NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Summary of

FY 2005 BUDGET REQUEST

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Overview

On January 14, 2004, President Bush established a new vision for U.S. space exploration that is bold and forward-thinking yet practical and responsible – one that seeks answers to longstanding questions of importance to science and society; develops revolutionary technologies and capabilities for the future; and genuinely inspires our nation, the world, and the next generation, while maintaining good stewardship of taxpayer dollars. The President's vision is documented in *A Renewed Spirit of Discovery, The President's Vision for U.S. Space Exploration*. To support the vision, NASA is simultaneously releasing the FY 2005 Congressional budget justification, the *FY 2005 Budget Estimates*, and another document, *The Vision for Space Exploration*, that links NASA's programs plans and the FY 2005 Budget request to the exploration vision. The material below provides a summary of both documents.

NASA's FY 2005 Budget request aligns with the goals set forth in *The President's Vision for U.S. Space Exploration* and provides a robust yet responsible five-year budget plan for achieving these goals. The programs supported by this budget will yield remarkable new scientific insights, stimulate American innovation, and inspire young and old alike, while supporting the Administration's goal of cutting the budget deficit in half within the next five years.

Policy Goals

The fundamental goal of the new exploration vision is to advance U.S. scientific, security, and economic interests through a robust space exploration program. In support of this goal, NASA, in cooperation with its partners in other Federal agencies, academia, the private sector, and the international community, will:

- Implement a sustained and affordable human and robotic program to explore the solar system and beyond;
- Extend human presence across the solar system, starting with a human return to the Moon by the year 2020, in preparation for human exploration of Mars and other destinations;
- Develop the innovative technologies, knowledge, and infrastructures both to explore and to support decisions about destinations for human exploration; and
- Promote international and commercial participation in exploration to further U.S. scientific, security, and economic interests.

Guiding Principles for Exploration

NASA does not undertake exploration merely for the sake of adventure, however exciting that may be. In pursuit of the exploration vision, NASA has identified six guiding principles:

Pursue Compelling Questions – Exploration of the solar system and beyond will be guided by compelling questions of scientific and societal importance. NASA exploration programs will seek profound answers to questions about the origins of our solar system, whether life exists beyond Earth, and how we could live on other worlds.

Across Multiple Worlds – NASA will make progress across a broad front of destinations, starting with a return to the Moon to enable future human exploration of Mars and other worlds. Consistent with recent discoveries, NASA will focus on possible habitable environments on Mars, the moons of Jupiter, and in other solar systems. Where advantageous, NASA will also make use of destinations like the Moon and near-Earth asteroids to test and demonstrate new exploration capabilities.

Employ Human and Robotic Capabilities – NASA will send human and robotic explorers as partners, leveraging the capabilities of each where most useful. Robotic explorers will visit new worlds first, to obtain

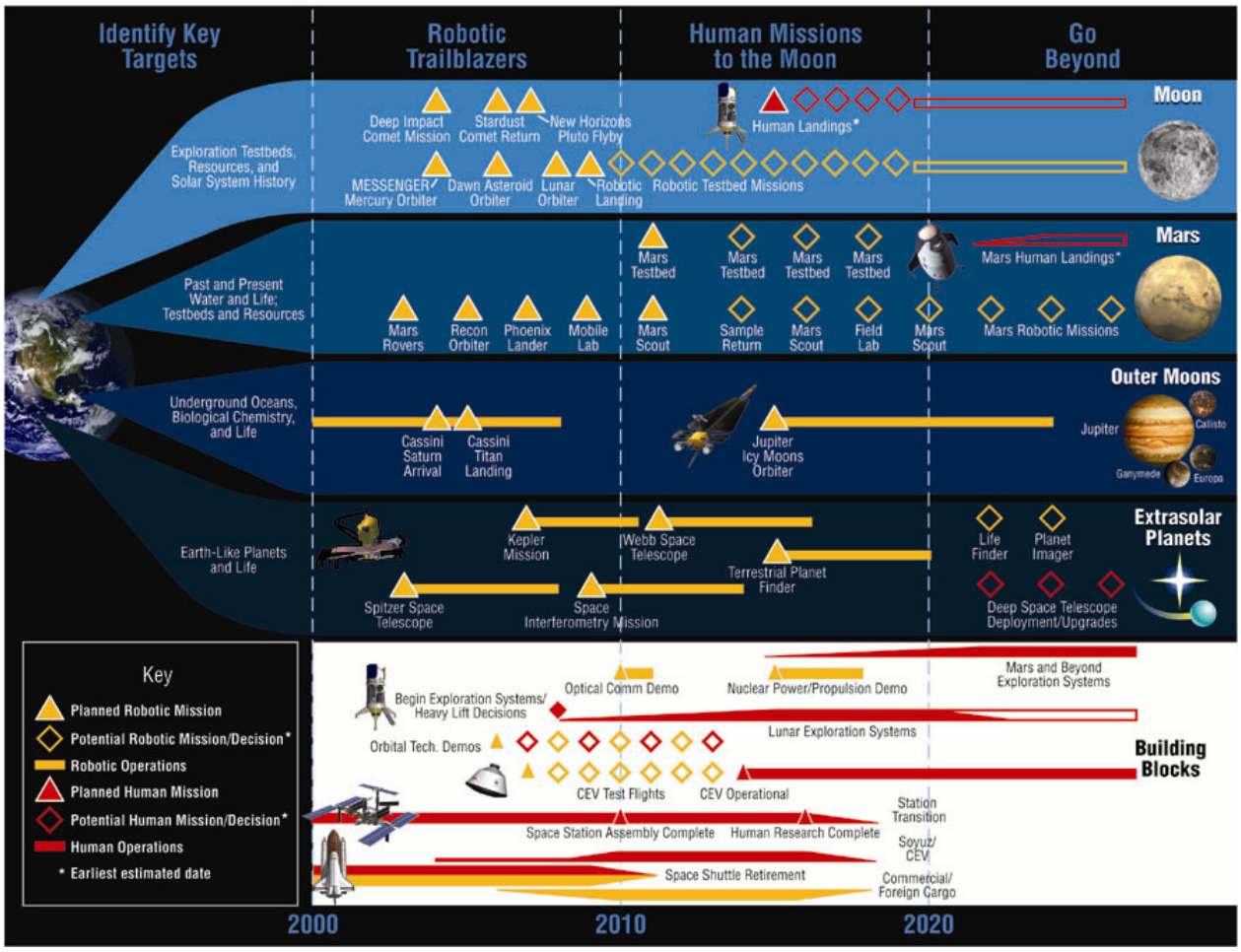
scientific data, assess risks to our astronauts, demonstrate breakthrough technologies, identify space resources, and send tantalizing imagery back to Earth. Human explorers will follow to conduct in-depth research, direct and upgrade advanced robotic explorers, prepare space resources, and demonstrate new exploration capabilities.

For Sustainable Exploration – NASA will pursue breakthrough technologies, investigate lunar and other space resources, and align ongoing programs to develop sustainable, affordable, and flexible solar system exploration strategies.

Use the Moon as a Testing Ground For Mars and Beyond – Under this new Vision, the first robotic missions will be sent to the Moon as early as 2008 and the first human missions as early as 2015 to test new approaches, systems and operations for sustainable human and robotic missions to Mars and beyond.

Starting Now – NASA will pursue this Vision as our highest priority. Consistent with the FY 2005 Budget, NASA will immediately begin to realign programs and organization, demonstrate new technical capabilities, and undertake new robotic precursor missions to the Moon and Mars before the end of the decade.

Exploration Roadmap for the Solar System and Beyond



Exploration Program Elements

Consistent with *The President's Vision for U.S. Space Exploration*, NASA has set a new course for exploration and discovery, as summarized in the exploration roadmap above. Implementation of the exploration vision will be informed by the recommendations of the Aldridge Commission.

Enhance Robotic Trailblazers – Over the next two decades, NASA will send increasingly advanced robotic probes to explore our solar system and beyond, including our Earth's Moon, Mars, the moons of Jupiter, and other outer planets, and launch new space telescopes to search for planets beyond our solar system. The stunning images we are now receiving from the *Spirit* and *Opportunity* rovers at Mars are just the beginning. In this decade alone, NASA plans to launch at least two robotic missions to the Moon, five robotic missions to Mars, three space telescopes that will expand our search for planets circling other stars, and four missions to other planets, comets, and asteroids. Starting at the Moon in 2008 and at Mars in 2011, NASA will launch dedicated robotic missions to demonstrate new technologies that will pave the way for more capable robotic and eventually human missions. Next decade, new classes of robotic missions are planned, including telescopes capable of characterizing planets beyond the solar system, a mission to demonstrate advanced power and propulsion capabilities while mapping oceans on Jupiter's moons, and missions that will return samples from the surface of Mars.

