities are the highest priority requirements currently planned for accomplishment in FY 2008. Deferral of these necessary environmental remediation measures would preclude NASA from complying with environmental requirements and regulatory agreements, and could jeopardize NASA operations. As studies, assessments, investigations, plans, regulatory approvals, and designs progress and as new discoveries or regulatory requirements change, it is expected that priorities may change and revisions to planned activities may become necessary.

Activities with the highest priority requirements planned for accomplishment in FY 2008 include the following:

1) Continue decontamination and demolition of NASA’s Plum Brook Reactor Facility;

2) Address groundwater and drinking water issues associated with contamination emanating from NASA’s Jet Propulsion Laboratory; and

3) Continue cleanup of groundwater contamination at White Sands Test Facility.

Institutional Construction of Facilities

Details on the Institutional Construction of Facilities Program are included in the overall discussion of Construction of Facilities presented below.

Summary of Resources Included in Budget Request

In Millions of Dollars	FY 2006	FY 2007	FY 2008
Total Construction of Facilities	**386.2**	**241.7**	**367.5**
Science, Exploration, and Aeronautics Programs	122.3	56.8	119.1
Exploration Capabilities Programs	63.4	24.5	5.2
Institutional (included in Institutional Investments)	200.5	160.4	243.2

The Construction of Facilities (CoF) program ensures that the facilities critical to achieving NASA's space and aeronautics programs are the right size and type, and that they are safe, secure, environmentally sound, and operated efficiently and effectively. It also ensures that NASA installations conform to requirements and initiatives for the protection of the environment and human health. NASA facilities are essential to the Agency and facility revitalization is needed to maintain infrastructure that is safe and capable of supporting NASA's missions. The facilities being revitalized or constructed in this program are expected to remain active in the long term and are consistent with current and anticipated Agency roles and missions.

Funding for construction projects required for specific programs is included in the appropriate budget line item within each Mission Directorate and summarized herein as program direct projects. Institutional CoF projects, also summarized herein, are required for components of NASA's basic infrastructure and institutional facilities. Funding for Institutional CoF projects is included within the Agency's Institutional Investment account. Descriptions and cost estimates of FY 2008 institutional and programmatic (or "program direct") projects are provided to show a complete picture of NASA's budget requirement for facilities revitalization and construction.

The institutional facility projects requested for FY 2008 continue the vital rehabilitation, modification, and repair of facilities to renew and help preserve and enhance the capabilities and usefulness of existing facilities and ensure the safe, economical, and efficient use of NASA's physical plants. The projects repair and modernize deteriorating and obsolete building and utility systems that have reached or exceeded their normal design life, are no longer operating effectively or efficiently, and cannot be economically maintained. These projects include mechanical, structural, cooling, steam, electrical distribution, sewer, and storm drainage systems. Some projects replace substandard facilities in cases where it is more economical to demolish and rebuild than it is to restore. Projects between $0.5 million and $5.0 million are included as Minor Revitalization and Construction projects, and projects with an estimated cost of at least $5.0 million are budgeted as Discrete projects. Projects which are less than $0.5 million are accomplished by routine day-to-day facility maintenance and repair activities provided for in direct program and Center operating budgets.

Funds requested for Facility Planning and Design (FP&D) cover: advance planning and design requirements for future projects; preparation of facility project design drawings and bid specifications; master planning; facilities studies; engineering reports and studies; and critical functional leadership activities directed at increasing the rate of return of constrained Agency resources while keeping the facility infrastructure safe, reliable, and available.

The projects that comprise this request are of the highest priority based on relative urgency and expected return on investment. The titles of the projects are designed to identify the primary intent of each project and may not always capture the entire scope or description of each project. During the year, some rearrangement of priorities may be necessary which may force a change in some of the items to be accomplished. Also, should residual CoF resources become available they will be used for urgently needed facility revitalization requirements. Any such changes, however, will be accomplished within the total resources available and Congress will be notified before work is initiated for any new construction project that is estimated to cost $5 million or greater.

Summary of FY 2008 Program Direct Projects by Mission Directorate

In Millions of Dollars	FY 2006	FY 2007	FY 2008
SCIENCE, AERONAUTICS, AND EXPLORATION CoF PROJECTS	122.3	56.8	119.1
SCIENCE	**73.8**	**56.8**	**38.0**
Construct Exploration Sciences Building (GSFC)	14.8	30.0	20.0
Construct Flight Projects Center (JPL)	23.9	26.8	14.2
Connect Madrid Deep Space Communication Complex to Commercial Power (JPL)	1.3	----	----
Infrastructure Improvements for NOAA at Stennis Space Center (SSC)	26.6	----	----
Minor Revitalization of Facilities at Various Locations (less than $5M per project)	2.2	----	3.8
Facility Planning and Design	5.0	----	----
EXPLORATION SYSTEMS	**43.5**	**----**	**81.1**
Construct CEV Avionics and Integration Lab (JSC)	----	----	**22.0**
Modify Vehicle Assembly Building (KSC)	----	----	**31.2**
Modify Dynamic Test Stand 4550 (MSFC)	----	----	**5.0**
Modify A-1 Propulsion Test Facility (SSC)	----	----	**6.6**
Construct Office Building 4601 (MSFC)	28.5	----	----
Construction for Constellation Systems (Various Locations)	15.0	----	----
Minor Revitalization of Facilities at Various Locations (less than $5M per project)	----	----	**8.6**
Facility Planning and Design	----	----	**7.7**
AERONAUTICS	**5.0**	**----**	**----**
Repair Compressor No. 5 (LaRC)	3.5	----	----
Repairs to Icing Research Tunnel (GRC)	1.5	----	----
EXPLORATION CAPABILITIES CoF PROJECTS	**63.4**	**24.5**	**5.2**
SPACE OPERATIONS (SPACE SHUTTLE)	**61.6**	**20.1**	**0.0**
Repairs to Vehicle Assembly Building (KSC)	15.6	14.1	----
Rehabilitate and Modernize Final Assembly Facility for TPS (MAF)	6.7	----	----
Minor Revitalization of Facilities at Various Locations (less than $5M per project)	38.7	6.0	----
Facility Planning and Design	0.6	----	----
SPACE AND FLIGHT SUPPORT	**1.8**	**4.4**	**5.2**
Minor Revitalization of Facilities at Various Locations (less than $5M per project)	1.8	4.4	4.7
Facility Planning and Design	----	----	0.5

Summary of FY 2008 Non-Programmatic CoF Projects

In Millions of Dollars	FY 2006	FY 2007	FY 2008
INSTITUTIONAL CoF PROJECTS	200.5	160.4	243.2
Construct New Office Facility (JSC)	--	15.0	12.0
Renovation of Operations & Checkout Building (KSC)	5.7	7.2	11.0
Construct Replacement Administrative Office Building (LaRC)	--	--	28.8
Construct Replacement Engineering Building (MSFC)	--	--	30.0
Replace Asbestos Siding and Provide Energy/Safety Upgrades, Building 4705 (MSFC)	--	--	8.9
Rehabilitate Building Systems, Building 4207 (MSFC)	--	6.9	--
Rehabilitate Electrical Distribution System (ARC)	5.0	--	--
Repair Emergency Chiller System, Building 24 (GSFC)	5.7	3.2	--
Construct Exploration Sciences Building (GSFC)	3.7	--	--
Seismic Upgrade of Telecommunications Building B238 (JPL)	6.0	--	--
Construct Liquid Nitrogen Plant (LaRC)	7.4	--	--
Repair/Replace 350 psig Steam Distribution System, Utility Tunnel #4 (LaRC)	0.9	--	--
Infrastructure Upgrades to Accommodate Unmanned Aerial Vehicles (WFF)	4.0	--	--
Institute of Science Research Earmark (GSFC)	10.0	--	--
Minor Revitalization of Facilities at Various Locations (less than $5M per project)	115.5	100.7	121.7
Facility Planning and Design	26.2	17.0	15.8
Demolition of Facilities	10.4	10.4	15.0

Discrete Direct Projects within the Science, Aeronautics, and Exploration Account

Science Mission Directorate

Project Title: Construct Exploration Sciences Building

Location: Goddard Space Flight Center (GSFC), Greenbelt, MD

Mission Directorate: Science

FY 2008 Estimate: $20.0M

This project will construct a new 262,500 square-foot laboratory and office building at the Greenbelt site. The facility will provide state of the art laboratory, support, and office space for 750 scientists. The new facility will consolidate science work groups and is expected to increase work efficiency and scientific collaboration. The new facility will replace the 44-year old Research Projects Laboratory building and the 37-year old Space Science Data Center building. These facilities must be replaced because the electrical and mechanical systems have become unreliable, impacting science functions. The buildings require extensive repairs, and have high energy and operating costs. The new Exploration Science Building will incorporate energy reducing and environmentally friendly features that will reduce overall operating costs and generate a cost savings over the life of the facility. This is the third and final phase with a total estimated cost of $65 million.

Project Title: Construct Flight Projects Center

Location: Jet Propulsion Laboratory (JPL), Pasadena, CA

Mission Directorate: Science

FY 2008 Estimate: $14.2M

This project will construct a new 17,000 square-meter (183,000 square feet) six-story building to provide office space plus conference and support facilities for approximately 620 people. The new facility will co-locate the program and project staffs for flight projects into a single building. The building will contain an integrated 400 fixed-seat sloped-floor Project Review Center to host large project reviews and JPL institutional meetings, as well as a 200 moveable-seat flat-floor conference room that will be divisible into four 50 seat conference rooms. Expensive off-site leased space will be vacated and the need for additional off-site leases will be avoided. Six 1940's vintage buildings and 44 wooden trailers will be demolished. The Flight Projects Center will provide the means to collocate essential flight project personnel into a single location for a true teaming environment. This will: increase project development efficiency; enhance communications; allow sharing of common resources; enable more efficient dissemination of lessons learned among projects; and enhance the ability of experts to support multiple program/project functions. This is the third and final phase with a total estimated cost of $65 million.

Exploration Systems Mission Directorate

Project Title: Construct CEV Avionics and Integration Lab

Location: Johnson Space Center, Houston, TX

Mission Directorate: Exploration Systems

FY2008 Estimate: $22.0M

This project will construct a new 56,000 square-foot Crew Exploration Vehicle (CEV) Avionics Integration Laboratory (CAIL) building at the Johnson Space Center in Houston, TX. This project will accommodate the development and integration of CEV flight avionics system test articles; house the test support equipment; and provide technical and office space for the test team. The CAIL is required for avionics integration and certification of flight readiness for the Orion CEV. The new building will be constructed in compliance with Leadership in Energy and Environmental Design (LEED) requirements for energy efficiency and low environmental impact. It will also be constructed to protect critical project resources from catastrophic weather related events. The design will take into account some foreseeable needs to support future avionics integration requirements. There are no existing JSC buildings currently available to be modified to house the CAIL. Current JSC avionics facilities must continue to support the Space Shuttle Program until flyout in 2010 and the International Space Station for the duration of its life.

Project Title: Modify Vehicle Assembly Building

Location: Kennedy Space Center, Merritt Island, Florida

Mission Directorate: Exploration Systems

FY 2008 Estimate: $31.2M

This project will modify the Vehicle Assembly Building (VAB) to accommodate assembly of the Ares I vehicle. Vertical assembly of Ares I launch vehicles will require modifications to work platforms, lifting devices, lighting and other building infrastructure systems. The VAB is uniquely designed to receive, assemble, integrate, process and service large, complex launch vehicles. No other United States facility has this capability.

Project Title: Modify Dynamic Test Stand 4550

Location: Marshall Space Flight Center, Huntsville, Alabama

Mission Directorate: Exploration Systems

FY 2008 Estimate: $5.0M

This project will modify Dynamic Test Stand 4550 located in the East Test Area at the Marshall Space Flight Center in Alabama. Ground Vibration Testing (GVT) is needed to determine the structural dynamic behavior of the launch vehicle, stages, payload, and flight configurations at critical points in the flight, such as, at lift-off, at stage separations, and other flight events. This project will reconfigure and refurbish Test Stand 4550 to conduct GVT for the Ares I Crew Launch Vehicle (CEV). Modifications to Test Stand 4550 will include updates and refurbishment of electrical power, lighting, communications and security systems. Repairs and modifications will be made to plumbing systems, fire protection and detection systems, special gas systems and utilities. Structure, control rooms, and other spaces will be modified to meet testing requirements.

Project Title: Modify A-1 Propulsion Test Facility

Location: Stennis Space Center, Mississippi

Mission Directorate: Exploration Systems

FY 2008 Estimate: $6.6M construction

This project will modify the existing A-1 sea-level propulsion test facility to increase thrust levels to test the J-2X Power Pack Assembly and provide J2-X engine development/certification and acceptance testing through 2011 for the Ares launch vehicle. Modifications to this test facility include: reconfiguration of propellant run systems piping and vent/flare systems to accommodate the J-2X engine; structural and thrust takeout structure reconfiguration; new thrust measurement system; corrosion control and painting; and minor data acquisition, control, and electrical system modifications. This is a three phase project with a total estimated construction cost of $21.4 million.

FY 2008 Institutional Construction of Facilities in Institutional Investments

In Millions of Dollars	FY 2006	FY 2007	FY 2008
Total Institutional Construction of Facilities	200.5	160.4	243.2
Discrete Projects	48.4	32.3	90.7
Minor Revitalization and Construction	115.5	100.7	121.7
Facility Planning and Design	26.2	17.0	15.8
Demolition	10.4	10.4	15.0

Non-Programmatic Discrete Projects

Project Title: Construct New Office Facility

Location: Johnson Space Center, Houston, TX

FY 2008 Estimate: $12.0M

This project provides for the construction of a new 92,000 square foot office building to be located near the central mall area of the Center and is an essential part of Johnson Space Center's plan to refurbish existing Pre-cast Exposed Aggregate Facing (PEAF) constructed office facilities. It will provide permanent space for 120 employees from temporary facility T-585 built in 1985 that will be demolished. The new facility will provide temporary housing for approximately 400 displaced employees each year during refurbishment of existing PEAF facilities. A total of 1.38 million square feet of refurbishment is planned over the next 22 years. The facility will provide permanent housing for employees currently in metal buildings that will be demolished after the refurbishment of PEAF facilities is completed. The refurbishment program will ultimately reduce the square footage of office space on the Center and increase building efficiency. The new facility will have open and flexible office space to accommodate churn during the refurbishment program. It will be designed to meet the US Green Building Council's Leadership in Environmental and Energy Design, Silver Certification as a minimum. This is the second and final phase with a total estimated construction cost of $27 million.

Project Title: Renovation of Operations and Checkout Building

Location: Kennedy Space Center, Merritt Island, FL

FY 2008 Estimate: $11.0M

This project revitalizes the Operations and Checkout Building for indoor air quality, energy efficiency and life safety compliance in various locations. The revitalization will: install a sprinkler system and energy-efficient office lighting; complete updating of the Heating, Ventilation, and Air Conditioning (HVAC) systems; and demolish the existing HVAC ductwork that contributes to poor indoor air quality. Asbestos abatement is also included in the project. Other facility systems include HVAC controls, lighting, and fire protection. This phase will include the demolition and renovation of a portion of the north wing, and replacement of the north wing roof and the lower roof between the north and south wings. In addition, this project will upgrade employees' office areas, including power, communications and data systems. This project addresses a critical need that exists at the Kennedy Space Center to revitalize substandard facilities affecting the health, safety and welfare of personnel. The deteriorated substandard facilities are contributing to costly maintenance requirements, highly inefficient energy consumption and unhealthy working environments. The facility has not been updated to current Florida Building Codes, Florida Fire Prevention Codes, or National Fire Protection Association Life Safety Standards. This project will relieve personnel of the health dangers associated with poor indoor air quality and building related illnesses. An increase in space utilization will be realized. This is the third of five phases with a total estimated construction cost of $50 million. The final phase is planned for FY 2010.

Project Title: Construct Replacement Administrative Office Building

Location: Langley Research Center, Langley, VA

FY 2008 Estimate: $28.8M

This project designs and constructs a multistory office building with associated infrastructure improvements. The proposed new facility will be approximately 100,000 square feet and accommodate up to 325 personnel. The new administrative office building will be energy efficient and sustainable, meeting United States Green Building Council Leadership in Energy and Environmental Design (LEED) guidelines. Site improvements include roadwork, parking lots, utilities, and extension of the existing pedestrian walkway. The project also includes demolition of over 148,000 square feet of substandard, abandoned, and inactive facilities. This project will replace aging and poorly maintained administrative facilities and reduce Langley's facilities footprint. The existing buildings contain hazardous substances such as asbestos, PCB ballasts, Mercury thermostats, and lead, chromium and cadmium containing paints and coatings. Operations and maintenance costs in the existing facilities are high. Renovation of the existing facilities is not cost effective and would result in marginal administrative space. Currently 300 Langley employees have substandard offices.

Project Title: Construct Replacement Engineering Building

Location: Marshall Space Flight Center, AL

FY 2008 Estimate: $30.0M

This project provides for the construction of a new 90,000 square foot engineering facility to replace the existing materials processing laboratory and engineering building, Building 4612, at MSFC. The existing facility is in poor condition, can not be maintained and will not support NASA's future engineering and materials research activities. Building 4602 will provide state-of-the-art lab and office space for approximately 75 people. The facility will provide testing and evaluation space critical to NASA's engineering development work. The office portion of the facility will meet "LEED Silver" criteria and the lab portion will meet "Lab21" standards. The completed building will be energy efficient and sustainable and provide for flexible laboratory space that can support a variety of development programs. Once this facility is complete, NASA will demolish approximately 99,000 square feet of antiquated engineering laboratory space.

Project Title: Replace Asbestos Siding and Provide Energy/ Safety Upgrades to Building Systems, Building 4705

Location: Marshall Space Flight Center, Huntsville, AL

FY 2008 Estimate: $8.9M

This project revitalizes a high-bay facility at MSFC, Building 4705. The facility supports manufacturing, research, development and testing for NASA's strategic space flight initiatives. Building HVAC, plumbing, piping, and electrical systems are in poor condition. They have become unreliable and can no longer support research and development missions. The project will replace the building's HVAC and piping systems, plumbing, and electrical systems and switchgear. Building interior architectural features related to mechanical and electrical removal, such as ceilings and walls, will also be replaced. Asbestos removal will be required for piping insulation, floor tiles, and asbestos-containing compounds. The completed project will provide a research and development facility that is reliable and energy efficient and will allow for consolidation of several manufacturing development functions in one facility.

Minor Revitalization & Construction of Facilities (projects less than $5.0M each)

FY 2008 Estimate ($ in millions)	Institutional Investments	Program Direct
	121.7	**17.1**
Ames Research Center	13.2	--
Dryden Flight Research Center	9.2	--
Glenn Research Center	10.5	--
Goddard Space Flight Center	12.6	--
Jet Propulsion Laboratory	8.2	3.8
Johnson Space Center	17.5	--
Kennedy Space Center	19.1	4.7
Langley Research Center	13.5	--
Marshall Space Flight Center	10.9	4.6
Stennis Space Center	7.0	4.0

This request includes facility revitalization and construction needs greater than $0.5 million but less than $5.0 million per project. Projects $0.5 million and less are normally accomplished by routine day-to-day facility maintenance and repair activities provided for in direct program and Center operating budgets. Proposed FY 2008 institutional minor revitalization and construction projects total $121.7 million for components of the basic infrastructure and institutional facilities, funded in Institutional Investments, and $17.1 million for Program Direct funded projects. These resources provide for revitalization and construction of facilities at NASA field installations and government-owned industrial plants supporting NASA activities. Revitalization and modernization projects provide for the repair, modernization, and/or upgrade of facilities and collateral equipment. Repair projects restore facilities and components to a condition substantially equivalent to the originally intended and designed capability. Repair and modernization work includes the substantially equivalent replacement of utility systems and collateral equipment necessitated by incipient or actual breakdown. It also includes major preventive measures that are normally accomplished on a cyclic schedule and those quickly needed out-of-cycle based on adverse condition information revealed during predictive testing and inspection efforts. Modernization and upgrade projects include both restoration of current functional capability and enhancement of the condition of a facility so that it can more effectively accomplish its designated purpose, increase its functional capability, or meet new building, fire, and accessibility codes.

The minor revitalization and construction projects that comprise this request are of the highest priority, based on relative urgency and expected return on investment. The titles of the projects are designed to identify the primary intent of each project and may not always capture the entire scope or description of each project. Also, during the year, some rearrangement of priorities may be necessary which may cause a change in some of the items to be accomplished.

