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Foreword

POCKET STATISTICS is published for the use of NASA managers and their staff. Included is Administrative and Organizational information, summaries of Space Flight Activity including the NASA Major Launch Record, and NASA Procurement, Financial and Manpower data.

The NASA Major Launch Record includes all launches of Scout class and larger vehicles. Vehicle and spacecraft development flights are also included in the Major Launch Record. Shuttle missions are counted as one launch and one payload, where free flying payloads are not involved. Satellites deployed from the cargo bay of the Shuttle and placed in a separate orbit or trajectory are counted as an additional payload.

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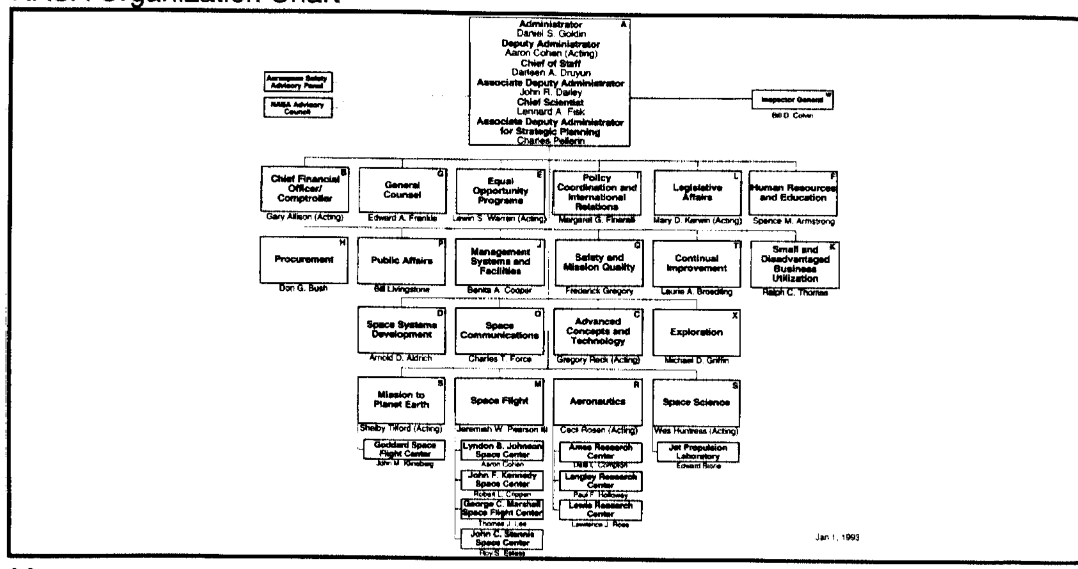
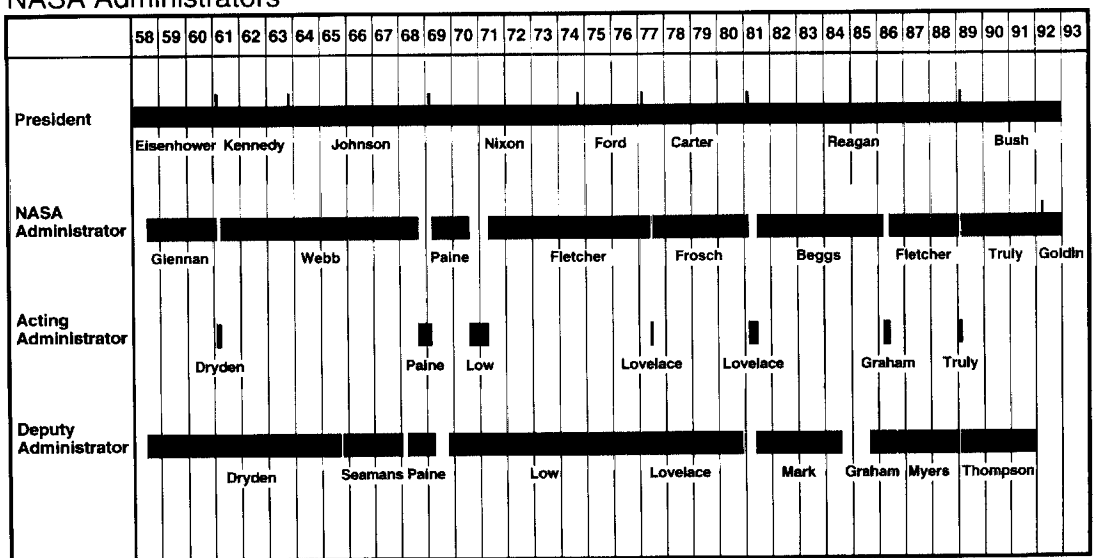


NASA Administrators



Excerpts From The National Aeronautics And Space Act Of 1958, As Amended

AN ACT To provide for research into problems of flight within and outside the Earth's atmosphere, and for other purposes.

Declaration Of Policy And Purpose

Sec. 102 (a) The Congress hereby declares that it is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind.

(b) The Congress declares that the general welfare and security of the United States require that adequate provision be made for aeronautical and space activities. The Congress further declares that such activities shall be the responsibility of, and shall be directed by, a civilian agency exercising control over aeronautical and space activities sponsored by the United States, except that activities peculiar to or primarily associated with the development of weapons systems, military operations, or the defense of the United States (including the research and development necessary to make effective provision for the defense of the United States) shall be the responsibility of, and shall be directed by, the Department of Defense; and that determination as to which such agency has responsibility for and direction of any such activity shall be made by the President in conformity with section 201(e).

(c) The Congress declares that the general welfare of the United States requires that the National Aeronautics and Space Administration (as established by title II of this act) seek and encourage to the maximum extent possible the fullest commercial use of space.

(d) The aeronautical and space activities of the United States shall be conducted so as to contribute materially to one or more of the following objectives:

(1) The expansion of human knowledge of phenomena in the atmosphere and space;

(2) The improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles;

(3) The development and operation of vehicles capable of carrying instruments, equipment, supplies, and living organisms through space;

(4) 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;

(5) 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;

(6) The making available to agencies directly concerned with national defense of discoveries that have military value or significance, and the furnishing by 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;

Excerpts From The National Aeronautics And Space Act Of 1958, As Amended

Declaration Of Policy And Purpose (Continued)

(7) Cooperation by 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; and

(8) 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.

(e) The Congress declares that the general welfare of the United States requires that the unique competence in scientific and engineering systems of the National Aeronautics and Space Administration also be directed toward ground propulsion systems research and development.

(f) The Congress declares that the general welfare of the United States requires that the unique competence in scientific and engineering systems of the National Aeronautics and Space Administration also be directed toward the development of advanced automobile propulsion systems.

(g) The Congress declares that the general welfare of the United States requires that the unique competence in scientific and engineering systems of the National Aeronautics and Space Administration also be directed to assisting in bioengineering research, development, and demonstration programs designed to alleviate and minimize the effects of disability.

Functions Of The Administration

Sec. 203 (a) The Administration, in order to carry out the purpose of this Act, shall --

(1) plan, direct, and conduct aeronautical and space activities;

(2) arrange for participation by the scientific community in planning scientific measurements and observations to be made through use of aeronautical and space vehicles, and conduct or arrange for the conduct of such measurements and observations; and

(3) provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof.

(b) (1) The Administration shall, to the extent of appropriated funds, initiate, support, and carry out such research, development, demonstration, and other related activities in ground propulsion technologies.

(2) The Administration shall initiate, support, and carry out such research, development, demonstration, and other related activities in solar heating and cooling technologies (to the extent that funds are appropriated therefor).

National Space Policy

On November 2, 1989, the President approved a national space policy that updates and reaffirms U.S. goals and activities in space. The policy is the result of a review undertaken by the National Space Council. The revisions clarify, strengthen, and streamline selected aspects of the policy. Areas affected include civil and commercial remote sensing, space transportation, space debris, federal subsidies of commercial space activities, and Space Station Freedom.

Overall, the President's national space policy revalidates the ongoing direction of U.S. space efforts and provides a broad policy framework to guide future U.S. space activities.

The policy reaffirms the nation's commitment to the exploration and use of space in support of our national well being. United States leadership in space continues to be a fundamental objective guiding U.S. space activities. The policy recognizes that leadership requires United States preeminence in key areas of space activity critical to achieving our national security, scientific, technical, economic, and foreign policy goals. The policy also retains the long-term goal of expanding human presence and activity beyond Earth orbit into the Solar System. This goal provides the overall policy framework for the President's human space exploration initiative, announced July 20, 1989, in which the President called for completing Space Station Freedom, returning permanently to the Moon, and exploration of the planet Mars.

INTRODUCTION

United States space activities are conducted by three separate and distinct sectors: two strongly interacting governmental sectors (Civil and National Security) and a separate, non-governmental Commercial Sector. Close coordination, cooperation, and technology and information exchange will be maintained among these sectors to avoid unnecessary duplication and promote attainment of United States space goals.

GOALS AND PRINCIPLES

A fundamental objective guiding United States space activities has been, and continues to be, space leadership. Leadership in an increasingly competitive international environment, does not require United States preeminence in all areas and disciplines of space enterprise. It does require United States preeminence in the key areas of space activity critical to achieving our national security, scientific, technical, economic, and foreign policy goals.

- The overall goals of United States space activities are: (1) to strengthen the security of the United States; (2) to obtain scientific, technological and economic benefits for the general population and to improve the quality of life on Earth through space-related activities; (3) to encourage continuing United States private-sector investment in space and related activities; (4) to promote international cooperative activities taking into account United States national security, foreign policy, scientific, and economic interests; (5) to cooperate with other nations in maintaining the freedom of space for all activities that enhance the security and welfare of mankind; and, as a long-range goal, (6) to expand human presence and activity beyond Earth orbit into the solar system.

- The United States space activities shall be conducted in accordance with the following principles:

  - The United States is committed to the exploration and use of outer space by all nations for peaceful purposes and for the benefit of all mankind. "Peaceful purposes" allow for activities in pursuit of national security goals.

  - The United States will pursue activities in space in support of its inherent right of self-defense and its defense commitments to its allies.

National Space Policy

- The United States rejects any claims to sovereignty by any nation over outer space or celestial bodies, or any portion thereof, and rejects any limitations on the fundamental right of sovereign nations to acquire data from space.

- The United States considers the space systems of any nation to be national property with the right of passage through and operations in space without interference. Purposeful interference with space systems shall be viewed as an infringement on sovereign rights.

- The United States shall encourage and not preclude the commercial use and exploitation of space technologies and systems for national economic benefit. These commercial activities must be consistent with national security interests, and international and domestic legal obligations.

- The United States will, as a matter of policy, pursue its commercial space objectives without the use of direct Federal subsidies.

- The United States shall encourage other countries to engage in free and fair trade in commercial space goods and services.

- The United States will conduct international cooperative space-related activities that are expected to achieve sufficient scientific, political, economic, or national security benefits for the nation. The United States will seek mutually beneficial international participation in space and space-related programs.

CIVIL SPACE POLICY

- The United States civil space sector activities shall contribute significantly to enhancing the Nation's science, technology, economy, pride, sense of well-being and direction, as well as United States world prestige and leadership. Civil sector activities shall comprise a balanced strategy of research, development, operations, and technology for science, exploration, and appropriate applications.

- The objectives of the United States civil space activities shall be (1) to expand knowledge of the Earth, its environment, the solar system, and the universe; (2) to create new opportunities for use of the space environment through the conduct of appropriate research and experimentation in advanced technology and systems; (3) to develop space technology for civil applications and, wherever appropriate, make such technology available to the commercial sector; (4) to preserve the United States preeminence in critical aspects of space science, applications, technology, and manned space flight; (5) to establish a permanently manned presence in space; and (6) to engage in international cooperative efforts that further United States overall space goals.

COMMERCIAL SPACE POLICY

The United States government shall not preclude or deter the continuing development of a separate non-governmental Commercial Space Sector. Expanding private sector investment in space by the market-driven Commercial Sector generates economic benefits for the Nation and supports governmental Space Sectors with an increasing range of space goods and services. Governmental Space Sectors shall purchase commercially available space goods and services to the fullest extent feasible and shall not conduct activities with potential commercial applications that preclude or deter Commercial Sector space activities except for national security or public safety reasons. Commercial Sector space activities shall be supervised or regulated only to the extent required by law, national security, international obligations, and public safety.

NATIONAL SECURITY SPACE POLICY

The United States will conduct those activities in space that are necessary to national defense. Space activities will contribute to national security objectives by (1) deterring, or if necessary, defending against enemy attack; (2) assuring that forces of hostile nations cannot prevent our own use of space; (3) negating, if necessary, hostile space systems; and (4) enhancing operations of United States and Allied forces. Consistent with treaty obligations, the national security space program shall support such functions as command and control, communications, navigation, environmental monitoring, warning, surveillance, and force application (including research and development programs which support these functions).

INTER-SECTOR POLICIES

This section contains policies applicable to, and binding on, the national security and civil space sectors.

- The United States Government will maintain and coordinate separate national security and civil operational space systems where differing needs of the sectors dictate.

- Survivability and endurance of national security space systems, including all necessary system elements, will be pursued commensurate with the planned use in crisis and conflict, with the threat, and with the availability of other assets to perform the mission.

- Government sectors shall encourage to the maximum extent feasible, the development and use of United States private sector space capabilities.

- A continuing capability to remotely sense the Earth from space is important to the achievement of United States space goals. To ensure that the necessary capability exists, the United States government will: (a) ensure the continuity of LANDSAT-type remote sensing data; (b) discuss remote sensing issues and activities with foreign governments operating or regulating the private operation of remote sensing systems; (c) continue government research and development for future advanced remote sensing technologies or systems; and (d) encourage the development of commercial systems, which image the Earth from space, competitive with, or superior to, foreign-operated civil or commercial systems.

- Assured access to space, sufficient to achieve all United States space goals, is a key element of national space policy. United States space transportation systems must provide a balanced, robust, and flexible capability with sufficient resiliency to allow continued operations despite failures in any single system. The United States government will continue research and development on component technologies in support of future transportation systems. The goals of United States space transportation policy are: (1) to achieve and maintain safe and reliable access to, transportation in, and return from, space; (2) to exploit the unique attributes of manned and unmanned launch and recovery systems; (3) to encourage to the maximum extent feasible, the development and use of United States private sector space transportation capabilities; and (4) to reduce the costs of space transportation and related services.

- Communications advancements are critical to all United States space sectors. To ensure necessary capabilities exist, the United States government will continue research and development efforts for future advanced space communications technologies.

- The United States will consider and, as appropriate, formulate policy positions on arms control measures governing activities in space, and will conclude agreements on such measures only if they are equitable, effectively verifiable, and enhance the security of the United States and our allies.

- All space sectors will seek to minimize the creation of space debris. Design and operations of space tests, experiments, and systems will strive to minimize or reduce accumulation of space debris consistent with mission requirements and cost effectiveness. The United States government will encourage other space-faring nations to adopt policies and practices aimed at debris minimization.

IMPLEMENTING PROCEDURES

Normal interagency procedures will be employed wherever possible to coordinate the policies enunciated in this directive.

Executive Order No 12675 established the National Space Council to provide a coordinated process for developing a national space policy and strategy and for monitoring its implementation.

The Vice President serves as the Chairman of the Council, and as the President's principal advisor on national space policy and strategy. Other members of the Council are the Secretaries of State, Treasury, Defense, Commerce, and Transportation; the Chief of Staff to the President, the Director of the Office of Management and Budget, the Assistant to the President for Science and Technology, the Director of Central Intelligence, and the Administrator of the National Aeronautics and Space Administration. The Chairman, from time to time, invites the Chairman of the Joint Chiefs of Staff, the heads of executive agencies, and other senior officials to participate in meetings of the Council.

NATIONAL SPACE LAUNCH STRATEGY

The National Space Launch Strategy is composed of four elements.

- Ensuring that existing space launch capabilities, including support facilities, are sufficient to meet U.S. Government manned and unmanned space launch needs.

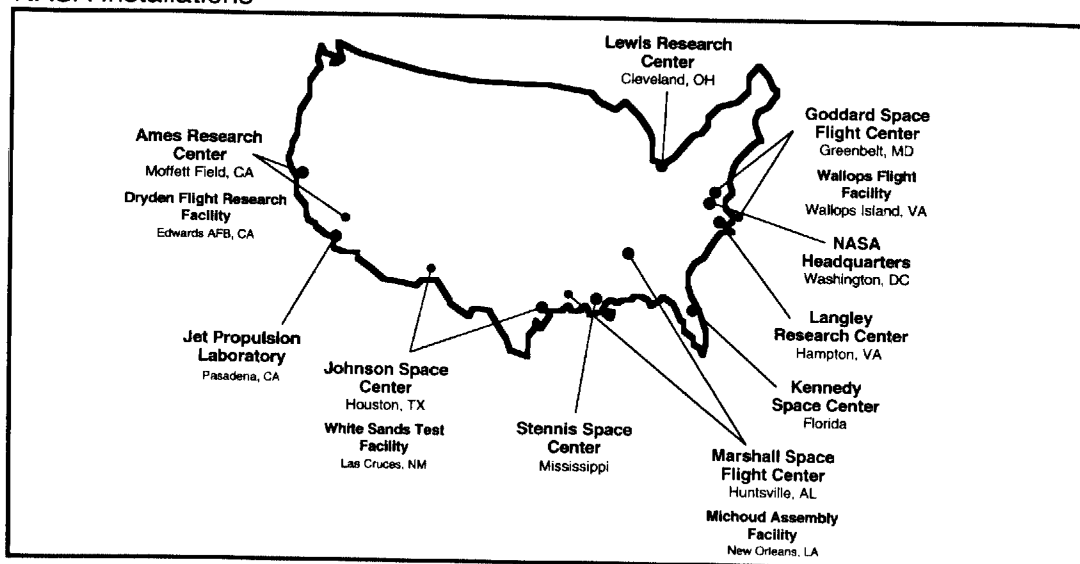
- Developing a new unmanned, but man-rateable, space launch system to greatly improve national launch capability with reductions in operating costs and improvements in launch system reliability, responsiveness, and mission performance.

- Sustaining a vigorous space launch technology program to provide cost effective improvements to current launch systems, and to support development of advanced launch capabilities, complementary to the new launch system.

- Actively considering commercial space launch needs and factoring them into decisions on improvements in launch facilities and launch vehicles.

These strategy elements will be implemented within the overall resource and policy guidance provided by the President.

NASA Installations



NASA HEADQUARTERS
Washington, DC 20546

NASA Headquarters exercises management over the space flight centers, research centers, and other installations that constitute the National Aeronautics and Space Administration.

Responsibilities of Headquarters cover the determination of programs and projects; establishment of management policies; procedures and performance criteria; evaluation of progress; and the review and analysis of all phases of the aerospace program.

Planning, direction, and management of NASA's research and development programs are the responsibility of the program offices which report to and receive overall guidance and direction from an associate or assistant administrator.

AMES RESEARCH CENTER
Moffett Field, CA 94035

Ames Research Center was founded in 1939 as an aircraft research laboratory by the National Advisory Committee for Aeronautics (NACA) and was named for Dr. Joseph S. Ames, Chairman of NACA from 1927 to 1939. In 1958, Ames became part of NASA, along with other NACA installations and certain Department of Defense facilities. In 1981, NASA merged Ames with the Dryden Flight Research Facility.

Ames specializes in scientific research, exploration and applications aimed toward creating new technology for the nation.

The center's major program responsibilities are concentrated in computer science and applications, computational and experimental aerodynamics, flight simulation, flight research, hypersonic aircraft, rotorcraft and powered-lift technology, aeronautical and space human factors, life sciences, space sciences, solar system exploration, airborne science and applications, and infrared astronomy.

HUGH L. DRYDEN FLIGHT RESEARCH FACILITY
Edwards, CA 93523

Since 1947, Ames-Dryden has developed a unique and highly specialized capability for conducting flight research programs. Its test organization, consisting of pilots, scientists, engineers, technicians and mechanics, is unmatched anywhere in the world. This versatile organization has demonstrated its capability, not only with high-speed research aircraft, but also with such unusual flight vehicles as the Lunar Landing Research Vehicle and the wingless lifting bodies.

The facility's primary research tools are research aircraft, ranging from a B-52 carrier aircraft and high performance jet fighters to the X-29 forward swept wing aircraft. Ground-based facilities include a high temperature loads calibration laboratory that allows ground-based testing of complete aircraft and structural components under the combined effects of loads and heat; a highly developed aircraft flight instrumentation capability; a flight systems laboratory with a diversified capability for avionics system fabrication, development and operations; a flow visualization facility that allows basic flow mechanics to be seen of models or small components; a data analysis facility for processing of flight research data; a remotely piloted research vehicles facility and a test range communications and data transmission capability that links NASA's Western Aeronautical Test Range facilities at Ames-Moffett, Crows Landing and Ames-Dryden.

NASA Installations

GODDARD SPACE FLIGHT CENTER
Greenbelt, MD 20771

This NASA field center has put together a multitalented spaceflight team -- engineers, scientists, technicians, project managers and support personnel -- which is extending the horizons of human knowledge not only about the solar system and the universe but also about our Earth and its environment.

The Goddard mission is being accomplished through scientific research centered in six space and Earth science laboratories and in the management, development and operation of several near-Earth space systems.

After being launched into space, satellites fall under the 24-hour-a-day surveillance of a worldwide ground and spaceborne communications network, the nerve center of which is located at Goddard. One of the key elements of that network is the Tracking and Data Relay Satellite System (TDRSS) with its orbiting Tracking and Data Relay Satellite and associated ground tracking stations.

Goddard's tracking responsibility extends to its Wallops Flight Facility. Wallops prepares, assembles, launches, and tracks satellites and suborbital space vehicles and manages the National Scientific Balloon Facility in Palestine, Texas.

JET PROPULSION LABORATORY
Pasadena, CA 91109

NASA's Jet Propulsion Laboratory (JPL) is a government-owned facility staffed by the California Institute of Technology. JPL operates under a NASA contract administered by the NASA Pasadena Office. In addition to the Pasadena site, JPL operates the Deep Space Communications Complex, a station of the worldwide Deep Space Network (DSN).

The laboratory is engaged in activities associated with deep space automated scientific missions -- engineering subsystem and instrument development, and data reduction and analysis required by deep space flight.

The laboratory also designs and tests flight systems, including complete spacecraft, and provides technical direction to contractor organizations.

LYNDON B. JOHNSON SPACE CENTER
Houston, TX 77058

Johnson Space Center was established in September 1961 as NASA's primary center for design, development and testing of spacecraft and associated systems for manned flight; selection and training of astronauts; planning and conducting manned missions; and extensive participation in the medical engineering and scientific experiments carried aboard space flights.

Johnson has program management responsibility for the Space Shuttle program, the nation's current manned space flight program. Johnson also has a major responsibility for the development of the Space Station, a permanently manned, Earth-orbiting facility to be constructed in space and operable within a decade. The center will be responsible for the interfaces between the Space Station and the Space Shuttle.

JOHN F. KENNEDY SPACE CENTER
Kennedy Space Center, FL 32899

Kennedy Space Center (KSC) was created in the early 1960's to serve as the launch site for the Apollo lunar landing missions. After the Apollo program ended in 1972, Kennedy's Complex 39 was used for the launch of the Skylab spacecraft, and later, the Apollo spacecraft for the Apollo Soyuz Test Project.

Kennedy Space Center serves as the primary center within NASA for the test, checkout and launch of payloads and space vehicles. This presently includes launch of manned and unmanned vehicles at Kennedy, the adjacent Cape Canaveral Air Force Station, and at Vandenberg Air Force Base in California.

The center is responsible for the assembly, checkout and launch of Space Shuttle vehicles and their payloads, landing operations and the turn-around of Space Shuttle orbiters between missions, as well as preparation and launch of unmanned vehicles.

LANGLEY RESEARCH CENTER
Hampton, VA 23665-5225

Langley's mission is basic research in aeronautics and space technology. Major research fields include aerodynamics, materials, structures, flight controls, information systems, acoustics, aeroelasticity, atmospheric sciences, and nondestructive evaluation. Langley's goal is to develop technologies to enable aircraft to fly faster, farther, safer, and to be more maneuverable, quieter, less expensive to manufacture, and more energy efficient.

The majority of Langley's work is in aeronautics, working to improve today's aircraft and to develop concepts and technology for future aircraft. Over 40 wind tunnels, other unique research facilities, and testing techniques as well as computer modeling capabilities aid in the investigation of the full flight range, from general aviation and transport aircraft through hypersonic vehicles.

Researchers also study atmospheric and Earth sciences, develop technology for advanced space transportation systems, conduct research in laser energy conversion techniques for space applications and provide the focal point for design studies for large space systems technology and Space Station activities.

Langley also manages an extensive program in atmospheric sciences to better understand the origins, chemistry, and transport mechanisms that govern the Earth's atmospheric data using aircraft, balloon, and land- and space-based remote sensing instruments designed, developed, and fabricated at Langley.

LEWIS RESEARCH CENTER
Cleveland, OH 44135

Lewis Research Center was established in 1941 by the National Advisory Committee for Aeronautics (NACA). Named for George W. Lewis, NACA's Director of Research from 1924 to 1947, the center developed an international reputation for its research on jet propulsion systems.

Lewis is NASA's lead center for research, technology and development in aircraft propulsion, space propulsion, space power and satellite communication.

The center has been advancing propulsion technology to enable aircraft to fly faster, farther and higher and also focused its research on fuel economy, noise abatement, reliability, and reduced pollution.

Lewis has responsibility for developing the largest space power system ever designed to provide the electrical power necessary to accommodate the life support systems and research experiments to be conducted aboard the Space Station. In addition, the center will support the Station in other major areas such as auxiliary propulsion systems and communications.

Lewis is the home of the Microgravity Materials Science Laboratory, a unique facility to qualify potential space experiments. Other facilities include a zero-gravity drop tower, wind tunnels, space tanks, chemical rocket thrust stands, and chambers for testing jet engine efficiency and noise.

MARSHALL SPACE FLIGHT CENTER
Marshall Space Flight Center, AL 35812

George C. Marshall Space Flight Center (MSFC) was formed on July 1, 1960, by the transfer to NASA of buildings and personnel comprising part of the U.S. Army Ballistic Missile Agency. Named for the famous soldier and statesman, General of the Army George C. Marshall, it was officially dedicated by President Dwight D. Eisenhower on September 8, 1960.

Marshall is a multiproject management, scientific and engineering establishment, with much emphasis on projects involving scientific investigation and application of space technology to the solution of problems on Earth.

In helping to reach the nation's goals in space, the center is working on many projects. Marshall had a significant role in the development of the Space Shuttle. It provides the orbiter's engines, the external tank that carries liquid hydrogen and liquid oxygen for those engines, and the solid rocket boosters that assist in lifting the Shuttle orbiter from the launch pad.

The center also plays a key role in the development of payloads to be flown aboard the Shuttle. One such payload is Spacelab, a reusable, modular scientific research facility carried in the Shuttle's cargo bay.

Marshall also is committed to the investigation of materials processing in space, which, in a gravity-free environment, promises to provide opportunities for understanding and improving Earth-based processes and for the formulation of space-unique materials. Exciting new techniques in materials processing have already been demonstrated in past Spacelab missions, such as the formation of alloys from normally immiscible products, and the growth of near-perfect large crystals impossible to grow on Earth.

MICHOUD ASSEMBLY FACILITY
New Orleans, LA 70189

The primary mission of the Michoud Assembly Facility is the systems engineering, engineering design, manufacture, fabrication, assembly, and related work for the Space Shuttle external tank. Marshall Space Flight Center exercises overall management control of the facility.

JOHN C. STENNIS SPACE CENTER
Stennis Space Center, MS 39529

The John C. Stennis Space Center (SSC) has grown into NASA's premier center for testing large rocket propulsion systems for the Space Shuttle and future generation space vehicles. Additionally, the center has developed into a scientific community actively engaged in research and development programs involving space, oceans, and the Earth.

The main mission of SSC is support the development testing of large propulsion systems for the Space Shuttle, Advanced Launch System, and the Advanced Solid Rocket Motor programs.

WALLOPS FLIGHT FACILITY
Wallops Island, VA 23337

Established in 1945, Wallops Flight Facility, a part of the Goddard Space Flight Center, is one of the oldest launch sites in the world. Wallops manages and implements NASA's sounding rocket program and the Scientific Balloon Program. The facility operates and maintains the Wallops launch range and data acquisition facilities. Approximately 100 rocket launches are conducted each year from the Wallops Island site.

NASA Management

Daniel S. Goldin became the ninth Administrator of NASA on April 1, 1992, appointed by President Bush to succeed Richard H. Truly. Prior to joining the agency, Goldin was Vice President and General Manager of the TRW Space & Technology Group.

Goldin assumed command at a time of shrinking financial resources caused by the recession, the deficit reduction effort and growing demands in other areas such as education, medical care and housing. Forecasts indicated that NASA would not receive appropriations sufficient to support outyear development of projects initiated prior to the recession.

Goldin initiated a series of efforts to respond to this situation with the goal of preserving essential space exploration and aeronautics research programs despite cost reductions, while permitting the nation to undertake new projects in both areas. Simultaneously, he launched campaigns to reform the agency's procurement process, introduce greater cultural diversity into the workforce and contracting, renew NASA's commitment to quality and stimulate public support for the programs.

"Cheaper, Faster, Better"

Constantly urging NASA employees and contractors alike to do things "cheaper, faster and better," Goldin created blue and red teams to review NASA projects and their organizational settings. The blue teams consisted of persons who would examine their own programs for creative ways to reduce costs without compromising safety or science. The red teams were composed of people unconnected with the programs who might bring fresh insights or insure that none were stifled. This review began in May and has led to significant changes in a number of major projects, with a 17 percent reduction in costs thus far. The process is intended to be ongoing. In a closely related effort, Goldin stressed the adoption of the approaches and tools of Total Quality Management (TQM) which calls for a continuous effort to improve quality, reduce costs and speed production.

A "Shared Vision" of the Future

Soon after the formation of the blue and red teams, Goldin called on NASA employees to submit their ideas for a NASA "shared vision of what we, as a nation, should strive to accomplish in space." Closely coupled with this was a series of well-attended "town meetings" held in cities throughout the country to give the general public the opportunity to state its view about the future of the space program. The goal of these activities was to produce a vision of America's future in space that would be shared and supported by NASA, Congress, the President and executive branch, academia, the space community and the general public.

Another major effort aimed at insuring quality and controlling costs was a series of procurement reforms. Awards would be made on the basis of well demonstrated adherence to quality, cost control and schedule maintenance. Award fees would be determined on the same basis, with opportunity for greater gain by staying on schedule and within estimates. The reforms emphasized opportunities for small and disadvantaged businesses, including culturally diverse businesses.

The Administrator also underscored the need for greater cultural diversity in the agency's workforce, requiring the head of each NASA facility to submit a plan to increase minority hiring. Goldin said he wanted NASA to reflect the nation's "wonderful mosaic of diverse people," and to signal opportunity to young people of all races.

In October, Goldin announced structural changes in the agency's organization to focus greater attention on certain projects critical to the nation's future. Mission to Planet Earth to aid the environment would become an individual office as would planetary science and astrophysics, or Mission From Planet Earth, to explore the solar system and look beyond into the universe.

Concern About America's Aeronautics Industry

Aeronautics and space technology development, which were combined in a single office, were to be separated. Goldin stated that the nation's aeronautics industry was loosing ground to aggressive foreign competitors to such a degree that it was in a crisis. He declared that NASA would place substantially greater emphasis on aeronautics and that this would be the sole responsibility of the Aeronautics Office. Technology was joined to the commercial development function in a "one-stop shopping" concept to serve both NASA and private industry. The goal is to speed the introduction of new technology throughout the space program and to enhance the process of spinoff to American industry which, in the past, has led to thousands of new commercial products and processes.

Goldin maintained an aggressive schedule of speaking throughout the country on a large variety of subjects. Of particular prominence was the effort to explain and win support for a return to the moon and exploration of Mars; to win anew congressional funding for Space Station Freedom; to explain the value of the space program as a national investment to rebuild technological leadership and hone a competitive edge, and to proclaim the need for far greater international cooperation in space to continue the exploration of the universe beyond planet Earth.

In the latter regard, the Administrator represented the nation in signing historic new agreements with the Soviet Union that will expand considerably space cooperation between the two nations. The agreements provide for the exchange of astronauts and cosmonauts on space flights, study of a Russian vehicle for possible emergency crew return from Space Station Freedom, a Shuttle-Mir Space Station link-up, and life sciences and robotic exploration activities.

Space Science

Exploring the Universe

Highlights of 1992 discoveries made by the Hubble Space Telescope (HST), Compton Observatory, Cosmic Background Explorer (COBE), Roentgen Satellite (ROSAT), and Extreme Ultraviolet Explorer (EUVE) are listed below, by astronomical object.

Planets -

- Conducting long-term observations of global weather changes on Mars (HST).
- Measured the extent of the atmosphere of the Jovian moon Io and looked for surface changes (HST).

Stellar Evolution -

- Provided the first clear view of one of the hottest known stars (360,000 degrees Fahrenheit), which lies at the center of the Butterfly Nebula, NGC 2440 (HST).

Star Clusters -

- Discovered a cataclysmic variable star in the core of globular cluster 47 Tucanae, the first known optical counterpart to an x-ray source in a globular cluster (HST).

Stars -

- Detected several sources of extreme ultraviolet light through interstellar gas and dust, including the corona of a star, a white dwarf companion star and red dwarf stars (EUVE).
- Discovered unexpected "gamma ray afterglow" on the sun. A strong emanation of high-energy gamma rays persisted for more than 5 hours after a solar flare explosion (Compton).

Pulsars -

- Solved 20-year old mystery about the power source of Geminga, a gamma ray pulsar, which was found to be a 300,000 year-old rotting neutron star (ROSAT, Compton).

Galaxies -

- Uncovered circumstantial evidence for the presence of a massive black hole in the core of the neighboring galaxy M32 as well as the giant elliptical galaxy M87 (HST).
- Provided the first direct view of an immense ring of dust which may fuel a massive black hole at the heart of the giant elliptical galaxy NGC 4261 and the spiral galaxy M51 (HST).
- Detected for the first time high-energy gamma rays from a class of active galaxy similar to quasars and possibly powered by a black hole (Compton).
- Found three new gamma-ray quasars, detected more than 200 cosmic gamma ray bursts and captured the best ever observation of the glow of gamma radiation from the disk of the Milky Way galaxy (Compton).

Cosmology -

- Detected the long-sought variations within the glow from the Big Bang -- the primeval explosion that began the universe 15 billion years ago. This detection is a major milestone in a 25-year search and supports theories explaining how the initial expansion happened (COBE).

- Determined more accurately the expansion rate of the universe. Detected 27 "Cepheid variable" (used to estimate distances to galaxies) stars in a faint spiral galaxy called IC 4182 (HST).

Exploring the Solar System

Mars Observer - Launched Sep 25 aboard a Titan III ELV to examine Mars much like Earth satellites now map our weather and resources. On Aug 23, 1993, the spacecraft will begin orbiting the planet Mars and will provide scientists with an orbital platform from which the entire Martian surface and atmosphere will be examined and mapped by the seven science instruments on board.

High Resolution Microwave Survey (HRMS) - Initiated on Columbus day, 500 years after the explorer landed in America, the HRMS project began searching for signals transmitted by other civilizations. The search will be conducted in two modes -- a sky survey to sweep the celestial sphere for signals and a targeted search to look at nearby stars. NASA's Deep Space Network in Goldstone, CA, and the Arecibo Observatory in Puerto Rico will conduct most of the survey.

Cassini - A comprehensive examination of the Cassini spacecraft and mission was successfully completed Dec 11. Cassini is scheduled for launch in Oct 1997 and arrive at Saturn in Jun 2004. Cassini will fly by Venus and twice by Earth and Jupiter before arriving at Saturn to begin a 4-year orbital tour of the ringed planet and its 18 moons. In addition to the 12 instruments aboard the orbiter, the Huygens probe, built by the European Space Agency, will penetrate the thick atmosphere of Titan (the largest of Saturn's moons) in Nov 2004.

Ulysses - The Ulysses spacecraft received a gravity assist as it flew by Jupiter on Feb 8 at 280,000 miles from the planet's center. Designed to study the sun's magnetic field and solar wind, it used Jupiter's gravity assist to gain the momentum needed to break out of the plane of the ecliptic and into a solar polar orbit. During the hazardous Jupiter fly-by, scientists investigated the interaction of the giant planet's magnetic field and the solar wind.

Pioneer Venus - After the Pioneer Venus orbiter's maneuvering fuel ran out, it entered Venus' upper atmosphere on Oct 8. Pioneer Venus had been orbiting the planet since 1978 and has returned numerous data about Venus' atmosphere and surface topography. The first topographic maps of the cloud-shrouded surface of the planet were made using the radar instruments on Pioneer Venus.

Magellan - The Magellan spacecraft, mapping the surface of Venus with radar since Aug 1990, lowered its altitude to Venus on Sep 14 when it began a full 243-day cycle of gravity mapping. Magellan has completed three cycles of mapping with its radar, covering 99 percent of the surface of Venus. The objective of cycle 4, which extends to May 15, 1993, is to obtain a global map of the Venus gravity field from the elliptical orbit.

Galileo - The Galileo spacecraft flew by the Earth on Dec 8 at an altitude of 189 miles above the South Atlantic Ocean, completing a 3-year gravity-assist trajectory. This latest gravity-assist added about 8,300 miles per hour to the spacecraft's speed in its solar orbit and changed its direction slightly, to put it on an elliptical trajectory directly to the orbit of Jupiter. The spacecraft will arrive at Jupiter on Dec 7, 1995. At Jupiter, Galileo will relay data from a probe launched into the planet's atmosphere to obtain direct measurements of that environment for the first time. The spacecraft will fly 10 different elliptical orbits of Jupiter, making at least two close passes by its four major satellites and carrying out extended observations of the planets atmosphere and magnetosphere.

Understanding the Earth-Sun Environment

Sampex - The Solar Anomalous and Magnetospheric Particle Explorer, launched Jul 2, is the first of a new series of Small Explorer missions to enable scientists to develop less costly astronomy and space science experiments in a shorter period of time. The spacecraft's peculiar elliptical orbit will enable the onboard instruments to use the Earth as a giant magnetic shield. By doing this, the four instruments can determine if particles are coming from the sun, from the Milky Way galaxy, or whether they are the anomalous cosmic rays. Sampex is expected to contribute new knowledge and improve understanding of the evolution of the sun, solar system and galaxies.

Geotail - Launched Jul 24, Geotail is investigating the interactions of the solar wind and the Earth's magnetosphere, providing scientists with new information on the flow of energy and its transformation in the region called the magnetotail. A joint U.S./Japanese project, Geotail is the first in a series of satellites in an international program to better understand the interaction of the sun, the Earth's magnetic field and the Van Allen radiation belts. The solar wind, interacting with the Earth's magnetic field, can cause disruptions in short-wave radio communications and power surges in long transmission lines.

The Year in Review

Living and Working in Space

Microgravity Science - Three Spacelab missions were flown to explore the effects of space on protein crystals, electronic materials, fluids, glasses and ceramics and metals and alloys. Missions flown aboard the Space Shuttle this year include the International Microgravity Laboratory, flown in January; United States Microgravity Laboratory-1, June, and United States Microgravity Platform-1, October. The September flight of Spacelab-J, the Japanese Spacelab, also included NASA-sponsored microgravity experiments. A total of 45 NASA-sponsored microgravity experiments flew on these missions. These flights represented more peer-reviewed, hands-on microgravity research than had been conducted by the United States since Skylab in 1974-75.

Life Sciences - The International Microgravity Laboratory-1 carried 29 life sciences experiments and Spacelab-J carried 7. The United States Microgravity Laboratory-1 (USML-1) mission, although dedicated to microgravity science, supported a series of medical investigations as part of the Extended Duration Orbiter Medical Project. The longest Space Shuttle mission to date, USML-1 proved to be an excellent laboratory for these investigations.

During the winter of 1992, life sciences experiments were conducted in Antarctica. NASA and the National Science Foundation sponsored several unique science and technology projects developed under a joint effort called the Antarctic Space Analog Program. NASA also is participating in a cooperative life sciences mission with Russia. Late in December, Russia will launch Cosmos '92 "biosatellite," a recoverable, unpiloted spacecraft that carries plant and animal experiments.

Flight Systems - In March, the Atlas-1 mission used two Spacelab pallets to conduct investigations into the sun's energy output, the chemistry of the Earth's atmosphere, space plasma physics and astronomy. A core set of six instruments will fly repeatedly to study the interaction of the Sun and the Earth's atmosphere.

The Offices of Aeronautics and Space Technology and Space Sciences managed NASA's contribution to the national High-Speed Computing and Communications program. In October, 29 supercomputing proposals were selected to study problems ranging from the environment to the evolution of the universe. These projects will use "parallel processing" computers, using thousands of processors to work simultaneously on a problem.

In January, the NASA Science Internet (NSI) helped implement the world's first high-speed computer network link to Antarctica, providing voice and data links between the continental United States and the U.S. base at McMurdo Sound. In November, NSI staff set up the first video link between Antarctica and the United States to transmit images between the Ames Research Center and a remotely operated vehicle maneuvering under ice-covered lakes.

In January, the National Space Science Data Center's Data Archive and Dissemination System became operational. User interest in these electronically available astrophysics and space physics data sets has been high, with recent access rates running at 700 remote user sessions per month.

Understanding the Earth

Topex/Poseidon - The Topex/Poseidon, launched in August, will measure the sea-surface height, providing scientists with global maps of ocean circulation. Oceans transport heat from the Earth's equator toward the poles and the data will provide a better understanding of how this mechanism works. Topex/Poseidon is a joint mission between NASA and CNES, the French space agency.

Lageos II - A passive satellite, the Italian Lageos II is covered with reflectors that send laser beams back to the ground stations that sent the beams. Measurements over the years and over wide geographic areas show how the tectonic plates that make up the Earth's crust are moving. Since most earthquakes and volcanoes occur where these planes meet, Lageos II will help geologists understand how these cataclysmic events occur and where they are likely to happen.

Earth Observing System - The Earth Observing System (EOS) continued to progress to the launch of its first satellite in June 1998. Internal teams reviewed the program with the goal of reducing funding requirements through FY 2000 by approximately 30 percent while retaining the essence of the instrument complement and science plan.

Ozone Research - NASA cooperated with NOAA and other organizations on the second Airborne Arctic Stratospheric Expedition (November 1991 - March 1992). The campaign discovered record-high levels of chlorine monoxide, a key chemical in the ozone depletion cycle, over Eastern Canada and New England. This finding was complemented by data from the Upper Atmosphere Research Satellite (UARS), which observed high concentrations of chlorine monoxide over Europe and Asia.

In the Antarctic, the Total Ozone Mapping Spectrometer, which has been observing global ozone levels for 14 years, indicated the 1992 ozone hole was 15 percent larger in area than any previously seen. Earlier, UARS had observed chemicals involved in ozone depletion in the Antarctic atmosphere as early as June, 3 months before significant ozone depletion begins.

NASA's ozone research expanded with the first of a new series of Space Shuttle missions in April. The Atlas program missions study the sun's energy output and the atmosphere's chemical makeup, and how these factors affect ozone levels. Atlas' instruments are precisely calibrated before and after flight, providing a check on data gathered by similar instruments on free-flying satellites.

Search and Rescue - NASA was involved in a technology test that already has significant down-to-Earth dividends. A hand-held transmitter, used in conjunction with Search-and-Rescue equipment flying aboard NASA-developed weather satellites, allowed rescuers to locate an Alaska hunter immobilized by abdominal cramps on Alaska's largely uninhabited North Slope.

Expendable Launch Vehicles

Five expendable vehicles were launched this year. On Jun 7, a Delta 2 placed the Extreme Ultraviolet Explorer, an astrophysics satellite, into low-Earth orbit. On Jul 3, a Scout placed Sampex, a small-explorer class space physics satellite, into low-Earth orbit. A Delta 2 carried the Japanese Geotail satellite into space on Jul 24. On Sep 25, a Titan III lifted the Mars Observer into Earth orbit where the Transfer Orbit Stage (TOS) ignited, sending the spacecraft on to Mars. This was the maiden flight of the TOS. The final launch of the year was on Nov 21 when a Scout placed a Strategic Defense Initiative Office payload into orbit.

Office of Space Flight

Space Shuttle

Highlighting the missions conducted was Endeavour's maiden voyage in May on the STS-49 mission. The crew rescued a wayward satellite and in the process set three new records for space flight - 4 spacewalks on a single mission, the longest spacewalk ever conducted (8 hours, 29 minutes) and the first 3-person spacewalk ever performed. Three Shuttle missions, STS-42 in January, STS-50 in June and STS-47 in September, carried the pressurized Spacelab module. Experiments conducted on those flights previewed the activities that will be undertaken on Space Station Freedom.

The Shuttle system showed its versatility throughout the year. In March it served as an orbiting observatory for the STS-45/Atlas mission. The STS-46 mission in July demonstrated new technology in space with the Tethered Satellite System payload. Columbia and the STS-52 crew in October showed the orbiter's ability to fly a combination mission as they deployed the Lageos satellite and then conducted microgravity research with the United States Microgravity Payload. The year also saw the last dedicated Department of Defense mission flown by the Shuttle during the STS-53 flight in early December.

Safety remained the Shuttle program's top priority. Space Shuttles Columbia and Discovery completed major structural inspections and modifications. Structural inspections and modifications of Space Shuttle Atlantis, including work to allow it to dock with the Mir Space Station, began in October. When Atlantis returns to flight status in 1993, all of NASA's orbiters will have incorporated modifications to the braking system and drag chutes.

During the year, a detailed budget review resulted in significant cost reductions. The total reduction achieved for FY 1992 was $368 million or 9 percent of the FY 1992 baseline budget. A budget reduction plan is in place that will result in over a billion dollars in cost savings in FY 1996, again, as compared to the FY 1992 baseline budget.

A new class of 19 astronaut candidates was named in March. During the year astronauts Vance D. Brand, Bruce E. Melnick, John O. Creighton, Kathryn D. Sullivan, David C. Hilmers, James C. Adamson, James F. Buchli and Daniel M. Brandenstein left the agency.

Office of Space Systems Development

Space Station Freedom

Moving ever-closer to the first element launch of Space Station Freedom, 1992 was the year of the critical design review (CDR). CDRs for each individual work package, leading to a design review for the entire human-tended configuration, are on schedule to be completed by June 1993. Completion of the CDR marks the point at which the design is 90 percent completed and the contractor is given authority to proceed with development of the flight hardware.

At the Marshall Space Flight Center, Huntsville, AL, prime contractor Boeing Defense and Space Group began a series of hardware tests demonstrating how space station components will be joined in orbit. At the Johnson Space Center, Houston, TX, responsible for major space station systems, several milestones were achieved in the Work Package 2 program.

More than 400 pieces of development hardware now exist and 50 percent of prime contractor McDonnell Douglas' development test program is complete. In the Data Management System, DMS kits, an integrated set of electronic units functionally equivalent to the station's data management system, were delivered to the Johnson Space Center and to the Kennedy Space Center. Releases of DMS software were delivered to NASA on or ahead of schedule.

At the Lewis Research Center, Cleveland, OH, responsible for the system that supplies Freedom's electrical power, nearly one-half of the critical design reviews for the various components of the Photovoltaic Module and the Power Management and Distribution System were completed.

In the power management and distribution area, Work Package-4 engineers have completed the first three phases of system tests in the Solar Power Electronics Laboratory at prime contractor Rocketdyne's facility in Canoga Park, CA.

In October, Administrator Goldin announced changes to Space Station Freedom management that would ensure NASA's top talent is working on the program. Marty Kress, previously the Assistant Administrator for Legislative Affairs, was named Deputy Program Manager for Policy and Management. Tom Campbell was named Chief Financial Officer for Freedom. Campbell had been serving as the NASA Comptroller. In December, NASA announced plans to consolidate management of the Space Station Freedom program in Reston, VA.

The Space Shuttle continued to play a critical role in paving the way for space station assembly, utilization and operations. Four Space Shuttle missions carried Spacelab hardware, demonstrating human interaction in the conduct of science in space and bridging the gap between the first steps taken in microgravity research in space started in Apollo to its full-blown maturity on Freedom. A number of space station precursor research facilities were flown on STS-50, the first United States Microgravity Laboratory, such as a glovebox and a crystal growth furnace. On STS-49, astronauts performed a space walk to evaluate construction techniques and the ability of astronauts to move large, heavy objects around in space.

The first major conference devoted to Freedom's capabilities and services to the user community was held in Huntsville, AL in August. Goldin, in his keynote address, called Freedom "NASA's 10th research facility, as well as a national and international program." He challenged NASA to increase participation by the user community to 200-300 real researchers at the next conference.

In Congress, Freedom's future was debated in three separate measures over a 13-month period. In each case, Congress voted to maintain America's commitment to build the space station and preserve U.S. leadership in space. A final conference bill resulted in NASA's securing $2.1 billion for space station in FY 1993, $150 million less than the President's request.

ASRM

Congress determined that the Advanced Solid Rocket Motor (ASRM) program should proceed but at a reduced level of funding for FY 1993. Consequently, the program was restructured resulting in a 22-month delay for the first launch, now scheduled for December 1998. ASRM facilities design reached 100 percent and construction of facilities passed the 50 percent mark. Construction of case production facilities in Southern Indiana was completed; two of a total of four large ASRM segment transporters were delivered to NASA by the German contractor in December.

NLS

Congress voted to terminate the joint NASA/Air Force New Launch System (NLS) which was to have been a new family of vehicles designed to meet both civil and military launch requirements after the turn of the century. The Air Force was appropriated $10 million to accomplish the termination; NASA was appropriated $10 million for continuation of development work begun under NLS, for a new Space Transportation Main Engine.

The Year in Review

Aeronautics

NASA's aeronautics research took on a higher profile, with major advanced in high-speed research, subsonic transports, high-performance aircraft and the creation of a separate Office of Aeronautics.

NASA's Lewis Research Center, General Electric Co. and Pratt & Whitney teamed up in a unique government-industry partnership to develop advanced materials for a next-generation U.S. supersonic transport. In July, construction began on a high-flying, lightweight unpiloted research aircraft called Perseus that NASA will use to measure ozone levels and gather other atmospheric data for the High-Speed Research Program.

The highlight of NASA's subsonic research was a dramatic series of flights to evaluate airborne windshear sensors under actual severe weather conditions. NASA and the Army began a 5-year program to increase helicopter agility and maneuverability. A NASA F-15 based at Ames-Dryden Flight Research Facility, Edwards, CA, started supersonic flight tests of a Performance Seeking Control system that may make future high-speed aircraft more fuel-efficient and reliable.

Dryden also became home to tests with the X-31 Enhanced Fighter Maneuverability aircraft. NASA is part of an international group flying the X-31 to show the value of coupling thrust vectoring (directing engine exhaust flow) with advanced flight control systems to increase maneuverability in nose-high forward flight.

National Aero-Space Plane (NASP)

The nation got a preview of tomorrow's space transportation in June when a mockup of the NASP rolled out of its hanger at Mississippi State University, Starkville, MS. Senior engineering students at the school won the chance to build the mockup in a nationwide competition sponsored by NASA and the Department of Defense (DOD).

NASP is a joint NASA/DOD effort to develop advanced technologies for future vehicles that could take off like an airplane, fly into Earth orbit using supersonic combustion ramjets (scramjets) and minimal rocket propulsion, then return through the atmosphere to land on a runway.

Space Technology

NASA's research on space technology stressed new methods that robots and humans eventually may use to explore the moon and Mars. Experiments evaluated telepresence technology that lets a person, wearing a video headset, see remote locations through cameras mounted on a robot.

Beginning in October, NASA scientists employed telepresence to direct the mini-sub during explorations of ice-covered Lake Hoare on Antarctica's Ross Island. In June, NASA's Jet Propulsion Laboratory, Pasadena, CA, unveiled Rocky IV, the latest in a series of planetary mini-rovers. Around the same time, NASA-Langley engineers assembled a large-scale parabolic (double-curve) antenna in a huge water tank at NASA's Marshall Space Flight Center, Huntsville, AL, to simulate the microgravity environment that astronauts must work in while putting together large objects in space.

Advanced Concepts and Technology

In October, Goldin announced that the agency's space technology work would be combined with commercial space activities to improve the way in which NASA approaches the development and transfer of advanced technology, as well a the commercialization of space and space technologies.

Commercial Flight Activities

Throughout 1992, more than 20 commercial payloads flew aboard the Space Shuttle. Five commercial payloads, consisting of more than 30 investigations in materials, fluids and biological processes, were flown on the STS-50 2-week mission.

In October, four commercial payloads, comprising more than 30 investigations, were flown aboard STS-52 to evaluate a compound being developed to treat osteoporosis; to further study protein crystal growth for drug research and development; to test a furnace to learn more about growing larger and more uniform industrial crystals; and to learn more about how microgravity can aid research in drug development and delivery, basic cell biology, protein and inorganic crystal growth, bone and invertebrate development, immune deficiencies, manufacturing processes and fluid sciences.

Other commercial experiments were flown aboard the Space Shuttle to study the influence of microgravity on the processing of gelled sols; to investigate the physical and chemical processes that occur during the formation of polymer membranes in microgravity; to further investigate and develop the bases for materials processing in space; to study the effects of the low-Earth orbit environment on space structure materials; and to assess the utility of an Electronic Still Camera.

Technology Transfer

1992 marked the 30th anniversary of NASA's Technology Transfer Program, established under congressional mandate to promote the transfer of aerospace technology to other sectors of the U.S. economy.

In January, as part of a major initiative to upgrade its technology transfer program, NASA established six Regional Technology Transfer Centers (RTTC) to directly serve the commercial sector through the transfer and commercial use of NASA and other federal technologies. The RTCCs, closely aligned with state-level programs, operate as industry-driven catalysts for federal technology transfer throughout their regions.

