NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1998 BUDGET ESTIMATES

NASA'S VISION FOR THE FUTURE

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

NASA's unique mission of exploration, discovery, and innovation has preserved the United States' role as both a leader in world aviation and as the preeminent spacefaring nation. It is NASA's mission to:

- Explore, use and enable the development of space for human enterprise;
- Advance scientific knowledge and understanding of the Earth, the Solar System, and the Universe and use the environment of space for research;
- Research, develop, verify and transfer advanced aeronautics, space and related technologies.

The outcomes of NASA's activities contribute significantly to the achievement of America's goals in four key areas:

- Economic growth and security - NASA conducts aeronautics and space research and develops technology in partnership with industry, academia, and other federal agencies to keep America capable and competitive.
- Preserving the Environment - NASA studies the Earth as a planet and as a system to understand global change, enabling the world to address environmental issues.
- Educational Excellence - NASA involves the educational community in our endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds.
- Peaceful Exploration and Discovery - NASA explores the Universe to enrich human life by stimulating intellectual curiosity, opening new worlds of opportunity, and uniting nations of the world in this quest.

To fulfill NASA's mission of exploration, discovery and innovation, NASA sets the following overarching goals to take its science and aeronautics program proudly into the 21st century:

- NASA will be at the forefront of exploration and science. We will develop and transfer cutting-edge technologies in aeronautics and space. NASA will establish a permanent human presence in space.

- As NASA pursues is mission, NASA will enrich the Nation's society and economy. NASA will contribute to a better life for this and future generations.
- In the coming decades, it is our goal to undertake bold and noble challenges -- exciting future programs, such as the return of humans to the Moon and human missions to Mars, which stir the imagination and fall within the grasp of the United States and its international partners' technical and financial grasp.

The President's civil space policy, released in September 1996, underscores NASA's role as the lead Federal agency for civil space R&D. It features NASA's strengthening of its focus on cutting edge R&D and deemphasis on operational activities. The policy highlights priorities in human space flight (permanent human presence in space), science (Earth observation, continuous robotic presence on Mars surface, celestial sample returns and search for other Earth-like planets), and space technology (reuseable launch vehicles and smaller, cheaper space missions). It also underscores NASA's leveraging of industry through purchases of launch services, spacecrafts, data products, communication services, and new technology; and continued close coordination with DoD and NOAA.

STRATEGY FOR ACHIEVING OUR GOALS

The framework for achieving these goals is embodied in the NASA Strategic Plan, which separates key NASA activities into four distinct Strategic Enterprises. They are:

- Mission to Planet Earth;
- Aeronautics and Space Transportation Technology;
- Human Exploration and Development of Space; and,
- Space Science;

Each Enterprise, similar to the strategic business units employed by the private sector, has a unique set of strategic goals, objectives, and concerns, and a unique set of primary external customers. NASA also provides capabilities that are required for each Enterprise to achieve its goals and meet the needs of their customers. These agency-level activities serve multiple Enterprises and the strategies of these functions are driven primarily by the strategic plans of the Enterprises. The fundamental values of excellence, responsibility, teamwork, trust, and honor form the bedrock of all of NASA's activities.

NASA's Strategic Plan transcends its organizational structure. Each of the Strategic Enterprises seeks to respond to a unique customer community. Each of the Enterprises has its own set of technology needs which are closely linked to performing future planned missions while reducing the cost and technical risk. At the same time, there is considerable synergy between the Enterprise activities which strengthens the activities of each. A broad description of the focus of each Strategic Enterprise follows:

Mission to Planet Earth - The activities which comprise this Enterprise are dedicated to understanding the total Earth system and the effects of humans on the global environment. This pioneering program of studying global climate change is developing many of the capabilities which will be needed indefinitely, for long-term environment and climate monitoring and prediction. Governments around the world need information based on the strongest possible scientific understanding. The unique vantage point of space provides information about the Earth's land, atmosphere, ice, oceans, and biota as a global system, which is available in no other way. In concert with the global research community, the Mission to Planet Earth Enterprise is developing the understanding needed to support the complex environmental policy decisions that lie ahead.

Aeronautics and Space Transportation Technology - NASA, and its predecessor, the National Advisory Committee for Aeronautics, have worked closely with U.S. industry, universities, and other Federal agencies to give the United States a preeminent position in Aeronautics. The Aeronautics program will pioneer the identification, development, verification, transfer, application and commercialization of high-payoff aeronautics technologies. Future U.S. competitiveness in aeronautics and access to space, including the continued safety and productivity of the Nation's air transportation system, is dependent upon sustained NASA advances in aeronautics research and technology. Activities pursued as part of this Enterprise emphasize customer involvement, encompassing U.S. industry, the Department of Defense, and the Federal Aviation Administration.

The Space Transportation Technology program will develop new technologies aimed at revitalizing access to space. The technologies targeted will reduce launch costs dramatically over the next decade, increase safety and the reliability of current and future generation launch vehicles. Additionally, new plateaus of performance for in-space propulsion will be established, while reducing cost and weight. The Reuseable Launch Vehicle (RLV) program is pursuing technology development and concept definition activities in support of next-generation reuseable launch systesm. The Advanced Space Transportation Program is developing key technologies to dramatically reduce space transportation costs across the mission spectrum, particularly advances with the potential of reducing launch costs beyond RLV goals. Programs in support of the effective transfer of NASA technology to the commercial sector are included in this Enterprise.

Human Exploration and the Development of Space - Human Space Flight serves as a foundation for much of what NASA does. Activities pursued as part of the Human Exploration and Development of Space Enterprise seek to bring the frontiers of space fully within the sphere of human activities for the benefit of America and all humankind in this and future generations. It will open the space frontier by exploring, using, and enabling the development of space. NASA was propelled into the space frontier, by an international political challenge born of the Cold War. With the Cold War behind us, we seek to work with other nations in our current and future activities, and to lay the foundations for human

development of space.

