National Aeronautics and Space Administration

# 2006 NASA Strategic Plan

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Cover: On December 24, 1968, the Apollo 8 crew were the first humans to see Earth rise above the Moon's horizon. (Photo: NASA)

# Message from the Administrator

As NASA approaches its 50th year, we are proud to be the Nation's leading research and development organization in the fields of space and aeronautics. Together with our partners, we are using NASA's unique skills and capabilities to continue the American tradition of exploring and settling new frontiers for the benefit of humankind.

Two years ago, President George W. Bush gave NASA a defining challenge for the 21st century with compelling new objectives outlined in the Vision for Space Exploration. The Vision commits our Nation to a new journey of exploration of the solar system, beginning with the return of humans to the Moon by the end of the next decade, and leading to subsequent landings on Mars and other destinations, such as near-Earth asteroids.

The fundamental goal of the Vision is "to advance U.S. scientific, security, and economic interests through a robust space exploration program." NASA already is working to develop a new generation of spacecraft and launch vehicles that will enable the achievement of these goals within the modest expenditure of tax revenues—fifteen cents per day from the average citizen or seven-tenths of one percent of the federal budget—that our Nation invests in space exploration and research.

By pursuing the goals of the Vision for Space Exploration, NASA will contribute to American leadership in defining and pursuing the frontiers that expand humankind's reach, and we will help keep our Nation at the cutting edge of science and technology. We also will work with other nations to do those things that fulfill the dreams of humankind, dreams that always have included the desire to see what lies beyond the known world.

To ensure the success of the space program through generations to come, we must have simple, but compelling, long-term goals and a coherent, thoughtful plan to achieve them. This NASA Strategic Plan embraces the goals articulated in the Vision for Space Exploration and addresses our strategy for reaching them.

As we look forward to the events that will define this century, there is no doubt that the expansion of human presence in space will be among the great achievements of this era. We have the opportunity and the obligation to lead this enterprise, to explore worlds beyond our own, and to help shape the destiny of this world for centuries to come. I am proud that America, through NASA, will lead the way.

Michael D. Griffin
Administrator

# NASA's Mission and Vision

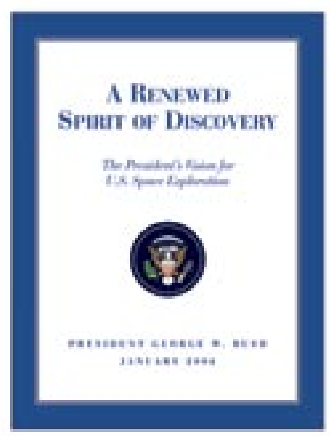
Congress enacted the National Aeronautics and Space Act of 1958 to provide for research into problems of flight within and outside Earth's atmosphere and to ensure that the United States conducts activities in space devoted to peaceful purposes for the benefit of humankind.  Nearly 50 years later, NASA proudly pledges that the Agency will continue the important work begun in 1958 by pursuing the American tradition of pioneering and exploration to redefine what is possible for the benefit of all humankind and by using NASA's unique competencies in scientific and engineering systems to fulfill the Agency's purpose and achieve NASA's Mission:

***To pioneer the future in space exploration, scientific discovery, and aeronautics research.***

On January 14, 2004, President George W. Bush announced *A Renewed Spirit of Discovery:  The President's Vision for U.S. Space Exploration*, a new directive for the Nation's space program.  The fundamental goal of this directive is "to advance U.S. scientific, security, and economic interests through a robust space exploration program."  In issuing it, the President committed the Nation to a journey of exploring the solar system and beyond: returning to the Moon in the next decade, then venturing further into the solar system, ultimately sending humans to Mars and beyond.  He challenged NASA to establish new and innovative programs to enhance understanding of the planets, to ask new questions, and to answer questions that are as old as humankind.

NASA enthusiastically embraced the challenge of extending a human presence throughout the solar system as the Agency's Vision, and in the NASA Authorization Act of 2005, Congress endorsed the Vision for Space Exploration and provided additional guidance for implementation.

NASA is committed to achieving this Vision and to making all changes necessary to ensure success and a smooth




The White House released *A Renewed Spirit of Discovery*, a new directive for the U.S. space program, on January 14, 2004.  This document laid the foundation for NASA's strategy to extend the frontiers of human exploration.

transition. These changes will include increasing internal collaboration, leveraging personnel and facilities, developing strong, healthy NASA Centers, and fostering a safe environment of respect and open communication for employees at all levels. NASA also will ensure clear accountability and solid program management and reporting practices.

Over the next 10 years, NASA will focus on six Strategic Goals to move forward in achieving the Vision for Space Exploration. Each of the six Strategic Goals is clearly defined and supported by multi-year Outcomes that will enhance NASA's ability to measure and report Agency accomplishments in this quest. (For a complete list, see Appendix: NASA's Strategic Goals and Outcomes.)

## NASA's Strategic Goals

**Strategic Goal 1: Fly the Shuttle as safely as possible until its retirement, not later than 2010.**

**Strategic Goal 2: Complete the International Space Station in a manner consistent with NASA's International Partner commitments and the needs of human exploration.**

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

**Strategic Goal 4: Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.**

**Strategic Goal 5: Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.**

**Strategic Goal 6: Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.**

# NASA's Strategic Goals: 2006 Through 2016

NASA's Mission Directorates and Centers will collaborate on an affordable, evolvable strategy to accomplish NASA's Strategic Goals. The Science Mission Directorate, through its robotic missions and space observatories, will continue to collect key data and provide stunning images of distant galaxies and planets in the solar system, including Earth. The Space Operations Mission Directorate will operate the Space Shuttle until its retirement and will manage completion and use of the International Space Station to ensure its continued availability as a unique space outpost and laboratory. The Exploration Systems Mission Directorate will develop future transportation systems and technologies to return humans to the Moon and to maintain a human presence in space. This Directorate, through its commercial and prize programs, also will stimulate new ideas and invite entrepreneurs to provide space capabilities from the private sector. The Aeronautics Mission Directorate will re-establish NASA's dedication to the mastery of core competencies in subsonic, supersonic, and hypersonic flight. This Directorate will develop system-level, multi-disciplinary capabilities to meet the needs of both civilian and military communities.

Missions to the International Space Station are yielding much information about the human impacts of long-duration space exploration. NASA and the International Partners are using this information to set the standards for longer missions to the Moon and Mars. Techniques demonstrated in robotics, assembly, and maintainability on the International Space Station will guide development of next-generation space vehicles that will fly farther, faster, and for longer duration.

NASA's lunar plans are coming into focus through the Exploration Systems Architecture Study. NASA soon will select a prime contractor to develop, test, and produce the Crew Exploration Vehicle. This vehicle will provide access to low Earth orbit and exploration destinations beyond for up to six people in a safe, affordable manner. The Crew Launch Vehicle project is developing the crew and cargo rockets of the future.

In 2004, the President charged NASA with the responsibility for planning and implementing an integrated, long-term robotic and human exploration program structured with measurable milestones and executed on the basis of available resources, accumulated experiences, and technology readiness. Congress endorsed this directive with two appropriations and the NASA Authorization Act. NASA will focus on six major Strategic Goals over the next 10 years to achieve this Vision of extending humankind's presence across the solar system, developing innovative technologies and promoting international and commercial participation in exploration to further U.S. scientific, security, and economic interests.

# Strategic Goal 1: Fly the Shuttle as safely as possible until its retirement, not later than 2010.

The Space Shuttle is the Nation's only human-rated launch vehicle. It also is the only vehicle in the world with the launch, return, and on-orbit capabilities needed to complete the planned assembly of the International Space Station.

The Vision for Space Exploration focuses the Shuttle program on completing assembly of the International Space Station, using as few Shuttle flights as possible, and retiring the Shuttle by 2010. NASA expects elements of the Shuttle's systems, including the external tank, solid rocket boosters, and main engines, to serve as the basis for future exploration systems that will carry crew and cargo to the International Space Station, the Moon, Mars, and beyond.

The Shuttle manifest through 2010 will assemble the International Space Station and, pending the results from the second return to flight test mission, the potential for a servicing mission to the Hubble Space Telescope. NASA's success in executing this manifest depends on the Agency's ability to safeguard critical Shuttle workforce, hardware, and infrastructure assets.

NASA will continue to ensure the safety of the Shuttle workforce, systems, and processes through an extensive engineering analysis and testing program supported by a rigorous and multi-layered review process. These processes include regular project and program-level reviews of ongoing analyses, tests, and mission activities. The NASA Office of Safety and Mission Assurance, the NASA Office of the Chief Engineer, the NASA Engineering and Safety Center, and the Aerospace Safety Advisory Panel will provide additional expertise and oversee or perform safety assessments for Shuttle program managers and senior Agency leadership.

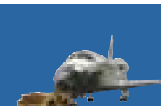
Astronaut Stephen Robinson photographed Shuttle *Discovery* as it was docked to the Destiny laboratory of the International Space Station during a spacewalk he conducted on August 3, 2005, as part of mission STS-114. (Photo: NASA)

Finally, a comprehensive Flight Readiness Review will provide Shuttle program and Space Operations Mission Directorate leadership with an opportunity to review the readiness of the Shuttle and its supporting assets prior to each launch.

Managing the retirement of the Shuttle is particularly challenging since NASA will conduct a series of complex International Space Station assembly and Hubble servicing missions using the Shuttle while simultaneously exploring and developing future transportation alternatives, including a new Shuttle-derived replacement transportation system. Simultaneous operations and development activities will require that NASA find new ways to use existing Shuttle workforce, hardware, and infrastructure assets efficiently and effectively. In conjunction with these activities, NASA will identify Shuttle capabilities required for new exploration systems and preserve them for potential future use. The Agency also will identify capabilities no longer required for near-term missions or future vehicle development so that their associated resources can be allocated to other investments and their important contributions to the history of human spaceflight can be recorded and preserved.

STS-121 second Return to Flight test mission (2006)

International Space Station assembly



Retire Shuttle fleet (no later than 2010)

# Strategic Goal 2: Complete the International Space Station in a manner consistent with NASA's International Partner commitments and the needs of human exploration.

This photograph of the International Space Station was taken during the Shuttle *Discovery*'s fly-around after it undocked on August 5, 2005. Visible are the Zarya module and the Zvezda Service Module. (Photo: NASA)

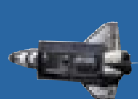
Completing assembly of the International Space Station is a vital part of NASA's program of exploration. The International Space Station demonstrates the utility of working with an international partnership on a permanently crewed platform in space and enables the Agency to develop, test, and validate the next generation of technologies and operational processes needed to continue exploring.

NASA will complete assembly of the International Space Station and meet the Agency's commitments to the International Partners. Once the Space Shuttle returns to flight, NASA will launch the remaining U.S. and International Partner elements. Before its retirement in 2010, the Agency also will use the Space Shuttle to carry spare equipment and other items to the International Space Station that are needed for maintenance and continued operations.

When the Space Shuttle returns to flight, NASA will return to supporting three-person International Space Station crews, then work to expand to larger crews as soon as feasible with a goal of providing the on-orbit capability to support a crew of six by the end of 2009. A six-person crew will be able to maintain and utilize fully the Space Station's capabilities. The size of the crew, however, is largely dependent on the capacity of the Space Station's life support systems. Over the next few years, NASA will deliver, fly, and test on-orbit the U.S. Regenerative Environmental Control and Life Support System, demonstrating a technology that will be vital for future exploration missions.

NASA will focus future International Space Station research primarily on supporting space exploration goals, looking particularly at how the space environment affects astronaut health. Researchers also will use this unique, orbiting laboratory environment to validate important science conducted in ground-based facilities.

Over the next year, NASA will develop plans for designating the U.S. segment of the International Space Station as a National Laboratory. In the long term, NASA will evaluate the costs and benefits of the International Space Station as an ongoing test bed in the space environment for exploration technology development and demonstration. The Agency will ensure that research on board the International Space Station matches exploration requirements.



Return to flight and three-phased Station assembly (through 2010)

Station utilization provides for exploration goals (2010 and beyond)

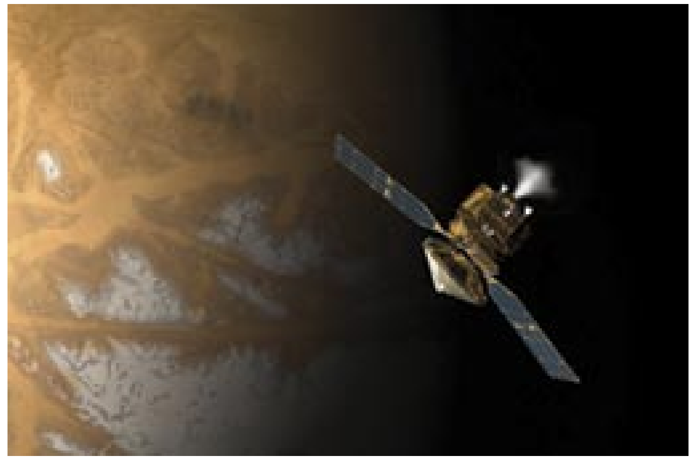
# Strategic Goal 3: Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.

The Vision for Space Exploration includes robotic exploration of planetary bodies in the solar system, advanced telescope searches for Earth-like planets around other stars, and the study of the origins, structure, evolution, and destiny of the universe. Other initiatives guide NASA's study of Earth from space and build on NASA's rich heritage of aeronautics and space science research.

In their endeavors to explore, researchers in aeronautics and astronautics, biomedical and physical sciences, Earth science, and space science will continue to develop new technologies and capabilities with the potential to benefit billions of people on Earth. In addition, the Vision for Space Exploration provides unprecedented opportunities for the United States to continue to lead peaceful and productive international partnerships in the world community.

Science both enables, and is enabled by, exploration. NASA's access to space makes possible research into scientific questions that are unanswerable by conventional means. Space-based telescopes observe the farthest reaches and earliest times in the universe. Robotic spacecraft travel to, land on, rove over, and even return from planetary bodies throughout the solar system. And, Earth-orbiting satellites keep watch over Earth, making regular observations of global change and enabling better predictions of climate, weather, and natural hazards.