The National Technology Transfer Center (NTTC), sponsored by NASA in cooperation with other federal agencies, initiated operations in conjunction with the RTCCs and other technology transfer programs. The RTTCs and NTTC, along with affiliated federal and state programs, now form the basis of the innovative National Technology Transfer Network.

In February, the National Technology Initiative (NTI) was launched by NASA and the Departments of Commerce, Energy and Transportation to spur U.S. economic competitiveness by promoting a better understanding of the opportunities for industry to commercialize new technology advances.

The third national technology transfer conference and exposition, Technology 2000, took place Dec 1-3 at the Baltimore Convention Center, Baltimore, MD. Sponsored by NASA, "NASA Tech Briefs" magazine and the Technology Utilization Foundation, the conference featured exhibits from NASA's nine field centers, other government agencies, universities, government research centers and a diverse array of high-tech companies.

Communications and Remote Sensing

In July, NASA selected 30 experiments proposed for inclusion in the Advanced Communications Technology Satellite (ACTS) program. The experiments represent the work of an impressive cross section of industry and academic investigators. Ten experiments also were selected to conduct propagation research at Ka-band. During the year, the ACTS Experiment Program signed memoranda of understanding with three agencies:

- The National Telecommunications and Information Administration/Institute for Telecommunications Sciences will test and evaluate the ACTS unique capabilities and technology to gain knowledge of advanced communication satellite system performance.
- The Defense Advanced Research Project Agency is developing a high data rate satellite research testbed network.
- The U.S. Army Space Command will use the ACTS to conduct demonstrations of technology and applications which involve interoperation between ACTS and the Army communications facilities.

Small Business Innovation Research

From December through March, the Small Business Innovation Research (SBIR) Division selected 138 research proposals for negotiation of Phase II contract awards in NASA's SBIR program. Included were 126 small, high technology firms located in 28 states. The selection of 348 research proposals for negotiation of Phase I contracts in the 1992 SBIR program was announced in November. Proposals selected were submitted by 256 small, high technology firms in 34 states.

Exploration

Early in the year the Office of Exploration conducted a workshop with the Lunar and Planetary Institute in Houston to define the scientific requirements for the first lunar orbital precursor missions. Instruments to fly on these missions were selected based on recommendations and input from the workshop.

In addition, Exploration program officials conducted an in-depth technical study of a First Lunar Outpost concept intended to be the baseline architecture to return humans to the Moon. The program is evaluating trade-offs and options for this baseline, which is expected to evolve and be modified before it is flows. Also initiated were conceptual studies of possible mission scenarios for human exploration of Mars.

International

Highlights of international space cooperation included increased cooperation with the Russian Space Agency; the launch of international spacecraft/payloads; flight of foreign payload specialists and an ESA mission specialist on the Space Shuttle and the culmination of the Space Agency Forum on International Space Year activities. Other highlights of 1992 include:

- Scientists from NASA, the European Space Agency (ESA), the Canadian Space Agency (CSA), the French National Center for Space Studies (CNES), the German Space Agency (DARA) and the National Space Development Agency of Japan (NASDA) cooperated in the International Microgravity Laboratory-1 (IML-1) Space Shuttle STS-42 mission launched on Jan 22. More than 200 scientists from 16 countries participated in the investigations.
- President George Bush and Russian President Boris Yeltsin signed a U.S./Russian space agreement in June which expanded bilateral cooperation in space science, space exploration, space applications and the use of space technology.
- In July NASA signed a contract with the Russian firm NPO Energia, focusing on possible use of the Russian Soyuz-TM vehicle as an interim Assured Crew Return Vehicle.
- Geotail, a Japanese built spacecraft, was launched on Jul 24. This joint U.S./Japanese project is the first in a series of five satellites with significant participation from NASA, ESA and Japan to better understand the interaction of the sun, the Earth's magnetic field and the Van Allen radiation belts.
- The Topex/Poseidon satellite was launched on an Ariane IV launch vehicle from the Guiana Space Center in Kourou, French Guiana on Aus 10. Topex/Poseidon is a joint NASA/CNES program to study ocean circulation and its role in regulating global climate.
- The July/August STS-46 Space Shuttle mission included the flight of the NASA-Italian Space Agency (ASI) Tethered Satellite System and deployment of the European Retrievable Carrier platform.
- The 50th Space Shuttle (STS-47) mission launched in September was a joint U.S./Japanese Spacelab mission: 34 Japanese experiments, collectively called Fuwatto '92, were flown on a reimbursable basis and shared the Spacelab module with 7 U.S. and 2 joint experiments.
- In October, NASA and the Russian Space Agency signed an agreement for the flight of a Russian cosmonaut on the U.S. Space Shuttle, the flight of a U.S. astronaut on the Russian Mir Space Station and a joint mission including the rendezvous and docking of the Space Shuttle with the Mir Space Station.
- The STS-52 mission in October included the ASI's Laser Geodynamics Satellite (Lageos) II launched on an Italian IRIS upper stage, CSA's Canex-2 payload and the CNES/French Atomic Energy Commission's Mephisto instrument on the U.S. Microgravity Payload.

Space Communications

The on-orbit Tracking and Data Relay Satellite System (TDRSS) provided continuous communications coverage to NASA space Network customers for up to 85 percent of each orbit, performing at a proficiency in excess of 99.8 percent. A 33 percent increase in Space Shuttle flights, the addition of the Extreme Ultraviolet Explorer (EUVE) and Ocean Topography Experiment satellites, and continued heavy support for the Compton Gamma Ray Observatory and Hubble Space Telescope contributed to the TDRSS's added workload. In addition, commercial use of the TDRSS C-band resources started, via a lease of those capabilities, to a small business private sector firm.

Since becoming operational in late 1983, TDRSS has relayed a 3.5 million minutes of data to the ground, and its resources have been required by every subsequent Space Shuttle mission.

The TDRSS Continuation Program moved closer to the completion of the ground terminal modifications required to maintain Space Network user services and meet the evolving needs for satellite tracking and communications through the first decade of the 21st Century. Construction of the Second TDRSS Ground Terminal at the White Sands Complex, NM, was completed and hardware/software integration testing is underway.

Ground Data Systems

The data processing program received and processed over 8 trillion bits of scientific data containing space acquired images and measurements from both free-flyer low Earth-orbiting spacecraft and Shuttle payloads. The captured data was converted to forms the science community could interpret and distributed to world-wide science facilities. With the advent of EUVE and Sampex data, a new all-time record of 1 trillion bits of data a month was processed.

Safety and Mission Quality

Frederick D. Gregory, NASA Astronaut and Colonel, USAF, was named to the position of Associate Administrator. Gregory is responsible for the safety and mission quality for all NASA programs and activities and for the direction of reporting and documentation of problem identification, problem resolution and trend analysis.

The Office of Safety and Mission Quality (SMQ) made significant contributions to the successful operation of this year's Space Shuttle and expendable launch vehicle missions. SMQ provided independent safety oversight, technical assessments, safety assurance engineering, policy development, risk assessment and mishap investigations.

A NASA Mechanical Parts Control Program Implementation Plan was initiated to assure the integrity of NSA spaceflight hardware components critical to protect human lives and programs. A Safety, Reliability and Quality Assurance Working Group was established to assure that both NASA's and the USSR's space plans for joint missions and operations will meet all safety, reliability and quality assurance needs.

Over 2,500 safety professionals, program personnel, and managers throughout NASA were trained at the newly implemented NASA Safety Training Center.

Education

During the International Space Year (ISY) kick-off celebration, NASA and the Young Astronaut Council announced an ISY student space art contest, called Outer Sight. Over 1,800 school children in grades K-9 entered the competition to capture ISY's spirit of world-wide celebration of space cooperation and discovery by expressing their vision of future space exploration and discovery.

July 22 marked a major milestone for aerospace education by expanding the National Space Grant College and Fellowship Program to include all 50 states, the District of Columbia and Puerto Rico. The addition of Kentucky, Nebraska, Puerto Rico, Vermont and Wyoming, with their 26 colleges and universities, brings the total number of participating institutions to more than 320 nationwide.

The first student managed and built payload flown on a NASA sounding rocket was launched on Sep 21 from the Wallops Flight Facility, Wallops Island, VA. Coinciding with the historic first flight of an African American Female astronaut in September, NASA Administrator Goldin, Congressman Louis Stokes (D-OH), and NAACP Chairman Dr. William Gibson participated in a symposium to expand education and career opportunities for minorities in science, engineering and technology.

During STS-52, the crew of Space Shuttle Columbia talked with the sea-voyaging crew of the historic Hawaiian canoe Hokule'a on Oct 28. At the same time, students throughout Hawaii, plotting the course of the canoe's historic voyage, watched the televised conversation.

Tens of thousands of students in more than 20 nations interacted with scientists, engineers and astronauts to learn about activities in space exploration and Mission to Planet Earth through a series of satellite video conferences. NASA conducted the first of two live, interactive satellite videoconferences. The first broadcast on Oct 21 featured "Space Exploration."

FY 1993 NASA Appropriations

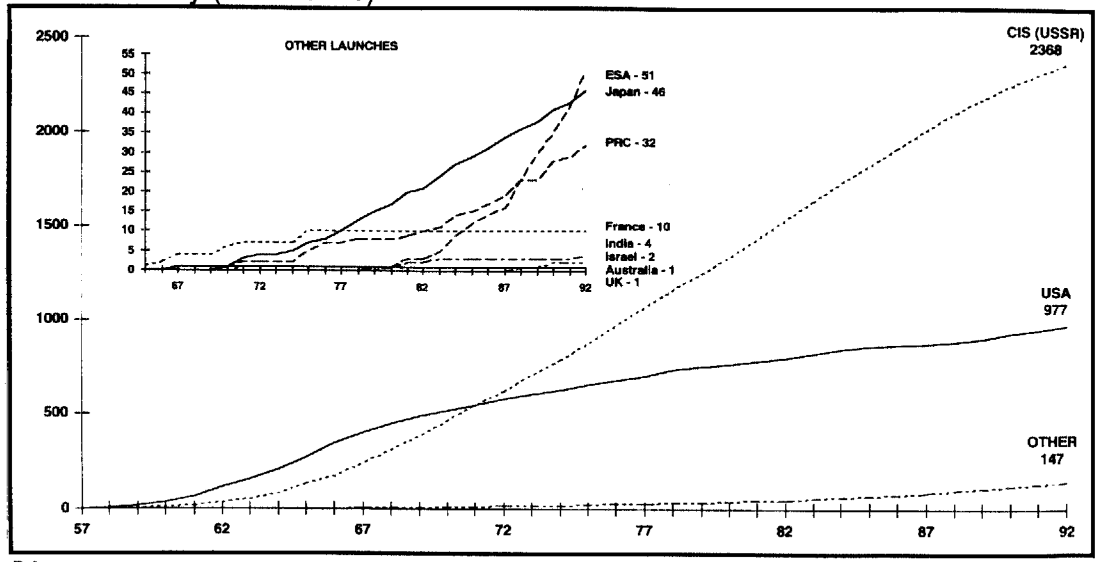
Under the constraints facing all domestic discretionary programs in 1992, congressional action on NASA's FY 1993 budget request produced a budget for the civil space program lower than FY 1992, marking the first decrease in NASA appropriations (not counting inflation) since 1974. However, given earlier indications that congressional budget cuts in NASA programs would be much deeper, possible including the deletion of funding for Space Station Freedom, the final congressional outcome for FY 1993 was significantly better than expected.

The FY 1993 VA-HUD-Independent Agencies Appropriations Bill cleared Congress on Sep 25 and was signed by President Bush on Oct 5. NASA's funding was set at $14.330 billion, $663 million less than the President's FY 1993 request, and a $4 million decrease from FY 1992.

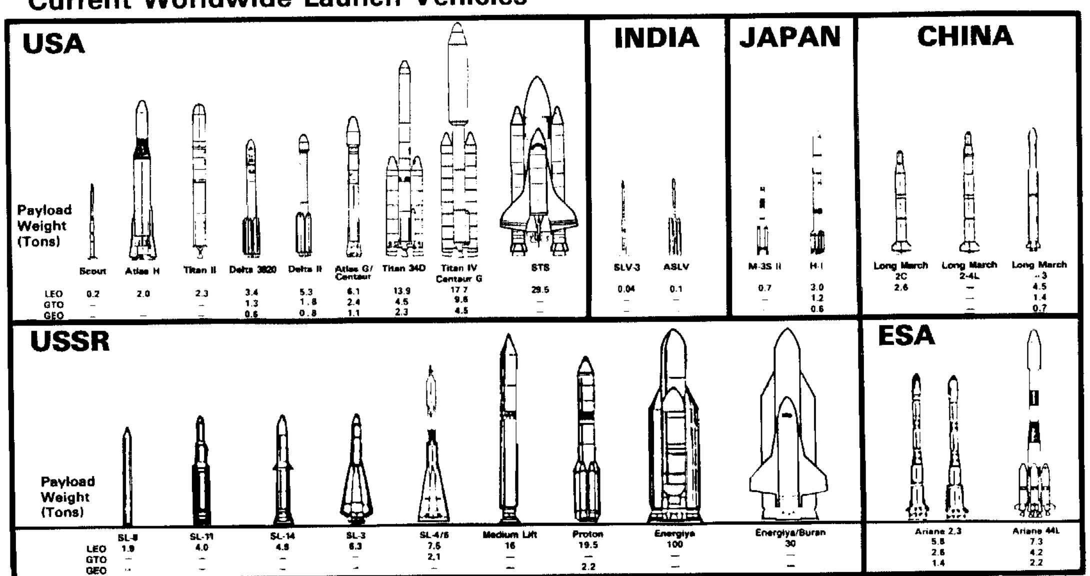
Section B

Space Flight Activity

Launch History (Cumulative)



Current Worldwide Launch Vehicles



Summary of Announced Launches

Worldwide Launches

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Australia	--	--	--	--	--	--	--	--	--	--	1	0	0	0	0	0	0	0	0
CIS (USSR)	2	1	3	3	6	20	17	30	48	44	66	74	70	81	83	74	86	81	89
DOD	--	5	6	11	19	34	27	35	39	42	32	26	19	17	17	13	10	8	9
ESA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
France	--	--	--	--	--	--	--	--	1	1	2	0	0	2	1	0	0	0	3
India	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Isreal	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Japan	--	--	--	--	--	--	--	--	--	--	--	--	--	1	2	1	0	1	2
NASA	--	2	5	5	10	18	11	22	24	31	26	19	21	12	15	18	13	16	19
PRC	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	0	0	0	3
United Kingdom	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0	0	0
US Commercial	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL	2	8	14	19	35	72	55	87	112	118	127	119	110	114	120	106	109	106	125

NASA Launches

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
NASA	--	2	5	5	10	15	9	20	21	26	18	12	13	6	6	9	9	2	10
Cooperative	--	--	--	--	--	2	0	2	2	0	2	3	2	0	5	1	0	5	1
DOD	--	--	--	--	--	--	1	0	0	1	0	0	0	0	0	1	1	0	1
USA	--	--	--	--	--	1	1	0	1	4	6	3	4	4	3	3	2	4	4
Foreign	--	--	--	--	--	--	--	--	--	--	--	1	2	2	1	4	1	5	3
TOTAL	--	2	5	5	10	18	11	22	24	31	26	19	21	12	15	18	13	16	19

Summary of Announced Launches

Worldwide Launches

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	TOTAL
Australia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
CIS (USSR)	99	98	88	87	89	98	101	98	97	97	91	95	90	74	75	59	54	2368
DOD	11	10	12	7	6	5	6	7	10	3	1	5	4	10	10	8	10	494
ESA	--	--	--	1	0	2	0	2	4	3	2	2	7	7	5	7	9	51
France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
India	--	--	--	--	1	1	0	1	0	0	0	0	0	0	0	0	1	4
Israel	--	--	--	--	--	--	--	--	--	--	--	--	1	0	1	0	0	2
Japan	1	2	3	2	2	3	1	3	3	2	2	3	2	2	3	2	3	46
NASA	15	14	20	9	7	13	12	15	12	14	5	3	8	7	8	8	13	470
PRC	2	0	1	0	0	1	1	1	3	1	2	2	4	0	5	1	3	32
United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
US Commercial	--	--	--	--	--	--	--	--	--	--	--	--	--	1	9	1	2	13
TOTAL	128	124	124	106	105	123	121	127	129	120	103	110	116	101	116	86	95	3492

NASA Launches

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	TOTAL
NASA	1	3	8	3	1	4	4	4	6	9	1	0	2	6	6	6	11	273
Cooperative	2	1	2	0	0	0	0	1	0	0	0	0	1	0	1	0	1	34
DOD	2	1	1	2	2	2	0	1	1	2	3	1	4	1	1	1	1	31
USA	8	2	4	3	4	7	6	8	4	3	1	1	1	0	0	1	0	92
Foreign	2	7	5	1	0	0	2	1	1	0	0	1	0	0	0	0	0	39
TOTAL	15	14	20	9	7	13	12	15	12	14	5	3	8	7	8	7	13	469

NASA Launches By Vehicle

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Atlas	--	--	--	--	2	3	1	0	0	1	0	0	0	0	0	0	0	0	0
Atlas Agena	--	--	--	--	2	4	0	5	2	9	6	1	0	0	0	0	0	0	0
Atlas E/F	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Atlas Centaur	--	--	--	--	--	--	1	1	1	4	4	3	3	0	3	4	3	1	2
Delta	--	--	--	--	--	--	1	4	7	8	12	7	10	7	5	7	5	7	12
Juno II	--	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Saturn I	--	--	--	--	--	--	--	3	3	0	0	0	0	0	0	0	0	0	0
Saturn IB	--	--	--	--	--	--	--	--	--	1	0	2	0	0	0	0	3	0	1
Saturn V	--	--	--	--	--	--	--	--	--	--	1	2	4	1	2	2	1	0	0
Scout	--	--	--	--	2	1	2	6	4	1	2	4	2	2	5	5	1	6	2
Shuttle	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thor Able	--	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thor Agena	--	--	--	--	--	1	0	2	2	2	1	0	2	2	0	0	0	0	0
Thor Delta	--	--	--	2	3	9	6	0	0	0	0	0	0	0	0	0	0	0	0
Titan II	--	--	--	--	--	--	--	1	5	5	0	0	0	0	0	0	0	0	0
Titan III	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Titan Centaur	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	2
Vanguard	--	--	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	--	2	5	5	10	18	11	22	24	31	26	19	21	12	15	18	13	16	19

NASA Launches By Vehicle

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	TOTAL
Atlas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Atlas Agena	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
Atlas E/F	--	--	2	1	1	1	0	1	1	0	1	0	1	0	0	1	0	10
Atlas Centaur	3	2	7	2	3	4	2	1	1	3	1	0	0	1	1	0	0	61
Delta	9	9	10	3	3	5	7	7	4	0	1	2	1	1	0	0	2	156
Juno II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Saturn I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Saturn IB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Saturn V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
Scout	2	1	1	3	0	1	0	1	1	2	1	1	4	0	1	1	2	67
Shuttle	--	--	--	--	--	2	3	4	5	9	1	0	2	5	6	6	8	51
Thor Able	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Thor Agena	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
Thor Delta	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	21
Titan II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
Titan III	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
Titan Centaur	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Vanguard	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
TOTAL	15	14	20	9	7	13	12	15	12	14	5	3	8	7	8	8	13	470

Summary of Announced Payloads

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Argentina	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
AsiaSat	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ASCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Australia	--	--	--	--	--	--	--	--	--	--	1	0	0	1	0	0	0	0	0
Brazil	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Canada	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	0	1
China	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	0	0	0	3
CIS (USSR)	2	1	3	3	4	20	17	35	66	44	66	74	70	88	96	88	106	95	109
Cooperative *	--	--	--	--	--	2	0	2	3	0	2	3	2	0	6	1	1	7	2
Czechoslovakia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ESA	--	--	--	--	--	--	--	--	--	--	--	1	1	0	0	3	0	0	1
France	--	--	--	--	--	--	--	--	1	1	2	0	0	2	1	1	0	0	5
Germany	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0	0	1	0
India	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
Indonesia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
InMarSat	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Israel	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Italy	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Japan	--	--	--	--	--	--	--	--	--	--	--	--	--	1	2	1	0	1	2
Korea	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mexico	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NATO	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	0	0	0	0
Pakistan	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PanAmSat	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Saudi Arabia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Spain	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sweden	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
United Kingdom	--	--	--	--	--	--	--	--	--	--	--	--	1	1	1	0	0	3	0
United States *	--	7	11	17	36	53	54	72	88	102	78	63	51	30	36	28	22	15	26
TOTAL	2	8	14	20	40	75	71	109	158	147	149	141	125	126	144	123	130	122	150

* Separate Breakdown Follows

Summary of Announced Payloads

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	TOTAL
Argentina	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0	1
AsiaSat	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0	1
ASCO	--	--	--	--	--	--	--	--	--	2	0	0	0	0	0	0	0	2
Australia	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	2	7
Brazil	--	--	--	--	--	--	--	--	--	1	1	0	0	0	1	0	0	3
Canada	0	0	1	0	0	0	2	1	1	1	0	0	0	0	0	2	1	12
China	2	0	1	0	0	3	1	1	3	1	3	1	3	0	5	1	2	32
CIS (USSR)	121	104	119	101	110	123	119	115	115	118	114	116	107	95	96	101	77	2838
Cooperative	2	2	2	0	0	1	0	2	0	0	0	0	1	0	3	5	3	52
Czechoslovakia	--	--	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2
ESA	0	2	2	1	0	4	0	2	2	1	0	1	2	2	1	4	1	31
France	0	1	0	0	0	0	0	0	1	1	1	0	1	1	2	6	3	30
Germany	0	0	0	0	0	0	0	2	1	0	0	1	1	2	1	1	1	12
India	0	0	0	1	1	3	1	2	0	0	0	0	2	0	1	1	2	15
Indonesia	1	1	0	0	0	0	0	1	1	0	0	1	0	0	1	0	1	7
InMarSat	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	1	2
Israel	--	--	--	--	--	--	--	--	--	--	--	--	1	0	1	0	0	2
Italy	--	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Japan	1	4	4	2	2	3	1	3	3	2	3	3	2	4	7	2	3	56
Korea	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
Mexico	--	--	--	--	--	--	--	--	--	2	0	0	0	0	0	0	0	2
NATO	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	7
Pakistan	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0	1
PanAmSat	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0	0	0	1
Saudi Arabia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
Spain	--	--	--	--	--	--	--	—	--	--	--	--	--	--	--	--	1	1
Sweden	--	--	--	--	--	--	--	--	--	--	1	0	0	1	0	0	1	3
United Kingdom	0	0	0	1	0	1	0	0	2	0	0	0	0	1	5	2	0	18
United States	27	17	29	17	13	19	17	22	32	33	9	9	15	22	31	30	27	1158
TOTAL	155	133	160	123	126	157	142	151	161	164	132	133	136	129	159	157	128	4300

Summary of USA Payloads

U.S. Payloads

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
AMSAT	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	1	0
AT&T	--	--	--	--	--	1	2	1	0	0	0	0	0	0	0	0	0	0	0
ASC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
COMSAT	--	--	--	--	--	--	--	---	1	1	3	1	3	3	2	2	1	1	2
DOD	--	5	6	12	23	39	44	50	66	71	57	43	32	18	24	14	11	8	10
GTE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hughes	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NASA	--	2	5	5	13	13	8	21	21	27	15	17	15	8	9	10	9	2	12
NOAA	--	--	--	--	--	--	--	--	--	3	3	2	1	1	1	1	1	1	1
N. Utah Univ	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RCA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
SBS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
WU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	0
TOTAL	--	7	11	17	36	53	54	72	88	102	78	63	51	30	36	28	22	15	26

Cooperative Payloads

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
NASA/Canada	--	--	--	--	--	1	0	0	1	0	0	0	1	0	1	0	0	0	0
NASA/DOD	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NASA/ESA	--	--	--	--	--	--	--	--	--	--	--	2	0	0	0	0	0	0	0
NASA/France	--	--	--	--	--	--	--	--	1	0	0	0	0	0	2	0	1	0	0
France/Germany	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
NASA/Germany	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0	1	0	1	0
NASA/Italy	--	--	--	--	--	--	--	1	0	0	1	0	0	0	1	0	0	1	0
NASA/Japan	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NASA/Netherlands	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0
NASA/NOAA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
NASA/NRL	--	--	--	--	--	--	--	--	1	0	0	1	0	0	1	0	0	0	0
NASA/Spain	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0
NASA/UK	--	--	--	--	--	1	0	1	0	0	1	0	0	0	1	0	0	1	0
TOTAL	--	--	--	--	--	2	0	2	3	0	2	3	2	0	6	1	1	7	2

Summary of USA Payloads

U.S. Payloads

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	TOTAL
AMSAT	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	5
AT&T	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5
ASC	--	--	--	--	--	--	--	--	--	1	0	0	0	0	0	1	0	2
COMSAT	6	1	3	0	1	3	2	2	2	3	0	0	1	1	2	1	3	51
DOD	18	12	14	11	8	7	6	8	12	11	5	8	9	12	16	15	11	716
GTE	--	--	--	--	--	--	--	--	2	1	1	0	2	0	1	1	0	8
Hughes	--	--	--	--	--	--	--	2	3	2	0	0	0	0	1	0	2	10
NASA	1	3	10	3	1	5	4	6	9	12	1	0	2	9	7	11	11	307
NOAA	1	1	1	1	2	2	0	2	2	0	1	1	1	0	0	1	0	31
N. Utah Univ	--	--	--	--	--	--	--	--	--	1	0	0	0	0	0	0	0	1
RCA	1	0	0	1	0	1	2	2	0	1	1	0	0	0	1	0	0	11
SBS	--	--	--	--	1	1	1	0	1	0	0	0	0	0	1	0	0	5
WU	0	0	0	1	0	0	2	0	1	0	0	0	0	0	0	0	0	6
TOTAL	27	17	29	17	13	19	17	22	32	33	9	9	15	22	31	30	27	1158

Cooperative Payloads

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	TOTAL
NASA/Canada	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
NASA/DOD	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	2	0	4
NASA/ESA	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	7
NASA/France	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	7
France/Germany	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
NASA/Germany	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	5
NASA/Italy	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	6
NASA/Japan	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
NASA/Netherlands	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2
NASA/NOAA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3
NASA/NRL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
NASA/Spain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
NASA/UK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	6
TOTAL	2	2	2	0	0	1	0	2	0	0	0	0	1	0	3	5	3	52

Shuttle Approach and Landing Tests

Flight	Flight Date	Weight (kg)	Description of Flight
Captive Inert Flight 1	Feb 18, 1977	64,717.0	Unmanned inert Orbiter (Enterprise) mated to Shuttle Carrier Aircraft (SCA) to evaluate low speed performance and handling qualities of Orbiter/SCA combination. SCA Crew: Fitzhugh L. Fulton, Jr., Thomas C. McMurtry, Vic Horton, and Skip Guidry. Flight Time: 2 hours 10 minutes.
Captive Inert Flight 2	Feb 22, 1977	64,717.0	Unmanned inert Orbiter (Enterprise) mated to SCA to demonstrate flutter free envelope. SCA Crew: Fitzhugh L. Fulton, Jr., Thomas C. McMurtry, Vic Horton, and Skip Guidry. Flight Time: 3 hours 15 minutes.
Captive Inert Flight 3	Feb 25, 1977	64,717.0	Unmanned inert Orbiter (Enterprise) mated to SCA to complete flutter and stability testing. SCA Crew: Fitzhugh L. Fulton, Jr., Thomas C. McMurtry. Vic Horton, and Skip Guidry. Flight Time: 2 hours 30 minutes.
Captive Inert Flight 4	Feb 28, 1977	64,717.0	Unmanned inert Orbiter (Enterprise) mated to SCA to evaluate configuration variables. SCA Crew: Fitzhugh L. Fulton, Jr., Thomas C. McMurtry, Vic Horton, and Skip Guidry. Flight Time: 2 hours 11 minutes.
Captive Inert Flight 5	Mar 2, 1977	65,142.0	Unmanned inert Orbiter (Enterprise) mated to SCA to evaluate maneuver performance and procedures. SCA Crew: Fitzhugh L. Fulton, Jr., A. J. Roy, Vic Horton, and Skip Guidry. Flight Time: 1 hour 40 minutes.
Captive Active Flight 1A	Jun 18, 1977	68,462.3	First manned captive active flight with Fred W. Haise, Jr. and C. Gordon Fullerton, Jr. Manned active Orbiter (Enterprise) mated to SCA for initial performance checks of Orbiter Flight Control System. SCA Crew: Fitzhugh L. Fulton, Jr., Thomas C. McMurtry, Vic Horton, and Skip Guidry. Flight Time: 56 minutes.
Captive Active Flight 1	Jun 28, 1977	68,462.3	Manned captive active flight with Joe H. Engle and Richard H. Truly. Manned active Orbiter (Enterprise) mated to SCA to verify conditions in preparation for free flight. SCA Crew: Fitzhugh L. Fulton, Jr. and Thomas C. McMurtry. Flight Time: 1 hour 3 minutes.
Captive Active Flight 3	Jul 26, 1977	68,462.3	Manned captive active flight with Fred W. Haise, Jr. and C. Gordon Fullerton, Jr. Manned active Orbiter (Enterprise) mated to SCA to verify conditions in preparation for free flight. SCA Crew: Fitzhugh L. Fulton, Jr. and Thomas C. McMurtry. Flight Time: 59 minutes.
Free Flight 1	Aug 12, 1977	68,039.6	First manned free flight with Fred W. Haise, Jr. and C. Gordon Fullerton, Jr. Manned Orbiter (Enterprise) with tailcone on, released from SCA to verify handling qualities of Orbiter. SCA Crew: Fitzhugh L. Fulton, Jr. and Thomas C. McMurtry. Flight Time: 53 minutes 51 seconds.
Free Flight 2	Sep 13, 1977	68,039.6	Manned free flight with Joe H. Engle and Richard H. Truly. Manned Orbiter (Enterprise) released from SCA to verify characteristics of Orbiter. SCA Crew: Fitzhugh L. Fulton, Jr. and Thomas C. McMurtry. Flight Time: 54 minutes 55 seconds
Free Flight 3	Sep 23, 1977	68,402.4	Manned free flight with Fred W. Haise, Jr. and C. Gordon Fullerton, Jr. Manned Orbiter (Enterprise) released from SCA to evaluate Orbiter handling characteristics. SCA Crew: Fitzhugh L. Fulton, Jr. and Thomas C. McMurtry. Flight Time: 51 minutes 12 seconds.
Free Flight 4	Oct 12, 1977	68,817.5	Manned free flight with Joe H. Engle and Richard H. Truly. Manned Orbiter (Enterprise) with tailcone off and three simulated engine bells installed, released from SCA to evaluate Orbiter handling characteristics. SCA Crew: Fitzhugh L. Fulton, Jr. and Thomas C. McMurtry. Flight Time: 1 hour 7 minutes 48 seconds.
Free Flight 5	Oct 26, 1977	68,825.2	Manned free flight with Fred W. Haise, Jr. and C. Gordon Fullerton, Jr. Manned Orbiter (Enterprise) with tailcone off, released from SCA to evaluate performance of landing gear on paved runway. SCA Crew: Fitzhugh L. Fulton, Jr and Thomas C. McMurtry. Flight Time: 54 minutes 42 seconds.

CIS (USSR) Spacecraft Designations

The Union of Soviet Socialist Republics (USSR) became the Confederation of Independent States (CIS) on December 25, 1991.

ALMAZ: Study geology, cartography, oceanography, ecology, and agriculture.
BURAN (Snowstorm): Reusable orbital space shuttle.
COSMOS: Designation given to many different activities in space.
EKRAN (Screen): Geosynchronous comsat for TV services.
ELEKTRON: Dual satellites to study the radiation belts.
FOTON: Scientific satellite to continue space materials studies.
GAMMA: Radiation detection satellite.
GORIZONT (Horizon): Geosynchronous comsat for international relay.
GRANAT: Astrophysical orbital observatory.
INFORMATOR: Collect and transmit information for the Ministry of Geology.
INTERCOSMOS: International scientific satellite.
ISKRA: Amateur radio satellite.
KRISTALL: Module carrying technical and biomedical instruments to MIR.
KVANT: MIR space station astrophysics module.
LUNA: Lunar exploration spacecraft.
MARS: Spacecraft to explore the planet Mars.
METEOR: Polar orbiting meteorological satellite.
MIR (Peace): Advanced manned scientific space station in Earth orbit.
MOLNIYA (Lightning): Part of the domestic communications satellite system.
NADEZHDA: Navigation satellite.
OKEAN: Oceanographic satellite to monitor ice conditions.
PHOBOS: International project to study Mars and its moon Phobos.
PION: Scientific satellite for research of the upper atmosphere.
POLYOT: Maneuverable satellite capable of changing orbits.
PROGNOZ (Forecast): Scientific interplanetary satellite.
PROGRESS: Unmanned cargo flight to resupply manned space stations.
PROTON: Scientific satellite to investigate the nature of Cosmic Rays.
RADIO: Small radio relay satellite for use by amateurs.
RADUGA (Rainbow): Geosynchronous comsat for telephone, telegraph, and domestic TV.
RESURS: Earth resources satellite.
SALYUT: Manned scientific space station in Earth orbit.
SOYUZ (Union): Manned spacecraft for flight in Earth orbit.
SPUTNIK: Early series of satellites to develop manned spaceflight.
VEGA: Two spacecraft international project to study Venus and Halley's Comet.
VENERA: Spacecraft to explore the planet Venus.
VOSKHOD: Modified Vostok capsule for two and three Cosmonauts.
VOSTOK (East): First manned capsule; placed six Cosmonauts in orbit.
ZOND: Automatic spacecraft development tests. Zond 5 was the first spacecraft to make a circumlunar flight and return safely to Earth.

NASA Astronauts

Name	Service	Mission	Position	Flight Time (hr:min:sec)	EVA (hr:min)	Total Flight Time (hr:min:sec)
Engle, Joe H., Col	USAF	STS-2	Cdr	54:13:12		244:30:54
		STS-51I	Cdr	170:17:42		
Evans, Ronald R., Capt	USN Ret	Apollo 17	CMP	301:51:59	01:06	301:51:59
Fabian, John M. Col.	USAF	STS-7	MS	146:23:59		316:02:51
		STS-51G	MS	169:38:52		
Fisher, Anna L., MD	Civ	STS-51A	MS	191:44:56		191:44:56
Fisher, William F., MD	Civ	STS-51I	MS	170:17:42	11:51	170:17:42
Foale, C. Michael, PhD	Civ	STS-45	MS	214:10:24		214:10:24
Frimout, Dirk D., PhD	Civ	STS-45	PS	214:10:24		214:10:24
Fullerton, C. Gordon, Col.	USAF	STS-3	Plt	192:04:46		382:50:12
		STS-51F	Cdr	190:45:26		
Furrer, Reinhard, PhD	Civ	STS-61A	PS	168:44:51		168:44:51
Gaffney, F. Drew Dr.	Civ	STS-40	PS	218:15:14		218:15:14
Gardner, Dale A.,	USN	STS-8	MS	145:08:43		336:53:39
		STS-51A	MS	191:44:56	12:14	
Gardner, Guy S., Lt. Col.	USAF	STS-27	Plt	105:05:37		320:10:44
		STS-35	Plt	215::05:07		
Garn, E. J. "Jake"	Civ	STS-51D	PS	167:55:23		167:55:23
Garneau, Marc, PhD	Civ	STS-41G	PS	197:23:33		197:23:33
Garriott, Owen K., PhD	Civ	Skylab 3	Plt	1416:11:09	13:44	1663:58:33
		STS-9	MS	247:47:24		
Gemar, Charles D., Lt. Col	USA	STS-38	MS	117:54:27		246:22:18
		STS-48	MS	128:27:51		
Gibson, Edward G., PhD	Civ	Skylab 4	Plt	2016:01:16	15:20	2016:01:16
Gibson, Robert L., Cdr.	USN	STS-41B	Plt	191:15:55		632:55:46
		STS-61C	Cdr	146:03:51		
		STS-27	Cdr	105:05:37		
		STS-47	Cdr	190:30:23		
Glenn, John H., Jr., Col	USMC Ret	Friendship 7	Cdr	4:55:23		4:55:23

*Lunar Surface EVA

Name	Service	Mission	Position	Flight Time (hr:min:sec)	EVA (hr:min)	Total Flight Time (hr:min:sec)
Godwin, Linda M. PhD	Civ	STS-37	MS	143:32:45		143:32:45
Gordon, Richard F., Jr., Capt.	USN Ret	Gemini 11	Plt	71:17:08	01:57	315:53:32
		Apollo 12	CMP	244:36:24		
Grabe, Ronald J., Col	USAF	STS-51J	Plt	97:44:38		387:56:46
		STS-30	Plt	96:56:28		
		STS-42	Cdr	193:15:43		
Gregory, Frederick D., Col	USAF	STS-51B	Plt	168:08:46		455:07:59
		STS-33	Cdr	120:06:46		
		STS-44	Cdr	166:52:27		
Griggs, S. David	Civ	STS-51D	MS	167:55:23	03:10	167:55:23
Grissom, Virgil I., Lt. Col.	USAF	**Liberty Bell	Plt	15:37		5:08:08
		Gemini 3	Cdr	4:52:31		
Gutierrez, Sidney M. Lt. Col.	USAF	STS-40	Plt	218:15:14		218:15:14
Haise, Fred W.	Civ	Apollo 13	LMP	142:54:41		142:54:41
Hammond, L. Blaine, Jr. Col	USAF	STS-39	Plt	199:26:17		199:26:17
Harbaugh, Gregory J.	Civ	STS-39	MS	199:26:17		199:26:17
Hart, Terry J	Civ	STS-41C	MS	167:40:07		167:40:07
Hartsfield, Henry W.	USAF Ret	STS-4	Plt	169:09:31		482:50:26
		STS-41D	Cdr	144:56:04		
		STS-61A	Cdr	168:44:51		
Hauck, Frederick H., Capt	USN	STS-7	Plt	146:23:59		435:09:06
		STS-51A	Cdr	191:44:56		
		STS-26	Cdr	97:00:11		
Hawley, Steven A., PhD	Civ	STS-41D	MS	144:56:04		412:16:01
		STS-61C	MS	146:03:51		
		STS-31	MS	121:16:06		
Henize, Karl G., PhD	Civ	STS-51F	MS	190:45:26		190:45:26
Hennen, Thomas J.	USA	STS-44	PS	166:52:27		166:52:27
Henricks, Terence T. Col.	USAF	STS-44	Plt	166:52:27		166:52:27

** Suborbital Flight

NASA Astronauts

Name	Service	Mission	Position	Flight Time (hr:min:sec)	EVA (hr:min)	Total Flight Time (hr:min:sec)
Hieb, Richard J	Civ	STS-39	MS	199:26:17		412:43:55
		STS-49	MS	213:17:38	17:42	
Hilmers, David C., Lt. Col.	USMC	STS-51J	MS	97:44:38		494:18:54
		STS-26	MS	97:00:11		
		STS-36	MS	106:18:22		
		STS-42	MS	193:15:43		
Hoffman, Jeffery A., PhD	Civ	STS-51D	MS	167:55:23	03:10	574:16:37
		STS-35	MS	215:05:07		
		STS-46	MS	191:16:07		
Hughes-Fulford, Millie Dr.	Civ	STS-40	PS	218:15:14		218:15:14
Irwin, James B., Col	USAF Ret	Apollo 15	LMP	295:11:53	*18:35	295:11:53
Ivins, Marsha S.	Civ	STS-32	MS	261:00:37		452:16:44
		STS-46	MS	191:16:07		
Jarvis, Gregory B	Civ	STS-51L	PS	N/A		N/A
Jemison, Mae C., MD	Civ	STS-47	MS	190:30:23		190:30:23
Jernigan, Tamara E. PhD	Civ	STS-40	MS	218:15:14		455:11:27
		STS-52	MS	236:56:13		
Kerwin, Joseph P., Capt	USN Ret	Skylab 2	Plt	672:49:49	03:30	672:49:49
Lee, Mark C. Maj	USAF	STS-30	MS	96:56:28		287:26:51
		STS-47	MS	190:30:23		
Leetsma, David C., Cdr	USN	STS-41G	MS	197:23:33	03:29	532:34:05
		STS-28	MS	121:00:08		
		STS-45	MS	214:10:24		
Lenoir, William B., PhD	Civ	STS-5	MS	122:14:26		122:14:26
Lichtenberg, Bryon K., PhD	Civ	STS-9	PS	247:47:24		461:57:48
		STS-45	PS	214:10:24		
Lind, Don Leslie, PhD	Civ	STS-51B	MS	168:08:46		168:08:46

*Lunar Surface EVA

Name	Service	Mission	Position	Flight Time (hr:min:sec)	EVA (hr:min)	Total Flight Time (hr:min:sec)
Lounge, John M.	Civ	STS-51I	MS	170:17:42		482:23:00
		STS-26	MS	97:00:11		
		STS-35	MS	215:05:07		
Lousma, Jack R., Col	USMC	Skylab 3	Plt	1416:11:09	10:59	1608:15:55
		STS-3	Cdr	192:04:46		
Lovell, James A., Jr., Capt	USN Ret	Gemini 7	Plt	330:35:01		715:04:55
		Gemini 12	Cdr	94:34:31		
		Apollo 8	CMP	147:00:42		
		Apollo 13	Cdr	142:54:41		
Low, G. David	Civ	STS-32	MS	261:00:37		474:23:04
		STS-43	MS	213:22:27		
Lucid, Shannon W., PhD	Civ	STS-51G	MS	169:38:52		502:40:39
		STS-34	MS	119:39:20		
		STS-43	MS	213:22:27		
Malerba, Franco, PhD	Civ	STS-46	PS	191:16:07		191:16:07
Mattingly, Thomas K., Capt	USN	Apollo 16	CMP	265:51:05	01:24	508:33:59
		STS-4	Cdr	169:09:31		
		STS-51C	Cdr	73:33:23		
McAuliffe, S. Christa	Civ	STS-51L	PS	N/A		N/A
McBride, Jon A., Cdr	USN	STS-41G	Plt	197:23:33		197:23:33
McCandless, Bruce, Capt.	USN	STS-41B	MS	191:15:55	11:37	191:15:55
McCulley, Michael, Cdr	USN	STS-34	Plt	119:39:20		119:39:20
McDivitt, James A., B. Gen	USAF Ret	Gemini 4	Cdr	97:56:12		338:57:06
		Apollo 9	Cdr	241:00:54		
McMonagle, Donald R. Lt.Col.	USAF	STS-39	MS	199:23:17		199:26:16
McNair, Ronald E., PhD	Civ	STS-41B	MS	191:15:55		191:15:55
		STS-51L	MS	N/A		

** Suborbital Flight

NASA Astronauts

Name	Service	Mission	Position	Flight Time (hr:min:sec)	EVA (hr:min)	Total Flight Time (hr:min:sec)
Meade, Carl J., Col.	USAF	STS-38	MS	117:54:27		449:24:31
		STS-50	MS	331:30:04		
Melnick, Bruce E., Cdr	USCG	STS-41	MS	98:10:03		311:27:41
		STS-49	MS	213:17:38		
Merbold, Ulf, PhD	Civ	STS-9	PS	247:47:24		441:03:07
		STS-42	PS	193:15:43		
Messerschmid, Ernest, PhD	Civ	STS-61A	PS	168:44:51		168:44:51
Mitchell, Edger D., Capt	USN Ret	Apollo 14	LMP	216:01:58	*09:23	216:01:58
Mohri, Mamoru, PhD	Civ	STS-47	PS	190:30:23		190:30:23
Mullane, Richard M., Col	USAF	STS-41D	MS	144:56:04		571:25:10
		STS-27	MS	105:05:37		
		STS-36	MS	106:18:22		
		STS-35	MS	215:05:07		
Musgrave, F. Story, MD, PhD	Civ	STS-6	MS	120:23:42	03:54	597:08:21
		STS-51F	MS	190:45:26		
		STS-33	MS	120:06:46		
		STS-44	MS	166:52:27		
Nagel, Steven R., Col.	USAF	STS-51G	MS	169:38:52		481:56:28
		STS-61A	Plt	168:44:51		
		STS-37	Cdr	143:32:45		
Nelson, Bill	Civ	STS-61C	PS	146:03:51		146:03:51
Nelson, George D., PhD	Civ	STS-41C	MS	167:40:07	10:06	410:44:09
		STS-61C	MS	146:03:51		
		STS-26	MS	97:00:11		
Neri Vela, Rodolpho, PhD	Civ	STS-61B	PS	165:04:49		165:04:49
Nicollier, Claude, PhD	Civ	STS-46	MS	191:16:07		191:16:07
Ockels, Wubbo J., PhD	Civ	STS-61A	PS	168:44:51		168:44:51

*Lunar Surface EVA

Name	Service	Mission	Position	Flight Time (hr:min:sec)	EVA (hr:min)	Total Flight Time (hr:min:sec)
O'Connor, Bryan O., Col	USMC	STS-61B	Plt	165:04:49		383:20:03
		STS-40	Cdr	218:15:14		
Onizuka, Ellison S., Lt. Col	USAF	STS-51C	MS	73:33:23		73:33:23
		STS-51L	MS	N/A		
Oswald, Steven S.	Civ	STS-42	Plt	193:15:43		193:15:43
Overmyer, Robert F., Col	USMC	STS-5	Plt	122:14:26		290:23:12
		STS-51B	Cdr	168:08:46		
Pailes, William A., Maj	USAF	STS-51J	PS	97:44:38		97:44:38
Parise, Ronald A., PhD	Civ	STS-35	PS	215:05:07		215:05:07
Parker, Robert A., PhD	Civ	STS-9	MS	247:47:24		462:52:31
		STS-35	MS	215:05:07		
Payton, Gary E., Maj	USAF	STS-51C	PS	73:33:23		73:33:23
Peterson, Donald H.	USAF Ret	STS-6	MS	120:23:42	03:54	120:23:42
Pogue, William R., Col.	USAF Ret	Skylab 4	Plt	2016:01:16	13:34	2016:01:16
Readdy, William F.	Civ	STS-42	MS	193:15:43		193:15:43
Reightler, Kenneth S., Jr. Cdr	USN	STS-48	Plt	128:27:51		128:27:51
Resnik, Judith A., PhD	Civ	STS-41D	MS	144:56:04		144:56:04
		STS-51L	MS	N/A		
Richards, Richard N., Cdr	USN	STS-28	Plt	121:00:08		550:40:15
		STS-41	Cdr	98:10:03		
		STS-50	Cdr	331:30:04		
Ride, Sally K., PhD	Civ	STS-7	MS	146:23:59		343:47:32
		STS-41G	MS	197:23:33		
Roosa, Stuart A., Col	USAF Ret	Apollo 14	CMP	216:01:58		216:01:58
Ross, Jerry L., Lt. Col	USAF	STS-61B	MS	165:04:49	12:20	413:43:11
		STS-27	MS	105:05:37		
		STS-37	MS	143:32:45	10:49	
Runco, Mario Jr. Lt.Cdr.	USN	STS-44	MS	166:52:27		166:52:27

** Suborbital Flight

NASA Astronauts

Name	Service	Mission	Position	Flight Time (hr:min:sec)	EVA (hr:min)	Total Flight Time (hr:min:sec)
Schirra, Walter M., Jr., Capt	USN Ret	Sigma 7	Plt	9:13:11		295:13:38
		Gemini 6A	Cdr	25:51:24		
		Apollo 7	Cdr	260:09:03		
Schmitt, Harrison H., PhD	Civ	Apollo 17	LMP	301:51:59	*22:04	301:51:59
Schweickart, Russell	Civ	Apollo 9	LMP	241:00:54	01:07	241:00:54
Scobee, Francis R. (Dick)	USAF Ret	STS-41C	Plt	167:40:07		167:40:07
		STS-51L	Cdr	N/A		
Scott, David R., Col	USAF Ret	Gemini 8	Plt	10:41:26		546:54:13
		Apollo 9	CMP	241:00:54	01:01	
		Apollo 15	Cdr	295:11:53	*19:08	
Scully-Power, Paul D.	Civ	STS-41G	PS	197:23:33		197:23:33
Seddon, M. Rhea, MD	Civ	STS-51D	MS	167:55:23		386:10:37
		STS-40	MS	218:15:14		
Shaw, Brewster H., Col	USAF	STS-9	Plt	247:47:24		533:52:21
		STS-61B	Cdr	165:04:49		
		STS-28	Cdr	121:00:08		
Shepard, Alan B., Jr., R. Adm.	USN Ret	**Freedom 7	Plt	15:22		216:17:20
		Apollo 14	Cdr	216:01:5	*09:23	
Shepherd, William M., Capt	USN	STS-27	MS	105:05:37		440:11:53
		STS-41	MS	98:10:03		
		STS-52	MS	236:56:13		
Shriver, Loren J., Col	USAF	STS-51C	Plt	73:33:23		386:05:36
		STS-31	Cdr	121:16:06		
		STS-46	Cdr	191:16:07		
Slayton, Donald K., Maj	USAF Ret	Apollo Soyuz	CMP	217:28:23		217:28:23
Smith, Michael J., Cdr	USN	STS-51L	Plt	N/A		N/A
Spring, Sherwood C., Lt. Col	USA	STS-61B	MS	165:04:49	12:20	165:04:49
Springer, Robert C., Col	USMC	STS-29	MS	119:38:52		237:33:19
		STS-38	MS	117:54:27		
Stafford, Thomas P., Lt. Gen	USAF Ret	Gemini 6A	Plt	25:51:24		507:44:00
		Gemini 9A	Cdr	72:20:50		
		Apollo 10	Cdr	192:03:23		
		Apollo Soyuz	Cdr	217:28:23		
Stewart, Robert L., Col	USA	STS-41B	MS	191:15:55	11:37	289:00:33
		STS-51J	MS	97:44:38		
Sullivan, Kathryn D., PhD	Civ	STS-41G	MS	197:23:33	03:29	532:50:03
		STS-31	MS	121:16:06		
		STS-45	MS	214:10:24		
Swigert, John L., Jr.	Civ	Apollo 13	CMP	142:54:41		142:54:41
Thagard, Norman E., MD	Civ	STS-7	MS	146:23:59		604:44:56
		STS-51B	MS	168:08:46		
		STS-30	MS	96:56:28		
		STS-42	MS	193:15:43		
Thornton, Kathryn	Civ	STS-33	MS	120:06:46		333:24:24
		STS-49	MS	213:17:38	7:45	
Thornton, William E., MD	Civ	STS-8	MS	145:08:43		313:17:29
		STS-51B	MS	168:08:46		
Thuot, Pierre J., Lt. Cdr	USG	STS-36	MS	106:18:22		319:36:00
		STS-49	MS	213:17:38	17:42	
Truly, Richard H., Capt	USN	STS-2	Plt	54:13:12		199:21:55
		STS-8	Cdr	145:08:43		
van den Berg, Lodewijk, PhD	Civ	STS-51B	PS	168:08:46		168:08:46
van Hoften, James D., PhD	Civ	STS-41C	MS	167:40:07	10:06	337:57:49
		STS-51I	MS	170:17:42	11:51	

*Lunar Surface EVA

** Suborbital Flight

NASA Astronauts

Name	Service	Mission	Position	Flight Time (hr:min:sec)	EVA (hr:min)	Total Flight Time (hr:min:sec)
Veach, Charles Lacy	USAF	STS-39	MS	199:23:17		436:19:30
		STS-52	MS	236:56:13		
Voss, James S. Lt.Col.	USA	STS-44	MS	166:52:27		342:12:14
		STS-53	MS	175:19:47		
Walker, Charles D.	Civ	STS-41D	PS	144:56:04		477:56:16
		STS-51D	PS	167:55:23		
		STS-61B	PS	165:04:49		
Walker, David M., Capt	USN	STS-51A	Plt	191:44:56		464:01:11
		STS-30	Cdr	96:56:28		
		STS-53	Cdr	175:19:47		
Wang, Taylor G., PhD	Civ	STS-51B	PS	168:08:46		168:08:46
Weitz, Paul J., Capt	USN Ret	Skylab 2	Plt	672:49:49	01:44	793:13:31
		STS-6	Cdr	120:23:42		
Wetherbee, James, Cdr	USN	STS-32	Plt	261:00:37		497:56:50
		STS-52	Cdr	236:56:13		
White, Edward H., Lt. Col	USAF	Gemini 4	Plt	97:56:12	00:23	97:56:12
Williams, Donald E., Capt	USN	STS-51D	Plt	167:55:23		287:34:43
		STS-34	Cdr	119:39:20		
Worden, Alfred M., Col	USAF Ret	Apollo 15	CMP	295:11:53	00:39	295:11:53
Young, John W., Capt	USN Ret	Gemini 3	Plt	4:52:31		835:41:55
		Gemini 10	Cdr	70:46:39		
		Apollo 10	CMP	192:03:23		
		Apollo 16	Cdr	265:51:05	*20:14	
		STS-1	Cdr	54:20:53		
		STS-9	Cdr	247:47:24		

*Lunar Surface EVA

Name	Service	Mission	Position	Flight Time (hr:min:sec)	EVA (hr:min)	Total Flight Time (hr:min:sec)

