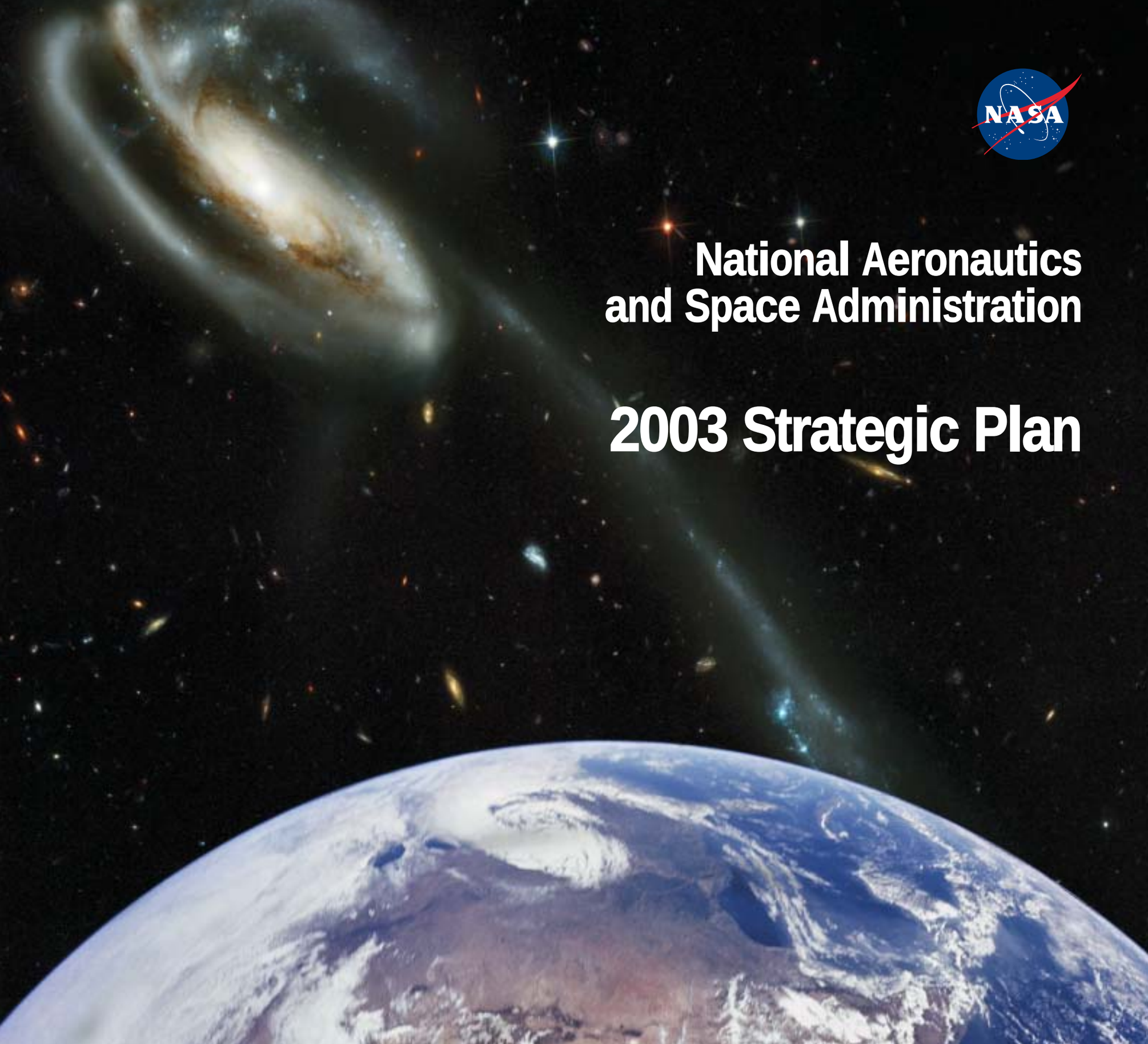

National Aeronautics and Space Administration

2003 Strategic Plan

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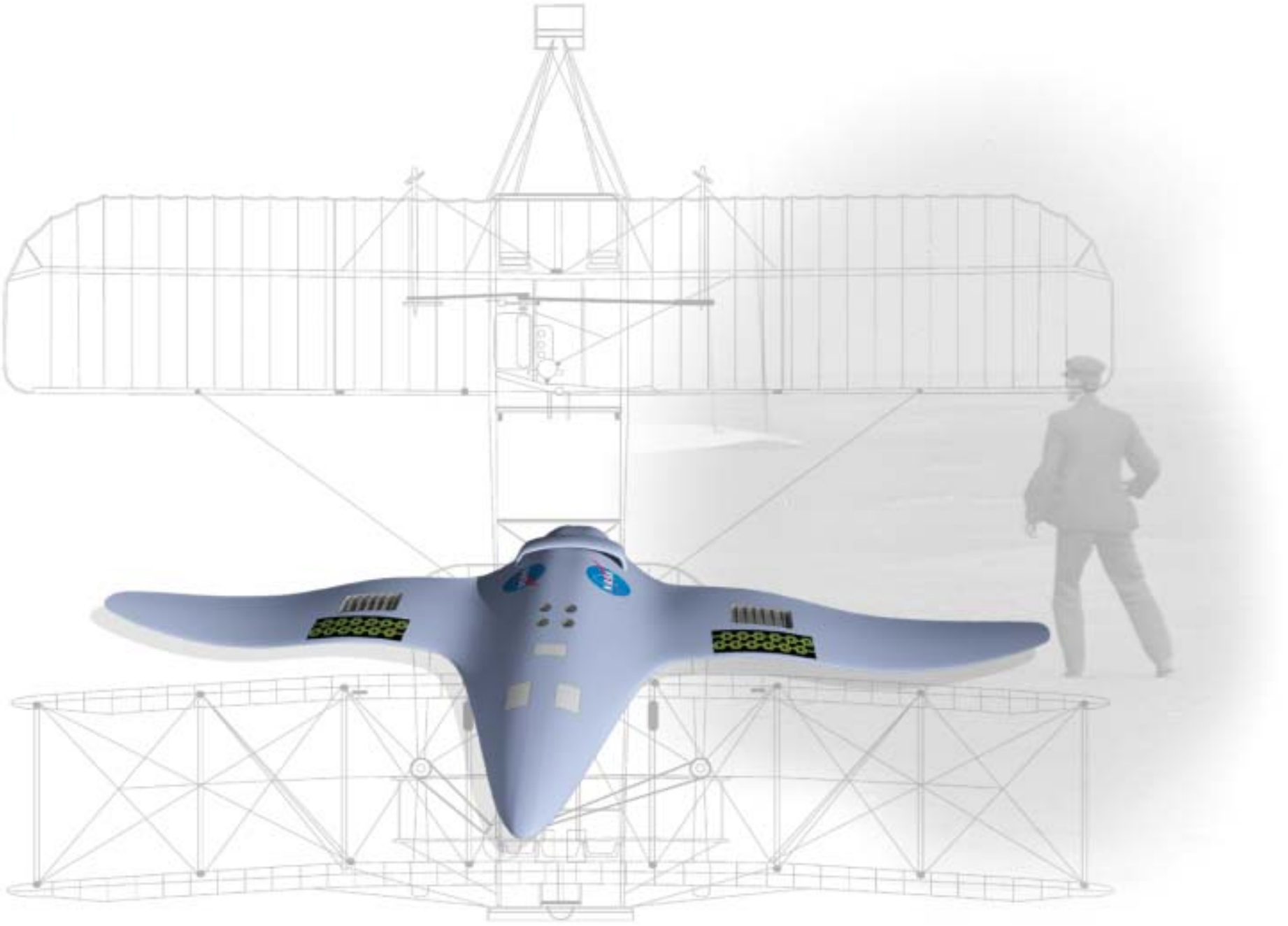
Shown at left is the launch of the Space Shuttle *Columbia* on mission STS-109.

The NASA Vision

To improve life here,
To extend life to there,
To find life beyond.

The NASA Mission

To understand and protect our home planet,
To explore the universe and search for life,
To inspire the next generation of explorers
… as only NASA can.



As we celebrate the 100th anniversary of the Wright brothers' first flight,
NASA is pursuing aeronautics technologies that they could not have imagined.

NASA Strategy

National
Aeronautics
and Space
Administration

2003 Strategic Plan

NASA Strategy

Imagine knowing that we are not alone, but that life is abundant in our solar system and throughout the universe. Imagine a world where we can safely travel anywhere, anytime, on our home planet, and in space. Imagine a world in which long-term weather forecasts are reliable, and natural disasters are predictable and perhaps even preventable. NASA is changing our understanding of the world, exploring the unknown, and creating new awareness about who we are and what our place is in the cosmos.

Compelling Questions Drive Exploration

For the first time in history, we have the tools, the insight and ability to seek answers to some of humanity's most profound questions.

How did we get here? We study the origins and evolution of the universe and the galaxies, stars, and planets within it. And we seek the building blocks of life that are preserved within our solar system and beyond.

Where are we going? We probe the critical interactions among Earth's atmosphere, oceans, weather, and climate—the complex systems upon which all living organisms depend. We study how the Sun and Earth are changing, and we learn how to predict future changes. We also develop the knowledge and capabilities for eventual human exploration of the solar system.

Are we alone? We seek evidence of life in our solar system and of life-sustaining, Earth-like worlds around nearby stars. We have embarked on an ambitious program to explore the planet Mars. Our spacecraft have discovered evidence that large amounts of liquid water once flowed on the planet, and that today, it may be frozen beneath the surface.

Shown at left is a stellar nursery in the Trifid Nebula.

Vision

To improve life here,
To extend life to there,
To find life beyond.

Mission

To understand and protect our home planet,
To explore the universe and search for life,
To inspire the next generation of explorers,
… as only NASA can.

In addition to pursuing these compelling questions, NASA helps the Nation to meet its challenges and address its urgent national needs. Among these are the requirements to improve the security and safety of our air transportation system and counter the looming shortage of U.S. scientists and engineers in our next generation of Americans.

Vision and Mission Guide Investments

NASA's new Vision and Mission focus the Agency's programs on the pursuit of answers to these compelling questions. Using our unique knowledge and expertise, we build the tools that enable revolutionary robotic and human missions. Through scientific research and strategic investments in transformational technologies, we open new pathways toward missions that were impossible only a few years ago.

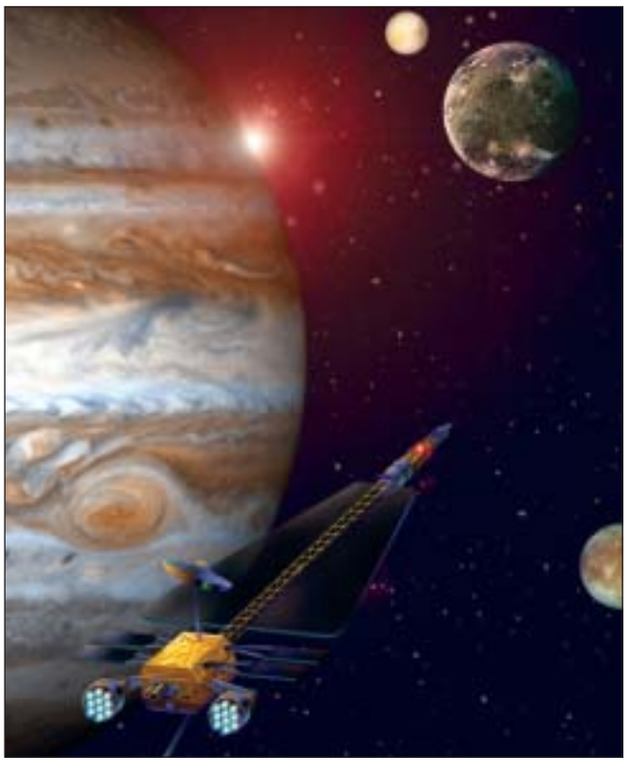
NASA's Vision and Mission reflect our hopes and challenges for the future. Through them, we emphasize our unique roles and focus the Agency on the things it does best. As the Nation's leading organization for research and development in aeronautics and space, we are explorers and pioneers who use our unique tools, capabilities, and perspective for the benefit of the Nation and the world.

Building Blocks Enable New Capabilities

NASA develops "building blocks" that open new pathways of exploration and discovery. Today, our telescopes peer billions of years into the past to witness the beauty and unlock the mysteries of the early universe. Our satellites view the entire planet from space, allowing us to study global change and its consequences for life on Earth. Our spacecraft travel throughout the solar system and into the uncharted territories beyond, exploring the processes that have led to the incredible diversity of the planets and the emergence of life. Our aeronautics research has given people the routine ability to travel safely and reliably all around the world. Our astronauts are living and working in space, and from them, we are learning how to expand our sphere of exploration far beyond the bounds of Earth.

But, our ability to fully achieve our Mission is constrained by the need for new technologies that can overcome our current limitations. We must provide ample power for our spacecraft as well as reliable and affordable transportation into space and throughout the solar system. We must deploy innovative sensors to probe Earth, other planets, and other solar systems. We must be able to communicate large volumes of data across vast distances, so that we can get the most from our robotic explorers. And we must learn to mitigate the physiological and psychological limitations of humans to withstand the harsh environment of space.

To address these challenges, we are making strategic investments in transformational technologies. These include new breakthrough propulsion techniques that will enable spacecraft to travel



NASA's Project Prometheus will transform our capability to explore the solar system.

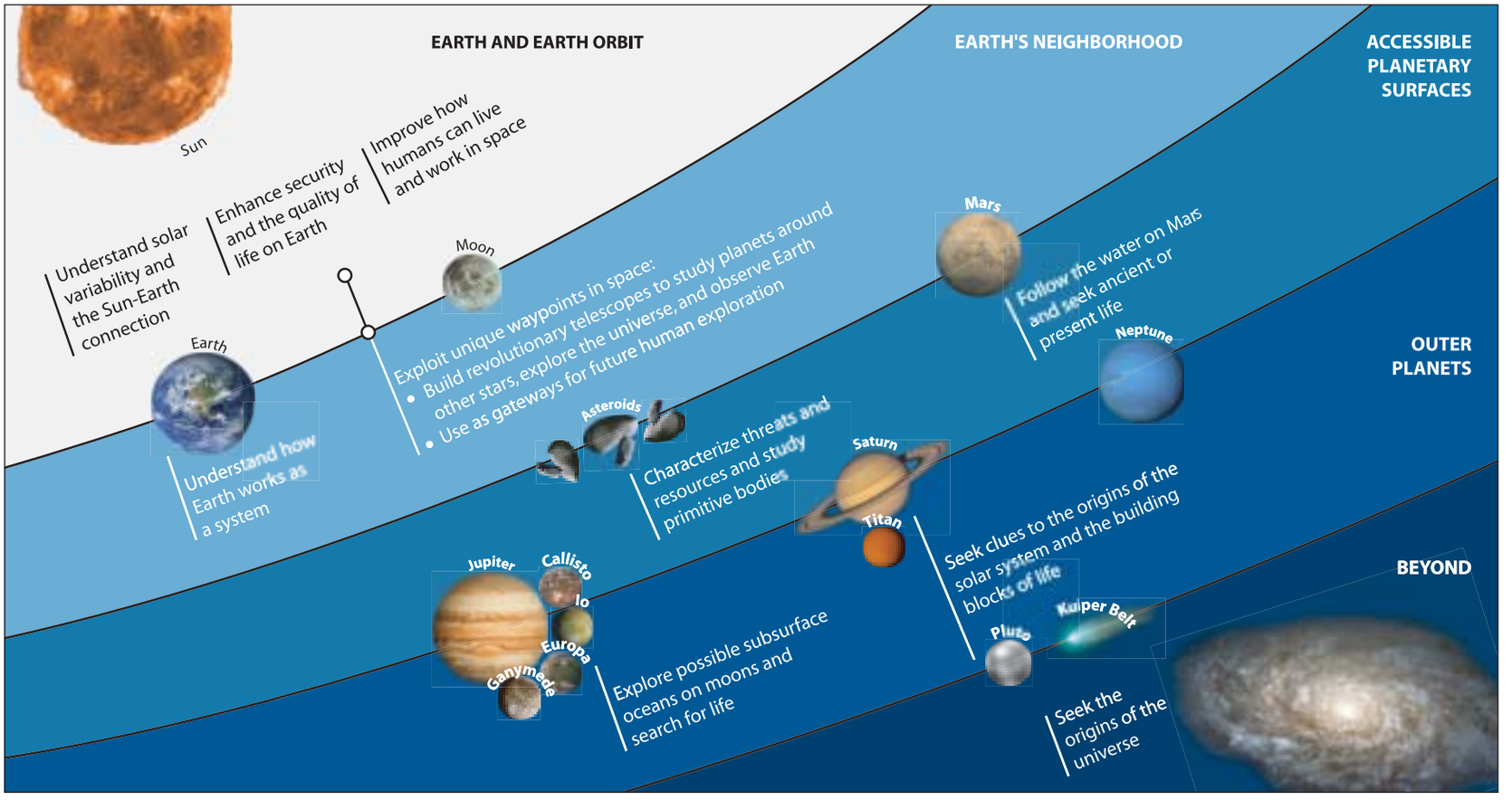
faster and farther and will allow them to carry larger scientific payloads and make new types of measurements. New power systems will transform the way we conduct research in space, and revolutionary communications technologies, using laser light instead of radio waves, will dramatically increase our ability to transmit information across the solar system. Constellations of networked spacecraft will allow us to study Earth, Mars, and other planets in fine detail, and large, deployable antennas will enable us to probe planetary surfaces and astronomical objects from great distances. Research into the human factors of space travel will enable us to understand the effects of the space environment on how we live and work in space and will ensure that future explorers can carry out their missions safely and effectively.

We will continually advance the boundaries of exploration and our knowledge of our home planet and our place in the universe. We seek answers along many paths, multiplying the possibilities for major discoveries. The capabilities we develop will eventually enable humans to construct and service science platforms at waypoints in space between Earth and the Sun. Someday, we may use those same waypoints to begin our own journeys into the solar system to search for evidence of life on Mars and beyond.

NASA's Mission is bold.
Our strategy is sound.
Humanity's greatest adventure has just begun.

	Building Blocks	
Technological Barriers	**Ongoing Efforts**	**New Efforts**
Power: Providing ample power for propulsion and science	**Nuclear Systems Initiative** • Greatly increased power for space science and exploration	**Project Prometheus** • Nuclear power and propulsion for revolutionary science and orbital capabilities • First mission to Jupiter's moons
Transportation: Providing safe, reliable, economical transportation to and from space, and throughout the solar system	**Integrated Space Transportation Plan** • Orbital space plane • Extended Shuttle operations • Next-generation launch systems	**Human Research Initiative** • Accelerate research to expand capabilities • Enable 100-plus day missions beyond low-Earth orbit
Human Capabilities: Understanding and overcoming human limitations in space	**In-Space Propulsion Program** • Efficient solar system transportation	**Optical Communications** • Vastly improved communication to transform science capability • First demonstration from Mars
Communications: Providing efficient data transfer across the solar system	**Space Station Restructuring** • Research priority focused • Management reforms • Sound financial base	
	Bioastronautics Program • Roadmap to address human limitations	

By investing in new building blocks, we can overcome the barriers that constrain research and discovery.



We are developing a robust, integrated exploration strategy to guide our investments. Through our new building-block capabilities and scientific discoveries, we create stepping-stones to the future while steadily increasing our ability to conduct ever more challenging robotic and human missions.

Achieving Our Vision and Mission

National Aeronautics and Space Administration

2003 Strategic Plan

Achieving Our Vision and Mission

Agency Goals

Our Vision and Mission are the guiding principles for this strategic plan. They represent NASA's fundamental contributions to the Nation and the world, and they provide us with a clear, unified, and long-term direction for all of our activities. To achieve the new Vision and Mission, we have established Agency goals that outline what NASA will achieve in the coming decades. They also will provide the context for planning and program development. Seven strategic goals are established to carry out NASA's Mission. In addition, three enabling goals are established in areas critical to the achievement of those strategic goals. All 10 goals are described in detail in the following section of this strategic plan.

The goals will be achieved by NASA's Enterprises and supporting organizations through a series of objectives that are summarized in Appendix III. The programs and tasks that implement the objectives are funded through 18 themes, which represent the Agency structure for budget planning, management, and performance reporting. Every activity that is funded within a theme must contribute to the achievement of one or more goals through its associated objectives. These contributions are documented by the long-term and annual performance measures which constitute NASA's Performance Plan; this is included with the annual budget submission in the Integrated Budget and Performance Document, a companion volume to this plan. This structure ensures that NASA is directly accountable for its performance, and that the results of every NASA program are visible to the taxpayers and traceable to the Agency's Vision and Mission.

The matrix shown on page eight lists the goals and shows their relationships to the budget themes and Enterprises that implement them. It also provides a roadmap for the strategic and enabling objectives that are described in Appendix III, as well as the supporting contributions that are described in detail in the Performance Plan.

Shown at left is the International Space Station, as viewed by the Space Shuttle *Endeavour*.

All elements of NASA work together to achieve Agency goals, a real demonstration of our One NASA philosophy. The Agency goals are listed below, and all themes are listed by Enterprise (at right). Elements of the matrix indicate each themes' primary (■) and supporting (○) contributions. Themes with primary contributions have at least one objective for which they are accountable. All objectives are described in Appendix III. Themes with supporting contributions are accountable through performance measures in the performance plan that is part of the Integrated Budget and Performance Document, a companion volume to this plan.