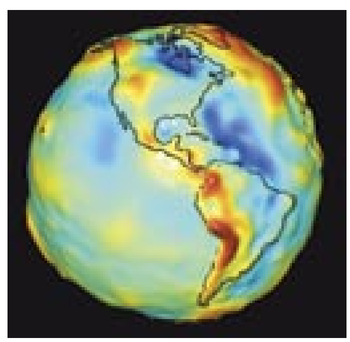
NASA also is the lead government agency for civil aeronautics research, and aeronautics remains a core part of the Agency's Mission. NASA's aeronautics research initiatives will expand the capacity and efficiency of the Nation's air transportation system and contribute to the safety, environmental compatibility, and performance of existing and future air and space vehicles. To achieve these objectives, NASA will reinvest in the Agency's inhous expertise to ensure that NASA retains the world-class skills, knowledge, and facilities needed to guarantee the Nation's innovative contributions to aeronautical challenges, both civilian and military. NASA will work with the White House Office of Science and Technology Policy to develop a national policy that articulates federal agency roles and responsibilities and guides the aeronautics research and development programs of the United States through 2020.



This artist's concept shows the Mars Reconnaissance Orbiter (MRO) during the critical process of Mars orbit insertion. To be captured into orbit, the spacecraft must conduct a 25-minute rocket burn just before reaching the planet. As MRO begins its insertion burn, it will pass under Mars' southern hemisphere, as shown here. (Image: NASA)

This Strategic Goal is broad and far-reaching. Therefore, NASA established six supporting Sub-goals to ensure a balanced focus.

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



This image was created using gravity field data from the Gravity Recovery And Climate Experiment (GRACE) twin satellites, launched in 2002, which study changes to Earth's gravitational fields over both land and sea. Red indicates the strongest gravity field; blue indicates the weakest. (Image: NASA)

Earth is changing on all spatial and temporal scales. The purpose of NASA's Earth science program is to develop a scientific understanding of Earth's system and its response to natural or human-induced changes and to improve prediction of climate, weather, and natural hazards.

Earth science is science in the national interest. While scientific discovery from space is inherent in the Agency's mission, NASA's programs in Earth science also are central to three important Presidential initiatives: the Climate Change Research Initiative, Global Earth Observation, and the Oceans Action Plan. NASA pioneers new global environmental observations and research, and works with other federal agencies to improve the operational services they provide to the Nation. These services include: weather forecasting; climate prediction; natural hazard assessment, prediction, and response; and environmental management, including air quality forecasting and land use assessment.

NASA recently completed deployment of the Earth Observing System (EOS), the world's most advanced and comprehensive capability to measure global climate change. Over the coming decade, NASA and the Agency's research partners will be analyzing EOS data to characterize, understand, and predict variability and trends in Earth's system for both research and applications. For example, NASA and the Agency's partners in the U.S. Climate Change Science Program are working to observe and model the uptake and release of carbon over North America—a science challenge that has important policy implications. NASA, the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Air Force, through the Joint Center for Satellite Data Assimilation, also are using EOS data to improve the weather and climate prediction models that produce routine weather forecasts and seasonal rainfall predictions.

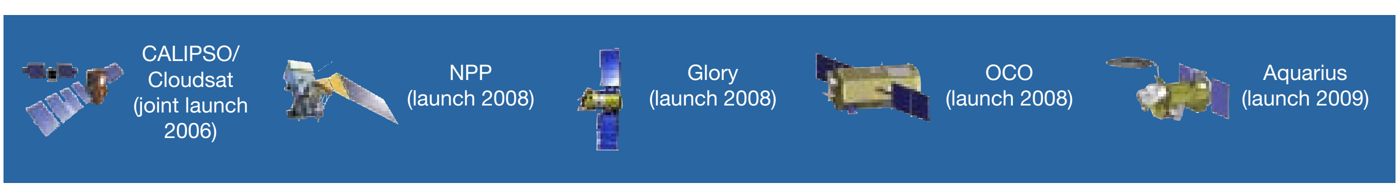
Over the next 10 years, NASA will deploy the next generation of advanced observing and research capabilities.

- Toward the end of this decade, the National Polar-Orbiting Operational Environmental Satellite System Preparatory Project (NPP) satellite will extend the data record of essential measurements begun by EOS and demonstrate new instruments for the Nation's future joint civilian and military weather satellite system.
- The Cloudsat and CALIPSO missions will use advanced radar and laser technologies to observe the three-dimensional structure of clouds and aerosol distribution, areas of high uncertainty in today's climate models.
- The Glory mission will help researchers characterize aerosol properties. Glory also will provide measurement continuity of the Sun's influence on Earth's climate system.
- The Global Precipitation Measurement (GPM) mission, an international constellation of satellites led by NASA and NASA's counterpart in Japan, will extend to global and more frequent coverage the observations demonstrated by the Tropical Rainfall Measuring Mission.
- The Ocean Surface Topography Mission (OSTM), a joint project with France, will take the next step toward an operational capability for ocean altimetry from space.
- The Orbiting Carbon Observatory (OCO) will take the first measurements of the global distribution of carbon dioxide, and the Aquarius mission will take the first global measurements of sea surface salinity, a key factor linking global ocean circulation and climate change.
- NASA and the U.S. Geological Survey will conduct a mission to secure near-term availability of Landsat-type data and will design a strategy for long-term data continuity.

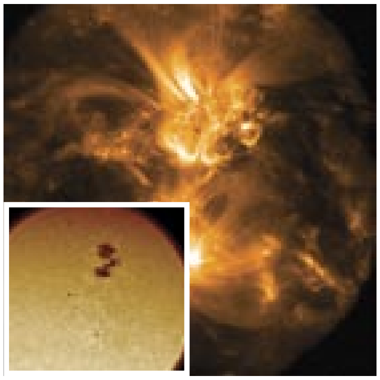
NASA's partnership efforts in global modeling and data assimilation over the next decade will shorten the distance from observations to answers for important, leading-edge science questions. NASA's Applied Sciences program will continue the Agency's efforts in benchmarking the assimilation of NASA research results into policy and management decision-support tools that are vital for the Nation's environment, economy, safety, and security. NASA also is working with NOAA and interagency forums to transition mature research capabilities to operational systems, primarily the polar and geostationary operational environmental satellites, and to utilize fully those assets for research purposes.

NASA also is working to advance radar, laser, and light detection and ranging technologies to enable monitoring of such key Earth system parameters as land surface, oceans, ice sheet topography, and global tropospheric winds that could lead to advances in weather and severe storm prediction.

(Note: NASA's priorities for Earth science through 2020 will be influenced strongly by the forthcoming decadal survey by the National Research Council.)



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



Large sunspots and their coronal structure observed by the Transition Region and Coronal Explorer (TRACE). Although sunspots can be observed by traditional telescopes from the ground, the solar corona can only be seen in extreme ultraviolet and X-ray wavelengths using instruments placed outside Earth's atmosphere. The million degree-hot bright coronal loops visible on the insert trace the magnetic field connecting two large sunspots and a cluster of pores. (Images: NASA)

Human life is linked to the behavior of the Sun, a star whose variability profoundly affects the viability of life on Earth. Changes in the Sun's long-term brightness cause ice ages, and the 11-year solar cycle of activity causes powerful flares and coronal mass ejections that impact Earth, disrupt telecommunications and navigation, threaten astronauts, damage satellites, and disable electric power grids. Research into the nature of solar activity and its effects on the solar system will help safeguard the journeys of robotic and human explorers.

Scientists are just beginning to understand the physics of the Sun–Earth connection. They have yet to understand the dynamo deep within the Sun, probe the intricate structures of its torrid atmosphere, and trace the complex responses of the solar system from the Sun to Earth. Such capabilities will provide insights into questions concerning how the system evolved, how it produced and sustains life, what will happen to this unique environment through the course of time, and how it will affect humankind.

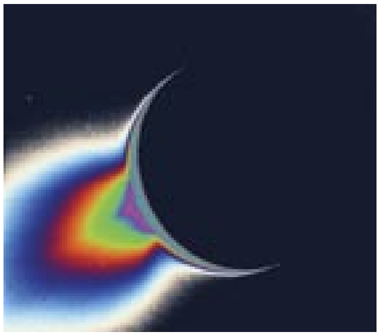
As society becomes increasingly dependent on space-based technologies, humankind's vulnerability to space weather becomes more apparent, and the need to understand and mitigate these effects becomes more urgent. NASA's objective is to understand and predict the causes of space weather by studying the Sun, the heliosphere, and planetary environments as a single, connected system.

To achieve this objective, NASA will open the frontier to space weather prediction by studying and understanding the fundamental physical processes of the space environment—from the Sun to Earth, to other planets, and beyond to the interstellar medium.

The following series of new missions will refresh NASA's multi-satellite Sun–Solar System Connection Great Observatory and improve prediction of hazardous events wherever explorers travel.

- During 2006, NASA will launch the Solar Terrestrial Relations Observatory (STEREO) mission and, in partnership with Japan, will use the Solar–B spacecraft both to observe how magnetic fields on the Sun's surface interact with the Sun's outer atmosphere and to track the evolution of solar disturbances from the Sun's surface to Earth.
- In 2006, NASA will launch the Aeronomy of Ice in the Mesosphere (AIM) Small Explorer mission to help scientists understand how and why the highest altitude clouds in the Earth's atmosphere form.
- NASA will use the Time History of Events and Macroscale Interactions during Substorms (THEMIS) mission to discover the mechanisms responsible for the explosive release of solar wind energy within Earth's geospace.
- In 2008, NASA will launch the Solar Dynamics Observatory (SDO) to observe the solar interior and to determine the causes of solar variability.
- In 2011, NASA's Radiation Belt Storm Probes and Geospace-Related missions will determine how space plasmas are accelerated to hazardous energies to enable predictions of changes in planetary radiation environments to protect space explorers.
- By 2013, NASA plans to launch the Magnetospheric Multiscale Mission to observe the fundamental processes responsible for the transfer of energy from the solar wind to Earth's magnetosphere and for the explosive release of energy during solar flares.

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



Backlit by the Sun, Saturn's moon Enceladus has a fountain-like plume of icy material that towers over the moon's south polar region. The greatly enhanced and colorized image, taken by the Cassini spacecraft during a July 2005 flyby, shows the extent of the fainter, larger-scale component of the plume. Scientists suspect that the plume is created by multiple jets arising from warm fractures in the region, indicating that the small moon is geologically active. (Image: NASA/JPL/Space Science Institute)

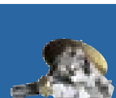
NASA explores the solar system with robotic science missions that cross vast distances and operate in alien and extreme environments. The results of such exploration help scientists understand how the planets formed, what triggered different evolutionary paths among worlds, and how Earth originated, evolved, and became habitable. The data also provide clues in the search for evidence of life and life's precursors. Robotic science missions extend knowledge and understanding and lay the groundwork for human exploration by making new discoveries, characterizing the environment, validating new capabilities, and delivering the infrastructure that will enable safe and effective human missions. Mars and the Moon are important research targets. They also are steppingstones to the vastly different planetary worlds beyond.

Researchers will learn how the Sun's family of planets and minor bodies originated. By the end of this decade, Cassini will complete its four-year mission at Saturn and will have returned data and imagery on the ringed planet and its major moons that will fuel discovery for years to come. The MESSENGER spacecraft will complete its global mapping of the planet Mercury, and the data collected should be sufficient to begin to answer questions about Mercury's core, magnetic fields, and the materials and volatiles at or near its surface. By 2020, NASA's New Horizons Pluto–Kuiper Belt mission will complete the first reconnaissance of Pluto and its moon, Charon, and begin the first visits to objects in the Kuiper Belt beyond Neptune. NASA will begin development of the next generation of robotic planetary explorers via the New Frontiers, Mars Scout, and Discovery programs.

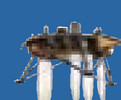
In the future, scientists will expand their understanding of the solar system's evolution to its current state and the processes that determined the history—and the future—of habitable worlds, including the origin and evolution of the Earth's biosphere and the character and extent of pre-biotic chemistry on other worlds like Mars. In 2006, NASA will begin analyzing comet particle samples from the Stardust mission, particles that may be the remains of materials that formed stars and planets, holding volatile, carbon-based rich elements that are likely to provide clues about the nature of the solar system's building blocks.

NASA scientists will explore the space environment to discover potential hazards and search for resources that would enable permanent human presence beyond Earth. As part of this process, they also must understand the processes that determine the fate of the solar system and life within it to determine if there is—or ever has been—life elsewhere in the solar system. To achieve these ambitious goals, NASA's Mars Reconnaissance Orbiter, launched in August 2005, will conduct a global reconnaissance of Mars over an entire Martian year (about two Earth years) to characterize the climate and geology of Mars and aid in the search for water. The Phoenix Mars Lander will measure volatiles, especially water and complex organic molecules, to uncover clues in the Martian arctic soils about the history of water and potential for habitability. Early in the next decade, the Mars Science Laboratory (MSL) will arrive on Mars to collect soil samples and rock cores and analyze them in situ for organic compounds and environmental conditions that are, or could have been, life-supporting.

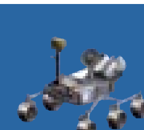
MESSENGER (launched 2005, first Mercury flyby 2008, orbit 2011)



New Horizons (launch 2006, arrive at Pluto 2015)



Phoenix Mars Lander (launch 2007, arrive at Mars 2008)



MSL (launch 2009, land on Mars 2010)

## Sub-goal 3D: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.

This infrared image taken by the Spitzer Space Telescope reveals towering pillars of dust, dubbed "Mountains of Creation," aglow with the light of embryonic stars, in white and yellow. (Image: NASA/JPL–Caltech/L. Allen, Harvard–Smithsonian CfA)

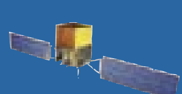
NASA pursues scientific exploration on its grandest scale and extends humanity's reach throughout the universe. The Agency uses space observatories, laboratory tests, and theoretical modeling to examine nature, expand scientists' understanding of the contents of the universe and the physical processes that govern their behavior, and answer fundamental questions: How did the Big Bang unfold? What happens at the edge of a black hole? What is causing the expansion and acceleration of the universe? How were stars and galaxies created? Are there other Earth-like planets? Does life exist elsewhere in the cosmos? Answers to these questions can come only by conducting observations and experiments above Earth's atmosphere. To reach this goal, NASA will conduct advanced telescopic searches for Earth-like planets and other habitable environments around nearby stars and explore the universe looking for clues to its origins, evolution, and ultimate fate.

NASA expands understanding of how the universe works and drives technical and engineering advances to create the great observatories that unlock the secrets of the stars. This effort benefits the scientific research community and the Nation's industrial base. It also excites the Nation's students about science and math and provides a natural way to foster increased interest in areas that are important to the country's future.