** Suborbital Flight

Summary of United States Manned Space Flight

Mission	Crew Members	Mission Duration (hr:min:sec)	Crew Hours (hr:min:sec)
MERCURY REDSTONE (Suborbital)			
Freedom 7	Shepard	15:22	15:22
Liberty Bell 7	Grissom	15:37	15:37
Total Flights - 2		30:59	30:59
MERCURY ATLAS (Orbital)			
Friendship 7	Glenn	4:55:23	4:55:23
Aurora 7	Carpenter	4:56:05	4:56:05
Sigma 7	Schirra	9:13:11	9:13:11
Faith 7	Cooper	34:19:49	34:19:49
Total Flights - 4		53:24:28	53:24:28
TOTAL MERCURY FLIGHTS - 6		53:55:27	53:55:27
GEMINI TITAN			
Gemini 3	Grissom, Young	4:52:30	9:45:02
Gemini 4	McDivitt, White	97:56:12	195:52:24
Gemini 5	Cooper, Conrad	190:55:14	381:50:28
Gemini 6A	Schirra, Stafford	25:51:24	51:42:48
Gemini 7	Borman, Lovell	330:35:01	661:10:02
Gemini 8	Armstrong, Scott	10:41:26	21:22:52
Gemini 9A	Stafford, Cernan	72:20:50	144:41:40
Gemini 10	Young, Collins	70:46:39	141:33:18
Gemini 11	Conrad, Gordon	71:17:08	142:34:16
Gemini 12	Lovell, Aldrin	94:34:31	189:09:02
TOTAL GEMINI FLIGHTS - 10		969:50:56	1939:41:52

Mission	Crew Members	Mission Duration (hr:min:sec)	Crew Hours (hr:min:sec)
APOLLO SATURN I			
Apollo 7	Schirra, Eisele, Cunningham	260:09:03	780:27:09
APOLLO SATURN V			
Apollo 8	Borman, Lovell, Anders	147:00:42	441:02:06
Apollo 9	McDivitt, Scott, Schweickart	241:00:54	723:02:42
Apollo 10	Stafford, Young, Cernan	192:03:23	576:10:09
Apollo 11	Armstrong, Collins, Aldrin	195:18:35	585:55:45
Apollo 12	Conrad, Gordon, Bean	244:36:24	733:49:12
Apollo 13	Lovell, Swigert, Haise	142:54:41	428:44:03
Apollo 14	Shepard, Roosa, Mitchell	216:01:58	648:05:54
Apollo 15	Scott, Worden, Irwin	295:11:53	885:35:39
Apollo 16	Young, Mattingly, Duke	265:51:05	797:33:15
Apollo 17	Cernan, Evans, Schmitt	301:51:59	905:35:57
Total Flights - 10		2241:51:34	6725:34:42
TOTAL APOLLO FLIGHTS - 11		2502:00:37	7506:01:51
SKYLAB SATURN IB			
Skylab 2	Conrad, Kerwin, Weitz	672:49:49	2018:29:27
Skylab 3	Bean, Garriott, Lousma	1416:11:09	4248:33:27
Skylab 4	Carr, E. Gibson, Pogue	2016:10:16	6048:03:48
TOTAL SKYLAB FLIGHTS - 3		4105:02:14	12315:06:42
APOLLO SATURN IB			
ASTP	Stafford, Brand, Slayton	217:28:23	652:25:09

Summary of United States Manned Space Flight

Mission	Crew Members	Mission Duration (hr:min:sec)	Crew Hours (hr:min:sec)
STS-1 - Columbia	Young, Crippen	54:20:53	108:41:46
STS-2 - Columbia	Engle, Truly	54:13:12	108:26:24
STS-3 - Columbia	Lousma, Fullerton	192:04:46	384:09:32
STS-4 - Columbia	Mattingly, Hartsfield	169:09:31	338:19:02
STS-5 - Columbia	Brand, Overmyer, Allen, Lenoir	122:14:26	488:57:44
STS-6 - Challenger	Weitz, Bobko, Peterson, Musgrave	120:23:42	481:34:48
STS-7 - Challenger	Crippen, Hauch, Ride, Fabian, Thagard	146:23:59	731:59:55
STS-8 - Challenger	Truly, Brandenstein, D. Gardner, Bluford, W. Thornton	145:08:43	725:43:35
STS-9 - Columbia	Young, Shaw, Garriott, Parker, Lichtenberg, Merbold	247:47:24	1486:44:24
STS-41B - Challenger	Brand, Gibson, McCandless, McNair, Stewart	191:15:55	956:19:35
STS-41C - Challenger	Crippen, Scobee, van Hoften, G. Nelson, Hart	167:40:07	838:20:35
STS-41D - Discovery	Hartsfield, Coats, Resnik, Hawley, Mullane, C. Walker	144:56:04	869:36:24
STS-41G - Challenger	Crippen, McBride, Ride, Sullivan, Leetsma, Garneau, Scully-Power	197:23:33	1381:44:51
STS-51A - Discovery	Hauck, D. Walker, Gardner, A. Fisher, Allen	191:44:56	958:49:40
STS-51C - Discovery	Mattingly, Shriver, Onizuka, Buchli, Payton	73:33:23	367:46:55
STS-51D - Discovery	Bobko, Williams, Seddon, Hoffman, Griggs, C. Walker, Garn	167:55:23	1175:27:41
STS-51B - Challenger	Overmyer, Gregory, Lind, Thagard, W. Thornton, van den Berg, Wang	168:08:46	1177:01:22
STS-51G - Discovery	Brandenstein, Creighton, Lucid, Fabian, Nagel, Baudry, Al-Saud	169:38:52	1187:32:04
STS-51F - Challenger	Fullerton, Bridges, Musgrave, England, Henize, Acton, Bartoe	190:45:26	1335:18:02
STS-51I - Discovery	Engle, Covey, van Hoften, Lounge, W. Fisher	170:17:42	851:28:30
STS-51J - Atlantis	Bobko, Grabe, Hilmers, Stewart, Pailes	97:44:38	488:43:10
STS-61A - Challenger	Hartsfield, Nagel, Buchli, Bluford, Dunbar, Furrer, Messerschmid, Ockels	168:44:51	1349:58:48
STS-61B - Atlantis	Shaw, O'Connor, Cleave, Spring, Ross, Neri Vela, C. Walker	165:04:49	1155:33:43
STS-61C - Columbia	R. Gibson, Bolden, Chang-Diaz, Hawley, G. Nelson, Cenker, B. Nelson	146:03:51	1022:26:57
STS-51L - Challenger	Scobee, Smith, Resnik, Onizuka, McNair, Jarvis, McAuliffe	N/A	N/A
STS-26 - Discovery	Hauck, Covey, Lounge, Hilmers, G. Nelson	97:00:11	485:00:55
STS-27 - Atlantis	R. Gibson, Gardner, Mullane, Ross, Shepherd	105:05:37	525:28:05
STS-29 - Discovery	Coats, Blaha, Bagian, Buchi, Springer	119:38:52	598:14:20
STS-30 - Atlantis	Walker, Grabe, Thagard, Cleave, Lee	96:56:28	484:42:20
STS-28 - Columbia	Shaw, Richards, Leetsma, Adamson, Brown	121:00:08	605:00:40
STS-34 - Atlantis	Williams, McCully, Baker, Chang-Diaz, Lucid	119:39:20	598:16:40
STS-33 - Discovery	Gregory, Blaha, Musgrave, K. Thornton, Carter	120:06:46	600:33:50
STS-32 - Columbia	Brandenstein, Wetherbee, Dunbar, Ivins, Low	261:00:37	1305:03:05
STS-36 - Atlantis	Creighton, Casper, Hilmers, Mullane, Thuot	106:18:22	531:31:50
STS-31 - Discovery	Shriver, Bolden, McCandless, Hawley, Sullivan	121:16:06	606:20:30
STS-41 - Discovery	Richards, Cabana, Melnick, Shepard, Akers	98:10:03	490:50:15
STS-38 - Atlantis	Covey, Springer, Meade, Culbertson, Gemar	117:54:27	589:35:15
STS-35 - Columbia	Brand, Lounge, Hoffman, Parker, G. Gardner, Parise, Durrance	215:05:07	1505:35:49
STS-37 - Atlantis	Nagel, Cameron, Ross, Apt, Godwin	143:32:45	717:43:45
STS-39 - Discovery	Coats, Hammond, Harbaugh, Hieb, McMonagle, Bluford, Veach	199:23:17	1395:42:59

Summary of United States Manned Space Flight

Mission	Crew Members	Mission Duration (hr:min:sec)	Crew Hours (hr:min:sec)
STS-40 - Columbia	Gutierrez, Seddon, Bagian, Jernigan, Gaffney, Hughes-Fulford, O'Connor	218:15:14	1527:46:38
STS-43 - Atlantis	Blaha, Baker, Lucid, Low, Adamson	213:22:27	1066:52:15
STS-48 - Discovery	Creighton, Reightler, Buchli, Brown, Gemar	128:27:51	642:19:15
STS-44 - Atlantis	Gregory, Henricks, Musgrave, Runco, Voss, Hennen	166:52:27	1001:14:42
STS-42 - Discovery	Grabe, Oswald, Thagard, Readdy, Hilmers Bondar, Merbold	193:15:43	1352:50:01
STS-45 - Atlantis	Bolden, Duffy, Sullivan, Leestma, Foale, Frimout, Lichtenburg	214:10:24	1499:12:48
STS-49 - Endeavour	Brandenstein, Chilton, Hieb, Melnick, Thout, Thornton, Akers	213:30:04	1493:03:26
STS-50 - Columbia	Richards, Bowersox, Dunbar, Meade, Baker Delucas	331:30:04	1989:00:24
STS-46 - Atlantis	Shriver, Allen, Hoffman, Chang-Diaz, Nicollier, Ivins, Malerba	191:16:07	1338:52:49
STS-47 - Endeavour	Gibson, Brown, Lee, Davis, Jemison, Apt, Mohri	190:30:23	1333:32:41
STS-52 - Columbia	Weatherbee, Baker, Shepherd, Jernigan, Veach	236:56:13	1184:41:05
STS-53 - Discovery	Walker, Cabana, Bluford, Voss, Clifford	175:19:47	876:38:55
TOTAL SHUTTLE FLIGHTS - 51		8180:07:16	45632:18:56

Mission	Crew Members	Mission Duration (hr:min:sec)	Crew Hours (hr:min:sec)

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-1 Columbia Mission Duration: 54 hrs 20 mins 53 secs	Apr 12, 1981 KSC	Apr 14, 1981 DFRF	Cdr: John W. Young Plt: Robert L. Crippen	**Deployable Payloads: None** **Attached PLB Payloads:** 1. Passive Sample Array 2. DFI (Development Flight Instrumentation) Pallet 3. ACIP (Aerodynamic Coefficient Identification Package)	**GAS (Getaway Special): None** **Crew Compartment Payloads: None** **Special Payload Mission Kits: None**
STS-2 Columbia Mission Duration: 54 hrs 13 mins 12 secs	Nov 12, 1981 KSC	Nov 14, 1981 DFRF	Cdr: Joe Henry Engle Plt: Richard H. Truly	**Deployable Payloads: None** **Attached PLB Payloads:** 1. OFT (Orbital Flight Test) Pallet a. MAPS (Measurement of Air Pollution From Satellite) b. SMIRR (Shuttle Multispectral Infrared Radiometer) c. SIR (Shuttle Imaging Radar) d. FILE (Features Identification and Location Experiment) e. OCE (Ocean Color Experiment) 2. DFI (Development Flight Instrument) Pallet 3. ACIP (Aerodynamic Coefficient Identification Package)	4. IECM (Induced Environment Contamination Monitor) 5. OSTA-1 (Office of Space and Terrestrial Applications) **GAS (Getaway Special): None** **Crew Compartment Payloads: None** **Special Payload Mission Kits:** 1. RMS (Remote Manipulator System (S/N 201)
STS-3 Columbia Mission Duration: 192 hrs 4 mins 46 secs	Mar 22, 1982 KSC	Mar 30, 1982 White Sands	Cdr: Jack R. Lousma Plt: Charles G. Fullerton	**Deployable Payloads: None** 1. Plasma Diagnostic Package **Attached PLB Payloads:** 1. OSS (Office of Space Science)-1 Pallet a. Plant Lignification Experiment b. Plasma Diagnostic Package * c. Vehicle Charging and Potential d. Space Shuttle Induced Atmosphere e. Thermal Canister f. Solar Flare X-ray Polarimeter g. Solar Ultraviolet and Spectral Irradiance Monitor h. Contamination Monitor Package i. Foil Microabrasion Package *RMS deployed/berthed	2. DFI (Development Flight Instrument) Pallet 3. ACIP (Aerodynamic Coefficient Identification Package) **GAS (Getaway Special):** 1. Verification Canister **Crew Compartment Payloads:** 1. MLR (Monodisperse Latex Reactor) 2. HBT (Heflex Bioengineering Test) **Special Payload Mission Kits:** 1. RMS (Remote Manipulator System (S/N 201)

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-4 Columbia Mission Duration: 169 hrs 9 mins 31 secs	Jun 27, 1982 KSC	Jul 4, 1982 DFRF	Cdr: Thomas K. Mattingly, II Plt: Henry W. Hartsfield, Jr.	**Deployable Payloads: None** 1. IECM (Induced Environment Contamination Monitor) deployed/reberthed by RMS **Attached PLB Payloads** 1. DFI (Development Flight Instrument) Pallet **Department of Defense** 1. DOD 82-1 **GAS (Getaway Special):** 1. Utah State University a. Drosophila Melanogaster (fruit fly) Growth Experiment b. Antemia (Brine Shrimp) Growth Experiment c. Surface Tension Experiments d. Composite Curing Experiment e. Thermal Conductivity Experiment f. Microgravity Soldering Experiment	g. Root growth of Lemna Minor L. (Duckweed) in Microgravity h. Homogeneous Alloy Experiment i. Algai Microgravity Bioassay Experiment **Crew Compartment Payloads:** 1. MLR (Monodisperse Latex Reactor) 2. CFES (Continuous Flow Electrophoresis System) 3. SSIP (Shuttle Student Involvement Program) S404: Effect of Prolonged Space Travel on Levels of Trivalent Chromium in the Body S405: Effect of Diet, Exercise, and Zero Gravity on Lipoprotein Profiles 4. VPCF (Vapor Phase Compression Freezer) **Special Payload Mission Kits:** 1. RMS (Remote Manipulator System (S/N 201)
STS-5 Columbia Mission Duration: 122 hrs 14 mins 26 secs	Nov 11, 1982 KSC	Nov 16, 1982 DFRF	Cdr: Vance DeVoe Brand Plt: Robert F. Overmyer MS: Joseph P. Allen MS: William B. Lenoir	**Deployable Payloads: None** 1. SBS-C/PAM-D (Satellite Business Systems/Payload Assist Module) 2. ANIK-C/PAM-D (Telesat Canada, Ltd/Payload Assist Module) **Attached PLB Payloads** 1. DFI (Development Flight Instrument) Pallet a. EIOM (Effects of Interaction of Oxygen with Materials) b. ISAL (Investigation of STS Atmospheric Luminosities)	**GAS (Getaway Special):** 1. G-026: ERNO/Stability of Metallic Dispersions (JSC PIP 14021) **Crew Compartment Payloads:** 1. SSIP (Shuttle Student Involvement Program) a. SE81-5 - Crystal Formation in Zero Gravity b. SE81-9 - Convection in Zero Gravity c. SE81-2 - Growth of Porifera **Special Payload Mission Kits:** 1. Mission Specialist Seats (2)
STS-6 Challenger Mission Duration: 120 hrs 23 mins 42 secs	Apr 4, 1983 KSC	Apr 9, 1983 DFRF	Cdr: Paul J. Weitz Plt: Karol J. Bobko MS: Donald H. Peterson MS: Story Musgrave	**Deployable Payloads: None** 1. TDRS-A/IUS (Tracking and Data Relay Satellite/Inertial Upper Stage) **Attached PLB Payloads** 1. CBSA (Cargo Bay Stowage Assembly) **GAS (Getaway Special):** 1. G-005: Asahi Shimban, Japan 2. G-049: U.S. Air Force Academy 3. G-381: Park Seed Company	**Crew Compartment Payloads:** 1. CFES (Continuous Flow Electrophoresis System) 2. MLR (Monodisperse Latex Reactor) 3. RME (Radiation Monitoring Experiment) 4. NOSL (Night/Day Optical Survey of Lightning) **Special Payload Mission Kits:** 1. Mini-MADS (Modular Auxiliary Data System) 2. EMU (Extravehicular Mobility Unit)

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-7 Columbia Mission Duration: 146 hrs 23 mins 59 secs	Jun 18, 1983 KSC	Jun 24, 1983 DFRF	Cdr: Robert L. Crippen Plt: Frederick H. Hauck MS: John M. Fabian MS: Sally K. Ride MS: Norman E. Thagard	**Deployable Payloads: None** 1. ANIK-C/PAM-D (Telesat Canada Satellite) 2. Palapa-B1/PAM-D (Indonesian Satellite 3. SPAS (Shuttle Pallet Satellite)-01 Unberthing/Berthing Tests **Attached PLB Payloads:** 1. OSTA (Office of Space and Terrestrial Applications)-2 2. CBSA (Cargo Bay Stowage Assembly) **GAS (Getaway Special):** 1. G-033: California Institute of Tech - Plant Gravireception and Liquid Dispersion 2. G-088: Edsyn, Inc. - Soldering of Material 3. G-002: Kayser Threde, W. Germany - Youth Fair Experiment	4. G-009: Purdue University - Geotropism Fluid Dynamics and Nuclear Particle Velocity 5. G-305: U.S. Air Force and National Research Labs - Ultraviolet Spectrometer 6. G-012: RCA, Camden, NJ Schools - Ant Colony 7. G-345: Goddard Space Flight Center and National Research Labs - Payload Bay Environment **Crew Compartment Payloads:** 1. CFES (Continuous Flow Electrophoresis System) 2. MLR (Monodisperse Latex Reactor) 3. SSIP (Shuttle Student Involvement Program) **Special Payload Mission Kits:** 1. RMS (Remote Manipulator System) S/N 201 2. TAGS (Text and Graphics System) 3. Mini-MADS (Modular Auxiliary Data System)
STS-8 Challenger Mission Duration: 145 hrs 8 mins 43 secs	Aug 30, 1983 KSC	Sep 5, 1983 DFRF	Cdr: Richard H. Truly Plt: Daniel C. Brandenstein MS: Dale A. Gardner MS: Guion S. Bluford, Jr. MS: William E. Thornton	**Deployable Payloads:** 1. Insat/PAM-D: Indian National Satellite 2. PFTA (Payload Flight Test Article) Unberthing/ Berthing Tests **Attached PLB Payloads:** 1. DFI (Development Flight Instrumentation) a. Oxygen Interaction and Heat Pipe Experiment b. Postal Covers (2 boxes) 2. CBSA (Cargo Bay Stowage Assembly) 3. SPAS (Shuttle Pallet Satellite)-01 Umbilical Disconnect **GAS (Getaway Special):** 1. U.S. Postal Service - 8 cans of philatelic covers 2. G-475: Asahi Shimban - Artificial Snow Crystal Experiment 3. G-348: Office of Space Science - Atomic Oxygen Erosion 4. G-347: Navy Research Lab - Ultraviolet PhotoFilm Test	5. G-346: Goddard Space Flight Center - Cosmic Ray Upset Experiment **Crew Compartment Payloads :** 1. CFES (Continuous Flow Electrophoresis System) 2. ICAT (Incubator-Cell Attachment Test) 3. ISAL (Investigation of STS Atmospheric Luminosities) 4. AEM (Animal Enclosure Module) - Evaluation of AEM using rate 5. RME (Radiation Monitoring Experiment) 6. SSIP (Shuttle Student Involvement Program) - Biofeedback **Special Payload Mission Kits:** 1. RMS (Remote Manipulator System) S/N 201 2. MADS (Modular Auxiliary Data System) II 3. COMSEC (Communication Security) 4. TAGS (Text and Graphics System)

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-9 Columbia Mission Duration: 247 hrs 47 mins 24 secs	Nov 28, 1983 KSC	Dec 8, 1983 DFRF	Cdr: John W. Young Plt: Brewster W. Shaw MS: Owen K. Garriott MS: Robert A. R. Parker PS: Byron K. Lichtenberg PS: Ulf Merbold	**Deployable Payloads: None** **Attached PLB Payloads:** 1. Spacelab-1: a. Spacelab Long Module b. Spacelab Pallet c. Tunnel d. Tunnel Extension e. Tunnel Adapter 2. Experiments a. Astronomy and Physics (6) b. Atmospheric Physics (4) c. Earth Observations (2)	d. Life Sciences (16) e. Materials Sciences (39) f. Space Plasma Physics (5) g. Technology (1) **GAS (Getaway Special): None** **Crew Compartment Payloads: None** **Special Payload Mission Kits:** 1. Cryogenic sets 4 and 5 2. Spacelab Utility Kit 3. TAGS (Text and Graphics System) 4. Galley
STS-41B Challenger Mission Duration: 191 hrs 15 mins 55 secs	Feb 3, 1984 KSC	Feb 11, 1984 KSC	Cdr: Vance D. Brand Plt: Robert L. Gibson MS: Bruce McCandless MS: Robert L. Stewart MS: Ronald E. McNair	**Deployable Payloads:** 1. Westar VI/PAM-D - Western Union Communications Satellite/Payload Assist Module 2. Palapa-B/PAM-D - Indonesian Communications Satellite/Payload Assist Module 3. SPAS (Shuttle Pallet Satellite)-01 - Not Deployed due to RMS anomaly 4. IRT (Integrated Rendezvous Target) - Failed to inflate due to internal failure **Attached PLB Payloads:** 1. MFR (Manipulator Foot Restraint) 2. SESA (Special Equipment Stowage Assembly) 3. Cinema 360 - High Quality Motion Picture Camera **GAS (Getaway Special):** 1. G-004: Utah State University/Aberdeen University 2. G-008: Utah State University/University of Utah/ Brighton High School	3. G-051: General Telephone Labs 4. G-309: U.S. Air Force 5. G-349: Goddard Space Flight Center (re: flight STS-8) **Crew Compartment Payloads:** 1. ACES (Acoustic Containerless Experiment System) 2. IEF (Isoelectric Focusing) 3. Cinema 360 Camera 4. Student Experiment SE81-10 - Effects of Zero g on Arthritis 5. MLR (Monodisperse Latex Reactor) 6. RME (Radiation Monitoring Experiment) **Special Payload Mission Kits:** 1. RMS (Remote Manipulator System) S/N 201 2. MMU (Manned Maneuvering Unit) - 2 3. Mini-MADS (Modular Auxiliary Data System) 4. Galley

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-41C Challenger Mission Duration: 167 hrs 40 mins 7 secs	Apr 6, 1984 KSC	Apr 13, 1984 DFRF	Cdr: Robert L. Crippen Plt: Francis R. Scobee MS: Terry J. Hart MS: James D. Van Hoften MS: George D. Nelson	**Deployable Payloads:** 1. LDEF (Long Duration Exposure Facility) - Office of Aeronautics and Space Technology 2. SMM (Solar Maximum Mission) Spacecraft - Rendezvous/Retrieve/Repair/Deploy **Attached PLB Payloads:** 1. SMRM (Solar Maximum Repair Mission) - Flight Support System 2. Cinema 360 - High Quality Motion Picture Camera 3. CBSA (Cargo Bay Stowage Assembly) - Bay 2, starboard side **GAS (Getaway Special): None**	**Crew Compartment Payloads:** 1. RME (Radiation Monitoring Experiment) 2. IMAX Camera - Canadian Commercial Company color film camera using 70mm x 280mm film 3. SSIP (Shuttle Student Involvement Program) - Comparison of honeycomb structure of bees in low g and bees in 1g **Special Payload Mission Kits:** 1. MMU (Manned Maneuvering Units) - 2 2. EMU (Extravehicular Mobility Units) - 3 3. RMS (Remote Manipulator System) S/N 302
STS-41D Discovery Mission Duration: 144 hrs 56 mins 4 secs	Aug 30, 1984 KSC	Sep 5, 1984 EAFB	Cdr: Henry W. Hartsfield Plt: Michael L. Coats MS: Richard M. Mullane MS: Steven A. Hawley MS: Judith A. Resnik PS: Charles D. Walker	**Deployable Payloads:** 1. SBS/PAM-D (Satellite Business System/Payload Assist Module) 2. Syncom IV-2 (Leased to DOD for UHF and SHF communications, also called Leasat) 3. Telstar/PAM-D (American Telephone and Telegraph/Payload Assist Module) **Attached PLB Payloads:** 1. OAST-1 (Office of Aeronautics and Space Technology) a. SAE (Solar Array Experiment) b. DAE (Dynamic Augmentation Experiment) c. SCCF (Solar Cell Calibration Facility) **GAS (Getaway Special): None**	**Crew Compartment Payloads:** 1. CFES III (Continuous Flow Electrophoresis System) 2. IMAX Camera - IMAX System Corporation (Canadian Company) 70mm x 280mm film 3. RME (Radiation Monitoring Experiment) USAF Space Division 4. Clouds - USAF Mikon F 3/T with 105mm lens 5. SSIP - (Shuttle Student Involvement Program) - Grow single crystal of Indium, Shawn Murphy, Hiram, OH; Rockwell Intl, Sponsor **Special Payload Mission Kits:** 1. RMS (Remote Manipulator System) S/N 301 2. MADS (Modular Auxiliary Data System)

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-41G Challenger Mission Duration: 197 hrs 23 mins 33 secs	Oct 5, 1984 KSC	Oct 13, 1984 KSC	Cdr: Robert L. Crippen Plt: Jon A. McBride MS: Kathryn D. Sullivan MS: Sally K. Ride MS: David D. Leetsma PS: Marc D. Garneau PS: Paul D. Scully-Power	**Deployable Payloads:** 1. ERBS (Earth Radiation Budget Satellite) **Attached PLB Payloads:** 1. OSTA-3 (Office of Space and Terrestrial Applications) a. SIR-B (Shuttle Imaging Radar) b. FILE (Feature Identification and Location Experiment) c. MAPS (Measurement of Air Pollution from Satellite) 2. LFC (Large Format Camera) 3. ORS (Orbital Refueling System **Crew Compartment Payloads:** 1. APE (Auroral Photography Experiment) 2. CANEX (Canadian Experiments) a. VISET b. ACOMEX c. OGLOW (Orbital Glow and Atmospheric Emissions) d. SPEAM (Sun Photometer Earth Atmosphere Measurement) e. SASSE (Space Adaptation Syndrome Stidoes Exp) 3. IMAX Camera 4. RME (Radiation Monitoring Experiment) 5. TLD (Thermoluminescent Dosimeter)	**GAS (Getaway Special):** 1. G007: Alabama Space and Rocket Center - Solidification of lead-antimony; and aluminum-copper student experiment 2. G032: ASAHI National Broadcasting Corp. Japan - Surface tension and viscosity; and materials experiment 3. G306: Air Force and U.S. Naval Research Lab - Low Energy Heavy Ions Search in the Inner Magnetosphere 4. G469: Goddard Space Flight Center - Cosmic Ray Upset Experiment (CRUX) 5. G038: Marshall-McShane - Vapor Deposition of Metals And Non-Metals 6. G074: McDonnell Douglas Company - Study Proposed Propellant Acquisition System 7. G013: Kayser Threde, West Germany - Verify Transport Mechanism in Halogen Lamps Performance in Extended Micro-g 8. G518: Utah State University - Study Solar Flux Separation, Capillary Waves on Water Surface, and Thermo-Capillary Flow in Liquid Columns **Special Payload Mission Kits:** 1. RMS (Remote Manipulator System) S/N 302 2. Galley 3. MMU (Manned Maneuvering Units) - 2 4. EMU (Extravehicular Mobility Units) - 3 5. PSA (Provisions Stowage Assembly)

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments
STS-51A Discovery Mission Duration: 191 hrs 44 mins 56 secs	Nov 8, 1984 KSC	Nov 16, 1984 KSC	Cdr: Frederick H. Hauck Plt: David M. Walker MS: Joseph P. Allen MS: Anna L. Fisher MS: Dale A. Gardner	**Deployable Payloads:** 1. Telesat-H (ANIK)-D2/PAM-D - Canadian 24 channel communications satellite. 2. Syncom IV-1 - Synchronous Communications Satellite, also called Leasat, leased to U.S. Navy **Retrieved Payloads:** 1. Palapa-B2 - Deployed during mission STS 41-B, failed to achieve proper transfer orbit due to PAM-D failure 2. Westar-VI - Deployed during mission 41-B, failed to achieve proper transfer orbit due to PAM-D failure **Attached PLB Payloads: None** **Crew Compartment Payloads:** 1. DMOS (Diffusive Mixing of Organic Solutions) 3M Corp 2. RME (Radiation Monitoring Experiment) **GAS (Getaway Special): None** **Special Payload Mission Kits:** 1. RMS (Remote Manipulator System) S/N 301 2. MMU (Manned Maneuvering Units) (2) 3. EMU (Extravehicular Mobility Units) (3) 4. PSA (Provisions Stowage Assembly) (2) 5. Satellite Retrieval Hardware: a. Modified Spacelab Pallet (2) b. MFR (Manipulator Foot Restraint) (2) c. Stinger Adapter (2) d. Satellite Adapter Trunnion (2) e. Berthing A Frame
STS-51C Discovery Mission Duration: 73 hrs 33 mins 23 secs	Jan 24, 1985 KSC	Jan 27, 1985 KSC	Cdr: Thomas K. Mattingly Plt: Loren J. Shriver MS: Ellison S. Onizuka MS: James F. Buchli PS: Gary E. Payton	**Deployable Payloads:** Data not available, DOD Classified Mission **Attached PLB Payloads:** Data not available, DOD Classified Mission **GAS (Getaway Special):** Data not available, DOD Classified Mission **Crew Compartment Payloads:** Data not available, DOD Classified Mission **Special Payload Mission Kits:** 1. RMS (Remote Manipulator System) S/N 301 2. Other data not available, DOD Classified Mission
STS-51D Discovery Mission Duration: 167 hrs 55 mins 23 secs	Apr 12, 1985 KSC	Apr 19, 1985 KSC	Cdr: Karol J. Bobko Plt: Donald E. Williams MS: M. Rhea Seddon MS: S. David Griggs MS: Jeffrey A. Hoffman PS: Charles D. Walker PS: E. J. Garn	**Deployable Payloads:** 1. Syncom IV-3 - Synchronous Communications Satellite, built by Hughes, third in a series of 4, leased to the Navy. Failed to activate after nominal deploy from Orbiter. 2. Telesat I (Anik C-1)/PAM-D - Canadian communications satellite. Placed in 3 year storage orbit. **Attached PLB Payloads: None** **GAS (Getaway Special):** 1. G035 - Asahi National Broadcasting Corp, Japan a. Surface tension and viscosity b. Alloy, lead oxide and carbon fiber 2. G471 - Goddard Space Flight Center, Thermal Engineering Branch. Capillary Pump Loop (CPU) Priming Experiment **Crew Compartment Payloads:** 1. CFES III (Continuous Flow Electrophoresis System) 2. AFE (American Flight Echocardiograph) 3. PPE (Phase Partitioning Experiment) 4. SSIP (Shuttle Student Involvement Program) (2) a. Corn Statolith b. Brain Cell **Special Payload Mission Kits:** 1. RMS (Remote Manipulator System) S/N 301 2. PSA (Provision Stowage Assembly) 3. MADS III (Modular Auxiliary Data System)

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-51B Challenger Mission Duration: 168 hrs 8 mins 46 secs	Apr 29, 1985 KSC	May 6, 1985 DFRF	Cdr: R. F. Overmyer Plt: F. D. Gregory MS: Don L. Lind MS: Norman E. Thagard MS: William E. Thornton PS: Lodewijk Vandenberg PS: Taylor Wang	**Deployable Payloads:** Refer to GAS Section **Attached PLB Payloads: Spacelab 3** 1. Materials Processing in Space a. Solution Growth of Crystals in Zero Gravity b. Mercuric Iodide Crystal Growth, Vapor Crystal Growth System (VCGS) c. Mercury Iodide Crystal Growth (MICG) 2. Technology a. Dynamics of Rotating and Oscillating Free Drops (DROP) 3. Environmental Observations a. Geophysical Fluid Flow Cell Experiment (GFFC) b. Atmospheric Trace Molecule Spectroscopy (ATMOS) c. Very Wide Field Galactic Camera (VWFGC) d. Aurora Observation 4. Astro Physics a Studies of the Ionization States of Solar and Galactic Cosmic Ray Heavy Nuclei (ION) 5. Life Sciences a. Research Animal Holding Facility (RAHF) b. Urine Monitoring Investigation (UMI) c. Autogenic Feedback Training (AFT)	**GAS (Getaway Special):** 1. G010 - NUSAT, Northern Utah Satellite. Weber State College, Utah, Utah State University, and New Mexico State University. First successful payload ejection from a GAS canister. 2. G303 - GLOMR, Global Low Orbiting Message Relay Satellite. Defense Systems, Inc., McLean, VA. Failed to eject from GAS canister. **Crew Compartment Payloads:** 1. UMS: Urine Monitoring System **Special Payload Mission Kits:** 1. Airlock 2. Long Transfer Tunnel 3. Galley 4. MPESS - Mission Peculiar Equipment Support Structure, carried ATMOS and ION.

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-51G Discovery Mission Duration: 169 hrs 38 mins 52 secs	Jun 17, 1985 KSC	Jun 24, 1985 EDW	Cdr: Daniel Brandenstein Plt: John O. Creighton MS: John M. Fabian MS: Steven R. Nagel MS: Shannon W. Lucid PS: Patrick Baudry PS: Prince Sultan Salman Al-Saud	**Deployable Payloads:** 1. Telstar-3D/PAM-D: Hughes 376 Communications Satellite with McDac Payload Assist Module Booster. Owned by AT&T Co. 2. ARABSAT-A/PAM-D: Aerospatiale Communication Satellite with McDac Payload Assist Module Booster. Owned by Saudi Arabian Communications Organization 3. MORELOS-A/PAM-D: Hughes 376 Communications Satellite with McDac Payload Assist Module Booster. Owned by Mexican Communications and Transportation Agency 4. Spartan-1: Shuttle Pointed Autonomous Research Tool for Astronomy a. SPSS: Spartan Flight Support Structure b. REM: Release/Engage Mechanism c. SEC: Scientific Experiment Carrier The SEC was released and retrieved using REM and RMS (Remote Manipulator System) **Attached PLB Payloads: None**	**GAS (Getaway Special);** 1. G007 - Alabama Space and Rocket Center/Marshall Amateur Radio Club - a. Solidification of Metals b. Crystal Growth c. Radish Seed Root Study d. Radio Transmission Experiment 2. G025 - ERNO - Dynamic Behavior of Liquid Propellants in low-g 3. G027: DFVLR of West Germany - Slipcasting in micro-g. 4. G028: DFVLR of West Germany - Manganese - Bismuth production in micro-g. 5. G034: Dickshire Coors, Texas High School Students a. 12 Biological/physical science experiments b. 1 Microprocessor controller 6. G314: USAF and USNRL - SURE (Space Ultraviolet Radiation Experiment) **Crew Compartment Payloads:** 1. ADSF - Automated Directional Solidification Furnace 2. FEE - French Echocardiograph Experiment 3. FPE - French Postural Experiment 4. HPTE - High Precision Tracking Experiment **Special Payload Mission Kits:** 1. RMS (Remote Manipulator System) S/N 301 2. Galley

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-51F Challenger Mission Duration: 190 hrs 45 mins 26 secs	Jul 29, 1985 KSC	Aug 6, 1985 EDW	Cdr: Charles Fullerton Plt: Roy D. Bridges MS: F. Story Musgrave MS: Anthony W. England MS: Karl G. Henize PS: Loren W. Acton PS: John-David Bartoe	**Deployable Payloads:** 1. Ejectable Plasma Diagnostic Package, Exp No 3, second flight of PDP (STS-3 first flight). First flight as free flyer to sample plasma away from Shuttle **Attached PLB Payloads: Spacelab 2** 1. Plasma Physics a. Deployable/Retrievable Plasma Diagnostic Package (PDP) (Exp 3) b. Plasma Depletion Experiments for Ionospheric and Radio astronomical Studies (Exp 4) 2. Astrophysical Research a. Small Helium Cooled Infrared Telescope (IRT) (Exp 5) b. Hard X-ray Imaging of Cluster of Galaxies and Other Extended X-ray Sources (XRT) (Exp 7) c. Elemental Composition and Energy Spectra of Cosmic Ray Nuclei (CRNE) (Exp 4) 3. Solar Astronomy a. Solar Magnetic and Velocity Field Measurement System (SOUP) (Exp 8) b. Coronal Helium Abundance Spacelab Experiment (CHASE) (Exp 9) c. High Resolution Telescope and Spectrograph (HRTS) (Exp 10) d. Solar Ultraviolet Spectral Irradiance Monitor (SUSIM) (Exp 11) 4. Technology a. Properties of Superfluid Helium Zero-g (SFHe) (Exp 13)	**GAS (Getaway Special): None** **Crew Compartment Payloads:** 1. Life Sciences a. Vitamin D Metabolites and Bone Demineralization (Exp 1) b. The Interaction of Oxygen and Gravity Induced Lignification (Exp 2) c. Shuttle Amateur Radio Experiment (SAREX) d. Dispenser Technology Experiment Dispensing Carbonated beverages in Micro-g e. Protein Crystal Growth **Special Payload Mission Kits:** 1. RMS (Remote Manipulator System) S/N 302 2. Galley

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-51I Discovery Mission Duration: 170 hrs 17 mins 42 secs	Aug 27, 1985 KSC	Sep 3, 1985 EDW	Cdr: Joe H. Engle Plt: Richard O. Covey MS: James van Hoften MS: John M. Lounge MS: William F. Fisher	**Deployable Payloads:** 1. ASC-1/PAM-D: American Satellite Company, first of two satellites built by RCA and owned by a partnership between Fairchild Industries and Continental Telecon Inc. PAM-D Payload Assist Module built by McDonnell Douglas. "D" indicates used for lightweight satellites, less than 2,250 lbs. 2. AUSSAT-1/PAM-D: Australian Communications Satellite, owned by Aussat Proprietary Ltd., built by Hughes Communications International, Model HS376. 3. SYNCOM IV-4: Synchronous Communications Satellite. Last in a series of four satellites built by Hughes Communication Services and leased to the Navy. Referred to as LEASAT when deployed. Failed to function after reaching correct geosynchronous orbit.	**Attached PLB Payloads: None** **GAS (Getaway Special): None** **Crew Compartment Payloads:** 1. PVTOS - Physical Vapor Transport Organic Solid Experiment, 3M Corporation. **Special Payload Mission Kits:** 1. RMS (Remote Manipulator System) S/N 301 2. Galley 3. Leasat-3 Salvage Equipment. Leasat-3 was successfully retrieved, repaired, and redeployed.
STS-51J Atlantis Mission Duration: 97 hrs 44 mins 38 secs	Oct 3, 1985 KSC	Oct 7, 1985 EDW	Cdr: Karol Bobko Plt: Ronald J. Grabe MS: Robert C. Stewart MS: David C. Hilmers PS: William A. Pailes	**Deployable Payloads:** Data not available, DOD Classified Mission **Attached PLB Payloads:** Data not available, DOD Classified Mission **GAS (Getaway Special):** Data not available. DOD Classified Mission	**Crew Compartment Payloads:** Data not available, DOD Classified Mission **Special Payload Mission Kits:** Data not available, DOD Classified Mission

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments
STS-61A Challenger Mission Duration: 168 hrs 44 mins 51 secs	Oct 30, 1985 KSC	Nov 6, 1985 EDW	Cdr: Henry Hartsfield Plt: Steven Nagel MS: Bonnie Dunbar MS: James Buchli MS: Guion Bluford PS: Ernst Messerschmid PS: Reinhard Furrer PS: Wubbo Ockels	**Deployable Payloads:** 1. GLOMR - Global Low Orbiting Message Relay Satellite. Built by Defense Systems, Inc, for DARPA. First launch attempt was on STS 51B which failed. Deployed from GAS canister. **Attached PLB Payloads: Spacelab D-1** First completed Spacelab mission under German Mission Management. Joint control by BMFT (Federal Ministry of Research and Technology) and DFVLR (Deutsche Forschugs-und Versurchanstalt Fur Luft-und Raumfahrt). 1. WL-Werkstoff Labor; experiments relating to metallurgy, crystal growth, glasses/ceramics, and fluid physics. Experiment facilities include: a. Mirror Heating Facility b. Isothermal Heating Facility c. Gradient Heating Facility d. High Temperature Thermostat e. Fluid Physics Module f. Cryostat 2. PK-Progresskammer; experiment relating to Bubble Transport Media. Experiment Facilities include: a. Holographic Interferometric Apparatus b. Marangoni Convention Boat c. Interdiffusion in Salt Melt 3. MD-MEDEA: A material science double rack. Experiment facilities include: a. Gradient Heating Facility b. Mono-ellipsoid Mirror Heating Facility c. High Precision Thermostat Facility 4. BW-Biowissenschaften: Experiments relating to Life Sciences. Experiments include: a. Biological (1) b. Medical (2) c. Botanical (3) 5. VS-Vestibular Sled: Experiments in Life Science regarding visio-vestibular coordination system and sensory perception process. Experiment facilities include: a. Mechanically accelerated sled b. Instrumented helmet 6. BR-Biorack: Multipurpose facility for biological research in cell development physiology, cell fertilization, and radiobiology. Facilities include: a. 2 Incubators b. Cooler freeze c. Glove box 7. NX-NAVEX: Navigation Experiment; located in payload bay attached to USS (Unique Support Structure) 8. ME-MEA: Materials Experiment Assembly: mounted on USS containing three materials, processing experiments. **GAS (Getaway Special): None** **Crew Compartment Payloads: None** **Special Payload Mission Kits:** 1. Airlock 2. Long Transfer Tunnel 3. Galley 4. USS - Unique Support Structure 5. RMS (Remote Manipulator System) S/N 302

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-61B Atlantis Mission Duration: 165 hrs 4 mins 49 secs	Nov 26, 1985 KSC	Dec 3, 1985 EAFB	Cdr: Brewster H. Shaw Plt: Bryan D. O'Connor MS: Mary L. Cleave MS: Sherwood C. Spring MS: Jerry L. Ross PS: Rudolfo Neri Vela PS: Charles Walker	**Deployable Payloads:** 1. MORELOS-B/PAM-D: Hughes 376 Comm Satellite with McDAC Payload Assist Module booster. Owned by Mexican Communications and Transportation Agency. 2. AUSSAT-2/PAM-D: Hughes 376 Comm Satellite with McDAC Payload Assist Module booster. Owned by Aussat Proprietary Ltd 3. SYNCOM KU-2/PAM-D: RCA built/owned 16 channel Ku-band communication satellite. First of four satellites. McDAC Payload Assist Module D2 is an uprated version of the PAM-D used for heavier payloads. **Attached PLB Payloads:** 1. EASE (Experiment Assembly of Structures in Extravehicular Activity): A study of EVA dynamics and human factors in construction of structures in space. An inverted tetrahedron consisting of six 12-feet beams was constructed by EV-1 and EV-2. 2. ACCESS (Assembly Concept for Construction of Erectable Space Structures): A validation of ground based timelines based on simulations. A 45-feet truss was assembled/disassembled by the two EV crew members. 3. ICBC (IMAX Cargo Bay Camera): A joint effort between the Canadian IMAX Corp and NASA, consists of a 70mm film camera in pressurized container used to document EASE/ACCESS experiments.	**GAS (Getaway Special):** 1. G-479 - Telesat-Canada a. Primary surface mirror production b. Metallic crystal production **Crew Compartment Payloads:** 1. CFES (Continuous Flow Electrophoresis System): Owned by McDonnell Douglas, separates biological samples using electrophoretic process. Third flight of this experiment. 2. DMOS (Diffusive Mixing of Organic Solutions); Sponsored by 3M Corporation, used to study organic crystal growth/kinetics, test molecular orbital model, and produce new materials for electro-optical applications. 3. MPSE (Morelos Payload Specialist Experiments): includes experiments in transportation of nutrients inside bean plants, inoculation of group bacteria viruses, germination of three seed types, and medical experiments testing internal equilibrium and volume change of the leg due to fluid shifts in zero-g. 4. OEX (Orbiter Experiments): An onboard experimental digital autopilot software package designed to provide precise stationkeeping capabilities between space vehicles. **Special Payload Mission Kits:** 1. Food Warmers (2), galley not flown. 2. RMS (Remote Manipulator System) S/N 301 3. PSA (Provision Stowage Assembly)

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments
STS-61C Columbia Mission Duration: 146 hrs 3 mins 51 secs	Jan 12, 1986 KSC	Jan 18, 1986 KSC	Cdr: Robert L. Gibson Plt: C. F. Bolden, Jr. MS: F. R. Chang-Diaz MS: George D. Nelson MS: Steven A. Hawley PS: Robert J. Cenker PS: C. William Nelson	**Deployable Payloads:** 1. SATCOM KU-1/PAM D-2: RCA built/owned 16 channel Ku-band communications satellite. Second of four satellites. McDAC Payload Assist Module D2 is an uprated version of the PAM-D which is used for heavier payloads. **Attached PLB Payloads:** 1. MSL-2 (Materials Science Laboratory) consisting of MSL carrier; MPE (Mission Peculiar Equipment), and 3 experiments: a. 3AAL (3-Axis Acoustic Levitator) b. ADSF (Automated Directional Solidification Furnace) c. SEECM (Shuttle Environmental Effects of Coated Mirror) 2. Hitchhiker G-1: A Goddard Space Flight Center (GSFC) managed program consisting of 3 experiments: a. PACS (Particle Analysis Camera for Shuttle) b. CPL (Capillary Pump Loop) c. SEECM (Shuttle Environmental Effects of Coated Mirror) 3. IR-IE (Infrared-Imaging Experiment) consisting of an RCA IR TV camera mounted in Orbiter CCTV pan/tilt unit. **GAS (Getaway Special):** 1. G-464: UVX (Ultraviolet Experiment), referred to as UCB University of California at Berkley) contains a Bowyer UV spectrometer. GSFC experiment. 2. G463: UVX, referred to as JHU (John Hopkins University) contains a Feldman Spectrophotometer. GSFC experiment. ACCESS experiments. 3. G462: UVX, referred to as GAP (GSFC Avionics Package) contains Telemetry System, Tape Recorder, and Battery. GSFC experiment. 4. G007: Alabama Space and Rocket Center/Marshall Amateur club. Contains 3 student experiments and 1 radio transmission experiment. 5. G446: HPLC (High Performance Liquid Chromatography) analytical columns. All Tech Assoc. Inc. 6. G494: PHOTONS (Photometric Thermospheric Oxygen Nightglow Study). Canada Centre for Space Science, National Research Council of Canada. 7. Not Numbered: EMP (Environmental Monitoring Package) measures the environment for GSFC. 8. G481: Unprimed, Prepared linen and painted canvas reactions to space travel. Vertical Horizons. 9. G062: 4 part experiment from PA State University/GE. 10. G449: JULIE (Joint Utilization of Laser Integrated Experiments) 4 part experiment from St. Mary's Hospital, Milwaukee, WI. 11. G332: 2 part experiment from Booker T. Washington Senior High School and High School for Engineering, Houston, TX 12. G310: USAF Academy experiment. Note: Above 12 listed GAS canisters mounted on GAS Bridge Carrier 13. G470: Experiment from GSFC and US Dept of Agriculture **Crew Compartment Payloads:** 1. IBSE (Initial Blood Storage Experiment) package in 4 middeck lockers. 2. CHAMP (Comet Halley Active Monitoring Program) uses cameras, spectroscopic grating, and filters to observe comet through aft flight deck overheat window. 3. HPCG (Handheld Protein Crystal Growth) experiment 4. SSIP (Shuttle Student Involvement Program) a. SE83-4, Production of Paper Fiber in Space b. SE83-6, Argon Injection as an Alternative to Honeycombing. c. SE82-19, Measurement of Auxin Levels and Starch Grains in Plant Roots. **Special Payload Mission Kits:** 1. GAS Bridge Carrier 2. Galley

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments
STS-51L Challenger Mission Duration: N/A	Jan 28, 1986 KSC	Jan 28, 1986	Cdr: Francis R. Scobee Plt: Michael J. Smith MS: Judith A. Resnik MS: Ellison S. Onizuka MS: Ronald E. McNair PS: Gregory Jarvis PS: S. Christa McAuliffe (Teacher)	**Deployable Payloads:** 1. TDRS-B/IUS: Tracking and Data Relay Satellite/ Inertial Upper Stage. 2. SPARTAN-203/Halley: Shuttle pointed Autonomous Research Tool for Astronomy/Halley's Comet Experiment Deployable/retrieval packages using RMS: a. SPARTAN experiment package: 1) 2 UV Spectrometers from Univ of Colorado 2) 2 Nikon F-3 Cameras 3) Optic Bench b. Halley's Comet Experiment; measure Halley's Comet composition/activity **Attached PLB Payloads: None** **GAS (Getaway Special): None** **Crew Compartment Payloads:** 1. Fluid Dynamics Experiment (FDE) - Hughes Aircraft Company Experiment composed of 6 experiments: a. Fluid position and ullage b. Fluid motion due to spin c. Fluid self-inertia d. Fluid motion due to payload deployment e. Energy dissipation due to fluid motion f. Fluid transfer 2. Comet Halley Active Monitoring Program (CHAMP), second flight. 3. Phase Partitioning Experiment (PPE) dissolves two polymer solutions in water to observe their separation 4. Teacher in Space: Six experiments including hydrophonics, magnetism, Newton's laws, effervescence, chromatography, and simple machines. 5. SSIP (Shuttle Student Involvement Program) packages: a. SE82-4: "The effects of weightlessness on grain formation and strength in metals" - L. Bruce, St. Louis, MO - Sponsor: McDonnell Douglas b. SE82-5: "Utilizing a semi-permeable membrane to direct crystal growth in zero gravity" - S. Cavou, Marlboro, NY - Sponsor: Union College c. "Chicken Embryo Development in Space" - J. Vellinger, Lafayette, IN - Sponsor: Kentucky Fried Chicken Corporation **Special Payload Mission Kits:** 1. RMS (Remote Manipulator System) 2. Galley 3. MADS

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-26 Discovery Mission Duration: 97 hrs 0 mins 11 secs	Sep 29, 1988 KSC	Oct 3, 1988 EAFB	Cdr: Frederick H. Hauck Plt: Richard O. Covey MS: John M. Lounge MS: David C. Hilmers MS: George D. Nelson	**Deployable Payloads:** 1. TDRS-C/IUS: Tracking and Data Relay Satellite/ Inertial Upper Stage. **Attached PLB Payloads:** 1. OASIS-1: Orbiter Experiment Autonomous Supporting Instrumentation System measures and records payload bay environmental data. **Crew Compartment Payloads:** 1. PVTOS - Physical Vapor Transport of Organic Solids, 3M Corporation. Second flight 2. ADSF - Automated Directional Solidification Furnace, MSFC, third flight, test material solidification in zero g. 3. IRCFE - Infrared Communication Flight Experiment, JSC, first flight. Test infrared transmitting crew headsets. 4. PCG - Protein Crystal Growth, MSFC, flown four previous flights in less complicated configurations to examine growth of protein crystals in zero g. 5. IEF - Isoelectric Focusing, MSFC, second flight, test isoelectric transport through a permeable membrane in zero g.	6. PPE - Phase Partitioning Experiment, MSFC, second flight, photograph fluid phase partitioning phenomena in zero g 7. ARC - Aggregation of Red Blood Cells, MSFC and Australia, investigate aggregation characteristics of human red blood cells in zero g. 8. MLE - Mesoscale Lightning Experiment, MSFC, first flight, photograph atmospheric lightning activity from orbit. 9. ELRAD - Earth Limb Radiance Experiment, JSC, first flight, photograph earth limb radiance pre-sunrise/ post-sunset. 10. Student Experiment SE82-4 - "Effects of weightlessness on Ti grain formation and strength." L. Bruce, St. Louis, MO, Sponsor: McDonnell Douglas 11. Student Experiment SE82-5 - "Utilizing a semi-permeable membrane to direct crystal growth in zero gravity." S. Cavou, Marlboro, NY. Sponsor: Union College **GAS (Getaway Special): None** **Special Payload Mission Kits:** 1. Galley 2. MADS
STS-27 Atlantis Mission Duration: 105 hrs 5 mins 37 secs	Dec 2, 1988 KSC	Dec 6, 1988 EAFB	Cdr: Robert L. Gibson Plt: Guy S. Gardner MS: Richard M. Mullane MS: Jerry L. Ross MS: William M. Shepherd	**Deployable Payloads:** Data not available, DOD Classified Mission. **Attached PLB Payloads:** Data not available, DOD Classified Mission. **GAS (Getaway Special): None** Data not available. DOD Classified Mission.	**Crew Compartment Payloads:** Data not available, DOD Classified Mission. **Special Payload Mission Kits:** Data not available, DOD Classified Mission.