Goals

MISSION I — Understand and protect our home planet

1. Understand Earth's system and apply Earth system-science to improve the prediction of climate, weather, and natural hazards.
2. Enable a safer, more secure, efficient, and environmentally friendly air transportation system.
3. Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia.

MISSION II — Explore the universe and search for life

4. Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space.
5. Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere.

MISSION III — Inspire the next generation of explorers

6. Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.
7. Engage the public in shaping and sharing the experience of exploration and discovery.

Enabling Goals

8. Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.
9. Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.
10. Enable revolutionary capabilities through new technology.

Themes
Enterprises
Science, Aeronautics, and Exploration
Space Flight Capabilities
Space Science
Earth Science
Biological and Physical Research
Aerospace Technology
Education
Space Flight
Aerospace Technology
Solar System Exploration (SSE)
Mars Exploration (MEP)
Astronomical Search for Origins (ASO)
Structure and Evolution of the Universe (SEU)
Sun-Earth Connection (SEC)
Earth System Science (ESS)
Earth Science Applications (ESA)
Biological Sciences Research (BSR)
Physical Sciences Research (PSR)
Research Partnerships and Flight Support (RPFS)
Aeronautics Technology (AT)
Education Programs (EP)
International Space Station (ISS)
Space Shuttle Program (SSP)
Space and Flight Support (SFS)
Space Launch Initiative (SLI)
Mission and Science Measurement Technology (MSM)
Innovative Technology Transfer Partnerships (ITTP)

NASA's Core Values

Safety.
NASA's Mission success starts with safety. A commitment to safety permeates everything we do. We are committed to protecting the safety and health of the general public, pilots and astronauts, the NASA workforce, and our high-value assets on and off the ground.

People.
Our greatest strength is our workforce, a team of highly qualified individuals that is representative, at all levels, of America's diversity. We foster a culture of trust, respect, teamwork, communication, creativity, equal opportunity, and empowerment.

Excellence.
We are committed to excellence. We continuously improve our processes, products, and services to better serve our customers.

Integrity.
We are honest and ethical in all that we do. We deliver on our commitments, and we are accountable for our performance.

Implementing Strategies

To fulfill our challenging Mission and realize the full potential of the benefits we can provide to the Nation, we will base all NASA activities on a foundation of sound planning and management practices. These Implementing Strategies are not necessarily unique to NASA; they are similar in intent to management strategies of all well-run organizations. But, they are critical to NASA's achievement of its strategic and enabling goals. The Implementing Strategies below are described in more detail in Appendix I:

- achieve management and institutional excellence comparable to NASA's technical excellence;
- demonstrate NASA leadership in the use of information technologies;
- enhance NASA's core engineering, management, and scientific capabilities and processes to ensure safety and mission success, increase performance, and reduce cost;
- ensure that all NASA work environments, on Earth and in space, are safe, healthy, environmentally sound, and secure; and
- manage risk and cost to ensure success and provide the greatest value to the American public.

All of NASA is committed to these Implementing Strategies. Through them, we will ensure that we maintain the excellence and innovation that the Nation expects, along with an unwavering commitment to safety and fiscal responsibility.

Transforming NASA

NASA's strategy for the future represents a new paradigm, in which strategic building blocks progressively create steppingstones to exploration and discovery. To be successful, NASA must transform itself while being guided by a set of core values. These values are not only central to responsible public service, they are also essential to the achievement of our Vision and Mission.

With these values as our solid foundation, we will pursue these five significant transformations.

All investments will contribute to a single set of Agency goals and will be directly traceable to our Vision and Mission.

The NASA of today is unified around a common purpose, expressed by our Vision and Mission. A single set of NASA-wide goals defines how we will achieve our Mission. These goals are not unique to any one organization within NASA; they span the entire Agency to provide a context for planning programs and monitoring performance. Every NASA program and project must be relevant to one or more of the goals, and thus to the Vision and Mission. Specific performance measures will be identified for each program to assess how well that program contributes to the goals. Underperforming programs will be redirected or canceled.

Human space flight capabilities will be expanded to enable research and discovery.

In the early days of NASA, the demonstration of human space flight was a national priority, motivated by the need to prove American technological preeminence. This demonstration led to some of the most spectacular achievements in human history, and during the past 20 years, NASA has systematically developed the capability to live and work in space. With a successful Space Shuttle program and an International Space Station that is nearing completion, we now have the tools that enable the utilization of the unique environment of space for research and development. Human space flight will always be an integral and critical element of our strategy for space exploration. NASA will continue to expand its human presence in space—not as an end in itself, but as a means to further the goals of exploration, research, and discovery.

Technology developments will be crosscutting.

With the new focus on a unified NASA Vision, Mission, and goals, we must carefully select our technology investments to provide the greatest benefit across the Agency and to the public. We will emphasize technologies with broad applications, such as propulsion, power, computation, communications, and information technologies. These and other crosscutting technologies

represent opportunities to leverage our limited resources to advance the overall NASA Mission. Project-specific technologies will continue to be identified and funded with resources from the project to which they apply.

Education and inspiration will be an integral part of all our programs.

Over the years, NASA's exploration and innovation have inspired and motivated countless individuals from all walks of life. The information age has made our task easier in some ways, but more difficult in others. Today, there is so much competition for the minds and imaginations of young people that it can be difficult to engage them in the science and engineering that will lead them to technical careers. NASA's education and public outreach programs must be modern, successful, exciting, and relevant to students, teachers, and parents. In the past, education and outreach were not always built into NASA programs at their inception, and their effectiveness varied as a result. Today, educational and motivational activities are being incorporated into every NASA program from the earliest stages. A new NASA Enterprise has been created to serve as the Agency's focal point for education planning and implementation, and the performance of our education programs will be tracked like that of any other NASA activity. The result will be a much more effective use of the vast educational potential of NASA's ongoing exploration and research. Over time, this may help to turn the tide of declining interest and performance in science and mathematics among America's youth and may motivate more of them to pursue careers as scientists, engineers, and explorers.

We will operate as One NASA in pursuit of our Vision and Mission.

NASA is a large Agency, consisting of thousands of public servant and contractor employees, Field Centers across the United States, and facilities in foreign countries. With our new focus on a unified long-range Vision and Mission, it is imperative that all elements of the Agency work together as a single team. By developing common procedures, capabilities, tools, and organizations, we will ensure that the overall functioning of the Agency is as smooth and efficient as possible. We will also present a single electronic presence to the Nation, so that all NASA products and information are readily available without confusion or delay. By unifying the Agency, we will reinforce the shared commitment of all NASA employees to our common goals.

As Only NASA Can

We will pursue activities unique to our Mission in air and space. If NASA does not do them, they will not get done. If others are doing them, we should question why NASA is involved.

NASA is the Nation's leading organization for research and development in aeronautics and space. We have developed expertise, tools, and facilities that collectively represent a unique national asset. It is our mandate to undertake challenging projects of national importance that fit our unique capabilities. We must apply those capabilities to conquer persistent limitations to exploration. By focusing on these requirements, we are able to apply extensive, but finite, capabilities to the challenges that truly demand this expertise. Our successes often spawn new projects that can then be accomplished by private industry, universities, or other Government agencies, and NASA-developed tools and techniques will be transferred to these organizations to help them succeed. In this way, we continuously enhance the collective capability of the Nation, and we ensure that the explorers and innovators of NASA are ready to take on the next challenge. By continuing to pioneer and discover, we will expand our horizons and inspire the Nation's youth . . . *as only NASA can*.

Mission I: To Understand and Protect Our Home Planet

Over the course of the space age, the opportunity to view Earth from space has been a moving experience for many astronauts. The dramatic views of the whole planet Earth, as seen during the Apollo program, have become some of the most enduring and inspiring images of our time. Today, more than 30 years later, the images of Earth being provided by NASA missions are equally inspiring, and they are proving to be tremendously valuable in our efforts to understand and protect our home planet.

NASA is a major contributor to the worldwide effort to understand the nature of planet Earth. Today, we continuously observe Earth from space, from different vantage points and in a variety of wavelengths, to better understand the behavior and interactions of the planet's complex systems and processes. We make our observational capabilities, scientific results, and technologies available to other agencies involved in land management, weather prediction, and the assessment of natural hazards and their effects. The knowledge provided by NASA's Earth observation programs is proving to be of tremendous practical benefit as humanity learns how to best live upon and protect our planet.

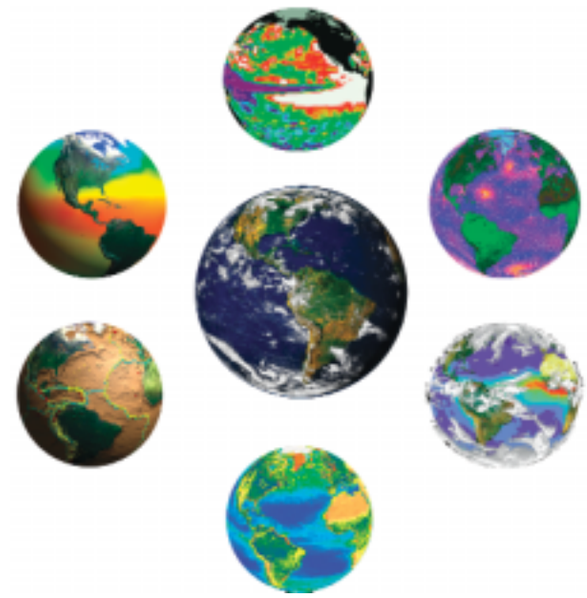
NASA is also a major contributor to America's efforts to protect its citizens and their freedoms and to improve their quality of life. NASA-developed technologies provide the Nation with unique capabilities to enhance homeland security, and we actively seek opportunities to apply our expertise to urgent national needs. NASA also develops a wide spectrum of technology and conducts research aimed at improving the safety and efficiency of America's air transportation system. Moreover, we use our scientific and technological capabilities to enable the vastly improved management of the country's natural resources.

Shown at left is Earth, our home planet.

The tremendous breadth of NASA's responsibilities and capabilities allows us to dramatically improve humankind's collective ability to understand and protect our planet and its people. And as we continue to explore the frontier of space, we gain a new appreciation for the importance, the vulnerability, and the uniqueness of planet Earth.

Goal 1: Understand Earth's system and apply Earth-system science to improve the prediction of climate, weather, and natural hazards.

We have come to understand that the only way to comprehend Earth's climate and manage its precious natural resources is to look at the planet as a single, integrated system of continents, oceans, atmosphere, ice, and life. Earth is a dynamic system, and we must understand how and why it changes in order to better anticipate, accommodate, and influence its course. Our view from space affords us a unique perspective on how global change affects specific regions and how local changes fit in a global context.



Viewing Earth in different ways exposes a variety of dynamic processes, from severe weather events to ozone loss and recovery to volcanic eruptions.

Global average temperature increased measurably over the 20th century, and climate models predict an even larger increase over the course of the 21st century. Such a change would have a dramatic effect on Earth's entire ecosystem. Related projections indicate a possible sea level rise of nearly 3 feet, which would have a major impact on heavily populated coastal regions. Much of New Orleans, for example, is below sea level, and several Northern European cities and Pacific Islands could be impacted by a sea level rise of this magnitude. NASA satellites will continue to measure parameters—such as sea surface height and temperature, ocean winds, and ice sheets—to look for signs of global change and to enable projections that will help to determine their likely impact. The economic and societal benefits of such predictive capabilities cannot be overstated.

We have learned that Earth's polar regions are central to the complex causes and consequences of global change. Arctic sea ice has lost 10 to15 percent of its spring/summer volume since the 1950s, yet Antarctic sea ice is largely unchanged. While the polar regions are hard to reach and thus difficult to study with conventional scientific expeditions, NASA satellites currently provide opportunities for observation 16 times each day to capture important seasonal, annual, and long-term dynamics. Alaskans are witnessing temperature changes two or three times that of the global average, leading to concerns about permafrost melting and the subsequent impact on roads, pipelines, and communities.We are using these observations to build predictive models, and we are now on the verge of understanding critical changes in the mass balance of the Greenland and Antarctic ice sheets. NASA satellites will also continue to track the dynamics of Antarctic springtime ozone loss and recovery, enabling determination of the effectiveness of new substitutes for banned ozone-depleting chemicals.

The knowledge we gain about Earth's system enables dramatic improvement in our ability to predict climate, weather, and natural hazards, as well as to mitigate and assess the effects of natural and human-induced disasters. Many Federal agencies that provide essential services to the Nation depend on such

predictive capabilities. Among them are the National Oceanic and Atmospheric Administration and the Department of Defense for civilian and military weather forecasting, the Federal Emergency Management Agency and the U.S. Geological Survey for natural hazard warning and mitigation, and the U.S. Department of Agriculture for protection of the Nation's forest resources and agricultural productivity. NASA will continue to work with these agencies to further develop our predictive capabilities.

Phenomena in the nearby space environment also have a major effect on planet Earth. Solar variability causes space weather that can affect satellite operations, human space activities, and electrical power grids on Earth. Long-term changes in the Sun's brightness, though small, affect our climate. We also know that near-Earth objects, such as asteroids, have regularly impacted Earth throughout its history, with severe consequences for Earth's biosphere and the evolution of life. NASA is engaged in a long-term systematic study of the Sun to understand its effects on Earth and society, and we study the population and dynamics of near-Earth objects to understand the probabilities and possible effects of future impacts better. By studying Earth's neighborhood as well as the planet itself, NASA will continue to provide the Nation with the knowledge to develop a comprehensive understanding of the nature and behavior of our home planet.

Goal 2: Enable a safer, more secure, efficient, and environmentally friendly air transportation system.

During the 20th century, transportation transformed our society, dramatically enhancing both national security and economic growth. Today aviation is an indispensable part of our Nation's transportation system, providing unequaled speed, mobility, and freedom of movement for people and goods. More than 800 million passengers fly more than 800 billion passenger-miles annually, and air freight carries 27 percent of the Nation's exports and imports. Global communications, commerce, and tourism have driven international growth in aviation to between 5 and 6 percent annually, well beyond the average annual growth in Gross Domestic Product. Aviation products add tens of billions of dollars annually to the Nation's balance of trade and provide support and stimulus for the country's high-technology industrial base.

NASA's graphical cockpit weather displays improve aviation safety and on-time performance. They provide aircrews with real-time information that will allow them to avoid areas of hazardous weather and turbulence.

But aviation is facing significant challenges. Air traffic and airport systems in the United States and overseas are reaching full capacity, resulting in significant delays and loss of output. Projections show that by 2015 this loss could reach nearly 200 billion in passenger-miles not served, translating to more than $20 billion of lost annual output for the airline industry and several times that number for the U.S. economy. Environmental issues such as noise and air pollution impose restrictions on the number and type of aircraft that can operate in certain areas, further limiting system capacity. And the need to ensure the safety and security of air travel is more pressing than ever before; it has the potential to seriously impact the transportation system for years.

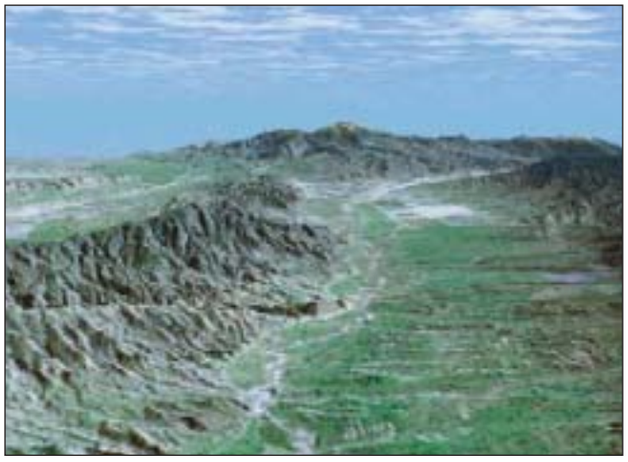
NASA provides the Nation with technological leadership in facing these challenges and ensuring continued improvements in aviation safety and efficiency. In partnership with other Government agencies, industry, and academia, NASA's role is to understand the

challenges and develop the long-term, cutting-edge and leap-ahead technological solutions.

NASA develops breakthrough concepts and technologies for aircraft, airspace systems, and safety and security to address these issues and to create new opportunities. For example, by developing the technology for real-time, intelligent information systems, we can make precise knowledge of the position of every aircraft available and provide precision approaches to every runway in the Nation. This ability could increase the capacity of our major airports, while expanding access to the more than 5,000 smaller airports around the country. At the same time, such real-time information can significantly enhance safety and security through better situational awareness of the total aviation system. NASA also provides research and technologies to enable advanced weather prediction, detection and warning of volcanic plumes, and the measurement of topography around airports to enhance air safety.

Advances in air traffic management will be complemented by improvements in aircraft technology. Adaptive aerodynamic and structural technologies, for example, will enable ultraefficient, quiet, long-distance transports that minimize environmental impact. Artificial vision, using advanced sensors, digital terrain databases, and digital processing, will enhance safety by providing a perfectly clear three-dimensional picture of the terrain, obstacles, runway, and traffic. Coupled with the aircraft's flight computer, such systems could also allow the vehicle to automatically recover from hazardous flight conditions. In addition, through the use of neural network computer technology, we can someday develop vehicles with embedded intelligence and artificial nervous systems that may provide the ultimate in vehicle safety.

As we mark the 100-year anniversary of aviation, we can see on the horizon opportunities for radical improvements and innovations in American aviation. NASA is uniquely positioned to provide solutions for the Nation's air transportation challenges and to lead the way to a vastly improved aviation system as we move forward in the 21st century.



The NASA Shuttle Radar Topography Mission provides unprecedented elevation data, as depicted in the computer-generated image above, to improve aviation efficiency and safety in challenging terrain and weather.

Goal 3: Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia.

NASA is a civilian Agency that was created to develop and promote the Nation's capabilities in air and space for peaceful purposes. The events of September 11, 2001, however, changed the very fabric of America, and now NASA and other Federal agencies share a responsibility and commitment to actively contribute to homeland security.

Since our challenging research and development objectives require the development of many unique technologies and capabilities, NASA is exceptionally well positioned to address key national security concerns. We will continue to share our expertise, technology, and databases with the Department of Defense, the Federal Aviation Administration, Government disaster management and counterterrorism officials, and the new Department of Homeland Security.

Applicable NASA research for Homeland Security falls into five major areas:

- aviation security, including aircraft hardening, airspace management, passenger management, and sensor integration;
- biological, chemical, and radiological sensors and detectors;
- geospatial data collection, analysis, and imagery and the capability to manage, fuse, and analyze large amount of data;
- robotic aerial vehicle development for use as platforms for surveillance, remote sensing, and communications; and
- continued and improved access to space for national security assets.

In addition, our expertise in systems engineering, communications, mission control, and project management can support the development of new, agile organizational and management approaches to complex homeland security challenges.

NASA works collaboratively with the Department of Defense to develop technologies and systems that help to keep U.S. military aviation and space capabilities the most advanced in the world. We now work with the Federal Aviation Administration on technologies for aircraft and airport security and with the National Imagery and Mapping Agency to develop accurate maps and images of key locations.

As Earth's population expands, people and valuable assets will be placed in closer proximity to areas where floods, earthquakes, and other natural hazards can cause extensive damage. NASA's observations from space improve the prediction of severe weather events and other hazards, saving lives and reducing property damage. Our research in the unique environment of space also provides insight into the workings of important industrial processes, such as combustion and chemical reactions. Even small gains in the efficiency of these widely used processes can produce huge benefits on Earth by improving productivity, reducing raw materials usage, and by minimizing pollution.