In the near future, researchers hope to use the James Webb Space Telescope (JWST)—NASA's next great observatory—to discover how the first stars and galaxies formed and how they changed over time to become the recognizable objects in the present universe. To do this, NASA will complete mission formulation activities, then begin construction of the JWST. NASA scientists will continue to study the formation and evolution of planetary systems using the Spitzer Space Telescope, and they will use the data it provides to study the frequency of protoplanetary dust disks to gain information about the likely lifetimes for planet-building within the disks.

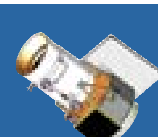
NASA will continue to explore the origin and destiny of the universe, study events around black holes, and pursue investigations about the nature of gravity. The Planck and Herschel missions, collaborations between the European Space Agency and NASA, will allow scientists to analyze remnants of the cosmic microwave background and study the far-infrared universe. Researchers will observe how black holes manipulate space-time and matter near the centers of galaxies using gamma-ray observatories like the Gamma-ray Large Area Space Telescope (GLAST), and they will use data from the Chandra X-ray Observatory to determine how matter interacts with the local environments of black holes of various sizes. The Beyond Einstein program will enable scientists to understand and explain what causes the expansion and acceleration of the universe. Researchers also will use these findings to study the physics of the space-time structure of the universe. Hubble Space Telescope observations, extended and augmented via a planned servicing mission, will help astronomers determine more precisely when the universe switched from decelerating to accelerating expansion rates and will provide a more quantitative picture of the ultimate fate of the cosmos.

NASA also is undertaking a series of missions designed to discover and study planets beyond this solar system. By the middle of the next decade, NASA plans to obtain key statistical information about the distribution of terrestrial planets using photometry of a large population of distant stars via the Kepler mission. NASA also will complete the activities necessary to prepare the Space Interferometry Mission (SIM) for implementation. The SIM project will search for Earth-like planets orbiting nearby stars and measure the precise positions of these stars to enable accurate mass determinations of any planets that orbit them.



GLAST
(launch 2007)

Kepler
(launch 2008)



WISE
(launch 2009)

## Sub-goal 3E: Advance knowledge in the fundamental disciplines of aeronautics, and develop technologies for safer aircraft and higher capacity airspace systems.

NASA's Aeronautics Research advances knowledge in core disciplines (e.g., fluid dynamics, chemistry, materials) up through integrated multidisciplinary system-level models, tools, and technologies to enable breakthroughs in Aeronautics. Understanding an aircraft's surface pressure distributions during transonic flight (shown) helps to improve flight performance and fuel efficiency. This solution was provided by the NASA Tetrahedral Unstructured Software System (TetrUSS) team. (Image: NASA)

The technologies that drove the first two waves in aeronautics growth in the last century—first in propeller aircraft, then in jets—led to today's National Airspace System, the hub-and-spoke commercial air carrier industry, and innumerable military, public service, and business aviation capabilities. All helped improve this country's quality of life and created prosperity for the Nation. However, the needs of the Nation now transcend available aviation solutions. Meeting current and future aviation needs will require dramatic improvements in capacity, environmental compatibility, flexibility, safety, and freedom of mobility.

Today, a third wave of aeronautics offers solutions to these challenges. This third wave is a radical technology shift built on fundamental aeronautics capabilities that will enable revolutionary change to both the airspace system and the aircraft that fly in it.

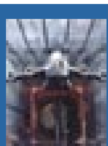
NASA is the Nation's leading government organization for aeronautical research. This world-class capability is built on a tradition of expertise in core disciplines. Beginning with theoretical insight, augmented by research and testing in the laboratory and in flight, NASA scientists and engineers have developed, and are using, a rich base of information, unique analytic tools, and their singular expertise to close the gap between empirical and abstract knowledge.

In recent years, the emphasis on transferring technologies to end-users shifted NASA's focus from long-term, high-risk, cutting-edge research to short-term technologies and "point solutions" to complex challenges. Today, NASA is restructuring the Agency's aeronautics programs to ensure long-term investments and fundamental research in both traditional aeronautical disciplines and relevant emerging fields that can be integrated into system-level, multi-disciplinary capabilities. This approach will enable both the civilian and military communities to build platforms and systems that meet their specific needs, including spaceflight.

Four key objectives are guiding the reshaped aeronautics programs: re-establishing NASA's commitment to mastery of core aeronautics competencies in subsonic (rotary and fixed wing), supersonic, and hypersonic flight; preserving the Agency's research facilities as national assets; focusing research in areas that are appropriate to NASA's unique capabilities; and directly addressing the needs of the Next Generation Air Transportation System (NGATS) in partnership with the Federal Aviation Administration (FAA) and other agencies. The NGATS, planned to be fully operational by 2025, is a multi-agency vision and plan to meet serious challenges facing the U.S. air transportation system.

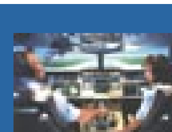
To reflect this reshaping, NASA is restructuring the Agency's three major aeronautics programs. First, the Vehicle Systems program is now the Fundamental Aeronautics program. NASA will invest heavily` in the core competencies of aeronautics in all flight regimes to produce knowledge, data, and design tools that are applicable across a broad range of air vehicles. This will include the continued stewardship of NASA's many aeronautics test facilities, including wind tunnels and propulsion test cells that are considered to be national assets.

Second, as the operation of the national airspace system transitions to the NGATS and higher capacity is achieved, new ways of achieving and assuring safety will be needed to reduce the rate of accidents and maintain a low rate of aviation fatalities. Through the Avia-



Ensure strategic facilities are available (by 2007)

improve prediction accuracy for existing aircraft behavior (by 2011)



Develop advanced flight deck capabilities for safety (by 2016) tion Safety Program (formerly the Aviation Safety and Security Program), NASA will pursue capabilities and technologies for improving safety consistent with the revolutionary changes in vehicle capabilities and changes embodied in the NGATS. The focus will be vehicle-centric, with areas of investigation that include advanced automation, advanced sensing and sensor/information fusion, and proactive approaches to achieving safety and assuring continued safe operations.

Finally, NASA is realigning the Airspace Systems Program to address the NGATS capacity and mobility requirements. NASA's primary research role will be to develop and demonstrate future concepts, capabilities, and technologies that will enable major increases in air traffic management effectiveness, flexibility, and efficiency while maintaining safety.

## Sub-goal 3F: Understand the effects of the space environment on human performance, and test new technologies and countermeasures for long-duration human space exploration.

Astronaut William McArthur, Expedition 12 commander and NASA International Space Station science officer, participates in Human Research Facility rack and workstation training in the Destiny laboratory mockup at Johnson Space Center in May 2005. Onboard the Station, the rack provides the equipment needed to conduct in-flight human health research. (Photo: NASA)

While researchers have learned a great deal about the effects of weightlessness on the human body during the human space missions to date, many questions remain unanswered, and the journey toward human exploration of Mars creates additional challenges. The International Space Station will continue to provide excellent preparatory experiences for the long-duration spaceflight required for missions to the Moon and Mars, and NASA's robotic exploration of Mars will continue to pave the way for human arrival. Still, one of the Agency's greatest challenges is to develop and deploy new capabilities and technologies that will support larger crews on the surface of the Moon and enable them to stay twice as long as before. In addition, new technologies must enable astronauts to "live off the land" (i.e., in situ resource utilization), reducing the amount of supplies needed by crews on lunar and Mars missions.

Space and its microgravity environment confront the human body with many challenges. They expose the body to different types of radiation; unused muscles may atrophy; and weight-bearing bones can lose calcium, potentially reducing bone density and increasing fracture risks. Therefore, NASA will develop and test candidate countermeasures to ensure the health of humans traveling in space and will investigate pharmaceuticals and other measures that may be useful in mitigating or eliminating the effects of extended-duration weightlessness. For example, scientists will complete the renal stone experiment ongoing on the International Space Station in search of ways to prevent renal stone formation in crewmembers. The Agency also will continue to rely on both ground-based and flight experiments for developing and testing other future countermeasures.

The most important requirement for a new crewed spacecraft is to keep the crew safe and healthy. Life support systems provide a breathable atmosphere and air circulation to prevent pockets of carbon dioxide from developing. These systems also remove excess humidity from the air, provide water for drinking, eating, and hygiene, remove harmful atmospheric contaminants, and maintain a comfortable temperature.

For short-duration missions or missions in low Earth orbit, existing technology is sufficient to provide life support for exploration crews. However, as mission duration increases and missions extend further into space, air and water must be recycled and waste must be minimized to reduce overall mission mass while not impacting crew health and performance. New technologies in carbon dioxide removal, potable water, and other vital systems will reduce overall systems mass while keeping crews healthy and productive.

Develop and test countermeasures to ensure crew health (by 2008)

Identify and test life support system technologies (by 2010)

Develop reliable spacecraft technologies for environmental monitoring, control, and fire safety (by 2010)

The lower overall pressures and greater oxygen percentages that are present in exploration vehicles on planetary surfaces (and in other closed spacecraft environments) increase the risk of fire.  NASA will protect and secure the safety of the crew more effectively by developing new spacecraft technologies to detect fire, quantify material flammability and fire signatures in reduced gravity, and monitor air and water for contamination.

NASA will conduct tests of new technologies on Earth and on the International Space Station as a basis for making informed decisions on future life support, human health maintenance, and reduced gravity countermeasures.  The International Space Station is akin to an Antarctic research station that is inhabited year-round in the most hostile environment on Earth.  But, unlike the Antarctic environment, about which extensive data on human survivability exists, the space environment is far less understood, and mysteries abound.  Therefore, NASA will prioritize research plans to ensure that International Space Station crews continue to be a valuable resource as operators and subjects for research on the most critical issues related to human health maintenance.

NASA also will develop and test technologies for power and autonomous systems that can enable more affordable and sustainable space exploration by reducing both consumables launched from Earth and the risks for mission operations.  Advanced power systems, including solar, fuel cell, and potentially nuclear power, will provide abundant power to a lunar outpost so that exploration will not be limited by the available energy.  Intelligent robotics will assist the crew in exploring, setting up, operating, and maintaining the outpost.  Autonomous systems will reduce mission risk by alerting the crew to impending failures, automatically reconfiguring in response to changing conditions and performing hazardous and complex operations.

# Strategic Goal 4: Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.

The current Space Transportation Systems—the Space Shuttle and existing expendable launch vehicles—are unsuitable for exploration beyond low Earth orbit. Therefore, the President and Congress directed NASA to develop new space transportation capabilities that will provide the Nation with the means to return humans to the Moon and eventually carry them to Mars. The initial capabilities, the Constellation Systems, include the Crew Exploration Vehicle (CEV), Crew Launch Vehicle (CLV), spacesuits and tools required by the flight crews, and associated ground and mission operations infrastructure to support low Earth orbit missions. NASA is targeting CEV and CLV operational availability for no later than 2014, however, the Agency will strive to bring that date as close to 2010 as possible as NASA achieves efficiencies and synergies between the Constellation Systems and the Space Shuttle programs.

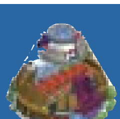
NASA envisions that the CEV and CLV will be evolutionary vehicles that use the best aspects of the Apollo and Space Shuttle systems (e.g., using the shape of the Apollo capsule as the basis for the shape of the CEV and using the proven Shuttle propulsion elements for the first stage of the CLV). NASA will develop the CEV and CLV using the Agency's rich resources of in-house and contractor expertise, leveraging the existing Space Shuttle workforce and infrastructure as much as possible.

The first part of the CEV is a pressurized Crew Module capable of carrying three to six astronauts, depending on mission requirements. Its Launch Abort System will provide emergency crew survivability in the event of a launch or early stage ascent mishap, and the Crew Module will incorporate a thermal protection system for re-entry and a Landing Attenuation System for dry-ground landing.

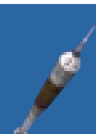

NASA's Crew Exploration Vehicle heads for a rendezvous with the International Space Station in this artist's concept. (Image: NASA/John Frassanito and Associates)

The second part of the CEV is the Service Module. The Service Module will provide propulsion for orbit correction, rendezvous, and de-orbit, as well as power, life support, and other essential functions. NASA also will develop the means to transport crew and cargo separately.

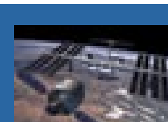
There are two launch vehicle projects: the CLV and the Heavy Lift Launch Vehicle (HLLV), each serving unique functions. The CLV will launch the CEV into orbit, and it will have cargo launch capabilities. The CLV will be operational no later than 2014. The HLLV, as currently envisioned, will launch cargo only and will provide the lift capability needed for transportation to the Moon no later than 2020, but as early as 2018.



Develop Crew Module
(no later than 2014,
but as early as 2010)

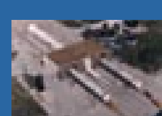


Develop CLV
(no later than 2014,
but as early as 2010)



Launch crew to the Station
(no later than 2014,
but as early as 2010)

Develop Service Module and
integrate with Crew Module
(no later than 2014, but as early as 2010)



Develop ground systems for payload
integration and launch services
(no later than 2014, but as early as 2010)

# Strategic Goal 5: Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.

Since the first commercial communications satellites were launched in the mid-1960s, the commercial space sector has grown into a multi-billion dollar industry that launches multiple commercial missions annually, including launches of NASA satellites and space probes on commercial launch vehicles.  With the recent success of the Ansari X-Prize and other ongoing private space efforts, the potential for the commercial space sector to engage new markets, especially those involving human spaceflight, is stronger than ever.

NASA will pursue collaborations that help expand the commercial space sector and support NASA's mission. By working with established commercial launch service providers and encouraging development of the emerging entrepreneurial launch sector through incentives like awarding prizes and intellectual property rights for their achievements in space technologies and systems, the Agency hopes to accelerate the growth of the commercial space industry.

Through the Agency's Commercial Crew/Cargo Project, NASA will pursue a two-phased approach to obtaining cost-effective commercial transportation services from Earth to the International Space Station and back.  First, the Agency will enter into agreements with one or more companies to demonstrate commercial crew and/or cargo transportation capabilities.  Then, once an orbital transportation capability is demonstrated (anticipated between 2008 and 2010), NASA will contract with commercial providers for transportation services to the International Space Station.