Space Science - The activities of the Space Science Enterprise seek answers to fundamental questions, such as understanding the origin of the universe and our solar system, how they have evolved, and whether the Earth is unique, if there are planets around other stars and if life exists elsewhere. The quest for this information, and the answers themselves, maintains scientific leadership, excites and inspires our society, strengthens education and scientific literacy, develops and transfers technologies to promote U.S. competitiveness, fosters international cooperation to enhance programs and share their benefits, and sets the stage for future space ventures.

The Strategic Enterprises comprise an integrated national effort. Synergism of broad purposes, technology requirements, workforce skills, facilities, and many other dimensions was the basis for amalgamating these activities in NASA in the National Aeronautics and Space Act in 1958, and the benefits remain strong today.

PLANS AND ACCOMPLISHMENTS

The NASA budget request for FY 1998 is reflected in four appropriations:

- **Human Space Flight** - providing funding for the Space Station and Space Shuttle programs, including development of research facilities for the Space Station and flight support for cooperative programs with Russia;

- **Science, Aeronautics and Technology** - providing funding for NASA's research and development activities, including all science activities, global monitoring, aeronautics, technology investments, education programs, mission communication services and direct program support;

- **Mission Support** - providing funding for NASA's civil service workforce, space communication services, safety and quality assurance activities, and facilities construction activities to preserve NASA's core infrastructure;

- **Inspector General** - providing funding for the manpower and support required to perform audits and evaluations of NASA's programs and operations.

The NASA Space Science program has achieved impressive successes this past year -- possible indications of primitive life on Mars; new discoveries about the origin of the universe; identification of planets around neighboring stars; and intriguing possibilities of liquid water on Jupiter's moon Europa. To capitalize on these enormous successes during the past year, the NASA budget request for FY 1998 highlights the Origins program. The Origins program is focused on answering fundamental questions regarding the creation of the universe and

planetary systems and the possibility of life elsewhere beyond Earth. A strategy for addressing these questions would involve returning surface samples from Mars; visiting comets and other planetary bodies; and deploying powerful telescopes to detect Earth-like planets elsewhere in our galaxy. NASA's Origins program is responsive to the President's new civil space policy and is a vital component of the Administration's investment strategy in science and technology.

The NASA budget request for FY 1998 continues the commitment by the President to invest in the future. This budget request recognizes the enormous potential for investments in the civil space and aeronautics program to benefit this country. The President's Space Policy, issued in September 1996, outlined a strong and stable program in space that will ensure America's role as the world's space leader. The Space Policy reaffirmed the United States' commitment to the International Space Station, to the next generation of launch vehicle programs, to an aggressive space science program, and to the continuing commitment to a long-term program of environmental monitoring from space. The President*'s* strategy for investing in science and technology, encompassing goals which emphasize world leadership in science, mathematics and engineering, economic growth, improved environmental quality, and harnessing information technology continues as the framework for development of federal science and technology policy. The President's budget request for NASA for FY 1998 is fully supportive of these goals.

The emphasis on cheaper, more capable science missions is continued in the FY 1998 budget request. These programs experiment with new innovative management and procurement practices, promote smaller affordable missions and enforce strict adherence to performance criteria and a cost cap.

- The Discovery program reflects NASA's commitment to ensuring a continuous stream of new planetary science data and more frequent access to space. The first two Discovery mission*s*, the Near Earth Asteroid Rendezvous (NEAR) mission and the Mars Pathfinder, were launched in 1996. The next Discovery mission, Lunar Prospector, is scheduled for launch in September 1997.
- The Mars Surveyor program is a series of small missions designed to resume the detailed exploration of Mars. The first mission, the Mars Surveyor mission, was launched in November 1996. The second series of Mars Surveyor spacecraft will be launched during the next launch opportunity in December 1998 and January 1999.
- The New Millennium Spacecraft program is an aggressive technology development and demonstration program underway that is designed to precipitate a revolution in the design, development and implementation of science spacecraft and instruments. Initiatives are underway in the Office of Space Science and the Mission to Planet Earth to identify, develop and flight validate a new generation of technologies. Technologies for the first two Space Science New Millennium missions have been selected and development has begun. An advanced land imager has been selected as the first Mission to Planet Earth mission in the New Millennium program. Future technologies

will be identified for development that reduce cost or improve performance of future Earth Observing spacecraft.

- The Earth System Source Pathfinder (ESSP) is a science-driven program intended to identify and develop small satellite missions to accomplish scientific objectives in response to national and international research priorities not addressed by current programs. The first ESSP mission is scheduled for selection in early 1997.

In order to achieve significant savings in the cost of space missions, the cost of going to orbit must be reduced by orders of magnitude. The Reusable Launch Vehicle program is addressing, in partnership with the private sector, the new and innovative technologies that are needed to meet the challenges and lower the costs of future space missions. Phase II of the X-33 program, encompassing both ground and flight tests, is underway, and is expected to lead to a decision by the government and our industry partners whether full-scale development of an RLV should be pursued. This program utilizes an innovative management approach, based on industry-led cooperative agreements. The government is acting as partners and subcontractors, reporting costs and manpower to the industry team leader as would any other subcontractor. This approach allows a much leaner management structure, lower program overhead costs and increased management efficiency.

NASA's ability to inspire and expand the horizons of present and future generations rests on the success of these efforts to maintain this nation's leadership in space within the reality of the fiscal constraints facing the federal budget. In order to ensure the stability to manage and execute programs within budget and schedule, NASA is seeking multi-year appropriations for selected space projects -- the International Space Station, the Space Infrared Telescope Facility (SIRTF), the Stratospheric Observatory for Infrared Astronomy (SOFIA), the X-33, and the Tracking and Data Relay Satellite (TDRS) Replenishment spacecraft.