Finish the Space Station and Accelerate Research to Support Exploration – NASA will meet U.S. commitments on the International Space Station by completing Station assembly by the end of the decade. NASA research aboard the Space Station will be focused on developing the knowledge and countermeasures necessary to support human exploration campaigns. NASA will augment its bioastronautics research with the goal of having these tools in hand by 2016.

Develop New Crew Transport Capabilities – To support Space Station assembly, NASA will return the Space Shuttle to flight as soon as possible, according to the recommendations of the *Columbia* Accident Investigation Board. The Shuttle's main purpose through the end of this decade will be Space Station assembly. With its job complete, the Space Shuttle will be retired from service when Space Station assembly is finished planned for the end of the decade. This will allow us to put crew and cargo on different launches, a safer approach to crew transport, and free up resources for exploration activities.

For future crew transport, NASA will undertake *Project Constellation* to develop a Crew Exploration Vehicle (CEV). The CEV will be developed in stages, with the first automated test flight in 2008, more advanced test flights soon thereafter, and a fully operational capability no later than 2014. The design of the CEV will be driven by the needs of future human exploration missions, but the CEV may also supplement international and commercial transportation systems to the Space Station.

Return to the Moon and Demonstrate Sustainable Exploration Capabilities – The President has set a goal of returning human explorers to our Moon as early as 2015 and no later than 2020 to demonstrate capabilities that will enable increasingly deep and more advanced exploration of our solar system. Human missions to the Moon will serve as precursors for human missions to Mars and other destinations, testing sustainable exploration approaches such as space resource utilization, pre-positioned propellants, robotic networks, and modular and reusable systems. They will also demonstrate human-scale exploration systems such as surface power, habitation and life support, and planetary mobility. Additionally, human lunar missions will pursue scientific investigations on the Moon, such as uncovering geological records of our early solar system. The scope and types of human lunar missions and systems will be determined by their support to furthering science, developing and testing new approaches, and their applicability to supporting sustained human space exploration to Mars and other destinations.

Go Beyond – The first human mission beyond the Moon will be determined on the basis of available resources, accumulated experience, and technology readiness. Potential candidates that might be considered include circumnavigating Mars, visiting a near-Earth asteroid, or erecting or upgrading a deep space telescope. The timing of the first human research missions to Mars will depend on discoveries from robotic explorers, the development of techniques to mitigate Mars hazard, advances in capabilities for sustainable exploration, and available resources.

Organizational Changes

To successfully execute the exploration vision, NASA will focus its organization, create new offices, align ongoing programs, experiment with new ways of doing business, and tap the great innovative and creative talents of our Nation.

To develop the Crew Exploration Vehicle and other exploration systems and technologies, NASA has created a new Exploration Systems Enterprise. Relevant elements of the Aerospace Technology, Space Science, and Space Flight Enterprises have been transferred to the Exploration Systems Enterprise. The Aerospace Technology Enterprise has been renamed the Aeronautics Enterprise to reflect its new focus.

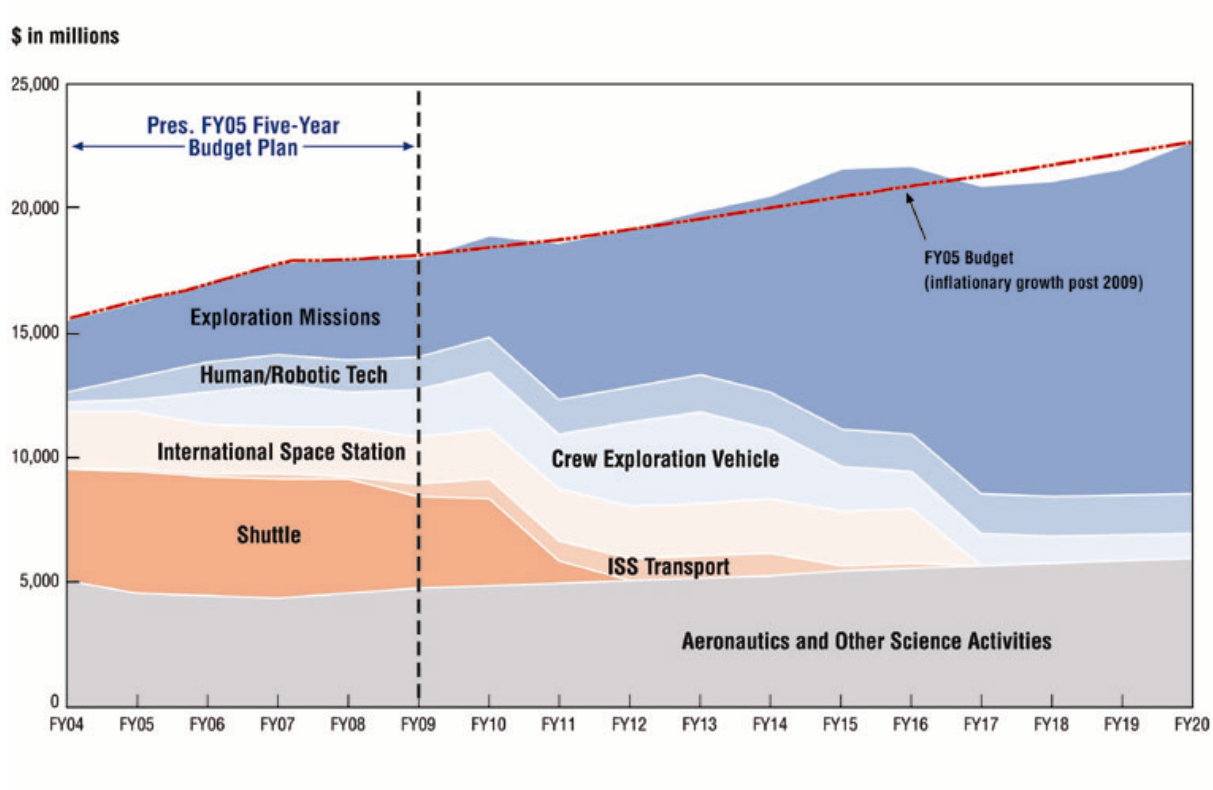
As human explorers prepare to join their robotic counterparts, increased coordination and integration will be necessary. The Exploration Systems Enterprise will work closely with the Space Science Enterprise to use the Moon as a testing ground for solar system exploration vehicles and technologies.

NASA's Space Science Enterprise will have responsibility for carrying out robotic testbeds on the Moon and Mars and will also demonstrate key exploration technologies in other missions to Mars and the outer moons. NASA's Space Science Enterprise will eventually integrate human capabilities into Mars science planning, and potentially deep space observatory and outer moon planning.

Many other elements of the NASA organization will be focused to support this new direction. NASA's Biological and Physical Research Enterprise will put much greater emphasis on bioastronautics research to enable human exploration of other worlds. NASA's Office of the Space Architect will be responsible for integrating the exploration activities of NASA's different Enterprises and for maintaining exploration roadmaps and coordinating high-level requirements.

As we move outward into the solar system, NASA will look for innovative ideas from the private sector and academia to support activities in Earth orbit and future exploration activities. NASA will actively seek international partners and lead the space agencies of these partners in executing exploration activities. NASA will also invigorate its workforce, focus its facilities, and revitalize its field Centers. The new NASA workforce flexibility legislation recently passed by Congress will be key to meeting future organizational challenges to exploration.

Exploration Strategy Based on Long-Term Affordability



Budget

The exploration vision is affordable in both the short term and the long term. NASA's FY 2005 Budget request is fiscally responsible and consistent with the Administration's goal of cutting the budget deficit in half within the next five years. NASA's FY 2005 Budget increases by 5.6 percent, followed by five percent annually the next two years and about one percent for the following two years. In the next decade, retiring the Space Shuttle will free up over $5 billion per year, enabling full-scale development and operation of human missions to the Moon.

The budget strategy supporting the exploration vision places a premium on avoiding balloon payments for future Congresses and Administrations (see chart above). Unlike previous major civil space initiatives, the approach is intentionally flexible, with adjustable exploration milestones and investments in sustainable exploration approaches to maintain affordability. As the President stated in his speech, we are embarking on a journey, not a race.

Budget Structure

NASA's budget accounts are renamed to reflect the President's exploration vision, with appropriation accounts entitled *Exploration, Science, & Aeronautics* (ESA), , and *Exploration Capabilities* (EC), which includes programs that enable the ESA activities to succeed. For the second year, all program budgets are presented in full cost. This means institutional activities, such as personnel and facilities, are included in the benefiting program's budget, reflecting the true cost of the program and enabling managers to make better economic decisions.

Below is a list of NASA's five-year budget broken down by three appropriation accounts, seven Enterprises, and 18 Themes. (NOTE: FY 2004 column represents the enacted budget.)