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-29 Discovery Mission Duration: 119 hrs 38 mins 52 secs	Mar 13, 1989 KSC	Mar 17, 1989 EAFB	Cdr: Michael L. Coats Plt: John E. Blaha MS: James P. Bagian MS: James F. Buchli MS: Robert C. Springer	**Deployable Payloads:** 1. TDRS-D/IUS: Tracking and Data Relay Satellite/ Inertial Upper Stage. One of four identical communications satellites providing support for STS and other customers. **Attached PLB Payloads:** 1. SHARE (Space Station Heat Pipe Advanced Radiator Element) 2. OASIS-1 (Orbiter Experiments Autonomous Supporting Instrumentation System	**GAS (Getaway Special): None** **Crew Compartment Payloads:** 1. Protein Crystal Growth (PCG-111-1) 2. Chromosome and Plant Cell Division in Space (CHROMEX) 3. IMAX Camera 4. Air Force Maui Optical Site Calibration Test (AMOS) 5. Chicken Embryo Development (CHIX) in space. 6. Effects of Weightlessness of Bones (SSIP 82-08) **Special Payload Mission Kits: None**
STS-30 Atlantis Mission Duration: 96 hrs 56 mins 28 secs	May 4, 1989 KSC	May 8, 1989 EAFB	Cdr: David M. Walker Plt: Ronald J. Grabe MS: Norman E. Thagard MS: Mary L. Cleave MS: Mark C. Lee	**Deployable Payloads:** 1. Magellan/IUS - Unmanned three-axis attitude-controlled exploration spacecraft containing systems required to achieve orbit of Venus and map its surface. **Attached PLB Payloads: None**	**GAS (Getaway Special): None** **Crew Compartment Payloads:** 1. Fluids Experiment Apparatus (FEA) 2. Mesoscale Lightning Experiment (MLE) 3. Air Force Maui Optical Site Calibration Test (AMOS) **Special Payload Mission Kits: None**
STS-28 Columbia Mission Duration: 121 hrs 0 mins 8 secs	Aug 8, 1989 KSC	Aug 13, 1989 EAFB	Cdr: Brewster H. Shaw Plt: Richard N. Richards MS: David C. Leetsma MS: James C. Adamson MS: Mark N. Brown	**Deployable Payloads:** Data not available, DOD Classified Mission. **Attached PLB Payloads:** Data not available, DOD Classified Mission. **GAS (Getaway Special):** Data not available, DOD Classified Mission.	**Crew Compartment Payloads:** Data not available, DOD Classified Mission. **Special Payload Mission Kits:** Data not available. DOD Classified Mission.
STS-34 Atlantis Mission Duration: 119 hrs 39 mins 20 secs	Oct 18, 1989 KSC	Oct 23, 1989 EAFB	Cdr: Donald E. Williams Plt: Michael McCulley MS: Ellen S. Baker MS: Franklin R. Chang-Diaz MS: Shannon W. Lucid	**Deployable Payloads:** 1. Galileo/IUS - Unmanned spin-stabilized exploration spacecraft comprising a Jupiter orbiter and a Jupiter atmospheric entry probe mated to the IUS. **Attached PLB Payloads:** 1. Shuttle Solar Backscatter Ultraviolet (SSBUV) **GAS (Getaway Special):** 1. Zero Gravity Growth of Ice Crystals	**Crew Compartment Payloads:** 1. Polymer Morphology 2. Growth Hormone Concentration & Distribution in Plants 3. Sensor Technology Experiment 4. IMAX Camera 5. Mesoscale Lightning Experiment 6. Air Force Maui Optical Site Calibration Test (AMOS) **Special Payload Mission Kits: None**

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-33 Discovery Mission Duration: 120 hrs 6 mins 46 secs	Nov 22, 1989 KSC	Nov 27, 1989 EAFB	Cdr: Frederick D. Gregory Plt: John E. Blaha MS: Manley L. Carter MS: Franklin Musgrave MS: Kathryn C. Thornton	**Deployable Payloads:** Data not available, DOD Classified Mission. **Attached PLB Payloads:** Data not available, DOD Classified Mission. **GAS (Getaway Special):** Data not available, DOD Classified Mission.	**Crew Compartment Payloads:** Data not available, DOD Classified Mission. **Special Payload Mission Kits:** Data not available, DOD Classified Mission.
STS-32 Columbia Mission Duration: 261 hrs 0 mins 37 secs	Jan 9, 1990 KSC	Jan 20, 1990 EAFB	Cdr: Daniel C. Brandenstein Plt: James D. Wetherbee MS: Bonnie J. Dunbar MS: Marsha S. Ivins MS: G. David Low	**Deployable Payloads:** 1. Syncom IV-5, a geostationary communications satellite also known as Leasat; leased to U.S. Navy **Attached PLB Payloads: None** **Returned Cargo:** 1. LDEF, a non-powered space vehicle containing experiments - Deployed on STS-41C. **Crew Compartment Payloads:** 1. American Flight Echocardiograph (AFE) 2. Air Force Maui Optical Site Calibration Test (AMOS) 3. Characterization of Neurospora Circadian Rhythms (CNCR)	4. Fluids Experiment Apparatus 5. IMAX Camera 6. Latitude/Longitude Locator (L3) 7. Mesoscale Lightning Experiment (MLE) 8. Protein Crystal Growth (PCG) **GAS (Getaway Special): None** **Special Payload Mission Kits:** 1. Remote Manipulator System (RMS) 2. Galley 3. MADS
STS-36 Atlantis Mission Duration: 106 hrs 18 mins 22 secs	Feb 28, 1990 KSC	Apr 14, 1990 DFRF	Cdr: John D. Creighton Plt: John H. Casper MS: David C. Hilmers MS: Richard M. Mullane MS: Pierre J. Thuot	**Deployable Payloads:** Data not available, DOD Classified Mission. **Attached PLB Payloads:** Data not available, DOD Classified Mission. **GAS (Getaway Special):** Data not available, DOD Classified Mission.	**Crew Compartment Payloads:** Data not available, DOD Classified Mission. **Special Payload Mission Kits:** Data not available, DOD Classified Mission.
STS-31 Discovery Mission Duration: 121 hrs 16 mins 6 secs	Apr 24, 1990 KSC	Apr 29, 1990 EAFB	Cdr: Loren J. Shriver Plt: Charles F. Bolden MS: Bruce McCandless MS: Steven A. Hawley MS: Kathryn D. Sullivan	**Deployable Payloads:** 1. Hubble Space Telescope (HST), a large aperture optical telescope. **Attached PLB Payloads:** 1. IMAX Cargo Bay Camera (ICBC) 2. Ascent Particle Monitor (APM) **GAS (Getaway Special): None** **Crew Compartment Payloads:** 1. Air Force Maui Optical Site Calibration Test (AMOS)	2. IMAX Camera 3. Investigation into Polymer Membrane Processing (IPMP) 4. Protein Crystal Growth (PCG) 5. Radiation Monitoring Experiment (RME) 6. Investigation of Arc and Ion Behavior in Microgravity (Student Experiment 82-16) **Special Payload Mission Kits:** 1. Remote Manipulator System (RMS) 2. Galley 3. HST EVA Tools

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-41 Discovery Mission Duration: 98 hrs 10 mins 3 secs	Oct 6, 1990 KSC	Oct 10, 1990 DFRF	Cdr: Richard N. Richards Plt: Robert D. Cabana MS: Bruce E. Melnick MS: William M. Shepherd MS: Thomas D. Akers	**Deployable Payloads:** 1. Ulysses/IUS/PAM-S **Attached PLB Payloads:** 1. Shuttle Solar Backscatter Ultraviolet (SSBUV) 2. Intelsat Solar Array Coupon (ISAC) - Attached to RMS arm **GAS (Getaway Special): None** **Crew Compartment Payloads:** 1. Chromosome and Plant Cell Division in Space (CHROMEX) 2. Solid Surface Combustion Experiment (SSCE)	3. Voice Command System (VCS) 4. Physiological Systems Experiment (PSE) 5. Radiation Monitor Experiment (RME-III) 6. Investigation into Polymer Membrane Processing (IPMP) 7. Air Force Maui Optical Site (AMOS) **Special Payload Mission Kits:** 1. Remote Manipulator System (RMS) 2. Galley 3. Radioisotope Generator (TRG) Cooling System
STS-38 Atlantis Mission Duration: 117 hrs 54 mins 27 secs	Nov 15, 1990 KSC	Nov 20, 1990 KSC	Cdr: Richard O. Covey Plt: Frank L. Culbertson MS: Robert C. Springer MS: Carl J. Meade MS: Charles D. Gemar	**Deployable Payloads:** Data not available, DOD Classified Mission. **Attached PLB Payloads:** Data not available, DOD Classified Mission. **GAS (Getaway Special):** Data not available, DOD Classified Mission.	**Crew Compartment Payloads** Data not available, DOD Classified Mission. **Special Payload Mission Kits:** Data not available, DOD Classified Mission.
STS-35 Columbia Mission Duration: 215 hrs 5 mins 7 secs	Dec 2, 1990 KSC	Dec 11, 1990 DFRF	Cdr: Vance Brand Plt: Guy S. Gardner MS: John M. Lounge MS: Jeffrey A. Hoffman MS: Robert A. R. Parker PS: Ronald A. Parise PS: Samuel T. Durrance	**Deployable Payloads: None** **Attached PLB Payloads:** 1. Astro-1 - Three ultraviolet telescopes attached to an Instrument Pointing System (IPS): a. Wisconsin UV Photopolarimeter Experiment (WUPPE) b. UV Imaging Telescope (UIT) c. Hopkins UV Telescope (HUT) 2. BBXRT - Broad Band X-ray Telescope. Attached to its own two-axis pointing system (TAPS)	**GAS (Getaway Special): None** **Crew Compartment Payloads:** 1. Shuttle Amateur Radio Experiment (SAREX) 2. Air Force Maui Optical Site (AMOS) **Special Payload Mission Kits:** 1. Galley 2. Aerodynamic Coefficient Identification Package (ACIP)
STS-37 Atlantis Mission Duration: 143 hrs 22 mins 45 secs	Apr 5, 1991 KSC	Apr 11, 1991 EAFB	Cdr: Steven R. Nagel Plt: Kenneth D. Cameron MS: Linda M. Godwin MS: Jerome Apt MS: Jerry L. Ross	**Deployable Payloads:** 1. Gamma Ray Observatory (GRO), an unmanned astronomical observatory designed to image objects at high energy (gamma ray) wavelengths. **Attached PLB Payloads:** 1. Crew and Equipment Translation Aids (CETA) - designed to evaluate candidate techniques/equipment for EVA crewmember translation 2. Ascent Particle Monitor (APM) - designed to assess the particulate contamination in the Orbiter PLB during ascent.	**GAS (Getaway Special): None** **Crew Compartment Payloads:** 1. Protein Crystal Growth (PCG)-II 2. Air Force Maui Optical Site (AMOS) 3. Radiation Monitoring Equipment (RME)-III 4. Shuttle Amateur Radio Experiment (SAREX)-II 5. Bioserve/Instrumentation Technology 6. Associates Materials Dispersion Apparatus (BIMDA) **Special Payload Mission Kits:** 1. Remote Manipulator System (RMS) S/N 301

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments
STS-39 Discovery Mission Duration: 199 hrs 23 mins 17 secs	Apr 28, 1991 KSC	May 6, 1991 EAFB	Cdr: Michael L. Coats Plt: Blaine L. Hammond, Jr. MS: Guion S. Bluford MS: Gregory J. Harbaugh MS: Richard J. Hieb MS: Donald R. McMonagle MS: Charles L. Veach	**Deployable Payloads:** 1. Shuttle Payload Autonomous Satellite (SPAS)-II/ Infrared Background Signature Survey (IBSS) - SPAS-II/IBSS was designed to observe rocket plume firings at infrared wavelengths. **Attached PLB Payloads:** 1. Air Force Program (AFP)-675 - The objective of AFP-675 was to observe near-Earth space and celestial objects at infrared & ultraviolet wavelengths. 2. Space Test Payload (STP)-1 - Five USAF experiments mounted on a Hitchhiker-M carrier. 3. Multi-Purpose Experiment Container (MPEC) - An additional USAF experiment mounted on STP-1. **GAS (Getaway Special): None** **Crew Compartment Payloads:** 1. Cloud Logic to Optimize Use of Defense Systems (CLOUDS)-1A 2. Radiation Monitoring Equipment (RME)-III **Special Payload Mission Kits:** 1. Remote Manipulator System (RMS) S/N 301
STS-40 Columbia Mission Duration: 218 hrs 15 mins 14 secs	Jun 5, 1991 KSC	Jun 14, 1991 DFRF	Cdr: Bryan O. O'Connor Plt: Sidney M. Gutierrez MS: James P. Bagian MS: Tamara E. Jernigan MS: M. Rhea Seddon PS: Drew F. Gaffney PS: Millie Hughes-Fulford	**Deployable Payloads: None** **Attached PLB Payloads: Spacelab Life Sciences (SLS)-1** a. Spacelab Long Module b. Tunnel c. Tunnel Extension d. Tunnel Adapter Experiments a. 6 Body Systems b. 6 Cardiovascular/Cardiopulmonary c. 3 Blood System d. 6 Musculoskeletal e. 3 Neurovestibular f. 1 Immune System g. 1 Renal/Endocrine System Gas Bridge Assembly (GBA)- 12 GAS experiments mounted on a truss structure in the PLB. **GAS (Getaway Special):** 12 Experiments on GBA 1. Solid State Microaccelerometer Experiment 2. Experiment in Crystal Growth 3. Orbital Ball Bearing Experiment 4. In-Space Commercial Processing 5. Foamed Ultralight Metals 6. Chemical Precipitate Formation 7. Microgravity Experiments 8. Flower and vegetable seeds exposure to Space 9. Semiconductor Crystal Growth Experiment 10. Active Soldering Experiments 11. Orbiter Stability Experiment 12. Effects of cosmic Ray Radiation on Floppy Disks and Plant Seeds Exposure to Microgravity **Crew Compartment Payloads:** 1. Physiological Monitoring System (PMS) 2. Urine Monitoring System (UMS) 3. Animal Enclosure Modules (AEM) 4. Middeck Zero-Gravity Experiment (MODE) **Special Payload Mission Kits:** 1. Airlock Transfer Tunnel

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-43 Atlantis Mission Duration: 213 hrs 22 mins 27 secs	Aug 2, 1991 KSC	Aug 11, 1991 KSC	Cdr: John E. Blaha Plt: Michael A. Baker MS: James C. Adamson MS: G. David Low MS: Shannon E. Lucid	**Deployable Payloads:** 1. TDRS-E/IUS: Tracking and Data Relay Satellite/ Inertial Upper Stage. One of four identical communications satellites providing support for STS and other customers. **Attached PLB Payloads:** 1. Space Station Heatpipe Advanced Radiator Element (SHARE-II) 2. Shuttle Solar Backscatter Ultraviolet (SSBUV) 3. Optical Communications Through the Window (OCTW) Experiments 1. Gas Bridge Assembly (GBA)	**GAS (Getaway Special):** 1. Tank Pressure Control Experiment (TPCE) **Crew Compartment Payloads:** 1. Air Force Maui Optical Site (AMOS) 2. Auroral Photography Experiment (APE) 3. Bioserve/Instrumentation Technology Associates Materials Dispersion Apparatus (BIMDA) 4. Investigations into Polymer Membrane Processing (IPMP) 5. Protein Crystal Growth (PCG) 6. Space Acceleration Measurement System (SAMS) 7. Solid Surface Combustion System (SSCS) 8. Ultraviolet Plume Instrument **Special Payload Mission Kits: None**
STS-48 Discovery Mission Duration: 128 hrs 27 mins 51 secs	Sep 12, 1991 KSC	Sep 18, 1991 EAFB	Cdr: John O. Creighton Plt: Kenneth S. Reightler MS: Mark F. Brown MS: James F. Buchli MS: Charles D. Gemar	**Deployable Payloads:** 1. Upper Atmosphere Research Satellite (UARS) **Attached PLB Payloads:** Experiments 1. Gas Bridge Assembly (GBA) **Crew Compartment Payloads:** 1. Ascent Particle Monitor (APM) 2. Cosmic Radiation Effects and Activation Monitor (CREAM)	3. Radiation Monitoring Experiment (RME) 4. Investigations into Polymer Membrane Processing (IPMP) 5. Protein Crystal Growth (PCG) 6. Middeck 0-Gravity Dynamics Experiment (MODE) 7. Shuttle Activation Monitor (SAM) 8. Physiological and Anatomical Rodent Experiment (PARE) **GAS (Getaway Special): None** **Special Payload Mission Kits: None**
STS-44 Atlantis Mission Duration: 166 hrs 52 mins 27 secs	Nov 14, 1991 KSC	Dec 1, 1991 EAFB	Cdr: Frederick D. Gregory Plt: Terence T. Henricks MS: F. Story Musgrave MS: Mario Runco, Jr. MS: James S. Voss PS: Thomas J. Hennen	**Deployable Payloads:** 1. Defense Support Program/Inertial Upper Stage satellite (DSP/IUS) **Attached PLB Payloads:** 1. Interim Operational Contamination Monitor (IOCM) Experiments 1. Gas Bridge Assembly (GBA) **Crew Compartment Payloads:** 1. Terra Scout 2. Military Man in Space (M88-1)	3. Air Force Maui Optical Site (AMOS) 4. Cosmic Radiation Effects and Activation Monitor (CREAM) 5. Shuttle Activation Monitor (SAM) 6. Radiation Monitoring Experiment (RME-III) 7. Visual Function Monitor (VFT-1) 8. Ultraviolet Plume Instrument (UVPI) **GAS (Getaway Special): None** **Special Payload Mission Kits: None**

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-42 Discovery Mission Duration: 193 hrs 15 mins 43 sec	Jan 22, 1992 KSC	Jan 30, 1992 EAFB	Cdr: Ronald J. Grabe Plt: Steven S. Oswald MS: Norman E. Thagard MS: William F. Readdy MS: David C. Hilmers PS: Roberta L. Bondar PS: Ulf D. Merbold	**Deployable Payloads: None** **Attached PLB Payloads:** International Microgravity Laboratory-1 (Spacelab Long Module) Objective: Conduct 9 Materials Science and 7 Life Sciences experiments in microgravity: 1. Fluid Experiment System - Crystal growth and fluid behavior 2. Vapor Crystal Growth System - Reflight from Spacelab 3 3. Mercury Iodide Crystal Growth - Reflight from Spacelab 3 4. Protein Crystal Growth - Reflight from STS 26, 29, 32, 37 (Middeck) 5. Organic Crystal Growth Facility - Crystal growth 6. Cryostat- Crystal growth 7. Space Acceleration Monitoring System - Measure on-orbit shuttle acceleration to support other microgravity experiments 8. Critical Point Facility - Measure material properties at the critical point 9. Gravitational Plant Physiology Facility - Biological Investigation of plants during spaceflight 10. Biorack - Biological investigation of various life forms during spaceflight 11. Space Physiology Experiments - Investigate human space adaptation and motion sickness 12. Microgravity Vestibular Investigations - Study space motion sickness 13. Biostack - Investigate space radiation effects on biological materials 14. Mental Workload and Performance Evaluation - Test human performance of computer tasks in Zero-G 15. Radiation Monitoring Container/Dosimeter - Measure effect of space radiation on biological material	**GAS (Getaway Special) Bridge consisting of 12 canisters:** 1. G-086 - Effects of microgravity on cysts hatched in space; thermal conductivity and bubble velocity of air in water 2. G-140 - Marangoni convection in a floating zone 3. G-143 - Glass bubbles in glass melts 4. G-329 - Solidification of phenomena in metal alloys 5. G-336 - Measurement of diffuse zodiacal and galactic emissions at B, R, and V standard 6. G-337 - Performance of thermoacoustic refrigerator under microgravity 7. G-457 - Gas-liquid separation under microgravity 8. G-609, G-610 - Ultraviolet observations of deep space 9. G-614 - Motion of debris under microgravity conditions: low melting point materials processing 10. Middeck 0-Gravity Dynamics Experiment (MODE) 11. GAS ballast payload no. 1 (GPB #1) 12. GAS ballast payload no. 2 (GPB #2) **Crew Compartment Payload:** 1. Gelation of Sols: Applied Microgravity Research (GOSAMR) - Objective: Investigate processing of gelled sols in microgravity 2. Student Experiment SE 93-2 - Objective: Study zero gravity capillary rise of liquid through granular porous media 3. Student Experiment SE 81-9 - Objective: Study convection in zero gravity 4. Investigation into Polymer Membrane Processing (IPMP) Objective: Manufacture polymers in space 5. Radiation Monitoring Experiment (RME-III) - Objective: Measure radiation environment on-orbit **Special Payload Mission Kits: None**

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-45 Atlantis Mission Duration: 214 hrs 10 mins 24 secs	Mar 24, 1992 KSC	Apr 2, 1992 KSC	Cdr: Charles F. Bolden Plt: Brian K. Duffy MS: Kathryn D. Sullivan MS: David C. Leestma MS: C. Michael Foale PS: Dirk D. Frimout PS: Bryon K. Lichtenburg	**Deployable Payloads: None** **Attached PLB Payloads:** ATLAS-1 (2 Spacelab Pallet and Igloo) - Objective: Study the composition of the middle atmosphere and its variations over an 11 year solar cycle. This is the first of 10 planned ATLAS missions over the next 11 years. Atmosphere Physics: 1. Atmosphere Trace Molecule Spectroscopy (ATMOS) - Previously flown on Spacelab 1, Reflight from Spacelab 3 2. Millimeter Wave Atmospheric Sounder (MAS) - First flight 3. Atmospheric Lyman Alpha Emissions (ALAE) - Previously flown on Spacelab 1 4. Grille Spectrometer (GRILLE) - Previously flown on Spacelab 1 5. Imaging Spectrometric Observatory (ISO) - Previously flown on Spacelab 1 Solar Science: 1. Active Cavity Radiometer Irradiance Monitor (ACRIM) - ACRIM 1 flown on the solar maximum satellite 2. Measurement of the Solar Constant (SOLCON) - Previously flown on Spacelab 1 3. Solar Spectrum Measurement from 180 to 3200 Nanometers (SOLSPEC) - Previously flown on Spacelab 1 4. Solar Ultraviolet Spectral Irradiance Monitor (SUSIM) - Previously flown on Spacelab 2 and on the Upper Atmosphere Research Satellite (UARS) Space Plasma Physics: 1. Atmospheric Emissions Photometric Imaging (AEPI) - Previously flown on Spacelab 1 2. Space Experiments with Particle Accelerators (SEPAC) - Previously flown on Spacelab 1 3. Energetic Neutral Atom Precipitation	Ultraviolet Astronomy: 1. Far Ultraviolet Space Telescope (FAUST) - Previously flown on Spacelab 1 2. Shuttle Solar Backscatter Ultraviolet/A (SSBUV/A) - Objective: To provide more accurate and reliable readings of global ozone to aid in the calibration of backscatter ultraviolet instruments being flown on free-flying satellites **GAS (Getaway Special):** 1. Getaway Special 229 (GAS-229) - Objective: To melt and regrow gallium arsenide crystals with convective effects absent **Crew Compartment Payload:** 1. Investigation into Polymer Membranes Processing (IPMP)- Objective: To flash evaporate mixed solvent systems in the absence of convection to control the porosity of the polymer membrane in microgravity 2. Space Tissue Loss-01 (STL-01) - Objective: To monitor the activities of tissue samples at the cellular level under the influence of microgravity 3. Radiation Monitoring Equipment-III (RME-III) - Objective: To measure ionizing radiation over repeated time intervals and digitally store the resulting data 4. Visual Function Tester-2 (VFT-2) - Objective: To measure basic vision performance parameters in an orbital space flight environment 5. Cloud Logic to Optimize Use of Defense System - Objective: To obtain photographic sequences of cloud fields of interest as targets of opportunity 6. Shuttle Amateur Radio Experiment (SAREX II) - Objective: To demonstrate voice, slow-scan television (SSTV), and pocket radio. All transmitted on 2 meter capabilities and fast scan television (FSTV) transmitted on 70 cm capability.

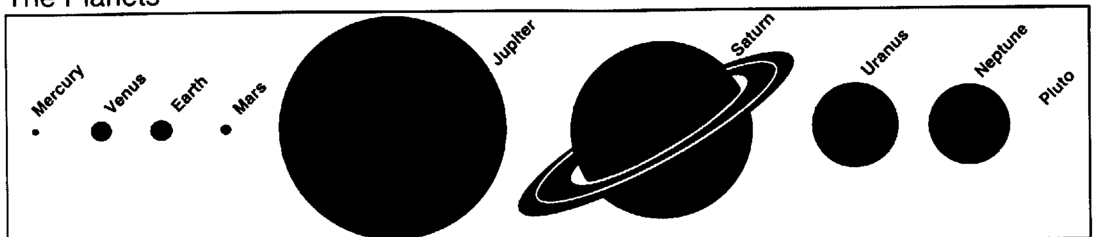
Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-49 Endeavour Mission Duration: 213 hrs 17 mins 38 secs	May 2, 1992 KSC	May 16, 1992 EAFB	Cdr: Daniel C. Brandenstein Plt: Kevin P. Chilton MS: Richard J. Hieb MS: Bruce E. Melnick MS: Pierre J. Thout MS: Kathryn C. Thornton MS: Thomas D. Akers	**Deployable Payloads:** 1. Intelsat VI F3 (International Telecommunications Satellite)/perigee kick motor (PKM) **Attached PLB Payloads:** 1. Assembly of station by EVA methods **GAS (Getaway Special): None**	**Crew Compartment Payloads:** 1. Commercial protein crystal growth (CPGC) 2. Air Force Maui Optical Site Calibration (AMOS) 3. Ultraviolet Plume Instrument (UVPI) **Special Payload Mission Kits: None**
STS-50 Columbia Mission Duration: 331 hrs 30 mins 04 secs	Jun 25, 1992 KSC	Jul 9, 1992 KSC	Cdr: Richard N. Richards Plt: Keneth D. Bowersox MS: Bonnie J. Dunbar MS: Carl J. Meade MS: Ellen S. Baker PS: Lawrence J. DeLucas	**Deployable Payloads: None** **Attached PLB Payloads:** 1. U.S. Microgravity Laboratory (USML-1) 2. Investigation into Polymer Membrane Processing (IPMP) 3. Shuttle Amateur Radio Experiment-II (SAREX-II) 4. Ultraviolet Plume Instrument (UVPI) 5. Orbital Acceleration Research Experiment (OARE) 6. Zeolite Crystal Growth (ZCG) 7. Astroculture 8. Generic Bioprocessing Apparatus (GBA) 9. Protein Crystal Growth (PCG) Block 1	**GAS (Getaway Special): None** **Crew Compartment Payloads:** 1. Zeolite Crystal Growth 2. Generic Bioprocessing Apparatus with 1 Refrigerator/Incubator Module (R/IM) 3. Astroculture (ASC) 4. Protein Crystal Growth (PCG) Block 1 with 3 R/IMs 5. Investigation into Polymer Membrane Processing (IPMP) 6. Shuttle Amateur Radio Experiment-II (SAREX-II) 7. Ultraviolet Plume Instrument (UVPI) **Special Payload Mission Kits: None**
STS-46 Atlantis Mission Duration: 191 hrs 16 mins 07 secs	Jul 31, 1992 KSC	Aug 8, 1992 KSC	Cdr: Loren J. Shriver Plt: Andrew M. Allen MS: Jeffrey A. Hoffman MS: Franklin R. Chang-Diaz MS: Claude Nicollier MS: Martha S. Ivins PS: Franco Malerba	**Deployable Payloads:** 1. EURECA **Attached PLB Payloads** 1. Tethered Satellite System (TSS-1) 2. Evaluation of Oxygen Interation with Materials-III/Thermal Energy Management Processes 2A-3 (EOIM-III/Temp 2A) 3. IMAX Cargo Bay Camera (ICBC) 4. Consortium for Material Development in Space Complex Autonomous Payload-II (CONCAP-II) 5. CONCAP-III 6. Limited Duration Space Environment Candidate Materials Exposure (LDCE)	**GAS (Getaway Special): None** **Crew Compartment Payloads:** 1. Gas Autonomous Payload Controller (GAPC) for Use in ICBC Operations 2. Pituitary Growth Hormone Cell Function (PHCF) 3. Air Force Maui Optical Site Calibration (AMOS) (Passive Requirements Only) 4.. Ultraviolet Plume Instrument (UVPI) **Special Payload Mission Kits: None**

Summary of Shuttle Payloads and Experiments

Flight	Launch Date	Landing Date	Crew	Payloads and Experiments	
STS-47 Endeavour Mission Duration: 190 hrs 30 mins 23 secs	Sep 12, 1992 KSC	Sep 20, 1992 KSC	Cdr: Robert L. Gibson Plt: Curtis L. Brown MS: Mark C. Lee MS: N. Jan Davis MS: Mae C. Jemison MS: Jerome Apt PS: Mamoru Mohri	**Deployable Payloads: None** **Attached PLB Payloads:** 1. Japanese Spacelab (Spacelab-J) Long Module Gas Bridge Assembly (GBA) with 12 Gas Canisters **GAS (Getaway Special): None**	**Crew Compartment Payloads:** 1. Israeli Space Agency Investigation about Hornets (ISAIAH) 2. Shuttle Amateur Radio Experiment (SAREX) 3. Solid Surface Combustion Experiment (SSCE) 4.. Ultraviolet Plume Instrument (UVPI) - Payload of Opportunity **Special Payload Mission Kits: None**
STS-52 Columbia Mission Duration: 236 hrs 56 mins 13 secs	Oct 22, 1992 KSC	Nov 1, 1992 KSC	Cdr: James D. Wetherbee Plt: Michael A. Baker MS: William M. Sheperd MS: Tamara E. Jernigan MS: Charles L. Veach	**Deployable Payloads: None** 1. Laser Geodynamics Satellite (LAGEOS) **Attached PLB Payloads** 1. United Stated Microgravity Payload (USMP-1) **GAS (Getaway Special): None** **Crew Compartment Payloads:** 1. Queens University Experiment in Liquid Metal Diffusion (QUELD) 2. Phase Partition in Liquid (PARLIQ) 3. Sun Photo Spectrometer Earth Atmosphere 3. Sun Photo Spectrometer Earth Atmosphere Measurement-2 (SPEAM)	4. Orbiter Glow-2 5. Commercial Materials Dispersion Apparatus Instrumentation Technology Associates Experiments (CMIX) 6. Crystal by Vapor Transport Experiment (CVTE) 7. Heat Pipe Performance (HPP) (CMIX) 8. Commercial Protein Crystal Growth (CPCG) 9. Shuttle Plume Impingement Experiment (SPIE) 10. Physiological System Experiment (PSE) **Special Payload Mission Kits: None**
STS-53 Discovery Mission Duration: 175 hrs 19 mins 47 secs	Jul 31, 1992 KSC	Aug 8, 1992 EAFB	Cdr: Loren J. Shriver Plt: Andrew M. Allen MS: Jeffrey A. Hoffman MS: Franklin R. Chang-Diaz MS: Claude Nicollier	**Deployable Payloads:** **Attached PLB Payloads**	**GAS (Getaway Special): None** **Crew Compartment Payloads:** **Special Payload Mission Kits: None**

The Planets



	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
Mean Distance from Sun Millions of Kilometers Millions of Miles	 57.9 36	 108.2 67.2	 149.6 93	 227.9 141.6	 778.3 483.6	 1,429 888.2	 2,875 1,786	 4,504 2,799	 5,900 3,666
Period of Revolution (in Earth time)	87.97 days	224.7 days	365.26 days	686.98 days	11.86 years	29.46 years	84.07 years	164.82 years	248.6 years
Period of Rotation (in Earth time)	58.65 days	243.01 days, Retrograde	23 hrs 56 mins	24 hrs 37 mins	9 hrs 56 mins	10 hrs 40 mins	17 hrs 14 mins	16 hrs 6 mins	6.39 days, Retrograde
Inclination of Axis (Degrees)	0.0	177.3	23.5	25.2	3.08	26.7	97.9	29.6	122
Inclination of Orbit to Ecliptic (Deg)	7.0	3.39	0.0	1.85	1.31	2.49	0.77	1.77	17.15
Eccentricity (Degrees)	0.206	0.007	0.017	0.093	0.048	0.056	0.046	0.010	0.248
Equatorial Diameter Kilometers Miles	 4,878 3,031	 12,104 7,521	 12,755 7,926	 6,790 4,219	 142,796 88,729	 120,660 74,975	 51,118 31,763	 49,528 30,775	 2,300 Appx. 1,429 Appx.
Atmosphere	Essentially None	Carbon Dioxide	Nitrogen, Oxygen	Carbon Dioxide	Hydrogen, Helium	Hydrogen, Helium	Hydrogen, Helium	Hydrogen, Helium	Methane
Satellites	None	None	1	2	16	18	15	8	1
Rings	None	None	None	None	1	Thousands	11	5	Probably None

The Solar System

Our automated spacecraft have traveled to the Moon and to all the planets beyond our world except Pluto; they have observed moons as large as small planets, flown by comets, and sampled the solar environment. The knowledge gained from our journeys through the solar system has redefined traditional Earth sciences like geology and meteorology and spawned an entirely new discipline called comparative planetology. By studying the geology of planets, moons, asteroids, and comets, and comparing differences and similarities, we are learning more about the origin and history of these bodies and the solar system as a whole. We are also gaining insight into Earth's complex weather systems. By seeing how weather is shaped on other worlds and by investigating the Sun's activity and its influence through the solar system, we can better understand climatic conditions and processes on Earth.

The Sun

Many spacecraft have explored the Sun's environment, but none have gotten any closer to its surface than approximately two-thirds of the distance from Earth to the Sun. Pioneers 5-11, the Pioneer Venus Orbiter, Voyagers 1 and 2, and other spacecraft have all sampled the solar environment. The Ulysses spacecraft, launched Oct 6, 1990, is a joint solar mission of NASA and the European Space Agency. After using Jupiter's gravity to change its trajectory, Ulysses will fly over the Sun's polar regions during 1994 and 1995 and will perform a wide range of studies using nine onboard scientific instruments.

The Sun dwarfs the other bodies in the solar system, representing approximately 99.86 percent of all the mass in the solar system. All of the planets, moons, asteroids, comets, dust, and gas add up to only about 0.14 percent. This 0.14 percent represents the material left over from the Sun's formation. One hundred and nine Earths would be required to fit across the Sun's disk, and its interior could hold over 1.3 million Earths.

As a star, the Sun generates energy by the process of fusion. The temperature at the Sun's core is 15 million degrees Celsius (27 million degrees Fahrenheit), and the pressure there is 340 billion times Earth's air pressure at sea level. The Sun's surface temperature of 5,500 degrees Celsius (10,000 degrees Fahrenheit) seems almost chilly compared to its core temperature. At the solar core, hydrogen can fuse into helium, producing energy. The Sun produces a strong magnetic field and streams of charged particles, extending far beyond the planets.

The Sun appears to have been active for 4.6 billion years and has enough fuel for another 5 billion years or so. At the end of its life, the Sun will start to fuse helium into heavier elements and begin to swell up, ultimately growing so large that it will swallow Earth. After a billion years as a "red giant," it will suddenly collapse into a "white dwarf" -- the final end product of a star like ours. It may take a trillion years to cool off completely.

Mercury

Obtaining the first close-up views of Mercury was the primary objective of the Mariner 10 spacecraft, launched Nov 3, 1973. After a journey of nearly 5 months, including a flyby of Venus, the spacecraft passed within 703 km (437 mi) of the solar system's innermost planet on Mar 29, 1974. Until Mariner 10, little was known about Mercury. Even the best telescopic views from Earth showed Mercury as an indistinct object lacking any surface detail. The planet is so close to the Sun that it is usually lost in solar glare. When the planet is visible on Earth's horizon just after sunset or before dawn, it is obscured by the haze and dust in our atmosphere. Only radar telescopes gave any hint of Mercury's surface conditions prior to the voyage of Mariner 10.

Mariner 10 photographs revealed an ancient, heavily cratered surface, closely resembling our Moon. The pictures also showed high cliffs crisscrossing the planet., apparently created when Mercury's interior cooled and shrank, buckling the planet's crust. The cliffs are as high as 3 km (2 mi) and as long as 500 km (310 mi).

Instruments on Mariner 10 discovered that Mercury has a weak magnetic field and a trace of atmosphere -- a trillionth the density of Earth's atmosphere and composed chiefly of argon, neon, and helium. When the planet's orbit takes it closest to the Sun, surface temperatures range from 467 degrees Celsius (872 degrees Fahrenheit) on Mercury's sunlit side to -183 degrees Celsius (-298 degrees Fahrenheit) on the dark side. This range in surface temperature is the largest for a single body in the solar system. Mercury literally bakes and freezes at the same time.

Days and nights are long on Mercury. The combination of a slow rotation relative to the stars (59 Earth days) and a rapid revolution around the Sun (88 Earth days) means that one Mercury solar day takes 176 Earth days or two Mercury years, the time it takes Mercury to complete two orbits around the Sun.

Mercury appears to have a crust of light silicate rock like that of Earth. Scientists believe Mercury has a heavy iron-rich core making up slightly less than half of its volume. That would make Mercury's core larger, proportionally, than the Moon's core or those of any of the planets.

After the initial Mercury encounter, Mariner 10 made two additional flybys -- on Sep 21, 1974, and Mar 16, 1975 -- before control gas used to orient the spacecraft was exhausted and the mission was concluded. Each flyby took place at the same local Mercury time when the identical half of the planet was illuminated; as a result, we still have not seen one-half of the planet's surface.

Venus

Veiled by dense cloud cover, Venus -- our nearest planetary neighbor -- was the first planet to be explored. The Mariner 2 spacecraft, launched Aug 27, 1962, was the first of more than a dozen successful American and Soviet missions to study the mysterious planet. On December 14, 1962, Mariner 2 passed within 34,839 kilometers (21,648 miles) of Venus and became the first spacecraft to scan another planet; onboard instruments measured Venus for 42 minutes. Mariner 5, launched in June 1967, flew much closer to the planet. Passing within 4,094 kilometers (2,544 miles) of Venus on the second American flyby, Mariner 5's instruments measured the planet's magnetic field, ionosphere, radiation belts, and temperatures. On its way to Mercury, Mariner 10 flew by Venus and transmitted ultraviolet pictures to Earth showing cloud circulation patterns in the Venusian atmosphere.

On Dec 4, 1978, the Pioneer Venus Orbiter became the first spacecraft to orbit the planet. Five days later, the five separate components making up a second spacecraft, the Pioneer Venus Multiprobe, entered the Venusian atmosphere at different locations above the planet. The four small probes and the main body radioed atmospheric data back to Earth during their descent toward the surface. Although designed to examine the atmosphere, one of the probes survived its impact with the surface and continued to transmit data for another hour.

Venus resembles Earth in size, physical composition, and density more closely than any other known planet. However, significant differences have been discovered. For example, Venus' rotation (west to east) is retrograde (backward) compared to the east-to-west spin of Earth and most of the other planets.

Approximately 96.5 percent of Venus' atmosphere (95 times as dense as Earth's) is carbon dioxide. The principal constituent of Earth's atmosphere is nitrogen. Venus' atmosphere acts like a greenhouse, permitting solar radiation to reach the surface but trapping the heat that would ordinarily be radiated back into space. As a result, the planet's average surface temperature is 482 degrees Celsius (900 degrees Fahrenheit), hot enough to melt lead.

A radio altimeter on the Pioneer Venus Orbiter provided the first means of seeing through the planet's dense cloud cover and determining surface features over almost the entire planet. NASA's Magellan spacecraft, launched on May 5, 1989, has orbited Venus since August 10, 1990. The spacecraft uses radar-mapping techniques to provide ultrahigh-resolution images of the surface.

Magellan has revealed a landscape dominated by volcanic features, faults, and impact craters. Hugh areas of the surface show evidence of multiple periods of lava flooding with flows lying on top of previous ones. An elevated region named Ishtar Terra is a lava-filled basin as large as the United States. At one end of this plateau sits Maxwell Montes, a mountain the size of Mount Everest. Scarring the mountain's flank is a 100-km (62-mi) wide, 2.5-km (1.5 mi) deep impact crater named Cleopatra. (Almost all features on Venus are named for women: Maxwell Montes, Alpha Regio, and Beta Regio are the exceptions.) Craters survive on Venus for perhaps 400 million years because there is no water and very little wind erosion.

Extensive fault-line networks cover the planet, probably the result of the same crustal flexing that produces plate tectonics on Earth. But on Venus the surface temperature is sufficient to weaken the rock, which cracks just about everywhere, preventing the formation of major plates and large earthquake faults like the San Andreas Fault in California.

Venus' predominant weather pattern is a high-altitude, high-speed circulation of clouds that contain sulfuric acid. At speeds reaching as high as 360 km (225 mi) per hour, the clouds circle the planet in only 4 Earth days. The circulation is in the same direction -- west to east -- as Venus' slow rotation of 243 Earth days, whereas Earth's winds blow in both directions -- west to east and east to west -- in six alternating bands. Venus' atmosphere serves as a simplified laboratory for the study of our weather.

The Solar System

Earth

As viewed from space, Earth's distinguishing characteristics are its blue waters, brown and green land masses, and white clouds. We are enveloped by an ocean of air consisting of 78 percent nitrogen, 21 percent oxygen, and 1 percent other constituents. The only planet in the solar system
known to harbor life, Earth orbits the Sun at an average distance of 150 million km (93 million mi). Earth is the third planet from the Sun and the fifth largest in the solar system, with a diameter a few hundred kilometers larger than that of Venus.

Our planet's rapid spin and molten nickel-iron core give rise to an extensive magnetic field, which, along with the atmosphere, shields us from nearly all of the harmful radiation coming from the Sun and other stars. Earth's atmosphere protects us from meteors as well, most of which burn up before they can strike the surface. Active geological processes have left no evidence of the pelting Earth almost certainly received soon after it formed -- about 4.6 billion years ago.

From our journeys into space, we have learned much about our home planet. The first American satellite -- Explorer 1 -- launched Jan 31, 1958, discovered an intense radiation zone, called the Van Allen radiation belts, surrounding Earth. Other research satellites revealed that our planet's magnetic field is distorted into a tear-drop shape by the solar wind. We've learned that the magnetic field does not fade off into space but has definite boundaries. And we now know that our wispy upper atmosphere, once believed calm and uneventful, seethes with activity -- swelling by day and contracting by night. Affected by changes in solar activity, the upper atmosphere contributes to weather and climate on Earth.

Besides affecting Earth's weather, solar activity gives rise to a dramatic visual phenomenon in our atmosphere. When charged particles from the solar wind become trapped in Earth's magnetic field, they collide with air molecules above our planet's magnetic poles. These air molecules then begin to glow and are known as the auroras or the northern and southern lights.

Satellites about 35,789 km (22,238 mi) out in space play a major role in daily local weather forecasting. These watchful electronic eyes warn us of dangerous storms. Continuous global monitoring provides a vast amount of useful data and contributes to a better understanding of Earth's complex weather systems.

From their unique vantage points, satellites can survey Earth's oceans, land use and resources, and monitor the planet's health. These eyes in space have saved countless lives, provided tremendous conveniences, and shown us that we may be altering our planet in dangerous ways.

The Moon

The Moon is Earth's single natural satellite. The first human footsteps on an alien world were made by American astronauts on the dusty surface of our airless, lifeless companion. In preparation for the Apollo expeditions, NASA dispatched the automated Ranger, Surveyor, and Lunar Orbiter spacecraft to study the Moon between 1964 and 1968.

NASA's Apollo program left a large legacy of lunar materials and data. Six 2-astronaut crews landed on and explored the lunar surface between 1969 and 1972, carrying back a collection of rocks and soil weighing a total of 382 km (842 lb) and consisting of more than 2,000 separate samples. From this material and other studies, scientists have constructed a history of the Moon that includes its infancy.

Rocks collected from the lunar highlands date to about 4.0-4.3 billion years old. The first few million years of the Moon's existence were so violent that few traces of this period remain. As a molten outer layer gradually cooled and solidified into different kinds of rock, the Moon was bombarded by huge asteroids and smaller objects. Some of the asteroids were as large as Rhode Island or Delaware, and their collisions with the Moon created basins hundreds of kilometers across.

This catastrophic bombardment tapered off approximately 4 billion years ago, leaving the lunar highlands covered with huge, overlapping craters and a deep layer of shattered and broken rock. Heat produced by the decay of radioactive elements began to melt the interior at depths of about 200 km (125 mi) below the surface. For the next 700 million years, lava rose from inside the Moon and gradually spread out over the surface, flooding the large impact basins to form the dark areas that Galileo Galilei, an astronomer of the Italian Renaissance, called maria, meaning seas. As far as we can tell, there has been no significant volcanic activity on the Moon for more than 3 billion years. Since then, the lunar surface has been altered only by micrometeorites, atomic particles from the Sun and stars, rare impacts of large meteorites, and spacecraft and astronauts.

The origin of the Moon is still a mystery. Four theories attempt an explanation: The Moon formed near Earth as a separate body; it was torn from Earth; it formed somewhere else and was captured by our planet's gravity, or it was the result of a collision between Earth and an asteroid about the size of Mars. The last theory has some good support but is far from certain.

Mars

Mars has long been considered the solar system's prime candidate for harboring extraterrestrial life. Astronomers studying the red planet through telescopes saw what appeared to be straight lines criss-crossing its surface. These observations, later determined to be optical illusions, led to the popular notion that intelligent beings had constructed a system of irrigation canals. Another reason for scientists to expect life on Mars was the apparent seasonal color changes on the planet's surface. This phenomenon led to speculation that conditions might support vegetation during the warmer months and cause plant life to become dormant during colder periods.

Six American missions to Mars have been carried out. Four Mariner spacecraft, three flying by the planet and one placed into martian orbit, surveyed the planet extensively before the Viking Orbiters and Landers arrived. Mariner 4, launched in late 1964, flew past Mars on Jul 14, 1965, within 9,846 km (6,118 mi) of the surface. Transmitting to Earth 22 close-up pictures of the planet, the spacecraft found many craters and naturally occurring channels but no evidence of artificial canals or flowing water. The Mariners 6 and 7 flybys, during the summer of 1969, returned 201 pictures. Mariners 4, 6, and 7 showed a diversity of surface conditions as well as a thin, cold, dry atmosphere of carbon dioxide.

On May 30, 1971, the Mariner 9 Orbiter was launched to make a year-long study of the martian surface. The spacecraft arrived 5-1/2 months after liftoff, only to find Mars in the midst of a planet-wide dust storm that made surface photography impossible for several weeks. After the storm cleared, Mariner 9 began returning the first of 7,329 pictures that revealed previously unknown martian features, including evidence that large amounts of water once flowed across the surface, etching river valleys and flood plains.

In Aug and Sep 1975, the Viking 1 and 2 spacecraft, each consisting of an orbiter and a lander, were launched. The mission was designed to answer several questions about the red planet, including, Is there life there? Nobody expected the spacecraft to spot martian cities, but it was hoped that the biology experiments would at least find evidence of primitive life, past or present.

Viking Lander 1 became the first spacecraft to successfully touch down on another planet when it landed on Jul 20, 1976. Photographs sent back from Chryse Planitia ("Plains of Gold") showed a bleak, rusty-red landscape. Panoramic images revealed a rolling plain, littered with rocks and marked by rippled sand dunes. Fine red dust from the martian soil gives the sky a salmon hue. When Viking Lander 2 touched down on Utopia Planitia on Sep 3, 1976, it viewed a more rolling landscape, one without visible dunes.

The results sent back by the laboratory on each Viking Lander were inconclusive. Small samples of the red martian soil were tested in three different experiments designed to detect biological processes. While some of the test results seemed to indicate biological activity, later analysis confirmed that this activity was inorganic in nature and related to the planet's soil chemistry. Is there life on Mars? No one knows for sure, but the Viking mission found no evidence that organic molecules exist there.

The Viking Landers became weather stations, recording wind velocity and direction as well as atmospheric temperature and pressure. Few weather changes were observed. The highest temperature recorded by either spacecraft was -14 degrees Celsius (7 degrees Fahrenheit) at the Viking Lander 1 site in midsummer. The lowest temperature, -120 degrees Celsius (-184 degrees Fahrenheit), was recorded in the more northerly Viking Lander 2 site during winter. Near-hurricane wind speeds were measured at the two martian weather stations during global dust storms, but because the atmosphere is so thin, wind force is minimal. Viking Lander 2 photographed light patches of frost, probably water-ice, during its second winter on the planet.

The martian atmosphere, like that of Venus, is primarily carbon dioxide. Nitrogen and oxygen are present only in small percentages. Martian air contains only about 1/1,000 as much water as our air, but this small amount can condense out, forming clouds that ride high in the atmosphere or swirl around the slopes of towering volcanoes. Patches of early morning fog can form in valleys. There is evidence that in the past a denser martian atmosphere may have allowed water to flow on the planet. Physical features closely resembling shorelines, gorges, riverbeds, and islands suggest that great rivers once marked the planet.

Mars has two moons, Phobos and Deimos. They are small and irregularly shaped and possess ancient, cratered surfaces. It is possible the moons were originally asteroids that ventured too close to Mars and were captured by its gravity.

The Viking Orbiters and Landers exceeded their design lifetimes of 120 and 90 days, respectively. The first to fail was Viking Orbiter 2, which stopped operating on Jul 24, 1978, when a leak depleted its attitude-control gas. Viking Lander 2 operated until Apr 12, 1980, when it was shut down due to battery degeneration. Viking Orbiter 1 quit on Aug 7, 1980, when the last of its attitude-control gas was used up. Viking Lander 1 ceased functioning on Nov 13, 1983.Despite the inconclusive results of the Viking biology experiments, we know more about Mars than any other planet except Earth.

Asteroids

The solar system has a large number of rocky and metallic objects in orbit around the Sun but are too small to be considered full-fledged planets. These objects are known as asteroids or minor planets. Most, but not all, are found in a band or belt between the orbits of Mars and Jupiter. Some have orbits that cross Earth's path, and there is evidence that Earth has been hit by asteroids in the past. One of the least eroded, best preserved examples is the Barringer Meteor Crater near Winslow, AZ.

Asteroids are material left over from the formation of the solar system. One theory suggests that they are the remains of a planet that was destroyed in a massive collision long ago. More likely, asteroids are material that never coalesced into a planet. In fact, if the estimated total mass of all asteroids was gathered into a single object, the object would be about 1,500 km (932 mi) across, less than half the diameter of our Moon. Thousands of asteroids have been identified from Earth and 100,000 may be bright enough to be photographed through Earth-based telescopes.

Much of our understanding about asteroids comes from examining pieces of space debris that fall to the surface of Earth. Asteroids that are on a collision course with Earth are called meteoroids. When a meteoroid strikes our atmosphere at high velocity, friction causes this chunk of space matter to incinerate in a streak of light known as a meteor. If the meteoroid does not burn u completely, what's left strikes Earth's surface and is called a meteorite. One of the best places to look for meteorites is the ice cap of Antarctica.

Of all the meteorites examined, 92.8 percent are composed of silicate (stone), and 5.7 percent are composed of iron and nickel; the rest are a mixture of the three materials. Stony meteorites are the hardest to identify since they look very much like terrestrial rocks. Since asteroids are material from the very early solar system, scientists are interested in their composition. Spacecraft that have flown through the asteroid belt have found that the best is really quite empty and that asteroids are separated by very large distances.

Jupiter

Beyond Mars and the asteroid belt, in the outer regions of our solar system, lie the giant planets of Jupiter, Saturn, Uranus and Neptune. In 1972, NASA sent the first of four spacecraft to conduct the initial surveys of these colossal worlds of gas and their moons of ice and rock.

Pioneer 10, launched in March 1972, was the first spacecraft to penetrate the asteroid belt and travel to the outer regions of the solar system. In December 1973, it returned the first close-up images of Jupiter, flying within 132,252 km (82,178 mi) of the planet's banded cloud tops. Pioneer 11 followed a year later. Voyagers 1 and 2, launched in the summer of 1977, returned spectacular photographs of Jupiter and its family of satellites during flybys in 1979. These travelers found Jupiter to be a whirling ball of liquid hydrogen and helium, topped with a colorful atmosphere composed mostly of gaseous hydrogen and helium. Ammonia ice crystals form white Jovian clouds. Sulfur compounds (and perhaps phosphorus) may produce the brown and orange hues that characterize Jupiter's atmosphere.

It is likely that methane, ammonia, water and other gases react to form organic molecules in the regions between the planet's frigid cloud tops and the warmer hydrogen ocean lying below. Because of Jupiter's atmospheric dynamics, however, these organic compounds, if they exist, are probably short-lived.

The Great Red Spot has been observed for centuries through telescopes on Earth. This hurricane-like storm in Jupiter's atmosphere is more than twice the size of our planet. As a high-pressure region, the Great Red Spot spins in a direction opposite to that of low-pressure storms on Jupiter; it is surrounded by swirling currents that rotate around the spot and are sometimes consumed by it. The Great Red Spot might be a million years old.

Our spacecraft detected lightning in Jupiter's upper atmosphere and observed auroral emissions similar to Earth's northern lights at the Jovian polar regions. Voyager 1 returned the first images of a faint, narrow ring encircling Jupiter. Largest of the solar system's planets, Jupiter rotates at a dizzying pace, once every 9 hours 55 minutes 30 seconds. The massive planet takes almost 12 Earth years to complete a journey around the Sun. With 16 known moons, Jupiter is something of a miniature solar system.

A new mission to Jupiter, the Galileo Project, is underway. After a 6-year cruise that will take the Galileo Orbiter once past Venus, twice past Earth and the Moon, and once past two asteroids, the spacecraft will drop an atmospheric probe into Jupiter's cloud layers and relay data back to Earth. The Galileo Orbiter will spend 2 years circling the planet and flying close to Jupiter's large moons, exploring in detail what the two Pioneers and two Voyagers revealed.

Galilean Satellites

In 1610, Galileo Galilei aimed his telescope at Jupiter and Spotted four points of light orbiting the planet. For the first time, humans had seen the moons of another world. In honor of their discoverer, these four bodies would become known as the Galilean satellites or moons. But Galileo might have happily traded this honor for one look at the dazzling photographs returned by the Voyager spacecraft as they flew past these planet-sized satellites.

One of the most remarkable findings of the Voyager mission was the presence of active volcanoes on the Galilean moon Io. Volcanic eruptions had never before been observed on a world other than Earth. The Voyager cameras identified at least nine active volcanoes on Io, with plumes of ejected material extending as far as 280 km (175 mi) above the moon's surface. Io's pizza-colored terrain, marked by orange and yellow hues, is probably the result of sulfur-rich materials brought to the surface by volcanic activity. Volcanic activity on this satellite is the result of tidal flexing caused by the gravitational tug-of-war between Io, Jupiter, and the other three Galilean moons.

Europa, approximately the same size as our Moon, is the brightest Galilean satellite. The moon's surface displays an array of streaks, indicating the crust has been fractured. Caught in a gravitational tug-of-war like Io, Europa has been heated enough to cause its interior ice to melt, producing a liquid-water ocean. This ocean is covered by an ice crust that has formed where water is exposed to the cold of space. Europa's core is made of rock that sank to its center. Like Europa, the other two Galilean moons -- Ganymede and Callisto -- are worlds of ice and rock. Ganymede is the largest satellite in the solar system -- larger than the planets Mercury and Pluto. The satellite is composed of about 50 percent water or ice and the rest rock. Ganymede's surface has areas of different brightness, indicating that, in the past, material oozed out of the moon's interior and was deposited at various locations on the surface.