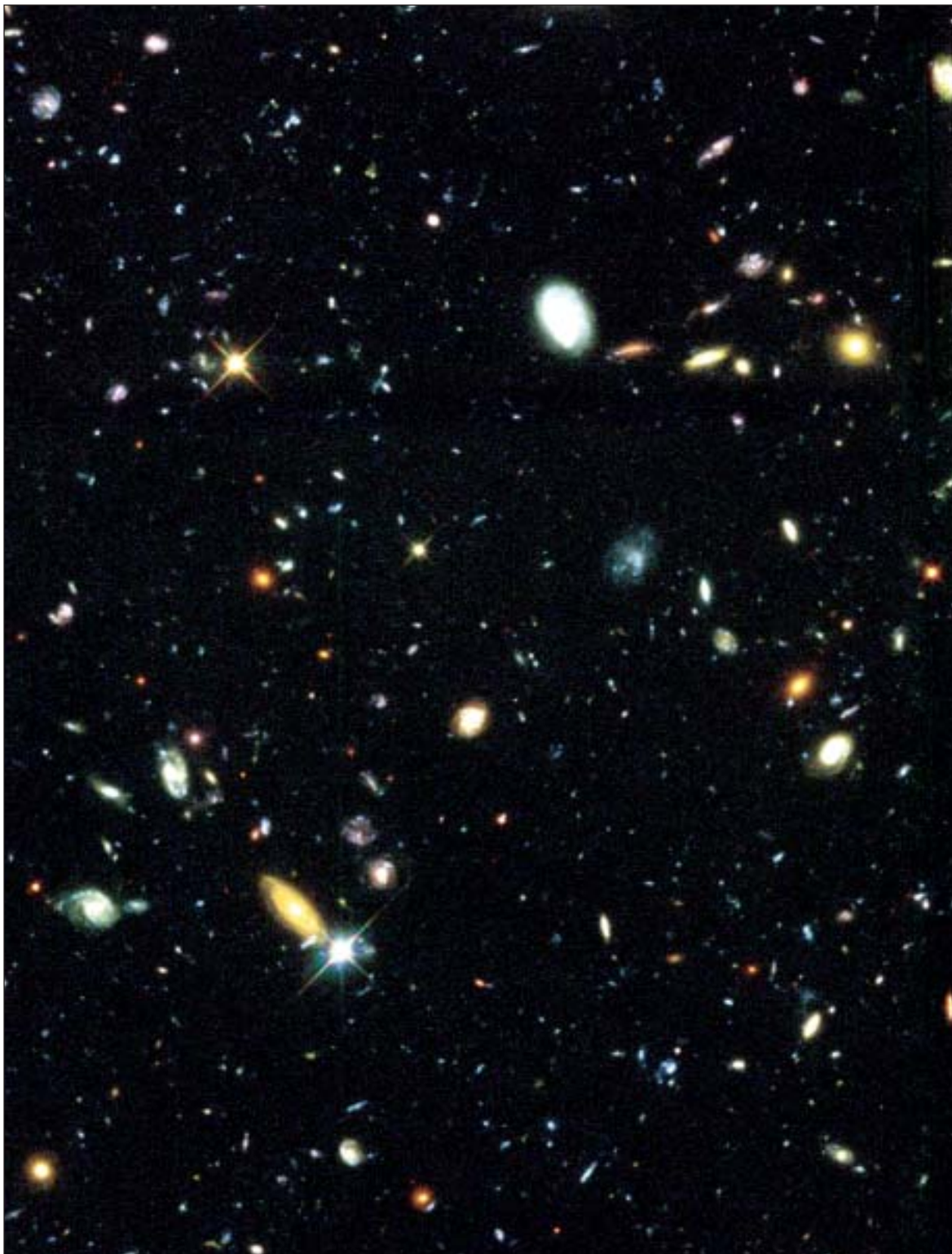
Technologies developed for space applications continue to find important new uses on Earth. New detector technologies, for example, that were originally developed to observe the universe now are being used to detect and diagnose cancer. Robotic technologies developed to explore the planets are being used to assess and mitigate environmental hazards on Earth. By pursuing challenging goals and exploring the unknown, NASA will continue to stimulate breakthroughs, new ideas, and new applications whose benefits to life on Earth can be immense.

Mission II: To Explore the Universe and Search for Life

Human history is a tale of boundaries encountered and surpassed, and surmounting each obstacle has required not only new technology and ingenuity but also courage, conviction, and the unrelenting human instinct to explore the unknown. Not so long ago, the unexplored frontier was the vastness of Earth's continents and their surrounding oceans; today, the frontier lies beyond the boundaries of our planet itself. NASA was created to blaze America's trail into space, and with the remarkable confluence of scientific discoveries and technological breakthroughs of recent years, we stand at the threshold of answering some of the most enduring questions about our origins and our destiny.

Humanity's journey into this promising future, just like the opening of the Earth-bound frontiers of the past, will not be completed in a single step; it consists of a long sequence of achievements and milestones, some carefully planned and some more fortuitous. In just 45 years, we have advanced from the first rudimentary satellites and brief sorties in Earth orbit to reaching the moon and the outer limits of our solar system. And now, we have a permanent human presence in space. Indeed, it is this laboratory in Earth orbit, the International Space Station, that will enable us to understand how physical and biological systems work in space, opening the way for future explorers.

Our exploration of the cosmos today focuses on understanding the origin and evolution of the solar system, the universe, and life itself. During the early decades of space science, reconnaissance and surveys gave us an understanding of the broad characteristics and diversity of the new frontier of space. Building on that foundation, today's scientific goals provide a clear direction for our investments, and they all contribute to



Shown at right is the Hubble Space Telescope's deep field image, revealing a vast array of galaxies.

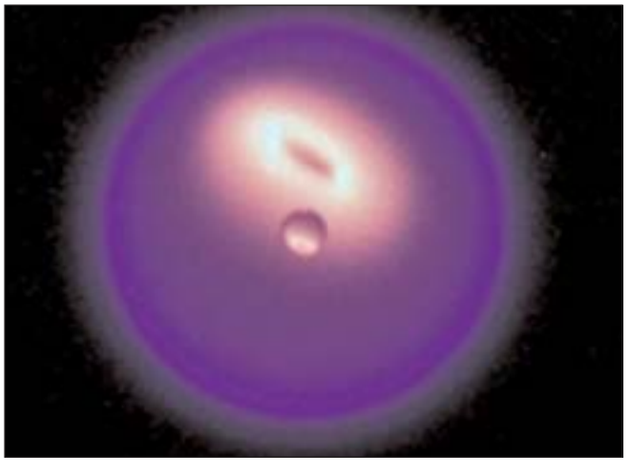
the long-term fulfillment of NASA's Vision and Mission. We are exploring the planets and primitive bodies to understand how they formed and evolved and how life eventually emerged. We are searching for—and finding—planets around other stars. Increasingly sensitive astronomical observatories are studying the universe in unprecedented detail. And we are learning why the Sun varies over time and how this variability influences life on Earth. Taken together, these diverse observations are gradually allowing us to read each chapter of the cosmic story, from our earliest origins to our ultimate destiny. For the first time we may be close to determining whether there is indeed life beyond Earth.

Today's frontier is as full of challenges and opportunities as all previous frontiers have been. NASA is proud to have led the world into the solar system and unveiled the beauty and mystery of the universe beyond. During the coming decades, we will continue to extend the horizons of knowledge and experience, helping our world to understand and fulfill humanity's destiny in the cosmos.

Goal 4: Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space.

Ever since humans gained access to space, we have been fascinated by the behavior of matter in reduced gravity. The early astronauts conducted impromptu experiments studying how reduced gravity affects the behavior of liquids, the movement of objects within a spacecraft, and everyday activities, such as eating and sleeping. We have the capability to live and work continuously in space, and this opportunity has provided us with access to a unique natural laboratory in which we can conduct experiments that are impossible on Earth. The knowledge derived from this research carries the potential for making dramatic advances in medicine and industry, as well as for developing new technologies to use both on Earth and in space.

Until the dawn of the space age, all scientific experimentation was conducted within the confines of Earth's gravity. By breaking that bond, we have been able to view the fundamental processes



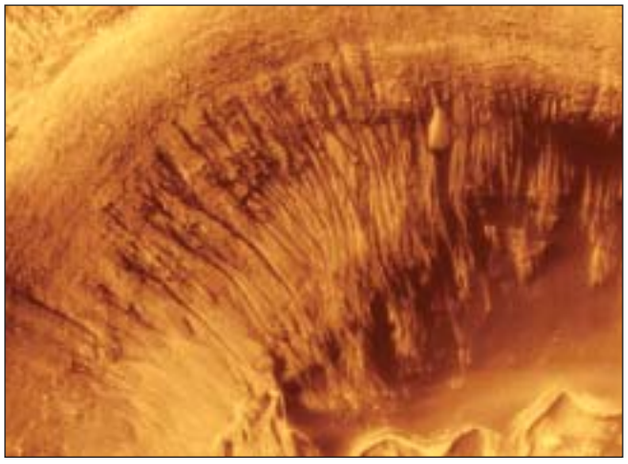
Combustion scientists use the unique environment on the Shuttle and International Space Station to create perfectly round flames, unachievable on Earth, to examine classical and new theories that impact the generation of pollution and energy from engines, boilers, and other combustion devices.

that govern our world in an entirely new light. Today, NASA manages a sophisticated program in which we use the microgravity environment of space to probe the behavior of matter at its atomic and molecular scales. Through such experiments, we can better understand how matter changes from one form to another, how chemical reactions are completed, and how complex biological systems operate to form the basis for life.

The virtual removal of gravity from the conditions of our experiments allows unprecedented precision in the measurement of physical constants. This capability enables the study of fundamental principles, such as Einstein's theory of gravitation and the properties of the electron, that would be severely constrained on Earth. Space-based research in complex systems will examine the dynamics of interacting elements and will have widespread applications in areas such as earthquake dynamics, soft-condensed-matter engineering, and biomaterials. We can also use the low gravity of space to study how to produce advanced materials, new chemicals, and pharmaceuticals as well as to enhance our understanding of high-temperature chemical reactions and combustion. This fundamental research will one day lead to new products, new medical treatments, and

improved energy production with reduced pollution—all very tangible Earthly benefits of research in space.

Research in space also gives scientists the ability to examine the role that gravity plays in the processes of life. While today we have only a limited understanding of gravity's effect on life at the molecular, cellular, systems, and behavioral levels, scientists can now begin extending this research to all levels of biological complexity. Studies of how cells and organisms respond and adapt to space will provide critical knowledge about the biological mechanisms underlying the known human health risks of space flight. In addition, new information about the general principles that regulate biological systems in space will provide fundamental knowledge regarding biological processes on Earth. The mechanisms at work in osteoporosis, balance disorders, and immune system function may be clarified by studying how similar systems change in space.



Channels in Martian crater walls provide strong evidence that liquid water may have flowed on the surface of Mars in the recent past. This water may originate in subsurface deposits that could be habitats for life.

Beyond the response and adaptation of individual organisms to space, long-duration space exposure provides the first opportunity to study how organisms respond to a totally new environment through complete life cycles and over multiple generations. This knowledge can have important implications for our understanding of the evolutionary processes at work in all living things. Research in the natural laboratory of space will continue to provide fundamental breakthroughs in our knowledge of the physical and biological processes that govern our lives on Earth.

Goal 5: Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere.

During the past few years, a series of technological breakthroughs and scientific discoveries has revolutionized our understanding of the formation and evolution of the universe and the origins of life. We now know that the ingredients of life are common in the universe, having been formed and disseminated by the explosions of stars. We also have learned that life is extremely robust and can survive in a tremendously wide range of environmental conditions on Earth. Recent discoveries indicate that many of these same types of environments have been present, and may be present today, on planets and moons in our solar system. These advances have brought us closer than ever before to being able to determine whether life has indeed taken hold beyond Earth.

NASA's observations of the universe and the solar system have led the world to a new understanding of our origins, our destiny, and the potential for life in the cosmos. Today, we are exploring our solar system to understand planetary evolution and to uncover the building blocks and chemical origins of life. Our robotic spacecraft have explored comets, asteroids, and virtually all of the planets and their major moons. We are engaged in a long-term, systematic exploration of the planet Mars to determine whether this most Earth-like of planets may once have harbored life and how humans might best explore Mars in the future.

Recent discoveries also provide compelling evidence for the presence of liquid water, one of the key ingredients of life, beneath the frozen surfaces of several moons in the outer

solar system. NASA's new Project Prometheus will demonstrate breakthrough nuclear propulsion and power technologies that can enable intensive exploration of these intriguing environments.

We now know that the observable matter in the universe makes up only a small percentage of the total. The rest is mysterious, invisible dark matter and dark energy, which have profound implications for the evolution and eventual fate of the universe. Operating above Earth's largely opaque atmosphere, our robotic observatories view the heavens in a variety of wavelengths to understand the nature of the stars, galaxies, and other objects in the universe and what they can tell us about our origins and our destiny. We are developing techniques such as interferometry to enable us to detect and study extrasolar planets, thus determining if any bear the telltale chemical signatures of life.

We also have embarked on a multidisciplinary program to observe the Sun and understand the causes and changes of solar variability. The Sun is the dominant source of energy for life on Earth. Understanding the history of the Sun is of fundamental importance to understanding the origin and evolution of life and the potential for its existence elsewhere. Studying the Sun also provides us with an opportunity to understand how stars work and to explore physical processes that cannot be created in the laboratory.

By integrating observations of the universe, the solar system, extrasolar planets, and our Sun, NASA's space science programs are providing a comprehensive new view of our origins and evolution. During the coming years, with the application of transformational technologies, we will continue to extend the limits of human understanding of the solar system, the universe, and our place within it.

Mission III: To Inspire the Next Generation of Explorers

Just before the dawn of the 20th century, outside of Boston, a 7-year-old boy gazes at the heavens and dreams of rocket flight. Then, in 1926, Robert Goddard launches the first liquid propellant rockets and opens the pathway to space.

In California in the 1960s, a young woman considers a career as a professional tennis player but, after watching the amazing Apollo missions, dreams of becoming an astronaut. In 1983, Sally Ride's ambition is fulfilled as she becomes the first American woman to orbit the Earth.

At McCall-Donnelly Elementary School in Idaho in 1984, a third-grade teacher applies to become a teacher in space. And today, more than fulfilling that dream, Barbara Morgan is a mission specialist and educator-astronaut. With her crewmates, she is preparing to travel to the International Space Station where she will live and work in space while taking her teaching profession to new heights.

NASA's challenging and exciting missions provide unique opportunities for engaging and educating the public. Air travel, space flight, the exploration of the unknown, and the discovery of new, mysterious, and beautiful things are all endeavors that hold an intrinsic fascination for people around the world. And the benefits—to NASA, the Nation, and the world—of engaging students and the public in our scientific and engineering adventures cannot be overstated. By stimulating people's imaginations and creativity and by meaningfully communicating the significance of our discoveries and developments to them, we can help to improve the scientific and technological literacy of our society and draw new students into careers in science and engineering.

Shown at right is Barbara Morgan, educator-astronaut, in the classroom.

"NASA and teachers share the same mission—to explore, learn, and to share."

—Barbara Morgan

NASA is committed to providing to all people, in engaging and understandable forms, the results of our missions and research. We will use our exploration as a context for meaningful educational activities, and we will bring people into our programs as active participants whenever possible. We will continue our tradition of partnership with schools, museums, libraries, and science centers in communities throughout the country striving to reach every young person in America.

Perhaps one of today's students, sitting in a classroom and learning about our latest discoveries on Mars, will become the first human to walk on the Red Planet.

Through our programs, we reach out to young people to provide them with a window into the exciting world of science and exploration.

Goal 6: Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

From the excitement of a countdown to the awe-inspiring images of the planets and galaxies, space exploration has a unique capacity to fire the imaginations of young and old alike. But the road to the planets does not begin at the launch pad; it begins at the classroom door. NASA's Mission to understand and explore depends upon educated, motivated people with the ingenuity to invent tools and solve problems and the courage to always ask the next question. It is not enough to depend on the excitement generated by our images; we must capitalize on that interest to provide meaningful educational programs that will benefit NASA and the Nation.

Throughout this decade, employment opportunities in science and technology are expected to increase at a rate almost three times greater than all other occupations. Yet enrollment in science and engineering courses at the college level is in decline. And NASA's situation is even more critical: the size of our technical workforce in its 20s is only one-third that of our workforce in its 60s, and we are encountering shortages in critical skills as older professionals retire. We must act now to counter this trend and ensure that NASA and the Nation can benefit from a workforce that is well versed in the scientific and technical disciplines that are needed in the 21st century. To meet this challenge, NASA has made education a part of its core Mission, and educational programs are now an integral part of every major NASA activity. We will increase our partnerships with education organizations to allow more citizens and students to become active participants in our exploration of air and space. Our education strategy also pays particular attention to minority and underrepresented populations to ensure that our Nation's diverse communities have access to NASA's unique opportunities. We will use the excitement of our missions and programs to inspire more students to pursue the study of science, technology, engineering, and mathematics and, ultimately, to pursue careers in aeronautics and space. NASA will also support educators in their efforts to increase student proficiency in these disciplines.

To add a human dimension to this effort, NASA will actively recruit educators to join the astronaut corps. As educator-astronauts, these select K–12 educators will help NASA to explore the bold frontiers in science, technology, engineering, and mathematics as never before. Proficient in the full range of mission responsibilities, this new cadre of astronauts will view the experience through the unique prism of an educator. They will be a key element of NASA's direct connection to classrooms by sharing with their fellow educators and students the talents and disciplines necessary to make history, break barriers, and explore frontiers. The merger of the talents and skills of educators with NASA's astronaut corps yields an unparalleled opportunity for

our Nation, the education community, and NASA to reach and educate our nations youth.

NASA will continue to collaborate with institutions of higher learning through student and faculty involvement in NASA research. A variety of ongoing programs connect college- and graduate-level students to NASA research activities. In so doing, they provide the real-world, hands-on experience that will truly engage these upper-level students in the excitement of NASA research and, therefore, will help them to become the next generation of explorers.

Goal 7: Engage the public in shaping and sharing the experience of exploration and discovery.

NASA's programs have long been a source of pride for the Nation. From our beginnings as an Agency, we have conducted all of our missions with the openness and broad participation that is a hallmark of America. As we move forward through the 21st century, our challenging missions, compelling scientific goals, and new information technologies will allow us to engage the public in new and exciting ways.

Effective public outreach and engagement is one of the primary objectives for each NASA Enterprise and for every NASA mission. We are a leader in the use of the Internet as a means of making images and knowledge freely available to anyone in the world. Images of the universe from the Hubble Space Telescope, and images of Mars and other planets sent by our robotic spacecraft, have made our Web site one of the most popular in the world. Via the Internet, we are enhancing our ability to give people the opportunity to experience the thrill of launch events and planetary encounters as they happen. NASA now also hosts regular Web chats with astronauts aboard the Space Shuttle and the International Space Station, providing everyone with the opportunity to ask questions and virtually experience space flight.

NASA also is committed to improving the capacity of science centers and museums by providing them with meaningful and engaging content based on our aeronautics and space research and exploration activities. These informal education opportunities are a major source of inspiration for people from all walks of life. We are also striving to find novel ways of engaging people more directly in our missions. For example, public opportunities to send digital signatures or messages to the planets aboard our robotic spacecraft enhance the connection that people feel with solar system exploration. Essay contests have provided people with a forum to express what space science and exploration means to them. Open houses, special events, and public speakers provide a still more direct connection between the public and NASA's activities.

Public enthusiasm for NASA's activities has always been high, because we are engaged in pursuits that, by their very nature, are exciting, unique, educational, and uplifting. In the coming years, we will see a dramatic increase in the number and extent of opportunities for public participation, as we undertake new missions and develop new technologies and capabilities. It is our goal to continuously enhance and improve our public outreach programs and to provide opportunities for every single American to share in the experience of exploration and discovery.

Image credit: Colorado School for the Deaf and Blind and STScI.

We seek to bring the beauty and mystery of the universe to every American. Here, a student from the Colorado School for the Deaf and Blind senses the planets through "Touch the Universe: A NASA Braille Book of Astronomy."

Space Flight Capabilities

NASA's Mission of exploration, discovery, and inspiration represents a unique contribution to the Nation and the global community. Our knowledge of the solar system, our ability to travel the skies safely, and the myriad technological innovations and inventions we have achieved are the direct result of the American public's investment in NASA. As we move forward in this new century to meet new challenges, we are prepared to fully realize and extend the value of those investments for the benefit of the Nation and the world.

To do so, we must develop and maintain the unique capabilities that will enable us to achieve our goals safely and effectively. These capabilities represent some of the most important and highly visible activities of the Agency. NASA ensures that the Nation will have reliable access to space for our human and robotic explorers and that our development of new space transportation systems will enhance national security as well as commercial space activities. Our space access workhorse, the Space Shuttle, is the world's only reusable space transportation system. It provides unique capabilities such as servicing research spacecraft like the Hubble Space Telescope. We are completing and operating a sophisticated laboratory in Earth orbit, the International Space Station, which enables groundbreaking research on physical, chemical, and biological processes as it opens the frontier for future human exploration. In partnership with American industry and universities, we are developing the revolutionary technologies that are required for our future missions. In the process, we are stimulating development of new products and techniques that will broadly benefit our Nation.

NASA's strategic goals provide a unified direction and common purpose for the Agency. Working together as One NASA, all of the Agency's Enterprises, Field Centers, and personnel play a role in defining and developing the unique capabilities through which we fulfill our Vision and Mission.

Shown at left is the Hubble Space Telescope, being serviced in the cargo bay of the Space Shuttle *Columbia* during mission STS-109.

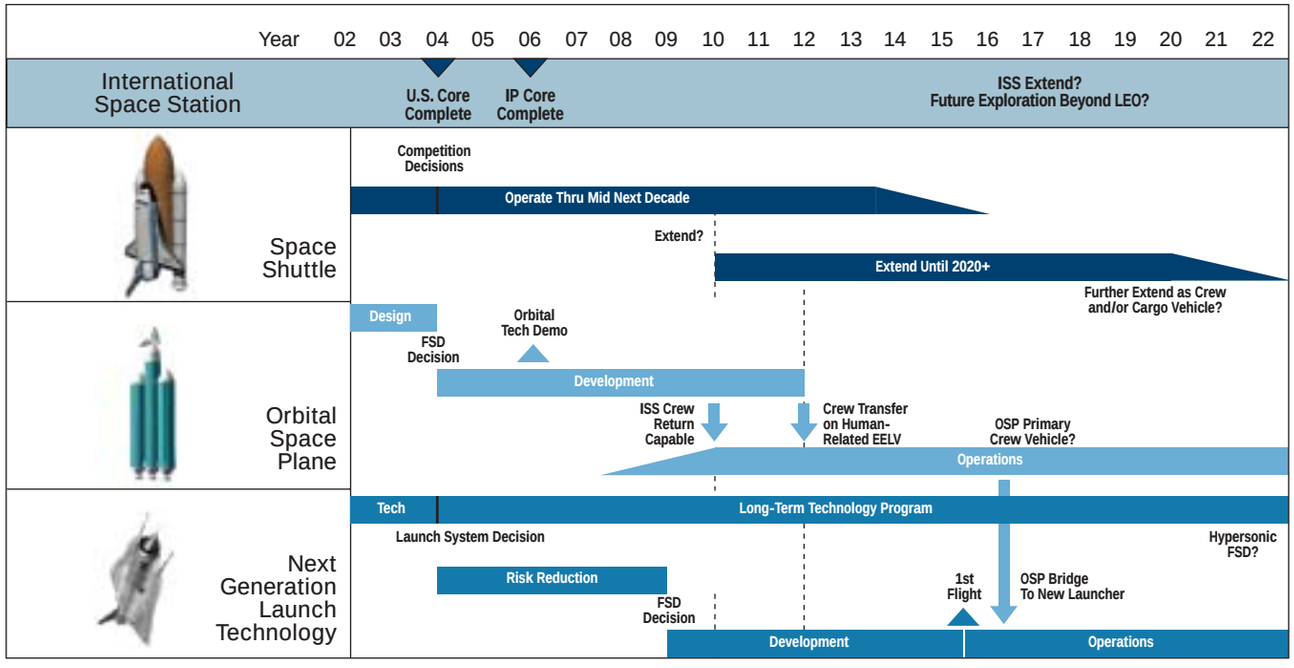
Goal 8: Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.

