The National Aeronautics and Space Administration: An Overview and FY1999 Budget Analysis

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ABSTRACT

The National Aeronautics and Space Administration (NASA) was created by the National Aeronautics and Space Act of 1958 (P.L. 85-568) to undertake civilian research, development, and flight activities in aeronautics and space. This report provides an overview of the agency, including a brief description of the Space Act of 1958, a short summary of NASA's historical activities, a description of the agency's current organization and field centers, a discussion of its FY1998 appropriations and FY1999 request by program line item, and a discussion of the agency's future budget prospects. A table summarizing the FY1998 appropriations, the FY1999 request, and FY1999 House and Senate Appropriations Committee recommendations is included. This report will be updated as legislative actions occur on NASA's budget. For more in-depth information on NASA's space station program see CRS Issue Brief 93017 *Space Stations* and for further information on the space shuttle and Reusable Launch Vehicle programs see CRS Issue Brief 93062 *Space Launch Vehicles: Government Requirements and Commercial Competition*.

The National Aeronautics and Space Administration: An Overview and FY1999 Budget Analysis

Summary

NASA was created by the National Aeronautics and Space Act of 1958 (P.L. 85-568) to undertake civilian research, development, and flight activities in aeronautics and space. Since its creation, NASA has undertaken a wide variety of successful programs and projects including the Apollo landings on the Moon, the development of communications and weather satellites, the sending of planetary probes to all the planets except Pluto, and research in aeronautics that has improved aircraft performance and safety and assisted the competitive stance of the U.S. aeronautics industry. The agency is currently undertaking ambitious programs such as the International Space Station to provide a permanently inhabited international space station in Earth orbit, and an Earth Science program to provide data relevant to the study of global change. Although NASA has a vaunted history, not all programs have been totally successful, and some have included the loss of human life. On January 27, 1967, three astronauts died of asphyxiation during a fire in the first Apollo spacecraft during prelaunch tests. On January 28, 1986, the Space Shuttle *Challenger* exploded shortly after launch, killing all seven astronauts on board.

The NASA organization consists of its headquarters, nine research and space flight field centers, and one government-owned, contractor-operated facility located throughout the United States. The agency currently employs approximately 19,400 civil servants. Daniel S. Goldin, appointed by President Bush, became the ninth Administrator of NASA on April 1, 1992.

In February 1998, NASA released its FY1999 budget request of $13.465 billion, a reduction of $178 million from the FY1998 level of $13.638 billion. The Senate Appropriations Committee has recommended $13.615 billion for FY1999 while the House Appropriations Committee has recommended $13.328 billion. While continuing to support the International Space Station (ISS), both Committees expressed concern about its continuing cost escalation and recent NASA actions to transfer funds from science and technology programs to fund those ISS cost increases. The Senate Commerce Committee in its NASA authorization bill for FY1998, 1999, and 2000 (S. 1250), recommends authorization of the full NASA request for FY1999. The Commerce Committee, too, expressed its optimism about the future of the ISS but noted the difficult budget situation facing NASA.

Ultimately, NASA's future budget prospects will be closely tied to potential efforts to reduce the federal deficit, the agency's ability to reduce costs to meet expected future appropriations, the level of congressional support for civilian research and development (R&D), and, especially the importance attached to space relative to other national priorities.

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Introduction

The National Aeronautics and Space Administration (NASA) was created by the National Aeronautics and Space Act of 1958 (P.L. 85-568) to undertake civilian research, development, and flight activities in aeronautics and space. This report provides an overview of the agency, including a brief description of the Space Act of 1958, a short summary of NASA's historical activities, a description of the agency's current organization and field centers, a breakdown of its FY1998 appropriations and FY1999 request, and a discussion of the agency's future budget prospects. A table summarizing the FY1997 and FY1998 appropriations and the FY1998 request also is included.

National Aeronautics and Space Act of 1958

The National Aeronautics and Space Act of 1958 (**P.L. 85-568**), known as the NASA Act, established NASA and outlined its objectives. NASA is to undertake civilian research, development, and flight activities in aeronautics and space to maintain United States preeminence in those areas. The Act stipulated, however, that the Department of Defense (DOD) is responsible for all military space activities. NASA incorporated a predecessor agency known as the National Advisory Committee for Aeronautics (NACA), whose staff and facilities were transferred to NASA by the Act. NASA's objectives as outlined by the NASA Act, as amended, are as follows:

- The expansion of human knowledge of the Earth and of phenomena in the atmosphere and space;
- The improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles;
- The development and operation of vehicles capable of carrying instruments, equipment, supplies, and living organisms through space;
- The establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes;
- The preservation of the role of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere;

- The making available to agencies directly concerned with national defense of discoveries that have military value or significance, and the furnishing of such agencies, to the civilian agency established to direct and control nonmilitary aeronautical and space activities, of information as to discoveries which have value or significance to that agency;
- Cooperation of the United States with other nations and groups of nations in work done pursuant to this Act and in the peaceful application of the results thereof;
- The most effective utilization of the scientific and engineering resources of the United States, with close cooperation among all interested agencies of the United States in order to avoid unnecessary duplication of effort, facilities, and equipment; and
- The preservation of the United States' preeminent position in aeronautics and space through research and technology development related to associated manufacturing processes.

NASA — A Brief History of Activities

Spurred on by the October 1957 launch of the first artificial satellite, *Sputnik 1*, by the Soviet Union, the mid-1958 creation of NASA symbolized the entrance of the United States into the space age. Only months earlier, in January 1958, the United States had launched its first satellite, *Explorer 1*. Since its creation, NASA has undertaken a wide variety of programs and projects including the following:

- Human spaceflight including trips to the moon;
- Applications satellites for communications, weather, and Earth land and ocean sensing;
- Scientific satellites and probes to examine processes that affect the Earth and its environment, explore the Moon and other planets, and provide data on stars, comets, and interstellar space; and
- Aeronautical research in aerodynamics, materials and propulsion, in addition to flight tests with advanced aircraft, to improve aircraft performance and improve safety in the nation's airspace.[1]

The 1960s

The 1960s are known for the first flights of astronauts, the Mercury and Gemini programs, the Apollo program, and the landing of Americans on the Moon. In his May 1961 address to Congress, President Kennedy called for the United States to commit itself to landing an astronaut on the Moon before the end of the decade. That

[1] For more information on NASA's aeronautics research, see: *Orders of Magnitude: A History of the NACA and NASA, 1915-1990*, by Roger E. Bilstein. (NASA SP-4406). 1989. Washington: National Aeronautics and Space Administration Office of Management, Scientific and Technical Information Division.

goal was met with the July 20, 1969, landing of Apollo 11 on the Moon with astronauts Armstrong and Aldrin.[2] Two earlier programs preceded the Apollo program. The Mercury program (1961-1963) developed knowledge about human reaction to the space environment. The Gemini program (1965-66) expanded the knowledge of humans in space and developed expertise in rendezvous and docking and extravehicular activity in Earth orbit.

The 1960s also saw the development of scientific, communications and meteorological satellites. Often, once NASA developed communications and weather satellites, operational responsibility was turned over to the private sector or to another government agency (such as the National Oceanic and Atmospheric Administration in the case of meteorological spacecraft). Several scientific probes and satellites provided information about the interaction between the Sun and Earth as well as data on other stars and the cosmos. Robotic probes were launched to the Moon and other planets. By the end of the decade, Venus and Mars had been visited by Mariner probes in flybys.

The 1970s

NASA's budgets fell significantly in the 1970s. In the early 1970s, five more Apollo lunar landings were accomplished, but the last three of the eight planned missions were canceled. A near tragedy occurred en route to the Moon on April 13, 1970, when an oxygen tank exploded aboard Apollo 13. The crew made it back safely to Earth 4 days later after improvising an ingenious plan. In 1972, President Nixon approved the start of the Space Shuttle program to develop the first reusable launch vehicle for taking people and cargo into space. From 1973 to 1974, three crews visited a space station called Skylab. The third crew remained on Skylab for 84 days, a record at the time. Skylab reentered the Earth's atmosphere in 1979.[3] In 1975, the Apollo-Soyuz Test Project, in which a two-man Soviet crew docked in orbit with a three-man U.S. crew for the first such international space flight, heralded the end of the Apollo era. No U.S. human spaceflights occurred for the remainder of the decade.

The success of science and applications satellites and planetary probes continued in the 1970s. The Landsat program was initiated to provide environmental information on such topics as land resources and pollution on the Earth's surface. In 1973, Pioneer 10 became the first probe to fly by Jupiter, and, in 1979, Pioneer 11 was the first probe to fly by Saturn. In 1974, Mariner 10 became the first probe to fly by Mercury. In 1976, Vikings 1 and 2 were the first U.S. probes to land on the surface of Mars.

NASA also undertook other astronomical and space physics projects such as four series of Earth orbiting observatories: the Orbiting Solar Observatory (OSO),

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[2] The Apollo program was not without its failures. On January 27, 1967, three astronauts (Grissom, White, and Chaffee) died of asphyxiation during a fire in the first Apollo spacecraft during prelaunch tests.

[3] Debris from Skylab that did not burn up in the atmosphere rained over the Indian Ocean and parts of Western Australia.

the Orbiting Astronomy Observatory (OAO), the Orbiting Geophysical Observatory (OGO), and the High Energy Astronomy Observatory (HEAO). In addition, NASA began a series of Explorer spacecraft probes such as the International Ultraviolet Explorer (IUE), which launched in 1978 and conducted a variety of astrophysical observations in the ultraviolet spectra. Two Helios spacecraft, which were joint U.S.-German efforts to examine the Sun, were launched in 1974 and 1976.

The 1980s

After a hiatus of 6 years, American astronauts once again returned to space with the first Space Shuttle launch, on April 12, 1981. A total of 24 successful Shuttle flights occurred before the January 28, 1986, Space Shuttle *Challenger* accident. The Space Shuttle exploded shortly after launch, killing all seven crew members. After the cause of the accident was discovered and fixes made, the Space Shuttle returned to flight on September 29, 1988.

In 1984, President Reagan endorsed development of a permanently occupied Space Station for operation in the mid-1990s. Skylab, the first U.S. space station, was never intended to be permanently occupied. This proposed space station, named *Freedom* in 1988, was redesigned several times in the 1980s due to changes to the shuttle program after the *Challenger* accident, rising costs, and lower than expected funding.

Limited budgets in the late 1970s and early 1980s, the development of fewer, large spacecraft with longer development times than those built previously, and the *Challenger* accident led to fewer launchings of space science probes and applications satellites in the 1980s. Prior to the *Challenger* accident, NASA and DOD were relying on the Space Shuttle fleet to launch most of their major spacecraft. The accident and the subsequent 32-month hiatus before the Shuttle returned to flight convinced NASA and the broader space community that a "mixed fleet" consisting of both the Shuttle and expendable launch vehicles (ELVs) would be necessary to assure continued access to space. Thus, the commercialization of the U.S. launch vehicle industry began to increase markedly as the private sector began to build ELVs to satisfy its own needs in addition to those of the military and NASA.