Institutional Minor Revitalization Projects: $121.7 million

A. Ames Research Center (ARC), $13.2 million for the following:

1. Restoration of Electrical Distribution System, Phase 7
2. Electrical Supply Reliability Improvement, Advanced Computing Facility, Phase 1
3. Replace Steam Vacuum System Cooling Tower at N234A

B. Dryden Flight Research Center (DFRC), $9.2 million for the following:

1. Construct Consolidated Information Technology Center
2. Repair Building 4853 Fire Pumping Station
3. Repair Storm Drainage Facilities
4. Repair Paving, Thompson Ave & Radar Site Roadways

C. Glenn Research Center (GRC), $10.5 million for the following:

1. Repair Water System Plum Brook Station, Phase 2
2. Repair Sewer Systems, Phase 8
3. Repair Parking Lots & Roads, Phase 3
4. Security Requirements for Lewis Field Main Gate Area, Phase 1
5. Repair Steam Regulator Stations, Phase 1

D. Goddard Space Flight Center (GSFC), $12.6 million for the following:

1. Restore Site Steam Distribution System, Greenbelt, Phase 6
2. Repair Airfield Lighting and Control Systems, WFF
3. Replace Central Power Plant Equipment, Building 24, Greenbelt, Phase 1
4. Upgrade Fire Alarm Systems, Various Buildings, Greenbelt
5. Repair Storm Drainage Structures, WFF
6. Repair Roofs, Various Buildings, Greenbelt and Wallops

E. Jet Propulsion Laboratory (JPL), $8.2 million for the following:

1. Upgrade Sewage Lift Station
2. Replace HVAC System, Space Flight Operations Facility, B230

3. Re-roof, Various Buildings, Phase 1
4. Upgrade 2.4kV Electrical Distribution to 16.5kV, Phase 7
5. Repair Fire Suppression Systems Various Buildings

F. Johnson Space Center (JSC), $17.5 million for the following:

1. Upgrade Emergency Power, Building 48
2. Replace Underground Natural Gas System
3. Replace Central Heating and Cooling Plant, Building 24
4. Repair and Upgrade 100 & 400 Area, WSTF, Phase 1
5. Repair Sprinkler and Fire Alarm Systems, Various Buildings, Phase 2
6. Replace Electrical Equipment, Avionics Systems Laboratory

G. Kennedy Space Center (KSC), $19.1 million for the following:

1. Replace Air Handlers, Headquarters Building, Phase 1
2. Revitalize Engineering Development Laboratory
3. Revitalize Prototype Shop
4. Replace Seawalls, NASA Causeway

H. Langley Research Center (LaRC), $13.5 million for the following:

1. Rehabilitate Building 1251
2. Rehabilitate Building 1268
3. Rehabilitate HVAC Systems, Buildings 1232 & 1244, Phase 1
4. Rehabilitate HVAC Systems, Buildings 1202 & 1208
5. Replace Electrical Power Cables, Building 1266
6. ADA Upgrades, Various Facilities, Phase 4

I. Marshall Space Flight Center (MSFC), $10.9 million for the following:

1. Upgrade Utility Control System Site Wide, Phase 2
2. Replace & Repair Roofs, Various Buildings, Phase 3
3. Construct Additional Logistics Bays
4. Refurbish West Test Area Industrial Water System, Phase 1

J. Stennis Space Center, $7.0 million for the following:

1. Construct Cryogenic Control Building
2. Rehabilitate HVAC Systems, Various Locations
3. Repairs to High and Low Voltage Electrical Systems, Phase 1

Science, Aeronautics & Exploration Direct Minor Revitalization Projects: $12.4 million

A. Jet Propulsion Laboratory (JPL), $3.8 million for the following:

1. Revitalize Water Transmission and Distribution System at GDSCC (Deep Space Network)
2. Replace Building G-86 HVAC Equipment &MCC at GDSCC (Deep Space Network)
3. Upgrade Fire Protection at Echo and Mars sites at GDSCC (Deep Space Network)
4. Replace Generator Switch Gear at GDSCC (Deep Space Network)
5. Modify Electrical Distribution System at CDSCC (Deep Space Network)
6. Replace “B” Bank Generator Switch Gear at CDSCC (Deep Space Network)

B. Marshall Space Flight Center (MSFC), $4.6 million for the following:

1. Modify Structural Strength Test Facility, Building 4572

2. Modify Cryogenic Structural Test Facility, Building, 4699
3. Modify TPS Development Facility, Building 4765

C. Stennis Space Center (SSC), $4.0 million for the following:

1. Modify J-2X Engine Assembly and Warehouse, Building 9101
2. Modify B-2 Propulsion Facility

Exploration Capabilities Direct Minor Revitalization Projects: $4.7 million

A. Kennedy Space Center (KSC), $4.7 million for the following:

1. Replace Roof and Doors, B836, Vandenberg AFB (Launch Services)
2. Revitalize Roof and Gutters, PHSF (Launch Services)
3. Revitalize HVAC System, PHSF (Launch Services)

Facility Planning and Design (FP&D)

Cognizant Office: Office of Infrastructure and Administration

FY 2008 Estimate: $15.8M

These funds are required to provide for: advance planning and design activities; special engineering studies; facility engineering research; preliminary engineering efforts required to initiate design-build projects; preparation of final designs, construction plans, specifications, and associated cost estimates; and participation in facilities-related professional engineering associations and organizations. These resources provide for project planning and design activities associated with non-programmatic construction projects. Project planning and design activities for construction projects required to conduct specific Exploration Capabilities or Science, Aeronautics and Exploration programs or projects are included in the appropriate budget line item. Other activities funded include: master planning; value engineering studies; design and construction management studies; facility operation and maintenance studies; facilities utilization analyses; engineering support for facilities management systems; and capital leveraging research activities.

Demolition of Facilities

Cognizant Office: Office of Infrastructure and Administration

FY 2008 Estimate: $15.0M

The amount requested is required to fund major demolition projects Agency-wide. NASA owns over 2,800 buildings, and over 2,600 other structures, totaling almost 44 million square feet with a current replacement value of over $24 billion. About two million square feet of these facilities are “mothballed” or “abandoned.” Another million square feet are to be closed in the next four years, and possibly more will be identified for closure due to an upcoming NASA Real Estate Strategic Review. Closed facilities are a drain on NASA resources and should be demolished because they can deteriorate into eyesores and possible safety hazards. Demolition projects have accounted for a deferred maintenance reduction of $98 million and have an estimated payback period of seven years.

Reimbursable Estimates by Appropriation

Reimbursable agreements are agreements where the NASA costs associated with the undertaking are borne by the non-NASA partner. NASA undertakes reimbursable agreements when it has equipment, facilities, and services that it can make available to others in a manner that does not interfere with NASA mission requirements. As most reimbursable requests to NASA do not occur until the year of execution, the FY 2008 estimate is projected based on historical data.

Budget Authority ($ in millions)	FY 2006 Actual	FY 2007 Current	FY 2008 Estimate
Science, Aeronautics, and Exploration	498.2	717.9	700.0
Exploration Capabilities	333.2	557.1	600.0
Office of Inspector General	.2	.5	.5
Total	**831.6**	**1275.5**	**1,300.5**

Summary of Consulting Services

NASA uses paid experts and consultants to provide advice and expertise to or beyond that which is available from its in-house civil service workforce. Management controls assure there is ample justification presented and the action is approved at top management levels, prior to entering a consulting services arrangement with an individual.

NASA also uses experts and consultants to provide expertise on the selection of experiments for future space missions. The use of these experts and consultants, in addition to NASA civil service personnel, provides the Agency with an independent view that assures the selection of experiments likely to have the greatest scientific merit. Other individuals provide independent looks at technical and functional problems in order to give top management the widest possible range of views before making major decisions.

Expert/Consultants (Total NASA) ($ in millions)	FY 2006 Actual	FY 2007 Current	FY 2008 Estimate
Number of Paid Experts and Consultants	24	25	25
Annual FTE Usage	2	2	2
Total Salary and Benefits Costs	0.2	0.2	0.2
Travel Costs	0.4	0.4	0.4
Total Costs	**0.6**	**0.6**	**0.6**

Obligations by Object Class Code

This table reflects FY 2006 and prior year funds obligated in FY 2006 and projections of obligations based on past trends for the FY 2007 and FY 2008 President's budget.

Obligations by Object Class Code ($ in millions)	FY 2006 Actual	FY 2007 Current	FY 2008 Estimate
Total Agency	**16,690.8**	**16,556.6**	**17,333.7**
Full-time permanent	1,612.1	1,655.7	1,700.4
Other than full-time permanent	111.0	114.0	117.0
Other personnel compensation	36.5	37.5	38.5
Special personal service payments	0.8	0.8	0.8
Civilian personnel benefits	448.6	460.7	473.2
Benefits to former personnel	9.3	9.6	9.8
Travel and transportation of persons	81.2	83.4	85.7
Transportation of things	51.3	51.8	52.3
Rental payments to GSA	33.3	33.7	34.0
Rental payments to others	5.6	5.7	5.8
Communications, utilities and misc. charges	110.1	111.8	112.9
Printing and reproduction	13.4	13.7	13.8
Advisory and assistance services	412.5	419.0	423.2
Other services	1,443.7	1,467.1	1,481.8
Other purchases of goods and services from gov. accounts	418.4	426.0	430.2
Operation and maintenance of facilities	2,446.1	2,508.1	2,533.2
Research and development contracts	7,462.7	7,134.3	7,777.1
Medical care	4.1	4.1	4.2
Operation and maintenance of equipment	87.9	89.7	90.6
Supplies and materials	171.7	175.0	176.8
Equipment	397.3	405.0	409.0
Land and structures	328.0	333.9	337.3
Grants, subsidies, and contributions	1,004.8	1,015.6	1,025.7
Insurance claims and indemnities	0.4	0.4	0.4

National Institute of Aerospace

The National Institute of Aerospace (NIA) provides research and education support to NASA to ensure a national capability for the Agency's mission by expanding collaboration with academia and leveraging expertise inside and outside NASA. A Nation-wide competitive procurement resulted in the selection of the NIA, which is a non-profit consortium that included the following founding members: American Institute of Aeronautics and Astronautics Foundation, Georgia Institute of Technology, North Carolina A&T University, North Carolina State University, University of Maryland, University of Virginia, and Virginia Polytechnic Institute and State University. Hampton University later became a full member, and Old Dominion University and the College of William and Mary are affiliate members. Since January 2003, the NIA has significantly expanded its research portfolio and collaborations with non-member universities and colleges, industry partners, and other government agencies both nationally and internationally. NIA's vibrant Visiting Scholars Program has also expanded its boundaries by engaging nationally and internationally recognized experts and scholars.

The NIA conducts leading edge research and develops revolutionary new technologies in all areas of interest to NASA through partnerships with the Nation's universities, industry, and other government agencies. NIA performs research in a broad range of disciplines relevant to NASA's Space Exploration, Science, Space Operations, and Aeronautics missions. In 2006, NIA's research programs continued to grow, with more emphasis on research programs in exploration, materials, and atmospheric sciences.

NIA's Graduate Education Program offers M.S. and Ph.D. degrees in the fields of engineering and science which are extremely relevant to the Agency. The NIA, through its university partners, offers 120 graduate engineering courses, including the newly created Space Exploration Core Curriculum, and Spacecraft and Launch Vehicle Design Programs. These courses are delivered by many different methods, including live classroom instruction and distance learning using interactive video. Of the 44 full-time graduate students in 2006, 36 percent are Ph.D. Candidates and 64 percent are M.S. candidates. NIA's Continuing Education Program has also grown substantially. In 2006, the NIA delivered 67 seminar programs, hosted and/or facilitated eight workshops, and conducted 13 short courses. The NASA Engineering and Safety Center (NESC) partnered with the NIA to develop and operate the NESC Academy. The purpose of the NESC Academy is to transfer the expertise and knowledge developed by previous generations that resulted in the development of Apollo, Saturn, and the Space Shuttle, to the current and next generations responsible for developing the new Crew Exploration Vehicle, Crew Launch Vehicle, and beyond. The NESC academy captures the knowledge and lessons learned from NASA's most accomplished space flight engineering leaders to develop short course training materials, offering a series of short courses on university campuses throughout the Nation.

Langley Research Center is committed to developing significant contributions to the Vision for Space Exploration, and has realigned its workforce to accommodate the Agency's strategic goals. The NIA is positioned to develop training and/or retraining programs for NASA's current workforce as well as provide a pipeline for developing the Agency's future workforce. FY 2007 was the final year of the original five year co-operative funding arrangement with NIA. All future funding for NIA is unknown and dependent upon NASA mission requirements.

Spending ($ in millions)	**FY 2006 Actual**
NASA Funding	27.9
University Cost Sharing	1.1
Total Program Funding	**29.0**

Note: University Cost Sharing based on estimate.

FY 2007 Commerce, Justice, and Science Appropriations as reported in the Senate H.R. 5672

Requirement	Reference
1) The actual, current, proposed funding level, and estimated budgets for the next five fiscal years by Directorate, Theme, Program, Project, and activity within each appropriations account.	Mission Directorate sections
2) The budget for headquarters including: (A) the budget by office for the actual, current, proposed funding level, and estimated budgets for the next 5 fiscal years; (B) the travel budget for each office for the actual, current, and proposed funding level; and (C) the civil service full time equivalent assignments per office including the number of Senior Executive Service personnel per office.	Supporting Data: Corporate G&A section *Note: Provided at the Agency level. Out year data by Office has not been allocated.*
3) Provide only to the Committee on Appropriations information for each Center and Federally Funded Research and Development Center operated by NASA. (A) Actual, current, proposed funding, and estimated budgets for next 5 fiscal years by Directorate, Theme, Program, Project and activity. (B) Proposed Programmatic and non programmatic Construction of Facilities. (C) Number of civil service FTE per Center for each identified fiscal year. (D) Number of civil service FTE considered to be uncovered capacity at each location for each identified fiscal year.	(A) Will be provided in a separate report. (B) Supporting Data: Construction of Facilities (C) Supporting Data: Workforce (D) Will be provided in a separate report.
4) Sufficient narrative to explain each Program, Project, and activity, and explanation for any deviations to adopted baselines.	Mission Directorate sections

NASA Authorization Act of 2005 P.L. 109-155

Requirement	Reference
TITLE I - GENERAL PRINCIPLES AND REPORTS SEC. 101. RESPONSIBILITIES, POLICIES, AND PLANS h) BUDGETS.— (1) CATEGORIES.—The proposed budget for NASA submitted by the President for each fiscal year shall be accompanied by documents showing -	
(A) by program— (i) the budget for space operations, including the ISS and the Space Shuttle; (ii) the budget for exploration systems; (iii) the budget for aeronautics; (iv) the budget for space science;	(i) Space Operations Mission Directorate (ii) Explorations Systems Mission Directorate (iii) Aeronautics Research Mission Directorate (iv) Science Mission Directorate

Requirement	Reference
(v) the budget for Earth science; (vi) the budget for microgravity science; (vii) the budget for education; (viii) the budget for safety oversight; and (ix) the budget for public relations;	(v) Science Mission Directorate: Earth Science Theme (vi) Supporting Data: Other Government Reporting Requirements (vii) Education Theme (viii) Supporting Data: Other Government Reporting Requirements (ix) Supporting Data: Other Government Reporting Requirements
(B) the budget for technology transfer programs;	Supporting Data: Other Government Reporting Requirements
(C) the budget for the Integrated Enterprise Management Program, by individual element;	Cross-Agency Support Programs: Advanced Business Systems
(D) the budget for the Independent Technical Authority, both total and by Center;	Supporting Data: Center Management and Operations
(E) the total budget for the prize program under section 104, and the administrative budget for that program;	Innovative Partnerships Program – Project Narrative for Centennial Challenges
(F) the comparable figures for at least the 2 previous fiscal years for each item in the proposed budget.	Mission Directorate sections
(G) The amount of unobligated funds and unexpended funds, by appropriations account--	
(i) that remained at the end of the fiscal year prior to the fiscal year in which the budget is being presented that were carried over into the fiscal year in which the budget is being presented; (ii) that are estimated will remain at the end of the fiscal year in which the budget is being presented that are proposed to be carried over into the fiscal year for which the budget is being presented; and (iii) that are estimated will remain at the end of the fiscal year for which the budget is being presented	Supporting Data: Other Government Reporting Requirements

Budget for Microgravity Science

NASA Authorization Act of 2005 P.L. 109-155: Title I h) budgets (1) categories, (A) by Program (viii) Budget for Microgravity Science

The Exploration Systems Mission Directorate (ESMD) conducts research to take advantage of the unique environment of reduced gravity in two broad categories; Exploration International Space Station (ISS) Research and Non-Exploration Research.

($ in millions)	FY 2006 Actual	FY 2007 Current	FY 2008 Estimate	FY 2009	FY 2010	FY 2011	FY 2012
Exploration ISS Research	219.3	92.3	67.5	65.8	67.3	64.5	56.6
Non-Exploration Research	14.0	14.1	13.3	11.7	11.2	11.6	--
Total	**233.3**	**106.4**	**80.8**	**77.5**	**78.5**	**76.1**	**56.6**

Exploration ISS Research

Exploration ISS Research supports the Agency's need for improved knowledge about working and living in space to enable advanced human exploration missions in the future. Part of this research includes a focus on human health and countermeasures; fire prevention, detection, and suppression; multiphase flow for fluids; advanced life support; and thermal control. More information is available on this research under the Human Research Program.

Non-Exploration Research

The NASA Authorization Act of 2005 created Non-Exploration Research and requires NASA to carry out to the maximum extent practicable, basic, applied and commercial research on the ISS, "free flyers", and ground-based laboratories and is not directly linked to the Vision for Space Exploration. This research focuses on reduced gravity investigations in the life and physical sciences in fields such as microbial, cellular and animal research, materials science, fluid physics and combustion science. The motivation for this research is to sustain the existing U.S. scientific expertise and research capability in microgravity research. The knowledge gained from these investigations has the potential to uncover information that may lead to novel applications both on Earth and in space.

Budget for Public Relations

NASA Authorization Act of 2005 P.L. 109-155: Title I h) budgets (1) categories, (A) by Program (viii) Budget for Public Relations

The NASA budget for Public Relations is not funded by program. Instead, it is budgeted in two separate accounts under Mission Support. Public Relations budgets are included as Mission Support costs within the Center Management and Operations and Corporate G&A budgets and are funded by installation as shown below.

Center ($ in millions)	FY 2007 Current	FY 2008 Estimate	FY 2009	FY 2010	FY 2011	FY 2012
Ames Research Center	1.9	1.7	1.8	1.8	2.0	2.0
Dryden Flight Research Center	0.7	0.7	0.7	0.7	0.8	0.8
Glenn Research Center	5.8	5.4	5.7	5.9	6.1	6.3
Goddard Space Flight Center	4.3	4.2	4.4	4.5	4.7	4.9
Johnson Space Center	6.9	6.6	6.8	7.0	7.1	7.3
Kennedy Space Center	5.1	4.7	4.9	5.1	5.3	5.4
Langley Research Center	3.4	3.2	3.3	3.4	3.6	3.7
Marshall Space Flight Center	6.1	6.1	6.5	6.5	7.3	7.7
NASA Headquarters	10.9	9.1	9.5	9.9	10.3	10.7
Stennis Space Center	1.9	1.8	1.9	1.5	1.5	1.6
Total	**47.1**	**43.6**	**45.5**	**46.3**	**48.5**	**50.4**

Budget for Safety Oversight

NASA Authorization Act of 2005 P.L. 109-155: Title I h) budgets (1) categories, (A) by Program (viii) Budget for Safety Oversight.

This information is the current plan for Safety and Mission Assurance staffing support to the Mission Directorates. The budget runout will be updated as the Agency completes its refinement of transition costs associated with the retirement of the Space Shuttle and the development of Exploration Systems components.

($ in millions)	FY 2006 Actual	FY 2007 Current	FY 2008 Estimate	FY 2009	FY 2010	FY 2011	FY 2012
Aeronautics Research	**0**	**3.4**	**3.5**	**3.6**	**3.7**	**3.8**	**3.9**
Flight Research	0	1.6	1.7	1.7	1.8	1.8	1.9
Exploration Systems	**13.4**	**47.5**	**48.9**	**50.4**	**51.9**	**53.5**	**55.1**
Science	**43.1**	**60**	**61.8**	**63.7**	**65.6**	**67.6**	**69.6**
Space Operations	**382.1**	**395.3**	**407.1**	**419.3**	**431.9**	**444.9**	**458.2**
Space Shuttle	328.7	334.2	344.2	354.6	365.2	376.2	387.5
International Space Station	53.3	50.5	52.1	53.6	55.2	56.9	58.6
Launch Services	0	7.5	7.7	7.9	8.2	8.4	8.7
Radiation Projects	0	3.1	3.1	3.2	3.3	3.4	3.5
Agency-wide Safety Oversight	**81.7**	**127.8**	**131.6**	**135.5**	**139.6**	**143.8**	**148.1**
Office of Safety and Mission Assurance	24.4	24.7	25.5	26.2	27	27.8	28.7
Institutional (Safety, Health, Environmental)	0	36.9	38	39.2	40.4	41.6	42.8
Contractor Oversight (DCMA, SAC, NCAS)	57.3	66.1	68.1	70.1	72.2	74.4	76.6
Other Programs	**94.6**	**28.1**	**28.9**	**29.8**	**30.7**	**31.6**	**32.5**

Budget for Technology Transfer Programs

NASA Authorization Act of 2005 P.L. 109-155: Title I h) budgets (1) categories B) the budget for technology transfer programs

($ in millions)	FY 2006 Actual	FY 2007 Current	FY 2008 Estimate	FY 2009	FY 2010	FY 2011	FY 2012
Technology Transfer Partnerships	35.6	39.7	33.3	31.0	30.2	26.2	26.2

Senate and House Reporting Requirements

The figures below represent actual unobligated balances within NASA's individual appropriation accounts as of September 30, 2006, and estimates for the disposition of those accounts at the future dates specified.