In the 45 years since space launch became possible, it has revolutionized many aspects of our daily lives, from communications to national security. But lifting payloads from the surface and accelerating them into Earth orbit, or beyond, remain challenging endeavors. The launch phase continues to be the highest risk period of any space mission. In addition, due to the thousands of dollars required to deliver each pound of hardware to low-Earth orbit, launch costs remain an obstacle to the complete utilization of space for research, exploration, and commercial purposes. Improving the Nation's access to space through the application of new technology is one of NASA's primary roles.

Access to space is currently provided by the Space Shuttle and a fleet of expendable launch vehicles provided by U.S. industry. These will continue to be the Nation's primary space transportation systems into the next decade. To plan for the future, NASA has developed a new Integrated Space Transportation Plan that represents a systematic approach to our space access needs. The plan will sustain the Space Shuttle through at least the middle of the next decade, will aggressively pursue a crew transfer vehicle called the Orbital Space Plane, and will develop the technologies that will enable future launch systems.

The Space Station represents both a major investment by the international community and a tremendous resource for space-based research and commercial development. In order to more fully use its capabilities in the long term, we must improve our ability to deliver crew and cargo and our ability to return crew members to Earth without exclusive reliance on the Space Shuttle. New U.S.-based access to and from the Space Station is a key near-term element of the transportation plan.

The development of safe, reliable, and affordable launch capabilities to serve the future needs of NASA and the Nation is critical. The Integrated Space Transportation Plan provides a framework for



The Integrated Space Transportation Plan provides a framework for continued Space Shuttle operations and for key decisions and developments.

the important near-term decisions and developments. In the longer term, by building on this foundation and incorporating advanced techniques for transferring between orbits, NASA and U.S. industry together will create a true highway to space.

Goal 9: Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.

Time and distance—these are the parameters that define the limits of human space travel. How far can we venture from our home planet? How long can we live and work in the space environment? When humans once again leave the relative safety of low-Earth orbit and venture into the solar system—as one day they will—their health, safety, and productivity will depend on the research being done today, both in orbit aboard the International Space Station and in our Earth-based laboratories.

Humans are remarkably well adapted to life on Earth, but for obvious reasons, they are very poorly suited to unassisted life in space. In addition to supplying human beings' need for basic life support, we must address the physiological and psychological health risks from radiation, reduced gravity, and isolation during space flight. For example, research has shown that astronauts lose about 1 percent of their bone mass in weight-bearing bones for every month in orbit. With today's technology, an astronaut on a trip to Mars may have to spend weeks recuperating from the journey before he or she could do any productive research upon reaching the planet. Furthermore, without heavy shielding or other protection, the total radiation dose an astronaut would experience during one round trip would pose a serious health risk and could even be fatal. These fundamental limitations must be addressed before humans will ever productively explore beyond low-Earth orbit.

NASA-sponsored biomedical researchers are working to understand the underlying mechanisms responsible for the physical and behavioral changes observed in humans during space flight. We are developing countermeasures to enable humans to live and work safely and effectively in microgravity, facilitate their re-adaptation to a gravitational environment, and to ensure crew health during space flight. We are also developing advanced

Tests of human physical capabilities aboard the International Space Station help us to understand and counteract the effects of the space environment.

human support technology that will enable dramatic reductions in mass, power, and volume, while increasing safety, reliability, and the availability of the crew to conduct scientific experiments.

Our experience in space demonstrates that human ingenuity and dexterity is absolutely required for certain types of tasks. The capacity for complex reasoning, intuition, and learned observational skills will not be available in robots for many decades, if ever. Humans have demonstrated an ability to diagnose and repair problems in space that may be beyond the reach of machine intelligence. By understanding and countering the physical limitations to human space flight, NASA is gradually opening the frontier of space to safe, efficient, productive exploration and discovery.

Goal 10: Enable revolutionary capabilities through new technology.

NASA's Vision and Mission lead us to challenging projects that will continue to extend the boundaries of science, engineering, and

discovery. To achieve them, we will need to develop new capabilities and revolutionary technologies that literally change the definition of what is possible.

We are pioneering new concepts that will make our scientific exploration of the universe more efficient and productive. By applying new information technologies, for example, intelligence will become an integral part of future spacecraft, enabling systems to autonomously make real-time decisions in the uncertain and unforgiving space environment. Advanced materials will incorporate embedded, adaptive microsensors and actuators to enable highly durable, damage-tolerant, self-repairing spacecraft. Such systems could autonomously overcome unanticipated problems in planetary environments and reprogram themselves to take advantage of new scientific opportunities.

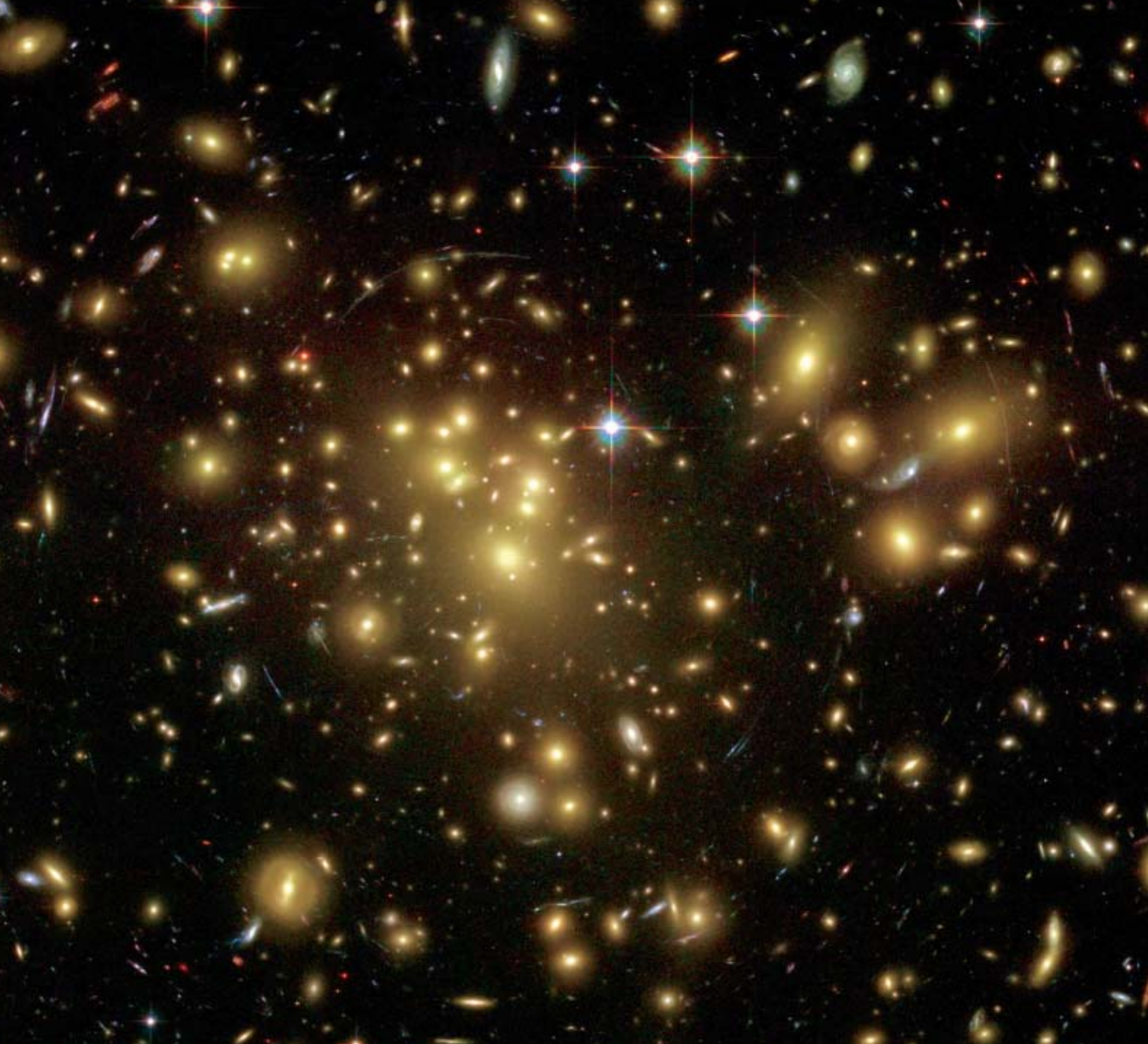
Based on such advances, entirely new exploration architectures will become possible. We envision multiple cooperative spacecraft that operate in interactive networks to thoroughly explore diverse phenomena. Evolving, reconfigurable sensor webs will look out into the universe and in toward our home planet to provide multidisciplinary, comparative measurements. Using new computational techniques, the data will be processed continuously to create a body of knowledge that will be made available in real time to the scientific community and the public. Enabled by these advances, the pace of space science and exploration will increase dramatically, and our discoveries in the cosmos will become an exciting and meaningful part of the human experience on Earth.

When human explorers venture into the solar system, they will be supported by a wide array of technologies for life support, information management, and scientific exploration. They also will operate in concert with robotic vehicles and devices that serve as their assistants and exploration partners. Today, we are planning and developing new technologies that will enable safe and efficient human exploration and optimize this human-robot partnership.

New technologies make the development of revolutionary exploration systems possible. Here, a “spider-bot” rover, small enough to fit in the palm of the hand, is being tested in the laboratory. With designs and capabilities inspired by biology, systems such as this one will permit the intensive exploration of harsh and remote environments in the solar system.

NASA technology will be developed in close partnership with industry and the university community, and competition will be used to ensure that the best and brightest scientists and engineers are engaged in meeting these challenges. We will assemble new tools and architectures to provide an intuitive, highly networked engineering design environment that will unleash the creative power of engineers and technologists throughout the Nation. Safety, high mission confidence, and rapid development and infusion will be the hallmarks of our engineering processes and culture.

Emerging fields such as biotechnology, information technology, and nanotechnology hold great promise for opening the frontier of space, and NASA will lead the way in their development and application. New spacecraft, instrument, and sensor technologies will enable us to make scientific measurements that are not possible today. And breakthrough power, propulsion, and communications technologies hold the promise of enabling fundamentally new missions. Driven by our scientific goals, NASA’s rich technology program will open the door to the future and pay tremendous dividends to the Nation.



Scenarios for the Future

By pursuing our new Vision and Mission, NASA is laying the foundation for further scientific advances and improved quality of life on Earth. Great societies are capable of doing great things, and when the history of the first quarter of the 21st century is written, we can imagine the following:

We have sought life's abodes.

NASA's missions have mapped continents on dozens of planets circling nearby stars, some of which will show signs of life-supporting atmospheres. Evidence continues to mount that life exists on planets within our own solar system, as revealed by advanced generations of robotic explorers. Humans and their robotic partners have assembled complex science facilities in space to unveil even more challenging cosmic questions.

We have come to understand our home.

NASA's missions have revealed complex interactions among Earth's major systems, vastly improving weather, climate, earthquake, and volcanic eruption forecasting and leading to a more complete understanding of the Sun's influence on our living world.

We have connected with the world's citizens.

NASA's technologies have led to dramatic improvements in air transportation, with quiet and clean aircraft, higher-speed international travel, and innovative methods to reduce aircraft accidents.

We have enabled new commerce.

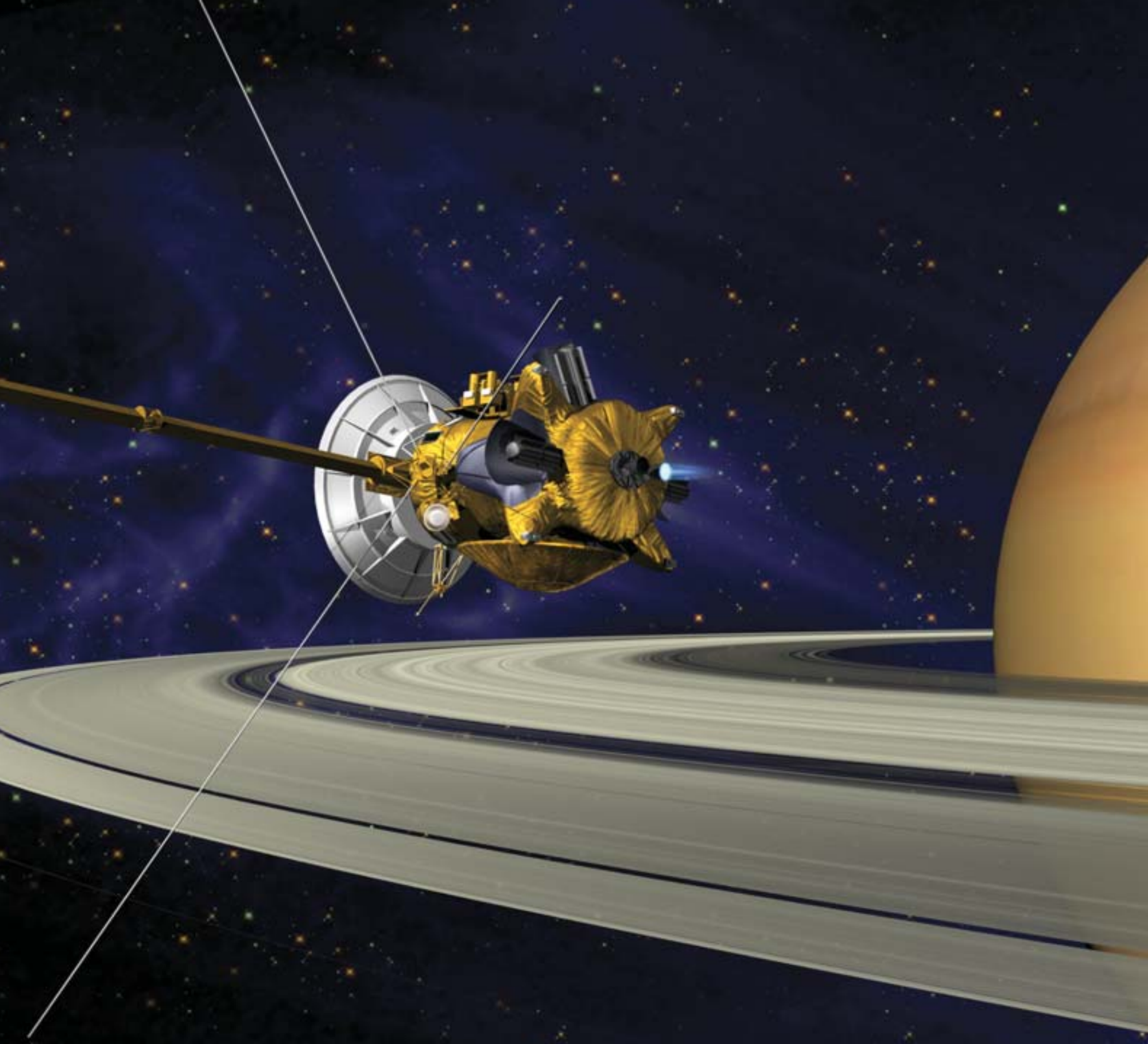
With advances by NASA, low-Earth orbit has become a rapid-growth economic zone, with commercial industries taking advantage of low gravity, abundant solar energy, low-cost access from Earth's surface, and a vista that encompasses the entire planet.

Shown at left is the massive galaxy cluster Abell 1689 that bends light from more distant galaxies, demonstrating a warp in space as predicted by Einstein's theory of gravity.

We have shared the Vision and the experience.

Throughout the world, students in Earth-bound classrooms have become excited by the fundamentals of physics, mathematics, and technology as they actively interact with space travelers via telepresence technology.

Astronauts and robots work together for science, exploration, and discovery.



Appendix I. Implementing Strategies

NASA must ensure that all of its activities are based on a foundation of sound planning and management practices. These practices are critical to NASA's achievement of its goals and are similar to the management strategies followed by all well-run organizations.

The five Implementing Strategies outlined in this section describe the ongoing framework under which NASA conducts its business. Each strategy has at least one objective that represents the near-term improvements to which NASA is committed. The responsibility for each objective is assigned to a specific NASA office or offices. Under that guidance, the entire Agency will adopt and practice these strategies to reach the objective. This common management framework will ensure that all of NASA is working together to achieve its Mission as safely and efficiently as possible.

The Implementing Strategies (IS) are summarized below.

IS-1. Achieve management and institutional excellence comparable to NASA's technical excellence.

Human Capital. NASA's most valuable asset is its workforce. As we enter this new era of exploration and discovery, the people of NASA will be the ones who allow the Agency to meet its challenges and accomplish its Mission safely, efficiently, and effectively. We must make sure the Agency continues to have the scientific and technical expertise to maintain the country's leadership in aeronautics, space science, and technology, as well as the professionals to meet financial, acquisition, and business challenges. To this end, NASA will implement an integrated Agencywide approach to human capital management.

This approach will attract and maintain a workforce that is representative of the Nation's diversity and includes the competencies that NASA needs to deliver the sustained levels of high performance that the Agency's challenging Mission requires.

The Assistant Administrator for Human Resources, working with Agency human resources professionals and senior managers, is responsible for providing tools, policies, and leadership in implementing the strategic human capital plan. The Associate Deputy Administrator for Technical Programs provides a specific focus on the technical capability of the workforce. NASA has made human capital management the shared responsibility of all organizations at all levels.

Competitive Sourcing. NASA will continue the competitive acquisition of programs and services. We will define programs and then leverage American industry and academia to accomplish them in the most cost-effective manner. At times, NASA must undertake technical and scientific projects on its own because of the challenging and unique nature of certain NASA programs. NASA is committed to expanding its use of competition for the benefit of the Nation.

NASA will define and adopt procedures to improve the competitive acquisition of programs, services, and assets to benefit the NASA Mission and the American taxpayer.

The Assistant Administrator for Procurement is responsible for defining, improving, implementing, and communicating the Agency's goals and procedures for competitive sourcing.

Financial Management. NASA is committed to improving our systems and procedures for financial planning, reporting, and management. NASA is responsible for complex and high-value systems such as the International Space Station, Space Shuttle, wind tunnels, and major scientific spacecraft that are unique in the world. These activities represent large investments by the American public. With Field Centers and laboratories throughout the country whose financial activities must be coordinated and integrated, our structure poses challenges for financial management. The diligence and accuracy with which we discharge our financial responsibilities will have a major effect on the taxpayers' views of the value of NASA programs.

NASA will improve and streamline the NASA financial management system to enhance accuracy, timeliness, and accountability.

The NASA Chief Financial Officer (CFO) is responsible for ensuring that our budget planning, reporting, and management are complete, timely, and accurate. The CFO must also ensure that each responsible individual within the Agency is given the tools and training to effectively manage his or her portion of the Agency budget. NASA will demonstrate continuous vigilance and accountability throughout its financial management structure.

Budget and Performance Integration. NASA and other Government agencies are shifting the way budgets are structured and reported. At NASA, performance planning and reporting are being fully integrated with the budget process. This change will ensure that individual programs are accountable for their results and that those results can be clearly identified within the budget. It will also give Agency managers insight into the details of each task they manage and how it contributes to the overall Agency Mission and goals.

NASA will unify the processes for strategic and budget planning, budget reporting, and performance planning and reporting.

For FY 2004, NASA is preparing an Integrated Budget and Performance Document (IBPD) that will unify what were previously disconnected and underutilized planning and reporting documents. The IBPD will start with the Agency's goals and objectives, as articulated in this strategic plan, and flow them through the desired outcomes and annual performance goals for every NASA budget theme. These goals will be displayed with budget details to show how every NASA budget item contributes to the overall

Shown at left, Cassini approaches Saturn.

Agency Mission. The IBPD will be coordinated with the annual Performance Report, which is a retrospective look at each budget year to assess how well our programs performed in meeting their goals. Metrics and long-term trends will be kept, and underperforming programs will be subject to redirection or cancellation. It is the responsibility of the NASA Comptroller to ensure that the Agency budget and performance planning and reporting are fully integrated and that clear and concise documentation is provided to the Administration in a timely manner.

Electronic Government. NASA is a leader in establishing electronic tools for information exchange. Along with other agencies, NASA is enhancing the way it uses these tools, not just for exchanging information among its employees and contractors, but also as an integral part of the way to plan and manage the results. NASA is simplifying its Internet presence to give the public easy access to exciting science and technology from NASA programs.

Beginning in early 2003, NASA will provide an integrated and user-friendly NASA-wide Internet portal that will provide improved public access to NASA Mission results and other products, improved visibility into NASA plans and programs, and enhanced communication among NASA employees and contractors.