In 1989, the Space Shuttle launched the Magellan and Galileo space probes. Magellan's mission (completed successfully) was to map Venus's surface. Galileo flew by the asteroids Gaspra and Ida in 1991 and 1993, respectively. Its primary mission began in December 1995, when it went into orbit around Jupiter. Voyager 2, which was launched in 1977, became the first probe to fly by Uranus (January 1986) and Neptune (August 1989), leaving Pluto the only planet in our solar system not visited by a probe.

In addition to planetary probes, some astronomical and earth sciences spacecraft were launched in the early 1980s. The Solar Max satellite, which was launched in 1980, was the first spacecraft to study specific phenomena of the Sun, using coordinated instrumentation. Landsats 4 and 5 were launched in 1982 and 1984, respectively, to continue operation of the Landsat system. The Infrared Astronomical Satellite (IRAS) was launched in 1983 to make the first all-sky infrared survey. Launched in 1989, the Cosmic Background Explorer (COBE) spacecraft examined

subtle differences in background radiation to provide clues about the universe's formation after the Big Bang.

The 1990s

Daniel S. Goldin, appointed by President Bush, became the ninth Administrator of NASA on April 1, 1992. After increased budgets in the late 1980s, constraints on NASA's funding since 1990 have caused many observers inside and outside of NASA to reexamine the space agency's goals and methods of doing business. Administration officials including Administrator Goldin have pushed for the "reinvention" of NASA, stressing "faster, cheaper, better" missions as the key to more efficient programs that still achieve their scientific and technical goals. During the early 1990s, NASA's overall budgets began to decline.

While technology traditionally has been a focus of NASA, Administrator Goldin has refocused attention on this area and also made partnerships with industry an important objective. Through the use of advanced technologies, Mr. Goldin believes it will be possible to succeed in developing smaller, more efficient spacecraft. He has stressed the importance of forging new partnerships between NASA and industry to share the financial burdens of space and aeronautics programs.

Similarly, many observers agree that NASA needs both to adapt existing commercial technologies for its own purposes and to improve "spinoff" of its relevant technologies to the private sector. Over the past 30 years, NASA has produced a wide range of products with consumer and industrial applications in non-aerospace fields such as medicine, agriculture, construction, and the environment. Some people, however, question whether the Nation is getting its money's worth from NASA's budget in this regard. While it is difficult to assess accurately the precise economic benefits from government-developed technology being transferred to the private sector, several older studies have found that the amount of funding that NASA invests in R&D is usually much less than the value of technological spinoffs.[4] In any event, technology transfer stands to be an important issue in lean budget times, as it could lay the groundwork for greater cooperation and cost sharing with private industry.

In the area of human space presence, the International Space Station (ISS) has continued to be a highly controversial issue for NASA, as critics have tried repeatedly to cancel the program. NASA has restructured the International Space Station program a number of times. The latest version added Russia to the list of participating countries.[5] It is hoped that Russia's participation, based on 26 years of

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[4] Studies by Chase Econometrics, Inc., and the Midwest Research Institute in the late 1980s determined that every NASA R&D dollar produced $5-$9 in economic activity. The latest similar study was done by the Chapman Research Group, Inc. in 1989 and concluded that the bulk of a sampling of NASA technology transfer activities created significant economic gains. NASA produces an annual volume entitled *Spinoffs* that covers the variety of offshoot technologies from the agency's research.

[5] In addition to Russia, the international partners include Japan, Canada, and 10 of the
(continued...)

operating space stations, will help create significant cost savings.[6] Recent delays in the program due to lack of funding for Russian components has diminished the anticipated savings. Part of the controversy concerns the basic rationale for building and operating the International Space Station. More recently, concern has centered on Russia's ability to fund its commitment to the program. While NASA currently has no specific plans for humans to return to the Moon or to visit Mars,[7] Station supporters have argued that valuable scientific data on materials research and the long-term effects of weightlessness on the human body could be obtained from a permanent outpost in space. Critics contend that there is no urgent need for a space station today and that NASA's program is too expensive and not well justified.

During the 1990s, congressional and media attention also have focused on the successes and failures of NASA's space science programs. Shortly after the much-heralded Hubble Space Telescope (HST) was put into orbit in 1990, scientists discovered a spherical aberration in HST's main mirror. During a dramatic Space Shuttle servicing mission of HST in December 1993, astronauts installed corrective optics that enabled HST to gaze clearly into the far reaches of the universe. No such recovery was possible for another NASA spacecraft, however. In August 1993, contact was lost with the Mars Observer spacecraft just prior to entering into a Martian orbit. To recover from this large disappointment, NASA has instituted the Mars Surveyor program, a series of low-cost spacecraft to explore Mars. Built and launched quickly, they will, among other tasks, collect some of the data that would have been obtained by Mars Observer. Missions to Mars began to receive increased interest in 1996 when NASA scientists announced evidence that life may have once existed on ancient Mars. Two NASA missions to Mars were launched in 1996, Mars Pathfinder and Mars Global Surveyor. Mars Pathfinder landed on the surface of Mars July 4, 1997, and sucessfully carried out its program plan. Mars Global Surveyor went into orbit around Mars in September 1997 and is slowly lowering its orbit.

A number of other significant space science programs include astronomical, physics, and planetary exploration. Under development, the Cassini spacecraft is to explore Saturn and is probably one of the last large space probes that NASA will build for the foreseeable future. Cassini was launched in October 1997. The Compton Gamma Ray Observatory (GRO) was launched in 1989 to examine gamma ray emissions from around the universe and to learn more about the possible causes of black holes, quasars, and supernovae. In space physics, one spacecraft, Wind, in the Global Geospace Science (GGS) program, was launched in 1994 and the other, Polar, in February 1996.

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[5](...continued)
14 member states of the European Space Agency (ESA).

[6] Russia's current operational space station, Mir, is its seventh since 1971.

[7] In 1989, the twentieth anniversary of the first Apollo landing on the Moon, President Bush outlined a strategy called the Space Exploration Initiative (SEI). Under this plan, the Space Station would be the initial step for lunar and Martian exploration. The SEI program was canceled by Congress in FY1993 because of budget constraints.

NASA also has been steadily building up its Earth science programs in recent years. The Earth Science Office is responsible for the Earth Observing System (EOS), the Landsat spacecraft, and other environmental monitoring spacecraft. The launch of the first EOS spacecraft, EOS-AM-1, is scheduled for June 1998. In keeping with the Clinton Administration's policy agenda, space-based environmental programs have grown rapidly over the past few years. This growth came under scrutiny by House Republicans in the 104th Congress.

In 1995, NASA also initiated a new effort, the Reusable Launch Vehicle (RLV) program, to develop and flight-test technologies for a new reusable launch vehicle that one day might replace the space shuttle. The program involves significant participation by the private sector. Its goal is to validate technologies that would allow for the development of an operational RLV that would be fully funded and operated by the private sector.

Current NASA Organization

NASA's organization consists of NASA headquarters and several research and space flight field centers and associated facilities located throughout the United States. The administrator of NASA is appointed by the President and confirmed by the Senate. The agency currently employs approximately 19,400 civil servants. NASA is currently an agency that is experiencing declining budgets, reductions in personnel, and shifts in program management.

As part of its strategic planning process, the agency has established four strategic enterprises to function as primary business areas for implementing NASA's mission. Each enterprise has a unique set of strategic goals, objectives, and implementation strategies, and is headed by an enterprise associate administrator. The four enterprises are: Aeronautics and Space Transportation Technology (ASTT), the Space Science Enterprise (SSE), Earth Science Enterprise (ESE—formerly Mission to Planet Earth), and Human Exploration and Development of Space (HEDS).

The following sections discuss the current status of the NASA organization, focusing on four main areas: NASA headquarters, the field centers, the Zero Base Review, and the agency's strategic management plan.

NASA Headquarters

NASA headquarters exercises management over the space flight centers, research centers, and associated installations. NASA headquarters is responsible for long-range strategic planning, program formulation, external advocacy and resource allocation for the agency's science and technology programs. Headquarters also establishes policy, defines requirements and objectives, and assesses performance of the agency's programs. It is divided into several program offices which plan, direct, and manage distinct research and development programs. Headquarters also has several functional and staff offices, which advise the NASA administrator, oversee agency workforce activities and facilities, set agency-wide standards, and assist in

compliance with statutory, regulatory, and fiduciary responsibilities. **Table 1** lists the program offices and managers, and **Table 2** lists the functional/staff offices and managers.

Table 1. NASA Headquarters Program Offices

(as of March 6, 1998)

Office	Manager(s)
Office of the Administrator (Code A)	Administrator: Daniel S. Goldin Deputy Administrator (Acting): John R. Dailey Associate Deputy Administrator: John R. Dailey Associate Deputy Admin. (Technical): Michael I. Mott Chief Engineer: Dr. Daniel R. Mulville Chief Information Officer: Lee B. Holcomb Chief Scientist: Vacant Chief Technologist: Samuel L. Venneri
Office of Space Flight (OSF) (Code M)	Joseph H. Rothenberg
Office of Aeronautics and Space Transportation Technology (OASTT) (Code R)	Richard Christiansen (Acting)
Office of Space Science (OSS) (Code S)	Dr. Wesley E. Huntress
Office of Life and Microgravity Sciences and Applications (OLMSA) (Code U)	Arnauld Nicogossian, MD
Office of Earth Science (OES) (Code Y)	Ghassem Asrar

Source: NASA. Prepared by CRS.

Note: NASA offices are often referred to by their letter mail code. For example, the Office of Space Science is often referred to as "Code S".

Table 2. NASA Headquarters Functional/Staff Offices

(as of March 6, 1998)

Office	Manager
Office of the Chief Financial Officer (CFO) (Code B)	Arnold G. Holz
Office of Headquarters Operations (Code C)	Michael D. Christensen
Office of Equal Opportunity Programs (Code E)	George E. Reese
Office of Human Resources & Education (Code F)	Spence M. Armstrong
Office of the General Counsel (Code G)	Edward A. Frankle
Office of Procurement (Code H)	Deidre A. Lee
Office of External Relations (Code I)	John D. Schumacher

Office	Manager
Office of Management Systems and Facilities (Code J)	Jeffrey E. Suttin (Acting)
Office of Small and Disadvantaged Business Utilization (Code K)	Ralph C. Thomas III
Office of Legislative Affairs (Code L)	Ed Heffernan (Acting)
Office of Public Affairs (Code P)	Peggy C. Wilhide
Office of Safety and Mission Assurance (OSMA) (Code Q)	Frederick D. Gregory
Office of the Inspector General (Code W)	Roberta L. Gross
Office of Policy and Plans (Code Z)	Alan M. Ladwig

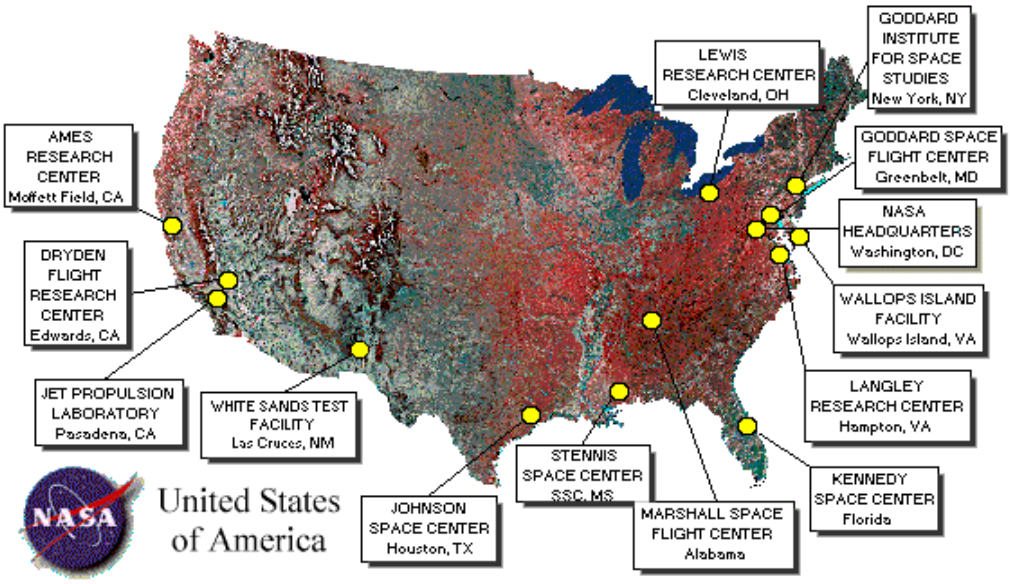
Source: NASA. Prepared by CRS.