NASA has been at the forefront of the Administration's efforts to reshape the federal government, to make it smaller, cut costs, and be more responsive to the ultimate customer, the taxpayer. During 1996, recommendations from the Zero Base Review continued to be implemented and real infrastructure changes were made to meet NASA's commitment to lower budget runout targets.

- A single Shuttle contractor was implemented at the Kennedy Space Center in October 1996;
- NASA's civil service workforce was reduced an additional 618 full time equivalents over the FY 1996 baseline of 21,555. Total civil service employment for NASA at the end of FY 1996 was 20, 937 full time equivalents.
- Center Missions and Centers of Excellence identified for each of the NASA field centers in the Zero Base Review, continued to be put into place. These Center Missions and Centers of Excellence map directly to NASA's Strategic Enterprises and provide a direct relationship to the way each Center supports NASA's goals. In 1996, NASA

transitioned its management practices to reflect this approach. The leaders of each Enterprise at Headquarters will provide the strategy for each area consistent with the NASA Strategic Plan. The responsibility and accountability for program implementation will be at the NASA field centers.

- Buildings and facilities continued to be closed during FY 1996. The replacement value of facilities closed through FY 1996 is $1.5 billion.

NASA continues to be a leader in responding to the challenge of reducing the federal deficit and the goals of the National Performance Review. Over the past several years, NASA has undergone a thorough scrutiny of its mission, organization and activities. The Zero Base Review, which involved a difficult introspective examination of NASA's activities and workforce, resulted in recommendations which are being implemented at every NASA field center, including Headquarters. A strengthened program management system has been implemented and *t*he Program Management Council regularly reviews the technical, schedule and financial status of NASA's major activities. A disciplined process has been established for the early identification of problems, and guidelines for addressing a solution. This process has resulted in senior management attention focused on program performance. The FY 1998 budget proposes mulit-year appropriations for development of the Space Infrared Telescope Facility (SIRTF), the Stratospheric Observatory for Infrared Astronomy (SOFIA), and the X-33 Experimental Launch Vehicle technology demonstrator. The multi-year funding will ensure the stability to manage and execute these programs within their budget and schedule commitments. A new Strategic Management process has been put in place to provide a continuous process for NASA to make critical decisions about its long-term goals, near-term activities, and institutional capabilities that are in alignment with customer requirements. A fundamental goal of NASA's Strategic Management process is to ensure that the Agency provides its customers with excellent products and services in the most cost-effective and timely manner.

HUMAN SPACE FLIGHT

This appropriation encompasses all human space flight activities, including development of the Space Station and the safe and efficient operation of the Space Shuttle. The International Space Station is the culmination of the redesign work begun in FY 1993 to reduce program costs while still providing significant research capabilities. Space Station partners include NASA, the Russian Space Agency (RSA), European Space Agency (ESA), the Canadian Space Agency (CSA), and the National Space Development Agency of Japan (NASDA). The partnerships significantly enhance the capabilities of the International Space Station, and ensure compatible interfacing elements. The program is led by a single contractor, Boeing, which has total development and integration responsibilities. A streamlined program office at the Johnson Space Center has primary management responsibility for the program, and is structured around integrated product teams with responsibility for bringing the systems and elements into

integrated launch packages.

The Administration continues to be strongly committed to development of the International Space Station, and the preservation of the partnerships between the United States, Russia, Europe, Japan and Canada. The proposed budget provides multi-year funding for the complete development of the Station within the $2.1 billion ceiling and the $17.4 billion development constraints, with Station assembly beginning in late 1997 and finishing by 2002. The Administration continues to monitor progress through this crucial development period and will consider future funding, schedule, or content adjustments if they prove necessary to minimize program costs, maintain international participation, and ensure a Station capable of continuous scientific and technological research and permanent human presence in space. During the past year, the Space Station program has focused on the continued qualification testing and manufacture of flight hardware as the program readies for first element launch in November 1997. Production of flight hardware continued in earnest during FY 1996. At the end of 1996, nearly 140,000 pounds of flight hardware had been completed. Major work has been completed on the FGB, the nodes, U.S. laboratory, and the subsystems needed for outfitting. The program has completed a system-level preliminary design review for the hardware and systems necessary for the first six U.S. flights, as well as preliminary design reviews for flights six through twelve. International efforts continued with negotiations on the International Space Station agreements to reflect the addition of Russia to the partnership. Agreement was reached between NASA and the Russian Space Agency on the Memorandum of Understanding. The International Space Station partners are well into the manufacturing phase for their hardware contributions.

During FY 1997, the major program focus will be manufacturing and testing flight hardware to support first element launch (FEL) in November of 1997 and subsequent launches throughout early 1998. Major preparation will be made in support of the FGB, node 1, truss segments, the U.S. laboratory, and the subsystems to support these elements. The international partners will continue development of flight hardware with the functional cargo block (FGB) flight article assembly completion and delivery to Baikanour, the start of the Space Station remote manipulator system (SSRMS) performance test, and the Japanese Experiment Module (JEM) critical design review (CDR)-2 . The Mission Control Center (MCC) at the Johnson Space Center (JSC) will be the prime site for the planning and execution of integrated system operations of the Space Station, with exclusive command and control authority. The MCC at JSC and the MCC at Kalingrad form the unified command and control center for the Space Station. The Marshall Space Flight Center (MSFC) has responsibility for the payload integration and operations process. The payload integration process has been streamlined and shortened significantly from procedures used on the Space Shuttle. Standardized payload accommodation and an express rack concept have been incorporated for later payload manifesting. A Payload Operations Integration Center and user support facilities will be located at the MSFC as part of existing facilities that support the Shuttle/Spacelab activities.