Callisto, only slightly smaller than Ganymede, has the lowest density of any Galilean satellite, suggesting that large amounts of water are part of its composition. Callisto is the most heavily cratered object in the solar system; no activity during its history has erased old craters except more impacts.

Detailed studies of all the Galilean satellites will be performed by the Galileo Orbiter.

Saturn

No planet in the solar system is adorned like Saturn. Its exquisite ring system is unrivaled. Like Jupiter, Saturn is composed mostly of hydrogen. But in contrast to the vivid colors and wild turbulence found in Jovian clouds, Saturn's atmosphere has a more subtle, butterscotch hue, and its markings are muted by high-altitude haze. Given Saturn's somewhat placid-looking appearance, scientists were surprised at the high-velocity equatorial jet stream that blows some 1,770 km (1,100 mi) per hour.

Three American spacecraft have visited Saturn. Pioneer 11 sped by the planet and its moon Titan in September 1979, returning the first close-up images. Voyager 1 followed in November 1980, sending back breathtaking photographs that revealed for the first time the complexities of Saturn's ring system and moons. Voyager 2 flew by the planet and its moons in August 1981.

The rings are composed of countless low-density particles orbiting individually around Saturn's equator at progressive distances from the cloud tops. Analysis of spacecraft radio waves passing through the rings showed that the particles vary widely in size, ranging from dust to house-sized boulders. The rings are bright because they are mostly ice and frosted rock.

The Solar System

Pluto

Pluto is the most distant of the planets, yet the eccentricity of its orbit periodically carries it inside Neptune's orbit, where it has been since 1979 and where it will remain until March 1999. Pluto's orbit is also highly inclined – tilted 17 degrees to the orbital plane of the other planets.

Discovered in 1930, Pluto appears to be little more than a celestial snowball. The planet's diameter is calculated to be approximately 2,300 km (1,430 mi), only 2/3 the size of our Moon. Ground-based observations indicate that Pluto's surface is covered with methane ice and that there is a thin atmosphere that may freeze and fall to the surface as the planet moves away from the Sun. Observations also show that Pluto's spin axis is tipped by 122 degrees.

The planet has one known satellite, Charon, discovered in 1978. Charon's surface composition is different from Pluto's: the moon appears to be covered with water-ice rather than methane ice. Its orbit is gravitationally locked with Pluto, so both bodies always keep the same hemisphere facing each other. Pluto's and Charon's rotational period and Charon's period of revolution are all 6.4 Earth days.

No spacecraft have ever visited Pluto.

Comets

The outermost members of the solar system occasionally pay a visit to the inner planets. As asteroids are the rocky and metallic remnants of the formation of the solar system, comets are the icy debris from that dim beginning and can survive only far from the Sun. Most comet nuclei reside in the Oort Cloud, a loose swarm of objects in a halo beyond the planets and reaching perhaps halfway to the nearest star.

Comet nuclei orbit in this frozen abyss until they are gravitationally perturbed into new orbits that carry them close to the Sun. As a nucleus falls inside the orbits of the outer planets, the volatile elements of which it is made gradually warm; by the time the nucleus enters the region of the inner planets, these volatile elements are boiling. The nucleus itself is irregular and only a few miles across, and is made principally of water-ice with methane and ammonia.

As these materials boil off of the nucleus, they form a coma or cloud-like "head" that can measure tens of thousands of kilometers across. The coma grows as the comet gets closer to the Sun. The stream of charged particles coming from the Sun pushes on this cloud, blowing it back and giving rise to the comet's "tails." Gases and ions are blown directly back from the nucleus, but dust particles are pushed more slowly. As the nucleus continues in its orbit, the dust particles are left behind in a curved arc.

Both the gas and dust tails point away from the Sun; in effect, the comet chases its tails as it recedes from the Sun. The tails can reach 150 million km (93 million mi) in length, but the total amount of material contained i this dramatic display would fit in an ordinary suitcase. Comets -- from the Latin cometa, meaning "long-haired" -- are essentially dramatic light shows.

Some comets pass through the solar system only once, but others have their orbits gravitationally modified by a close encounter with one of the giant outer planets. These latter visitors can enter closed elliptical orbits and repeatedly return to the inner solar system.

Halley's Comet is the most famous example of a relatively short period comet, returning on an average of once every 76 years and orbiting from beyond Neptune to within Venus' orbit. Confirmed sightings of the comet go back to 240 B.C. This regular visitor to our solar system is named for Sir Edmund Halley, because he plotted the comet's orbit and predicted its return, based on earlier sightings and Newtonian laws of motion. His name became part of astronomical lore when, in 1759, the comet returned on schedule. Unfortunately, Sir Edmund did not live to see it.

A comet can be very prominent in the sky if it passes comparatively close to Earth. Unfortunately, on its most recent appearance, Halley's Comet passed no closer than 62.4 million km (28.8 million mi) from our world. The comet was visible to the naked eye, especially for viewers in the southern hemisphere, but it was not spectacular. Comets have been so bright, on rare occasions, that they were visible during daytime. Historically, comet sightings have been interpreted as bad omens and have been artistically rendered as daggers in the sky.

Several spacecraft have flown by comets at high speed; the first was NASA's International Cometary Explorer in 1985. An armada of five spacecraft (two Japanese, two Soviet, and the Giotto spacecraft from the European Space Agency) flew by Halley's Comet in 1986.

USA Planetary Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Mariner 1	Venus Flyby	Jul 22, 1962		Destroyed shortly after launch when vehicle veered off course.
Mariner 2	Venus Flyby	Aug 27, 1962	Dec 14, 1962	First successful planetary flyby. Provided instrument scanning data. Entered solar orbit.
Mariner 3	Mars Flyby	Nov 5, 1964		Shroud failed to jettison properly; Sun and Canpous not acquired; spacecraft did not encounter Mars. Transmissions ceased 9 hours after launch. Entered solar orbit.
Mariner 4	Mars Flyby	Nov 28, 1964	Jul 14, 1965	Provided first close-range images of Mars, confirming the existence of surface craters. Entered solar orbit.
Mariner 5	Venus Flyby	Jun 14, 1967	Oct 19, 1967	Advanced instruments returned data on Venus' surface temperature, atmosphere, and magnetic field environment. Entered solar orbit.
Mariner 6	Mars Flyby	Feb 24, 1969	Jul 31, 1969	Provided high-resolution photos of Martian surface, concentrating on equatorial region. Entered solar orbit.
Mariner 7	Mars Flyby	Mar 27, 1969	Aug 5, 1969	Provided high-resolution photos of Martian surface, concentrating on southern hemisphere. Entered solar orbit.
Mariner 8	Mars Orbiter	May 8, 1971		Centaur stage malfunctioned shortly after launch.
Mariner 9	Mars Orbiter	May 30, 1971	Nov 13, 1971	First interplanetary probe to orbit another planet. During nearly a year of operations, obtained detailed photographs of the Martian moons, Phobos and Deimos, and mapped 100 percent of the Martian surface. Spacecraft is inoperable in Mars orbit.
Pioneer 10	Jupiter Flyby	Mar 2, 1972	Dec 3, 1973	First spacecraft to penetrate the Asteroid Belt. Obtained first close-up images of Jupiter, investigated its magnetosphere, atmosphere and internal structure. Still operating in the outer Solar System.

USA Planetary Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Pioneer 11	Jupiter/Saturn Flyby	Apr 5, 1973	Dec 2, 1974 (Jupiter) Sep 1, 1979 (Saturn)	The successful encounter of Jupiter by Pioneer 10 permitted Pioneer 11 to be retargeted in flight to fly by Jupiter and encounter Saturn. Still operating in the outer Solar System.
Mariner 10	Venus/Mercury Flyby	Nov 3, 1973	Feb 5, 1974 (Venus) Mar 29, 1974 (Mercury) Sep 21, 1974 (Mercury) Mar 16, 1975 (Mercury)	First dual-planet mission. Used gravity of Venus to attain Mercury encounter. Provided first ultraviolet photographs of Venus; returned close-up photographs and detailed data of Mercury. Transmitter was turned off March 24, 1975, when attitude control gas was depleted. Spacecraft is inoperable in solar orbit.
Viking 1	Mars Orbiter and Lander	Aug 20, 1975	Jul 19, 1976 (in orbit) Jul 20, 1976 (landed)	First U.S. attempt to soft land a spacecraft on another planet. Landed on the Plain of Chryse. Photographs showed an orange-red plain strewn with rocks and sand dunes. Both Orbiters took a total of 52,000 images during their mission; approximately 97% percent of the surafce was imaged. Orbiter 1 operated until August 7, 1980, when it used the last of its attitude control gas. Lander 1 ceased operating on Nov 13, 1983.
Viking 2	Mars Orbiter and Lander	Sep 9, 1975	Aug 7, 1976 (in orbit) Sep 3, 1976 (landed)	Landed on the Plain of Utopia. Discovered water frost on the surface at the end of the Martian winter. The two Landers took 4,500 images of the surface and provided over 3 million weather reports. Orbiter 2 stopped operating on July 24, 1978, when its attitude control gas was depleted because of a leak. Lander 2 operated until April 12, 1980, when it was shut down due to battery degeneration.
Voyager 1	Tour of Jupiter and Saturn	Sep 5, 1977	Mar 5, 1979 (Jupiter) Nov 12, 1980 (Saturn)	Investigated the Jupiter and Saturn planetary systems. Returned spectacular photographs and provided evidence of a ring encircling Jupiter. Continues to return data enroute toward interstellar space.
Voyager 2	Tour of the Outer Planets	Aug 20, 1977	Jul 9, 1979 (Jupiter) Aug 25, 1981 (Saturn) Jan 24, 1986 (Uranus) Aug 25, 1989 (Neptune)	Investigated the Jupiter, Saturn and Uranus planetary systems. Provided first close-up photographs of Uranus and its moons. Used gravity-assist at Uranus to continue on to Neptune. Swept within 1280 km of Neptune on August 25, 1989. The spacecraft will continue into interstellar space.

USA Planetary Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Pioneer Venus 1	Venus Orbiter	May 20, 1978	Dec 4, 1978	Mapped Venus' surface by radar, imaged its cloud systems, explored its magnetic environment and observed interactions of the solar wind with a planet that has no intrinsic magnetic field. Provided radar altimetry maps for nearly all of the surface of Venus, resolving features down to about 50 miles across. Still operating in orbit around Venus.
Pioneer Venus 2	Venus Probe	Aug 8, 1978	Dec 9, 1978	Dispatched heat-resisting probes to penetrate the atmosphere at widely separated locations and measured temperature, pressure, and density down to the planet's surface. Probes impacted on the surface.
Magellan	Venus Radar Mapping	May 4, 1989	Aug 1990	Returned radar images that showed geological features unlike anything seen on Earth. One area scientists called crater farms; another area was covered by a checkered pattern of closely spaced fault lines running at right angles. Most intriguing were indications that Venus still may be geologically active. Will continue to map the entire surface and observe evidence of volcanic eruption into 1991.
Galileo	Jupiter Orbiter and Probe	Oct 18, 1989	Dec 8, 1990 (Earth) Feb 1991 (Venus)	A sophisticated two-part spacecraft; an Orbiter will be inserted into orbit around Jupiter to remotely sense the planet, its satellites and the Jovian magnetosphere and a Probe will descend into the atmosphere of Jupiter to make in situ measurements of its nature. Galileo flew by Venus, conducting the first infrared imagery and spectroscopy below the planet's cloud deck and used the Earth's gravity to speed it on its way to Jupiter.
Mars Observer	Mars Orbiter	Sep 25, 1992	Nov 1993 (expected)	A single spacecraft in orbit around Mars to examine the surface and atmosphere of Mars for 1 Martian year (687 Earth days). The objectives of the mission are to determine the elemental and minerological composition of the surface, global surface topography, and gravity and magnetic field. It will use the Mars Balloon Relay (MBR) to send communications back to Earth from Russian landers in 1995.

CIS (USSR) Planetary Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Venera 1	Venus Probe	Feb 12, 1961		First Soviet planetary flight; launched from Sputnik 8. Radio contact was lost during flight; spacecraft was not operating when it passed Venus.
Sputnik 19	Venus Probe	Aug 25, 1962		Unsuccessful Venus attempt.
Sputnik 20	Venus Probe	Sep 1, 1962		Unsuccessful Venus attempt.
Sputnik 21	Venus Probe	Sep 12, 1962		Unsuccessful Venus attempt.
Sputnik 22	Mars Probe	Oct 24, 1962		Spacecraft and final rocket stage blew up when accelerated to escape velocity.
Mars 1	Mars Probe	Nov 1, 1962		Contact was lost when the spacecraft antenna could no longer be pointed towards Earth.
Sputnik 24	Mars Probe	Nov 4, 1962		Disintegrated during an attempt at Mars trajectory from Earth parking orbit.
Zond 1	Venus Probe	Apr 2, 1964		Communications lost. Spacecraft went into solar orbit.
Zone 2	Mars Probe	Nov 30, 1964		Passed by Mars; failed to return data. Went into solar orbit.
Venera 2	Venus Probe	Nov 12, 1965	Feb 27, 1966	Passed by Venus, but failed to return data.
Venera 3	Venus Probe	Nov 16, 1965	Mar 1, 1966	Impacted on Venus, becoming the first spacecraft to reach another planet. Failed to return data.
Venera 4	Venus Probe	Jun 12, 1967	Oct 18, 1967	Descent capsule transmitted data during parachute descent. Sent measurements of pressure, density, and chemical composition of the atmosphere before transmissions ceased.

CIS (USSR) Planetary Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Venera 5	Venus Probe	Jan 5, 1969	Mar 16, 1969	Entry velocity reduced by atmospheric braking before main parachute was deployed. Capsule entered atmosphere on planet's dark side; transmitted data for 53 minutes while traveling into the atmosphere before being crushed.
Venera 6	Venus Probe	Jan 10, 1969	Mar 17, 1969	Descent capsule entered the atmosphere on the planet's dark side; transmitted data for 51 minutes while traveling into the atmosphere before being crushed.
Venera 7	Venus Lander	Aug 17, 1970	Dec 15, 1970	Entry velocity was reduced aerodynamically before parachute deployed. After fast descent through upper layers, the parachute canpoy opened fully, slowing descent to allow fuller study of lower layers. Gradually increasing temperatures were transmitted. Returned data for 23 minutes after landing.
Cosmos 359	Venus Lander	Aug 22, 1970		Unsuccessful Venus attempt; failed to achieve escape velocity.
Cosmos 419	Mars Probe	May 10, 1971		First use of Proton launcher for a planetary mission. Placed in Earth orbit but failed to separate from fourth stage.
Mars 2	Mars Orbiter and Lander	May 19, 1971	Nov 27, 1971	Landing capsule separated from spacecraft and made first, unsuccessful attempt to soft land. Lander carried USSR pennant. Orbiter continued to transmit data.
Mars 3	Mars Orbiter and Lander	May 28, 1971	Dec 2, 1971	Landing capsule separated from spacecraft and landed in the southern hemisphere. Onboard camera operated for only 20 seconds, transmitting a small panoramic view. Orbiter transmitted for 3 months.
Venera 8	Venus Lander	Mar 27, 1972	Jul 22, 1972	As the spacecraft entered the upper atmosphere, the descent module separated while the service module burned up in the atmosphere. Entry speed was reduced by aerodynamic braking before parachute deployment. During descent, a refrigeration system was used to offset high temperatures. Returned data on temperature, pressure, light levels, and descent rates. Transmitted from surface for about 1 hour.

CIS (USSR) Planetary Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Cosmos 482	Venus Lander	Mar 31, 1972		Unsuccessful Venus probe; escape stage misfired leaving craft in Earth orbit.
Mars 4 & 5	Mars Orbiters and Landers	Jul 21, 1973 Jul 25, 1973	Feb 10, 1974 Feb 12, 1974	Pair of spacecraft launched to Mars. Mars 4 retro rockets failed to fire, preventing orbit insertion. As it passed the planet, Mars 4 returned one swath of pictures and some radio occultation data. Mars 5 was successfully placed in orbit, but operated only a few days, returning photographs of a small portion of southern hemisphere of Mars.
Mars 6 & 7	Mars Orbiters and Landers	Aug 5, 1973 Aug 9, 1973	Mar 12, 1974 Mar 9, 1974	Second pair of spacecraft launched to Mars. Mars 6 lander module transmitted data during descent, but transmissions abruptly ceased when the landing rockets were fired. Mars 7 descent module was separated from the main spacecraft due to a problem in the operation of one of the onboard systems, and passed by the planet.
Venera 9	Venus Orbiter and Lander	Jun 8, 1975	Oct 22, 1975	First spacecraft to transmit a picture from the surface of another planet. The lander's signals were transmitted to Earth via the orbiter. Utilized a new parachute system, consisting of six chutes. Signals continued from the surface for nearly 2 hrs 53 mins.
Venera 10	Venus Orbiter and Lander	Jun 14, 1975	Oct 25, 1975	During descent, atmospheric measurements and details of physical and chemical contents were transmitted via the orbiter. Transmitted pictures from the surface of Venus.
Venera 11	Venus Orbiter and Lander	Sep 9, 1978	Dec 25, 1978	Arrived at Venus 4 days after Venera 12. The two landers took nine samples of the atmosphere at varying heights and confirmed the basic components. Imaging system failed; did not return photos. Operated for 95 minutes.
Venera 12	Venus Orbiter and Lander	Sep 14, 1978	Dec 21, 1978	A transit module was positioned to relay the lander's data from behind the planet. Returned data on atmospheric pressure and components. Did not return photos; imaging system failed. Operated for 110 minutes.

CIS (USSR) Planetary Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Venera 13	Venus Orbiter and Lander	Oct 31, 1981	Mar 1, 1982	Provided first soil analysis from Venusian surface. Transmitted eight color pictures via orbiter. Measured atmospheric chemical and isotopic composition, electric discharges, and cloud structure. Operated for 57 minutes.
Venera 14	Venus Orbiter and Lander	Nov 4, 1981	Mar 3, 1982	Transmitted details of the atmosphere and clouds during descent; soil sample taken. Operated for 57 minutes.
Venera 15	Venus Orbiter	Jun 2, 1983	Oct 10, 1983	Obtained first high-resolution pictures of polar area. Compiled thermal map of almost entire northern hemisphere.
Venera 16	Venus Orbiter	Jun 7, 1983	Oct 16, 1983	Provided computer mosiac images of a strip of the northern continent. Soviet and U.S. geologists cooperated in studying and interpreting these images.
Vega 1 & 2	Venus/Halley	Dec 15, 1984 Dec 21, 1984	Jun 11, 1985 (Venus) Mar 6, 1986 (Halley) Jun 15, 1985 (Venus) Mar 9, 1986 (Halley)	International two-spacecraft project using Venusian gravity to send them on to Halley's Comet after dropping the Venusian probes. The Venus landers studied the atmosphere and acquired a surface soil sample for analysis. Each lander released a helium-filled instrumented balloon to measure cloud properties. The other half of the Vega payloads, carrying cameras and instruments, continued on to encounter Comet Halley.
Phobos 1 & 2	Mars/Phobos	Jul 7, 1988 Jul 12, 1988	Jan 1989 (Mars) Jan 1989 (Mars)	International two-spacecraft project to study Mars and its moon Phobos. Phobos 1 was disabled by a ground control error. Phobos 2 was successfully inserted into Martian orbit in January 1989 to study the Martian surface, atmosphere, and magnetic field. On March 27, 1989, communications with Phobos 2 were lost and efforts to contact the spacecraft were unsuccessful.

USA Lunar Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Pioneer 1	Lunar Orbit	Oct 11, 1958		Did not achieve lunar trajectory; launch vehicle second and third stages did not separate evenly. Returned data on Van Allen Belt and other phenomena before reentering on October 12, 1958.
Pioneer 2	Lunar Orbit	Nov 8, 1958		Third stage of launch vehicle failed to ignite. Returned data that indicated the Earth's equatorial region has higher flux and energy levels than previously believed. Did not achieve orbit.
Pioneer 3	Lunar Probe	Dec 6, 1958		First stage of launch vehicle cut off prematurely; transmitted data on dual bands of radiation around Earth. Reentered December 7, 1958.
Pioneer 4	Lunar Probe	Mar 3, 1959	Mar 4, 1959	Passed within 37,300 miles from the Moon; returned excellent data on radiation. Entered solar orbit.
Pioneer P-3	Lunar Orbit	Nov 26, 1959		Payload shroud broke away 45 seconds after liftoff. Did not achieve orbit.
Ranger 1	Lunar Probe	Aug 23, 1961		Flight test of lunar spacecraft carrying experiments to collect data on solar plasma, particles, magnetic fields, and cosmic rays. Launch vehicle failed to restart resulting in low Earth Orbit. Reentered August 30, 1961.
Ranger 2	Lunar Probe	Nov 18, 1961		Flight test of spacecraft systems for future lunar and interplanetary missions. Launch vehicle altitude control system failed, resulting in low Earth orbit. Reentered November 20, 1961.
Ranger 3	Lunar Landing	Jan 26, 1962		Launch vehicle malfunction resulted in spacecraft missing the Moon by 22,862 miles. Spectrometer data on radiation were received. Entered solar orbit.
Ranger 4	Lunar Landing	Apr 23, 1962	Apr 26, 1962	Failure of central computer and sequencer system rendered experiments useless. No telemetry received. Impacted on far side of the Moon.

USA Lunar Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Ranger 5	Lunar Landing	Oct 18, 1962		Power failure rendered all systems and experiments useless; 4 hours of data received from gamma ray experiment before battery depletion. Passed within 450 miles of the Moon. Entered solar orbit.
Ranger 6	Lunar Photo	Jan 30, 1964	Feb 2, 1964	TV cameras failed; no data returned. Impacted in the Sea of Tranquility area.
Ranger 7	Lunar Photo	Jul 28, 1964	Jul 31, 1964	Transmitted high quality photographs, man's first close-up lunar views, before impacting in the Sea of Clouds area.
Ranger 8	Lunar Photo	Feb 17, 1965	Feb 20, 1965	Transmitted high quality photographs before impacting in the Sea of Tranquility area.
Ranger 9	Lunar Photo	Mar 21, 1965	Mar 24, 1965	Transmitted high quality photographs before impacting in the Crater of Alphonsus. Almost 200 pictures were shown live via commercial television in the first TV spectacular from the Moon.
Surveyor 1	Lunar Lander	May 30, 1966	Jun 2, 1966	First U.S. spacecraft to make a fully controlled soft landing on the Moon; landed in the Ocean of Storms area. Returned high quality images, from horizon views of mountains to close-ups of its own mirrors, and selenological data.
Lunar Orbiter 1	Lunar Orbiter	Aug 10, 1966	Aug 14, 1966	Photographed over 2 million square miles of the Moon's surface. Took first photo of Earth from lunar distance. Impacted on the far side of the Moon on October 29, 1966.
Surveyor 2	Lunar Lander	Sep 20, 1966	Sep 22, 1966	Spacecraft crashed onto the lunar surface southeast of the crater Copernicus when one of its three vernier engines failed to ignite during a mid-course maneuver.
Lunar Orbiter 2	Lunar Orbiter	Nov 6, 1966	Nov 10, 1966	Photographed landing sites, including the Ranger 8 landing point, and surface debris tossed out at impact. Impacted the Moon on October 11, 1967.

USA Lunar Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Lunar Orbiter 3	Lunar Orbiter	Feb 4, 1967	Feb 8, 1967	Photographed lunar landing sites; provided gravitational field and lunar environment data. Impacted the Moon on October 9, 1967.
Surveyor 3	Lunar Lander	Apr 17, 1967	Apr 19, 1967	Vernier engines failed to cut off as planned and the spacecraft bounced twice before landing in the Ocean of Storms. Returned images, including a picture of the Earth during lunar eclipse, and used a scoop to make the first excavation and bearing test on an extraterrestrial body. Returned data on a soil sample. Visual range of TV cameras was extended by using two flat mirrors.
Lunar Orbiter 4	Lunar Orbiter	May 4, 1967	May 8, 1967	Provided the first pictures of the lunar south pole. Impacted the Moon on Oct 6, 1967.
Surveyor 4	Lunar Lander	Jul 14, 1967	Jul 17, 1967	Radio contact was lost 2-1/2 minutes before touchdown when the signal was abruptly lost. Impacted in Sinus Medii.
Lunar Orbiter 5	Lunar Orbiter	Aug 1, 1967	Aug 5, 1967	Increased lunar photographic coverage to better than 99%. Used in orbit as a tracking target. Impacted the Moon on January 31, 1968.
Surveyor 5	Lunar Lander	Sep 8, 1967	Sep 10, 1967	Technical problems were successfully solved by tests and maneuvers during flight. Soft-landed in the Sea of Tranquility. Returned images and obtained data on lunar surface radar and thermal reflectivity. Performed first on-site chemical soil analysis.
Surveyor 6	Lunar Lander	Nov 7, 1967	Nov 9, 1967	Soft-landed in the Sinus Medii area. Returned images of the lunar surface, Earth, Jupiter, and several stars. Spacecraft engines were restarted, lifting the spacecraft about 10 feet from the surface and landing it 8 feet from the original site.
Surveyor 7	Lunar Lander	Jan 7, 1968	Jan 9, 1968	Landed near the crater Tycho. Returned stereo pictures of the surface and of rocks that were of special interest. Provided first observation of artificial light from Earth.

CIS (USSR) Lunar Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Luna 1	Lunar Impact	Jan 2, 1959		Intended to impact the Moon; carried instruments to measure radiation. Passed the Moon and went into solar orbit.
Luna 2	Lunar Impact	Sep 12, 1959	Sep 15, 1959	First spacecraft to reach another celestial body. Impacted east of the Sea of Serenity; carried USSR pennants.
Luna 3	Lunar Probe	Oct 4, 1959		First spacecraft to pass behind Moon and send back pictures of far side. Equipped with a TV processing and transmission system, returned pictures of far side including composite full view of far side. Reentered Apr 29, 1960.
Sputnik 25	Lunar Probe	Jan 4, 1963		Unsuccessful lunar attempt.
Luna 4	Lunar Orbiter	Apr 2, 1963		Attempt to solve problems of landing instrument containers. Contact lost as it passed the Moon. Barycentric orbit.
Luna 5	Lunar Lander	May 9, 1965	May 12, 1965	First soft landing attempt. Retrorocket malfunctioned; spacecraft impacted in the Sea of Clouds.
Luna 6	Lunar Lander	Jun 8, 1965		During midcourse correction maneuver, engine failed to switch off. Spacecraft missed Moon and entered solar orbit.
Zond 3	Lunar Probe	Jul 18, 1965		Photographed lunar far side and transmitted photos to Earth 9 days later. Entered solar orbit.
Luna 7	Lunar Lander	Oct 4, 1965	Oct 7, 1965	Retrorockets fired early; crashed in Ocean of Storms.
Luna 8	Lunar Lander	Dec 3, 1965	Dec 6, 1965	Retrorockets fired late; crashed in Ocean of Storms.

CIS (USSR) Lunar Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Luna 9	Lunar Lander	Jan 31, 1966	Feb 3, 1966	First successful soft landing; first TV transmission from lunar surface. Three panoramas of the lunar landscape were transmitted from the eastern edge of the Ocean of Storms.
Cosmos 111	Lunar Probe	Mar 11, 1966		Unsuccessful lunar attempt. Reentered March 16, 1966.
Luna 10	Lunar Orbiter	Mar 31, 1966		First lunar satellite. Studied lunar surface radiation and magnetic field intensity; monitored strength and variation of lunar gravitation. Selenocentric orbit.
Luna 11	Lunar Orbiter	Aug 24, 1966		Second lunar satellite. Data received during 277 orbits. Selenocentric orbit.
Luna 12	Lunar Orbiter	Oct 22, 1966		TV system transmitted large-scale pictures of Sea of Rains and Crater Aristarchus areas. Tested electric motor for Lunokhod's wheels. Selenocentric orbit.
Luna 13	Lunar Lander	Dec 21, 1966	Dec 24, 1966	Soft landed in Ocean of Storms and sent back panoramic views. Two arms were extended to measure soil density and surface radioactivity.
Luna 14	Lunar Orbiter	Apr 7, 1968		Studied gravitational field and "stability of radio signals sent to spacecraft at different locations in respect to the Moon." Made further tests of geared electric motor for Lunokhod's wheels. Selenocentric orbit.
Zond 5	Circumlunar	Sep 15, 1968		First spacecraft to circumnavigate the Moon and return to Earth. Took photographs of the Earth. Capsule was recovered from the Indian Ocean on September 21, 1968. Russia's first sea recovery.
Zond 6	Circumlunar	Nov 10, 1968		Second spacecraft to circumnavigate the Moon and return to Earth "to perfect the automatic functioning of a manned spaceship that will be sent to the Moon." Photographed lunar far side. Reentry made by skip-glide technique; capsule was recovered on land inside the Soviet Union on November 17, 1968.

CIS (USSR) Lunar Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Luna 15	Lunar Sample Return	Jul 13, 1969	Jul 21, 1969	First lunar sample return attempt. Began descent maneuvers on its 52nd revolution. Spacecraft crashed at the end of a 4 minute descent in the Sea of Crises.
Zond 7	Circumlunar	Aug 7, 1969		Third circumlunar flight. Far side of Moon photographed. Color pictures of Earth and Moon brought back. Reentry by skip-glide technique on August 14, 1969.
Cosmos 300	Lunar Probe	Sep 23, 1969		Unsuccessful lunar attempt. Reentered September 27, 1969.
Cosmos 305	Lunar Probe	Oct 22, 1969		Unsuccessful lunar attempt. Reentered October 24, 1969.
Luna 16	Lunar Sample Return	Sep 12, 1970	Sep 20, 1970	First recovery of lunar soil by an automatic spacecraft. Controlled landing achieved in Sea of Fertility; automatic drilling rig deployed; samples collected from lunar surface and returned to Earth on September 24, 1970.
Zond 8	Circumlunar	Oct 20, 1970		Fourth circumlunar flight. Color pictures taken of Earth and Moon. Russia's second sea recovery occurred on October 27, 1970, in the Indian Ocean.
Luna 17	Lunar Rover	Nov 10, 1970	Nov 17, 1970	Carrying the first Moon robot, soft landed in Sea of Rains. Lunokhod 1, driven by 5-man team on Earth, traveled over the lunar surface for 11 days; transmitted photos and analyzed soil samples.
Luna 18	Lunar Lander	Sep 2, 1971		Attempted to land in Sea of Fertility on September 11, 1971. Communications ceased shortly after command was given to start descent engine.
Luna 19	Lunar Orbiter	Sep 28, 1971		From lunar orbit, studied Moon's gravitational field; transmitted TV pictures of the surface. Selenocentric orbit.

CIS (USSR) Lunar Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Luna 20	Lunar Sample Return	Feb 14, 1972		Soft landed in Sea of Crises. Used "photo-telemetric device" to relay pictures of surface. A rotary-percussion drill was used to drill into rock; samples were lifted into a capsule on ascent stage and returned to Earth on Feb 25, 1972.
Luna 21	Lunar Rover	Jan 8, 1973	Jan 15, 1973	Carried improved equipment and additional instruments; second Lunokhod rover soft landed near the Sea of Serenity. Lunar surface pictures were transmitted and experiments were performed. Ceased operating on the 5th lunar day.
Luna 22	Lunar Orbiter	May 29, 1974	Jun 2, 1974	Placed in circular lunar orbit then lowered to obtain TV panoramas of high quality and good resolution. Altimeter readings were taken and chemical rock composition was determined by gamma radiation. Selenocentric orbit.
Luna 23	Lunar Sample Return	Oct 28, 1974		Landed on the southern part of the Sea of Crises on November 6, 1974. Device for taking samples was damaged; no drilling or sample collection possible.
Luna 24	Lunar Sample Return	Aug 9, 1976	Aug 14, 1976	Landed in Sea of Crises on August 18, 1976. Carried larger soil carrier. Core samples were drilled and returned. U.S. and British scientists were given samples for analyses.

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
1958								**1958**
Pioneer I (U) Eta I	Thor-Able I 130 (U)	Oct 11		DOWN OCT 12, 1958			34.2	Measure magnetic fields around Earth or Moon. Error in burnout velocity and angle; did not reach Moon. Returned 43 hours of data on extent of radiation band, hydromagnetic oscillations of magnetic field, density of micrometeors in interplanetary space, and interplanetary magnetic field.
Beacon I (U)	Jupiter C (U)	Oct 23		DID NOT ACHIEVE ORBIT			4.2	Thin plastic sphere (12-feet in diameter after inflation) to study atmosphere density at various levels. Upper stages and payload separated prior to first-stage burnout.
Pioneer II (U)	Thor-Able I 129 (U)	Nov 8		DID NOT ACHIEVE ORBIT			39.1	Measurement of magnetic fields around Earth or Moon. Third stage failed to ignite. Its brief data provided evidence that equatorial region about Earth has higher flux and higher energy radiation than previously considered.
Pioneer III (U)	Juno II (U)	Dec 6		DOWN DEC 7, 1958			5.9	Measurement of radiation in space. Error in burnout velocity and angle; did not reach Moon. During its flight, discovered second radiation belt around Earth.
1959								**1959**
Vanguard II (U) Alpha 1	Vanguard (SLV-4) (U)	Feb 17	122.8	3054	557	32.9	9.4	Sphere (20 inches in diameter) to measure cloud cover. First Earth photo from satellite. Interpretation of data difficult because satellite developed precessing motion.
Pioneer IV (S) Nu 1	Juno II (S)	Mar 3		HELIOCENTRIC ORBIT			6.1	Measurement of radiation in space. Achieved Earth-Moon trajectory; returned excellent radiation data. Passed within 37,300 miles of the Moon on March 4, 1959.
Vanguard (U)	Vanguard (SLV-5) (U)	Apr 13		DID NOT ACHIEVE ORBIT			10.6	Payload consisted of two independent spheres: Sphere A contained a precise magnetometer to map Earth's magnetic field, Sphere B was a 30-inch inflatable sphere for optical tracking. Second stage failed because of damage at stage separation.
Vanguard (U)	Vanguard (SLV-6) (U)	Jun 22		DID NOT ACHIEVE ORBIT			9.8	Magnesium alloy sphere (20 inches in diameter), to measure solar-Earth heating process which generates weather. Faulty second-stage pressure valve caused failure.
Explorer (S-1) (U)	Juno II (U)	Jul 16		DID NOT ACHIEVE ORBIT			41.5	To measure Earth's radiation balance. Destroyed by Range Safety Officer 5-1/2 seconds after liftoff; failure of power supply to guidance system.

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Explorer 6 (S-2) (S) Delta 1	Thor-Able III 134 (S)	Aug 7		DOWN PRIOR TO JULY 1961			64.4	Carried instruments to study particles and meteorology. Helped in the discovery of three radiation levels, a ring of electric current circling the Earth, and obtained crude cloud cover images.
Beacon II (U)	Juno II (U)	Aug 14		DID NOT ACHIEVE ORBIT			4.5	Thin plastic inflatable sphere (12-feet in diameter) to study atmosphere density at various levels. Premature fuel depletion in first stage caused upper stage malfunction.
Big Joe (Mercury) (S)	Atlas 10 (S)	Sep 9		SUBORBITAL FLIGHT				Suborbital test of the Mercury Capsule. Capsule recovered successfully after reentry test. (WFF)
Vanguard III (S) Eta 1	Vanguard (SLV-7) (S)	Sep 18	127.4	3417	512	33.4	45.4	Solar-powered magnesium sphere with magnetometer boom; provided a comprehensive survey of the Earth's magnetic field, surveyed location location of lower edge of radiation belts, and provided an accurate count of micrometeorite impacts. Last transmission December 8, 1959.
Little Joe 1 (S)	Little Joe (L/V #6) (S)	Oct 4		SUBORBITAL FLIGHT				Suborbital test of the Mercury Capsule to qualify the booster for use with the Mercury Test Program.
Explorer 7 (S-1a) (S) Iota 1	Juno II (S)	Oct 13		DOWN JULY 16, 1989			41.5	Provided data on energetic particles, radiation, and magnetic storms. Also recorded the first micrometeorite penetration of a sensor.
Little Joe 2 (S)	Little Joe (L/V #1A) (S)	Nov 4		SUBORBITAL FLIGHT				Suborbital test of Mercury Capsule to test the escape system. Vehicle functioned perfectly, but escape rocket ignited several seconds too late. (WFF)
Pioneer P-3 (U)	Atlas-Able 20 (U)	Nov 26		DID NOT ACHIEVE ORBIT			168.7	Lunar Orbiter Probe; payload shroud broke away after 45 seconds.
Little Joe 3 (S)	Little Joe (L/V #2)(S)	Dec 4		SUBORBITAL FLIGHT				Suborbital test of the Mercury Capsule, included escape system and biomedical tests with monkey (Sam) aboard, to demonstrate high altitude abort at max q. (WFF)
1960								**1960**
Little Joe 4 (S)	Little Joe (L/V #1B)(S)	Jan 21		SUBORBITAL FLIGHT				Suborbital test of Mercury Capsule included escape system and biomedical test with monkey (Miss Sam) aboard. (WFF)
Pioneer V (P-2) (S) Alpha 1	Thor-Able IV 219 (S)	Mar 11		HELIOCENTRIC ORBIT			43.0	Sphere, 26 inches in diameter, to investigate interplanetary space between orbits of Earth and Venus; test long-range communications; and determine strength of magnetic fields.
Explorer (S-46) (U)	Juno II (U)	Mar 23		DID NOT ACHIEVE ORBIT			16.0	Analyze electron and proton radiation energies in a highly elliptical orbit. Telemetry lost shortly after first stage burnout; one of the upper stages failed to fire.

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Tiros I (S) Beta 2	Thor-Able II 148 (S)	Apr 1	98.3	695	658	48.4	122.5	First successful weather-study satellite. Demonstrated that satellites could be used to survey global weather conditions and study other surface features from space. Transmitted 22,952 good-quality cloud-cover photographs.
Scout X (U)	Scout X (U)	Apr 18		SUBORBITAL FLIGHT				Suborbital Launch Vehicle Development Test with live first and third stages. Vehicles broke up after first-stage burnout.
Echo A-10 (U)	Thor-Delta (1) (U)	May 13		DID NOT ACHIEVE ORBIT			75.3	100-foot passive reflector sphere to be used in a series of communications experiments. During coast period, attitude control jets on second stage failed.
Scout I (S)	Scout 1 (S)	Jul 1		SUBORBITAL FLIGHT				Launch Vehicle Development Test; first complete Scout vehicle. (WFF)
Mercury (MA-1) (U)	Atlas 50 (U)	Jul 29		DID NOT ACHIEVE ORBIT				Suborbital test of Mercury Capsule Reentry. The Atlas exploded 65 seconds after launch.
Echo I (A-11) (S) Iota 1	Thor-Delta (2) (S)	Aug 12		DOWN MAY 24, 1968			75.3	First passive communications satellite (100-foot sphere). Reflected a pre-taped message from President Eisenhower across the Nation, demonstrating feasibility of global radio communications via satellite.
Pioneer (P-30) (U)	Atlas-Able 80 (U)	Sep 25		DID NOT ACHIEVE ORBIT			175.5	Highly instrumented probe, in lunar orbit, to investigate the environment between the Earth and the Moon. Second stage failed due to malfunction in oxidizer system.
Scout II (S)	Scout 2 (S)	Oct 4		SUBORBITAL FLIGHT				Launch Vehicle Development Test; second complete Scout vehicle, reached an altitude of 3,500 mi. (WFF)
Explorer 8 (S-30) (S) Xi 1	Juno II (S)	Nov 3	102.5	1361	395	49.9	40.8	Contained instrumentation for detailed measurements of the ionosphere. Confirmed the existence of a helium layer in the upper atmosphere.
Little Joe 5 (U)	Little Joe (L/V #5)(S)	Nov 8		SUBORBITAL FLIGHT				Suborbital test of Mercury Capsule to quality capsule system. Capsule did not separate from booster. (WFF)
Tiros II (S) Pi 1	Thor-Delta (3) (S)	Nov 23	96.3	614	549	48.5	127.0	Test of experimental television techniques and infrared equipment for global meteorological information system.
Explorer (S-56) (U)	Scout 3 (U)	Dec 4		DID NOT ACHIEVE ORBIT			6.4	12-foot sphere to determine the density of the Earth's atmosphere. Second stage failed to ignite.
Pioneer (P-31) (U)	Atlas-Able 91 (U)	Dec 15		DID NOT ACHIEVE ORBIT			175.9	Highly instrumented probe, in lunar orbit, to investigate the environment between the Earth and the Moon. Vehicle exploded about 70 seconds after launch due to malfunction in first stage.
Mercury (MR-1A) (S)	Redstone (S)	Dec 19		SUBORBITAL FLIGHT				Unmanned Mercury spacecraft, in suborbital trajectory, impacted 235 miles down range after reaching an altitude of 135 miles and a speed of near 4,200 mph. Capsule recovered about 50 minutes after launch.

NASA Major Launch Record

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
1961								**1961**
Mercury (MR-2) (S)	Redstone (S)	Jan 31		SUBORBITAL FLIGHT			1315.0	Suborbital test of Mercury Capsule; 16-minute flight included biomedical test with chimpanzee (Ham) aboard.
Explorer 9 (S) Delta 1	Scout 4 (S)	Feb 16		DOWN APR 9, 1964			6.8	12-foot sphere to determine the density of the Earth's Atmosphere. First spacecraft orbited by an all-solid rocket. (WFF)
Mercury (MA-2) (S)	Atlas 67 (S)	Feb 21		SUBORBITAL FLIGHT			1315.0	Suborbital test of Mercury Capsule; upper part of Atlas strengthened by an 8-inch wide stainless steel band. Capsule recovered less than 1 hour after launch.
Explorer (S-45) (U)	Juno II (U)	Feb 24		DID NOT ACHIEVE ORBIT			33.6	Investigate the shape of the ionosphere. A malfunction following booster separation resulted in loss of payload telemetry; third and forth stages failed to ignite.
Little Joe 5A (U)	Little Joe (L/V #5A) (U)	Mar 18		SUBORBITAL FLIGHT			1315.0	Suborbital test of Mercury Capsule. Escape rocket motor fired prematurely and prior to capsule release. (WFF)
Mercury (MR-BD) (S)	Redstone (S)	Mar 24		SUBORBITAL FLIGHT			1315.0	Suborbital test of launch vehicle for Mercury flight to acquire further experience with booster before manned flight was attempted.
Explorer 10 (S) Kappa 1	Thor-Delta (4) (S)	Mar 25		DOWN JUN 1968			35.8	Injected into highly elliptical orbit. Provided information on solar winds, hydromagnetic shock waves, and reaction of the Earth's magnetic field to solar flares.
Mercury (MA-3) (U)	Atlas 100 (U)	Apr 25		DID NOT ACHIEVE ORBIT			907.2	Orbital flight test of Mercury capsule. Destroyed after 40 seconds by Range Safety Officer when the inertial guidance system failed to pitch the vehicle over toward the horizon.
Explorer 11 (S) Nu 1	Juno II (S) (4 stages)	Apr 27	14.5	1465	479	28.8	37.2	Placed in elliptical orbit to detect high energy gamma rays from cosmic sources and map their distribution in the sky.
Little Joe 5B (S)	Little Joe (L/V #5B)(S)	Apr 28		SUBORBITAL FLIGHT			1315.0	Suborbital flight test to demonstrate the ability of the escape and sequence systems to function properly at max q. (WFF)
Mercury (S) (Freedom 7)	Mercury-Redstone-3 (S)	May 5		SUBORBITAL FLIGHT LANDED MAY 5, 1961			1315.0	First manned suborbital flight with Alan B. Shepard, Jr. Pilot and spacecraft recovered after 15 minute 22 second flight.
Explorer (S-45a) (U)	Juno II (U)	May 24		DID NOT ACHIEVE ORBIT			33.6	Investigate the shape of the ionosphere. Second stage ignition system malfunctioned.
Meteoroid Sat A Explorer (S-55) (U)	Scout 5 (U)	Jun 30		DID NOT ACHIEVE ORBIT			84.8	Evaluate launch vehicle; investigate micrometeoroid impact and penetration. Third stage failed to ignite. (WFF)
Tiros III (S) Rho 1	Thor-Delta (5) (S)	Jul 12	100.0	791	723	47.9	129.3	Development of meteorological satellite system. Provided excellent photos and infrared data. Photographed many tropical storms during 1961 hurricane season; credited with discovering Hurricane Esther.

NASA Major Launch Record

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS			WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
				Apogee (km)	Perigee (km)	Incl (deg)		
Mercury (S) (Liberty Bell 7)	Mercury-Redstone-4 (S)	Jul 21			SUBORBITAL FLIGHT LANDED JUL 21, 1961		1470.0	Second manned suborbital flight with Virgil I. Grissom. After landing, spacecraft was lost but pilot was rescued from surface of water. Mission Duration 15 minutes 37 seconds.
Explorer 12 (S-3) (S) Upsilon 1	Thor-Delta (6) (S)	Aug 16			DOWN SEP 1963		37.6	First of a series to investigate solar winds, interplanetary magnetic fields, and energetic particles. Identified the Van Allen Belts as a magnetosphere.
Ranger I (U) Phi 1	Atlas-Agena B 111 (U)	Aug 23			DOWN AUG 30, 1961		306.2	Flight test of lunar spacecraft carrying experiments to investigate cosmic rays, magnetic fields, and energetic particles. Agena failed to restart, resulting in low Earth orbit.
Explorer 13 (U) Chi 1	Scout 6 (U)	Aug 25			DOWN AUG 28, 1961		84.8	Evaluate launch vehicle; investigate micrometeoroid impact and penetration. Third stage failed to ignite. (WFF)
Mercury (MA-4) (S) A-Alpha 1	Atlas 88 (S)	Sep 13			DOWN SEP 13, 1961		1224.7	Orbital test of Mercury capsule to test systems and ability to return capsule to predetermined recovery area after one orbit. All capsule, tracking, and recovery objectives met.
Probe A (P-21) (S)	Scout 7 (S)	Oct 19			SUBORBITAL FLIGHT			Vehicle test/scientific Geoprobe. Reached altitude of 4,261 miles; provided electron density measurements. (WFF)
Saturn Test (SA-1) (S)	Saturn I (S)	Oct 27			SUBORBITAL FLIGHT			Suborbital launch vehicle development test of S-1 booster propulsion system; verification of aerodynamic/structural design of entire vehicle.
Mercury (MS-1) (U)	AF 609A Blue Scout (U)	Nov 1			DID NOT ACHIEVE ORBIT		97.1	Orbital test of the Mercury Tracking Network. First Stage exploded 26 seconds after liftoff; other three stages destroyed by Range Safety Officer 44 seconds after launch.
Ranger II (U) A-Theta 1	Atlas-Agena B 117 (U)	Nov 18			DOWN NOV 20, 1961		306.2	Flight test of spacecraft systems designed for future lunar and interplanetary missions. Inoperative roll gyro prevented Agena restart resulting in a low Earth orbit.
Mercury (MA-5) (S) A-Iota 1	Atlas 93 (S)	Nov 29			DOWN NOV 29, 1961		1315.4	Final flight test of all Mercury systems prior to manned orbital flight; chimpanzee Enos on board. Spacecraft and chimpanzee recovered after two orbits.
1962								**1962**
Echo (AVT-1) (S)	Thor 338 (S)	Jan 15			SUBORBITAL FLIGHT		256.0	Suborbital Communications Test. Canister ejection and opening successful, but 135-foot sphere ruptured.
Ranger III (U) Alpha 1	Atlas-Agena B 121 (U)	Jan 26			HELIOCENTRIC ORBIT		329.8	Rough land instrumented capsule on the Moon. Booster malfunction resulted in the spacecraft missing the Moon by 22,862 miles and going into solar orbit. TV pictures were unusable.

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Tiros IV (S) Beta 1	Thor-Delta (7) (S)	Feb 8	99.9	812	694	48.3	129.3	Continued research and development of meteorological satellite system. U.S. Weather Bureau initiated international radio facsimile transmission of cloud maps based on data received.
Mercury (MA-6) (Friendship 7) (S) Gamma 1	Atlas 109 (S)	Feb 20			LANDED FEB 20, 1962		1354.9	First U.S. manned orbital flight. John H. Glenn, Jr. made three orbits of the Earth. Capsule and pilot recovered after 21 minutes in the water. Mission Duration 4 hours 55 minutes 23 seconds.
Reentry I (U)	Scout 8 (S)	Mar 1			SUBORBITAL FLIGHT			Launch vehicle development test/Reentry test. Desired speed was not achieved. (WFF)
OSO-I (S) Zeta 1	Thor-Delta (8) (S)	Mar 7			DOWN OCT 8, 1981		207.7	Carried 13 instruments to study Sun-Earth relationships. Transmitted almost 1,000 hours of information on solar phenomena, including measurements of 75 solar flares.
Probe B (P-21a) (S)	Scout 9 (S)	Mar 29			SUBORBITAL FLIGHT			Suborbital vehicle test/scientific geoprobe. Reached an altitude of 3,910 miles; provided electron density measurements. (WFF)
Ranger 4 (U) Mu 1	Atlas-Agena B (S)	Apr 23			IMPACTED MOON ON APR 26, 1962		331.1	Second attempt to rough land instrumented capsule on Moon. Failure of central computer and sequencer system rendered experiments useless. Impacted on far side of Moon after flight of 64 hours.
Saturn Test (SA-2) (S)	Saturn I (S)	Apr 25			SUBORBITAL FLIGHT		86167.0	Suborbital launch vehicle test; carried 95 tons of ballast water in upper stages which was released at an altitude of 65 miles to observe the effect on the upper region of the atmosphere (Project High Water).
Ariel I (S) Omicron 1	Thor-Delta (9) (S)	Apr 26			DOWN MAY 24, 1976		59.9	Carried six British experiments to study the ionosphere, solar radiation, and cosmic rays. First International Satellite. Cooperative with UK.
Centaur Test 1 (AC-1)(U)	Atlas-Centaur (F-1) (U)	May 8			SUBORBITAL FLIGHT			Launch vehicle development test. Centaur exploded before separation.
Mercury (MA-7) (Aurora 7) (S) Tau 1	Atlas 107 (S)	May 24			LANDED MAY 24, 1962		1349.5	Second orbital Manned Flight with M. Scott Carpenter. Reentered under manual control after three orbits. Mission Duration 4 hours 56 minutes 5 seconds.
Tiros V (S) A-Alpha	Thor-Delta (S)	Jun 19	99.4	889	573	58.1	129.3	Continued research and development of meteorological satellite system. Extended observations to higher latitudes. Observed ice breakup in northern latitudes and storms originating in these areas.
Telstar 1 (S) A-Epsilon	Thor-Delta (10) (S)	Jul 10	157.8	5642	947	44.8	77.1	First privately built satellite to conduct communication experiments. First telephone and TV experiments transmitted. Reimbursable (AT&T).
Echo (AVT-2) (S)	Thor-Delta (11) (S)	Jul 18			SUBORBITAL FLIGHT		256.0	Suborbital communications test. Inflation successful; radar indicated that the sphere surface was not as smooth as planned.