NASA's information technology strategy, discussed in IS-2, describes how it will achieve these objectives. The NASA Chief Information Officer is responsible for providing the tools and infrastructure necessary to achieve the vision of electronic Government.

Institutions and Asset Management. NASA's capital assets are valued at more than $60 billion. These assets include real property (land, buildings, facilities, roads, and utility systems) and personal property (equipment and space vehicles). Achieving excellence in the institutional management of our capital assets, including the implementation of best practices, ensures that NASA has the necessary assets in place. It also ensures that these assets are safe and environmentally sound, are affordable, are of the right type and size, and are in operating condition. We will use new technologies to move our physical infrastructure beyond brick-and-mortar facility solutions and will leverage the Nation's industrial and intellectual capital. To ensure that NASA's assets are properly aligned with the NASA Mission, excess capability will be removed and new capabilities will be pursued with an emphasis on using innovative and creative teaming approaches, including partnerships with the commercial sector and other Government agencies. This strategy will ensure the most efficient possible use and improvement of NASA's capital assets.

NASA will improve the institutional management of capital assets to ensure that NASA's real property, personal property, processes, and systems are sustained and optimized to support NASA's missions and the capabilities required for today and tomorrow.

The Assistant Administrator for Management Systems, working with senior managers and the Agency's facilities, logistics, environmental management, and management systems professionals, is responsible for providing the tools, policies, and leadership to improve the management of capital assets.

IS-2. Demonstrate NASA leadership in the use of information technologies.

NASA is, first and foremost, an agency of technical and scientific knowledge. All of its science, engineering, and technology efforts are focused on the generation of knowledge—about our planet and how we can best live upon it, about the universe around us, and about life in the cosmos. The management, dissemination, and preservation of knowledge within NASA are critical to the effectiveness of our programs, and the distribution to the public of clear and timely information will ultimately define our value to the Nation.

Modern tools and techniques have dramatically increased the amount of information that NASA programs can produce, and they have greatly improved our ability to analyze and interpret this information to create a body of knowledge. But with these improvements comes the challenge of managing this vast amount of information in a coherent and cost-effective manner. With 15 percent of NASA costs devoted to information technologies and information management, it is imperative that we plan and leverage our information technology investments.

By 2005, NASA plans to implement the following measures:

- *provide all NASA operations with secure, highly reliable, interoperable information systems;*
- *enable NASA people to communicate across an integrated, low-cost information technology infrastructure;*
- *design and operate a One NASA network to improve organizational interactions and foster improved collaboration and sharing of accumulated NASA knowledge assets; and*
- *establish systems to deliver superior information services to consumers, educators, students, researchers, and the general public, as well as to Government agencies, NASA contractors and suppliers, and other businesses.*

The NASA Chief Information Officer is responsible for achieving these objectives and for ensuring that all Enterprises and offices throughout the Agency can take full advantage of the new and improved capabilities. Our information technology strategy will enable NASA to not only fulfill its Mission but also to remain a world leader in developing and deploying techniques for managing information.

IS-3. Enhance NASA's core engineering, management, and scientific capabilities and processes to ensure safety and mission success, increase performance, and reduce cost.

With more than two-thirds of the NASA workforce involved in scientific research, engineering, and engineering management, NASA must maintain and continuously improve its core capabilities in engineering, science, and technology. The successful management of programs and projects, including the appropriate oversight of their

progress, is a key requirement for achieving NASA's Mission. Program and project managers are challenged to use their expertise and to apply innovative techniques to improve safety and performance while reducing schedule and cost. Improvement of the management system that governs the formulation, approval, implementation, and evaluation of programs is critical to NASA Mission success.

NASA is committed to excellence in all of its programs. To ensure that the quality of the science that drives the Mission is outstanding, the Agency uses a competitive peer-review process to examine and guide the selection of the most meritorious scientific proposals. Through the use of formal research announcements, the Agency can ensure that the research is aligned with the Mission-driven goals.

Using modern computational and data-sharing tools, it is now possible to achieve, even in the early conceptual stages of projects, a level of design fidelity that was previously possible only after numerous design iterations and the development of hardware test beds. These new capabilities can be of significant benefit in the reduction of life-cycle cost and technical, cost, and schedule risk across NASA programs. The complex nature of NASA programs also requires that our systems engineering capability be second to none. Major programs such as Apollo, the Space Shuttle, and the Space Station were made possible by NASA's systems engineering expertise, and the programs of the future will be no less demanding.

To ensure that we achieve success safely and efficiently, NASA will take the following steps:

- *implement collaborative engineering capabilities and integrated design solutions to reduce the life-cycle cost and technical, cost, and schedule risk of major programs;*
- *apply methods and technologies to ensure that designs are safe and have a high likelihood for success;*
- *improve our systems engineering capability and ensure that all NASA programs follow systems engineering best practices throughout their life cycles;*
- *establish a process management approach that can be tailored to the needs of all projects and programs based on safety, scope, complexity, cost, and acceptable risk; and*
- *use peer review to ensure that NASA's scientific research is of the highest quality.*

It is the responsibility of the Associate Deputy Administrator for Technical Programs, the Associate Administrator for Safety and Mission Assurance, the Chief Engineer, and the Chief Technologist to ensure that our engineering and technological tools, capabilities, and processes are ready to meet NASA's challenges. In addition, it is the responsibility of the Associate Administrators for Space Science, Earth Science, and Biological and Physical Sciences, along with NASA's Chief Scientist, to ensure that NASA's scientific capabilities and processes are of the highest possible quality.

IS-4. Ensure that all NASA work environments, on Earth and in space, are safe, healthy, environmentally sound, and secure.

NASA boasts some of the most challenging work environments ever known. Protecting our home planet is part of NASA's Mission. NASA programs and operations rely on unique facilities and require careful planning and constant vigilance to be conducted safely and in an environmentally friendly manner. Our managers and employees are committed to making NASA work environments safe and secure, both on Earth and in space. This commitment to protect the public, the NASA workforce, and the assets under NASA's charge is deliberately reflected in the Agency's decisionmaking processes. The framework for mission success starts with a solid foundation of safety. By focusing on safety, we also will improve quality and decrease costs and schedules in the long run. We will keep safety and security considerations foremost when we develop, operate, and manage NASA facilities and high-value equipment.

To that end, NASA will pursue the following objectives:

- *prevent injuries from occurring during the course of NASA activities on NASA facilities or in the use of NASA equipment;*
- *work closely with other Government agencies and local authorities to identify and try to remove all security threats to NASA people, facilities, and information;*
- *protect NASA's physical assets from damage or theft;*
- *eliminate the incidence of occupational health problems for the NASA workforce; and*
- *eliminate environmental incidents, toxic chemical use, hazardous waste, and environmental liability at all NASA sites.*

The Associate Administrator for Safety and Mission Assurance is responsible for establishing and monitoring NASA's practices for safety and Mission success, and the Assistant Administrator for Security and Safeguards is responsible for assessing and mitigating all potential threats to NASA people and facilities. It is the Chief Health and Medical Officer's responsibility to evaluate, monitor, and improve the occupational health of the NASA workforce; it is the responsibility of the Assistant Administrator for Management Systems to study and monitor all environmental issues and to implement innovative processes to improve the environment at NASA facilities.

IS-5. Manage risk and cost to ensure success and provide the greatest value to the American public.

NASA has undertaken some of the most challenging projects ever attempted by humankind with a can-do spirit. NASA must continue to tackle these problems in a way that is safe, prudent, and cost-effective.

Decisionmaking in the face of uncertainties that affect cost, schedule, and technical parameters demands that our managers understand the impact of trade-offs on the potential for program success. Our managers must have the information and training they need to make well-informed decisions, and our stakeholders must be able to see how we arrive at key Mission decisions. We must develop modern tools for

cost and risk analysis, customized for NASA's unique needs. The Associate Administrator for Safety and Mission Assurance is responsible for ensuring that the Agency's managers have the ability to analyze the risk versus reward equation for major projects. NASA's Chief Engineer is responsible for providing top flight program management tools and ensuring that the Agency's engineering workforce has the necessary tools to minimize technical risk.

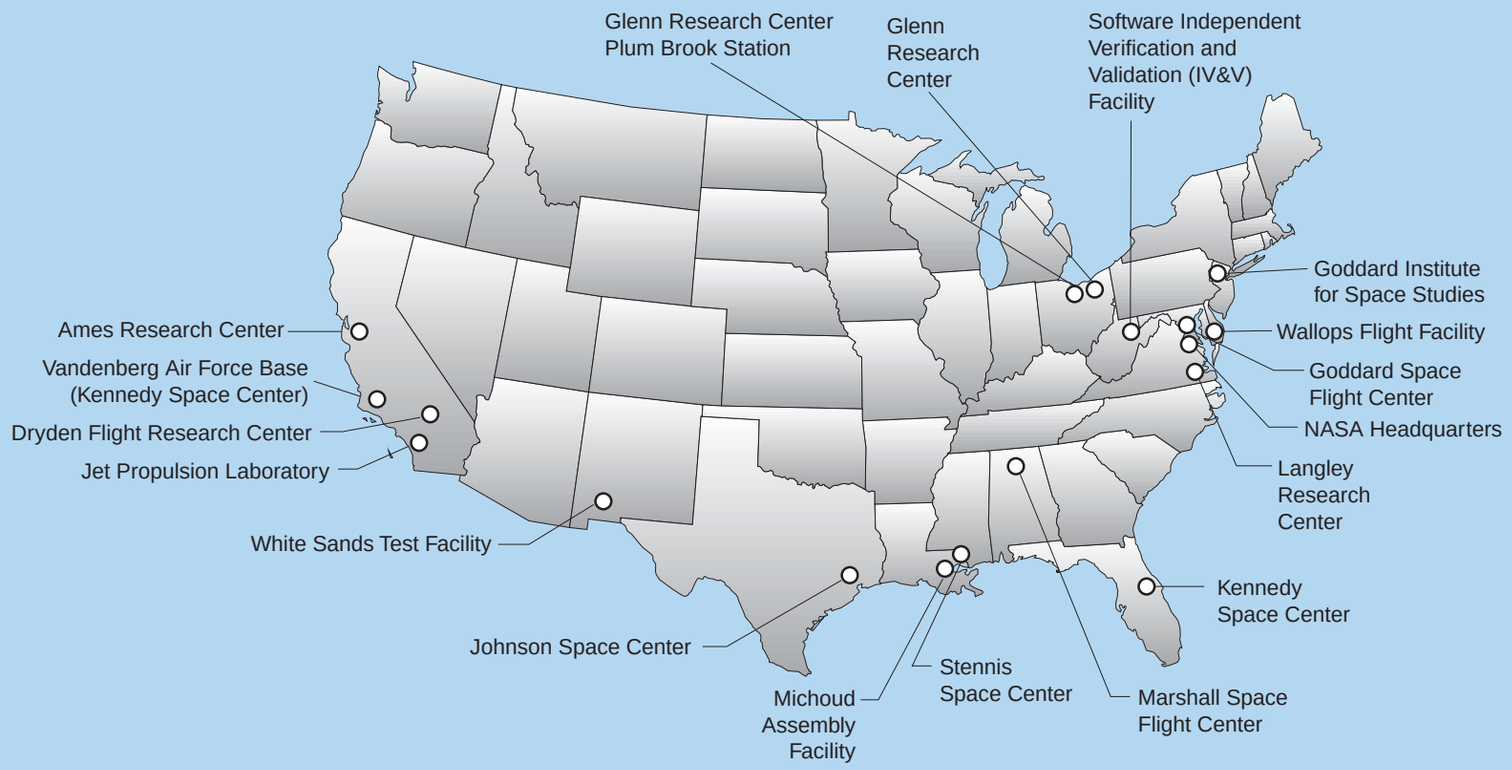
To achieve this goal, NASA will provide tools, techniques, and expertise that will enable all elements of the Agency to make well-informed decisions on matters of critical Mission importance.

Predicting and managing costs for long-term projects that involve many unknowns at their inception is another challenge for NASA. We have an obligation to assess costs accurately before we begin and to manage and report those costs diligently as the projects mature. The NASA Chief Financial Officer is responsible for ensuring that the required processes are in place for high-fidelity cost estimation and management.

NASA will improve its processes for cost estimation and the management of major NASA projects and programs.

By understanding and managing technical risk and cost throughout the Agency, we will ensure that NASA continues to explore, protect, and inspire in a manner that increases public trust and confidence.

Appendix II. Agency Organization



Additional NASA sites: Deep Space Network (New Mexico, Spain, Australia); Western Operations Support (Palmdale, CA); other miscellaneous sites.

The NASA team is a dedicated, skilled, and diverse group of scientists, engineers, managers, and support staff. We work in partnership with industry, academia, other U.S. agencies, and the space agencies of other nations.

NASA is composed of Headquarters in Washington, DC, nine Field Centers throughout the country, and additional installations that support specific Centers. NASA also owns the Jet Propulsion Laboratory (JPL), which is operated by the California Institute of Technology under a contract with NASA.

NASA Headquarters develops, coordinates, and promulgates Agency policy. It sets program direction at the highest level. Headquarters has the primary responsibility for NASA's communications with the Administration and Congress and is the Agency's focal point for accountability with external entities. It guides an integrated budget process, defines the Agency's long-term institutional investments, and coordinates Agencywide functions. To carry out its Mission, NASA is organized into six Enterprises. Each Enterprise draws on the capabilities of several Centers, while each Center contributes to multiple Enterprises.

Space Science Enterprise

The Space Science Enterprise seeks to answer fundamental questions about life in the universe: how it arose, what its mechanisms are, where in the solar system life may have originated or may exist today, and whether there are similar planetary environments around other stars where the signature of life can be found. The Space Science Enterprise is composed of five themes:

- Solar System Exploration,
- Mars Exploration,
- Astronomical Search for Origins,
- Structure and Evolution of the Universe, and
- Sun-Earth Connection.

The **Solar System Exploration** theme seeks to understand how our own solar system formed and evolved. This knowledge may have important implications about how other solar systems formed and for the search for life beyond Earth. The planets of our solar system and the ancient icy bodies far from the Sun are Rosetta Stones that can tell unique stories about the evolution of our solar system. As we learn more about the origins of living systems on Earth and our solar system's planets and moons, we may learn that life has also arisen on some of these other bodies.

The **Mars Exploration** theme investigates the mysteries of the history and present conditions on Mars. Dry and cold today, its surface shows the traces of a wet and warmer past. Frozen water at its poles and hints of relatively recent liquid water flows make Mars the most likely place to seek evidence of ancient or present extraterrestrial life. Contrasts between the current and past geology, atmospheres, and magnetic fields of Mars and Earth promise insights into why these neighboring planets differ so much today. Advances in our understanding of Mars would be useful for future human exploration.

The **Astronomical Search for Origins** theme strives to answer two questions: 1) Where did we come from? and 2) Are we alone? This theme seeks to observe the birth of the earliest galaxies and the formation of stars, find all the planetary systems in our solar neighborhood, including those capable of harboring life, and learn whether life exists beyond our solar system. We need to understand the building blocks of life, the conditions necessary for life to persist, and the signatures it writes on the sky. By exploring the diversity of other worlds and searching for those that may harbor life, we hope to understand the origins of our own world.

The **Structure and Evolution of the Universe** theme seeks to understand the nature and phenomena of the universe and the fundamental laws of space, time, and energy, and to trace the cycles that have created the conditions for our own existence. This objective is accomplished in part by observing signals from the Big Bang, mapping the extreme distortions of space-time near black holes, investigating galaxies, and understanding the most energetic events in the universe. We also must try to understand the mysterious dark energy that pervades the universe and will determine its ultimate destiny.

Shown above is the Hubble Space Telescope image of the Tadpole galaxy. The spiral "s" shape was distorted by a small hit-and-run galaxy whose gravity pulled out a long tail of stars and gas. In the background is a "wallpaper pattern" of 6,000 galaxies.

The **Sun-Earth Connection** theme investigates our Sun and how its structure and behavior affect Earth. The Sun's energy is responsible for Earth's present ecosystem, but the Sun is a variable star. Its small variability profoundly affects Earth. Changes in its long-term brightness cause ice ages, and its 11-year cycle of activity causes aurorae and other disturbances on Earth. Solar flares affect the upper atmosphere and can damage satellites and disable the power distribution grid on the ground. The Sun is also our nearest star and is an ideal laboratory for basic physics and learning about other stars.

Earth Science Enterprise

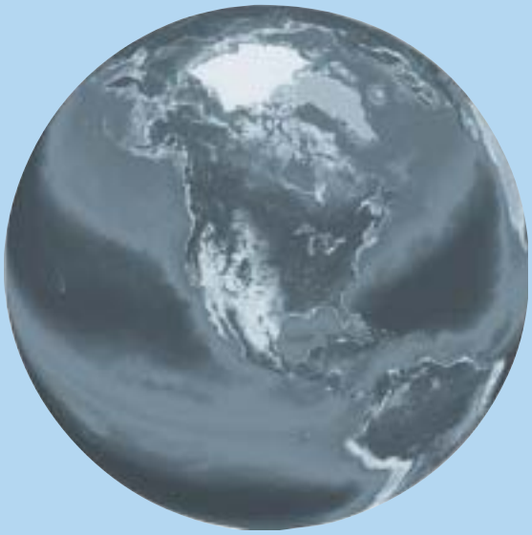
NASA's Vision to improve life here starts with the Earth Science Enterprise's study of planet Earth from space. The Enterprise seeks to understand and protect our home planet by advancing Earth-system science.

The Earth Science Enterprise is composed of two themes:
- Earth System Science and
- Earth Science Applications.

Within the **Earth System Science** theme, we are deploying and operating the first comprehensive constellation of Earth-observing research satellites designed to reveal interactions among Earth's continents, atmosphere, oceans, ice, and life. These interactions produce the conditions that sustain life on Earth. Data and information from our satellites enable researchers to understand the causes and consequences of global change and to provide governments, businesses, and citizens with the information to make decisions and improve our quality of life. Earth is the only planet known to harbor highly diversified life; as a result, it helps to direct NASA's search for life elsewhere in the universe.

NASA's armada of Earth-viewing satellites is opening a new window on the world by providing amazing views of Earth and discoveries that would not have been comprehensible decades ago. Our ability to look at the polar regions of Earth from space and study the role ice plays in the global water cycle is one example. Understanding how water cycles through Earth's system of oceans, atmosphere, land, and ice is essential for assessing the future of fresh water availability in the Southwest and in other thirsty regions of the globe.

Within the **Earth Science Applications** theme, NASA works with other Federal agencies to apply our research results and Earth-observation information products to applications of national priority. We have identified 12 applications in which our partner agencies have decision-support systems, such as weather prediction models and terrain databases for aviation, that are being improved based on NASA research and technological innovations. For each application, joint applications research and demonstrations are under way or are being developed. In addition, the Earth Science Applications program develops crosscutting solutions that advance the use of NASA information and technology across a range of potential new applications.



NASA created the first record of the global biosphere using data from the SeaWiFS instrument, flown in an innovative Government/commercial partnership. Compiling data on changes in the global biosphere across the seasons and years helps researchers understand how carbon circulates in Earth's system, which is one key piece of the climate change puzzle.

NASA's Earth Science Enterprise develops research programs and observing systems to meet the needs of the Nation's scientific communities and is a major participant in interagency research efforts, such as the Climate Change Science Program, the U.S. Weather Research Program, and a national program on reducing natural disasters.

NASA brings to the field of interagency and international partnerships a unique expertise in interdisciplinary research, advanced technology for Earth observation, and system engineering of end-to-end research programs.

Biological and Physical Research Enterprise

The space environment offers a unique laboratory in which to study biological and physical processes. Access to laboratories in space allows scientists to conduct research under conditions that have no parallel in the history of science. Experiments that take advantage of this environment extend from basic biology to quantum mechanics and from fundamental research to research with near-term applications in medicine and industry. The Biological and Physical Research Enterprise has a primary role to play in encouraging and engaging the next generation of explorers, and it supports direct student participation in space research from the graduate level down through the primary-school level.

The Enterprise is composed of three themes:
- Physical Sciences Research,
- Biological Sciences Research, and
- Research Partnerships and Flight Support.

The **Physical Sciences Research** theme supports research that takes advantage of the special environment of space to expand our understanding of the fundamental laws of nature. We also support applied physical science research to improve the safety and performance of human exploration and research efforts that have applications in terrestrial industry.

Through NASA's **Biological Sciences Research** theme, we investigate ways to support a safe, human presence in space. Space flight exposes humans to physiological and psychological health risks from radiation, reduced gravity, and isolation. We are researching how to define and control these risks.

The Biological Research theme also conducts research and development to improve the performance of life-support systems. It includes a basic biological research component that seeks to pursue fundamental biological

research questions and produce results that can support advanced methods for controlling the human health risks of space flight.

NASA's **Research Partnerships and Flight Support** theme establishes policies and allocates space resources to encourage and develop commercial partners' access to space research. This research supports product development on Earth and leverages industry resources to accelerate the commercial development of space. Ultimately, research partnerships may support the development of an infrastructure that can be leveraged for human exploration.

Aerospace Technology Enterprise

The Aerospace Technology Enterprise contributes to the NASA Vision by pioneering and developing advanced technologies. These technologies, in turn, improve the air transportation system, access to space, and science missions.