One of NASA's challenges is to expand the Agency's base of launch services providers to include emerging U.S. companies.  The current requirements for launching NASA payloads are designed to protect NASA's investment in Agency missions.  NASA payloads are often

A team demonstrates their concept for a robotic climber that could scale a 200-foot cable powered only by the beam from an industrial searchlight during the 2005 Beam Power Challenge. The challenge was part of NASA's Centennial Challenges.  Although none of the 11 teams won the challenge, the University of Saskatchewan Space Design Team had the farthest beam-powered climb, approximately 40 feet.  (Photo:  NASA/K. Davidian)

one-of-a-kind and of high value, so it is imperative that all reasonable measures be taken to assure launch success.  The NASA Launch Services Program is exploring ways to open the bidding process to a larger number of launch providers and help emerging U.S. launch providers gain experience to compete more successfully for future, high-risk missions.  By encouraging a more competitive market, NASA will help lower launch costs and provide a better return-on-investment to U.S. taxpayers.

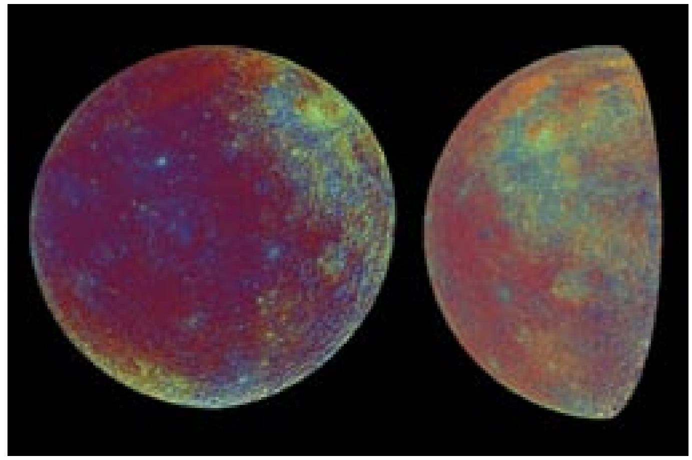
NASA also is encouraging the emergence of a U.S. commercial space sector through more creative, less traditional approaches. Historically, prize competitions like the Ansari X-Prize, the DARPA Grand Challenge, early aviation prizes, and the Longitude Prize, have stimulated innovative feats in private sector flight, engineering, science, and exploration.  NASA has initiated a series of small prizes for ground-based demonstrations of breakthroughs in various aerospace technologies.  However, the most rewarding prize competitions are for full flight systems that involve multiple technologies.  Therefore, by 2012, NASA plans to offer one or more prize competitions for independently designed, developed, launched, and operated missions related to space science or space exploration, like a soft lunar robotic lander, a propellant storage and transfer mission,

Internal Cargo—<br>Commercial or Progress<br>until CEV available<br>(earliest transition 2008)

External Cargo—<br>Commercial or HTV until<br>CEV available<br>(earliest transition 2009)

Crew—Commercial or<br>Soyuz until CEV available<br>(earliest transition 2010) a station-keeping solar sail, various suborbital launch achievements, and/or a human orbital flight. Although there is no guarantee that a breakthrough or winner will emerge from any particular prize competition, by encouraging multiple teams to compete for such system-level challenges, NASA hopes to encourage private sector breakthroughs across a broad range of technologies and designs.

# Strategic Goal 6: Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.



These color visualizations of the Moon were obtained by the Galileo spacecraft after completing its first Earth gravity assist, sending it on its journey to Jupiter, in December 8, 1990. The deep blue regions are relatively rich in titanium, while the greens, yellows, and light oranges indicate basalts low in titanium but rich in iron and magnesium. The reds (deep orange in the right picture) are typically cratered highlands relatively poor in titanium, iron, and magnesium. (Images: NASA)

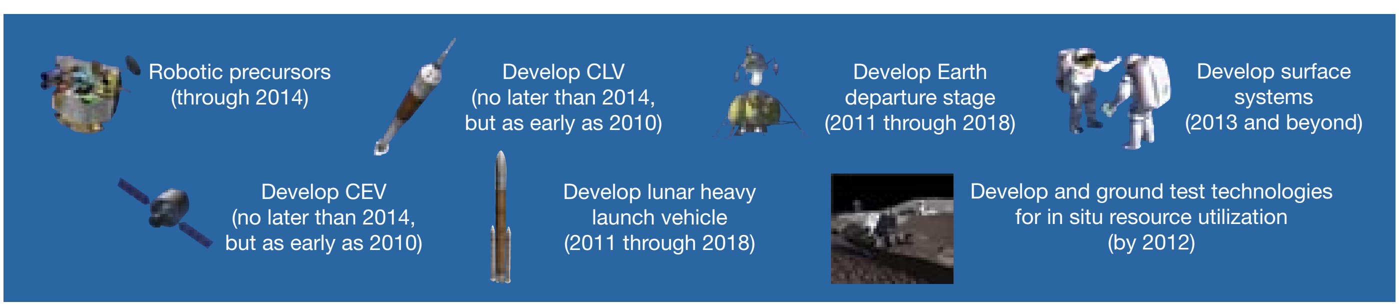
Transporting humans from Earth to the Moon and back in a sustainable, safe, and affordable manner will recapture the spirit of the Apollo program and ignite the Nation's excitement about space exploration as the United States takes the first major steps in preparing for future missions to Mars and beyond. However, missions to the Moon will be vastly different in this century. More crewmembers will land on the lunar surface with no limit on the location of the landing sites, and they will remain on the lunar surface for longer periods of time, exploring more of the lunar surface per trip than did their Apollo predecessors. Future explorers also will determine if lunar resources can be used to reduce the amount of supplies brought from Earth.

Initially, robotic missions will survey and characterize potential lunar landing sites, including sites that could become long-term lunar outposts. These robotic missions will include orbiters to provide total coverage of the Moon and take measurements to characterize the Moon's surface and the space environment in support of science objectives.

Prior to the first human mission back to the Moon, NASA will conduct studies to determine requirements for future missions through the Robotic Lunar Exploration Program (RLEP). By 2008, NASA plans to launch a Lunar Reconnaissance Orbiter. This mission is designed to carry six scientific instruments, orbit the Moon at a nominal altitude of 50 kilometers (31 miles), and have a mission lifetime of one year. Its orbit will provide coverage of the area near the lunar poles, since NASA's baseline exploration architecture calls for establishing a future lunar outpost at one of these locations.

NASA will develop and test technologies for in situ resource utilization so astronauts can "live off the land." In the long term, this capability will reduce the amount of supplies and consumables launched from Earth to the Moon, and eventually to Mars, making space exploration more affordable and sustainable. Technology development will include excavation systems, volatile material extraction systems, and other technologies to reduce logistics requirements for lunar habitats. In the future, in situ resource utilization systems also may be used to produce propellants and oxygen from lunar resources (regolith and potentially ice) to meet the needs of lunar outpost crews.

Since capable space communication is a prerequisite for future lunar and Mars missions, as well as robotic exploration of the solar system, NASA established an Agency-wide Space Communications Architecture Working Group (SCAWG) to address future communication



needs. The SCAWG is developing five-year “snapshots” of the space communication architecture, evolving from the present Deep Space Network, Space Network, and Ground Network to ensure the continued availability of space communication and navigation capabilities that exist today and to address deficiencies in that capability that must be resolved for the near-term lunar exploration program. In addition, the SCAWG is identifying both a suitable communication architecture for longer-term Mars exploration efforts and ways in which the lunar communication architecture can evolve smoothly through the next stage of exploration initiatives. To do this, the SCAWG is employing space communication and navigation expertise from across the Agency, as well as incorporating state-of-the-art technology inputs from industry to identify architectural options, evaluate the options against rigorous standards, estimate cost, and choose best-value space communication architecture recommendations for implementation.

Safe, efficient, plentiful energy is the key to robotic and human exploration. In low Earth orbit, fuel cells provide electricity for short-duration Space Shuttle missions. For long-duration flights, solar energy provides electricity to power life support systems, thermal control systems, computer and navigation systems, and scientific experiments. For future long-duration habitats on the Moon, and for long and short stays on Mars, reliable and plentiful energy is a priority requirement. While NASA will employ existing technologies for short-term lunar exploration, advanced capabilities in the form of nuclear surface fission power systems would enable longer stays on the Moon. Therefore, NASA plans to initiate a research and development program to develop nuclear technologies essential to achieving the goals of long-duration stays on the lunar surface and exploration of Mars. In the near-term, nuclear technology development will focus on developing a technology roadmap for fission surface power systems. An essential feature of this roadmap will be a clear path for selecting a fuel system and power conversion combination that will meet lunar exploration requirements and be adaptable to a Martian environment.

## NASA's Values

NASA is privileged to take on missions of extraordinary risk, complexity, and national priority. The Agency's employees recognize their responsibilities and are accountable for the important work entrusted to them. They strive to achieve an uncompromising standard of technical excellence in a healthy and safe environment.

The Agency's four shared core values support NASA's commitment to technical excellence and express the ethics that guide the Agency's behavior. These values are the underpinnings of NASA's spirit and resolve.

- **Safety:** NASA's constant attention to safety is the cornerstone upon which NASA builds mission success. NASA employees are committed, individually and as a team, to protecting the safety and health of the public, NASA team members, and the assets that the Nation entrusts to the Agency.
- **Teamwork:** NASA strives to ensure that the Agency's workforce functions safely at the highest levels of physical and mental well-being. NASA's most powerful tool for achieving mission success is a multi-disciplinary team of competent people. The Agency builds and values high-performing teams that are committed to continuous learning, trust, and openness to innovation and new ideas.
- **Integrity:** NASA is committed to maintaining an environment of trust built upon honesty, ethical behavior, respect, and candor. Building trust through ethical conduct as individuals and as an organization is a necessary component of mission success.

The Atlantis processing team gathers for a photo in July 2005 as the Shuttle is rolled over to the Vehicle Assembly Building at NASA Kennedy Space Center. (Photo: NASA)

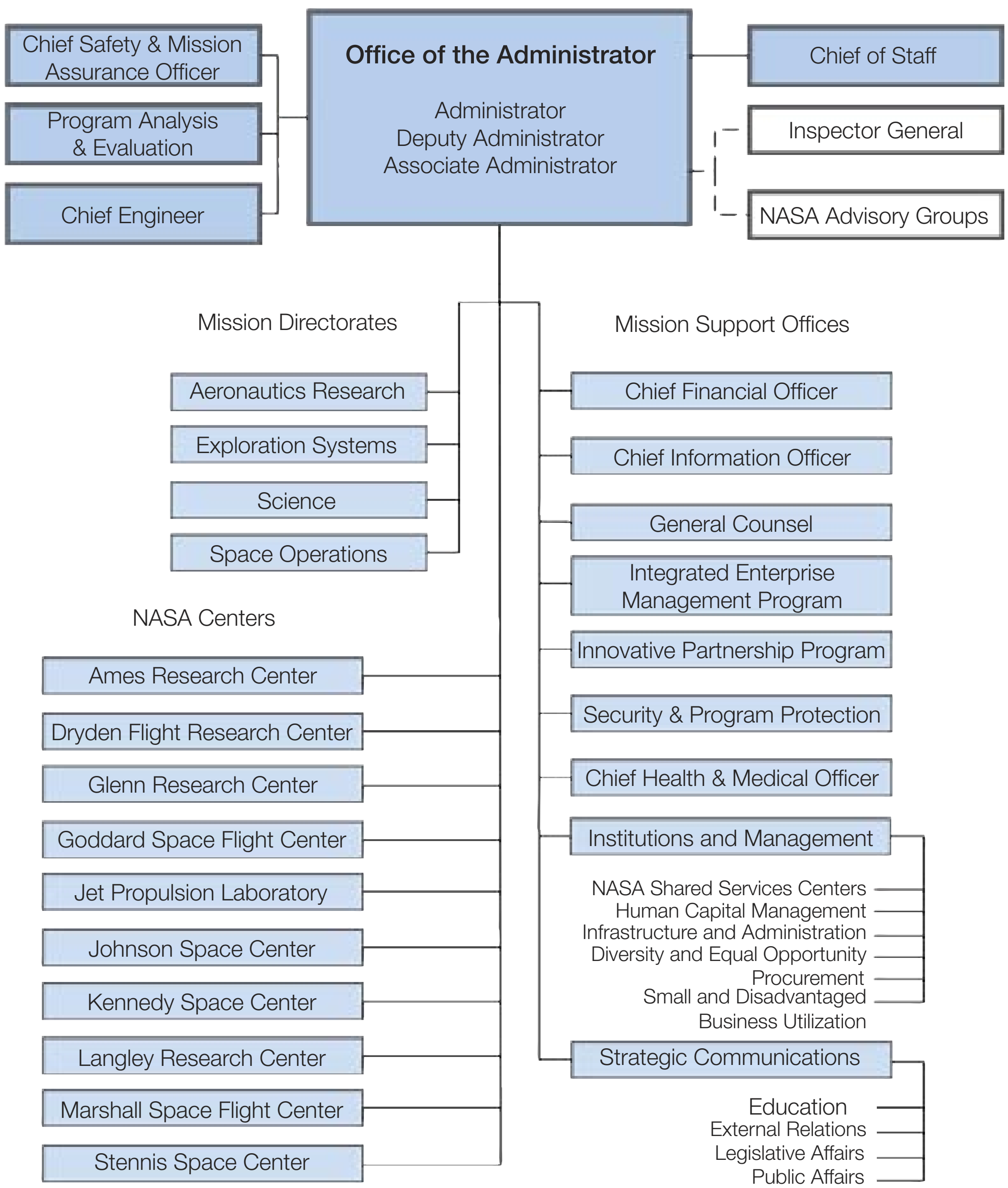
- **Mission Success:** NASA's purpose is to conduct successful space missions on behalf of the Nation and to explore, discover, and learn. Every NASA employee believes that mission success is the natural consequence of an uncompromising commitment to technical excellence, safety, teamwork, and integrity.

## NASA's Organization

NASA's organization is comprised of NASA Headquarters in Washington, D.C., nine Centers located around the country, and the Jet Propulsion Laboratory, a Federally Funded Research and Development Center operated under a contract with the California Institute of Technology. In addition, NASA has a wide variety of partnership agreements with academia, the private sector, state and local governments, other federal agencies, and a number of international organizations that create an extended NASA family of civil servants, allied partners, and stakeholders. Together, this skilled, diverse group of scientists, engineers, managers, and support personnel share the Vision, Mission, and Values that are NASA.

### NASA Headquarters

To implement NASA's Mission, NASA Headquarters is organized into four Mission Directorates.