FY06 – FY08 Appropriations ($ in millions)	Unobligated Balances Sept. 30, 2006	Estimated Unobligated Balances Sept. 30, 2007	Estimated Unobligated Balances Sept. 30, 2008
Science, Exploration, & Aeronautics	1363	1142	1270
Exploration Capabilities *	644*	526*	563*
Inspector General	0	0	0
Total NASA	**2007**	**1668**	**1833**

** Includes unobligated emergency hurricane supplemental appropriation of $268M in FY06: $165million in FY07; and $65 million in FY08.*

Prior Year Appropriations ($ in millions)	Unobligated Balances Sept. 30, 2006	Estimated Unobligated Balances Sept. 30, 2007	Estimated Unobligated Balances Sept. 30, 2008
Science, Exploration, & Aeronautics	13	1	0
Exploration Capabilities	54	30	12
Other (SAT/HFS/MS)	25	12	0
Total NASA	**92**	**43**	**12**

E-Gov initiatives and Benefits

OMB Circular A-11, Sections 22.6 and 53.5

Each agency's Congressional Justification should include funding for E-Gov initiatives as provided below as well as the benefits associated with each initiative for the agency.

FY 2007 and FY 2008 Expected Benefits to NASA from the President's E-Gov Initiatives

NASA is providing funding contributions in FY 2007 and FY 2008 for each of the following E-Government Initiatives:

Initiative	FY 2007 Agency Contributions	FY 2007 Agency Service Fees*	FY 2008 Agency Contributions	FY 2008 Agency Service Fees*
E-Rulemaking (026-00-01-99-04-0060-24)	$280,000	--	$241,000	--
Business Gateway (026-00-01-99-04-0100-24)	$131,527	--	$44,000	--
Grants.gov (026-00-01-99-03-0160-24)	$520,570	--	$536,187	--
E-Training (026-00-01-99-04-1217-24)	--	$700,000	--	$700,000
Recruitment One-Stop 026-00-0199-04-1200-24	--	$100,378	--	$116,014
E-Payroll	--	$3,480,790	--	$3,480,790
E-Travel (026-00-01-99-04-0221-24)	--	$940,000	--	$1,069,088
Integrated Acquisition Environment (026-00-01-99-04-0230-24)	$1,443,128	--	$1,226,334	--
E-Authentication (026-00-01-99-04-0250-24)	--	--	$65,217	--
Financial Management LoB (026-00-01-99-04-1100-24)	$83,333	--	$75,000	--
Human Resources Management LoB (026-00-01-99-04-1200-24)	$65,217	--	$65,217	--
Grants Management LoB (026-00-01-99-03-1309-24)	$60,147	--	$59,316	--
Geospatial LoB (026-00-01-99-04-3100-24)	$15,000	--	$15,450	--
Budget Formulation and Execution LoB (026-00-01-99-04-3200-24)	$75,000	--	$85,000	--
IT Infrastructure LoB (026-00-01-99-04-3300-24)	$80,000	--	$80,000	--
NASA Total	**$2,753,922**	**$7,975,090**	**$2,532,721**	**$5,365,892**

**Service Fees are estimates as provided by the E-Government initiative Managing Partners.*

NASA's FY 2007 Exhibit 300 IT business cases will be posted at: www.nasa.gov/offices/ocio/busmanagement/index.html within two weeks of the release of the President's Budget.

The PMA E-Government initiatives serve citizens, businesses, and federal employees by delivering high quality services more efficiently at a lower price. Instead of expensive "stove-piped" operations, agencies work together to develop common solutions that achieve mission requirements at reduced cost, thereby making resources available for higher priority needs. Benefits realized through the use of these initiatives for NASA in FY 2007 and in FY 2008 are as follows:

E-Rulemaking (Managing Partner EPA) FY 2007 and FY 2008 Benefits

Since the deployment of the Federal Docket Management System (FDMS) in December 2005, NASA has used FDMS to receive public comment on Agency rules. Previously, NASA used a paper-based system for all public comments on rulemaking. For FY 2007 and FY 2008, this conversion to an electronic system will continue allowing NASA to increase the speed of disposition comments and to reduce the redundancies built into the paper-based system. Through a single online Web site, FDMS will enable NASA to improve public access to its rulemaking materials, provide a central location for the public to find and comment on regulatory actions. Additional benefits will include reduced data storage costs and an easier method for regulation writers to collaboration on cross-agency/cross-government regulatory matters.

Business Gateway (Managing Partner SBA) FY 2007 and FY 2008 Benefits

For FY 2007 and FY 2008, Business Gateway (BG) will continue to offer NASA another potential channel to identify businesses with the interest and expertise to engage in technological development and partnerships. Additional benefits include Business Gateway's powerful outreach channel to match businesses with the various initiatives that are part of NASA's outreach to the business community, as well as the plain-English compliance information BG provides to help businesses know what they need to do to comply with regulations across federal agencies. Finally, the BG Forms Catalog contains links to 18 NASA forms/instructions, which can improve the ability of businesses to locate and submit government forms.

The following additional benefit information for NASA was provided by the Business Gateway initiative, based on calculations from publicly available data and data from the existing Business.gov site. NASA has not independently verified this data:

- Business Gateway provides one-stop, equal access to cross-agency compliance information for the benefit of NASA's customers.
- As a single-source, cross-agency alternative to multiple paper- and Web-based sources, Business Gateway encourages and simplifies regulatory compliance for the benefit of all citizens.
- Time and cost savings: NASA customers seeking compliance information report that each visit to Business.gov saved them 12 labor hours (at a savings of $870)[i].
- Online forms and filing: Customers will realize additional time and cost savings through paper reduction and reduced postage costs.
- Burden hours: Business.gov helps agencies comply with the e-Gov Act and Small Business Paperwork Relief Act (SBPRA) requirements. Customers looking for NASA compliance regulations save 202,000 burden hours per year[ii].
- Leveraged outreach: Business.gov outreach materials provide access to 16,000 additional NASA customers who would not otherwise be reached[iii].
- Maintenance savings: Business.gov's search technology will provide NASA with valuable user statistics and feedback, enabling it to simplify content management on its business compliance site.

- Online forms: By making six forms (to date) available on Forms.gov, NASA saves Agency time in forms management, and is expected to produce significant savings in paper and postage[iv].
- Reduced burden on field offices: By directing compliance-related inquiries to Business.gov, agencies with field offices will save training and staff-time dollars.
- Future data harmonization savings: It is reasonable to expect that every federal agency has at least one "vertical" opportunity; in NASA's case, opportunities exist to refine the processes with DOS and DOD regarding the protection of cutting-edge technologies. DOI and DOL together estimate savings of $341,000 in the first three years of their vertical opportunity, and are expected to save $570,000 over 5 years[v].
- Increased citizen/business engagement: Business Gateway gives 16,000 new customers quick access to NASA's regulatory information[vi].
- Resources refocused on Agency business: Because Business Gateway makes compliance information easily available, NASA's compliance enforcement budget, for example, can be redirected toward achieving other areas of the Agency's core mission.
- Transparency: Business Gateway enables NASA to meet the Agency's public service commitment to transparency in government by providing customers with ready, equal access to information about compliance requirements.

Grants.gov (Managing Partner HHS) FY 2007 and FY 2008 Benefits

The Grants.gov Initiative benefits NASA and the Agency's grant programs by providing a single location to publish grant (funding) opportunities and application packages, where more than $400 billion in grants were awarded government-wide by the 26 grant-making agencies and other federal grant-making organizations. By providing a single site for the grants community to apply for grants using common forms, processes and systems, it makes the process easier for applicants to apply to multiple agencies. The Grants.gov Website also receives over 1.5 million hits and sends over 1 million email notifications per week at the public's request. The site has been adopted by all 26 grant-making agencies and 77 percent of the grants posted on the site are available for electronic submission.

E-Training (Managing Partner OPM) FY 2007 and FY 2008 Benefits

NASA streamlined the Agency's three separate online training systems into one centralized, learning management system, SATERN, a "one-stop" approach offering Web-based access to training and career development resources. Through SATERN, employees can view required training, launch online content, view training history, and self-register for courses. In addition, the system allows NASA to identify offices that have not met training requirements, and bring them in line with federal mandates. Once fully implemented, SATERN will also offer employees access to career planning tools, individual development plans, and competency management.

Recruitment One-Stop (Managing Partner OPM) FY 2007 and FY 2008 Benefits

Recruitment One-Stop provides state-of-the-art online recruitment services to federal job seekers including online job posting, intuitive job searching, resume warehousing, online application submission, and automated eligibility and status feedback. USAJOBS provides federal agencies with a unified system to attract and hire highly qualified and talented individuals. Integration with Recruitment One-Stop allows NASA to better attract individuals who can accomplish the Agency's mission. The new USAJOBS interface allows job seekers to view and apply for all NASA employment opportunities, as well as those from other federal agencies. Job seekers now need only one user ID and password to access all NASA employment opportunities. All federal agencies use the Office of Personnel Management's Recruitment One-Stop site, and 84 percent of government jobs are posted on the Website.

NASA adopted the USAJOBS resume as the basic application document for all NASA positions, except for Astronaut positions, with Phase II implementation completed in September 2005. Currently, NASA has not identified any savings, either in terms of budgeted savings or cost avoidance. Although the Agency believes that implementation of Recruitment One-Stop (ROS) has resulted in significant intangible benefits in terms of providing better vacancy information to applicants, it has not resulted in any cost savings.

E-Payroll (Managing Partner OPM) FY 2007 and FY 2008 Benefits

The E-Payroll Initiative standardizes and consolidates government-wide federal civilian payroll services and processes by simplifying and standardizing human resources (HR) payroll policies and procedures and better integrating payroll, HR, and finance functions. Prior to beginning the initiative, 26 federal agencies provided payroll services. Four providers were selected to furnish payroll services for the Executive branch. In August 2004, the Department of Interior (DOI) began serving as NASA's payroll provider, using their system, the federal Personnel and Payroll System (FPPS), to process NASA's HR and payroll transactions. The E-Payroll initiative benefits NASA by permitting the Agency to focus on mission related activities, rather than on administrative payroll functions. Payroll processing costs are reduced through economies of scale and avoiding the cost of duplicative capital system modernization activities. The initiative also promotes standardization of business processes and practices and unified service delivery.

E-Travel (Managing Partner GSA) FY 2007 and FY 2008 Benefits

NASA is currently scheduled to migrate Agency travel services to Electronic Data Systems Corporation (EDS), one of the three designated E-Travel service providers, by March 2007. Upon completion of this migration, NASA will be able to provide more efficient and effective travel management services. The benefits include cost savings associated with cross-government purchasing agreements and improved functionality through streamlined travel policies and processes, strict security and privacy controls, and enhanced Agency oversight and audit capabilities. NASA employees also will also benefit through more efficient travel planning, authorization, and reimbursement processes.

Integrated Acquisition Environment (Managing Partner GSA) FY 2007 and FY 2008 Benefits

The Integrated Acquisition Environment (IAE) initiative launched the new electronic Subcontractor Reporting System (eSRS) (http://www.acq.osd.mil/scst/esrs.htm) in October 2005, with the promise of creating higher visibility and introducing greater transparency into the process of gathering information on federal subcontracting accomplishments. This Internet-based tool is designed to streamline the process of reporting on subcontracting plans and to provide agencies with access to analytical data on subcontracting performance. IAE has seen increased usage of its major acquisition systems over the past year. For example, as of January 2006, over 400,000 vendors have registered on the Central Contractor Registration (CCR) (http://www.ccr.gov/).

Through adoption of the tools and services provided by IAE, NASA improves its ability to make informed and efficient purchasing decisions and allows it to replace manual processes. If NASA were not allowed to use the IAE systems, they would need to build and maintain separate systems to record vendor and contract information, and to post procurement opportunities. Agency purchasing officials would not have access to databases of important information from other agencies on vendor performance and could not use systems to replace paper-based and labor-intensive work efforts. For FY06, NASA received estimated benefits of $2,103,602 based upon the processes, personnel, roles, steps, and actions involved. In addition, the agency realized an estimated cost avoidance of $185,402 and estimated operational cost savings of $1,011,431.

E-Authentication (Managing Partner GSA) FY 2007 and FY 2008 Benefits

The E-Authentication Initiative will provide a trusted and secure standards-based authentication architecture to support federal E-Government applications and initiatives. This approach will provide a uniform process for establishing electronic identity and eliminate the need for each initiative to develop a redundant solution for the verification of identity and electronic signatures. E-Authentication's federated architecture will also enable citizens and businesses to use credentials issued by commercial entities, such as financial institutions, to conduct transactions with the government. Successful implementation of E-Authentication will produce numerous benefits for the public and the federal government. Citizens and businesses will have a secure, easy-to-use and consistent method of proving identity to the government and will be spared the burden of having to keep track of multiple sets of registration information. Federal agencies will be able to reduce authentication system development and acquisition costs and reallocate labor resources previously used to develop such systems, resulting in faster, less expensive implementation of E-Government.

The initiative will ultimately benefit NASA by providing E-Authentication expertise, guidance, and documentation, including project planning and reporting templates, to enable NASA to achieve production implementation of E-Authentication for its NASA Account Management System (NAMS) application to include a tie to all of its back-end applications that require authentication. In addition, the E-Authentication Federation allows NASA to use identity credentials issued and managed by organizations within and outside the federal government, thereby relieving NASA of much of the cost of providing its own identity management solutions.

Lines of Business

Financial Management LoB (Managing Partners DoE and DoL) FY 2007 and FY 2008 Benefits

Federal agencies began implementing the Financial Management Line of Business (FM LoB) initiative in FY 2006 by actively migrating to centers of excellence service providers and initiating solutions to integrate financial data among and between agency business systems. Agencies have submitted their FY 2007 business cases to continue migrations or submit applications to become a center of excellence service provider for other agencies. The FM LoB also announced new milestones and changes to the initiative governance structure. These changes will facilitate agency migrations and improve the cost, quality and performance of financial management systems government-wide.

The initiative will ultimately benefit NASA by providing the reference tools and templates needed to assist the Agency in planning and managing migration to a selected center of excellence. The FM LoB has established an Advisory Board to govern the activities and decision making process for the initiative. NASA's involvement with this board affords them the opportunity to review critical issues impacting their FM systems, voice their unique needs and concerns, and collaboratively offer recommendations and influence decisions on how best to implement the common solution. In the long term, NASA will have the opportunity to play an active role in standardizing core FM business process and data elements. NASA's involvement in this crucial task ensures their needs and requirements are addressed in the target FM LoB enterprise architecture supporting the FM LoB common solution. This work allows NASA to influence the future direction of financial management across the government from both an information technology and business process perspective.

Human Resources Management LoB (Managing Partner OPM) FY 2007 and FY2008 Benefits

Through the HR LoB, OPM will use enterprise architecture (EA)-based principles and best practices, proven through the E-Gov initiatives and Federal Enterprise Architecture (FEA), to identify common solutions for HR business processes and/or technology-based shared HR services to be made available to government agencies. Driven from a business perspective rather than a technology focus, the solutions will address distinct business improvements that enhance government's performance of HR services in support of agency missions delivering services to citizens. The end result of the HR LoB efforts will be to save taxpayer dollars, reduce administrative burdens, and significantly improve HR service delivery.

NASA will ultimately benefit from the HR LoB through its use of best-in-class HR services and systems provided by one of the approved service providers. Through NASA's adoption of an approved service provider, the Agency can achieve the benefits of "best-in-class" HR solutions without the costs of developing and maintaining their own HR systems. In addition, employees across the Agency will benefit from improved HR services.

Grants Management LoB (Managing Partner HHS and NSF) FY 2007 and FY 2008 Benefits

The Grants Management Line of Business (GM LoB) will ultimately offer the development of a government-wide solution to support end-to-end grants management activities promoting citizen access, customer service, and financial and technical stewardship for the Agency. The end result is intended to be a government-wide streamlined grant making process providing transparency and efficiency in the grant decision-making process. The benefits of GM LoB include increased service to citizens through standardized processes; cost savings for grant-making agencies through use of shared IT infrastructure; a reduction in the number of redundant grants management systems; and improved reporting on government-wide grant activities and results. The GM LoB adopted a "consortia-based" approach to implementation and developed a process for forming consortia and having agencies participate in consortia as members.

Geospatial LoB (Managing Partner DoI) FY 2007 and FY 2008 Benefits

As a science agency, the work of NASA's science and mission professionals is inherently different from duties and functions performed by operational agencies. These differences lead NASA to organize and manage data to best facilitate science activities rather than a central focus of data dissemination. Scientific inquiry often leads scientist to use different schemas for analyzing data and information produced from remote sensing data (e.g. a common grid or projection). While the data that will be created for and disseminated by the Geospatial LoB is consensus driven community based, NASA still advocates for and uses such data. NASA will continue to apply the elements of FGDC standards where these are appropriate.

Budget Formulation & Execution LoB (Managing Partner Education) FY 2007 and FY 2008 Benefits

The Budget Formulation and Execution LoB will ultimately benefit NASA by focusing on building a "budget of the future", employing standards and technologies for electronic information exchange to link budget, execution, performance, and financial information throughout all phases of the annual budget formulation and execution cycle. In addition, BFE LoB will identify opportunities for common solutions and automated tools to enhance agency and central budget processes; provide government with enhanced capabilities for analyzing budget, performance, and financial information; and promote integration and standardize information exchange between budget formulation, execution, financial management, and performance measurement systems and activities across Government.

LoB - IT Infrastructure LoB (Managing Partner GSA) FY 2007 and FY 2008 Benefits

The IT Infrastructure LoB offers the potential to identify opportunities for IT infrastructure consolidation and optimization, and the development of government-wide common solutions. This LoB will define specific common performance measures for service levels and costs, identify best practices, and develop guidance for transition plans within agencies and/or across agencies. Consolidation and optimization of IT infrastructure represents a significant opportunity to realize future cost savings by taking a more coordinated approach to spending on commodity IT infrastructure. IT infrastructure consolidation and optimization case studies also demonstrate agencies could improve IT service levels and, when relieved of the burden of managing these non-core functions, can concentrate more on mission priorities and results.

Supporting Data: Other Government Reporting Requirements

Based on the objectives and goals of this LoB, NASA believes that there is great potential for numerous benefits from the LoB both for NASA and for other federal agencies. Some of these benefits are relatively easy to quantify, while others are more indirect and require an extended period of time and some econometric analysis prior to producing an estimate. A few of the anticipated FY 2007 benefits from NASA's viewpoint are: improved performance, enhanced productivity, greater consistency and standardization of infrastructure platforms, aggregate purchasing of infrastructure components, cross-Agency integration possibilities, and a planned approach to new technology infusion. At this stage of the formulation process, NASA is unable to provide any quantifiable cost savings that may results from these anticipated benefits.

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i ForeSee Results, Customer Satisfaction Report, August 2006.

ii Business.gov Database Analysis, September 2006.

ForeSee Results, Customer Satisfaction Report, August 2006; in the period July 2005 through June 2006, 27,328 visitors (7%) received the survey of the 390,400 visitors who were eligible to receive the survey (by viewing at least 7 pages).

iii JDG Communications Outreach Plan, May 2006 and Business.gov Database Analysis, September 2006.

iv Business.gov Database Analysis, September 2006.

v DOI Office of Surface Mining, "SSCR Pilot Implementation Report," 2005.

vi Business Gateway Usage Statistics, FY2006 and Business.gov Database Analysis, September 2006.

National Aeronautics and Space Administration Proposed Appropriation Language

SCIENCE, AERONAUTICS AND EXPLORATION (INCLUDING TRANSFER OF FUNDS)

For necessary expenses, not otherwise provided for, in the conduct and support of science, aeronautics and exploration research and development activities, including research, development, operations, support and services; maintenance; construction of facilities including repair, rehabilitation, revitalization, and modification of facilities, construction of new facilities and additions to existing facilities, facility planning and design, and restoration, and acquisition or condemnation of real property, as authorized by law; environmental compliance and restoration; space flight, spacecraft control and communications activities including operations, production, and services; program management; personnel and related costs, including uniforms or allowances therefor, as authorized by 5 U.S.C. 5901–5902; travel expenses; purchase and hire of passenger motor vehicles; not to exceed $35,000 for official reception and representation expenses; and purchase, lease, charter, maintenance and operation of mission and administrative aircraft, $10,483,100,000, to remain available until September 30, 2009, of which amounts as determined by the Administrator for salaries and benefits; training, travel and awards; facility and related costs; information technology services; science, engineering, fabricating and testing services; and other administrative services may be transferred to ‘‘Exploration Capabilities’’ in accordance with section 313 of the National Aeronautics and Space Act of 1958, as amended.

Note.—A regular 2007 appropriation for this account had not been enacted at the time the budget was prepared; therefore, this account is operating under a continuing resolution (P.L. 109–289, Division B, as amended). The amounts included for 2007 in this budget reflect the levels provided by the continuing resolution.

EXPLORATION CAPABILITIES (INCLUDING TRANSFER OF FUNDS)

For necessary expenses, not otherwise provided for, in the conduct and support of exploration capabilities research and development activities, including research, development, operations, support and services; maintenance; construction of facilities including repair, rehabilitation, revitalization and modification of facilities, construction of new facilities and additions to existing facilities, facility planning and design, and acquisition or condemnation of real property, as authorized by law; environmental compliance and restoration; space flight, spacecraft control and communications activities including operations, production, and services; program management; personnel and related costs, including uniforms or allowances therefor, as authorized by 5 U.S.C. 5901–5902; travel expenses; purchase and hire of passenger motor vehicles; not to exceed $35,000 for official reception and representation expenses; and purchase, lease, charter, maintenance and operation of mission and administrative aircraft, $6,791,700,000, to remain available until September 30, 2009, of which amounts as determined by the Administrator for salaries and benefits; training, travel and awards; facility and related costs; information technology services; science, engineering, fabricating and testing services; and other administrative services may be transferred to ‘‘Science, Aeronautics and Exploration’’ in accordance with section 313 of the National Aeronautics and Space Act of 1958, as amended.