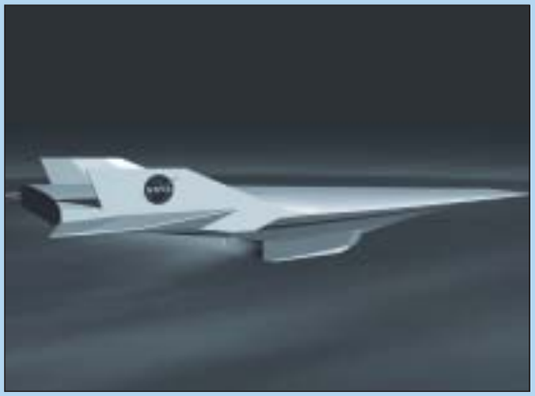
Peggy Whitson, the International Space Station's first Science Officer, conducted research on soybeans in space. Researchers on Earth are now studying the first-ever space-grown soybean crop to learn of potential unique, desirable traits.

The Aerospace Technology Enterprise helps others use NASA technology for nonaerospace commercial purposes and develops technology partnerships with those in industry and academia that are outside of traditional aerospace fields. The Aerospace Technology Enterprise composes four themes:

- Aeronautics Technology,
- Space Launch Initiative,
- Mission and Science Measurement Technology, and
- Innovative Technology Transfer Partnerships.

The **Aeronautics Technology** theme holds a unique role within NASA as the sole administrator of the Agency's aeronautics investments. By developing and transferring technologies, NASA's investments in Aeronautics Technology play a key role in creating a safer, more secure, more environmentally friendly, and more efficient air transportation system, increasing performance of military aircraft and developing new uses for science or commercial missions. This theme also enhances the Nation's security through its partnerships with the Department of Defense (DOD) and the Federal Aviation Administration (FAA). Research areas include advanced propulsion technologies, lightweight high-strength adaptable structures, adaptive controls, advanced vehicle designs, and new collaborative design and development tools. In collaboration with the FAA, research is conducted in air traffic management technologies for new automation tools and concepts of operations. Many vehicle types, including subsonic, supersonic, and general aviation aircraft, extremely short-takeoff and landing airplanes, and unmanned aerial vehicles, are addressed.

New space transportation capabilities are needed to ensure that America continues its leadership in space. The **Space Launch Initiative** theme ensures safe, affordable, and reliable access to space. It helps to create a more secure world by collaborating with the DOD on critical access to space and hypersonics technologies that support future civil and military aerospace missions. The theme gives special emphasis to NASA's unique needs, including crew escape



The X-43 scramjet hypersonic demonstrator represents the intersection of air and space transportation, potentially serving as a first stage to orbit, or as a means of global reach for military applications.

and survival systems, which will not be developed by the private sector without Government funding.

The **Mission and Science Measurement Technologies** theme is responsible for developing crosscutting technology for a variety of aviation and space applications, such as communications, power and propulsion systems, microdevices and instruments, information technology, nanotechnology, and biotechnology. These technology advances will have the potential to open a new era in aviation and allow space missions to expand our knowledge of Earth and the universe. By developing advanced science instrument, sensor, communications, autonomy, and data analysis technologies, we contribute to NASA's Mission to understand and protect our home planet and explore the universe. Our technologies are unique to NASA because we focus on space mission applications. Quality and performance requirements usually exceed those of all other potential users. Our end-use applications may have no known customer outside NASA.

Under the **Innovative Technology Transfer Partnerships** theme, we will work to form partnerships with industry and academia in order to develop new technology that supports Enterprise programs. We will also commercialize and

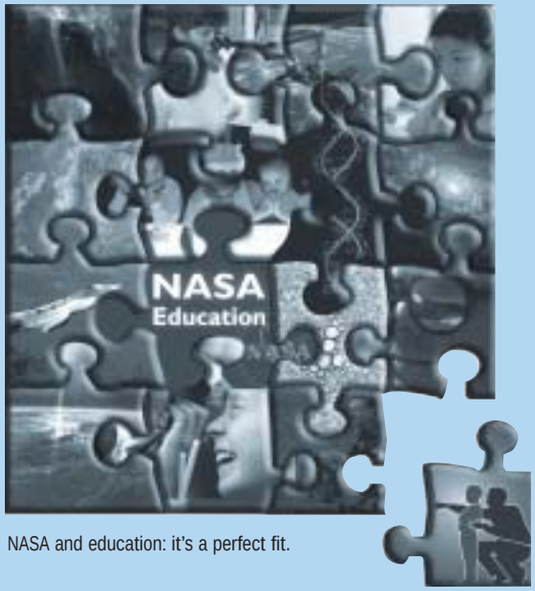
transfer NASA technology to U.S. industry and enhance NASA technology and commercial objectives through the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. In FY 2004, NASA will introduce the Enterprise Engine to create innovative partnerships with nonaerospace industrial firms and venture capitalists in order to address NASA's new technology Mission.

Education Enterprise

Education, our newest Enterprise, was established in 2002 to inspire more students to pursue the study of science and engineering, with the ultimate goal of having them choose careers in aeronautics and space at NASA. This new Enterprise will unify the educational programs in NASA's other five Enterprises and at the nine NASA Field Centers and JPL. Under this One NASA vision, NASA Education will permeate and be embedded within all Agency activities.

The Education Enterprise includes the **Education Programs** theme. This theme includes two new programs specifically designed to motivate students to pursue careers in science and engineering: the Educator Astronaut Program (EAP) and the NASA Explorer Schools Program. EAP will select teachers and transport them into space to inspire and motivate students. The universe will be their classroom; the Space Shuttle and the International Space Station will be their laboratories; and the unique environment of space will provide teaching opportunities unparalleled on Earth. The NASA Explorer Schools program will engage teachers, students, parents, and the community by providing a customized and sustained learning environment using NASA's most recent discoveries and latest technologies.

The Education Enterprise will provide unique teaching and learning experiences, as only NASA can, through the Agency's research and flight capabilities. Students and educators will be able to work with NASA and university scientists to use real data to study Earth, explore Mars, and conduct other scientific investigations. They will work



NASA and education: it's a perfect fit.

with our engineers to learn what it takes to develop the necessary new technology to reach the farthest regions of the solar system and to live and work in space. Agency assets such as the Hubble Space Telescope, the Earth Observing Systems, the Space Shuttle, and the International Space Station will become tools for advancing the frontiers of education as well as science and technology.

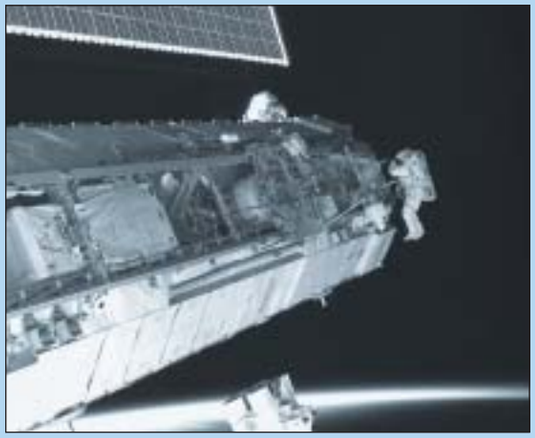
It is important that the next generation of explorers represent the full spectrum of the U.S. population, including minority students and those from low-income families. To ensure diversity in NASA's workforce, our education programs pay particular attention to underrepresented groups. Consistent with Presidential Executive orders, NASA will continue to engage and support Historically Black Colleges and Universities, Hispanic-Serving Institutions, and the Tribal Colleges and Universities. NASA Education will support our Nation's universities to educate more students in science and engineering by providing meaningful research and internship opportunities for qualified students, plus a roadmap for students seeking NASA careers.

Space Flight Enterprise

The Space Flight Enterprise provides many critical enabling capabilities that make possible much of the science, research, and exploration achievements of the rest of the Agency. The Space Flight Enterprise does this through three themes:

- International Space Station,
- Space Shuttle, and
- Space and Flight Support.

The **International Space Station** theme supports activities for establishing a permanent human presence in Earth orbit—the International Space Station. The Space Station provides a long-duration, habitable laboratory for science and research activities investigating the limits of human performance, expanding human experience in living and working in space, and enabling the commercial development of space. The Space Station will allow unique, long-duration, space-based research in cell and developmental biology, plant biology, human physiology, fluid physics, combustion science, materials science, and fundamental physics. It will also provide a unique platform for observing Earth's surface and atmosphere, the Sun, and other astronomical objects.



Assembly of the International Space Station has been a spectacular success, providing an orbiting laboratory in which to conduct world-class research.

The **Space Shuttle** theme builds on the Shuttle's primacy as the world's most reliable and versatile launch system. The Shuttle, first launched in 1981, provides the only capability in the United States for human access to space. In addition to transporting people, materials, and equipment, the Space Shuttle allows astronauts to service and repair satellites and build the Space Station. The Space Shuttle can be configured to carry different types of equipment, spacecraft, and scientific experiments that help scientists understand and protect our home planet, explore the universe, and inspire the imagination of the American people.

The **Space and Flight Support** theme encompasses several programs. They are the Space Communications, Launch Services, Rocket Propulsion Testing, and Advanced Systems. Space Communications consists of two programs: the Tracking and Data Relay Satellite System (TDRSS), which supports the Space Shuttle, Expendable Launch Vehicles, and research aircraft; and the NASA Integrated Services Network (NISN), which provides telecommunications services at facilities such as the flight support networks, mission control centers, science facilities, and administrative communications networks for NASA Centers. The Launch Services program focuses on meeting the Agency's launch and payload processing requirements by ensuring safe, cost-effective access to space via the Space Shuttle. The Rocket Propulsion Testing Program supports a core of highly trained test and engineering crews and test facilities. Finally, the Advanced Systems Program conducts studies, identifies and develops technology, and pursues transformational new capabilities that work to promote the future of human and robotic exploration of space.

Appendix III. Agency Objectives

Agency goals are met through objectives which are summarized below. The tables at the end of this section provide an integrated summary that includes the themes associated with each objective. The themes are accountable for the objectives through the annual performance plan, which includes both long-term-outcome and annual-output measures.

Goal 1: Understand Earth's system and apply Earth-system science to improve the prediction of climate, weather, and natural hazards.

Objective 1.1: Understand how Earth is changing, better predict change, and understand the consequences for life on Earth.

Earth science research, observations, modeling, and scientific assessments are designed to enable reliable predictions of future global change. With our partners and the scientific community, we are addressing key science questions through Earth observations from space-based, suborbital, and in situ platforms. We are maturing a suite of observing capabilities and will hand them over to our operational observing partners, such as the National Oceanic Atmospheric Administration (NOAA). We also are moving to deploy advanced observing satellites to measure other important parameters for the first time, such as carbon sources and sinks and ocean surface salinity. These new measurements enable more reliable predictions of climate changes and other globally important changes in Earth's system.

Objective 1.2: Expand and accelerate the realization of economic and societal benefits from Earth science, information, and technology.

Results from NASA Earth science research contribute to information solutions that enhance economic and homeland security using improved predictions of weather, climate, and natural hazards. NASA provides the research-quality, Earth-observing systems and Earth science models that advance the Nation's ability to understand and protect Earth's dynamic system. By working through partnerships with NOAA, the U.S. Geological Survey (USGS), and other Federal agencies, we improve essential services such as tracking hurricanes, assessing crop health and productivity, and evaluating forest fire risks, aviation safety, energy forecasts, and the potential for the climate-driven spread of infectious disease.

Objective 1.3: Understand the origins and societal impacts of variability in the Sun-Earth connection.

Changes in the Sun affect global climate change, disrupt technological systems, and pose a radiation danger for humans in space. NASA seeks to develop the scientific understanding necessary for predicting and mitigating these effects. We will forecast solar activity, measure the radiation inputs to the terrestrial system, and determine the causes of variability in Earth's radiation belts and of storms and irregularities in the ionosphere and upper atmosphere. We also will characterize the radiation environment to enable spacecraft design improvements. Later, we will probe the links among the Sun's photosphere, chromosphere, corona, solar wind, and the heliosphere; and closer to home, among the Earth's mesosphere, thermosphere, ionosphere, plasmasphere, and lower atmosphere. Partnerships with other agencies, particularly NOAA and the Department of Defense (DOD), are key to understanding these very complex systems.

Objective 1.4: Catalogue and understand potential hazards to Earth from space.
It has been estimated that impacts by asteroids as small as one kilometer in diameter could cause major global climate perturbations and global devastation. The direct effects of impacts by bodies as small as 100 meters could cause major damage on regional scales. NASA is working toward a congressionally mandated goal to discover, by 2008, at least 90 percent of asteroids and comets larger than 1 kilometer in diameter that could come near Earth and determine their orbits with sufficient accuracy to predict whether any of them pose a threat to Earth. None of the objects studied to date has been found to pose a threat to Earth.

Goal 2: Enable a safer, more secure, efficient, and environmentally friendly air transportation system.

Objective 2.1: Decrease the aircraft fatal accident rate and the vulnerability of the air transportation system to threats and mitigate the consequences of accidents and hostile acts.
Research into the most common causes of accidents is the highest priority in safety. Loss of control and limited visibility are the greatest risks in peacetime military, commercial, and general aviation. Other key areas for our research and technological development are flight during hazardous weather, controlled flight into terrain, air traffic management, human-error-induced accidents and incidents, and mechanical or software malfunctions. Preventing aircraft sabotage or the disruption of the command, navigation, and surveillance infrastructure and protecting against electronic viruses are areas of great interest. Beginning in 2004, NASA will examine security concepts and technologies that could help stop terrorist acts.

Objective 2.2: Protect local and global environmental quality by reducing aircraft noise and emissions.
Aircraft emissions of greenhouse gas (CO_2) are directly related to fuel consumption. Research into lighter-weight vehicles and components will reduce fuel consumption. We also will pursue innovative vehicle concepts—such as blended-wing bodies and propulsion designs like vaneless, counter-rotating turbomachinery—that show great potential for reducing the emissions that create smog and global warming.

New computational and experimental tools are being developed that will allow for a better modeling and understanding of noise sources, mainly for the aircraft engines and the airframe, and how noise propagates from these sources. Low-noise propulsion systems, advanced vehicle concepts, advanced materials, and innovative noise-shielding techniques will be developed.

Objective 2.3: Enable more people and goods to travel faster and farther, with fewer delays.
NASA and the Federal Aviation Administration (FAA) will modernize equipment, software, and procedures for significant improvements in the air and at airports. The highly complex nature of the air transportation system requires the integration of technological solutions from many disciplines. Technologies to enable high-bandwidth, highly reliable, secure networks with global connectivity will be developed to support information-intensive applications, particularly for safety and security. NASA also will develop and test new vehicle concepts and technologies to meet differing requirements for speed versus distance and will expand the use of the large number of regional and local airports without towers.

Goal 3: Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia.

Objective 3.1: Enhance the Nation's security by developing and demonstrating critical access-to-space technologies that benefit NASA, DOD, and other Government agencies.
NASA will work with DOD to pursue air-breathing hypersonic propulsion and supporting technologies, such as airframe design and materials and thermal protection systems. NASA and DOD are collaborating in many areas, including communications, conventional rocket-based propulsion development and the research and development of hypersonic technologies, as part of the National Aerospace Initiative (NAI). Related technologies such as remote sensing, surveillance, image processing, and advance computing also are being pursued.

Objective 3.2: Enhance the Nation's security through aeronautical partnerships with DOD and other Government agencies.
NASA will support national security by working with DOD through research collaborations, including advanced propulsion technologies; lightweight, high-strength, adaptable structures; adaptive controls; advanced vehicle designs; and new, collaborative design and development tools. Continued reduction in forces based around the globe and arising new threats call for innovation in operational concepts and new vehicles, including subsonic and supersonic aircraft, sensing vehicles, extremely short take-off and landing airplanes, and unmanned aerial vehicles.

Objective 3.3: Improve the Nation's economic strength and quality of life by facilitating the innovative use of NASA technology.
NASA's technologies are available to industry for use in the U.S. economy. NASA works closely with large and small businesses to facilitate the innovative use of NASA technology.

Objective 3.4: Leverage resources in support of national priorities through partnerships across industry, academia, and the Government for market-driven research in space.
NASA seeks to couple its technology with private-sector technology to the advantage of both. Partnerships with the industrial research community are an efficient method for applying the advantages of space research to improve the quality of life on Earth. A number of these partnerships are using the unique resources of the International Space Station to advance mutually beneficial development activities.

Objective 3.5: Resolve scientific issues impacting Earth-based technological and industrial applications by using the unique low-gravity environment of space.
NASA will pursue far-reaching goals in cell science, tissue engineering, disease modeling, the in vitro growth of organs, and infectious disease. We will build upon the current ability to grow tissues outside the body by introducing and exploiting a novel, rotating bioreactor design.

Goal 4: Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space.

Objective 4.1: Understand how life responds to the space environment and the role of gravity in the processes of life.
NASA will pursue exploratory biological research of the adaptation of terrestrial life forms such as cells and organisms (e.g., bacteria, insects, plants, animals) to achieve new insights into the effects of gravity on biological processes. We seek answers to questions that range from understanding physical, chemical, molecular, and cellular changes to changes at the level of the whole organism, and the complex interaction of multiple species in closed environments. The critical questions include the following:

- Does space affect life at its most fundamental levels, from the gene to the cell?
- How does long-term exposure to space affect organisms?
- How does space affect the life cycles of organisms from one to many generations?
- How do systems of organisms change in space?

This knowledge will provide critical strategic information for human exploration.

Objective 4.2: Understand the fundamental organizing principles of nature and how they give rise to structure and complexity, using the low-gravity environment in space.
Earth's gravity limits our ability to test phenomena in fundamental physics, combustion science, and material science. These experiments must be done in space to achieve the accuracy necessary to meaningfully test the theories under question. Through research in space, NASA will learn how gases condense into fluids, how the structure and properties of these fluids arise, and how quantum phenomena affect real, observable systems.

Goal 5: Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere.

Objective 5.1: Learn how the solar system originated and evolved to its current diverse state.
The planets of our solar system formed within the first billion years or so of their 5-billion-year history. Many of the current characteristics of the solar system were determined during this critical formative epoch. The tremendous changes that Earth and the planets have undergone over the intervening eons have erased most physical records. Fortunately, vital clues are scattered throughout the solar system, from the oldest rocks on the Moon and Mars, and the cratered surfaces of Mercury and Callisto to the frozen reaches of the Kuiper Belt in the outer solar system. Major NASA missions will gain an understanding of the evolution of our solar system through outer solar system exploration, as well as surface exploration of and sample return from the inner planets and small bodies. More modest and frequent solar system exploration missions will investigate more limited scientific objectives.

Objective 5.2: Determine the characteristics of the solar system that led to the origin of life.
Our understanding of the emergence of life on Earth is the basis for our knowledge of the conditions necessary for life anywhere. In the past, it was believed that the habitable zone of our solar system was confined to a fairly narrow region at about Earth's distance from the Sun. On Earth, habitable environments were believed to be limited to regions on or near the surface, where temperature, pressure, and chemical conditions are favorable to the ecosystem we see around us. Discoveries in the past few decades, however, have greatly expanded our view of the range of conditions capable of supporting life on our own planet. These discoveries on Earth, coupled with a greater understanding of the range of conditions on other planetary bodies, have multiplied the number of environments within our solar system thought possibly to be conducive to life. Many NASA missions over the past 30 years have safely and successfully used radioisotope generators, a form of nuclear power. NASA will work with the Department of Energy to develop nuclear fission-based power systems that will enable an entirely new class of solar system exploration missions. The first of these missions is expected to orbit Europa, which probably has a liquid water ocean under its frozen surface, and other icy moons of Jupiter for an extended period of time to learn about the evolution of the solar system and potential habitable zones.

Research suggests that when the Earth was formed, conditions in the solar nebula were too hot to retain the water and organic materials seen on Earth today. Instead, these materials probably condensed in the outer reaches of the solar nebula in comets. Subsequently, comet impacts may have delivered these essential ingredients of life to the planets as they formed. NASA will seek to retrieve a sample of organic material from the surface of a comet for clues to the origin of life.

Planetary interiors, surfaces, atmospheres, magnetospheres, and even radiation belts are now known to be highly interdependent. Earth's magnetosphere, for example, which is generated by a dynamo process within its molten core, shields us from fatal high-energy radiation. NASA observations suggest that Mars may have had a similar protective magnetosphere early in its history, which might have allowed life to develop and survive.

Objective 5.3: Understand how life begins and evolves.
To understand how life can begin on a habitable planet, such as Earth, it is essential to know what organic compounds were available early in its development and how they interacted with the planetary environment. Laboratory simulations have demonstrated that relevant molecules can by synthesized in interstellar ices in an emerging solar system. Analysis of meteorites, asteroids, comets, and interplanetary dust particles has

shown that many chemical compounds essential to life processes are present in these bodies, supporting the hypothesis that these materials were transported to Earth by comet and asteroid impacts. NASA research will help establish the sources of prebiotic organic compounds and understand their history on newly formed planets.

Objective 5.4: Understand the current state and evolution of the atmosphere, surface, and interior of Mars.
Understanding atmosphere, surface, and interior of Mars, and their interactions with one another, can tell us much about the environment in which life could have developed there and about the possibility of life elsewhere in the universe. NASA is planning a succession of orbital and surface probes over the next decade to extend our understanding of Mars. NASA will continue ongoing pioneering imaging and physical and chemical observations of Mars from orbit. In 2004, we will make measurements on the surface of Mars at two locations where liquid water appears to have played a major role. Also beginning in 2004, we will map the Martian surface layer in search of water-related layering. Later in the decade, we will measure atmospheric processes over a full Mars year and provide observations of the role of liquid water on the surface. In 2009, we expect to directly search the most promising local site on the surface of Mars for evidence of organic materials within the surface layer. We will shape future activities based on new knowledge gained by these investigations.