- The **Aeronautics Research Mission Directorate** conducts research in aeronautical disciplines and develops capabilities, tools, and technologies to enable safe, reliable, capable, and efficient flight vehicles and aviation systems.
- The **Science Mission Directorate** carries out the scientific exploration of the Earth, Sun, solar system, and universe. Strategic missions are complemented by select, smaller, Principal Investigator-led missions, including ground and space-based observatories, fly-by spacecraft, orbiters, landers, and robotic and sample return missions. This Directorate also develops increasingly refined instrumentation, spacecraft, and robotic techniques in pursuit of NASA's science goals.
- The **Exploration Systems Mission Directorate** develops capabilities and supporting research and technology that enable sustained and affordable human and robotic exploration and that ensure the health and performance of crews during long-duration space exploration. This Directorate will develop the robotic precursor missions, human transportation elements, and life support systems for the near-term goal of lunar exploration.
- The **Space Operations Mission Directorate** directs spaceflight operations, space launches, and space communications and manages the operation of integrated systems in low Earth orbit and beyond, including the International Space Station. This Directorate also is laying the foundation for human missions to Mars and a human lunar outpost through using the International Space Station. This orbital outpost will continue to provide vital scientific and engineering information that will lead to more capable and safer future systems for human explorers. It is a superb test bed for technologies to sustain and enhance the lives of human space explorers.

The opportunities and challenges associated with achieving the Vision for Space Exploration are exciting. However, success requires that all parts of the Agency act as a team to make decisions for the common good, collaborate across traditional boundaries, and leverage the Agency's many unique capabilities in support of a single focus.

To help achieve the Agency's goals, NASA is transforming supporting functional organizations. These organizations focus on reducing risks to missions by using effective and efficient management strategies and operations. For example, NASA is using standard business and management tools to improve the effectiveness of cross-Agency operations. NASA has implemented standard practices in human capital management that support and encourage increased teamwork and Agency-wide perspectives. The Agency's practices in environmental stewardship are reducing long-term operations costs by decreasing environmental liability costs. And, the Agency is improving communication and information sharing so everyone in NASA can contribute more effectively.

## Building Strong, Healthy NASA Centers

Achieving the Vision for Space Exploration is a challenge requiring new and innovative roles, responsibilities, capabilities, and relationships throughout NASA. Mission success will depend not only on Agency program success, but also on building and maintaining a strong internal institution and infrastructure.

On December 13, 2005, NASA's Strategic Management Council proposed a set of attributes that will define strong, healthy Centers—Centers strategically positioned, configured, and operated to support NASA's Mission. These attributes represent performance expectations for NASA Centers to guide them toward successful management of the Agency's people, physical assets, and finances.

Attributes of strong, healthy Centers will include:

- Clear, stable, and enduring roles and responsibilities;
- Clear program/project management leadership roles;
- Major in-house, durable spaceflight responsibility;
- Skilled and flexible blended workforce with sufficient depth and breadth to meet the Agency's challenges;
- Technically competent and value-centered leadership;
- Capable and effectively utilized infrastructure; and
- Strong stakeholder support.

# NASA's Strategic Management Framework

In 2005, NASA published the *NASA Strategic Management and Governance Handbook*. This handbook describes the process and principles of strategic management at NASA and identifies the internal and external requirements that drive these key management principles. The handbook also describes Agency-wide, cross-cutting management strategies that support NASA's programmatic and institutional operations and guide the Agency's strategic investment decisions and performance.

NASA's goal is to achieve management and institutional excellence comparable to the Agency's technical excellence.

## NASA's Key Management Principles

### Lean Governance

NASA controls all strategic management processes through a governance structure consisting of three Agency-level management councils.

- The Strategic Management Council determines NASA strategic direction at the Vision and Mission levels and assesses the Agency's progress at these levels.
- The Program Management Council guides program and project performance and defines successful achievement of NASA's Strategic Goals and Outcomes.
- The Operations Management Council reviews and approves institutional plans.

Together, these councils ensure that NASA's programmatic and institutional decisions are integrated and visible. All other councils and boards are chartered for specific purposes and are time-limited.

### Responsibility and Decision-Making

Agency managers are responsible for making and executing decisions within their authorized budgets, schedules, and human and capital assets. Managers also are responsible for working across organizational lines to perform and ensure appropriate integration functions. In exceptional cases, at the request of the Administrator, special ad hoc teams or organizational elements will oversee integration issues that cross Mission Directorates, Mission Support Offices, and Centers.

### Sensible Competition

NASA uses competition to the maximum extent, consistent with the Competition in Contracting Act. NASA also maintains program management and systems engineering competencies within the Agency's civil service workforce. Because NASA most often builds one-of-a-kind systems rather than high-production units, it is essential to have strong in-house capabilities for the development phases of programs and projects. However, NASA will continue to engage prime contractors in the development of major systems, including launchers, upper stages, crew vehicles, and habitats, and to manage the interfaces between major systems.

### Balance of Power

NASA's mission success depends on integration and coordination of missions, programs, and projects that can be achieved only through a reasonable balance of power between Headquarters and Centers. Headquarters is responsible for providing the Agency's strategic direction, top-level requirements, schedules, budgets, and oversight of NASA's Mission. The Centers are responsible for executing the programs and projects.

### Checks and Balances

NASA uses a system of checks and balances for effective internal control and to ensure the successful achievement of missions, assigning proper levels of influence and action to different organizations. While program and project management focus on program execution, NASA's Chief Engineer maintains independent authority by setting technical requirements below the Mission Directorate-owned, top-level requirements. When there is any deviation from these lower-level technical requirements, the Chief Engineer has the authority to approve these deviations. The Office of Safety and Mission Assurance maintains responsibility for verifying program compliance through strategies, policies, and standards, and NASA's Mission Support Offices provide institutional checks and balances.

## NASA's Cross-Cutting Management Strategies

### Integrated Financial Management

NASA will direct Agency resources effectively and efficiently toward the priorities set forth by Congress and the President.

NASA's vision for integrated financial management pairs information with accountability and links the Agency's financial, programmatic, and institutional communities for mission success. Therefore, NASA will develop a culture that integrates financial decision-making with scientific and technical leadership by providing Agency leaders with timely, accurate, and useful information about where initiatives are and are not succeeding.

To achieve this objective, NASA is embarking on a set of Agency-wide initiatives to improve the Agency's financial performance and health. These initiatives reflect integrated responsibilities, activities, and commitments NASA-wide.

NASA's core financial management improvement initiatives will align the Agency's accounting practices—rooted in generally accepted accounting principles—with the Agency's strategic direction. NASA will revise accounting practices to reflect changes to accounting policies, including opportunities for simplification and the incorporation of new Office of Management and Budget (OMB) internal controls Agency-wide. NASA also will revise the Agency's budget process to link strategic program direction with resource allocation and to streamline the distribution of funds to mission programs. This process is planned for implementation with the Agency's FY 2007 budget.

To achieve the Agency's financial management objectives, NASA must capture, assign, track, and report accurately the millions of financial transactions recorded every year NASA-wide. In 2006, the Agency will update the accounting system implemented in 2003. This update will address system weaknesses noted in the Agency's financial audit, enhance NASA's ability to support management reporting, and drive accounting process improvements.

### Strategic Management of Information and Information Technologies

One of NASA's most valuable assets is the Agency's accumulated base of technical and scientific knowledge and information generated by NASA's research, science, engineering, technology, and exploration initiatives. Technology has increased the amount of information that NASA programs can produce, analyze, store, and interpret. Effectively managing, preserving, protecting, and disseminating this information across the Agency and externally to NASA stakeholders, including the public, is imperative for mission success. Therefore, NASA will plan, design, implement, and manage programmatic and institutional information systems and services that enable NASA's Mission and management objectives. NASA will meet the Agency's internal and external information needs, conforming to the highest standards of security and information management feasible, with the fewest number of systems possible.

To achieve these objectives, NASA will:

- Evaluate the Agency's information solution and service needs required for mission success against the current state by using the NASA Enterprise Architecture, identify any gaps, and formulate concepts and opportunities to fill the gaps;

- Apply best practices and portfolio management in the selection of initiatives and projects for information solutions and services that best meet NASA's priorities within resource constraints;
- Ensure cost, schedule, and performance success of initiatives and projects for information solutions and services by applying Agency policies and best practices for program and project management; and
- Protect the confidentiality, integrity, and availability of information and information systems based on the categorization of the information processed by, or stored within, NASA's information systems.

## Strategic Management of Human Capital

NASA's initiatives for the near and long term—retiring the Space Shuttle, completing the International Space Station, developing new transportation and associated launch and support systems, maintaining a robust science portfolio, and re-focusing the Agency's aeronautics program on technical excellence in core disciplines and research areas appropriate to NASA's unique capabilities make the Agency's human capital management challenge greater than ever.

NASA will develop and implement NASA-wide human capital management initiatives to ensure that the workforce has the right mix of skills and the right balance between civil service, contractor, and other components to achieve the Agency's Vision.

First, NASA will identify the workforce core competencies required to achieve the Vision for Space Exploration and implement effective Agency-wide recruitment, retention, development, and reshaping activities to ensure that sustains these competencies.

Second, NASA will implement initiatives to create a civil service workforce that is flexible and responsive to external and internal changes. For example, retiring the Space Shuttle will create a major transition phase for NASA as the Agency balances the workforce requirements of the Shuttle program and the workforce needs of new programs. Similarly, NASA must maintain, and where necessary develop, the technical skills required to support a vibrant aeronautics research program that leverages excellence in core disciplines with innovative tools, technologies, and capabilities critical to the Nation's civilian and military aeronautical communities.

Third, NASA will implement a succession management and leadership development strategy. Achieving the Vision for Space Exploration will require new leaders to replace those who will retire.

Finally, NASA will align individual efforts with mission objectives by using NASA Performance Management Systems to link individual performance expectations and results with organizational goals.

NASA remains committed to achieving these human capital management objectives in a climate that supports the safety and health of all NASA employees, both on and off the job.

## Strategic Management of Capital Assets

NASA's capital assets, including real property, land, buildings, facilities, roads, and utility systems, constitute a major capital investment and make this Agency the ninth largest federal government property holder. NASA owns more than 100,000 acres of real estate and approximately 5400 buildings and other structures totaling more than 44 million square feet. The current replacement value for NASA real property is over $23 billion.

NASA will continue to purchase, construct, and operate only those assets required to conduct NASA programs, maintain the Agency's core capabilities, and meet national responsibilities, fully leveraging Agency retained assets to increase their functionality in support of mission success. First, NASA will identify, evaluate, and address real property and other assets and requirements as an integral part of Agency planning activities. NASA will include real property, logistics, and environmental requirements and associated life-cycle costs in program and project budgets by ensuring that facility program and project managers, logistics managers, and environmental specialists participate as members of mission and program planning teams. The Agency will ensure that Mission Directorates and program managers review real property, logistics, and environmental requirements throughout program life cycles and address changing requirements as they occur. The Agency also will identify capability shortages and determine how they can be addressed to ensure that Agency-validated future capabilities are maintained. And, NASA will identify and eliminate redundant and excess real property capabilities and demolish or deconstruct unneeded facilities and equipment consistent with the requirements of the National Historic Preservation Act.

Second, NASA will seek alternative options to ownership of real property where feasible and economically viable, and alternative uses for Agency underutilized real property, including leasing and consolidation of functions. NASA will make full use of authorities that allow public/private agreements and cost sharing to sustain real property management capacity. NASA also will seek third-party financing and servicing opportunities and will market temporarily available capacities to non-NASA customers, divest real property when appropriate, and seek adaptive re-use of historical facilities wherever possible.

Third, NASA will sustain and revitalize its real property assets and purchase, construct, and/or operate new real property only when existing capabilities (including those owned by NASA and other external entities) cannot be used or modified cost-effectively. When construction is needed, NASA will use advanced technologies for master planning, design, construction, and facility operations to ensure that NASA facilities are built for sustainability, safety, security, and environmental soundness.

Finally, through the Agency's corporately-managed Shared Capability Asset Program, NASA will ensure that the Agency's unique, high-value research, test, and evaluation capabilities remain available to support missions that require them. NASA will identify and prioritize these critical assets and their associated human capital investments and make strategic investment decisions to replace, modify, or disposition them based on NASA and/or other national needs.

NASA will coordinate Shared Capabilities and Assets investments with overall real property management planning and execution initiatives to ensure that the needs of the four special classes of assets currently identified (wind tunnels, rocket propulsion testing, thermal vacuum test capability, and high performance computing) are considered in long-term planning. NASA will continue to assess requirements and performance of the asset classes and, over time, assets and/or asset classes may be added to, or withdrawn from, the Shared Capability Assets Program account based on Agency priorities and balance among the assets being considered.

## Environmental Management

Proactive, sound environmental management contributes to risk reduction, mission success, and lower environmental liability. Environmental management encompasses a wide range of activities: identifying and mitigating the environmental consequences of program and project activities; informing systems engineering decisions to enhance safety and minimize life-cycle costs; and correcting environmental damage from past operations. NASA addresses these activities as three strategic focus areas.

- **Direct Mission Support:** Environmental planning will be integrated into program and project planning efforts early in formulation. The National Environmental Policy Act process will be completed prior to taking any action that could have an adverse environmental impact or limit the choice of reasonable alternatives. NASA will work to ensure an adequate supply of essential materials and services needed to achieve the Agency's Mission that might be subject to increased demand, supply shortages, or increasingly stringent environmental regulation.
- **Proactive Risk Mitigation:** NASA will identify environmentally driven risks early and develop appropriate mitigation strategies to prevent adverse mission impacts. Continual risk identification, analysis, prioritization, and mitigation will enhance Agency capabilities by reducing NASA's overall exposure to institutional, programmatic, and operational risk.
- **Protection of Mission Resources:** NASA will pursue environmental initiatives that preserve, protect, and enhance mission resources. These initiatives will range from the efficient use of energy, water, and other resources to preserving the natural, cultural, and historic assets entrusted to the Agency and managing effective contamination clean-up initiatives to protect human health and the environment.

## Innovative Partnerships and Commercial Services

While NASA will continue to maintain strong internal science, technology, and engineering capabilities, the Agency also will develop portions of NASA's technology and capability portfolio by partnering with innovators in the commercial, academic, and other external sectors. Such partnerships, usually created through mechanisms other than those prescribed in the Federal Acquisition Regulation, offer the additional benefit of targeting companies that are non-traditional service providers to NASA.