Beginning in FY 1998, funding for all elements of the $2.1 billion Space Station program is included in the Human Space Flight appropriation. This will allow maximum flexibility in providing a balanced program, especially as program activities intensify in support of FEL. Program elements now included in the International Space Station budget are: Space Station Development, Operations, and the Research Program, including research facilities under development by the Offices of Life and Microgravity Sciences and Applications and the Mission to Planet Earth and the flight support component of the Russian cooperation program to Mir. Program reserves are being closely monitored to maintain as high a level as possible to address technical issues that are expected to inevitably occur during this peak period of Space Station engineering and development.

The highest priority of the Shuttle program remains the safe launch, operation and return of the orbiter and crew. Funding is included to continue modifications that will significantly improve the Space Shuttle's overall safety, including modifications to the Main Engine and the Orbiter, as well as to initiate a program of upgrades to increase reliability and maintainability. In addition, funding for investments to improve Shuttle performance, such as the Super Lightweight External Tank, is included in order to satisfy space station requirements. Transition to a consolidation of Space Shuttle operations contracts into a single prime contractual arrangement was accomplished in October 1996. Transition activities will continue over the next 2 years. It is expected that this consolidation will achieve the challenge of finding additional cost savings in the outyears. These savings have been incorporated into NASA's budget planning.

During 1996, valuable experience was gained in docking procedures during three Space Shuttle flights to the Russian Space Station Mir. U.S. astronauts maintained a continuing presence on the Mir, highlighted by the record setting stay of 181 days by astronaut Shannon Lucid. This experience is allowing NASA to gain valuable experience in the long term effects of weightlessness, as well as allowing the United States and Russia to work closely together in as Space Station partners. In 1997, an American astronaut will be continuously on board the Mir Space Station, performing scienctific experiments. Currently, nine joint U.S. visits to the Mir are planned, which will provide approximately 24 months of on-orbit time to test science hardware planned for the Space Station. In FY 1996 and in FY 1997, American astronauts will spend 12 months aboard the Mir conducting research. U.S. - Russian cooperation in space and aeronautics extends across the NASA programs.

The Space Shuttle continues to provide its unique capabilities. In FY 1996, eight missions were completed, including three missions to the Mir Space Station. Seven missions are planned for FY 1997, including three missions to the Mir Space Station and a Hubble Space Telescope servicing mission. Seven missions are planned for FY 1998, including the first assembly flights for the International Space Station, the final two flights to the Mir Space Station and the AXAF deployment. Spacelab flights focusing on life sciences and materials sciences will be conducted during FY 1997 in preparation for operations using the

International Space Station. The Spacelab program will terminate in FY 1998 following the Neurolab mission.

SCIENCE, AERONAUTICS AND TECHNOLOGY

Space Science

The Space Science program is designed to expand our scientific understanding of the Sun, solar system, and universe beyond Planet Earth. It seeks answers to fundamental questions, such as understanding the origin of the universe and our solar system, how they have evolved, and whether the Earth is unique; if there are planets around other stars; and, if life exists elsewhere. In 1996, several scientific discoveries rocked fundamental theories and opened discussions of long-held beliefs. The discovery of evidence in a meteorite believed to come from Mars that may indicate life began on Mars early in its history; the discovery of a possible subsurface ocean on Jupiter's moon Europa; and the possible discovery of deep frozen lakes on the south pole of the Earth's moon are among the highlights. To capitalize on these enormous successes the past year, the NASA budget request for FY 1998 highlights the Origins program. The Origins program is focused on answering fundamental questions regarding the creation of the universe and planetary systems, and possibility of life elsewhere beyond Earth. A strategy for addressing these questions would involve returning surface samples from Mars; visiting comets and other planetary bodies; and deploying powerful telescopes to detect Earth-like planets elsewhere in our galaxy. NASA's Origins program is responsive to the President's new civil space policy and is a vital component of the Administration investment strategy in science and technology.

The Space Science program has assumed management responsibility in the FY 1998 budget for those elements of the Spacecraft and Remote Sensing program which support unique space science technology requirements, and which develop crosscutting technology for future space science, Earth observing, and human exploration spacecraft systems. These new technologies are expected to reduce costs and increase preformance to enable new and more flexible missions for all of NASA's enterprises. This program was formerly conducted by the Office of Space Access and Technology, which was disbanded in 1996. Program elements specific to other NASA programs were transferred to those offices.

The Space Science program continues a robust program of flight development activities. The first two Discovery missions, the Near Earth Asteroid Rendezvous (NEAR) mission and the Mars Pathfinder were launched in 1996, both on Delta II launch vehicles. A Discovery mission development cost (phase C/D through launch plus 30 days) must be less than $150 million (FY 1992 dollars) and the mission must be launched within 3 years from start of development. These missions are designed to ensure a continuous stream of new planetary

science data and more frequent access to space - both of which are critical requirements for a robust science program in the future. Funding is included to continue the Discovery program, with the next mission, the Lunar Prospector mission, planned for launch in September 1997. The first spacecraft in the Mars Surveyor program, Mars Global Surveyor, was launched in November 1996, Funding for *t*he Mars Surveyor Program, initiated in FY 1995 continues. Mars Surveyor is a series of small missions designed to resume the detailed exploration of Mars following the loss of the Mars Observer mission in 1993; subsequent missions are to be launched at two year intervals, due to the orbital periods of Earth and Mars. Funding is included to complete development activities and begin flight operations on the Cassini mission to Saturn, scheduled for launch in October 1997 on a Titan IV launch vehicle. Development activities on the Advanced X-ray Astrophysics Facility (AXAF) continue, with launch by the Shuttle scheduled for August 1998. With its unprecedented capabilities in energy coverage, spatial resolution, spectral resolution and sensitivity, the AXAF will provide unique and crucial information on the nature of objects ranging from nearby stars like our sun to quasars at the edge of the observable universe. Definition activities on the final "Great Observatory", the Space Infrared Telescope Facility (SIRTF) are planned for completion in FY 1997; funding to initiate development of the spacecraft is included for FY 1998. The other "Great Observatories", include the Compton Gamma Ray Observatory, the Hubble Space Telescope,and the AXAF.