Objective 5.5: Determine if life exists or has ever existed on Mars.
NASA will study meteorites from Mars to detect the presence of chemical indicators of life itself, or at least life-hospitable indicators such as water, and also will develop new sensors that will be able to search for evidence of organic materials on the surface of Mars. Orbital reconnaissance will enable us to focus landed missions on the highest priority surface sites relevant to the search for life. Two rovers launched in 2003 will be followed in 2009 by a sophisticated surface laboratory to search for mineralogical and chemical evidence of the role of water and organic materials or prebiotic molecules in the accessible surface layer.

Objective 5.6: Develop an understanding of Mars in support of possible future human exploration.
Analyzing the Martian environment for potential hazards to human explorers and inventorying Martian resources will benefit future human missions. Missions over the next decade will characterize the distribution of water—as ice or liquid—both from orbit and from a surface analysis of local materials. We already have improved estimates of the abundance of water on Mars, and in 2005, we will use radar to search as deep as hundreds of meters for evidence of water-bearing layers. Surface measurements of the mechanical properties, toxicity of local materials, and composition of specific materials will be conducted in 2004 and 2009. We are currently measuring the galactic cosmic radiation background from Mars orbit, and measurements of solar and cosmic radiation will be conducted from the surface of Mars in this decade. In 2009, we will penetrate the shallow subsurface to measure the presence of water and oxidants as a function of depth. By early in the next decade, an inventory of critical environmental parameters, local hazards, and potential resources will be available to support future human exploration.

Objective 5.7: Discover what powered the Big Bang and the nature of the mysterious dark energy that is pulling the universe apart.
NASA's astrophysics missions seek to understand the origin, evolution, and ultimate destiny of the universe. This quest is advanced through discoveries about its beginning in the Big Bang and the forces that dominate its subsequent evolution, including gravity and the mysterious and invisible newly discovered dark energy.

We are currently measuring the amount of ordinary matter, unseen dark matter, and dark energy in the universe. By measuring the change in dark energy properties over the history of the universe, we will directly address the question of the nature of dark energy. We also will attempt the first observations of primordial gravitational radiation that remains from the Big Bang.

Objective 5.8: Learn what happens to space, time, and matter at the edge of a black hole.
Black holes are among the most exotic phenomena in the universe, and exploration of the universe is not complete without understanding them and their impact on their surroundings. We have learned that black holes are ubiquitous, and we will take a census of black holes in the nearby universe to help us understand their formation and evolution. We will map space-time near merging supermassive black holes throughout the entire universe. The behavior of matter and time, as matter plunges into a black hole, will be analyzed by observing the last radiation escaping from distant black holes.

Objective 5.9: Understand the development of structure and the cycles of matter and energy in the evolving universe.
The exploration of the universe begins with understanding how the formless energy of the Big Bang became the richly structured pattern of stars and galaxies that we see today. Similarly, the first step in understanding the origin and evolution of life is to learn how the elements that make up life were created inside stars and dispersed into planetary systems. We will examine the x-ray emissions from clusters of galaxies to determine the relative roles of normal and dark matter in the formation and dynamics of galaxies. By measuring the merger rates of supermassive black holes, we will analyze the development of structure in the early universe. The birthplace of the elements will be mapped with powerful spectrometers. The universe is also a laboratory for studying extremes of matter and energy that cannot be produced in terrestrial laboratories and we will study gamma-ray bursts, the most powerful explosions since the Big Bang. We also will peer into the heart of cosmic jets ejected from rotating, magnetic black holes.

Objective 5.10: Understand how today's universe of galaxies, stars, and planets came to be.
Stars began to form even before the first galaxies, and what had been a calm, nearly formless sea began to surge

with complex forms of matter and energetic processes. Today, the universe is full of structure, from giant but structurally simple galaxies to minuscule but complex single living cells. Our objective is to understand how this came about, how stars and planets form, how the chemical elements are made, and ultimately how life originates. Our research focuses on how the cosmic web of matter organized into the first stars and galaxies, how these evolved into the stars and galaxies we see today, how different galactic ecosystems of stars and gas formed, and which ones might support the existence of planets and life.

Objective 5.11: Learn how stars and planetary systems form and evolve.

During the past three decades, we have used both ground- and space-based facilities to look inside the nurseries where stars and planets are born. In parallel, meteorite studies and planetary probes have revealed clues to the processes that shaped the early evolution of our own planetary system. An overarching goal is to connect the processes we observe elsewhere in the universe with the objects and phenomena in our solar system. How did interstellar gas and dust become stars and planets, and how did simple molecules and dust evolve into the complex organic molecules important for life? An important facet is to observe planetary systems around other stars and compare their architectures and evolution to our own.

Objective 5.12: Understand the diversity of other worlds and search for those that might harbor life.

Astronomers have found evidence of many planets orbiting stars other than our Sun. While most planets found to date are unlike those in our own solar system, we seek to establish if there are Earth-like planets. If such planets exist, we will define their characteristics and determine whether they show signs of past or present life. To do this, tools and techniques to search for life on planets beyond our solar system will be needed. In the near term, we will seek Earth-sized planets by searching for the slight dimming of a star's light as a planet passes between the star and Earth.

Objective 5.13: Understand the changing flow of energy and matter throughout the Sun, heliosphere, and planetary environments.

The dynamics of the solar system define the environment in which we live. These dynamics include the origins of variability in the Sun and solar wind, how the magnetospheres and atmospheres of Earth and other planets respond now and have evolved, and how the outermost region of space influenced by our star interacts with the rest of the galaxy of which it is a part. The Sun-Earth system is the only planetary system where life is known to exist. Learning about the past and present influences of the Sun on the terrestrial environment will illuminate the origins of life and help protect society. We also will show how the outer layers of the solar atmosphere are energized, and we will track the causes of terrestrial disturbances from their magnetic origins in the solar atmosphere, through the solar wind, and finally into the interacting regions of Earth's magnetosphere and upper atmosphere. Even the interstellar gas that enters through the outer boundary of the solar system can be analyzed using remote sensing.

Objective 5.14 Understand the fundamental physical processes of space plasma systems.

Most of the universe is filled with plasma, where electrically charged matter interacts with electric and magnetic fields. Three fundamental physical processes occur in space plasmas: the acceleration of charged particles; the creation, annihilation, and reconnection of magnetic fields; and the coupling of processes that operate on vastly different size scales. Understanding these important plasma properties enables us to understand a wide range of phenomena in the universe, from Earth's local space weather and radiation environment to the interaction of galaxies. The diverse conditions in various regions of the solar system provide excellent opportunities to observe these phenomena. In a mission to Earth's magnetosphere, we will focus on magnetic reconnection, turbulence, multiscale coupling, and particle acceleration. Then, follow-on missions to Mercury and Jupiter will permit comparisons between plasma interactions in their magnetospheres and ionospheres, and those of Earth's, which are very different. A later mission will focus on magnetic field reconnection and small-scale processes in the solar atmosphere.

Goal 6: Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

Objective 6.1: Improve student proficiency in science, technology, engineering, and mathematics by creating a culture of achievement, using educational programs, products, and services based on NASA's unique missions, discoveries, and innovations.

Students who are proficient in science, technology, engineering, and mathematics are more likely to pursue related subjects in high school and college and in career fields. NASA will support improved proficiency by creating a culture of achievement. NASA will continue to provide scientific content, advanced technological tools, and supplemental educational services in a sustained manner. This will foster a rich learning environment that is designed to support increased achievement in student mathematics and science, ultimately leading students to careers in these fields.

Objective 6.2: Motivate K–16+ students from diverse communities to pursue science and math courses and, ultimately, college degrees in science, technology, engineering, and mathematics.

The next generation of explorers must represent the diversity of the U.S. population, including minority students and those from low-income families. NASA will pursue this objective through the Educator Astronaut Program and the Explorer Schools Program. Additionally, NASA will build on its relationship with Historically Black Colleges and Universities, Hispanic-Serving Institutions, and Tribal Colleges and Universities.

Objective 6.3: Enhance science, technology, engineering, and mathematics instruction with unique teaching tools and experiences that only NASA can provide, that are compelling to educators and students.
Student achievement is dependent upon the efforts of well-prepared teachers and school leaders. NASA's Explorer Schools will provide educators with unique science, technology, engineering, and mathematics-based teaching and collaborative tools, and computer resources. The Educator Astronaut Program is perhaps the most unique teaching tool and is one that only NASA can provide. The universe is the classroom; the Shuttle and the Space Station are the laboratories; and the unique environment of space provides teaching opportunities unparalleled on Earth.

Objective 6.4: Improve higher education capacity to provide for NASA's and the Nation's future science and technology workforce requirements.
NASA will help boost university enrollment in technical fields by providing research and internship opportunities and career roadmaps. Undergraduate and graduate students at our Nation's universities also will benefit from research opportunities and support from NASA-sponsored research contracts.

Goal 7: Engage the public in shaping and sharing the experience of exploration and discovery.

Objective 7.1: Improve the capacity of science centers, museums, and other institutions, through the development of partnerships, to translate and deliver engaging NASA content.
NASA artifacts are among the top attractions at many science and technology museums across the country, and NASA missions are changing textbooks almost daily. NASA will make breaking news available to these institutions, as well as the latest imagery from missions such as the Hubble Space Telescope, Chandra X-ray Observatory, and Earth Observing Satellites. We also will continue to connect people with NASA through live events with the International Space Station and Shuttle crew members and through our scientists, engineers, and other professionals.

Objective 7.2: Improve science literacy by engaging the public in NASA missions and discoveries, and their benefits, through such avenues as public programming, community outreach, mass media, and the Internet.
We recognize that informal education institutions and organizations are sources of inspiration and learning for anyone with an interest in aviation, Earth, the universe, or just a passion for learning. By providing information and guest speakers to science centers, museums, and local organizations such as PTAs and the Girl Scouts, we help improve the science literacy of the Nation and allow the public to share in the experience of exploration and discovery.

Objective 7.3: Increase public awareness and understanding of how research and innovations in aerospace technology affect and improve the quality of life.
NASA's Enterprises provide many venues for the public to learn how aerospace technology improves the quality of life and how the potential benefits of technology are becoming integrated into everyday products and services. We will provide details of our technological breakthroughs in understandable formats on Web sites, television programs, publications, exhibits, and museums. We will create special traveling exhibits, such as the one crafted to celebrate the Centennial of Flight, to let the public experience a taste of the future.

Goal 8: Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.

Objective 8.1: Assure safe, affordable, and reliable U.S.-based crew access and return from the International Space Station.
Under the Integrated Space Transportation Plan (ISTP), NASA is developing an Orbital Space Plane (OSP). The OSP is envisioned as a multipurpose vehicle, initially serving as a Space Station crew-return vehicle that will be launched on an expendable launch vehicle (ELV). As OSP capabilities are improved, the vehicle will complement and back up the Space Shuttle for the transportation of astronauts between Earth and the International Space Station. It also will open a technical development pathway toward future reusable launch vehicle systems. Later, the OSP may be integrated with a new launch vehicle and may serve as the long-term follow-on to the Space Shuttle.

Objective 8.2: Improve the safety, affordability, and reliability of future space transportation systems.
NASA will undertake technology development, technical risk reduction, and systems analysis studies to enable key decisions on the development of a second-generation reusable launch vehicle (RLV) to replace the Space Shuttle. We will focus on the most critical technology development and risk-reduction activities to lower the cost, increase the reliability, and improve the safety of future space transportation systems. NASA will continue to aggressively pursue common goals with DOD through the National Aerospace Initiative.

Objective 8.3: Improve the accessibility of space to better meet research, Space Station assembly, and operations requirements.
We are aggressively pursuing competitive sourcing to manage future Shuttle costs. NASA will ensure that the Shuttle continues to fly safely and meets its flight manifest commitments. We also will pursue a service-life extension for the Shuttle to improve safety, reliability, and maintainability. NASA also will work to effect a smooth transition from the Space Shuttle to the next-generation systems at the appropriate time.

Objective 8.4: Assure capabilities for world-class research on a laboratory in low-Earth orbit.
Of the 40 Shuttle flights needed to transport and assemble the various Space Station components, approximately half have been completed, and more than 400,000 pounds of equipment has been delivered. The U.S. core configuration, to be completed in FY 2004, will provide the

capabilities that are required to accommodate international contributions. NASA is committed to continuing the restoration of the financial management control that was demonstrated in 2002 and to completing the U.S. core within available resources. NASA will manage the research activities of the Space Station more effectively through the transition to a Space Station Research Institute, beginning in FY 2004.

Objective 8.5: Provide services for space communications and rocket propulsion testing and launch in support of NASA, other Government agencies, and industry.
NASA will continue to provide critical services to support NASA missions and other users in payload testing and integration to enable safe and cost-effective access to space via the Space Shuttle, technical oversight of private expendable launch vehicle services, and launch-site maintenance and operations at Vandenberg Air Force Base and Cape Canaveral Air Force Station. NASA will support rocket-propulsion testing, which is critical to the development of low-cost, safe, and reliable space transportation propulsion systems. NASA also will continue to provide and improve high-quality, reliable, cost-effective space communications networks and services for the Space Shuttle, International Space Station, launch vehicles, Earth-orbiting satellites, and other spacecraft throughout the solar system.

Objective 8.6: Create concepts, technologies, and capabilities for transportation beyond low-Earth orbit and define plans to enable affordable future infrastructures.
NASA will create new approaches and conduct trade studies for potential human research missions beyond low-Earth orbit. NASA will advance the human and robotic exploration and the development of space in the most cost-effective manner by carefully identifying and analyzing options and by determining the best high-leverage investments NASA can make to help achieve our Vision and Mission.

Goal 9: Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.

Objective 9.1: Understand and control the human health risks of space flight.
NASA research addresses the health issues created by the radiation, microgravity, and isolation associated with space travel. The results of this research will provide science and medical knowledge to enable flight crews to leave Earth (and eventually to leave low-Earth orbit), perform their assigned tasks, and return to Earth with their health intact. This includes the development of therapeutics, procedures, techniques, and equipment to address flight, medical, safety, and performance issues. NASA also will conduct research to address questions of crew psychosocial health and enable the practice of basic medicine in space. This human-centered research is augmented by exploratory biological research into the adaptation of nonhuman terrestrial life to low-gravity environments.

Objective 9.2: Develop knowledge and technologies to make life-support systems self-sufficient and improve human performance in space.
To enable the human exploration of space, we must first determine how humans and other life forms adapt to the effects of space flight, and then provide them with the tools and techniques to support life off Earth. NASA is developing technology for advanced, efficient life-support systems that provide for human needs with minimal resupply from Earth. Ultimately, we will develop and demonstrate technologies for closed-loop, life-support systems that will drastically reduce the need for supplies and permit independent, extended missions of exploration. These systems will require sophisticated intelligent arrays of sensors and highly efficient processes for recycling consumables like air, water, and food.

Objective 9.3: Resolve fundamental low-gravity issues affecting technologies for human space travel beyond low-Earth orbit.
NASA will ensure that astronauts can work safely and effectively in space through research and demonstrations in such crosscutting areas as new fluid flow and thermal control technologies, advanced materials and in-space material processing, and fire safety devices. This strategic research will provide a comprehensive body of knowledge and flight-worthy technology that will serve as a lasting foundation for space development. The basic principles to be studied will result in new tools and techniques and will enable humans to be active, productive scientists and explorers in space.

Objective 9.4: Demonstrate the ability to support a permanent human presence in low-Earth orbit (LEO) as a stepping-stone to a human presence beyond LEO.
One of the most important aspects of the International Space Station, in addition to the scientific and technological innovations that it supports, is that it provides invaluable experience in actually working and living in space. Our astronauts and ground controllers help teach us how to eat and sleep, how to live for months at a time in orbit, and what to expect upon return to Earth. Our success in managing and operating the Space Station will tell us when we are ready to take the next steps into the solar system. Extending the boundaries of human space flight requires knowledge of the space environment, the effects of living and working there, and the development of countermeasures to maintain crew safety, health, and efficiency. It also requires that we determine the best mix of humans and machines for various tasks to take advantage of the unique capabilities of both. Through the Space Station, NASA is developing a large body of knowledge on the practical aspects of human activities in space.

Objective 9.5: Develop innovative approaches and concepts to inform future decisions concerning systems, infrastructures, and missions for the human and robotic exploration of space.
NASA is continuing to examine the possibilities and concepts for the future human exploration of space. Mission concepts, technology investment strategies, flight demonstrations, and scientific priorities will be carefully studied

in order to ensure a well-informed decisionmaking process. Robotic scientific exploration of potential human destinations—Mars, the Moon, and asteroids, for example—will provide key data on the risks and rewards of possible future human exploration.

Goal 10: Enable revolutionary capabilities through new technology.

Objective 10.1: Improve the capability to accurately assess and manage risk in the synthesis of complex systems.

Success in assessing and managing risk can help us find critical equilibrium among cost, performance, and schedule, while protecting the safety of our people and investments. NASA's research and development activities to ensure mission success are built upon technologies that identify and eliminate risks; capture, integrate, and utilize knowledge; and provide an intelligent response to hazards. NASA will define the tools and techniques to manage risks and customize solutions for NASA's various missions.

Objective 10.2: Create system concepts and demonstrate technologies that enable new scientific measurements.

Driven by future mission needs, NASA will research, develop, and evaluate a range of fundamental technologies that enable new and improved missions and new science measurement capabilities. NASA will validate new technologies to facilitate their infusion into missions at a minimal cost and risk.

Objective 10.3: Develop breakthrough information and communication systems to increase our understanding of scientific data and phenomena.

NASA will develop advanced communications technologies to enable a greater science return. Ease of access to distributed computing, information, and knowledge, whether it is ground-, air-, or space-based, will enable greater quality and quantities of data collection for aerospace, Earth science, and space science missions. Communications technology will provide a broad, continuous presence and coverage for high-rate data delivery to scientists and engineers. Research in intelligent data-understanding technologies will enable scientists and engineers to discover new information from large databases, increasing our understanding of the data or phenomena.

Objective 10.4: Create novel aerospace concepts in support of the future human and robotic exploration and development of space.

A key element of NASA's technology investment strategy is to synthesize exciting advances being made in a range of discipline technology areas—including computing, software, and materials—into transformational new systems concepts and space mission architectures. Ultimately, the best technology and systems concept options will be selected through open competitive processes and will be developed by broadly based teams that span Government, academia, industry, and others. NASA will pursue the most promising options through ground and flight experiments and demonstrations. NASA will coordinate the efforts of technology research programs, science-focused developments, and the development and validation of new advanced systems with a range of NASA, U.S. Government, and non-Government uses.

Objective 10.5: Create novel aerospace concepts to support Earth and space science missions.

NASA will pursue novel concepts to meet the needs of future missions. One such area will be autonomous flight—flight in which there is no pilot, either on board the aircraft or remotely flying it from the ground. Autonomous flight is necessary to realize the vision of high-altitude, long-endurance, unmanned aerial vehicles, providing expanded science-measuring capability for Earth science applications. This same technology can provide the basis for a Mars flyer, supporting a unique untended platform to support planetary science needs. NASA also will make aeronautical concepts available for mobile, regional communications, and surveillance platforms for commercial, homeland security, defense, firefighting, and other applications.

Objective 10.6: Enhance NASA's Mission by expanding partnerships between NASA Enterprises and nonaerospace U.S. industrial firms and by leveraging the venture capital community for innovative technology development.

NASA will seek partnerships with U.S. industrial firms and the venture capital community that support NASA's technology needs. NASA will continue to conduct innovative research to address the broach spectrum of Enterprise mission needs under the Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR) programs to better achieve our Mission.