By Appropriation Account By Enterprise By Theme	FY 2004	**FY 2005**	FY 2006	FY 2007	FY 2008	FY 2009
Exploration, Science & Aeronautics	**7,831**	**7,760**	**7,869**	**8,320**	**8,900**	**9,091**
Space Science	**3,943**	**4,138**	**4,404**	**4,906**	**5,520**	**5,561**
Solar System Exploration	1,302	1,187	1,202	1,300	1,392	1,438
Mars Exploration	595	691	724	944	1,188	1,268
Lunar Exploration		70	135	280	375	420
Astronomical Search for Origins	894	1,067	1,196	1,212	1,182	927
Structure & Evolution of the Univ.	404	378	365	382	425	457
Sun-Earth Connections	749	746	781	788	958	1,051
Earth Science	**1,526**	**1,485**	**1,390**	**1,368**	**1,343**	**1,474**
Earth System Science	1,451	1,409	1,313	1,290	1,266	1,397
Earth Science Applications	74	77	77	77	77	77
Biological & Physical Research	**965**	**1,049**	**950**	**938**	**941**	**944**
Biological Sciences Research	356	492	499	496	500	502
Physical Sciences Research	350	300	220	210	210	210
Research Partnerships & Flight Supt	259	257	232	232	231	232
Aeronautics	**946**	**919**	**957**	**938**	**926**	**942**
Aeronautics Technology	946	919	957	938	926	942
Education	**164**	**169**	**169**	**171**	**170**	**170**
Education	164	169	169	171	170	170
Earmarks**	**287**					
Exploration Capabilities	**7,521**	**8,456**	**9,104**	**9,465**	**9,070**	**8,911**
Exploration Systems*	**1,563**	**1,782**	**2,579**	**2,941**	**2,809**	**3,313**
Human & Robotic Technology	655	1,094	1,318	1,317	1,386	1,450
Transportation Systems	909	689	1,261	1,624	1,423	1,863
Space Flight	**5,857**	**6,674**	**6,525**	**6,524**	**6,261**	**5,598**
Space Station	1,497	1,863	1,764	1,780	1,779	2,115
Space Shuttle	3,928	4,319	4,326	4,314	4,027	3,030
Space Flight Support	432	492	435	430	456	453
Earmarks**	**101**					
Inspector General	**27**	**28**	**29**	**30**	**31**	**32**
TOTAL	**15,378**	**16,244**	**17,002**	**17,815**	**18,001**	**18,034**
year to year increase		5.6%	4.7%	4.8%	1.0%	0.2%

* In FY 2004 Exploration Systems replaces Crosscutting Technologies
**FY 2004 budget column does not allocate earmarks across Enterprises
NOTE: May not add due to rounding

President's Management Agenda

	Human Capital	Competitive Sourcing	Financial Performance	E-Government	Budget and Performance Integration
Status	● ⇧	● ⇧	●	● ⇧	● ⇧
Progress	●	●	●	●	●

Arrow indicates change in status rating since evaluation of September 30, 2003.

NASA is a leading agency in the implementation of the President's Management Agenda (PMA). This is evidenced by the fact that NASA is the first and only agency that is green in either Human Capital or in Budget and Performance Integration. In addition, NASA was recently honored by the President's Quality Awards with an honorable mention for Budget and Performance Integration efforts in FY 2003 – the only such award for Budget and Performance Integration.

The *President's Vision for U.S. Space Exploration* has been enabled by NASA's progress in strengthening our management foundation and agency credibility in PMA and other areas. As of 2003, NASA has received top scores in the key President's Management Agenda areas of human capital management and budget and performance integration. NASA has also successfully implemented management reforms as demonstrated in programs such as the International Space Station.

NASA has made major progress in improving the quality of our management by implementing the President's Management Agenda. This is a government-wide effort to improve the way that Government manages in five key areas: Human Capital, Financial Management, E-Government, Competitive Procurement, and Integrated Budget and Performance. The President's Management Agenda provides the central focus for all management reform efforts across the Agency, including our Freedom to Manage initiatives. NASA has established a highly integrated, disciplined process for getting to green, with weekly status reports to the Administrator by each of our five PMA area champions. Since last year, NASA has improved status in four out of five initiatives, achieving green in both Human Capital and Budget and Performance Integration and yellow in both Competitive Sourcing and E-Government.

- Human Capital: NASA implemented our first human capital plan, established an accountability system to track the associated results, and demonstrated our ability to make distinctions in employee performance using a comprehensive awards system. **NASA is the first government agency to achieve green for this initiative.**

- Competitive Sourcing: NASA has a competitive sourcing plan and has announced two standard competitions involving more than 230 positions.

- Financial Performance: NASA has taken significant steps toward resolving inconsistencies in financial reporting and issues relating to valuation of contractor-held property by implementing the Core Financial Module of the Integrated Financial Management Program. Data reconciliation issues due to the conversion from the old to the new systems, however, have presented us with challenges in preparing our 2003 financial statements.

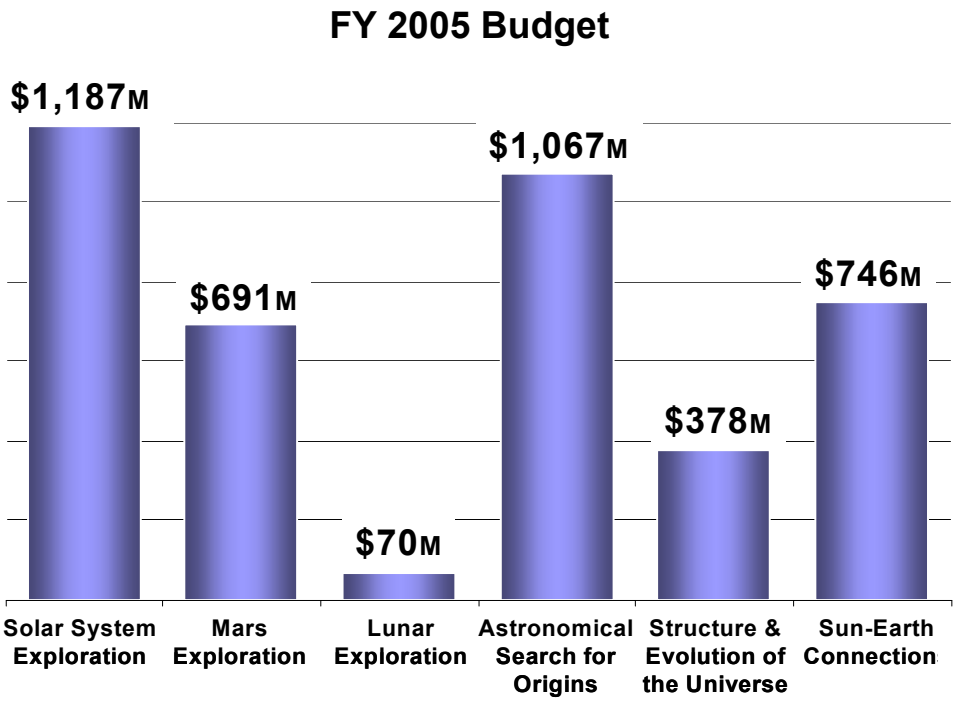
- E-Government: NASA has an information technology (IT) architecture in place to guide our investments and strengthen our IT security. All NASA IT systems are now operating within 10 percent of planned budget and schedule.

- Budget & Performance Integration: NASA used performance information and full-cost considerations to develop our FY05 budget request and to inform our management decisions. **NASA is the first government agency to achieve green for this initiative.**

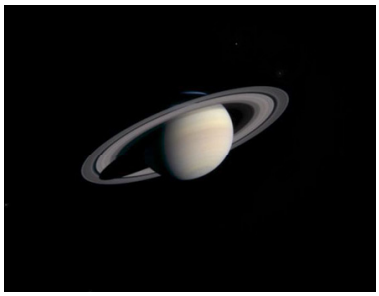
Space Science Enterprise

Thousands of years ago, on a small rocky planet orbiting a modest star in an ordinary spiral galaxy, our remote ancestors looked up and wondered about their place between Earth and sky. Today, we are beginning to answer these questions. Using tools of science that range from abstract mathematics and computer modeling to laboratories and observatories, humans are filling in the details of the amazing story of the universe. In the last 40 years, space probes and space observatories have played a central role in this fascinating process, and NASA's Space Science Enterprise will continue to address these profound questions: How did the universe begin and evolve? How did we get here? Where are we going? Are we alone?

Now, in support of the exploration vision, orbiting observatories and planetary probes will be joined by human explorers in seeking answers to these questions. Robotic scouts will blaze the trail, reconnoitering the planets, moons, asteroids, and comets of the solar system in advance of human expeditions, as observatories monitor the sun and its effects on its planetary retinue. The Space Science Enterprise will work with the new Exploration Systems Enterprise to develop and deploy new technologies, first on automated spacecraft and then on human missions. The Space Science Enterprise is comprised of six Themes described below.



