

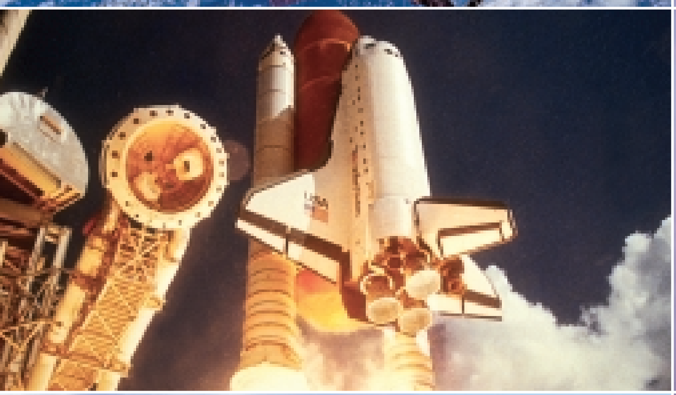

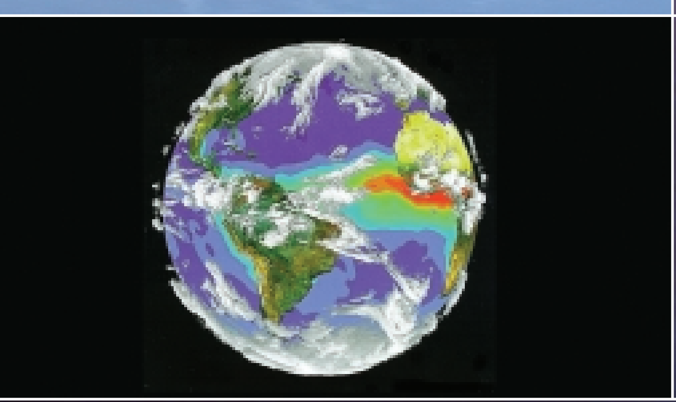

FISCAL YEAR 2003 BUDGET ESTIMATES

Agency Summary, Human Space Flight, Science, Aeronautics and Technology, and Inspector General

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Background and Introduction

The Government Performance and Results Act

The Government Performance and Results Act (GPRA) was passed by Congress and signed by the President in 1993. GPRA was enacted to improve the efficiency of all Federal agencies, with the following specific goals:

Improve Federal program management, effectiveness, and public accountability
Improve Congressional decision making on where to commit the Nation's financial and human resources
Improve citizen confidence in Government performance

GPRA directs Executive Branch agencies to develop a customer-focused strategic plan that aligns activities with concrete missions and goals. The Act directs agencies to manage and measure results to justify Congressional appropriations and authorizations. One hundred and eighty days after the completion of the fiscal year, agencies report on the degree of success in achieving the goals and performance measures defined in the strategic and performance plans. NASA's third Annual Performance Report will be furnished to the Congress in March 2002, covering performance in FY 2001.

NASA's Strategic Management System

Processes within NASA's Strategic Management System provide the information and results for GPRA's planning and reporting requirements. This system is defined in the NASA Strategic Management Handbook (NASA Procedures and Guidelines 1000.2, February 2000). Strategic Management Elements are depicted in the handbook (Figure 1-2) illustrating the hierarchy of documentation for the Strategic Management System (Agency--Enterprise--Centers--Program/Project--Employees).

The NASA Strategic Plan (NASA Policy Directive 1000.1b) defines the vision, mission, and fundamental questions of science and research that provide the foundation of the Agency's goals. The Plan describes five Strategic Enterprises that manage the programs and activities to implement our mission, answer fundamental questions, and provide service to identified customers. These Strategic Enterprises are the: *Space Science Enterprise, Earth Science Enterprise, Human Exploration and Development of Space Enterprise, Biological and Physical Research Enterprise and Aerospace Technology Enterprise*. The support systems for the Strategic Enterprises, defined as Crosscutting Processes, are: *Manage Strategically, Provide Aerospace Products and Capabilities, Communicate Knowledge and Generate Knowledge*. Interested readers may access NASA's Strategic Plan at the following website: http://www.hq.nasa.gov/office/codez/new/

The FY 2003 Performance Plan reflects the recent Strategic Plan. In the NASA Strategic Plan, the vision and mission statements of the Agency are articulated. We reprint them here for the convenience of the reader.

NASA Vision Statement

NASA is an investment in America's future. As explorers, pioneers, and innovators, we boldly expand frontiers in air and space to inspire and serve America and to benefit the quality of life on Earth.

NASA Mission Statement

- **To advance and communicate scientific knowledge and understanding of the Earth, the solar system, and the universe;**
- **To advance human exploration, use, and development of space;**
- **To research, develop, verify, and transfer advanced aeronautics, space, and space technologies.**

Outcomes of NASA's Activities

Government investment decisions on funding for space and aeronautics research and technology cannot be made knowing in advance the full benefits ("outcomes") that will accrue from making the investments. Nor can the exact timetable be known as to when these benefits will be realized. However, we can identify how the outcomes of NASA's activities contribute significantly to the achievement of America's goals in five key areas:

Economic growth and security – NASA conducts aeronautics and space research and develops technology in partnership with industry, academia, and other federal agencies to keep America capable and competitive.

Increased understanding of science and technology – NASA communicates widely the content, relevancy, and excitement of our mission and discoveries to inspire and increase the understanding and the broad application of science and technology.

Protection of the Earth's Environment – NASA studies the Earth as a planet and as a system to understand global climate change, enabling the world to address environmental issues.

Educational Excellence – NASA involves the educational community in our endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds.

Peaceful Exploration and Discovery – NASA explores the Universe to enrich human life by stimulating intellectual curiosity, opening new worlds of opportunity, and uniting nations of the world in this quest.

Annual performance goals (APGs) supporting the first three outcomes can be found in all of the Enterprises and Crosscutting Processes. APGs supporting the preservation of the environment can be found in the Earth Science Enterprise.

NASA's Fiscal Year 2003 Budget

The NASA FY 2003 budget request to OMB supports the President's commitment to support NASA's space and aeronautics program. This budget supports NASA's near-term priorities to fly the Space Shuttle safely and build the International Space Station. NASA's longer-term investments in America's future—developing more affordable, reliable means of access to space and conducting cutting-edge scientific and technological research – are also supported.

The successful execution of NASA's strategic goals and objectives is contingent on receipt of the requested appropriations, as well as the provision of funds, materials, or services which have been committed to the cooperative agreements or partnerships that are referenced in this document. The parties to these agreements include: foreign governments, other Federal Agencies or Departments, and commercial entities.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
FISCAL YEAR 2003 ESTIMATES
(IN MILLIONS OF REAL YEAR DOLLARS)
FEDERAL RETIREES COST DISTRIBUTED BY ENTERPRISE

For Display Purposes Only

	FY 2001	FY 2002 EXCLUDES EMERGENCY RESPONSE FUNDS	FY 2002 INCLUDES EMERGENCY RESPONSE FUNDS	FY 2003
HUMAN SPACE FLIGHT	**7,198.5**	**6,797.1**	**6,873.1**	**6,172.9**
INTERNATIONAL SPACE STATION	2,127.8	1,721.7	1,721.7	1,492.1
SPACE SHUTTLE	3,118.8	3,272.8	3,272.8	3,208.0
PAYLOAD & ELV SUPPORT	90.0	91.3	91.3	87.5
HEDS INVESTMENTS AND SUPPORT	1,292.8	1,181.5	1,257.5	1,220.2
SPACE COMMUNICATIONS & DATA SYSTEMS	521.7	482.2	482.2	117.5
SAFETY, MISSION ASSURANCE & ENGINEERING	47.4	47.6	47.6	47.6
SCIENCE, AERONAUTICS & TECHNOLOGY	**7,134.5**	**8,082.3**	**8,114.8**	**8,918.5**
SPACE SCIENCE	2,617.6	2,872.7	2,880.1	3,428.3
BIOLOGICAL & PHYSICAL RESEARCH	365.2	823.5	828.0	851.3
EARTH SCIENCE	1,771.2	1,631.2	1,635.7	1,639.4
AEROSPACE TECHNOLOGY	2,247.8	2,527.6	2,543.7	2,855.6
ACADEMIC PROGRAMS	132.7	227.3	227.3	143.7
INSPECTOR GENERAL	**23.9**	**24.7**	**24.7**	**25.6**
SUBTOTAL AGENCY	**14,357.2**	**14,904.2**	**15,012.7**	**15,117.0**
EMERGENCY RESPONSE FUND		**108.5**		
TOTAL AGENCY		**15,012.7**		

*FY 2001 restructured to reflect new FY 2002 Two Appropriation Structure

Fiscal Year 2003 Estimates
(In millions of Dollars)

	FY 1999	**FY 2000**	***FY 2001**	**FY 2002[1]**	**FY2003**
NASA Total Including Federal Retirees Cost			[14,357]	[15,013]	15,117
NASA Total Excluding Federal Retirees Cost	13,653	13,602	14,253	14,902	15,000
SPACE SCIENCE	2,119	2,194	2,321	2,867	3,414
EARTH SCIENCE	1,414	1,443	1,485	1,626	1,628
HUMAN EXPLORATION AND DEVELOPMENT OF SPACE**	6,345	6,302	5,973	6,830	6,131
AEROSPACE TECHNOLOGY	1,339	1,125	1,404	2,508	2,816
BIOLOGICAL & PHYSICAL RESEARCH***			313	820	842
R&PM/CoF/OIG/ACADEMIC PROGRAMS	2,436	2,538			
OIG/ACADEMIC PROGRAMS				251	169
FEDERAL RETIREES COST			[104]	[111]	117
CIVIL SERVICE FTEs******	18,469	18,375	18,711	19,005	19,050

*Reflects 9/28/01 Operating Plan

** Includes Human Space Flight, Biological & Physical Research, Mission Communications and Space Communications Services, Space Operations, and Safety, Mission Assurance & Engineering.
***Beginning in FY 2001, Biological & Physical Research is a separate Enterprise.
**** FTE's reflect total Agency including Office of Inspector General (OIG).
[1]Includes $108M for Emergency Response Fund

The mission support line in the preceding table (FY 1999 – 2001) provides funding for mission support and includes: safety, mission assurance, engineering and advanced concepts activities supporting agency programs; salaries and related expenses in support of research in NASA field installations; design, repair, rehabilitation and modification of institutional facilities and construction of new institutional facilities; and other operations activities supporting conduct of agency programs such as the OIG and Academic Programs.

NASA is making progress towards full cost management. Beginning in FY 2002, NASA is implementing a two-appropriation budget (excluding the Inspector General account). The two-appropriation budget includes Human Space Flight (HSF) and Science, Aeronautics and Technology (SAT). The budget for Mission Support and other select elements have been allocated against the Enterprises contained in the two-appropriation budget that began in FY 2002.

For informational purposes, the Enterprise sections of this plan will display: 1) Enterprise FY funding levels for FY 1999-2003 and, 2) Civil Service staffing levels assigned to each Enterprise.

Additional detail on the means and strategies for accomplishing these performance targets is included in the budget narrative sections of this document. The NASA FY 2003 Budget will be available through the NASA homepage at the following internet address: http://ifmp.nasa.gov/codeb/budget2003/

NASA's Performance Plan

The performance plan describes performance measures for program activities requested in the FY 2003 budget. FY 2003 Performance goals and objectives are defined for NASA's Strategic Enterprises and for Crosscutting Processes in the NASA Strategic Plan (NPD 1000.1b).

The FY 2003 Plan provides information on how NASA plans to verify and validate performance data. Enterprises/Crosscutting Processes also include a description of the individual means that they will use to verify and validate measured values in performance reporting. These added features are provided to communicate various approaches used in the verification and validation of performance data and to support the credibility of reported performance.

Strategic goals and objectives are provided along with annual performance goals and indicators in the introductory section for each Enterprise and Crosscutting Process. The annual performance goals and indicators used in performance tracking are integrated with the strategic goals and objectives to provide a better linkage between the Strategic Plan and the Performance Plan. This format provides greater performance context and eliminates the necessity for a separate performance table to demonstrate the linkage between the Strategic Plan and the Annual Performance Plan that was a duplicative effort.

Generate Knowledge, a crosscutting process, is central to NASA's mission and is the primary means through which we seek the answers to our fundamental questions. Based on a NASA Advisory Council recommendation, Generate Knowledge was not included in the FY 2002 Performance Plan. The NAC's recommendation was based on the potential duplication of science research metrics across the Enterprises. As a result, NASA has been exploring alternative ways to effectively communicate this performance. Beginning with FY 03, an alternative method for reporting Generate Knowledge, in lieu of using performance metrics, will be provided in the Agency Performance Report. Based on the input provided by the Committee on Science, Engineering, and Public Policy (COSEPUP) report titled *Implementing the Government Performance and Results Act for Research* (2000), NASA will take a new approach to reporting the knowledge generated by the Agency's funded research. The NASA Research Results report will be an annual compilation of research highlights and most important discoveries made possible by the Generate Knowledge process via NASA funding. This report will augment the enterprise metrics that are detailed in the Agency Performance Plan. This report will not measure performance, but will describe research products resulting from NASA investments.

In accordance with OMB Circular A-ll requirements, annual performance goals for FY 1999-2003 are displayed by Enterprise/Crosscutting Process. Multi-year formats help to demonstrate cumulative progress towards achievement of strategic goals and objectives. Each annual performance goal also has an associated color assessment to facilitate trend analysis.

The following color key is used to assess performance:

Blue: Significantly exceeded performance
Green: Achieved performance target
Yellow: Did not achieve performance target, progress was significant and achievement is anticipated within next fiscal year
Red: Failed to achieve performance target, do not anticipate completion within the next fiscal year

Each Enterprise or Crosscutting Process section continues to include a budget link table that recaps the relationship of budget account and annual performance goals. To facilitate configuration management, control numbers have been assigned to all performance targets. The numbering sequences may not be contiguous, as targets may have been dropped out as the formulation process progressed.

The Performance Evaluation Process

NASA uses a process of extensive internal and external reviews to evaluate our progress against established plans. Enterprises and functional managers conduct reviews on a periodic basis. There are regular reviews for functional management activities, such as procurement, finance, facilities, personnel, and information resources management. There are also programmatic reviews of science, engineering, and technology plans and performance. The NASA Inspector General conducts independent reviews and provides recommendations for corrective actions.

NASA has established management councils, as described in the NASA Strategic Management Handbook, which conduct internal oversight reviews. Throughout the year, Program Management Councils (PMCs) at Headquarters and the Centers assess program schedules, cost, and technical performance against established programmatic commitments. The Senior Management Council (SMC) brings together both Headquarters and Field Installation Directors to conduct assessment reviews twice a year of the progress being made in meeting the Enterprise and Crosscutting Process performance targets.
NASA's extant management review processes provide appropriate forums for internal reporting and reviewing of project and program performance data. The recent streamlining of agency processes provides confidence that new data collection and oversight processes need not be created for compliance with GPRA. Our mission oriented organizational structure and established management processes are well suited to assessment of this type of performance evaluation.

There are also significant external review processes in place. The external reviews typically begin with the peer review processes in which NASA uses panels of outside scientific experts to ensure that science research proposals are selected strictly on the merits of the planned research. This process takes into account past performance for selection and/or continued funding.
NASA requests assistance from other federal agencies to provide expert advice and council. In some cases, the organizations are advisory bodies of experts from the public and private sectors that work with NASA to establish priorities in particular scientific disciplines. For example, NASA has requested that its senior advisory body, the NASA Advisory Council (NAC), independently review NASA's annual performance. Since FY 1999, the NAC has reviewed reported performance and provided a qualitative assessment of the Agency's progress that is included in the Agency Performance Report. In other cases, reviews are conducted by organizations such as the NASA Advisory Council, the Aerospace Safety Advisory Panel, and the National Academy of Sciences, which share responsibility for oversight of the Agency.

Additionally, the General Accounting Office reviews both the Performance Plan and Performance Report in their annual report "Status of Plans for Achieving Key Outcomes and Addressing Major Management Challenges."

The use of these external reviews allows NASA to receive a report card on whether we are making the anticipated progress towards accomplishing the priorities established by the Administration, the Congress, and our advisory bodies. When necessary, these external assessments result in the revision of either implementation plans or strategic plans.

The GPRA Performance Evaluation and Report Process

For the purposes of the GPRA performance reporting process, NASA uses advisory committees as the critical input when assessing performance. These committees provide inputs on NASA's Strategic Plan, individual Enterprise Strategic Plans, and budgetary priorities. NASA furnishes program performance status information, and in turn, the committees render advice and council. NASA uses this process to generate an independent "scorecard" report on our annual performance.
NASA has historically been one of the most open federal agencies in terms of performance measurements. Public attention is drawn quickly to program successes, and particularly to program failures. Press conferences on scientific results and program technical status are commonplace. The technical measurement of program progress is a management imperative due to the heavy emphasis on development programs, and within the programs, the specific projects. Flight programs such as the International Space Station compile thousands of technical performance metrics, schedule milestones, and cost performance data.

However, the GPRA requires a heavier focus on outcome metrics rather than NASA's ubiquitous input and output metrics. Like other federal agencies engaged in science and technology, NASA has difficulty in quantifying outcomes and, especially, relating current outcomes to current fiscal expenditures. This is appropriate since NASA's development programs are multi-year in character. In some cases, past expenditures began more than a decade ago. For example, the Hubble Space Telescope that entered into development in the mid-1970's. More recently, NASA has focused on programs and projects with much shorter development periods, on the order of 3-5 years. Yet, the science outcomes are dependent on scientists analyzing the information gathered in the years after launch. Therefore, in measuring the incremental annual performance of a multi-year research or development activity, where an outcome is not realized for several years, output metrics are the most appropriate way to measure the progress towards the achievement of strategic goals and objectives.

The stated objectives of programs within NASA's Enterprises are long-term in character. Annual performance evaluations assess whether appropriate progress is being made in obtaining the scientific or technical data that was believed necessary to achieve these objectives at the time they were developed. By obtaining such information, NASA provides the outputs necessary to achieve outcomes such as answering scientific questions or implementing new aerospace technologies. However, in many cases, NASA cannot guarantee that such outcomes will be achieved since other factors outside NASA's direct control (like breakthroughs in scientific understanding or private sector investments in technology) may be required to achieve a given outcome.

It is particularly important in our view to avoid evaluating actual output performance in R&D organizations solely by counting the number of planned events for the year with the number that actually occurred. The "beancount" approach is more appropriate to a known manufacturing environment. In the high-performance, high-risk R&D environment that characterizes NASA's programs, it is inadvisable to incentivize on-time performance at the expense of safety, budget, quality, high performance and appropriate risk-taking.

NASA has worked hard to maintain the highest emphasis on safety; this value applies not only to safety of personnel but also to preservation of high value facilities, equipment, experimental hardware, and related capabilities. Quality goes hand-in-hand with safety, but extends well beyond it. For example, taking credit for completing a critical design review (CDR) for a spacecraft is only appropriate when the CDR process has been thorough, complete, and meets performance standards. Great care must be taken that quality does not suffer when contract fee incentives call for a milestone payment upon completion of the CDR. Other examples abound, and give rise to our constant vigilance to avoid rushing to launch in order to achieve a given date.

It is possible, of course, to emphasize safety and quality and achieve little of lasting significance or have the achievement take an inordinate amount of time. Building spacecraft that do not test new designs, but rely only on proven designs, is appropriate for operational, mission agencies or commercial entities. It is not the appropriate role for an R&D agency like NASA. Conducting basic and applied research involves experimentation. When exploring new methods and new technologies in these high-performance ventures, it is acceptable to take risks, to push the envelope, and to fail. The tolerance of failure puts NASA and other R&D agencies into a different category than other federal agencies involved in the delivery of services to the public. Note, however, that this does not translate into an acceptance of failures that result from taking an inappropriate level of risk. The level of appropriate risk is tailored to the environment. The distinction is critical, particularly in high-value, high-cost environments, such as human space flight, the maintenance of the Hubble Space Telescope, and the launch of research spacecraft. The risk of failure in those venues is limited by all practicable means.

Thus, output measures are best used in suitable context. For these reasons, NASA management encourages Space Shuttle program managers to set aside metrics dealing with launches planned vs. launches achieved during a given fiscal year. If by waiting, one less launch is achieved than planned, but the result is better safety or quality or enables improved performance or reduces risk, then the latter result is what NASA wants to incentivize.

NASA's Verification and Validation of Performance Data

NASA is committed to ensuring that reported performance information is valid and reliable. Data credibility is a critical element in the Agency's ability to manage for results and to be accountable for the accuracy of performance data. NASA's performance in developing and delivering products and services is evaluated at the Agency, Strategic Enterprise, functional office, program and project, crosscutting process, and individual levels. Each level has responsibility to execute requirements and to measure, evaluate, and report results. Methods and procedures for collecting this information are evaluated and validated by program managers who are responsible for data collection and reporting. As each part of the organization completes its measurement process, data are used to validate that performance meets or exceeds planned goals, objectives and performance targets. In those situations in which performance does not meet expectations, opportunities for continuous improvement are identified.

Communicating our verification and validation approaches provides greater confidence that reported performance information is credible while enhancing the usefulness of the information. In an audit of the FY 2000 Performance Report, GAO stated that NASA's validation and verification reporting efforts provided greater confidence that results were credible. Specific documentation of achievement was provided for each annual performance goal. This effort will continue as demonstrated by individual enterprise/crosscut verification and validation efforts summarized in the Plan and verification/validation/data source information by APG reported in the Report. Data sources that were used included, but were not limited to, databases used for other purposes, third-party reviews, and certification by managers and/or contractors. Changes or improvements to existing data collection and reporting systems or processes were included in the verification methodology. As appropriate, reliance upon external sources was identified in the data sources section of each target's performance. With regards to external data sources, NASA relies on the individuals responsible for the performance to validate and verify the information provided for GPRA compliance.

For the purpose of assessing NASA's overall performance, we will continue to ask our Advisory Committees to evaluate accomplishments at the Enterprise level. Their assessments not only integrate quantitative output measures but also provide balance in the context of safety, quality, high performance, and appropriate risk. The NAC evaluates annual performance for both the Enterprises and the Crosscutting Processes, assessing both actual performance and progress towards strategic goal and objective achievement. In addition, the Office of the Inspector General (OIG) has conducted validation audits of reported performance data used to support the Agency's actual results on selected performance targets to ensure that underlying performance data are accurate and reliable.

Space Science

FY 2003 Performance Plan

Mission

The mission of NASA's Space Science Enterprise is to seek the answers to three fundamental questions:

- How did the Universe begin and evolve?
- How did we get here?
- Are we alone?

While these appear to be fairly straightforward questions, their answers have eluded humankind throughout the course of history.

Perhaps for the first time since humans began pondering the cosmos and our place in it, scientists stand poised to make the breakthrough discoveries that are necessary to answer these questions. With each space science mission NASA launches to study the planets, the stars, and other celestial phenomena comes new and profound scientific discovery. Discoveries made in recent years by NASA's space science missions are rewriting textbooks and fundamentally challenging long-standing scientific thought. Space science images of our Universe – beautiful, mysterious, and even volatile – have captured the fascination of not only the science community, but of the general public worldwide. In the last year, space science images graced the covers of dozens of popular magazines and newspapers.

Enterprise Resource Requirements

The budget to support the accomplishment of Space Science goals, including the President's FY 2002 and FY 2003 requests, is as follows:

	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
NOA $M	**$2,119**	**$2,194**	**$2,321**	**$2,867**	**$3,414**
CS FTEs	**1,846**	**2,362**	**2,064**	**2,481**	**2,453**

The structure of the Space Science Performance Plan is aligned with that of the Space Science Strategic Plan. However, in addition to considering strategic significance, an important factor in the formulation of the Performance Plan is adequate coverage of the Space Science budget. The Performance Plan contains twelve annual performance goals. Nine (75%) of these goals support Strategic Plan science objectives, and involve programs that comprise approximately 73% of the Space Science budget. The other three annual performance goals support the technology and education Strategic Plan objectives, and account for the remainder of Space Science funding.

Implementation Strategy

The Space Science Enterprise Performance Plan is aligned directly with the Space Science Strategic Plan. The Strategic Plan is based on science goals and objectives with research and flight programs structured to implement these goals. The Performance Plan then measures the Enterprise's annual performance progress towards the achievement of the science goals and objectives contained in the Strategic Plan.

The Space Science Enterprise continues to use scientific merit as the primary criterion for program planning and resource commitment. Projects are not approved for implementation until a clear technology path to successful implementation is demonstrated. New technologies are applied aggressively, within the constraints of prudent stewardship of public investment.

Active participation of the research community outside NASA in planning, flight programs, research investigations, and peer review is viewed as critical to the success of the Space Science Enterprise. Collaborative efforts with other Federal agencies, such as the National Science Foundation, Department of Defense and Department of Energy, as well as with international partners, play a key role in carrying out space science research. Finally, a fundamental consideration in planning and conducting all Space Science programs is the recognition that the national investment in space science is a public trust. The Space Science Enterprise places a very high priority on sharing the results and excitement of our programs through the formal education system and public engagement. Knowledge and discoveries will be shared with the public to enhance science, mathematics, and technology education and increase the scientific and technological literacy of all Americans.

FY 2003 Performance Metrics

Strategic Plan Goal:
***Science:* Chart the evolution of the Universe, from origins to destiny, and understand its galaxies, stars, planets, and life.**

Public Benefit: Perhaps for the first time since humans began pondering the cosmos and our place in it, scientists stand poised to make the breakthrough discoveries that are necessary to answer three fundamental questions:

- How did the Universe begin and evolve?
- How did we get here?

– Are we alone?

With each space science mission NASA launches to study the planets, the stars, and other celestial phenomena comes new and profound scientific discovery.

Objective: Understand the structure of the Universe, from its earliest beginnings to its ultimate fate.

Public Benefit: One of the great quests since ancient philosophers first pondered the sky has been to understand where humanity fits within the Cosmos: What is the age of the Universe? How did it begin and how will it end? What are its primary constituents and how do they interact? NASA's pursuits in the research focus areas are intended to answer these questions.

APG 3S1: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Identify dark matter [the matter in the universe that can be inferred but not directly seen using today's astronomical techniques] and learn how it shapes galaxies and systems of galaxies.
- Determine the size, shape, age, and energy content of the Universe.

Indicators

- Demonstrate significant progress toward the goal, as determined by external expert review.
- Obtain expected data from at least 80% of operating missions supporting this goal (as identified and documented at the beginning of the fiscal year).

Objective: Explore the ultimate limits of gravity and energy in the Universe.

Public Benefit: Astronomical observations show that energy, not matter, dominated the early universe. The evolution of the Universe from the energetic chaos of the Big Bang, a universe dominated by energy, to one filled with galaxies, stars, and planets, depends on the behavior of matter, energy, and forces (the laws of nature) under conditions that can never be duplicated or tested on Earth. Using the Universe as a laboratory of extreme environments will give us insight into the fundamental processes of nature and may reveal "new physics" and new phenomena that cannot be discovered in any Earthbound laboratory.

APG 3S2: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Discover the sources of gamma ray bursts and high energy cosmic rays [two phenomena that astronomers believe are created are the most energetic events in the universe].
- Test the general theory of relativity near black holes and in the early universe, and search for new physical laws, using the universe as a laboratory.
- Reveal the nature of cosmic jets and relativistic flows. [Understand the physical mechanisms that can accelerate matter to near the speed of light, as observed in cosmic jets and other relativistic flows.]

Indicators

- Demonstrate significant progress toward the goal, as determined by external expert review.
- Obtain expected data from at least 80% of operating missions supporting this goal (as identified and documented at beginning of fiscal year).

Objective: Learn how galaxies, stars, and planets form, interact, and evolve.

Public Benefit: Life on Earth is the product of a complex sequence of events, which are not fully understood at present. This sequence begins with the birth of the galaxies and continues through the creation of heavy elements inside stars and the birth of stars and other planetary systems. To understand how life arose on Earth, and perhaps elsewhere, a complete understanding of the entire "thread of life" in the Cosmos is necessary.

APG 3S3: Earn external review rating of “green” on average, on making progress in the following research focus areas:

- Observe the formation of galaxies and determine the role of gravity in this process.
- Establish how the evolution of a galaxy and the lifecycle of stars influence the chemical composition of material available for making stars, planets, and living organisms.
- Observe the formation of planetary systems [outside our solar system] and characterize their properties.
- Use the exotic space environments within our Solar System as natural science laboratories and cross the outer boundary of the Solar System to explore the nearby environment of our galaxy. [This will advance our knowledge of the composition of material between stars from which stars and planets are formed.]

<u>Indicators</u>

- Demonstrate significant progress toward the goal, as determined by external expert review.
- Obtain expected data from at least 80% of operating missions supporting this goal (as identified and documented at beginning of fiscal year).

Objective: Look for signs of life in other planetary systems.

Public Benefit: "Are we alone?" is one of the most profound questions that humanity can ask, and its answer will affect almost every aspect of how humans view themselves and their place in the Universe.

APG 3S4: Earn external review rating of “green” on average, on making progress in the following research focus areas:

- Discover planetary systems of other stars [beyond our solar system] and their physical [and chemical] characteristics.
- Search for worlds that could or do harbor life.

<u>Indicators</u>

- Demonstrate significant progress toward the goal, as determined by external expert review.
- Obtain expected data from at least 80% of operating missions supporting this goal (as identified and documented at beginning of fiscal year).

Objective: Understand the formation and evolution of the Solar System and the Earth within it.

Public Benefit: Research shows that the Earth and all of the other bodies in the Solar System formed at about the same time from a common disk of gas and dust that surrounded the Sun. While these bodies share some similarities, there are striking differences among them. A fundamental goal of the NASA Space Science Enterprise is to understand the physical conditions and processes that led to those differences. What do these differences imply about the response of Earth’s environment to natural and manmade influences? What do they imply about the likelihood of Earth-like planets, potential habitats for life, circling other stars?

APG 3S5: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Inventory and characterize the remnants of the original material from which the Solar System formed.
- Learn why the planets in our Solar System are so different from each other.
- Learn how the Solar System evolves.

Indicators

- Demonstrate significant progress toward the goal, as determined by external expert review.
- Obtain expected data from at least 80% of operating missions supporting this goal (as identified and documented at beginning of fiscal year).

Objective: Probe the origin and evolution of life on Earth, and determine if life exists elsewhere in our Solar System.

Public Benefit: The interactions between a changing Earth, its space environment, and the origin and evolution of life are not completely known. However, what we do learn will further the understanding of the organizing principles of life and its origin and thereby guide our search for extraterrestrial life.

APG 3S6: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Investigate the origin and early evolution of life on Earth, and explore the limits of life in terrestrial environments that might provide analogues for conditions on other worlds.
- Determine the general principles governing the organization of matter into living systems and the conditions required for the emergence and maintenance of life
- Chart the distribution of life-sustaining environments within our Solar System, and search for evidence of past and present life.
- Identify plausible signatures of life on other worlds.

Indicators

- Demonstrate significant progress toward the goal, as determined by external expert review.
- Obtain expected data from at least 80% of operating missions supporting this goal (as identified and documented at beginning of fiscal year).

Objective: Understand our changing Sun and its effects throughout the Solar System.

Public Benefit: Short-term changes in the Sun's output affect life and society by causing "space weather," which can affect space assets vital to the national economy (communications, military, and weather satellites), short wave radio communications, electric power grids, and astronauts. Long-term changes in the Sun's output are also a natural drivers of global climate change and appear to have affected Earth's climate in the past.

APG 3S7: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Understand the origins of long- and short-term solar variability.
- Understand the effects of solar variability on the solar atmosphere and heliosphere.

- Understand the space environment of Earth and other planets.

  Indicators
  - Demonstrate significant progress toward the goal, as determined by external expert review.
  - Obtain expected data from at least 80% of operating missions supporting this goal (as identified and documented at beginning of fiscal year).

Objective: Chart our destiny in the Solar System.

Public Benefit: The course of life on Earth has been profoundly altered by impacts of asteroids and comets. It is widely accepted that a major impact 65 million years ago led to the extinction of dinosaurs and cleared the way for the rise of mammals. Impacts did not end in prehistoric times. In 1908, a fragment of a comet or asteroid leveled hundreds of square miles of forest in the remote Siberian region of Tunguska; had the object fallen about four hours later, it would have annihilated the city of St. Petersburg.

It is estimated that there are between 700 and 1,000 objects whose orbits cross Earth's that are large enough to cause global catastrophe if they were to strike Earth. (These are known as Near Earth Objects, or NEOs.) NASA Space Science supports the search for such NEOs. By identifying those objects that actually have a potential to collide with Earth, we expect to have decades of advance warning in which to take countermeasures, if necessary.

APG 3S8: Earn external review rating of "green," on average, on making progress in the following research focus areas:

- Understand forces and processes, such as impacts, that affect habitability of Earth.
- Develop the capability to predict space weather.
- Find extraterrestrial resources and assess the suitability of Solar System locales for future human exploration.

  Indicators
  - Demonstrate significant progress toward the goal, as determined by external expert review.
  - Obtain expected data from at least 80% of operating missions supporting this goal as identified and documented at beginning of fiscal year.

Support of Strategic Plan Science Objectives (1-8); Development/ Near-Term Future Investments

Public Benefit: NASA has been chartered by the American people to undertake challenging scientific explorations of our Solar System and the Universe beyond by building and launching missions that will achieve ambitious scientific goals. Missions in development have moved beyond study and preliminary design, and into detailed design and fabrication. Once launched and operational, the images and data they provide will advance our understanding of our Solar System and the Universe in which we live.

APG 3S9: Earn external review rating of "green" on making progress in the following area:

- Design, develop, and launch projects to support future research in pursuit of Strategic Plan science objectives.

  Indicator

  Meet no fewer than 75% of the development performance objectives for "major programs/projects," and complete a majority of performance objectives for "other projects."

Major Programs/Projects:

- Hubble Space Telescope (HST) Development: Complete thermal vacuum test of the Cosmic Origins Spectrograph (COS).
- Stratospheric Observatory for Infrared Astronomy (SOFIA) Development: Complete the SOFIA aircraft fuselage structural modification.
- Gravity Probe-B (GP-B) Development: Successful launch and check-out.
- Mars Exploration Rover ‘03 Development: Successful launch and check-out.
- Mars Reconnaissance Orbiter ’05 Development: Conduct Critical Design Review (CDR).
- Stereo Mission Development: Conduct Critical Design Review (CDR).
- Gamma-ray Large Area Space Telescope (GLAST) Development: Conduct Large Area Telescope (LAT) Critical Design Review (CDR).
- Mercury Surface, Space Environment, Geochemistry and Ranging (MESSENGER) Development: Begin spacecraft integration and test.

Other Projects:

- Swift Development: Complete instrument payload module and spacecraft integration.
- Full-sky Astrometric Mapping Explorer (FAME) Development: Begin spacecraft integration.
- Coupled Ion-Neutral Dynamics Investigations (CINDI) Development: Complete payload module.
- Deep Impact Development: Conduct Integration and Test (I&T) Readiness Review.
- Solar-B Development: Conduct the Pre-Environmental Review for the X-ray Telescope (XRT) Instrument.
- Planck Development: Complete the Cryocooler Qualification Model.
- Herschel Development: Complete Spectral and Photometric Imaging Receiver (SPIRE) Qualification Model Detectors.

Strategic Plan Goal:
Technology/Long-Term Future Investments: **Develop new technologies to enable innovative and less expensive research and flight missions.**

Objectives: Acquire new technical approaches and capabilities.
Apply and transfer technology.

Public Benefit: NASA must be a prudent steward of the taxpayers’ money by investing in essential technologies that are clearly relevant to future missions. This important principle includes consideration of the possibilities for commercialization, as well as options for using key technologies for multiple missions.

APG 3S10: Earn external review rating of “green” on making progress in the following technology development area:

- Focus (advance) technology development on a well-defined set of performance requirements covering the needs of near-term to mid-term strategic plan missions.

  Indicator

Meet no fewer than 66% of the performance objectives for technology development.

- Next Generation Space Telescope (NGST): Complete and document final analysis of Advanced Mirror System Demonstrator (AMSD) technology program.
- StarLight: Conduct System Preliminary Design Review.
- Europa Orbiter: Complete Phase 1 X-2000 hardware.
- In-Space Propulsion: Select Phase II award(s) for electric propulsion technology development.
- Future Mars Exploration: Begin Phase A studies for Mars 2007 missions.
- Future Solar Terrestrial Probes: Award Magnetospheric MultiScale (MMS) instrument contract.
- Living With a Star: Complete the Initial Confirmation Review (Phase A to Phase B transition) for the Solar Dynamics Observatory (SDO).
- Constellation-X: Complete and test the Spectroscopy X-ray Telescope (SXT) Optics Engineering Unit.
- Laser Interferometer Space Antenna (LISA): Begin Phase A studies.

Objectives: Validate new technologies in space.
Apply and transfer technology.

Public Benefit: Careful stewardship of public money requires that challenging new technologies be evaluated via cost-effective demonstration and precursor missions so that NASA's most ambitious research facilities can be reliably developed using proven technologies.

APG 3S11: Earn external review rating of "green" on making progress in the following technology validation area:

- Formulate and implement cost-effective space demonstrations of selected technologies on suitable carriers.

<u>Indicator</u>

Meet no fewer than 66% of the performance objectives for flight validation.

- Flight Validation/New Millennium Program: Conduct Space Technology 6 (ST-6) Critical Design Review (CDR).
- Flight Validation/New Millennium Program: Conduct Space Technology 7 (ST-7) Confirmation Review.
- Flight Validation/New Millennium Program: Complete Space Technology 8 (ST-8) Initial Confirmation (Phase B Downselect).

<u>Strategic Plan Goal</u>:
Education and Public Outreach: **Share the excitement and knowledge generated by scientific discovery and improve science education.**

Objectives: Share the excitement of space science discoveries with the public.
Enhance the quality of science, mathematics, and technology education, particularly at the pre-college level.
Help create our 21st Century scientific and technical workforce.

Public Benefit: Space Science Enterprise education and public outreach goals center on sharing the results of our missions and research programs with wide audiences and using space science discoveries as vehicles to improve teaching and learning at all levels. This is a deliberate expansion of the traditional role of the Enterprise in supporting graduate and postgraduate professional education, a central element of meeting our responsibility to help create the scientific workforce of the future. Our commitment to education includes a special emphasis on pre-college education and on increasing the general public's understanding and appreciation of science, mathematics, and technology.

APG 3S12: Earn external review rating of "green," on average, on making progress in the following focus areas:

- Incorporate a substantial, funded education and outreach program into every space science flight mission and research program.
- Increase the fraction of the space science community that contributes to a broad public understanding of science and is directly involved in education at the pre-college level.
- Establish strong and lasting partnerships between the space science and education communities.
- Develop a national network to identify high-leverage education and outreach opportunities and to support long-term partnerships.
- Provide ready access to the products of space science education and outreach programs.
- Promote the participation of underserved and underutilized groups in the space science program by providing new opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs.
- Develop tools for evaluating the quality and impact of space science education and outreach programs.

  Indicator

  Meet no fewer than six (75%) of the eight performance objectives for education and public outreach (E/PO).

  - Ensure that every stand-alone mission approved for development start in FY 2003 has a funded E/PO program (and preliminary E/PO plan) in place at the start of development, with a definitive E/PO plan prepared by its Critical Design Review (CDR). For cases in which E/PO is planned and implemented at the Program level (with individual missions contributing to the overall program), have a long-term program E/PO plan prepared by the end of FY 2003.
  - Increase the number of space scientists directly participating in E/PO activities by 5% over the baseline established by the E/PO Annual Report published in FY 2002.
  - Plan and/or implement Enterprise-supported E/PO activities taking place in at least forty-five states.
  - Ensure that at least thirteen Enterprise-sponsored, favorably peer-reviewed, research, mission development or operations, or education projects are underway in Historically Black Colleges and Universities, Hispanic Serving Institutions, and Tribal Colleges, with at least three being underway in an institution of each type.
  - Provide exhibits, materials, workshops, and personnel at a minimum of five national and seven regional education and outreach conferences.
  - Have at least eight Enterprise-sponsored exhibits or planetarium shows on display or on tour at major science museums or planetariums across the country.
  - Develop a comprehensive plan for the reproduction and distribution of educational products. During FY 2003, focus on defining and implementing the mechanisms for the dissemination of audiovisual and CD-based products.

- Complete a major external review of the accomplishments of the Space Science E/PO efforts over the past five years, and initiate a comprehensive study directed towards collecting evidence concerning the E/PO program's effectiveness and educational impact. Use the results of both studies to guide adjustments in program direction and content.

VERIFICATION AND VALIDATION

Internal Assessment and Verification

The Space Science program consists of numerous diverse components, and each component's performance must be assessed in an appropriate way. For some program elements, such as mission and technology development, achievement of major milestones serves as the mechanism for assessing performance. For missions in an operational phase, performance is gauged in terms of operating efficiency or major data sets returned. In each of these cases, performance data is retrieved from normal project management reporting during the course of the fiscal year, and is verified and validated by the cognizant Program Executive or Program Scientist. This performance data is also monitored and regularly reviewed at the Enterprise level to ensure that performance is accurately reported.

External Assessment and Verification

For basic research programs, evaluation must include consideration of important contextual factors such as: the relative value of the research objectives; progress toward those objectives; productivity by prevailing research community standards; and impact on related research funded or performed by other agencies. Measures such as number of grants or scientists supported, publication counts, or research citations are not able to capture these important aspects of the evaluation requirement. The best way to assess research programs has been demonstrated to be an external peer review approach. The Enterprise will employ this mechanism to qualitatively assess the progress of its programs in basic research and data analysis against Enterprise strategic plan science goals and objectives. The reviews will determine whether outcomes of these programs are fully effective, are not as strong as desired but have returned results of significant value, or are not scientifically or technologically competitive. The review process will also identify those programs that have produced important unexpected results or have contributed to an unanticipated degree to other research.

External Assessment

At the conclusion of the verification process, the performance results will be assessed by the NASA Advisory Council.

PERFORMANCE-RELATED REVIEWS

In FY 2003, the Enterprise will continue to operate under its established project management review structure, and will continue rigorous peer review of research programs.

The annual review of Enterprise education and public outreach (E&PO) activities and accomplishments will be conducted, with results published. In addition, a major external review of the accomplishments of E&PO efforts over the past five years will be completed, and a second comprehensive study, directed towards collecting evidence concerning the E/PO program's effectiveness and educational impact, will be initiated. The results of both studies will be used to guide adjustments in program direction and content.

FY 2003 MULTI-YEAR PERFORMANCE TREND

SPACE SCIENCE

Strategic Objective: Solve mysteries of the universe.

	FY99	FY00	FY01
Annual Performance Goal and APG #	Successfully launch seven spacecraft, within 10% of budget, on average. #9S1		
APG Assessment	Blue		

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	FY00	FY01
Annual Performance Goal and APG #	Measure the Hubble constant within an accuracy of about 10 percent, as compared to previous measurements that differ among themselves by a factor of two. (R&A) #9S2		
APG Assessment	Green		

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	Record 25 images and spectra at a resolution of better than an arcsecond, five to ten times sharper than images gathered earlier by the Einstein Observatory. (CXO) #9S3	The Chandra X-ray Observatory (formerly AXAF) instrument will meet nominal performance expectations, and science data will be taken with 70% efficiency, with at least 90% of science data recovered on the ground. #OS1	
APG Assessment	Green	Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	Record data on approximately 12 compact stellar objects with a sensitivity 50 times greater than the Einstein Observatory. (CXO) #9S4		
APG Assessment	Green		

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	Observe physical phenomena 25,000 times closer to the event horizon of black holes than permitted with optical wavelength measurements. (RXTE) #9S5	The baseline RXTE mission ended in 1997; the target for FY00 is to operate at least three of the five instruments at an efficiency of 45%, with 95% data recovery; All Sky Monitor data will be posted on the web within 7 days, and Proportional Counter Array and High-Energy X-ray Timing Experiment data will be released within 60 days. #OS2	
APG Assessment	Green	Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Complete final integration and test of the Gravity Probe-B science payload with the spacecraft in August 2000. #OS3	
APG Assessment		Yellow	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Successfully install and activate three key Hubble upgrades during the third servicing mission: flight computer, advanced camera, and solar arrays. Maintain an average on-target pointing efficiency of 35% during FY00 operations before they are interrupted for the third servicing mission, presently scheduled for May 2000. #OS4	
APG Assessment		Yellow	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Complete the SOFIA 747 Section 46 mockup test activity during June 2000, with no functional test discrepancies that would invalidate CDR-level designs and cause significant design rework, with attendant cost and schedule impact. #OS43	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Deliver the SIRTF Infrared Array Camera (IRAC), Multiband Imaging Photometer (MIPS), and Infrared Spectrograph (IRS) instruments during April 2000. The instruments shall perform at their specified levels at delivery. #OS5	
APG Assessment		Yellow	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Prepare the INTEGRAL Science Data Center (ISDC) for data archiving and prepare instrument analysis software for the spectrometer on INTEGRAL (SPI) instrument within 10% of estimated cost. #OS6	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Assemble and successfully test the breadboard cooler for ESA's Planck mission in April 2000. #OS7	
APG Assessment		Yellow	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Deliver the GALEX science instrument from JPL to the Space Astrophysics Laboratory at Caltech during April 2000 for science calibration. The instrument will be fully integrated, functionally tested, and environmentally qualified at the time of the scheduled delivery. #OS8	
APG Assessment		Yellow	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	FY00	FY01
Annual Performance Goal and APG #		Begin system-level environmental testing of the MAP spacecraft during July 2000. #OS9	
APG Assessment		Green	

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	FY00	FY01
Annual Performance Goal and APG #		The baseline mission of the CGRO ended in 1996; the target for FY00 is to continue to operate those instruments not dependent on expended consumables (Oriented Scintillation Spectrometer Experiment, OSSE; Burst and Transient Source Experiment, BATSE; and Imaging Compton Telescope, COMPTEL) at an average efficiency of at least 60%. #OS11	
APG Assessment		Green	

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		The 3-year FUSE mission will complete at least one-third of the observations needed for its minimum science program, with six of the eight instrument performance parameters being met. #OS12	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		The prime mission of SAMPEX ended in 1995; the FY00 target is to obtain at least 60% data coverage from at least three of SAMPEX's four instruments. #OS15	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		If launched, activate the XRS and XIS instruments on the Japanese Astro-E spacecraft after launch and collect at least 90% of the XRS and XIS data. #OS14	
APG Assessment		Red	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Complete the NGST Developmental Cryogenic Active Telescope Testbed (DCATT) phase 1, measure ambient operation with off-the-shelf components, and make final preparations for phase 2, the measurement of cold telescope operation with selected “flight-like” component upgrades. #OS53	
APG Assessment		Red	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Demonstrate performance of the Superconductor-Insulator-Superconductor (SIS) mixer to at least 8hv/k at 1,120 GHz and 10hv/k at 1,200 GHz. The U.S. contribution to the ESA FIRST is the heterodyne instrument, which contains the SIS receiver. #OS62	
APG Assessment		Yellow	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		The prototype primary instrument for GLAST will demonstrate achievement of the established instrument performance level of angular resolution of 3.5 degrees across the entire 20-MeV to 100-GeV energy range. #OS63	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Based on an overall goal of successfully launching 25 sounding rocket missions, at least 23 payloads shall successfully achieve their required altitude and orientation, and at least 21 investigators shall achieve their minimum mission success goals. #OS65	
APG Assessment		Red	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Based on an overall goal of conducting 26 worldwide science and technology demonstration balloon missions, at least 23 campaigns shall successfully achieve altitude and distance, and investigators' instrumentation shall function as planned for at least 19 missions. #OS66	
APG Assessment		Red	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			Successfully develop and launch no fewer than three of four planned missions within 10% of budget and schedule. Missions are: GALEX, MAP, GP-B, and CATSAT. (Indicators have also been established for other missions in development.) (#1S1)
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			Obtain expected scientific data from at least 80% of operating missions. Missions are: HST, CXO, XTE, ACE, FUSE, SWAS, and, if successfully launched, GALEX, and GP-B. (#1S2)
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	FY00	FY01
Annual Performance Goal and APG #			Perform innovative scientific research and technology development by meeting technology development objectives for major projects, by achieving mission success in astronomy rocket and balloon flights, and by making satisfactory research progress in related Research and Analysis (R&A) and Data Analysis (DA) programs. Meet no fewer than 66% of the performance objectives for the following technology and research programs: NGST, Herschel (FIRST), GLAST, Sounding Rockets, Balloons, and R&A. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee. (#1S3)
APG Assessment			

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

Strategic Objective: Understand the structure of the Universe, from its earliest beginnings to its ultimate fate.

	FY99	FY00	FY01
Annual Performance Goal and APG #			
APG Assessment			

	FY02	FY03	FY04
Annual Performance Goal and APG #	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Identify dark matter and learn how it shapes galaxies and systems of galaxies. • Determine the size, shape, age, and energy content of the universe. (#2S1)	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Identify dark matter and learn how it shapes galaxies and systems of galaxies. • Determine the size, shape, age, and energy content of the universe. (#3S1)	
APG Assessment			

Strategic Objective: **Explore the ultimate limits of gravity and energy in the Universe.**

	FY99	FY00	FY01
Annual Performance Goal and APG #			
APG Assessment			

	FY02	FY03	FY04
Annual Performance Goal and APG #	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Discover the sources of gamma ray bursts and high energy cosmic rays. • Test the general theory of relativity near black holes and in the early universe, and search for new physical laws, using the universe as a laboratory. • Reveal the nature of cosmic jets and relativistic flows. (#2S2)	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Discover the sources of gamma ray bursts and high energy cosmic rays [two phenomena that astronomers believe are created are the most energetic events in the universe]. • Test the general theory of relativity near black holes and in the early universe, and search for new physical laws, using the universe as a laboratory. • Reveal the nature of cosmic jets and relativistic flows. [Understand the physical mechanisms that can accelerate matter to near the speed of light, as observed in cosmic jets and other relativistic flows.] (#3S2)	
APG Assessment			

Strategic Objective: **Learn how galaxies, stars, and planets form, interact, and evolve.**

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Observe the formation of galaxies and determine the role of gravity in this process. • Establish how the evolution of a galaxy and the life cycle of stars influence the chemical composition of material available for making stars, planets, and living organisms. • Observe the formation of planetary systems and characterize their properties. • Use the exotic space environments within our Solar System as natural science laboratories and cross the outer boundary of the Solar System to explore the nearby environment of our galaxy. (#2S3)	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Observe the formation of galaxies and determine the role of gravity in this process. • Establish how the evolution of a galaxy and the life cycle of stars influence the chemical composition of material available for making stars, planets, and living organisms. • Observe the formation of planetary systems [outside our solar system] and characterize their properties. • Use the exotic space environments within our Solar System as natural science laboratories and cross the outer boundary of the Solar System to explore the nearby environment of our galaxy. [This will advance our knowledge of the composition of material between stars from which stars and planets are formed.] (#3S3)	
APG Assessment			

Strategic Objective: Explore the solar system.