The pool of innovators and potential partners has grown beyond large corporations and government-supported laboratories, so NASA must expand the Agency's ability to identify new technologies and technology sources. To achieve these objectives, NASA will use a variety of initiatives to engage potential innovators, including the Innovative Partnership Program, the Commercial Orbital Transportation Services project, and the Centennial Challenges Program, all of which will help connect NASA to communities of innovators and leverage resources for mutual benefits. These partnerships also will enable NASA to fine-tune Agency investments based on increased knowledge of external capabilities. In turn, NASA will demonstrate the Agency's commitment to being a reliable, stable, and responsive partner in joint innovation endeavors by enhancing opportunities for partner communities to interact with NASA and by minimizing bureaucratic obstacles to interactions and partnerships.

## Strategic Communications: Outreach to Stakeholders

NASA is committed to communicating with key partners and stakeholders, including elected public officials, the media, the public, academia, other government agencies, and international space agencies, to enhance understanding of the Agency's programs, policies, and plans and to advance the Nation's space program agenda. NASA's strategic communications initiatives include focused efforts in Legislative Affairs, Public Affairs, External Relations, and Education, coordinated Agency-wide to ensure a consistent NASA message.

NASA will continue to work and coordinate with the Agency's International Partners and other U.S. government agencies on matters related to space partnerships, new initiatives, and space policy. For example, NASA will continue meeting with the International Space Station partners to support continuing International Space Station operations and to endorse a final International Space Station configuration. The Agency also will continue coordination and outreach efforts with potential international partners by holding bilateral and multilateral meetings with foreign entities and by providing international conference support. Outreach efforts also may include development and negotiation of international agreements to support specific cooperative activities.

NASA will expand Agency-wide efforts to communicate the benefits of the U.S. space program to the U.S. public, decision makers, and stakeholders. NASA will focus on expanding outreach to the media and the public through special events, conferences, and exhibitions highlighting Agency initiatives and achievements, particularly in exploration. NASA also will expand the capabilities of NASA television to touch a wider and more diverse population.

Additional outreach efforts will include initiatives to maintain and expand NASA's Congressional relationships. Specifically, NASA will renew the Agency's focus on Congressional leadership and key caucuses and will dedicate special outreach efforts to Congressional

Inside NASA's International Space Station exhibit, "Space Station Imagination," an animatronic robot doubling as "Dr. Emily Richards" explains what it is like to live and work aboard the orbital outpost. The exhibit is housed inside two 48-foot trailers linked in an L-shape for easy public access. NASA operates the exhibit as part of its community outreach program, bringing the excitement of human space flight to communities around the United States. (Photo: NASA)

Members not serving on NASA committees of jurisdiction. In addition, NASA will enhance the Agency's intergovernmental affairs partnerships with state and local governments and increase efforts to reach the space industry and trade associations.

## Strategic Communications: Education Initiatives

NASA will continue the Agency's tradition of investing in the Nation's education programs and supporting the country's educators who play a key role in preparing, inspiring, exciting, encouraging, and nurturing the young minds of today who will manage and lead the Nation's laboratories and research centers of tomorrow.

In 2006 and beyond, NASA will pursue three major education goals:

- Strengthen NASA and the Nation's future workforce—NASA will identify and develop the critical skills and capabilities needed to ensure achievement of the Vision for Space Exploration. To help meet this demand, NASA will continue contributing to the development of the Nation's science, technology, engineering, and mathematics (STEM) workforce of the future through a diverse portfolio of education initiatives that target America's students at all levels, especially those in traditionally underserved and underrepresented communities.
- Attract and retain students in STEM disciplines—NASA will focus on engaging and retaining students in STEM education programs to encourage their


NASA volunteers help young visitors use extension arms to pick up and stack balls as part of an exhibit on the International Space Station's Remote Manipulator System, or Canadarm. The exhibit was part of Bright Futures, an event to introduce children to space exploration and to encourage an interest in science, technology, engineering, and mathematics, hosted by NASA's Johnson Space Center in August 2005. (Photo: NASA)

pursuit of educational disciplines and careers critical to NASA's future engineering, scientific, and technical missions.

- Engage Americans in NASA's mission—NASA will build strategic partnerships and linkages between STEM formal and informal education providers. Through hands-on, interactive educational activities, NASA will engage students, educators, families, the general public, and all Agency stakeholders to increase Americans' science and technology literacy.

As the United States begins the second century of flight, the Nation must maintain its commitment to excellence in STEM education to ensure that the next generation of Americans can accept the full measure of their roles and responsibilities in shaping the future.

## NASA's Strategic Planning and Performance Management System

NASA's planning and performance management system is key to strategic management at NASA. Through this system, NASA identifies the Agency's long-term strategic goals, near-term outcomes, and key performance measures, develops and implements plans to achieve these objectives, and continuously measures NASA's progress in reaching the Agency's goals. NASA managers use these tracked performance results as a basis for key investment decisions, and NASA performance data provides a foundation for both programmatic and institutional decision-making.

The National Aeronautics and Space Act of 1958 (as amended) established NASA's purpose. The President refocused the Agency's Vision in 2004, and Congress endorsed the Vision and provided additional guidance in the NASA Authorization Act of 2005. NASA's direction for the future is clear, and the Agency's six Strategic Goals affirm these priorities. But, staying on course to achieve the Vision, ensure that the efforts of every NASA organization and employee are tied directly to the Agency's strategic goals, continuously assess and document NASA's performance, making valid financial and performance data available to NASA decision-makers, and respond to external and internal requirements for performance assessments and recommendations will require an integrated system of policies, procedures, and tools.

NASA has in place such an integrated system to plan, monitor, assess, evaluate, and measure the Agency's performance, identify issues (including the status of resources), gauge the organization's overall health, and provide appropriate data and information to NASA decision-makers. NASA's system produces ongoing monthly and quarterly analyses and reviews, annual assessments in support of budget formulation, periodic program and special purpose assessments, and recurring and special reports to internal and external organizations. NASA also regularly responds to (and reports on) the Agency's internally and externally imposed performance planning measurement and reporting requirements (e.g., NASA's annual performance plan; reporting requirements of the Government Performance and Results Act; and Erasmus).

# NASA's External Advisors and Partners

## NASA's Advisors

NASA traditionally turns to accomplished citizens and world-class experts for independent advice and guidance on major program and policy issues. This tradition originated with NASA's predecessor organization, the National Advisory Committee for Aeronautics (NACA). Enacted by Congress in 1915, NACA became the Nation's premier aeronautical research institution and was governed by an advisory committee appointed by the President of the United States. The NACA "main committee" served as the board of directors, and a group of research advisory committees guided NACA research in specific areas.

With the establishment of NASA in 1958, the earlier NACA tradition of seeking independent judgment and guidance from scientific and technical experts in academia, industry, and other government agencies continued. For nearly 50 years, NASA has sponsored numerous advisory committees covering the full range of Agency programmatic activities, including aeronautics, space technology, space science and applications, Earth science, and human spaceflight.

Today, NASA relies primarily on four advisory bodies for independent assessments of Agency programs: the Aerospace Safety Advisory Panel, the NASA Advisory Council, the National Research Council of the National Academies, and the National Academy of Public Administration.

### Aerospace Safety Advisory Panel

The Aerospace Safety Advisory Panel (ASAP) is a senior advisory committee that reports to NASA and Congress. Congress established the ASAP after the Apollo 204 Command and Service Module spacecraft fire in January 1967 to advise the NASA Administrator on safety issues and hazards in NASA's aerospace program. On November 18, 2005, the NASA Administrator revised the ASAP charter to include an advisory role on issues related to implementing the Vision for Space Exploration and to expand the ASAP's safety review duties to include evaluating and advising the Agency on elements of NASA's safety and quality systems, including industrial and system safety, risk management and trend analysis, and management of these activities. The revised charter also requires that the ASAP give priority consideration to programs that involve the safety of human spaceflight. To achieve this, new ASAP members will continue to include individuals from academia, private industry, and other government agencies who are recognized for their expertise in safety, management, and engineering.

The ASAP consists of a maximum of nine members appointed by the NASA Administrator. Members serve for two years and may be reappointed by the Administrator for a maximum of six years. The ASAP designates one member to serve as Chairperson. NASA Headquarters provides a full-time NASA employee staff, including an Executive Director, to support the ASAP.

The ASAP meets quarterly and submits a quarterly report to the Administrator, although if the ASAP's findings are time critical, the findings can be reported immediately. The Administrator may ask the ASAP to conduct special studies, reviews, and evaluations. In these cases, the ASAP would submit its reports, comments, and/or recommendations within a specified timeframe.

### NASA Advisory Council

In 1977, NASA merged the Space Program Advisory Council and the Research and Technology Advisory Council to create the NASA Advisory Council (NAC). In 2005, the NASA Administrator revised the NAC and its sub-committee structure to enhance the NAC's advisory capabilities and communication with Agency program managers. The new NAC committees cover topics directly related to executing the Vision for Space Exploration: Exploration, Science, Aeronautics, Human Capital, and Audit and Finance. The revised NAC charter was signed by the NASA Administrator on October 21, 2005, and the Administrator selected new NAC members for their unique experience, expertise, knowledge, and ability to contribute to pioneering the future in space exploration, scientific discovery, and aeronautics research.

### National Academies and National Academy of Public Administration

The prestigious National Academies, specifically the Institute of Medicine and the National Research Council's Space Studies Board and Aeronautics and Space Engineering Board, regularly provide NASA with scientific assessments, decadel surveys, and technical analyses that are important sources of independent external advice to the Agency. NASA also seeks advice on improving effectiveness, efficiency, and accountability from the National Academy of Public Administration, an independent, nonpartisan, nonprofit organization chartered by Congress to improve government performance, and other highly reputed private sector and academic organizations.

## NASA's Partnerships for Progress

Since the Agency's creation, NASA has been able to take on challenging missions because stakeholders from industry, academia, other federal agencies, not-for-profit organizations, and international organizations have supported NASA and shared in the Agency's work. The National Aeronautics and Space Act of 1958 inspired these partnerships, and the Vision for Space Exploration is no less explicit in requiring innovative partnerships and collaborative commercial expansion.

NASA will maintain and expand partnership arrangements to meet the Agency's increasingly complex, diverse needs. For example, future robotic and human exploration of the solar system will require a rich array of partners including: the aerospace industry, prime contractors for the spacecraft and launch vehicles used in robotic solar system missions; non-profit corporations that manage numerous research institutes involved in robotic exploration; and international space agencies.

The benefit of partnerships is that NASA gains access to a wider variety of technologies than the Agency could develop in-house and can select from partner providers the specific technologies, capabilities, and services that best meet the Agency's goals, schedules, and budget constraints. NASA's partners also benefit from these relationships. For example, commercial providers have the opportunity to further develop technologies and services, like launch services for the satellite communications industry, that they could not afford without government support or would not pursue without the incentive of industry competition. This helps stimulate the commercial space industry while helping NASA achieve the Vision for Space Exploration.

### Federal Agency Partnerships

The safe execution of NASA missions depends on a number of partnerships between NASA, the Department of Defense (DoD), and other federal military and civilian agencies. For example, NASA maintains a number of standing communications agreements with DoD regarding Space Shuttle operations, including Memoranda of Agreement with the Air Force and the United States Space Command for launch range services in Florida and with Vandenberg Air Force Base in California for operations and maintenance and radio frequency interference analysis.

In functional areas, NASA has additional federal partners, including the General Services Administration, OMB, the Federal Facilities Council, and the White House Office of Science and Technology Policy. The collaborative outcome of these and other federal partnerships help NASA reduce risks to missions while complying with laws and federal regulations.

NASA has research and development agreements with several federal agencies, including the National Institutes of Health, DoD, the Department of Energy, the National

Science Foundation, and the Department of Agriculture. In addition, NASA has aeronautics partnerships with DoD and the FAA, and with the multi-agency Joint Planning and Development Office seeking to transform the Nation's air transportation system. NASA also partners with other agencies, including NOAA and the Environmental Protection Agency, to ensure that science results and data from NASA's Earth observing satellites are available to those agencies' decision support systems to improve the essential services they provide to the Nation.

NASA also participates in a number of integrated national programs, many of which implement major presidential initiatives, including the U.S. Integrated Earth Observation System (this Nation's contribution to the International Global earth Observation System of Systems) and the Ocean Action Plan. NASA is the largest contributor to the Climate Change Science Program, historically providing at least 60 percent of the funding identified with it (and with its predecessor, the U.S. Global Change Research Program).

Additional agreements between NASA and the U.S. National Geospatial-Intelligence Agency and other elements of the U.S. national intelligence community are put in place when required for unique mission support.

## International Partnerships

International cooperation is a significant component of NASA's activities. Currently, each of NASA's Mission Directorates includes some level of international involvement in its programs ranging from simple data exchange agreements to complex arrangements for development and operation of spacecraft missions.

The National Aeronautics and Space Act of 1958 established international cooperation as an objective of the Agency. To achieve this objective, NASA operates within broad U.S. government policies, including economic, scientific, and foreign policies, and has established Agency policy guidelines for international cooperation. Potential benefits of international cooperation include access to unique capabilities or expertise, increased mission flight opportunities, access to program-critical locations outside the United States, cost sharing, and building or reinforcing positive international relations among nations. Since its inception, NASA has concluded thousands of agreements with over 100 nations and international organizations.

The Vision for Space Exploration directs NASA to pursue opportunities for international participation in support of U.S. government exploration goals. As NASA implements the Vision, the Agency will continue discussions with existing International Partners in areas of mutual interest and also will seek to foster new international partnerships through a variety of bilateral and multilateral mechanisms.

The CALIPSO spacecraft is lowered toward the Lower Delta Payload Attach Fitting at the Astrotech Payload Processing Facility at Vandenberg Air Force Base, California. CALIPSO, a joint project of NASA and the French space agency Centre National d'Etudes Spatiales (CNES), will launch with the Cloudsat satellite in 2006. The satellites will fly in formation as part of the Afternoon Satellite Constellation, or "A-Train," to to provide a three-dimensional perspectives of how clouds and aerosols form, evolve, and affect weather and climate. (Photo: NASA)

## Private Sector Partnerships

NASA will expand and create partnerships with U.S. private industry to develop the Nation's new space transportation systems, infrastructure, and other technologies and capabilities. Using authorities granted by the National Aeronautics and Space Act of 1958, the

Agency plans to establish agreements with one or more companies to develop capabilities for commercial crew and cargo services to the International Space Station. Under the same authority, NASA has entered into agreements with private organizations to conduct prize competitions, and NASA guarantees payments to the winners of the competitions. The private organizations bear the burden of administering the competitions.