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Mariner I (P-37) (U)	Atlas-Agena B 145 (U)	Jul 22		DID NOT ACHIEVE ORBIT			202.8	Venus Flyby. Vehicle destroyed by Range Safety Officer about 290 seconds after launch when it veered off course.
Mariner II (P-38) (S) A-Rho 1	Atlas-Agena B 179 (S)	Aug 27		HELIOCENTRIC ORBIT			202.8	Second Venus flyby. First successful interplanetary probe. Passed Venus on December 14, 1962, at 21,648 miles; 109 days after launch. Provided data on solar wind, cosmic dust density, and particle and magnetic field variations.
Reentry II (U)	Scout 13 (U)	Aug 31		SUBORBITAL FLIGHT				Reentry test at 28,000 fps: late third stage ignition; desired speed was not achieved. (WFF)
Tiros VI (S) A-Psi 1	Thor-Delta (12) (S)	Sep 18	97.6	652	635	58.3	127.5	Provide coverage of the 1962 hurricane season. Returned high quality cloud cover photographs.
Alouette I (S) B-Alpha 1	Thor-Agena B (S)	Sep 29	105.2	1022	987	80.5	145.2	Designed and built by Canada to measure variations in the ionosphere electron density distribution. Returned excellent data to 13 Canadian, British, and U.S. stations. Cooperative with Canada.
Explorer 14 (S-3a)(S) B-Gamma 1	Thor-Delta (13) (S)	Oct 2		DOWN JULY 1, 1966			40.4	Monitor trapped corpuscular radiation, solar particles, cosmic radiation, and solar winds. Placed into a highly elliptical orbit; excellent data received.
Mercury(MA-8) (Sigma 7) (S) B-Delta 1	Atlas 113 (S)	Oct 3		LANDED OCT 3, 1962			1360.8	Manned Orbital Flight with Walter M. Schirra, Jr. Made six orbits of the Earth. Mission Duration 9 hours 13 minutes 11 seconds.
Ranger V (U) B-Eta 1	Atlas-Agena B 215 (S)	Oct 18		HELIOCENTRIC ORBIT			342.5	Rough land instrumented capsule on the Moon. Malfunction caused power supply loss after 8 hours 44 minutes. Passed within 450 miles of the Moon.
Explorer 15 (S-3b) (S) B-Lambda	Thor-Delta (14) (S)	Oct 27		DOWN OCT 5, 1967			44.5	Study location, composition, and decay rate of artificial radiation belt created by high altitude nuclear explosion over the Pacific Ocean. Despin device failed; considerable useful data transmitted.
Saturn (SA-3) (S)	Saturn I (S)	Nov 16		SUBORBITAL FLIGHT			86167.0	Suborbital launch vehicle development flight. Second "Project High Water" using 95 tons of water released at an altitude of 90 n.mi.
Relay I (S) B-Upsilon 1	Thor-Delta (15) (S)	Dec 13	185.1	7436	1323	47.5	78.0	Test intercontinental microwave communication by low-altitude active repeater satellite. Initial power failure overcome. Over 500 communication tests and demonstrations conducted.
Explorer 16 (S-55b) (S) B-Chi 1	Scout 14 (S)	Dec 16	104.1	1159	745	52.0	100.7	Measure micrometeoroid puncture hazard to structural skin samples. First statistical sample; flux level found to lie between estimated extremes. (WFF)

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
1963								**1963**
Syncom I (U) 1963 04A	Thor-Delta (16) (S)	Feb 14		CURRENT ELEMENTS NOT MAINTAINED			39.0	First test of a communication satellite in geosynchronous orbit. Initial communication tests successful; all contact was lost 20 seconds after command to fire apogee motor.
Saturn Test (SA-4) (S)	Saturn I (S)	Mar 28		SUBORBITAL FLIGHT				Suborbital launch vehicle development test. Programmed in-flight cutoff of one of eight engines; successfully demonstrated propellant utilization system function.
Explorer 17 (SA-4) (S) 1963 09A	Thor-Delta (17) (S)	Apr 3		DOWN NOV 24, 1966			183.7	Measure density, composition, pressure and temperature of the Earth's atmosphere. Discovered a belt of neutral helium around the Earth.
Telstar II (S) 1963 13A	Thor-Delta (18) (S)	May 7	225.3	10807	967	42.8	79.4	Conduct wideband communication experiments. Color and black and white television successfully transmitted to Great Britain and France. Reimbursable (AT&T).
Mercury (MA-9) (Faith 7) (S) 1963 15A	Atlas 130 (S)	May 15		LANDED MAY 16, 1963			1360.8	Fourth Orbital Manned flight with L. Gordon Cooper, Jr. Various tests and experiments were performed. Capsule reentered after 22 orbits. Mission Duration 34 hours 19 minutes 49 seconds.
RFD-1 (S)	Scout 19 (S)	May 22		SUBORBITAL FLIGHT			217.6	Suborbital reentry flight test; carried AEC Reactor mockup. Reimbursable (AEC). (WFF)
Tiros VII (S) 1963 24A	Thor-Delta (19) (S)	Jun 19	92.7	415	398	58.2	134.7	Continued meteorological satellite development. Furnished over 30,000 useful cloud cover photographs, including pictures of Hurricane Ginny in its early stages in mid-October.
CRL (USAF) (S) 1963 26A	Scout 21 (S)	Jun 28		DOWN DEC 14, 1983			99.8	Cambridge Research Lab geophysics experiment test. Reimbursable (DOD). (WFF)
Reentry III (U)	Scout 22 (U)	Jul 20		SUBORBITAL FLIGHT				Suborbital reentry flight demonstration test of an ablation material at reentry speeds. Vehicle failed. (WFF)
Syncom II (S) 1963 31A	Thor-Delta (20) (S)	Jul 26		CURRENT ELEMENTS NOT MAINTAINED			39.0	Geosynchronous communication satellite test. Voice, teletype, facsimile, and data transmission tests were conducted.
Little Joe II Test (S)	Little Joe II #1 (S)	Aug 28		SUBORBITAL FLIGHT				Suborbital Apollo launch vehicle test. Booster qualification test with dummy payload. (White Sands)
Explorer 18 (S) (IMP-A) 1963 46A	Thor-Delta (21) (S)	Nov 27		DOWN DEC 30, 1965			62.6	First in a series of Interplanetary Monitoring Platforms to observe interplanetary space over an extended period of the solar cycle. Discovered a region of high-energy radiation beyond the Van Allen belts; reported stationary shock wave created by the interaction of the solar wind and geomagnetic field.

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Centaur Test II (S) 1963 47A	Atlas-Centaur (AC-2) (S)	Nov 27	104.6	1485	468	30.4	4620.8	Launch vehicle development test. Instrumented with 2,000 pounds of sensors, equipment, and telemetry; performance and structural integrity test.
Explorer 19 (AD-A) (S) 1963 53A	Scout 24 (S)	Dec 19		DOWN MAY 10, 1981			7.7	Sphere, 12 feet in diameter, was optically tracked after tracking beacon failed, to obtain long-term atmospheric density data and study density changes. (WSMC)
Tiros VIII (S) 1963 54A	Delta 22 (S)	Dec 21	98.5	711	663	58.5	120.2	Continued meteorological satellite development; initial flight test of Automatic Picture Transmission camera system which made it possible to obtain local cloud cover pictures using inexpensive ground stations.
1964								**1964**
Relay II (S) 1964 03A	Delta 23 (S)	Jan 21	194.7	7535	1966	46.4	85.3	Modified communication satellite with a capability of TV or 300 one-way voice transmissions or 12 two-way narrowband communication. Completed more than 230 demonstrations and tests; also obtained over 600 hours of radiation data.
Echo II (S) 1964 04A	Thor-Agena B (S)	Jan 25		DOWN JUN 7, 1969			348.4	Rigidized sphere, 135 feet in diameter, to conduct passive communication experiments (radio, teletype, facsimile tests). Good experiment results obtained; data exchanged with USSR. (WSMC)
Saturn I (SA-5) (S) 1964 05A	Saturn I (S)	Jan 29		DOWN APR 30, 1966			17,554.2	Launch vehicle development test. Fifth flight of Saturn, first Block II Saturn, first live flight of the LOX/LH2 fueled second stage (S-IV). 11,146 measurements taken.
Ranger VI (U) 1964 07A	Atlas-Agena B 199 (S)	Jan 30		IMPACTED MOON ON FEB 2, 1964			364.7	Photograph lunar surface before hard impact. No video signals received. Impacted on west side of Sea of Tranquility, within 20 miles of target, after 65.6 hour flight.
Beacon Explorer A (S-66) (U)	Delta 24 (U)	Mar 19		DID NOT ACHIEVE ORBIT			54.7	Provide data on ionosphere; conduct laser and Doppler shift geodetic tracking experiments. Vehicle third stage malfunctioned.
Ariel II (UK) (S) 1964 15A	Scout 25 (S)	Mar 27		DOWN NOV 18, 1967			74.8	Carried three British experiments to measure galactic radio noise. Cooperative with UK. (WFF)
Gemini I (S) 1964 18A	Titan II 1 (S)	Apr 8		DOWN APR 12, 1964			3175.2	Qualification of Gemini spacecraft configuration/Gemini launch vehicle combination in launch environment through orbital insertion phase.
Fire I (S)	Atlas-Antares 263 (S)	Apr 14		SUBORBITAL FLIGHT			1995.8	Reentry Test to study the heating environment encountered by a body entering the Earth's atmosphere at high speed.
Apollo Abort A-001 (S)	Little Joe II (S)	May 13		SUBORBITAL FLIGHT				Vehicle development test to demonstrate Apollo spacecraft atmospheric abort system capabilities. (White Sands)

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS			WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
				Apogee (km)	Perigee (km)	Incl (deg)		
Saturn I (SA-6) (S) 1964 25A	Saturn I (SA-6) (S)	May 28		DOWN JUN 1, 1964			17644.9	Vehicle development test. First flight of unmanned model of the Apollo spacecraft. 106 measurements obtained.
Centaur Test III (S)	Atlas-Centaur (AC-3) (S)	Jun 30		SUBORBITAL FLIGHT				Launch vehicle development test; performance and guidance evaluation.
SERT I (S)	Scout 28 (S)	Jul 20		SUBORBITAL FLIGHT				Test ion engine performance in space. Confirmed that high prevalence ion beams could be neutralized in space. (WFF)
Ranger VII (S) 1964 41A	Atlas-Agena B 250 (S)	Jul 28		IMPACTED MOON ON JUL 31, 1964			364.7	Photograph lunar surface before hard impact. Transmitted 4,316 high quality photographs showing amazing detail before impacting in Sea of Clouds; flight time 68 hours 35 minutes 55 seconds.
Reentry IV (S)	Scout 29 (S)	Aug 18		SUBORBITAL FLIGHT				Reentry Test. Demonstrated the ability of the Apollo spacecraft to withstand reentry conditions at 27,950 fps.
Syncom III (S) 1964 47A	Delta 25 (S)	Aug 19		CURRENT ELEMENTS NOT MAINTAINED			65.8	Experimental geosynchronous communications satellite. Provided live TV coverage of the Olympic games in Tokyo and conducted various communications tests.
Explorer 20 (S) 1964 51A	Scout 30 (S)	Aug 25	103.6	1001	855	79.9	44.5	Ionosphere Explorer to obtain radio soundings of upper ionosphere as part of the Topside Sounder program.
Nimbus I (S) 1964 52A	Thor-Agena B (S)	Aug 28		DOWN MAY 16, 1974			376.5	Improved meteorological satellite; Earth oriented to provide complete global cloud cover images. Returned more than 27,000 excellent photographs; APT system supplied daytime photos to low-cost ground stations.
OGO I (U) 1964 54A	Atlas-Agena B 195 (S)	Sep 4		CURRENT ELEMENTS NOT MAINTAINED			487.2	Standardized spacecraft capable of conducting related experiments. Carried 20 instruments to investigate geophysical and solar phenomena. Boom deployment anomaly obscured horizon scanner's view of Earth. Varying quality data received from all experiments.
Saturn I (SA-7) (S) 1964 57A	Saturn I (S)	Sep 18		DOWN SEP 22, 1964				Demonstrate Launch Vehicle/spacecraft compatibility and test launch escape system. Telemetry obtained from 131 separate and continuous measurements.
Explorer 21 (U) 1964 60A	Delta 26 (U)	Oct 4		DOWN JAN 30, 1966				Interplanetary Monitoring Platform to obtain magnetic fields, radiation, and solar wind data. Failed to reach planned apogee;provided good data
RFD-2 (S)	Scout 31 (S)	Oct 9		SUBORBITAL FLIGHT			217.6	Reentry flight carried AEC Reactor Mockup. Reimbursable (AEC).
Explorer 22 (S) 1964 64A	Scout 32 (S)	Oct 10	104.3	1054	872	79.7	52.6	Beacon Explorer; to provide data on variations in the ionosphere's structure and relate ionospheric behavior to solar radiation. Low-cost ground stations throughout the world received uncoded radio signals. Laser tracking accomplished on October 11, 1964. (WSMC)

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Mariner III (U) 1964 73A	Atlas-Agena D 289 (U)	Nov 5		HELIOCENTRIC ORBIT			260.8	Mars flyby. Fiberglass shroud failed to jettison properly, solar panels failed to extend, Sun and Canopus not acquired. Transmissions ceased 9 hours after launch.
Explorer 23 (S-55C) (S) 1964 74A	Scout 33 (S)	Nov 6		DOWN JUN 29, 1983			133.8	Provided data on meteoroid penetration and resistance of various materials to penetration.
Explorer 24 (S) 1964 76A	Scout 34 (S)	Nov 21		DOWN OCT 18, 1968			8.6	First dual payload (Air Density/Injun); two satellites provided detailed information on complex radiation-air density relationships in the upper atmospheres. (WSMC)
Explorer 25 (S) 1964 76B			114.6	2354	522	81.3	34.0	
Mariner IV (S) 1964 77A	Atlas-Agena D 288 (S)	Nov 28		HELIOCENTRIC ORBIT			260.8	Second of two 1964 Mars flyby launches. Encounter occurred on July 14, 1965, with closest approach at 6,118 miles of the planet. Transmitted 22 pictures.
Apollo Abort A-002 (S)	Little Joe II (S)	Dec 8		SUBORBITAL FLIGHT			42593.0	First test of Apollo emergency detection system at abort altitude. (White Sands)
Centaur 1964 82A	Atlas-Centaur (AC-4) (S)	Dec 11		DOWN DEC 12, 1964			2993.0	Vehicle development flight carried mass model of Surveyor spacecraft; propulsion and stage separation test.
San Marco 1 (S) 1964 84A	Scout 35 (S)	Dec 15		DOWN SEP 13, 1965			115.2	Flight test of satellite to furnish data on air density and ionosphere characteristics. Launch vehicle provided by NASA; launched by Italian launch crew. Cooperative with Italy. (WFF)
Explorer 26 (S) 1964 86A	Delta 27 (S)	Dec 21		CURRENT ELEMENTS NOT MAINTAINED			45.8	Energetic Particles Explorer; carried five experiments to provide data on high-energy particles.
1965								**1965**
Gemini II (S)	Titan II 2 (S)	Jan 19		SUBORBITAL FLIGHT			3133.9	Demonstrate structural integrity of reentry module heat protection during maximum heating rate reentry and demonstrate variable lift on reentry module.
Tiros IX (S) 1965 04A	Delta 28 (S)	Jan 22	118.9	2564	702	96.4	138.3	First "Cartwheel" configuration for Weather Bureau's Operational system. Provided increased coverage of global cloud cover with pictures of excellent quality.
OSO B-2 (S) 1965 07A	Delta 29 (S)	Feb 3		DOWN AUG 9, 1989			244.9	Second in a series to measure the frequency and energy of solar electromagnetic radiation in the ultraviolet, X-ray and gamma-ray regions of the spectrum.
Pegasus I (S) 1965 09A	Saturn I (SA-9) (S)	Feb 16		DOWN SEP 17, 1978			1451.5	Obtained scientific and engineering data on the magnitude and direction of meteoroids in near-Earth orbit.

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MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS			WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
				Apogee (km)	Perigee (km)	Incl (deg)		
Ranger VIII (S) 1965 10A	Atlas-Agena B 196 (S)	Feb 17		IMPACTED MOON ON FEB 20, 1965			364.7	Photograph lunar surface before hard impact. Transmitted 7,137 high quality photographs before impacting in the Sea of Tranquility; flight time 64.54 hours.
Centaur Test (U)	Atlas-Centaur (AC-5) (U)	Mar 2		SUBORBITAL FLIGHT			2548.0	Vehicle development test; Atlas stage failed 4 seconds after liftoff.
Ranger IX (S) 1965 23A	Atlas-Agena B 204 (S)	Mar 21		IMPACTED MOON ON MAR 24, 1965			364.7	Photograph lunar surface before hard impact. Transmitted 5,814 excellent quality pictures; about 200 pictures relayed live via commercial TV. Flight time 64.52 hours.
Gemini III (S) 1965 24A	Titan II 3 (S)	Mar 23		LANDED MAR 23, 1965			3236.9	First manned orbital flight of the Gemini program, with astronauts Virgil I. Grissom and John W. Young. Manually controlled reentry after three orbits. Mission Duration 4 hours 52 minutes 31 seconds.
Intelsat 1 (F-1) (S) 1965 28A	Delta 30 (S)	Apr 6		CURRENT ELEMENTS NOT MAINTAINED			38.5	First operational satellite for Comsat Corp., to provide commercial trans-Atlantic communications. Reimbursable (Comsat).
Explorer 27 (S) 1965 32A	Scout 36 (S)	Apr 29	107.7	1312	929	41.2	60.8	Beacon Explorer; obtained data on Earth's gravitational field. Also carried laser tracking experiments.
Apollo Abort A-003 (U)	Little Joe II (U)	May 19		SUBORBITAL FLIGHT				Demonstration of abort capability of Apollo spacecraft. Launch escape vehicle at high altitude not accomplished due to malfunction of Little Joe II Booster. (White Sands)
Fire II (S)	Atlas-Antares 264 (S)	May 22		SUBORBITAL FLIGHT			2005.8	Second Reentry Test to study heating environment encountered by a body entering the Earth's atmosphere at high speed.
Pegasus II (S) 1965 39A	Saturn I (SA-8) (S)	May 25		DOWN NOV 3, 1979			1451.5	Micrometeoroid detection experiment confirmed lower meteoroid density than expected.
Explorer 28 (S) 1965 42A	Delta 31 (S)	May 29		DOWN JUL 4, 1968			59.0	Third Interplanetary Monitoring Platform, carrying eight scientific instruments, to measure magnetic fields, cosmic rays, and solar wind beyond the Earth's magnetosphere.
Gemini IV (S) 1965 43A	Titan II 4 (S)	Jun 3		LANDED JUN 7, 1965			3537.6	Second manned Gemini flight with James A. McDivitt and Edward H. White. During flight, White performed a 22 minute EVA using the Zero-G Integral Propulsion Unit. Mission Duration: 97 hrs 56 mins 12 secs.
Tiros X (S) 1965 51A	Delta 32 (S)	Jul 1	100.1	807	722	98.8	127.0	First U.S. Weather Bureau-funded Tiros; obtained maximum coverage of 1965 hurricane and typhoon season.
Pegasus III (S) 1965 60A	Saturn I (SA-10) (S)	Jul 30		DOWN AUG 4, 1969			1451.5	Final micrometeoroid detection experiment. Results of Pegasus program indicated that the flux of small particles was less than expected, the flux of large particles was more than expected, and the flux of medium-sized particles was about as predicted.

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Scout Test (S) Secor (S) 1965 63A	Scout 37 (S)	Aug 10	122.2	2419	1134	69.2	20.0	Vehicle development test. Carried U.S. Army Secor geodetic satellite. Reimbursable (DOD).
Centaur Test (S) 1965 64A	Atlas-Centaur (AC-6) (S)	Aug 11		BARYCENTRIC ORBIT			952.6	Vehicle development test. Carried Surveyor dynamic model. Direct-ascent test for guidance evaluation.
Gemini V (S) 1965 68A REP 1965 68C	Titan II 5 (S)	Aug 21		LANDED AUG 29, 1965 DOWN AUG 27, 1965			3175.2	Third manned orbital flight with L. Gordon Cooper and Charles Conrad, Jr. Ejected Rendezvous Evaluation Pod (REP) for simulated rendezvous maneuvers experiment; participated in communications and other on-board experiments. Mission Duration: 190 hours 55 minutes 14 seconds.
OSO-C (U)	Delta 33 (U)	Aug 25		DID NOT ACHIEVE ORBIT			281.2	Third in a series to maintain continuity of observations during solar activity cycle. Vehicle third stage ignited prematurely.
OGO II (U) 1965 81A	Thor-Agena D (S)	Oct 14		DOWN SEP 17, 1981			507.1	Carried 20 experiments to investigate near-Earth space phenomena on an interdisciplinary basis. Failure of primary launch vehicle guidance resulted in higher than planned orbit. Nineteen experiments returned useful data. (WSMC)
Gemini VI (U)	Atlas-Agena D 5301 (U)	Oct 25		DID NOT ACHIEVE ORBIT				Agena target vehicle. Simultaneous countdown of the Gemini spacecraft and Atlas-Agena Target Vehicle. Telemetry was lost 375 seconds after launch of the target vehicle; Gemini launch was terminated at T-42 minutes.
Explorer 29 (S) 1965 89A	Delta 34 (S)	Nov 6	120.3	2274	1113	59.4	174.6	GEOS-A, part of U.S. Geodetic Satellite Program to provide new geodetic data about the Earth.
Explorer 30 (S) 1965 93A	Scout 38 (S)	Nov 18	100.4	881	664	59.7	56.7	Monitor solar X-rays and ultraviolet emissions during final portion of IQSY. Data acquired by NRL and foreign stations in 13 countries. Cooperative with NRL. (WFF)
Explorer 31 (S) 1965 98B Alouette II (S) 1965 98A	Thor-Agena B (S)	Nov 29	120.0 118.3	2859 2708	501 501	79.8 79.8	98.9 146.5	Make related studies of ionospheric composition and temperature variations. Provided excellent data from regions of the ionosphere never before investigated. Cooperative with Canada. (WSMC)
Gemini VII (S) 1965 100A	Titan II 6 (S)	Dec 4		LANDED DEC 18, 1965			3628.8	Fourth manned mission with Frank Borman and James A. Lovell, Jr. Astronauts flew part of the mission without wearing pressure suits. Mission Duration: 330 hours 35 minutes 01 seconds.
French 1A (S) 1965 101A	Scout 39 (S)	Dec 6	98.8	708	696	75.9	71.7	Study VLF wave propagation in the ionosphere and magnetosphere and measure electron densities. Cooperative with France. (WSMC)

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Gemini VI-A (S) 1965 104A	Titan II 7 (S)	Dec 15		LANDED DEC 16, 1965			3175.2	Fifth manned mission with Walter M. Schirra, Jr. and Thomas P. Stafford. First rendezvous in space accomplished with Gemini VII spacecraft. Mission Duration 25 hours 51 minutes 24 seconds.
Pioneer VI (S) 1965 105A	Delta 35 (S)	Dec 16		HELIOCENTRIC ORBIT			63.5	Operated in solar orbit to provide data on solar wind, interplanetary magnetic fields, solar physics, and high-energy charged particles and magnetic fields.
1966								**1966**
Apollo Abort A-004 (S)	Little Joe II (S)	Jan 20		SUBORBITAL FLIGHT			4989.0	Apollo development flight to demonstrate launch escape vehicle performance. Last unmanned ballistic flight. (White Sands)
ESSA I (S) 1966 08A	Delta 36 (S)	Feb 3	99.7	806	684	97.8	138.3	Sun-synchronous orbit permitted satellite to view weather in each area of the globe each day, photographing a given area at the same local time every day. First Advanced Vidicon Camera System provided valuable information about weather patterns and conditions. Reimbursable (NOAA). (WSMC)
Reentry V (S)	Scout 42 (S)	Feb 9		SUBORBITAL FLIGHT			95.0	Test to investigate the heating environment of a body reentering the Earth's atmosphere at 27,000 fps. (WFF)
Apollo Saturn (AS-201) (S)	Saturn IB (S)	Feb 26		SUBORBITAL FLIGHT			20820.1	Launch Vehicle development flight; carried unmanned Apollo spacecraft.
ESSA II (S) 1966 16A	Delta 37 (S)	Feb 28	113.4	1412	1352	101.0	131.5	Provided direct readout of cloud cover photos to local users. Along with ESSA I, completed the initial global weather satellite system. Reimbursable (NOAA). (WSMC)
Gemini VIII (U) 1966 20A GATV (S) 1966 19A	Titan II 8 (S) Atlas-Agena D 5302 (S)	Mar 16 Mar 16		LANDED MAR 17, 1966 DOWN SEP 15, 1967			3788.0	Agena Target Vehicle launched from Complex 14 and manned Gemini launched from Complex 19. Astronauts Neil A. Armstrong and David R. Scott accomplished rendezvous and docking. Attitude and maneuver thruster malfunction caused the docked spacecraft to tumble. Astronauts separated the vehicles and terminated the mission early; EVA was not accomplished. First Pacific Ocean landing. Mission Duration 10 hours 41 minutes 26 seconds.
Centaur Test (U) 1966 30A	Atlas-Centaur (AC-8) (U)	Apr 8		DOWN MAY 5, 1966			784.7	Launch vehicle development flight; carried Surveyor model. Second Centaur Engine firing unsuccessful.
OAO I (U) 1966 31A	Atlas-Agena D 5002C (S)	Apr 8	100.6	793	783	35.0	1769.0	Carried four experiments to study UV, X-ray and gamma-ray regions. Primary battery malfunctioned.
Nimbus II (S) 1966 40A	Thor-Agena D D 5303 (S)	May 14	108.0	1174	1091	100.6	413.7	Provided global weather photography on 24-hour basis for meteorological research and operational use. (WSMC)

NASA Major Launch Record

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Gemini IX (U)	Atlas-Agena D 5303 (U)	May 17		DID NOT ACHIEVE ORBIT			3252.0	Target vehicle for Gemini IX; vehicle failure caused by a short in the servo control circuit.
Explorer 32 (S) 1966 44A	Delta 38 (S)	May 25		DOWN FEB 22, 1985			224.5	Atmosphere Explorer; carried 8 experiments to measure temperatures, composition, density and pressures in the upper atmosphere.
Surveyor I (S) 1966 45A	Atlas-Centaur (AC-10) (S)	May 30		LANDED ON MOON JUN 2, 1966			995.2	Achieved soft lunar landing in Ocean of Storms. Performed engineering tests and transmitted photography. Landing pads penetrated the lunar surface to a maximum depth of 1 inch.
Gemini IXA (U) 1966 47A GATV (U) 1966 46A	Titan II 9 (S) Atlas-Agena D 5304 (S)	Jun 3 Jun 1		LANDED JUN 6, 1966 DOWN JUN 11, 1966			3705.3	Seventh manned mission with Thomas P. Stafford and Eugene A. Cernan. Target vehicle shroud failed to separate; docking was not achieved. EVA was successful, but evaluation of AMU was not achieved. Mission Duration 72 hours 20 minutes 50 seconds.
OGO III (S) 1966 49A	Atlas-Agena B 5601 (S)	Jun 7		CURRENT ELEMENTS NOT MAINTAINED			514.8	Carried 21 experiments to obtain correlated data on geophysical and solar phenomena in the Earth's atmosphere. First 3-axis stabilization in highly elliptical orbit.
OV-3 (S) 1966 52A	Scout 46 (S)	Jun 9	142.9	4703	645	40.8	173.0	Radiation research satellite for the USAF. Reimbursable (DOD). (WFF)
Pageos I (S) 1966 56A	Thor-Agena D (S)	Jun 23	177.0	5599	2533	84.5	56.7	Sphere, 100 feet in diameter, to determine the location of continents, land masses, and other geographic points using a world-wide triangulation network of stations. (WSMC)
Explorer 33 (S) 1966 58A	Delta 39 (S)	Jul 1		CURRENT ELEMENTS NOT MAINTAINED			93.4	Interplanetary Monitoring Platform to study, at lunar distance, the Earth's magnetosphere and magnetic tail. Planned anchored lunar orbit was not achieved; useful data obtained from Earth orbit.
Apollo Saturn AS-203 (S) 1966 59A	Saturn IB (S)	Jul 5		DOWN JUL 5, 1966			2635.4	Launch vehicle development flight to evaluate the S-IVB stage vent and restart capability.
Gemini X (S) 1966 66A GATV (S) 1966 65A	Titan II 10 (S) Atlas-Agena D 5305 (S)	Jul 18 Jul 18		LANDED JUL 21, 1966 DOWN DEC 29, 1966			3762.6	Eighth manned mission with John W. Young and Michael Collins. Performed first docked vehicle maneuvers; standup EVA of 89 minutes; umbilical EVA of 27 minutes. Mission duration 70 hours 46 minutes 39 seconds.
Lunar Orbiter I (S) 1966 73A	Atlas-Agena D 5801 (S)	Aug 10		DOWN OCT 29, 1966			385.6	Photograph landing sites for Apollo and Surveyor missions from lunar orbit. Photographed over 2 million square miles of the Moon's surface; took the first two photos of the Earth from the distance of the Moon. Demonstrated maneuverability in lunar orbit.

NASA Major Launch Record

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS			WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
				Apogee (km)	Perigee (km)	Incl (deg)		
Pioneer VII (S) 1966 75A	Delta 40 (S)	Aug 17		HELIOCENTRIC ORBIT			63.5	Second in a series of interplanetary probes to provide data on solar wind, magnetic fields, and cosmic rays.
Apollo Saturn AS-202 (S)	Saturn IB (S)	Aug 25		SUBORBITAL FLIGHT			25809.7	Apollo launch vehicle/spacecraft development flight to test Command Module heat shield and obtain launch vehicle and spacecraft data.
Gemini XI (S) 1966 81A GATV (S) 1966 80A	Titan II 11 (S) Atlas-Agena D 5306 (S)	Sep 12 Sep 12		LANDED SEP 15, 1966 DOWN DEC 30, 1966			3798.4	Ninth manned mission with Charles Conrad, Jr. and Richard F. Gordon, Jr. Rendezvous and docking achieved. Umbilical and standup EVA performed and as well as tethered spacecraft experiment. Mission Duration 71 hours 17 minutes 8 seconds.
Surveyor II (U) 1966 84A	Atlas-Centaur (AC-7) (S)	Sep 20		IMPACTED MOON ON SEP 23, 1966			1000.2	Second soft lunar landing planned. One vernier engine did not fire for midcourse correction, sending the spacecraft into a tumbling mode. Crashed southeast of crater Copernicus after 62.8 hour flight.
ESSA III (S) 1966 87A	Delta 41 (S)	Oct 2	114.5	1483	1384	100.9	147.4	Replaced ESSA I in Tiros Operational Satellite (TOS) system. Sophisticated cameras and sensors provided valuable information about the world's weather patterns/conditions. Reimbursable (NOAA) (WSMC)
Centaur Test (AC-9) (S) 1966 95A	Atlas-Centaur (AC-9) (S)	Oct 26		DOWN NOV 6, 1966			952.6	Launch vehicle development flight; Surveyor model injected into simulated lunar transfer orbit. Demonstrated two-burn parking orbit operational capability.
Intelsat II F-1 (U) 1966 96A	Delta 42 (S)	Oct 26	717.7	37229	3123	16.9	87.1	Comsat commercial communications satellite. Apogee monitor malfunction resulted in elliptical orbit. Reimbursable (Comsat).
Lunar Orbiter 2 (S) 1966 100A	Atlas-Agena D 5802 (S)	Nov 6		DOWN OCT 11, 1967			385.6	Photographed lunar landing sites from lunar orbit; provided new data on lunar gravitational field; photographed Ranger VIII landing point and surface debris tossed out at impact.
Gemini XII (S) 1966 104A GATV (S) 1966 103A	Titan II 12 (S) Atlas-Agena D 5307 (S)	Nov 11 Nov 11		LANDED NOV 15, 1966 DOWN DEC 23, 1966			3762.1	Tenth and last manned Gemini flight with James A. Lovell, Jr. and Edwin E. Aldrin, Jr. Rendezvous and docking achieved. Two EVA's performed. Mission duration 94 hours 34 minutes 31 seconds.
ATS I (S) 1966 110A	Atlas-Agena D 5101 (S)	Dec 7	1436.0	35817	35750	14.3	703.1	Perform various communication, meteorology, and control technology experiments and carry out scientific measurements of orbital environment. Experiments results outstanding. Spin-scan cloud camera photographed changing weather patterns; air-to-ground and air-to-air communications demonstrated for the first time.
Biosatellite I (U) 1966 114A	Delta 43 (S)	Dec 14		DOWN FEB 15, 1967			426.4	Carried biological specimens to determine the effects of the space environment on life processes. Reentry vehicle separated but rocket failed, leaving the capsule in orbit. No useful scientific data obtained.

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted) 1967
1967								
Intelsat I F-2 (S) 1967 01A	Delta 44 (S)	Jan 11		CURRENT ELEMENTS NOT MAINTAINED			87.1	Comsat commercial communication satellite. Reached intended location on February 4, 1967. Reimbursable (Comsat).
ESSA IV (S) 1967 06A	Delta 45 (S)	Jan 26	113.4	1437	1323	102.0	131.5	Replaced ESSA II in TOS system. Provided daily coverage of local weather systems to APT receivers. Shutter malfunction rendered one camera inoperative. Reimbursable (NOAA). (WSMC)
Lunar Orbiter 3 (S) 1967 08A	Atlas-Agena D 5803 (S)	Feb 5		DOWN OCT 9, 1967			385.6	Photographed lunar landing sites from lunar orbit; also returned 600,000 sq. mi. of front and 250,000 sq. mi. of back side lunar photography; provided gravitational field and lunar environment data.
OSO III (S) 1967 20A	Delta 46 (S)	Mar 8		DOWN APR 4, 1982			284.4	Carried 9 experiments to study structure, dynamics and chemical composition of the outer solar atmosphere through X-ray, visible, and UV radiation measurements.
Intelsat II F-3 (S) 1967 26A	Delta 47 (S)	Mar 22		CURRENT ELEMENTS NOT MAINTAINED			87.1	Comsat commercial communication satellite. Completed Intelsat II system. Reimbursable (Comsat).
ATS II (U) 1967 31A	Atlas-Agena D 5102 (U)	Apr 6		DOWN SEP 2, 1969			324.3	Test of the gravity gradient control system; carried microwave communications, meteorological cameras, and eight scientific experiments. Second stage failed to restart, resulting in an elliptical orbit. Limited data obtained.
Surveyor III (S) 1967 35A	Atlas-Centaur (AC-12) (S)	Apr 17		LANDED ON MOON APR 20, 1967			1035.6	Vernier engines failed to cut off as planned; spacecraft bounced twice before landing. Surface sampler was used for pressing, digging, trenching, scooping, and depositing surface material in view of the camera. Returned over 6,300 photographs, including pictures of the Earth during lunar eclipse.
ESSA V (S) 1967 36A	Delta 48 (S)	Apr 20	113.5	1419	1352	102.0	147.4	Replaced ESSA III in TOS System. Furnished daily global coverage of weather systems. Reimbursable (NOAA). (WSMC)
San Marco II (S) 1967 38A	Scout 52 (S)	Apr 26		DOWN OCT 14, 1967			129.3	First satellite launch attempt from a mobile sea-based platform in the Indian Ocean; launched conducted by Italian crew. Provided continuous equatorial air density measurements. Cooperative with Italy. (SM)
Lunar Orbiter IV (S) 1967 41A	Atlas-Agena D 5804 (S)	May 4		DOWN OCT 6, 1967			385.6	Lunar orbit achieved. Photographed 99% of the Moon's front side and additional back side areas.
Ariel III (S) 1967 42A	Scout 53 (S)	May 5		DOWN DEC 14, 1970			102.5	First UK-built satellite to extend atmospheric and ionospheric investigations. Cooperative with UK. (WSMC)
Explorer 34 (S) 1967 51A	Delta 49 (S)	May 24		DOWN MAY 3, 1969			73.9	Fifth in Interplanetary Monitoring Platform series to study Sun-Earth relationships. Elliptical orbit achieved. Useful data returned. (WSMC)

NASA Major Launch Record

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				Apogee (km)	Perigee (km)	Incl (deg)		
ESRO II-A (U)	Scout 55 (U)	May 29	DID NOT ACHIEVE ORBIT				89.1	Carried 7 experiments to study solar and cosmic radiation. Third stage vehicle failure. Cooperative with ESRO. (WSMC)
Mariner V (S) 1967 60A	Atlas-Agena D 5401 (S)	Jun 14	HELIOCENTRIC ORBIT				244.9	Venus flyby. Returned data on planet's atmosphere, radiation, and magnetic field environment.
Surveyor IV (U) 1967 68A	Atlas-Centaur (AC-11) (S)	Jul 14	IMPACTED MOON ON JUL 17, 1967				1037.4	Lunar soft landing mission. All systems were normal until 2 seconds before retro rocket burnout (2-1/2 minutes before touchdown) when the signal was abruptly lost.
Explorer 35 (S) 1967 70A	Delta 50 (S)	Jul 19	SELENOCENTRIC ORBIT				104.4	Interplanetary Monitoring Platform to study solar wind and interplanetary fields at lunar distances. Lunar orbit achieved. Results indicated no shock front precedes the Moon, no magnetic field, no radiation belts or evidence of lunar ionosphere.
OGO IV (S) 1967 73A	Thor-Agena D (S)	Jul 28	DOWN AUG 16, 1972				551.6	Study relationship between Sun and Earth's environment. Near-polar orbit achieved, 3-axis stabilized. (WSMC)
Lunar Orbiter V (S) 1967 75A	Atlas-Agena D 5805 (S)	Aug 1	DOWN JAN 31, 1968				385.6	Fifth and final mission to photograph potential landing sites from lunar orbit. Increased lunar photographic coverage to better than 99%.
Biosatellite II (S) 1967 83A	Delta 51 (S)	Sep 7	DOWN SEP 9, 1967				425.4	Carried 13 experiments to conduct biological experiments in low Earth orbit. Reentry initiated 17 orbits early because of communications difficulties and storm in recovery area. Air recovery successful.
Surveyor V (S) 1967 84A	Atlas-Centaur (AC-13) (S)	Sep 8	LANDED ON MOON SEP 11, 1967				1006.1	Lunar soft landing accomplished; returned TV photos of lunar surface and data on chemical characteristics of lunar soil.
Intelsat II (S) 1967 94A	Delta 52 (S)	Sep 28	CURRENT ELEMENTS NOT MAINTAINED				87.1	Comsat commercial communications satellite to provide 24-hour transoceanic service. Reimbursable (Comsat).
OSO-IV (S) 1967 100A	Delta 53 (S)	Oct 18	DOWN JAN 15, 1982				276.7	Continuation of OSO program to better understand the Sun's structure and determine the solar influence upon the Earth. Obtained the first pictures made of the Sun in extreme ultraviolet.
RAM C-1 (S)	Scout 57 (S)	Oct 19	SUBORBITAL FLIGHT				116.6	Reentry test to investigate communications problems experienced during reentry. (WFF)
ATS III (S) 1967 111A	Atlas-Agena D 5103 (S)	Nov 5	1436.1	35844	35730	14.2	714.0	Further development of experiments and concepts in useful applications of space technology to communications, meteorology, navigation, and Earth resources management.
Surveyor VI (S) 1967 112A	Atlas-Centaur (AC-14) (S)	Nov 7	LANDED ON MOON NOV 10, 1967				1008.3	Lunar soft landing achieved; pictures and soil analysis data transmitted. Vernier engines restarted, lifting spacecraft 10 feet from the surface and landing 8 feet from the original landing site, performing the first rocket-powered takeoff from the lunar surface.

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				Apogee (km)	Perigee (km)	Incl (deg)		
Apollo 4 (S) 1967 113A	Saturn V AS-501 (S)	Nov 9		DOWN NOV 9, 1967			45506.0	Launch vehicle/spacecraft development flight. First launch of the Saturn V; carried unmanned Apollo Command/Service Module.
ESSA VI (S) 1967 114A	Delta 54 (S)	Nov 10	114.8	1482	1407	102.2	129.7	Replaced ESSA II and ESSA IV in the TOS system; used in central analysis of global weather. Reimbursable (NOAA). (WSMC)
Pioneer VIII (S) 1967 123A	Delta 55 (S)	Dec 13		HELIOCENTRIC ORBIT			65.8	Third in a series of interplanetary probes to provide data on the solar wind, magnetic fields, and cosmic rays. Carried TETR-1, the first NASA piggyback payload.
TETR-1 (S) 1967 123B				DOWN APR 28, 1968			20.0	
1968								**1968**
Surveyor VII (S) 1968 01A	Atlas-Centaur (AC-15) (S)	Jan 7		LANDED ON MOON JAN 9, 1968			1040.1	Lunar soft landing achieved; provided pictures of lunar terrain, portions of spacecraft, experiment operations, stars, planets, crescent Earth as it changed phases, and first observation of artificial light from the Earth.
Explorer 36 (S) 1968 02A	Delta 56 (S)	Jan 11	112.2	1572	1079	105.8	212.3	GEOS spacecraft to provide precise information about the size and shape of the Earth and strength of an variations in its gravitational field; part of the National Geodetic Program. (WSMC)
Apollo 5 (S) 1968 07A	Saturn IB AS-204 (S)	Jan 22		DOWN JAN 24, 1968			42,506.0	First flight test of the Lunar Module; verified the ascent and descent stages, propulsion systems, and restart operations.
OGO V (S) 1968 14A	Atlas-Agena D 5602A (S)	Mar 4		CURRENT ELEMENTS NOT MAINTAINED			611.0	Provided measurements of energy characteristics in the Earth's radiation belts; first evidence of electric fields in the bow shock.
Explorer 37 (S) 1968 17A	Scout 60 (S)	Mar 5		DOWN NOV 16, 1990			89.8	Solar Explorer to provided data on selected solar X-ray and ultraviolet emissions. Cooperative with NRL. (WFF)
Apollo 6 (U) 1968 25A	Saturn V AS-502 (U)	Apr 4		DOWN APR 4, 1968			42856.0	Launch vehicle and spacecraft development flight. Launch vehicle engines malfunctioned; spacecraft systems performed normally.
Reentry VI (S)	Scout 61 (S)	Apr 27		SUBORBITAL FLIGHT			272.0	Turbulent heating experiment to obtain heat transfer measurements at 20,000 fps. (WFF)
ESRO IIB (S) 1968 41A	Scout 62 (S)	May 17		DOWN MAY 8, 1971			89.1	Carried seven experiments to study solar and cosmic radiation in the lower Van Allen belt. Cooperative with ESRO. (WSMC)
Nimbus B (U) Secor 10 (U)	Thor-Agena D (U)	May 18		DID NOT ACHIEVE ORBIT		20.4	571.5	Experimental meteorological satellite; also carried Secor 10 (DOD) as a secondary payload. Booster malfunctioned; destruct signal sent by Range Safety Officer. (WSMC)
Explorer 38 (S) 1968 55A	Delta 57 (S)	Jul 4	224.2	5869	5825	120.8	275.4	Radio Astronomy Explorer to monitor low-frequency radio signals originating in our own solar system and the Earth's magnetosphere and radiation belts.

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Explorer 39 (S) 1968 66A	Scout 63 (S)	Aug 8			DOWN JUN 22, 1981		9.3	Dual payload (Air Density/Injun Explorers) to continue the detailed scientific study of the density and radiation characteristics of the Earth's upper atmosphere. (WSMC)
Explorer 40 (S) 1968 66B			117.9	2494	677	80.7	69.4	
ATS IV (U) 1968 68A	Atlas-Centaur (AC-17) (U)	Aug 10			DOWN OCT 17, 1968		390.1	Evaluate gravity-gradient stabilization, simultaneous transmission of voice, TV, telegraph, and digital data. Centaur failed to reignite for second burn; spacecraft remained in parking orbit attached to Centaur.
ESSA VII (S) 1968 69A	Delta 58 (S)	Aug 16	114.9	1471	1428	101.4	147.4	Replaced ESSA V as the primary stored data satellite in the TOS system. Reimbursable (NOAA). (WSMC)
RAM CII (S)	Scout 64 (S)	Aug 22			SUBORBITAL FLIGHT		122.0	Measure electron and ion concentrations during reentry. (WFF)
Intelsat III F-1 (U)	Delta 59 (U)	Sep 18			DID NOT ACHIEVE ORBIT		286.7	Comsat commercial communications satellite. Vehicle failure. Reimbursable (Comsat).
ESRO IA (S) 1968 84A	Scout 65 (S)	Oct 3			DOWN JUN 26, 1970		85.8	Carried eight experiments to measure energies and pitch angles of particles impinging on the polar ionosphere during magnetic storms and quiet periods. Cooperative with ESRO. (WSMC)
Apollo 7 (S) 1968 89A	Saturn IB AS-205 (S)	Oct 11			LANDED OCT 22, 1968		51,655.0	First manned flight of the Apollo spacecraft with Walter M. Schirra, Jr., Donn F. Eisele, and Walter Cunningham. Performed Earth orbit operations. Mission Duration 260 hours 9 minutes 3 seconds.
Pioneer IX (S) 1968 100A	Delta 60 (S)	Nov 8			HELIOCENTRIC ORBIT		66.7	Deep space probe to collect scientific data on the electromagnetic and plasma properties of interplanetary space. Carried TETR 2 as a secondary payload.
TETR 2 (S) 1968 100B					DOWN SEP 19, 1979			
HEOS A (S) 1968 109A	Delta 61 (S)	Dec 5			DOWN OCT 28, 1975		108.8	Study interplanetary magnetic fields and solar cosmic ray particles. Reimbursable (ESA).
OAO II (S) 1968 110A	Atlas-Centaur (AC-16) (S)	Dec 7	99.9	759	750	35.0	2016.7	Perform astronomy investigations of celestial objects in the ultraviolet region of the electromagnetic spectrum.
ESSA VIII (S) 1968 114A	Delta 62 (S)	Dec 15	114.6	1461	1411	101.8	136.1	Meteorological satellite for ESSA. Reimbursable (NOAA). (WFF)
Intelsat III F-2 (S) 1968 116A	Delta 63 (S)	Dec 18			CURRENT ELEMENTS NOT MAINTAINED		286.7	Initial increment of first global commercial communications satellite system for Comsat. Reimbursable (Comsat).
Apollo 8 (S) 1968 118A	Saturn V AS-504 (S)	Dec 21			LANDED DEC 27, 1968		51655.0	First manned Saturn V flight with Frank Borman, James A. Lovell, Jr., and William A. Anders. First manned lunar orbit mission; provided a close-up look at the Moon during 10 lunar orbits. Mission Duration 147 hours 0 minutes 42 seconds.

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted) 1969
1969								
OSO V (S) 1969 06A	Delta 64 (S)	Jan 22		DOWN APR 2, 1984			288.5	Continuation of OSO program to study Sun's X-rays, gamma rays, and radio emissions.
ISIS-A (S) 1969 09A	Delta 65 (S)	Jan 30	127.7	3471	574	88.4	235.9	Satellite built by Canada: carried 10 experiments to study the ionosphere. Cooperative with Canada. (WSMC)
Intelsat III F-3 (S) 1969 11A	Delta 66 (S)	Feb 5		CURRENT ELEMENTS NOT MAINTAINED			286.7	Second increment of Comsat's operational commercial communication satellite system. Reimbursable (Comsat).
Mariner VI (S) 1969 14A	Atlas-Centaur (AC-20) (S)	Feb 25		HELIOCENTRIC ORBIT			411.8	Mars flyby; provided high resolution photographs of the Martian surface. Closest approach was 2,120 miles on July 31, 1969.
ESSA IX (S) 1969 16A	Delta 67 (S)	Feb 26	115.2	1503	1422	101.4	157.4	Ninth and last in the TOS series of meteorological satellites. Reimbursable (NOAA).
Apollo 9 (S) 1969 18A	Saturn V SA-504 (S)	Mar 3		LANDED MAR 13, 1969			51655.0	Earth orbital flight with James A. McDivitt, David R. Scott, and Russell Schweickart. First flight of the lunar module. Performed rendezvous, docking, and EVA. Mission Duration 241 hours 0 minute 54 seconds.
Mariner VII (S) 1969 30A	Atlas-Centaur (AC-19) (S)	Mar 27		HELIOCENTRIC ORBIT			411.8	Mars flyby; provided high resolution photographs of the Martian surface. Closest approach was 2,190 miles on August 5, 1969.
Nimbus III (S) 1969 37A	Thor-Agena (S)	Apr 14	107.2	1128	1069	100.0	575.6	Provided night and day global meteorological measurements from space. Secor (DOD) provided geodetic position determination measurements. (WSMC)
Secor 13 (S) 1969 37B			107.2	1127	1067	100.0	20.4	
Apollo 10 (S) 1969 43A	Saturn V SA-505 (S)	May 18		LANDED MAY 26, 1969			51655.0	Manned lunar orbital flight with Thomas P. Stafford, John W. Young, and Eugene A. Cernan to test all aspects of an actual manned lunar landing except the landing. Mission Duration 192 hrs 3 mins 23 secs.
Intelsat III F-4 (S) 1969 45A	Delta 68 (S)	May 21		CURRENT ELEMENTS NOT MAINTAINED			143.8	Third increment of Comsat's operational commercial communication satellite system. Reimbursable (Comsat).
OGO VI (S) 1969 51A	Thor-Agena (S)	Jun 5		DOWN OCT 12, 1979			631.8	Last in the OGO series to provide measurements of the energy characteristics in the Earth's radiation belts; provided the first evidence of electric fields in the bow shock. (WSMC)
Explorer 41 (S) 1969 53A	Delta 69 (S)	Jun 21		DOWN DEC 23, 1972			78.7	Seventh Interplanetary Monitoring Platform to continue study of the environment within and beyond Earth's magnetosphere. (WSMC)
Biosatellite III (U) 1969 56A	Delta 70 (S)	Jun 28		DOWN JUL 7, 1969			696.3	Conduct intensive experiments to evaluate effects of weightlessness with a pigtail monkey onboard. Spacecraft deorbited after 9 days because the monkey's metabolic condition was deteriorating rapidly. Monkey expired 8 hours after recovery, presumably from a massive heart attack brought on by dehydration.

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Apollo 11 (S) 1969 59A	Saturn V SA-506 (S)	Jul 16		LANDED JUL 24, 1969			51655.0	First manned lunar landing and return to Earth with Neil A. Armstrong, Michael Collins, and Edwin A. Aldrin. Landed in the Sea of Tranquility on July 20, 1969; deployed TV camera and EASEP experiments, performed lunar surface EVA, returned lunar soil samples. Mission Duration 195 hours 18 minutes 35 seconds.
Intelsat III F-5 (U) 1969 64A	Delta 71 (S)	Jul 26		DOWN OCT 14, 1988			146.1	Fourth increment of Comsat's operational commercial communication satellite system. Third-stage malfunctioned; satellite did not achieve desired orbit. Reimbursable (Comsat).
OSO VI (S) 1969 68A PAC (S) 1969 68B	Delta 72 (S)	Aug 9		DOWN MAR 7, 1981 DOWN APR 28, 1977			173.7 117.9	Continuing study of Sun's X-rays, gamma rays, and radio emissions. Carried PAC experiment to stabilize spent Delta stage.
ATS V (U) 1969 69A	Atlas-Centaur (AC-18) (S)	Aug 12	1447.5	36031	35986	13.9	432.7	Evaluate gravity-gradient stabilization for geosynchronous satellites. Anomaly after apogee motor firing resulted in counterclockwise spin; gravity-gradient booms could not be deployed. Nine of 13 experiments returned useful data.
Pioneer E (U) (TETR C) (U)	Delta 73 (U)	Aug 27		DID NOT ACHIEVE ORBIT		18.1	67.1	Deep space probe to study magnetic disturbances in interplanetary space. Vehicle malfunctioned; destroyed 8 minutes 3 seconds into powered flight by Range Safety Officer.
ESRO 1B (S) 1969 83A	Scout 66 (S)	Oct 1		DOWN NOV 23, 1969			85.8	Fourth European-designed and built satellite to study ionospheric and auroral phenomena over the northern polar regions. Reimbursable (ESA). (WSMC)
GRS-A (S) 1969 97A	Scout 67 (S)	Nov 7	110.8	2155	371	102.8	72.1	Study the inner Van Allen belt and auroral zones of the Northern Hemisphere. Cooperative with Germany. (WSMC)
Apollo 12 (S) 1969 99A	Saturn V SA-507 (S)	Nov 14		LANDED NOV 24, 1969			51655.0	Second Manned lunar landing and return with Charles Conrad, Jr., Richard F. Gordon, and Alan F. Bean. Landed in the Ocean of Storms on November 19, 1969; deployed TV camera and ALSEP experiments; two EVA's performed; collected core sample and lunar materials; photographed and retrieved parts from Surveyor III spacecraft. Mission duration 244 hours 36 minutes 24 seconds.
Skynet A (S) 1969 101A	Delta 74 (S)	Nov 21		ELEMENTS NOT AVAILABLE			242.7	Communication satellite for the United Kingdom. Reimbursable (UK).

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MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
1970								1970
Intelsat III F-6 (S) 1970 03A	Delta 75 (S)	Jan 14		CURRENT ELEMENTS NOT MAINTAINED			155.1	Part of Comsat's operational commercial communication satellite system. Reimbursable (Comsat).
ITOS I (S) 1970 08A	Delta 76 (S)	Jan 23	115.0	1477	1431	101.3	306.2	Second generation meteorological satellite to provide daytime and nighttime cloud cover observations in both direct and stored modes.
Oscar 5 (S) 1970 08B			115.0	1475	1431	101.3	9.1	Oscar (Australia), carried as a piggyback, was used by radio amateurs throughout the world. (WSMC)
SERT II (U) 1970 09A	Thor-Agena (S)	Feb 3	106.0	1044	1038	99.2	503.5	Ion engine test. Fell short of mission duration objective by less than 1 month. (WSMC)
NATOSAT I (S) 1970 21A	Delta 77 (S)	Mar 20	1436.2	35798	35779	12.9	242.7	Communications satellite for NATO. Reimbursable (NATO).
Nimbus D (S) 1970 25A	Thor-Agena (S)	Apr 8	107.1	1096	1086	99.9	619.6	Stabilized, Earth-oriented platform to test advanced systems for collecting meteorological and geological data. TOPO, carried as a
TOPO 1 (S) 1970 25B			106.9	1084	1082	99.8	21.8	piggyback, performed triangulation exercises. (WSMC)
Apollo 13 (U) 1970 29A	Saturn V SA-508 (S)	Apr 11		LANDED APR 17, 1970			51655.0	Third manned lunar landing attempt with James A. Lovell, Jr., John L. Swigert, Jr., and Fred W. Haise, Jr. Pressure lost in SM oxygen system; mission aborted; LM used for life support. Mission Duration 142 hours 54 minutes 41 seconds.
Intelsat III F-7 (S) 1970 32A	Delta 78 (S)	Apr 22		CURRENT ELEMENTS NOT MAINTAINED			290.3	Part of Comsat's operational commercial communication satellite system. Reimbursable (Comsat).
Intelsat III F-8 (U) 1970 55A	Delta 79 (S)	Jul 23	1408.2	36634	33842	13.9	290.3	Part of Comsat's operational commercial communication satellite system. Malfunction during apogee motor firing; failed to achieve desired orbit. Reimbursable (Comsat).
Skynet 2 (U) 1970 62A	Delta 80 (S)	Aug 19		CURRENT ELEMENTS NOT MAINTAINED			242.7	Communication satellite for the United Kingdom. Telemetry terminated following apogee motor failure. Reimbursable (UK).
RAM CIII (S)	Scout 69 (S)	Sep 30		SUBORBITAL FLIGHT			134.0	Reentry test of radio blackout.
OFO I (S) 1970 94A	Scout 70 (S)	Nov 9		DOWN MAY 9, 1971			132.9	Orbiting Frog Otolith (OFO) in which frogs were used to study the effects of weightlessness on the inner ear, which controls balance.
RMS (S) 1970 94B				DOWN FEB 7, 1971			21.0	Radiation Meteoroid Spacecraft (RMS) provided data on radiation belts. (WFF)
OAO B (U)	Atlas-Centaur (AC-21) (U)	Nov 30		DID NOT ACHIEVE ORBIT			2122.8	Perform stellar observations in the UV region. Centaur nose fairing failed to separate; orbit not achieved.