	FY99	FY00	FY01
Annual Performance Goal and APG #	Orbit Eros closer than 50 kilometers, 20-30 times closer than previous asteroid flybys. (NEAR) #9S6	NEAR will successfully orbit 433 Eros and meet primary scientific objectives while not exceeding projected mission cost by more than 10%. #OS16	
APG Assessment	Yellow	Green	

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	FY00	FY01
Annual Performance Goal and APG #	Measure the shape of Eros to an accuracy of 1 kilometer or better, about 10 times better than previous measurements, and measure the asteroid's mass to an accuracy of 20 percent. (NEAR) #9S7		
APG Assessment	Green		

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	Complete the first direct compositional measurements of an asteroid. (NEAR) #9S8		
APG Assessment	Yellow		

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	Map the 75 to 80 percent of the Moon's surface not accessible during the Apollo missions conducted from 1969 to 1972. (Lunar Prospector) #9S9		
APG Assessment	Green		

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	Provide definitive measurements of the weak lunar magnetic field. (Lunar Prospector) #9S10		
APG Assessment	Green		

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	Provide data with spatial resolution five times better than were collected from the Yohkoh Soft X-ray Telescope. (TRACE) #9S11 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	Collect pixel-limited images in all Transition Region and Coronal Explorer (TRACE) wavelength bands, operating 24-hour schedules for sustained periods over eight months. #OS17 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment	Green	Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Deliver the Mars '01 Orbiter and Lander science instruments that meet capability requirements by June 1, 2000; prelaunch Gamma Ray Spectrometer (GRS) tests shall determine abundances in known calibration sources to 10% accuracy. #OS29	
APG Assessment		Yellow	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Assuming the Mars Surveyor program architecture is confirmed, meet the milestones for the Mars 03 instrument selection and initiate implementation of the Lander mission. Deliver engineering models of the radio-frequency subsystem and antennae for the radar sounder instrument to ESA (if ESA approves the Mars Express mission), and select the contractors for the major system elements of the Mars Surveyor 05 mission. #OS30	
APG Assessment		Yellow	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	FY00	FY01
Annual Performance Goal and APG #		The Rosetta project will deliver the electrical qualification models for the four U.S.-provided instruments to ESA in May 2000 for integration with the Rosetta Orbiter. #OS20	
APG Assessment		Green	

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	FY00	FY01
Annual Performance Goal and APG #		The TIMED mission will be delivered on time for a planned May 2000 launch, within 10% of the planned development budget. #OS18 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Yellow	

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		If successfully launched, the TIMED mission will acquire global data in the mesosphere and lower thermosphere/ionosphere region globally (all the latitudes) for at least 90 days at the required spatial resolution, coverage, and accuracy and for all local solar times. #OS19 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Yellow	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Complete the development of the Cluster-II instrument analysis software for the one U.S. and five U.S.-partnered instruments before launch and, if launch occurs in FY00, activate and verify the wideband data and U.S. subcomponents after launch. #OS21 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		HESSI will be delivered in time for a planned July 2000 launch, within 10% of the planned development budget. #OS22 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Yellow	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Assuming launch and normal checkout, HESSI operations will return data to achieve at least the primary science objectives, with at least 80% coverage of the time allowed by orbit. #OS23 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Yellow	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Deliver to the Los Alamos National Laboratory in March 2000 all components for system integration and testing of the first flight system for the TWINS mission. #OS25 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		IMAGE will be delivered on time for a planned February 2000 launch and within 10% of the planned development budget. #OS26 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		If launched, IMAGE will acquire critical measurements at minute time scales, returning 85% real-time coverage of Earth's magnetospheric changes. #OS27 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Select two Small Explorer (SMEX) missions and release a University Explorer (UNEX) Announcement of Opportunity (AO). #OS28 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Red	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Acquire calibrated observational data from the Japanese Yohkoh high-energy solar physics mission (including the U.S.-provided SXT) for at least 75% of the time permitted by tracking coverage. #OS24 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	FY00	FY01
Annual Performance Goal and APG #		Complete Genesis spacecraft assembly and start functional testing in November 1999. #OS31	
APG Assessment		Green	

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Release an AO for the next Discovery mission. #OS32	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Successfully complete the breadboard of the imager instrument for CONTOUR and award the contract for the propulsion system after a PDR that confirms the design and maintains 15% margins for mass and power. #OS42	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		The baseline Galileo mission ended in 1997; the target for FY00 is to recover at least 90% of playback data from at least one Galileo flyby of Io. #OS45	
APG Assessment		Blue	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		The Mars Climate Orbiter (MCO) will aerobrake from its initial insertion orbit into a near-polar, Sun-synchronous, approximately 400-km circular orbit and will initiate mapping operations no later than May 2000, acquiring 70% of the available science data and relaying to Earth 70% of the data transmitted at adequate signal levels by the Mars Polar Lander (MPL). #OS40	
APG Assessment		Red	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		MPL will successfully land on Mars in December 1999 and operate its science instruments for the 80-day prime mission with at least 75% of planned science data returned. #OS41	
APG Assessment		Red	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		The Mars Global Surveyor (MGS) will acquire 70% of science data available, conduct at least two five-day atmospheric mapping campaigns, and relay to Earth at least 70% of data transmitted at adequate signal levels by the Deep Space-2 Mars microprobes. #OS46 *(Also shown below, under "Mars, the Moon, and small bodies.")*	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Collect 85% of data acquired from the International Solar-Terrestrial Physics Program (ISTP) spacecraft and successfully execute the WIND trajectory plan. #OS33 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Cassini: Continue operations during the quiescent cruise phase without major anomalies, conduct planning for the Jupiter gravity-assist flyby, and explore early science data collection opportunities. The following in-flight activities will be completed: Instrument Checkout #2; uplink Articulation and Attitude Control Subsystem (AACS) software update with Reaction Wheel Authority capability; Command and Data Subsystem Version 8; and Saturn tour designs for selection by the Program Science Group. #OS34	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Capture at least 90% of available Ulysses science data. These will be the only data observed from outside-of-the-ecliptic plane. #OS35 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Average 12 hours of Voyager Interstellar Mission data capture per day per spacecraft to characterize the heliosphere and the heliospheric processes at work in the outer solar system as well as the transition from the solar system to interstellar space. #OS36 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Yellow	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	FY00	FY01
Annual Performance Goal and APG #		Stardust: Continue spacecraft cruise operations without major anomalies and perform interstellar dust collection for at least 36 days. #OS37	
APG Assessment		Green	

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		FAST will return simultaneous data from high-latitude, low-altitude magnetosphere locations in the Sun-Earth connected system through solar maximum at the required resolution and accuracy with at least 85% efficiency. #OS38 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	FY00	FY01
Annual Performance Goal and APG #		Collect and process data from the Interplanetary Monitoring Platform (IMP-8, launched in 1973), making data from at least six instruments available within 15 months and the magnetic field and plasma data available within 2 months. #OS39 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Green	

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		ACE will: measure the composition and energy spectra of heavy nuclei in at least eight solar energetic particle events; maintain real-time solar wind data transmissions at least 90% of the time; measure the isotopic composition of a majority of the "primary" galactic cosmic ray elements from carbon to zinc; and provide browse parameters within three days for 90% of the year. #OS48 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective includes missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Complete the system CDR for the New Millennium Deep Space-4 (Champollion) project before the end of FY00, including successful completion of the avionics subsystem CDR and the mechanical subsystem CDR. #OS47	
APG Assessment		Red	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		The Advanced Radioactive Power Source (ARPS), which is a partnership with the Department of Energy to develop small, robust, highly efficient radioisotope power sources, will accomplish the following five objectives on time and within budget in 2000: fabricate and test 15 prototype AMTEC cells by January; complete the final design of the AMTEC cells by March; complete the final design for a 75-watt ARPS by April; begin the prototype AMTEC four-cell lifetime test by April; and begin qualification unit fabrication by September. #OS58	
APG Assessment		Red	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Complete and deliver for testing Solar-B's four Electrical Engineering Models in September 2000. #OS60 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Yellow	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Complete STEREO Phase A studies by June 2000, including the release of an AO for investigations with specific instruments and selection of the formulation phase payload. #OS61 *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*	
APG Assessment		Yellow	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Successfully complete a preliminary design for either the Europa Orbiter or Pluto-Kuiper Express mission (whichever is planned for earlier launch) that is shown to be capable of achieving the Category 1A science objectives with adequate cost, mass, power, and other engineering margins. #OS64	
APG Assessment		Red	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		The first engineering model (EM-1) of the X2000 First Delivery will be delivered in September 2000. Successful development includes the integration of all EM-1 hardware, the functional verification of delivered hardware and software, and the ability to support ongoing testing, hardware integration, and software verification for delivered software. #OS70	
APG Assessment		Red	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			Successfully develop and launch no fewer than one of two missions within 10% of budget and schedule. Missions are: Mars Odyssey ('01 Orbiter) and Genesis. (Indicators have also been established for other projects in development.) (#1S4)
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			Obtain expected scientific data from at least 80% of operating missions. Missions are: Cassini, Voyager, Ulysses, SAMPEX, FAST, TRACE, Stardust, Mars Global Surveyor, and ISTP spacecraft; also, if successfully launched, TIMED, HESSI, IMAGE, Genesis, and Mars Odyssey ('01 Orbiter). (#1S5) *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			Perform innovative scientific research and technology development by meeting technology development objectives for major projects, by achieving mission success in space physics rocket and balloon flights, and by making satisfactory research progress in related R&A and DA programs. Meet no fewer than 66% of the performance objectives for the following technology and research programs: Solar-B, STEREO, Solar Probe, Future Solar Terrestrial Probes, Future Deep Space Technology, CISM, X2000, Sounding Rockets, and Balloons. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee. (#1S6) *Note: In performance plans prior to FY02, the "Explore the Solar System" objective included missions to increase our understanding of the Sun and its effects on the Earth.*
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

<u>Strategic Objective</u>: Understand the formation and evolution of the Solar System and the Earth within it.

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Inventory and characterize the remnants of the original material from which the Solar System formed. • Learn why the planets in our Solar System are so different from each other. • Learn how the Solar System evolves. (#2S5)	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Inventory and characterize the remnants of the original material from which the Solar System formed. • Learn why the planets in our Solar System are so different from each other. • Learn how the Solar System evolves. (#3S5)	
APG Assessment			

<u>Strategic Objective</u>: Probe the evolution of life on Earth, and determine if life exists elsewhere in our Solar System.

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Investigate the origin and early evolution of life on Earth, and explore the limits of life in terrestrial environments that might provide analogues for conditions on other worlds. • Determine the general principles governing the organization of matter into living systems and the conditions required for the emergence and maintenance of life • Chart the distribution of life-sustaining environments within our Solar System, and search for evidence of past and present life. • Identify plausible signatures of life on other worlds. (#2S6)	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Investigate the origin and early evolution of life on Earth, and explore the limits of life in terrestrial environments that might provide analogues for conditions on other worlds. • Determine the general principles governing the organization of matter into living systems and the conditions required for the emergence and maintenance of life • Chart the distribution of life-sustaining environments within our Solar System, and search for evidence of past and present life. • Identify plausible signatures of life on other worlds. (#3S6)	
APG Assessment			

<u>Strategic Objective</u>: Understand our changing Sun and its effects throughout the Solar System.

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Understand the origins of long- and short-term solar variability. • Understand the effects of solar variability on the solar atmosphere and heliosphere. • Understand the space environment of Earth and other planets. (#2S7)	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Understand the origins of long- and short-term solar variability. • Understand the effects of solar variability on the solar atmosphere and heliosphere. • Understand the space environment of Earth and other planets. (#3S7)	
APG Assessment			

<u>Strategic Objective</u>: Chart our destiny in the Solar System.

	<u>FY99</u>	**<u>FY00</u>**	**<u>FY01</u>**
Annual Performance Goal and APG #			
APG Assessment			

	<u>FY02</u>	**<u>FY03</u>**	**<u>FY04</u>**
Annual Performance Goal and APG #	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Understand forces and processes, such as impacts, that affect habitability of Earth. • Develop the capability to predict space weather. • Find extraterrestrial resources and assess the suitability of Solar System locales for future human exploration. (#2S8)	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Understand forces and processes, such as impacts, that affect habitability of Earth. • Develop the capability to predict space weather. • Find extraterrestrial resources and assess the suitability of Solar System locales for future human exploration. (#3S8)	
APG Assessment			

<u>Strategic Objective</u>: Discover planets around other stars.

	FY99	FY00	FY01
Annual Performance Goal and APG #	Assemble and lab-test the interferometer beam combiner. This state-of-the-art system will approximately double observational efficiency by using a new approach to fringe detection. (Keck) #9S12	Development of the interferometer program for connecting the twin Keck 10-meter telescopes with an array of four two-meter class outrigger telescopes will be tested by detecting and tracking fringes with two test siderostats at two- and ten-micron wavelengths. #OS55	
APG Assessment	Green	Yellow	

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		The Space Interferometry Mission (SIM) System Testbed (STB) will demonstrate, in May 2000, that an rms optical path difference can be controlled at 1.5 nanometers, operating in an emulated on-orbit mode. #OS52	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Complete and deliver a technology development plan for the Terrestrial Planet Finder (TPF) mission by June 2000. This infrared interferometer mission is projected for a 2010 launch and requires the definition of technologies that will not be developed or demonstrated by precursor missions. #OS54	
APG Assessment		Red	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			Perform innovative scientific research and technology development by meeting interferometry technology development objectives and by making satisfactory research progress in related R&A programs. Meet no fewer than 66% of the performance objectives for SIM, TPF, ST-3, Keck, and R&A. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee. (#1S7)
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

Strategic Objective: **Look for signs of life in other planetary systems.**

	FY99	FY00	FY01
Annual Performance Goal and APG #			
APG Assessment			

	FY02	FY03	FY04
Annual Performance Goal and APG #	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Discover planetary systems of other stars and their physical characteristics. • Search for worlds that could or do harbor life. (#2S4)	Earn external review rating of "green," on average, on making progress in the following research focus areas: • Discover planetary systems of other stars and their physical characteristics. • Search for worlds that could or do harbor life. (#3S4)	
APG Assessment			

<u>Strategic Objective</u>: Search for life beyond Earth.

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	Successfully complete and receive scientific data from at least 8 of 10 planned data-taking encounters with Europa. #9S13 (Galileo)		
APG Assessment	Green	Blue	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	Bring the total mapping coverage to about 1 percent of the surface at about 30-meter resolution, and multispectral coverage distributed over 50 percent of the surface at lower resolution. #9S14 (Galileo coverage of Jupiter's moon Europa)		
APG Assessment	Green		

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	Initiate Institute operations by linking up to 8 institutions and engaging approximately 50 investigators. #9S17 (Astrobiology Institute)		
APG Assessment	Green		

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		The Europa Orbiter project will successfully complete a PDR in March 2000 and will begin the integration and test of the Avionics Engineering Model in July 2000. #OS56	
APG Assessment		Red	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			Perform innovative scientific research and technology development by meeting technology development objectives and by making satisfactory research progress in the related R&A program, including the Astrobiology program. Meet no fewer than two of the three performance objectives for Europa Orbiter, Astrobiology, and R&A. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee. (#1S8)
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			Advance the search for life beyond Earth by successfully launching a Mars mission, by obtaining data from operational spacecraft, and by performing innovative technology development. Meet no fewer than two of the three performance objectives for Mars Odyssey ('01 Orbiter), Mars Global Surveyor, and Terrestrial Planet Finder. (#1S14)
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

Strategic Objective: Investigate the composition, evolution, and resources on Mars, the Moon, and small bodies.

	FY99	FY00	FY01
Annual Performance Goal and APG #	Achieve the final science orbit. #9S15 (Mars Global Surveyor)		
APG Assessment	Green		

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	FY00	FY01
Annual Performance Goal and APG #	Measure the topography with 10-meter precision, about 100 times more accurate than previous measurements. #9S19 (Mars Global Surveyor)		
APG Assessment	Blue		

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	Provide high-resolution 1.5-meter imaging data, 10 times more detailed than the best imaging from the 1976 Viking mission. #9S20 (Mars Global Surveyor)		
APG Assessment	Green		

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	Provide the first thermal infrared spectrometry of the planet. #9S21 (Mars Global Surveyor)		
APG Assessment	Green		

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			Investigate the composition, evolution, and resources of Mars, the Moon, and small bodies by successfully launching a Mars mission, by obtaining data from operational spacecraft, and by making satisfactory progress in related R&A and DA programs. Meet no fewer than 75% of the performance objectives for Mars Odyssey ('01 Orbiter), CONTOUR, Mars Global Surveyor, and R&A. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee. (#1S10)
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

<u>Strategic Objective</u>: Improve the reliability of space weather forecasting.

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	Achieve complete coverage (maximum and minimum) of the solar cycle, an increase from 35 percent. #9S22 (Space Physics fleet of spacecraft)	*(Refer to Space Physics spacecraft targets under "Explore the Solar System." These include SAMPEX, TRACE, TIMED, HESSI, TWINS, IMAGE, Yohkoh, ISTP, WIND, Ulysses, Voyager, FAST, IMP-8, ACE, Solar-B, and STEREO.)*	
APG Assessment	Green		

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			Develop the knowledge to improve the reliability of space weather forecasting by obtaining scientific data from three of five missions and by making satisfactory progress in related areas in R&A and DA programs. Meet no fewer than 75% of the performance objectives for R&A, ACE, SAMPEX, TRACE, ISTP, and, if successfully launched, HESSI. Achieve a "fully effective" (green) overall science achievement rating from the Space Science external advisory committee. (#1S11)
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			Further understanding of basic natural processes and the effects of solar variability on humans and technology. Meet no fewer than two of the three performance objectives for: Strategic Plan Development, Solar Dynamics Observatory, and Research and Data Analysis. Achieve a "fully effective' (green) overall science achievement rating from the Space Science external advisory committee. (#1S13)
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

Strategic Objective: **Develop innovative technologies for Enterprise missions and external customers.**

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	Demonstrate an improvement in measurement precision for optical path lengths in laser light to the 100-picometer (million-millionths of a meter) range. #9S24 (Micro-Arcsecond Metrology Testbed)		
APG Assessment	Yellow		

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	Demonstrate an advanced robotic manipulator with an order of magnitude performance improvement compared to the manipulator used on Viking in 1976. #9S25 (Robotic Manipulator, Mars Polar Lander)		
APG Assessment	Green		

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	FY00	FY01
Annual Performance Goal and APG #		Information Systems R&T will demonstrate the search, discovery, and fusion of multiple data products at a major science meeting. Accomplish and document the infusion of five information systems R&T efforts into flight projects or the broad research community. Space science data services shall be acknowledged as enabling for two interdisciplinary collaborations. #OS49	
APG Assessment		Green	

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	FY00	FY01
Annual Performance Goal and APG #		The Remote Exploration and Experimentation element of the HPCC program will demonstrate software-implemented fault tolerance for science teams' applications on a first-generation embedded computing testbed, with the applications' sustained performance degraded by no more than 25% at fault rates characteristic of deep space and low-Earth orbit. #OS50	
APG Assessment		Yellow	

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		In April 2000, the Center for Integrated Space Microelectronics will deliver to the X2000 First Delivery project -- the first engineering model of an integrated avionics system that includes the functionality of command and data handling, attitude control, power management and distribution, and science payload interface. The system will be used on the Europa Orbiter and other missions. #OS57	
APG Assessment		Red	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

Strategic Objective: **Develop new technologies needed to carry out innovative and less costly mission and research concepts.**

	FY99	FY00	FY01
Annual Performance Goal and APG #			Plan, develop, and validate new technologies needed to enable future research and flight missions by achieving performance objectives in the space science core technology programs and by making progress as planned in the Flight Validation program. Meet no fewer than 66% of the performance objectives for Information Systems, High Performance Computing, Explorer Program Technology, and Flight Validation. (#1S12)
APG Assessment			

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

<u>Strategic Objective:</u> Acquire new technical approaches and capabilities. Validate new spacecraft capabilities in space. Apply and transfer technology.

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #	Earn external review rating of "green" on making progress in the following technology development area: • Focus technology development on a well-defined set of performance requirements covering the needs of near-term to mid-term strategic plan missions. (#2S10)	Earn external review rating of "green" on making progress in the following technology development area: • Focus (advance) technology development on a well-defined set of performance requirements covering the needs of near-term to mid-term strategic plan missions. (#3S10)	
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #	Earn external review rating of "green" on making progress in the following technology validation area: • Formulate and implement cost-effective space demonstrations of selected technologies on suitable carriers. (#2S11)	Earn external review rating of "green" on making progress in the following technology validation area: • Formulate and implement cost-effective space demonstrations of selected technologies on suitable carriers. (#3S11)	
APG Assessment			

Strategic Objective: **Incorporate education and enhanced public understanding of science as integral components of space science missions and research.**

	FY99	FY00	FY01
Annual Performance Goal and APG #	Account for 4 percent of the 150 "most important science stories" in the annual review by *Science News*. #9S26		
APG Assessment	Green		

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	FY00	FY01
Annual Performance Goal and APG #	Account for no less than 25 percent of total contributions to the college textbook *Astronomy: From the Earth to the Universe*. #9S27		
APG Assessment	Green		

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	FY00	FY01
Annual Performance Goal and APG #	Each new Space Science Enterprise mission initiated in FY 1999 will have a funded education and outreach program. #9S28		
APG Assessment	Green		

	FY02	FY03	FY04
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #	The Space Science Enterprise will complete an organized network of contacts by the end of FY 1999 to work with educators and space scientists to formulate and implement space science education and outreach programs. This network will be available to every state in the United States. #9S29	Successful achievement of at least seven of the following eight objectives will be made. (1) Each new Space Science mission will have a funded education and outreach program. (2) By the end of FY00, 10% of all Space Science research grants will have an associated education and outreach program under way. (3) Twenty-six states will have Enterprise-funded education or outreach programs planned or underway. (4) At least five research, mission development/operations, or education programs will have been planned/undertaken in Historically Black Colleges and Universities, Hispanic Serving Institutions, or Tribal Colleges, with at least one project underway in each group. (5) At least three national and two regional educational or outreach conferences will be supported with a significant Space Science presence. (6) At least three exhibits or planetarium shows will be on display. (7) An online directory providing enhanced access to major Space Science-related products and programs will be operational by end of the fiscal year. (8) A comprehensive approach to assessing the effectiveness and impact of the Space Science education and outreach efforts will be under development, with a pilot test of the evaluation initiated. #OS67	
APG Assessment	Green	Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

<u>Strategic Objective</u>: Make education and enhanced public understanding of science an integral part of our missions and research.

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			Continue and expand the integration of education and enhanced public understanding of science with Enterprise research and flight mission programs. Meet no fewer than 75% of the eight performance objectives for education and public outreach. (#1S9)
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

<u>Strategic Objective</u>: Share the excitement of space science discoveries with the public. Enhance the quality of science, mathematics, and technology education, particularly at the pre-college level. Help create our 21st Century scientific and technical workforce.

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			
APG Assessment			

	FY02	FY03	FY04
Annual Performance Goal and APG #	Earn external review rating of "green," on average, on making progress in the following focus areas: • Incorporate a substantial, funded education and outreach program into every space science flight mission and research program. • Increase the fraction of the space science community that contributes to a broad public understanding of science and is directly involved in education at the pre-college level. • Establish strong and lasting partnerships between the space science and education communities. • Develop a national network to identify high-leverage education and outreach opportunities and to support long-term partnerships. • Provide ready access to the products of space science education and outreach programs. • Promote the participation of underserved and underutilized groups in the space science program by providing new opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs. • Develop tools for evaluating the quality and impact of space science education and outreach programs. (#2S12)	Earn external review rating of "green," on average, on making progress in the following focus areas: • Incorporate a substantial, funded education and outreach program into every space science flight mission and research program. • Increase the fraction of the space science community that contributes to a broad public understanding of science and is directly involved in education at the pre-college level. • Establish strong and lasting partnerships between the space science and education communities. • Develop a national network to identify high-leverage education and outreach opportunities and to support long-term partnerships. • Provide ready access to the products of space science education and outreach programs. • Promote the participation of underserved and underutilized groups in the space science program by providing new opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs. • Develop tools for evaluating the quality and impact of space science education and outreach programs. (#3S12)	
APG Assessment			

<u>Strategic Objective</u>: Multi-theme / support all objectives.

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Conduct research and analysis. #OS68	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #		Conduct data analysis. #OS69	
APG Assessment		Green	

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #			
APG Assessment			

<u>Strategic Objective</u>: Support of Strategic Plan Science Objectives*; Development/ Near-Term Future Investments

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG #			
APG Assessment			

	FY02	**FY03**	**FY04**
Annual Performance Goal and APG #	Earn external review rating of “green” on making progress in the following area: • Design, develop, and launch projects to support future research in pursuit of Strategic Plan science objectives. (#2S9)	Earn external review rating of “green” on making progress in the following area: • Design, develop, and launch projects to support future research in pursuit of Strategic Plan science objectives. (#3S9) (The Strategic Plan science objectives are detailed in Annual Performance Goals 3S1 through 3S9.)	
APG Assessment			

***Supports Strategic Plan Science Objectives:**

Understand the structure of the Universe, from its earliest beginnings to its ultimate fate.
Explore the ultimate limits of gravity and energy in the Universe.
Learn how galaxies, stars, and planets form, interact, and evolve.
Look for signs of life in other planetary systems.
Understand the formation and evolution of the Solar System and the Earth within it.
Probe the origin and evolution of life on Earth, and determine if life exists elsewhere in our Solar System.
Understand our changing Sun and its effects throughout the Solar System.
Chart our destiny in the Solar System.

Space Science Enterprise
FY 2003 Budget Link Table

Annual Performance Goal & APG #	**Budget Category**	HST Development	GP-B	SOFIA	STEREO	GLAST	Payloads	Explorers	Discovery	Mars Exploration	Operating Missions	Technology Program	Research Program
Earn external review rating of “green,” on average, on making progress in the following research focus areas: (1) Identify dark matter and learn how it shapes galaxies and systems of galaxies. (2) Determine the size, shape, age, and energy content of the universe. APG #3S1											X		X
Earn external review rating of “green,” on average, on making progress in the following research focus areas: (1) Discover the sources of gamma ray bursts and high energy cosmic rays. (2) Test the general theory of relativity near black holes and in the early universe, and search for new physical laws using the universe as a laboratory. (3) Reveal the nature of cosmic jets and relativistic flows. APG #3S2											X		X
Earn external review rating of “green,” on average, on making progress in the following research focus areas: (1) Observe the formation of galaxies and determine the role of gravity in this process. (2) Establish how the evolution of a galaxy and the life cycle of stars influence the chemical composition of material available for making stars, planets, and living organisms. (3) Observe the formation of planetary systems [outside our solar system] and characterize their properties. (4) Use the exotic space environments within our Solar System as natural science laboratories and cross the outer boundary of the Solar System to explore the nearby environment of our galaxy. APG #3S3											X		X
Earn external review rating of “green,” on average, on making progress in the following research focus areas: (1) Discover planetary systems [beyond our solar system] of other stars and their physical characteristics. (2) Search for worlds that could or do harbor life. APG #3S4											X		X

Space Science Enterprise
FY 2003 Budget Link Table

	Budget Category	HST Development	GP-B	SOFIA	STEREO	GLAST	Payloads	Explorers	Discovery	Mars Exploration	Operating Missions	Technology Program	Research Program
Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Inventory and characterize the remnants of the original material from which the Solar System formed. (2) Learn why the planets in our Solar System are so different from each other. (3) Learn how the Solar System evolves. APG #3S5											X		X
Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Investigate the origin and early evolution of life on Earth, and explore the limits of life in terrestrial environments that might provide analogues for conditions on other worlds. (2) Determine the general principles governing the organization of matter into living systems and the conditions required for the emergence and maintenance of life. (3) Chart the distribution of life-sustaining environments within our Solar System, and search for evidence of past and present life. (4) Identify plausible signatures of life on other worlds. APG #3S6											X		X
Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Understand the origins of long- and short-term solar variability. (2) Understand the effects of solar variability on the solar atmosphere and heliosphere. (3) Understand the space environment of Earth and other planets. APG #3S7											X		X
Earn external review rating of "green," on average, on making progress in the following research focus areas: (1) Understand forces and processes, such as impacts, that affect habitability of Earth. (2) Develop the capability to predict space weather. (3) Find extraterrestrial resources and assess the suitability of Solar System locales for future human exploration. APG #3S8											X		X
Earn external review rating of "green" on making progress in the following area: Design, develop, and launch projects to support future research in pursuit of Strategic Plan science objectives. APG #3S9		X	X	X	X	X	X	X	X	X			

Space Science Enterprise **FY 2003 Budget Link Table**	**Budget Category**	HST Development	GP-B	SOFIA	STEREO	GLAST	Payloads	Explorers	Discovery	Mars Exploration	Operating Missions	Technology Program	Research Program
Earn external review rating of “green” on making progress in the following technology development area: Focus (advance) technology development on a well-defined set of performance requirements covering the needs of near-term to mid-term strategic plan missions. APG #3S10												X	
Earn external review rating of “green” on making progress in the following technology validation area: Formulate and implement cost-effective space demonstrations of selected technologies on suitable carriers. APG #3S11												X	
Earn external review rating of “green,” on average, on making progress in the following focus areas: (1) Incorporate a substantial, funded education and outreach program into every space science flight mission and research program. (2) Increase the fraction of the space science community that contributes to a broad public understanding of science and is directly involved in education at the pre-college level. (3) Establish strong and lasting partnerships between the space science and education communities. (4) Develop a national network to identify high-leverage education and outreach opportunities and to support long-term partnerships. (5) Provide ready access to the products of space science education and outreach programs. (6) Promote the participation of underserved and underutilized groups in the space science program by providing new opportunities for minorities and minority universities to compete for and participate in space science missions, research, and education programs. (7) Develop tools for evaluating the quality and impact of space science education and outreach programs. APG #3S12		X	X	X	X	X	X	X	X	X	X	X	X

Earth Science

FY 2003 Performance Plan

Prologue

The mission of NASA's Earth Science Enterprise (ESE) is to develop a scientific understanding of the Earth system and its response to natural and human-induced changes to enable improved prediction of climate, weather, and natural hazards for present and future generations. NASA brings to this endeavor the vantage point of space, allowing global views of Earth system change. NASA is a provider of objective scientific information, via observation, research, modeling, and applications demonstration, for use by decision-makers in both the public and private sectors. NASA has been studying the Earth from space since inception as an agency. These efforts have led to current and future generations of national weather satellites, and the first series of comprehensive Earth Observing System (EOS) satellites that will concurrently observe for the first time the major interactions of the land, oceans, atmosphere, ice, and life that comprise the Earth system.

We know that natural and human-induced changes are acting on the Earth system. Natural forces include, but are not limited to, variation in the Sun's energy output, and volcanic eruptions, which spew dust into the atmosphere and scatter incoming sunlight. Human forces include deforestation, carbon emission from burning of fossil fuels, methane and soil dust production from agriculture, and ozone depletion by various industrial chemicals. Internal climate factors such as atmospheric water vapor and clouds also introduce feedbacks that serve to either dampen or enhance the strength of climate forcing. We also know the climate system exhibits considerable variability in time and space, i.e., both short and long term changes and regionally specific impacts.

NASA introduced the concept of Earth System Science to promote total understanding of how Earth's atmosphere, biosphere, oceans, and continents shape Earth's climate and its variations. Researchers have constructed computer models to simulate the Earth system, and to explore the possible outcomes of potential changes they introduce in the models. This way of looking at the Earth as a system is a powerful means of understanding changes we see around us. That has two implications for Earth Science. First, we need to ***characterize*** (that is, identify and measure) the forces acting on the Earth system and its responses. Second, we have to ***understand*** the sources of Earth's internal variability: the complex interplay among atmosphere, oceans, continents, and life that comprise the system.

Earth system changes are global phenomena. Yet the system comprises many micro-scale processes and the most significant manifestations are regional. Thus, studying such changes requires a global view at regionally discerning resolutions. This is where NASA comes in, bringing the unique capability to study planet Earth from the vantage point of space. By combining observations, research and modeling, we create a capability to ***predict*** Earth system change to help our partners produce better forecasts of change.

To ***characterize*** the forces acting on the Earth system and its responses, ***understand*** the source of internal variability and ***predict*** Earth system change, NASA must observe the Earth, conduct research and analysis of the data, model the data and synthesize the information into new knowledge. Where we are on this knowledge "life cycle" determines the strategy for our investment decisions.

Implementation Strategy

The baseline ESE program is pursuing a targeted research program, focused on a set of specific science questions that can be addressed effectively with NASA's capabilities. ESE formulates comprehensive research strategies that can lead to definitive scientific answers and to effective applications for the nation.

The key Earth Science research topics sponsored by NASA fall largely into three categories: forcings, responses, and the processes that link the two and provide feedback mechanisms. This conceptual approach applies in essence to all research areas of NASA's Earth Science program, although it is particularly relevant to the problem of climate change, a major Earth Science-related challenge facing our nation and the rest of the world. The ESE has articulated an overarching question and a set of strategic science questions which its observational programs, research and analysis, modeling, and advanced technology activities are directed at answering.

How is the Earth system changing, and what are the consequences for life on Earth?

How is the global Earth system changing?

What are the primary causes of change in the Earth system?

How does the Earth system respond to natural and human-induced changes?

What are the consequences of changes in the Earth system for human civilization?

How can we predict future changes in the Earth system?

In this and subsequent Performance Plans, NASA's annual results in Earth Science will be measured in terms of progress made toward answering these questions. Accordingly, the assessment of performance against the first strategic goal is structured in the form of key questions whose answers are provided by the ongoing mission of NASA's Earth Science program. While these questions will be answered over a period greater than a single year, the general nature of activities in FY 2003 continues to focus on completion of the first EOS satellite series and characterization of the forces acting on the Earth system and its responses. For subsequent plans starting in FY 2004, the Enterprise is developing a set of detailed roadmaps which define the program elements required to achieve answers to these questions and the timing of their achievability. These multiyear roadmaps will then form the basis for future annual performance plans and provide further insight into the ESE longer-term research outcomes.

Research conducted by NASA, within the scope of scientific questions and issues outlined in the ESE Research Strategy, normally follows a well tested process leading from a Principal Investigator (PI) led research activity through periodic publication of interim and final results in the peer reviewed literature, culminating in improved knowledge and/or new technology that can be applied to practical applications involving the solution of contemporary environmental problems of national importance. This process is reflected in our Research Strategy and, as appropriate, in our performance indicators.

The Global Climate Change Act of 1990 specifically highlights the importance of results that apply to the areas of energy and community growth. Given this focus and ESE activities and results in Earth science research and related remote sensing technology development, ESE has recognized the potential to provide socioeconomic benefits in the areas of applying weather forecast optimization to more efficient energy management and to applications in aviation. For example, *USA Today* has noted that the annual cost of electricity could decrease by at least $1B if the accuracy of 30-hour weather forecasts improved 1 degree Fahrenheit. Moreover, the projected annual savings of operating aircraft using NASA developed advanced Synthetic Vision Systems at just 10 airports in the U.S. in one year is estimated to be over $2B. Through existing and planned projects such as Geostationary Imaging Fourier Transform Spectrometer (GIFTS), Shuttle Radar Topography Mission (SRTM), and Earth Observing-1 (EO-1) and our work in atmospheric modeling, climate prediction modeling, topography, and land use/land cover, the ESE will contribute to the potential for such socioeconomic realization in this decade. Earth Science is science in the national interest. NASA is pleased to play a leadership role in exploring and understanding the Earth. This ESE Performance Plan describes our planned accomplishments toward this great scientific endeavor with tangible societal benefits in FY 2003. These planned accomplishments, while important and useful in their own right, are essential stepping-stones on the path to answering the ESE science questions over the next decade.

Characterization of FY 2002 VS FY 2003 Performance Plans

The FY 2003 plan structure, as outlined with its strategic goals and objectives, remains the same as that in the FY 2002 plan. The indicators of progress are the only elements that have changed. This year, we have only developed detailed indicators for one-third of our basic research portfolio. However a qualitative assessment will be provided on progress made in every science question in the FY 2003 report. In future years, we will assess progress against the road maps we are developing for our entire research portfolio.

NASA Earth Science Enterprise Roadmap

Objectives	**Through 2002 Characterize the Earth System**	**2003-2010 Understand the Earth System**	**2010-2025 and Beyond Predict Changes in the Earth System**
Science • Understand Earth system variability • Identify & measure primary causes of change • Determine how the Earth system responds • Identify the consequences for civilization • Predict future Earth system changes	• Establish a benchmark for global rainfall • Estimate uptake of atmospheric CO_2 from global measurements of the terrestrial biosphere • Provide precise global measurements of atmospheric temperature and humidity • Make global measurements of cloud properties to determine Earth's response to solar radiation • Measure global ocean winds and topography to improve accuracy and length of weather prediction and drive models of ocean impacts on climate change • Produce 3-D maps of the entire inhabited surface of the Earth	• Achieve a quantitative understanding of the global fresh water cycle • Quantify with a "high" or "moderate" degree of confidence all the principal Earth system forcing and response factors • Quantify the variation and trends in terrestrial and marine ecosystems; estimate carbon stocks in forests and oceans globally • Assess impacts of climate change on global ecosystems using interactive ecosystem-climate models • Assimilate ocean winds, topography, & surface temperature, tropospheric winds, and precipitation into climate and weather forecasting models	Demonstrate capability for: • 10 year climate forecasts • 12 month rain rate • 7 day forecast of pollution alerts • 60 day volcanic eruption prediction • 15-20 month El Nino forecasts • 5 day hurricane track forecast • 1-5 year earthquake forecast (experimental) • Assess sea-level rise and effects • Predict regional impacts of decadal climate change
Applications / Education • Demonstrate scientific & technical capabilities into practical tools for public & private sector decisions •Stimulate public understanding of Earth science and encourage careers in science & technology	• Demonstrate applications of geospatial data to agriculture, forestry, urban & transportation planning, etc. • Expand use of commercial systems in collecting Earth system science data • Collaborate with educators to develop new curricula support materials using Earth science data and discoveries	•Enable 7-10 day weather and seasonal precipitation prediction capability; enable broad use of data in precision agriculture • Enable an effective mix of private, government, & international data sources and users • Incorporate Earth System Science into education curricula at the K-14 and university levels	• Conduct research to enable 10-14 day weather and annual precipitation prediction capability • Enable wide spread commercial supply and use of global environmental data; integration of environmental information and economic decision-making • Produce the next generation of Earth System Scientists
Technology • Develop advanced technologies for Earth observation • Develop advanced information technologies for Earth science data • Partner with others for Earth system monitoring & prediction	• Implement satellite formation flying to improve science return; New Millennium Program to space- validate revolutionary technologies • Explore new instrument concepts for next decade missions • Employ high-performance computing to address Earth system modeling challenges • Collaborate with operational agencies in mission planning, development & utilization	• Develop and implement autonomous satellite control • Demonstrate a new generation of small, highly capable active, passive and in situ instruments • Employ distributed computing & data mining techniques for Earth system modeling • Transition advanced instruments for systematic measurements to operational systems • Develop high data rate communications and on-board data processing & storage	• Deploy cooperative satellite constellations and intelligent sensor webs • Design instruments for new scientific challenges; deploy advanced instruments to migrate selected observations from LEO & GEO to L1 and L2 • Develop a collaborative synthetic environment to facilitate understanding and enable remote use of models and results • Collaborate in an international global observing and information system; improve operational systems with new technology

Figure 1. Strategic Roadmap for the Earth Science Enterprise

Resource Requirements:

	FY 1999*	FY 2000*	FY 2001*	FY 2002	FY 2003
$ in M	1,414	1,443	1,485	1,626	1,628
Civil Service FTE	1,365	1,907	1,913	1,747	1,848

* Two-appropriation structure starts in FY 2002.

FY 2003 Performance Measures

Enterprise Mission: Develop a scientific understanding of the Earth system and its response to natural and human-induced changes to enable improved prediction of climate, weather, and natural hazards for present and future generations.

NASA's ESE is dedicated to understanding the total Earth system and the effects of natural and human-induced changes on the global environment. The vantage point of space provides information about Earth's land, atmosphere, ice, oceans, and biota that is obtainable in no other way. Programs of the ESE study the interactions among these components to advance the new discipline of Earth System Science. Our research results contribute to the development of sound environmental policy and economic investment decisions**.**

NASA's ESE also develops innovative technologies and applications of remote sensing for solving practical societal problems in agriculture and food production, natural hazard mitigation, water resources, regional planning, and national resource management in partnership with other Federal agencies, with industry, and with state and local governments. Earth Science discoveries are shared with the public to enhance science, mathematics, and technology education and increase the scientific and technological literacy of all Americans. ESE combines the excitement of scientific discovery with the reward of practical contribution to the sustainability of planet Earth.

Strategic Goal: Observe, understand, and model the Earth system to learn how it is changing, and the consequence for life on Earth.

NASA's Earth observing and research program elements are the principal means by which global-scale questions about our home planet are posed and answered. These elements identify the variability in the Earth system, the forces responsible for change, responses of the Earth system to changes, and the consequences and predictability of future change. Nations and industries make billions of dollars worth of investment decisions yearly that will be better informed by the information and understanding we provide.

Objective: Discern and describe how the global Earth system is changing.

Annual Performance Goal (3Y1). Increase understanding of global precipitation, evaporation and how the cycling of water through the Earth system is changing.

It is important to establish a baseline for determining the existence or absence of significant trends in the water cycle, and the extent to which observed changes match predictions. Acceleration of the global water cycle could result in intensification and/or redistribution of rainfall patterns, severe storm frequency, droughts and glacial melting. Understanding of the water cycle enables prediction of freshwater availability.

The last set of indicators and associated progress was presented in the FY 2002 performance plan. We did not develop specific indicators for FY 2003. An assessment of progress toward answering this question will be published in the FY 2003 report.

Annual Performance Goal (3Y2). Increase understanding of global ocean circulation and how it varies on interannual, decadal, and longer time scales.

Establishing the basis for variations in the temperature and circulation of the upper ocean can be used to help assess any changes that may be affecting the Earth's weather and climate, including EL Niño phenomena.

<u>Performance Indicator</u>: Update the record of trends in sea ice duration, concentration and extent to span the period from 1979-2000. Current records extend to 1996.

<u>Performance Indicator</u>: Initiate production of sub-monthly analysis from a data-assimilating global ocean model, using NASA and other agency satellite and *in situ* observations, to evaluate ocean circulation changes such as those associated with EL Niño. This work is done in the context of the Global Ocean Data Assimilation Experiment. [http://www.ecco.ucsd.edu/]

Annual Performance Goal (3Y3). Increase understanding of global ecosystems change.

The activity establishes the basis for short-term, seasonal, and inter-annual variability of ecosystems. It also provides a baseline against which to evaluate future change. Measurements of seasonal, annual, and inter-annual changes in ecosystems are used to estimate productivity in agriculture, forestry, fisheries, and Earth's unmanaged lands and oceans.

The last set of indicators and associated progress was presented in the FY 2002 performance plan. We did not develop specific indicators for FY 2003. An assessment of progress toward answering this question will be published in the FY 2003 report.

Annual Performance Goal (3Y4). Increase understanding of stratospheric ozone changes, as the abundance of ozone-destroying chemicals decreases and new substitutes increases by meeting 2 of 2 performance indicators.

Reduction in atmospheric ozone amounts leads to an increased flux of ultraviolet radiation at the Earth's surface, with harmful effects on plant and animal life including human health. Understanding and possibly mitigating this process is a key ESE concern.

> Performance Indicator: Provide continuity of calibrated data sets from ground-based, suborbital, and space-based instruments for determining long term trends in the total column and profile abundances of stratospheric ozone with sufficient precision to enable the later assessment of expected ozone recovery.

> Performance Indicator: Characterize the inter-annual variability and possible long-term evolution of stratospheric aerosols (characteristics and profile abundances) and of the vertical profiles of methane, water vapor, and temperature to assist in the interpretation of observed ozone changes and chemistry-climate interactions. This requires a combination of data records from ground-based, airborne, balloon-borne, and space-based measurements.

Annual Performance Goal (3Y5). Increase understanding of change occurring in the mass of the Earth's ice cover by meeting at least 3 of 4 performance indicators.

Sea level is estimated to have been rising by as much as 2 mm/year over the last century. Possible contributions to this change include thermal expansion of the oceans and the loss of ice from glaciers and the large ice sheets. Of these, the large ice sheets present the greatest uncertainty in terms of their contribution to sea level rise and also represent the greatest potential threat to the coastal ecosystems and infrastructure. It is therefore important to establish whether Polar Regions are in the process of losing mass and contributing to the current observed sea level rise.

> Performance Indicator: Convert remotely sensed observations of Greenland ice sheet surface melting to estimates of ice mass loss in order to quantify how much ice is lost to melting, and its variability from year to year.

> Performance Indicator: Produce the first high-resolution (~10-15m) synthetic aperture radar "mini-mosaics" for key coastal regions in Antarctica to be used as a baseline for comparison to past and present high-resolution imagery.

> Performance Indicator: Use initial ICESat elevation data in Greenland and Antarctica to determine a baseline elevation for regions measured.

Performance Indicator: Perform initial assessment of the extent to which sea ice thickness can be determined using ICESat.

Annual Performance Goal (3Y6). Increase understanding of the motions of the Earth, the Earth's interior, and what information can be inferred about the Earth's internal processes.

Motions of the Earth's Interior are the forcings, which drive earthquakes, volcanoes, and build our mountains and valleys. Knowledge, which has been building over the past decades, has led to a quantum leap in our understanding of how our planet has evolved. Through this new knowledge has come a better understanding of natural hazards and natural resource assessment. Technological by-products include better navigation (including civilian Global Positioning System (GPS), the tracking of ocean height variability, and the attendant visualization of EL Niño and related phenomena to name just a few of many applications.

The last set of indicators and associated progress was presented in the FY 2002 performance plan. We did not develop specific indicators for FY 2003. Progress toward answering this question will be published in the FY 2003 report.

Objective: Identify and measure the primary causes of change (forcings) in the Earth system.

Annual Performance Goal (3Y7). Increase understanding of trends in atmospheric constituents and solar radiation and the role they play in driving global climate by meeting at least 4 of 5 performance indicators.

Solar radiation is the primary external force acting on Earth's climate. Atmospheric constituents, clouds, and aerosols drive the climate system; changes in their concentration/distribution will contribute to climate change through a variety of processes.

Performance Indicator: Continue and extend the current 23-year record of concentration measurements (and associated standards development) of anthropogenic and naturally occurring halogen-containing chemicals and other chemically active and greenhouse gases to provide for an understanding of future changes in ozone and climate forcing.

Performance Indicator: Characterize global sources of carbon monoxide using data assimilation techniques to combine carbon monoxide measurements from Measurements of Pollution in the Troposphere (MOPITT) with chemical transport models.

Performance Indicator: Use the comprehensive multi-instrument integrated data set for studying the sources/sinks and distribution of tropospheric aerosols over land, based on data from the Total Ozone Mapping Spectrometer (TOMS), Moderate Resolution Imaging Spectro Radiometer (MODIS), and Multi-angle Imaging Spectroradiometer (MISR) instruments to support evaluation of the impact on climate forcing of natural and anthropogenic aerosols in the atmosphere.

Performance Indicator: Combine multiple instrument data sets on the total solar irradiance (i.e. the total solar radiation per unit of Earth surface) and the solar ultraviolet (UV) flux (i.e. the UV component of total solar irradiance) over a full solar cycle in order to explore correlations between solar variation and climate without resorting to solar proxies (i.e. indirect measures of solar variability).

Performance Indicator: Reduce uncertainty (i.e. error) in the retrievals (calculation) of upper troposphere / lower stratosphere water vapor abundances (from microwave soundings) by 10 – 30% through improved laboratory spectroscopic measurements of the water vapor continuum.

Annual Performance Goal (3Y8). Increase understanding about the changes in global land cover and land use and their causes.

Change in land cover and land use is the dominant present-day forcing of change in terrestrial and coastal ecosystems and constitutes our largest uncertainty in the global carbon budget. Understanding the human and biophysical factors that cause land cover and land use change will be essential for assessing consequences for food production, natural resources availability, and resource management as well as for predicting future global changes.

The last set of indicators and associated progress was presented in the FY 2002 performance plan. We did not develop specific indicators for FY 2003. Progress toward answering this question will be published in the FY 2003 report.

Annual Performance Goal (3Y9). Increase understanding of the Earth's surface and how it is transformed and how such information can be used to predict future changes.

This effort is leading to a better understanding of natural events/processes that transform or change the topographic surface of the Earth, and the impact of such changes on human activities. Progress toward answering this question will lead to a better understanding of the risk of natural hazards and societies vulnerability to natural disasters. By products of these activities include better topographic maps of the Earth surface. These are important to many endeavors such as airplane landing and routing, watershed assessment, and roadway planning. Risk assessment for natural hazards such as flooding, earthquakes, landslides, and volcanoes is becoming increasingly important as societal resources are developed and concentrated in vulnerable areas.

The last set of indicators and associated progress was presented in the FY 2002 performance plan. We did not develop specific indicators for FY 2003. Progress toward answering this question will be published in the FY 2003 report.

Objective: Determine how the Earth system responds to natural and human-induced changes.

Annual Performance Goal (3Y10). Increase understanding of the effects of clouds and surface hydrologic processes on climate change.