Note.—A regular 2007 appropriation for this account had not been enacted at the time the budget was prepared; therefore, this account is operating under a continuing resolution (P.L. 109–289, Division B, as amended). The amounts included for 2007 in this budget reflect the levels provided by the continuing resolution.

OFFICE OF INSPECTOR GENERAL

For necessary expenses of the Office of Inspector General in carrying out the Inspector General Act of 1978, as amended, $34,600,000, to remain available until September 30, 2009.

Note.—A regular 2007 appropriation for this account had not been enacted at the time the budget was prepared; therefore, this account is operating under a continuing resolution (P.L. 109–289, Division B, as amended). The amounts included for 2007 in this budget reflect the levels provided by the continuing resolution.

ADMINISTRATIVE PROVISIONS

Notwithstanding the limitation on the availability of funds appropriated for ‘‘Science, Aeronautics and Exploration’’, or ‘‘Exploration Capabilities’’ by this appropriations Act, when any activity has been initiated by the incurrence of obligations for construction of facilities or environmental compliance and restoration activities as authorized by law, such amount available for such activity shall remain available until expended. This provision does not apply to the amounts appropriated for institutional minor revitalization and construction of facilities, and institutional facility planning and design.

Notwithstanding the limitation on the availability of funds appropriated for ‘‘Science, Aeronautics and Exploration’’, or ‘‘Exploration Capabilities’’ by this appropriations Act, the amounts appropriated for construction of facilities shall remain available until September30, 2010.

Funds for announced prizes otherwise authorized shall remain available, without fiscal year limitation, until the prize is claimed or the offer is withdrawn.

The balances of prior appropriations to the National Aeronautics and Space Administration for activities for which funds are provided under this Act may be transferred to the new account established for the appropriation that provides such activity under this Act. Balances so transferred shall be merged with funds in the newly established account and thereafter may be accounted for as one fund under the same terms and conditions but shall remain available for the same period of time as originally appropriated.

Amounts made available in this Act under the headings, ‘‘Science, Exploration, and Aeronautics’’ and ‘‘Exploration Capabilities’’ may be transferred between such accounts, subject to the reprogramming procedures in section 605 of this Act.

Management and Performance Overview

The Agency's planning and performance management system is an essential part of strategic management and governance at NASA. The Agency has in place an integrated system to plan strategy and implementation; monitor, assess, evaluate, and measure performance toward NASA's commitments; identify issues (including the status of resources); gauge the organization's overall health; and provide appropriate data and information to NASA decision-makers. Through this system, NASA identifies the Agency's long-term strategic goals, near-term outcomes, and other key performance measures; develops and implements plans to achieve these goals; and continuously measures the Agency's progress toward those goals. NASA managers use these performance results as a basis for key investment decisions, and NASA performance data provides a foundation for both programmatic and institutional decision-making processes.

NASA's planning and performance management system provides data to Agency management through the following: ongoing monthly and quarterly analyses and reviews; annual assessments in support of budget formulation (for budget guidance and issue identification, analysis and disposition); annual reporting of performance, management issues, and financial position; periodic, in-depth program or special purpose assessments; and recurring or special assessment reports to internal and external organizations.

NASA was the first agency in the federal government to integrate strategic, budget, and performance planning processes and documents and use full cost budgeting/accounting to identify the true costs for evaluating investment alternatives. The Agency initiated an improved approach last year with the introduction of the Planning, Programming, Budgeting and Execution (PPBE) processes. These integrated processes assure that resources are aligned with strategy and that appropriate performance commitments are assigned to those resources. This section includes the FY 2007 and the proposed FY 2008 performance commitments or the target results to be accomplished for the requested resources. The enclosed FY 2007 Performance Plan has not been updated, pending Congressional budget action. It will be updated, and provided to Congress at a later date, to reflect any changed performance commitments.

NASA's performance system is built and managed to align with the Agency's internally and externally imposed performance measurement and reporting requirements, tools, and practices including the Government Performance and Results Act, the President's Management Agenda, and the Office of Management and Budget's (OMB) Program Assessment Rating Tool (PART). NASA tracks six initiatives under the President's Management Agenda (PMA) umbrella in FY 2006: Strategic Management of Human Capital; Competitive Sourcing; E-Government; Budget and Performance Integration; Real Property; and Financial Performance. The progress on these initiatives and the planned improvements and future directions are summarized within this section. As a result of the PMA initiatives and the Program Assessment Rating Tool (PART), NASA programs are reviewed followed by recommendations that are incorporated into investment decisions. NASA has also committed to a series of follow-up actions in response to these findings, which are listed in the individual theme sections of this document.

NASA continues to strive to find new ways to use program performance information to support decisions concerning strategy and budget. A continuing focus for NASA in the coming year is to improve the policy, metrics, and analysis processes for life cycle cost and schedule performance monitoring and reporting. The summary of the Major Program Annual Reports described in this section is one of the reporting tools used to determine how NASA performs this task. The detailed annual reports are located in the individual project sections of this document.

President's Management Agenda

The President's Management Agenda (PMA) commits the executive branch of the federal government to a series of reforms to improve efficiencies and effectiveness in the management of federal programs. The PMA initiative serves as a foundation to improve effective and efficient management in the areas of human capital, real property asset management, acquisitions (competitive sourcing), financial performance, E-Government (information technology), and budget-performance integration. OMB oversees the PMA effort, negotiates performance goals with each agency, and rates agency performance quarterly. NASA's most current ratings for the PMA initiatives are included at the end of this section.

NASA's overall progress in implementing the President's Management Agenda (PMA) principles, goals and objectives contribute to improvements in Agency management and performance. The PMA initiatives provide requirements and common sense principles, and as such they serve as a foundation to more strategically and efficiently manage and implement the Agency's performance goals and objectives in the areas of human capital, information technology, real property, acquisitions (competitive sourcing), finance and strategy-performance-budget.

NASA's commitment to PMA implementation continues to improve the Agency's ability to accomplish the NASA Mission and Strategic Goals. PMA commitments strengthen Agency performance in the target areas and improve Agency strategic planning, program management, and overall performance. Key activities planned for FY 2007 include: integrated Agency-wide workforce planning; implementing effective solutions to Information Technology (IT) security weaknesses; extending competitions to new areas and providing for post-competition reviews; improving in the use of performance data for more effective management; and conducting follow-on activities to assure responsible management of real property government assets.

The following sub-sections outline NASA's progress to date in implementing these key initiatives, and the Agency's plans for the coming year to improve its management efficiency and effectiveness. Many of these plans are currently underway and provide a continuation of important past efforts.

NASA's President's Management Agenda Scorecard:

	Human Capital	Competitive Sourcing	Financial Performance	E-Government	Budget and Performance Integration	Federal Real Property Management
STATUS	GREEN	GREEN	RED	RED	GREEN	GREEN
PROGRESS	GREEN	GREEN	YELLOW	RED	GREEN	YELLOW

Scorecard Status as of: December 31, 2006

Human Capital

Since the inception of the President's Management Agenda, NASA has worked with the Office of Personnel Management to transition the Agency from an often manual and Center-specific workforce management approach to a more strategic, integrated and automated Agency-wide approach. In particular, the Agency has attempted to tie workforce management more closely to NASA's mission and Strategic Goals. The achievement of NASA's planned Human Capital PMA milestones will continue to take the Agency in this direction.

In FY 2007, NASA will develop and implement an integrated Agency-wide workforce planning process, enabling a proactive identification of future workforce requirements. Information generated from analyses conducted during this process will drive a large portion of the remaining Human Capital Program, including recruitment, training and development, information systems, and overall skills rebalancing activities. In particular, NASA will conduct a comprehensive review of all existing leadership development programs and revise those programs as required to ensure that requisite leadership capabilities are being instilled in the current and future workforce. NASA will also develop an enhanced performance planning and appraisal system (the Employee Performance and Communication System) to ensure that employees understand how their efforts contribute to the Agency's performance goals, and to ensure that supervisors are evaluating individual employee performance against those contributions.

NASA will continue to enhance and improve its efforts to assess and measure the efficiency and effectiveness of its overall Human Capital Program. The Agency plans to complete, and implement, a Human Capital Accountability System (HCAS). One primary component of the HCAS will be an innovative series of Center-by-Center assessments designed to gauge Center performance and provide opportunities for sharing best practices from across NASA's multiple installations.

Competitive Sourcing

NASA's current status is "Green" for the Competitive Sourcing initiative, based on the Office of Management and Budget's (OMB) latest assessment. One of the requirements for an agency to get a "Green" rating for the Competitive Sourcing initiative is to develop and get approved by OMB a Green Plan. In response to OMB's guidelines, NASA submitted its updated Green Plan on August 1, 2006. Pursuant to the Green Plan, NASA has now completed two standard public-private competitions, the "Metallic Test Article Development and General Precision and Machining Services" at Langley Research Center (LaRC), and the NASA Shared Services Center (NSSC). To date, NASA has also reviewed or competed 2,531 of the 4,380 FTE originally designated as commercial in nature in the Agency's 2003 FAIR Act inventory.

In order for NASA to maintain its "Green" status in Competitive Sourcing, the Agency is also responsible for performing post-competition accountability reviews of the selected service providers in each competition for evidence of improved performance and reduced costs. The NSSC review was completed in April 2006, and the LaRC review was performed in August 2006. NASA will continue with its phase-in of activities to the NSSC as scheduled to enable the Agency to achieve savings of $42 million over a 10-year period. In addition, NASA will evaluate net savings from the LaRC Metallic Test Article service provider. NASA expects to complete annual science competitions involving at minimum 643 FTE agency-wide through NASA's Research Announcements and Announcements of Opportunity using the approved deviation for scientific and technological research, as reported in response to Section 647(b) of Division F of the Consolidated Appropriations Act for FY 2004 (P.L. 108-199). These awards will stretch the research dollar and enhance the value of NASA's funded research.

Financial Performance

During FY 2006, NASA made measurable progress toward achieving the objectives for Improved Financial Performance, achieving a "Yellow" rating for progress toward this initiative. Additionally, the Agency's independent financial auditors acknowledged NASA's improvement, which included the resolution of two financial management weaknesses.

In FY 2006, NASA:
- Improved accumulation, analysis and distribution of reliable financial information by developing and implementing procedures to validate financial data and processes.
- Strengthened internal controls by implementing a multi-year plan for validating and improving financial management controls at Centers and Headquarters.
- Built greater consistency in Agency financial management strategy, policy and practice by establishing a comprehensive governance structure and publishing the remaining 5 volumes of the Agency's Financial Management Requirements.
- Strengthened controls over each major category of NASA's assets (Mission-Related Assets, Personal Property, Real Property and Internal Use Software) by defining policies and processes and the plans for implementing them during FY 2007.

NASA recognizes that there is much work left to be done. Enhancements to NASA's Core Financial system implemented in FY 2007, will further integrate important process changes related to the Agency's financial systems. The FY 2006 Financial Audit Corrective Action Plan will define the strategy, goals, and objectives NASA will pursue to address specific weaknesses and continue to improve overall financial management. As required by the Improved Financial Performance PMA initiative, the Agency is working diligently to achieve a clean audit opinion and to ensure that Agency decision-makers have timely, accurate, and reliable financial data.

E-Government

NASA's Information Resources Management (IRM) Strategic Plan was updated in September 2006, to align with the Agency's 2006 Strategic Plan. The six strategic goals of the IRM Strategic Plan will provide the foundation necessary for NASA to achieve all of its FY 2007 E-Government Implementation milestones.

NASA's E-Government rating was downgraded from "Green" to "Red" in 2006 due to challenges in meeting the new National Institute for Standards and Technology's certification and accreditation requirements. In response, in FY 2007, NASA will conduct a comprehensive IT security review to determine the root causes of Agency IT security weaknesses and propose solutions. An Agency corrective action plan will be developed after the conclusion of the review. NASA will also finalize privacy policy documentation, develop and implement roles-based employee privacy training, and integrate IT system privacy impact assessments into the Agency's system certification and accreditation process.

Throughout FY 2007, the NASA Agency Enterprise Architecture (EA) team will focus on increased insight and support within the core Agency missions, with special attention on EA for the Space Operations Mission Directorate and the Exploration Systems Mission Directorate. The goal of this EA oversight will be to provide additional value in identifying redundant activities that can be merged as the two mission directorates converge to achieve the Agency's exploration goals.

The NASA OCIO Business Management Division has developed an approach for FY 2007 that will accelerate and innovate NASA's investment management maturity within an integrated portfolio management perspective. These activities are part of stage two of the Government Accountability Office's (GAO's) Information Technology Investment Management Maturity Framework, which reviews current IT investment and portfolio management solutions, integrated project plans, earned value management, and operational support tools to ensure best practices are incorporated at NASA.

As part of NASA's plan to close IT workforce skills gaps, the Agency will achieve its goal of Federal Enterprise Architecture Certification for at least 75 percent of its civil servants and support contractor personnel. In terms of the President's Management Agenda, NASA continues to participate in 16 of the original 24 E-Government initiatives, plus the E-Authentication crosscutting initiative. In addition, NASA is actively engaged in five of the six initial Federal Lines of Business (LoB) initiatives, and is currently exploring potential opportunities for the three newest LoBs (IT Infrastructure, Geospatial, and Budget Formulation and Execution). Additional information about NASA's FY 2007 and FY 2008 funding contributions and expected benefits for these E-Government initiatives can be found in the supporting data section of this document.

Budget and Performance Integration

NASA improves effectiveness by using performance data to inform budget development and execution decisions. The Government Performance and Results Act (GPRA) of 1993 introduced accountability for doing so through the requirement for strategic plans, annual performance plans, and annual reports. However, GPRA requirements alone did not provide NASA with the leverage needed to round out linking performance and budget. The President' Management Agenda (PMA) Budget and Performance Integration (BPI) Initiative provided standards and deliverables, which have informed, complemented and linked NASA's on-going efforts and the GPRA requirements. The initiative provided the additional leverage to institutionalize into the fabric of the agency an overarching system that more effectively links strategy to performance to budget.

NASA was the first federal agency to receive a "Green" rating for BPI. This rating was achieved by demonstrating to OMB that NASA is guided by a single framework that integrates budget, performance, strategic and programmatic planning, reporting processes, and documents into strategy and budget decisions. In this framework, budget decisions are linked to performance and specific performance goals are set for budget amounts via the use of the PPBE process. For FY 2006, NASA continued to receive a "Green" rating BPI on status and received Yellow in one quarter on progress but returned to Green by the end of the year.

In FY 2007, NASA plans to increase effectiveness through the development of an integrated set of Agency-level performance metrics that includes both programmatic and institutional metrics and improved reporting and analysis for lifecycle cost and schedule. As part of these efforts, the Agency will develop better estimating processes, increased baseline reviews, improvements in tracking and reporting, and improved decision-support tools. NASA will also improve the process for program/project performance tracking and reporting and ensure that it is institutionalized into the Agency-level Program Management Council.

Federal Real Property Management

During FY 2006, NASA made measurable progress toward achieving the objectives of the President's Management Agenda for Federal Real Property Management. OMB acknowledged NASA's progress toward improved real property management by upgrading its measure for NASA's (PMA) Status and Progress scores to "Green". Although NASA slipped to "Yellow" in Progress in the final quarter of FY 2006, NASA expects to be able to re-gain "Green" in both status and progress in the coming year.

NASA will continue its role as a leader in promoting efficient and economical use of its real property assets via its real property initiatives and the Agency's Real Property Asset Management Plan. NASA uses the Agency's Asset Management Plan as a tool to integrate real property considerations into the Agency's corporate decision-making process. NASA will continue as an active participant on the Federal Real Property Council, which guides and informs development of government wide best practices.

NASA recognizes that there is much work left to be done. In FY 2007, NASA will complete the following actions:
- Have measurable progress in identifying and disposing of excess assets through demolition, sales, exchanges, and other methods.
- Bring in revenue and improve conditions by leveraging the value of under-utilized, but necessary to retain, assets through innovative out-leasing and public-private ventures.
- Have measurable progress in the improved utilization of NASA assets, including the establishment of improved utilization measures.
- Have measurable progress in the improvement of NASA asset condition, maintaining NASA assets as safe, secure, and environmentally sound, and available when needed, with set goals for future real property condition.
- Have a continuously improved real property asset management plan including an "Agency-wide master plan" and a five-year capital improvement plan.
- Have measurable progress in reduction of operating costs as a result of increased facility condition and optimal sizing of real property to support mission.
- Have measurable progress in adaptive re-use of historic structures where functionally and economically feasible.

Specifically, in support of the PMA and its Asset Management Plan NASA will continue to develop its standards for use of the US Green Building Council Leadership in Energy and Environment Design (LEED) "existing building "standards which will support sustainable management of existing assets. NASA will also refine the Plant Replacement Value (PRV) calculations submitted in the FY2006 government-wide Federal Real Property Profile. Further, NASA will investigate the potential of using the NASA Disposition Model as a means to develop a meaningful metric for comparison of facility operations and maintenance (O&M) cost to the facilities replacement value.

Major Program Annual Report Summary

This report is provided to meet the requirements of section 103 of the National Aeronautics and Space Administration Authorization Act of 2005 (Pub. Law 109-155; 42 U.S.C. 16613; the Act). The FY2007 Major Program Annual Report (MPAR) includes eight annual updates and seven new baseline reports. Report details are found in the individual project sections with a summary table provided below.

An annual report update was required for the following projects: Dawn, the Gamma-ray Large Area Space Telescope (GLAST), Kepler, Herschel, Mars Phoenix, the Solar Dynamics Observatory (SDO), and the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP). The Core Financial System Update, the ISS and STEREO completed development in 2006. The Hubble Space Telescope Servicing Mission 4 (HST SM4) was reclassified as a sustaining engineering activity and is not included in this reporting. Baseline reports were added for: the Wide-field Infrared Survey Explorer (WISE), the Stratospheric Observatory for Infrared Astronomy (SOFIA), Aquarius, Glory, the Orbiting Carbon Observatory (OCO), Mars Science Lab 2009, and the Lunar Reconnaissance Orbiter (LRO). These projects received authority to proceed into development in 2006.

In the following table, the Current Development Cost column is provided in full cost dollars and reflects FY2008 accounting changes, which includes the reallocation of Center overheads and other indirect costs. Due to differences between FY 2007 and FY 2008 cost accounting, the actual development cost growth may be less than the figures provided in the MPAR summary table. The MPAR is provided under FY 2008 accounting rules to correspond with the requested budget numbers.

Three projects, Herschel, Kepler, and NPP, have exceeded the Congressional thresholds as compared to the FY2006 baseline. Two of these projects were undergoing reassessments for various programmatic issues at the time of the FY2006 submission. The reassessments are complete and the resulting changes are reflected in the MPAR reports. Herschel is the exception and has slipped in schedule due to ESA's decision to move the launch date. The projects that exceed the cost threshold reflect an apparent development cost growth in the below table. The actual cost growth is: Herschel (15%), Kepler (21%) and NPP (17%), adjusted for the accounting differences between the base and current years.

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (Months)
NPOESS Preparatory Project (NPP)	2006	604.2	2007	732.4	21	Launch Readiness	4/30/2008	9/30/2009	17
Glory Mission	2007	192.9	2007	192.9	0	Launch Readiness	12/31/2008	12/31/2008	0
Aquarius	2007	215.9	2007	215.9	0	Launch Readiness	3/31/2009	3/31/2009	0
Orbiting Carbon Observatory (OCO)	2007	199.3	2007	199.3	0	Launch Readiness	9/30/2008	9/30/2008	0
Solar Dynamics Observatory (SDO)	2006	652.7	2007	672.6	3	Launch Readiness	8/30/2008	8/30/2008	0
Phoenix (Scouts 07)	2006	273.6	2007	303.8	11	Launch Readiness	8/30/2007	8/30/2007	0
2009 Mars Science Lab	2007	1,068.5	2007	1,068.5	0	Launch Readiness	9/30/2007	9/30/2007	0
Dawn	2006	273.5	2007	263.4	-4	Launch Readiness	9/30/2007	9/30/2007	0
Gamma-ray Large Space Telescope (GLAST) Project	2006	414.0	2007	439.8	6	Launch Readiness	9/30/2007	11/30/2007	2
Kepler	2006	322.0	2007	418.4	30	Launch Readiness	6/30/2008	11/30/2008	5
Stratospheric Observatory for Infrared Astronomy (SOFIA)	2007	1,005.5	2007	1,005.5	0	Full Operation (FOC)	1/1/2013	1/1/2013	0
Wide-Field Infrared Survey Explorer	2007	217.9	2007	217.9	0	Launch Readiness	10/31/2009	10/31/2009	0
Herschel	2006	117.0	2007	134.9	15	Launch Readiness	8/30/2007	7/31/2008	11
Lunar Reconnaissance Orbiter	2007	420.8	2007	420.8	0	Launch Readiness	10/30/2008	10/30/2008	0

FY 2007 Performance Plan Update Narrative

The enclosed FY 2007 Performance Plan has not been updated pending Congressional budget action. It will be updated and provided to the Congress, at a later date, to reflect any changed performance commitments of NASA per the appropriated amounts.

Note the performance measures reflect the outdated Theme structures within the Science Mission Directorate and the Exploration Systems Mission Directorate.