Driven initially by the need to formulate more realistic budgets and to achieve a streamlined workforce, NASA headquarters has been restructuring the way it does business by changing its management structure and reducing its civil servant workforce. In early 1996, Administrator Goldin decided to transfer program management responsibilities and some support functions to the field centers and establish "lead centers" to coordinate major programs. Over 200 headquarters staff will have been transferred to the field centers in that effort by the end of FY1997. Employee levels at headquarters peaked at 2,078 full-time-equivalents (FTEs) in FY1993. The agency's target for headquarters is now 954 FTEs by FY2000.

NASA Field Centers

NASA's principal technical strength lies in its nine field centers and one federally funded research and development center (FFRDC) facility. Each center has its own mission and roles that carry out NASA's many programs and projects. Four of the centers are principally concerned with aeronautical research: Ames Research Center, Dryden Flight Research Center, Langley Research Center, and Lewis Research Center. Four of NASA's centers deal primarily with human space flight operations and systems: Lyndon B. Johnson Space Center, John F. Kennedy Space Center, George C. Marshall Space Flight Center, and John C. Stennis Space Center. Two facilities are the principal space science centers: Goddard Space Flight Center and the Jet Propulsion Laboratory (JPL). Except for JPL, an FFRDC, all these centers are federally owned and operated facilities.

The current roles of NASA's field centers are described below. As part of its Zero Base Review (see below) functions at the NASA centers are being streamlined, so each center becomes a "center of excellence," concentrating on specific aspects of NASA's mission. In step with transferring program management responsibilities from headquarters to the centers, each center also has an identified primary mission for managing NASA programs.



Source: NASA.

Ames Research Center (ARC) — Moffett Field, CA. Ames' primary mission areas are aviation operation systems and astrobiology. ARC also is NASA's center of excellence in information systems technologies. ARC's principal program responsibilities are concentrated in computational aerodynamics and flight testing, computational/numerical simulation, rotorcraft technology, short and vertical takeoff and landing technology, life sciences dealing with gravitational biology and exobiology, human-vehicle interactions, autonomous systems, and guidance and controls.

Dryden Flight Research Center (DFRC) — Edwards Air Force Base, CA. Dryden's primary mission area is flight research. DFRC is NASA's center of excellence for atmospheric flight operations. DFRC also functions as the backup landing site for the Space Shuttle and provides servicing support including mating the Shuttle with its carrier aircraft. In 1994, the DFRC returned to its earlier status as an independent center; for several years it had been a functional unit of Ames.

Goddard Space Flight Center (GSFC) — Greenbelt, MD. Goddard's primary mission areas are Earth science and physics and astronomy. GSFC is NASA's center of excellence for scientific research. GSFC's principal roles include the development and operation of Earth orbital flight experiments and spacecraft to conduct scientific investigations in our solar system and the universe, management of tracking and data acquisition activities, operation of an instrumented flight range for aeronautical and space research, and procurement of expendable launch services for small and medium payloads. Goddard is responsible for the development of the Earth Observing System (EOS) and its associated data system, in addition to operations of the Hubble Space Telescope (HST). The Wallops Flight Facility (Wallops Island, VA), which conducts suborbital scientific experiments using balloons and sounding rockets, is an operational element and component installation

of Goddard. The NASA Goddard Institute for Space Studies (GISS) in New York also is affiliated with GSFC. GISS research emphasizes a broad study of global change.

Jet Propulsion Laboratory (JPL) — Pasadena, CA. The Jet Propulsion Laboratory (JPL) is the only NASA center that is a government-owned, contractor-operated facility. JPL is operated under contract to NASA by the California Institute of Technology. Its primary mission area is planetary science and exploration and it is NASA's center of excellence for deep space missions. JPL is responsible for the conduct of automated missions concerned with scientific exploration of the solar system and deep space; management of the Deep Space Network (DSN); spacecraft tracking and data acquisition; space science research and analysis; and the development of advanced spacecraft technologies including propulsion, power, structures, guidance and control, thermal control, and electronics.

Johnson Space Center (JSC) — Houston, TX. Johnson's primary mission areas are human exploration and astromaterials. It is NASA's center of excellence for human operations in space. JSC is responsible for the selection and training of astronauts and is the lead center for the Space Shuttle program. Its main shuttle responsibilities also include flight operations, mission planning, operational procedures, and flight control (Mission Control Center is located at JSC). JSC also is the lead center for development of the International Space Station.

Kennedy Space Center (KSC) — Cape Canaveral, Florida. Kennedy's primary mission area is space launch. It is NASA's center of excellence for launch and cargo processing systems. KSC is involved in Space Shuttle launch operations, including orbiter processing, final payload checkout and integration with the Shuttle, Shuttle launch, landing, and postlanding. KSC also handles Space Station operational launch-readiness planning.

Langley Research Center (LaRC) — Hampton, VA. Langley's primary mission areas are airframe systems and atmospheric science. It is NASA's center of excellence for structures and materials. The majority of Langley's work is in aeronautics. Its principal roles are in airframe aerodynamics and structures research and technology; hypersonic propulsion; experimental and theoretical aerodynamics; environmental quality monitoring by remote sensing; materials, guidance and controls; and airframe/propulsion integration of aerospace planes.

Lewis Research Center (LeRC) — Cleveland, OH. Lewis's primary mission area is aeropropulsion and it is NASA's center of excellence for turbomachinery. LeRC is involved in the conduct of aeronautical propulsion, nuclear space propulsion, electric space propulsion, and space power research and technology; space communications research and technology; development of microgravity sciences for fluid physics and combustion science; and procurement of expendable launch services on intermediate and large payload vehicles.

Marshall Space Flight Center (MSFC) — Huntsville, AL. Marshall's primary mission areas are transportation systems development and microgravity research. It is NASA's center of excellence for space propulsion. MSFC is responsible for managing the Space Shuttle Main Engine, Solid Rocket Booster, and

External Tank projects of the Space Shuttle system. The center conducts, develops, and manages development of advanced space transportation technologies; conducts and develops experiments in materials processing in space; manages NASA's activities with Spacelab, which flies in the cargo bay of the Space Shuttle; manages the Space Station's pressurized module development and the station's permanently inhabited capability; and conducts space science activities such as the Advanced X-Ray Astrophysics Facility (AXAF) development. Michoud Assembly Facility (New Orleans, LA) is an operational element and component installation of MSFC.

John C. Stennis Space Center (SSC) — Bay St. Louis, MS. Stennis's primary mission area is propulsion testing. It is NASA's center of excellence for propulsion testing systems. SSC's responsibilities include Space Shuttle Main Engine testing, future rocket propulsion testing, and Earth resources research and technology transfer. SSC is the lead center for commercial remote sensing.

Zero Base Review

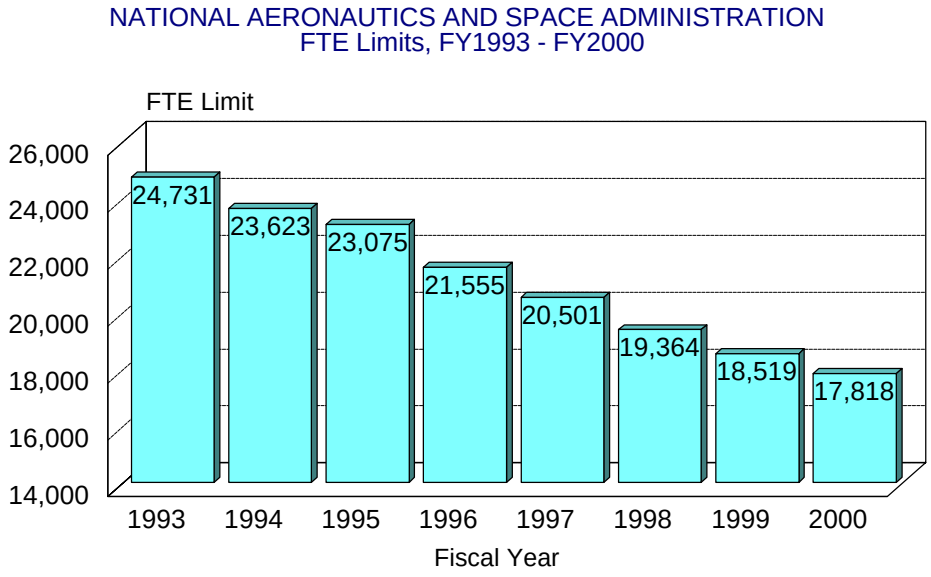
In step with the FY1996 budget process, in January 1995, the White House and the Office of Management and Budget (OMB) directed NASA to cut $5 billion from the agency's 5-year budget plan. NASA's response, known as the Zero Base Review (ZBR) identified $4 billion in savings from FY1997 through FY2000 by cutting jobs and facilities through a significant agency restructuring. The plan did not include any program cuts or closure of any NASA centers.

The review proposed streamlining functions at the NASA centers, so each center would become a center of excellence, concentrating on specific aspects of NASA's mission. At the same time, the proposed changes would reduce overlap and consolidate administration and program functions across the agency. The review also recommended that NASA Headquarters transfer program management responsibility to the field centers and that the agency increase the involvement of outside entities in NASA's science programs by pursuing establishment of science institutes.

Under the review's findings, NASA's total civil service employment would be cut to approximately 17,500 FTEs by the year 2000. That is the lowest level of civil servants at NASA since 1961. The FTE goal for FY 2000 is now set at 17,818. In addition, the budget reductions would cut an estimated 25,000 contractor personnel. The agency has not had to resort to reductions-in-force to lower its civilian servant numbers. NASA's FY1997 appropriations included multiyear buyout authority for NASA which the agency has used extensively. As a result of buyouts and restrictive hiring practices, the agency used only 19,883 FTES in FY1997 compared to the original plan of 20,501. The buyout authority is available through FY2000.