It is important to establish a basis for determining the vertical distribution and optical properties of cloud particles to provide measurement-based estimates of atmospheric heating rather than relying on climatological statistics or models. Clouds are the most important factor that controls the Earth's radiation balance, which, along with evaporation and condensation of atmospheric and surface water, drives the major weather systems. Thus, determining the vertical distribution and optical properties of cloud particles will ultimately lead to better climate predictions. Soil moisture is an important land surface state variable, currently unmeasured at large spatial scales that also affects weather and climate.

The last set of indicators and associated progress was presented in the FY 2002 performance plan. We did not develop specific indicators for FY 2003. Progress toward answering this question will be published in the FY 2003 report.

Annual Performance Goal (3Y11). Increase understanding of how ecosystems respond to and affect global environmental change and affect the global carbon cycle.

Today, Earth's ecosystems are experiencing multiple, interacting, changing environmental conditions, and it will be vitally important to understand the implications of their responses, including some that may surprise us, for sustained agriculture, forestry, and fisheries, and for the continued provision of ecosystem goods and services that are valuable to human societies. We also need to know how their responses provide feedback to the atmosphere through fluxes of water, energy, and trace gases. Most importantly, we must develop understanding of the past, present, and future role of ecosystems as sources and sinks of carbon and in regulating the global carbon cycle.

The last set of indicators and associated progress was presented in the FY 2002 performance plan. We did not develop specific indicators for FY 2003. An assessment of progress toward answering this question will be published in the FY 2003 report.

Annual Performance Goal (3Y12). Increase understanding of how climate variations induce changes in the global ocean circulation by meeting at least 2 of 3 performance indicators.

Ocean circulation patterns strongly influence regional climates, yet these are known to have exhibited variability. For example, circulation associated with the global "conveyor" belt, including the Gulf Stream, provides for the relatively mild climate of northern Europe. Changes in such large-scale ocean circulation could significantly impact the habitability of this region in particular.

> <u>Performance Indicator</u>: Use diagnostic analysis of seasonal and interannual variability induced in the interior ocean based on Seawinds high-resolution ocean winds to evaluate improvements in climate and marine weather forecasting. (Ocean Surface Vector Winds Science Team http://winds.jpl.nasa.gov).

> <u>Performance Indicator</u>: Use near decade-long sea surface topography and in situ upper-ocean temperature profile measurement time series to develop a high resolution Pacific Ocean model to elucidate the mechanisms of the Pacific Decadal Oscillation and its impact on seasonal/decadal climate variations [http://decvar.org].

> <u>Performance Indicator</u>: Utilize space-based Ocean Topography time series, in situ observations of the World Climate Research Program, and assimilation of these data into ocean models to ascertain whether detectable changes in the deep ocean have occurred over the last decade.

Annual Performance Goal (3Y13). Increase understanding of stratospheric trace constituents and how they respond to change in climate and atmospheric composition.

Stratospheric composition, most importantly amounts of UV-absorbing ozone, responds to concentrations of chemically active trace gases and underlying meteorological conditions, such as temperature and wind distributions. Changing atmospheric conditions associated with global chemical change (and associated global warming) have the potential to affect the stratosphere, which can in turn affect fluxes of biologically damaging UV radiation at the Earth’s surface.

> <u>Performance Indicator</u>: Utilize combined data sets from ground-based, sub-orbital, and space-based measurements to assess the possible impact of the increased abundances of greenhouse gases on the future evolution of Northern Hemisphere high latitude ozone concentrations. This will include extended analysis of data from the SAGE III Ozone Loss and Validation Experiment (SOLVE).

> <u>Performance Indicator</u>: Quantify the relationship between wintertime tropospheric wave energy and late winter temperatures in the Arctic lower stratosphere in order to analyze the effects of changing tropospheric weather patterns on Arctic ozone chemistry.

Annual Performance Goal (3Y14). Increase understanding of global sea level and how it is affected by climate change.

The polar ice sheets are a repository for about 75% of the Earth's fresh water and a reduction in their combined mass of just 1% would increase sea level by about 90 cm. Of the order of 100 million people would be at direct risk from a sea level rise of this magnitude (Intergovernmental Panel on Climate Change (IPCC), 1995) and many more would be indirectly affected through economic and other impacts. It is therefore important to establish whether the ice sheets have the potential, under climate change scenarios, to exhibit major changes in mass balance and if so, what the expected time-scale for such changes would be.

> Performance Indicator: Compare remotely sensed discharge fluxes of ten outlet glaciers in Antarctica to estimates based on balance velocities to determine the basin mass balance, which will provide an assessment of how major outlet glaciers contribute to sea level rise.

> Performance Indicator: Initiate development of improved models of outlet glacier flow characteristics that will assess nature of discharge and sensitivity to climate changes, which will improve prediction capabilities of sea level rise from ice sheet dynamics.

Annual Performance Goal (3Y15). Increase understanding of the effects of regional pollution on the global atmosphere, and the effects of global chemical and climate changes on regional air quality by meeting at least 4 of 5 performance indicators.

There is significant evidence that pollutant gases can be transported over very long distances (e.g., across the Pacific or Atlantic oceans). The global effects of atmospheric pollution (on agriculture, materials, human health, etc.) are poorly known due to inexact characterization of tropospheric transport, physics, and chemistry.

> Performance Indicator: Continue and extend the four-year data record of tropical ozone soundings in order to establish a climatology (i.e. the natural pattern/cycle of ozone) of the high-resolution vertical distribution of ozone (i.e. the concentration at each altitude) in the tropics, leading to improved retrievals of tropospheric ozone concentrations from space-based measurements.

> Performance Indicator: Characterize the atmospheric plume from East Asia and assess its contribution to regional and global atmospheric chemical composition by completing the archival of the Transport of Chemical Evolution over the Pacific (TRACE-P) airborne mission and associated data sets, which will improve the assessment of intercontinental transport of pollution.

> Performance Indicator: Update the estimate of the tropospheric distributions and possible trends of hydroxyl (OH) radicals and examine the consistency between different model types (i.e. inverse and

assimilation) in determining global OH fields using multiple data sets, which will allow assessment of the atmosphere's capacity for self-cleansing.

Performance Indicator: Continue development and testing of a coupled aerosol-chemistry-climate general circulation model to project future changes in atmospheric composition over the 21st century. This model, which will include first-time parameterization of tropospheric aerosol chemistry, will help to diagnose the climatic consequences of these emissions and the associated feedbacks on atmospheric composition.

Performance Indicator: Improve estimates of the stratospheric contribution to tropospheric ozone through chemical transport models. The stratosphere-troposphere exchange included in these model calculations will be examined for its sensitivity to global warming.

Objective: Identify the consequences of change in the Earth system for human civilization.

Annual Performance Goal (3Y16). Increase understanding of variations in local weather, precipitation, and water resources and how they relate to global climate variation.

This activity establishes a basis for determining what changes will be induced by climate trends in the frequency, strength, and path of weather systems, which produce clouds and rain which replenish fresh water supplies.

The last set of indicators and associated progress was presented in the FY 2002 performance plan. We did not develop specific indicators for FY 2003. An assessment of progress toward answering this question will be published in the FY 2003 report.

Annual Performance Goal (3Y17) Increase understanding of the consequence of land cover and land use change for the sustainability of ecosystems and economic productivity.

Today, land cover, and land use changes are primarily due to human activities, and are most prevalent where human populations are large; thus the consequences of land cover and land use change impact our daily lives and the potential sustainability of food production, natural resource use, and environmental quality. Consequences of concern include changes in carbon sources and sinks; the loss of biodiversity; inputs of sediments, nutrients, and pollutants to coastal regions; land degradation, and increased risks to human health.

The last set of indicators and associated progress was presented in the FY 2002 performance plan. We did not develop specific indicators for FY 2003. An assessment of progress toward answering this question will be published in the FY 2003 report.

Annual Performance Goal (3Y18). Increase understanding of the consequences of climate and sea level changes and increased human activities on coastal regions.

The consequences of global environmental change are often seen in the coastal zone. Human populations are concentrated near coastlines, and there are severe impacts on coastal communities from pollution, excess nutrients, storm-surge, and sea-level rise. It will be important to understand the relative contributions of each of these factors to the overall changes in coastal regions, and especially, their effect on the resident human communities.

> The last set of indicators and associated progress was presented in the FY 2002 performance plan. We did not develop specific indicators for FY 2003. An assessment of progress toward answering this question will be published in the FY 2003 report.

Objective: Enable the prediction of future changes in the Earth system.

Annual Performance Goal (3Y19). Increase understanding of the extent that weather forecast duration and reliability can be improved by new space-based observations, data assimilation, and modeling.

This activity contributes to improving the accuracy of short-term weather predictions and increasing the period of validity of long-range forecasts that are used by government, business, and individuals to protect lives and property and make investment decisions.

> The last set of indicators and associated progress was presented in the FY 2002 performance plan. We did not develop specific indicators for FY 2003. An assessment of progress toward answering this question will be published in the FY 2003 report.

Annual Performance Goal (3Y20). Increase understanding of the extent that transient climate variations can be understood and predicted

This activity contributes to the ability to predict global and regional climate on seasonal-to-interannual time scales with sufficient accuracy for concerned socioeconomic interests to estimate the likely impact of climate variations, such as those associated wit EL Niño /La Nina, and to issue warnings and make appropriate contingency plans. NASA will endeavor to transition the results of this research to those public agencies that have operational planning and warning responsibilities. In addition, NASA will also make the results available to concerned interests in the private sector.

> The last set of indicators and associated progress was presented in the FY 2002 performance plan. We did not develop specific indicators for FY 2003. An assessment of progress toward answering this question will be published in the FY 2003 report.

Annual Performance Goal (3Y21). Increase understanding of the extent that long-term climate trends can be assessed or predicted.

This activity will provide information needed to determine policies for possible mitigation of, or adaptation to, climate change. Specifically, it will provide information on the causes of recent and current climate changes as well as the expected magnitude and causes of future climate trends including the nature of regional climate changes. An integral part of this research is an assessment of the reliability of climate predictions and how alternative assumptions and policies affect them.

> The last set of indicators and associated progress was presented in the FY 2002 performance plan. We did not develop specific indicators for FY 2003. An assessment of progress toward answering this question will be published in the FY 2003 report.

Annual Performance Goal (3Y22). Increase understanding of the extent that future atmospheric chemical impacts on ozone and climate can be predicted by meeting at least 2 of 3 performance indicators.

A sound scientific basis is essential for informed decision making at the national and international level on environmental issues that underlie human health and well being as well as the health of the numerous ecosystems. Only through the integration of science and policy, as occurred effectively through the assessment process (for example the various assessment panels associated with the Montreal Protocol), can the sustainable development of our Nation be insured.

> <u>Performance Indicator</u>: Analyze the measured trends in atmospheric trace gas concentrations using updated data sets and compare the results with those estimated from industrial production and emission data. The analysis will be used to assess the completeness of our understanding of the atmospheric persistence and degradation of industrial chemicals as well as to examine the efficiency of current regulatory agreements and international reporting on the production and emissions of regulated chemicals. Provide the results of such analyses for inclusion in the next international Assessments of Stratospheric Ozone Depletion.

> <u>Performance Indicator</u>: Perform laboratory studies designed to assess the atmospheric fate of industrial and naturally occurring chemicals by characterizing the key photochemical processes responsible for their atmospheric breakdown.

> <u>Performance Indicator</u>: Complete the implementation of the Global Modeling Initiative (GMI) to provide metrics, benchmarks, and controlled numerical experiments for model and algorithm simulations performance, which will allow the development of standards of model behavior for participation in national/international assessments.

Annual Performance Goal (3Y23). Increase understanding of the extent that future concentrations of carbon dioxide and methane and their impacts on climate can be predicted.

A sound scientific basis is essential for informed decision making at the national and international level on environmental issues that relate to the Earth's future climate and underlie human health and well being as well as the health of the numerous ecosystems. Only through the integration of science and policy, as occurred effectively through the assessment process (for example the various assessment panels associated with the Montreal Protocol), can the sustainable development of our Nation be insured.

The last set of indicators and associated progress was presented in the FY 2002 performance plan. We did not develop specific indicators for FY 2003. An assessment of progress toward answering this question will be published in the FY 2003 report.

Strategic Goal: Expand and accelerate the realization of economic and societal benefits from Earth science, information, & technology.

Scientific data must be transformed into information products useful to non-scientists in order for the economy and society to realize the full benefit of it. Our applications and education programs are designed to achieve this end through partnerships between NASA and professional information product providers and educators. The accomplishment of the identified performance indicators will enable the user community to accomplish their day-to-day decision-making in a more effective manner resulting in either cost savings, improved timeliness or quality, or to accomplish tasks that were not previously possible with conventional means. The accomplishment of the performance indicators will enable the U.S. taxpayer to reap the potential socio-economic benefits of NASA’s investment in Earth science and technology.

Objective: Demonstrate scientific and technical capabilities to enable the development of practical tools for public and private sector decision-makers.

Annual Performance Goal (3Y24): Provide regional decision-makers with scientific and applications products and tools.

Increased application of and access to ESE science and technology results will enable the Nation to reap significant benefits in the areas of community growth and infrastructure, disaster management, environmental assessment, and resource management. The performance indicators are aimed at measuring: (a) the identification of the most significant needs in the federal, state, local, and tribal government community that can benefit from these results; (b) the development of new and advanced applications as well as related methods and practices in cooperation with the user community; and (c) the demonstration and distribution of these results to the targeted users. The accomplishment of the identified target indicators and related application activities will enable the user community to accomplish their day-to-day decision-making in a more effective and efficient manner resulting in either cost savings, improved timeliness or quality, or in an ability to accomplish tasks that were not previously possible with conventional means. The accomplishment of the performance indicators will enable the U.S. taxpayer to reap the potential socio-economic benefits of NASA's investment in Earth science and technology.

Performance Indicator: Identify at least 2 common information requirements that address the Applications Program's constituencies' user needs and develop plans that will address those requirements and successfully move applications in those areas toward operational use.

Performance Indicator: Verify and validate technology, algorithms, and scientific results in partnership with selected commercial partners. Fully verify and validate at least 2 demonstration products that meet program priorities.

Performance Indicator: Plan, implement and/or manage twenty demonstration projects by the end of FY 2003 in cooperation with state, local, and tribal decision-makers. The progress of each project towards full implementation and adoption by the end users will be measured systematically.

Objective: Stimulate public interest in and understanding of Earth system science and encourage young scholars to consider careers in science and technology.

Annual Performance Goal (3Y25): Share the excitement of NASA's scientific discoveries and the practical benefits of Earth science to the public in promoting understanding of science and technology in service to the society. Success will equate to meeting 3 of 4 performance indicators.

Increased public awareness and understanding of how the Earth functions as a system and increased literacy in Earth science and technology will result in attracting the next generation of scientists and engineering students to pursue their degrees in Earth system science. This will build capacity for productive use of Earth science information in resolving everyday practical problems.

Performance Indicator: Sponsor 2-3 leading undergraduate institutions to develop courses that enable pre-service science educators to become proficient in Earth system science and in using NASA remotely sensed observations in such curriculum.

Performance Indicator: Work with at least one professional organization to develop content guidelines for professional practice of Earth remote sensing and geospatial data.

Performance Indicator: Provide, in public venues, at least 2-3 stories per month that cover scientific discoveries, practical benefits or new technologies sponsored by NASA's Earth science program.

Performance Indicator: Continue to train a pool of highly qualified scientists and educators in Earth science and remote sensing by sponsoring approximately 140 graduate fellowships (approximately 1/3 each in their first, second and third year) and approximately 25-30 New Investigator awards per year to recent Ph.D. recipients.

Strategic Goal: Develop and adopt advanced technologies to enable mission success and serve national priorities.

New and less costly remote sensing capabilities are made possible by targeted investment in advanced technologies. These technologies will make possible the next generation of weather, climate, and Earth systems monitoring satellites. They will leverage advances in information technologies to make vast quantities of Earth science data useful and accessible to scientists, practitioners, and the public.

Objective: Develop advanced technologies to reduce the cost and expand the capability for scientific Earth observation.

Annual Performance Goal (3Y26): Successfully develop and infuse technologies that will enable future science measurements, and/or improve performance as well as reduce the cost of existing measurements. Increase the readiness of technologies under development, retiring risks, and advancing them to a maturity level where they can be infused into new missions with shorter development cycles. Success will equate to meeting 3 of 4 performance indicators.

New space-based technologies enable measurements that were not previously possible. Often, these measurements support new Earth-science research activities from the vantage point of space and enable monitoring that leads to early warnings to the public of natural hazards (ozone, fire, flood, earthquake, and volcano threats) or life threatening weather conditions. Alternatively, many new technologies reduce the cost of existing measurements while improving their quality. Predictive information can be generated for the public with more reliability, at lower cost, with delivery to users in a shorter period.

A key enabler for advanced technology infusion is space flight validation where the risk to the first uses is perceived to be high, but the payoff to science and applications is high. Consequently, space flight validation of breakthrough technologies to enable high priority future science measurement capabilities is an integral part of the technology infusion strategy.

Advanced information system capabilities will enable increased on-board autonomy for space-based assets, new levels of performance for ground-based analysis, and simulation of Earth-system processes towards making available such information to users in a timely and affordable fashion.

Performance Indicator: Annually advance 25% of funded technology developments by one Technology Readiness Level (TRL).

Performance Indicator: Annually mature at least three (3) technologies to the point where they can be validated in space or incorporated directly into a science and/or operational project(s).

Performance Indicator: Annually infuse at least one (1) technology development to a commercial entity; into a remote sensing or in-situ project; or into the ESE information systems infrastructure.

Performance Indicator: Annually establish at least one (1) joint agreement with a program external to NASA's ESE that results in the inclusion of at least one new ESE technology requirement.

Objective: Develop advanced information technologies for processing, archiving, accessing, visualizing, and communicating Earth science data.

Annual Performance Goal (3Y27): Develop hardware/software tools to demonstrate high-end computational modeling to further our understanding and ability to predict the dynamic interaction of physical, chemical, and biological processes affecting the earth. Success will equate to meeting 2 of 3 indicators.

Advanced computational capabilities support deployment of increasingly complex observation systems; higher quality, more refined characterization of Earth-system processes; accurate longer-range predictions of natural hazards and life threatening weather conditions; and near real-time delivery of data and information to users.

Performance Indicator: Successfully demonstrate networked high performance computer for Earth science modeling challenges.

Performance Indicator: Publish software libraries that enable climate models to scale to at least 512 nodes on a high performance computer cluster.

Performance Indicator: Demonstrate quasi-operational usage of a high performance computer with a throughput of at least 30 days/day of data assimilation.

Performance Indicator: Successfully demonstrate an increase in sustained high-end computing performance over the present level of 100 gigaflops. Additional scenarios of climate change simulations and the model sensitivities to the parameterizations can be assessed with the increased sustained performance.

Annual Performance Goal (3Y28): Develop baseline suite of multidisciplinary models and computational tools leading to scalable global climate simulations.

Performance Indicator: Successfully demonstrate up to three Earth science modeling codes interoperating on a functioning Modeling Framework early prototype. (A Modeling Framework means the existence of a consistent pre-defined interface between different model components. The model components are swappable and interchangeable between different models if these models follow the same framework design.)

Performance Indicator: Demonstrate a doubling of performance over FY 2002 in at least one (1) suite of multidisciplinary models or computational tool sets that support the Earth Science Research Strategy.

Objective: Partner with other domestic and international agencies to develop and implement better methods for using remotely sensed observations in Earth system monitoring and prediction.

The challenges of Earth System Science and its applications including sustainable development, and mitigation of risks to people, property, and the environment from natural disasters, require collaborative efforts among a broad range of domestic and international partners. This cooperation provides significant benefits to NASA's ESE through the pooling of financial resources, access to unique domestic and foreign capabilities including infrastructure and expertise, increases in mission flight opportunities and enhances the overall scientific return.

Annual Performance Goal (3Y29): Collaborate with other domestic and international agencies in developing and implementing better methods for using remotely sensed observations to support national and international assessments of climate changes and their practical consequences. Success will equate to meeting 4 of 5 performance indicators.

Performance Indicator: Continue collaborative relations with such Federal agencies as the U.S. Department of Transportation (DOT), the U.S. Department of Commerce (DOC), the Federal Aviation Administration (FAA), the U.S. Geological Survey (USGS), the U.S. Department of Agriculture (USDA) and the Environmental Protection Agency (EPA) to promote the use of remotely sensed data and information to accomplish U.S. strategic scientific, environmental and economic objectives.

Performance Indicator: Continue to identify and establish international cooperation with international agencies to promote the use of remotely sensed data and information to accomplish U.S. strategic scientific, environmental, and economic objectives.

Performance Indicator: Demonstrate enhanced interoperability and interconnectivity of international remote sensing information systems and services through NASA's participation in the Committee on Earth Observation Satellites (CEOS) Working Group on Information Systems and Services.

Performance Indicator: Demonstrate enhanced mission coordination and complementarity of remote sensing data through NASA's participation in the CEOS Working Group on Calibration and Validation.

Performance Indicator: Demonstrate the establishment of an agreed international approach to an integrated global observing strategy for the oceans and the terrestrial carbon cycle through participation in the Integrated Global Observing Strategy - Partners (IGOS-P).

Enterprise-Wide Activities that enable achievement of Earth Science strategic goals.

Annual Performance Goal (3Y30): Successfully develop one (1) spacecraft and have ready for launch. Operate instruments on orbiting spacecraft to enable Earth Science research and applications goals and objectives.

Performance Indicator: Successfully develop and have ready for launch at least one spacecraft.

Performance Indicator: At least 90% of the total on-orbit instrument complement will be operational during their design lifetime.

Annual Performance Goal (3Y31): Successfully disseminate Earth Science data to enable our science research and applications goals and objectives. Success will equate to meeting 4 of 5 performance indicators.

Performance Indicator: Make available ESE acquired data and information on Earth's atmosphere, land and/or oceans to users within 3-5 days of their request.

Performance Indicator: Increase by 20 - 30% the total volume of data acquired by and available from NASA for its research programs compared to FY 2002. (This equates to a maximum of 1170 terabytes)

Performance Indicator: Maintain satisfactory support for the number of distinct NASA ESE data and information center customers compared to FY 2002. (This equates to 2,019,600 users).

Performance Indicator: Enable production of and distribute scientifically valid data sets from the Aqua mission.

Performance Indicator: User Satisfaction: Maintain or improve the overall level of ESE data center customer satisfaction as measured by User Working Group surveys.

Annual Performance Goal (3Y32): Safely operate airborne platforms to gather remote and *in situ* earth science data for process and calibration/validation studies.

Performance Indicator: Support and execute seasonally dependent coordinated research field campaigns within two-weeks of target departure with the aid of airborne and sub-orbital platforms, as scheduled at the beginning of the fiscal year.

Verification and Validation

While performance indicators are noted in order to demonstrate significant scientific progress toward the annual performance goal, the ESE will also rely on external expert review. The Earth System Science and Applications Advisory Committee (ESSAAC) of the NASA Advisory Council will conduct an annual assessment of the ESE near-term science objectives. It will provide a qualitative progress measurement (Green, Yellow, or Red). "Green" will indicate that the objective was met; "Yellow" will indicate a concern that an objective was not fully accomplished; and "Red" will indicate that events occurred that prevented or severely impaired the accomplishment of the objective. The assessment will include commentary to clarify and supplement the qualitative measures.

The ESSAAC is a committee of the NASA Advisory Council under the Federal Advisory Committee Act, and comprises outside scientific and technical experts from academia, industry and other government agencies. ESSAAC meets at least twice a year to review plans and progress in the ESE. After the end of each fiscal year, the ESE will provide to ESSAAC a self-assessment in each of the relevant objectives, highlighting performance against the metrics in the Performance Plan for that year. ESSAAC will deliberate internally and render its own assessment, which may confirm or modify the ESE self-assessment. The ESSAAC assessment will be reported in the Performance Report for that year. This process will be repeated annually.

The ESE will regularly review performance objectives as part of an existing monthly review process. Tracking current performance on a monthly basis for each specific FY 2003 annual performance goal enables the ESE to institute measures to ensure improvement and progress toward meeting its strategic goals.

MULTI-YEAR PERFORMANCE TREND

Earth Science

***New objectives were developed in FY 2002. The APGs can be mapped to the following new objectives:**
Objective (1A): Discern and describe how the Earth is changing.
Objective (1B): Identify and measure the primary causes of change in the Earth system.
Objective (1C): Determine how the Earth system responds to natural and human-induced changes
Objective (1D): Identify the consequences of change in the Earth system for human civilization.
Objective (IE): Enable the prediction of future changes in the Earth system.

<u>Strategic Objective</u>: Understand the causes and consequences of land-cover/land-use change

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #	Collect near-daily measurements of ocean color (index of ocean productivity from which calculations of ocean update of carbon are made). (Y3). Refresh the global archive of 30m land imagery from Landsat 7, two to three times per year. A single global archive has not been constructed since late 1970's. This will include a 15m panchromatic band (Y1). Collect near-daily global measurements of the terrestrial biosphere (index of terrestrial photosynthetic processes from which calculations of carbon uptake are made) from instruments on TERRA (Y2).	SIMBIOS will merge MODIS ocean color data into the global ocean color time series, which began with Ocean Color Temperature Sensor (OCTS) and SeaWiFS. Use time series to understand and predict response of the marine ecosystem to climate change. Make data set available via the Goddard DAAC (0Y4). Continue the ocean color time series with 60% global coverage every 4 days (0Y3). Continue the development of a global land-cover/use change data set based on Landsat and EOS instrument, at seasonal refresh rate (0Y1). Continue to collect near-daily global measurements of the terrestrial biosphere (index of terrestrial photosynthetic processes from which calculations of carbon uptake are made) from instruments on TERRA (0Y2). Produce near-real-time fire monitoring and impact assessment based on Landsat and EOS inventory and process monitoring to provide an observational foundation for monitoring change in ecosystem productivity and disturbance. Post near-real-time assessments on a web site for quick access by researchers and regional authorities (0Y7).	Increase understanding of the dynamics of the global carbon cycle by developing, analyzing and documenting multi-year data sets and meeting at least 3 of 4 performance indicators in this research area (1Y3). Explain the dynamics of global carbon cycle by building improved models and prediction capabilities and meeting 2 of 2 performance indicators in this research area (1Y4).
APG Assessment	Yellow	0Y4 was yellow. 0Y3, 0Y1, 0Y2, and 0Y7 were green.	TBD

Strategic Objective: Understand the causes and consequences of land-cover/land-use change (continued)

	FY 02	FY 03	FY 03 Cont'd
Annual Performance Goal and APG #	Increase understanding of global ecosystem change by meeting at least 3 of 4 performance indicators (2Y3). Increase understanding about the changes in global land cover and land use and their causes by meeting at least 2 of 3 performance indicators (2Y8). Increase understanding of how ecosystems respond to and affect global environmental change and affect the global carbon cycle by meeting at least 4 of 5 performance indicators (2Y11). Increase understanding of the consequence of land cover and land use change for the sustainability of ecosystems and economic productivity by meeting at least 2 of 3 performance indicators (2Y17). Increase understanding of the consequences of climate and sea level changes and increased human activities on coastal regions by meeting 2 of 2 performance indicators (2Y18).	Increase understanding of global ecosystems change. Next set of indicators to measure progress toward answering this question will be given in the FY04 plan. Last set of indicators and associated progress was presented in FY02 performance plan. An assessment of progress toward answering this question will be published FY03 report. (3Y3). Increase understanding about the changes in global land cover and land use and their causes. Next set of indicators to measure progress toward answering this question will be given in the FY04 plan. Last set of indicators and associated progress was presented in FY02 performance plan. An assessment of progress toward answering this question will be published in the FY03 report. (3Y8). Increase understanding of how ecosystems respond to and affect global environmental change and affect the global carbon cycle. Next set of indicators to measure progress toward answering this question will be given in the FY04 plan. Last set of indicators and associated progress was presented in FY02 performance plan. An assessment of progress toward answering this question will be published in the FY03 report. (3Y11). Increase understanding of the consequence of land cover and land use change for the sustainability of ecosystems and economic productivity. Next set of indicators to measure progress toward answering this question will be given in the FY04 plan. Last set of indicators and associated progress was presented in FY02 performance plan. An assessment of progress toward answering this question will be published in the FY03 report. (3Y17).	Increase understanding of the consequences of climate and sea level changes and increased human activities on coastal regions. Next set of indicators to measure progress toward answering this question will be given in the FY04 plan. Last set of indicators and associated progress was presented in FY02 performance plan. An assessment of progress toward answering this question will be published in the FY03 report. (3Y18).
APG Assessment	TBD	TBD	TBD

<u>Strategic Objective</u>: Understand the causes and consequences of land-cover/land-use change (continued)

	<u>FY 02</u>	**<u>FY 03</u>**	
Annual Performance Goal and APG #			
APG Assessment	TBD		

***New objectives have been developed for FY 2002. The APGs can be mapped to the following new objectives:**

Objective (1A): Discern and describe how the Earth is changing.

Objective (1B): Identify and measure the primary causes of change in the Earth system.

Objective (1C): Determine how the Earth system responds to natural and human-induced changes

Objective (1D): Identify the consequences of change in the Earth system for human civilization.

Objective (IE): Enable the prediction of future changes in the Earth system.

Strategic Objective: Objective: Predict seasonal-to-interannual climate variations

	FY 99	FY 00	FY01
Annual Performance Goal and APG #	TRMM will begin the second of a 3-year sequence of instantaneous measurements of rainfall rates and monthly accumulations in the global tropics. This will be the first measurement of global tropical rainfall. Current uncertainty is 50 percent. TRMM data will reduce uncertainty to 10 percent. (Y4). QuikScat to provide 25km resolution wind speed & direction measurements over at least 90% of the ice-free oceans every two days. Resolution increases by a factor of two, and a 15% increase of coverage over previous measurement (Y5).	Establish a benchmark for global and regional rainfall measurements by combining TRMM measurements with measurements from other sources. Create maps of the diurnal cycle of precipitation for the first time. Combine the existing ten-year data set with TRMM measurements to validate climate models and demonstrate the impact of rainfall on short-term weather forecasting. Distribute through the Goddard DAAC for ease of access to science and operational users (0Y9). Develop/improve methods to couple state-of-the-art land surface and sea ice models to a global coupled ocean-atmosphere model and use to predict regional climactic consequences of El Nino or La Nina occurrence in the tropical Pacific. Results of research will be published in the open literature and provided to NOAA's National Climate Prediction Center and the U.S. Navy's Fleet Numeric Prediction Center. Ultimate goal: develop a capability to significantly improve the prediction for seasonal-to-interannual climate variations and their regional climate consequences. The main focus is on North America (0Y10).	Increase understanding of the dynamics of global water cycle by developing, analyzing, and documenting multi-year data sets and meeting 2 of 2 performance indicators in this research area. (1Y5). Explain the dynamics of global water cycle by building improved models and prediction capabilities and meeting at least 2 of 3 performance indicators in this research area (1Y6).
APG Assessment		Green	TBD

<u>Strategic Objective</u>: Objective: Predict seasonal-to-interannual climate variations (continued)

	FY 02	FY 03	FY 03 Cont'd
Annual Performance Goal and APG #	Increase understanding of global precipitation, evaporation and how the cycling of water is changing by meeting at least 3 of 4 performance indicators (2Y1). Increase understanding of global ocean circulation and how it varies on interannual, decadal, and longer time scales by meeting 2 of 2 performance indicators (2Y2). Increase understanding of how climate variations induce changes in the global ocean circulation by meeting at least 4 of 6 performance indicators (2Y12) Increase understanding of variations in local weather, precipitation and water resources and how they relate to global climate variation by meeting 2 of 2 performance indicators (2Y16) Increase understanding of the extent that weather forecast duration and reliability can be improved by new space-based observations, data assimilation and modeling by meeting at least 2 of 3 performance indicators (2Y19). Increase understanding of the extent that transient climate variations can be understood and predicted by meeting at least 4 of 5 performance indicators (2Y20).	Increase understanding of global precipitation, evaporation and how the cycling of water through the earth system is changing. Next set of indicators to measure progress toward answering this question will be given in the FY04 plan. Last set of indicators and associated progress was presented in FY02 performance plan. An assessment of progress toward answering this question will be published in the FY03 report. (3Y1). Increase understanding of global ocean circulation and how it varies on interannual, decadal, and longer time scales.(3Y2). Increase understanding of how climate variations induce changes in the global ocean circulation by meeting at least 2 of 3 performance indicators (3Y12) Increase understanding of variations in local weather, precipitation and water resources and how they relate to global climate variation. Next set of indicators to measure progress toward answering this question will be given in the FY04 plan. Last set of indicators and associated progress was presented in FY02 performance plan. An assessment of progress toward answering this question will be published in the FY03 report. (3Y16) Increase understanding of the extent that weather forecast duration and reliability can be improved by new space-based observations, data assimilation and modeling. Next set of indicators to measure progress toward answering this question will be given in the FY05 plan. Last set of indicators and associated progress was presented in FY02 performance plan. An assessment of progress toward answering this question will be published in the FY03 report. (3Y19)	Increase understanding of the extent that transient climate variations can be understood and predicted. Next set of indicators to measure progress toward answering this question will be given in the FY05 plan. Last set of indicators and associated progress was presented in FY02 performance plan. An assessment of progress toward answering this question will be published in the FY03 report. (3Y20).
APG Assessment	TBD	TBD	

<u>Strategic Objective</u>: Objective: Predict seasonal-to-interannual climate variations (continued)

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #		Measure production and radiative properties of aerosols produced by biomass burning in Africa based on SAFARI 2000 (field experiment) and EOS instruments. Includes extensive international participation. This burning is estimated to contribute one-half of global atmospheric aerosols (0Y11). Launch the NASA-CNES Jason-1 mission. This follow-on to TOPEX/ Poseidon is to achieve a factor-of-four improvement in accuracy in measuring ocean basin-scale sea-level variability. This is 1 order of magnitude better than that specified for TOPEX/Poseidon. (0Y12). Generate the first basin-scale high-resolution estimate of the state of the Pacific Ocean as part of the international Global Ocean Data Assimilation Experiment (GODAE) (0Y47).	
APG Assessment	Blue, green, yellow or red	0Y11 was green. 0Y12 was yellow 0Y47 was green.	

	FY 02	**FY 03**	
Annual Performance Goal and APG #			
APG Assessment	TBD	TBD	

***New objectives have been developed for FY 2002. The APGs can be mapped to the following new objectives:**

Objective (1A): Discern and describe how the Earth is changing.
Objective (1B): Identify and measure the primary causes of change in the Earth system.
Objective (1C): Determine how the Earth system responds to natural and human-induced changes
Objective (1D): Identify the consequences of change in the Earth system for human civilization.
Objective (IE): Enable the prediction of future changes in the Earth system.

<u>Strategic Objective</u>: Identify natural hazards, processes, and mitigation strategies

	FY 99	FY 00	FY01
Annual Performance Goal and APG #	The Enterprise will provide the technology and instruments to create the first digital topographic map of 8o percent of Earth's land surface, everything between 60°N and 56°S. SRTM will be ready to launch in September 1999. (Y6). Use GPS array in southern California to monitor crustal deformation on a daily basis with centimeter precision; initiate installation of the next 100 stations. Data will be archived at JPL and run in models, with results given to the California Seismic Safety Commission and FEMA. (Y7). Use GPS data to test improved algorithms for sounding the atmosphere with the occulted GPS signal. Data will be archived at JPL and results published in science literature. (Y8).	Use Southern California Global Positioning System (GPS) array data to understand the connection between seismic risk and crustal strain leading to Earthquakes (0Y37). Develop models to use time-varying gravity observations for the first time in space (0Y38). Demonstrate the utility of spaceborne data for floodplain mapping with the Federal Emergency Management Agency (0Y39). Develop an automatic volcano cloud/ash detection algorithm employing EOS data sets for use by the Federal Aviation Administration (0Y40).	Increase understanding of the dynamics of the Earth's interior and crust by developing, analyzing, and documenting multi-year data sets and meeting 2 of 2 performance indicators in this research area (1Y11). Explain the dynamics of the Earth's interior and crust by building improved models and prediction capabilities and meeting 2 of 2 performance indicators in this research area (1Y12).
APG Assessment	Green	Green	TBD

<u>Strategic Objective</u>: Identify natural hazards, processes, and mitigation strategies (continued)

	FY 02	**FY 03**	
Annual Performance Goal and APG #	Increase understanding of the motions of the Earth, the Earth's interior, and what information can be inferred about the Earth's internal processes by meeting at least 3 of 4 performance indicators (2Y6). Increase understanding of the Earth's surface and how it is transformed and how such information can be used to predict future changes by meeting at least 4 of 5 performance indicators (2Y9).	Increase understanding of the motions of the Earth, the Earth's interior, and what information can be inferred about the Earth's internal processes. Next set of indicators to measure progress toward answering this question will be given in the FY05 plan. Last set of indicators and associated progress was presented in FY02 performance plan. An assessment of progress toward answering this question will be published in the FY03 report. (3Y6). Increase understanding of the Earth's surface and how it is transformed and how such information can be used to predict future changes. Next set of indicators to measure progress toward answering this question will be given in the FY05 plan. Last set of indicators and associated progress was presented in FY02 performance plan. An assessment of progress toward answering this question will be published in the FY03 report. (3Y9).	
APG Assessment	TBD	TBD	

***New objectives have been developed for FY 2002. The APGS can be mapped to the following new objectives:**

Objective (1A): Discern and describe how the Earth is changing.

Objective (1B): Identify and measure the primary causes of change in the Earth system.

Objective (1C): Determine how the Earth system responds to natural and human-induced changes

Objective (1D): Identify the consequences of change in the Earth system for human civilization.

Objective (IE): Enable the prediction of future changes in the Earth system.

<u>Strategic Objective</u>: Detect long-term climate change, causes, and impacts.

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #	MODIS, MISR, ASTER, CERES (TERRA instruments) will begin to conduct daily observations of cloud properties such as extent, height, optical thickness and particle size. Data will be distributed through the Goddard DAAC (Y9). TERRA will map aerosol formation, distribution and sinks over the land and oceans (Y10). The TERRA instrument will achieve a 40-percent reduction in the uncertainty in Earth's radiation balance (that is improved angular models leading to an estimated error reduction in regional-scale monthly average net radiation of about 50 percent. (Y11).	Complete the collection of satellite data needed for the 17-year cloud climatology being developed under the International Satellite Cloud Climatology Project. Data will be used to improve the understanding and modeling of role of clouds in climate. Data will be available in the Goddard DAAC (0Y13). Continue the development of the global aerosol climatology data set and analysis of this climatology in climate models. Data will be available in the Goddard DAAC (0Y14). Provide for the continuation of the long-term, precise measurement of the total solar irradiance with the launch of EOS ACRIM (0Y15). Acquire, through a Radarsat repeat of Antarctic Mapping Mission conducted in Sept.-Oct. 1997, a second set of high-resolution radar data over all of Antarctica for comparison with baseline data set acquired in 1997, to identify changes on the ice sheet (0Y16). Publish the first detailed estimates of thickening/thinning rates for all major ice drainage basins of Greenland ice sheet derived from repeated airborne laser-altimetry surveys. Measures represent the baseline data set to compare with early GLAS data (July 2001 launch) (OY17).	Increase understanding of the dynamics of long term climate variability by developing, analyzing, and documenting multi-year data sets and meeting at least 2 of 3 performance indicators in this research area (1Y7). Explain the dynamics of long term climate variability by building improved models and prediction capabilities and meeting at least 3 of 4 performance indicators in this research (1Y8).
APG Assessment	Yellow	All were green	TBD

Strategic Objective: **Detect long-term climate change, causes, and impacts (continued)**

	FY 02	FY 03	
Annual Performance Goal and APG #	Increase understanding of change occurring in the mass of the Earth's ice cover by meeting at least 3 of 4 performance indicators (2Y5). Increase understanding of the effects of clouds and surface hydrologic processes on climate change by meeting at least 4 of 5 performance indicators (2Y10). Increase understanding of global sea level and how it is affected by climate change by meeting at least 2 of 3 performance indicators (2Y14). Increase understanding of the extent that long-term climate trends can be assessed or predicted by meeting at least 4 of 5 performance indicators (2Y21).	Increase understanding of change occurring in the mass of the Earth's ice cover by meeting at least 3 of 4 performance indicators (3Y5). Increase understanding of the effects of clouds and surface hydrologic processes on climate change. Next set of indicators to measure progress toward answering this question will be given in the FY04 plan. Last set of indicators and associated progress was presented in FY02 performance plan. An assessment of progress toward answering this question will be published in the FY03 report. (3Y10). Increase understanding of global sea level and how it is affected by climate change. (3Y14). Increase understanding of the extent that long-term climate trends can be assessed or predicted. Next set of indicators to measure progress toward answering this question will be given in the FY05 plan. Last set of indicators and associated progress was presented in FY02 performance plan. An assessment of progress toward answering this question will be published in the FY03 report. (3Y21). Increase understanding of extent that future concentrations of carbon dioxide and methane and impacts on climate can be predicted. Next set of indicators to measure progress toward answering this question will be given in the FY05 plan. Last set of indicators and associated progress was presented in FY02 performance plan. An assessment of progress toward answering this question will be published in the FY03 report. (3Y23)	
APG Assessment	TBD	TBD	

<u>Strategic Objective</u>: Detect long-term climate change, causes, and impacts (continued)

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #		Initiate a program of airborne mapping of layers within the Greenland ice sheet to decipher the impact of past climate variation of polar regions (0Y18). Develop a remote-sensing instrument/technique for ocean surface salinity measurements from aircraft. Goal: to improve measurement accuracy to ` order of magnitude better than available in FY98. The ultimate goal is the capability to globally measure sea surface salinity from space (0Y19). Continue to improve the design and sophistication of a global climate system model, including use of higher resolution, to make it a state-of-the-art climate system model for projecting the climatic consequences at the regional level. Improvement will be manifested in increased resolution from added computing power and better numerical representations (0Y20).	
APG Assessment	Blue, green, yellow or red	All were green	

	FY 02	**FY 03**	
Annual Performance Goal and APG #			
APG Assessment			

<u>*New objectives have been developed for FY 2002. The APGs can be mapped to the following new objectives:</u>

Objective (1A): Discern and describe how the Earth is changing.
Objective (1B): Identify and measure the primary causes of change in the Earth system.
Objective (1C): Determine how the Earth system responds to natural and human-induced changes
Objective (1D): Identify the consequences of change in the Earth system for human civilization.
Objective (IE): Enable the prediction of future changes in the Earth system.

<u>Strategic Objective</u>: Understand the causes of variation in atmospheric ozone concentration and distribution.

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #	TOMS data will be used for new retrieval methods to collect and analyze three new data products, including surface ultraviolet, tropospheric aerosols, and tropospheric columns. With SBUV/2 data, TOMS will make a continuous 20-year data set for total ozone-measuring effectiveness of Montreal Protocol. New and extended data products will be made available on TOMS web site. (Y12). Complete initiation of the full Southern Hemisphere Additional Ozonesonde network to obtain the first-ever climatology of upper tropospheric ozone in the tropics (Y14). With data from other atmospheric ozone programs, continue the detailed multi-aircraft study of troposphere chemistry over the tropical Pacific Ocean, especially the contribution of long-range transport of air from South America and Africa to unpolluted areas. Complete the field measurements phase of PEM-Tropics-B (rainy season) with an improved payload that has resulted from an initiative to develop a smaller, lighter payload with equal or better performance than PEM-Tropics-A (dry season). Results will be fully analyzed and published. (Y15).	Implement the SAGE III Ozone Loss and Validation Experiments. Measurements will be made from October 1999 to March 2000 in the Arctic/high-latitude region from the NASA DC-8, ER-2, and balloon platforms. Will acquire correlative data to validate SAGE III data and assess high-latitude ozone loss (0Y22). (Green) Complete the analysis and publication of the PEM-Tropics-B field experiment (0Y23). (Green) Complete the Troposphere Chemistry aircraft instrument size and weight reductions (by ~40%) initiative (0Y24). (Green) Complete the planning for major new 2001 airborne/unmanned aerospace vehicle mission that will use a smaller Troposphere Chemistry aircraft instrument (0Y25).	Increase understanding of the dynamics of atmospheric composition by developing, analyzing, and documenting multi-year data sets and meeting at least 4 of 5 performance indicators in this research area (1Y9). Explain the dynamics of atmospheric chemistry by building improved models and prediction capabilities and meeting at least 2 of 3 performance indicators in this research area (1Y10).
APG Assessment	Yellow	All were green.	TBD

Strategic Objective: **Understand the causes of variation in atmospheric ozone concentration and distribution (continued)**

	FY 02	FY 03	FY04
Annual Performance Goal and APG #	Increase understanding of stratospheric ozone changes, as the abundance of ozone-destroying chemicals decreases and new substitutes increases by meeting 2 of 2 performance indicators (2Y4). Increase understanding of trends in atmospheric constituents and solar radiation and the role they play in driving global climate by meeting at least 3 of 4 performance indicators (2Y7). Increase understanding of stratospheric trace constituents and how respond to change in climate and atmospheric composition by meeting 2 of 2 performance indicators (2Y13). Increase understanding of the effects of regional pollution on the global atmosphere, and the effects of global chemical and climate changes on regional air quality by meeting at least 4 of 5 performance indicators (2Y15). Increase understanding of the extent that future atmospheric chemical impacts on ozone and climate can be predicted by meeting at least 2 of 3 performance indicators (2Y22).	Increase understanding of stratospheric ozone changes, as the abundance of ozone-destroying chemicals decreases and new substitutes increases by meeting 2 of 2 performance indicators (3Y4). Increase understanding of trends in atmospheric constituents and solar radiation and the role they play in driving global climate by meeting at least 4 of 5 performance indicators (3Y7). Increase understanding of stratospheric trace constituents and how respond to change in climate and atmospheric composition by. (3Y13). Increase understanding of the effects of regional pollution on the global atmosphere, and the effects of global chemical and climate changes on regional air quality by meeting at least 4 of 5 performance indicators (3Y15). Increase understanding of the extent that future atmospheric chemical impacts on ozone and climate can be predicted by meeting at least 2 of 3 performance indicators (3Y22).	
APG Assessment	TBD	TBD	

Strategic Objective: Understand the causes of variation in atmospheric ozone concentration and distribution (continued)

	FY 99	FY 00	FY01
Annual Performance Goal and APG #	Use SAGE III to improve the collection and analysis of measurements provided by SAGE II, and add: nitrogen trioxide and chlorine dioxide measures; additional wavelength sampling to directly measure and retrieve aerosols throughout the troposphere; and, higher spectral resolution (Y13). With data from other atmospheric ozone programs, measure surface levels of chlorine-and bromine-containing chemical compounds addressed in the Montreal Protocol to document decreasing concentrations of regulated compounds and increasing concentrations of replacement compounds. Analyses will be provided to researchers supporting the WMO assessment process. (Y16). APGs Y13 and Y16 are linked to FY00-FY03 APGs (see previous pages).		
APG Assessment	Yellow		

	FY 02	FY 03	FY04
Annual Performance Goal and APG #			
APG Assessment			

FY 2002-2003 Enterprise-Wide Supporting Activities/FY 99-01 Objective: Successfully launch spacecraft

	FY 99	FY 00	FY01
Annual Performance Goal and APG #	The Enterprise will successfully launch three spacecraft within 10% of budget on average (Y35).	Launch three spacecraft and deliver two instruments for international launches within 10% of budget on average (0Y36).	Successfully develop, have ready for launch, and operate instruments on a least two spacecraft within 10 percent of their schedules and budget to enable Earth Science research and applications goals and objectives (1Y1).
APG Assessment	Yellow	Green	TBD

	FY 02	FY 03	FY 04
Annual Performance Goal and APG #	Successfully develop, have ready for launch, and operate instruments on at least two spacecraft to enable Earth Science research and applications goals and objectives (2Y29).	Successfully develop one spacecraft and have ready for launch. Operate instruments on orbiting spacecraft to enable Earth Science research and applications goals and objectives. (3Y30).	
APG Assessment	TBD	TBD	

FY 2002-2003 Enterprise-Wide Supporting Activities/FY 99-01 Objective: Implement open, distributed, and responsive data system architectures

	FY 99	FY 00	FY01
Annual Performance Goal and APG #	Make available data on prediction, land surface, and climate to users within 5 days (Y17). Increase the volume of data archived by 10% compared to FY97 (target = 139 terabytes). Goddard has been collecting trend data since FY94. (Y18). Increase the number of distinct customers by 20% compared to FY97 (target = 839,000). Goddard has been collecting trend data since FY94 (Y19). Increase products delivered from the DAACs by 10% compared to FY97 (target = 3.8 million). Goddard has been collecting trend data since FY94 (Y20).	EOSDIS make available data on prediction, land surface, and climate to users within five days (0Y26). EOSDIS will double the volume of data archived compared to FY98 (0Y27). EOSDIS will increase the number of distinct customers by 20% compared to FY98 (0Y28). EOSDIS will increase products delivered from the DAACs by 10% compared to FY98 (0Y29).	Successfully disseminate Earth Science data to enable our science research and applications goals and objectives by meeting all performance indicators in this research area (1Y2).
APG Assessment	Blue	All were blue.	TBD

	FY 02	FY 03	FY 04
Annual Performance Goal and APG #	Successfully disseminate Earth Science data to enable our science research and applications goals and objectives. Success will equate to meeting 4 of 5 performance indicators (2Y30). Safely operate airborne platforms to gather remote and in situ earth science data for process and calibration/validation studies (2Y31).	Successfully disseminate Earth Science data to enable our science research and applications goals and objectives. Success will equate to meeting 4 of 5 performance indicators (3Y31). Safely operate airborne platforms to gather remote and in situ earth science data for process and calibration/validation studies (3Y32).	
APG Assessment	TBD	TBD	

<u>Strategic Objective</u>: Stimulate public interest in and understanding of Earth system science and courage young scholars to consider careers in science and technology/FY 99-01 Objective: Increase public understanding of Earth system science through education and outreach.