In the future, NASA's industry partnerships for aeronautics will shift from near-term, evolutionary procurements to collaborative, long-term, intellectual partnerships that can guide and support fundamental research and help NASA focus on long-term, stable investments in capabilities that benefit industry.

The Innovative Partnerships Program (IPP) will facilitate partnering with the U.S. private sector, and leverage private sector resources, to produce technologies needed for NASA missions. The IPP and NASA's Mission Directorates will identify new opportunities to adopt technologies developed through innovative psartnerships.

In addition, since NASA procures most of the instrumentation used for Earth and space science satellite missions from the private sector through peer-reviewed competitive processes, private sector scientists and engineers will continue to participate in NASA research, technology, and spaceflight projects based on their success in competition.

### Academic Partnerships

Much of the Nation's scientific expertise resides in academia, and NASA recognizes the vast capability in the Nation's universities. Therefore, the Agency will continue to form and maintain strong partnerships with academia through a variety of research and outreach initiatives. For example, NASA will continue to sponsor academic researchers to help conceive, implement, and use the data from NASA missions, and NASA will expand Agency partnerships with colleges and universities that contribute to replenishing the future scientific and engineering workforce available to NASA and industry.

## Program Evaluation Processes

NASA's external partners provide the Agency with excellent feedback on NASA programs to ensure program consistency with the Strategic Goals and Outcomes. In addition, NASA assesses the effectiveness of Agency programs using the Program Assessment Rating Tool (PART) developed for government-wide use by OMB. PART provides a rigorous and interactive methodology to assess program planning, management, and performance toward quantitative, outcome-oriented goals.

NASA submits one-third of the Agency's program portfolios (known as Themes) to OMB each year resulting in a complete NASA-wide assessment every three years. To date, NASA and OMB have conducted 17 PART reviews of NASA's programs. Accounting for shifts in the NASA portfolio as a result of the Vision for Space Exploration, these reviews encompass about 80 percent of the Agency's current programs. The remaining 20 percent will be reviewed in calendar year 2006.

NASA considers the PART findings in making decisions about future program structures and factors them into the Agency's strategy, budget, and performance planning and reporting cycles.

NASA and OMB will continue to work together to ensure that performance measures reflected in PART are consistent with the performance measures included in the Agency's annual performance plan and annual Performance and Accountability Report.

# External Challenges


NASA engages in research and exploration for the benefit of the American public. Achieving this objective depends on a changing equation of resources, results, technology support, national priorities, partnerships, market forces, and other variables. Therefore, NASA will pursue the Agency's Strategic Goals with dedication while remaining attuned to external factors beyond NASA's control.

## Legislative and Policy Framework

NASA is focused on achieving the Vision for Space Exploration while continuing strong programs of science and aeronautics research. Congress has demonstrated support for NASA's Vision through the NASA Authorization Act of 2005 and annual appropriations. NASA is implementing Congressional and Presidential priorities within the resources provided. Future resource decisions could affect NASA's ability to meet the Agency's goals and schedules.

## Economy and Public Support

NASA's Strategic Plan is based on the assumption that the economy will remain strong enough to support future Agency budgets and associated commercial activities. NASA also assumes continued public support for America's space program and honors this support by being accountable for performance, explaining Agency activities, sharing the results of NASA's exciting discoveries, transferring technology whenever possible, and keeping NASA's goals consistent with the Nation's needs. Changes in the strength of the Nation's economy or public support could affect NASA's ability to meet Agency goals.


Employees of Stennis Space Center's Applied Sciences Directorate help clean a coworker's house after Hurricane Katrina. During 2005, hurricanes affected the lives of NASA employees and contractors, damaged NASA facilities, and disrupted work schedules. Such acts of nature present unique challenges to NASA planning. (Photo: NASA)

## Changing Relationships with Other Nations

NASA welcomes new partnerships with other nations because they can enhance the Agency's ability to achieve NASA's Strategic Goals while also benefiting partner nations. However, NASA understands that international space agency partnerships do not exist in a vacuum; there are risks involved. Therefore, NASA will develop contingency plans that address the challenge of maintaining partnerships with other nations as world conditions and international relationships change.

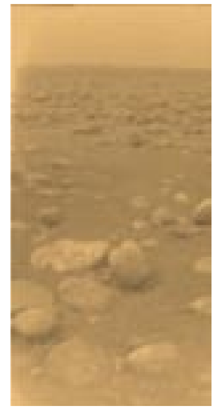
## National Security/Homeland Security

From the Agency's establishment, NASA has provided support to DoD and other federal and local agencies where there has been mutual interest in achieving a goal. For example, technologies developed for civil applications, like remote-sensing capabilities and aviation safety improvements, also can be utilized to meet certain civil and national security needs. The Nation's changing, and increasingly complex, security environment could have a significant impact on national priorities and, subsequently, on Agency programs. In the event of such a change, NASA could be called upon—and will be prepared—to redirect the Agency's expertise, capabilities, and technologies to homeland security initiatives.

## Markets

Space presents enormous future business opportunities. NASA-pioneered areas like communications satellite technology have led to profitable new industries. In the future, NASA will continue to pioneer and help commercialize new areas of space activity to maintain a strong U.S. position in this arena. Should space markets experience robust growth, NASA could benefit from the availability of low-cost services supporting space commerce. Alternatively, if launch markets decline, NASA could experience higher launch costs because the launch industry would have a smaller business base over which to spread fixed costs.

On January 14, 2005, the European Space Agency's Huygens probe, part of the Cassini–Huygens mission to Saturn and its moons, took a first-ever image of Titan's surface. Normally obscured by the moon's hazy atmosphere, the surface shown here consists of a mixture of water and hydrocarbon ice. There also is evidence of erosion, indicating possible fluvial activity. Many NASA missions yield unexpectedly rich or serendipitous results that may inspire new missions or redirect an area of science or technology development. (Image: NASA/JPL/ESA/Univ. of Arizona)



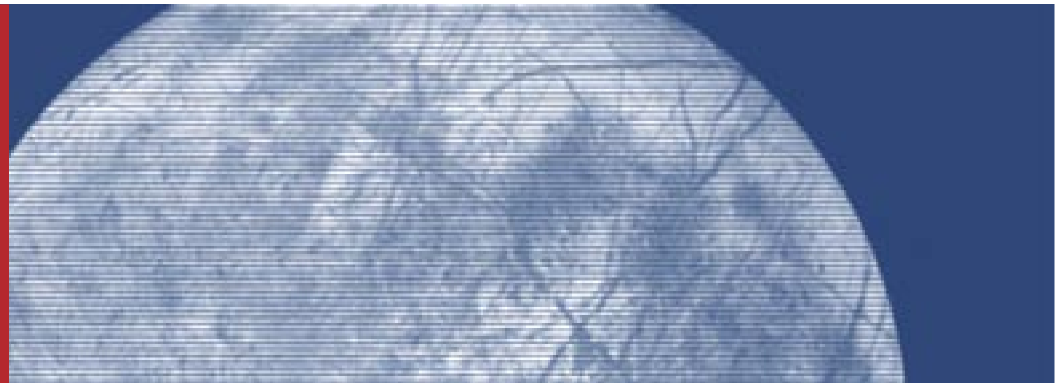
## Discovery

NASA's Strategic Goals constitute a balanced and feasible program for the future. However, new discoveries could change these goals. For example, a greater level of certainty about global warming could either relax or intensify concern about this phenomenon and diminish or increase support for the related goals. Discoveries of other unexpected phenomena could result in new goals drawing resources away from the current program. To cite perhaps the most extreme example, NASA is seeking evidence of life elsewhere in the universe. If the Agency finds such evidence, NASA would certainly need to reorient the Agency's Strategic Goals.

## Technology

Many of NASA's Strategic Goals rely on future technological breakthroughs, and the unpredictability of technological advances can either delay or accelerate the accomplishment of these goals. In addition, research and development efforts may yield unanticipated benefits that further or inspire other NASA goals and provide new technologies to assist industry and benefit the public.

# Scenarios for the Future:
## Looking Beyond 2016



NASA's Vision for the next ten years is clear: return the Space Shuttle to flight; complete the International Space Station; launch robotic missions to the Moon for long-duration stays in preparation for robotic and human exploration of the solar system and the universe; and return humans to the Moon's surface. In the years beyond that, NASA will continue its unique work in science and aeronautics to support the Agency's long-term goals of exploration and to improve the lives of humankind on Earth. The possibilities for future exploration and discovery are as vast as the frontiers of space.

## Exploration: Beyond the Moon to Mars

There will continue to be a close partnership between robotic and human exploration in the years ahead. Initial analyses suggest that NASA could begin to put into place the critical infrastructure in advance of human lunar landings, so robotics likely will complement human missions for logistics, communications, maintenance, and system status monitoring. Future robotic lunar missions also may be used to conduct technology demonstrations—for example, to extract volatiles and process them to useful materials like oxygen and/or hydrogen. In addition, developing a common lander may provide a utility available to international and

After a successful seven-day mission, the crew leaves the surface of the Moon in the upper part of the lander to dock with the orbiting capsule and return to Earth in this artist concept. NASA will use human lunar missions to test and further develop technologies, countermeasures, and capabilities needed to send humans to Mars. (Image: John Frassanito and Associates) commercial partners for more comprehensive site surveys, scientific measurements, and commercial proofs-of-concept.

Beyond 2016, technology development will demonstrate closed-loop life support technologies that reduce the logistics required for long-duration human space missions. In the area of human health, countermeasure development technology will expand to meet the need for, and evaluation of, countermeasures on the lunar surface. Data obtained on the International Space Station for crew health and performance will be coupled with data obtained from lunar mission crewmembers to enhance scientists' understanding of the demands of low gravity on the human body.

Getting to Mars will be a tremendous challenge, and NASA will require new technology solutions to support human missions to the Red Planet and beyond. Design reference missions using chemical propulsion systems postulate that NASA will need a very large spacecraft for a Mars mission, with the majority of mass going to propellants. Nuclear thermal propulsion systems offer a promising technological approach for providing a high-thrust, high-efficiency departure stage to transport astronauts to future destinations while reducing spacecraft mass.

Nuclear systems likely will play an important role in power systems capabilities beyond 2016. Deployment and utilization of nuclear systems on the Moon could directly enable scientific and human exploration of the Moon and operational understanding of the requirements of these systems for eventual exploration on Mars.

Building on successful demonstrations on the Moon, new technologies in in-situ resource utilization will allow future explorers to use the resources of Mars identified by previous robotic missions. Martian resources that will be useful in long-duration stays on the surface include carbon dioxide from the Martian atmosphere and expected sub-surface water ice and hydrated minerals to provide the essential components of breathable oxygen and rocket fuel for the return to Earth. Building upon early demonstrations of power systems, an electrical system could provide the energy to support explorers for up to 500 days on the Martian surface.

## Aeronautics

Closer to home, NASA will use the tools, capabilities, future concepts, and technologies developed through aeronautics research to help create the Next Generation Air Transportation System (NGATS), an air transportation system designed to provide greater efficiency, resource utilization, and mobility. The most convincing precursor to the NGATS is the U.S. military's future "net-centric" battlefield, with requirements for on-demand, distributed operations across foreign and domestic airspace. For civil operations, these advanced capabilities translate to the full use of the airspace across very different classes of aircraft, and ultimately spacecraft, with maximum versatility. At peak operation in today's airspace, over 4,000 aircraft are tracked continuously. In the NGATS, several thousand more aircraft could fly in U.S. airspace

The multi-agency Joint Planning and Development Office identified the capability requirements needed for NGATS, assigning key roles to the member agencies. NASA's research will help make NGATS possible by taking on some of the most technically challenging aspects of system transformation. The research spans critical technology for intelligent aircraft systems and advanced vehicle performance, including the next-generation control environment that integrates the complex data provided by satellites, the Global Positioning System, and digital data links, and forms the foundation for safety and capacity in the future. The unprecedented challenges faced in this transformation will require a focused and long-term commitment by NASA and its federal partners. (Image: NASA) at any one time without compromising safety and environmental compatibility standards.

It is not merely a dynamic, digital airspace that will empower the third wave of aviation, but also the integration of advanced sensors, intelligent and adaptive controls, powered-lift aerodynamics, low noise propulsion, lightweight and resilient structures, and other vehicle technologies. Revolutionary piloted and uncrewed vehicles will enable greater capacity and mobility as they are integrated with an airspace system that can adapt to constantly changing airspace conditions and the aircraft flying within it. These advances will yield critical capabilities for societal good and enhance the Nation's economy by creating markets for new applications and services that take advantage of these concepts and technologies.

Even though technology has improved powered flight over its 100-year history, physical unknowns remain a barrier to the mastery of flight. NASA is investing in fundamental aeronautics research, relevant emerging disciplines, and needed facilities to ensure that critical national capabilities are maintained for both civilian and military communities. Therefore, the aeronautics capabilities developed by NASA's researchers beyond 2016 will have a level of maturity and multi-disciplinary integration that will support an unprecedented ability to simulate and model physical systems in all flight regimes, including those related to space exploration. These key aeronautical capabilities can be applied to designs for high-speed vehicles that exit and enter Earth's atmosphere, as well as to those vehicles that will operate within atmospheres of other planetary bodies.

## Earth Science

Most of NASA's satellite observations of Earth to date have provided two-dimensional information about land, ocean surfaces, and atmospheric particulates, and limited three-dimensional information about Earth's atmospheric state, both physical and chemical. These observations are essential to detecting variability and trends, and they will be core pieces of the operational systems being developed by NASA's partner agencies. However, to understand fully the forces of Earth science change, researchers need three-dimensional views of land, ocean and ice sheet topography, atmospheric composition, coastal regions, forest canopies, and other phenomena. Detecting changes as they happen requires higher temporal resolution and sampling frequency than is possible from low Earth orbit. Therefore, NASA's long-term Earth science plan is to use sentinel orbits (e.g., Lagrange points, geostationary, and medium Earth orbit) and constellations of smart satellites as parts of an integrated, interactive "sensorweb" observing system that complements satellites in low Earth orbit, airborne sensors, and surface-based sensors. NASA will mature active remote sensing technologies (radars and lasers) to take global measurements of Earth system processes from low and geostationary Earth orbits.