Figure 2 displays NASA FTE limits from FY1993 to FY2000. **Table 3** details the number of civil servant personnel at NASA headquarters and the various field centers from FY1998 through FY1999.

Figure 2



Source: NASA. Prepared by CRS.

Table 3. National Aeronautics and Space Administration Distribution of Workyears by Installation FY1998 - FY1999

	FY1998	FY1999
Johnson Space Center	3,048	2,796
Kennedy Space Center	1,805	1,701
Marshall Space Flight Center	2,782	2,670
Stennis Space Center	223	214
Ames Research Center	1,417	1,409
Dryden Flight Research Center	584	586
Langley Research Center	2,426	2,339
Lewis Research Center	2,022	1,947
Goddard Space Flight Center	3,300	3,235
Headquarters	1,067	965
Full-Time Permanent Workyears	**18,674**	**17,862**
Other Than Full-Time	690	657
Total FTE	**19,364**	**18,519**

Source: NASA FY1999 budget justification documents. Prepared by CRS.
Note: Since it is a contractor operated facility, JPL does not have civil service employees.

NASA Strategic Plan

In 1992, after the appointment of Dan Goldin as administrator, NASA began to recognize a need for an effective strategic management process. At that time, the agency had questionable budget expectations and lacked consensus on priorities and goals. Externally, there also was the perception that the agency was directionless as a result of the end of the Cold War. Previously developed agency strategic plans were seen as "wish lists" that had no perception of budget realities.

Vice President Gore's National Performance Review and the Government Performance and Results Act (GPRA) of 1993 (P.L. 103-62) added further impetus for the development of an agency strategic planning process.[8]

From October 1993 through May 1994, NASA held a series of retreats for senior managers and established several employee working groups to develop an agency strategic plan. The foundation for the plan was based on the NASA Act of 1958, the National Space Policy of 1989, and employee inputs. During this time the agency identified its strategic enterprises and strategic functions and agreed on an agency vision and mission with associated values and goals. The first strategic plan from this process was published in May 1994. Revised plans were published in February 1995 and February 1996.

To comply with GPRA, NASA submitted a revised 5-year strategic plan to Congress on September 30, 1997.[9] Further agency changes have taken place since the 1996 version. The most significant is the elimination of the Space Technology enterprise, resulting in the agency having only four strategic enterprises instead of five as stated in the 1996 plan. The plan contains the agency vision, its mission, and a strategic roadmap defining the near-, mid-, and long-term goals that NASA intends to achieve in its mission areas over the next 25 years. The plan also contains more detailed plans for each of the enterprises. As stated in the plan, the agency's vision is as follows:

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

The agency's mission is divided into three main areas. Each of these mission areas has near-, mid-, and long-terms goals. NASA's three strategic missions are as follows:

> - to advance and communicate scientific knowledge and understanding of the Earth, the solar system, and the universe and use the environment of space for research;

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[8] GPRA encourages greater efficiency, effectiveness, and accountability in federal spending, and requires agencies to set goals and use performance measures for management and, ultimately, for budgeting.

[9] The Act requires that agencies update their strategic plans at least every 3 years.

- to explore, use, and enable the development of space for human enterprise; and
- to research, develop, verify, and transfer advanced aeronautics, space, and related technologies.

NASA Programs and Budget Figures

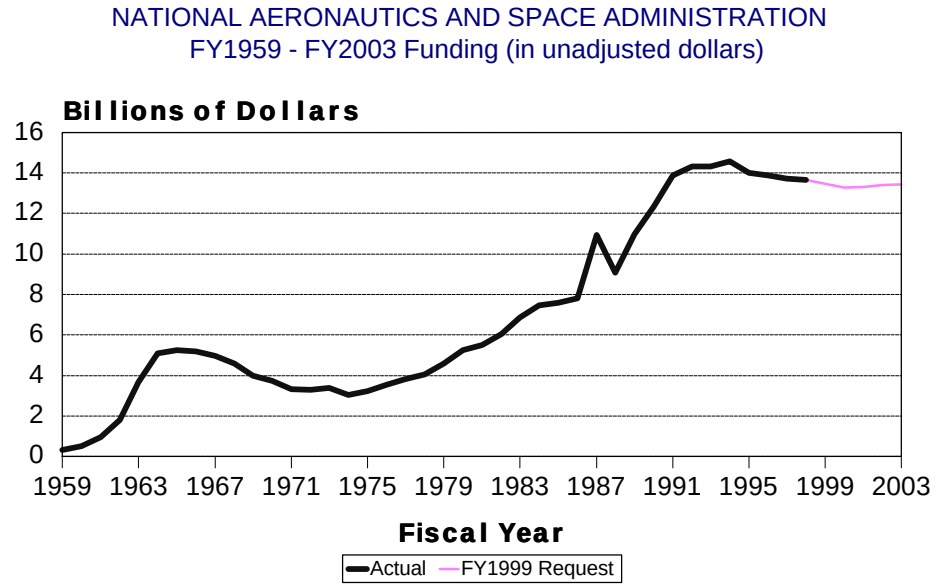
NASA's budget is funded in four appropriations categories: Human Space Flight (HSF), Science Aeronautics and Technology (SAT), Mission Support (MS), and the Inspector General (IG). All NASA research and development activities are undertaken under the HSF and SAT categories. The MS category funds NASA personnel, administration of programs, telecommunications, and space communications for agency-wide activities.

The following sections briefly describe NASA's historical budget and the and FY1998 budgets. A more detailed description of the FY1999 budget request is presented along with congressional appropriations and authorization actions to date.

Historical Budget

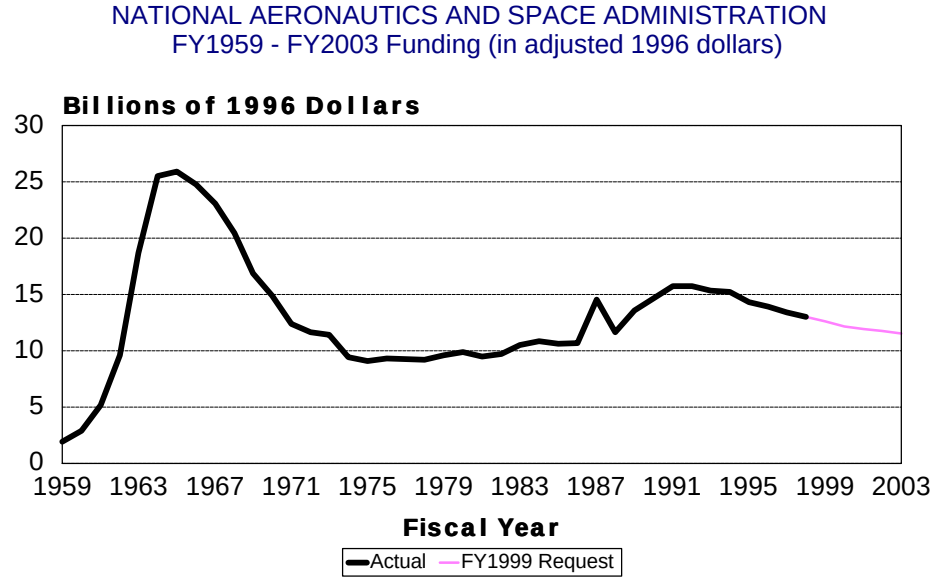
Since its creation, NASA has experienced both increasing and declining budgets. In the early 1960s, as the nation strived to put an American on the Moon by the end of the decade, NASA's budget steadily increased, peaking at $5.25 billion in FY1965. As other national priorities gained precedent, NASA's budget declined on an annual basis from FY1965 until it reached a $3 billion level in FY1974. After FY1974, NASA's budget once again began to increase steadily, peaking at $14.5 billion in FY1994. The recent national focus on reducing the federal budget deficit has resulted in a declining NASA budget. Its current year FY1998 level is $13.638 billion. The following figures depict NASA's budget from FY1959 through Administration proposed levels in FY2003. **Figure 3** displays the agency's budget unadjusted for inflation. **Figure 4** displays the funding in 1996 dollars. (The one-year spike in funding in 1987 was to build a replacement orbiter following the *Challenger* tragedy.)

Figure 3



Source: Office of Management and Budget. Prepared by CRS.

Figure 4



Source: Office of Management and Budget. Prepared by CRS using GDP deflators.

FY1998 Budget

In February 1997 the Administration released its FY1998 budget requesting $13.5 billion for NASA. A significant feature of the request was that the outyear numbers for NASA were revised upward to a level almost identical to those envisioned in the FY1996 request. Under the FY1998 plan, NASA's budget would have declined from $13.709 billion in FY1997 to $13.2 billion in FY2000 and then remain flat at $13.2 billion through FY2002.

Congress appropriated NASA $148 million above the request, however President Clinton line-item vetoed $10 million of the amount, leaving a total budget of $13.638 billion in FY1998. Most of the increase goes to the space station program. In September 1997, NASA informed Congress that it needed $430 million more than expected for the space station in FY1998. Congress appropriated $100 million in additional funds for station and gave the agency authority to transfer $130 million from other NASA programs to the station program. NASA is hoping that Congress will permit the transfer of an additional $200 million from other NASA accounts into the station program.

As part of a FY1998 supplemental and rescission request, the Adminstration is asking Congress for transfer authority to permit NASA to reallocate $173 million in existing resources to fund the space station. The remaining $27 million needed for station would come from a reallocation within the Human Space Flight appropriation account.

FY 1999 Budget

Overview. For FY1999 NASA has requested $13.465 billion, a reduction of $173 million below the FY1998 level. The detailed breakdown of that request along with the FY1998 appropriations and House and Senate Appropriation Committee recommendations for FY1999, are shown in Table 4 on the next page.

For FY1999, the Senate Appropriations Committee has recommended a total of $13.62 billion, 1.2% above the request but 0.2% below the FY1998 level (S.2168/S.Rpt.105-216). In the report, the Committee expressed its continued support of activities carried out by NASA. The Committee, however, expressed concern about the continued cost escalation of the ISS and the potential effects of that escalation on other NASA activities, in particular, science and aeronautics. The Committee, in an attempt to control NASA reallocation of funds to cover ISS cost increases, established new accounts for FY1999, which are shown in Table 4 and described in more detail below. The Committee also noted NASA's efforts to consolidate space operations management and control through the creation of the space management operations office (SOMO) and the imminent award of the consolidated space operations contract (CSOC). The Committee directed NASA to provide it with full details of SOMO and CSOC operations in order to evaluate whether cost-savings goals are being achieved.

On May 22, 1998, the Senate Commerce Committee reported S.1250 (S.Rpt.105-195), the National Aeronautics and Space Administration Authorization

Act, FY1998, FY1999 and FY2000. The bill would authorize $13.46 billion for NASA for FY1999, the same as the request. The Committee urged NASA to "reassess its traditional ways of doing business" and make greater use of partnerships with industry, academia, and non-federal organizations. In addition, the Committee urged NASA to ensure that the relevancy of its activities to all those involved and to the general public. The Committee also expressed its recognition of the need for a core program funding and stated that its authorization recommendation was intended to provide funding and guidance needed for a "robust and balanced space program."