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #	Award 50 new graduate student research grants and 20 early career postdoctoral fellowships in Earth Science. (Y21). Conduct over 300 teacher workshops to train teachers in use of Earth Science Enterprise education products (Y22). Increase number of schools participating in GLOBE from to 8,000, from 5,900 in FY98, a 35-percent increase; increase participating countries from 70 in FY98 to 72 (Y23).	Award 50 new graduate student research grants and 20 early career fellowships in Earth Science (0Y30). Conduct at least 300 workshops to train teachers in use of ESE education products (0Y31). Increase number of schools participating in GLOBE to 10,500, a 30% increase over FY99; increase participating countries to 77 (from 72). (0Y32).	Increase public understanding of Earth system science through formal and informal education by meeting at least 3 of 4 performance targets in this area (1Y18).
APG Assessment	Green	0Y30 was green. 0Y31 was blue. 0Y32 was yellow.	TBD

	FY 02	**FY 03**	**FY 04**
Annual Performance Goal and APG #	Share NASA's discoveries in Earth science with the public to enhance understanding of science and technology (2Y24).	Share the excitement of NASA's scientific discoveries and the practical benefits of earth science to the public in promoting understanding of science and technology in service to society. Success will equate to meeting 3 of 4 performance targets. (3Y25).	
APG Assessment	TBD	TBD	

<u>Strategic Objective</u>: Develop advanced technologies to reduce the cost and expand the capability for scientific Earth observation/FY 99-01 Objective: Develop and transfer advanced remote-sensing technologies.

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #	Annually advance at least 25% of funded instrument technology developments one TRL (Y30). Demonstrate a new capability to double the calibration quality for moderate-resolution land imagery. (Y28). Annually transfer at least one technology development to a commercial entity for operational use (Y29).	Advance at least 25% of funded instrument technology development one TRL to enable future science missions and reduce their total cost (0Y35). Achieve a 50% reduction in mass for future land imaging instruments (0Y33). Transfer at least one technology development to a commercial entity for operational use (0Y34).	Achieve success with timely development and infusion of technologies. Enable future science missions by increasing technology readiness for mission concepts to reduce their total cost. Do this by meeting at least 3 of 4 performance indicators for this advanced technology area (1Y13).
APG Assessment	Green	0Y35 was blue 0Y33 and 0Y34 were green	TBD

	FY 02	**FY 03**	**FY 04**
Annual Performance Goal and APG #	Successfully develop and infuse technologies that will enable future science measurements, and/or improve performance and reduce the cost of existing measurements. Increase the readiness of technologies under development, advancing them to a maturity level where they can be infused into new missions with shorter development cycles (2Y25).	Successfully develop and infuse technologies that will enable future science measurements, and/or improve performance and reduce the cost of existing measurements. Increase the readiness of technologies under development, retiring risks and advancing them to a maturity level where they can be infused into new missions with shorter development cycles. Success will equate to meeting 3 of 4 performance indicators. (3Y26).	
APG Assessment	TBD	TBD	

Strategic Objective: Develop advanced information systems for processing, archiving, accessing, visualizing, and communicating Earth science data. (Introduced in FY02)

	FY 99	**FY 00**	**FY 01**
Annual Performance Goal and APG #			
APG Assessment			

	FY 02	**FY 03**	**FY 04**
Annual Performance Goal and APG #	Develop hardware/software tools to demonstrate high-end computational modeling to further our understanding and ability to predict the dynamic interaction of physical, chemical and biological processes affecting the earth (2Y26). Develop baseline suite of multidisciplinary models and computational tools leading to scalable global climate simulations. (2Y27)	Develop hardware/software tools to demonstrate high-end computational modeling to further our understanding and ability to predict the dynamic interaction of physical, chemical and biological processes affecting the earth. Success will equate to meeting 2 of 3 performance indicators. (3Y27) Develop baseline suite of multidisciplinary models and computational tools leading to scalable global climate simulations. (3Y28)	
APG Assessment	TBD	TBD	

Strategic Objective: Demonstrate scientific and technical capabilities to enable the development of practical tools for public and private-sector decision makers/FY 99-01 Strategic Objective: Extend the use of Earth Science research for regional, state, and local applications

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #	Establish at least five Regional Earth Science Applications Centers (RESACs) (Y31). Complete solicitation for seven co-operative agreements with State and local governments in areas of land use planning, land capability analysis, critical areas management, and water resource management (Y33). Establish at least eight new projects, with USDA, in the areas of vegetation mapping and monitoring, risk and damage assessment, resources management and precision agriculture (Y32).	At least one of seven Regional Earth Science Applications Center (RESAC) becomes self-sustaining. Continue funding for the remaining centers (0Y41). Develop two new validated commercial information products as a result of verification and validation partnerships with industry (0Y46). Implement at least five joint applications research projects/partnerships with State and local governments in remote –sensing applications (0Y43).	Provide regional decision-makers with scientific and applications products/tools by meeting at least 7 of 8 performance indicators for this applications research area (1Y14). Improve access to and understanding of remotely sensed data and processing technology by meeting 3 of 3 performance indicators in this area (1Y15).
APG Assessment	Blue	0Y41 was yellow 0Y46 and 0Y43 were green	TBD

	FY 02	**FY 03**	**FY 04**
Annual Performance Goal and APG #	Provide regional decision-makers with scientific and applications products and tools (2Y23).	Provide regional decision-makers with scientific and applications products and tools by meeting 3 of 3 performance indicators. (3Y24)	
APG Assessment	TBD	TBD	

Strategic Objective: Partner with other agencies to develop and implement better methods for using remotely sensed observations in Earth system monitoring and prediction/FY 99-01 Strategic Objective: Extend the use of Earth Science research for regional, state, and local applications.

	FY 99	**FY 00**	**FY 01**
Annual Performance Goal and APG #			
APG Assessment			

	FY 02	**FY 03**	**FY 04**
Annual Performance Goal and APG #	Collaborate with other Federal and international agencies in developing and implementing better methods for using remotely sensed observations (2Y28)	Collaborate with other domestic and international agencies in developing and implementing better methods for using remotely sensed observations. Success will equate to meeting 4 of 5 performance indicators. (3Y29)	
APG Assessment	TBD	TBD	

FY 99-01 Objective: Support the development of a robust commercial remote sensing industry.

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	Establish at least 75 commercial partnerships in "value-added" remote sensing product development; an increase from 37 over FY97 (Y34).	Focus EOCAP joint commercial applications research to develop 20 new market commercial products (e.g., oil spill containment software by EarthSat and map sheets products by ERDAS, Inc.). (0Y44). Provide three commercial sources of science data (from the data buy) for global change research and applications (0Y45). Develop two new validated commercial information products as a result of verification and validation partnerships with industry (0Y46).	Stimulate the development of a robust commercial remote sensing industry by meeting at least 4 of 5 performance indicators in this area (1Y16). Increase efficiencies in food and fiber production with the aid of remote sensing by meeting the performance indicator in this area (1Y17).	**Note: No longer a strategic objective.**
Assessment	Blue	0Y44 was yellow 0Y45 and 0Y46 were green	TBD	

FY 99-01 Strategic Objective: Make major scientific contributions to national and international environmental assessments

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #	Make significant contribution to World Meteorological Organization (WMO) Ozone Assessment by providing a lead chapter author and most of the global-scale data (Y26). Contribute model results of climate affects of measured aircraft emissions and provide report to IPCC assessment report (Y24). Make significant contributions to US. Regional/national assessments in partnership with U.S. Global Change Research Program agencies (Y25). Provide lead chapter author and most of the global-scale data and contributing researchers to the IPCC Assessment Report, sponsored by the United Nations Environment Program and WMO (Y27).	Sponsor two regional national assessment studies of environmental variations and natural resources vulnerability (0Y48). (Green) Complete the contribution to the First National Assessment of the Potential Consequences of Climate Variability and Change: provide climate scenario information, support the national synthesis, conduct several regional U.S. analyses, and provide supporting research for sector analyses. Provide information to the U.S. National Assessment Coordination Office. (0Y5). (Green)	**Note: Incorporated into science objectives in FY01 and beyond.**	
Assessment	Green	Green		

FY 99-01 Strategic Objective: Make major scientific contributions to national and international environmental assessments (continued)

	FY 1999	FY 2000	FY 2001	FY 2002
Annual Performance Goal and APG #		Conduct the first regional international assessment in South Africa: quantify the effects of climate variability and management practices on the environment, publish in open literature, and provide analyses to IPCC for their 2000 assessment. (0Y6). Provide the first global, regional and country-by country forest cover inventory in support of national and international needs research, operational and policy communities. Publish and provide to IPCC and the International Geosphere-Biosphere Program for their 2000 assessment report (0Y8).		
Assessment		0Y6 was yellow. 0Y8 was green.		

APG #	Office of Earth Science FY 2003 Budget Link Table	Budget Category	Earth Observing System	Earth Explorers	Operations	Research and Technology	Investments
3Y1	Increase understanding of global precipitation, evaporation and how the cycling of water through the earth system is changing		X		X	X	
3Y2	Increase understanding of global ocean circulation and how it varies on interannual, decadal, and longer time scales				X	X	
3Y3	Increase understanding of global ecosystems change		X			X	
3Y4	Increase understanding of stratospheric ozone changes, as the abundance of ozone-destroying chemicals decreases and new substitutes		X		X	X	
3Y5	Increase understanding of change occurring in the mass of the Earth's		X	X		X	
3Y6	Increase understanding of the motions of the Earth, the Earth's interior, and what information can be inferred about the Earth's internal			X		X	
3Y7	Increase understanding of trends in atmospheric constituents and solar radiation and the role they play in driving global climate		X			X	
3Y8	Increase understanding about the changes in global land cover and land use and their causes		X			X	
3Y9	Increase understanding of the Earth's surface and how it is transformed and how such information can be used to predict future changes		X	X		X	
3Y10	Increase understanding of the effects of clouds and surface hydrologic processes on climate change		X			X	
3Y11	Increase understanding of how ecosystems respond to and affect global environmental change and affect the global carbon cycle		X		X	X	
3Y12	Increase understanding of how climate variations induce changes in the global ocean circulation		X			X	
3Y13	Increase understanding of stratospheric trace constituents and how they respond to change in climate and atmospheric composition				X	X	
3Y14	Increase understanding of global sea level and how it is affected by climate change					X	

APG #	**Office of Earth Science** **FY 2003 Budget Link Table**	**Budget Category**	Earth Observing System	Earth Explorers	Operations	Research and Technology	Investments
3Y15	Increase understanding of the effects of regional pollution on the global atmosphere, and the effects of global chemical and climate changes on regional air quality		X		X	X	
3Y16	Increase understanding of variations in local weather, precipitation and water resources and how they relate to global climate variation		X		X	X	
3Y17	Increase understanding of the consequence of land cover and land use change for the sustainability of ecosystems and economic productivity		X			X	
3Y18	Increase understanding of the consequences of climate and sea level changes and increased human activities on coastal regions		X			X	
3Y19	Increase understanding of the extent that weather forecast duration and reliability can be improved by new space-based observations, data assimilation and modeling				X	X	
3Y20	Increase understanding of the extent that transient climate variations can be understood and predicted		X		X	X	
3Y21	Increase understanding of the extent that long-term climate trends can be assessed or predicted					X	
3Y22	Increase understanding of the extent that future atmospheric chemical impacts on ozone and climate can be predicted					X	
3Y23	Increase understanding of the extent that future concentrations of carbon dioxide and methane and their impacts on climate can be					X	
3Y24	Provide regional decision-makers with scientific and applications products and tools.					X	
3Y25	Share the excitement of NASA's scientific discoveries and the practical benefits of Earth science to the public in promoting understanding of science and technology in service to society					X	

APG #	**Office of Earth Science** **FY 2003 Budget Link Table**	**Budget Category**	Earth Observing System	Earth Explorers	Operations	Research and Technology	Investments
3Y26	Successfully develop and infuse technologies that will enable future science measurements, and/or improve performance and reduce the cost of existing measurements. Increase the readiness of technologies under development, retiring risks, and advancing them to a maturity level where they can be infused into new missions with shorter					X	
3Y27	Develop hardware/software tools to demonstrate high-end computational modeling to further our understanding and ability to predict the dynamic interaction of physical, chemical and biological					X	
3Y28	Develop baseline suite of multidisciplinary models and computational tools leading to scalable global climate simulations					X	
3Y29	Collaborate with other domestic and international agencies in developing and implementing better methods for using remotely sensed observations to support national and international assessments of climate changes and their practical consequences					X	
3Y30	Successfully develop one (1) spacecraft and have ready for launch. Operate instruments on orbiting spacecraft to enable Earth science research and applications goals and objectives		X	X		X	
3Y31	Successfully disseminate Earth Science data to enable our science research and applications goals and objectives		X			X	
3Y32	Safely operate airborne platforms to gather remote and in situ earth science data for process and calibration/validation studies					X	

Human Exploration and Development of Space
FY 2003 Performance Plan

Mission

As America enters a new millennium, people the world over are reflecting on the accomplishments of the past and speculating about opportunities of the future. Some of the most inspiring and important accomplishments of the past four decades have resulted from the space program. Events such as the planet-wide impact of the Apollo landings on the moon and images of the Earth; discoveries such as the astonishing Hubble Space Telescope (HST) photos of solar system formation; achievements such as the sending of the first human-built spacecraft—Pioneer and Voyager spacecraft—beyond our solar system; and new capabilities such as communications and weather satellites. Space has touched the lives of many hundreds of millions worldwide.

The mission of HEDS is to expand the frontiers of space and knowledge by exploring, using, and enabling the development of space for human enterprise. To achieve this mission, NASA's Human Exploration and Development of Space (HEDS) Enterprise is pursuing four strategic goals:

- Explore the space frontier
- Enable humans to live and work permanently in space
- Enable the commercial development of space, and
- Share the experience and benefits of discovery

HEDS begins with the foundation of the Space Shuttle and the International Space Station, now under construction in Earth orbit, and look to the future by fostering technology development and commercialization in space.

HEDS also aspires to make possible U.S. leadership of international efforts to extend permanently human presence beyond the bounds of Earth, involving both machines and humans as partners in innovative approaches to exploration. HEDS engages the private sector in the commercial development of space in order to enable the continuation of current space business and the creation of new wealth and new jobs for the U.S. economy.

Accomplishment of these goals will enable historic improvements in our understanding of nature, in human accomplishment, and in the quality of life. The Human Exploration and Development of Space Strategic Plan is a first step. This performance plan shows how we plan to measure our success.

Resource Requirements:

(NOA, dollars in millions)	FY1999	FY 2000	FY 2001	FY 2002	FY 2003
$M	6,345	6,302	5,973	6,830	6,131
CS FTE	7,209	7,416	7,936	7,182	6,877

Implementation Strategy

Goal 1 - Explore the Space Frontier
There are certain ideas that many believe to be inherent in the human psyche and integral to American culture: ambition for progress, curiosity about the unknown, the need to pose profound questions and to answer them, the concept of new frontiers that—once achieved—promise a better quality of life for all peoples. Space is such a frontier. Earth orbit, the Moon, near-Earth space, Mars and the asteroids, eventually the moons of the giant planets of the outer solar system, and someday more distant worlds—these are collectively the endless, ever-expanding frontier of the night sky under which the human species evolved and toward which the human spirit is inevitably drawn. It is a fundamental goal of NASA to expand the space frontier progressively through human exploration, utilization of space for research, and commercial development.

Strategic Objectives

- Invest in the development of high-leverage technologies to enable safe, effective and affordable human/robotic exploration.
- Conduct engineering research on the International Space Station to enable exploration beyond Earth orbit.
- Enable human exploration through collaborative robotic missions.
- Define innovative human exploration mission approaches.
- Develop exploration/commercial capabilities through private sector and international partnerships.

Goal 2 - Enable Humans to Live and Work Permanently in Space
Advances in technology notwithstanding, the human element continues to be the major factor in the success or failure of most terrestrial enterprises. In many cases, innovative technologies are most effective when used to leverage or enhance the productivity of humans. Moreover, the human element is a quintessential component in the public's continuing interest in, and support for the space program. Human presence will be an essential factor in successfully opening the space frontier and expanding knowledge through research in space. As our activities in space grow, so too must human involvement. In this way, we open the door to an array of benefits, tangible and intangible, for the people of the United States and the world. It is, therefore, a goal of NASA to enable and establish permanent and productive human presence in space, to advance America's aspirations and opportunities in space through new technologies and new ways of doing business.

Strategic Objectives

- Provide and make use of safe, affordable, and improved access to space.
- Operate the International Space Station to advance science, exploration, engineering, and commerce.
- Ensure the health, safety, and performance of humans living and working in space.
- Meet sustained space operations needs while reducing costs.

Goal 3 - Enable the Commercial Development of Space

Commerce is essential to human society; free market transactions are the foundation of the dramatic progress humankind has made during the past several centuries. Wherever humans go and wherever they live, there too is commerce. Moreover, the free market is an effective mechanism for delivering tangible benefits from space broadly to the American people.

If humanity is to explore and develop space, to better exploit the space environment for profound scientific discoveries, and someday to settle the space frontier, it may be through the continuing expansion of the private sector—of individuals and of industry—into space. As the space frontier opens, it is important must therefore seek to expand the free market into space.

It is a goal of NASA to enable the commercial development of space.

Strategic Objectives

- Improve the accessibility of space to meet the needs of commercial research and development.
- Foster commercial endeavors with the International Space Station and other assets.
- Develop new capabilities for human space flight and commercial applications through partnerships with the private sector.

Goal 4 - Share the Experience and Benefits of Discovery

Americans—of all backgrounds—should have the opportunity to share in the experience and benefits of space exploration and development. During the past four decades, ambitious human space flight missions have inspired generations of young people to undertake careers in science, mathematics, and engineering— benefiting both themselves and society. The space program can enrich society by directly enhancing the quality of education. Terrestrial applications of technologies developed for space have saved many lives, made possible medical breakthroughs, created countless jobs, and yielded diverse other tangible benefits for Americans. The further commercial development of space will yield still more jobs, technologies, and capabilities to benefit people the world over in their everyday lives. A goal of NASA is therefore to share the experience, the excitement of discovery, and the benefits of human space flight with all.

Strategic Objectives

- Engage and involve the public in the excitement and the benefits of—and in setting the goals for—the exploration and development of space.
- Provide significantly more value to significantly more people through exploration and space development efforts.
- Advance the scientific, technological, and academic achievement of the Nation by sharing our knowledge, capabilities, and assets.

Performance Measures

Goal 1: Explore the Space Frontier

Objective: Invest in the development of high-leverage technologies to enable safe, effective and affordable human/robotic exploration.

Annual Performance Goal 3H01: The HEDS Advanced Programs office works collaboratively with other NASA Enterprises and Field Centers on advanced planning activities to leverage available resources in advanced technologies that will enable safe, effective, and affordable human/robotic exploration.

- NASA Exploration Team (NEXT) will produce and distribute an annual report documenting advanced planning activities and advanced technology advancement.

Objective: Conduct engineering research on the International Space Station to enable exploration beyond Earth orbit.

Annual Performance Goal 3H02: Provide for science and technology research on the International Space Station a minimum average of five mid-deck lockers for each Space Shuttle mission to the ISS and maintain 80% availability of Space Station resources to support science and technology research.

- Demonstrate that an average of five mid-deck lockers was used to support research for each Space Shuttle mission going to the International Space Station (source International Space Station manifest).
- Formulate a customer survey that measures customer satisfaction of available Space Station resources to ISS researchers.
- Determine if adequate resources were available to the science and technology researchers conducting experiments on the International Space Station -- Conduct a customer survey of International Space Station researchers at the conclusion of their research on Space Station (80% customer satisfaction on available resources = green).

Annual Performance Goal 3H25: Space Shuttle supports exploration by transporting payloads, logistics, and crew to the International Space Station.

- Achieve 100% on-orbit mission success for all flights in FY 2003. For this metric, mission success criteria are those provided to the prime contractor (SFOC) for purposes of determining successful accomplishment of the performance incentive fees in the contract

Public Benefit: Many of the key technologies needed for future human/robotic exploration and development of space will require testing and later demonstrations in the actual space environment before they can be cost-effectively applied in future space systems. Conducting engineering research and development at the International Space Station, will result in more timely, affordable and successful application of these new technologies (including the capability to design to cost and implement to cost for future HEDS projects). In addition, the space application of these technologies will result in expanded scope for human commerce and an improved quality of life by enabling potential high-value new space industries (e.g., advanced communications satellites, manufacturing in space, R&D in space, public space travel, space utilities, and others) while improving the quality of life (e.g., through advances in our understanding of human physiology and human factors, in medicine and medical systems). Promote continuous research and development activities through the International Space Station assembly period.

Objective: Enable human exploration through collaborative robotic missions.

Annual Performance Goal 3H03: Provide reliable launch services for approved missions.
- NASA success rate at or above a running average of 95% for missions noted on the Flight Planning Board manifest and launched pursuant to commercial launch service contracts.

Annual Performance Goal 3H04: Provide reliable space communication services for Space Science and Earth Science missions be consistent with program and project requirements.
- Achieve at least 95 percent of planned data delivery for space flight missions.

Public Benefit: A better understanding (at the earliest possible dates) of the space and planetary environments to which human explorers will one day travel will make possible a more focused, more effective and lower cost investment to develop the technologies needed for future human/robotic exploration and development of space. This knowledge and understanding will also make possible reduced risks to the health and safety of future astronauts. Overall, pursuing collaborative robotic missions will result in future human/robotic exploration missions with lower costs and greater benefits that would be otherwise achievable. HEDS supports this strategic objective by working collaboratively with other enterprises on advanced planning activities and providing launch services supporting NASA sponsored missions including robotic spacecraft missions.

Goal 2: Enable Humans to Live and Work Permanently in Space

Objective: Provide and make use of safe, affordable, and improved access to space.

Annual Performance Goal 3H05: Assure public, flight crew, and workforce safety for all Space Shuttle operations, measured by the following:
- Achieve zero type A (damage to property at least $1M or death) or B (damage to property at least $250K or disability/hospitalization) mishaps in FY 2003.
- Achieve an average of 8 or fewer flight anomalies per Space Shuttle mission.

Public Benefit: Successfully meeting goal 3H05 allows researchers to apply the knowledge gained from flying payloads on the Space Shuttle thus assuring a positive return on the public's investment in space transportation

Annual Performance Goal 3H06: Safely meet the FY 2003 manifest and flight rate commitment. Annual performance goal is measured for Space Shuttle performance only.
- Achieve 100% on-orbit mission success for all flights in FY 2003. For this metric, mission success criteria are those provided to the prime contractor (SFOC) for purposes of determining successful accomplishment of the performance incentive fees in the contract.

Public Benefit: Successfully meeting goal 3H06 allows researchers to apply the knowledge gained from flying payloads on the Space Shuttle thus assuring a positive return on the public's investment in space transportation

Annual Performance Goal 3H07: Maintain a "12-month" manifest preparation time.

- Baselined Flight Requirements Document (FRD) tracks achievement of this goal and it defines the primary cargo manifest that uses the "12 month" template. Achievement of performance goal is independent of delays caused by non-manifest related issues, for example payload readiness to launch.

Public Benefit: Ensuring the most effective and efficient access to space for primary payload customers while supporting the safety and reliability of the Shuttle transportation system.

Annual Performance Goal 3H08: Have in place a Shuttle safety investment program that ensures the availability of a safe and reliable Shuttle system for International Space Station assembly and operations.

- Meet the major FY 2003 Space Shuttle Safety Upgrade milestones. For this metric, major milestones are defined to be the Preliminary Design Review dates, Critical Design Review dates, Ready dates for upgrade installation/integration with flight hardware/software, and Ready dates for first flight.

Annual Performance Goal 3H09: HEDS will collaborate with NASA's Office of Human Resources and Education, and Second Generation Program Office to establish and implement an agency wide training program for employees that support the Space Launch Initiative needs. The training program will communicate and document "lessons learned" from other major technology development and operational programs. "Lessons learned" would be based on but not limited to both government and contractor experience on the Space Shuttle program, Saturn program, and other commercial launch vehicle programs. HEDS shall with the Second Generation Program Office and NASA's Office of Human Resources and Education:

- Establish and implement a curriculum in program and project management that communicates management practices, tools, and "lessons learned".
- Establish and implement a curriculum in systems engineering and management that communicates system engineering practices, tools, and "lessons learned".

Annual Performance Goal 3H10: HEDS Enterprise will work with the Second Generation Program to define available opportunities to utilize Office of Space Flight assets to test 2nd Generation Reusable Launch Vehicle enabling technologies. HEDS shall:

- Develop comprehensive list of test environments and associated test specimen size that can be accommodated.
- Define available window(s) of opportunity.
- Participate in Second Generation Program technical interchange meetings.
- Attend quarterly SLI and Space Transportation reviews.

Public Benefit: Ensuring a safe and reliable space transportation system that maximizes long-term benefits to the public through support to the International Space Station program and other primary payload customers.

Objective: Operate the International Space Station to advance science, exploration, engineering, and commerce.

Annual Performance Goal 3H11: Demonstrate International Space Station on-orbit vehicle operational safety, reliability, and performance.

- Zero safety incidents (i.e. no on-orbit injuries)
- Actual resources available to the payloads measured against the planned payload allocation for power, crew time, and telemetry. (Green = 80% or greater)

Public Benefit: Meeting operations targets and beginning research activities will provide many benefits of space research directly to the public through new discoveries and improved technology applications in areas such as medicine, industrial processes and fundamental knowledge.

Annual Performance Goal 3H12: Demonstrate and document the International Space Station program progress and readiness at a level sufficient to show adequate support of the assembly schedule.

- Conduct monthly status reviews to show maturity and preparation of flight readiness products. Maintaining 80% of defined activities are within scheduled targets.

Public Benefit: Meeting development targets and beginning research activities will provide many benefits of space research directly to the public through new discoveries and improved technology applications in such areas as medicine, industrial processes and fundamental knowledge.

Annual Performance Goal 3H13: Successfully complete 90% of International Space Station planned mission objectives.

- Achieve 90% on-orbit mission success for planned International Space Station assembly and logistics activities on the Space Shuttle flights scheduled for FY 2003. Sum total of the successfully accomplished primary mission objectives divided by the total number of mission objectives per year.

Public Benefit: Improving life on Earth. Successfully implementing goal 3H12 brings the many benefits of space research directly to the public through new discoveries and improved technology applications in areas such as medicine, industrial processes and fundamental knowledge.

Objective: Meet sustained space operations needs while reducing costs.

Annual Performance Goal 3H14: Space Communications performance metrics for each Space Shuttle and International Space Station mission/expedition will be consistent with detailed program and project operations requirements in project Service Level Agreements.

- Achieve at least 95 percent of planned data delivery for each Space Shuttle mission and International Space Station expedition

Public Benefit: The public's investment in space operations demands NASA's attention to safety first and cost reduction whenever possible. We are accountable for maximizing the return on the public's investment.

Annual Performance Goal 3H15: Develop and execute a management plan and open future Station hardware and service procurements to innovation and cost-saving ideas.

- Implement management plan – The International Space Station Integrated Program Management Plan (IPMP) addresses the cost and management challenges/risks in OMB, GAO and OIG reports. It contains reforms that strengthen headquarters involvement, increases communications, provide more accurate assessment and maintains budget accountability. Instituted processes will define the International Space Station baseline, develop a WBS and associated schedule and cost milestones for core complete, provide funding rationale and justification for the operations budget, simplify contract relationships, improve the MIS, provide rigorous and independent cost estimates, provide more accurate assessments of Program trends and issues to develop an early warning system of major program risks and cost growth, and assure budget and earned value plans are met. Assessment reports will include documentation of the discovery and resolution of major issues. The Integrated Program Management Plan (IPMP) is a more comprehensive management document that incorporates the Program Management Action Plan (PMAP).

Public Benefit: To ensure effective management of the International Space Station program.

Goal 3: Enable the Commercial Development of Space

Objective: Improve the accessibility of space to meet the needs of commercial research and development.

Annual Performance Goal 3H16: The Space Communications program will conduct tasks that enable commercialization and will minimize investment in government infrastructure for which commercial alternatives are being developed.

- Increase the percentage of the space operations budget allocated to the acquisition of communications and data services from the commercial sector from 15% in FY 2001 and 20% in FY 2002 to 25% in FY 2003.

Public Benefit: The public's investment in space operations demands NASA's attention to safety first and cost reduction whenever possible. We are accountable for maximizing the return on the public's investment.

Annual Performance Goal 3H17: Establish mechanisms to enable NASA access to the use of U.S. commercially developed launch systems.

- Assure that NASA launch service contracts include annual on-ramps for newly developed commercial launch services as they meet NASA's risk mitigation policy.

Public Benefit: New commercially developed launch services will be able to compete for NASA launches when they meet NASA's risk mitigation policy.

Objective: Foster commercial endeavors with the International Space Station and other assets.

Annual Performance Goal 3H18: Establish mechanisms to enable NASA to utilize commercial payload processing facilities.

- Fifty percent or greater of the Space Shuttle (excluding International Space Station) and ELV (excluding planetary) payloads will be processed utilizing commercial facilities.

Annual Performance Goal 3H19: Increase collaboration in space commerce with a variety of industry, academia and non-profit organizations.

- Materially participate in the development and issuance of a NASA-wide enhanced space commerce strategy document; and produce formal documents that demonstrate serious potential collaboration with at least three private sector companies

Objective: Develop new capabilities for human space flight and commercial applications through partnerships with the private sector.

Annual Performance Goal 3H20: NASA will aggressively pursue Space Shuttle competitive sourcing opportunities that improve the Shuttle's safety and operational efficiency.

- Obtain Administration approval of Space Shuttle competitive sourcing plan and implementation approach.
- Complete cost benefit analyses of competitive sourcing opportunities by an independent third party.
- Pursue contract mechanisms for shuttle competitive sourcing which assures maintenance of shuttle system safety,

Public Benefit: Partnership with commercial interests brings the results and benefits of living and working in space to the public more quickly than the government could do by itself.

Goal 4: Share the Experience and Benefits of Discovery

Objective: Engage and involve the public in the excitement and the benefits of and in setting the goals for the exploration and development of space.

Annual Performance Goal 3H21: Conduct HEDS related Education and Outreach Programs to improve the engagement/involvement of the formal education, informal education, and the general public communities.

- Revise and implement action plans for the Education and Outreach Programs.
- Continuously evaluate HEDS Education and Outreach Programs and events to provide information about their effectiveness in meeting identified goals.

Public Benefit: Continuing to improve the involvement of formal education, informal education, and the general public communities in setting the HEDS goals and activities will assure that future exploration and development of space programs are well aligned with the interests and the intentions of the primary constituents for NASA exploration programs and projects that are more cost-effective in achieving educational and public goals and objectives.

Objective: Provide significantly more value to significantly more people through exploration and space development efforts.

Annual Performance Goal 3H22: Expand public access to HEDS missions information (especially International Space Station) by working with industry, academia, and the media to create media projects and public engagement initiatives that allow "first-hand" public participation using telepresence for current missions, and virtual reality or mock-ups for future missions beyond Earth orbit.

- Museums – track the number of science museums and other informal education forums incorporating first person participation with the International Space Station.
- Develop a seamless education/outreach website presence providing public and educational access and availability to HEDS education/outreach programs, products, and public affairs information.
- Publish a HEDS Commercial Outreach Initiative Notice of Opportunity designed to enhance public knowledge about human exploration of space.

Public Benefit: Continuing to improve public involvement in the conduct of and results from future HEDS activities will assure that future exploration and development of space programs are well understood by the primary constituents for NASA exploration programs. In addition, more effective communication of the knowledge and technologies resulting from HEDS activities will promote a rapid transition of these innovations into private sector applications, with resulting benefits to the economy and quality of life.

Objective: Advance the scientific, technological, and academic achievement of the Nation by sharing our knowledge, capabilities, and assets.

Annual Performance Goal 3H23: Initiate the development and implementation of a formal and systematic mechanism to integrate HEDS latest research knowledge into the K-12/University classroom environment.

- Ensure the number of HEDS research projects, which are currently flying or scheduled to fly on the Space Shuttle and International Space Station, will be transferred to and made accessible to the education community.
- Enhance the formal and informal education programs through research, products, services, and distance learning technologies.
- Collaborate with other NASA education organizations and the external education community to ensure that HEDS-related educational materials and products are developed and made available to K-12 educators.

Annual Performance Goal 3H24: Engage and collaborate with research universities (1) for joint generation of new knowledge in HEDS related areas, (2) for the advancement of the HEDS mission and development of cutting edge technical capabilities, and (3) for ensuring a high quality future workforce.

- Track the number of collaborative partnerships with research universities
- Develop, utilize, and disseminate science, mathematics, and technology instructional materials based on HEDS unique missions and results, and to support the development of higher education curricula.

- Increase the number of opportunities for teachers and students to enhance their knowledge of HEDS and science, mathematics, technology, engineering and to enhance their skills through mechanisms such as internships, professional development workshops, and research opportunities.

Public Benefit: HEDS is an important investment in the future of the US. By presenting and disseminating informational and educational materials on HEDS, including new discoveries, in a form that is accurate and current, understandable to both educators and students, and tied to local, state, and national curriculum frameworks, HEDS can contribute to advancing the academic achievements of the Nation. Similarly, by effectively advancing scientific and technological achievements, new discoveries and new industries will result, contributing to a stronger economy in the future.

Management Challenges and High Risk Areas

NASA is responding to feedback from it stake holders regarding management challenges and high-risk areas. The HEDS related material is identified below starting with the reference, relevant excerpt(s) or section(s), and related Annual Performance Goal.

FY 2002 President's Budget: A Blueprint for New Beginnings – A Responsible Budget for America's Priorities
Fulfilling the President's promise to make Government more market-based, NASA will pursue management reforms to promote innovation, open Government activities to competition, and improve the depth and quality of NASA's research and development (R&D) expertise. These reforms, described below, will help reduce NASA's operational burden and focus resources on Government-unique R&D at NASA.

<u>International Space Station:</u> NASA will undertake reforms and develop a plan to ensure that future International Space Station costs will remain within the President's 2002 Budget plan. Annual Performance Goal **<u>3H15</u>**

<u>Space Shuttle Competitive Sourcing:</u> NASA will aggressively pursue Space Shuttle competitive sourcing opportunities that improve the Shuttle's safety and operational efficiency. Annual Performance Goal **<u>3H20</u>**

General Accounting Office (GAO): Major Management Challenges and Program Risks National Aeronautics and Space Administration (NASA), January 2001
<u>Controlling International Space Station Development and Support Costs</u>: Annual Performance Goal **<u>3H15</u>**

NASA Office of Inspector General (OIG): NASA's Top 10 Management Challenges, December 2000
<u>International Space Station</u> – cost and planning. Annual Performance Goal **<u>3H15</u>**

Comments related to GAO concerning changes in Annual Performance Goals (APGs): In a previous meeting with GAO concerns were raised over changing the annual performance goals. Annual performance goals are set for a particular year to meet a strategic goal and strategic objective. Annual performance goals by their nature can change yearly. Strategic goals and strategic objectives do not change yearly but are locked in place for at least three years. These are the goals and objectives we track to show a trend not the APGs. The last change to the NASA Strategic Plan took place in October 2000 -- this accounts for the changes in strategic goals and strategic objectives from FY 2001 to FY 2002. The Performance Plan for FY 2002 is the first year under the new NASA Strategic Plan. At present HEDS has not changed its strategic goals or strategic objectives since the publication of the NASA Strategic Plan 2000.

Verification and Validation

Internal Assessment
Interim evaluation and monitoring of performance targets will be conducted – as required – as an element of regular meetings of the Office of Space Flight and HEDS Management Boards.

Final data collection, reporting and verification for inclusion in NASA's Annual Performance Report will rely on several different processes depending on the particular Annual Performance Goal. Wherever possible, a specific tangible product has been identified in the indicator for individual performance goals to strengthen the validation process.

For many HEDS performance goals, (e. g. Space Shuttle in-flight anomalies, International Space Station assembly milestones) verification of performance is straightforward and progress is monitored through regular management channels and reports.

External Assessment
To assist in evaluating those performance goals that are more difficult to associate with specific tangible products, HEDS will employ an annual external assessment process. Past external assessors have included the: NASA Advisory Council, Space Flight Advisory Committee, General Accounting Office, NASA's Office of the Inspector General, and National Research Council.

The Space Flight Advisory Committee (an OSF Advisory Committee) reviews and evaluates OSF performance annual performance goals.

FY 2003 MULTI-YEAR PERFORMANCE TREND

Human Exploration and Development of Space

Invest in the development of high-leverage technologies to enable safe, effective, and affordable human/robotic exploration.

	FY 1999	FY 2000	FY 2001
Explore the Space Frontier		0H38: In coordination with other Enterprises, develop and implement tests and demonstrations of capabilities for future human exploration in the areas of advanced space power, advanced space transportation, information and automation systems, and sensors and instruments.	1H32: Initiate the HEDS Technology/Commercialization program and establish a synergistic relationship with industry.
Assessment		Yellow	TBD

Conduct engineering research on the International Space Station to enable exploration beyond Earth orbit.

	FY 1999	FY 2000	FY 2001
Explore the Space Frontier			
Assessment			

Invest in the development of high-leverage technologies to enable safe, effective, and affordable human/robotic exploration.

	FY 2002	FY 2003	FY 2004
Explore the Space Frontier		3H01: The HEDS Advanced Programs office work collaboratively with other NASA Enterprises and Field Centers on advanced planning activities and leverage available resources in advanced technologies that will enable safe, effective, and affordable human/robotic exploration.	
Assessment		TBD	

Conduct engineering research on the International Space Station to enable exploration beyond Earth orbit.

	FY 2002	FY 2003	FY 2004
Explore the Space Frontier		3H25: Space Shuttle supports exploration by transporting payloads, logistics, and crew to the ISS.	
Assessment			

Enable human exploration through collaborative robotic missions

	FY 1999	FY 2000	FY 2001
Explore the Space Frontier		OH35: Complete the integration and testing of the Mars In-situ Propellant Production Precursor (MIP) flight unit for the 2001 Mars Surveyor mission.	1H1: Complete testing and delivery for spacecraft integration of experiments for the Mars Surveyor Program 2001 missions.
Assessment		Red	TBD
Explore the Space Frontier		OH35: Complete the integration and testing of the Mars In-situ Propellant Production Precursor (MIP) flight unit for the 2001 Mars Surveyor mission.	1H1: Complete testing and delivery for spacecraft integration of experiments for the Mars Surveyor Program 2001 missions.
Assessment		Red	TBD

Provide and make use of safe, affordable and improved access to space.

	FY 1999	FY 2000	FY 2001
Enable Humans to live and Work Permanently in Space	9H15: Achieve seven or fewer flight anomalies per mission	0H12: Achieve seven or fewer flight anomalies per mission	1H7: Achieve 8 or fewer flight anomalies per mission.
Assessment	Green	Green	TBD

Enable human exploration through collaborative robotic missions

	FY 2002	FY 2003	FY 2004
Explore the Space Frontier		3H04: Provide reliable space communication services for Space Science and Earth Science missions be consistent with program and project requirements.	
Assessment			
Explore the Space Frontier	2H03: Provide reliable launch services for approved missions. • NASA success rate at or above a running average of 95% for missions noted on the Flight Planning Board manifest and launched pursuant to commercial launch service contracts.	3H03: Provide reliable launch services for approved missions. • NASA success rate at or above a running average of 95% for missions noted on the Flight Planning Board manifest and launched pursuant to commercial launch service contracts.	
Assessment	TBD	TBD	

Provide and make use of safe, affordable and improved access to space.

Enable Humans to live and Work Permanently in Space	2H06: Assure public, flight crew, and workforce safety for all Space Shuttle operations, measured by the following: • Achieve zero type A or B mishaps in FY 2002. • Achieve an average of 8 or fewer flight anomalies per Space Shuttle mission	3H05: Assure public, flight crew, and workforce safety for all Space Shuttle operations, measured by the following: • Achieve zero type A or B mishaps in FY 2003 • . Achieve an average of 8 or fewer flight anomalies per Space Shuttle mission	
Assessment	TBD	TBD	

Provide and make use of safe, affordable and improved access to space.

	FY 1999	**FY 2000**	**FY 2001**
Enable Humans to live and Work Permanently in Space	9H16: Achieve 85% on time, successful launches, excluding weather risk.	0H13: Achieve 85% on time, successful launches, excluding weather risk. Changed to: Achieve 100% on-orbit mission success.	1H30: Achieve 100% on-orbit mission success
Assessment	Yellow	Green	TBD
Enable Humans to live and Work Permanently in Space	9H17: Achieve a 13-month manifest preparation time.	0H14: Achieve a 12- month manifest preparation time.	
Assessment	Green	Green	
Enable Humans to live and Work Permanently in Space	9H18: Achieve a 60% increase in predicted reliability of Space Shuttle over 1995	0H15: Have in place an aggressive Shuttle program that ensures the availability of a safe and reliable Shuttle system through the ISS era.	1H6: Expedite a safety improvement program to ensure the continued safe operations of the Space Shuttle that ensures the availability of a safe and reliable Shuttle system to support Space Station Assembly milestones and operations.
Assessment	Green	Red	TBD

Provide and make use of safe, affordable and improved access to space.

	FY 2002	FY 2003	FY 2004
Enable Humans to live and Work Permanently in Space	2H07: Safely meet the FY 2002 manifest and flight rate commitment. Annual performance goal is measured for Space Shuttle performance only.	3H06: Safely meet the FY 2003 manifest and flight rate commitment. Annual performance goal is measured for Space Shuttle performance only.	
Assessment	TBD	TBD	
Enable Humans to live and Work Permanently in Space	2H08: Maintain a "12-month" manifest preparation time.	3H07: Maintain a "12-month" manifest preparation time.	
Assessment	TBD	TBD	
Enable Humans to live and Work Permanently in Space	2H09: Have in place a Shuttle safety investment program that ensures the availability of a safe and reliable Shuttle system for ISS assembly and operations.	3H08: Have in place a Shuttle safety investment program that ensures the availability of a safe and reliable Shuttle system for ISS assembly and operations.	
Assessment	TBD	TBD	

Provide and make use of safe, affordable and improved access to space.

	FY 1999	FY 2000	FY 2001
Enable Humans to live and Work Permanently in Space			
Assessment			
Enable Humans to live and Work Permanently in Space			
Assessment			

Provide and make use of safe, affordable and improved access to space.

	FY 2002	FY 2003	FY 2004
Enable Humans to live and Work Permanently in Space		3H09: HEDS will collaborate with NASA's Office of Human Resources and Education, and Second Generation Program Office to establish and implement an agency wide training program for employees that support the Space Launch Initiative needs. The training program will communicate and document lessons learned from other major technology development and operational programs. Lessons learned would be based on but not limited to both government and contractor experience on the Space Shuttle program, Saturn program, and other commercial launch vehicle programs.	
Assessment		TBD	
Enable Humans to live and Work Permanently in Space		3H10: HEDS Enterprise will work with the Second Generation Program to define available opportunities to utilize Office of Space Flight assets to test 2nd Generation Reusable Launch Vehicle enabling technologies.	
Assessment		TBD	

Operate the International Space Station to advance science, exploration, engineering and commerce.

	FY 1999	FY 2000	FY 2001
Enable Humans to live and Work Permanently in Space		0H61: Conduct operations with a three-person human presence on the ISS.	1H12: Successfully complete the majority of combined ISS planned operations schedules and milestones as represented by permanent human on-orbit operations.
Assessment		Yellow	TBD
Enable Humans to live and Work Permanently in Space	9H42: Initiate full-scale Multi-Element Integration Testing (MEIT) for elements in the first four launch.		1H10: Successfully complete the majority of the planned development schedules and milestones required to support the Multi-element Integration Testing.
Assessment	Green		TBD
Enable Humans to live and Work Permanently in Space	9H44: Conduct physical integration of the Z1 Truss launch package and initiate MEIT.		
Assessment	Green		
Enable Humans to live and Work Permanently in Space	9H43: Deliver the U.S. laboratory module to the launch site in preparation for MEIT.	0H16: Deploy and activate the U.S. Laboratory Module to provide a permanent on orbit laboratory capability.	
Assessment	Green	Yellow	
Enable Humans to live and Work Permanently in Space	9H19: Deploy and activate the Russian-built Functional Cargo Block as the early propulsion and control module.	0H18: Deploy and activate the Airlock to provide an ISS-based EVA capability.	1H11: Successfully complete the majority of the ISS planned on-orbit activities such as delivery of mass to orbit and enhanced functionality.
Assessment	Green	Yellow	TBD

Operate the International Space Station to advance science, exploration, engineering and commerce.

	FY 2002	FY 2003	FY 2004
Enable Humans to live and Work Permanently in Space	2H10: Demonstrate ISS on-orbit vehicle operational safety, reliability, and performance.	3H11: Demonstrate ISS on-orbit vehicle operational safety, reliability, and performance.	
Assessment	TBD	TBD	
Enable Humans to live and Work Permanently in Space	2H11: Demonstrate ISS program progress and readiness at a level sufficient to show adequate readiness in the assembly schedule.	3H12: Demonstrate and document the ISS program progress and readiness at a level sufficient to show adequate support of the assembly schedule.	
Assessment	TBD	TBD	
Enable Humans to live and Work Permanently in Space			
Enable Humans to live and Work Permanently in Space			
Assessment			
Enable Humans to live and Work Permanently in Space	2H12: Successfully complete 90% of the ISS planned mission objectives.	3H13: Successfully complete 90% of the ISS planned mission objectives.	
Assessment	TBD	TBD	

Operate the International Space Station to advance science, exploration, engineering and commerce.

	FY 1999	FY 2000	FY 2001
Enable Humans to live and Work Permanently in Space	9H41: Deploy and activate the first U.S.-built element, Unity (Node 1), to provide docking locations and attach ports.	0H17: Deploy and activate the Canadian-built Space Station Remote Manipulator System to provide an ISS-based remote manipulating capability for maintenance and assembly.	
Assessment	Green	Yellow	
Enable Humans to live and Work Permanently in Space		0H19: Deliver to orbit the first of three Italian-build Multi-Purpose Logistic Modules to provide a reusable capability for delivering payload and systems racks to orbit.	
Assessment		Yellow	
Enable Humans to live and Work Permanently in Space		0H20: Complete preparations for the initial ISS research capability through the integration of the first rack of the Human Research Facility (HRS-1), five EXPRESS racks with small payload research and the Microgravity Science Glovebox (MSG).	1H13: Successfully complete the majority of the planned research activities in support of initiation of on-orbit research opportunities
Assessment		Yellow	TBD
Enable Humans to live and Work Permanently in Space			1H14: Successfully complete no less than 85% of the planned Russian Program Assurance schedules and milestones required for the development of the Propulsion Module.
Assessment			TBD

Operate the International Space Station to advance science, exploration, engineering and commerce.

	FY 2002	FY 2003	FY 2004
Enable Humans to live and Work Permanently in Space			
Assessment			
Enable Humans to live and Work Permanently in Space			
Assessment			
Enable Humans to live and Work Permanently in Space			
Assessment			
Enable Humans to live and Work Permanently in Space			
Assessment			

Operate the International Space Station to advance science, exploration, engineering and commerce.

	FY 1999	FY 2000	FY 2001
Enable Humans to live and Work Permanently in Space		0H22: Complete the production of the X-38 first space flight test article in preparation for a Shuttle test flight in 2001.	1H15: Successfully complete no less than 75% of the planned crew return capability schedules. FY01 indicators will include accomplishment of program schedule milestones for Phase 1 development of a Crew Return Vehicle (CRV) that could provide the U.S. crew return capability.
Assessment		Yellow	TBD

Meet sustained space operations needs while reducing costs.

	FY 1999	FY 2000	FY 2001
Enable Humans to live and Work Permanently in Space	9H30: Complete the development of a commercialization plan for the ISS and the Space Shuttle in partnership with the research and commercial communities, and define and recommend policy and legislative changes.	0H39: Promote privatization of Space Shuttle operations and reduce civil service resource requirements for operations by 20% (from the FY 1996 FTE levels) in FY 2000.	
	Yellow	Red	
Enable Humans to live and Work Permanently in Space	9H34: Develop options and recommendations to commercialize space communications.	0H42: Increase the expenditures for commercial services to 10% of the total space communications budget by FY 2000.	1H20: Increase the percentage of the space operations budget allocated to acquisition of communications and data services from the commercial sector to 15%.
Assessment	Red	Green	TBD

Operate the International Space Station to advance science, exploration, engineering and commerce.

	FY 2002	FY 2003	FY 2004
Enable Humans to live and Work Permanently in Space			
Assessment			

Meet sustained space operations needs while reducing costs.

	FY 2002	FY 2003	FY 2004
Enable Humans to live and Work Permanently in Space		3H14: Space Communications performance metrics for each Space Shuttle and ISS mission/expedition will be consistent with detailed program and project operations requirements in project Service Level Agreements.	
Enable Humans to live and Work Permanently in Space	2H15: The Space Communications program will conduct tasks that enable commercialization and will minimize investment in government infrastructure for which commercial alternatives are being developed.	3H15: Develop and execute a management plan and open future Station hardware and service procurements to innovation and cost-saving ideas.	
Assessment	TBD		

Meet sustained space operations needs while reducing costs.

	FY 1999	FY 2000	FY 2001
Enable Humans to live and Work Permanently in Space		0H40: Promote privatization and commercialization of Space Shuttle payload operations through the transition of payload management functions (payload integration managers, payload officers, etc.) by FY 2000.	1H21: Achieve at least 95 percent of planned data delivery from space flight missions as documented in space, ground, deep space, and NASA integrated service networks performance metrics consistent with detailed program and project operations requirements in project service level agreements.
Assessment		Green	TBD
Enable Humans to live and Work Permanently in Space		0H41: Within policy limitations and appropriate waivers, pursue the commercial marketing of Space Shuttle payloads by working to allow the Space Flight Operations Contractor to target two reimbursable flights, one in FY 2001 and one in FY 2002.	
Assessment		No longer applicable - see 2000 Performance Report	
Enable Humans to live and Work Permanently in Space	9H33: Reduce space communications operations costs by 30 to 35% compared to the FY96 budget, through a consolidated space communications contract to meet established budget targets.	0H43: Reduce the space communications budget submit for FY 2000 by 30-35% from the FY 1996 congressional budget submit.	
Assessment	Green	Green	

Meet sustained space operations needs while reducing costs.

	FY 2002	FY 2003	FY 2004
Enable Humans to live and Work Permanently in Space	2H16: Performance metrics for each mission will be consistent with detailed program and project operations requirements in project Service Level Agreements • Achieve at least 95 percent of planned data delivery for space flight missions.	Captured by metric 3H14	
Assessment	TBD		
Enable Humans to live and Work Permanently in Space	2H19: Develop and execute a management plan and open future Station hardware and service procurements to innovation and cost-saving ideas.		
Assessment			
Enable Humans to live and Work Permanently in Space			
Assessment			

Improve the accessibility of space to meet the needs of commercial research and development.