Funding is requested to continue the New Millennium Program, which will develop and demonstrate revolutionary new spacecraft technologies to enable more frequent, less costly missions on smaller spacecraft. This program is addressing key technology advancements -- including communications, navigation and attitude control, power, propulsion, avionics, instrumentation, rover technologies, operations and ground control. The smaller, more intelligent, less expensive spacecraft resulting from these technology advancements will not only revolutionize NASA's exploration programs, but have beneficial payoffs for the commercial spacecraft industry as well. Funding is included for continued development of the first two technology demonstrations missions, Deep Space (DS)-1 and DS-2, as well as definition of future New Millennium missions. Independent Product Development Teams and Science Working Groups have been selected and are developing roadmaps and selected technologies for the Deep Space missions. Funding is initiated in FY 1998 to support development of revolutionary technologies required for a new generation of outer planetary missions, with an ultimate goal of a "spacecraft on a chip". These new technologies are regarded as too high risk for industry investment at this stage in their development and include advanced microelectronics and avionics, power generation, micro-devices, and telecommunications, all to be designed and fabricated on a single chip as opposed to larger subsystem "black boxes". Funding is also included, within the Space Science Supporting Research and Technology program, beginning in FY 1998, to undertake an aggressive technology development effort to enable new missions to the outer planets, and to search for Earth-like planets around nearby stars. New technologies are also being pursued to enhance our capability to explore our own Solar System robotically, and perhaps to confirm the past or

current presence of life on other planets or their moons.

Funding is included in FY 1997 to complete final definition and preliminary design of the Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics (TIMED) mission and to initiate hardware development; funding is included in FY 1998 to continue hardware development toward a targeted launch date in January 2000.

Funding is also included for the continued development of the Gravity Probe-B mission and for Explorer missions, which conduct investigations of an exploratory or survey nature, as well as for a number of instruments and payloads to be used on international satellites or on Spacelab missions. In Explorers, the Fast Auroral Snapshot (FAST) mission was launched in August 1996. Development activities continue on the Advanced Composition Explorer (ACE) for launch in 1997 and on the Far Ultraviolet Spectroscopy Explorer (FUSE) for launch in 1998. Selection of a prime contractor to develop and operate the Stratospheric Observatory for Infrared Astronomy (SOFIA) was made in early FY 1997. SOFIA is a cooperative program with Germany that will replace the retired Kuiper Airborne Observatory. (KAO). Together with data from the Hubble Space Telscope (HST) and the SIRTF, these programs will launch a new era in infrared astronomy.

Results from the refurbished HST continued to dominate the world of astronomy through 1996. The results from Hubble continue to touch on some of the most fundamental astronomical questions of the 20th century, including the existence of black holes, the age of the universe and the formation of planets around stars. Funding for the science data management, archiving, and science networking is continued. Funding is included to support ongoing servicing support and new instrument development for the HST. The HST Imaging Spectrograph (STIS) and Near Infrared Camera and Multi-object Spectrometer (NICMOS) are being developed for the second servicing mission, scheduled for flight in 1997. Funding is included to continue development of the Advanced Camera for flight in 1999.

Results from initial data received from the Galileo mission to Jupiter are challenging scientists to reexamine long-held theories on the environment of this largest planet in our solar system and providing startling new details concerning Jupiter's moons. Galileo's atmospheric probe was released in July 1995 and successfully entered Jupiter's atmosphere shortly before Galileo was successfully inserted into Jupiter orbit December 7, 1995. The Orbiter is partially through its 23 month study of the Jovian system, and will orbit the giant planet 11 times. Galileo completed the return of the probe data as well as new science and images from Jupiter and encounters with the four Galilean satellites, Io, Ganymede, Europa and Callisot in 1996. Among the most important discoveries are:

- the intrinsic magnetic field and probable iron core of Io;
- the intrinsic magnetic field of Ganymede
- the lack of an intrinsic magnetic field on Callisto; and,

- evidence that Callisto's interior is undifferentiated.

In situ measurements during the Galileo probe's descent into Jupiter's atmosphere in December 1995 produced a wealth of results. The most significant are that there is much less water vapor than expected, and that winds persist much deeper into the atmosphere than expected. Galileo has also provided images of Europa that indicate the possibility of liquid water on that moon. Additional information on Europa will be provided in the data from the December 1996 Galileo fly-by, the closest encounter to date with Europa. Funding to continue mission operations and data analysis activities is included.

Life and Microgravity Sciences and Applications

The Life and Microgravity Sciences and Applications program uses the space environment to understand the response of biological and materials systems to weightlessness. Six Shuttle missions involving materials and life sciences experiments were conducted in 1996, includeing two Spacelab missions and three NASA/MIR missions. In addition to conducting basic and applied research, these missions have provided the opportunity to refine the definition, design, and development of experiment hardware planned for use on the International Space Station. These research activities will continue during FY 1997 as U.S. astronauts continue their visits to the Mir. Three joint Russian/U.S. flights were conducted in FY 1996, and three flights are planned for FY 1997. In addition to the Mir missions, the Materials Sciences Laboratory (MSL-1) mission is planned. In 1998, the NASA/NIH Neurolab mission is planned, which will continue the agency's efforts to expand its collaborative activities with the National Institutes of Health and other federal agencies to maximize the return on science investments. Funding for development of the International Space Station payloads is included in the Human Space Flight appropriation beginning in FY 1998.

Mission to Planet Earth

The Mission to Planet Earth (MTPE) program seeks to improve the scientific understanding of the Earth system, including the mechanisms that drive the climate and ecology of Earth, and how human activity is affecting the environment. NASA's base program combines ground-based measurements , laboratory studies, data analysis and model development with a progressive series of satellite missions to study cloud climatology, Earth radiation budget, ozone levels, atmospheric chemistry, changes in land cover and ocean circulation. This is just a first step. The capability to model and predict the consequences of global change is the ultimate objective.