Table 4. NASA Budget Authority
(in millions of dollars)

Funding Category	FY1998[a]	FY1999 Request	FY1999 House	FY1999 Senate
HUMAN SPACE FLIGHT	**5,506.5**	**5,511.0**	**5,309.0**	**—**
Space Station	2,301.3	2,270.0	2,100.0	—
U.S./Russian Cooperation	50.0	0.0	0.0	—
Space Shuttle	2,927.8	3,059.0	3,027.0	—
Payload and Utilization Operations	227.4	182.0	182.0	—
INTERNATIONAL SPACE STATION	**—**	**—**	**—**	**2,300.0**
LAUNCH VEH AND PAYLOAD OPS	—	—	—	**3,241.0**
Space Shuttle	—	—	—	3,059.0
Payload and Utilization Operations	—	—	—	182.0
SCIENCE, AERO, AND TECH	**5,680.0**	**5,457.4**	**5,541.6**	**—**
Space Science	2,033.8	2,058.4	2,102.0	—
Life and Microgravity Sciences	214.2	242.0	263.5	—
Earth Science	1,417.3	1,372.0	1,312.6	—
Aeronautics & Space Trans. Tech.	1,483.9	1,305.0	1,348.0	—
Mission Communications	400.8	380.0	385.0	—
Academic Programs	130.0	100.0	129.4	—
SCIENCE AND TECHNOLOGY	**—**	**—**	**—**	**4,257.4**
Space Science	—	—	—	2,108.4
Life and Microgravity Sciences	—	—	—	242.0
Earth Science	—	—	—	1,397.0
Mission Communications	—	—	—	380.0
Academic Programs	—	—	—	130.0
AERO, SPACE TRANS &TECH	**—**	**—**	**—**	**1,305.0**
MISSION SUPPORT	**2,433.2**	**2,476.6**	**2,458.6**	**2,491.6**
Safety and Quality Assurance	37.8	35.6		
Space Communications	209.2	177.0		
Research and Program Management	2,051.8	2,099.0		
Construction of Facilities	134.4	165.0		
INSPECTOR GENERAL	**18.3**	**20.0**	**19.0**	**20.0**
TOTAL	**13,638.0**	**13,465.0**	**13,328.2**	**13,615,0**

[a] FY1998 levels do not reflect requested transfer of $200 million to space station.

The House Appropriations Committee recommended $13.46 million for FY1999, 1.0% below the request and 2.3% below FY1998. It also expressed concern about ISS cost escalation, but recommended no changes in the NASA accounts.

The following sections describe in greater detail the FY1999 request and NASA's current program plans by funding category.[10]

Human Space Flight (HSF). The request for NASA's HSF program is $5.511 billion. This is an increase of $4.5 million above the FY1998 level of $5.506 billion. HSF provides funding for NASA's programs that involve human exploration in space. Programs included under this category include the International Space Station (ISS), the cooperative program with Russia, the Space Shuttle, and payload and utilization operations. For FY1999, the House Appropriations Committee is recommending $5.31 billion, 3.6% below the request and the FY1998 level. The Senate Appropriations Committee has recommended that this account be replaced by two new accounts, one for the ISS and one for all other operations. The total recommended for these two new accounts is $5.54 billion, 0.5% above the request and the FY1998 level. The Senate Commerce Committee has recommended authorization of the amount requested.

International Space Station (ISS). This category provides funding for the development, operations, and research for the International Space Station (ISS). Funding for ISS continues to be a source of contentious debate in both the House and the Senate.[11] After being appropriated $2.301.3 billion in FY1998, NASA has requested $2.270 billion for ISS in FY1999. NASA also has requested authority to transfer an additional $200 million to ISS in FY1998 from other accounts.

The most pressing ISS concerns include whether Russia can fulfill its commitments to the program and whether NASA can maintain current schedule and cost projections on its own elements. Assembly of ISS was originally scheduled to begin in November 1997, but delays with the Russian Service Module due to lack of funding from the Russian government have postponed the first assembly launch until June 1998. Press reports indicate that the launch may slip again a couple of months. The Administration and Congress might have to continue to address the issue of Russia's involvement in ISS if future Russian funds do not come forward. In addition, there have been problems in the development of the U.S. node, scheduled for launch in July 1998. [For more information, see CRS Issue Brief *Space Stations*, IB93017, updated regularly].

The Senate Appropriations Committee has $2.3 billion, 1.3% above the request. It also recommended that the ISS be put into a separate account to enhance accountability. While maintaining its support of the station, the Committee expressed strong concern about continuing cost escalations. It also noted that NASA's past response to such cost growth has been to transfer funding from other NASA programs. The Committee stated that while it believes the space station is important, it is not more important that other NASA activities. The Committee reaffirmed its support for a balanced space program. It notified NASA that it will not

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[10] Comparisions of FY1999 levels with FY1998 levels assumes that the $200 million transfer to space station has not occurred.

[11] For more information on the Space Station program, *Space Stations*, by Marcia S. Smith. CRS Issue Brief 93017. U.S. Library of Congress. Congressional Research Service. (updated regularly)

look with favor on further requests to transfer funds from other NASA accounts to the space station. The Committee also stated its intent to provide necessary funds for contractual obligations should the ISS be terminated.

The House Appropriations Committee has recommended $2.1 million for the ISS, 7.5% below the request. The Committee expressed concern about the lack of management control by NASA and its contractors. It noted that NASA's claims about funding requirements for the station in FY1998 turned out to be nearly $400 million to high. Therefore, it directed NASA to take immediate steps to improve project management. The Committee also directed NASA to shift management of space station research program to the Office of Life Science and Microgravity Sciences and Applications. The Committee noted a lack of focus by the ISS research program because of preoccupation with station assembly.

The NASA Authorization Act, FY1998, 1999, and 2000 from the Senate Commerce Committee would authorize $2.27 million for the ISS for FY1999. The Committee noted the cost overruns and stated that the accuracy of ISS cost estimates and schedules needs careful oversight as a result. The Committee also expressed its optimism about the ISS, but stated that it will carefully monitor program to make sure it does not create problems for other NASA activities.

U.S./Russian Cooperation and Program Assurance. U.S./Russian Cooperation and Program Assurance provides funding for the original $400 million contract NASA signed with the Russian Space Agency as well as contingency funding to address delays with some of the Russian components to ISS. The contract provides services and hardware for Phase I and "selected Phase II" activities related to the ISS program. Phase I includes the joint participation by U.S. and Russian crews in Russian space station *Mir* operations and U.S. Space Shuttle operations. Phase II involves building a bilateral U.S.-Russian space station that can be permanently inhabited in 1999. FY1997 funding provided the last funds for the original contract with the Russian Space Agency. The FY1998 level of $50 million provides for program assurance contingency funds. No funds are requested in FY1999.

Space Shuttle. This category provides funding for the entire Space Shuttle program including shuttle operations and safety and performance upgrades. NASA's budget for the shuttle in FY1998 Congress is $2.928 billion. The program has now had a 26% cut in its budget over the past 4 years. The request for FY1999 is $3.059 billion ($2.487 billion for operations and $571.6 million for upgrades). The shuttle program plans to maintain the capability to fly a maximum of seven to eight flights every year. Pressure on the agency to provide shuttle flight opportunities for science missions to compensate for reduced science opportunities on ISS during assembly might require an increased shuttle flight rate. How to achieve an increased rate with a declining shuttle budget is unclear.

One of the Zero Base Review's recommendations was to restructure the shuttle program by consolidating major shuttle contracts so that it is run by a single prime contractor. That would be the initial step in preparing the program for potential privatization. On September 26, 1996, NASA signed a $7 billion, 6-year contract with United Space Alliance for Space Shuttle operations. The contract initially consolidates 12 major existing contracts into one. It also includes two, 2-year

extension options that could bring the potential value of the contract to $12 billion over 10 years.

With the funding reductions in the program over the past 4 years, several management changes, turning over operations to United Space Alliance, and the upcoming assembly of ISS, many observers have been concerned about safety in the shuttle program. How to determine the safety impact, however, is difficult to assess.

The Senate Appropriations Committee recommended the full request for this program. In addition, it recommended that it be placed in a new account called Launch Vehicles and Payload Operations.

The House Appropriation Committee has recommended $3.03 million for space shuttle operations, 1.1% below the request but 4.5% above FY1998. The reduction from the request is a result of a revised shuttle schedule announced by NASA in May that would require only four ISS assembly flights in FY1999 rather than six as originally announced. The Committee also urged NASA to undertake efforts authorized by the House Science Committee to create opportunities for commercialization of spare shuttle resources as long as they did not conflict with NASA research functions. Such actions, according to the Committees could help meet increased ISS development costs. The House Appropriations Committee recommended full funding for shuttle safety and performance upgrades.

The Senate Commerce Committee is recommending authorization of the full FY1999 request for the space shuttle. The Committee expressed its support of NASA efforts to cut costs but only if shuttle safety is not compromised.

Payload and Utilization Operations. This budget category supports the processing and flight of Space Shuttle payloads in the Spacelab module and the engineering and technical base for operation of space flight laboratories, facilities, and testbeds. Spacelab is a reusable observatory and laboratory facility located in the Shuttle payload bay to support a wide variety of science and technology development experiments that are developed by NASA and other external organizations. Spacelab was jointly developed by NASA and the European Space Agency (ESA). Funding requirements for this category have been declining steadily since FY1992 due to the phasing out of Spacelab with the advent of ISS. The FY1998 funding in this area is $227.4 million and the FY1999 request is $182 million. The last Spacelab flight is scheduled for April 1998.

The X-38 experimental vehicle also is funded under this category. The X-38 is designed to demonstrate the technologies and processes required to provide a crew return vehicle for ISS in a “better, faster, cheaper” mode.

Actions by the House and Senate Appropriations Committees would provide the full request for this program. The Senate Appropriations Committee also recommended that this program be placed in the new Launch Vehicles and Payload Operations account. The Senate Commerce Committee is recommending authorization of the full request.

Science, Aeronautics, and Technology (SAT). SAT provides funding for the research and development activities of NASA that include extending our knowledge of the Earth, its space environment, and the universe; investments in new aeronautics and advanced space transportation technologies; and research on the effect of the microgravity environment on living systems and materials. Funding also is included to provide telecommunications services in support of the agency's science and aeronautics programs, and to conduct NASA's agency-wide university, minority university, and elementary and secondary school programs.

Programs included under the SAT category are Space Science, Life and Microgravity Sciences and Applications, Mission to Planet Earth, Aeronautics and Space Transportation Technology, Mission Communication Services, and Academic Programs. For FY1998, SAT is funded at $5.680 billion with $5.457 billion requested for FY1999.