FY 2007 Performance Plan Update

Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
Strategic Goal 1	**1. Fly the Shuttle as safely as possible until its retirement, not later than 2010.**		
Outcome 1.1	**Assure the safety and integrity of the Space Shuttle workforce, systems and processes while flying the manifest.**		
APG 7SSP1	Achieve zero Type-A (damage to property at least $1M or death) or Type-B (damage to property at least $250K or permanent disability or hospitalization of 3 or more persons) mishaps in FY2007.	Space Shuttle	Space Shuttle
APG 7SSP2	Complete 100 percent of all mission objectives for all Space Shuttle missions in FY2007 as specified in the Flight Requirements Document for each mission.	Space Shuttle	Space Shuttle
Outcome 1.2	**By September 30, 2010, retire the Space Shuttle.**		
APG 7SSP3	Demonstrate continued progress in identifying, evaluating, documenting, and dispositioning Space Shuttle program resources for phase-out or transition.	Space Shuttle	Space Shuttle
Strategic Goal 2	**2. Complete the International Space Station in a manner consistent with NASA's International partner commitments and the needs of human exploration.**		
Outcome 2.1	**By 2010, complete assembly of the U.S. On-orbit Segment; launch International Partner elements and sparing items required to be launched by the Shuttle; and provide on-orbit resources for research to support U.S. human space exploration.**		
APG 7ISS1	Based on the actual space Shuttle flight rate, number of remaining Shuttle flights, and the discussions with the International Partners, update the agreed to ISS assembly sequence and transportation plan as necessary.	International Space Station	International Space Station
APG 7ISS2	Accomplish a minimum of 90% of the on-orbit research objectives as established one month prior to a given increment.	International Space Station	International Space Station
APG 7ISS3	Per the final configuration agreed to by the International Partners, fly the ISS elements and logistics baselined for FY 2007.	International Space Station	International Space Station
Outcome 2.2	**By 2009, provide the on-orbit capability to support an ISS crew of six crewmembers.**		
APG 7ISS4	Establish flight-ready status for the urine processing capability (part of the U.S. Regenerative Environmental Control Life Support System).	International Space Station	International Space Station
APG 7ISS5	In concert with the International Partners, assure a continuous crew presence on the ISS.	International Space Station	International Space Station

FY 2007 Performance Plan Update

Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
Strategic Goal 3	**3. Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.**		
Sub Goal 3A	**3A Study Earth from space to advance scientific understanding and meet societal needs.**		
Outcome 3A.1	**Progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition.**		
APG 7ESS1	Demonstrate progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition. Progress will be evaluated by external expert review.	Multiple Programs	Earth-Sun System
Outcome 3A.2	**Progress in enabling improved predictive capability for weather and extreme weather events.**		
APG 7ESS2	Demonstrate progress in enabling improved predictive capability for weather and extreme weather events. Progress will be evaluated by external expert review.	Multiple Programs	Earth-Sun System
Outcome 3A.3	**Progress in quantifying global land cover change and terrestrial and marine productivity, and in improving carbon cycle and ecosystem models.**		
APG 7ESS3	Demonstrate progress in quantifying global land cover change and terrestrial and marine productivity, and in improving carbon cycle and ecosystem models. Progress will be evaluated by external expert review.	Multiple Programs	Earth-Sun System
APG 7ESS4	Complete Landsat Data Continuity Mission (LDCM) Confirmation Review.	Earth Systematic Missions	Earth-Sun System
APG 7ESS6	Complete Orbiting Carbon Observatory (OCO) Assembly, Test and Launch Operations (ATLO) Readiness Review.	Earth System Science Pathfinder	Earth-Sun System
Outcome 3A.4	**Progress in quantifying the key reservoirs and fluxes in the global water cycle and in improving models of water cycle change and fresh water availability.**		
APG 7ESS5	Demonstrate progress in quantifying the key reservoirs and fluxes in the global water cycle and in improving models of water cycle change and fresh water availability. Progress will be evaluated by external expert review.	Multiple Programs	Earth-Sun System
Outcome 3A.5	**Progress in understanding the role of oceans, atmosphere, and ice in the climate system and in improving predictive capability for its future evolution.**		
APG 7ESS7	Demonstrate progress in understanding the role of oceans, atmosphere, and ice in the climate system and in improving predictive capability for its future evolution. Progress will be evaluated by external expert review.	Multiple Programs	Earth-Sun System
APG 7ESS8	Complete Glory mission Pre-Ship Review.	Earth Systematic Missions	Earth-Sun System
APG 7ESS9	Complete Ocean Surface Topography Mission (OSTM) Critical Design Review (CDR).	Earth Systematic Missions	Earth-Sun System
Outcome 3A.6	**Progress in characterizing and understanding Earth surface changes and variability of Earth's gravitational and magnetic fields.**		

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Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
APG 7ESS10	Demonstrate progress in characterizing and understanding Earth surface changes and variability of Earth's gravitational and magnetic fields. Progress will be evaluated by external expert review.	Multiple Programs	Earth-Sun System
Outcome 3A.7	**Progress in expanding and accelerating the realization of societal benefits from Earth system science.**		
APG 7ESS11	Issue twelve reports with partnering organizations that validate that using NASA research capabilities (e.g., observations and/or forecast products) could improve their operational decision support systems.	Applied Sciences	Earth-Sun System
APG 7ESS12	Complete five studies on plans to transition the results of NASA research and development, including scientific spacecraft and instruments, models, and research results, with potential to improve future operational systems of partner agencies.	Earth-Sun Research	Earth-Sun System
Sub Goal 3B	**3B Understand the Sun and its effects on Earth and the solar system.**		
Outcome 3B.1	**Progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium.**		
APG 7ESS13	Demonstrate progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium. Progress will be evaluated by external expert review.	Multiple Programs	Earth-Sun System
APG 7ESS14	Deliver Solar Dynamics Observatory (SDO) instruments to spacecraft for integration.	Living with a Star	Earth-Sun System
APG 7ESS15	Complete Magnetospheric MultiScale (MMS) instrument suite Preliminary Design Review (PDR).	Solar Terrestrial Probes	Earth-Sun System
APG 7ESS16	Award Geospace Missions Radiation Belt Mapper Phase A instrument contracts.	Living with a Star	Earth-Sun System
APG 7ESS17	Successfully launch Time History of Events and Macroscale Interactions during Substorms (THEMIS) spacecraft.	Explorer	Earth-Sun System
APG 7ESS18	Release Explorer Program Announcement of Opportunity (AO).	Explorer	Earth-Sun System
Outcome 3B.2	**Progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields.**		
APG 7ESS14	Deliver Solar Dynamics Observatory (SDO) instruments to spacecraft for integration.	Living with a Star	Earth-Sun System
APG 7ESS15	Complete Magnetospheric MultiScale (MMS) instrument suite Preliminary Design Review (PDR).	Solar Terrestrial Probes	Earth-Sun System
APG 7ESS16	Award Geospace Missions Radiation Belt Mapper Phase A instrument contracts.	Living with a Star	Earth-Sun System
APG 7ESS18	Release Explorer Program Announcement of Opportunity (AO).	Explorer	Earth-Sun System
APG 7ESS19	Demonstrate progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields. Progress will be evaluated by external expert review.	Multiple Programs	Earth-Sun System

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Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
Outcome 3B.3	**Progress in developing the capability to predict the extreme and dynamic conditions in space in order to maximize the safety and productivity of human and robotic explorers.**		
APG 7ESS14	Deliver Solar Dynamics Observatory (SDO) instruments to spacecraft for integration.	Living with a Star	Earth-Sun System
APG 7ESS16	Award Geospace Missions Radiation Belt Mapper Phase A instrument contracts.	Living with a Star	Earth-Sun System
APG 7ESS20	Demonstrate progress in developing the capability to predict the extreme and dynamic conditions in space in order to maximize the safety and productivity of human and robotic explorers. Progress will be evaluated by external expert review.	Multiple Programs	Earth-Sun System
Sub Goal 3C	**3C Advance scientific knowledge of the solar system, search for evidence of life, and prepare for human exploration.**		
Outcome 3C.1	**Progress in learning how the Sun's family of planets and minor bodies originated and evolved.**		
APG 7SSE1	Demonstrate progress in learning how the Sun's family of planets and minor bodies originated and evolved. Progress will be evaluated by external expert review.	Multiple Programs	Solar System Exploration
APG 7SSE2	Perform MErcury Surface, Space ENvironment, GEochemistry, and Ranging mission (MESSENGER) second Venus flyby.	Discovery	Solar System Exploration
APG 7SSE3	Complete Juno Preliminary Design Review (PDR).	New Frontiers	Solar System Exploration
Outcome 3C.2	**Progress in understanding the processes that determine the history and future of habitability in the solar system, including the origin and evolution of Earth's biosphere and the character and extent of prebiotic chemistry on Mars and other worlds.**		
APG 7SSE4	Demonstrate progress in understanding the processes that determine the history and future of habitability in the solar system, including the origin and evolution of Earth's biosphere and the character and extent of prebiotic chemistry on Mars and other worlds. Progress will be evaluated by external expert review.	Multiple Programs	Solar System Exploration
APG 7SSE5	Complete 2009 Mars Science Laboratory Critical Design Review (CDR).	Mars Exploration	Solar System Exploration
Outcome 3C.3	**Progress in identifying and investigating past or present habitable environments on Mars and other worlds, and determining if there is or ever has been life elsewhere in the solar system.**		
APG 7SSE6	Demonstrate progress in identifying and investigating past or present habitable environments on Mars and other worlds, and determining if there is or ever has been life elsewhere in the solar system. Progress will be evaluated by external expert review.	Multiple Programs	Solar System Exploration
APG 7SSE7	Successfully launch Phoenix 2007 spacecraft.	Mars Exploration	Solar System Exploration
Outcome 3C.4	**Progress in exploring the space environment to discover potential hazards to humans and to search for resources that would enable human presence.**		

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Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
APG 7SSE8	Demonstrate progress in exploring the space environment to discover potential hazards to humans and to search for resources that would enable human presence. Progress will be evaluated by external expert review.	Multiple Programs	Solar System Exploration
APG 7SSE9	Begin Mars Reconnaissance Orbiter (MRO) primary science phase.	Mars Exploration	Solar System Exploration
Sub Goal 3D	**3D Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.**		
Outcome 3D.1	**Progress in understanding the origin and destiny of the universe, phenomena near black holes, and the nature of gravity.**		
APG 7UNIV1	Demonstrate progress in understanding the origin and destiny of the universe, phenomena near black holes, and the nature of gravity. Progress will be evaluated by external expert review.	Multiple Programs	The Universe
APG 7UNIV2	Complete Gamma-ray Large Area Space Telescope (GLAST) Operations Readiness Review (ORR).	Gamma-ray Large Space Telescope (GLAST) Program	The Universe
APG 7UNIV3	Complete Hubble Space Telescope Servicing Mission 4 (SM4) Test Readiness Review.	Hubble Space Telescope	The Universe
APG 7UNIV4	Complete James Webb Space Telescope (JWST) Integrated Science Instrument Module (ISIM) Preliminary Design Review (PDR).	James Webb Space Telescope	The Universe
Outcome 3D.2	**Progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects recognized in the present universe.**		
APG 7UNIV3	Complete Hubble Space Telescope Servicing Mission 4 (SM4) Test Readiness Review.	Hubble Space Telescope	The Universe
APG 7UNIV4	Complete James Webb Space Telescope (JWST) Integrated Science Instrument Module (ISIM) Preliminary Design Review (PDR).	James Webb Space Telescope	The Universe
APG 7UNIV5	Demonstrate progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects we recognize in the present universe. Progress will be evaluated by external expert review.	Multiple Programs	The Universe
Outcome 3D.3	**Progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems.**		
APG 7UNIV3	Complete Hubble Space Telescope Servicing Mission 4 (SM4) Test Readiness Review.	Hubble Space Telescope	The Universe
APG 7UNIV4	Complete James Webb Space Telescope (JWST) Integrated Science Instrument Module (ISIM) Preliminary Design Review (PDR).	James Webb Space Telescope	The Universe
APG 7UNIV6	Demonstrate progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems. Progress will be evaluated by external expert review.	Multiple Programs	The Universe
Outcome 3D.4	**Progress in creating a census of extra-solar planets and measuring their properties**		
APG 7UNIV7	Demonstrate progress in creating a census of extra-solar planets and measuring their properties. Progress will be evaluated by external expert review.	Multiple Programs	The Universe
APG 7UNIV8	Begin Kepler assembly, test, and launch operations (ATLO).	Discovery	The Universe

FY 2007 Performance Plan Update

Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
Sub Goal 3E	**3E Advance knowledge in the fundamental disciplines of aeronautics, and develop technologies for safer aircraft and higher capacity airspace systems.**		
Outcome 3E.1	**By 2016, identify and develop tools, methods, and technologies for improving overall aircraft safety of new and legacy vehicles operating in the Next Generation Air Transportation System (projected for the year 2025)**		
APG 7AT1	Establish a baseline for state-of-the-art aircraft safety concepts and flight deck information management systems.	Aviation Safety	Aeronautics Technology
Outcome 3E.2	**By 2016, develop and demonstrate future concepts, capabilities, and technologies that will enable major increases in air traffic management effectiveness, flexibility, and efficiency, while maintaining safety, to meet capacity and mobility requirements of the Next Generation Air Transportation System.**		
APG 7AT2	Complete flight test evaluation of oceanic in-trail climb and descent using an Airborne Separation Assistance System (ASAS) and an Automatic Dependent Surveillance - Broadcast (ADS-B).	Airspace Systems	Aeronautics Technology
APG 7AT3	Complete development of an incremental, sustainable transition roadmap from today's air transportation system to the Next Generation Air Transportation System (NGATS) 2025 concept of operations.	Airspace Systems	Aeronautics Technology
Outcome 3E.3	**By 2016, develop multidisciplinary design, analysis, and optimization capabilities for use in trade studies of new technologies, enabling better quantification of vehicle performance in all flight regimes and within a variety of transportation system architectures.**		
APG 7AT4	Baseline state-of-the-art analysis methods and tools to address aeronautics challenges within the hypersonic, subsonic (for rotary and fixed wing vehicles), and supersonic flight regimes.	Fundamental Aeronautics	Aeronautics Technology
APG 7AT5	Develop preliminary engine performance models for flight-weight propulsion systems to support hypersonic reference vehicles.	Fundamental Aeronautics	Aeronautics Technology
APG 7AT6	Determine fundamental propulsion system integration design issues for existing and advanced rotorcraft configurations.	Fundamental Aeronautics	Aeronautics Technology
Outcome 3E.4	**Ensure the continuous availability of a portfolio of NASA-owned wind tunnels/ground test facilities, which are strategically important to meeting national aerospace program goals and requirements.**		
APG 7AT7	Develop a long-term, aeronautic test facility vision and funded plan working with all the appropriate stakeholders, to assure that the plan reflects the priorities of the long-term needs of the Nation.	Aeronautics Test Program	Aeronautics Technology
Sub Goal 3F	**3F Understand the effects of the space environment on human performance, and test new technologies and countermeasures for long-duration human space exploration.**		
Outcome 3F.1	**By 2008, develop and test candidate countermeasures to ensure the health of humans traveling in space.**		
APG 7HSRT1	Complete development of a renal stone countermeasure and validate it for use.	Human Health & Performance	Human Systems Research & Technology

FY 2007 Performance Plan Update

Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
APG 7HSRT2	Begin validation of bone and cardiovascular countermeasures on the ISS.	Human Health & Performance	Human Systems Research & Technology
Outcome 3F.2	**By 2010, identify and test technologies to reduce total mission resource requirements for life support systems.**		
APG 7HSRT3	Complete laboratory testing of Crew Exploration Vehicle candidate technologies for carbon dioxide (CO2) and humidity removal, water disinfection, and solid waste volume compaction, increasing the technology maturation in all areas.	Life Support & Habitation	Human Systems Research & Technology
Outcome 3F.3	**By 2010, develop reliable spacecraft technologies for advanced environmental monitoring and control and fire safety.**		
APG 7HSRT4	Complete critical design review for an ISS technology demonstration of the advanced environmental monitoring system.	Life Support & Habitation	Human Systems Research & Technology
APG 7HSRT5	Conduct at least two experiments on the ISS to advance next generation technologies for fire prevention, detection, and suppression on spacecraft.	Life Support & Habitation	Human Systems Research & Technology
Strategic Goal 4	**4. Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.**		
Outcome 4.1	**No later than 2014, and as early as 2010, transport three crewmembers to the International Space Station and return them safely to Earth, demonstrating an operational capability to support human exploration missions.**		
APG 7CS1	Complete the Systems Design Review for the Constellation Program.	Constellation Systems Program	Constellation Systems
APG 7CS2	Complete the Preliminary Design for the Crew Exploration Vehicle (CEV).	Constellation Systems Program	Constellation Systems
APG 7CS3	Complete the Preliminary Design for the Crew Launch Vehicle (CLV) First Stage.	Constellation Systems Program	Constellation Systems
APG 7CS4	Begin construction and/or modifications to Kennedy Space Center ground processing and launch control facilities needed to support the CEV and CLV in accordance with the Systems Requirements Document.	Constellation Systems Program	Constellation Systems
APG 7CS5	Begin construction and/or modifications to Johnson Space Center flight control facilities needed to support the CEV and CLV in accordance with the Systems Requirements Document.	Constellation Systems Program	Constellation Systems
Outcome 4.2	**No later than 2014, and as early as 2010, develop and deploy a new space suit to support exploration, that will be used in the initial operating capability of the Crew Exploration Vehicle.**		
APG 7CS6	Define the acquisition strategy for the design and development of the initial space suit for exploration.	Constellation Systems Program	Constellation Systems
APG 7CS7	Initiate procurement/development of the initial space suit for exploration.	Constellation Systems Program	Constellation Systems
Strategic Goal 5	**5. Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.**		
Outcome 5.1	**Develop and demonstrate a means for NASA to purchase launch services from emerging launch providers.**		
APG 7SFS4	Realize competitive rates from emerging U.S. launch providers and open the bidding process to a larger number of launch providers.	Launch Services	Space and Flight Support (SFS)

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Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
Outcome 5.2	**By 2010, demonstrate one or more commercial space services for ISS cargo and/or crew transport.**		
APG 7CS8	Complete assessment of at least two contractor deliverables that will support the development of vehicles that can provide commercial cargo or crew transport services.	Constellation Systems Program	Constellation Systems
Outcome 5.3	**By 2012, complete one or more prize competitions for independently designed, developed, launched, and operated missions related to space science or space exploration.**		
APG 7ESRT3	Conduct at least two prize competitions that encourage the development and demonstration of advanced, critical technologies supporting NASA's missions and goals.	Centennial Challenges	Exploration Systems Research & Technology
Strategic Goal 6	**6. Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.**		
Outcome 6.1	**By 2008, launch a Lunar Reconnaissance Orbiter (LRO) that will provide information about potential human exploration sites.**		
APG 7ESRT4	Complete the Non-Advocate Review (Authority to Proceed) for the Lunar Reconnaissance Orbiter.	Robotic Lunar Exploration	Exploration Systems Research & Technology
Outcome 6.2	**By 2012, develop and test technologies for in-situ resource utilization, power generation, and autonomous systems that reduce consumables launched from Earth and moderate mission risk.**		
APG 7ESRT1	Demonstrate the feasibility of extracting volatiles and oxygen from lunar regolith in a laboratory environment.	Exploration Technology Development	Exploration Systems Research & Technology
APG 7ESRT2	Demonstrate remote supervision of a robotic system to deploy and set up lunar surface infrastructure in a laboratory environment.	Exploration Technology Development	Exploration Systems Research & Technology
Outcome 6.3	**By 2010, identify and conduct long-term research necessary to develop nuclear technologies essential to support human-robotic lunar missions and that are extensible to exploration of Mars.**		
APG 7ESRT5	Complete a focused plan and initiate research for nuclear systems technology development for lunar surface fission power generation in support of protracted missions.	Prometheus Power and Propulsion	Exploration Systems Research & Technology
Outcome 6.4	**Implement the space communications and navigation architecture responsive to Science and Exploration mission requirements**		
APG 7SFS1	Develop and submit in February 2007 a space communications plan based on an architecture that supports NASA's exploration and science programs for the 2010-2015 timeframe and beyond.	Space Communications	Space and Flight Support (SFS)
APG 7SFS2	Implement technology initiatives consistent with approved baseline space communications and navigations architecture.	Space Communications	Space and Flight Support (SFS)
APG 7SFS3	Pursue commercial opportunities for the space communication and navigation architecture.	Space Communications	Space and Flight Support (SFS)

FY 2007 Performance Plan Update

Cross-Agency Support Programs

Performance Measure #	Description	Contributing Program (s)
Education Theme		
Outcome ED-1	**Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals through a portfolio of programs.**	
APG 7ED1	Award 1,200 competitive internships, fellowships, and research opportunities for higher education students and faculty in STEM disciplines.	Higher Education
APG 7ED2	Award 500 competitive scholarships, internships, fellowships, and research opportunities for underrepresented and underserved students, teachers and faculty in STEM disciplines.	Higher Education
APG 7ED3	Provide 100 grants to enhance the capability of 50 underrepresented and underserved colleges and universities to compete for and conduct basic or applied NASA-related research.	Higher Education
APG 7ED4	Complete a retrospective longitudinal study of student participants to determine the degree to which participants maintain affiliation with NASA through the pipeline.	Higher Education
APG 7ED5	Collect, analyze, and report longitudinal data on student participants to determine the degree to which participants enter the NASA workforce or other NASA-related career fields.	Higher Education
Outcome ED-2	**Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.**	
APG 7ED6	Conduct 10 Educator Astronaut workshops, involving approximately 200 educators.	Elementary & Secondary Education
APG 7ED7	Select and support 50 additional schools to participate in the NASA Explorer Schools program, maintaining the total number at 100.	Elementary & Secondary Education
APG 7ED8	Select 100 student experiments, involving 1,000 students, to participate in the Flight Projects program.	Elementary & Secondary Education
Outcome ED-3	**Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission.**	
APG 7ED10	Award competitive grants to NASA Centers and informal education partners to conduct 10 Explorer Institutes projects.	Informal Education
APG 7ED9	Digitize and meta-tag 10 percent of NASA's approved learning materials to be delivered using technology-enabled learning systems.	Informal Education
Advanced Business Systems Theme		
Outcome IEM-1	**By 2008, implement Agency business systems that provide timely, consistent and reliable business information for management decisions.**	
APG 7IEM1	Upgrade NASA's existing Core Financial system, through the SAP Version Update Project, resulting in improved data integrity.	Integrated Enterprise Management Program
Outcome IEM-2	**Increase efficiency by implementing new business systems and reengineering Agency business processes.**	
APG 7IEM2	Implement the Contract Management Module to increase efficiency in procurement processes.	Integrated Enterprise Management Program