Solar System Exploration



This Theme seeks to understand how our own solar system formed and evolved and whether there might be life in the solar system beyond Earth. In support of the President's new vision of space exploration, the robotic spacecraft dedicated to answering these questions will serve as trailblazers for the future human exploration of the solar system. 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 them. Highlights for FY 2005 include:

Overall budget
FY 2005 budget request is $1,187 million for Solar System Exploration, including funding to support missions to Saturn and Saturn's moon Titan; investigate evidence of oceans on Jupiter's icy moons; visit Mercury and Pluto; and orbit the largest asteroids and crack open the interior of a comet. Funding in this Theme includes:

- $94 million for the Dawn mission to orbit two asteroids and the Deep Impact mission to probe below the surface of a comet;
- $116 million for the New Horizons mission to Pluto and the Kuiper Belt;
- $164 million for an In-Space Power and Propulsion program, which includes an effort to develop a new radioisotope power system to enable greatly extended mission lifetimes;
- $75 million for Astrobiology research to improve the ability to find and identify life on other planets;
- $261 million for operation of the Deep Space Mission System; and
- Transfer of Project Prometheus to the new Exploration Systems Enterprise (except for some Space Science-unique elements).

Major Events in 2005

- Deep Impact will launch in December 2004. The spacecraft will release a small (820 lbs.) impactor directly into the path of comet Tempel 1 in July 2005. The resulting collision is expected to produce a small impact crater on the surface of the comet's nucleus, enabling scientists to investigate the composition of the comet's interior.
- Onboard the Cassini orbiter is a 703-pound scientific probe called Huygens that will be released in December 2004, beginning a 22-day coast phase toward Titan, Saturn's largest moon; Huygens will reach Titan's surface in January 2005.

Mars Exploration

This Theme explores the mysteries of the history and present conditions on Mars. Dry and cold today, the Martian surface shows 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 will be critical for future human exploration. The FY 2005 program includes multiple efforts to build upon the recent success of the Mars Exploration Rover program. Highlights for FY 2005 include:

Overall budget
FY 2005 budget request is $691 million for Mars Exploration. This represents a $96 million, or 16 percent, increase over FY 2004. By FY 2009, spending is planned to double to $1.3 billion. The budget funds the operations of: four spacecraft currently at Mars; four new spacecraft through 2010; technology for science missions after 2010; and a new line of testbed missions to support future human and robotic Mars exploration, with first launch in 2011. Funding in this Theme includes:

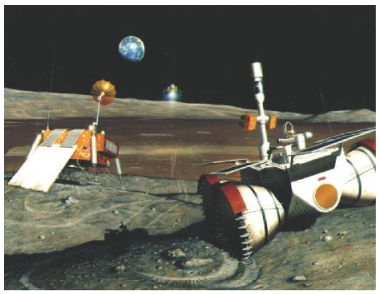
- $104 million for development of 2005 Mars Reconnaissance Orbiter, an orbiter that will map Martian surface features as small as a basketball (20-30 cm).
- $103 million (nearly four times the FY 2004 funding level) for the 2007 Scout Mission called Phoenix, a competitively selected mission to land on the Martian plains and analyze surface and subsurface samples of water and ice;
- $175 million (a 49 percent increase above FY 2004) for the 2009 Mars Science Laboratory, a rover that will traverse tens of kilometers over Mars and last over a year, digging and drilling for unique samples to study in its onboard laboratory;

- $25 million (nearly three times the FY 2004 funding level) for the 2009 Mars Telesat Orbiter (MTO), a multi-band (X-, Ka-, and UHF band) spacecraft that will provide communications relay support for assets at Mars and will also provide entry, descent, and landing, and Mars orbit insertion support for the 2009 Mars Science Laboratory; and
- $56 million for an optical communication technology demonstration, which will help develop technology to increase communication data rate and improve the cost-per-bit of data returned. This technology will be demonstrated on the 2009 MTO.

Major Events in 2005

- The Mars Reconnaissance Orbiter (MRO) will launch in August 2005. MRO will observe the atmosphere, surface, and subsurface of Mars in unprecedented detail.
- Development of the 2007 Mars Scout mission will continue. This mission, the first in the competitively selected Mars Scout Program, is called Phoenix, and will land in and explore the ice-rich terrain of the high northern latitudes of Mars.

Lunar Exploration



The new Lunar Exploration (LE) Theme will undertake lunar exploration activities that enable sustained human and robotic exploration of Mars and other bodies in the solar system, through the development of new approaches, technologies, and systems. The major focus of the LE Theme will be demonstrating capabilities to conduct sustained research on Mars as well as deeper and more advanced explorations of our solar system. The specifics of lunar missions and systems will be driven by the requirements of future human and robotic explorations of Mars and other solar system destinations, as well as by research results from ongoing robotic missions in the solar system. Lunar missions will also pursue scientific investigations on the Moon, such as uncovering geological records of our early solar system. Robotic lunar missions will begin in 2008, with human lunar missions following as early as 2015. Highlights for FY 2005 include:

Overall budget

FY 2005 budget request is $70 million for Lunar Exploration. By FY 2009, spending will increase six-fold to $420 million. Funding supports a new line of robotic missions to demonstrate sustainable solar system exploration, including: a lunar orbiter planned for launch in 2008; a lunar landing planned for launch in 2009; and up to one lunar mission per year thereafter to demonstrate new exploration capabilities.

Major Events in 2005

- Lunar Exploration will be established as a new Theme for FY 2005, in response to the *President's Vision for U.S. Space Exploration*. Major activities for FY 2005 will be developed prior to the start of FY 2005.
- Space Science will conduct preliminary work in support of the 2008 lunar mission.

Astronomical Search for Origins

This Theme strives to answer two questions: Where did we come from? Are we alone? The Theme seeks to observe the birth of the earliest galaxies and the formation of stars, find planetary systems in our region of the galaxy, including those capable of harboring life, and learn whether life exists beyond our solar system. We seek to understand the building blocks of life, the conditions necessary for life to persist, and the signatures of life that might be detectable from Earth. 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. Highlights for FY 2005 include:

Overall budget

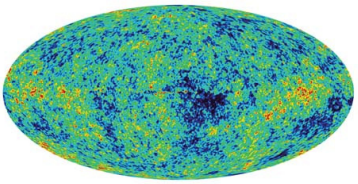
FY 2005 budget request is $1.1 billion for the Astronomical Search for Origins. This represents a $168 million, or 19 percent, increase over FY 2004. These increases support techniques to extend the Hubble Space Telescope's lifetime, James Webb Space Telescope development, Spitzer Space Telescope operation, and two additional space observatories. Funding in this Theme includes:

- $130 million for Hubble Space Telescope operations and data analysis, as well as funding for a robotic mission to safely deorbit the telescope when it ends operations;
- $318 million (a 26 percent increase above the FY 2004 amount) for development of the James Webb Space Telescope planned for launch about 2011, promising to build on the legacy of Hubble Space Telescope; and
- $155 million (more than double the FY 2004 funding level) for development of the Space Interferometry Mission planned for launch in late 2009 to detect planets around other stars.

Major Events in 2005

- The Spitzer Space Telescope (formerly SIRTF, the Space Infrared Telescope Facility) will begin its second cycle of science proposals.
- The Stratospheric Observatory for Infrared Astronomy (SOFIA), an aircraft-based infrared telescope, will be delivered for final science testing.
- James Webb Space Telescope (JWST) will undergo its System Definition Review.

Structure and Evolution of the Universe



This Theme seeks to understand the nature and phenomena of the universe, the fundamental laws of space, time, and energy, and to trace the cycles that created the conditions for our own existence. Strategies include observing signals from the Big Bang, mapping the extreme distortions of space-time near black holes, investigating galaxies, and analyzing the most energetic events in the universe. Highlights for FY 2005 include:

Overall budget

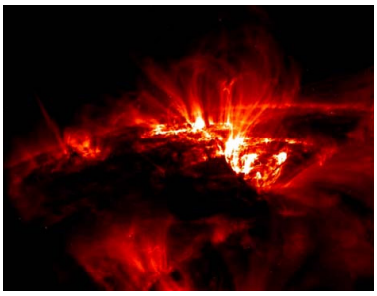
FY 2005 budget request is $378 million for Structure and Evolution of the Universe missions. This funding supports operation of the Chandra X-ray Observatory, development of the Gamma-ray Large Area Space Telescope (GLAST) mission, and development of two future missions. Funding in this Theme includes:

- $103 million for development of Gamma-ray Large Area Space Telescope (GLAST), a mission to study high-energy objects like black holes;
- $31 million for continued technology development for two missions: Laser Interferometer Space Antenna (LISA) and Constellation-X. LISA will use three spacecraft "formation flying" 5 million kilometers apart in a triangle to observe the distortion of space due to gravity waves. Constellation-X will use a team of powerful X-ray telescopes working in unison to observe black holes, investigate "recycled" stellar material, and search for the "missing matter" in the universe; it will be 100 times more powerful than any single X-ray telescope that has come before it. As a result of the reprioritized agency activities, development will be slowed down, and launch dates for Con-X and LISA will be deferred; and
- $210 million (a 12 percent increase over the FY 2004 amount) for research into the structure and evolution of the universe.