NASA Major Launch Record

1970

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
ITOS A (S) 1970 106A	Delta 81 (S)	Dec 11	114.8	1471	1421	101.5	306.2	To augment NOAA's satellite world-wide weather observation capabilities. Reimbursable (NOAA). (WSMC)
Explorer 42 (S) 1970 107A	Scout 71 (S)	Dec 12		DOWN APR 5, 1979			142.0	Small Astronomy Satellite to catalog celestial X-ray sources within and outside the Milky Way. First X-ray satellite. (San Marco)
1971								**1971**
Intelsat IV F-2 (S) 1971 06A	Atlas-Centaur (AC-25) (S)	Jan 25		ELEMENTS NOT AVAILABLE			1387.1	Fourth generation satellite to provide increased capacity for Comsat's global commercial communications network. Reimbursable (Comsat).
Apollo 14 (S) 1971 08A	Saturn V SA-509 (S)	Jan 31		LANDED FEB 9, 1971			51655.0	Third Manned lunar landing with Alan B. Shepard, Jr., Stuart A. Roosa, and Edgar D. Mitchell. Landed in the Fra Mauro area on February 5, 1971; performed EVA, deployed lunar experiments, returned lunar samples. Mission duration 216 hours 1 minute 58 seconds.
NATOSAT 2 (S) 1971 09A	Delta 82 (S)	Feb 2	1436.1	35830	35744	13.7	242.7	Second communications satellite for NATO. Reimbursable (NATO)
Explorer 43 (S) 1971 19A	Delta 83 (S)	Mar 13		DOWN OCT 2, 1974			288.0	Second generation Interplanetary Monitoring Platform to extend man's knowledge of solar-lunar relationships.
ISIS B (S) 1971 24A	Delta 84 (S)	Mar 31	113.5	1421	1355	8.2	264.0	Study electron production and loss, and large scale transport of ionization in the ionosphere. Cooperative with Canada. (WSMC)
San Marco C (S) 1971 36A	Scout 72 (S)	Apr 24		DOWN NOV 29, 1971			163.3	Study atmosphere drag, density, neutral composition, and temperature. Cooperative with Italy. (SM)
Mariner H (U)	Atlas-Centaur (AC-24) (U)	May 8		DID NOT ACHIEVE ORBIT			997.9	Mariner Mars '71 Orbiter mission to map the Martian surface. Centaur stage malfunctioned shortly after launch.
Mariner I (S) 1971 051A	Atlas-Centaur (AC-23) (U)	May 30		AEROCENTRIC ORBIT			997.9	Second Mariner Mars '71 Orbiter mission to map the Martian surface. Achieved orbit around Mars on November 13, 1971. Transmitted 6,876 pictures.
PAET (S)	Scout 73 (S)	Jun 20		SUBORBITAL FLIGHT			62.1	Test to determine the structure and composition of an atmosphere from a probe entering at high speed.
Explorer 44 (S) 1971 58A	Scout 74 (S)	Jul 8		DOWN DEC 15, 1979			115.0	Solar radiation spacecraft to monitor the Sun's X-ray and ultraviolet emissions. Cooperative with NRL. (WFF)
Apollo 15 (S) 1971 63A	Saturn V SA-510 (S)	Jul 26		LANDED AUG 7, 1971			51655.0	Fourth manned lunar landing with David R. Scott, Alfred M. Worden, and James B. Irwin. Landed at Hadley Rille on July 30, 1971; performed EVA with Lunar Roving Vehicle; deployed experiments.
P&F Subsat (S) 1971 63D	SM	Aug 4		IMPACTED MOON JUL 30, 1971			36.3	P&F Subsatellite spring-launched from SM in lunar orbit. Mission Duration 295 hours 11 minutes 53 seconds.

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MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
CAS/EOLE (S) 1971 71A	Scout 75 (S)	Aug 16	99.7	837	652	50.2	85.0	Obtain data on winds, temperatures, and pressures using instrumented balloons launched from Argentina and a satellite. Cooperative with France. (WFF)
BIC (S)	Scout 76 (S)	Sep 20		SUBORBITAL FLIGHT			31.7	Barium Ion Cloud Project to study the Earth's magnetic field. Cooperative with Germany. (WFF)
OSO H (S) 1971 83A	Delta 85 (S)	Sep 29		DOWN JUL 9, 1974			635.0	Observe active physical processes on the Sun and how it influences the Earth and its space environment.
TETR4 (S) 1971 83B				DOWN SEP 21, 1978			20.4	
ITOS B (U) 1971 91A	Delta 86 (U)	Oct 21		DOWN JUL 21, 1972			31.7	To augment NOAA's satellite world-wide weather observation capabilities. Second stage failed. Reimbursable (NOAA). (WSMC)
Explorer 45 (S) 1971 96A	Scout 77 (S)	Nov 15		DOWN JAN 10, 1992			50.0	Small Scientific Satellite to study magnetic storms and acceleration of charged particles within the inner magnetosphere. (San Marco)
UK-4 (S) 1971 109A	Scout 78 (S)	Dec 11		DOWN DEC 12, 1978			102.4	Study the interactions between plasma and charged particle streams in the atmosphere. Cooperative with UK. (WSMC)
Intelsat IV F-3 (S) 1971 116A	Atlas-Centaur (AC-26) (S)	Dec 20	1445.5	36013	35928	10.3	1387.1	Fourth generation satellite to provide increased capacity for Comsat's global commercial communications network. Reimbursable (Comsat).
1972								**1972**
Intelsat IV F-4 (S) 1972 03A	Atlas-Centaur (AC-28) (S)	Jan 22	1442.4	35921	35896	9.7	1387.1	Fourth generation satellite to provide increased capacity for Comsat's global commercial communications network. Reimbursable (Comsat).
HEOS A-2 (S) 1972 05A	Delta 87 (S)	Jan 31		DOWN AUG 2, 1974			117.0	Carried seven experiments provided by various European organizations to investigate particles and micrometeorites in space. Reimbursable (ESA). (WSMC)
Pioneer 10 (S) 1972 12A	Atlas-Centaur (AC-27) (S)	Mar 2		SOLAR SYSTEM ESCAPE TRAJECTORY			258.0	Jupiter Flyby. First spacecraft to flyby Jupiter and return scientific data.
TD-1 (S) 1972 14A	Delta 88 (S)	Mar 11		DOWN JAN 9, 1980			470.8	Western European satellite to obtain data on high-energy emissions from stellar and galactic sources. Reimbursable (ESA). (WSMC)
Apollo 16 (S) 1972 31A	Saturn V SA-511 (S)	Apr 16		LANDED APR 27, 1972			5655.0	Fifth manned lunar landing mission with John W. Young, Ken Mattingly, and Charles M. Duke. Landed at Descartes on Apr 20, 1972. Deployed camera and experiments; performed EVA with lunar roving vehicle. Deployed P&F Subsatellite in lunar orbit. Mission Duration 265 hours 51 minutes 5 seconds.
P&F Subsat (S) 1972 31D	SM	Apr 16		IMPACTED MOON MAY 29, 1972			36.3	
Intelsat IV F-5 (S) 1972 41A	Atlas-Centaur (AC-29) (S)	Jun 13	1438.6	35858	35811	10.7	1387.1	Fourth generation satellite to provide increased capacity for Comsat's global commercial communications network. Reimbursable (Comsat).

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ERTS-A (S) 1972 58A	Delta 89 (S)	Jul 23	103.0	908	896	99.3	941.0	Demonstrate remote sensing technology of the Earth's surface on a global scale and on a repetitive basis. (WSMC)
Explorer 46 (S) 1972 61A	Scout 79 (S)	Aug 13	DOWN NOV 2, 1979				206.4	Meteoroid Technology Satellite to measure meteoroid penetration rates and velocity. (WFF)
OAO 3 (S) 1972 65A	Atlas-Centaur (AC-22) (S)	Aug 21	99.2	725	713	35.0	2200.0	Study interstellar absorption of common elements in the interstellar gas, and investigate ultraviolet radiation emitted from young hot stars.
Transit (S) 1972 69A	Scout 80 (S)	Sep 2	99.9	796	707	90.0	94.0	Navigation Satellite for the U.S. Navy. Reimbursable (DOD). (WSMC)
Explorer 47 (S) 1972 73A	Delta 90 (S)	Sep 22	CURRENT ELEMENTS NOT MAINTAINED				375.9	Interplanetary Monitoring Platform; an automated space physics lab to study interplanetary radiation, solar wind, and energetic particles.
ITOS D (S) 1972 82A	Delta 91 (S)	Oct 15	114.9	1453	1446	102.0	34.5	To augment NOAA's satellite world-wide weather observation capabilities. Oscar, an amateur radio satellite, was carried as a piggyback. Reimbursable (ITOS/NOAA; Oscar/AMSAT). (WSMC)
Oscar (S) 1972 82B		Oct 15	114.9	1452	1446	102.0	15.9	
Telesat A (ANIK) (S) 1972 90A	Delta 92 (S)	Nov 9	1457.1	36258	36136	10.8	544.3	First of a series of domestic communications satellites for Canada. Reimbursable (Canada). (WSMC)
Explorer 48 (S) 1972 91A	Scout 81 (S)	Nov 15	DOWN AUG 20, 1980				186.0	Small Astronomy Satellite; carried a gamma ray telescope in a bulbous dome to study gamma rays. Launched by an Italian crew from San Marco. (SM)
ESRO IV (S) 1972 92A	Scout 82 (S)	Nov 21	DOWN APR 15, 1974				114.0	Carried five experiments to investigate the ionosphere, the near magnetosphere, auroral, and solar particles. Reimbursable (ESA). (WSMC)
Apollo 17 (S) (AS-512/CSM-114/LM-12) 1972 96A	Saturn V SA-512 (S)	Dec 7	LANDED DEC 19, 1972				51655.0	Sixth and last manned lunar landing mission in the Apollo series with Eugene A. Cernan, Ronald E. Evans, and Harrison H. (Jack) Schmitt. Landed at Taurus-Littrow on Dec 11., 1972. Deployed camera and experiments; performed EVA with lunar roving vehicle. Returned lunar samples. Mission duration 301 hours 51 minutes 59 seconds.
Nimbus E (S) 1972 97A	Delta 93 (S)	Dec 11	107.1	1099	1086	99.8	716.8	Stabilized, Earth-oriented platform to test advanced systems for collecting meteorological and geological data. (WSMC)
AEROS (S) 1972 100A	Scout 83 (S)	Dec 16	DOWN AUG 22, 1973				125.7	Study the state and behavior of the upper atmosphere and ionosphere. Cooperative with Germany. (WSMC)
1973								**1973**
Pioneer G (S) 1973 19A	Atlas-Centaur (AC-30) (S)	Apr 5	SOLAR SYSTEM ESCAPE TRAJECTORY				259.0	Investigate the interplanetary medium beyond the orbit of Mars, the Asteroid Belt, and the near-Jupiter environment.

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Telesat B (ANIK-2) (S) 1973 23A	Delta 94 (S)	Apr 20	1443.0	35970	35873	9.4	544.3	Second domestic communications satellite for Canada. Reimbursable (Canada).
Skylab Workshop (S) 1973 27A	Saturn V SA-513 (S)	May 14		DOWN JUL 11, 1979			71500.0	Unmanned launch of the first U.S. Space Station. Workshop incurred damage during launch. Repaired during follow-on manned missions.
Skylab 2 206/CSM-116 (S) 1973 32A	Saturn IB SA-206 (S)	May 25		LANDED JUN 22, 1973			29750.0	First manned visit to Skylab workshop with Charles (Pete) Conrad, Jr., Joseph P. Kerwin, and Paul J. Weitz. Deployed parasol-like thermal blanket to protect the hull and reduce temperatures within the workshop; freed solar wing that was jammed with debris. Mission duration 672 hours 49 minutes 49 seconds.
Explorer 49 (S) 1973 39A	Delta 95 (S)	Jun 10		SELENOCENTRIC ORBIT			328.0	Radio Astronomy Explorer to measure low frequency radio noise from galactic and extragalactic sources and from the Sun, Earth and Jupiter.
ITOS E (U)	Delta 96 (U)	Jul 16		DID NOT ACHIEVE ORBIT			333.8	Augment NOAA's satellite world-wide weather observation capabilities. Vehicle second stage malfunctioned. Reimbursable (NOAA). (WSMC)
Skylab 3 207/CSM-117 (S) 1973 50A	Saturn IB SA-207 (S)	Jul 28		LANDED SEP 25, 1973			29750.0	Second manned visit to Skylab Workshop with Alan L. Bean, Owen K. Garriott, and Jack R. Lousma. Performed systems and operational tests, conducted experiments, deployed thermal shield. Mission Duration 1416 hours 11 minutes 9 seconds.
Intelsat IV F-7 (S) 1973 58A	Atlas-Centaur (AC-31) (S)	Aug 23	1452.4	36138	36072	9.7	1387.1	Fourth generation satellite to provide increased capacity for Comsat's global commercial communications network. Reimbursable (Comsat).
Explorer 50 (S) 1973 78A	Delta 97 (S)	Oct 25		ELEMENTS NOT AVAILABLE			397.2	Last Interplanetary Monitoring Platform to investigate the Earth's radiation environment.
Transit (S) 1973 81A	Scout 84 (S)	Oct 30	105.2	1123	885	89.9	95.0	Navigation satellite for the U.S. Navy. Reimbursable (DOD). (WSMC)
Mariner 10 (Mariner/Venus/ Mercury) (S) 1973 85A	Atlas-Centaur (AC-34) (S)	Nov 3		HELIOCENTRIC ORBIT			504.0	Venus and Mercury flyby mission; first dual-planet mission. Photographed the Earth and the Moon on its flight to Venus; Venus encounter (at 5,800 km) on February 5, 1973; Mercury encounter (at 704 km) on March 29, 1974; second Mercury encounter (at 48,069 km) on September 21, 1974; third Mercury encounter (at 327 km) on March 16, 1975. Engineering tests conducted before attitude control gas was depleted and transmitter commanded off on March 24, 1975.
ITOS F (S) 1973 86A	Delta 98 (S)	Nov 6	116.1	1508	1499	116.1	345.0	To augment NOAA's satellite world-wide weather observation capabilities. Reimbursable (NOAA). (WSMC)
Skylab 4 (S) 1973 90A	Saturn IB SA-208 (S)	Nov 16		LANDED FEB 8, 1974			29,750.0	Third manned visit to Skylab Workshop with Gerald P. Carr, Edward G. Gibson, and William R. Pogue. Performed inflight experiments; obtained medical data on crew; performed four EVA's. Mission duration: 2016 hours 1 minute 16 seconds.

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Explorer 51 (S) 1973 101A	Delta 99 (S)	Dec 16		DOWN DEC 12, 1978			663.0	Atmosphere Explorer; carried 14 instruments to study energy transfer, atomic and molecular processes, and chemical reactions in the atmosphere. (WSMC)
1974								**1974**
Skynet II-A (U) 1974 02A	Delta 100 (U)	Jan 18		DOWN JAN 25, 1974			435.5	Communication satellite for the United Kingdom. Short circuit in electronics package caused vehicle failure. Reimbursable (UK).
Centaur Proof Flight (U)	Titan IIIE Centaur (76) (U)	Feb 11		DID NOT ACHIEVE ORBIT				Launch vehicle development test of the Titan IIIE/Centaur (TC-1); carried simulated Viking spacecraft and Sphinx. Liquid oxygen boost pump failed to operate during Centaur starts. Destruct command sent 748 seconds after liftoff.
San Marco C-2 (S) 1974 09A	Scout 85 (S)	Feb 18		DOWN MAY 4, 1976			170.0	Measure variations of equatorial neutral atmosphere density, composition, and temperature. Cooperative with Italy. (San Marco)
UK-X4 (S) 1974 13A	Scout 86 (S)	Mar 8	100.3	867	677	97.9	91.6	Three-axis stabilized spacecraft to demonstrate the technology involved in the design and manufacture of this type platform for use on small spacecraft. Reimbursable (UK). (WSMC)
Westar A (S) 1974 13A	Delta 101 (S)	Apr 13	1441.6	35907	35907	9.1	571.5	Domestic communications satellite for Western Union. Reimbursable (WU).
SMS A (S) 1974 33A	Delta 102 (S)	May 17		ELEMENTS NOT AVAILABLE			628.0	Geostationary environmental satellite to provide Earth imaging in visible and IR spectrum. First weather observer to operate in a fixed geosynchronous orbit about the Equator. Cooperative with NOAA.
ATS F (S) 1974 39A	Titan III C Centaur 79 (S)	May 30	1412.1	35440	35190	12.5	1403.0	Applications Technology Satellite capable of providing good quality TV signals to small, inexpensive ground receivers. Carried over 20 technology and science experiments.
Explorer 52 (S) 1974 40A	Scout 87 (S)	Jun 3		DOWN APR 28, 1978			26.6	"Hawkeye" spacecraft to investigate the interaction of the solar wind with the Earth's magnetic field. (WSMC)
AEROS B (S) 1974 55A	Scout 88 (S)	Jul 16		DOWN SEP 25, 1975			125.7	German-built satellite to study the state and behavior of the upper atmosphere and ionosphere. Reimbursable (Germany). (WSMC)
ANS A (S) 1974 70A	Scout 89 (S)	Aug 30		DOWN JUN 14, 1977			129.8	Study the sky in ultraviolet and X-ray from above the atmosphere. Cooperative with the Netherlands. (WSMC)
Westar B (S) 1974 75A	Delta 103 (S)	Oct 10	1442.2	35928	35883	8.9	571.5	Domestic communications satellite for Western Union. Reimbursable (WU).
UK-5 (S) 1974 77A	Scout 90 (S)	Oct 15		DOWN MAR 14, 1980			130.3	Measure the spectrum, polarization and pulsar features of non-solar X-ray sources. Cooperative with UK. (San Marco)

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
ITOS-G (S) 1974 89A	Delta 104 (S)	Nov 15	114.9	1457	1442	101.9	345.0	ITOS-G - To augment NOAA's satellite world-wide weather observation capabilities. Reimbursable (NOAA).
Intasat (S) 1974 89B			114.8	1457	1439	101.9	20.4	Intasat - Conduct worldwide observations of ionospheric total electron counts. Cooperative with Spain.
Oscar (S) 1974 89C			114.8	1457	1437	101.9	28.6	Oscar - provide communications capability for amateur radio enthusiasts around the world. Reimbursable (AMSAT) (WSMC)
Intelsat IV F-8 (S) 1974 93A	Atlas-Centaur (AC-32) (S)	Nov 21	1443.0	35949	35894	8.1	1387.1	Fourth generation satellite to provide increased capacity for Comsat's global commercial communications network. Reimbursable (Comsat).
Skynet II-B (S) 1974 94A	Delta 105 (S)	Nov 22	1436.9	35828	35775	11.6	435.0	Communication satellite for the United Kingdom. Reimbursable (UK).
Helios A (S) 1974 97A	Titan IIIE Centaur 83 (S)	Dec 10		HELIOCENTRIC ORBIT			370.0	Study the Sun from an orbit near the center of the solar system. Cooperative with West Germany.
Symphonie A (S) 1974 101A	Delta 106 (S)	Dec 18	1440.6	35896	35853	11.9	402.0	Joint French-German communications satellite to serve North and South America, Europe, Africa and the Middle East. Reimbursable (France/Germany).
								1975
1975								
Landsat 2 (S) 1975 04A	Delta 107 (S)	Jan 22	103.1	911	899	98.8	953.0	Second Earth Resources Technology Satellite to locate, map, and measure Earth resources parameters from space and demonstrate the applicability of this approach to the management of the worlds resources. (WSMC)
SMS-B (S) 1975 11A	Delta 108 (S)	Feb 6		ELEMENTS NOT AVAILABLE			628.0	Together with SMS-A, provide cloud-cover pictures every 30 minutes to weathermen at NOAA. Cooperative with NOAA.
Intelsat IV F-6 (U)	Atlas-Centaur (AC-33) (U)	Feb 20		DID NOT ACHIEVE ORBIT			1387.1	Fourth generation satellite to provide increased capacity for Comsat's global commercial communications network. Launch vehicle malfunctioned. Reimbursable (Comsat).
GEOS C (S) 1975 27A	Delta 109 (S)	Apr 9	101.6	851	815	115.0	340.0	Oceanographic and geodetic satellite to measure ocean topography, sea state, and other features. (WSMC)
Explorer 53 (S) 1975 37A	Scout 91 (S)	May 7		DOWN APR 9, 1979			196.7	Small Astronomy Satellite to study X-ray sources within and beyond the Milky Way galaxy. (San Marco)
Telesat C (S) 1975 38A	Delta 110 (S)	May 7	1439.5	35872	35833	8.2	544.3	Third domestic communications satellite for Canada. Reimbursable (Canada).
Intelsat IV F-1 (S) 1975 42A	Atlas-Centaur (AC-35) (S)	May 22	1450.8	36133	36015	8.1	1387.1	Fourth generation satellite to provide increased capacity for Comsat's commercial communications network. Last of the IV series. Reimbursable (Comsat).

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS			WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
				Apogee (km)	Perigee (km)	Incl (deg)		
Nimbus F (S) 1975 52A	Delta 111 (S)	Jun 12	107.4	1111	1098	99.8	827.0	Stabilized, Earth-oriented platform to test advanced systems for collecting meteorological and geological data. (WSMC)
OSO I (S) 1975 57A	Delta 112 (S)	Jun 21		DOWN JUL 9, 1986			1088.4	Observe active physical processes on the Sun and how it influences the Earth and its space environment.
Apollo Soyuz Test Project (S) 1975 66A	Saturn IB SA-210 (S)	Jul 15		DOWN JUL 24, 1975			14,856.0	Manned Apollo spacecraft with Thomas P. Stafford, Vance D. Brand and Donald K. Slayton Rendezvoused and docked with Soyuz 19 spacecraft (also launched July 15, 1975) with Aleksey Leonov and Valeriy Kubasov on July 17, 1975. Mission Duration 217 hours 28 minutes 23 seconds.
COS B (S) 1975 72A	Delta 113 (S)	Aug 8		CURRENT ELEMENTS NOT MAINTAINED			277.5	Cosmic ray satellite to study extraterrestrial gamma radiation. Reimbursable (ESA). (WSMC)
Viking A Orbiter(S) 1975 75A	Titan IIIE Centaur 88 (S)	Aug 20		AEROCENTRIC ORBIT			2324.7	Mars Orbiter and Lander mission to conduct systematic investigation of Mars. U.S. first attempt to soft land a spacecraft on another planet achieved on July 20, 1976. First analysis of surface material on another planet.
Viking A Lander (S) 1975 75C				LANDED ON MARS JUL 20, 1976			571.5	
Symphonie B (S) 1975 77A	Delta 114 (S)	Aug 29	1440.4	35880	35861	12.1	402.0	Second joint French-German communications satellite to serve North and South America, Europe, Africa and the Middle East Reimbursable (France/Germany).
Viking B Orbiter(S) 1975 83A	Titan IIIE Centaur 89 (S)	Sep 9		AEROCENTRIC ORBIT			2324.7	Second Mars Orbiter and Lander mission to conduct systematic investigation of Mars. Soft landed on Mars on September 3, 1976. Returned excellent scientific data.
Viking B Lander 1975 83C				LANDED ON MARS SEP 3, 1976			571.5	
Intelsat IVA F-1 (S) 1975 91A	Atlas-Centaur (AC-36) (S)	Sept 25	1441.0	35914	35852	8.1	1515.0	Improved satellite with double the capacity of previous Intelsats for Comsat's global commercial communications network. Reimbursable (Comsat).
Explorer 54 (S) 1975 96A	Delta 115 (S)	Oct 6		DOWN MAR 12, 1976			675.0	Atmosphere Explorer to investigate chemical processes and energy transfer mechanisms which control the Earth's atmosphere. (WSMC)
Transit (S) 1975 99A	Scout 92 (S)	Oct 12		DOWN MAY 26, 1991			161.9	Second in a series of improved navigation satellite for the U.S. Navy. Reimbursable. (WSMC)
SMS-C/GOES A (S) 1975 100A	Delta 116 (S)	Oct 16	1435.7	35801	35756	7.6	628.0	First operational satellite in NOAA's geosynchronous weather satellite system. Reimbursable (NOAA).
Explorer 55 (S) 1975 107A	Delta 117 (S)	Nov 20		DOWN JUN 10, 1981			719.6	Atmosphere Explorer to investigate the chemical processes and energy transfer mechanisms which control Earth's atmosphere.

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Dual Air Density Explorer (U)	Scout 93 (U)	Dec 5		DID NOT ACHIEVE ORBIT			35.3	Measure global density of upper atmosphere and lower exosphere. Malfunction during third stage burn resulted in loss of vehicle control; destroyed by Range Safety Officer at 341 seconds. (WSMC)
RCA A (S) 1975 117A	Delta 118 (S)	Dec 13	1445.8	36084	35873	8.2	867.7	First RCA domestic communications satellite. Reimbursable (RCA).
1976								**1976**
Helios B (S) 1976 03A	Titan IIIE Centaur 93 (S)	Jan 15		HELIOCENTRIC ORBIT			374.7	Carried 11 scientific instruments to study the Sun. Cooperative with Germany.
CTS (S) 1976 04A	Delta 119 (S)	Jan 17	1437.1	35887	35726	12.2	347.0	Experimental high-powered communication satellite to provide communications in remote areas. Cooperative with Canada.
Intelsat IVA F-2 (S) 1976 10A	Atlas-Centaur (AC-37) (S)	Jan 29	1444.5	35968	35933	8.3	1515.0	Second improved satellite with double the capacity of previous Intelsats for Comsat's global commercial communications network. Reimbursable (Comsat).
Marisat A (S) 1976 17A	Delta 120 (S)	Feb 19	1436.1	35797	35777	10.4	655.4	Comsat Maritime Satellite to provide rapid, high-quality communications between ships at sea and home offices. Reimbursable (Comsat).
RCA B (S) 1976 29A	Delta 121 (S)	Mar 26	1460.1	36501	36010	7.8	867.7	Second RCA domestic communications Satellite. Reimbursable (RCA).
NATO IIIA (S) 1976 35A	Delta 122 (S)	Apr 22	1442.3	36008	35806	10.1	670.0	Third-generation communications satellite for NATO. Reimbursable (NATO)
LAGEOS (S) 1976 39A	Delta 123 (S)	May 4	225.4	5945	5838	109.9	411.0	Solid, spherical passive satellite to provide a reference point for laser ranging experiments. (WSMC)
Comstar 1A (S) 1976 42A	Atlas-Centaur (AC-38) (S)	May 13	1442.6	35921	35905	8.0	1490.1	First domestic communications satellite for Comsat. Reimbursable (Comsat).
Air Force P76-5 (S) 1976 47A	Scout 94 (S)	May 22	105.4	1044	981	99.6	72.6	Evaluate propagation effects of disturbed plasmas on radar and communications systems. Reimbursable (DOD). (WSMC)
Marisat B (S) 1976 53A	Delta 124 (S)	Jun 9	1436.1	35813	35760	9.5	655.4	Second Comsat Maritime Satellite to provide rapid, high-quality communications between ships at sea and home offices. Reimbursable (Comsat).
Gravity Probe A (S)	Scout 95 (S)	Jun 18		SUBORBITAL FLIGHT			102.5	Scientific probe to test Einstein's Theory of Relativity. (WFF)
Palapa A (S) 1976 66A	Delta 125 (S)	Jul 8	1439.1	35867	35821	8.0	573.8	Communication Satellite for Indonesia. Reimbursable (Indonesia).
Comstar B (S) 1976 73A	Atlas-Centaur (AC-40) (S)	Jul 22	1436.2	35791	35784	7.9	1490.1	Second domestic communications satellite for Comsat. Reimbursable (Comsat).

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
ITOS H (S) 1976 77A	Delta 126 (S)	Jul 29	116.2	1518	1505	102.1	345.0	Second generation satellite for NOAA's world-wide weather observation. Reimbursable (NOAA). (WSMC)
TIP III (S) 1976 89A	Scout 96 (S)	Sep 1	DOWN MAY 30, 1981				166.0	Improved Transit Navigation Satellite for the U.S. Navy. Reimbursable (DOD). (WSMC)
Marisat C (S) 1976 101A	Delta 127 (S)	Oct 14	1436.0	35791	35779	10.9	655.4	Third Comsat Maritime Satellite to provide rapid, high-quality communications between ships at sea and home offices. Reimbursable (Comsat).
1977								1977
NATO IIIB (S) 1977 05A	Delta 128 (S)	Jan 27	1436.2	35789	35788	9.9	670.0	Third-generation communications satellite for NATO. Reimbursable (NATO).
Palapa B (S) 1977 18A	Delta 129 (S)	Mar 10	1439.5	35873	35831	6.9	573.8	Second Communication Satellite for Indonesia. Reimbursable (Indonesia).
GEOS/ESA (U) 1977 29A	Delta 130 (U)	Apr 20	734.1	38283	2874	26.6	571.5	ESA scientific satellite; carried seven experiments to investigate the Earth's magnetosphere. Malfunction during second stage/third stage spinup placed GEOS in unusable orbit. Reimbursable (ESA).
Intelsat IVA F-4 (S) 1977 41A	Atlas-Centaur (AC-39) (S)	May 26	1448.1	36075	35966	7.0	1515.0	Improved satellite with double the capacity of previous Intelsats for Comsat's global commercial communications network. Reimbursable (Comsat).
GOES/NOAA (S) 1977 48A	Delta 131 (S)	Jun 16	1435.8	35797	35762	10.2	635.0	Visible/infrared spin-scan radiometer provided day and night global weather pictures for NOAA. Reimbursable (NOAA).
GMS (S) 1977 65A	Delta 132 (S)	Jul 14	1451.0	36152	36001	10.4	669.5	Operational weather satellite; Japan's contribution to the Global Atmosphere Research Program (GARP). Reimbursable (Japan).
HEAO A (S) 1977 75A	Atlas-Centaur (AC-45) (S)	Aug 12	DOWN MAR 15, 1979				2551.9	High Energy Astronomy Observatory to study and map X-rays and gamma rays.
Voyager 2 (S) 1977 76A	TITAN III E Centaur 106 (S)	Aug 20	SOLAR SYSTEM ESCAPE TRAJECTORY				2086.5	Investigate the Jupiter and Saturn planetary systems and the interplanetary medium between the Earth and Saturn. Jupiter flyby occurred on July 9, 1979; Saturn flyby occurred on August 25, 1981; Uranus flyby occurred on January 24, 1986; and Neptune flyby occurred on August 25, 1989. Will continue into interstellar space
SIRIO (S) 1977 80A	Delta 133 (S)	Aug 25	1438.7	35925	35750	8.3	398.0	Italian scientific satellite to study the propagation characteristics of radio waves transmitted at super high frequencies during adverse weather. Reimbursable (Italy).

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Voyager 1 (S) 1977 84A	Titan III E Centaur 107 (S)	Sep 5		HELIOCENTRIC ORBIT			2086.5	Investigate the Jupiter and Saturn planetary systems and the interplanetary medium between the Earth and Saturn. Jupiter flyby occurred on March 5, 1979; Saturn flyby occurred on November 12, 1980; departed Saturn at a high angle to the ecliptic plane to observe the large cloud-covered moon Titan. Will not be involved in any more planetary encounters.
ESA/OTS (U)	Delta 134 (U)	Sep 13		DID NOT ACHIEVE ORBIT			865.0	ESA experimental communications satellite. Vehicle exploded at 54 seconds after liftoff. Reimbursable (ESA).
Intelsat IVA F-5 (U)	Atlas-Centaur (AC-43) (U)	Sep 29		DID NOT ACHIEVE ORBIT			1515.0	Improved satellite with double the capacity of previous Intelsats for Comsat's global commercial communications network. Launch vehicle failed. Reimbursable (Comsat).
ISEE A/B 1977 102A (S) 1977 102B (S)	Delta 135 (S)	Oct 22		 DOWN SEP 26, 1987 DOWN SEP 26, 1987			 329.0 157.7	Dual payload International Sun Earth Explorer to the study interaction of the interplanetary medium with the Earth's immediate environment. Cooperative with ESA.
Transat (S) 1977 106A	Scout 97 (S)	Oct 27	106.8	1096	1060	89.7	93.9	Improved Transit navigation satellite for the U.S. Navy. Reimbursable (DOD). (WSMC)
Meteosat (S) 1977 108A	Delta 136 (S)	Nov 22	1435.9	35815	35748	11.3	695.3	ESA Meteorological satellite; Europe's contribution to the Global Atmospheric Research Program (GARP). Reimbursable (ESA).
CS/Japan (S) 1977 118A	Delta 137 (S)	Dec 14	1455.8	36182	36162	9.8	677.0	Experimental communication satellite for Japan. Reimbursable (Japan).
1978								**1978**
Intelsat IVA F-3 (S) 1978 02A	Atlas-Centaur (AC-46) (S)	Jan 6	1441.4	35901	35877	6.5	1515.0	Provide increased telecommunications capacity for Intelsat's global network. Reimbursable (Comsat).
IUE-A (S) 1978 12A	Delta 138 (S)	Jan 26	1435.6	41343	30210	33.8	698.5	International Ultraviolet Explorer to obtain high resolution data of stars and planets in the UV region of the spectrum. Cooperative with ESA.
Fltsatcom-A (S) 1978 16A	Atlas-Centaur (AC-44) (S)	Feb 9	1436.1	35798	35776	10.5	1863.3	Provide communications capability for the USAF and the USN for fleet relay and fleet broadcast. Reimbursable (DOD).
Landsat-C (S) 1978 26A Oscar-8 (S) 1978 26B PIX-I (S) 1978 26C	Delta 139 (S)	Mar 5	103.1 103.0	916 904 CURRENT ELEMENTS NOT MAINTAINED	894 893	98.8 99.2	900.0 27.3 34.0	Third Earth Resources Technology Satellite to study the Earth's natural resources; measure water, agricultural fields, and mineral deposits. Carried Lewis Research Center Plasma Interaction Experiment (PIX-I) and AMSAT Oscar Amateur Radio communications relay satellite. Reimbursable (Oscar/AMSAT).
Intelsat IVA F-6 (S) 1978 35A	Atlas-Centaur (AC-48) (S)	Mar 31	1435.6	35801	35753	6.5	1515.0	Provide increased telecommunications capacity for Intelsat's global network. Reimbursable (Comsat).

NASA Major Launch Record

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
BSE/Japan (S) 1978 39A	Delta 140	Apr 7	1435.2	35796	35740	11.0	665.0	Japan's Broadcasting Satellite/Experimental for conducting TV broadcast experiments. Reimbursable (Japan).
HCMM/AEM-A (S) 1978 41A	Scout 98 (S)	Apr 26	DOWN DEC 22, 1981				134.3	Heat Capacity Mapping Mission to test the feasibility of measuring variations in the Earth's temperatures. (WSMC)
OTS-B (S) 1978 44A	Delta 141	May 11	1452.6	36124	36092	8.5	865.0	Orbital Test Satellite to conduct communications experiments for ESA. Reimbursable (ESA).
Pioneer Venus-A (Orbiter) (S) 1978 51A	Atlas-Centaur (AC-50) (S)	May 20	ELEMENTS NOT AVAILABLE				582.0	One of two Pioneer flights to Venus in 1978; was placed in orbit around Venus for remote sensing and direct measurements of the planet and its surrounding environment.
GOES-C/NOAA (S) 1978 62A	Delta 142 (S)	Jun 16	1436.0	35808	35761	9.1	635.0	Part of NOAA's global network of geostationary environmental satellites to provide Earth imaging, monitor the space environment, and relay meteorological data to users. Reimbursable (NOAA).
Seasat-A (S) 1978 64A	Atlas-F (S)	Jun 26	100.1	765	761	108.0	2300.0	Demonstrate techniques for global monitoring of oceanographic phenomena and features. After 106 days of returning data, contact was lost when a short circuit drained all power from the batteries. (WSMC)
Comstar C (S) 1978 68A	Atlas-Centaur (AC-41) (S)	Jun 29	1451.8	36181	36004	6.3	1516.0	Third domestic communications satellite for Comsat. Reimbursable (Comsat).
GEOS-B/ESA (S) 1978 71A	Delta 143 (S)	Jul 14	1449.1	36056	36033	11.1	575.0	Positioned on magnetic field lines to study the magnetosphere and correlate data with ground station, balloon, and sounding rocket measurements. Reimbursable (ESA).
Pioneer/Venus-B (Multiprobe) 1978 78A	Atlas-Centaur (AC-51) (S)	Aug 8	PROBES LANDED DEC 9, 1978				904.0	Second Pioneer flight to Venus in 1978 to determine the nature and composition of the atmosphere of Venus. All four probes and the bus transmitted scientific data. The large probe, north probe, and night probe went dead upon impact; the day probe continued to transmit for 68 minutes after impact.
ISEE-C (S) 1978 79A ICE (S)	Delta 144 (S)	Aug 12	HELIOCENTRIC ORBIT				479.0	Monitored the characteristics of solar phenomena about 1 hour before ISEE-A and B to gain knowledge of how the Sun controls the Earth's near space environment. The spacecraft was renamed ICE in 1985 and its orbit was changed to encounter the Comet Giacobini-Zinner on September 11, 1985. Cooperative with ESA.
Tiros-N (S) 1978 96A	Atlas-F (S)	Oct 13	101.7	845	829	98.7	1405.0	Third generation polar orbiting environmental spacecraft to provide improved meteorological and environmental data. Operated by NOAA. (WSMC)

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Nimbus-G (S) 1978 98A Cameo 1978 98B	Delta 145 (S)	Oct 24	104.0 104.0	955 966	940 924	99.1 99.6	987.0	Carried advanced sensors and technology to conduct experiments in pollution monitoring, oceanography, and meteorology. ESA received and processed data direct. After separation from Nimbus-G, the Delta vehicle released lithium over Northern Scandinavia and barium over Northern Alaska as part of Project CAMEO (Chemically Active Material Ejected in Orbit).
HEAO-B (S) 1978 103A	Atlas-Centaur (AC-52) (S)	Nov 13		DOWN MAR 25, 1982			3152.0	Second High Energy Astronomical Observatory; carried a large X-ray telescope to study the high energy universe, pulsars, neutron stars, black holes, quasars, radio galaxies, and supernovas.
NATO IIIC (S) 1978 106A	Delta 146 (S)	Nov 18	1462.2	36307	36283	6.9	706.0	Third-generation communications satellite for NATO. Reimbursable (NATO).
Telesat D (S) 1978 116A	Delta 147 (S)	Dec 15	1442.7	35943	35887	5.8	887.2	Fourth domestic communications satellite for Canada. Reimbursable (Canada).
1979								**1979**
SCATHA (S) 1979 07A	Delta 148 (S)	Jan 30	1418.4	42737	28140	9.4	658.6	Spacecraft Charging at High Altitudes (SCATHA) carried 12 experiments to investigate electrical static discharges that affect satellites. Reimbursable (DOD).
SAGE/AEM-2 (S) 1979 13A	Scout 99 (S)	Feb 18		DOWN APR 11, 1989			127.0	Stratospheric Aerosol and Gas Experiment Applications Explorer Mission, to map vertical profiles of ozone, aerosol, nitrogen dioxide, and Rayleight molecular extinction around the globe. (WFF)
Fltsatcom B (S) 1979 38A	Atlas-Centaur (AC-47) (S)	May 4	1461.3	36334	36222	9.2	1876.1	Provide communications capability for the USAF and the USN for fleet relay and fleet broadcast. Reimbursable (DOD). (WFF)
UK-6 (S) 1979 47A	Scout 100 (S)			DOWN SEP 23, 1990			154.5	Measure ultra-heavy cosmic ray particles and study low-energy cosmic X-rays. Reimbursable (UK). (WSMC)
NOAA-6 (S) 1979 57A	Atlas-F (S)	Jun 27	100.7	801	786	98.6	1405.0	To provide continuous coverage of the Earth and high-accuracy world-wide meteorological data. Reimbursable (NOAA). (WSMC)
Westar C (S) 1979 72A	Delta 149 (S)	Aug 9	1441.0	35889	35874	4.6	571.5	Domestic communications satellite for Western Union. Reimbursable (WU).
HEAO 3 (S) 1979 82A	Atlas-Centaur (AC-53) (S)	Sep 20		DOWN DEC 7, 1981			2898.5	High Energy Astronomy Observatory carried two cosmic ray experiments and one gamma ray spectrometer to obtain data on cosmic rays observed across the far reaches of space.
MAGSAT/AEM-3 (S) 1979 94A	Scout 101 (S)	Oct 30		DOWN JUN 11, 1980			183.0	Magnetic Field Satellite, Applications Explorer Mission to map the magnetic field of the Earth. (WSMC)
RCA-C (U) 1979 101A	Delta 150 (S)	Dec 6	788.9	35423	8385	8.2	895.4	Third RCA domestic communications satellite. Contact was lost shortly after apogee motor firing. Reimbursable (RCA).

NASA Major Launch Record

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS			WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
				Apogee (km)	Perigee (km)	Incl (deg)		
1980								**1980**
Fltsatcom C (S) 1980 04A	Atlas-Centaur (AC-49) (S)	Jan 17	1436.7	35885	35710	8.4	1864.7	Provide communications capability for the USAF and the USN for fleet relay and fleet broadcast. Reimbursable (DOD).
SMM-A (S) 1980 14A	Delta 151 (S)	Feb 14		DOWN DEC 2, 1989			2315.0	Solar Maximum Mission; first solar satellite designed to study specific solar phenomena using a coordinated set of instruments; performed a detailed study of solar flares, active regions, sunspots, and other solar activity. Also measured the total output of radiation from the Sun.
NOAA-7 (U) 1980 43A	Atlas 19F (U)	May 29		DOWN MAY 3, 1981			1405.0	A companion to TIROS N to provide continuous coverage of the Earth and provide high-accuracy worldwide meteorological data. Launch vehicle malfunctioned; failed to place satellite into proper orbit. Reimbursable (NOAA). (WSMC)
GOES D (S) 1980 74A	Delta 152 (S)	Sep 9	1451.3	36713	35453	8.6	832.0	Part of NOAA's global network of geostationary environmental satellites to provide Earth imaging, monitor the space environment, and relay meteorological data. Reimbursable (NOAA).
Fltsatcom D (S) 1980 87A	Atlas-Centaur (AC-57) (S)	Oct 30	1436.1	35798	35775	8.5	1863.8	Provide communications capability for the USAF and the USN for fleet relay and fleet broadcast. Reimbursable (DOD).
SBS-A (S) 1980 91A	Delta 153 (S)	Nov 15	1442.5	35946	35878	5.3	1057.0	Satellite Business Systems (SBS) to provide fully switched private networks to businesses, government agencies, and other organizations with large, varied communications requirements. Reimbursable (SBS).
Intelsat V-A F-2 (S) 1980 98A	Atlas-Centaur (AC-54) (S)	Dec 6	1436.2	35806	35769	3.8	1928.2	Advanced series of spacecraft to provide increased telecommunications capacity for Intelsat's global network. Reimbursable (Comsat).
1981								**1981**
Comstar D (S) 1981 18A	Atlas-Centaur (AC-42) (S)	Feb 21	1436.2	35791	35785	6.4	1484.0	Fourth domestic communications satellite for Comsat. Reimbursable (Comsat).
STS-1 (S) 1981 34A	Shuttle (S) (Columbia)	Apr 12		LANDED AT DFRF APR 14, 1981				First Manned orbital test flight of the Space Transportation System with John W. Young and Robert L. Crippen to verify the combined performance of the Space Shuttle Vehicle. Mission duration 54 hours 20 minutes 53 seconds.
NOVA-1 (S) 1981 44A	Scout 102 (S)	May 15		ELEMENTS NOT AVAILABLE			166.9	Improved Transit satellite for the Navy's operational navigation system. Reimbursable (DOD).
GOES E (S) 1981 49A	Delta 154 (S)	May 22	1436.6	35808	35785	5.7	837.0	Part of NOAA's Geostationary Operational Environmental Satellite system to provide near continual, high resolution visual and infrared imaging over large areas. Reimbursable (NOAA).

NASA Major Launch Record

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Intelsat V-8 F-1 (S) 1981 50A	Atlas-Centaur (AC-56) (S)	May 23	1438.2	35856	35799	4.4	1928.2	Advanced series of spacecraft to provide increased telecommunications capacity for Intelsat's global network. Reimbursable (Comsat).
NOAA-C (S) 1981 59A	Atlas 87F (S)	Jun 23	101.7	847	829	98.9	1405.0	To provide continuous coverage of the Earth and provide high-accuracy worldwide meteorological data. Reimbursable (NOAA) (WSMC)
DE A & B(S) 1981 70A (S) 1981 70B (S)	Delta 155	Aug 3	410.4	23286	505 DOWN FEB 19, 1983	88.8	424.0 420.0	Dynamic Explorer (DE-A & B); dual spacecraft to study the Earth's electromagnetic fields. (WSMC)
Fltsatcom E (U) 1981 73A	Atlas-Centaur (AC-59) (S)	Aug 6	1460.4	36311	36209	8.1	1863.8	Provide communications capability for the USAF and the USN for fleet relay and fleet broadcast. Reimbursable (DOD).
SBS-B 1981 96A	Delta 156 (S)	Sep 24	1436.2	35797	35778	4.4	1057.0	Satellite Business Systems (SBS) to provide fully switched private networks to businesses, government agencies, and other organizations with large, varied communications requirements. Reimbursable (SBS).
SME (S) 1981 100A	Delta 157 (S)	Oct 6			DOWN MAR 5, 1991		437.0	Solar Mesosphere Explorer, an atmospheric research satellite to study reactions between sunlight, ozone and other chemicals in the
UoSAT 1 (S) 1981 100B					DOWN OCT 13, 1989		52.0	atmosphere. Carried UoSat-Oscar 9 (UK) Amateur Radio Satellite as secondary payload. Reimbursable (UoSat-Oscar 9)
STS 2 (S) 1981 111A	Shuttle (S) (Columbia)	Nov 12		LANDED AT DFRF NOV 14, 1981				Second Manned orbital test flight of the Space Transportation System with Joe E. Engle and Richard H. Truly to verify the combined performance of the Space Shuttle vehicle. OSTA-1 payload demonstrated capability to conduct scientific research in the attached mode. Mission duration 54 hours 13 minutes 12 seconds.
RCA-D (S) 1981 114A	Delta 158 (S)	Nov 19	1438.6	35846	35826	1.8	1081.8	Fourth RCA domestic communications satellite. Reimbursable (RCA).
Intelsat V F-3 (S) 1981 119A	Atlas-Centaur (AC-55) (S)	Dec 15	1436.1	35801	35770	3.4	1928.2	Advanced series of spacecraft to provide increased telecommunications capacity for Intelsat's global network. Reimbursable (Comsat).
1982								**1982**
RCA C' (S) 1982 04A	Delta 159 (S)	Jan 16	1446.0	35988	35970	1.1	1081.8	RCA domestic communications satellite. Reimbursable (RCA).
Westar IV (S) 1982 14A	Delta 160 (S)	Feb 25	1443.4	35934	35923	1.1	1072.0	Second generation domestic communications satellite for Western Union. Reimbursable (WU).
Intelsat V-D F-4 (S) 1982 17A	Atlas-Centaur (AC-58) (S)	Mar 4	1435.3	35791	35751	3.4	1928.2	Advanced series of spacecraft to provide increased telecommunications capacity for Intelsat's global network. Reimbursable (Comsat).

NASA Major Launch Record

1982

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
STS 3 (S) 1982 22A	Shuttle (S) (Columbia)	Mar 22	LANDED AT WHITE SANDS MAR 30, 1982					Third Manned orbital test flight of the Space Transportation System with Jack R. Lousma and C. Gordon Fullerton to verify the combined performance of the Space Shuttle vehicle. OSS-1 scientific experiments conducted from the cargo bay. Mission duration 192 hrs 4 mins 46 secs.
Insat 1-A (U) 1982 31A	Delta 161 (S)	Apr 10	1434.2	35936	35562	0.1	1152.1	Multipurpose telecommunications/meteorology spacecraft for India. Reimbursable (India).
Westar V (S) 1982 58A	Delta 162 (S)	Jun 8	1451.4	36149	36023	0.8	1105.0	Western Union domestic communications satellite. Reimbursable (WU).
STS 4 (S) 1982 65A	Shuttle (S) (Columbia)	Jun 27	LANDED AT DFRF JUL 4, 1982					Fourth and last manned orbital test flight of the Space Transportation System with Thomas K. (Ken) Mattingly II and Henry W. Hartsfield to verify the combined performance of the Space Shuttle vehicle. Carried first operational Getaway Special canister for Utah State University and payload DOD 82-1. Mission duration 169 hours 9 minutes 31 seconds.
Landsat D (S) 1982 72A	Delta 163 (S)	Jul 16	98.8	705	693	98.3	1942.0	Earth Resources Technology Satellite to provide a continuing Earth remote sensing data. Instruments included a multispectral scanner and thematic mapper. (WSMC)
Telesat G (S) 1982 82A	Delta 164 (S)	Aug 25	1438.5	35851	35814	1.5	1238.3	Commercial communications satellite for Canada. Reimbursable (Canada).
Intelsat V-E F-5 (S) 1982 97A	Atlas-Centaur (AC-60) (S)	Sep 28	1436.1	35819	35754	2.9	1928.2	Advanced series of spacecraft to provide increased telecommunications capacity for Intelsat's global network. Carried Maritime Communications Services (MCS) package for INMARSAT. Reimbursable (Comsat).
RCA-E (S) 1982 105A	Delta 165 (S)	Oct 27	1436.2	35795	35779	1.7	1116.3	RCA domestic communications satellite. Reimbursable (RCA).
STS 5 (S) 1982 110A	Shuttle (S) (Columbia)	Nov 11	LANDED AT DFRF NOV 16, 1982					First operational flight of STS with Vance Brand, Robert Overmeyer, Joseph Allen and William Lenoir. Two satellites deployed: SBS-C (Reimbursable - SBS) and Telesat-C (Reimbursable - Canada). Demonstrated ability to conduct routine space operations. Mission duration 122 hours 14 minutes 26 seconds.
SBS-C (S) 1982 110B		Nov 11	1436.2	35799	35776	1.2	3344.8	
Telesat-E (S) 1982 110C		Nov 12	1436.1	35796	35796	01.3	4443.4	
1983								**1983**
IRAS (S) 1983 04A	Delta 166 (S)	Jan 25	102.9	903	884	99.0	1075.9	Infrared Astronomical Satellite to make the first all-sky survey for objects that emit infrared radiation and to provide a catalog of infrared sky maps. Cooperative with the Netherlands. Lewis Research Center Plasma Interaction Experiment (PIX), to investigate interactions between high voltage systems and space environment, activated by Delta after IRAS separation.
PIX II (S) 1983 04B			102.3	882	851	100.0		

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
NOAA-8 (S) 1983 22A	Atlas 73E (S)	Mar 28	101.0	817	793	98.5	1712.0	Advanced Tiros spacecraft to provide continuous coverage of the Earth and provide high-accuracy worldwide meteorological data. Reimbursable (NOAA). (WSMC)
STS 6 (S) 1983 26A	Shuttle (S) (Challenger)	Apr 4	LANDED AT DFRF APR 9, 1983					Second operational flight of the STS with Paul Weitz, Karol Bobko, Donald Peterson, Story Musgrave. Deployed Tracking and Data Relay Satellite (TDRS) to provide improved tracking and data acquisition services to spacecraft in low Earth orbit; performed EVA. Mission duration 120 hours 23 minutes 42 seconds.
TDRS-A (S) 1983 26B		Apr 4	1436.1	35797	35777	6.6	17014.0	
RCA F (S) 1983 30A	Delta 167 (S)	Apr 11	1442.0	35956	357847	0.1	1116.3	RCA domestic communications satellite. Reimbursable (RCA).
GOES 6 (S) 1983 41A	Delta 168 (S)	Apr 28	1435.4	35785	35758	4.5	838.0	Part of NOAA's Geostationary Operational Environmental Satellite system to provide near continual, high resolution visual and infrared imaging over large areas. Reimbursable (NOAA).
Intelsat V-F F-6 (S) 1983 47A	Atlas-Centaur (AC-61) (S)	May 19	1436.2	35797	35779	1.9	1928.2	Advanced series of spacecraft to provide increased telecommunications capacity for Intelsat's global network. Carried Maritime Communications Services (MCS) package for INMARSAT. Reimbursable (Comsat).
EXOSAT (S) 1983 51A	Delta 169 (S)	May 26	DOWN MAY 6, 1986				500.0	X-ray satellite to provide continuous observations of X-ray sources. Reimbursable (ESA).
STS 7 (S) 1983 59A	Shuttle (S) (Challenger)	Jun 18	LANDED AT DFRF JUN 24, 1983					Third operational flight of STS with Robert L. Crippen, Frederick H. Hauck, John M. Fabian, Sally K. Ride (first woman astronaut), and Norman E. Thagard. Deployed two communications satellites. Telesat (Reimbursable - Canada) and Palapa (Reimbursable - Indonesia). Carried out experiments including launching and recovering SPAS 01 (Reimbursable - Germany). Mission duration 146 hours 23 minutes 59 seconds.
Telesat-F (S) 1983 59B		Jun 18	1436.1	35793	35780	1.2	4443.4	
Palapa-B-1 (S) 1983 59C		Jun 18	1436.1	35790	35784	2.4	4521.5	
SPAS-01 (S) 1983 59F		Jun 18	RETRIEVED JUN 24, 1983					
AF P83-1 (S) 1983 63A	Scout 103 (S)	Jun 27	100.6	819	754	82.0	112.6	Air Force HILAT satellite to evaluate propagation effects of disturbed plasmas on radar and communication systems. Reimbursable (DOD). (WSMC)
Galaxy 1 (S) 1983 65A	Delta 170 (S)	Jun 28	1436.1	35791	35782	0.0	519.0	Hughes Communications, Inc. communications satellite. Reimbursable (Hughes).
Telsat 3A (S) 1983 77A	Delta 171 (S)	Jul 28	1436.2	35796	35780	0.1	635.0	AT&T communications satellite. Reimbursable (AT&T).