	FY 1999	FY 2000	FY 2001
Enable the Commercial Development of Space			
Assessment			
Enable the Commercial Development of Space			
Assessment			
Enable the Commercial Development of Space			
Assessment			

Foster commercial endeavors with the International Space Station and other assets.

	FY 1999	FY 2000	FY 2001
Enable the Commercial Development of Space			
Assessment			

Improve the accessibility of space to meet the needs of commercial research and development.

	FY 2002	FY 2003	FY 2004
Enable the Commercial Development of Space		3H16: The Space Communications program will conduct tasks that enable commercialization and will minimize investment in government infrastructure for which commercial alternatives are being developed.	
Assessment		TBD	
Enable the Commercial Development of Space	2H17: Provide an average of five mid-deck lockers on each Space Shuttle mission to the International Space Station for research.	3H02: Provide for science and technology research on the ISS a minimum average of 5 mid-deck lockers for each Space Shuttle mission to the ISS and maintain 80% availability of Space Station resources to support science and technology research.	
Assessment	TBD		
Enable the Commercial Development of Space	2H18: Establish mechanisms to enable NASA access to the use of U.S. commercially developed launch systems.	3H17: Establish mechanisms to enable NASA access to the use of U.S. commercially developed launch systems.	
Assessment	TBD	TBD	

Foster commercial endeavors with the International Space Station and other assets.

	FY 2002	FY 2003	FY 2004
Enable the Commercial Development of Space	2H26: Increase collaboration in space commerce with a variety of industry, academia and non-profit organizations.	3H18: Establish mechanisms to enable NASA to utilize commercial payload processing facilities.	
Assessment	TBD		

Foster commercial endeavors with the International Space Station and other assets.

	FY 1999	FY 2000	FY 2001
Enable the Commercial Development of Space			
Assessment			

Develop new capabilities for human space flight and commercial applications through partnerships with the private sector

	FY 1999	FY 2000	FY 2001
Enable the Commercial Development of Space		0H44 Invest 25% of the space communications technology budget by FY 2000 in projects that could enable space commercial opportunities, including leveraging through a consortium of industry, academia, and Government.	
Assessment		Green	
Enable the Commercial Development of Space			1H23: Foster commercial endeavors by reviewing and/or implementing new policies and plans, such as the Space Station resource pricing policy and intellectual property rights policy. Ensure that Space Station resources allocated to commercial research are utilized by commercial partners to develop commercial products and improve industrial processes.
Assessment			TBD

Foster commercial endeavors with the International Space Station and other assets.

	FY 2002	**FY 2003**	**FY 2004**
Enable the Commercial Development of Space		3H19: Increase collaboration in space commerce with a variety of industry, academia and non-profit organizations.	
Assessment			

Develop new capabilities for human space flight and commercial applications through partnerships with the private sector

	FY 2002	**FY 2003**	**FY 2004**
Enable the Commercial Development of Space	2H21: Continue implementation of planned and new privatization efforts through the Space Shuttle prime contract and further efforts to safely and effectively transfer civil service positions and responsibilities to private industry.	3H20: NASA will aggressively pursue Space Shuttle competitive sourcing opportunities that improve the Shuttle's safety and operational efficiency.	
Assessment			
Enable the Commercial Development of Space	2H21: Continue implementation of planned and new privatization efforts through the Space Shuttle prime contract and further efforts to safely and effectively transfer civil service positions and responsibilities to private industry.	3H20: NASA will aggressively pursue Space Shuttle competitive sourcing opportunities that improve the Shuttle's safety and operational efficiency.	
Assessment			

Engage and involve the public in the excitement and the benefits of—and in setting the goals for—the exploration and development of space.

	FY 1999	**FY 2000**	**FY 2001**
Share the Experience and Benefits of discovery			
Assessment			

Provide significantly more value to significantly more people through exploration and space development efforts.

	FY 1999	**FY 2000**	**FY 2001**
Share the Experience and Benefits of discovery			
Assessment			

Engage and involve the public in the excitement and the benefits of—and in setting the goals for—the exploration and development of space.

	FY 2002	**FY 2003**	**FY 2004**
Share the Experience and Benefits of discovery		3H21: Conduct HEDS related Education and Outreach Programs to improve the engagement/involvement of the formal education, informal education, and the general public communities.	
Assessment		TBD	

Provide significantly more value to significantly more people through exploration and space development efforts.

	FY 2002	**FY 2003**	**FY 2004**
Share the Experience and Benefits of discovery	2H24: Expand public access to HEDS missions information (especially ISS) by working with industry to create media projects and public engagement initiatives that allow "first-hand" public participation using telepresence for current missions, and virtual reality or mock-ups for future missions beyond Earth orbit.	3H22: Expand public access to HEDS missions information (especially ISS) by working with industry, academia, and the media to create media projects and public engagement initiatives that allow "first-hand" public participation using telepresence for current missions, and virtual reality or mock-ups for future missions beyond Earth orbit.	
Assessment	TBD	TBD	

Advance the scientific, technological, and academic achievement of the Nation by sharing our knowledge, capabilities, and assets.

	FY 1999	**FY 2000**	**FY 2001**
Share the Experience and Benefits of discovery			
Assessment			
Share the Experience and Benefits of discovery			
Assessment			

Advance the scientific, technological, and academic achievement of the Nation by sharing our knowledge, capabilities, and assets.

	FY 2002	FY 2003	FY 2004
Share the Experience and Benefits of discovery	2H28: Initiate the development and implementation of a formal and systematic mechanism to integrate HEDS latest research knowledge into the K-12 and University classroom environment.	3H23: Initiate the development and implementation of a formal and systematic mechanism to integrate HEDS latest research knowledge into the K-12 / University classroom environment.	
Assessment		TBD	
Share the Experience and Benefits of discovery		3H24: Engage collaborate with research universities (1) for joint generation of new knowledge in HEDS related areas, (2) for the advancement of the HEDS mission and development of cutting edge technical capabilities, and (3) for ensuring a high quality future workforce.	
Assessment		TBD	

Human Exploration and Development of Space FY 2003 Annual Performance Goals	**Budget Category**	Access to Space (ELV's and Payloads)	Advanced Programs	External Affairs	International Space Station	Office of the Chief Engineer	Space Communications (Space Operations)	Space Shuttle
Annual Performance Goal								
3H01: The HEDS Advanced Programs office work collaboratively with other NASA Enterprises and Field Centers on advanced planning activities and leverage available resources in advanced technologies that will enable safe, effective, and affordable human/robotic exploration.			X					
3H02: Provide for science and technology research on the International Space Station a minimum average of five mid-deck lockers for each Space Shuttle mission to the ISS and maintain 80% availability of Space Station resources to support science and technology research.					X			
3H03: Provide reliable launch services for approved missions.		X						X
3H04: Provide reliable space communication services for Space Science and Earth Science missions consistent with program and project requirements.							X	
3H05: Assure public, flight crew, and workforce safety for all Space Shuttle operations.								X
3H06: Safely meet the FY 2003 manifest and flight rate commitment. Annual performance goal is measured for Space Shuttle performance only.								X
3H07: Maintain a "12-month" manifest preparation time.		X						X

Human Exploration and Development of Space FY 2003 Annual Performance Goals	**Budget Category**	Access to Space (ELV's and Payloads)	Advanced Programs	External Affairs	International Space Station	Office of the Chief Engineer	Space Communications (Space Operations)	Space Shuttle
Annual Performance Goal								
3H08: Have in place a Shuttle safety investment program that ensures the availability of a safe and reliable Shuttle system for International Space Station assembly and operations.								X
3H09: HEDS will collaborate with NASA's Office of Human Resources and Education, and Second Generation Program Office to establish and implement an agency wide training program for employees that support the Space Launch Initiative needs. The training program will communicate and document "lessons learned" from other major technology development and operational programs. "Lessons learned" would be based on but not limited to both government and contractor experience on the Space Shuttle program, Saturn program, and other commercial launch vehicle programs.					X	X		
3H10: HEDS Enterprise will work with the Second Generation Program to define available opportunities to utilize Office of Space Flight assets to test 2nd Generation Reusable Launch Vehicle enabling technologies.						X		X
3H11: Demonstrate International Space Station on-orbit vehicle operational safety, reliability, and performance.					X			

Human Exploration and Development of Space FY 2003 Annual Performance Goals	**Budget Category**	Access to Space (ELV's and Payloads)	Advanced Programs	External Affairs	International Space Station	Office of the Chief Engineer	Space Communications (Space Operations)	Space Shuttle
Annual Performance Goal								
3H12: Demonstrate and document the International Space Station program progress and readiness at a level sufficient to show adequate support of the assembly schedule.					X			
3H13: Successfully complete 90% of International Space Station planned mission objectives.					X			
3H14: Space Communications performance metrics for each Space Shuttle and International Space Station mission/expedition will be consistent with detailed program and project operations requirements in project Service Level Agreements.							X	
3H15: Develop and execute a management plan and open future Station hardware and service procurements to innovation and cost- saving ideas.					X			
3H16: The Space Communications program will conduct tasks that enable commercialization and will minimize investment in government infrastructure for which commercial alternatives are being developed.							X	
3H17: Establish mechanisms to enable NASA access to the use of U.S. commercially developed launch systems.		X						
3H18: Establish mechanisms to enable NASA to utilize commercial payload processing facilities.		X						

Human Exploration and Development of Space FY 2003 Annual Performance Goals	**Budget Category**	Access to Space (ELV's and Payloads)	Advanced Programs	External Affairs	International Space Station	Office of the Chief Engineer	Space Communications (Space Operations)	Space Shuttle
Annual Performance Goal								
3H19 - Increase collaboration in space commerce with a variety of industry, academia and non-profit organizations.				X				
3H20: NASA will aggressively pursue Space Shuttle competitive sourcing opportunities that improve the Shuttle's safety and operational efficiency.								X
3H21: Conduct HEDS related Education and Outreach Programs to improve the engagement/involvement of the formal education, informal education, and the general public communities.				X				
3H22: Expand public access to HEDS missions information (especially International Space Station) by working with industry, academia, and the media to create media projects and public engagement initiatives that allow "first-hand" public participation using telepresence for current missions, and virtual reality or mock-ups for future missions beyond Earth orbit.				X				
3H23: Initiate the development and implementation of a formal and systematic mechanism to integrate HEDS latest research knowledge into the K-12/University classroom environment.				X				

Human Exploration and Development of Space FY 2003 Annual Performance Goals	**Budget Category**	Access to Space (ELV's and Payloads)	Advanced Programs	External Affairs	International Space Station	Office of the Chief Engineer	Space Communications (Space Operations)	Space Shuttle
Annual Performance Goal								
3H24: Engage and collaborate with research universities (1) for joint generation of new knowledge in HEDS related areas, (2) for the advancement of the HEDS mission and development of cutting edge technical capabilities, and (3) for ensuring a high quality future workforce.				X				
3H25: Space Shuttle supports exploration by transporting payloads, logistics, and crew to the International Space Station.								X

Aerospace Technology
FY 2003 PERFORMANCE PLAN

1. Mission: The Office of Aerospace Technology (OAT) Enterprise mission is to maintain U.S. preeminence in aerospace research and technology. The Enterprise plays a key role in 1) maintaining a safe and efficient national aviation system 2) enabling an affordable, reliable space transportation system, and developing basic technologies for a broad range of space missions. Research and development programs conducted by the Enterprise also contribute to NASA's science and exploration missions, national security, economic growth, and the long-term competitiveness of American aerospace companies.

A modern air and space transportation system is fundamental to our national economy, quality of life, and security of the United States, For 75 years, a strong base for aerospace technology research and development has provided enormous contributions to this system, contributions that have fostered the economic growth of our Nation and provided unprecedented mobility for U. S. citizens. Although major technical advances have made our Nation's air and space transportation system the largest and best of its kind, the future holds critical challenges to its continued growth and performance. Because the U. S. air and space transportation system serves both critical national security needs and the public good, ensuring the continued health and preeminence of that system is a key issue for the future of the Nation.

In order to develop the aerospace systems of the future, revolutionary approaches to system design and technology development will be necessary. Pursuing technology fields that are in their infancy today, developing the knowledge bases necessary to design radically new aerospace systems, and performing efficient, high-confidence design and development of revolutionary vehicles are challenges that face us in innovation. These challenges are intensified by the demand for safety in our highly complex aerospace systems.

Although NASA technology benefits the aerospace industry directly, the creative application of NASA's advanced technology to disparate design and development challenges has made numerous contributions to other areas such as the environment, surface transportation, and medicine.

2. Resource Requirements:

	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
NOA $M	1,339	1,125	1,404	2,508	2,816
CS FTE	4,227	4,345	6,170	6,140	6,344

3. Implementation Strategy: The foundation for the Aerospace Technology Enterprise program is based on the accomplishment of three goals. (A fourth goal, Commercialize Technology, is addressed in NASA's crosscutting goals: Providing Aerospace Products and Capabilities (APG 3P7) and Communicate Knowledge (APG 3CK3) performance plan.) Enterprise objectives are outcome-focused and "stretch" beyond our current knowledge base. The outcome-focused nature of the objectives projects a preferred end-state within the air and space transportation and mission spacecraft and instrument systems. The Enterprise goals are:

Goal 1 – Revolutionize Aviation: Enable the safe, environmentally friendly expansion of aviation. Expanding the aviation system of the future to meet demands for growth will mean providing a more distributed, flexible, and adaptable network of airways. This growth must take place within the physical and environmental constraints of today's system, while meeting the evolving needs of air travel. The system of the future will continue to be international in scope, requiring close coordination across a global network. Advanced vehicles will operate in this new infrastructure with better performance and new capabilities. Advanced information and sensor technologies will make air travel safer and more efficient. Air transportation will be easily accessible from urban, suburban, or rural communities. Airplanes will be cleaner, quieter, and faster. NASA aims to revolutionize aviation by delivering the long-term, high payoff aerospace technologies, materials, and operations, research needed for enabling these new vehicle and system characteristics and capabilities.

Goal 2: – Advance Space Transportation Create a safe, affordable highway through the air and into space. Revolutionizing our space transportation system to significantly reduce costs and increase reliability and safety will open the space frontier to new levels of exploration and commercial endeavor. With the creation of the Integrated Space Transportation Plan (ISTP), NASA defined a single, integrated investment strategy for all its diverse space transportation efforts. By investing in a sustained progression of research and technology development initiatives, NASA will enable future generations of reusable launch vehicles and in-space transportation systems that will surmount the Earth-to-orbit challenge and allow less costly, more frequent, and more reliable access to our neighboring planets and the stars beyond.

Goal 3 – Pioneer Revolutionary Technology: Enable a revolution in aerospace systems. In order to develop the aerospace systems of the future, revolutionary approaches to system design and technology development will be necessary. Pursuing technology fields that are in their infancy today, developing the knowledge bases necessary to design radically new aerospace systems, and developing tools for efficient high-confidence design and development of revolutionary vehicles are some of the challenges that are being addressed. In addition, the NASA Aerospace Enterprise is also developing the fundamental new technologies that will be used by other NASA Enterprises to accomplish their strategic Objectives. In these cases, the technology transition plans are developed that will allow the smooth incorporation of these revolutionary technologies into NASA missions. These technologies will enable the collection, analysis, and distribution of increased and previously unobtainable scientific data and discoveries in an expeditious and efficient manner.

The Aerospace Technology Enterprise program work breakdown structure has been restructured to create a clear linkage between the Enterprise strategic goals and the program management structure. This restructuring creates an unambiguous linkage from National policy, to the Agency strategic plan to the budget and provides a foundation for transparent, measurable performance reporting. Enterprise programs are often conducted in cooperation with other Federal agencies, primarily the Federal Aviation Administration and the Department of Defense. These partnerships take advantage of the national investment in aeronautics and space capabilities and eliminate unnecessary duplication. The Enterprise supports the maturation of technology to a level such that it can be confidently integrated into current and new systems. In most cases, technologies developed by the Enterprise can be directly transferred to the external customer. The Enterprise approach for implementing the program begins with investment decisions based on rigorous systems analysis. Independent programmatic and expert reviews will provide supplemental information that will be incorporated in management decisions. Annual program reviews will be used to measure progress (technical, schedule and cost) against requirements and deliverables, and outside expert technical reviews will assure the quality of the products and future directions to meet strategic goals. The Enterprise research and technology programs are:

Revolutionize Aviation – Aviation Safety Program: The Aviation Safety program is developing and demonstrating technologies and strategies to improve aviation safety by reducing both aircraft accident and fatality rates. The program is structured around developing technologies along three major thrusts: (1) aviation system monitoring and modeling to help aircraft and aviation system operators identify unsafe conditions before they lead to accidents; (2) accident prevention in targeted accident categories, including system-wide, single aircraft, and weather; and (3) accident mitigation to increase accident survivability in those cases when accidents do occur.

Revolutionize Aviation – Vehicle Systems Program: The Vehicle Systems program is taking advantage of the emergence of revolutionary advances in biotechnology, nanotechnology, and information technology to enable significant advances it the functionality of 21st Century aircraft. It consists of a balance of mid- and far-term technology development activities, including the areas of materials, structures, aerodynamics, flight control, propulsion, and power, and the integration of these technologies into new vehicle concepts. Experimental vehicles will be developed for flight-testing to further mature the technologies that can be developed with government and industry partners into high leverage products.

Revolutionize Aviation – Airspace Systems Program: The objective of the Aviation System Capacity Program is to enable improvements in mobility, capacity, efficiency and access of the airspace system by developing, validating and transferring technologies that improve collaboration, predictability and flexibility for the airspace users, enable runway-independent aircraft, provide more access for general aviation operations, and maintain system safety and environmental protection. The program is developing decision support tools that will be transferred to the Federal Aviation Administration and the airlines, as well as an airspace systems modeling capability to simulate and analyze new and innovative future air traffic management concepts. Additionally, the program is developing airborne technologies for precision guidance of small aircraft to virtually any small airport to create alternative means to respond to the demand for increased throughput in the National Airspace System in the near term.

Advance Space Transportation – 2nd Generation Reusable Launch Vehicle Program: The 2nd Generation Reusable Launch Vehicle (RLV) program performs systems engineering, technology development and architecture definition trade studies to define at least two 2nd Generation RLV architecture designs that will best meet the requirements to make access to space safer, more reliable, and less expensive for present and future customers. The systematic approach targets the research and development of high-priority advanced technologies to be integrated into at least two vehicle architectures to provide the foundation for future potential full-scale development decisions.

Advance Space Transportation – Space Transfer and Launch Technology Program: The Space Transfer and Launch Technology program is developing high-payoff technologies for the 3rd generation of reusable launch vehicles to enable missions that are currently not technically or economically feasible. The efforts are centered around integrated ground demonstrations of potential hypersonic launch platforms, including rocket based combined cycle systems, turbine based combined cycle systems and flight demonstration of high speed scramjet propulsion/airframe integration, for safe, routine earth-to-orbit transportation to enable new commercial space markets, ensure seamless aerospace national security and enable the human exploration and development of space.

Pioneer Revolutionary Technology – Computing, Information and Communications Technology Program. The Computing, Information and Communications Technology program is developing and demonstrating revolutionary computing, information and communications technologies in the specific areas of autonomy, human-centered systems, intelligent data understanding, advanced computing and networking, information environments, and fundamental information, bio- and nano-technologies. Through their integration and transfer into aerospace systems and missions, these new technologies will enable: smarter, more adaptive systems and tools that work collaboratively with humans; seamless access to ground-, air- and space-based distributed hardware, software and information resources to enable NASA missions in aerospace, Earth science and space science; and broad, continuous presence and coverage for high rate data delivery from ground-, air-, and space-based assets directly to the users.

Pioneer Revolutionary Technology – Enabling Concepts and Technologies Program. The Enabling Concepts and Technologies program provides revolutionary aerospace system concepts that can enable NASA's strategic visions and expand future mission possibilities. As the front end of the enabling technology pipeline that feeds the focused technology development programs of NASA's Enterprises, the program develops potentially high pay-off technologies that may involve considerable risk to successful or rapid development. These areas include: sensing and spacecraft systems to enable bold new missions of exploration and to provide increased scientific return at lower cost; advanced energetics technology to provide power, propulsion, and electric thrust augmentation for enhanced mission capabilities and to enable missions beyond current horizons; and fundamental research in high-payoff spacecraft technologies such as micro-electronic and mechanical systems (MEMS), high performance materials, and nanotechnology to stimulate breakthroughs that could enable new system concepts.

Pioneer Revolutionary Technology – Engineering for Complex Systems Program. The Engineering for Complex Systems program has a three-pronged approach to achieving its objective of enabling ultra-high levels of safety and mission success through the infusion of advanced information. First, the program intends to significantly advance the scientific and engineering understanding of system complexities and failures, including human and organizational risk characteristics. Second, processes, tools and organizational methods will be developed to quantify, track, visualize and trade-off system designs and/or mission options with an emphasis on risk management throughout the system lifecycle. Third, software based resiliency tools and technologies will be developed to help mitigate risk in the operational and maintenance phases of the program lifecycles.

4. Performance Metrics:

Goal 1 – Revolutionize Aviation: Enable the safe, environmentally friendly expansion of aviation.

Objective One – Increase Safety: Make a safe air transportation system even safer by reducing the aircraft accident rate by a factor of 5 by 2007 and by a factor of 10 by 2022.

Strategy:

- **System Monitoring and Modeling:** Develop technologies for using the vast amounts of data available within the aviation system to identify, understand, and correct aviation system problems before they lead to accidents.

- **Accident Prevention:** Identify interventions and develop technologies to eliminate the types of accidents that can be categorized as "recurring."
- **Accident Mitigation:** Develop technologies to reduce the risk of injury in the unlikely event of an accident.

Public Benefit: These innovative technologies will improve the safety of the flying public. The public benefit can be characterized in three ways: (1) elimination of major categories of recurring accidents; (2) early warning and prevention of hidden and potential safety issues, and (3) reduced risk of injury to passengers and crew in the unlikely event of an accident.

Technical Approach: The Aviation Safety program has examined the historical aviation accident trends and determined high payoff technologies that will improve the safety of the National Airspace System. In cooperation with the Federal Aviation Administration and the aviation industry, research and technology will address accidents and incidents involving hazardous weather, controlled flight into terrain, human-performance related casual factors, and mechanical or software malfunctions and the development and integration of information technologies needed to build a safer airspace system and provide information for the assessment of situations and trends that indicate unsafe conditions before they lead to accidents. The program is structured into three investment thrust areas consisting of vehicle safety, weather safety and system safety technologies. These investment areas address targeted accident categories, as well as known accident precursors, aviation hazards and human survival rates when accidents do occur and cover all parts of the aviation system, including aircraft, people, and operations. In addition, the Vehicle Systems program will explore revolutionary and high-risk technology that will significantly improve the safety of future generations of aircraft and engine systems.

APG 3R1: Demonstrate progress in maturing, through flight tests and/or simulations, the critical technologies that will be necessary to meet the aviation safety objective. These tests and simulations are critical steps in the development of a suite of technologies that when completely developed and implemented by the customer, will provide a minimum of 50 percent reduction in fatal accident rate.

Performance Indicators:

System Monitoring and Modeling

- Demonstrate fast time simulation of system wide risks
- Model high error rate probability context and solution

Accident Prevention

- Provide new software certification procedures
- Demonstrate flight critical system validation methods
- Demonstrate a smart icing system that will sense the presence of ice accretion on the aircraft, automatically activate and manage the ice protection systems, and provide the pilot with feedback including the effect on measured aircraft performance, stability and control
- Complete initial flight evaluation of synthetic vision concepts
- Complete initial evaluation of a next-generation cockpit weather information and digital datalink technologies

- Validate life prediction methodology for critical powder metallurgy super-alloy engine components (nickel-based turbine disk) to enhance aircraft safety
- Initiate intelligent flight control generation I flight test
- Conduct flight testing of the research flight computing system which includes intelligent flight control and propulsion control
- Develop a transient disturbances recovery strategy for implementation in the SPIDER architecture

Objective Two – Reduce Emissions: Protect local air quality and our global climate by reducing oxides of nitrogen (NO_X) emissions of future aircraft by 70 percent by 2007 and by 80 percent by 2022 (Baseline: 1996 ICAO Standard) and also reducing carbon dioxide (CO_2) emissions of future aircraft by 25 percent by 2007 and by 50 percent by 2022.

Strategy:

- **Airframe Weight and Drag Reduction:** Develop airframe technologies that reduce fuel consumption and therefore reduce CO_2 and NO_X emissions.
- **Propulsion Optimization:** Develop advanced engine system technologies to reduce emissions such as NO_X that have an impact on local air quality and those such as CO_2 that affect the global climate.
- **Operation Optimization:** Develop more efficient operations at and around airports, in order to reduce aviation fuel burn and therefore reduce emissions.
- **Alternative Vehicle Concepts:** Develop advanced concepts for propulsion systems, airframe structures, and fuels that dramatically reduce or completely eliminate emissions from civil aviation aircraft.

Public Benefit: NO_X emissions are a known pollutant that degrades local air quality CO_2 emissions affect global air quality and have been identified as a major driver of climate change.. In summary, the public benefit of the NASA technologies can be characterized in three ways: (1) significant or total elimination of aircraft emissions as a source of climate change, (2) minimization of the impact of aviation operations on local air quality, and (3) elimination of unnecessary aviation emissions due to operational procedures. Another potential benefit of significantly improved vehicle efficiency is reduced air travel costs.

Technical Approach: NASA is addressing this problem by developing critical engine technologies that provide a significant reduction in emissions (primarily NO_X) as well as both airframe and other engine technologies that provide a dramatic increase in efficiency that will result reduced fuel burn. Reduced fuel burn leads to a reduction in total emissions, including carbon dioxide (CO_2). Independent assessments will be made throughout the life of the programs to evaluate our progress towards these ambitious goals and provide a sound foundation to make adjustments in technology investments. Adequate technology maturation from subcomponent testing in the laboratory, to component testing in more realistic environments, to full integrated testing in a relevant environment will be key to ensuring that these technologies are used in future air fleets. The technology development efforts are being conducted in close cooperation and coordination with the Department of Defense and industry.

The NO_X emissions reduction objective (70 percent landing and takeoff (LTO) NO_X reduction) will be accomplished via advanced combustor designs. NASA will continue to build on the knowledge gained through the development of the low NO_X combustor technology, which demonstrated a 50 percent NO_X reduction and is now being incorporated in production engines, to achieve the 70 percent goal. Several promising technologies have met the 70 percent goal in laboratory tests (i.e. flame tubes) and are being prepared for sector tests. This is one of a series of tests (i.e. sector, annular and full combustor) with intervening modifications and enhancements that are be required to maintain performance during these increasingly more demanding tests. This process ensures that the technology is developed sufficiently for subsequent transfer to industry.

CO_2 reduction is directly related to fuel burn and as the fuel burn decrease; both the CO_2 and NO_X emittants decrease. To achieve the reductions in fuel burn, NASA is developing technologies that will produce more efficient engines and airframes. Specific engine technologies that are being pursued include revolutionary, highly loaded compressor and turbine designs, ultra effective cooling configurations in turbines and combustor, innovative engine and airframe integration methods, and high temperature, durable propulsion materials supporting more efficient and higher performance cycle operations. The airframe effort is focused on the use of advanced materials and technologies to reduce weight and drag of current aircraft and engine configurations. In addition non-traditional aircraft configuration and propulsion systems (e.g., fuel cells) will be investigated for feasibility including an assessment of the potential benefits and technology barriers.

APG 3R2: Complete combustor sector test for concepts capable of achieving the 70%NO_X goal by 2007 and select the most promising approaches leading to full annular rig testing for large and regional jet engine applications. Complete an Interim Technology Assessment of the aggregate potential benefits from the engine and airframe technologies to reduce emissions. The results from this analysis will provide a benchmark for measuring overall progress, and guide future investment decisions.

Performance Indicators:

Airframe Weight and Drag

- Demonstrate the fabrication of carbon nanotube laminates
- Demonstrate advanced aeroelastic wing twist (flexible wing) on an F-18 to determine available roll power.
- Complete laminar flow experiment on F-15 testbed
- Demonstrate adaptive drag reduction techniques

Propulsion Optimization

- Engine test a coated polymer matrix composite inlet guide vane
- Simulate a benchmark combustion experiment with a liquid spray injector
- Develop a ceramic matrix composite (CMC) turbine vane
- Demonstrate a CMC complex part in rig test
- Downselect large engine contractor for full annular combustor testing
- Downselect regional engine contractor for full annular combustor testing
- Complete sector evaluations of 70% LTO NO_X configurations
- Complete an interim technology benefits assessment

Alternative Vehicle Concepts

- Complete evaluation of active flow control concepts for propulsion airframe integration (PAI)
- Complete initial high Reynolds number validation in wind tunnel of PAI method
- Complete evaluation of estimated technology benefits on future vehicle concepts
- Complete flutter risk assessment of high-speed slotted wing
- Validate nonlinear structural analysis tools
- Conduct testing of Stingray vehicle (morphing)
- Complete oil free FJX-2 core testing
- Demonstrate a prototype electric powered UAV capable of sustaining 14 hours of operation above an altitude of 50,000 feet

Objective Three – Reduce Noise: Benefit airport neighbors, the aviation industry, and travelers by reducing the perceived noise of future aircraft by a factor of two (10 decibels) by 2007 and by a factor of four (20 decibels) by 2022 (using 1997 subsonic aircraft technology as the baseline) thereby confining aircraft noise to within the airport boundary.

Strategy:

- **Propulsion System Source Noise Reduction:** Develop technologies to reduce engine noise at the source.
- **Aircraft System Source Noise Reduction:** Develop technologies to diminish airframe-related noise.
- **Operational Noise Reduction:** Develop advanced aircraft operating procedures, including steeper glide-slopes and precision, wind-compensated flight paths

Public Benefit: Reduction in noise impact surrounding airports, ultimately confining objectionable air transport noise within the compatible land-use areas around airports will benefit homes and businesses located close to an airport and enable faster and more efficient growth in the nation's air system by reducing constraints on where new airports and runways can be located.

Technical Approach: NASA is conducting a balanced effort at making major advances in noise reduction by 2007 and looking to high impact technologies to affect the more substantial targets of 2022. The work to be completed in FY 2003 provides the foundation for the future developmental efforts and has demonstrated technologies that when incorporated in aviation systems will result in an additional 2-decibel reduction from the 1997 baseline aircraft. The fundamental understanding of source noise mechanisms gained from computational, as well as experimental diagnostic investigations, will lead to the discovery and optimization of component noise reduction concepts necessary to achieve the Enterprise 10 decibel noise reduction objective. A critical step in the achievement of the Enterprise goals will be the development and validation of advanced physics-based noise prediction models. These models will be used to identify and assess the benefits of potential engine and airframe noise reduction technologies as well as improvements tat could result from changes in aircraft operations. Technologies and operational concepts will be selected for development and subsequent validation in laboratory and flight experiments.

Adequate technology maturation from subcomponent testing in the laboratory, to component testing in more realistic environments, to full integrated testing in a relevant environment will be key to ensuring that these technologies are used in future air fleets.

Independent assessments will be made throughout the life of the programs to evaluate progress towards these ambitious goals and make adjustments in technology investments.

APG 3R3: Complete development of initial physics-based prediction models to guide the development potential noise reduction technology concepts. Complete an interim technology assessment of the potential benefits for these concepts to reduce noise emissions. The results from this analysis will provide a benchmark for measuring overall progress, and guide future investment decisions.

Performance Indicators:

Propulsion System Source Noise Reduction.

- Three-dimensional noise propagation code for engine nacelles

Aircraft System Source Noise Reduction

- Develop initial physics-based noise prediction models

Operational Noise Reduction

- Quantify potential benefits of advanced noise abatement profiles and procedures at key airports

Integrated Activities

- Complete an interim technology benefits assessment
- Develop initial physics-based noise prediction models

Objective Four – Increase Capacity: Enable the movement of more air passengers with fewer delays by doubling the capacity of the aviation system within 10 years and tripling it within 25 years based on 1997 levels.

Strategy:

- **Infrastructure and Operation Optimization:** Optimize use of the current infrastructure without adding new airports or new runways by developing air traffic management technologies that increase the efficiency and capacity of the National Airspace System (NAS).
- **Alternative Vehicle Concepts:** Develop new civil aviation vehicle concepts that are designed to use segments of the NAS not suited for traditional commercial aircraft, such as short runways and vertical take-off and landing pads.
- **Alternative Infrastructure Concepts:** Develop entirely new concepts and systems, such as fully automated towers and airports that would increase the use and capacity of the Nation's 5000 public-use airports.

Public Benefit: Increase the capacity of the NAS sufficiently to meet projected public demand and alleviate delays without compromising safety. Although the events of September 11 have temporarily reduced demand on the nation's air system, delays are expected to return as demand for passenger and cargo flights increase.

Technical Approach: As part of the Airspace Systems Program, and in cooperation with the FAA, development of airspace systems technologies capable of meeting the strategic goal is being approached through two paths. First, to improve the gate-to-gate air traffic management and control process to increase capacity within the existing and planned aviation system for the next 15 years, the AATT project focuses on developing decision support technologies to assist air traffic controllers, pilots and aircraft operators in using airspace more efficiently through reduced spacing, improved scheduling, collaboration with operators, and other techniques. The project is conceiving new tools, developing them through laboratory simulations, and maturing them through field-testing. Some tools have been delivered to and accepted by the FAA for implementation in their "Free Flight" concept, some tools are in field testing and others are in the laboratory development phase. Second, in the first steps toward evaluating concepts of air traffic management that will enable three times the capacity, the Virtual Airspace Modeling and Simulation (VAMS) project, initiated in FY 2002, will establish a virtual airspace simulation environment for the test and evaluation of new and innovative solutions to the nation's aviation system problems. The challenge that technology development will address is the need for real-time analysis with never-before-achieved fidelity of a complex system. This capability is key to evaluating revolutionary air traffic management operational and technological concepts to dramatically reduce airport congestion and delays while maintaining or increasing air system safety and provide the information needed to establish a direction for the future air traffic management system beyond the technologies developed under AATT

APG 3R4: Complete development, initial functionality and evaluate human factors for at least one decision support tool to enable achievement of the planned progress towards the goal of doubling the capacity of the National Airspace System in 10 years. Complete the initial build of a toolbox of state-of-the-art airspace models to enable the planned progress towards the 2022 Objective.

Performance Indicators:

- Develop, demonstrate initial functionality, and evaluate human factors for a decision support tool for complex airspace
- Develop, demonstrate initial functionality, and evaluate human factors for an active terminal area decision support tool
- Complete initial build of state-of-the-art airspace model toolbox
- Provide strategies for improving training and procedures to reduce misunderstandings between pilots and air traffic controllers

Objective Five – Increase Mobility: Enable people to travel faster and farther, anywhere, anytime by reducing the time for inter-city door-to-door transportation by half by 2007 and by two-thirds by 2022, and reducing long-haul transcontinental travel time by half by 2022

Strategy:

- **Small Aircraft Transportation:** Develop vehicle, communication, and information technologies to allow small aircraft to operate easily and affordably at small airports in most weather conditions.
- **Supersonic Transportation:** Develop technologies critical to the economic viability of supersonic transport, such as propulsion concepts that meet stringent noise and emissions criteria.
- **Advanced Mobility Concepts and Technology:** Investigate non-traditional vehicles and operations concepts to take advantage of operational airspace that is currently underused.

Public Benefit: By developing new technologies that could permit small aircraft operations during near all weather at thousands of airports in the United States the capability of the nation's air system to transport goods, individuals, families, or groups of business associates could be greatly increased. The Small Aircraft Transportation System (SATS) concept is conceived as a safe travel alternative freeing people and products from constraints of today's ground and air transportation systems, by creating access to more communities in less time. The SATS concept increases reliable air access to virtually any community could lead to transportation services that improve all aspects of quality of life. While not specifically designed for current commercial operations, over time, the targeted technologies would also provide benefits to commuter and major air carrier operations in the hub-and-spoke system as well, through other focused research programs.

Technical Approach: The technical approach for the program operates through a joint public-private R&D collaboration involving NASA, the DOT, FAA, and state & local authorities, universities, industry, and transportation service providers. The program balances technology development, technology validation and demonstration, and technology assessment and includes laboratory, simulation, and flight experiments. These technical efforts integrate selected airborne enabling technologies to create and demonstrate four specific SATS operating capabilities. Products will include the design guidelines, systems standards, and identification of certification issues for the enabling technologies and operating capabilities.

APG 3R5: Select candidate technologies for experimental flight evaluation based on their impact on mobility. Mobility metrics will be measured by accessibility, doorstep-to-destination transit time, system and user costs, and related trip reliability and safety metrics. These flight experiments will evaluate individually, at the sub-system level, the impact of selected technologies on lowering required landing minimums and increasing the volume of operations at non-towered landing facilities in non-radar airspace during instrument meteorological conditions.

Performance Indicators:

Small Aircraft Transportation

- Select flight experiment technologies
- Complete lower landing minimum flight experiment
- Complete higher volume operations flight experiment
- Evaluate integrated single-crew flight deck technologies
- Demonstrate increased mobility without compromising enroute capacity

Advanced Mobility Concepts and Technology

- Demonstrate the fabrication of carbon nanotube laminates
- Validate nonlinear structural analysis tools
- Publish AWS validated figures of merit and design guidelines
- Conduct Stingray vehicle testing (Morphing))

Goal 2 – Advance Space Transportation: Create a safe, affordable highway through the air and into space.

Objective Six – Mission Safety: Radically improve the safety and reliability of space launch systems by reducing the incidence of crew loss for a second generation Reusable Launch Vehicle (RLV) to 1 in 10,000 missions (a factor of 40) by 2010 and to less than 1 in 1,000,000 missions (an additional factor of 100) for a third generation RLV by 2025.

Strategy:

- **Reusable and Robust Propulsion Systems:** Develop technologies for inherent reliability, more robust subsystems, and an increased performance margin for propulsion and power systems.
- **Integrated Vehicle Health Management:** Develop advanced sensors and algorithms to integrate intelligence, such as real-time failure detection and isolation, into vehicle systems.
- **Crew Escape:** Develop systems to remove the crew safely from a vehicle in the event of catastrophic failure during the highest risk phases of a mission, including vehicle ascent and descent

Public Benefit: A safe earth-to-orbit space transportation system is a key enabler of the commercial development, civil exploration and National security of space. Human space flight remains a hazardous endeavor in spite of advances in aerospace technology.. NASA intends to substantially increase the safety of routine space operations by developing the technologies and architectures for the next generation of RLVs and by concurrently developing the advanced technologies that will be required for future generations of RLVs. These future vehicles and associated systems could enable a broad expansion in scientific research, open new commercial markets, improve national security, and the enable the human exploration and development of space.

Technical Approach (Next Generation): Building on 20 years of success with America's 1st Generation RLV—the Space Shuttle—the 2nd Generation RLV program defines the plan of action to design and develop America's next-generation RLV. In partnership with the Department of Defense (DoD), the U.S. aerospace industry, and academia, NASA will perform systems engineering, technology development and architecture definition trade studies to define at least two 2nd Generation RLV architecture designs that will best meet the requirements to make access to space safer, more reliable, and less expensive for present and future customers. The ongoing 2nd Generation RLV design-and-development activities took into account extensive NASA studies and contractor-provided input from prior solicitations, which focused on detailed requirements evaluation, updated market projections, and risk-reduction priorities and plans. This systematic approach targets the research and development of high-priority advanced technologies—such as lightweight structures, long-life rocket engines, advanced crew systems, life support, robotics, flight control and avionics, and thermal protection systems—to be integrated into at least two launch architectures to provide the foundation for future potential full-scale development decisions in FY 2006. The emphasis is on risk-reduction activities selected according to industry and NASA needs. The high priority risk reduction areas identified included technology development and demonstration, business and program planning, and systems engineering and analysis.

APG 3R6: Down-select to a minimum of two launch architectures for detailed development based on their ability to meet the safety and affordability goals. This selection will determine what launch architectures and critical technology developments will be continued through FY 2006.

Performance Indicators:

- Architecture systems requirements document for 2nd Generation RLV will be baselined
- Successful completion of the 2nd Generation RLV systems requirement review
- Successful completion of the main engine prototype critical design reviews
- Down-select to a minimum of two launch architectures for detailed development

Technical Approach (Future Generation): Significantly increase the inherent reliability, flexibility and intact abort options of future launch systems. This will be achieved primarily by dramatically increasing system margin (performance, weight and operating margins). In addition, NASA will work to reduce the variability and increase the intelligence, redundancy and robustness of future systems. As a critical first demonstration of dramatically increased system margin, NASA will ground validate a rocket based combined cycle engine, ground validate a Mach 4 turbine accelerator for a turbine-based combined cycle engine and flight validate a multi-Mach scramjet and critical supporting technologies and tools by 2007. These concepts utilize oxygen from the atmosphere to greatly increase the efficiency of the propulsion system. NASA will leverage investments of parallel programs to make advances in supporting technologies. Based on these results, a decision will be made on the next steps of flight validating combined cycle propulsion systems. This effort is being conducted in close cooperation and coordination with the DoD as part of the National Hypersonic's Plan.

APG 3R7: Complete the independent evaluation of three revolutionary hypersonic propulsion technology systems demonstrations and associated ground technologies. This independent evaluation will validate ability of each propulsion system, a rocket-based combined-cycle engine, a turbine-based combined cycle engine and a scramjet engine, to achieve the strategic objectives within cost and schedule.

Performance Indicators:

- Complete the independent evaluation of three revolutionary hypersonic propulsion technology systems demonstrations, including a rocket-based combined-cycle engine, a turbine-based combined cycle engine and a scramjet engine.
- Demonstrate resin transfer molded polymer matrix composite with 550°F use temperature
- Complete X-43 scramjet launch system preliminary design review
- Complete direct connect injector testing for RBCC engine
- Complete flowpath air augmented rocket for RBCC engine
- Complete water cooled single thruster for RBCC engine

Objective Seven – Mission Affordability: Create an affordable highway to space by reducing the cost of delivering a payload to low-Earth orbit to $1,000 per pound (a factor of 10) by 2010 and to $100 per pound (an additional factor of 10) by 2025 and reducing the cost of inter-orbital transfer by a factor of 10 within 15 years and by an additional factor of 10 by 2025.

Strategy:

- **Reusable and Robust Propulsion Systems:** Develop long-life, highly reusable engine systems and inherently reliable integrated propulsion systems.

- **Low-Cost, Lightweight Materials and Structures:** Reduce the overall system weight of vehicles using lightweight, long-life primary structures and low-cost metallic and non-metallic propellant tanks.
- **Operations Optimization:** Develop the capability for autonomous checkout and vehicle control, modular payload systems, and new launch site operations.
- **Risk Reduction:** Develop key technologies for full-scale development of a second-generation RLV system.

Public Benefit: An affordable earth-to-orbit space transportation system is a key enabler of the commercial development, civil exploration and national security. Human space flight remains an expensive endeavor in spite of advances in aerospace technology. NASA intends to substantially reduce the resources devoted to routine space operations by developing the technologies and architectures for the next generation of RLVs and by concurrently developing the advanced technologies that will be required for future generations of RLV. These future vehicles and their associated systems could enable a broad expansion in scientific research, ensure the seamless security of aerospace, open new commercial markets, increase national security, and enable the human exploration and development of space.

Technical Approach (Next Generation): Building on 20 years of success with America's 1st Generation RLV—the Space Shuttle—the 2nd Generation RLV program defines the plan of action to design and develop America's next-generation RLV. In partnership with the Department of Defense (DoD), the U.S. aerospace industry, and academia, NASA will perform systems engineering, technology development and architecture definition trade studies to define at least two 2nd Generation RLV architecture designs that will best meet the requirements to make access to space safer, more reliable, and less expensive for present and future customers. The ongoing 2nd Generation RLV design-and-development activities took into account extensive NASA studies and contractor-provided input from prior solicitations, which focused on detailed requirements evaluation, updated market projections, and risk-reduction priorities and plans. This systematic approach targets the research and development of high-priority advanced technologies—such as lightweight structures, long-life rocket engines, advanced crew systems, life support, robotics, flight control and avionics, and thermal protection systems—to be integrated into at least two launch architectures to provide the foundation for future potential full-scale development decisions in FY 2006. The emphasis is on risk-reduction activities selected according to industry and NASA needs. The high priority risk reduction areas identified included technology development and demonstration, business and program planning, and systems engineering and analysis.

APG 3R8 Down-select to a minimum of two launch architectures for detailed development based on their ability to meet the safety and affordability goals. This selection will determine what RLV architectures and critical technology developments will be continued through FY 2006.

Performance Indicators:

- Architecture systems requirements document for 2nd Generation RLV will be baselined
- Successful completion of the 2nd Generation RLV systems requirement review
- Successful completion of the main engine prototype critical design reviews
- Down-select to a minimum of two launch architectures for detailed development

Technical Approach (Future Generation): Significantly increase the inherent reliability, flexibility and intact abort options of future launch systems. This will be achieved primarily by dramatically increasing the system margin (performance, weight and operating). In addition, NASA will work to reduce the variability and increase the intelligence, redundancy and robustness of future systems. As a critical first demonstration of dramatically increased system margin, NASA will ground validate a rocket-based combined-cycle engine, ground validate a Mach 4 turbine accelerator for a turbine-based combined cycle engine, and flight validate a multi-Mach scramjet and critical supporting technologies and tools by 2007. These concepts utilize oxygen from the atmosphere to greatly increase the efficiency of the propulsion system. NASA will leverage investments of parallel programs to make advances in supporting technologies. Based on these results, a decision will be made on the next steps of flight validating combined cycle propulsion systems. This effort is being conducted in close cooperation and coordination with the DoD as part of the National Hypersonic's Plan.

APG 3R9 Complete the independent evaluation of three revolutionary hypersonic propulsion technology systems demonstrations and associated ground technologies. This independent evaluation will validate ability of each propulsion system, a rocket-based combined-cycle engine, a turbine-based combined cycle engine and a scramjet engine, to achieve the strategic objectives within cost and schedule.

Performance Indicators:

- Complete the independent evaluation of three revolutionary hypersonic propulsion technology systems demonstrations, including a rocket-based combined-cycle engine, a turbine-based combined cycle engine and a scramjet engine.
- Demonstrate reaction transfer molded polymer matrix composite (PMC) with 550°F use temperature
- Complete RBCC Engine Test of a PMC combustor support chamber
- Complete X-43 scramjet launch system preliminary design review
- Complete direct connect injector testing for RBCC engine
- Complete flowpath air augmented rocket for RBCC engine
- Complete water cooled single thruster for RBCC engine

Objective Eight – Mission Reach: Extend our reach in space with faster travel times by reducing the time for planetary missions by a factor of 2 by 2015 and by a factor of 10 by 2025.

Strategy:

- **Advanced Propulsion Concepts:** Identify and develop breakthrough technology for advanced propulsion systems.
- **Materials and Structures:** Develop lightweight airframes, tanks, and micro-components using nano-technology and ultra-high temperature ceramics.

Public Benefit A major NASA objective is the exploration of the solar system to provide the American public with an understanding of the nature, history, and origins of the planets and their moons. Some NASA planetary missions also seek evidence of existing or extinct life at key planets and moons or provide comparative planetary data that helps in the development of accurate, predictive environmental, weather, climate, natural disaster, and natural resource models for Earth. The distance of planetary science targets from Earth is a major obstacle to conducting these missions. Current launch vehicles and on-board chemical propulsion systems require years of transit time with spacecraft in dormant states to reach the outer planets. Once they arrive at a target, mass and power limits imposed by today's propulsion systems further limit the size of planetary mission science instruments. The technologies that are being developed will provide the major breakthroughs are needed to enable science missions that are beyond the limits of chemical systems in order to provide an increased understanding of our neighboring celestial bodies and galactic phenomena and, possibly, explore beyond them.

Technical Approach: The will focus on the discovery and development of high-risk, high-payoff technologies with specific application to enabling rapid interplanetary access. Innovative ideas from the external community, leveraged by emerging technologies outside the aerospace field, will complement NASA capabilities in critical areas. Very advanced concepts with potentially huge improvements over current systems, but that are in early stages of understanding and development, are emphasized. Among the current foci are an electric engine fueled by nuclear fusion, a magnetohydrodynamic (MHD) by-pass, and a Lithium propellant concept. Component and process technologies and performance prediction methods are being developed to enable subsystem test beds that will feed system level test-beds for methods that show promise. Technology products will be integrated into proof-of-concept systems to validate performance in practical applications as practical system emerge over a period expected to be 8-10 years.

APG 3R10 Complete initial component tests to provide data for evaluating feasibility of key concepts by completing all of the following indicators.

Performance Indicators:

- Demonstrate plasma compressors for fusion concept
- Successfully complete arc-shock tunnel tests for magneto-hydrodynamic bypass concept
- Initiate lithium propellant tests
- Complete magnetic nozzle high power (on the order of one gigawatt) test for high temperature plasma

Goal 3 – Pioneer Technology Innovation: Enable a revolution in aerospace systems.

Objective Nine – Engineering Innovation: Enable rapid, high-confidence, and cost efficient design of revolutionary systems by enabling the capability to predict and alleviate with 95 percent confidence, during mission design, all probable threats to mission success by 2012. By 2022 enable the capability to methodically design missions with safety, cost, technical performance, and life defined with 95 percent confidence.

Strategy:

- **Process and Concept Innovation:** Develop new processes and concepts for accomplishing full-life-cycle ("cradle-to-grave") planning and design of new, revolutionary aerospace systems.
- **Validation and Implementation:** Develop technologies and concepts for new ways of certifying and fielding new aerospace systems.
- **Information Technologies:** Develop computational capabilities and knowledge bases necessary to design new aerospace systems.

- **Advanced Engineering and Analysis Technologies:** Develop design tools and the ability to model any part of a new vehicle design during any part of the system's span and under all operating conditions and environments.

Public Benefit: Reduced cost and increased reliability and safety of aerospace systems.