Major Events in 2005

- Astro-E2, a powerful x-ray observatory developed jointly by the U.S. and Japan, will be launched.
- A host of missions, including the Chandra X-Ray Observatory, WMAP, and GALEX, will continue their operations and science investigations.

Sun-Earth Connection



This Theme investigates our Sun and how its structure and behavior affect Earth. The Sun's energy is responsible for the Earth's present ecosystem, but the Sun is a variable star, whose variability profoundly affects Earth. Changes in its long-term brightness cause ice ages, and its 11-year cycle of activity causes aurora and other disturbances on Earth. Solar flares affect the upper atmosphere and can damage satellites and disable the power distribution grid on the ground. As our nearest star, the Sun is also an ideal laboratory for basic physics and learning about other stars. Highlights for FY 2005 include:

Overall budget

The FY 2005 budget request is $746 million for Sun-Earth Connection missions. This funding supports the Solar Dynamics Observatory (SDO), development of the Solar-Terrestrial Relations Observatory (STEREO) mission, and other Living With a Star and Solar-Terrestrial Probe missions. Funding in this Theme includes:

- $74 million for development of STEREO;
- $158 million (more than double the FY 2004 funding level) for SDO, a cornerstone mission in the Living With a Star program that will study the Sun's magnetic field and the dynamic processes that influence space weather;
- $47 million for future flight missions in the Living With a Star program; and
- $195 million for research in SEC (a 10 percent increase over the FY 2004 level).

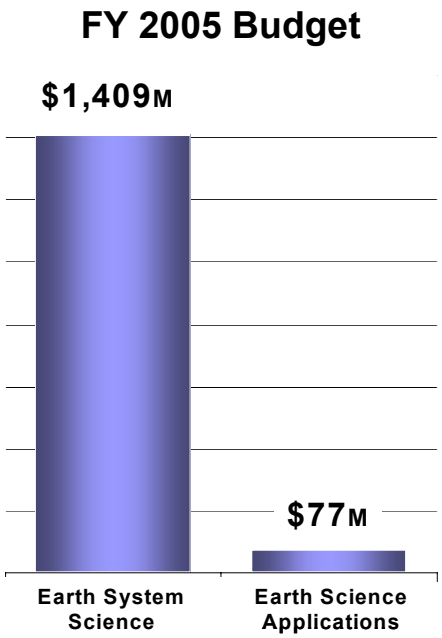
Major Events in 2005

- STEREO will be prepared for launch in FY 2006. STEREO will use two identically equipped spacecraft to provide revolutionary three-dimensional imaging of Coronal Mass Ejections.

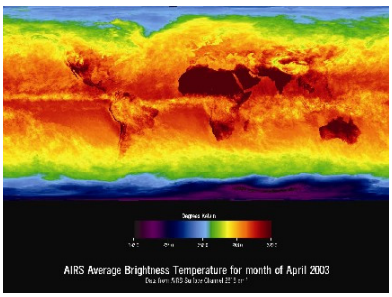
Earth Science Enterprise

The mission of NASA's Earth Science Enterprise (ESE) is to develop a scientific understanding of the Earth system and its response to natural and human-induced changes. This understanding enables us to improve prediction of climate, weather, and natural hazards. NASA brings to this endeavor the unique vantage point of space, allowing global views of Earth system change. NASA provides scientific information in the form of observations, research, modeling, and integrated solutions to meet national priorities. NASA has been studying Earth from space since its beginnings as an Agency. NASA research and development of aerospace science and technology has resulted in deployment of the first series of Earth Observing System (EOS) satellites, which monitor the major interactions of the land, oceans, atmosphere, ice, and life that comprise the Earth system.

ESE works to provide scientific answers to the fundamental question: How is Earth changing and what are the consequences for life on Earth?



Earth System Science



This Theme is deploying and operating the first phase of an integrated constellation of Earth observation research satellites that will reveal interactions among Earth's continents, atmosphere, oceans, ice, and life. These Earth processes produce the conditions that sustain life on Earth. Data from NASA Earth observation satellites enable researchers to understand the causes and consequences of global change and inform the decisions made by governments, industry, and citizens to improve our quality of life. Highlights for FY 2005 include:

Overall budget

The FY 2005 request is $1,408.5 million:

- $54 million for the Climate Change Research Initiative, making NASA's Earth Science Enterprise the largest contributor to the interagency Climate Change Science Program (CCSP) in FY05;
- $141 million (a 36 percent increase above FY 2004) for development of the NPOESS Preparatory Project (NPP), in partnership with the National Oceanic and Atmospheric Administration and the Department of Defense;
- $560 million for research in Earth System Science (a 7 percent increase above FY 2004), allowing NASA to take advantage of data from 80 sensors on 18 operating satellites by supporting a steady level of competitive, world-class research; and
- $240 million for missions in formulation (a 37% increase above FY 2004) including such missions as Orbiting Carbon Observatory, Aquarius, and Hydros.

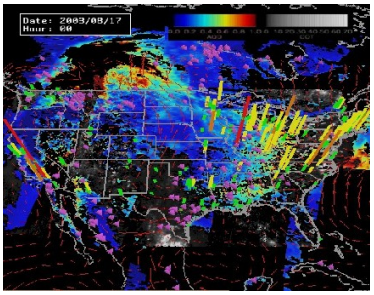
Major Events in 2005

- Several Explorer missions (Orbiting Carbon Observatory, Aquarius) begin implementation in FY05.
- NASA remote sensing and modeling research in the North American Carbon Program will be supporting major intensive field campaigns, very likely in the mid-continental United States and in one or more

coastal regions, with the exact regions to be identified through peer review processes occurring in 2004. Also, NASA, the Department of Energy, and the National Oceanic and Atmospheric Administration will be completing the preparation and release of the first State of the Carbon Cycle Report, a Carbon Cycle Science Plan Synthesis and Assessment product.

- Cloudsat and CALIPSO will launch in FY05 and will begin providing key measurements to improve climate predictions. Specifically, these satellites will observe the roles of clouds in Earth's climate, and the role of clouds and aerosols in Earth's radiation budget.
- NASA's next generation Earth-observing satellite, Aura, will begin supplying the most complete information yet on the health of Earth's atmosphere. The data flowing from these global observations will help scientists track the sources and processes controlling global and regional air quality, quantify the impact of aerosols, tropospheric ozone and upper tropospheric water vapor on Earth's climate, and answer other key scientific questions.
- The first phase of the Earth System Modeling Framework will be completed. With the completion of ESMF, new science will be enabled and the collaboration between the Earth system modeling centers will be enhanced.

Earth Science Applications



Within this Theme, NASA works with other Federal agencies to apply Earth Science research results and information products to 12 applications of national priority and to serve national priorities in education. NASA partner agencies' decision support systems are being improved due to NASA-sponsored scientific research and technological innovations. Examples include the Federal Aviation Administration (FAA) National Airspace System and the U.S. Department of Agriculture (USDA) Crop Assessment Data Retrieval and Evaluation (CADRE) system. NASA and its partners benchmark the enhancements that result from delivering Earth science research results through integrated system solutions, leading to increased use of NASA information and technology for both domestic and international decision support systems and education projects. Highlights for FY 2005 include:

Overall budget

The FY 2005 request is $76.9 million:

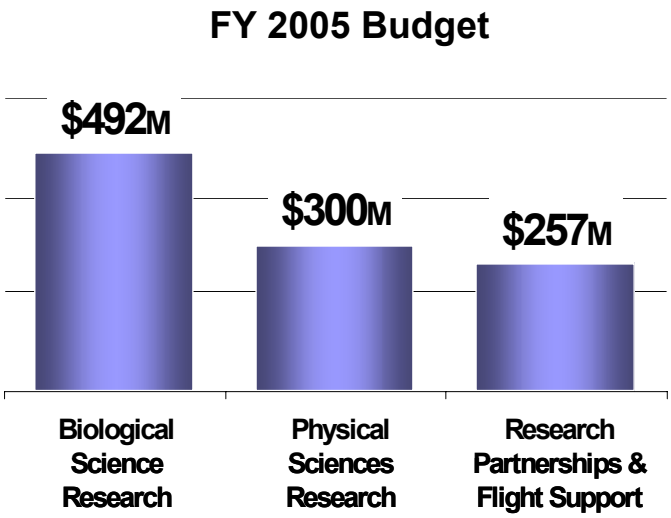
- The request includes funding for benchmarking the use of Earth observations from nine NASA Earth observatories into decision support tools through partnerships with eight Federal agencies for air quality, agricultural efficiency, aviation, carbon management, coastal management, disaster management, ecological forecasting, energy management, invasive species, public health, and water management.
- $14.3 million for an enhanced outreach and education program to communicate significant Earth science research and application results, and to expand the Digital Earth Virtual Environment and Learning Outreach Project (DEVELOP). The request will sponsor over 150 projects to develop post-graduate, graduate, K-12, and informal education capacity for extending the use of Earth system science research results to serve society.