The ongoing Mission to Planet Earth program is making critical near-term contributions to understanding the Earth as an integrated system as well as environmental issues, such as global warming and ozone depletion. Data from satellites and instruments in orbit, such as Total Ozone Mapping Spectrometer (TOMS), the NASA Scatterometer on the Japanese

Advanced Earth Observing System, the Upper Atmospheric Research Satellite (UARS) and Ocean Topography Experiment (TOPEX)/Poseidon, and the Earth Radiation Budget Experiment (ERBE) are being used in multidisciplinary studies focused on understanding various aspects of the global environment.

The Earth Observing System (EOS) is a key element in the Administration's U.S. Global Change Research Program, and NASA's major contribution to this effort. The EOS is a series of spacecrafts designed to provide long-term data sets for use in modeling and understanding global processes. The Earth Probes provide data in specialized areas, such as tropical rainfall, ocean wind speed and direction, and global ozone concentrations. The EOS Data Information System (EOSDIS) will provide the processing, storage, and distribution of the EOS science data and resulting scientific products. Funding for the continued development of the Landsat-7 spacecraft, instruments and ground system is included. Landsat-7 is scheduled to launch in 1998. After launch and check out, the National Oceanic and Atmospheric Administration (NOAA) will be responsible for Landsat-7 operations.

Funding requested for FY 1997 and FY 1998 supports the continued development of the EOS program, including a robust science program. The first EOS satellites, Landsat-7 and EOS AM-1, will be launched in 1998. Preceeding launch of the EOS satellites, a number of individual satellite and Shuttle based missions are helping to reveal basic processes. Complementing EOS will be a series of small, rapid development Earth System Science Pathfinders missions, and an aggressive technology development program to provide for the infusion of innovative new technologies into the second and third series of EOS measurements. Funding is also included to initiate a data purchase program designed to acquire from private sources data sets that are necessary to accomplish broad research goals of Earth system science. Funding is also included to support three initiatives which will further contribute to a robust science program and to technology infusion. These initiatives include: an uncrewed aerial vehicle-based scientific research program to make detailed temporal changes by staying over a target area for extended periods of time; an instrument incubator for enabling rapid deployment of new, less costly and less resource-intensive scientific instruments; and, an initiative for concept/technology studies of the application of the latest technology to the development of small, compact, geostationary satellites to reduce operations costs.

Aeronautics and Space Transportation Technology

The Aeronautics and Space Transportation Technology program provides high payoff, critical technologies with effective transfer of design tools and technology products to industry and government. A new Headquarters program office was established in FY 1997 to reflect the incorporation of the Advanced Space Transportation and Commercial Programs activities into the Office of Aeronautics, following the dissolution of the Office of Space Access and Technology in 1996.

The Aeronautics program provides a broad foundation of advanced technology to strengthen the United States' leadership in aviation, an industry which plays a vital role in the economic strength, transportation infrastructure and national defense of the United States. The NASA Aeronautics program provides the nation with leadership in high payoff critical technologies which are transferred to industry, the Department of Defense, and the Federal Aviation Administration for application to safe, superior and environmentally compatible U.S. civil and military aircraft, and for a safe and efficient National Aviation System. NASA's unique research capabilities contribute to the strengthening of America's aviation industry in many ways, and the FY 1998 program continues important investments required to pursue the high leverage technologies required to support both the subsonic and high-speed civil transport economic viability. The Advanced Subsonic Transport (AST) program continues to make substantial progress in the development of high-risk, high-payoff technologies for a new generation of environmentally compatible, economic subsonic aircraft and a safe, highly productive global air transportation system. The AST program is refocused to emphasize technologies which will signficantly enhance the safety of the aviation system, improve the environment through noise and emissions reductions, and increase the capacity for a highly productive global air transportation system. Funding is included to continue development of high payoff technologies enabling a safe, highly productive global air transportation system with reduced environmental impact. Phase II of the High Speed Research program, begun in FY 1994, is directed at developing and verifying, in cooperation with U.S. industry, the high leverage technologies essential for economic viability in addition to environmental compatibility. A preliminary conceptual definition of a supersonic transport technology configuration was selected and efforts to develop these technologies continue. NASA is an active participant in the High Performance Computing and Communications (HPCC) program, and has pioneered the application of design and simulation software on parallel machines and developed the most widely accepted performance evaluation/tuning software for applications on parallel machines. Research activities conducted within the Research and Technology Base provide a foundation for longer-term technology development for application by industry and are organized around customer-driven discipline areas. As part of the HPCC program, the President's FY 1998 budget proposes $100 million each year for the next three years to support a new Next Generation Internet initiative whose goal is to develop a research network capable of achieving speeds of 100 to 1,000 times faster than today's Internet and large gains in the quality of service. This initiative will involve several Federal agencies including Defense, National Science Foundation, Energy, Commerce, and NASA. NASA's contribution to this effort is $10 million.

The Space Transportation Technology program leads NASA's efforts to develop advanced space technologies critical to the economic, scientific, and technological competitiveness of the U.S. New technologies critical to revitalizing access to space have been targeted for their potential to reduce launch costs dramatically over the next decade, and increase safety and the reliability of current and future generation launch vehicles. In 1996, the Reuseable Launch Vehicle program continued to pursue technology development and concept definition activities

in support of next generation reusable systems, focusing on the X-34 and X-33 flight demonstrators. In 1996, the Administration approved the decision to proceed with Phase II of the X-33 program. Funding is included to continue technology development in preparation for flight of the technology demonstrators. Funding is also included to continue the Advanced Space Transportation Program (ASTP), to develop key technologies to dramatically reduce space transportation costs across the mission spectrum. The ASTP program will focus on technological advances with the potential of reducing launch costs beyond RLV goals, as well as supporting technology development required to support NASA strategic needs not addressed by RLV.