The Senate Appropriations Committee has recommended that two new accounts be created to replace this account. The Aeronautics and Space Transportation Technology program would be placed in one account called Aeronautics, Space Transportation and Technology, and all the other programs would be placed in an account called Science and Technology. The total recommendation for these two accounts is $5.56 billion, 1.5% above the request but 2.1% below the FY1998 level. The Committee expressed its concern about the potential effect of NASA's "smaller, faster, cheaper, better" guidelines on its ability to accomplish its scientific goals. It cited a report by the National Research Council that stated that some goals could not be achieved within the limits set by those guidelines. The Committee directed NASA to contract with the NRC for another study to cover both space and Earth sciences to identify those projects that cannot be done under those conditions, and provide estimates of the resources needed to accomplish the scientific goals in those cases.

The House Appropriations Committee has recommended $5.54 billion for this account, 1.5% above the request but 2.5% below the FY1998 level. The Senate Commerce Committee has recommended an authorization level that would fully fund the request.

Space Science. The Space Science category provides funding for research and spacecraft that seek to expand our understanding of the origin and evolution of the universe, the fundamental laws of physics, the formation of stars and planets, and the processes by which our solar system developed. Space Science also seeks to discover and investigate extrasolar planets and to determine the origin and evolution of life in the universe.

The request for Space Science is $2.058 billion, a slight increase over the FY1998 level of $2.034 billion. A major thrust of NASA's Space Science programs is to increase the overall cost effectiveness of missions by providing more frequent access to space for the science community within an increasingly constrained budget environment. Space Science missions are often the focus of NASA's "faster, cheaper, better" philosophy.

Several significant programs and projects are funded within this category including the Advanced X-Ray Astrophysics Facility (AXAF); the Space Infrared

Telescope Facility (SIRTF); the Relativity Mission; the Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics (TIMED) spacecraft; Explorers; the Discovery program; and the Mars Surveyor program. Mission series such as Explorers, Discovery, and Mars Surveyor emphasize the selection of future missions with predetermined cost, schedule, and launch services requirements.

AXAF, a spacecraft that is to examine the universe in the x-ray spectrum from its orbit around Earth, was scheduled for launch in August 1998, but problems with testing have delayed the launch until December 1998. SIRTF was a new start in FY1998. It is to examine the universe in the infrared portion of the electromagnetic spectrum and is scheduled for launch in December 2001. The Relativity Mission (also known as Gravity Probe-B) is to verify Einstein's theory of general relativity and is scheduled for launch in January 2000. TIMED is a spacecraft designed to explore the Earth's mesosphere and lower thermosphere and is scheduled for launch in May 2000.

Explorer is a series of small- to mid-sized spacecraft that are to provide frequent, low-cost access to space for physics, astronomy, and atmospheric investigators. More than 70 Explorers have been launched since 1958. The Discovery program provides frequent access to space for small planetary missions whose development cost may not exceed $150 million (in FY1992 dollars) and whose launch must come within 3 years from the start of development. The first two Discovery missions were launched in 1996, the Near Earth Asteroid Rendezvous (NEAR) and Mars Pathfinder. The third, Lunar Prospector, was launched in January 1998 and recently found strong evidence of ice on the Moon. Three future Discovery missions are currently being developed, Stardust, Genesis, and CONTOUR.

The Mars Surveyor program is a series of small, low-cost spacecraft planned for launch between 1996 and 2005 at 26-month intervals (when the planetary alignment between Earth and Mars is conducive to launching). The first, Mars Global Surveyor, was launched in 1996. Next are the 1998 Mars Surveyor Orbiter and Lander. Planned funding for the Mars Surveyor program was augmented in FY1998 and beyond to permit acceleration of a sample return mission from FY2007 to FY2005, while maintaining the ability to develop and launch two spacecraft each (an orbiter and a lander) in 2001 and 2003.

Funding under the Space Science category also is provided for mission operations and data analysis (which includes operations funding for mission such as the Hubble Space Telescope); supporting research and technology; launch services for all Space Science missions; and the suborbital program, which includes the balloon missions, sounding rocket missions, and the Stratospheric Observatory for Infrared Astronomy (SOFIA). SOFIA is a 2.5 meter optical/infrared telescope designed to be flown on a 747 aircraft. Development of SOFIA began in FY1997 with science flights scheduled to begin in 2001.

The Senate Appropriations Committee has recommended $2.11 billion for this program, 2.4% above the request and 3.6% above the FY1998 level. The Committee noted the transfer of Mars 2001 project responsibilities from the Human Space Flight account without the $55 million needed to pay for them. The Committee is recommending an addition $20 million for Space Science for FY1999 to help cover

those costs. The Committee also directed NASA to restore the Mars 2001 in FY2000 to reflect the original project budget. Further it expressed its opposition to NASA transferring funds from the science programs to pay for Human Space Flight activities, and directed the agency to go through the proper reprogramming process for any such requests in the future. The Committee also has recommended an additional $7 million for next generation space telescope development and an additional $11 million for Sun-Earth connecting advanced technology developoment.

The House Appropriations Committee has recommended $2.10 billion for this program, 2.4% above the request and 3.6% above the FY1998 level. The additions above the request recommended by the Committee include $20 million for the Mars 2001 program and $20 million for the Space Solar Power program. For the former, the Committee also noted the transfer of activities from the Human Space Flight account without any accompanying shift of funds. It expressed displeasure at that apparent lack of proper support for the Mars program and directed NASA to keep the Committee informed of any such problems in the future. For the Space Solar Power program, the Committee cited that project as an example of potentially commercially beneficial research that should be part of NASA's efforts.

The Senate Commerce Committee has recommended an authorization level that would fully fund the request. It also stated that such authorization assumed the NASA program designed to reduce the size and development time of scientific spacecraft would be in effect.

Life and Microgravity Sciences and Applications. The Life and Microgravity Sciences and Applications (LMSA) category provides funding for experiments, both ground-based and space-based, to perform research on the impact of the space and microgravity environment on living systems (such as humans) and materials. FY1998 funding is set at $214.2 million and the FY1999 request is $242 million. For FY1998, the science components of ISS—the NASA-*Mir* Research program, and the Space Station Facilities and Utilization—which were originally funded under LMSA, are now found under the Space Station funding category in the HSF account.

Programs funded under LMSA include Life Sciences research and analysis and flight programs, the Microgravity Sciences research and analysis and flight programs, the Space Product Development program, and Aerospace Medicine. Within Life Sciences, $10.0 million each year supports collaborative activities with the National Institutes of Health (NIH). A key collaborative venture between NASA and NIH is the Human Brain project, an activity that concentrates on neural science and informatics research. The next life sciences-dedicated Spacelab mission, Neurolab, is scheduled for launch in April 1998. This is the last planned Spacelab mission.

The Space Product Development program is to facilitate the use of space for commercial products and services. The program is conducted in partnership with industry, universities, state governments, and other federal agencies. It provides access to NASA experiment facilities and offers access to space utilizing the shuttle mid-deck, the Spacehab module, and the Wake Shield Facility.

The Senate Appropriations Committee has recommended the full request for this program. It also directed NASA to request a substantial increase for the National Space Biomedical Research Institute in its FY2000 request.

The House Appropriations Committee has recommended $263.5 million for this program, an 8.9% increase over the request and 23.0% increase above FY1998. The increase includes $6.5 million for space radiation research. The Committee also recommended provision of $15 million to develop new life science missions to fill a projected seven to nine year gap between major mission.

The Senate Commerce Committee has recommended an authorization that would provide the full amount requested. Of that amount, the Committee directed that $2 million be used for research on various women's health issues.

Earth Science. Earth Science (formerly known as Mission to Planet Earth) provides funding for spacecraft and ground-based research to understand the total Earth system and the effects of natural and human-induced changes on the global environment. The program is NASA's central contribution to the U.S. Global Climate Change Research Program, and its focus is on global climate change. Earth Science's main program is the space-based Earth Observing System (EOS), a series of satellites in various Earth orbits that are to examine regional and global climate changes over the long term. The companion EOS Data Information System (EOSDIS) handles the processing, storage, and distribution of EOS and other MTPE scientific data. NASA has requested $1.372 billion in FY1999 funding for Earth Science. The program is funded at $1.417 billion in FY1998.

The request for EOS is $659.1 million. EOS includes Landsat-7 and three main series of spacecraft: AM, PM, and CHEMISTRY. Other spacecraft series and instruments included under EOS are the Radar Altimetry and Laser Altimetry spacecraft; and the SeaWinds, Stratospheric Gas and Aerosol Experiment-III (SAGE-III), Active Cavity Radiometer Irradiance Monitor (ACRIM), Solar Stellar Irradiance Comparison Experiment (SOLSTICE), and Clouds and Earth's Radiant Energy System (CERES) instruments. The first EOS spacecraft, AM-1, is scheduled for launch in June 1998, and Landsat-7 is scheduled for launch in late 1998. Current plans have PM-1 being launched in the year 2000 and CHEMISTRY-1 in 2002.

The EOS program also maintains a technology infusion effort that includes the New Millennium spacecraft, sensor and detector technology development, and an instrument incubator. The first Earth Science New Millennium spacecraft, Earth Orbiting-1 (EO-1), is scheduled for launch in 1999. EO-1 is to carry the Advanced Land Imager instrument to demonstrate instruments and spacecraft systems that may enable future land-imaging satellites (such as a follow-on to Landsat-7) to be much smaller and cheaper than they are currently. The instrument incubator initiative is to pursue emerging technologies and proactively close the technology transfer gaps that exist in the instrument development process. The initiative would take detectors and other instrument components coming from NASA's fundamental-technology development-programs and other sources, and focus on combining them into new smaller, cheaper instrument systems for future missions, including EOS follow-on missions.

The request for EOSDIS is $256.6 million. EOSDIS is to operate the EOS satellites, acquire instrument data from EOS satellites and other Earth Science missions, produce data and information products from EOS and preserve these and other observations for continued use, and make all data and products available for research, education, and government communities. EOSDIS is designed to be evolutionary, to enable adaptation to changes in user needs and information technology.

Funding for Earth Probes, applied research and data analysis, launch services, and the Global Observations to Benefit the Environment (GLOBE) initiative also are included under Earth Science. Earth Probes complement EOS by providing the ability to investigate Earth processes with sensors that require special orbits or have unique requirements. Earth Probes also offer the opportunity to take advantage of international cooperative efforts or technical innovation. The currently approved Earth Probes are the Total Ozone Mapping Spectrometer (TOMS), NASA Scatterometer (NSCAT), Tropical Rainfall Measuring Mission (TRMM), Lewis and Clark, and Earth System Science Pathfinders (ESSP). ESSP is a science-driven program intended to identify and develop small missions to accomplish scientific objectives not addressed by current programs. Selection of the first two ESSP missions occurred in March 1997. The most recent TOMS instrument and NSCAT were launched in August 1996 by Japan aboard its Advanced Earth Observing Satellite (ADEOS), but the ADEOS satellite failed on-orbit in summer 1997. TRMM was launched by Japan in November 1997. The Lewis land-imaging satellites was launched in August 1997, but communications with the satellite were lost shortly after. The Clark land-imaging satellite was terminated by NASA in February 1998 due to cost overruns and schedule delays.