Major Events in 2005

- ESA will continue participation in Joint Agency Commercial Imagery Evaluation (JACIE) to provide Earth scientists with verification of the performance of commercial data, thereby optimizing the value to the government of private sector investments
- ESA will expand the Digital Earth Virtual Environment and Learning Outreach Project (DEVLOP) in an effort to develop human capital that will meet the future needs of the Earth Science Enterprise and the Applications program. This will be accomplished through student-centered programs that serve communities in at least 26 states.

Biological and Physical Research Enterprise

The Biological and Physical Research (BPRE) Enterprise has a unique role in support of NASA's Vision and Mission. In concert with the new exploration vision, BPRE will refocus research on activities that prepare human explorers to travel beyond low Earth orbit, such as the development of countermeasures against space radiation and the long-term effects of reduced gravity.



Coordinated strategic research thrusts address topics such as radiation health and protection, biomedical countermeasures, bio-regenerative life support, and engineering research supporting the technologies required for sustained human exploration of space.

If we are to venture safely into space, NASA must provide the same kind of safe cocoon for space explorers that Earth provides for its inhabitants. Understanding how humans and other life forms adapt to the environment of space is a critical BPRE role.

The Enterprise's contributions to realizing NASA's Vision address five questions that provide a framework for all Enterprise activities: (1) How can we assure the survival of humans traveling far from Earth? (2) How does life respond to gravity and space environments? (3) What new opportunities can research bring to expand understanding of the laws of nature and enrich lives on Earth? (4) What technology must we create to enable the next explorers to go beyond where we have been? (5) How can we educate and inspire the next generation to take the journey?

The FY05 budget will allow BPRE to complete and launch a wide range of research facilities to the ISS over the next five years that will enable exploration-focused research in biology and technology development. The FY05 budget fully supports increased BPRE research on ISS following return to flight. Four major facilities are completed and will be launched on the first two missions to ISS. BPRE will be conducting a thorough review of all research activities to achieve full alignment with and support of the new exploration vision.

Biological Sciences Research

Within this Theme, we determine 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 carrying out research to define and control these risks and to improve the performance of life support systems. The Biological Sciences Research Theme also pursues fundamental biological questions on scales ranging from cell to tissues to whole organisms to ecosystems. These results will advance human exploration of space, understanding of biological systems, and improve human health on Earth.

Overall budget

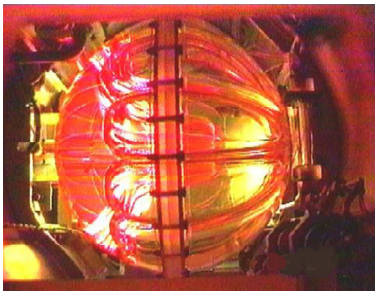
The FY 2005 request is $492 million, a $123.5 million (34 percent) increase above FY 2004, and a $353 million (12 percent) increase over 5 years:

- $343 million (a 61 percent increase above FY 2004) for Bioastronautics Research, including the Human Research Initiative, to perform research and develop technology for systems that will enable humans to live and work safely and effectively in space. These research activities are aligned with the Bioastronautics Critical Path Roadmap, which identifies the critical risks associated with long-term human space travel; and
- $149 million for Fundamental Space Biology to focus on research on life's responses to space environments at all levels including cell sciences and genomics, physiological adaptation and developmental biology, ecosystem interactions and multigenerational studies, and the development of hardware for the Centrifuge Accommodation Module.

Major Events in 2005

- BSR will systematically explore the utility of Artificial Gravity as a multi-system countermeasure in ground based venues using test subjects deconditioned by bed rest.
- BSR will improve ability to predict risks associated with exposure to radiation by using the National Space Radiation Laboratory.
- BSR will complete preliminary study of Advanced Integration Matrix.
- BSR will continue development of Sabatier technology to help close the water recovery cycle on the International Space Station (ISS).
- BSR will complete readiness of Habitat Holding Rack No. 2, and the Japanese Aerospace Exploration Agency (JAXA) provided Life Sciences Glovebox.

Physical Sciences Research



This Theme supports research that uses the unique environment of space to expand our understanding of the fundamental laws of nature and to advance industrial and technological applications on Earth. This Theme also supports applied physical science and engineering research to develop reduced gravity technologies critical to human space exploration, such as radiation shielding, microgravity fire safety, and those elements of spacecraft power and propulsion systems that are gravity dependent. The Physical Sciences Research program develops technologies for space crew health programs and new processes to produce life-sustaining resources in a reduced-gravity remote environment.

Overall budget

The FY 2005 request is $300 million to continue important research in physical sciences.

The request covers the development of hardware for inserts to be used with the ISS Research Facilities such as:

- Sample Cartridge Development,
- Lab-on-a-Chip Application Development,
- Multi-user Gaseous Fuel Apparatus,
- Granular Flow Module,
- Space Acceleration Measurement System,
- Microgravity Acceleration Measurement System, and
- Primary Atomic Reference Clock in Space.

Major Events in 2005

- PSR will complete three (3) Microgravity Science Glovebox experiments.
- PSR will initiate an Advanced Life Support research flight experiment development.
- PSR will initiate design of an In-space Fabrication and Repair experiment.
- PSR will publish STS-107 research results together with International Space Station (ISS) flight experiments.

Research Partnerships and Flight Support

This Theme establishes policies and allocates space resources to support space flight research and also encourage development of research partnerships in the pursuit of NASA missions and Enterprise scientific objectives. This research supports product development on Earth and accelerates progress in our strategic research areas. Ultimately, research partnerships may support development of an infrastructure that can be applied to human exploration. This Theme also funds ISS research planning, integration, and operations, as well as development and maintenance of research hardware that is used across multiple research disciplines such as the Express Rack and refrigerator/freezers.

Overall budget

The FY 2005 request is $257 million.

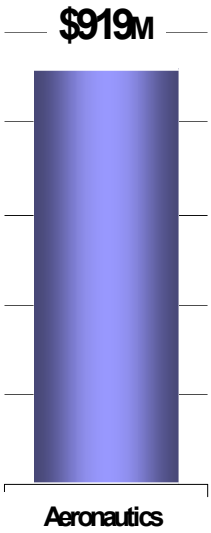
Major Events in 2005

- RPFS will develop new research partnerships with other divisions of BPRE, other NASA enterprises and other federal agencies.
- RPFS will start work on four new realignment initiatives that directly address NASA's mission and involve the RPC industrial partners.
- RPFS will expand education and outreach activities to engage the public in NASA's missions, discoveries and technology.
- The ISS Downlink Enhancement Architecture will demonstrate 150 megabyte per second communication for ISS research.
- The ISS will have the capability for –80 C cold stowage of research samples upon launch of the Minus Eighty-Degree Laboratory for ISS freezer unit in FY2005.
- Mid-deck locker size units will be developed to provide additional volume for storing research samples at +4 C, -20 C and –180 C.

Aeronautics Enterprise

Aviation is an indispensable part of our Nation's transportation system, providing unequaled speed and mobility for people and goods. The Aeronautics Enterprise holds a unique role within NASA as the sole steward 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, environmentally friendly and efficient air transportation system, increasing performance of military aircraft, and developing new platforms for science or commercial uses. This Enterprise also enhances the Nation's security through its partnerships with the Department of Defense, the Department of Homeland Security, and the Federal Aviation Administration (FAA). Research areas include advanced propulsion technologies, lightweight high-strength adaptable structures, revolutionary display and control systems, adverse weather countermeasures, 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.