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Cross-Agency Support Programs

Performance Measure #	Description	Contributing Program (s)
APG 7IEM3	Implement the Aircraft Management Module to reduce the risk of flight operations through improved tracking of crew and aircraft currency qualifications.	Integrated Enterprise Management Program
Innovative Partnerships Program Theme		
Outcome IPP-1	**Promote and develop innovative technology partnerships among NASA, U.S. industry, and other sectors for the benefit of Agency programs and projects.**	
APG 7IPP1	Develop 20 technology-related significant partnerships that create leveraged value for NASA's programs and projects. Track both quantitative dollar value and qualitative benefits to NASA (e.g. reduced volume or mass, improved safety).	Innovative Partnerships
APG 7IPP2	Complete 50 technology transfer agreements with the commercial and academic community through such mechanisms as: licenses, software use agreements, facility use agreements, and space act agreements.	Innovative Partnerships
APG 7IPP3	Fully implement an annual portfolio licensing approach that targets licensing goals of greatest value/benefit to NASA. Examples of such value are: licensing royalties, and new technology products available to NASA. Royalties should be $4M per year or greater.	Innovative Partnerships
APG 7IPP4	Complete and institutionalize an enhanced Intellectual Property (IP) management process that enables stronger use of NASA's IP to support NASA's strategies. Implement such IP management together with at least two significant NASA programs or projects.	Innovative Partnerships
Shared Capabilities Theme		
Outcome SC-1	**Establish and maintain selected Agency level shared capabilities, across multiple classes of assets (e.g., wind tunnels, vacuum chambers, etc.), to ensure that they will continue to be available to support the missions that require them.**	
APG 7SC1	Prioritize funding requirements and select classes of assets for inclusion in the Shared Capability Assets Program.	Multiple Programs
APG 7SC2	Identify re-investment/re-capitalization opportunities within and among classes of assets and execute the approved changes (e.g., reallocate funds, upgrade facilities, etc.).	Multiple Programs

FY 2007 Performance Plan Update

Efficiency Measures

Performance Measure #	Description
Aeronautics Technology Theme	
APG 7AT8	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 7AT9	Increase the annual percentage of research funding awarded to Aeronautics University Partnerships.
Constellation Systems Theme	
APG 7CS9	Complete all development projects within 110% of the cost and schedule baseline.
Education Theme	
APG 7ED11	Collect, analyze, and report that 100% of grantees annually report on their accomplishments.
APG 7ED12	Peer review and competitively award at least 85%, by budget, of research projects.
Exploration Systems Research & Technology Theme	
APG 7ESRT6	Complete all development projects within 110% of the cost and schedule baseline.
APG 7ESRT7	Increase the number of technology products transferred to Constellation Systems developers for mission application.
Earth-Sun System Theme	
APG 7ESS21	Complete all development projects within 110% of the cost and schedule baseline.
APG 7ESS22	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 7ESS23	Peer-review and competitively award at least 80%, by budget, of research projects.
APG 7ESS24	Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 130 days.
Human Systems Research & Technology Theme	
APG 7HSRT6	Increase percentage of HSRT procurement funding, solely dedicated to Exploration Activities.
APG 7HSRT7	Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 130 days.
International Space Station Theme	
APG 7ISS6	Complete all development projects within 110% of the cost and schedule baseline.
APG 7ISS7	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
Space and Flight Support (SFS) Theme	
APG 7SFS5	Complete all development projects within 110% of the cost and schedule baseline.
APG 7SFS6	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
Solar System Exploration Theme	
APG 7SSE10	Complete all development projects within 110% of the cost and schedule baseline.
APG 7SSE11	Deliver at least 90% of scheduled operating hours for all operations and research facilities.

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Efficiency Measures

Performance Measure #	Description
APG 7SSE12	Peer-review and competitively award at least 80%, by budget, of research projects.
APG 7SSE13	Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 130 days.
Space Shuttle Theme	
APG 7SSP4	Complete all development projects within 110% of the cost and schedule baseline.
APG 7SSP5	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 7SSP6	While ensuring the safety of ongoing flight operations and by working with exploration development programs, reduce Space Shuttle sustaining engineering hours, annual value of Space Shuttle production contracts, and the number of dedicated Space Shuttle facilities, where possible.
The Universe Theme	
APG 7UNIV10	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 7UNIV11	Peer-review and competitively award at least 80%, by budget, of research projects.
APG 7UNIV12	Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 130 days.
APG 7UNIV9	Complete all development projects within 110% of the cost and schedule baseline.

FY 2007 Performance Plan Update

Annual Performance Goals Eliminated For FY 2007

Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)

FY 2008 Performance Plan Narrative

NASA's six Strategic Goals are reflected below. Each is clearly defined and supported by Sub-goals (where appropriate), multi-year Outcomes, and annual performance goals (APGs) that will enhance NASA's ability to measure and report the Agency's progress in achieving these Strategic Goals.

An additional Outcome within Strategic Goal 6, with ensuing APGs, has been added to lay the foundation for future exploration directions. Further, as NASA prepares for future exploration, it will be important to transition from mature systems, such as the Space Shuttle and its various support systems, to new Constellation Systems. The beginning of this transition is reflected in NASA's FY 2008 Performance Plan, in both Strategic Goals 1 and 4.

The table below provides a summary of all of the commitments identified by each of the 14 Themes in the preceding sections.

FY 2008 Performance Plan

Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
Strategic Goal 1	**Fly the Shuttle as safely as possible until its retirement, not later than 2010.**		
Outcome 1.1	**Assure the safety and integrity of the Space Shuttle workforce, systems and processes, while flying the manifest.**		
APG 8SSP01	Achieve zero Type-A (damage to property at least $1 million or death) or Type-B (damage to property at least $250 thousand or permanent disability or hospitalization of three or more persons) mishaps in FY2008.	Space Shuttle Program	Space Shuttle
APG 8SSP02	Complete 100 percent of all mission objectives for all Space Shuttle missions in FY2008 as specified in the Flight Requirements Document for each mission.	Space Shuttle Program	Space Shuttle
Outcome 1.2	**By September 30, 2010, retire the Space Shuttle.**		
APG 8SSP03	Develop a detailed schedule of last-need dates for all significant Space Shuttle program element capabilities.	Space Shuttle Program	Space Shuttle
APG 8SSP04	A 9 percent reduction (over FY2007 values) in the annual value of Shuttle production contracts for Orbiter, External Tank, Solid Rocket Boosters, Reusable Solid Rocket Motor, Space Shuttle Main Engine and Launch & Landing, while maintaining safe flight.	Space Shuttle Program	Space Shuttle
Strategic Goal 2	**Complete the International Space Station in a manner consistent with NASA's International partner commitments and the needs of human exploration.**		
Outcome 2.1	**By 2010, complete assembly of the U.S. On-orbit Segment; launch International Partner elements and sparing items required to be launched by the Shuttle; and provide on-orbit resources for research to support U.S. human space exploration.**		
APG 8ISS01	Based on the actual Space Shuttle flight rate, number of remaining Shuttle flights, and the discussions with the International Partners, update the agreed-to ISS assembly sequence and transportation plan as necessary.	International Space Station Program	International Space Station
APG 8ISS02	Accomplish a minimum of 90 percent of the on-orbit research objectives as established one month prior to a given increment.	International Space Station Program	International Space Station
APG 8ISS03	Per the final configuration agreed to by the International Partners, fly the ISS elements and logistics baselined for FY2008.	International Space Station Program	International Space Station

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Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
APG 8ISS04	Provide increased power capability by assembling the remaining Truss element as baselined in FY2008.	International Space Station Program	International Space Station
Outcome 2.2	**By 2009, provide the on-orbit capability to support an ISS crew of six crewmembers.**		
APG 8ISS05	Establish flight-ready status for the Water Recovery System (part of the U.S. Regenerative Environmental Control Life Support System).	International Space Station Program	International Space Station
APG 8ISS06	In concert with the International Partners, assure a continuous crew presence on the ISS.	International Space Station Program	International Space Station
Outcome 2.3	**Conduct basic and applied biological and physical research to advance and sustain U.S. scientific expertise.**		
APG 8AC01	Design, build, and deliver for flight two ISS experiments.	Exploration Technology Development	Advanced Capabilities
APG 8AC02	Design, build, and deliver for flight two Foton M3 experiments.	Exploration Technology Development	Advanced Capabilities
APG 8AC03	Conduct 30 ground-based investigations in the physical and biological sciences that promote the development of related microgravity research capabilities.	Exploration Technology Development	Advanced Capabilities
Strategic Goal 3	**Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.**		
Sub Goal 3A	**Study Earth from space to advance scientific understanding and meet societal needs.**		
Outcome 3A.1	**Progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition.**		
APG 8ES01	Demonstrate progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition, based on measurements from presently orbiting NASA and non-NASA assets. Progress will be evaluated by external expert review.	Multiple Programs	Earth Science
Outcome 3A.2	**Progress in enabling improved predictive capability for weather and extreme weather events.**		
APG 8ES02	Demonstrate progress in enabling improved predictive capability for weather and extreme weather events. Progress will be evaluated by external expert review.	Multiple Programs	Earth Science
Outcome 3A.3	**Progress in quantifying global land cover change and terrestrial and marine productivity, and in improving carbon cycle and ecosystem models.**		
APG 8ES03	Demonstrate progress in quantifying global land cover change and terrestrial and marine productivity, and in improving carbon cycle and ecosystem models. Progress will be evaluated by external expert review.	Multiple Programs	Earth Science
APG 8ES04	Complete the Orbiting Carbon Observatory (OCO) Operational Readiness Review.	Earth System Science Pathfinder	Earth Science

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Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
Outcome 3A.4	**Progress in quantifying the key reservoirs and fluxes in the global water cycle and in improving models of water cycle change and fresh water availability.**		
APG 8ES05	Demonstrate progress in quantifying the key reservoirs and fluxes in the global water cycle and in improving models of water cycle change and fresh water availability. Progress will be evaluated by external expert review.	Multiple Programs	Earth Science
APG 8ES06	Complete Global Precipitation Measurement (GPM) Mission Spacecraft Preliminary Design Review (PDR).	Earth Systematic Missions	Earth Science
Outcome 3A.5	**Progress in understanding the role of oceans, atmosphere, and ice in the climate system and in improving predictive capability for its future evolution.**		
APG 8ES07	Demonstrate progress in understanding the role of oceans, atmosphere, and ice in the climate system and in improving predictive capability for its future evolution. Progress will be evaluated by external expert review.	Multiple Programs	Earth Science
APG 8ES08	Launch the Ocean Surface Topography Mission (OSTM).	Earth Systematic Missions	Earth Science
APG 8ES09	Complete the Glory mission Operational Readiness Review (ORR).	Earth Systematic Missions	Earth Science
APG 8ES10	Complete the Aquarius Instrument Pre-ship Review.	Earth System Science Pathfinder	Earth Science
Outcome 3A.6	**Progress in characterizing and understanding Earth surface changes and variability of Earth's gravitational and magnetic fields.**		
APG 8ES11	Demonstrate progress in characterizing and understanding Earth surface changes and variability of Earth's gravitational and magnetic fields. Progress will be evaluated by external expert review.	Multiple Programs	Earth Science
Outcome 3A.7	**Progress in expanding and accelerating the realization of societal benefits from Earth system science.**		
APG 8ES12	Issue twelve reports with partnering organizations that validate using NASA research capabilities (e.g., observations and/or forecast products) could improve their operational decision support systems.	Applied Sciences	Earth Science
APG 8ES13	Increase the number of distinct users of NASA data and services.	Earth Science Research	Earth Science
APG 8ES14	Maintain a high level of customer satisfaction, as measured by exceeding the most recently available federal government average rating of the Customer Satisfaction Index.	Earth Science Research	Earth Science
Sub Goal 3B	**Understand the Sun and its effects on Earth and the solar system.**		
Outcome 3B.1	**Progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium.**		
APG 8HE01	Demonstrate progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium. Progress will be evaluated by external expert review.	Multiple Programs	Heliophysics
APG 8HE02	Complete Magnetospheric Multiscale (MMS) System Design Review (SDR).	Solar Terrestrial Probes	Heliophysics

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Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
Outcome 3B.2	**Progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields.**		
APG 8HE03	Demonstrate progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields. Progress will be evaluated by external expert review.	Multiple Programs	Heliophysics
APG 8HE04	Complete Phase A for the Geospace Radiation Belt Storm Probes mission.	Living with a Star	Heliophysics
Outcome 3B.3	**Progress in developing the capability to predict the extreme and dynamic conditions in space in order to maximize the safety and productivity of human and robotic explorers.**		
APG 8HE05	Demonstrate progress in developing the capability to predict the extreme and dynamic conditions in space in order to maximize the safety and productivity of human and robotic explorers. Progress will be evaluated by external expert review.	Multiple Programs	Heliophysics
APG 8HE06	Complete Solar Dynamics Observatory (SDO) Integrated Observatory Performance Test.	Living with a Star	Heliophysics
Sub Goal 3C	**Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space.**		
Outcome 3C.1	**Progress in learning how the Sun's family of planets and minor bodies originated and evolved.**		
APG 8PS01	Demonstrate progress in learning how the Sun's family of planets and minor bodies originated and evolved. Progress will be evaluated by external expert review.	Multiple Programs	Planetary Science
APG 8PS02	Complete the Mercury Surface, Space Environment, Geochemisry and Ranging (MESSENGER) Mercury Flyby 1.	Discovery	Planetary Science
APG 8PS03	Begin Juno instruments detailed design.	New Frontiers	Planetary Science
Outcome 3C.2	**Progress in understanding the processes that determine the history and future of habitability in the solar system, including the origin and evolution of Earth's biosphere and the character and extent of prebiotic chemistry on Mars and other worlds.**		
APG 8PS04	Demonstrate progress in understanding the processes that determine the history and future of habitability in the solar system, including the origin and evolution of Earth's biosphere and the character and extent of prebiotic chemistry on Mars and other worlds. Progress will be evaluated by external expert review.	Multiple Programs	Planetary Science
APG 8PS05	Begin 2009 Mars Science Laboratory (MSL) Assembly, Test, Launch Operations (ATLO).	Mars Exploration	Planetary Science
Outcome 3C.3	**Progress in identifying and investigating past or present habitable environments on Mars and other worlds, and determining if there is or ever has been life elsewhere in the solar system.**		
APG 8PS06	Demonstrate progress in identifying and investigating past or present habitable environments on Mars and other worlds, and determining if there is or ever has been life elsewhere in the solar system. Progress will be evaluated by external expert review.	Multiple Programs	Planetary Science

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Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
APG 8PS07	Land the Phoenix spacecraft on the Martian surface and begin science operations.	Mars Exploration	Planetary Science
Outcome 3C.4	**Progress in exploring the space environment to discover potential hazards to humans and to search for resources that would enable human presence.**		
APG 8AC04	Develop and deliver the Radiation Assessment Detector (RAD) for the Mars Science Laboratory, scheduled to fly in 2009.	Human Research Program	Advanced Capabilities
APG 8PS08	Demonstrate progress in exploring the space environment to discover potential hazards to humans and to search for resources that would enable human presence. Progress will be evaluated by external expert review.	Multiple Programs	Planetary Science
Sub Goal 3D	**Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.**		
Outcome 3D.1	**Progress in understanding the origin and destiny of the universe, phenomena near black holes, and the nature of gravity.**		
APG 8AS01	Demonstrate progress in understanding the origin and destiny of the universe, phenomena near black holes, and the nature of gravity. Progress will be evaluated by external expert review.	Multiple Programs	Astrophysics
APG 8AS02	Launch the Gamma-ray Large Area Space Telescope (GLAST).	Gamma-ray Large Space Telescope (GLAST) Program	Astrophysics
Outcome 3D.2	**Progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects recognized in the present universe.**		
APG 8AS03	Demonstrate progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects we recognize in the present universe. Progress will be evaluated by external expert review.	Multiple Programs	Astrophysics
APG 8AS04	Complete James Webb Space Telescope (JWST) Preliminary Design Review (PDR).	James Webb Space Telescope	Astrophysics
APG 8AS05	Complete Hubble Space Telescope Servicing Mission 4 (HST SM4) Pre-ship Review.	Hubble Space Telescope	Astrophysics
Outcome 3D.3	**Progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems.**		
APG 8AS04	Complete James Webb Space Telescope (JWST) Preliminary Design Review (PDR).	James Webb Space Telescope	Astrophysics
APG 8AS05	Complete Hubble Space Telescope Servicing Mission 4 (HST SM4) Pre-ship Review.	Hubble Space Telescope	Astrophysics
APG 8AS06	Demonstrate progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems. Progress will be evaluated by external expert review.	Multiple Programs	Astrophysics
Outcome 3D.4	**Progress in creating a census of extra-solar planets and measuring their properties.**		
APG 8AS07	Demonstrate progress in creating a census of extra-solar planets and measuring their properties. Progress will be evaluated by external expert review.	Multiple Programs	Astrophysics
APG 8AS08	Complete the Kepler spacecraft Integration and Test (I&T) phase.	Discovery	Astrophysics

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Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
Sub Goal 3E	**Advance knowledge in the fundamental disciplines of aeronautics, and develop technologies for safer aircraft and higher capacity airspace systems.**		
Outcome 3E.1	**By 2016, identify and develop tools, methods, and technologies for improving overall aircraft safety of new and legacy vehicles operating in the Next Generation Air Transportation System (projected for the year 2025).**		
APG 8AT01	Provide definition of an Integrated Resilient Aircraft Control (IRAC) architecture and capabilities, and identify technology implementation barriers for full IRAC capability.	Aviation Safety	Aeronautics Technology
APG 8AT02	Complete a feasibility study for assessment of active operator assistance in approach and landing task, including active attention management.	Aviation Safety	Aeronautics Technology
APG 8AT03	Develop a framework that integrates Aging Aircraft and Durability technologies to detect, predict, and mitigate aging/durability related hazards and insert current state-of-the -art methods in framework to establish a baseline.	Aviation Safety	Aeronautics Technology
APG 8AT04	Using aircraft landing gear system as a testbed, develop and validate Integrated Vehicle Health Management sensor fusion, fault detection, and isolation methods.	Aviation Safety	Aeronautics Technology
Outcome 3E.2	**By 2016, develop and demonstrate future concepts, capabilities, and technologies that will enable major increases in air traffic management effectiveness, flexibility, and efficiency, while maintaining safety, to meet capacity and mobility requirements of the Next Generation Air Transportation System.**		
APG 8AT05	Conduct service-provider-based automated separation assurance simulation.	Airspace Systems	Aeronautics Technology
APG 8AT06	Demonstrate trajectory analysis technology for automated separation assurance.	Airspace Systems	Aeronautics Technology
Outcome 3E.3	**By 2016, develop multidisciplinary analysis and design tools and new technologies, enabling better vehicle performance (e.g., efficiency, environmental, civil competitiveness, productivity, and reliability) in multiple flight regimes and within a variety of transportation system architectures.**		
APG 8AT07	Develop and test component technology concepts used in conventional aircraft configurations that establish the feasibility of achieving Stage 3 -42 EPNdb (cumulative) noise reduction.	Fundamental Aeronautics	Aeronautics Technology
APG 8AT08	Develop and test component technology concepts for unconventional aircraft configurations that establish the feasibility of achieving short take-off and landings on runways less than 3000 feet.	Fundamental Aeronautics	Aeronautics Technology
APG 8AT09	Validate model engine stall control concepts using component test data obtained in test cell CE18 in order to extend rotorcraft engine operability range.	Fundamental Aeronautics	Aeronautics Technology
APG 8AT10	Develop a rotorcraft model, validated with data from gear noise and vibration testing, to predict reductions in gear vibration transmission.	Fundamental Aeronautics	Aeronautics Technology
APG 8AT11	Demonstrate a composite supersonic engine fan blade containment system that is 20 percent lighter than the High Speed Research Program metallic containment system and validate through laboratory tests.	Fundamental Aeronautics	Aeronautics Technology