Funding for the Commercial Technology Program is continued, to support development of commercial partnerships with industry. In FY 1997 and FY 1998, emphasis will be on increasing commercial partnerships with industry and continued refinement of a technology and partnership database.

Academic Programs

Science and mathematics achievement is an integral element of the National Education Goals, and NASA's efforts in the education arena strongly support making U.S. students first in the world in science and mathematics achievement by the year 2000. NASA's programs at the pre-college, college and graduate levels use NASA's unique mission and results to capture and channel student interest in science, mathematics and technology, as well as enhance teacher and faculty knowledge and skills related to these subjects. At the undergraduate and graduate level, programs are geared to providing opportunities for students and faculty to participate in NASA-sponsored research activities at NASA field centers.

NASA has made a commitment to playing a leadership role in strengthening the capabilities of minority universities and to increasing opportunities for students at Historically Black Colleges and Universities and Other Minority Universities, primarily Hispanic-serving institutions and Tribal Colleges, to participate in and benefit from NASA's research and education programs. The FY 1998 budget request for the Minority University Research program continues this commitment through funding for initiatives which are underway.

Mission Communication Services

Support which is most directly related to NASA's science and aeronautics programs, including ground network support, mission planning for robotics spacecraft programs, suborbital mission support, support to aeronautics test programs, and technology development activities to improve the state of space communications technology, is included in the Science Aeronautics and Technology appropriation.

MISSION SUPPORT

Safety, Reliability, Maintainability and Quality Assurance

NASA is committed to providing leadership in quality management of science and engineering programs. The Office of Safety and Mission Assurance (OSMA) is responsible for the development and implementation of risk management practices and Safety, Reliability, Maintainability and Quality Assurance (SRM&QA) practices into all NASA activities. The funding requested will continue a wide range of activities underway through which SRM&QA practices are integrated into the earliest phases of development for space and aeronautics programs. The Office of the Chief Engineer provides a focus for NASA's engineering discipline, oversees applications, and improves NASA's practices and capabilities through targeted initiatives in the Engineering programmatic area.

Space Communications Services

Funding for the operation, sustainment, and replenishment of NASA's Space Network is in NASA's Mission Support appropriation. This program supports the operation of the Tracking and Data Relay Satellite (TDRS) System, the ground terminals at White Sands, New Mexico, and the NASA Control Center at the Goddard Space Flight Center. Funds for services provided to non-science users of the TDRSS are included under this program. The NASA Communications (NASCOM) system and the Program Support Communications Network (PSCN) are also funded by this appropriation. Planning is underway to consolidate and streamline major support contract services in order to optimize space operations. In FY 1996, as an interim measure, a voluntary contractor partnership between the major incumbents, AlliedSignal Technical Services Corporation and Computer Sciences Corporation was formed. A new contract is required in FY 1998. At that time, transition to a performance-based space operations contract, or possibly, a privatized or commercialized operation will be decided. The FY 1998 budget proposes multi-year appropriations for development and launch of three Tracking and Data Relay satellite (TDRS) replenishment spacecraft. The multi-year funding will support NASA's plans for the TDRS fixed price spacecraft contract with industry.

Research and Program Management

The NASA workforce is the foundation underpinning the successful achievement of NASA's goals. Funding for the salaries, travel support and other personnel expenses for the entire NASA workforce is included. Funding for support activities to the NASA workforce and physical plant is also included in Research and Program Management.

NASA's workforce in the year 2000 will be focused on the crucial research and development that will keep this country even with the incredible pace at which the global economy is

changing. The largest segment of savings resulting from the Zero Base Review is achieved from reductions in planned levels of civil service staffing and support. Current planning supports a civil service workforce of around 18,000 by FY 1999. This workforce will be technically outstanding to meet the challenges of NASA's diverse and highly technical programs, and will be engaged in activities which keep NASA at the forefront of cutting edge technology development.

Construction of Facilities

Funding is included for discrete projects to repair and modernize the basic infrastructure and institutional facilities, the minor repair, rehabilitation and modification of existing facilities, minor new construction projects, environmental compliance and restoration activities, the design of facilities projects, and the advanced planning related to future facilities needs.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1998 ESTIMATES

(IN MILLIONS OF REAL YEAR DOLLARS)

BUDGET PLAN (Thousands of Dollars)	FY 1996	FY 1997	FY 1998
HUMAN SPACE FLIGHT	**5,710.4**	**5,674.8**	**5,326.5**
SPACE STATION	2,143.6	2,148.6	2,121.3
US/RUSSIAN COOPERATION	100.0	100.0	--
SPACE SHUTTLE	3,143.8	3,150.9	2,977.8
PAYLOAD AND UTILIZATION OPERATIONS	323.0	275.3	227.4
SCIENCE, AERONAUTICS AND TECHNOLOGY	**5,670.4**	**5,453.1**	**5,642.0**
SPACE SCIENCE	2,175.9	1,969.3	2,043.8
LIFE AND MICROGRAVITY SCIENCES AND APPLICATIONS	304.2	243.7	214.2
MISSION TO PLANET EARTH	1,360.8	1,361.6	1,417.3
AERONAUTICS AND SPACE TRANSPORTATION TECHNOLOGY	1,270.1	1,339.5	1,469.5
MISSION COMMUNICATION SERVICES	449.5	418.6	400.8
ACADEMIC PROGRAMS	109.9	120.4	96.4
MISSION SUPPORT	**2,487.3**	**2,564.3**	**2,513.2**
SAFETY, RELIABILITY AND QUALITY ASSURANCE	39.0	38.8	37.8
SPACE COMMUNICATION SERVICES	255.4	277.7	245.7
RESEARCH AND PROGRAM MANAGEMENT	2,047.9	2,092.5	2,070.3
CONSTRUCTION OF FACILITIES	145.0	155.3	159.4
INSPECTOR GENERAL	**15.9**	**17.0**	**18.3**
TOTAL BUDGET AUTHORITY	**13,884.0**	**13,709.2**	**13,500.0**
TOTAL OUTLAYS	**13,881.0**	**13,697.0**	**13,594.0**