FY 2005 Budget



Aeronautics Technology

Aeronautics Technology consists of three integrated programs. The Aviation Safety and Security Program directly addresses the safety and security research and technology development needs of the nation's aviation system, to either prevent unintentional and intentional actions that would cause damage, harm, and loss of life or mitigate the consequences when these types of situations occur. The Airspace Systems Program conducts research and technology development that will enable revolutionary improvements to, and modernization of, the National Airspace System, as well as the introduction of new systems for vehicles whose operation can take advantage of the improved, modern air traffic management system. The Vehicle Systems Program develops enabling technologies that will produce future vehicles that are environmentally friendly, quieter, faster, more efficient, and technologically superior and supports science missions and commercial applications requiring high altitude, long endurance, and remote operations. Highlights for FY 2005 include:

Overall budget

The FY 2005 request is $919 million:

- $7 million to study technologies and concepts that may enable planetary aircraft in support of the new vision;
- $188 million (a 4 percent increase above FY 2004) for Aviation Safety and Security projects aimed at reducing accident and fatality rates reducing the vulnerability of the aviation system to terrorist and criminal threat;
- $154 million for Airspace Systems projects to provide technologies that can dramatically increase the capacity and mobility of the nation's air transportation system;
- $209 million to reduce the emissions and enhance the efficiency of aircraft, improving our environment;
- $133 million for flight and systems demonstration of enabling aeronautics technologies;
- $75 million increase through 2009 for rotorcraft research; and
- $72 million (an 11 percent increase above FY 2004) to reduce the noise made by aircraft, improving the quality of life around airports.

Major Events in 2005

- NASA will demonstrate 70 percent reduction in nitrous oxides emissions in full-scale tests of combustor configurations suitable for a large subsonic vehicle.
- NASA will demonstrate integrated technologies and polices that would allow routine un-piloted vehicle flight operations in the National Airspace System above an altitude of 40,000 feet.
- NASA will complete Human in the Loop concept and technology evaluation of shared aircraft separation.
- NASA will conduct experimental flight evaluation of key Small Airplane Transportation System enabling technologies.
- NASA will accomplish its objective of developing technologies that will enable a 50 percent reduction in the fatal accident rate from the 1991-1996 level.

Education Enterprise

The Education Enterprise was established in 2002 to inspire more students to pursue the study of science, technology, engineering, and mathematics, and ultimately to choose careers in aeronautics- and space-related fields. This Enterprise unifies the educational programs in NASA's other Enterprises and at the 10 field centers under a *One NASA Education* vision. NASA Education will be embedded within all the Agency's activities. The Education Enterprise includes the Education Programs Theme.

FY 2005 Budget

$169M

Education Programs

Education Programs

The Education Enterprise will provide unique teaching and learning experiences, as only NASA can, through the Agency's research and flight missions. Students and educators will be able to work with NASA and university scientists to use real data to study Earth, explore Mars, and conduct scientific investigations. They will work with our engineers to learn what it takes to develop the new technology required to reach the farthest regions of the solar system and to live and work in space. It is important that the next generation of explorers represents the full spectrum of the U.S. population. To ensure diversity in NASA's workforce, the Education Enterprise's programs pay particular attention to under-represented groups. NASA Education will support the 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 to seek NASA careers.

Overall budget

The FY 2005 request is $168.5 million:

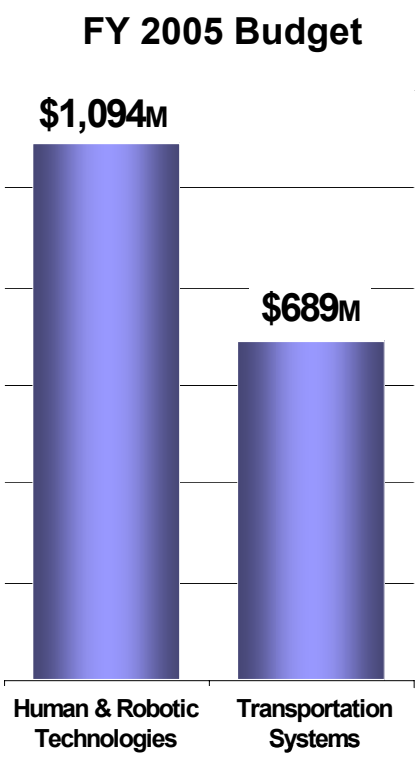
- $10 million for the newly authorized Science and Technology Scholarship program to ensure NASA's pipeline of new scientists and engineers includes the best of the best;
- $13.7 million for the NASA Explorer Schools program, which enters its third phase, selecting 50 new schools for a total of 150 participating schools;
- $91 million for minority university research and education (a 2 percent increase above FY 2004) to expand NASA's scientific and technical base through partnerships with Historically Black Colleges and Universities (HBCUs), Hispanic Serving Institutions (HSIs), Tribal Colleges and Universities (TCUs), and Other Minority Universities (OMUs); and
- Another estimated $70 million in education-related funding, managed by the other NASA Enterprises in coordination with the Education Enterprise.

Major Events in 2005

- The NASA Explorer Schools program enters its third phase, selecting 50 new schools for a total of 150 participating schools.
- The first class of students will be selected for the Science and Technology Scholarship program.
- NASA will capitalize on the ongoing training of the new class of Educator Astronauts by developing learning modules for K-12 students and teachers.
- The Explorer Institute program will move into its first full year of implementation, building relationships with, and professional development opportunities for, museums, science centers, planetaria, and other informal education institutions across the country.

Exploration Systems Enterprise

The relationship between discovery and exploration has driven human curiosity throughout U.S. and global history. New World pioneers demonstrated the value of exploration, as they obtained knowledge, technology, resources, and inspiration for our nation. At the beginning of the 21st century, we stand at a unique time in our exploration of the heavens. The exploratory voyages of the next few decades have the potential – within our lifetimes – to answer age-old questions about how life begins, whether life exists elsewhere, and how humans will exist in the future.

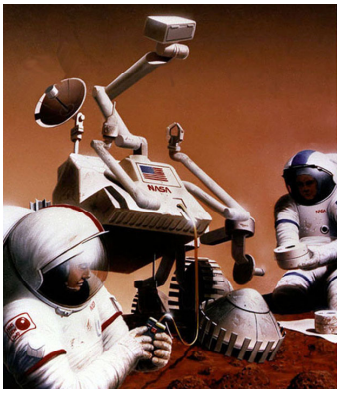


These voyages will not be easy. Mars is 100,000 times farther away from Earth than is the International Space Station. At the moons of Jupiter, the power supplied by sunlight is 27 times weaker than on Earth. Radiation presents an ever-present challenge to human and robotic explorers. Using existing systems and technology, it takes over a decade and a half to reach the boundaries of our solar system.

To enable an effective and exciting program of solar system exploration, the constraints of distance, energy, and time must be overcome. Meeting these challenges will require innovative approaches, new vehicles, and breakthrough technologies. The new Exploration Systems Enterprise has been allocated $13.4 billion over the next five years for developing and demonstrating the strategies and systems that will allow human and advanced robotic exploration of other worlds.

The Exploration Systems Enterprise includes two new Themes that will function cooperatively to enable sustainable exploration and scientific discovery in the solar system: Human and Robotic Technology and Transportation Systems.

Human and Robotic Technology



The Human and Robotic Technology (HRT) Theme is responsible for developing innovative technologies to enable sustainable exploration of our solar system. Through applied technology research, focused technology maturation, and timely technology transition, the HRT Theme will develop technologies that can be integrated into LE Theme missions and applied in the exploration activities of other NASA Enterprises.

For sustainable solar system exploration, NASA requires safe, affordable, effective, and flexible architectures, vehicles, and systems. This may require systems that can be reused, systems that are highly reliable and require limited maintenance and support, systems that can be applied to more than one destination, systems that can operate intelligently without human control, and architectures that use space resources to improve efficiency. NASA plans to invest in a number of new approaches and technologies for exploration that could enable these kinds of architectures, vehicles, and systems. These technologies will be demonstrated on the ground, at the Space Station and other locations in Earth orbit, and at the Moon starting this decade and into the next. Where they provide for safety,

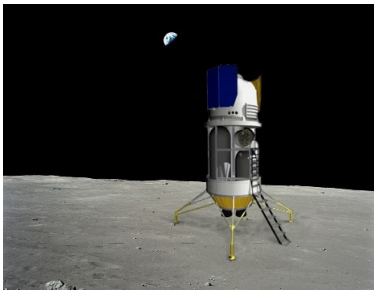
affordability, effectiveness, and flexibility in architectures, these new tools will be incorporated in full-scale, operational exploration systems.

The HRT Theme consists of five programs: Centennial Challenges, Project Prometheus, Technology Maturation, Advanced Space Technology, and Innovative Technology Transfer Partnerships.

Overall budget
The FY 2005 request is $1,093.7 million, including:

- $438 million for Project Prometheus to develop advanced nuclear technologies for power and propulsion.
- $115 million (growing to $500 million by FY 2009) in new funding for Technology Maturation to identify and develop the technologies and building blocks necessary in pursuit of the exploration vision; and
- $20 million in new funding for Centennial Challenges to provide awards to non-traditional innovators in academia, industry, and the public who can provide novel solutions to the technical challenges of solar system exploration and other NASA priorities.

Transportation Systems



The Transportation Systems (TS) Theme will provide crew transfer and other NASA-unique space transportation capabilities to support exploration of the solar system. The TS Theme will be focused on development and demonstration of a crew exploration vehicle under Project Constellation that can transport and support human crews traveling to destinations beyond low Earth orbit. The TS Theme will also be responsible for planning for potential future NASA-unique space transportation needs, such as heavy lift launch, that cannot be met through commercial or international partner capabilities.