Mission I: To Understand and Protect Our Home Planet

		Objectives		Enterprise	Primary Theme	Supporting Theme
Goal 1:	**Understand Earth's system and apply Earth-system science to improve the prediction of climate, weather, and natural hazards.**	1.1	Understand how Earth is changing, better predict change, and understand the consequences for life on Earth.	Y, M	ESS	SSP, ISS, SFS
		1.2	Expand and accelerate the realization of economic and societal benefits from Earth science, information, and technology.	Y	ESA	
		1.3	Understand the origins and societal impacts of variability in the Sun-Earth connection.	S	SEC	
		1.4	Catalogue and understand potential hazards to Earth from space.	S	SSE	
Goal 2:	**Enable a safer, more secure, efficient, and environmentally friendly air transportation system.**	2.1	Decrease the aircraft fatal accident rate and the vulnerability of the air transportation system to threats and mitigate the consequences of accidents and hostile acts.	R	AT	
		2.2	Protect local and global environmental quality by reducing aircraft noise and emissions.	R	AT	
		2.3	Enable more people and goods to travel faster and farther, with fewer delays.	R	AT	
Goal 3:	**Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia.**	3.1	Enhance the Nation's security by developing and demonstrating critical access-to-space technologies that benefit NASA, DOD, and other Government agencies.	R, M, S	SLI	AT, SFS, ESA
		3.2	Enhance the Nation's security through aeronautical partnerships with DOD and other Government agencies.	R, M	AT	ISS
		3.3	Improve the Nation's economic strength and quality of life by facilitating the innovative use of NASA technology.	R	ITTP	
		3.4	Leverage resources in support of national priorities through partnerships across industry, academia, and the Government for market-driven research in space.	U	RPFS	
		3.5	Resolve scientific issues impacting Earth-based technological and industrial applications by using the unique low-gravity environment of space.	U, M	PSR	ISS

Legend

Enterprises
M–Space Flight
R–Aerospace Technology
S–Space Science
U–Biological and Physical Research
Y–Earth Science

Themes
AT–Aeronautics Technology
ESA–Earth Science Applications
ESS–Earth System Science
ISS–International Space Station
ITTP–Innovative Technology Transfer Partnerships
PSR–Physical Sciences Research
RPFS–Research Partnerships and Flight Support
SEC–Sun-Earth Connection
SFS–Space and Flight Support
SLI–Space Launch Initiative
SSE–Solar System Exploration
SSP–Space Shuttle Program

Mission II: To Explore the Universe and Search for Life

	Objectives	Enterprise		Primary Theme	Supporting Theme	
Goal 4:	**Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space.**	4.1	Understand how life responds to the space environment and the role of gravity in the processes of life.	U, M	BSR	SSP
		4.2	Understand the fundamental organizing principles of nature and how they give rise to structure and complexity, using the low-gravity environment in space.	U, M	PSR	ISS
Goal 5:	**Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere.**	5.1	Learn how the solar system originated and evolved to its current diverse state.	S, M	SSE	SSP
		5.2	Determine the characteristics of the solar system that led to the origin of life.	S	SSE	
		5.3	Understand how life begins and evolves.	S	SSE	
		5.4	Understand the current state and evolution of the atmosphere, surface, and interior of Mars.	S	MEP	
		5.5	Determine if life exists or has ever existed on Mars.	S, M	MEP	
		5.6	Develop an understanding of Mars in support of possible future human exploration.	S	MEP	SFS
		5.7	Discover what powered the Big Bang and the nature of the mysterious dark energy that is pulling the universe apart.	S	SEU	
		5.8	Learn what happens to space, time, and matter at the edge of a black hole.	S	SEU	
		5.9	Understand the development of structure and the cycles of matter and energy in the evolving universe.	S	SEU	
		5.10	Understand how today's universe of galaxies, stars, and planets came to be.	S	ASO	
		5.11	Learn how stars and planetary systems form and evolve.	S	ASO	
		5.12	Understand the diversity of other worlds and search for those that might harbor life.	S	ASO	
		5.13	Understand the changing flow of energy and matter throughout the Sun, heliosphere, and planetary environments.	S	SEC	
		5.14	Understand the fundamental physical processes of space plasma systems.	S	SEC	

Legend

Enterprises
M–Space Flight
S–Space Science
U–Biological and Physical Research

Themes
ASO–Astronomical Search for Origins
BSR–Biological Sciences Research
ISS–International Space Station
MEP–Mars Exploration Program
PSR–Physical Sciences Research
SEC–Sun-Earth Connection
SEU–Structure and Evolution of the Universe
SFS–Space and Flight Support
SSE–Solar System Exploration
SSP–Space Shuttle Program

Mission III: To Inspire the Next Generation of Explorers

		Objectives		Enterprise	Primary Theme	Supporting Theme
Goal 6:	**Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.**	6.1	Improve student proficiency in science, technology, engineering, and mathematics by creating a culture of achievement, using educational programs, products, and services based on NASA's unique missions, discoveries, and innovations.	N, U, R, S, M	EDU	multiple
		6.2	Motivate K–16+ students from diverse communities to pursue science and math courses and, ultimately, college degrees in science, technology, engineering, and mathematics.	N, Y, S, M	EDU	multiple
		6.3	Enhance science, technology, engineering, and mathematics instruction with unique teaching tools and experiences that only NASA can provide, that are compelling to educators and students.	N, R, U, S, Y, M	EDU	multiple
		6.4	Improve higher education capacity to provide for NASA's and the Nation's future science and technology workforce requirements.	N, R, S, M	EDU	multiple
Goal 7:	**Engage the public in shaping and sharing the experience of exploration and discovery.**	7.1	Improve the capacity of science centers, museums, and other institutions, through the development of partnerships, to translate and deliver engaging NASA content.	N, S	multiple	
		7.2	Improve science literacy by engaging the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the Internet.	S, Y, M, U	multiple	
		7.3	Increase public awareness and understanding of how research and innovations in aerospace technology affect and improve the quality of life.	R	AT	MSM

Legend

Enterprises
M–Space Flight
N–Education
R–Aerospace Technology
S–Space Science
U–Biological and Physical Research
Y–Earth Science

Themes
AT–Aeronautics Technology
EDU–Education Programs
MSM–Mission and Science Measurement Technology
Multiple–All Other Themes

Space Flight Capabilities

		Objectives		Enterprise	Primary Theme	Supporting Theme
Goal 8:	**Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.**	8.1	Assure safe, affordable, and reliable U.S.-based crew access and return from the International Space Station.	R	SLI	
		8.2	Improve the safety, affordability, and reliability of future space transportation systems.	R	SLI	
		8.3	Improve the accessibility of space to better meet research, Space Station assembly, and operations requirements.	M	SSP	
		8.4	Assure capabilities for world-class research on a laboratory in low-Earth orbit.	M	ISS	
		8.5	Provide services for space communications and rocket propulsion testing and launch in support of NASA, other Government agencies, and industry.	M	SFS	
		8.6	Create concepts, technologies, and capabilities for transportation beyond low-Earth orbit and define plans to enable affordable future infrastructure.	M	SFS	
Goal 9:	**Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.**	9.1	Understand and control the human health risks of space flight.	U	BSR	
		9.2	Develop knowledge and technologies to make life-support systems self-sufficient and improve human performance in space.	U	BSR	MSM
		9.3	Resolve fundamental low-gravity issues affecting technologies for human space travel beyond low-Earth orbit.	U	PSR	
		9.4	Demonstrate the ability to support a permanent human presence in low-Earth orbit (LEO) as a steppingstone to a human presence beyond LEO.	M	ISS	SSP
		9.5	Develop innovative approaches and concepts to inform future decisions concerning systems, infrastructures, and missions for the human and robotic exploration of space.	M	SFS	MEP, SLI
Goal 10:	**Enable revolutionary capabilities through new technology.**	10.1	Improve the capability to accurately assess and manage risk in the synthesis of complex systems.	R	MSM	
		10.2	Create new system concepts and demonstrate new technologies that enable new scientific measurements.	R	MSM	
		10.3	Develop breakthrough information and communication systems to increase our understanding of scientific data and phenomena.	R	MSM	
		10.4	Create novel aerospace concepts in support of the future human and robotic exploration and development of space.	M	SFS	
		10.5	Create novel aerospace concepts to support Earth and space science missions.	R	AT	
		10.6	Enhance NASA's Mission by leveraging partnerships between NASA Enterprises and nonaerospace U.S. industrial firms and by leveraging the venture capital community for innovative technology development.	R	ITTP	

Legend

Enterprises
M–Space Flight
R–Aerospace Technology
U–Biological and Physical Research

Themes
AT–Aeronautics Technology
BSR–Biological Sciences Research
ISS–International Space Station
ITTP–Innovative Technology Transfer Partnerships
MEP–Mars Exploration Program
MSM–Mission and Science Measurement Technology
PSR–Physical Sciences Research
SFS–Space and Flight Support
SLI–Space Launch Initiative
SSP–Space Shuttle Program

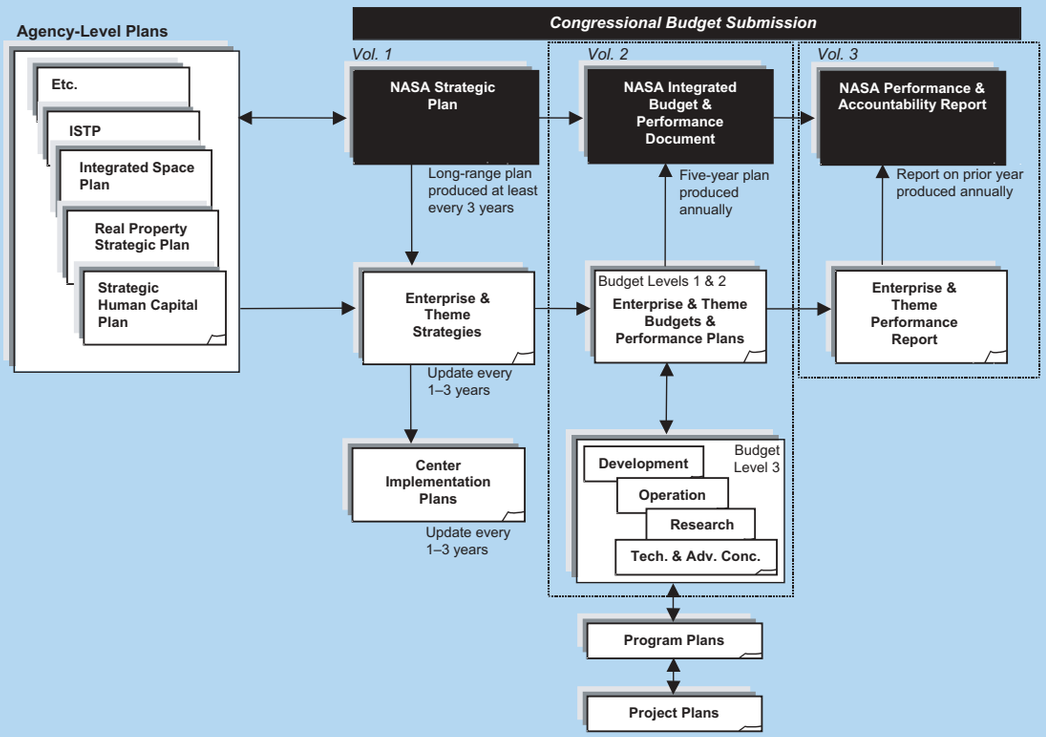
Appendix IV. Relationship Among Strategic and Planning Documents

NASA's planning process starts with long-term Vision and Mission and flows to more focused near-term plans and documents.

The NASA Vision, Mission, goals, and objectives are documented in this strategic plan. The proposed outcomes and FY 2004 annual performance goals (APG) have been submitted with the Performance Plan as part of the FY 2004 budget in the Integrated Budget and Performance Document. NASA will improve the quality of these measures, and our objectives as necessary, making them more quantifiable and verifiable, and it will release an updated FY 2004 performance plan prior to September 15, 2003. NASA also plans to release an updated FY 2003 performance plan that is consistent with this new strategic plan and the new strategic framework for budget and performance integration.

In order to make performance planning an integral part of how the Agency is managed, NASA will incorporate the performance planning process into our annual budget formulation or program operating plan (POP) development process. The POP for preparing the FY 2005 budget request will be the first formal development cycle tasked with defining the outcomes and annual performance goals for each theme.

NASA will also be revising Enterprise and theme implementation plans to provide more detail as to how the goals and objectives in this plan will be achieved. NASA Centers will also be revising their implementation plans to illustrate how they will support the Enterprises and themes in meeting NASA's Mission and Vision.



The following example demonstrates the flow from the top level of this strategic plan through the detailed performance measures:

Strategic Plan	Vision (element)	To improve life here.
	Mission I	To understand and protect our home planet
	Goal 2	Enable a safer, more secure, efficient, and environmentally friendly air transportation system.
	Objective 2.1	Decrease the aircraft fatal accident rate and the vulnerability of the air transportation system to threats, and mitigate the consequences of accidents and hostile acts.
Performance Plan	Outcome 2.1.1	Develop and demonstrate technologies that will enable the reduction of the aviation fatal accident rate by a factor of five.
	FY 2004 Annual Performance Goals	4AT4: Utilizing results of component testing, simulations, and analyses, complete an integrated program assessment of the suite of aviation safety technologies to determine their synergistic effect on reducing the fatal accident rate. 4AT5: NASA will produce prototype disks and engine containment materials with inherent failure-resistant characteristics that will be ready for a full-scale engine system integration test to be conducted jointly with the FAA in FY 2005. 4AT6: NASA will complete the flight evaluation of a synthetic vision system that improves pilot situational awareness by providing a display of "out-the–window" information that is not affected by adverse meterological conditions. This system, when fully implemented, has the potential to eliminate 90% of CFIT accidents.
Accountable Organization	Enterprise/Theme/ Program	Aerospace Technology/Aeronautics Technology/Aviation Systems Safety Program

Appendix V. External Factors

NASA engages in research and exploration for the benefit of the American public. Achieving our goals and objectives depends on a changing equation of resources, results, technology support, national priorities, partnerships, market forces, and other variables. We will pursue our goals with dedication while remaining attuned to external factors beyond our control. These are some of those factors:

The Legislative and Policy Framework. Our Mission and goals derive from legislation and Presidential policy. In 1958, Congress passed the National Aeronautics and Space Act, establishing NASA and directing it to carry out specific purposes. A succession of laws and national policies since then at times redirected, expanded, or refined NASA's role. Future changes in law and policy may invalidate or reinforce goals. Administration and congressional budget decisions also affect NASA's ability to meet the goals and objectives as set forth in this plan. The plan is consistent with the near-term budget estimates in NASA's FY 2004 budget request to Congress.

The Economy and Public Support. The strength of the economy and support of the public are also outside influences on NASA's ability to meet its goals and objectives. Our plan is based upon the assumption that the economy will remain strong enough to support our budgets and our associated commercial activities. We also assume continued public support. NASA's actions are critical in this equation. To win and keep public support, we must hold ourselves accountable for our performance, explain our activities, transfer technology whenever possible, and keep our goals and objectives in tune with the public.

Partnerships with Other Agencies and Nations. NASA conducts many projects with other organizations, agencies, and nations. NASA's international partnerships reflect the scope of each partner's aerospace capabilities and interests and our relations with each nation. We welcome new partnerships with other nations because they can enhance NASA's ability to achieve its goals and reduce its costs.

National Security/Homeland Security. From its earliest days, NASA has provided support to the DOD and other Federal and local agencies where there has been mutual interest in achieving a goal. For example, technologies developed for civil applications, such as remote-sensing capabilities and aviation safety improvements, also can be utilized to meet other civil and national security needs. The changing security environment can have a significant impact on national priorities and can affect what NASA does. The increasingly complex and dangerous world compels us to apply our expertise and technologies to improve homeland security.

Markets. Space presents enormous future business opportunities. In the past, NASA pioneered areas such as communications satellite technology that led to profitable new industries unforeseen by most citizens and businesses at the time. This pattern continues today. We remain convinced that it is essential to pioneer and help commercialize new areas of space activity to maintain a strong American position in this arena. Should space markets experience robust growth, NASA could benefit from the availability of low cost services that are supporting space commerce. Alternatively, if launch markets continue to decline, NASA could experience higher launch costs because the launch industry would have a smaller business base over which to spread the fixed costs.

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

Demographics. The convergence of two major demographic factors may hinder the accomplishment of our goals: the reduction in the proportion of the population of working-age individuals and the relatively poor high school performance and low graduate school enrollment of U.S. students in science and mathematics.

Discovery. NASA's goals and objectives constitute a balanced program of what we believe to be valuable and feasible for the future. However, new discoveries may suddenly change them. 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 we find it, NASA might have to radically reorient its goals.

Appendix VI. Program Evaluations

NASA is committed to a rigorous and open process of strategic planning, performance planning and reporting, and internal and external program review. In the preparation of this plan, NASA consulted with congress and sought the views and considerations of others. The Government Performance and Results Act of 1993 and the President's Management Agenda of 2002 establish the requirements and guiding principles that NASA will follow in program planning and evaluation.

NASA makes extensive use of both internal and external reviews in the planning, selection, implementation, and performance evaluation of its missions and programs. NASA programs are reviewed by management councils and committees, staffed by Headquarters and Center senior managers, which meet regularly to assess progress and performance for each major program. The Executive Leadership Council brings together Headquarters and Center senior managers to assess progress toward Enterprise performance targets. In addition, NASA's Joint Strategic Assessment Committee and Institutional Committee evaluates whether our investment decisions adequately support our goals and objectives and the associated performance targets.

Special panels brought together for limited time periods to address specific issues may review areas of particular concern. They may investigate the causes of technical or management failures and provide advice on problem mitigation, and they may assess the degree to which we meet our performance goals, or they may be asked to provide independent review and expert insight on important topics. NASA programs have benefited greatly from the willingness of technical experts to provide advice on complex program issues.

In addition to our internal evaluation processes, NASA relies substantially on external, independent reviews. These include an extensive peer-review process in which NASA uses panels of experts to ensure that science research proposals are selected strictly on the merits of the planned research. NASA also maintains a broad and diverse system of advisory committees under the Federal Advisory Committee Act, including the NASA Advisory Council and the Aerospace Safety Advisory Panel and their subcommittees. Hundreds of experts from around the Nation provide their input into NASA's priorities and plans in this manner. NASA advisory committees explicitly review and evaluate the Agency's performance for both quantitative and qualitative performance measures, and the results of their evaluations are a part of the Agency's Annual Performance Report. The National Academy of Sciences, the National Academy of Public Administration, the NASA Inspector General, and the General Accounting Office, among others, also provide extremely valuable input into and assessment of NASA programs.

Appendix VII. Acronyms, Abbreviations, and Glossary

ARC Ames Research Center
ASO Astronomical Search for Origins (Theme)
APG Annual Performance Goal
AST Aerospace Technology (Enterprise)
AT Aeronautics Technology (Theme)
BPR Biological and Physical Research (Enterprise)
BSR Biological Sciences Research (Theme)
CFIT Controlled Flight into Terrain
CFO Chief Financial Officer
DFRC Dryden Flight Research Center
DOD Department of Defense
DOE Department of Energy
EAP Educator Astronaut Program
EELV Evolved Expendable Launch Vehicle
ELV Expendable Launch Vehicle
CO_2 Carbon Dioxide
Enterprises Space Science, Earth Science, Biological and Physical Research, Aerospace Technology, Education, and Space Flight
EOS Earth Observing System
EP Education Programs (Theme)
ESA Earth Science Applications (Theme)
ESE Earth Science Enterprise
ESS Earth System Science (Theme)
FAA Federal Aviation Administration
FEMA Federal Emergency Management Agency
FSD Full-Scale Development
FY Fiscal Year
GEO Geosynchronous Earth Orbit
GPRA Government Performance and Results Act
GRC Glenn Research Center at Lewis Field
GSFC Goddard Space Flight Center
HQ Headquarters
HRI Human Research Initiative
IBPD Integrated Budget and Performance Document
IC Institutional Committee
IP International Partners
IS Implementing Strategy
ISS International Space Station (Theme)
ISTP Integrated Space Transportation Plan
IT Information Technology
ITTP Innovative Technology Transfer Partnerships (Theme)
IV & V Independent Verification and Validation
JPL Jet Propulsion Laboratory
JSC Johnson Space Center
JSAC Joint Strategic Assessment Committee
K–12 Kindergarten through grade 12
K–16+ Kindergarten through graduate school
KSC Kennedy Space Center
LEO Low Earth Orbit
LISA Laser Interferometer Space Antenna
MAF Michoud Assembly Facility
MEP Mars Exploration Program (Theme)
MSFC Marshall Space Flight Center
MSM Mission and Science Measurement Technology (Theme)
NAI National Aerospace Initiative
NAC NASA Advisory Council
NASA National Aeronautics and Space Administration
National Aeronautics and Space Act Space Act of 1958
NEO Near Earth Object
NGLT Next Generation Launch Technology
NIH National Institutes of Health
NISN NASA Integrated Services Network
NOAA National Oceanic and Atmospheric Administration
NSI Nuclear Systems Initiative
NSTC National Science and Technology Council
OBPR Office of Biological and Physical Research (Enterprise)
OMB Office of Management and Budget
OSF Office of Space Flight (Enterprise)
OSP Orbital Space Plane
OSTP Office of Science and Technology Policy
PMA President's Management Agenda
PMC Program Management Council
POP Program Operating Plan
PSR Physical Sciences Research (Theme)
PTA Parent Teacher Association
RLV Reusable Launch Vehicle
RPFS Research Partnerships and Flight Support (Theme)
SBIR Small Business Innovative Research
SeaWiFS Sea-viewing Wide Field-of-view Sensor
SEC Sun-Earth Connection (Theme)
SEU Structure and Evolution of the Universe (Theme)
SFS Space and Flight Support (Theme)
SLI Space Launch Initiative (Theme)
SMC Senior Management Council
SRTM Shuttle Radar Topography Mission
SSC Stennis Space Center
SSE Space Science Enterprise or Solar System Exploration (Theme)
SSP Space Shuttle Program (Theme)
STEM Science, Technology, Engineering, and Mathematics
STScI Space Telescope Science Institute
STTR Small Business Technology Transfer
Themes (NASA) NASA's 18 themes represent the Agency's structure for budget planning, management, and performance reporting.
TDRSS Tracking and Data Relay Satellite System
TSA Transportation Security Administration
U.S. United States
USAF U.S. Air Force
USDA U.S. Department of Agriculture
USGS U.S. Geological Survey
WFF Wallops Flight Facility
WSTF White Sands Test Facility
X-43 Flight demonstrator that combines NASA airframe experience and USAF propulsion development.

Official White House photograph

President George W. Bush greets astronauts in the Oval Office.

For More Information

For more information about NASA and its programs, visit: *http://www.nasa.gov*

For the NASA budget, performance plans, performance reports, the Strategic Management System Handbook, Enterprise Plans, Center Implementation Plans, or other information on NASA plans, visit: *http://www.plans.nasa.gov*

Contacting NASA

NASA values the comments and recommendations of our stakeholders, customers, partners, employees, contractors, and the public. To comment on this strategic plan please contact:

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