The Senate Appropriations Committee has recommended $1.397 billion for the Earth Science program, 1.8% above the request but 1.4% below the FY1998 level. The Committee noted the budget pressures on this program with its growing requirements at the same time it has received budget reductions. It particularly cited the potential challenges facing the EOS program as the launch of two spacecraft nears. For that reason, the Committee is providing an additional $25 million above the request for support of the EOS AM-1 launch. The Committee also urged NASA to continue its efforts to help develop a commercial remote sensing industry, and expressed support of NASA's efforts on the LightSAR program. In that connection, the Committee urged NASA to proceed with the LightSAR launch and to secure a commercial partner for the program.

The House Appropriations Committee has recommended $1.31 billion for the Earth Science program, 4.4% below the request and 7.4% below the FY1998 level. The Committee directed that the reduction be taken by a general reduction in the uncosted carryover funds, which totaled over $600 million at the close of FY1998. In this connection, the Committee expressed its concern about how NASA was carrying out several of the large projects within the program, and the resultant large amount of unobligated funds. The Committee also directed that no funds could be expended for feasibility studies or satellite procurement in connection with a project to place an earth-observing satellite at the Earth-Sun LaGrange-1 point. It noted that this proposal has not undergone peer review, lacks focus, and is particularly of concern during this period of constrained fiscal resources for NASA.

The Senate Commerce Committee has recommended an authorization of the full request for this program. It expressed its strong support for this program and noted that support should be provided for all of the program's components including the EOS, Landsat, Earth Probes, and the EOS Data and Information Systems.

Aeronautics and Space Transportation Technology (ASTT). Aeronautics and Space Transportation Technology (ASTT) provides funding for NASA's aeronautics program, advanced space-transportation technology-development, and the agency's commercial technology programs. The request for ASTT in FY1999 is $1.305 billion. The FY1998 funding level is $1.484 billion.

The request for NASA's aeronautics program is $786 million. The aeronautics program includes the research and technology base and focused programs. Focused programs include the High-Speed Research (HSR) program, the Advanced Subsonic Technology (AST) program, and the High-Performance Computing and Communications (HPCC)[12] initiative. The HSR program is to develop the technologies that industry may need to design and build an environmentally compatible and economically competitive supersonic airliner. The request for HSR is $190 million. The AST program is to develop high-payoff technologies, in cooperation with the Federal Aviation Administration (FAA) and U.S. industry, to benefit the civil aviation industry and the flying public. Those technologies are aimed at reducing industry costs while increasing safety, reducing impact of civil aircraft on the environment, and increasing the capability of the airspace system. The request for AST is $157.4 million. The NASA HPCC program is to accelerate the development, application and transfer of high performance computing technologies to meet the needs of the U.S. aeronautics, Earth science, and space science communities. NASA's program is a component of the multiagency HPCC effort and includes participation in the federally coordinated Large Scale Networking Initiative also know as the Next Generation Initiative.

The request for NASA's advanced space transportation technology efforts is $388.6 million. This includes $338.8 million for the Reusable Launch Vehicle (RLV) program, $20 million for Future Space Launch studies, and $28.3 million for the Advanced Space Transportation Program (ASTP). The RLV program currently consists of the X-33 advanced technology demonstrator, the X-34 technology demonstration program, and the Future-X Demonstration program, with the goal of reducing the cost of access to space tenfold. The X-33 ($282.8 million request) is a technology development and flight-test program for a large reusable launch vehicle. The program is funded jointly by NASA and Lockheed Martin. The first X-33 flight test is scheduled for July 1999. It is hoped that the technologies developed and flight-tested will lead to an operational vehicle, named *Venturestar*, in the first decade of the 21st century. This operational vehicle could potentially replace the Space Shuttle. As currently envisioned, *Venturestar* would be funded entirely by the private sector, not NASA. The X-34 ($39 million request) is a technology development and flight-test program for reusable launch vehicles. The X-34 is much

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[12] For further information see, *Computing, Information, and Communications R&D: Issues in High-Performance Computing*, by Glenn J. McLoughlin. CRS Report 97-31 SPR. U.S. Library of Congress. Congressional Research Service.

smaller and less capable than the X-33 and is to bridge the performance gap between the X-33 and previous flight tests of the DC-XA (Delta Clipper). The first X-34 test flight is scheduled for March 1999. Orbital Science Corporation (OSC) is currently under a fixed-price, 30-month contract for the X-34.

The X-33 program is technologically challenging. A follow-on RLV "X-program" may be necessary before the agency or the private sector is ready to take on development of an operational RLV. The X-33 is already encountering some problems in its development. As currently designed, the vehicle is heavier than expected and will not be able to reach the mach number (speed) originally planned in the flight tests. NASA asserts that it is still capable of achieving its flight test goals and will still provide adequate data to make a decision on whether to build an operational RLV.

ASTP is to develop technologies to reduce space transportation costs dramatically across all mission aspects. The program will focus on advances that offer the potential to reduce costs beyond RLV goals as well as technology development required to support NASA needs not addressed by the RLV program. The request for ASTP is $28.3 million.

The request for Commercial Technology Programs is $130.4 million. Funding under this category is for NASA's technology transfer efforts and the agency's Small Business Innovation Research (SBIR) program. Funding for the National Technology Transfer Center in Wheeling, West Virginia, also is included.

The Senate Appropriations Committee has recommended the full request for this program. It also directed NASA to place this program in a separate account as noted above. The reason for this move as stated by the Committee is to protect "critical" aeronautics and space transportation technology activities from budget reductions. The Committee noted proposed legislation to extend NASA's current indemnification authority to developers of experimental vehicles in connection with the development of the X-33 and X-34 vehicles. The Committee stated that it expects such legislation to be enacted this year. The Committee also expressed its strong support of NASA's efforts to reduce space launch costs, and asked that those efforts include investigation of changes in NASA space launch requirements that would allow more participation by the commercial sector. In particular, the Committee directed NASA to consider changes that would allow smaller launch systems to service the ISS and a two-way crew transfer vehicle instead of a one-way crew return vehicle to service the ISS. The Committee also directed NASA to provide an additional $4 million to consider an "upgraded version of the current solid rocket booster" as an alternative to the liquid fly back booster system now under study with advanced space transportation.

The House Appropriations Committee has recommended $1.35 billion for this program, 3.3% above the request but 9.2% below the FY1998 level. The Committee directed that $30 million of the increase over the request go to the Future-X program. The Committee commended NASA on this effort but it considers the funding to be inadequate. The Committee expressed strong support for the High Speed Research program. It expressed its concern that the NASA aeronautics research programs do

not receive sufficient funding. It noted the contribution made by this research and urged NASA to expand funding for aeronautics research in the future.

The Senate Commerce Committee has recommended authorization levels that would provide the full request for this program. The Committee stated that the full funding would be provided for all of the NASA aeronautics programs including $100 million for an Aviation Safety Program to be performed cooperatively with the Department of Defense, the Federal Aviation Administration, and the private sector.

Mission Communication Services. Mission Communication Services provides funding for telecommunications support for all HSF and SAT programs. Mission Communications Services are comprised of Ground Networks, Mission Control and Data Systems, and Space Network Customer Service. Services include tracking, orbit and attitude determination, communications scheduling, spacecraft command, spacecraft health and safety data acquisition, and science data acquisition. The request for Mission Communication Services is $380 million. The category is funded at $400.8 million in FY1998.

The National Space Policy released by the Administration in September 1996 states that NASA will "seek to commercialize its space communications operations no later than 2005." Efforts are underway to consolidate and streamline major support contracts, to optimize space operations. NASA is planning a transition to a Consolidated Space Operations Contract (CSOC). In May 1997, NASA announced that it had selected Boeing North America Space Systems Division and Lockheed Martin Space Mission Systems and Services Inc. for Phase 1 of CSOC. Each firm is to receive an 8-month, $4 million fixed-price contract for development of an Integrated Operations Architecture (IOA) for NASA space operations. NASA plans are to award a single contract in FY1998 to implement the chosen IOA.

Significant efforts funded under the Ground Networks category include the Deep Space Network (DSN) and the Spaceflight Tracking and Data Network (STDN). DSN facilities track deep space probes with antenna at three sites worldwide: Goldstone, California; Canberra, Australia; and Madrid, Spain. STDN facilities provide tracking and data for launches of the Space Shuttle and expendable launch vehicles.

The Senate Appropriations Committee has recommended funding the full request for this program. The House Appropriations Committee has recommended $385 million, 1.3% above the request but 3.9% below FY1998. The Committee expressed its concern about whether the FY1998-FY1999 funding decrease would be more than could be prudently absorbed by the program. The added funds are designed to ensure that the mission communications function continues to operate well. The Senate Commerce Committee has recommended an authorization that would fund the full request.

Academic Programs. Academic Programs provides funding for NASA's education programs to increase interest and promote excellence in science and technological competence in the U.S. education system. The program also provides funds for strengthening the research infrastructure capabilities of minority

universities. The request for Academic Programs is $100 million. A total of $130 million is available in FY1998.

Academic Programs is divided into the Education Program and the Minority University Research and Education Program. The Education Program brings students and teachers into NASA missions and research as participants. NASA provides the opportunity for teachers and students to experience first hand involvement with NASA's scientists and engineers and their research and development activities. The NASA Space Grant College and Fellowship Program and the Experiment Program to Stimulate Competitive Research (EPSCoR) are examples of NASA's academic efforts. The Space Grant program, authorized by Congress in 1987, provides grants to consortia of colleges and universities with interest in aerospace research, training, and education. All consortia match their grants at 100% with either dollars and/or cost-sharing arrangements with NASA. EPSCoR aims to strengthen the research capability of states that do not successfully participate in competitive space and aeronautical research activities. The program provides seed funding to eligible states to develop academic research capabilities in the areas of space and aeronautics research.

The Minority University Research and Education Program focuses on expanding and advancing NASA's scientific and technological base through collaborative efforts with Historically Black Colleges and Universities (HBCU) and Other Minority Universities (OMUs) including Hispanic-Serving Institutions and Tribal Colleges and Universities. Efforts in this area include the establishment of research centers at minority universities or colleges and the funding of institutional research awards and individual principal investigator awards.

The Senate Appropriations Committee has recommended $130 million for Academic Programs, 30% above the request and the same as FY1998. The Committee added $10 million to the NASA EPSCoR program directing NASA to support a broad range of research from each of the NASA programs in each EPSCoR State. It also directed NASA to distribute the awards to the largest number of states possible. The Committee added $10 million to NASA's minority university research and education actitivies. It directed NASA to use those funds to strengthen graduate science and engineering education at historically black colleges and universities. In particular, the Committee directed NASA to support doctoral programs in order to expand representation of African-Americans at that level. The Committee stated that $23 million of the recommendation was to be used for the National Space Grant College and Fellowship Program and that NASA should use that number as a baseline for future budget requests for that program.