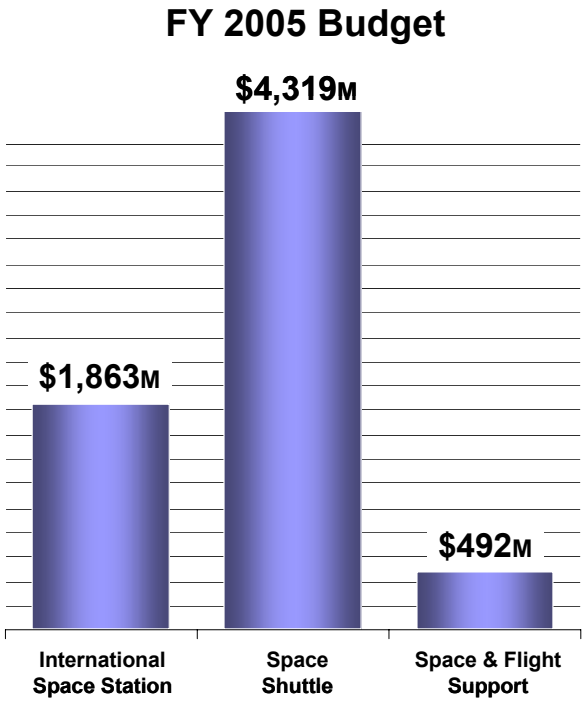
The TS Theme includes transition and closeout activities for the Orbital Space Plane and Next Generation Launch Technology programs.

Overall budget
The FY 2005 request is $688.8 million, including:

- $428 million ($6.6 billion over five years) for Project Constellation to develop a crew exploration vehicle that will take humans back out of low Earth orbit, by 2014. By leveraging existing technologies and lessons learned from past programs, NASA will ensure rapid demonstration and deployment, including a first test flight in 2008.

Space Flight Enterprise

The Space Flight Enterprise programs ensure that the Nation will have reliable, safe, and affordable access to space for NASA's human and robotic explorers and open new exploration and research opportunities through the extension of human presence in Space. The Space Flight Enterprise enables research by providing transportation systems such as the Space Shuttle, operational research facilities in space such as the International Space Station (ISS), and space communications systems and supporting space infrastructure. The Enterprise also provides the unique system–the human system–necessary to open the space frontier to the broadest extent possible. The Space Flight Enterprise does this through three Themes described below.



International Space Station

This Theme supports activities for establishing a research facility in Earth orbit aboard the ISS. The ISS provides a long-duration habitable laboratory for science and research activities primarily to support future human and robotic exploration of the solar system. The ISS can also support unique, long-duration, space-based research in cell and developmental biology, plant biology, fluid physics, combustion science, materials science, and fundamental physics. It provides a unique platform for observing Earth's surface and atmosphere, the Sun, and other astronomical objects.

All U.S. Core assembly flight elements and the first International Partner Laboratory have been delivered to the launch site. Upon completion of final ground integration, all assembly launch packages will be placed in protected stowage awaiting the Shuttle's return to flight. Highlights for FY 2005 include:

Overall budget

The FY 2005 request is $1.9 billion (a 24 percent increase above FY 2004) for the International Space Station to continue assembly and operations:

- $140 million in new funding (increasing to $500 million in FY 2009) for crew and cargo services to improve research productivity this decade and for transition from Shuttle as it is phased out; and
- $30 million in FY 2005 for funding Node 3 and the Environmental Closed Life Support System.
- This reflects Administration approval to proceed beyond the U.S. Core configuration following the program's successful completion of program management and cost control reforms.

Major Events in 2005

- NASA will increase the ISS crew size to three persons after Shuttle returns to flight.
- ISS Assembly will resume after the Shuttle returns to flight

Space Shuttle

The Shuttle, first launched in 1981, provides the only capability in the United States for human access to space. The Shuttle is also a versatile cargo launch vehicle and serves as a platform to support construction activities in space. The Shuttle's primary role is to complete the assembly of the International Space Station. The Shuttle's retirement is planned for the end of the decade, following the completion of its role in the ISS assembly. Highlights for FY 2005 include:

Overall budget

The FY 2005 request is $4.3 billion (a 9 percent increase above FY 2004) for Space Shuttle to return to flight and continue assembly of the ISS:

- $680 million to the Shuttle program through FY 2007, including more than $200 million in FY 2005, dedicated for return to flight activities.
- This includes high-priority mission assurance projects for safety, supportability, and infrastructure to combat obsolescence of vehicle, ground systems, and facilities.

Major Events in 2005

- Space Station assembly missions will resume.
- Space Shuttle Main Engine Advanced Health Management System will be completed.
- NASA will prepare for the planned retirement of the Space Shuttle following completion of its role in Space Station assembly.

Space and Flight Support

This Theme encompasses space communications, launch services, rocket propulsion testing, and environmental clean-up. Space communications supports the Space Shuttle, ISS, expendable launch vehicles, and research aircraft, and provides telecommunications services for 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 assuring safe and cost-effective access to space via the Space Shuttle and expendable launch vehicles. Rocket propulsion testing supports a core of highly trained test and engineering crews and test facilities. The two environmental clean-up initiatives (Plum Brook Reactor Facility and Environmental Compliance and Restoration) address environmental legacy liabilities of decades of space explorations and demonstrate NASA's commitment to providing a safe and clean natural environment for future generations. Highlights for FY 2005 include:

Overall budget

The FY 2005 request is $492 million:

- $196 million (a 57 percent increase above FY 2004) for the Space Communications budget;
- $146 million (a 3 percent increase above FY 2004) for oversight of expendable launch vehicle flights and supporting payload carriers for Shuttle launches;
- $67 million (an 8 percent increase above FY 2004) for rocket propulsion testing;
- $77 million for environmental compliance (including $46 million for Plum Brook cleanup), an increase of 22% over five years to meet increasing environmental requirements; and
- $10 million in new funding for flight demonstration initiative to pursue launch services with emerging launch systems.

Major Events in 2005

- FY 2005 will include the first full year of service for the Space Mission Communications and Data Service contract, the follow-on to the Consolidated Space Operations Contract.

Institutional Investments

As a function of full cost management, the following institutional investments are included in the preceding Enterprise budgets as either direct program charges or as Center or Corporate General and Administrative (G&A) charges. These areas are included in the summary below to provide visibility into the resources provided for these activities. Due to the new exploration vision, NASA will be reviewing its institutional needs and may adjust the FY 2005 estimates below upon completion.

Center G&A

Center G&A costs include Center security, ground maintenance, fire protection, business computing, public affairs, institutional construction of facilities (CoF), human resources, procurement, budgeting, etc. FY 2005 highlights include:

- $1.2 billion total for FY 2005 allocated as shown below;
- Includes $17 million additional funding for enhanced security; and
- $34 million for Center Investment Accounts.

($ in millions)	FY 2005
Ames Research Center	124
Glenn Research Center	106
Dryden Flight Research Center	53
Goddard Space Flight Center	183
Johnson Space Center	185
Kennedy Space Center	243
Langley Research Center	120
Marshall Space Flight Center	143
Stennis Space Center	44
Total, Center G&A	1,201

Corporate G&A

Corporate G&A costs include Headquarters operations and Agency-wide functions. FY 2005 highlights include:

- $848 million total for FY 2005, as shown in the table below;
- Includes $119 million for the Integrated Financial Management Program (IFMP);
- $27 million for Independent Verification and Validation Facility (IV&V);
- $22 million for Space Architect; and
- $77 million for the NASA Engineering and Safety Center.

($ in millions)	FY 2005
Headquarters Corporate Activities	373
Corporate IFMP/HQ IFM	120
Agency Operations	69
Chief Information Officer	38
Chief Engineer	28
Safety & Mission Assurance	48
NASA Engineering & Safety Center	77
Chief Health & Medical Officer	5
Space Architect	22
Security Management	8
Corporate CofF	12
Center-Based Corporate G&A	21
Independent Verif. & Valid. Facility	27
Total Corporate G&A	848

Workforce

FY 2005 highlights include:

- $2.307 billion for salaries and benefits and $69.0 million for travel.

Construction of Facilities

FY 2005 highlights include:

- $208 million for Construction of Facilities (CoF);
- Includes $55 million for program direct CoF, carried in program budgets;
- Includes $143 million for non-programmatic CoF, carried within Center G&A; and
- Includes $10 million for a Facility Demolition initiative, carried within Corporate G&A, to remove unused buildings at the NASA field Centers.

Environmental Compliance

FY 2005 highlights include:

- $76.5 million for environmental compliance, including $30.5 million for Plum Brook cleanup.