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Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
APG 8AT12	Demonstrate a high fidelity analysis technique for assessing the impact of nozzle plume effects on the off body flow field of a supersonic aircraft and validate predicted results within 5 percent of flight data.	Fundamental Aeronautics	Aeronautics Technology
APG 8AT13	Characterize multi-functional advanced ablator systems in arcjet facilities to provide a database for material degradation models for hypersonic vehicles.	Fundamental Aeronautics	Aeronautics Technology
APG 8AT14	Evaluate state-of-the-art hypersonic flight simulation tools, ablator systems, and GNC technologies using data from sub-orbital SOAREX flight 1.	Fundamental Aeronautics	Aeronautics Technology
Outcome 3E.4	**Ensure the continuous availability of a portfolio of NASA-owned wind tunnels/ground test facilities, which are strategically important to meeting national aerospace program goals and requirements.**		
APG 8AT15	Develop a maintenance and investment strategy for NASA owned wind tunnels/ground test facilities to ensure their long-term health and operational availability.	Aeronautics Test Program	Aeronautics Technology
APG 8AT16	Develop a long-term, flight operations/test infrastructure vision and funded plan working with all the appropriate stakeholders, to assure that the plan reflects the priorities of the long-term needs of the Nation.	Aeronautics Test Program	Aeronautics Technology
Sub Goal 3F	**Understand the effects of the space environment on human performance, and test new technologies and countermeasures for long-duration human space exploration.**		
Outcome 3F.1	**By 2008, develop and test candidate countermeasures to ensure the health of humans traveling in space.**		
APG 8AC05	Publish results of renal stone countermeasure experiments and evaluate for operational use.	Human Research Program	Advanced Capabilities
APG 8AC06	Complete study of a non-pharmacological countermeasure for bone loss in a spaceflight analog environment.	Human Research Program	Advanced Capabilities
APG 8AC07	Characterize the size distribution of lunar dust (from Apollo samples) in the inhalable size range (<10 micrometers), and begin toxicity testing with simulated lunar dust.	Human Research Program	Advanced Capabilities
APG 8AC08	Determine the stability of a controlled set of food/nutritional items and common medications, representative of the types and classes typically provided on space missions, after six months exposure to the space flight environment.	Human Research Program	Advanced Capabilities
Outcome 3F.2	**By 2010, identify and test technologies to reduce total mission resource requirements for life support systems.**		
APG 8AC09	Deliver two prototype life support systems: the Carbon Dioxide and Moisture Removal Amine System (CAMRAS); and the Sorbent Based Air Revitalization (SBAR) System.	Human Research Program	Advanced Capabilities
Outcome 3F.3	**By 2010, develop reliable spacecraft technologies for advanced environmental monitoring and control and fire safety.**		
APG 8AC10	Deliver the Vehicle Cabin Atmosphere Monitoring (VCAM) flight hardware in preparation for launch to ISS.	Exploration Technology Development	Advanced Capabilities
APG 8AC11	Deliver the Electronic Nose (E-Nose) flight hardware in preparation for launch to ISS	Exploration Technology Development	Advanced Capabilities
APG 8AC12	Launch the Smoke Aerosol Measurement Experiment (SAME) to ISS and initiate testing.	Exploration Technology Development	Advanced Capabilities

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Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
APG 8AC13	Deliver the Combustion Integrated Rack (CIR) and its insert, the Flame Extinguishment Experiment in preparation for launch to ISS.	Exploration Technology Development	Advanced Capabilities
Strategic Goal 4	**Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.**		
Outcome 4.1	**No later than 2014, and as early as 2010, transport three crewmembers to the International Space Station and return them safely to earth, demonstrating an operational capability to support human exploration missions.**		
APG 8CS01	Complete the Preliminary Design Review (PDR) for the Orion/Crew Exploration Vehicle (CEV).	Constellation Systems Program	Constellation Systems
APG 8CS02	Complete Critical Design Review (CDR) for the Ares I-1 flight demonstration test.	Constellation Systems Program	Constellation Systems
APG 8CS03	Complete the Preliminary Design Review (PDR) for Ares-I/Crew Launch Vehicle.	Constellation Systems Program	Constellation Systems
APG 8CS04	Complete the Critical Design Review (CDR) for the ground infrastructure/systems at the launch site.	Constellation Systems Program	Constellation Systems
APG 8CS05	Complete the System Design Review (SDR) for mission operations infrastructure and systems.	Constellation Systems Program	Constellation Systems
APG 8CS06	Complete the Preliminary Design Review (PDR) for the Extravehicular Activity (EVA) Systems.	Constellation Systems Program	Constellation Systems
Outcome 4.2	**By 2010, successfully transition applicable Shuttle components, infrastructure, and workforce to the Constellation Systems program.**		
APG 8CS07	Demonstrate progress towards the transition of Space Shuttle and International Space Station Infrastructure for utilization in Constellation Systems, including transfer of Mobile Launch Platform 1.	Constellation Systems Program	Constellation Systems
Strategic Goal 5	**Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.**		
Outcome 5.1	**Develop and demonstrate a means for NASA to purchase launch services from emerging launch providers.**		
APG 8IPP05	Demonstrate purchase of services from the emerging commercial space sector for microgravity research and training.	Innovative Partnerships Program	Innovative Partnerships Program
APG 8SFS01	Realize competitive rates from emerging U.S. launch providers and open the bidding process to a larger number of launch providers.	Launch Services	Space and Flight Support (SFS)
Outcome 5.2	**By 2010, demonstrate one or more commercial space services for ISS cargo and/or crew transport.**		
APG 8CS08	Complete the Flight Demonstration 1 Readiness Review leading up to demonstration flights in FY2009.	Constellation Systems Program	Constellation Systems
APG 8CS09	Complete the Flight Demonstration 2 Preliminary Design Review (PDR) leading up to demonstration flights in FY2009.	Constellation Systems Program	Constellation Systems
APG 8CS10	Complete the Flight Demonstration 3 System Requirements Review (SRR) leading up to demonstration flights in FY2009.	Constellation Systems Program	Constellation Systems
Outcome 5.3	**By 2012, complete one or more prize competitions for independently designed, developed, launched, and operated missions related to space science or space exploration.**		
APG 8IPP06	Demonstrate benefits of prize competitions by awarding at least one prize and communicating the resulting technology advancements.	Innovative Partnerships Program	Innovative Partnerships Program

FY 2008 Performance Plan

Performance Measure #	Description	Contributing Program (s)	Contributing Theme (s)
Strategic Goal 6	**Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.**		
Outcome 6.1	**By 2008, launch a Lunar Reconnaissance Orbiter (LRO) that will provide information about potential human exploration sites.**		
APG 8AC14	Complete the Critical Design Review (CDR), Mission Readiness Review (MRR), and Payload Engineering Review (PER) for the Lunar Reconnaissance Orbiter.	Lunar Precursor Robotic Program	Advanced Capabilities
APG 8AC15	Complete the Critical Design Review (CDR) and Mission Readiness Review (MRR) for the Lunar Crater Observation and Sensing Satellite.	Lunar Precursor Robotic Program	Advanced Capabilities
Outcome 6.2	**By 2012, develop and test technologies for in situ resource utilization, power generation, and autonomous systems that reduce consumables launched from Earth and moderate mission risk.**		
APG 8AC16	Achieve authority to proceed for a medium lander mission to be launched in the 2010-2011 timeframe that would characterize the lunar surface environment.	Lunar Precursor Robotic Program	Advanced Capabilities
Outcome 6.3	**By 2013, sufficiently develop and test technologies for nuclear power systems to enable an informed selection of systems for flight development to provide power to a lunar outpost.**		
APG 8AC17	By 2008, demonstrate high efficiency power conversion systems in the laboratory at power levels in excess of 10 kilowatts that are relevant to future fission surface power systems.	Exploration Technology Development	Advanced Capabilities
Outcome 6.4	**Implement the space communications and navigation architecture responsive to science and exploration mission requirements.**		
APG 8CS11	Provide the Command, Control, Communication and Information (C3I) standards, validation processes and test systems designs, and demonstrate life cycle feasibility at the Ground Operations and Mission Operations Preliminary Design Reviews (PDRs).	Constellation Systems Program	Constellation Systems
APG 8SFS02	Implement technology initiatives consistent with approved baseline space communications and navigation architecture.	Space Communications	Space and Flight Support (SFS)
APG 8SFS03	Complete the Exploration Communications and Navigation System (ECANS) Preliminary Design Review (PDR).	Space Communications	Space and Flight Support (SFS)
Outcome 6.5	**No later than 2020, demonstrate the capability to conduct an extended human expedition to the lunar surface and lay the foundation for extending human presence across the solar system.**		
APG 8CS12	Develop and annually refine a lunar return architecture that has the maximum possible utility for later missions to Mars and other destinations.	Extended Lunar Stay Capability	Constellation Systems
APG 8CS13	Demonstrate progress towards the refinement of initial cargo launch vehicle conceptual designs to establish preliminary cargo launch vehicle system requirements.	Extended Lunar Stay Capability	Constellation Systems

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Cross-Agency Support Programs

Performance Measure #	Description	Contributing Program (s)
Education Theme Theme		
Outcome ED-1	**Contribute to the development of the Science, Technology, Engineering and Math (STEM) workforce in disciplines needed to achieve NASA's strategic goals, through a portfolio of programs.**	
APG 8ED01	Provide 100 NASA-supported courses offered at institutions of higher education targeted at the STEM skills needed by NASA.	Education
APG 8ED02	Serve 250 students, 150 faculty, and 40 institutions in designated EPSCoR states.	Education
APG 8ED03	Support 125 Minority Institutions and 4,500 underserved students in STEM education programs.	Education
Outcome ED-2	**Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers and faculty.**	
APG 8ED04	Increase by 5 percent the number of elementary and secondary student participants in NASA instructional and enrichment activities.	Education
APG 8ED05	Increase by 5 percent elementary and secondary educators' use of NASA resources in their classroom instruction.	Education
Outcome ED-3	**Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission.**	
APG 8ED06	Provide support to 100 museums and science centers across the country to actively engage the public in NASA events and activities.	Education
Advanced Business Systems (IEMP) Theme		
Outcome IEM-1	**By 2009, implement Agency business systems that provide timely, consistent and reliable business information for management decisions.**	
APG 8IEM01	Implement the Property, Plant and Equipment (PP&E) module of the Integrated Asset Management Project to provide integration between functional and financial processes for accountable personal property.	Integrated Enterprise Management Program
APG 8IEM02	Implement the Human Capital Information Environment to strategically plan and manage NASA's Human Capital resulting in the elimination of redundant systems and integrating the remaining Human Capital processes and systems.	Integrated Enterprise Management Program
APG 8IEM03	Implement Phase 2 of the Aircraft Management Module, including the Aircraft Logistics System, Aircraft Financial System Interface to NASA's Core Financial system and the Maintenance Management module to ensure safety of ground and flight operations and improve visibility into aircraft operations processes.	Integrated Enterprise Management Program
Outcome IEM-2	**By 2009, increase efficiency by implementing new business systems and reengineering Agency business processes.**	
APG 8IEM04	Reduce the number of quarterly corrective adjustments to financial statements from the 2006 baseline of 5948 steps to the 2008 goal of 3345 steps (a 44 percent reduction).	Integrated Enterprise Management Program
APG 8IEM05	Increase percentage of total travel booking completed on-line, from the 2006 baseline of 1.8 percent to the 2008 goal of 50 percent.	Integrated Enterprise Management Program

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Cross-Agency Support Programs

Performance Measure #	Description	Contributing Program (s)
Innovative Partnerships Program Theme		
Outcome IPP-1	**Promote and develop innovative technology partnerships among NASA, U.S. industry, and other sectors for the benefit of Agency programs and projects.**	
APG 8IPP01	Develop 20 technology-related significant partnerships that create value for NASA's programs and projects. Track both quantitative dollar value and qualitative benefits to NASA (e.g., reduced volume or mass, improved safety).	Innovative Partnerships Program
APG 8IPP02	Complete 50 technology transfer agreements with the commercial and academic community through mechanisms like licenses, software use agreements, facility use agreements, and Space Act Agreements.	Innovative Partnerships Program
APG 8IPP03	Fully implement an annual portfolio licensing approach that targets licensing goals of greatest value/benefit to NASA. Examples include licensing royalties and new technology products available to NASA. Royalties should be $4 million per year or greater.	Innovative Partnerships Program
APG 8IPP04	Complete and institutionalize an enhanced Intellectual Property (IP) management process that enables stronger use of NASA's IP to support NASA's strategies. Implement such IP management together with at least two significant NASA programs or projects.	Innovative Partnerships Program
Shared Capability Assets Program Theme		
Outcome SC-1	**Establish and maintain selected Agency level shared capabilities, across multiple classes of assets (e.g., wind tunnels, vacuum chambers, etc.), to ensure that they will continue to be available to support the missions that require them.**	
APG 8SC01	Prioritize funding requirements and select classes of assets for inclusion in the Shared Capability Assets Program.	Shared Capability Assets Program
APG 8SC02	Identify re-investment/re-capitalization opportunities within and among classes of assets and execute the approved changes (e.g., reallocate funds, upgrade facilities, etc.).	Shared Capability Assets Program
APG 8SC03	Assets identified in FY2007 that no longer have requirements for use by NASA will be dispositioned (decision made on whether to place on standby, be mothballed, be demolished, etc).	Shared Capability Assets Program

FY 2008 Performance Plan

Efficiency Measures

Performance Measure #	Description
Advanced Capabilities Theme	
APG 8AC18	Complete all development projects within 110% of the cost and schedule baseline.
APG 8AC19	Increase the relative amount technology products transferred to Constellation Systems developers for mission application compared to the total budget.
APG 8AC20	Reduce time within which NRA research grants are awarded, from proposal due date to selection, by 2.5% per year, with a goal of 135 days.
Astrophysics Theme	
APG 8AS09	Complete all development projects within 110% of the cost and schedule baseline.
APG 8AS10	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 8AS11	Peer-review and competitively award at least 90%, by budget, of research projects.
APG 8AS12	Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 130 days.
Aeronautics Technology Theme	
APG 8AT17	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 8AT18	Increase the annual percentage of research funding awarded to Aeronautics University Partnerships.
Constellation Systems Theme	
APG 8CS14	Complete all development projects within 110% of the cost and schedule baseline.
APG 8CS15	Reduction in ground operations cost (through 2012) of the Constellation Systems based on comparison with the Space Shuttle Program.
Education Theme Theme	
APG 8ED07	Reduce turn around time by 10% from submission of supplementary curriculum products for formal review to online distribution.
APG 8ED08	Reduce the cost per program participant by 5%.
Earth Science Theme	
APG 8ES15	Complete all development projects within 110% of the cost and schedule baseline.
APG 8ES16	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 8ES17	Peer-review and competitively award at least 90%, by budget, of research projects.
APG 8ES18	Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 130 days.
Heliophysics Theme	
APG 8HE07	Complete all development projects within 110% of the cost and schedule baseline.
APG 8HE08	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 8HE09	Peer-review and competitively award at least 90%, by budget, of research projects.
APG 8HE10	Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 130 days.

FY 2008 Performance Plan

Efficiency Measures

Performance Measure #	Description
Advanced Business Systems (IEMP) Theme	
APG 8IEM06	Complete all development projects within 110% of the cost and schedule baseline.
APG 8IEM07	Reduce the number of financial processing steps/time to perform year end closing from the 2005 baseline of 120 steps to the 2008 goal of 20 steps (an 83% reduction).
International Space Station Theme	
APG 8ISS07	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 8ISS08	Achieve an Annual Cost Performance Index (CPI), the ratio of the value of the work accomplished versus the actual cost of the work accomplished, of greater than or equal to one.
Planetary Science Theme	
APG 8PS09	Complete all development projects within 110% of the cost and schedule baseline.
APG 8PS10	Deliver at least 90% of scheduled operating hours for all operations and research facilities.
APG 8PS11	Peer-review and competitively award at least 90%, by budget, of research projects.
APG 8PS12	Reduce time within which 80% of NRA research grants are awarded, from proposal due date to selection, by 5% per year, with a goal of 130 days.
Space and Flight Support (SFS) Theme	
APG 8SFS04	Achieve at least 98% Space Network proficiency for delivery of Space Communications services.
APG 8SFS05	Achieve less than 3% of lost operating time on the NASA Integrated Services Network (NISN) available services.
APG 8SFS06	Complete all development projects within 110% of the cost and schedule baseline.
Space Shuttle Theme	
APG 8SSP05	Annually reduce the Space Shuttle sustaining engineering workforce for flight hardware and software, while maintaining safe flight.
APG 8SSP06	Deliver at least 90% of scheduled operating hours for all operations and research facilities.

AA	Associate Administrator
AAA	Assistant Associate Administrator
AATT	Advanced Air Transportation Technologies
AC	Advanced Concepts
ACCESS	Advanced Collaborative Connections for Earth System Science
ACE	Advanced Composition Explorer
ACES	Airspace Concepts Evaluation System
ACIS	Advanced CCD Imaging Spectrometer
ACRIMSat	Active Cavity Radiometer Irradiance Monitor Satellite
ACS	Advanced Camera for Surveys (Hubble Space Telescope instrument)
ADFT	Ascent Development Flight Test
AESP	Aerospace Education Services Program
AF	Air Force
AFB	Air Force Base
AFRL	Air Force Research Laboratory
AFS	Aircraft Financial System
AFT	Advanced Food Technology
AIA	Atmospheric Imaging Assembly (Solar Dynamic Observatory instrument)
AIM	Aeronomy of Ice in the Mesosphere
AISR	Applied Information Systems Research
ALS	Aircraft Logistics System
ALV	Air Launch Vehicle
AMM	Aircraft Management Module
AMMOS	Advanced Multi-Mission Operations System
AMR	Advanced Microwave Radiometer (Ocean Surface Topography Mission instrument)
AMS	Alpha Magnetic Spectrometer
AMSR-E	Advanced Microwave Scanning Radiometer for the Earth Observing System
AO	Announcement of Opportunity
APG	Annual Performance Goal
APL	Applied Physics Laboratory (Johns Hopkins University)
APS	Advanced Polarimeter Sensor (Glory instrument)
APT	Advanced Platform Technology
ARC	Ames Research Center
ARM	Active Risk Manager
ARMD	Aeronautics Research Mission Directorate
ASAP	Aerospace Safety Advisory Panel
ASI	Agenzia Spaziale Italiana (Italian Space Agency)
ASP	Airspace Systems Program
ASPERA-3	Analyzer of Space Plasma and Energetic Atoms-3
ASRG	Advanced Stirling Radioisotope Generator
ASTER	Advanced Spaceborne Thermal Emission Reflection Radiometer
ASVM	Aircraft and Systems Vulnerability Mitigation
ATLO	Assembly, Test, Launch Operations
ATM	Air Traffic Management
ATMS	Advanced Technology Microwave Sounder (NPOESS Preparatory Project instrument)
ATP	Aeronautics Test Program
BAR	Basic and Applied Research
BE	Beyond Einstein
BEPAC	Beyond Einstein Program Assessment Committee
BHP	Behavioral Health and Performance
BPI	Budget Performance and Integration
BWB	Blended Wing Body
C3I	Command, Control, Communication Information
C3PO	Commercial Crew, Cargo Program Office
CALIPSO	Cloud–Aerosol Lidar and Infrared Pathfinder Satellite Observations
CAN	Cooperative Agreement Notice
CARA	California Association for Research in Astronomy
CASP	Cross Agency Support Programs
CAST	Commercial Aviation Safety Team
CCRI	Climate Change Research Initiative
CCSP	Climate Change Science Program
CDC	Centers for Disease Control
CDL	Center for Distance Learning
CDR	Critical Design Review
CDRA	Carbon Dioxide Removal Assembly
CEV	Crew Exploration Vehicle
CFO	Chief Financial Officer
CGRO-EGRET	Compton Gamma-Ray Observatory–Energetic Gamma-Ray Experiment Telescope
ChemCam	Chemistry Camera
CHIPS	Cosmic Hot Interstellar Plasma Spectrometer
CHS	Crew Health and Safety
CINDI	Coupled Ion Neutral Dynamics Investigation
CIPA	Curriculum Improvement Partnership Awards
CIPAIR	Curriculum Improvement Partnership Award for the Integration of Research
CIR	Combustion Integrated Rack
CLV	Crew Launch Vehicle
CMB	Cosmic Microwave Background
CME	Coronal Mass Ejection
CMO	Center Management Operations
CNES	Centre Nationale D'Etudes Spatiale (French Space Agency)
CO	Carbon Monoxide
CO2	Carbon Dioxide
CoF	Construction of Facilities
CONAE	Argentina's National Committee of Space Activities
CONTOUR	Comet Nucleus Tour
CORE	Central Operation of Resources for Educators
COS	Cosmic Origins Spectrograph
COTF	Classroom of the Future
COTR	Contracting Officer Technical Representative
COTS	Commercial Orbital Transportation Services
CPR	Cloud Profiling Radar (CloudSat instrument)
CRaTER	Cosmic Ray Telescope for the Effects of Radiation
CrIS	Cross-track Infrared Sounder (NPOESS Preparatory Project instrument)
CSA	Canadian Space Agency