The House Appropriations Committee has recommended $129.4 million for Academic Programs, 29% above the request but 0.5% below the FY1998 level. The Committee provided $10 million of the increase for minority university education and research activities. It directed NASA to use the funds to expand opportunities for minority institutions to participate in NASA centers of excellence. The Committee also expressed its interest in seeing that NASA achieved a better funding balance between minority and other higher education institutions. The Committee noted the success of the Partnership Awards program in reaching underserved minority institutions and disadvantaged students. If directed that $9.4 million of the

increase be used to expand this program. The Committee also urged NASA to strengthen and expand its math/science teacher preparation program in order to help improve K-12 teacher quality in rural and urban areas.

The Senate Commerce Committee has recommended an authorization that would fully fund the Academic Programs request. The Committee expressed disappointment, however, that NASA had reduced funding requests for education programs in both FY1998 and FY1999. The Committee directed NASA to use any additional funds to enhance efforts to support K-12 education improvement through student support, teacher training, and educational technology.

Mission Support. Mission Support provides funding for agency-wide activities that support NASA's missions. They include NASA's civil service workforce, the space tracking and communications capabilities required by all missions, all safety and quality assurance activities, and construction of core agency facilities. The programs funded by Mission Support are Safety, Mission Assurance, Engineering, and Advanced Concepts; Space Communications Services; Research and Program Management; and Construction of Facilities. The request for Mission Support is $2.477 billion. A total of $2.433 billion is available in FY1998.

The Senate Appropriations Committee has recommended $2.492 billion for Mission Support, 0.6% above the request and 2.4% above the FY1998 level. The Committee did not provide any breakdown by the programs listed below. The Committee provided the additional $15 million for continued development of the NASA integrated financial management system, which it strongly supports. The Committee also noted its support of test facility modernization at the Stennis Space Center, and the importance of that facility for NASA, DOD, and commercial propulsion testing. Finally, the Committee expressed its concern about the growth in the level of NASA's uncosted budget authority. It directed the agency to take steps to reduce that authority to a minimum, and spelled out criteria for what it considered to be legitimate unobligated budget authority at the fiscal year's end.

The House Appropriations Committee has recommended $2.459 billion for Mission Support, 0.7% below the request but 1.1% above the FY1998 level. The Committee did not provide any breakdown by the programs listed below. The Committee directed NASA to reduce this account by $20 million and supply it with a report on which of the programs will be affected by that reduction.

The Senate Commerce Committee has recommended an authorization that would fully fund the request. It broke up its recommendation by program element, and each would also be funded at its FY1999 request level.

Safety, Mission Assurance, Engineering, and Advanced Concepts. The Safety, Mission Assurance, Engineering, and Advanced Concepts program invests in the safety and success of all NASA programs. This program develops insight into the agency's programs and performs independent oversight that contributes to program safety and success. The program also develops and promulgates NASA-wide safety and risk management policies, standards, and guidelines. The request for this program is $35.6 million.

Space Communications Services. Space Communications Services provides funding for agency-wide telecommunications that are not funded under the category of Mission Communications Services. The Space Communications Services program is composed of the Space Network and Telecommunications programs. These programs provide communications support to human space flight missions and low-Earth-orbital spacecraft and the Tracking and Data Relay Satellite (TDRS) system. Communications services are provided between separate ground facilities and between the flight vehicles and ground facilities. The request for Space Communications Services is $177 million.

NASA's Space Network is comprised of a constellation of geosynchronous TDRS spacecraft and associated dual ground network terminals located in White Sands, New Mexico. The current TDRS constellation consists of two fully operational satellites in service (TDRS-4 and -5), two fully functional satellites stored on-orbit (TDRS-6 and -7), and two partially functional spacecraft (TDRS-1 and -3). TDRS provides almost continuous communications contact between spacecraft on orbit and White Sands. TDRS' most significant use is for communications with the Space Shuttle when in orbit. It also will be used for communications with the International Space Station. NASA is currently undertaking the TDRS Replenishment Spacecraft program to provide three additional TDRS spacecraft under a fixed-price, commercial practices contract. The first TDRS Replenishment Spacecraft is planned to be ready for launch in the fourth quarter of 1999.

Research and Program Management. Research and Program Management funds the salaries, travel expenses, and other administrative expenses of NASA's civil servants. A major focus in this area has been efforts to downsize the workforce of the agency. By the end of FY2000, NASA plans to have restructured the size of the workforce to 17,818 FTEs, nearly a 30% reduction from the authorized levels of just over 25,000 in FY1992. Assuming natural attrition rates, it will be extremely difficult to meet the FY2000 goal. The agency is investigating several voluntary approaches to reductions before resorting to involuntary methods such as a reduction in force (RIF). One such method is an employee buyout. The FY1997 VA-HUD-IA appropriations bill granted NASA "buyout" authority to reduce its staff levels. NASA has undertaken a few buyout seasons. NASA now has an FTE level of 19,364. The FTE goal for FY1999 is 18,519. The exodus of employees also has raised concern about the agency's ability to maintain a skilled workforce when so many employees are leaving and so few are being hired. The total FY1999 request for Research and Program Management is $2.099 billion. A total of $2.052 billion is available in FY1998.

Construction of Facilities. Construction of Facilities provides funding for construction or rehabilitation of core agency facilities. This includes funding for the repair and upgrade of existing NASA facilities and the design and planning of future ones. Environmental Compliance and Restoration activities also are funded in this category. For FY1999, NASA is requesting $165 million for Construction of Facilities. The agency has $134.4 million available in FY1998.

Inspector General. The Inspector General (IG) category provides funds for activities of NASA's independent auditor staff. The majority of this funding goes for salaries. The IG's mission is to conduct independent audits, investigations, and

inspections/assessments of NASA's programs and operations while working cooperatively, as feasible, with NASA management and program managers. NASA's FY1999 funding request for the Inspector General is $20 million. That will support 210 FTEs. The IG's office has $18.3 million available in FY1998.

The Senate Appropriations Committee has recommended $20 million for this account, the same as the request and 9.3% above the FY1998 level. The House Appropriations Committee has recommended $19 million for this account, 5% below the request but 3.8% above the FY1998 level. The Senate Commerce Committee has recommended authorization at a level that would fully fund the request.

Future NASA Budget Outlook

Federal budget constraints have led to an intensified debate on the balance of funding between NASA programs and other nonaerospace national priorities. The constraints also have led to increased funding competition among individual NASA programs and to debate about NASA's future and mission. Some observers and Members of Congress are concerned that expenditures on large NASA programs such as the Space Shuttle, the International Space Station (ISS), and the Earth Science programs have limited the amount of funding available for other smaller space activities. Some observers also fear that funding for ISS may preclude adequate funding for space science missions.

NASA Administrator Goldin has publicly committed to maintaining a funding balance among the agency's science, technology, aeronautics, and human spaceflight programs. Many observers, however, question whether NASA, in a declining budget atmosphere, can continue to fund new programs and initiatives, let alone fund all ongoing programs. NASA asserts that its budget does fund the balanced program in its strategic plan and that efforts to undertake its missions "faster, smaller, cheaper, and better" have allowed the agency to increase the number of science missions even with a declining budget. NASA also asserts that funding for ISS and Space Shuttle as a percentage of the overall NASA budget has been steadily declining and current plans would continue that trend. Although the FY1999 request is a cut from FY1998, NASA asserts that this request represents Presidential support for a stable NASA budget. The outyear levels would decline to $13.278 billion by FY2000, but increase to $13.435 billion by FY2003.

Ultimately, NASA's future budget prospects will be closely tied to potential efforts to reduce the federal deficit, the agency's ability to reduce program costs to meet expected future appropriations, the level of congressional support for civilian research and development, and the emphasis placed on space relative to other national priorities.

Selected NASA World Wide Web Sites

General

National Aeronautics and Space Administration (NASA) Home Page

http://www.nasa.gov

NASA Headquarters
http://www.hq.nasa.gov

Program Offices

Space Flight
http://www.osf.hq.nasa.gov

Aeronautics and Space Transportation Technology
http://www.aero.hq.nasa.gov

Space Science
http://www.hq.nasa.gov/office/oss

Life and Microgravity Sciences and Applications
http://www.hq.nasa.gov/office/olmsa

Mission to Planet Earth
http://www.hq.nasa.gov/office/mtpe

Functional/Staff Offices

NASA Legislative Affairs
http://www.hq.nasa.gov/office/legaff

Chief Financial Officer
http://booster.nasa.gov:443/codeb

Headquarters Operations
http://www.hq.nasa.gov/office/codec

Equal Opportunity Programs
http://www.hq.nasa.gov/office/codee

Human Resources and Education
http://www.hq.nasa.gov/office/codef

Procurement
http://www.hq.nasa.gov/office/procurement

External Relations
http://www.hq.nasa.gov/office/codei

Management Systems and Facilities
http://www.hq.nasa.gov/office/codej

Small and Disadvantaged Business Utilization
http://www.hq.nasa.gov/office/codek

Public Affairs
http://www.gsfc.nasa.gov/hqpao/hqpao_home.html

Safety and Mission Assurance
http://www.hq.nasa.gov/office/codeq

Inspector General
http://www.hq.nasa.gov/office/oig/hq

Policy and Plans
http://www.hq.nasa.gov/office/codez

Field Centers

Ames Research Center
http://www.arc.nasa.gov

Dryden Flight Research Center
http://www.dfrc.nasa.gov/dryden.html

Goddard Space Flight Center
http://www.gsfc.nasa.gov

Jet Propulsion Laboratory
http://www.jpl.nasa.gov

Johnson Space Center
http://www.jsc.nasa.gov

Kennedy Space Center
http://www.ksc.nasa.gov/ksc.html

Langley Research Center
http://www.larc.nasa.gov/larc.cgi

Lewis Research Center
http://www.lerc.nasa.gov/LeRC_homepage.html

Marshall Space Flight Center
http://www.msfc.nasa.gov

Stennis Space Center
http://www.ssc.nasa.gov

National Aeronautics and Space Administration (NASA). Michael A. Meador* Lanetra C. Tate. National Science Foundation (NSF) Khershed Cooper* Fred Kronz Lynnette Madsen Mihail C. Roco* Nora Savage Charles Ying*.Â Image Credits: (a) National Aeronautics and Space Administration; (b) Paul Westerhoff, Nanosystems Engineering Research Center for Nanotechnology-Enabled Water Treatment; (c) David Kamm, U.S. Army Research, Development, and Engineering Command; (d) John Rogers, Northwestern University; (e) Joseph Walish, Massachusetts Institute of Technology; (f) Tyler Hernandez, Michael Strand, Daniel Slotcavage, and Michael McGehee, Stanford University; (g) David Scaglione.Â 1. Introduction and Overview. National Aeronautics Research and Development Policy and Plan The National Science and Technology Council (NSTC) released their National Aeronautics Research and Development Policy in December 2006, to establish long term goals for US aeronautics R&D endeavors.Â The Administration s proposed NASA budget for FY 2014 indicates an overall philosophical commitment to revitalizing space technology research and development efforts, which the Task Force fully supports.Â Furthermore, NASA s aeronautics budget should reflect the priorities laid out in the NSTCÂ AIAA Public Policy Carol A. Cash, VP Public Policy Aeronautics and Space Engineering Board April 5, 2011 AIAA Overview AIAA is the