Technical Approach: Two programs contribute to the accomplishment of this strategic goal. The Engineering for Complex Systems Program will develop comprehensive capabilities and components for knowledge access, model based reasoning, risk prediction & management, experience capture, software engineering tools, resilient software-based systems and design decision-making. Methods will be developed for integrating advanced system health measurement approaches in the design process that take advantage of current and future developments in on-board sensing, self-healing materials, and self-reliant systems.

The Computing, Information, and Communications Technology Program will develop technologies to provide seamless and collaborative access to distributed ground-, air-, or space based hardware resources. It will also develop technologies to provide seamless and collaborative access to distributed software resources, whether they are in the form of data, tools, processes, or knowledge. This will allow better sharing of information, improves tracking of assumptions about complex processes, and reduce time spent on hardware and software integration. These prediction, modeling, and design capabilities will be integrated into a progressively improving set of user-accepted tools that can enable reliable design for mission safety and accurate assessment of mission cost and performance. Broadly announced peer reviewed solicitations are used to capture innovative ideas from the external community and to leverage emerging technologies from outside the aerospace field. These concepts will be combined with NASA expertise to synergistically form the basis for generating research programs in current critical areas and identifying new areas for research. Technology products will be integrated into proof-of-concept systems to validate performance in practical applications.

APG 3R11: Complete development of an organizational risk model and establish initial high dependability computing testbeds and tools as defined in the following indicators.

Performance Indicators:

Process and Concept Innovation

- Complete initial Organizational Risk Model that captures and analyzes data on social/organizational system risks and manage and evolve the organization by enabling the description and analysis of risks in organizational level decisions

V**alidation and Implementation**

- Establish initial High Dependability Computing Testbeds - install, load and provide initial simulations for at least two key NASA software systems that mitigate risks in the areas of dependability, performance/risk measurement tools, and testing of complex intelligent systems.
- Demonstrate certifiable program synthesis technology

Advanced Engineering and Analysis Technologies

- Validate nonlinear structural analysis tools

Objective Ten – Technology Innovation: Enable fundamentally new aerospace system capabilities and missions by enabling a 500 percent increase in useful new science information acquired from NASA science missions, data sources, and science system simulations as compared to equivalent FY 2000-2002 science programs by 2012, and by 2022, a 1000 percent increase. Enable heretofore-impractical or unaffordable mission classes by improving, by a factor of 3 in 2012 and 10 in 2020 over comparable systems and concepts designed using FY 2000 – 2002 flight –ready technology, flight resources including payload mass, volume, and power. By FY 2012, enable mission systems that can operate safely and successfully with less than 10 percent of the human participation required for FY 2000-2002 designs, and by FY 2020 enable missions that can analyze unexpected events and adjust plans and adapt systems accordingly with no human participation.

Strategy:

- **Core Competencies:** Build and advance, within NASA, the technology competencies that have potential for major benefits to aerospace applications.
- **Enabling New Missions:** Develop technologies for missions that are currently unrealistic, from personal air transportation to interstellar travel. This thrust will remove barriers such as high technology costs, limits to human endurance, and immense mission timeframes, to open exciting new possibilities.
- **Enabling New Capabilities:** Develop capabilities that are not possible today, such as autonomy sufficient to conduct an entire mission without human intervention, or self-repair of a vehicle's skin.

Public Benefit: NASA's science objectives are to answer diverse and far-reaching scientific questions regarding the universe, galaxies, stars, and planets including their make-up, origins, and the physical, chemical and biological processes involved. These include understanding the Earth and Sun and modeling the complex processes and interactions of the two to provide models of weather, climate, natural disaster, and natural resources for the improvement of the quality of life on earth. The total range of observations, measurements, and data analyses needed to address these objectives far exceeds the capabilities and affordability of current capabilities. The Aerospace Technology Enterprise seeks to provide radical improvements in sensing, instrument, and data processing technologies that are applicable to broad classes of science missions that can obtain information not currently attainable and to provide needed information at a lower cost.

NASA is developing revolutionary technologies for sensing and spacecraft systems to provide increased scientific return from future missions at lower cost. Advanced technologies will allow NASA to explore new regions of space, and to gain greater knowledge of the Earth, the Solar System, and the Universe. More capable and cost-effective missions will provide a higher return on investment in NASA programs over the next decade. NASA research in this program could also lead to lighter weight, higher strength materials for commercial applications, power concepts for remote locations, and very small biochemical probes applicable to medicine.

A huge cost factor in the operation of aerospace systems, once they are deployed, is the workload and cost of human operators whether it be for air traffic control, Space Shuttle launch, Space Station operation, or the monitoring and control of science missions. Science missions are frequently terminated, even though the spacecraft is operating perfectly and has considerable remaining life, because the cost of operation is too high relative to the remaining scientific potential. The workload and danger to astronauts in operating current and future exploration missions is a serious concern. Operating spacecraft on planetary surfaces and behind planets and moons is dangerous to mission success without the ability for the spacecraft to react to unplanned events.

Systems will be developed that can think, team, and make decisions with minimum human involvement to enable space exploration at far lower cost in human resources and to far more inaccessible locations than is currently possible. In addition to enabling breakthrough opportunities for space missions, this technology could improve many aspects of life on earth, for example, automating complex or hazardous work environments such as mining, rescue in natural disasters, or underwater operations.

With the vast amounts of scientific data being returned to Earth for analysis, another critical area of importance for NASA is in the area of data mining and data understanding. Tools and techniques are required to automatically analyze the data and to extract relevant scientific features for further human analysis and knowledge extraction. In addition to feature recognition and extraction, a key goal of this technology is to provide the underlying basis for establishing causal effects through modeling that can be used for analysis and study of the underlying physical or biological phenomena.

Finally, new revolutionary technologies in distributed information environments are required to enable much of the key capabilities discussed above. Seamless access to ground-, air- and space-based data and information are needed for effective command and control of NASA's exploration assets, optimal science return and knowledge generation, and for engineering and scientific collaborations. This distributed information environment will also benefit many other aspects of human life including other areas of science discovery and key operational environments such as the National Air Space system.

Note on APG's for Technology Innovation objective: The research and technology development supporting the Technology Innovation objective is necessarily about discovery; that is, exploring new ideas that may have high payoffs, but are also high-risk because outcomes and the timing of the outcomes that are unknown. Without being able to predict these outcomes, yet ensure advances in the state-of-the-art, numerous ideas from numerous sources are investigated. The few ideas that are successfully implemented typically result in enabling new, in some cases, unexpected functionality in future systems, including sensors, spacecraft or missions. If we fail to meet an indicator, it does not preclude the state-of-the-art from being advanced on the attempt. The following APG's for the Technology Innovation objective are to "advance the state-of-the-art."

Technical Approach (Science Data): Develop fundamental advances in automated reasoning technologies for spacecraft and rover autonomy and mission planning and scheduling. Develop fundamental advancements in instrument and data delivery capabilities, such as sensitivity, spatial coverage, resolution, spectral bandwidth and selectivity, data delivery rate, and data quality that vastly expand the reach of space and earth science in observable phenomena, physical space/time, and information richness. Seek bold new approaches to measurement, sensing, and decision processes though new concepts in bio-/nano-/information technology. Develop breakthrough capabilities for accessing, analyzing, and applying new and existing science data and for simulating systems to increase quality, timeliness, and understanding of information obtained. Develop breakthrough capabilities for data fusion and synthesis (e.g. for combining data from experiment and computation) and for data, information and knowledge mining. Broadly announced peer reviewed solicitations are used to capture innovative ideas from the external community, to leverage emerging technologies outside the aerospace field, and to complement NASA capabilities in critical areas. Technology products are integrated into proof-of-concept systems to validate performance in practical applications. Potential NASA mission customers are involved in the technology planning process and co-funded partnerships with user Enterprises for transition of maturing technologies to mission applications are pursued actively.

APG 3R12: Advance the state-of-the-art in automated data analysis, mission command and communications, and science sensors and detectors that are potentially beneficial for future NASA missions.

Performance Indicators:

Automated Science Data Understanding

- Discover a novel feature in skewed data
- Demonstrate tools and techniques for automated feature extraction from large datasets
- Demonstrate distributed analysis and data processing to support new problem solving paradigms
- Demonstrate component autonomy technologies in planning and scheduling supporting Mars mission operations

Mission Command and Data Delivery

- Demonstrate technology capable of two-times improvement in Mars-to-Earth communications
- Demonstrate technology capable of ten-fold improvement in Earth-orbit to ground communications
- Demonstrate capability for ad-hoc space and surface networking

Science Sensors and Detectors

Demonstrate molecular-level sensors for environmental health monitoring
Demonstrate high-efficiency, tunable, narrow-line 2 micron laser transmitters

- Demonstrate a fully conductively cooled laser transmitter

Characterize 2 micron detector and receiver components

- Perform advanced quantum mechanical modeling and spectroscopy of laser systems
- Demonstrate photonic/electronic hybrid power devices compatible with flexible substrates
- Demonstrate terahertz amplifiers with gain above 500 gigahertz
- Demonstrate superconducting terahertz receivers
- Demonstrate a prototype liquid Helium 4° Kelvin miniature sorption cooler
- Demonstrate 20 channel radio frequency single electron transistor multiplexor
- Demonstrate a prototype 256x256 Gallium Nitride Schottky photodiode array
- Demonstrate a prototype 512x512 prototype MicroElectroMechanical Systems (MEMS) microshutter array
- Demonstrate a prototype continuous Adiabatic Demagnetization Refrigerator at less than 0.1 degree Kelvin

Technical Approach (Ultra Efficiency): NASA will focus on the development of high-risk, high-payoff technologies with broad application to many classes of missions. These technologies are unique to NASA's long-term needs, and are not being developed elsewhere. Fundamental research and development will be performed in a variety of technical areas, including micro-devices and sensors, on-board power, electric propulsion, structures and materials, and bio-nanotechnology. To reduce cost and enhance scientific capabilities, technology development will emphasize miniaturization and launch-packaging efficiency, integration of functions, frugal use of flight resources, and resiliency. Broadly announced peer-reviewed solicitations are used to capture innovative ideas from the external community, to leverage emerging technologies outside the aerospace field, and to complement NASA capabilities in critical areas. Technology products are integrated into proof-of-concept systems to validate performance in practical applications. Potential NASA mission customers are involved in the technology planning process and co-funded partnerships with user Enterprises for transition of maturing technologies to mission applications are actively pursued.

APG 3R13: Advance the state-of-the-art in power / propulsion systems, spacecraft systems, and large or distributed space systems and our knowledge of space environmental effects that are required to support future NASA missions.

Performance Indicators:

Advanced Power and Electric Propulsion Systems

- Validate ion optics for a 2X increase in life relative to Deep Space 1
- Complete Hall thruster life and operating point correlations
- Complete Hall thruster modeling
- Demonstrate feasibility of high efficiency (i.e., greater than 30 percent) multi-band-gap solar cell on silicon substrate
- Demonstrate single axis integrated momentum and power control with flywheels
- Demonstrate 100 percent thrust augmentation of high area ratio nozzle
- Complete laboratory characterization of solid hydrogen behavior in liquid helium

Micro and Multipurpose Spacecraft Components and Systems

- Demonstrate integrated micropropulsion subsystem with control electronics
- Demonstrate three-axis inertial measurement unit using microgyros
- Demonstrate alpha voltaic power microgenerator
- Demonstrate integrated microinductors for miniature voltage converter
- Demonstrate sun sensor on chip for microspacecraft navigation
- Demonstrate micro electromechanical system microvalve
- Demonstrate 200 watt-hours per kilogram multifunctional battery/spacecraft structure panel

Large and Distributed Space Systems Concepts

- Develop algorithms for attitude determination for spacecraft formations using Global Positioning System (GPS)
- Develop algorithms for attitude control of spacecraft formations using GPS
- Develop relative equations of motion for spacecraft formations at L2 libration point
- Identify viable new concepts for in-space assembly of large space systems
- Demonstrate a prototype membrane waveguide antenna for remote sensing
- Demonstrate the deployment and ultraviolet-rigidization of inflatable boom for solar sails in a laboratory environment
- Demonstrate the deployment of a space boom using shape-memory-composite materials
- Establish proof of concept for a printable electronic circuit on multifunctional membranes

- Demonstrate a prototype electric powered unpiloted air vehicle capable of sustaining 14 hours of operation above an altitude of 50,000 feet

Space Environments and Effects

- Deliver meteoroid environmental model for inner solar system, Venus, and Mars
- Deliver revised NASA / Air Force Spacecraft Charging Analyzer Program (NASCAP-2K, Version 2.0)
- Develop Electronic Properties of Materials Database for use by spacecraft charging models and materials engineers
- Deliver Magneto-tail Charged Particle model for materials degradation studies
- Deliver Low Earth Orbit Spacecraft Charging Guidelines
- Deliver initial state of the art materials knowledge base (SAM-K, Version 1.0)

Technical Approach (Self Reliance): Develop technologies that can enable systems and systems of systems that can think, reason, make decisions, adapt to change, and cooperate among themselves and with humans to provide safe and successful aerospace processes and mission functions with greatly reduced human participation in their execution. Technology products will be integrated into proof-of-concept systems to validate performance in practical applications. Broadly announced peer-reviewed solicitations are used to capture innovative ideas from the external community, to leverage emerging technologies outside the aerospace field, and to complement NASA capabilities in critical areas. Technology products will be integrated into proof-of-concept systems to validate performance in practical applications.

APG 3R14: Demonstrate progress toward achievement of systems and systems of systems that can think, reason, make decisions, adapt to change, and cooperate among themselves and with humans to provide safe and successful aerospace processes and mission functions with greatly reduced human participation by successfully demonstrating individual autonomy components.

Performance Indicator

- Demonstrate individual autonomy component technologies to be included in the larger, integrated demonstration

5. Management Challenges: The overall organizational and management structure of NASA technology development is built around its Strategic Enterprises, including specific program formulation and funding responsibility for all technology activities. This ensures that technology considerations are closely coupled with mission decisions, that technologies are relevant to Enterprise needs, and that mechanisms are provided to transfer successful maturing technologies into operational systems. NASA has undertaken sweeping changes in technology program management to strengthen and highlight the significance of advanced technology in NASA's future. These changes influence how NASA identifies new technology investments and how NASA ensures the efficient transition of new technologies into missions. Specifically, this includes: the realignment of the budget to more closely correspond with Enterprise Strategic Objectives, development and implementation of system analysis tools to aid in program assessment and development of technology portfolios, use of the Aerospace Technology Advisory Committee of the NASA Advisory Council and the National Research Council to provide independent relevance and quality reviews of the Enterprise's technology development projects, and strengthening the relationships with other NASA Enterprises in the development of the research program, and participation in technology maturation activities. Overall, the adjustments have resulted in a closer alignment of technology investments with the goals identified in the NASA Strategic Plan and will allow management to assess the quality and relevance of the Enterprise's research program.

Coordination and integration among all of the Agency's Enterprises is provided through the NASA Chief Technologist. The Chief Technologist advises the Administrator and other senior officials on matters relating to technology, assures an Agency-wide investment strategy for advanced innovative technology, and is the principal Agency advocate for advanced technology. The Chief Technologist also chairs the Technology Leadership Council, which includes the Associate Administrators for the Strategic Enterprises, the NASA Field Center Directors, the NASA Comptroller, and other senior NASA officials. This council establishes the technology strategy for the Agency, addresses critical issues, and is responsible for formulating and advancing NASA's vision for technology. The Associate Administrator for Aerospace Technology is the NASA Chief Technologist to centralize planning and execution of Agency-level technology within one organization while still providing for Enterprise-specific mission technology development by each of the other NASA Enterprises.

As part of the development of the FY 2003 budget development, the Aerospace Technology Enterprise has restructured its programs and projects to more closely align with its Strategic Objectives. This revised structure will simplify the management structure and increase responsiveness to the customer communities.

The Enterprise will also be using independent reviews to provide external assessments of its programs. In total these reviews will assess the programmatic status of each of the programs, the progress that the Enterprise is making toward the achievement of its strategic objectives, the scientific quality of its research, and relevance of the research to the customer's needs. The results of these reviews will provide the Enterprise with objective information on the status and effectiveness of its research programs and impact the content and future elements of the program. Each of these reviews is discussed below.

- An Inter-Center System Analysis Team has been formed and conducts an independent assessment of the progress the Enterprise is making toward the accomplishment of each of its strategic objectives. System analysis tools have been developed to support this process, which will provide the Enterprise with a benchmark for measuring its overall progress toward the accomplishment of its Strategic goals.

- An Independent Annual Review (IAR) will be performed to assess the progress and continued executability of each Enterprise program the annual program review will assess performance against plan, including technical performance, schedule and cost. Additionally the IAR will assess the future executability of the program plan. The IAR compiles its report and provides findings to the Enterprise and governing Program Management Council.

- The quality and relevance review process includes two separate and independent review mechanisms.

- The NASA Advisory Council Aerospace Technology Advisory Committee (ATAC) will conduct an annual review of the relevance and quality of Aerospace Technology Enterprise programs with emphasis on relevance. This review will provide input from our primary customers on the relevancy of our program to their needs and the agency goals.

- The National Research Council Aeronautics and Space Engineering Board (ASEB) will conduct periodic review of the quality and relevance of each Aerospace Technology Enterprise project with emphasis on quality. This review will assess: the scientific and technical quality of each research project, the quality of the performers conducting the research, whether the proper mix of personnel from government, industry, and academia are assigned to each project, the relevance of each project to the customer, and the quality of the program planning behind each project. The team will examine the research portfolio, the research goals, the research plans, the overall capabilities of the research team, the technical progress and prognosis of the research, and the relationship of the research to the broader scientific community.

The management challenges facing the Aerospace Technology Enterprise are similar to that of any organization that is responsible for the identification and development of revolutionary and high-risk technologies for a wide range of using organizations. These include:

- Ensuring that the user needs are well understood, reflected in the research plans and that the user also recognizes the benefits of the on-going research
- Ensuing research being conducted in the proper areas and that the far term research being conducted at the forefront of science and determined to be a world-class endeavor
- Ensuring that research is being conducted by the proper performer (government, academia, or industry).
- Ensuring the proper balance between fundamental and user driven research
- Ensuring that there is the proper balance between far term research and the application of fundamental science to solve real world problems
- Ensuring that the research plans are sound (including regular external reviews, off-ramps, and sunsets) and that adequate progress is being made toward the end objective
- Ensuring effective knowledge transfer

The Office of Aerospace Technology has established the following goals to address the above management challenges. The accomplishment of these goals is on an Enterprise wide basis since they address the totality of the research program and not individual goals / objectives.

APG 3R15: Implement an effective oversight process to insure that the research programs are addressing the correct areas, meeting user requirements, have the proper balance, are properly formulated and planned, and are making sufficient process toward the Enterprise goals

Performance Indicators:

Strategic Planning and Decisions

- Effective use of the Office of Aerospace Technology Investment Planning process to assess the needs against the current research portfolio and identify potential technology gaps
- Conducting a inter center system analysis to assess the progress the current research portfolio is making toward the accomplishment of the Enterprise Strategic Objectives

Program Quality and Relevance

- Conducting independent technical reviews to assess the relevance and quality of selected items of the research program. The reviews will examine the research portfolio, goals and the relationship to the broader scientific community, in terms of the quality of the technology being developed and the needs of the customer organizations.

- Establishment of a review team consisting of representatives of the customer NASA Enterprises and their mission programs and projects to conduct NASA mission relevancy reviews of the research program.

Program Management and Oversight

- Effective use of an Enterprise Program Management Council with appropriate representation from other NASA Enterprises and Offices
- Successful completion of a Program Readiness Review and Non-Advocate Review for every new program / project prior to program go-ahead
- Conducting an Independent Annual review (IAR) of each program to assess its progress and continued executability. The annual program review will assess performance against plan including technical performance, schedule, and cost. Additionally, the IAR will assess the future executability of the program.

APG 3R16: To contribute toward maintaining a well-prepared workforce pipeline, all Enterprise program activities will establish and implement, or continue implementation of, an education outreach plan that results in an educational product. The product shall be consistent with the NASA Implementation Plan for Education and use program content to demonstrate or enhance the learning objectives.

Performance Indicators:

- Implementation of current education outreach plans.
- Establishment of education outreach plans for all remaining programs
- Effective use of the 5 University-based Research, Education, and Training Institutes (RETIs).
- Inclusion of a University research strategy for each Enterprise program

Verification/Validation Summary: The data used to substantiate actual performance originates at the NASA Center responsible for project implementation. The data will be reviewed and verified by senior Center official and the program and project managers. The NASA HQ Program Executive Officer and Director of the Research and Technology Division will validate this data. The NASA Advisory Council will also provide an independent assessment of each Aerospace Technology program performance.

FY 2003 MULTI-YEAR PERFORMANCE TREND

Aerospace Technology

Goal 1: Revolutionize Aviation

Strategic Objective: Increase Safety-Make a safe air transportation system even safer

	FY 99	FY 00	FY01
Annual Performance Goal and APG #	9R5: For the aviation safety areas of Controlled Flight into Terrain, runway incursion, and loss of control, identify the contributing causes to be addressed, potential solutions using current capabilities, and gaps that require technology solutions.	0R3: Flight demonstrate a conceptual aircraft flight deck integrated with evolving ground-based runway incursion avoidance technologies installed at a major airport.	1R1: NASA's research stresses aviation system monitoring and modeling, accident prevention and accident mitigation. The performance target is to complete 75% of the conceptual designs of systems for preventing and mitigating accidents, and to demonstrate tools for accident analysis and risk assessment.
Assessment	Green	Yellow	
Annual Performance Goal and APG #	9R2: Characterize the Super-cooled Large Droplets (SLD) icing environment, determine its effects on aircraft performance, and acquire and publish data to improve SLD forecasting confidence.		
Assessment	Yellow		
	FY 02	FY 03	
Annual Performance Goal and APG #	2R1: Complete the interim progress assessment utilizing the technology products of the Aviation Safety program as well as the related Aerospace Base R&T efforts and transfer to industry an icing CD-ROM, conduct at least one demonstration of an aviation safety related subsystem, and develop at least two-thirds of the planned models and simulations.	APG 3R1: Demonstrate progress in maturing, through flight tests and/or simulations, the critical technologies that will be necessary to meet the aviation safety objective. These tests and simulations are critical steps in the development of a suite of technologies that when completely developed and implemented by the customer, will provide a minimum of 50 percent reduction in fatal accident rate.	
Assessment	TBD	TBD	

<u>Strategic Objective</u>: Reduce Emissions-Protect local air quality and our global climate

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #	9R1: Demonstrate an advanced turbine-engine combustor that will achieve up to a 50 percent reduction of Oxides of Nitrogen emissions based on 1996 International Civil Aviation Organization (ICAO) standards.	0R1: Demonstrate, in a laboratory combustion experiment, an advanced turbine-engine combustor concept that will achieve up to a 70% reduction of oxides of nitrogen emissions based on the 1996 ICAO standard.	1R2: NASA's research stresses engine technology to reduce the emissions of oxides of nitrogen and carbon dioxide. The performance target is to complete one system level technology benefit assessment, one component concept selection and one new material system.
Assessment	Green	Blue	
	FY 02	**FY 03**	
Annual Performance Goal and APG #	2R2: NASA's research stresses engine technology to reduce the emissions of oxides of nitrogen (NOx) and carbon dioxide (CO2). The annual performance goal is to complete sector testing of a low-NOx combustor concept capable of a 70% reduction in NOx from the 1996 International Civil Aviation Organization (ICAO) baseline, and demonstrate at least one additional concept for the reduction of other emittants.	APG 3R2: Complete combustor sector test for concepts capable of achieving the 70%NOX goal by 2007 and select the most promising approaches leading to full annular rig testing for large and regional jet engine applications. Complete an Interim Technology Assessment of the aggregate potential benefits from the engine and airframe technologies to reduce emissions. The results from this analysis will provide a benchmark for measuring overall progress, and guide future investment decisions.	
Assessment	TBD	TBD	

Strategic Objective: Reduce Noise-Reduce aircraft noise to benefit airport neighbors, the aviation industry, and travelers

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #		0R2: Validate the technologies to reduce noise for large commercial transports by at least 7 decibels relative to 1992 production technology.	1R3: NASA's research has stressed reducing noise in the areas of engines, nacelles, engine/airframe integration, aircraft interiors and flight procedures. The performance target is completion of NASA's research in noise reduction through large scale demonstration of a 2-5 decibel reduction in aircraft noise based on 1997 production technology, and initial assessments of concepts offering additional reduction.
Assessment		Green	
	FY 02	**FY 03**	
Annual Performance Goal and APG #	2R3: NASA's research stresses reducing noise in the areas of engines, nacelles, engine-airframe integration, aircraft interiors and flight procedures. The annual performance goal is to assess and establish the strongest candidate technologies to meet the 10 decibel reduction in community noise.	APG 3R3: Complete development of initial physics-based prediction models to guide the development potential noise reduction technology concepts. Complete an interim technology assessment of the potential benefits for these concepts to reduce noise emissions. The results from this analysis will provide a benchmark for measuring overall progress, and guide future investment decisions.	
Assessment	TBD	TBD	

Strategic Objective: Increase Capacity-Enable the movement of more air passengers with fewer delays

	FY 99	FY 00	FY01
Annual Performance Goal and APG #		0R4: Conclude the Terminal Area Productivity project by field demonstrations of the complete suite of technologies and procedures that enable a 12% increase over 1994 nonvisual operations for single-runway throughput.	1R4: NASA's research stresses operations systems for safe, efficient air traffic management and new aircraft configurations for high productivity utilization of existing runways. The performance target is to complete the civil tiltrotor project by validating databases for contingency power, flight paths, and noise reduction, as well as complete at least one demonstration of an airspace management decision support tool.
Assessment		Green	
	FY 02	**FY 03**	
Annual Performance Goal and APG #	2R4: NASA's research stresses operations systems for safe, efficient air traffic management and new aircraft configurations for high productivity utilization of existing runways. The annual performance goal is to develop a decision support tool, and define concepts for future aviation systems.	APG 3R4: Complete development, initial functionality and evaluate human factors for at least one decision support tool to enable achievement of the planned progress towards the goal of doubling the capacity of the National Airspace System in 10 years. Complete the initial build of a toolbox of state-of-the-art airspace models to enable the planned progress towards the 2022 Objective.	
Assessment	TBD	TBD	

Strategic Objective: Increase Mobility-Enable people to travel faster and farther, anywhere, anytime

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #	9R8: Conclude pre-flight ground testing of the general aviation piston and turbofan engines.	0R7: Perform flight demonstrations of advanced general aviation piston and turbine engines at the annual Oshkosh air show.	1R7: NASA's research stresses operations systems for safe, efficient air traffic management and new aircraft configurations for high productivity utilization of existing runways. The performance target is to complete the Advanced General Aviation Transport Experiments project by validating transportation system concepts through flight test and publish design guidelines.
Assessment	Yellow	Yellow	
Annual Performance Goal and APG #	9R6: Produce a complete vehicle system configuration document that includes impact of technology validation efforts from 1990 through 1999. This document will support the evaluation of technology selection decisions for a future High Speed Civil Transport (HSCT).		
Assessment	Green		

	FY 02	**FY 03**	
Annual Performance Goal and APG #	2R5: NASA's research stresses aircraft technologies which enable the use of existing small community and neighborhood airports, without requiring control towers, radar installations, and more land use for added runway protection zones. The annual performance goal is to baseline, in partnership with the FAA, the system engineering	APG 3R5: Select candidate technologies for experimental flight evaluation based on their impact on mobility. Mobility metrics will be measured by accessibility, doorstep-to-destination transit time, system and user costs, and related trip reliability and safety metrics. These flight experiments will evaluate individually, at the sub-system level, the impact of selected technologies on lowering required landing minimums and increasing the volume of operations at	
Assessment	TBD	TBD	

Goal 2: Advance Space Transportation

Strategic Objective: Mission Safety-Radically improve the safety and reliability of space launch systems

	FY 99	FY 00	FY 01	
Annual Performance Goal and APG #				
Assessment				

	FY 02	**FY 03**	
Annual Performance Goal and APG #	2R6: NASA's investments emphasize thorough mission needs development, requirements definition, and risk reduction effort leading to commercially owned and operated launch systems to meet NASA needs with commercial application where possible. The annual performance goal is to complete risk reduction and architecture reviews to support design and demonstration decisions.	APG 3R6: Down-select to a minimum of two launch architectures for detailed development based on their ability to meet the safety and affordability goals. This selection will determine what launch architectures and critical technology developments will be continued through FY 2006.	
Assessment	TBD	TBD	
Annual Performance Goal and APG #		APG 3R7: Complete the independent evaluation of three revolutionary hypersonic propulsion technology systems demonstrations and associated ground technologies. This independent evaluation will validate ability of each propulsion system, a rocket-based combined-cycle engine, a turbine-based combined cycle engine and a scramjet engine, to achieve the strategic objectives within cost and schedule.	
Assessment		TBD	

<u>Strategic Objective</u>: Mission Affordability-Create an affordable highway to space

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #	9R14: Continue the X-33 Vehicle Assembly in Preparation for Flight Testing.	0R9: Conduct the flight testing of the X-33 vehicle.	1R10: NASA's research stresses highly reliable, fully reusable configurations, advanced materials and innovative structures. The performance target is complete assembly of the third X-34 test vehicle, demonstrate 75% of supporting technology developments, and complete competitive solicitations for expanded 2nd generation reusable launch vehicle efforts.
Assessment	Green	Red	
Annual Performance Goal and APG #	9R15: Complete Vehicle Assembly and Begin Flight Testing of the X-34.	0R12: Complete vehicle assembly and begin the flight test of the second X-34 vehicle.	1R11: NASA's research stresses technology for reusable, long life, high power electric and advanced, clean chemical engines for earth orbital transfer and breakthrough propulsion, precision landing systems and aerocapture systems for planetary exploration. The performance target is to commence X-37 vehicle assembly, and complete one Pathfinder flight experiment.
Assessment	Yellow	Red	
Annual Performance Goal and APG #			
Assessment			
Annual Performance Goal and APG #		0R17: Complete small payload focused technologies and select concepts for flight demonstration of a reusable first stage (Bantam).	
Assessment		Red (project terminated 10/99)	

<u>Strategic Objective</u>: Mission Affordability-Create an affordable highway to space (cont.)

	FY 02	**FY 03**	
Annual Performance Goal and APG #	2R7: NASA's investments emphasize thorough mission needs development, requirements definition, and risk reduction effort leading to commercially owned and operated launch systems to meet NASA needs with commercial application where possible. The annual performance goal is to complete risk reduction and architecture reviews and initial hardware demonstrations to support design and demonstration decisions.	APG 3R8 Down-select to a minimum of two launch architectures for detailed development based on their ability to meet the safety and affordability goals. This selection will determine what RLV architectures and critical technology developments will be continued through FY 2006.	
Assessment	TBD	TBD	
Annual Performance Goal and APG #			
Assessment		TBD	
Annual Performance Goal and APG #		APG 3R9 Complete the independent evaluation of three revolutionary hypersonic propulsion technology systems demonstrations and associated ground technologies. This independent evaluation will validate ability of each propulsion system, a rocket-based combined-cycle engine, a turbine-based combined cycle engine and a scramjet engine, to achieve the strategic objectives within cost and schedule.	
Assessment		TBD	
Annual Performance Goal and APG #			
Assessment			

<u>Strategic Objective</u>: Mission Reach-Extend our reach in space with faster travel times

	<u>FY 99</u>	**<u>FY 00</u>**	**<u>FY01</u>**
Annual Performance Goal and APG #		0R10: Complete NASA Solar Electric Propulsion Technology Application Readiness (NSTAR) Mission Profile (100% design life) ground testing for Deep Space-1 (concurrent, identical firing of an NSTAR engine in a vacuum chamber with the actual firing sequence of the in-flight propulsion system).	
Assessment		Green	
	<u>FY 02</u>	**<u>FY 03</u>**	
Annual Performance Goal and APG #	2R8: NASA's long-term research emphasizes innovative propulsion systems. The performance target is to conduct a test of an advanced ion propulsion engine.	APG 3R10 Complete initial component tests to provide data for evaluating feasibility of key concepts by completing all of the following indicators.	
Assessment	TBD	TBD	

Goal 3: Pioneer Revolutionary Technology

Strategic Objective: Engineering Innovation-Enable rapid, high-confidence, and cost efficient design of revolutionary systems

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #	9R12: Demonstrate up to a 200-fold improvement over the 1992 baseline (reduction from 3,200 hours to 15) in the timeto-solution for a full combustor simulation on NASA's National Propulsion System Simulation advanced applications computational testbeds that can be increased to sustain teraFLOPS capability.	0R8: Demonstrate a prototype heterogeneous distributed computing environment.	1R8: Develop at least three new design tools, accomplish at least four demonstrations of advances in computation and communications, and complete the intelligent synthesis environment proof-of-concept system capability build to technology readiness level
Assessment	Blue	Green	
Annual Performance Goal and APG #	9R13: Demonstrate communication testbeds with up to 500-fold improvement over the 1996 baseline (increase from 300 kilobits per second to 150 megabits per second) in end-to-end performance.		
Assessment	Blue		
	FY 02	**FY 03**	
Annual Performance Goal and APG #	2R9: NASA's investments emphasize advances in experimental vehicles, flight testbeds, and computing tools to enable revolutionary designs. The annual performance goal is to conduct at least five demonstrations of revolutionary aerospace subsystems.	APG 3R11: Complete development of an organizational risk model and establish initial high dependability computing testbeds and tools as defined in the following indicators.	
Assessment	TBD	TBD	

<u>Strategic Objective</u>: Technology Innovation-Enable fundamentally new aerospace system capabilities and missions.

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #	9R10: Complete low altitude flights of an Remotely Piloted Aircraft (RPA) with a wingspan greater than 200 feet, suitable for flight to 100,000 feet in altitude once outfitted with high performance solar cells.	0R11: Demonstrate improved remotely piloted aircraft science mission capability by increasing operational deployment time from 3 weeks to 9 with minimum airfield provisions and unrestricted airspace. (Original) Demonstrate continuous over-the-horizon command and control capabilities ofan RPA that would extend the operating range from 40 to 200 nautical miles. (Replacement)	
Assessment	Green	Red (orig.); Green (replacement)	
Annual Performance Goal and APG #	9R11: Conduct RPA flight demonstration to validate the capability for science missions of greater than 4 hours duration in remote deployments to areas such as the polar regions above 55,000 feet.		
Assessment	Green		
Annual Performance Goal and APG #		0R6: Demonstrate in flight an airframe-integrated, dual-mode, scramjet-powered vehicle.	1R9: NASA's research stresses affordable flight demonstrations of revolutionary vehicle concepts (low-cost X-Planes) to accelerate technology advances in laboratory research, new design tools and advanced simulation. The performance target is to demonstrate two new concepts in flight and identify five new concepts for further examination.
Assessment		Yellow	

Strategic Objective: Technology Innovation-Enable fundamentally new aerospace system capabilities and missions. (cont.)

	FY 02	FY 03	
Annual Performance Goal and APG #	2R10: NASA's investments emphasize revolutionary technologies such as nanotechnology, information technology and biotechnology which could enable new missions and capabilities. The annual performance goal is to develop at least two new materials concepts and demonstrate the feasibility of at least two nanotechnology concepts and two other concepts.	APG 3R12: Advance the state-of-the-art in automated data analysis, mission command and communications, and science sensors and detectors that are potentially beneficial for future NASA missions.	
Assessment	TBD	TBD	
Annual Performance Goal and APG #		APG 3R13: Advance the state-of-the-art in power / propulsion systems, spacecraft systems, and large or distributed space systems and our knowledge of space environmental effects that are required to support future NASA missions.	
Assessment		TBD	
		APG 3R14: Demonstrate progress toward achievement of systems and systems of systems that can think, reason, make decisions, adapt to change, and cooperate among themselves and with humans to provide safe and successful aerospace processes and mission functions with greatly reduced human participation by successfully demonstrating individual autonomy components.	

Management Challenge objective

	FY 99	FY 00	FY01
Annual Performance Goal and APG #	9R16: Complete 90 percent of all Enterprise-controlled milestones within 3 months of schedule.	0R13: Complete 90 percent of all Enterprise-controlled milestones within 3 months of schedule.	
Assessment	Yellow	Red	
Annual Performance Goal and APG #	9R17: Achieve a facility utilization customer satisfaction rating of 95 percent of respondents at "5" or better and 80 percent at "8" or better based on exit interviews.	0R14: Achieve a facility utilization customer satisfaction rating of 95% of respondents at "5" or better and 80% at "8" or better, based on exit interviews.	
Assessment	Blue	Green	
Annual Performance Goal and APG #	9R18: Complete the Triennial Customer Satisfaction Survey, and achieve an improvement from 30 percent to 35 percent in "highly satisfied" ratings from Enterprise customers.		1R12: Customer Feedback: Continue the solicitation of customer feedback on the services, facilities, and expertise provided by the Aerospace Technology Enterprise.
Assessment	Green		
Annual Performance Goal and APG #	9R19: Transfer at least 10 new technologies and processes to industry during the fiscal year.	0R15: Transfer at least 12 new technologies and processes to industry during the fiscal year.	
Assessment	Blue	Blue	
Annual Performance Goal and APG #	9R21: For all new program activities initiated in FY 99, develop an education outreach plan, which includes and results in an educational product. This product shall be consistent with current educational standards and use program content to demonstrate	0R16: Continue the implementation of current education outreach plans and establish new plans for all new program activities initiated in FY 00.	1R13: Education Outreach: Continue the implementation of current education outreach plans, and establish new plans for all new program activities initiated in FY 2001.
Assessment	Yellow	Blue	
Annual Performance Goal and APG #	9R20: Establish an Aeronautics Education Laboratory in at least three new sites in the United States.		
Assessment	Blue		

Management Challenge objective (cont.)

	FY 02	FY 03	FY04
Annual Performance Goal and APG #			
Assessment			
Annual Performance Goal and APG #			
Assessment			
Annual Performance Goal and APG #	2R11: The annual performance goal is to continue the solicitation of customer feedback on the services, facilities, and expertise provided by the Aerospace Technology Enterprise.	APG 3R15:. Implement an effective oversight process to insure that the research programs are addressing the correct areas, meeting user requirements, have the proper balance, are properly formulated and planned, and are making sufficient process toward the Enterprise goals	
Assessment	TBD	TBD	
Annual Performance Goal and APG #	2R13: Review results of NASA and commercial-sector performed launch system architecture studies, related requirements, and refinements in planned risk reduction investments.		
Assessment	TBD		
Annual Performance Goal and APG #	2R12: Continue the implementation of current education outreach plans, and establish new plans for all new program activities initiated in FY 2002.	APG 3R16: To contribute toward maintaining a well-prepared workforce pipeline, all Enterprise program activities will establish and implement, or continue implementation of, an education outreach plan that results in an educational product. The product shall be consistent with the NASA Implementation Plan for Education and use program content to demonstrate or enhance the learning objectives.	
Assessment	TBD	TBD	
Annual Performance Goal and APG #			
Assessment			

Aerospace Technology FY 2003 Budget Link Table	Budget Category	Vehicle Systems	Aviation safety	Airspace Systems	2nd Generation	3rd Generation	Engineering for Complex Systems	Computing, Information and Communications Technology	Enabling Concepts and Technologies
Annual Performance Goal & APG #									
APG 3R1: Demonstrate progress in maturing, through flight tests and/or simulations, the critical technologies that will be necessary to meet the aviation safety objective. These tests and simulations are critical steps in the development of a suite of technologies that when completely developed and implemented by the customer, will provide a minimum of 50 percent reduction in fatal accident rate.		X	X						
APG 3R2: Complete combustor sector test for concepts capable of achieving the 70%NOX goal by 2007 and select the most promising approaches leading to full annular rig testing for large and regional jet engine applications. Complete an Interim Technology Assessment of the aggregate potential benefits from the engine and airframe technologies to reduce emissions. The results from this analysis will provide a benchmark for measuring overall progress, and guide future investment decisions.		X							
APG 3R3: Complete development of initial physics-based prediction models to guide the development potential noise reduction technology concepts. Complete an interim technology assessment of the potential benefits for these concepts to reduce noise emissions. The results from this analysis will provide a benchmark for measuring overall progress, and guide future investment decisions.		X							
APG 3R4: Complete development, initial functionality and evaluate human factors for at least one decision support tool to enable achievement of the planned progress towards the goal of doubling the capacity of the National Airspace System in 10 years. Complete the initial build of a toolbox of state-of-the-art airspace models to enable the planned progress towards the 2022 Objective.				X					

Aerospace Technology FY 2003 Budget Link Table	**Budget Category**	Vehicle Systems	Aviation safety	Airspace Systems	2nd Generation	3rd Generation	Engineering for Complex Systems	Computing, Information and Communications Technology	Enabling Concepts and Technologies
APG 3R5: Select candidate technologies for experimental flight evaluation based on their impact on mobility. Mobility metrics will be measured by accessibility, doorstep-to-destination transit time, system and user costs, and related trip reliability and safety metrics. These flight experiments will evaluate individually, at the sub-system level, the impact of selected technologies on lowering required landing minimums and increasing the volume of operations at non-towered landing facilities in non-radar airspace during instrument meteorological conditions		**X**		**X**					
APG 3R6: Down-select to a minimum of two launch architectures for detailed development based on their ability to meet the safety and affordability goals. This selection will determine what launch architectures and critical technology developments will be continued through FY 2006					**X**				
APG 3R7: Complete the independent evaluation of three revolutionary hypersonic propulsion technology systems demonstrations and associated ground technologies. This independent evaluation will validate ability of each propulsion system, a rocket-based combined-cycle engine, a turbine-based combined cycle engine and a scramjet engine, to achieve the strategic objectives within cost and schedule.						**X**			
APG 3R8: Down-select to a minimum of two launch architectures for detailed development based on their ability to meet the safety and affordability goals. This selection will determine what RLV architectures and critical technology developments will be continued through FY 2006.					**X**				
APG 3R9: Complete the independent evaluation of three revolutionary hypersonic propulsion technology systems demonstrations and associated ground technologies. This independent evaluation will validate ability of each propulsion system, a rocket-based combined-cycle engine, a turbine-based combined cycle engine and a scramjet engine, to achieve the strategic objectives within cost and schedule.						**X**			

Aerospace Technology FY 2003 Budget Link Table	**Budget Category**	Vehicle Systems	Aviation safety	Airspace Systems	2nd Generation	3rd Generation	Engineering for Complex Systems	Computing, Information and Communications Technology	Enabling Concepts and Technologies
APG 3R10: Complete initial component tests to provide data for evaluating feasibility of key concepts by completing all of the following indicators.									X
APG 3R11: Complete development of an organizational risk model and establish initial high dependability computing testbeds and tools as defined in the following indicators.		X					X	X	X
APG 3R12: Advance the state-of-the-art in automated data analysis, mission command and communications, and science sensors and detectors that are potentially beneficial for future NASA missions.								X	X
APG 3R13: Advance the state-of-the-art in power / propulsion systems, spacecraft systems, and large or distributed space systems and our knowledge of space environmental effects that are required to support future NASA missions.		X							X
APG 3R14: Demonstrate progress toward achievement of systems and systems of systems that can think, reason, make decisions, adapt to change, and cooperate among themselves and with humans to provide safe and successful aerospace processes and mission functions with greatly reduced human participation by successfully demonstrating individual autonomy components.								X	X
APG 3R15: Implement an effective oversight process to insure that the research programs are addressing the correct areas, meeting user requirements, have the proper balance, are properly formulated and planned, and are making sufficient process toward the Enterprise goals		X	X	X	X	X	X	X	X
APG 3R16: To contribute toward maintaining a well-prepared workforce pipeline, all Enterprise program activities will establish and implement, or continue implementation of, an education outreach plan that results in an educational product. The product shall be consistent with the NASA Implementation Plan for Education and use program content to demonstrate or enhance the learning objectives.		X	X	X	X	X	X	X	X

Biological and Physical Research Enterprise (BPRE)
FY 2003 Performance Plan

Mission

NASA's Office of Biological and Physical Research seeks

- to understand and enable the human experience in space, and
- use space to better understand the laws of nature and the evolution of life

The microgravity environment of space allows scientists to open a new window on the most basic and important biological, chemical, and physical processes. At the same time, the space environment poses major challenges to the well being of space travelers. Space flight exposes humans to low gravity and radiation environments never before encountered in our evolutionary history. As we seek to exploit the rich opportunities of space flight for fundamental research and commercial development, we must develop efficient and effective technologies and methods for protecting human health in space.

Goal 1: Conduct research to enable safe and productive human habitation of space.
BPRE conducts fundamental and applied research in the biological and physical sciences to reduce the health risks of space travel. We conduct research on technology for efficient, self-sustaining life-support systems to provide safe, hospitable environments for space exploration, and develop advanced technologies for healthcare delivery. Advances in healthcare first developed for the space flight environment are applied on Earth to enhance healthcare.

Goal 2: Use the space environment as a laboratory to test the fundamental principles of physics, chemistry, and biology.
The space environment offers a unique laboratory in which to study biological and physical processes. Researchers take advantage of this environment to conduct experiments that are impossible on Earth. For example, most combustion processes on Earth are dominated by the fact that hot gases rise. In space, this is not the case, and hidden properties of combustion emerge. Materials scientists study the role of gravity in important industrial processes. Physicists take advantage of microgravity to study exotic forms of matter that are better handled in space. Biological researchers investigate the role of gravity in life processes and how the space environment affects living organisms. The knowledge derived from BPRE's diverse research will inform and expand scientific understanding, support economic and technological progress, and help to enable human exploration of space.

Goal 3: Enable and promote commercial research in space.

BPRE provides knowledge, policies, and technical support to facilitate industry investment in space research. BPRE will continue to enable commercial researchers to take advantage of space flight opportunities for proprietary research. The commercial sector will grow to become the premier mechanism for applying space knowledge to benefit the American people. Commercial applications of space knowledge will generate new products, new jobs, and new spin-off companies.

Goal 4: Use space research opportunities to improve academic achievement and the quality of life.
BPRE seeks to use its research activities to encourage educational excellence and to improve scientific literacy from primary school through the university level and beyond. We deliver value to the American people by facilitating access to the experience and excitement of space research. BPRE strives to involve society as a whole in the transformations that will be brought about by research in space.

Resource Requirements

(NOA, dollars in millions)	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
$M	--	--	313	820	842
CS FTE			427	1,242	1,273

Each annual performance goal is associated with a specific program budget; however, the majority of BPRE performance goals are overarching and interdependent in nature. They are not budgeted as discrete elements of BPRE programs.

Implementation Strategy

BPRE's program is implemented at seven NASA Field Centers and the Jet Propulsion Laboratory, as well as through the participation of Commercial Space Centers (CSCs), a National Space Biomedical Research Institute, and a National Center for Microgravity Research on Fluids and Combustion. BPRE relies upon an extensive external community of academic, commercial and government scientists and engineers for the implementation of its programs. BPRE-supported science and technology research projects are reviewed by scientific or technical peers. In selecting investigations and projects to support—and ultimately for access to space—BPRE follows peer-review processes appropriately designed for scientific research, technology research and development, and commercial research. Our peer review processes ensure the competitiveness and quality of BPRE research.

BPRE implements its research programs through ground-based as well as space flight research. Ground-based research precedes flight research and employs NASA facilities such as drop towers, centrifuges, and bed-rest facilities. The space flight research programs use the full spectrum of platforms, including free-flying satellites, Space Shuttle, and the International Space Station (ISS). In FY 2002, BPRE assumed responsibility for the ISS research budget. The ISS research budget funds continued build-up and utilization of research equipment on the ISS to support in flight research during fiscal years 2002 and 2003, leading to a broad-based, multidisciplinary flight research program upon completion of the ISS assembly phase.

Roadmap: [Source: NASA Strategic Plan]

Near–term Plans (2000-2005)	Mid-term Plans (2006-2011)	Long-term Plans (2012-2025)
• Identify mechanisms of health risk and potential physiological and psychological problems to humans living and working in space, and begin developing and testing countermeasures. • Conduct scientific and engineering research and enable commercial research activities on the ISS to enrich health, safety, and the quality of life on Earth. • Begin developing interdisciplinary knowledge (e.g., biology, physics, materials) to support safe, effective, and affordable human/robotic exploration.	• Understand the effects of long-duration space flight (e.g., radiation), validate countermeasures and technology and begin developing countermeasures for long-duration space flight. • Extend our understanding of chemical, biological, and physical systems. • Test and validate technologies that can reduce the overall mass of human support systems by a factor of three (compared to 1990's levels).	• Apply and refine countermeasures for safe, effective, and affordable long-duration human space flight. • Achieve a deep understanding of the role of gravity in complex chemical, biological, and physical processes. • Test and validate technologies for safe, self-sufficient, and self-sustaining life support systems that can enable humans to live and work in space and on other planets for extended periods.

BPRE is preparing for the transition to a new era in human space flight. The International Space Station (ISS) will provide a growing capability as a research platform. BPRE will work to extract the maximum scientific and commercial return from this promising research facility while conducting research to ensure the health and safety of space travelers in the near term and into the future.

BPRE will conduct a rigorous prioritization exercise during the spring and summer of 2002 to prioritize the research questions being pursued. This prioritization will help focus resources on priority questions, increasing the speed and likelihood that they will be answered. The strategic roadmap shown above is subject to change based on this ongoing assessment of priorities.

Performance Measures

The following performance measures rely heavily on review by BPRE's advisory committee using standard color-coded assessment criteria as follows:

Blue = Annual Performance Goal exceeded, or performance is exceptional
Green = Annual Performance Goal met
Yellow:= Annual Performance Goal not met, but a recovery plan is in place for the coming fiscal year
Red = Annual Performance Goal not met.

Goal 1: Conduct research to enable safe and productive human habitation of space.

Objective: Conduct research to ensure the health, safety, and performance of humans living and working in space.

Millions of years of evolution have molded the human body to cope with and rely upon gravity. Virtually every system of the body responds when a person travels to space. Weight-bearing bones lose about 1% of bone mass per month. Muscles atrophy, and nerves in the balance system begin to rewire their connections to take account of the sudden disappearance of up and down. Many of these changes pose significant health issues, especially when space travelers return to gravity. NASA research will identify methods that will efficiently control the effects of space travel and ensure the health and safety of future space travelers. Humans can only travel to space by bringing a microcosm of the Earth with us. We need an atmosphere, food, water, and protection from temperature extremes and space radiation. NASA research will develop advanced technologies for efficient life support systems to provide these needs with minimal resupply from Earth.