As new types of Earth observations become available, information systems, modeling, and partnerships to enable full use of the data for scientific research and timely decision support will become increasingly important. The sensorweb observing systems of the future will perform satellite constellation management, automated detection of environmental phenomena, tasking of other elements of the observing network, on-board data processing, data transmittal, and data archival and distribution to users of Earth observations. The sensorweb will be linked to "modelwebs" of prediction systems enabled by NASA and formed by Agency partners to improve the forecast services they provide. NASA's investment in these areas (through such means as the Advanced Information Systems Technology program) will help the Nation take full advantage of enhanced information availability. In particular, the role of models in converting the satellite-produced information into useful products

This artist's concept depicts a future laboratory in which researchers will work with three-dimensional images of Earth derived from data collected by a comprehensive system of Earth-observing satellites and airborne and ground sensors. NASA is helping to make this future a reality to benefit the public. Data and research results from NASA's Earth science missions are used increasingly by other federal agencies to improve the essential services they provide to the Nation, including weather prediction, crop yield forecasting, hazard mitigation, and disaster assessment. (Image: NASA)

Looking billions of years back in time, the Hubble Space Telescope captured this image of galaxies and protogalaxies just after they formed. NASA's Great Observatories, including Hubble, the Spitzer Space Telescope, and the Chandra X-ray Observatory, look farther into the universe and further back in time than any missions before them, and they continue to deliver astounding and beautiful images. Next-generation space observatories will provide more capabilities, opening new windows to the universe. (Image: NASA/ESA/ The Hubble Heritage Team)

for environmental characterization and prediction will become more crucial.

## Understanding the Solar System

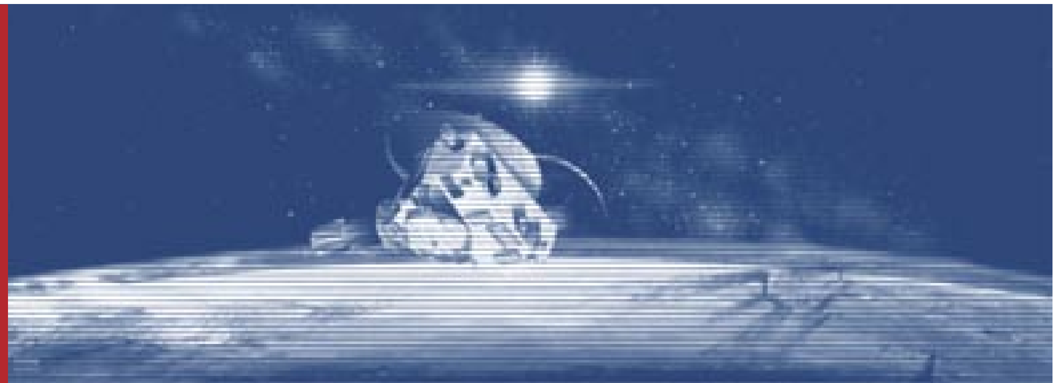
NASA's priorities for robotic solar system exploration beyond 2016 will be influenced by the National Research Council decadel survey. The goals in this time frame include: returning sample(s) from the surface of the Moon, Mars, and a comet; exploring Europa as a potentially habitable world; and further exploring Titan and the deep atmosphere of one of the outer gas giant planets in the solar system.

NASA accomplishes solar system planetary exploration through a balanced program of both strategic missions and competitively selected flight missions. The Discovery program of small missions (under $425 million) is designed to make new selections every 24 to 36 months, and the Mars Scout program (greater than $500 million) makes selections approximately every 52 months—every other launch opportunity for Mars. The New Frontiers program of medium class missions (greater than $700 million) targets a new selection every three to four years, and the goal for flagship missions is to launch once each decade, as budgetary constraints allow.

## Exploring the Extremes of the Cosmos and the Search for Earth-like Worlds

With the next generation of space observatories in place, including the James Webb Space Telescope and the Space Interferometry Mission, NASA will be poised to unfold many mysteries of the universe and study Earth-like worlds. Some future missions will open new windows on the universe by detecting gravitational waves directly while others will provide a more detailed examination of the many high-energy X-ray phenomena of the universe. Future planet-finding missions will seek to observe directly and characterize those planets as part of NASA's quest to find habitable worlds outside the solar system.

# Appendix:
## NASA's Strategic Goals and Outcomes

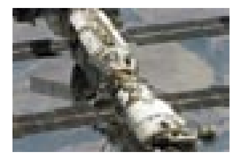


Each of NASA's six Strategic Goals is clearly defined and supported by sub-goals (where appropriate) and multi-year Outcomes that will enhance NASA's ability to measure and report Agency accomplishments.

*Strategic Goal 1: Fly the Shuttle as safely as possible until its retirement, not later than 2010.*

1.1. Assure the safety and integrity of the Space Shuttle workforce, systems and processes, while flying the manifest.

1.2. By September 30, 2010, retire the Space Shuttle.



*Strategic Goal 2: Complete the International Space Station in a manner consistent with NASA's International partner commitments and the needs of human exploration.*

2.1. By 2010, complete assembly of the U.S. On-orbit Segment; launch International Partner
elements and sparing items required to be launched by the Shuttle; and provide on-orbit
resources for research to support U.S. human space exploration.

2.2. By 2009, provide the on-orbit capability to support an ISS crew of six crewmembers.

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

### Sub-goals

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

3A.1. Progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition.

3A.2. Progress in enabling improved predictive capability for weather and extreme weather events.

3A.3. Progress in quantifying global land cover change and terrestrial and marine productivity, and in improving carbon cycle and ecosystem models.

3A.4. Progress in quantifying the key reservoirs and fluxes in the global water cycle and in improving models of water cycle change and fresh water availability.

3A.5. Progress in understanding the role of oceans, atmosphere, and ice in the climate system and in improving predictive capability for its future evolution.

3A.6. Progress in characterizing and understanding Earth surface changes and variability of Earth's gravitational and magnetic fields.

3A.7. Progress in expanding and accelerating the realization of societal benefits from Earth system science.

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

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

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

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

*Sub-goal 3C: Advance scientific knowledge of the solar system, search for evidence of life, and prepare for human exploration.*

3C.1. Progress in learning how the Sun's family of planets and minor bodies originated and evolved.

3C.2. Progress in understanding the processes that determine the history and future of habitability in the solar system, including the origin and evolution of Earth's biosphere and the character and extent of prebiotic chemistry on Mars and other worlds.

3C.3. Progress in identifying and investigating past or present habitable environments on Mars and other worlds, and determining if there is or ever has been life elsewhere in the solar system.

3C.4. Progress in exploring the space environment to discover potential hazards to humans and to search for resources that would enable human presence.

*Sub-goal 3D: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.*

3D.1. Progress in understanding the origin and destiny of the universe, phenomena near black holes, and the nature of gravity.

3D.2. Progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects recognized in the present universe.

3D.3. Progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems.

3D.4. Progress in creating a census of extra-solar planets and measuring their properties.

*Sub-goal 3E: Advance knowledge in the fundamental disciplines of aeronautics, and develop technologies for safer aircraft and higher capacity airspace systems.*

3E.1. By 2016, identify and develop tools, methods, and technologies for improving overall aircraft safety of new and legacy vehicles operating in the Next Generation Air Transportation System (projected for the year 2025).

3E.2. By 2016, develop and demonstrate future concepts, capabilities, and technologies that will enable major increases in air traffic management effectiveness, flexibility, and efficiency, while maintaining safety, to meet capacity and mobility requirements of the Next Generation Air Transportation System.

3E.3. By 2016, develop multidisciplinary design, analysis, and optimization capabilities for use in trade studies of new technologies, enabling better quantification of vehicle performance in all flight regimes and within a variety of transportation system architectures.

3E.4. Ensure the continuous availability of a portfolio of NASA-owned wind tunnels/ground test facilities, which are strategically important to meeting national aerospace program goals and requirements.

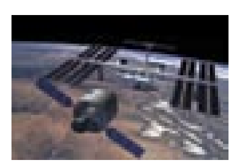
*Sub-goal 3F: Understand the effects of the space environment on human performance, and test new technologies and countermeasures for long-duration human space exploration.*

3F.1. By 2008, develop and test candidate countermeasures to ensure the health of humans traveling in space.

3F.2. By 2010, identify and test technologies to reduce total mission resource requirements for life support systems.

3F.3. By 2010, develop reliable spacecraft technologies for advanced environmental monitoring and control and fire safety.

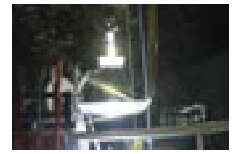
*Strategic Goal 4: Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.*



4.1. No later than 2014, and as early as 2010, transport three crewmembers to the International Space Station and return them safely to Earth, demonstrating an operational capability to support human exploration missions.

4.2. No later than 2014, and as early as 2010, develop and deploy a new space suit to support exploration, that will be used in the initial operating capability of the Crew Exploration Vehicle.

*Strategic Goal 5: Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.*

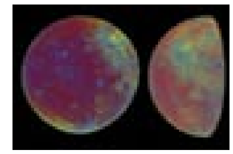


5.1. Develop and demonstrate a means for NASA to purchase launch services from emerging launch providers.

5.2. By 2010, demonstrate one or more commercial space services for ISS cargo and/or crew transport.

5.3. By 2012, complete one or more prize competitions for independently designed, developed, launched, and operated missions related to space science or space exploration.

*Strategic Goal 6: Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.*



6.1. By 2008, launch a Lunar Reconnaissance Orbiter (LRO) that will provide information about potential human exploration sites.

6.2. By 2012, develop and test technologies for in-situ resource utilization, power generation, and autonomous systems that reduce consumables launched from Earth and moderate mission risk.

6.3. By 2010, identify and conduct long-term research necessary to develop nuclear technologies essential to support human-robotic lunar missions and that are extensible to exploration of Mars.

6.4. Implement the space communications and navigation architecture responsive to Science and Exploration mission requirements.

## Cross-Agency Support Programs

### Shared Capability Assets Program

Outcome SC-1: Establish and maintain selected Agency level shared capabilities, across multiple classes of assets (e.g., wind tunnels, vacuum chambers, etc.), to ensure that they will continue to be available to support the missions that require them.

### Innovative Partnerships Program

Outcome IPP-1: Promote and develop innovative technology partnerships among NASA, U.S. industry, and other sectors for the benefit of Agency programs and projects.

### Advanced Business Systems (Integrated Enterprise Management Program)

Outcome IEM-1: By 2008, implement Agency business systems that provide timely, consistent and reliable business information for management decisions.

Outcome IEM-2: Increase efficiency by implementing new business systems and reengineering Agency business processes.

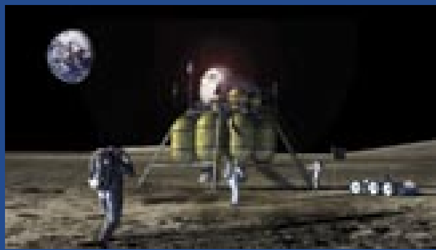
### Education

Outcome ED-1: Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals through a portfolio of programs.

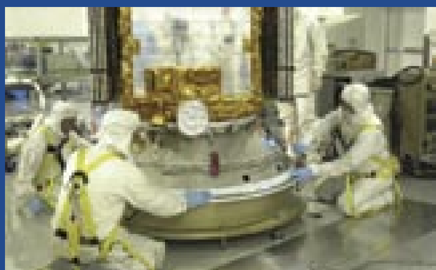
Outcome ED-2: Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.

Outcome ED-3: Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission.

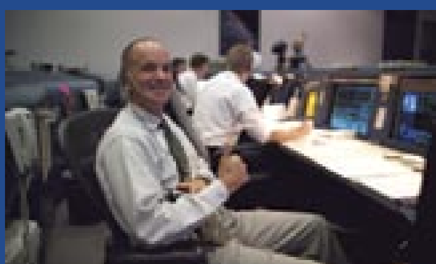
## Banner Images



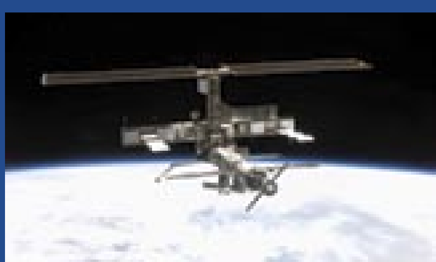
NASA's Mission and Vision: Astronauts work around a lander in this artist's concept of a future lunar mission. (Image: John Frassanito and Associates)



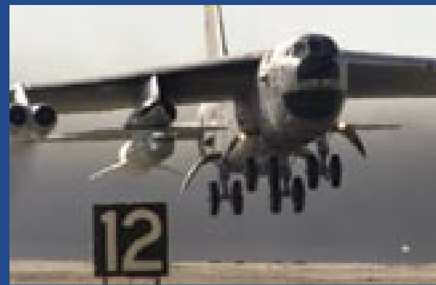
NASA's Strategic Goals: Workers secure the CALIPSO spacecraft onto a payload attach fitting at Vandenberg Air Force Base, California. (Photo: NASA)



Inside NASA: Astronaut Rick Sturckow, weather expert at the spacecraft communicator (CAPCOM) console in the Shuttle Control Room of Houston's Mission Control Center, expresses his elation after *Discovery* safely launched on July 26, 2005. (Photo: NASA)



NASA's Strategic Management Framework: An STS-114 crewmember took this photo of the International Space Station after *Discovery* undocked on August 6, 2005. (Photo: NASA)




NASA's External Advisors and Partners: NASA's B-52 takes off on November 16, 2004, with a Pegasus booster rocket and the X-43A hypersonic research aircraft tucked under its wing. (Photo: NASA/T. Tschida)

External Challenges: Crews take Shuttle *Atlantis* to the Vehicle Assembly Building to prepare it for a future mission. (Photo: NASA)

Scenarios for the Future: This approximate natural-color image of Jupiter's moon, Europa, taken by the Galileo spacecraft, shows the lined and mottled surface of this water-ice covered moon. (Image: NASA/DLR)

Appendix: The New Horizons spacecraft passes by Pluto in this artist's concept. (Image: NASA)

Back cover: The Moon is visible above Earth's horizon and airglow in this panoramic view taken by a member of International Space Station Expedition 11 on July 16, 2005. Near the lower edge of the picture, the eye of Hurricane Emily, which was a category 4 hurricane in the Gulf of Mexico at the time, is visible as a bright white dimple in the clouds. (Photo: NASA)

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