FISCAL YEAR 1998 ESTIMATES

SUMMARY RECONCILIATION OF APPROPRIATIONS TO BUDGET PLANS

(IN MILLIONS OF REAL YEAR DOLLARS)

	TOTAL	Human Space Flight	Science, Aeronautics & Technology	Mission Support	Inspector General
FISCAL YEAR 1996	**13,884.6**	**5,456.6**	**5,928.9**	**2,483.1**	**16.0**
FY 1996 OMNIBUS APPROPRIATIONS ACT (P.L. 104-134) APPROPRIATIONS TRANSFER AUTHORITY	**0.0**	50.0	-50.0	--	--
LAPSE OF FY 1996 UNOBLIGATED FUNDS	**-0.6**	--	--	-0.5	-0.1
TOTAL FY 1996 BUDGET PLAN	**13,884.0**	**5,506.6**	**5,878.9**	**2,482.6**	**15.9**
FISCAL YEAR 1997					
VA-HUD INDEPENDENT AGENCIES APPROPRIATIONS ACT, FY 1997 (P.L. 104-204)	**13,704.2**	**5,362.9**	**5,762.1**	**2,562.2**	**17.0**
OMNIBUS CONSOLIDATED APPROPRIATIONS ACT (P.L. 104-208)	**5.0**	--	--	5.0	--
VA-HUD INDEPENDENT AGENCIES APPROPRIATIONS ACT, FY 1997 (P.L. 104-204) APPROPRIATIONS TRANSFER AUTHORITY	**0.0**	--	177.0	-177.0	--
TOTAL FY 1997 BUDGET PLAN	**13,709.2**	**5,539.9**	**5,590.1**	**2,562.2**	**17.0**

NATIONAL AERONAUTICS AND SPACE AD

FISCAL YEAR 1988 ESTIMATE

DISTRIBUTION OF PROGRAM BY INST
(Thousands of Dollars)

	Total			Human Space Flight			Sci
	1996	1997	1998	1996	1997	1998	199
Johnson Space Center	3,548,062	3,535,168	3,380,330	3,073,329	3,094,300	2,966,000	103,9
Kennedy Space Center	1,214,942	1,189,989	1,176,330	935,249	921,100	904,300	28,3
Marshall Space Flight Center	2,465,676	2,565,991	2,343,615	1,502,684	1,519,200	1,306,900	609,8
Stennis Space Center	161,662	170,064	119,100	53,300	42,200	35,300	69,
Ames Research Center	590,740	522,871	563,649	26,296	19,900	27,300	390,
Dryden Flight Research Center	136,164	168,379	181,874	5,600	5,400	5,900	86,
Langley Research Center	607,805	636,827	648,320	5,167	9,300	4,900	390,
Lewis Research Center	694,425	621,540	671,501	44,136	18,100	26,600	428,

Goddard Space Flight Center	2,511,355	2,723,809	2,763,979	10,365	7,400	7,600	1,975,
Jet Propulsion Laboratory	1,069,945	1,002,499	1,045,110	2,600	200	2,800	1,037,
Headquarters	848,893	531,163	560,192	51,674	37,700	38,900	550,
Undistributed:							
Construction of Facilities:							
Various locations	18,470	23,900	27,700	--	--	--	
Inspector General	15,863	17,000	18,300	--	--	--	
TOTAL NASA	13,884,002	13,709,200	13,500,000	5,710,400	5,674,800	5,326,500	5,670,

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PROPOSED APPROPRIATION LANGUAGE

ADMINISTRATIVE PROVISIONS

[INCLUDING TRANSFER OF FUNDS]

Notwithstanding the limitation on the availability of funds appropriated for "Human space flight", "Science, aeronautics and technology", or "Mission support" by this appropriations Act, when [(1)] any activity has been initiated by the incurrence of obligations for construction of facilities as authorized by law, [or (2) amounts are provided for full-funding for the Tracking and Data Relay Satellite (TDRS) replenishment program.] such amount available for such activity shall remain available until expended. This provision does not apply to the amounts appropriated in "Mission support" pursuant to the authorization for repair, rehabilitation and modification of facilities, minor construction of new facilities and additions to existing facilities, and facility

Notwithstanding the limitation on the availability of funds appropriated for "Human space flight", "Science, aeronautics and technology", or "Mission support" by this appropriations Act, the amounts appropriated for construction of facilities shall remain available until September 30, [1999] 2000.

Notwithstanding the limitation on the availability of funds appropriated for "Mission support" and "Office of Inspector General", amounts made available by this Act for personnel and related costs and travel expenses of the National Aeronautics and Space Administration shall remain available until September 30, [1997] 1998 and may be used to enter into contracts for training, investigations, cost associated with personnel relocation, and for other services, to be provided during the next fiscal year.

[Upon the determination by the Administrator that such action is necessary, the Administrator may, with the approval of the Office of Management and Budget, transfer not to exceed $177,000,000 of funds made available in this Act to the National Aeronautics and Space Administration for the International Space Station between "Science, aeronautics and technology" and "Human space flight", to be merged with and to be available for the same purposes, and for the same time period, as the appropriation to which transferred; Provided, That such authority may not be used unless for higher priority items than those for which originally appropriated; Provided further, That the Administrator of the National Aeronautics and Space Administration shall notify the Congress promptly of all transfers made pursuant to this authority.] (Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1997.)