Public Benefit: The primary goal of this research is to improve health and safety for space travelers; however, this research also has the potential to make significant contributions to medical care on Earth. For example, space flight can provide models for exploring osteoporosis and other diseases of muscle and bone. It has provided unique insights into nerve regeneration and the capacity of the nervous system to grow, change, and adapt in response to environmental stimuli. The parallels between aging and space travel are currently under study by researchers at NASA and the National Institutes of Aging. BPRE research on life support technologies will reduce the cost of space travel. This technology will also find application in process control systems for industry, and may even in help to provide clean environments in homes, vehicles, and offices.

Annual Performance Goal 3B1: Earn external review rating of "green" or "blue" by making progress in the following research focus areas: identify and test biomedical countermeasures that will make space flight safer for humans, and identify and test technologies that will enhance human performance in space flight.

Performance Indicators:

- Complete experiments that will determine whether pulmonary edema occurs in spaceflight (West-PUFF).
- Complete studies that will provide knowledge for the improvement psychological well being of ground and flight crews for ISS (Kansas-Psychosocial).
- Maintain a cutting-edge, investigator-initiated peer-reviewed research program in Biomedical Research and Countermeasures and in Advanced Human Support Technology, including a National Space Biomedical Research Institute that will perform team-based, focused countermeasure-development research.
- Complete and commission the Brookhaven Booster Application Facility (BAF) in June, 2003 to enable investigators to perform research using heavy ion radiation.
- Analyze data from STS-107 Flight experiments
- Gather data from experiments using the Human Research Facility on ISS
- Produce scientific discoveries in Biomedical research, and publish in mainstream peer-reviewed archival journals.
- Publish results of Bioastronautics experiments conducted during early ISS Increments (1 through 6) and preliminary results from Increments 7 and 8.

Public Benefit: Research on the biomedical issues of space flight is important for improving the safety of all future space travelers. In addition to its direct application to space flight, this research contributes to biomedical research progress on Earth. NASA has 18 active cooperative agreements with the National Institutes of Health that help both organizations advance the state of medical knowledge and practice.

Annual Performance Goal 3B2: Earn external review rating of “green” or “blue” by making progress in the following research focus area: identify and test new technologies to improve life support systems for spacecraft.

Performance Indicators:

- BPRE will demonstrate, through vigorous research and technology development, a **40%** reduction in the projected mass of a life support flight system compared to the system baselined for ISS. The quantitative calculation of this metric will be posted on the Internet.

Public benefit: The primary benefit of research on technologies for life support systems is to reduce the cost of human space travel while increasing safety and efficiency. However, these technologies are frequently applicable to technical problems here on Earth. For example, the small, light, low-power technologies that NASA is developing for monitoring space craft atmosphere may find applications in monitoring industrial processes, monitoring air quality in confined environments, and possibly for detecting terrorist activities.

Goal 2: Use the space environment as a laboratory to test the fundamental principles of physics, chemistry, and biology.

Objective: Investigate chemical, biological, and physical processes in the space environment, in partnership with the scientific community.

Gravity's influence is everywhere. From the structure that gives steel its strength, to the structure of bone in a growing child, gravity plays a role. Researchers can only eliminate the effects of gravity in space. In space, we can study how gravity has shaped life on Earth and how living things respond to its absence. We enter a new realm of research in physics, chemistry, and biology. BPRE relies on the advice of the Space Studies Board of the National Research Council, as well as the NASA Advisory Committees and associated cross-disciplinary task groups to set the strategic direction of the program.

BPRE will conduct a rigorous prioritization exercise during the spring and summer of 2002 to prioritize the research questions being pursued. This prioritization will help focus resources on priority questions, increasing the speed and likelihood that they will be answered.

Public Benefit: BPRE uses the space environment to conduct research in focused areas with the potential to improve life on Earth. These focused areas of research range from fundamental physics, to biotechnology and from materials science to basic biology. The benefits of fundamental physical and biological research in space include improved understanding of physical and biological processes that provide the foundation for improving the quality of life on Earth. For example:

- Combustion science research contributes to the understanding of burning and help to improve energy efficiency and reduce pollution.
- Biotechnology research may contribute to the development of new drugs and improve medical care by exploring and expanding advanced technologies for growing tissues outside the body.
- Basic physics research may lead to future advances in information technology.
- Fundamental Biology research in space provides a new window on evolution and development which may lead to improved medical care and improved plants for agriculture
- Materials scientists exploit the space environment to benchmark novel materials as well as to improve understanding of industrial processes here on Earth.

Annual Performance Goal 3B3: Earn external review rating of “green” or “blue” by making progress in the following research focus areas as described in the associated indicators: advance the scientific understanding of complex biological and physical systems.

Performance Indicators:

- Maintain a peer-reviewed research program in Complex Systems physics and chemistry.
- Analyze ISS flight experiments results in colloidal physics.

Public Benefit: Research on complex physical and biological systems has the potential to benefit industrial applications in optical computing and communications, pharmaceutical packaging, food manufacturing, cosmetics, and polymer manufacturing.

Annual Performance Goal 3B4: Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: elucidate the detailed physical and chemical processes associated with macromolecular crystal growth and cellular assembling processes in tissue cultures.

Performance Indicators:

- Maintain a peer-reviewed research program in macromolecular and cellular biotechnology.
- Analyze ISS flight experiments results in macromolecular and cellular biotechnology

Public Benefit: This biotechnology research may have applications in structural biology, rational drug design, and artificial tissues engineering for medical applications.

Annual Performance Goal 3B5: Earn external review rating of "green" or "blue" by making progress in the following research focus area: investigate fundamental and unresolved issues in condensed matter physics and atomic physics, and carry out atomic clock development for space-based utilization.

Performance Indicators:

- Maintain an outstanding and peer-reviewed research program in condensed matter physics, Bose-Einstein Condensation, and atomic clocks development for space-based utilization.
- Produce scientific discoveries in atomic and condensed matter physics, and publish in mainstream peer-reviewed archival journals.

Benefit: This basic research has the potential to substantially enhance the accuracy of our time-keeping standard, support development of ultra-precise Global Positioning System time measurements, and support the development of molecular-based medical diagnostic devices.

Annual Performance Goal 3B6: Earn external review rating of "green" or "blue" by making progress in the following research focus area: Investigate fundamental and unresolved issues in fluid physics, and materials and combustion science using gravity as a theoretical and experimental revealing tool.

Performance Indicators:

- Maintain an outstanding and peer-reviewed program in fluid physics, and materials and combustion sciences.
- Employ a new annual process to solicit and select peer-reviewed ground-based investigations in materials science, fluid physics, and combustion research
- Analyze results of STS-107 flight experiments in combustion research and fluid physics

Public Benefit: This research has the potential to support advances in energy production efficiency, combustion products emission control, advanced materials manufacturing, and the chemical engineering industry.

Annual Performance Goal 3B7: Earn external review rating of "green" or "blue" by making progress in the following research focus area: understand the role of gravity in biological processes at all levels of biological complexity.

Performance Indicators:

- Maintain an outstanding and peer-reviewed program in fundamental space biology
- Solicit ground-based research in all Fundamental Biology disciplines
- Analyze data from STS-107 flight experiments
- Determine baseline data requirements for model specimens to be used on ISS
- Plan for incorporation of baseline data collection in ISS hardware validation flights

Public Benefit: This basic research has the potential to support improved medical care and agricultural performance by strengthening our basic understanding of biological processes.

Objective: Develop strategies to maximize scientific research output on the International Space Station and other space research platforms.

Space flight opportunities for biological and physical research are very limited. BPRE develops strategies and approaches to enhance flight opportunities and to support a balanced research program that maximizes scientific return.

Public Benefit: By working with the scientific community, BPRE seeks to maximize scientific return from space flight opportunities to achieve the greatest benefit for the investment that taxpayers make into this research program.

Annual Performance Goal 3B8: In close coordination with the research community, allocate flight resources and develop facilities to achieve a balanced and productive research program.

Performance Indicators:

- Complete Phase A definition studies and award contract to manage ISS utilization to a Non Government Organization (NGO)
- Coordinate scientific community participation in the definition of ISS research.
- Balance resource allocations and flight opportunities through a Partner Utilization Plan.
- Deploy ISS research facilities on-orbit consistent with budget constraints and BPRE prioritization

Goal 3: Enable and promote commercial research in space.

Objectives: Provide technical support for companies to begin space research.
Foster commercial research endeavors with the International Space Station and other assets.

Ultimately, the solutions to the challenges of human space flight will open up new avenues of commerce. Even now, dozens of commercial firms conduct small-scale research projects in space. BPRE provides knowledge, policies, and technical support to facilitate industry investment in space research. BPRE will continue to enable commercial researchers to take advantage of space flight opportunities for proprietary research. The commercial sector will grow to become the premier mechanism for applying space knowledge to benefit the American people. Commercial applications of space knowledge will generate new products, new jobs, and new spin-off companies.

Public Benefit: The benefits of commercial research in space include improved products and services to enhance economic performance on Earth. In the long-term, economic activity in space will provide strengthened infrastructure for the exploration and development of space.

Annual Performance Goal 3B9: Engage the commercial community and encourage non-NASA investment in commercial space research by meeting at least two of three performance indicators.

Performance Indicators:

- Maintain a ratio of Non-NASA funding to NASA funding not less than 3:1
- Ensure that at least one of 39 product lines currently under investigation is brought to market in FY 03.
- Enable at least 10 new active industrial partnerships to be established with the Space Product Development Commercial Space Centers

Objective: Systematically provide basic research knowledge to industry.

Public Benefit: Conducting outreach to the commercial community extends the benefits of commercial research to the broadest set of participants and strengthens the contributions of commercial research for the development of space.

Annual Performance Goal 3B10: Highlight ISS-based commercial space research at business meetings and conferences.

Performance Indicators:

- Support at least 3 business/trade conferences to highlight ISS-based commercial space research.

Goal 4: Use space research opportunities to improve academic achievement and the quality of life.

Objective: Advance the scientific, technological, and academic achievement of the Nation by sharing our knowledge, capabilities, and assets.

Public Benefit: BPRE seeks to use its research activities to encourage educational excellence and to improve scientific literacy from primary school through the university level and beyond.

Annual Performance Goal 3B11: Provide information and educational materials to American teachers.

Performance Indicators:

- Develop electronic and printed educational materials that focus on biological and physical research, and distribute these materials at least three conferences and through the Internet.

Objective: Engage and involve the public in research in space.

Public Benefit: BPRE delivers value to the American people by facilitating access to the experience and excitement of space research. BPRE strives to involve society as a whole in the transformations that will be brought about by research in space.

Annual Performance Goal 3B12: Work with media outlets and public institutions to disseminate BPRE information to wide audiences.

Performance Indicators:

- Work with Life Science Museum Network members to explore opportunities for the development of projects, special events, or workshops focused on Life Sciences biology-related research themes to attract and engage public audiences.
- Make available to wide audiences an online database of Commercial Space Center activities, including publications listings, patents, and other information useful to the public.

Verification/Validation

BPRE cooperates with NASA's Inspector General during an annual review of the accuracy of our reporting process. In addition, BPRE reviews its performance with the Biological and Physical Research Advisory Committee (BPRAC) of the NASA Advisory Committee. The BPRAC is not expected to independently confirm the accuracy of data presented by BPRE. Rather, the Committee's role is to assess progress based on the data that BPRE presents and apply its expert judgment based on a set of criteria jointly developed with BPRE to produce an evaluation. The Office of the Inspector General selects a subset of targets for detailed audits to determine the accuracy and reliability of BPRE's data on performance targets.

Annual performance goals 3B1 and 3B3 through 3B9 are fundamentally qualitative in nature and the committee will work with NASA to establish guidelines and criteria for assigning scores on these goals based on performance indicators as well as other information. Annual performance goal 3B2 is evaluated using a novel formula developed by BPRE's Advanced Human Support Technology program. Details of this process are available for review on the program's website at http://ADVLIFESUPPORT.JSC.NASA.GOV/ under the title "Advanced Life Support Metric Document

FY 2003 MULTI-YEAR PERFORMANCE TREND
Biological and Physical Research Enterprise (BPRE)

Strategic Objective: Conduct research to ensure the health, safety, and performance of humans living and working in space.

	FY 99	FY 00	FY 01
Annual Performance Goal and APG#	Perform component and subsystem ground tests without humans in the loop to demonstrate advanced technologies, including biological water processor, and flight test a new electronic "nose" sensor on a chip. (H29)	Complete the first phase (including outfitting three test chambers) of the Advanced Life Support System Integration Test Bed facility that will provide the capability to conduct a series of long duration, human-in-the-loop, advanced technology tests over the next six years. Demonstrate key technology capabilities for human support, such as advanced techniques for water processing using microbes, waste processing using biological degradation and fluidized bed incineration, a no-expendable trace gas contaminant control system, solid waste processing, and flight test of a miniature mass spectrometer. (0H31)	Demonstrate, in ground test, at least one technology that could reduce up to 25% of life support logistics over ISS baseline and release report of progress for review on the Internet. (1H18)
Assessment	Green	Green	

<u>Strategic Objective</u>: Conduct research to ensure the health, safety, and performance of humans living and working in space.

	<u>FY 02</u>	<u>FY 03</u>	
Annual Performance Goal and APG#	Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: • Identify and test biomedical countermeasures that will make space flight safer for humans. • Identify and test technologies that will enhance human performance in space flight. (2B1)	Earn external review rating of "green" or "blue" by making progress in the following research focus areas: • Identify and test biomedical countermeasures that will make space flight safer for humans. • Identify and test technologies that will enhance human performance in space flight. (3B1)	
Assessment			

<u>Strategic Objective</u>: Conduct research to ensure the health, safety, and performance of humans living and working in space.

	<u>FY 99</u>	<u>FY 00</u>	<u>FY 01</u>
Annual Performance Goal and APG#	Complete the development of countermeasure research protocols, and begin testing a minimum of three countermeasures intended to protect bone, muscle, and physical work capacity. (H25) Publish a report defining the time course adaptations in the balance system to altered gravitational environments. (H6) Document Mir radiation research data to facilitate ISS EVA planning. (H10) Document Mir data lessons learned to facilitate ISS biomedical and countermeasure research. (H7)	Develop medical protocols and test the capability of the Crew Health Care System as integrated in the ISS U.S. Laboratory. (0H26) Evaluate and develop for flight testing a minimum of three major research protocols intended to protect bone, muscle, and physical work capacity and prepare a minimum of 10 biomedical research experiments, (utilizing the capabilities of the STS and ISS HRF) to study human responses to the gravitational environment. (0H25)	Develop new biomedical and technological capabilities to facilitate living and working in space and safe return to Earth. (1H17) Initiate implementation of the Bioastronautics Initiative by beginning a NASA /NCI collaboration and conducting a peer review of NSBRI to assess expansion. (1H31)
Assessment	Green	Green	

Strategic Objective: Conduct research to ensure the health, safety, and performance of humans living and working in space.

	FY 02	FY 03	
Annual Performance Goal and APG#	Earn external review rating of "green" or "blue" by making progress in the following research focus area: • Identify and test new technologies to improve life support systems for spacecraft. (2B2)	Earn external review rating of "green" or "blue" by making progress in the following research focus area: • Identify and test new technologies to improve life support systems for spacecraft. (3B2)	
Assessment			

<u>Strategic Objective</u>: Conduct research on biological and physical processes to enable future missions of exploration.

	FY 99	FY 00	FY 01
Annual Performance Goal and APG#	Publish a report of comparison of 3 different biological models to understand the influence of gravity on the nervous system. H8 Document Mir data lessons learned to facilitate ISS research in fundamental biology and regenerative life support. (H5)	Complete Radiation Research Instrument for Mars 2001 mission to study transit, orbital, and surface radiation effects and conduct three workshops to define and prioritize research tasks in subjects such as radiation shielding materials, in situ resource utilization, and fluids management and heat transfer technology. Complete the science definition of granular flows, flight, and dust management experiments to begin gathering research data to alleviate critical problems of dust buildup, habitat foundation engineering, and rover performance during planetary exploration. (0H33)	Initiate implementation of the Bioastronautics Initiative by beginning a NASA /NCI collaboration and conducting a peer review of NSBRI to assess expansion. (1H31)
Assessment	Green	Green	
Annual Performance Goal and APG#	Initiate a collaborative program to design and develop instruments. (H26)		Complete testing and delivery for spacecraft integration of experiments for the Mars Surveyor Program 2001 missions. (1H1)
Assessment	Green		

<u>Strategic Objective</u>: Conduct research on biological and physical processes to enable future missions of exploration.

	<u>FY 02</u>	<u>FY 03</u>	
Annual Performance Goal and APG#	Earn external review rating of "green" or "blue" by making progress in the following research focus areas: • Develop and test cutting-edge methods and instruments to support molecular-level diagnostics for physiological and chemical process monitoring. • Identify and study changes in biological and physical mechanisms that might be exploited for ultimate application to improving the health and safety of space travelers. (2B3)		
Assessment			
Annual Performance Goal and APG#			
Assessment			

Strategic Objective: Investigate chemical, biological, and physical processes in the space environment, in partnership with the scientific community.

	FY 99	FY 00	FY 01
Annual Performance Goal and APG#	Use data obtained by fluid physics experiments on suspensions of colloidal particles on MSL-1 to answer fundamental questions in condensed matter physics regarding the transition between liquid and solid phases and publish data on the transition from liquids to solids and the results in peer-reviewed open literature. (H13) Improve predictive capabilities of soot processes by at least 50% through analysis of MSL-1 data; publish results in peer-reviewed open literature. (H11) Use MSL-1 results to eliminate one of the three primary fluid flow regimes from consideration by casting engineers, and publish this result in peer reviewed literature. Casting engineers may use this information to improve metal casting processes in industry. (H12)	Using suborbital rockets, complete one combustion experiment on the flame spread of liquid fuels to better control Earth/space-based fire hazards, and conduct one investigation to test theories of fundamental physics properties and physical laws of fluids to provide key data for earth and space-based processing materials; report the results. (0H11)	
Assessment	Green	Red	
Annual Performance Goal and APG#	Analyze Mir data to achieve a 3-year jump-start for cell culture and protein crystal growth research and document analyses & lessons learned. (H9)		
Assessment	Green		

<u>Strategic Objective</u>: Investigate chemical, biological, and physical processes in the space environment, in partnership with the scientific community.

	FY 02	FY 03	
Annual Performance Goal and APG#	Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: • Advance the scientific understanding of complex biological and physical systems. (2B4)	Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: • Advance the scientific understanding of complex biological and physical systems. (3B3)	
Assessment			
Annual Performance Goal and APG#	Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: • Elucidate the detailed physical and chemical processes associated with macromolecular crystal growth and cellular assembling processes in tissue cultures. (2B5)	Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: • Elucidate the detailed physical and chemical processes associated with macromolecular crystal growth and cellular assembling processes in tissue cultures. (3B4)	
Assessment			

<u>Strategic Objective</u>: Investigate chemical, biological, and physical processes in the space environment, in partnership with the scientific community.

	FY 99	FY 00	FY 01
Annual Performance Goal and APG#		Develop medical protocols and test the capability of the Crew Health Care System as integrated in the ISS U.S. Laboratory. (0H26)	Continue initial research on the International Space Station by conducting 6 to 10 investigations. (1H5)
Assessment		Green	
	FY 99	FY 00	FY 01
Annual Performance Goal and APG#			
Assessment			

<u>Strategic Objective</u>: Investigate chemical, biological, and physical processes in the space environment, in partnership with the scientific community.

	FY 02	FY 03	
Annual Performance Goal and APG#	Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: • Initiate a focused research program specifically integrating fluid physics and materials science with fundamental biology. (2B6)		
Assessment			
Annual Performance Goal and APG#	Earn external review rating of "green" or "blue" by making progress in the following research focus area: • Investigate fundamental and unresolved issues in condensed matter physics and atomic physics, and carry out atomic clock development for space-based utilization. (2B7)	Earn external review rating of "green" or "blue" by making progress in the following research focus area: • Investigate fundamental and unresolved issues in condensed matter physics and atomic physics, and carry out atomic clock development for space-based utilization. (3B5)	
Assessment			

<u>Strategic Objective</u>: Investigate chemical, biological, and physical processes in the space environment, in partnership with the scientific community.

	<u>FY 99</u>	<u>FY 00</u>	<u>FY 01</u>
Annual Performance Goal and APG#			
Assessment			
	<u>FY 99</u>	<u>FY 00</u>	<u>FY 01</u>
Annual Performance Goal and APG#			
Assessment			

<u>Strategic Objective</u>: Investigate chemical, biological, and physical processes in the space environment, in partnership with the scientific community.

	FY 02	FY 03	
Annual Performance Goal and APG#	Earn external review rating of "green" or "blue" by making progress in the following research focus area: • Investigate fundamental and unresolved issues in fluid physics, and materials and combustion sciences using gravity as a theoretical and experimental revealing tool. (2B8)	Earn external review rating of "green" or "blue" by making progress in the following research focus area: • Investigate fundamental and unresolved issues in fluid physics, and materials and combustion science using gravity as a theoretical and experimental revealing tool. (3B6)	
Assessment			
Annual Performance Goal and APG#	Earn external review rating of "green" or "blue" by making progress in the following research focus area: • Understand the role of gravity in biological processes at all levels of biological complexity. (2B9)	Earn external review rating of "green" or "blue" by making progress in the following research focus area: • Understand the role of gravity in biological processes at all levels of biological complexity. (3B7)	
Assessment			

<u>Strategic Objective</u>: Develop strategies to maximize scientific research output on the International Space Station and other space research platforms.

	FY 99	FY 00	FY 01
Annual Performance Goal and APG#		Complete data reduction from the STS-95 Research Module mission. Begin to explore new cooperative efforts with NIH in the area of aging and transfer space-derived research for industry development of a new drug to treat Chagas' disease. (0H9)	Conduct outstanding peer-reviewed and commercial research on STS-107 to advance knowledge in the fields of medicine, fundamental biology, biotechnology, fluid physics, materials processing and combustion. (1H4)
Assessment		Green	
Annual Performance Goal and APG#	Support an expanded research program of approximately 800 investigations, an increase of ~9% over FY 1998. (H1) Publish 90% of FY 1998 science research progress in the annual OLMSA Life Sciences and Microgravity Research Program Task Bibliographies and make it available on the Internet. (H2) Establish a National Center for Evolutionary Biology with participation of at least 5 research institutions and engaging at least 20 investigators. (H3)	Support an expanded research program of approximately 935 investigations, an increase of ~17% over FY 1999. Publish 100 percent of science research progress in the annual OLMSA Life Sciences and Microgravity Research Program Task Bibliographies and make this available on the Internet. (0H1)	Support an expanded, productive research community to include 975 investigations annually by 2001. (1H3)
Assessment	Green	Green	
Annual Performance Goal and APG#			
Assessment			

<u>Strategic Objective</u>: Develop strategies to maximize scientific research output on the International Space Station and other space research platforms.

	<u>FY 02</u>	<u>FY 03</u>	
Annual Performance Goal and APG#	In close coordination with the research community, allocate flight resources to achieve a balanced and productive research program. (2B10)	In close coordination with the research community, allocate flight resources and develop facilities to achieve a balanced and productive research program. (3B8)	
Assessment			
Annual Performance Goal and APG#			
Assessment			
Annual Performance Goal and APG#	Demonstrate progress toward ISS research hardware development. (2H13)		
Assessment			

<u>Strategic Objective</u>: Foster commercial research endeavors with the International Space Station and other assets.
<u>Strategic Objective</u>: Provide technical support for companies to begin space research.

	FY 99	FY 00	FY 01
Annual Performance Goal and APG#	Increase non-NASA investment (cash and in-kind) in space research from $35M in FY96 to at least $50M in FY 1999, a 40% increase. (H35) Complete the development of a commercialization plan for the ISS and Space Shuttle in partnership with the research and commercial investment communities and define and recommend policy and legislative changes. (H30) Establish a new food technology Commercial Space Center. (H36)	Establish up to 2 new Commercial Space Centers. (0H47) Foster the establishment of a telemedicine hub in Western Europe. NASA and CNES will develop an international telemedicine program to incorporate and connect existing medical informatics capabilities into a user-friendly commercial electronic telemedicine hub and apply lessons learned to human space flight. (0H49) Utilize at least 30% of Space Shuttle and ISS FY 2000 capabilities for commercial investigations, per the U.S. Partner Utilization Plan. (0H46)	Foster commercial endeavors by reviewing and/or implementing new policies and plans such as the Space Station resource pricing policy and intellectual property rights policy. Ensure that Space Station resources allocated to commercial research are utilized by commercial partners to develop commercial products and improve industrial processes. (1H23) Establish at least ten new, active industrial partnerships to research tomorrow's space products and improve industrial processes through NASA's Commercial Space Centers, and find opportunities for space experiments. (1H22)
Assessment	Green (H35, H36); Yellow (H30)	Green	

Strategic Objective: **Foster commercial research endeavors with the International Space Station and other assets.**
Strategic Objective: **Provide technical support for companies to begin space research.**

	FY 02	FY 03	
Annual Performance Goal and APG#	Engage the commercial community and encourage non-NASA investment in commercial space research by meeting at least three of four performance indicators. (2B11)	Engage the commercial community and encourage non-NASA investment in commercial space research by meeting at least two of three performance indicators. (3B9)	
Assessment			

Strategic Objective: **Advance the scientific, technological, and academic achievement of the Nation by sharing our knowledge, capabilities, and assets.**

	FY 99	FY 00	FY 01
Annual Performance Goal and APG#	Initiate a curriculum development program, in partnership with the International Technology Education Association (ITEA), for gravity related educational modules for national distribution which meet the current National Science Teachers Association (NSTA) National Standards for Science for Grades K-12, and the ITEA National Standards for Technology Education to be published June 1999. (H37) Conduct at least two demonstrations of the applicability of the "Telemedicine Instrumentation Pack" for health care delivery to remote areas. (H39) Demonstrate the application of laser light scattering technology for early detection of eye-tissue damage from Diabetes; publish results in peer-reviewed open literature. (H40)	The NASA-Sponsored National Space Biomedical Research Institute will conduct an open symposium relaying the results of space-oriented research activities focusing on up to 10 ground-related applications with the participation of interested investigators; publish results in a conference proceedings report. (0H56)	Support participation in HEDS research. (1H26)
Assessment	Green	Green	

Strategic Objective: **Systematically provide basic research knowledge to industry.**

	FY 99	FY 00	FY 01
Annual Performance Goal and APG#			
Assessment			

Strategic Objective: **Advance the scientific, technological, and academic achievement of the Nation by sharing our knowledge, capabilities, and assets.**

	FY 02	FY 03	
Annual Performance Goal and APG#	Provide information and educational materials to American teachers. (2B13)	Provide information and educational materials to American teachers. (3B11)	
Assessment			

Strategic Objective: **Systematically provide basic research knowledge to industry.**

	FY 02	FY 03	
Annual Performance Goal and APG#	Highlight ISS-based commercial space research at business meetings and conferences. (2B12)	Highlight ISS-based commercial space research at business meetings and conferences. (3B10)	
Assessment			

Strategic Objective: Engage and involve the public in research in space.

	FY 99	FY 00	FY 01
Annual Performance Goal and APG#	Expand the microgravity research program's World Wide Web-based digital image archive established in 1998 by 50%. (H38)		
Assessment	Green		

Strategic Objective: Engage and involve the public in research in space.

	FY 02	FY 03	
Annual Performance Goal and APG#	Work with media outlets and public institutions to disseminate OBPR information to wide audiences. (2B14)	Work with media outlets and public institutions to disseminate BPRE information to wide audiences. (3B12)	
Assessment			

Biological and Physical Research FY 2003 Budget Link Table	**Budget Category**	**Advanced Human Support Technology**	**Biomedical Research & Countermeasures**	**Fundamental Space Biology**	**Physical Sciences Research**	**Space Product Development**	**Mission Integration**
Annual Performance Goals & APG#							
3B1: Earn external review rating of "green" or "blue" by making progress in the following research focus areas: 1) Identify and test biomedical countermeasures that will make space flight safer for humans; 2) Identify and test technologies that will enhance human performance in space flight.		X	X				
3B2: Earn external review rating of "green" or "blue" by making progress in the following research focus area: Identify and test new technologies to improve life support systems for spacecraft.			X				
3B3: Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: Advance the scientific understanding of complex biological and physical systems.				X	X		
3B4: Earn external review rating of "green" or "blue" by making progress in the following research focus areas as described in the associated indicators: Elucidate the detailed physical and chemical processes associated with macromolecular crystal growth and cellular assembling processes in tissue cultures.					X		
3B5: Earn external review rating of "green" or "blue" by making progress in the following research focus area: Investigate fundamental and unresolved issues in condensed matter physics and atomic physics, and carry out atomic clock development for space-based utilization.					X		
3B6: Earn external review rating of "green" or "blue" by making progress in the following research focus area: Investigate fundamental and unresolved issues in fluid physics, and materials and combustion science using gravity as a theoretical and experimental revealing tool.					X		

Biological and Physical Research FY 2003 Budget Link Table	**Budget Category**	**Advanced Human Support Technology**	**Biomedical Research & Countermeasures**	**Fundamental Space Biology**	**Physical Sciences Research**	**Space Product Development**	**Mission Integration**
Annual Performance Goals & APG#							
3B7: Earn external review rating of "green" or "blue" by making progress in the following research focus area: Understand the role of gravity in biological processes at all levels of biological complexity.				X			
3B8: In close coordination with the research community, allocate flight resources and develop facilities to achieve a balanced and productive research program.		X	X	X	X	X	X
3B9: Engage the commercial community and encourage non-NASA investment in commercial space research by meeting at least two of three performance indicators.						X	
3B10: Highlight ISS-based commercial space research at business meetings and conferences.						X	
3B11: Provide information and educational materials to American teachers.		X	X	X	X	X	
3B12: Work with media outlets and public institutions to disseminate OBPR information to wide audiences.		X	X	X	X	X	

Manage Strategically

FY 2003 Performance Plan

Through NASA, the American people have invested in America's future by supporting a public aerospace research and development infrastructure consisting of a unique combination of physical resources and human talents. Managing these resources effectively and strategically is critical to achieving NASA's goals and objectives. Therefore, the goal of the Manage Strategically crosscutting process is to provide a basis for the Agency to carry out its responsibilities effectively, efficiently, and safely through sound management decisions and practices. By integrating good general management practices with NASA's strategic processes, the Agency ensures that decisions are consistent with the goals, objectives, and strategies contained in NASA's Strategic, Implementation, and Performance Plans. Managing strategically also encourages all parts of the Agency to proceed together toward achieving a single set of strategic goals while enhancing management's ability to leverage limited resources, standardize processes where it makes sense to do so, streamline processes for timely results, and ensure rapid, reliable, open exchanges of information. Finally, managing strategically ensures that the public's investment in NASA is well-served and that the Agency's initiatives and achievements continuously inspire and serve America and benefit the quality of life on Earth for all humankind.

The performance metrics selected for FY 2003 address key management challenges facing NASA, as well as the challenging, government-wide high risk areas of strategic human capital management and information security identified by the General Accounting Office. These management areas are also consistent with the Administration's reform agenda that emphasizes a Federal Government that is citizen-centered, results-oriented, and market-based.

Strategic Goal:
Enable the Agency to carry out its responsibilities effectively, efficiently, and safely through sound management decisions and practices.

Performance Metrics

MS Objective #1: Protect the safety of our people and facilities and the health of our workforce.

Public Benefit: Safety is NASA's number one core value. NASA protects the public's investment in our vision and missions by protecting the safety and health of our people, the public, and our high-value assets and facilities on and off the ground. To emphasize the critical importance of health, as addressed in the Agency's Safety Initiative, the Office of the Chief Health and Medical Officer (OCHMO) was created in May 2000. The OCHMO provides strategic direction and oversight in the Agency's pursuit of protecting the safety and health of the entire NASA workforce. The OCHMO also provides oversight of health care delivery and professional competency, assuring quality and consistency of services Agency-wide. And, the OCHMO ensures that NASA employees at all levels incorporate health and safety principles and practices into daily decision making and that the Agency adheres to the highest medical and ethical standards and satisfies all applicable regulatory and statutory requirements.

Annual Performance Goal (3MS1): NASA will increase the safety of its infrastructure and the health of its workforce through facilities safety improvements, reduced environmental hazards, increased physical security, enhanced safety and health awareness, and appropriate tools and procedures for health enhancement.

Performance Indicators for 3MS1:

- No fatalities will result from NASA mishaps.
- Per the Federal Worker 2000 Initiative, reduce the overall occurrence of injuries (due to occupational injury or illness) by 3% per year from the FY 1997 baseline to 1.15 occurrences per 100 workers.
- Award construction contract(s) for all identified critical facilities safety requirements as specified in the Agency Annual Construction Program.
- Ensure that at least 95% of Agency Minimum Essential Infrastructures (MEI) have completed all physical security countermeasure upgrades and are in compliance with Presidential Decision Directive 63.
- Close at least 90% of compliance findings from environmental functional reviews by target date, and track all findings to closure.
- Complete an environmental functional review of at least 30% of Centers and component facilities annually, reviewing all within a 3-year cycle.
- Increase the utilization rate of prevention and wellness programs (including health maintenance examinations, immunizations, skin cancer screenings, and website access) by 10% over FY 2000 rates.
- The OCHMO, supported by the Occupational Health Principal Center, will ensure that at least 90% of NASA Centers receive the tools and techniques necessary to improve their overall Health and Medical Quality Assurance programs.

Justification for Changes from FY 2002: Manage Strategically encourages the Agency to ensure rapid, reliable, easily accessible and open exchanges of information. In FY 2002, one of the performance indicators for enhancing employee health awareness and procedures for health enhancement was the establishment of a mechanism to aggregate and track epidemiological preventive health risk data as a basis for policy decisions. Unfortunately, the funding to establish an employee longitudinal health database was not approved in FY 2001 or in FY 2002. However, the recently established occupational health relational database - - Agency Health Enhancement Database (AHED) will enable accurate tracking of such health indicators as immunization screenings and training. While different, this database will provide a suitable basis for policy decisions. Over time, this database can be expanded and modified to include an epidemiological aspect as funding is authorized.

MS Objective #2: Achieve the most productive application of Federal acquisition policies.

Public Benefit: NASA serves the public interest by implementing acquisition efficiencies and cost-saving strategies that provide the best return on the public's investment. These include streamlining acquisition regulations, assigning contractors more program-integration responsibility and accountability, and moving civil service employees into review rather than operational positions. In addition, NASA continuously seeks opportunities to partner with small, small disadvantaged, and women-owned businesses to increase the competitive base from which we purchase goods and services.

Annual Performance Goal (3MS2): Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of Performance Based Contracts (PBCs).

Performance Indicator for 3MS2:

- Maintain PBC obligations at 80% of funds available for PBCs (funds available exclude grants, cooperative agreements, actions under $100,000, SBIR, STTR, FFRDCs, intragovernmental agreements, and contracts with foreign governments and organizations).

Annual Performance Goal (3MS9): Continue integrating small, small disadvantaged, and women-owned businesses together with minority universities into the competitive base from which NASA can purchase goods and services.

Performance Indicators for 3MS9:

- Achieve at least an 8% Congressionally mandated goal for annual funding to small disadvantaged businesses (includes funding for prime and subcontractors awarded to programs supporting small disadvantaged businesses, Historically Black Colleges and Universities and other minority educational institutions, and women-owned small businesses).
- Award 1% of NASA's total contract and subcontract dollars to Historically Black Colleges and Universities and other minority institutions.

MS Objective #3: Manage our fiscal and physical resources optimally.

Public Benefit: NASA's budget and physical assets represent a significant investment to the American taxpayers, so it is incumbent on the Agency to manage these resources effectively and efficiently to optimize the return to the public on their investment. Agency strategies for ensuring optimal return include partnering, value engineering, outsourcing, performance-based contracting, energy conservation, recycling, and pollution prevention.

Annual Performance Goal (3MS3): Renew the Agency's management systems and facilities through the use of updated automated systems and facilities revitalization, and meet four out of five performance indicators in this area.

Performance Indicators for 3MS3:

- Increase facility capital repairs funding and reduce outdated, unused, marginal, and lower-priority facilities to improve facility revitalization rate to 100-year frequency.
- Reduce the Agency's unfunded environmental liability through a long-term strategy, annually investing an amount of not less than 3-5% of the Agency's environmental liability in environmental compliance and restoration (ECR) funding.

Annual Performance Goal **(3MS10):** Improve the Agency's financial management and accountability.

Performance Indicators for 3MS10:

- Cost at least 75% of the resources authority available to cost during the fiscal year.
- Complete the operational cutover to the new Core Financial System (CFS) at six Centers.
- Initiate at least one new Integrated Financial Management project.

MS Objective #4: Enhance the security, efficiency, and support provided by our information technology resources.

Public Benefit: The public's investment in NASA ensures that the Agency's explorers, pioneers, and innovators can continue to expand frontiers in air and space. Therefore, NASA's missions to advance and communicate scientific knowledge and understanding of the Earth, the solar system, and the universe, to use and develop space, and to research, develop, verify, and transfer advanced aeronautics and space technologies require optimal efficiencies in the use of NASA's limited Information Technology (IT) resources. To achieve this goal, NASA's IT planning is focused on four areas: safety and security, cost-effective common infrastructure and services, innovative technology and practices, and emerging IT areas (e.g., e-Business and e-Government).

Annual Performance Goal **(3MS4):** Improve IT infrastructure service delivery by providing increased capability and efficiency while maintaining a customer rating of satisfactory.

Performance Indicators for 3MS4:

- Maintain a customer rating of satisfactory for each major IT service.
- Hold costs per resource unit at or below established baselines for each major service.

Service	Established Cost Baseline
NASA ADP Consolidation Center (NACC)	$3,513,871/processing resource/quarter
NASA Integrated Services Network (NISN)	$0.78/ KBPS per month
Outsourcing Desktop Initiative for NASA (ODIN)	$2,940/General Purpose Seat

Annual Performance Goal **(3MS5)**: Enhance IT security by meeting established performance indicators in three critical areas.

Performance Indicators for 3MS5:

- Reduce IT system vulnerabilities specified for the year across all NASA Centers to at least the established target ratios.

- Meet established targets for IT security awareness training for all NASA employees, managers, and system administrators.
- Complete the IT security plans at a targeted level, including authorization to process, for critical NASA systems.

IT Security Element	**FY 2003 Target**
Ratio of Vulnerabilities Detected to Systems Scanned. *	.25
ITS Training: **	
Civil Service Employees	95%
Civil Service Managers	95%
Civil Service System Administrators	95%
IT Security Plans completed for critical systems and re-evaluated every 3 years. ***	100%

NOTES: * This goal/ratio is based on the Phase III list of vulnerabilities. The vulnerability list is dynamic, changes every quarter, has ever-increasing stringency, and requires manual audit of some system weaknesses. Therefore, the target ratio is larger than in FY 2002. ** Goal is to achieve this target by July 2002 and to achieve as close to 100% as possible in all three training levels. *** There is a grace period for a new or enhanced system to develop security plans. During this grace period, the absence of a completed plan does not count against the target.)	

<u>Annual Performance Goal</u> (3MS6): Enhance mission success through seamless, community-focused electronic service delivery by meeting the established performance indicators in this area.

<u>Performance Indicators for 3MS6:</u>

- Implement the *eNASA Strategic Plan and Roadmap* to deliver electronic services and information to the public, partners, suppliers, key stakeholders, and the internal employees and teams that execute NASA's missions.
- Make the NASA Web more accessible, community-focused, and useful to all of NASA's diverse audiences as demonstrated by increased customer satisfaction from the FY 2002 baseline.
- Increase the scope and level of corporate and shared electronic services from the FY 2002 baseline.
- Process 60% of NASA's competitive grant opportunities online consistent with interagency efforts to simplify the grants process.

<u>MS Objective #5</u>: Invest wisely in our use of human capital, developing and drawing upon the talents of all our people.

Public Benefit: NASA's human capital investment strategies are rooted in the Agency's belief that employees are our most important resource. Therefore, to deliver on our research and development commitments to the public, NASA is constantly realigning this resource consistent with changing Agency goals and objectives. In addition, NASA is committed to attracting and retaining a workforce that is: (1) representative at all levels of the diverse public it serves; and (2) renowned for its world-class, cutting-edge skills and competencies.

<u>Annual Performance Goal</u> (3MS7): Align management of human resources to best achieve Agency strategic goals and objectives.

<u>Performance Indicators for 3MS7:</u>

- Implement at least three of the National Recruitment Team's FY 2002 Report recommendations to enhance Centers' ability to attract, recruit, and retain a high-quality workforce.
- By the end of FY 2003, increase the availability of assessment tools in Agency-wide leadership and project management training and development over those available in FY 2001. (These types of tools include multi-rater instruments that assess knowledge, skills, competencies, and experiences in leadership and project management. They are used to develop current and future leaders within the Agency.)

<u>Annual Performance Goal</u> (3MS8): Attract and retain a workforce that is representative of America's diversity at all levels, and maximize individual performance through training and development experiences.

<u>Performance Indicators for 3MS8:</u>

- Increase representation of minorities by at least 0.6%, women by at least 0.4%, and individuals with targeted disabilities by at least 0.085%.
- Ensure that women, minorities, and employees with targeted disabilities participate in career development and training programs at rates equal to or greater than their workforce representation.

Verification/Validation

Performance plan goals, indicators, and accomplishment claims are subject to audit by a number of internal and external groups. To ensure this capability, NASA relies on a number of processes for verifying and validating performance claims.

First, whenever possible, data in support of performance claims are gleaned from and/or validated against officially maintained databases. The data-gathering process in all cases is subject to strict oversight, and independent audits and periodic checks by internal and/or external reviewers ensure the integrity of the databases. These databases include: the NASA Personnel Payroll System (NPPS); the Consolidated Agency Payroll and Personnel System (CAPPS); the Incident Reporting System (IRIS); the Financial and Contractual Status of Programs System (FACS); the NASA Environmental Tracking System (NETS); the Veterans Administration Workers' Compensation Database; the consolidated NASA Occupational Health Annual Cost and Staffing Report; the Agency Health Enhancement Database (AHED); NASA Center Personal Property Reports; and the Center Cost Avoidance Database.

Second, a number of specific verification and validation processes are in place to support performance claims in specific areas.

1. Integrated Financial Management System (IFMS) verification and validation are based on measures in the signed Program Commitment Agreement. Non-advocate and independent reviews are conducted periodically, and the results are reported to the HQ Program Management Council (PMC) and the IFM Council.

2. Performance Based Contracts (PBCs) verification and validation are based on contract sampling to validate PBC criteria and on Financial And Contractual Status (FACS) data.

3. Contract awards to small and small disadvantaged businesses are documented for verification and validation in the Summary Contractor Reports (SF 295) that are reviewed during Center Procurement Management Survey data checks. In addition, the Small Business Administration and the Department of Defense Contract Management Agency conduct periodic on-site surveys to verify and validate performance claims and process integrity. The Minority Business Resource Advisory Council and the NASA/Prime Contractor Roundtable also do periodic reviews and make recommendations for process improvements to NASA management.

4. Information Technology (IT): NASA and Center Chief Information Officers, staff of the NASA ADP Consolidation Center (NACC), project office staff of the NASA Integrated Services Network (NISN), project office staff of the Outsourcing Desktop Management Initiative (ODIN), and other process overseers verify and validate performance data during periodic reviews. In addition, NASA's IT customers are given frequent opportunities to offer evaluations and recommendations for improved IT performance.

5. Safeguarding employee health verification and validation is based upon specific indicators and statistics gathered through on-going Center occupational health site assessments and evaluations recorded in NASA's relational database, AHED.

NASA continues to seek new verification and validation techniques for on-going performance indicators and to develop additional performance indicators that can be verified and validated precisely.

Addressing Management Challenges/High Risk Areas

Procurement Management Challenges: NASA's Office of Procurement has undertaken proactive management approaches in three key areas: human capital; outsourcing and oversight; and electronic commerce.

- **Human Capital**: The Office of Procurement continues to emphasize three initiatives to address entry-level, mid-level, and senior-level staff developmental needs:

    - The NASA Career Development and Procurement Certification Programs, designed to ensure that acquisition professionals receive uniform, high quality training that meets or exceeds statutory standards;
    - NASA's Contracting Intern Program, designed to ensure that an adequate number of well-trained, college-educated, entry-level employees are available to the Agency to offset retirements and demographic trends (i.e., the aging of the work force); and
    - Rotational Assignments with Industry, designed to add a corporate experience dimension to the Office of Procurement's other developmental programs and to equip high performing, senior acquisition professionals with the tools they will need to assume procurement management and other leadership positions.

- **Outsourcing and Oversight**: As its personnel numbers have decreased, NASA has outsourced various functions (such as IT support) and has relied on less oversight of its contractors than it did historically. Given this environment, NASA recognized that it must manage risk within the acquisition process to achieve mission success without compromising safety. Therefore, NASA introduced a Risk-based Acquisition Management Initiative that re-focused risk as a key management concern and emphasized considerations of risk throughout the acquisition process. One of the key risk considerations in the acquisition process is the type and level of contractor surveillance to be performed.

- **Electronic Commerce**: The Office of Procurement continues to focus on the Internet as a means to achieve rapid, low-cost, reliable delivery of procurement information to broad audiences, especially small and small disadvantaged business concerns. The NASA Acquisition Internet Service (NAIS) remains a simple, effective, and user-friendly system for disseminating information on contract opportunities. NAIS continues to be NASA's primary mechanism for electronic commerce, and it has won both government and private sector praise for its accomplishments as a portal to a broad range of procurement-related functions and information.

Small Business Challenge: In the new century, the world of business is more diverse and more technologically driven. Businesses and their customers are much more diverse, and women, individuals with disabilities, and minority-owned businesses are important players. The rapid pace of technological advances poses both opportunities and challenges for small business. Small businesses are at the forefront of technological change because they are flexible and close to the customer. Accordingly, NASA's

Office of Small and Disadvantaged Business Utilization will continue its effort to increase contract and subcontract dollars awarded to small disadvantaged businesses, particularly in high technology areas. This includes the participation of such firms in NASA's technology transfer and commercialization activities.

In the FY 2002 NASA Performance Plan, the NASA Administrator established a specific Agency-wide goal for awards to Historically Black Colleges and Universities and other minority institutions of 1 percent of NASA's total contract and subcontract dollars to increase utilization of these entities. These awards will continue in FY 2003 and will be based upon conformance with NASA's mission needs, technical superiority, and cost reasonableness, and NASA expects that the entire student population of these colleges and universities will benefit from these expanded opportunities to satisfy NASA's programmatic requirements.

Fiscal Management Challenges: In FY 2001, a new contractor was selected to provide the Core Financial System (CFS) software. Additionally a provider was selected to implement the new software, and an Agency-level project team was put into place at the Marshall Space Flight Center (MSFC), the Lead Center for the project. The design phase was completed in June 2001.

In FY 2001, two "pathfinder" projects began to test the processes and technical requirements for Agency-wide implementation of new administrative systems. The Langley Research Center (LaRC) is leading the implementation of a new Travel Management system and is working with the receiving Centers and the Integration Project Office (IPO) to schedule follow-on Center implementations. The Goddard Space Flight Center (GSFC) is responsible for acquiring and implementing the Resume Management functional module throughout the Agency. (Resume Management is one of several modules within the Human Resources track of the IFM Program.) After a successful Operational Readiness Review in June 2001 at GSFC, implementation of the Agency's new automated Staffing and Recruitment System (NASA STARS) began at GSFC. Implementation will continue in a phased deployment through November 2001.

In FY 2002, MSFC begins implementation of the SAP Core Financial module, and full Agency rollout will be completed in FY 2003. The Rollout Phase for the Travel Management System begins in September 2001 after completion of the pilot at LaRC, and full Agency-wide implementation will be completed in April 2003. As Lead Center, GSFC will build and test a Budget Formulation Prototype and present options and recommended solutions to meet Agency budget formulation requirements. In accordance with one of the IFM Program's first principles, the Budget Formulation Prototype Project will use COTS software without modification.

The NASA Human Resources community will participate with SAP and other agencies in the federalization requirements of definition for the SAP software product. This collaboration to add unique federal functionality to the SAP Enterprise Resources Planning (ERP) solution could allow us to initiate a Human Resources Project in FY 2003.

IT Management Challenge: IT Security remains a significant area of management concern government-wide. In particular, IT security program reviews noted that NASA's IT security training practices were inadequate and inconsistent. To address these criticisms, NASA conducted specialized IT security awareness training for employees, managers, and system administrators in FY 2001-2002 and is expanding the use of web-based training to broaden course offerings, simplify distribution, and make training available to any employee who has access to the Internet.

While substantial progress has been made in closing out most of the GAO and internal review IT-security recommendations, NASA will continue making IT security an integral part of all systems operated by the Agency. We recognize that significant improvements must be followed by a focused, ongoing effort.

Strategic Human Capital Management Challenge: NASA is focusing on the restructure and revitalization of the workforce. This focus involves a human capital management strategy centered on:

- Strategic planning for human capital management;
- Attracting and retaining a high caliber, high tech, and diverse workforce whose skills and competencies are aligned with Agency mission objectives;
- Investing in the technical training and career development of this critical resource; and
- Cultivating a continued pipeline of talent to meet future science, math, and technology needs.

In formulating its human capital management strategy, the Agency considered findings and recommendations contained in both internal reviews and external reports relating to human capital issues, including those of the Aerospace Safety Advisory Panel, the Office of Management and Budget, and the General Accounting Office.

- **Human Capital Planning and Alignment**: In FY 2001, NASA initiated a strategic resources review based on NASA's future vision and mission. The challenge of the review is to identify the core competencies resident at the NASA Centers, to ensure that resources are prioritized and directed at the most critical Agency requirements, and to focus on the Agency's fundamental roles and missions. As part of the strategic resources review, NASA will identify human capital resource gaps between the Centers' existing capabilities and what is unique and required in-house to meet NASA's future goals. The Agency also will examine its management and organizational structure to identify opportunities for streamlining and for re-deploying resources from less critical activities at NASA Centers to the Agency's highest priority missions. Results of the review will be incorporated into future Agency Performance Plans. (The results of the review also may lead to requests for specific civil service reforms to ensure that NASA can recruit and retain top science, engineering, and management talent.)