Cx	Constellation
CY	Calendar Year
DAAC	Distributed Active Archive Centers
DAFT	Dust and Aerosol Measurement Facility Test
DARPA	Defense Advanced Research Projects Agency
DASS	Distress Alerting Satellite System
DCR	Design Certification Review
DDT&E	Design, Development, Test, and Evaluation
DEVELOP	Digital Earth Virtual Environment and Learning Outreach Program
DFRC	Dryden Flight Research Facility
DIXI	Deep Impact Extended Investigation of Comets
DLN	Digital Learning Network
DLR	Deutches Zentrum für Luft- und Raumfahrt (German Aerospace Center)
DoD	Department of Defense
DOE	Department of Energy
DORIS	Doppler Orbitography by Radiopositioning Integrated by Satellite (Ocean Surface Topography Mission instrument)
DOT	Department of Transportation
DPR	Dual-frequency Precipitation Radar (Global Precipitation Measurement instrument)
DRL	Direct Readout Laboratory
DRS	Disturbance Reduction System
DSMS	Deep Space Mission System
DSN	Deep Space Network
E&S	Elementary and Secondary Education Project
EA	Enterprise Architecture
EAP	Educator Astronaut Program
EASI	Efficient Aerodynamic Shapes and Integration
ECANS	Exploration Communication and Navigation Systems
ECC	Education Coordinating Committee
ECLSS	Environmental Control and Life Support System
ECT	Energetic Particle, Composition and Thermal Plasma
EDL	Entry, Descent, and Landing
EDS	Earth Departure Stage
EEE	Evolution of EOSDIS Elements
EELV	Evolved Expendable Launch Vehicle
EFASCO	Electric Field and Search Coil
EFI	Electric Field Instrument (Thermal Emission Imaging System instrument)
EFPO	Education Flight Projects
ELC	ExPRESS Logistics Carrier
ELM-PS	Experiment Logistics Module-Pressurized Section
ELV	Expendable Launch Vehicle
ELVIS	Expendable Launch Vehicle Integrated Support
EMC	Exploration Medical Capability
EMFISIS	Electric and Magnetic Field Instrument Suite and Integrated Science
ENose	Electronic nose
EO-1	Earth Observing One Mission
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
EPA	Environmental Protection Agency
e-PD	e-Professional Development
EPOCh	Extrasolar Planet Observations and Characterization
EPSCoR	Experimental Program to Stimulate Competitive Research
E&S	Elementary and Secondary Education
ESA	European Space Agency
ESAS	Exploration Systems Architecture Study
ESD	Earth Science Division
ESMD	Exploration Systems Mission Directorate
ESRT	Exploration Systems Research and Technology
ESSF	Earth System Science Fellowship
ESSP	Earth System Science Pathfinder
ESTO	Earth Science Technology Office
ESTP	Earth Science Technology Program
ET	External Tank
ETD	Exploration Technology Development
ETDP	Exploration Technology Development Program
ETM	Enhanced Thematic Mapper
EUMETSAT	European Organization for the Exploitation of Meteorological
EVA	Extravehicular Activity
EVE	Extreme-ultraviolet Variability Experiment (Solar Dynamics Observatory instrument)
EVM	Earned Value Management
EXPRESS	Expedite the Processing of Experiments to the Space Station
FAA	Federal Aviation Administration
FACET	Future Air Traffic Management Concepts Evaluation
FAP	Fundamental Aeronautics Program
FAR	Faculty Awards for Research
FAST	Fast Auroral Snapshot
FFMIA	Federal Financial Management Improvement Act of 1996
FGM	Fluxgate Magnetometer (Thermal Emission Imaging System instrument)
FGS	Fine Guidance Sensor
FMI	Finnish Meteorological Institute
FOSS	Fiber Optic Strain System
FTE	Full Time Equivalency
FUSE	Far Ultraviolet Spectroscopic Explorer
FY	Fiscal Year
G&A	General and Administrative
GALEX	Galaxy Evolution Explorer
GAO	Government Accountability Office
GBM	Gamma-ray Burst Monitor (Gamma-ray Large Area Telescope instrument)
GCRP	Global Change Research Program
GE	General Electric
GEO	Geosynchronous Earth Orbit
GHz	Gigahertz

GI	Guest Investigator
GLAST	Gamma–ray Large Area Space Telescope
GLOBE	Global Learning and Observations to Benefit the Environment
GMAO	Global Modeling and Assimilation Office
GMI	GPM Microwave Imager (Global Precipitation Measurement instrument)
GM–OO	Geospace Missions of Opportunity
GN	Ground Networks
GNC	Guidance, navigation and control
GO	Ground Operations
GOES	Geostationary Operational Environmental Satellite
GP–B	Gravity Probe–B
GPM	Global Precipitation Measurement
GPRA	Government Performance Results Act of 1993
GPS	Global Positioning System
GRACE	Gravity Recovery and Climate Experiment
GRAIL	Gravity Recovery and Interior Laboratory
GRB	Gamma Ray Burst
G-RBSP	Geospace- Radiation Belt Storm Probes
GRC	Glenn Research Center
GRC-PBS	Glenn Research Center–Plum Brook Station
GSFC	Goddard Space Flight Center
GSRP	Graduate Student Research Project
GSSR	Goldstone Solar System Radar
GTO	Geosynchronous Transfer Orbit
HALE	High-Altitude, Long-Endurance
HBCU	Historically Black Colleges and Universities
HCIE	Human Capital Information Environment
HE	Higher Education Project
HECC	High End Computing Columbia
HETE–2	High Energy Transient Explorer
HETG	High Energy Transmission Grating
HFI	High Frequency Instrument
HHC	Health and Human Countermeasures
HIFI	Heterodyne Instrument for the Far Infrared
HIRDLS	High Resolution Dynamic Limb Sounder
HMI	Helioseismic and Magnetic Imager (Solar Dynamic Observatory instrument)
HMP	Human Measures and Performance
HOM	Heliophysics Operating Missions
HQ	NASA Headquarters
HRC	High Resolution Camera
HRP	Human Research Program
HSB	Humidity Sounder for Brazil
HSI	Hispanic Service Institutions
HSRT	Human Systems Research and Technology
HST	Hubble Space Telescope
HTF	Hypersonic Test Facility
Hy-BoLT	Hypersonic Boundary Layer Transition Flight Experiment
I&T	Integration and test
IAM	Integrated Asset Management
IBEX	Interstellar Boundary Explorer
IBPD	Integrated Budget and Performance Document
ICESat	Ice, Cloud, and Land Elevation Satellite
IEMP	Integrated Enterprise Management Program
IFMP	Integrated Financial Management Program
IGA	Intergovernmental Agreement
IIFD	Integrated Intelligent Flight Deck
IIR	Imaging Infrared Radiometer (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations instrument)
IMAGE	Imager for Magnetopause–to–Aurora Global Exploration
IMD	Institutional Management and Dissemination
INPE	Brazilian Institute for Space Research
INSPIRE	Interdisciplinary National Science Program Incorporating Research and Education Experiences
INTEGRAL	International Gamma Ray Astrophysics Laboratory
IOM	Institute of Medicine
IP	Intellectual Property
IPAO	Independent Program Assessment Office
IPO	Integrated Program Office
IPP	Innovative Partnerships Program
IPS	Integrated Planning System
IPY	International Polar Year
IR	Infrared
IRA	Institutional Research Awards
IRAC	Integrated Resilient Aircraft Controls
IRT	Independent Review Team
ISAS	Institute of Space and Astronautical Science
ISC	Inertial Stellar Compass
ISIM	Integrated Science Instrument Module
ISP	In-Space Propulsion Project
ISRO	Indian Space Research Organization
ISRU	In-Situ Resource Utilization
ISS	International Space Station
ISSC	International Space Science Collaboration
ISSMP	International Space Station Medical Program
ISTP	Integrated Space Transportation Plan
ITAR	International Traffic in Arms Regulation
ITAS	Integrated Tailored Aerostructures
ITF	Integrated Training Facility
IVHM	Integrated Vehicle Health Management
JAXA	Japan Aerospace Exploration Agency
JDEM	Joint Dark Energy Mission
JEM PM	Japanese Experiment Module Pressured Module
JHU	John Hopkins University
JHU-APL	Johns Hopkins University–Applied Physics Laboratory
JPDO	Joint Planning and Development Office
JPFP	Harriet Jenkins Pre-doctoral Fellowship Program
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
JSC-WSTF	Johnson Space Center–White Sands Test Facility
JWST	James Webb Space Telescope

KHz	Kilohertz
KI	Keck Interferometer
KNM	Royal Netherlands Meteorological Institute
KSC	Kennedy Space Center
kW	Kilowatt
LAMP	Lyman-Alpha Mapping Project
LANL	Los Alamos National Laboratory
LaRC	Langley Research Center
LAS	Launch Abort System
LASP	Laboratory for Atmospheric and Space Physics (University of Colorado, Boulder)
LAT	Large Area Telescope (Gamma-ray Large Area Telescope instrument)
LBT	Large Binocular Telescope
LBTI	Large Binocular Telescope Interferometer
LCAS	Low-Cost Access to Space
LCC	Launch Control Center
LCROSS	Lunar Crater Observation and Sensing Satellite
LDCM	Landsat Data Continuity Mission
LEAP	Low Emissions Alternative Power
LEND	Lunar Exploration Neutron Detector
LEO	Low Earth Orbit
LETG	Low Energy Transmission Grating
LFI	Low Frequency Instrument
LISA	Laser Interferometer Space Antenna
LMS	Launch and Mission Systems
LN2	Liquid Nitrogen
LOLA	Lunar Orbiter Laser Altimeter
LoB	Lines of Business
LOX	Liquid Oxygen
LPRP	Lunar Precursor Robotic Program
LRA	Laser Retroreflector Array (Ocean Surface Topography Mission instrument)
LRD	Launch Readiness Date
LRO	Lunar Reconnaissance Orbiter
LROC	Lunar Reconnaissance Orbiter Camera
LSAH	Longitudinal Study of Astronaut Health
LSAM	Lunar Surface Access Module
LSH	Life Support and Habitation
LSP	Launch Services Program
LV	Launch Vehicle
LWS	Living with a Star
M3	Moon Mineralogy Mapper
MASTAP	Math Science Teacher and Curriculum Enhancement Program
MCC	Mission Control Center
MCR	Mission Confirmation Review
MD	Mission Directorate
MDA	Missile Defense Agency
MDAO	Multidisciplinary Design Analysis and Optimization
MECA	Mars Environmental Compatibility Assessment
MEP	Mars Exploration Program
MEPAG	Mars Exploration Program Analysis Group
MESSENGER	Mercury Surface, Space Environment, Geochemistry and Ranging
METI	Ministry of Economy Trade and Industry (Japan)
MGS	Mars Global Surveyor
MI	Minority Institutions
MIDEX	Medium-Class Explorer
Mini-RF	Radiation Frequency
MIRI	Mid-infrared Instrument (James Webb Space Telescope instrument)
MIT	Massachusetts Institute of Technology
MLP	Mobile Launch Platform
MM	Maintenance Management
MMOD	Micrometeoroid/ Orbital Debris
MMRTG	Multi-missions Radioisotope Thermoelectric Generators
MMS	Magnetospheric Multiscale
MO	Missions of Opportunity
MO&DA	Mission Operations and Data Analysis
MoonROx	Moon Regolith Oxygen
MOPITT	Measurements of Pollution in the Troposphere
MOR	Mission Operations Review
MPE	Max-Planck-Institut fur Extra-terrestriche Physik (Germany)
MRO	Mars Reconnaissance Orbiter
MRR	Mission Requirement Request
MSFC	Marshall Space Flight Center
MSG	Magnetic Spectrometer
MSI	Minority-Serving Institute
MSL	Mars Science Laboratory
MSRR	Materials Science Research Rack
MTO	Mars Telecommunications Orbiter
MUREP	Minority University Research and Education Project
MUSES-C	Mu Space Engineering Spacecraft–C
MUSS	Multi-User Systems and Support
MUST	Motivating Undergraduate in Science and Technology
NAC	NASA Advisory Committee
NAFP	NASA Administrator’s Fellowship Program
NAPA	National Academy of Public Administration
NAR	Non-Advocacy Review
NAS	National Airspace System
NASDA	National Space Development Agency of Japan
NASSMC	National Alliance of State Science and Mathematics Coalitions
NEAR	Near-Earth Asteroid Rendezvous
NEI	NASA Explorer Institute
NEN	Near Earth Network
NEO	Near-Earth Object
NEOO	Near-Earth Object Observations
NEPER	NASA Education Program Evaluation Review
NES	NASA Explorer School
NESC	NASA Engineering and Safety Center
NESSF	NASA Earth and Space Science Fellowship Program

NETS	NASA Educational Technology Services
NEXT	NASA Evolutionary Xenon Thruster
NGATS	Next Generation Air Transportation System
NGLT	Next Generation Launch Technology
NGST	Northrop Grumman Space Technology
NIA	National Institute of Aerospace
NICMOS	Near Infrared Camera and Multi-Object Spectrometer (Hubble Space Telescope instrument)
NIP	New Investigator Program
NISN	NASA Integrated Services Network
NIST	National Institute of Science and Technology
NIVR	Netherlands Agency for Aerospace Programs
NLS	NASA Launch Services
NLT	NASA Learning Technologies
NMP	New Millennium Program
NOAA	National Oceanic and Atmospheric Administration
NOAA-N	National Oceanic and Atmospheric Administration–N
NOx	Nitrogen Oxide
NPOESS	National Polar–orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project
NPR	NASA Procedural Requirement
NRA	NASA Research Announcement
NRC	Nuclear Regulatory Commission
NRC	National Research Council
NRL	Naval Research Laboratory
NSBRI	National Space Biomedical Research Institute
NSF	National Science Foundation
NSSC	NASA Shared Services Center
NSSDC	National Space Science Data Center
NSTA	National Science Teachers Association
NSTC	National Science and Technology Council
NSTI-MI	NASA Science and Technology Institute for Minority Institutions
NTTC	National Technology Transfer Center
O&SS	Operations and Sustaining Support
OA	Office of Audits
OCE	Office of Chief Engineer
OCFO	Office of Chief Financial Officer
OCHMO	Office of the Chief Health and Medical Officer
OCIO	Office of Chief Information Officer
OCO	Orbiting Carbon Observatory
OFT	Orbital Flight Test
OGS	Oxygen Generation System
OIG	Office of Inspector General
OLI	Operational Land Imager (Landsat Data Continuity Mission instrument)
OMB	Office of Management and Budget
OMI	Ozone Monitoring Instrument
OMPS	Ozone Mapping and Profiler Suite (NPOESS Preparatory Project instrument)
OMU	Other Minority Universities
OPF	Orbiter Processing Facility
ORR	Operations Readiness Review
OSD	Office of Secretary of Defense
OSIRIS	Origins Spectral Interpretation Resource Identification and Security
OSMA	Office of Safety and Mission Assurance
OSTM	Ocean Surface Topography Mission
OSTP	Office of Science and Technology Policy
PA&E	Program Analysis and Evaluation
PAIR	Partnership Awards for the Integration of Research into Undergraduate Education
PAR	Program Acceptance Review
PART	Program Assessment Rating Tool
PBS	President's Budget Submit
PDR	Preliminary Design Review
PDS	Planetary Data System
PI	Principal Investigator
PIR	Program Implementation Review
PMA	President's Management Agenda
PMC	Program Management Council
PNAR	Preliminary Non-Advocate Review
POES	Polar Operational Environmental Satellites
PP&E	Property, Plant, and Equipment
PPAR	Preliminary Program Acceptance Review
PPBE	Planning Programming Budget and Evaluation
PPF	Payload Processing Facility
PR	Precipitation Radar
PSR	Physical Sciences Research
PWR	Pratt and Whitney Rocketdyne
QAT	Quiet Aircraft Technology
QTR	Quarter
QuickSCAT	Quick Scatterometer
R&A	Research and Analysis
R&D	Research and Developemnt
RAD	Radiation Assessment Detector
RBSPICE	Radiation Belt Science of Protons, Ions, Composition, and Electrons
RDT&E	Research, Development, Testing, and Evaluation
REASoN	Research, Education and Applications Solutions Network
REMS	Rover Environmental Monitoring System
RFI	Request for Information
RFP	Request for Proposal
RHESSI	Reuven Ramaty High Energy Solar Spectroscopic Imager
RLEP	Robotic Lunar Exploration Program
ROA	Remotely Operated Aircraft
ROSES	Research Opportunities in Space and Earth Science
RPCT	Radioisotope Power Conversion Technology
RpK	Rocket Plane-Kistler
RPS	Radioisotope Power System
RPT	Rocket Propulsion Testing
RSDO	Rapid Spacecraft Development Office
RSRB	Reusable Solid Rocket Booster

RSRM	Reusable Solid Rocket Motor
RTG	Radioisotope Thermoelectric Generators
RXTE	Rossi X–ray Timing Explorer
S&MA	Safety and Mission Assurance
SAC-D	Satellite de Aplicaciones Cientificas–D (Argentina)
SAGE	Stratospheric Aerosol and Gas Experiment
SAIC	Science Applications International Corporations
SAMPEX	Solar Anomalous and Magnetospheric Particle Explorer
SAO	Smithsonian Astrophysical Observatory
SAR	Synthetic Aperture Radar
SATS	Small Aircraft Transportation System
SAU	Strategic Airspace Usage
SBIR	Small Business Innovative Research
SBT	Space-Based Technology
SC	Shared Capabilities
SCAP	Shared Capability Assets Program
SCM	Search Coil Magnetometer (Thermal Emission Imaging System instrument)
SCP	Space Communications Program
SDO	Solar Dynamics Observatory
SDR	System Design Review
SDSC	Satish Dhawan Space Center
SEC	Sun–Earth Connection
SELENE	Selenological and Engineering Explorer (Japan)
SEMAA	Science Engineering Mathematics Aerospace Academy
SET	Space Environmental Spacecraft
SFS	Space and Flight Support
SHFH	Space Human Factors and Habitability
SIM	Space Interferometry Mission
SLAC	Stanford Linear Accelerator Center
SLR	Satellite Laser Ranging
SM-4	Servicing Mission–4
SMC/TEL	Space and Mission Command/Test and Evaluation Directorate
SMD	Science Mission Directorate
SMEX	Small Explorer
SN	Space Network
SOA	State of the Art
SOAREX	Sub-Orbital Aerodynamic Re-entry Experiment
SOFIA	Stratospheric Observatory for Infrared Astronomy
SOHO	Solar Heliospheric Observer
SOMD	Space Operations Mission Directorate
SORCE	Solar Radiation and Climate Experiment
SpaceX	Space Exploration and Technology
SPDM	Special Purpose Dexterous Manipulater
SPF	Software Production Facility
SPIRE	Spectral and Photometric Imaging Receiver
SPOC	Space Program Operations Contract
SPP	Science Power Platform
SR	Space Radiation
SRB	Solid Rocket Booster
SRG	Stirling Radioisotope Generator
SRR	System Requirement Review
SSC	Stennis Space Center
SSE	Solar System Exploration
SSME	Space Shuttle Main Engines
SSP	Space Shuttle Program
SSR	Solar System Radar
SSS	Sea Surface Salinity
SST	Solid State Telescope (Thermal Emission Imaging System instrument)
ST	Space Technology
STaR	Shuttle Transition and Retirement
STEM	Science, Technology, Engineering, and Mathematics
STEREO	Solar Terrestrial Relations Observatory
STIS	Space Telescope Imaging Spectrograph (Hubble Space Telescope instrument)
STOCC	Space Telescope Operations Control Center
STP	Solar Terrestrial Probes
STS	Space Transportation System
STScI	Space Telescope Science Institute
STSS	Space Tracking Surveillance System
STTR	Small Business Technology Transfer Program
SVA	Strategic Vehicle Architecture
SVD	System Vulnerability Detection
SwRI	Southwest Research Institute
T2	Technology transfer
TAA	Technology Assistance Agreements
TCU	Tribal Colleges and Universities
TDRS	Tracking and Data Relay Satellite
TE	Technical Excellence
TEGA	Thermal and Evolved Gas Analyzer
THEMIS	Time History of Events and Macroscale Interactions during Substorms
TIM	Total Irradiance Monitor (Glory instrument)
TIMED	Thermosphere, Ionosphere, Mesosphere, Energetics and Dynamics
TOC	Test Operations Contract
TOMS	Total Ozone Mapping Spectrometer
TOMS-EP	Total Ozone Mapping Spectrometer - Earth Probe
TOPEX	Topographic Experiment for ocean circulation
TPF	Terrestrial Planet Finder
TPS	Thermal Protection System
T&R	Transition and Retirement
TRACE	Transition Region and Coronal Explorer
TRL	Technology Readiness Level
TRMM	Tropical Rainfall Measuring Mission
TT&C	Flight Tracking Telemetry and Command
TVC	Thermal Vacuum Chambers
TWINS	Two Wide–angle Imaging Neutral–atom Spectrometers
UAS	Uninhabited Air Systems
UAV	Unmanned Aerial Vehicle
UAZ	University of Arizona
UCLA	University of California at Los Angeles

UEET	Ultra–efficient Engine Technology
ULF	Utilization and Logistics Flight
UNCFSP	United Negro College Fund Special Programs
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNITeS	Unified NASA Information Technology Services
URC	University Research Center
URETI	University Research Engineering, and Technology Institute
USA	United Space Alliance
USAF	United States Air Force
USDA	United States Department of Agriculture
USGS	United States Geological Survey
USOS	United States Orbital Segment
USRA	Universities Space Research Association
USRP	Undergraduate Student Research Project
UTMB	University of Texas Medical Branch
UV	Ultraviolet
VAB	Vehicle Assembly Building
VAMS	Virtual Airspace Modeling and Simulation
VCAMS	Vehicle Cabin Atmosphere Monitoring
VIIRS	Visible-Infrared Imager Radiometer Suite (NPOESS Preparatory Project instrument)
VSE	Vision for Space Exploration
VSP	Vehicle Systems Program
WATR	Western Aeronautical Test Range
WAVES	Radio and Plasma Waves Instrument (Wind)
WFC-3	Wide Field Camera–3 (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations instrument)
WISE	Widefield Infrared Survey Explorer
WMAP	Wilkinson Microwave Anisotropy Probe
WRS	Water Recovery System
WSTF	White Sands Test Facility
XMM	X-ray Multi-mirror Mission (Newton Observatory)