In FY 2002-2003, NASA will develop and implement a process by which Centers will do consistent workforce planning. This planning process will link staffing, funding resources, mission and activities, and core competencies. In years to come, it will enable Centers to plan recruitment, retention, succession, and training and career development activities that are tailored to their unique circumstances while supporting Agency goals and objectives.

Another aspect of the Agency's approach to addressing workforce needs is to achieve an effective balance of permanent civil servants, time-limited civil services appointees, and individuals from the academic world who contribute through post-doctoral fellowships, grants programs, Intergovernmental Personnel Assignments, and other partnerships. The intent is to draw from a variety of sources to ensure effective use of talent both within and outside the Agency. Combined with contractor support (approximately 85 percent of NASA's annual budget is contracted out), this approach will permit the Agency to focus on being a premier research and development organization – doing the things that NASA does best and relying on others to take on operations and other appropriate functions.

• **Recruitment and Retention**: In order to be competitive with other employers, NASA recognizes it must have a continuing presence on college and university campuses. After years of downsizing, the NASA Centers are re-establishing recruitment networks and rebuilding the once extensive Co-operative Education Program. The Agency will continue to utilize the Presidential Management Intern Program and student employment programs as sources for entry-level hires. A new national recruitment initiative also has been established to institutionalize new Agencywide recruitment strategies and tools to enhance Centers' recruitment capabilities, focusing on "fresh-outs" to counterbalance the aging of the workforce.

NASA's programs excite the imagination, so the Agency has been able to attract people eager to be a part of NASA's mission. Potential candidates, however, also must weigh financial considerations. The NASA Centers utilize various hiring authorities that enable them to offer starting salaries above the minimum rate of a grade and, when appropriate, NASA Centers can offer retention allowances. In fact, using recruitment bonuses and retention allowances to attract and retain the "best and the brightest" has increased recently – a trend the Agency expects to continue because of the competitive job market and high cost of living surrounding some NASA Centers.

NASA also continues to emphasize quality of work-life initiatives such as alternative work schedules, family friendly leave programs, part-time employment and job sharing, telecommuting, dependent day care, and employee assistance programs. Promoting safety in the workplace and providing effective awards, recognition, and stimulating work enhances job satisfaction and fosters retention.

• **Training, Career Development, Leadership Continuity, and Succession Planning**: As important as it is to attract and retain the right people, it is equally vital to provide further training and development opportunities for those already in the workforce. In addition to funding university level courses, NASA has made a strong investment in ensuring NASA participation in conferences and symposia where breakthrough research and ideas are being presented and shared, as well as training in other core functional areas. NASA also is revitalizing the development of leadership and program/project management capabilities through a number of methods. The Agency's curriculum for developing project management leaders is being reviewed to ensure that appropriate skills and competencies are developed, and assessment tools and other training mechanisms to identify individual training needs are being emphasized to identify and develop project management and leadership potential.

NASA also is emphasizing "just in time" training opportunities for project leaders and team members to improve project team competencies. The Agency is pursuing learning through simulations, as well as coaching and mentoring opportunities, as well as developing e-learning alternatives that can be accessed at all locations and levels. For example, NASA demonstrated a prototype online tool for project management based on the Mars Pathfinder project and has established an e-zine (online magazine/journal) for sharing lessons learned in project management.

NASA also has updated its leadership model to reflect the cutting edge skills and behaviors required for effective Agency leadership. The model is linked to NASA's Strategic Plan and defines skill requirements for team leaders through senior executives. In addition, the new Global Leadership Program provides an international perspective and skills for NASA management in an increasingly global environment. And, NASA has developed partnerships with academia to provide fellowships in leadership and project management development. These include a partnership with the Massachusetts Institute of Technology in Project Management and another with the Darden Business School to develop a Business Education Program. Several other long-term developmental processes are in place at both the Center and the Agency levels. These include the Senior Executive Service Candidate Development Program and the Professional Development Program.

- **Future Pipeline**: NASA continues to look for ways to help ensure a future pipeline of talent from which NASA and others can draw. The new Agencywide Undergraduate Student Research Program began its pilot phase in FY 2001 with 107 students. It was developed to extend and strengthen NASA's commitment to educational excellence and university research, and to highlight the critical need to increase the nation's undergraduate and graduate science, engineering, mathematics, and technology skill base. The first class represents the nation's diversity and includes students from 29 states and Puerto Rico representing 70 different institutions. The program provides students opportunities for participating in research and gaining experience in their chosen disciplines. It also will build a national program bridge from existing NASA K12 Education Program activities to other NASA Higher Education Program options that encourage and facilitate student interest in future professional opportunities with NASA and its partner organizations. Such opportunities might include NASA career employment, temporary assignment, undergraduate and graduate co-op appointment, or contractor positions. In addition, in FY 2002-2003, the Agency plans to develop and implement a scholarship program targeted to the core skills needed to fulfill NASA's research and development mission and designed to guide students toward careers in engineering, physical sciences, biological and life sciences, and computer technology. NASA is pursuing legislation that would enable the Agency to include a service requirement in the scholarship program.

NASA recognizes its greatest strength is its people – essential to safe operations, mission success, and responsible stewardship of the taxpayers' dollars. The Agency will continue to pursue focused activities to position NASA as an employer of choice, recruit and retain the best talent, and provide learning and developmental opportunities for the workforce.

Environmental Management Challenge

The Environmental Management Division in NASA's Office of Management Systems takes a very proactive and integrated approach to environmental management. Consistent with the strategy articulated in *NASA Environmental Excellence for the Twenty-First Century*, the Agency is working on the immediate priority of bringing all NASA activities into compliance with current environmental requirements, while simultaneously restoring previously contaminated sites as quickly as funds allow. Conservation and pollution prevention will be considered in all new projects and programs to minimize environmental impacts and preserve our natural and cultural resources. This approach is clearly captured in NASA's environmental vision that "we will continue as a world leader in space exploration and aeronautics while maintaining environmental excellence." The strategy for achieving this vision includes four focus areas: prevention, compliance, restoration, and conservation.

NASA management is focusing attention on the decommissioning of the Plum Brook Reactor and consistent implementation of the National Environmental Policy Act (NEPA). In fact, both issues are on NASA's Top 10 Environmental Priorities. (The first five priorities are concerned with mandatory requirements that characteristically have associated legal liabilities. The next five priorities emphasize "best management practices" offering the Agency the greatest benefits in terms of efficiency, effectiveness and cost.) By placing emphasis on achieving the 10 priorities, NASA will greatly improve its legal and management situation in the area of environmental management.

MULTI-YEAR PERFORMANCE TREND

Manage Strategically

Strategic Objective: Protect the safety of our people and facilities and the health of our workforce.

	FY99	FY00	FY01
Annual Performance Goal and APG#	Reduce the number of Agency lost workdays (from occupational injury or illness) by 5 percent from the FY 1994-96 3-year average. (MS3) Achieve a 5 percent increase in physical resource costs avoided from the previous year through alternative investment strategies in environmental and facilities operations. (MS4)	Reduce the number of Agency lost workdays (from occupational injury or illness) by 5 percent from the FY 1994-96 3-year average. (0MS3) Achieve a 5 percent increase in physical resource costs avoided from the previous year through alternate investment strategies in environmental and facilities operations. (0MS12)	NASA will increase the safety of its infrastructure and workforce with facilities safety improvements, reduced environmental hazards, increased physical security, and enhanced safety awareness among its employees by meeting all five performance indicators in this area. (1MS1)
Assessment	MS3 was green. MS4 was green.	0MS3 was blue. 0MS12 was blue.	
	FY02	**FY03**	**FY04**
Annual Performance Goal and APG#	NASA will increase the safety of its infrastructure and the health of its workforce through facilities safety improvements, reduced environmental hazards, increased physical security, and enhanced safety and health awareness, and appropriate tools and procedures for health enhancement. (2MS1)	NASA will increase the safety of its infrastructure and the health of its workforce through facilities safety improvements, reduced environmental hazards, increased physical security, enhanced safety and health awareness, and appropriate tools and procedures for health enhancement. (3MS1)	
Assessment			

<u>Strategic Objective</u>: Achieve the most productive application of Federal acquisition policies.

	FY99	FY00	FY01
Annual Performance Goal and APG#	Increase obligated funds available for Performance Based Contracts (PBC) to 80 percent (funds available exclude grants, cooperative agreements, actions less than $100K, Small Business Innovative Research, Small Business Technology Transfer Programs, Federally Funded Research and Development Centers, intragovernmental agreements, and contracts with foreign governments or international organizations). (MS6) Achieve at least the congressionally mandated 8 percent goal for annual funding to small disadvantaged businesses (including prime and subcontractors to small disadvantaged businesses, Historically Black Colleges and Universities, other minority institutions, and women-owned small businesses). (MS7) Enhance contract management through improved systems and information for monitoring and through an emphasis on the training of procurement personnel, and revise metrics to assess the overall health of the procurement function. (MS9) Enhance contract management through improved systems and information for monitoring by implementing a strategy for evaluating the efficacy of procurement operations. (MS10)	Of funds available for Performance Based Contracts (PBCs), maintain PBC obligations at 80 percent (funds available exclude grants, cooperative agreements, actions less than $100K, SBIR, STTR, FFRDCs, intragovernmental agreements, and contracts with foreign governments or international organizations). (0MS5) Achieve at least the congressionally mandated 8 percent goal for annual funding to small disadvantaged businesses (including prime and subcontractors to small disadvantaged businesses, Historically Black Colleges and Universities, other minority institutions, and women-owned small businesses). (0MS8)	Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of Performance Based Contracts, and maintain a significant involvement in NASA programs of small businesses, minority institutions, and minority and women-owned businesses by meeting 2 out of 3 performance indicators in this area. (1MS2)
Assessment	All targets were green	0MS5 was green. 0MS8 was blue.	

Strategic Objective: Achieve the most productive application of Federal acquisition policies.

	FY02	FY03	FY04
Annual Performance Goal and APG#	Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of Performance Based Contracts (PBCs). (2MS2) Continue integrating small, small disadvantaged, and women-owned businesses together with minority universities into the competitive base from which NASA can purchase goods and services. (2MS9)	Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of Performance Based Contracts (PBCs). (3MS2) Continue integrating small, small, disadvantaged, and women-owned businesses together with minority universities into the competitive base from which NASA can purchase goods and services. (3MS9)	
Assessment			

Strategic Objective: Manage our fiscal and physical resources optimally.

	FY99	**FY00**	**FY01**
Annual Performance Goal and APG#	Achieve 70 percent or more of the resources authority available to cost within the fiscal year. (MS5) Complete system validation of the Integrated Financial Management Program (IFMP), and complete system implementation at Marshall and Dryden. (MS12)	Cost 70 percent or more of available resources. (0MS4) Begin the implementation at the NASA installations of the Integrated Financial Management System following the completion of system testing. (0MS11)	Renew Agency's management systems, facilities, and human resources through updated use of automated systems, facilities revitalization, and personnel training by meeting 4 out of 7 performance indicators in this area. (1MS3)
Assessment	MS5 was green MS12 was red.	0MS4 was green 0MS11 was red.	
	FY 02	**FY03**	**FY04**
Annual Performance Goal and APG#	Revitalize Agency facilities, and reduce environmental liability. (2MS3) Improve the Agency's financial management and accountability. (2MS10)	Renew the Agency's management systems and facilities through the use of updated automated systems and facilities revitalization, and meet four out of five performance indicators in this area. (3MS3) Improve the Agency's financial management and accountability. (3MS10)	
Assessment			

Strategic Objective: Enhance the security, efficiency, and support provided by our information technology resources.

	FY99	FY00	FY01
Annual Performance Goal and APG#	Improve information technology infrastructure service delivery to provide increased capability and efficiency while maintaining a customer rating of "satisfactory" and holding costs per resource unit to the FY 1998 baseline. (MS8) Complete remediation of mission-critical systems by March 1999, consistent with Government-wide guidance for the Year 2000. (MS11)	Improve information technology infrastructure service delivery to provide increased capability and efficiency while maintaining a customer rating of "satisfactory" and holding costs per resource unit to the FY 1998 baseline. (0MS10)	Improve IT infrastructure service delivery to provide increased capability and efficiency while maintaining a customer rating of "satisfactory," and enhance IT security through a reduction of system vulnerabilities across all NASA Centers, emphasizing IT security awareness training for all NASA personnel, by meeting 2 out of 2 performance indicators in this area. (1MS4)
Assessment	MS8 was green. MS11 was green.	0MS10 was green.	
	FY02	**FY03**	**FY04**
Annual Performance Goal and APG#	Improve IT infrastructure service delivery by providing increased capability and efficiency while maintaining a customer rating of satisfactory. (2MS4) Enhance IT security by meeting established performance indicators in three critical areas: IT system vulnerabilities detected, training, and IT security plans. (2MS5) Enhance mission success through seamless, community-focused electronic service delivery. (2MS6)	Improve IT infrastructure service delivery by providing increased capability and efficiency while maintaining a customer rating of satisfactory. (3MS4) Enhance IT security by meeting established performance indicators in three critical areas (IT system vulnerabilities, IT security awareness training, and IT security plans). (3MS5) Enhance mission success through seamless, community-focused electronic service delivery by meeting the established performance indicators in this area. (3MS6)	
Assessment			

Strategic Objective: Invest wisely in our use of human capital, developing and drawing upon the talents of all our people.

	FY99	FY00	FY01
Annual Performance Goal and APG#	Reduce the civil service workforce level to below 19,000. (MS1) Maintain a diverse NASA workforce through the downsizing efforts. (MS2)	Reduce the civil service workforce level to below 18,200. (0MS1) Maintain a diverse NASA workforce through the downsizing efforts. (0MS2)	Renew Agency's management systems, facilities, and human resources through updated use of automated systems, facilities revitalization, and personnel training by meeting 4 out of 7 performance indicators in this area. (1MS3)
Assessment	All targets were green.	0MS1 was no longer applicable. 0MS2 was green.	
	FY02	**FY03**	**FY04**
Annual Performance Goal and APG#	Align management of human resources to best achieve Agency strategic goals and objectives. (2MS7) Attract and retain a workforce that is representative at all levels of America's diversity. (2MS8)	Align management of human resources to best achieve Agency strategic goals and objectives. (3MS7) Attract and retain a workforce that is representative of America's diversity at all levels, and maximize individual performance through training and development experiences. (3MS8)	
Assessment			

Manage Strategically **FY 2003 Annual Performance Goals**	**Budget Category**	**HEDS**	**Biological and Physical Research**	**Aero-Space Technology**	**Space Science**	**Earth Science**	**Research and Program Management**
Annual Performance Goals & APG#							
3MS1: NASA will increase the safety of its infrastructure and the health of its workforce through facilities safety improvements, reduced environmental hazards, increased physical security, enhanced safety and health awareness, and appropriate tools and procedures for health enhancement.		X	X	X	X	X	X
3MS2: Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of Performance Based Contracts (PBCs).		X	X	X	X	X	X
3MS9: Continue integrating small, small disadvantaged, and women-owned businesses together with minority universities into the competitive base from which NASA can purchase goods and services.		X	X	X	X	X	X
3MS3: Renew the Agency's management systems and facilities through the use of updated automated systems and facilities revitalization, and meet four out of five performance indicators in this area.		X	X	X	X	X	X
3MS10: Improve the Agency's financial management and accountability.		X	X	X	X	X	X
3MS4: Improve IT infrastructure service delivery by providing increased capability and efficiency while maintaining a customer rating of satisfactory.		X	X	X	X	X	X
3MS5: Enhance IT security by meeting established performance indicators in three critical areas (IT system vulnerabilities, IT security awareness training, and IT security plans).		X	X	X	X	X	X
3MS6: Enhance mission success through seamless, community-focused electronic service delivery by meeting the established performance indicators in this area.		X	X	X	X	X	X
3MS7: Align management of human resources to best achieve Agency strategic goals and objectives.		X	X	X	X	X	X
3MS8: Attract and retain a workforce that is representative of America's diversity at all levels, and maximize individual performance through training and development experiences.		X	X	X	X	X	X

Provide Aerospace Products and Capabilities

FY 2003 Performance Plan

Mission

The Provide Aerospace Products and Capabilities process is the means by which NASA's Strategic Enterprises and their Centers deliver systems (ground, aeronautics, space), technologies, data, and operational services to customers within and outside NASA. Through the use of Agency facilities, customers can conduct research, explore and develop space, and improve life on Earth. This process determines what cutting-edge technologies, processes, techniques, and engineering capabilities NASA must develop to implement its research agenda. This process also determines which technologies, processes, techniques, and engineering capabilities NASA can eliminate, downsize, or outsource to industry and academia so that resources are focused on critical needs that cannot be provided elsewhere. PAPAC helps to assure that NASA strategically utilizes public resources in an efficient and effective means such that the public benefit is maximized.

Implementation Strategy

The goal of this process is to enable NASA's Strategic Enterprises and their Centers to deliver products and services to customers more effectively and efficiently. The process is also used to enable the Communicate Knowledge process to extend the technology, research, and science benefits from NASA programs broadly to the public and commercial sectors.

Performance Metrics

Strategic Plan Goal:
To Enable NASA's Strategic Enterprises and their Centers to deliver products and services to their customers more effectively and efficiently.

Objectives: **-Enhance Program safety and mission success in the delivery of products and operational services.**

-Improve NASA's engineering capability to remain as a premier engineering research and development organization

-Capture engineering and technological best practices and process knowledge to continuously improve NASA's program/project management

Public Benefit: NASA's role in the advancement of research and technology is conducted through the construction and operation of facilities such as telescopes, satellites, and ground-based laboratories and test facilities. This element tracks the effectiveness and efficiency with which NASA's Strategic Enterprises and Centers serve their customers. NASA's improvements in program and project management yields an increased number of successful missions within budget, an increase of information to researchers and the public, more technological breakthroughs, and more discoveries about our planet and universe. NASA's ability to improve and maintain engineering capabilities results in more efficient processes and reduced cost.

APG 3P1: Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110 % of cost and schedule estimates, on average.

<u>Indicator</u>

- Development schedule and cost data are drawn from NASA budget documentation for major programs and projects to calculate the average performance measures.

APG 3P2: Track the availability of NASA's spacecraft and major ground facilities by keeping the operating time lost due to unscheduled downtime to less than 10% of scheduled operating time.

<u>Indicator</u>

- Each field center reports the operational downtime of the major spacecraft and groundfacilities.

Objective - Facilitate technology insertion and transfer, and utilize commercialization partnerships in research and development to the maximum extent practicable

Public Benefit: The percentage of NASA's R&D budget dedicated to commercial partnerships affects integrated technology planning and development with NASA partners. This reduces the taxpayer cost while increasing products and services to the consumer and allows NASA the ability to produce more technology break-thru and science by leveraging financial and human capital. This is an overwhelming benefit to the public investment. NASA believes that colleges and universities as well as government and industry bring their scientific, economic, engineering and social research competencies to bear on aerospace problems and on the broader social, economic, and international implications of our technical programs. It is expected that, in doing so, they will strengthen both their research and educational capabilities to contribute more effectively to the national well-being. Working with our academia, industry, Department of Defense, and Federal Aviation Administration partners, our joint goals reach beyond what can be accomplished today and stretch the imagination.

APG 3P3: Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships.

<u>Indicator</u>

- Each of the Enterprises reports contribution to commercial partnerships.

Verification and Validation

Data will be verified by collaborating with the Enterprises and Centers, and during the Quarterly Status Reviews and monthly status reports.

Data will be validated by various independent assessments of program/project activity, and the review of several Center and Agency databases.

Management Challenges/High Risk Areas

All of the PAPAC management challenges/high risk areas are being addressed in the implementation of the NASA Integrated Action Team (NIAT) actions. Each of the 17 NIAT actions has an Action Plan that defines how, when, and by whom the plan is being implemented. All of the action plans have been initiated, and most will be fully implemented by the end of FY 2002 although some will continue beyond that. The result of the NIAT assessment presents a framework for strengthening the approach used by NASA to formulate and implement its programs and projects and to improve the supportive nature of the environment in which they are executed.

The NIAT actions represent a systems solution to continually improve NASA's ability to effectively execute its programs and projects. This involves a comprehensive set of practices that focus on the objectives of well-prepared people, sound decision making, and effective communications.

Safety and Mission Assurance:

In response to NIAT 8, and as part of its assigned role to assist the Agency in decreasing the risk for mishap and failure, the Office of Safety and Mission Assurance is expanding and sharpening its focus on safety and mission assurance processes by:

1) Establishing clear commodity/product line oriented safety and mission assurance direction and guidance, including adoption of a comprehensive safety and mission assurance certification process to aid in assuring the safety and mission success of all activities.

2) Improving requirements, guidelines and training related to the identification, tracking, resolution and closure of problems/failures.

3) Developing guidance for the application of safety and mission assurance to non-contractual activities (for example grants and cooperative agreements that are being increasingly utilized by NASA).

There are other activities by other organizations that will also serve to enhance safety and mission success including increased emphasis on proper standards, procurement, and program and project education and training.

Program and Project Management:

The revision of NASA Procedures and Guidelines (NPG) 7120.5, NASA Program and Project Management Processes and Requirements is approaching completion, and it includes extensive changes/clarifications of the processes involved in program/project management. The NIAT Report was the driving force behind the extent of the changes. Several of the NIAT action plans are related to strengthening program/project management. Some of the action plans include more rigorous program/project formulation, continuous evaluation of mission risk profile and balance of scope and resources, and inclusion of management and stakeholders in mission risk acceptance process. Some specific areas of improvement include software development and assurance, the integrated review process, ensuring adequate resources, surveillance, verification and validation, and knowledge management.

Implementing FBC approach to Space Exploration Projects:

The specific actions delineated in the NIAT report focus on how NASA must approach execution of all programs and projects because the underlying principles of FBC, when properly applied, have applicability to all that the Agency does. The governing process by which the Agency guides execution of its programs and projects does not currently differentiate projects that are FBC and those that are not FBC. Instead, it relies upon a careful assessment on a case-by-case basis to establish the risk posture associated with a particular mission or endeavor. NASA's work is and will continue to be inherently high risk. Different NASA projects will have different risk profiles, depending on the criticality of the project to NASA's program goals, the amount invested in the project, and the nature of the project. For example, the acceptable technical risks on a small technology testbed may be substantially greater than those on a large science spacecraft or a human space flight mission. NASA's goal is to strive for a reduction of risk on every project that is commensurate with these factors. In this light, NASA has no differentiation of FBC projects. However, in all projects, individual competency, team functionality, utilization of technology, prudent risk taking, rigor of practice, and management awareness and consent are all key to properly identifying and managing risk. Through the actions of the report, the Agency will improve its approach to safety and prudent acceptance of mission risk as key criteria for proper project and program management.

Provide Aerospace Products and Capabilities
FY 2003 Performance Plan

Strategic Objective: Enhance Program safety and mission success in the delivery of products and operational services

	FY99	FY00	FY01	FY02	FY03
Annual Target and Target #	Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average. (P1)	Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average. (0P1)	Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average. (1P1)	Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average. (2P1)	Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average. (3P1)
Target Assessment	Green	Red			

Strategic Objective: Enhance Program safety and mission success in the delivery of products and operational services

	FY99	FY00	FY01	FY02	FY03
Annual Target and Target #	Set up process to determine, on average, the operating time of NASA's spacecraft and ground facilities lost to unscheduled downtime. Establish a baseline in FY99. (P2)	Ensure the availability of NASA's spacecraft and facilities by decreasing the downtime relative to FY1999 spacecraft and facility performance. (0P2)	Ensure the availability of NASA's spacecraft and major ground facilities by keeping the operating time lost due to unscheduled downtime to less than 10% of scheduled operating time. (1P3)	Track the availability of NASA's spacecraft and major ground facilities by keeping the operating time lost due to unscheduled downtime to less than 10% of scheduled operating time. (2P2)	Track the availability of NASA's spacecraft and major ground facilities by keeping the operating time lost due to unscheduled downtime to less than 10% of scheduled operating time. (3P2)
Target Assessment	Green	Blue			

Strategic Objective: Enhance Program safety and mission success in the delivery of products and operational services

	FY99	FY00	FY01	FY02	FY03
Annual Target and Target #			Develop and approve NASA policy for Software Independent Verification and Validation, and conduct an evaluation of projects for its application through achievement of three indicators. (1P7)		
Target Assessment					

Strategic Objective: Improve NASA's engineering capability to remain as a premier engineering research and development organization

	FY99	**FY00**	**FY01**	**FY02**	**FY03**
Annual Target and Target #	Set up process to improve engineering skills and tools within the Agency. (P8)			Strengthen the NASA engineering capability through the completion of two indicators in FY02. (2P3)	
Target Assessment	Yellow				

Strategic Objective: Capture engineering and technological best practices and process knowledge to continuously improve NASA's program/project management

	FY99	**FY00**	**FY01**	**FY02**	**FY03**
Annual Target and Target #				Improve program and project management through the completion of two of three indicators in FY02. (2P4)	
Target Assessment					

Strategic Objective: Capture engineering and technological best practices and process knowledge to continuously improve NASA's program/project management

	FY99	**FY00**	**FY01**	**FY02**	**FY03**
Annual Target and Target #	Set up a process in FY99 to capture a set of best practices/lessons learned from each Program, to include at least one from each of the four PAPAC subprocesses, commensurate with current program status. (P5)	Capture a set of best practices/lessons learned from each Program, to include at least one from each of the four PAPAC subprocesses, commensurate with current program status. Inputs will be used in PAPAC process improvement and in Program/Project Management training. (0P5)	Capture a set of best practices/lessons learned from each Program, to include at least one from each of the four PAPAC subprocesses, commensurate with current program status. Inputs will be used in PAPAC process improvement and in Program/Project Management training. (1P4)	Capture a set of best practices/lessons learned from each Program, to include at least one from each of the four PAPAC subprocesses, commensurate with current program status. Inputs will be used in PAPAC process improvement and in Program/Project Management training. (2P5)	
Target Assessment	Green	Yellow			

Strategic Objective: Facilitate technology insertion and transfer, and utilize commercial partnerships in research and development to the maximum extent practicable

	FY99	FY00	FY01	FY02	FY03
Annual Target and Target #	Set up a process to determine percent of Agency's R and D budget dedicated to commercial partnerships and establish a baseline. (P6)	Dedicate thepercentage of the Agency's R&D budget that is established in the FY00 processto commercial partnerships. (0P6)	Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships. (1P5)	Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships. (2P6)	Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships. (3P3)
Target Assessment	Green	Blue			

Strategic Objective: Enable technology planning, development, and integration driven by Strategic Enterprise customer needs

	FY99	FY00	FY01	FY02	FY03
Annual Target and Target #	Set up a data collection process to determine the amount of leveraging of the R and D budget with activities of other organizations. Establish a baseline in FY99. (P7)	Increase the amount of leveraging of the technology budget with activities of other organizations, relative to the FY99 baseline that is established during process development. (0P7)	Complete redefinition of the NASA Technology Plan to emphasize investments in the emerging strategic cross-Enterprise technology areas & include roadmaps for each Enterprise to show how Enterprise technology investments are linked to future mission needs. (1P6)		
Target Assessment	Green	Green			

PAPAC FY 2003 Annual Performance Goals	**Budget Category**	HEDS	Aero-Space Technology	Space Science	Earth Science
Annual Performance Goal					
Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average. (3P1)		X	X	X	X
Track the availability of NASA's spacecraft and major ground facilities by keeping the operating time lost due to unscheduled downtime to less than 10% of scheduled operating time. (3P2)		X	X	X	X
Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships. (3P3)		X	X	X	X

Communicate Knowledge

FY 2003 Performance Plan

Mission

NASA communicates knowledge by coordinating, managing and sharing information and experiences related to the content, relevance, results, applications, and excitement of NASA's mission. The Communicate Knowledge (CK) process facilitates the distribution of information on NASA's missions and discoveries. It ensures increased public understanding of science and technology, promotes the application of NASA-generated information, and inspires achievement and innovation. The process ensures that knowledge derived from NASA research programs is available to meet the specific needs and interests of constituent groups. It begins at the inception of a research project and increases in intensity as the effort reaches maturity to ensure the appropriate delivery, archiving, and future convenient access of all research results. The goal of the Communicate Knowledge Process is to ensure that NASA's customers (including scientists and technologists around the world, companies and innovators, educators, publishers, museums, the media, and every citizen) receive information derived from the Agency's efforts in a timely and useful form.

Implementation Strategy

The Agency will work to expose more people to the activities of NASA's Aeronautics and Space programs by maintaining an exhibits loan service, supporting Visitor Center activities, and by providing live satellite interviews with astronauts, program managers, and other Agency officials. Through increased availability of documentation and digital images, the Agency will provide scientists and the public greater access to NASA generated knowledge. For example, the Scientific Technical Information (STI) program offers the public easy access to results from basic applied research. The STI Program was established to support the objectives of NASA's missions and research and is a unique resource to scientists, engineers, technicians, and managers. The Agency will also improve the utility of NASA World Wide Web pages and ease of locating areas of interest, based on the public's demand. NASA will increase the opportunities for transferring technology to private industry and the public through the Internet using the *NASA TechTracS database*, by producing a series of technology publications, and by attending industry specific conferences and trade shows. The Agency involves the educational community in its endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds. This will be accomplished by providing opportunities for students and educators at all levels to become involved in our mission; providing excellent and valuable education programs and services as judged by our customer, the education community; increasing the number of sites that offer science and engineering curriculum to the underrepresented and minority students; and increasing the involvement of minority universities through sponsored research projects.

Changes from the FY 2002 to FY 2003 Plan reflect an effort to more accurately measure the Communicate Knowledge process. A few indicators were consolidated to avoid duplication and others were discontinued when we completed an activity.

The Objectives described in the NASA Strategic Plan for this cross-cutting process are:

- Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable
- Disseminate scientific information generated by NASA programs to our customers
- Transfer NASA technologies and innovations to private industry and the public sector
- Support the Nation's education goals

The Agency has defined 4 CK Annual Performance Goals for Fiscal Year 2003. Each goal has specific indicators that will provide a quantitative manner to measure performance. The goals are listed in the text that follows.

Strategic Goal: Ensure that NASA's customers receive information from the Agency's efforts in a timely and useful form.

Objective: Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable.

Public Benefit: American citizens can experience NASA in ways that are meaningful and useful to them, by participating in NASA supported events.

Annual Performance Goal 3CK1: Share the experience of expanding the frontiers of air and space with the public and other stakeholders by meeting 4 of the 5 indicators for this goal.

Indicators:

- Provide public access to a minimum of 1,200 events featuring traveling exhibits that showcase NASA programs, research efforts and technological discoveries; in addition to more permanent attractions easily accessible to the public at the visitor centers located at many NASA Centers across the United States.
- Increase the NASA-sponsored, -funded, and/or -generated Scientific Technical Information (STI) available to NASA, the scientific community, and/or the public by 15,750 new items.
- Agency officials and astronauts will convey clear information on NASA activities through the most used media in America: television, through no less than 30 live shots per month on average.
- NASA's activities and achievements will be chronicled and put into perspective for the American public through 10 new historical publications.
- Documents significant in the Agency's history will be made available to a larger audience by at least one new electronic document – a CD/ROM.

Strategic Goal: Ensure that NASA's customers receive information from the Agency's efforts in a timely and useful form.

Objective: Disseminate scientific information generated by NASA programs to our customers.

Public Benefit: The public will have greater access to increased, relevant and understandable scientific information that will enable them to share in the excitement of discovery.

Annual Performance Goal 3CK2: Inform, provide status, enthuse, and explain results, relevance and benefits of NASA's programs by meeting 2 of the 3 indicators for this goal.

Indicators:

- Effective use of the NASA Home Page to communicate knowledge about NASA's scientific and technological achievements to the public. Effectiveness will be rated by placing at least 150 stories about breaking news on science and technology discoveries.
- The History Office will create one additional on-line exhibit on the NASA History Web page.
- The History Office will meet the need for a timely and effective response to the public by meeting or exceeding 90% of the time a 15-day response standard.

Strategic Goal: Ensure that NASA's customers receive information from the Agency's efforts in a timely and useful form.

Objective: Transfer NASA technologies and innovations to private industry and the public sector.

Public Benefit: General and targeted members of the public can benefit economically as well as intellectually through clear, effective communications concerning the Agency's activities.

Annual Performance Goal 3CK3: Enhance communication about and dissemination of technologies available for commercial use, technologies that have been commercialized by industry, and increase accessibility to targeted industry sectors by meeting 2 of 2 indicators.

Indicators:

- Publish and distribute program specific publications, including 1 industry specific publication, to encourage and increase partnerships with targeted industry sectors and develop an effective marketing campaign to increase accessibility to targeted industry sectors where NASA can promote its technologies available for commercialization and acquire new readership from the public.

- Provide public and industry access to the TechTracS database which features approximately 18,000 updated and evolving new technologies; as well as technical briefs, diagrams, and illustrations.

Strategic Goal: Ensure that NASA's customers receive information from the Agency's efforts in a timely and useful form.

Objective: Support the Nation's education goals.

Public Benefit: The general public will have increased learning opportunities in science and technology fields through NASA sponsored programs.

Annual Performance Goal 3CK4: Using NASA's unique resources (mission, people, and facilities) to support educational excellence for all, NASA will support the Nation's education goals by meeting 3 of the 4 indicators for this performance goal.

Indicators:

- Provide excellent and valuable educational programs and services, maintaining an "excellence" customer service rating ranging between 4.3 and 5.0 (on a 5.0 scale) 90% of the time.

- NASA will involve the educational community in its endeavors, maintaining a level of involvement of approximately 3 million participants, which include teachers, faculty, and students.

- Increase the amount of funding for and participation of Minority Universities.

- Increase the number of refereed publications by Investigators and the number of research papers and presentations by students at Minority Universities, using FY02 as a baseline.

Verification/Validation

Due to the broad nature of the Communicate Knowledge crosscutting process, there is a broad array of methods to verify and validate the reported metric data. These methods include the following:

1) Monthly reports from Field Centers.

2) Automatic built in statistics gathering software (web statistics).

3) On-air records and reports from NASA Field Centers television producers.

4) Field Center reports and commercially acquired video monitoring report from Burrelles.

5) Count of publications (History Office).

6) General and targeted distribution of *Aerospace Technology Innovation*, *SPINOFF* annual report, and *Tech Brief* publications. Monitoring of electronic subscription request file, recorded print distribution request and inventory, and downloads from Website. Sponsorship of NASA technology exhibitions at targeted industry trade shows and reports of prospective partnerships.

7) Education Computer-aided Tracking System (EDCATS) has a multi-layered process to verify the accuracy and quality of the data collected.

    a) Each program manager has access to rollup reports and to raw data, which identify the total number of records, the name of the reporter or participant, and a summary of the data. Thus, duplicate records can be identified, checked, and removed or corrected, or missing data sets can be identified and the reporter notified that they must complete their reports.

    b) Each NASA-wide program manager and Center or Enterprise point of contact has access to a report which compiles all the records entered for their area of responsibility, so they can access the status of their specific program records and thus work with the program managers to correct errors or provide for missing reports. These "roll up" reports also provide data at a level of detail which permits the kind of visibility that can highlight implausible numbers so that action can be taken to make corrections where needed.

    c) The EDCATS Program Manager has access to all levels of data and checks the status of data at the program level regularly, working with Agency points of contact and/or program managers to ensure the quality of data. The EDCATS software developer also checks the data and informs the EDCATS Program Manager of anomalies or suspected problems.

8) *NASA TechTracS* - The authorization for release of new technology reports to the public is carried out by each Center's patent counsel and commercial technology office. A set of written procedures for this process is available upon request. The actual implementation of a release is controlled when the "release to public" data field in each Centers' *TechTracS* is set to "yes" by both the patent counsel and the commercial technology office. Access to this data field is tightly controlled by each Center.

9) The Contractor, as part of their report, collects metric data. A NASA representative of the STI Program Office, Principal Center for the STI Program, verifies improvements.

10) On-site visits.

11) Counters on the web pages, reports on the numbers of information requests, monthly activity reports, e-mails, memos, letters, press releases, publications, and the NASA History Program Review, which takes place each year. There is some limitation to

this data in the sense that the web page counters do not document why an individual accesses the web page.

12) Listings of events, activities and products are available on the Internet. The NASA Web site, http://www.nasa.gov/, is updated daily and provides to the general public information about the most interesting information about the Agency. This Web site is the "hub" for the other NASA Web sites and provides links to all other areas of the agency. For example, there is a link to the Space Science Web site, http://spacescience.nasa.gov/, an excellent location updated daily with the latest news, pictures of space, and education activities. In addition to links to the NASA enterprises, the main NASA Web site also contains links to areas such as the education programs, the history office, human resources, research opportunities, and business opportunities. The Education Programs Web site (http://education.nasa.gov/), for example, provides to the visitor user-friendly activity calendars, and educational products and resources. Each field center also offers a central Web site with numerous links to activities, events, and products specific to the area of excellence that distinguishes each Center.

13) Reports from the NASA Centers regarding their imagery additions for the year.

14) Data are collected from participants in Agency wide, Enterprise, and Center education programs via an on-line data collection system. Program participants have the opportunity to rate our programs by answering a series of questions including, would they recommend the program to others; how would they rate the staff; do they expect to apply what was learned; and was the program a valuable experience. The ratings provided on these questions are then used to create an "overall average for excellence."

MULTI-YEAR PERFORMANCE TREND

Communicate Knowledge

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00, and 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 99	FY 00	FY01
Annual Performance Goal and APG #	Produce 10 new publications chronicling and placing NASA's activities and achievements in perspective for the American public. Sponsor or co-sponsor one major scholarly conference. (CK9)	Produce 12 new historical publications chronicling and placing NASA's activities and achievements in perspective for the American public. (0C3)	Share the experience of expanding the frontiers of air and space with the public and other stakeholders by meeting 5 of the 6 indicators for this target. (1CK1)
APG Assessment	Blue	Green	TBD

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00, 01).

	FY 99	FY 00	FY01
Annual Performance Goal and APG #	Acquire 10,550 NASA-sponsored, -funded, and/or -generated report documents for the American scientific community and public, publish 26 issues of an electronic current awareness product to announce additions to the NASA STI database, and add 24,400 bibliographic/citation records to the online NASA STI data base describing scientific and technical publications available to the American public.(CK10)		
APG Assessment	Blue		

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00, 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #	Share the experience of expanding the frontiers of air and space with the public and other stakeholders by meeting 4 of the 5 indicators for this goal. (2CK1)	Share the experience of expanding the frontiers of air and space with the public and other stakeholders by meeting 4 of the 5 indicators for this goal. (3CK1)	
APG Assessment	TBD	TBD	

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00, 01).

	FY 02	**FY 03**	
Annual Performance Goal and APG #			
APG Assessment			

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #		The Office of Public Affairs is acquiring the capability to provide the media with digital, high-definition video when the broadcasting industry converts to digital broadcasting in the next decade. It will also add a searchable online digital version of the NASA Headquarters photo archive to the NASA Home Page. (0C12)	
APG Assessment		Green	

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00, and 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #		The Office of Public Affairs will open exhibits to new audiences. A series of new exhibits with updated information on the Agency's four Enterprises will begin circulation. New Internet sites to inform the public of exhibits available for loan will expedite the loan process and attract new audiences. Two NASA Centers will create new exhibits and renovate visitor facilities to attract and accommodate additional visitors. (0C13)	Captured in APG (1CK1).
APG Assessment		Green	TBD

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00, 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #			
APG Assessment			

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00, and 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #	Captured in APG (2CK1).	Captured in APG (3CK1).	
APG Assessment	TBD	TBD	

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00, and 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 99	FY 00	FY01
Annual Performance Goal and APG #		Maintain a baseline for live satellite interview programs of no less than 10 live shots per month. (0C19)	Captured in APG (1CK1)
APG Assessment		Blue	TBD

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00, and 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 99	FY 00	FY01
Annual Performance Goal and APG #		Maintain a baseline of 5 Video File elements per week, issuing raw video and animation daily on NASA TV. (0C20)	
APG Assessment		Blue	

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00, and 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #	Captured in APG (2CK1).	Captured in APG (3CK1).	
APG Assessment	TBD	TBD	

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00, and 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #	Captured in APG (2CK1).	Captured in APG (3CK1).	
APG Assessment	TBD	TBD	

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00 and 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #		Increase the NASA-sponsored, funded, or generated report documents for the scientific community and public from 11,600 to 13,920. (0C4)	Captured in APG (1CK1).
APG Assessment		Blue	TBD

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00 and 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #		Increase the nontraditional NASA-sponsored scientific and technical information through the NASA Image eXchange (NIX) digital image database from 300,000 in FY98 to more than 470,000 in FY00. (0C16)	Captured in APG (1CK1).
APG Assessment		Green	TBD

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00 and 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #		Captured in APG (3CK1).	
APG Assessment		TBD	

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00 and 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #			
APG Assessment			

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00 and 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #		The History Office will target high school students through the use of a History Day competition on "Science, Technology, and Invention." The contest is being conducted in concert with the History Day Organization, with co-sponsored teacher workshops at every NASA Center. (0C14)	
APG Assessment		Red	

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00 and 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #		The Office of Scientific and Technical Information Program plans to improve the NASA Image eXchange (NIX) meta-search engine accessing all NASA digital image databases, adding Quick-Time, video, animation, and browse categories on NASA's key topics of interest to customers. (0C6)	
APG Assessment		Green	

Strategic Objective: **:** Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00 and 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #			
APG Assessment			

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00 and 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #			
APG Assessment			

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00 and 01). Disseminate scientific information generated by NASA programs to our customers (FY02 and 03).

	FY 99	FY 00	FY01
Annual Performance Goal and APG #		Increase the number of searched pages in NASA Web space by 5% per year, relative to the FY99 baseline. (0C17)	Inform, provide status, enthuse, and explain results, relevance and benefits of NASA's programs by meeting 2 of the 3 indicators for this target. (1CK2)
APG Assessment		Blue	TBD

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00, 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02). Disseminate scientific information generated by NASA programs to our customers (FY03).

	FY 99	FY 00	FY01
Annual Performance Goal and APG #		Increase the capacity of the NASA Home Page to meet public demand by providing for a 5% per year increase in download capacity, using FY99 figures as a baseline. (0C18)	Captured in APG (1CK2).
APG Assessment		Blue	TBD

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00, 01). Disseminate scientific information generated by NASA programs to our customers (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #	Inform, provide status, enthuse, and explain results, relevance and benefits of NASA's programs by meeting 2 of the 3 indicators for this target. (2CK2)	Inform, provide status, enthuse, and explain results, relevance and benefits of NASA's programs by meeting 2 of the 3 indicators for this target. (3CK2)	
APG Assessment	TBD	TBD	

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY99, 00, 01). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02). Disseminate scientific information generated by NASA programs to our customers (FY03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #			
APG Assessment			

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY00).

	FY 99	FY 00	FY01
Annual Performance Goal and APG #		Provide the public with internal access to listings of (1) existing and upcoming communications events, activities, and products and (2) best communications practices within NASA. (0C7)	
APG Assessment		Red	

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY00, 01). Transfer NASA technologies and innovations to private industry and the public sector (FY02, 03).

	FY 99	FY 00	FY01
Annual Performance Goal and APG #		Provide publications that will communicate technologies available for commercial use and technologies that have been commercialized by industry to facilitate technology transfer. The three principal publications are *Innovations*, (12,000), *Spinoff* (50,000), and *Tech Briefs* (205,000), whose effectiveness will be measured by monitoring readership and frequency of use as a sources of reference. (0C21)	Ensure consistent, high-quality, external communication by meeting 2 of the 3 indicators for this target. (1CK3)
APG Assessment		Green	TBD

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY00).

	FY 02	**FY 03**	
Annual Performance Goal and APG #			
APG Assessment			

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY00, 01). Transfer NASA technologies and innovations to private industry and the public sector (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #	Ensure consistent, high-quality, external communication by meeting 3 of the 4 indicators for this goal. (2CK3)	Enhance communication about and dissemination of technologies that have been commercialized by industry and increase accessibility to targeted industry sectors by meeting 2 of the 2 indicators. (3CK3)	
APG Assessment	TBD	TBD	

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY00, 01). Transfer NASA technologies and innovations to private industry and the public sector (FY02, 03).

	FY 99	FY 00	FY01
Annual Performance Goal and APG #		Publish at least 1 industry specific *Aerospace Technology Innovation* issue per year. (0C22)	Captured in APG (1CK3).
APG Assessment		Blue	TBD

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY00, 01). Transfer NASA technologies and innovations to private industry and the public sector (FY02, 03).

	FY 99	FY 00	FY01
Annual Performance Goal and APG #		The Office of Aero-Space Technology's *Aerospace Technology Innovation* Publication will be targeting medical facilities for new readership, as well as the automotive industry for new technology transfer opportunities. The organization will attend the Society for Automotive Engineers annual tradeshow in Detroit, Michigan. (0C15)	
APG Assessment		Red	

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY00, 01). Transfer NASA technologies and innovations to private industry and the public sector (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #	Captured in APG (2CK3).	Captured in APG (3CK3).	
APG Assessment	TBD	TBD	

Strategic Objective: Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA programs (FY00, 01). Transfer NASA technologies and innovations to private industry and the public sector (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #	Captured in APG (2CK3).		
APG Assessment	TBD		

Strategic Objective: Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery (FY99, 00, 01). Transfer NASA technologies and innovations to private industry and the public sector (FY02, 03).

	FY 99	FY 00	FY01
Annual Performance Goal and APG #	Increase new technology opportunities from 19,600 to 19,700. These will be made available to the public through the NASATechTracs database and will be measured by monitoring a controlled data field that indicates the number of new technologies communicated to the public. (CK12)	Increase new opportunities to transfer technology developed at NASA to private industry from 19,600 to 19,800. These opportunities will be made available to the public through the NASATechTracs database and will be measured by monitoring a controlled data field that indicates the number of new technologies communicated to the public. (0C9)	Captured in APG (1CK3).
APG Assessment	Blue	Green	TBD

Strategic Objective: Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery (FY99).

	FY 99	FY 00	FY01
Annual Performance Goal and APG #	Increase the number of educators who participate annually in NEWEST/NEWMAST (the programs have been combined and are being called NEW-NASA's Education Workshops) to 500 from 400 in FY 98. (CK1)		
APG Assessment	Green		

Strategic Objective: Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery (FY99, 00, 01). Transfer NASA technologies and innovations to private industry and the public sector (FY02, 03).

	FY 02	FY 03	
Annual Performance Goal and APG #	Captured in APG (2CK3).	Captured in APG (3CK3).	
APG Assessment	TBD	TBD	

Strategic Objective: Highlight existing and Identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery (FY99).

	FY 02	FY 03	
Annual Performance Goal and APG #			
APG Assessment			

Strategic Objective: Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery (FY99).

	FY 99	FY 00	FY01
Annual Performance Goal and APG #	Increase the number of students reached through NEWEST/NEWMAST program to 42,000 students from 33,600 in FY 98. (CK2)		
APG Assessment	Green		

Strategic Objective: Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery (FY99, 00, 01). Support the Nation's education goals (FY02, 03).

	FY 99	FY 00	FY01
Annual Performance Goal and APG #	Maintain the participation level in Agency-wide educational programs at more than 1 million teachers and students. (CK3)	Seek to maintain a level of participation involvement of approximately 3 million with teachers, faculty, and students in the education community. (0C1)	Use NASA's ability to support meeting the Nation's education goals by meeting 3 of the 4 indicators for this target. (1CK4)
APG Assessment	Blue	Blue	TBD

Strategic Objective: Highlight existing and Identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery (FY99).

	FY 02	**FY 03**	
Annual Performance Goal and APG #			
APG Assessment			

Strategic Objective: Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery (FY99, 00, 01). Support the Nation's education goals (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #	Using NASA's unique resources (mission, people, and facilities) to support educational excellence for all, NASA supports the Nation's education goals by meeting 3 of the 4 indicators for this performance goal. (2CK4)	Using NASA's unique resources (mission, people, and facilities) to support educational excellence for all, NASA will support the Nation's education goals by meeting 3 of the 4 indicators for this performance goal. (3CK4)	
APG Assessment	TBD	TBD	

Strategic Objective: Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery (FY00, 01). Disseminate scientific information generated by NASA programs to our customers (FY02, 03). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #		Assist customers who use the STI Help Desk and the NASA Image eXchange (NIX) digital image database within a specific turnaround period. (0C10)	Captured in APG (1CK2).
APG Assessment		Green	TBD

Strategic Objective: Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery (FY00, 01). Disseminate scientific information generated by NASA programs to our customers (FY02, 03). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 99	**FY 00**	**FY01**
Annual Performance Goal and APG #		Support no less than 800 portable exhibit loans and send portable exhibits to a minimum of 175 targeted events per year. (0C11)	
APG Assessment		Blue	

Strategic Objective: Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery (FY00, 01). Disseminate scientific information generated by NASA programs to our customers (FY02, 03). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #			
APG Assessment			

Strategic Objective: Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to directly participate in space research and discovery (FY00, 01). Disseminate scientific information generated by NASA programs to our customers (FY02, 03). Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable (FY02, 03).

	FY 02	**FY 03**	
Annual Performance Goal and APG #		Captured in APG (3CK1).	
APG Assessment	TBD	TBD	

Communicate Knowledge FY 2003 Budget Link Table	**Budget Category**	Space Science*	Earth Science*	Biological and Physical Research*	HEDS*	Aero-Space Techology*	Academic Programs
Share the experience of expanding the frontiers of air and space with the public and other stakeholders by meeting 4 of the 5 indicators of this goal. (3CK1)		x	x	x	x	x	
Inform, provide status, enthuse, and explain results, relevance and benefits of NASA's programs by meeting 2 of the 3 indicators for this goal. (3CK2)		x	x	x	x	x	
Enhance communication about and dissemination of technologies available for commercial use, and technologies that have been commercialized by industry and increase accessibility to targeted industry sectors by meeting 2 of the 2 indicators. (3CK3)		x	x	x	x	x	x
Using NASA's unique resources (mission, people, and facilities) to support educational excellence for all, NASA will support the Nation's education goals by meeting 3 of the 4 indicators. (3CK4)		x	x	x	x	x	x
* The Enterprises also have specific APGs and indicators dealing with Communicating Knowledge.							