NASA Major Launch Record

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
STS 8 (S) 1983 89A	Shuttle (S) (Challenger)	Aug 30		LANDED AT DFRF SEP 5, 1983				Fourth operational flight of STS with Richard H. Truly, Daniel C. Brandenstein, Dale A. Gardner, Guion S. Bluford (first black astronaut), and William E. Thornton. First night launch and landing. Deployed satellite, INSAT (Reimbursable - India), performed tests and experiments. Mission duration 145 hours 8 minutes 43 seconds.
INSAT-B (S) 1983 89B		Aug 31	1436.2	35811	35765	3.0	3391.0	
RCA G (S) 1983 94A	Delta 172 (S)	Sep 8	1436.2	35803	35772	0.0	1121.3	RCA domestic communications Satellite. Reimbursable (RCA).
Galaxy 2 (S) 1983 98A	Delta 173 (S)	Sep 22	1436.2	35792	35783	0.0	579.0	Hughes Communications satellite. Reimbursable (Hughes).
STS-9 (S) Spacelab-1 1983 116A	Shuttle (S) (Columbia)	Nov 28		LANDED AT DFRF DEC 8, 1983				Fifth operational flight of STS with John W. Young, Brewster W. Shaw, Jr., Owen K. Garriott, Robert A. R. Parker, Byron K. Lichtenberg, and Ulf Merbold (ESA). Spacelab-1, a multi-discipline science payload, carried in Shuttle Cargo Bay. Cooperative with ESA. Mission Duration 247 hours 47 minutes 24 seconds.
1984								**1984**
STS 41-B (S) 1984 11A	Shuttle (S) (Challenger)	Feb 3		LANDED AT KSC FEB 11, 1984				Fourth Challenger flight with Vance D. Brand, Robert L. Gibson, Bruce McCandless, Ronald E. McNair and Robert L. Stewart. Deployed Westar (Reimbursable - WU), and Palapa B-2 (Reimbursable - Indonesia). Both PAM's failed; both satellites retrieved on STS 51-A mission. Rendezvous tests performed with IRT, using deflated target. Evaluated Manned Maneuvering Unit (MMU) and Manipulator Foot Restraint (MFR). First STS landing at KSC. Mission duration 191 hours 15 minutes 55 seconds.
Westar 6 (U) 1984 11B		Feb 3		RETRIEVED NOV 16, 1984 (51-A)			3309.0	
IRT (S) 1984 11C		Feb 3		DOWN FEB 11, 1984			234.0	
Palapa B-2 (U) 1984 11D		Feb 6		RETRIEVED NOV 16, 1984 (51-A)			3419.0	
Landsat 5 (S) 1984 21A	Delta 174 (S)	Mar 1	98.8	703	695	98.2	1947.0	Earth resources technology satellite to provide continuing Earth remote sensing data. Instruments included a multispectral scanner and thematic mapper. Reimbursable (NOAA). UoSAT sponsored by AMSAT (Reimbursable - AMSAT). (WSMC)
UoSAT (S) 1984 21B			98.0	670	653	97.8	52.0	
STS 41-C (S) 1984 34A	Shuttle (S) (Challenger)	Apr 6		LANDED AT DFRF APR 13, 1984				Fifth Challenger flight with Robert L. Crippen, Frances R. Scobee, Terry J. Hart, George D. Nelson and James D. Van Hoften. Deployed LDEF; SMM retrieved and repaired in Cargo Bay; redeployed April 12. Mission duration 167 hours 40 minutes 7 seconds
LDEF (S) 1984 34B		Apr 6		RETRIEVED JAN 20, 1990 (STS-32)			9670.0	
Intelsat V-G F-9 (U) 1984 57A	Atlas-Centaur (AC-62) (U)	Jun 9		DOWN OCT 24, 1984			1928.2	Advanced series of spacecraft to provide increased telecommunications capacity for Intelsat's global network. Carried Maritime Communications Services (MCS) package for INMARSAT. Vehicle failed to place satellite in useful orbit. Reimbursable (Comsat).

NASA Major Launch Record

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
AMPTE	Delta 175 (S)	Aug 16						Three active magnetospheric particle tracer explorers: Charge Composition Explorer (CCE) provided by the U.S.; Ion Release Module (IRM) provided by the Federal Republic of Germany ; and the United Kingdom Subsatellite (UKS) provided by the UK; to study the transfer of mass from the solar wind to the magnetosphere. International Cooperative.
CCE (S) 1984 88A			730.9	39217	1784	64.4	242.0	
IRM (S) 1984 88B			2653.4	113818	402	27.0	605.0	
UKS (S) 1984 88C			2659.6	113417	1002	26.9	77.0	
STS 41-D (S) 1984 93A	Shuttle (S) (Discovery)	Aug 30	LANDED AT EAFB SEP 5, 1984					First Discovery flight with Henry W. Hartsfield, Michael L. Coats, Richard M. Mullane, Steven Hawley, Judith A. Resnik, and Charles D. Walker. Deployed SBS (Reimbursable - SBS), Leasat (Reimbursable - Hughes), and Telstar (Reimbursable - AT&T), carried out experiments including OAST-1 solar array structural testing. Mission duration 144 hours 56 minutes 4 seconds.
SBS-4 (S) 1984 93B		Aug 31	1436.2	35795	35780	0.0	3344.0	
Syncom IV-2 (S) 1984 93C		Aug 31	1463.0	35787	35779	04.1	6889.0	
Telstar 3-C (S) 1984 93D		Sep 1	1436.2	35793	35783	0.0	3402.0	
Galaxy C (S) 1984 101A	Delta 176 (S)	Sep 21	1436.2	35793	35782	0.1	519.0	Hughes Communications Satellite. Reimbursable (Hughes).
STS 41-G (S) 1984 108A	Shuttle (S) (Challenger)	Oct 5	LANDED AT KSC OCT 13, 1984					Sixth Challenger flight with Robert L. Crippen, Jon A. McBride, Kathryn D. Sullivan, Sally K. Ride, David C. Leestma, Paul D. Scully-Power, and Marc Garneau (Canada). Deployed ERBS to provide global measurements of the Sun's radiation reflected and absorbed by the Earth; performed scientific experiments using OSTA-3 and other instruments. Mission duration 197 hours 23 minutes 33 seconds.
ERBS (S) 1984 108B		Oct 5	96.4	590	578	57.0	2449.0	
NOVA III (S) 1984 110A	Scout 104 (S)	Oct 11	108.9	1199	1149	89.9	173.7	Improved Transit Navigation Satellite for the U.S. Navy. Reimbursable (DOD). (WSMC)
STS 51-A (S) 1984 113A	Shuttle (S) (Discovery)	Nov 8	LANDED AT KSC NOV 16, 1984					Second Discovery flight with Frederick H. Hauck, David M. Walker, Joseph P. Allen, Anna L. Fisher, Dale A. Gardner. Deployed Telesat (Reimbursable - Canada) and Syncom IV-1 (Reimbursable - Hughes). Retrieved and returned Palapa B-2 and Westar 6 (Launched on 41-B). Mission duration 191 hours 44 minutes 56 seconds.
Telesat-H (S) 1984 113B		Nov 9	1436.2	35796	35780	0.0	3420.0	
Syncom IV-1 (S) 1984 113C		Nov 10	1466.8	36427	36341	2.8	6889.0	
NATO III-D (S) 1984 115A	Delta 177 (S)	Nov 13	1436.2	35796	35780	1.4	761.0	Fourth in a series of communication satellites for NATO. Reimbursable (NATO).
NOAA-9 (S) 1984 123A	Atlas 39E (S)	Dec 12	101.8	854	834	99.1	1712.0	Advanced TIROS-N spacecraft to provide continuous coverage of the Earth and provide high-accuracy worldwide meteorological data. Reimbursable (NOAA). (WSMC)

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
1985								1985
STS 51-C (S) 1985 10A	Shuttle (S) (Discovery)	Jan 24		LANDED AT KSC JAN 27, 1984				Third Discovery flight with Thomas K. Mattingly, Loren J. Shriver, Ellison S. Onizuka, James F. Buchli, and Gary E. Payton. Deployed unannounced payload for DOD. (Reimbursable - (DOD)). Mission duration 73 hours 33 minutes 23 seconds.
DOD (S) 1985 10B				ELEMENTS NOT AVAILABLE				
Intelsat V-A F-10 (S) 1985 25A	Atlas-Centaur (AC-63) (S)	Mar 22	1436.1	35807	35768	0.0	1996.7	First in a series of improved Commercial Communication satellites for Intelsat. Reimbursable (Comsat).
STS 51-D (S) 1985 28A	Shuttle (S) (Discovery)	Apr 12		LANDED AT KSC APR 19, 1985				Fourth Discovery flight with Karol K. Bobko, Donald F. Williams, M. Rhea Seddon, S. David Griggs, Jeffrey A. Hoffman, Charles D. Walker, and E. J. "Jake" Garn (U.S. Senator). Deployed Syncom (Reimbursable - Hughes) and Telesat (Reimbursable - Canada). Syncom Sequencer failed to start, despite attempts by crew; remained inoperable until restarted by crew of 51-I (August 1985). Mission duration 167 hours 55 minutes 23 seconds.
Telesat-I (S) 1985 28B		Apr 13	1436.1	35796	35778	0.0	3550.0	
Syncom IV-3 (S) 1985 28C		Apr 12	1436.2	35803	35772	3.3	6889.0	
STS 51-B (S) Spacelab-3 1985 34A	Shuttle (S) (Challenger)	Apr 29		LANDED AT DFRF MAY 6, 1985 DOWN DEC 15, 1986			47.6	Sixth Challenger flight with Robert F. Overmeyer, Frederick D. Gregory, Don Lind, Norman E. Thagard, William E. Thornton, Lodewijk Vanderberg, and Taylor Wang. Spacelab-3 (Cooperative with ESA) mission to conduct applications, science and technology experiments. Deployed Northern Utah Satellite (NUSAT) (Reimbursable - Northern Utah University). Global Low Orbiting Message Relay Satellite (GLOMR) (Reimbursable - DOD) failed to deploy and was returned. Mission duration 168 hours 8 minutes 46 seconds.
STS 51-G (S) 1985 48A	Shuttle (S) (Discovery)	Jun 17		LANDED AT EAFB JUN 24, 1985				Fifth Discovery flight with Daniel C. Brandenstein, John O. Creighton, Shannon W. Lucid, John M. Fabian, Steven R. Nagel, Patrick Baudry (France), and Prince Sultan Salman Al-Saud (Saudi Arabia). Deployed Morelos (Reimbursable - Mexico), Arabsat (Reimbursable - ASCO) and Telstar (Reimbursable - AT&T). Deployed and retrieved Spartan 1. Mission duration 169 hours 38 minutes 52 seconds.
Morelos-A (S) 1985 48B		Jun 17	1436.1	35793	35781	0.0	3443.0	
ARABSAT-A (S) 1985 48C		Jun 18	1434.4	35891	35614	1.0	3499.0	
TELSTAR 3-D (S) 1985 48D		Jun 19	1436.1	35789	35783	0.0	3437.0	
SPARTAN 1 (S) 1985 48E		Jun 20		RETRIEVED JUN 24, 1985			2051.0	
Intelsat VA F-11 (S) 1985 55A	Atlas-Centaur (AC-64) (S)	Jun 29	1436.1	35804	35769	0.1	1996.7	Second in a series of improved Commercial Communications Satellites for Intelsat. Reimbursable (Comsat).

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
STS 51-F (S) Spacelab-2 1985 63A	Shuttle (S) (Challenger)	Jul 29		LANDED AT EAFB AUG 6, 1985				Seventh Challenger flight with Charles G. Fullerton, Roy D. Bridges, Jr., Karl G. Heinze, Anthony W. England, F. Story Musgrave, Loren W. Acton, and John-David F. Bartow/. Conducted experiments in Spacelab-2 (Cooperative with ESA). Deployed Plasma Diagnostic Package (PDP) which was retrieved 6 hours later. Mission duration 190 hours 45 minutes 26 seconds.
PDP (S) 1985 63B				RETRIEVED JUL 29, 1985				
Navy SOOS-I 1985 66A (S)	Scout 105 (S)	Aug 2	107.9	1255	999	89.9	64.2	Two Navigation Satellites for the U.S. Navy. Reimbursable (DOD). (WSMC)
1985 66B (S)			107.9	1256	999	89.9	64.2	
STS 51-I (S) 1985 76A	Shuttle (S) (Discovery)	Aug 27		LANDED AT EAFB SEP 3, 1985				Sixth Discovery flight with Joe H. Engle, Richard O. Covey, James D. VanHoften, William F. Fisher, John M. Lounge. Deployed Aussat (Reimbursable - Australia), ASC (Reimbursable - American Satellite Co.), and Syncom IV-4 (Reimbursable - Hughes). After reaching Geosynchronous Orbit, Syncom IV-4 ceased functioning. Repaired Syncom IV-3 (launched by 51-D, April 1985). Mission duration 170 hours 17 minutes 42 seconds.
Aussat-1 (S) 1985 76B		Aug 27	1436.1	35798	35777	0.0	3445.5	
ASC (S) 1985 76C		Aug 27	1436.1	35794	35778	0.0	3406.1	
Syncom IV-4 (U) 1985 76D		Aug 29	1430.1	35843	35809	3.2	6894.7	
Intelsat VA F-12 (S) 1985 87A	Atlas-Centaur (AC-65) (S)	Sep 28	1436.1	35801	35772	0.1	1996.7	Third in a series of improved commercial Communications Satellites for Intelsat. Reimbursable (Comsat).
STS 51-J (S) (DOD) 1985 92A	Shuttle (S) (Atlantis)	Oct 3		LANDED AT EAFB OCT 7, 1985				First Atlantis flight with Karol J. Bobko, Ronald J. Grabe, Robert A. Stewart, David C. Hilmers, and William A. Pailes. DOD mission. Mission duration 97 hours 44 minutes 38 seconds.
STS 61-A (S) Spacelab D-1 1985 104A	Shuttle (S) (Challenger)	Oct 30		LANDED AT EAFB NOV 6, 1985				Eighth Challenger flight with Henry W. Hartsfield, Steven R. Nagel, Bonnie J. Dunbar, James F. Buchli, Guion S. Bluford, Ernst Messerschmid (Germany), Reinhard Furrer (Germany), and Wubbo Ockels (Dutch). Spacelab D-1 mission (Cooperative with ESA) to conduct scientific experiments. Deployed GLOMR (Reimbursable - DOD). Carried Materials Experiment Assembly (MEA) for on-orbit processing of materials science experiment specimens. Mission duration 168 hours 44 minutes 51 seconds.
GLOMR (S) 1985 104B				DOWN DEC 26, 1986			267.6	

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
STS 61-B (S) 1985 109A	Shuttle (S) (Atlantis)	Nov 26		LANDED AT EAFB DEC 3, 1985				Second Atlantis Flight with Brewster H. Shaw, Bryan D. O'Conner, Mary L. Cleave, Sherwood C. Spring, Jerry L. Ross, Rudolfo Neri Vela (Morelos). Charles D. Walker (MDAC). Deployed Morelos (Reimbursable - Mexico), Aussat (Reimbursable - Australia), and Satcom (Reimbursable - RCA). Demonstrated construction in space by manually assembling EASE and ACCESS Experiments. Deployed Station Keeping Target (OEX) to conduct advanced Station Keeping Tests. Mission duration 165 hours 4 minutes 49 seconds.
Morelos-B (S) 1985 109B		Nov 27	1436.1	35793	35780	0.0	4539.6	
Aussat-2 (S) 1985 109C		Nov 27	1436.2	35796	35779	0.0	4569.1	
Satcom (S) 1985 109D		Nov 28	1436.2	35797	35779	0.0	7225.3	
OEX Target 1985 109E				DOWN MAR 2, 1987				
AF-16	Scout 106 (S)	Dec 12						Air Force instrumented test vehicle. (Dual Payload) Reimbursable (DOD). (WFF)
1985 114A (S)				DOWN MAY 11, 1989				
1985 114B (S)				DOWN AUG 9, 1987				
1986								**1986**
STS 61-C (S) 1986 03A	Shuttle (S) (Columbia)	Jan 12		LANDED AT EAFB JAN 18, 1986				Seventh Columbia flight with Robert L. Gibson, Charles F. Bolden, Jr., Franklin R. Chang-Diaz, George D. Nelson, Steven A. Hawley, Robert J. Cenker (RCA), and C. William Nelson (Congressman). Deployed Satcom (Reimbursable - RCA). Evaluated material science lab payload carrier and processing facilities. Carried HHG-1 to accommodate GAS payloads. Mission duration 146 hours 3 minutes 51 seconds.
SATCOM (S) 1986 03B		Jan 12	1436.2	35796	35780	0.0	7225.3	
STS 51-L (U) TDRS-B (U)	Shuttle (U) (Challenger)	Jan 28		DID NOT ACHIEVE ORBIT			2103.3	Ninth Challenger flight with Francis R. Scobee, Michael J. Smith, Judith A. Resnik, Ellison S. Onizuka, Ronald E. McNair, Gregory Jarvis (Hughes), S. Christie McAuliffe (Teacher). Approximately 73 seconds into flight, the Shuttle exploded.
GOES-G (U)	Delta 178 (U)	May 5		DID NOT ACHIEVE ORBIT			840.0	Provide systematic world-wide weather coverage for NOAA. Vehicle failed. Reimbursable NOAA).
DOD (U) 1986 69A	Delta 180 (U)	Sep 5		DOWN SEP 28, 1986				Carried DOD experiment. Reimbursable (DOD).
NOAA-G (S)	Atlas 52E	Sep 17	101.0	816	796	98.5	1712.0	Operational environmental satellite for NOAA. Included ERBE instrument to complement data being acquired by ERBS, launched in 1984. Carried search and rescue instruments provided by Canada and France. Reimbursable (NOAA). (WSMC)

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
AF P87-11 (S) Polar Bear 1986 88A	Scout 107 (S)	Nov 13	104.8	1014	954	89.6		Scientific satellite to study the atmospheric effect on electromagnetic propagation. Reimbursable (DOD). (WSMC)
Fltsatcom (F-7) (S) 1986 96A	Atlas-Centaur (AC-66) (S)	Dec 4	1436.2	35849	35728	0.4	1128.5	Provide communication between aircraft, ships, and ground stations for DOD. Reimbursable (DOD).
1987								**1987**
GOES-H (S) 1987 22A	Delta 179 (S)	Feb 26	1436.2	35800	35775	0.4	840.0	Operational environmental satellite to provide systematic worldwide weather coverage. Reimbursable (NOAA).
Palapa B2-P 1987 29A	Delta 182	Mar 20	1436.2	35788	35788	0.0	652.0	Provide communication coverage over Indonesia and the Asian countries. Reimbursable (Indonesia).
Fltsatcom (F-6) (U)	Atlas-Centaur (AC-67) (U)	Mar 26		DID NOT ACHIEVE ORBIT			1038.7	Part of the worldwide communications system between aircraft, ships, and ground stations for the DOD. Telemetry lost shortly after launch; destruct signal sent at 70.7 seconds into flight. An electrical transient, caused by a lighting strike on the launch vehicle, most probable cause of loss. Reimbursable (DOD).
SOOS-2	Scout 108 (S)	Sep 16						Two Transit navigation satellites in a stacked configuration for the U.S. Navy. Reimbursable (DOD). (WSMC)
1987 80A (S)			107.1	1178	1011	90.4	64.5	
1987 80B (S)			107.2	1180	1010	90.4	64.5	
1988								**1988**
DOD (SDI) (S) 1988 08A	Delta 181 (S)	Feb 8		DOWN MAR 1, 1988				Strategic Defense Initiative Organization (SDIO) Payload. Reimbursable (DOD).
San Marco D/L (S) 1988 26A	Scout 109 (S)	Mar 25		DOWN DEC 6, 1988			273.0	Explore the relationship between solar activity and meteorological phenomena. Cooperative with Italy. (San Marco)
SOOS-3	Scout 110 (S)	Apr 25					129.6	Two Transit navigation satellites in a stacked configuration for the U.S. Navy. Reimbursable (DOD). (WSMC)
1988 33A (S)			108.5	1302	1013	90.3		
1988 33B (S)			108.5	1300	1012	90.3		
Nova II 1988 52A	Scout 111 (S)	Jun 16	108.9	1199	1149	90.0	170.5	Improved Transit Navigation Satellite for the U.S. Navy. Reimbursable (DOD). (WSMC)
SOOS-4	Scout 112 (S)	Aug 25					128.2	Two Transit navigation satellites in a stacked configuration for the U.S. Navy. Reimbursable (DOD). (WSMC)
1988 74A (S)			107.3	1175	1030	89.9		
1988 74B (S)			107.3	1173	1031	89.9		
NOAA-H (S) 1988 89A	Atlas 63E (S)	Sep 24	101.9	855	838	99.1	1712.0	Operational environmental satellite for NOAA. Carried Search and Rescue instruments provided by Canada and France. Reimbursable (NOAA). (WSMC)

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
STS-26 (S) 1988 91A	Shuttle (S) (Discovery)	Sep 29		LANDED AT EAFB OCT 3, 1988				Sixth Discovery flight with Frederick H. Hauck, Richard O. Covey, John M. Lounge, David C. Hilmers, and George D. Nelson. Deployed TDRS-3. Performed experiment activities for commercial and scientific middeck experiments. Mission Duration 97 hours 0 minutes 11 seconds.
TDRS-3 (S) 1988 91B		Sep 29	1436.2	35804	35772	0.1	2224.9	
STS-27 (S) 1988 106A	Shuttle (S) (Atlantis)	Sep 29		LANDED AT EAFB DEC 6, 1988				Third Atlantis flight with Robert L. Gibson, Guy S. Gardner, Richard M. Mullane, Jerry L. Ross and William M. Shepherd. DOD Mission. Mission Duration 105 hours 05 minutes 37 seconds.
DOD (S) 1988 106B				ELEMENTS NOT AVAILABLE				
1989								**1989**
STS-29 (S) 1989 21A	Shuttle (S) (Discovery)	Mar 13		LANDED AT EAFB MAR 18, 1989				Eighth Discovery flight with Michael L. Coats, John E. Blaha, James Bagian, James F. Buchli, Robert Springer. Deployed a new Tracking and Data Relay Satellite. Performed commercial and scientific experiments. Mission Duration 119 hours 38 minutes 52 seconds.
TDRS-D (S) 1989 21B			1436.1	35808	35768	0.0	2224	
STS-30 (S) 1989 33A	Shuttle (S) (Atlantis)	May 4		LANDED AT EAFB MAY 8, 1989				Fourth Atlantis flight with David M. Walker, Ronald J. Grabe, Mary L. Cleave, Mark C. Lee, Norman E. Thagard. Deployed the Magellan spacecraft on a mission toward Venus. Performed commercial and scientific middeck experiments. Mission Duration: 96 hours 56 minutes 28 seconds.
Magellan (S) 1989 33B				TRANS-VENUS TRAJECTORY				
STS-28 (S) 1989 61A	Shuttle (S) (Columbia)	Aug 8		LANDED AT EAFB AUG 13, 1989				Ninth Columbia flight with Brewster H. Shaw, Richard N. Richards, David C. Leetsma, James C. Adamson, and Mark N. Brown. DOD Mission. Mission Duration: 121 hours 0 minutes 08 seconds.
Fltsatcom (S) 1989 77A	Atlas-Centaur (AC-68) (S)	Sep 25	1436.1	35701	35774	2.9	1863	Navy Communications satellite to provide communications between aircraft, ships and ground stations for DOD. Reimbursable (DOD).
STS-34 (S) 1989 84A	Shuttle (S) (Atlantis)	Oct 18		LANDED AT EAFB OCT 23, 1989				Fifth Atlantis flight with Donald E. Williams, Michael J. McCulley, Ellen Baker, Shannon N. Lucid, and Franklin Chang-Diaz. Deployed the Galileo spacecraft on a mission toward Jupiter. Performed experiment activities for commercial and scientific middeck experiments. Mission Duration: 119 hours 39 minutes 22 seconds.
Galileo (S) 1989 84B				ELEMENTS NOT AVAILABLE				
COBE (S) 1989 89A	Delta 2 (S)	Nov 18	102.6	885	873	99.0	2206	Cosmic Background Explorer spacecraft to provide the most comprehensive observations to date of radiative content of the universe.
STS-33 (S) 1989 90A	Shuttle (S) (Discovery)	Nov 23		LANDED AT EAFB NOV 28, 1989				Ninth Discovery flight with Frederick Gregory, John E. Blaha, Manly L. Carter, Franklin S. Musgrave and Kathryn C. Thornton. DOD Mission. Mission Duration: 120 hours 6 minutes 46 seconds.
DOD (S) 1989 90B				ELEMENTS NOT AVAILABLE				

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted) 1990
1990								
STS-32 (S) 1990 2A Syncom IV-5 (S) 1990 2B	Shuttle (S) (Columbia)	Jan 9	LANDED AT EAFB JAN 20, 1990 1436.2	35815	35759	2.7	6953.4	Tenth Columbia flight with Daniel C. Brandenstein, James D. Wetherbee, Bonnie J. Dunbar, Marsha S. Ivins and G. David Low. Deployed Syncom IV-5 (Reimbursable - DOD), a geostationary communications satellite also known as Leasat, for the U.S. Navy. Also retrieved the Long Duration Exposures Facility (LDEF) deployed on STS-41C on April 6, 1984. Mission Duration: 261 hrs 0 mins 37 secs.
STS-36 (S) 1990 19A DOD (S) 1990 19B	Shuttle (S) (Atlantis)	Feb 28	LANDED AT EAFB MAR 4, 1990 ELEMENTS NOT AVAILABLE					Sixth Atlantis flight with John D. Creighton John H. Casper, David C. Hilmers, Richard M. Mullane and Pierre J. Thuot. DOD Mission. Mission Duration: 106 hours 18 minutes 22 seconds.
Pegsat (S) 1990 28A	Pegasus (S) (Orb Sci)	Apr 5	94.1	539	410	94.1		A 50-foot rocket (Pegasus), dropped from the wing of a B-52 aircraft flying over the Pacific Ocean, launched the Pegsat satellite in the first demonstration flight of the Pegasus launch vehicle. The Pegsat science investigations are part of the Combined Release and Radiation Effects Satellite (CRRES), a joint NASA/DOD program.
STS-31 (S) 1990 37A HST (S) 1990 37B	Shuttle (S) (Discovery)	Apr 24	LANDED AT EAFB APR 29, 1990 96.6	598	591	28.5	11355.4	Tenth Discovery flight with Loren J. Shriver, Charles F. Bolden, Bruce McCandless, Steven A. Hawley, and Kathryn D. Sullivan. Deployed the Edwin P. Hubble Space Telescope (HST) astronomical observatory. Designed to operate above the Earth's turbulent and obscuring atmosphere to observe celestial objects at ultraviolet, visible and near-infrared wavelengths. Joint NASA/ESA mission. Mission Duration: 121 hours 16 minutes 6 seconds.
Macsat (S) 1990 43A 1990 43B	Scout 113 (S)	May 9	98.3 98.3	755 752	601 600	89.9 89.9	89.9	Two Multiple Access Communications Satellites (MACSATs) to provide global store-and-forward message relay capability for DOD Users. Reimbursable (DOD). (VAFB)
ROSAT (S) 1990 49A	Delta 2 (S)	Jun 1	95.6	557	542	53.0	2421.1	Roentgen Satellite (ROSAT), an Explorer class scientific satellite configured to accommodate a large X-ray telescope, to study X-ray emissions from non-solar celestial objects. International cooperative program with NASA, Germany, and the UK.
CRRES (S) 1990 65A	Atlas-Centaur (AC-69) (S)	Jul 25	614.4	34781	345	18.0		Combined Release and Radiation Effects Satellite (CRRES) which uses chemical releases to study the Earth's magnetic fields and the plasmas, or ionized gases, that travel through them. Joint NASA/DOD program.

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS			WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
				Apogee (km)	Perigee (km)	Incl (deg)		
STS-41 (S) 1990 90A Ulysses (S) 1990 90B	Shuttle (S) (Discovery)	Oct 6		LANDED AT EAFB OCT 10, 1990 HELIOCENTRIC ORBIT			20079.5	Eleventh Discovery flight with Richard N. Richards, Robert D. Cabana, Bruce E. Melnick, William M. Shepherd, and Thomas D. Akers. Deployed the Ulysses spacecraft, a joint NASA/ESA mission to study the poles of the Sun and the interplanetary space above and below the poles. Mission Duration: 98 hours 10 minutes 3 seconds.
STS-38 (S) 1990 97A DOD (S) 1990 97B	Shuttle (S) (Atlantis)	Nov 15		LANDED AT KSC NOV 20, 1990 ELEMENTS NOT AVAILABLE				Seventh Atlantis flight with Richard O. Covey, Robert C. Springer, Carl J. Meade, Frank L. Culbertson and Charles D. Gemar. DOD Mission. Mission Duration: 117 hours 54 minutes 27 seconds.
STS-35 (S) 1990 106A	Shuttle (S) (Columbia)	Dec 2		LANDED AT EAFB DEC 11, 1990				Eleventh Columbia flight with Vance D. Brand, John M. Lounge, Jeffrey A. Hoffman, Robert A. Parker, Guy S. Gardner, Ronald A. Parise, and Samuel T. Durrance. Carried Astro-1, a Space Shuttle attached payload to acquire high priority astrophysical data on a variety of celestial objects. Mission Duration: 215 hours 5 minutes 7 seconds.
1991								**1991**
STS-37 (S) 1991 27A GRO (S) 1991 27B	Shuttle (S) (Atlantis)	Apr 5	92.0	LANDED AT EAFB APR 11, 1991 376	370	28.5	15900.0	Eighth Atlantis flight with Steven R. Nagel, Kenneth D. Cameron, Linda M. Godwin, Jerome Apt, and Jerry L. Ross. An unplanned EVA took place to help with the deployment of GRO's high gain antenna. Also demonstrated were mobility aids which will be used on Space Station Freedom. Mission Duration: 143 hrs 32 min 45 sec.
STS-39 (S) 1991 31A IBSS (S) 1991 31B	Shuttle (S) (Discovery)	Apr 28		LANDED AT KSC MAY 6, 1991 DOWN MAY 6, 1991				Twelfth Discovery flight with Michael L. Coats, Blaine L. Hammond, Jr., Guion S. Bluford, Gregory J. Harbaugh, Richard J. Hieb, Donald R. McMonagle, and Charles L. Veach. Discovery performed dozens of maneuvers, deploying canisters from the cargo bay, releasing and retrieving a payload with the RMS, allowing the Department of Defense to gather important plume observation data and information for the SDIO. Mission Duration: 199 hrs 26 min 17 sec.
NOAA-12 (S) 1991 32A	Atlas-E (S)	May 14	101.2	824	806	98.7	1418.0	Third-generation operational spacecraft to provide systematic global weather observations. Will replace NOAA-10 as the morning satellite in NOAA's two polar satellite system. Joint NASA/NOAA effort. (WSMC)

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS			WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
				Apogee (km)	Perigee (km)	Incl (deg)		
STS-40 (S) Spacelab (SLS-1) 1991 40A	Shuttle (S) (Columbia)	Jun 5	LANDED AT EAFB JUN 14, 1991					Twelfth Columbia flight with Bryan D. O'Connor, Sidney M. Gutierrez, M. Rhea Seddon, James P. Bagian, Tamara E. Jerrigan, F. Drew Gaffney, and Millie Hughes-Fulford. The first mission since Skylab to do intensive investigations into the effects of weightlessness on humans. Data learned from this flight will be used in NASA's planning for longer Shuttle missions set for 1992, and in the planning of Space Station Freedom. Mission Duration: 218 hrs 15 mins 14 secs.
REX (S) 1991 45A	Scout (S)	Jun 29	101.3	867	769	89.6	96.7	Radiation Experiment to do further research to overcome and understand the physics of the electron density irregularities that cause disruptive scintillation effects on transionospheric radio signals. Reimbursable - DOD. (VAFB)
STS-43 (S) 1991 54A	Shuttle (S) (Atlantis)	Aug 2	LANDED AT KSC AUG 11, 1991					Ninth Atlantis flight with John E. Blaha, Michael A. Baker, James C. Adamson, G. David Low, and Shannon E. Lucid. A TDRS satellite was deployed, keeping the network which supports Shuttle missions and other spacecraft at full operational capability. Mission Duration: 213 hours 22 minutes 27 seconds.
TDRS-E (S) 1991 54B			1436.1	35793	35779	0.0	2226.9	
STS-48 (S) 1991 63A	Shuttle (S) (Discovery)	Sep 12	LANDED AT EAFB SEP 18, 1991					Thirteenth Discovery flight with John O. Creighton, Kenneth S. Reightler, Mark F. Brown, James F. Buchli, and Charles D. Gemar. The Upper Atmosphere Research Satellite (UARS) will study physical processes acting within and upon the stratosphere, mesosphere, and lower thermosphere. Mission Duration: 128 hrs 27 mins 51 secs.
UARS (S) 1991 63B			96.2	580	573	57.0	6532.2	
STS-44 (S) 1991 80A	Shuttle (S) (Atlantis)	Nov 24	LANDED AT EAFB DEC 1, 1991					Tenth Atlantis flight with Frederick D. Gregory, Terence T. Henricks, F. Story Musgrave, Mario Runco, Jr., James S. Voss, and Thomas J. Hennen. A dedicated mission for the Department of Defense to gather data for their programs. Deployed Defense Support Program satellite (DSP). The mission was shortened when an inertial measurement unit failed on the sixth day of the mission. Mission Duration: 166 hrs 52 mins 27 secs.
DSP (S) 1991 80B		Nov 25	ELEMENTS NOT AVAILABLE					
1992								**1992**
STS-42 (S) 1992 2A	Shuttle (S) (Discovery)	Jan 22	LANDED AT EAFB JAN 30, 1992					Fourteenth Discovery flight with Ronald J. Grabe, Steven S. Oswald, Norman E. Thagard, William F. Readdy, David C. Hilmers, Roberta L. Bondar, and Ulf D. Merbold. The International Microgravity Laboratory (IML-1) studied the effects of microgravity on living organisms and materials processes. Mission duration: 193 hrs 15 mins 43 secs.

NASA Major Launch Record

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS Apogee (km)	Perigee (km)	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
STS-45 (S) 1992 15A	Shuttle (S) (Atlantis)	Mar 24		LANDED AT KSC APR 2, 1992				Eleventh Atlantis flight with Charles F. Bolden, Brian K. Duffy, Kathryn D. Sullivan, David C. Leetsma, C. Michael Foale, Dirk D. Frimout and Bryon K. Lichtenburg. The Atmospheric Laboratory for Applications and Science (ATLAS 1) studied stmospheric science, solar science, space physics and astronomy. Mission Duration: 214 hrs 10 mins 24 secs.
STS-49 (S) 1992 26A	Shuttle (S) (Endeavour)	May 2		LANDED AT EAFB MAY 16, 1992				First flight of Endeavour with Daniel C. Brandenstein, Kevin P. Chilton, Richard J. Hieb, Bruce E. Melnick, Pierre J. Thout, Kathryn C. Thornton, and Thomas D. Akers. On orbit repair of the Intelsat VI satellite and redeployment with new kick motor. Assembly of Station by Extravehicular Activity Methods (ASEM), while attached to the cargo bay. Mission duration: 213 hrs 17 mins 38 secs.
EUVE (S) 1992 31A	Delta II (S)	Jun 7	95.1	529	514	28.4	3250	The Extreme Ultraviolet Explorer (EUVE), designed to study the extreme ultraviolet (EUV)portion of the electromagnetic spectrum as well as selected EUV targets, in order to create a definitive map and catalog of these sources.
STS-50 (S) 1992 34A	Shuttle (S) (Columbia)	Jun 25		LANDED AT KSC JUL 9, 1992				Twelfth Columbia flight with Richard N. Richards, Kenneth D. Bowersox, Bonnie J. Dunbar, Carl J. Meade, Ellen S. Baker, and Lawrence J. Delucas. The First United States Microgravity Laboratory (USML-1) studied scientific and technical questions in materials science, fluid dynamics, biotechnology and combustion science. Mission duration: 331 hrs 30 mins 4 secs.
SAMPEX (S) 1992 38A	Scout (S)	Jul 3	96.6	679	509	81.7		First of the Small Explorer (SMEX) fleet, carrying four cosmic ray monitoring instruments, to study solar energetic particles, anomalous cosmic rays, galactic cosmic rays, and magnetospheric electrons.
GEOTAIL (S) 1992 44A	Delta II (S)	Jul 24	4750.6	508542	41363	22.4	1009	Joint mission between the United States and Japan to study the geomagnetic tail region of the magnetosphere. Geotail will also measure the physics of the magnetosphere, the plasma sheet, reconnection and neutral line formation to better understand fundamental magnetosphere processes.
STS-46 (S) 1992 49A EURECA 1992 49B	Shuttle (S) (Atlantis)	Jul 31	94.6	LANDED AT AUG 8, 1992 503	499	28.5		Twelfth Atlantis flight with Loren J. Shriver, Andrew M. Allen, Jeffrey A. Hoffman, Franklin R. Chang-Diaz, Claude Nicollier, Marsha S. Ivins, and Franco Malerba. Deployed ESA'S European Retrievable Carrier (EURECA), a platform placed in orbit for 6 months offering conventional services to experimenters. Tested Tethered Satellite System (TTS-1), a joint program between the United States and Italy. Mission duration: 191 hrs 16 mins 7 secs.

NASA Major Launch Record

MISSION/ Intl Design	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS			WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
				Apogee (km)	Perigee (km)	Incl (deg)		
STS-47 (S) (Spacelab-J) 1992 61A	Shuttle (S) (Endeavour)	Sep 12		LANDED AT KSC SEP 20. 1992				Second Endeavour flight with Robert L. Gibson, Curtis L. Brown, Mark C. Lee, N. Jan Davis, Mae C. Jemison, Jerome Apt, and Mamoru Mohri. The Spacelab J mission, a joint mission between the U.S. and Japan, performed a series of 43 exlore the effects of producing new materials in the micogravity of space, and the study of living organisms in the organisms in the environission duration: 190 hrs 30 mins 23 secs.
Topex/Poseidon (S) 1992 52A	Ariane 42P (S)	Aug 10	112.4	1342	1330	66.0		U.S. French Satellite to help define the relationship between the Earth's oceans and climate. NASA payload launched on commercial Ariane vehicle. Joint NASA/CNES mission.
Mars Observer (S) 1992 63A	Titan III (S)	Sep 25		TRANS-MARTIAN TRAJECTORY				After an 11-month cruise, the Mars Observer (MO) will arrive at Mars and be inserted into orbit to examine the surface for elemental and mineralogical composition, global surface topography, gravity field and magnetic field determination and climatological conditions. The Mars Balloon Relay (MBR), on the Mars Observer, will relay communications from Mars landers that will be sent by the Russians in 1995.
STS-52 (S) 1992 70A LAGEOS (S) 1992 70B	Shuttle (S) (Columbia)	Oct 22	222.5	LANDED AT KSC NOV 1, 1992 5950	5616	52.7		Thirteenth Columbia flight with James D. Wetherbee, Michael A. Baker, William M. Sheperd, Tamara E. Jernigan, and Charles L. Veach. The Laser Geodynamics Satellite (LAGEOS) is a cooperative mission of the U.S. and Italy to obtain precise measurements of the crustal movement and gravitational field. The U.S. Microgravity Payload-2 (USMP-2), carried in the cargo bay, is one in a series of payloads for scientific experimentation and material processing in a reduced gravity. Mission duration: 236 hrs 56 mins 13 secs.
MSTI-1 (S) 1992 78A	Scout (S)	Nov 21	91.2	378	292	96.7		DOD/SDIO payload.
STS-53 (S) 1992 86A	Shuttle (S) (Discovery)	Dec 2		LANDED AT EAFB DEC 9, 1992				Fifteenth Discovery flight with David M. Walker, Robert Cabana, Guion S. Bluford, James Voss, and M. Richard Clifford. This was a DOD mission. Mission duration: 175 hrs 19 mins 47 secs.

Section C

Procurement, Funding and Manpower

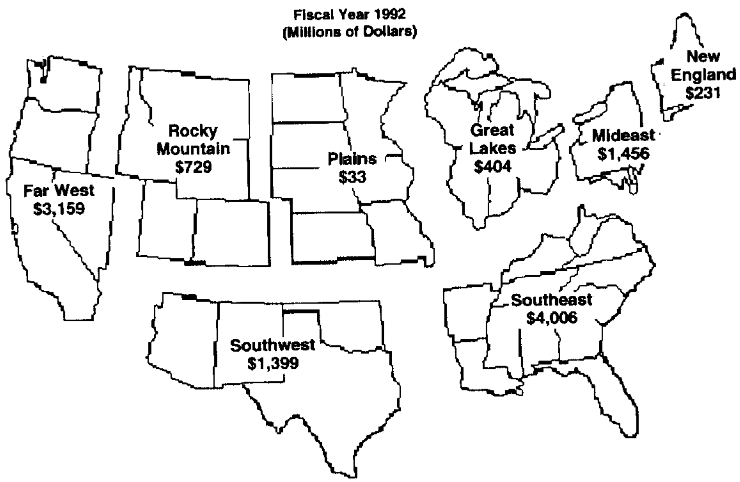
NASA Contract Awards By State

(FY 1992)

State	Total (Thousands)	Business (Thousands)	Educational & Nonprofit (Thousands)
Alabama	1,232,905	1,205,202	27,703
Alaska	8,618	50	8,568
Arizona	43,651	20,843	22,808
Arkansas	407	94	313
California	3,110,769	2,926,135	184,634
Colorado	195,956	169,652	26,304
Connecticut	73,623	71,978	1,645
Delaware	3,212	1,212	2,000
District of Columbia	130,783	102,352	28,431
Florida	1,498,227	1,482,440	15,787
Georgia	13,438	4,343	9,095
Hawaii	8,420	789	7,631
Idaho	2,774	--	2,774
Illinois	17,118	4,882	12,236
Indiana	12,102	6,482	5,620
Iowa	11,512	790	10,722
Kansas	2,162	(273)	2,435
Kentucky	1,284	375	909
Louisiana	373,055	371,977	1,719
Maine	1,326	669	657
Maryland	953,479	855,116	98,363
Massachusetts	137,717	31,945	105,772
Michigan	44,058	4,939	39,119
Minnesota	5,869	2,789	3,080
Mississippi	324,116	320,473	3,643
Missouri	10,475	16,021	4,454
Montana	1,229	198	1,031
Nebraska	1,427	374	1,053
Nevada	1,600	1,056	544
New Hampshire	14,537	3,544	10,993
New Jersey	120,670	113,134	7,536
New Mexico	57,344	50,524	6,820
New York	58,447	27,776	30,671
North Carolina	11,915	1,788	10,127
North Dakota	457	--	457
Ohio	291,195	258,335	32,860
Oklahoma	7,263	127	7,136
Oregon	7,998	2,898	5,100
Pennsylvania	190,168	169,255	20,913
Rhode Island	3,549	683	2,866
South Carolina	1,609	106	1,503
South Dakota	882	157	725
Tennessee	33,035	10,271	22,764
Texas	1,290,889	1,215,398	75,491
Utah	528,606	516,064	12,542
Vermont	515	285	230
Virginia	504,850	467,104	37,746
Washington	38,957	29,062	9,895
West Virginia	10,936	434	10,502
Wisconsin	39,585	24,679	14,906
Wyoming	640	--	640
TOTAL	**$11,435,359**	**$10,483,886**	**$951,473**

Note: Excludes smaller procurements, generally those of $25,000 or less; also excludes awards placed through other Government agencies, awards outside the U.S., and actions on the JPL contracts.

U.S. Geographical Distribution of NASA Prime Contract Awards *



* Excludes smaller procurements, generally those of $25,000 or less; also excludes awards placed through other Government agencies, awards outside the U.S., and awards on the JPL contracts.

Procurement Activity

Total Procurement By Installation (FY 1992)

Installation	Awards ($M)	Percent
TOTAL	**$13,478.2**	**100.0**
Marshall Space Flight Center	3,234.1	24.0
Johnson Space Center	2,686.9	19.9
Goddard Space Flight Center	2,044.3	15.2
Kennedy Space Center	1,484.6	11.0
NASA Resident Office/JPL	1,263.7	9.4
Lewis Research Center	831.6	6.2
Headquarters	808.6	6.0
Ames Research Center	568.0	4.2
Langley Research Center	436.0	3.2
Stennis Space Center	120.4	.9

Awards Through Other Government Agencies (FY 1992)

Agency	Awards ($M)	Percent
TOTAL	**$498.6**	**100.0**
Over $25,000	**384.2**	**77.1**
Air Force	191.3	38.4
Energy Department	57.5	11.5
Navy	39.7	8.0
Navy	27.9	5.6
National Science Foundation	15.6	3.1
Interior Department	13.8	2.8
Commerce Department	13.1	2.6
Defense Department	7.3	1.5
Other Government Agencies	18.0	3.6
$25,000 and Under	**114.4**	**22.9**

Awards Placed Outside The United States (FY 1992)

Place of Performance	Awards ($Thousands)
TOTAL	**$76,874***
Direct NASA Awards	**76,760**
Australia	11,805
Bermuda	967
Canada	37,754
Chile	1,332
France	136
Germany	2,444
Hong Kong	48
Ireland	49
Israel	116
Italy	39
Japan	1,782
Netherlands	124
New Zealand	37
Puerto Rico	838
Russia	1,000
Spain	16,465
Sweden	174
United Kingdom	1,650
Placed Through Other Government Agencies	**114**
Canada	114

*Excludes smaller procurements, generally those of $25,000 or less

Contract Awards by Type of Effort

Category	Number of Contracts	Total (Millions)
TOTAL	5,227	$10,484.2 *
Research and Development	**1,883**	**3,247.5**
Aeronautics & Space Technology	700	1,043.5
Space Science & Applications	475	432.9
Space Flight	109	585.9
Space Operations	41	312.4
Commercial Programs	60	55.2
Space Station	18	473.4
Other Space R&D	417	331.3
Other R&D	63	12.9
Services	**1,535**	**4,206.6**
ADP & Telecommunication	134	403.0
Maintenance, Repair & Rebuilding of Equipment	186	1,109.5
Operation of Government-owned Facilities	49	418.4
Professional, Administrative & Management Support	225	1,233.5
Utilities & Housekeeping	98	210.1
Construction of Structures & Facilities	169	353.1
Maintenance, Repair, Alteration of Real Property	343	174.1
Other Services	331	306.9

Category	Number of Contracts	Total (Millions)
Supplies & Equipment	**1,809**	**3,028.1**
Ammunition & Explosives	12	326.1
Space Vehicles	32	1,463.9
Engines, Turbines & Components	19	911.7
Materials Handling Equipment	13	11.0
Communication, Detection & Coherent Radiation Equipment	116	18.9
Instruments & Laboratory Equipment	434	32.0
ADP Equipment, Software, Supplies & Support Equipment	648	177.1
Fuels, Lubricants, Oils & Waxes	19	24.5
Other Supplies & Equipment	516	53.9

* Excludes smaller procurements, generally those of $25,000 or less.

Distribution of NASA Procurements

(In Millions of Dollars)

Fiscal Years 1961 - 1992

	FY 61	FY 62	FY 63	FY 64	FY 65	FY 66	FY 67	FY 68	FY 69	FY 70	FY 71	FY 72
Total Business	423.3	1,030.1	2,261.7	3,521.1	4,141.4	4,087.7	3,864.1	3,446.7	3,022.3	2,759.2	2,279.5	2,143.3
(Small Business)	(63.5)	(123.6)	(191.3)	(240.3)	(286.3)	(255.9)	(216.9)	(189.6)	(162.8)	(161.2)	(178.1)	(160.9)
Educational	24.5	50.2	86.9	112.9	139.5	150.0	132.9	131.5	131.3	134.3	133.9	118.8
Nonprofit			15.3	29.1	25.3	27.7	39.6	33.6	32.3	33.0	29.3	28.0
JPL	86.0	148.5	230.2	226.2	247.2	230.3	222.2	207.2	156.3	179.8	173.3	210.8
Government	221.7	321.8	628.5	692.6	622.8	512.5	366.9	287.0	279.0	265.8	212.5	207.8
Outside U.S.	(*)	(*)	7.9	12.0	11.2	23.4	25.2	26.7	30.8	33.5	29.7	29.1
Total	755.5	1,550.6	3,230.5	4,593.9	5,187.4	5,031.6	4,650.9	4,132.7	3,652.0	3,405.6	2,858.2	2,737.8

	FY 73	FY 74	FY 75	FY 76	FY 7T	FY 77	FY 78	FY 79	FY 80	FY 81	FY 82	FY 83
Total Business	2,063.8	2,118.6	2,255.0	2,536.1	663.2	2,838.1	2,953.8	3,416.4	3,868.3	4,272.8	4,805.6	5,586.0
(Small Business)	(155.3)	(181.2)	(216.0)	(218.3)	(68.4)	(255.0)	(281.5)	(325.4)	(384.6)	(409.4)	(430.1)	(482.3)
Educational	111.7	97.8	111.4	123.0	27.7	125.5	137.2	147.2	177.0	192.5	187.0	211.3
Nonprofit	26.4	39.3	33.0	32.0	7.6	32.0	42.8	50.8	82.2	155.1	108.8	102.5
JPL	202.3	215.2	234.5	263.7	63.6	289.0	283.8	338.6	397.2	410.8	426.3	454.9
Government	235.2	208.6	198.3	222.4	63.9	223.2	216.0	221.4	271.8	321.9	308.1	394.2
Outside U.S.	34.0	34.1	34.2	27.4	3.8	24.5	26.0	37.4	46.1	55.2	47.9	47.9
Total	2,673.4	2,713.6	2,866.4	3,204.6	829.8	3,532.3	3,659.6	4,211.8	4,842.6	5,408.3	5,883.7	6,796.8

	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89	FY 90	FY 91	FY 92
Total Business	5,967.4	6,652.9	6,356.0	6,540.5	7,274.9	8,567.6	10,071.5	10,417.3	10,716.7
(Small Business)	(556.2)	(644.7)	(671.3)	(786.3)	(801.4)	(857.3)	(924.3)	(968.3)	(1,010.6)
Educational	22.6	256.9	276.6	315.4	370.3	464.2	513.6	592.0	659.3
Nonprofit	98.6	103.1	119.0	119.1	129.5	180.0	200.6	244.0	297.8
JPL	533.1	724.6	891.3	1,005.6	979.9	1,058.1	1,106.8	1,139.6	1,229.6
Government	494.3	535.1	489.7	594.9	734.6	543.2	610.4	693.4	498.6
Outside U.S.	38.1	35.4	47.1	34.3	55.9	63.3	62.3	72.7	76.2
Total	7,154.1	8,308.0	8,179.7	8,609.8	9,545.1	10,876.4	12,565.2	13,159.0	13,478.2

*Included In Government

Principal Contractors (Business Firms)

One Hundred Contractors (Business Firms) Listed According To Total Awards Received (FY1992)

	Contractor and Principle Place of Contract Performance	Awards (Thousands)	Awards (Percent)
	Total Awards To Business Firms	$10,716,743	100.00
1.	Rockwell International Corp Canoga Park, CA	1,449,346	13.52
2.	McDonnell Douglas Corp Huntington Beach, CA	1,045,418	9.75
3.	Lockheed Space Operations Co Kennedy Space Center, FL	599,449	5.59
4.	Lockheed Missiles & Space Co Marshall Space Flight Center, AL	530,153	4.95
5.	Thiokol Corp Brigham City, UT	510,292	4.76
6.	Boeing Co Marshall Space Flight Center, AL	500,115	4.67
7.	Martin Marietta Corp New Orleans, LA	444,799	4.15
8.	Rockwell Space Operations Inc Houston, TX	345,886	3.23
9.	General Electric Co King of Prussia, PA	299,400	2.79
10.	Lockheed Engrg & Science Co Houston, TX	269,905	2.52
11.	Computer Sciences Corp Greenbelt, MD	232,354	2.17
12.	E G & G Florida Inc Kennedy Space Center, FL	212,843	1.99
13.	U S B I Booster Production Co Huntsville, AL	207,274	1.93
14.	T R W Inc Redondo Beach, CA	194,369	1.81
15.	Bendix Field Engineering Corp Greenbelt, MD	180,926	1.69
16.	Loral Aerospace Corp Houston, TX	140,521	1.31
17.	Boeing Computer Support Services Marshall Space Flight Center, AL	139,816	1.30
18.	United Technologies Corp West Palm Beach, FL	135,840	1.27
19.	Sverdrup Technology Inc Middleburgh Heights, OH	109,444	1.02
20.	Grumman Aerospace Corp Reston, VA	103,250	.96
21.	Space Systems Loral Inc San Jose, CA	99,944	.89
22.	Johnson Controls World Services Inc Stennis Space Center, MS	76,139	.71
23.	International Business Machines Houston, TX	76,085	.71
24.	Cae Link Corp Houston, TX	61,467	.57
25.	Harris Space Systems Corp Rockledge, FL	60,099	.56

Principal Contractors (Business Firms)

One Hundred Contractors (Business Firms) Listed According To Total Awards Received (FY1992)

	Contractor and Principle Place of Contract Performance		Awards (Thousands)	Awards (Percent)
26.	BAMSI Inc Marshall Space Flight Center, AL	(D)	58,739	.55
27.	Orbital Sciences Corp Denver, Co	(S)	55,631	.52
28.	Teledyne Industries Inc Marshall Space Flight Center, AL		53,863	.50
29.	G T E Government Systems Corp Gaithersburg, MD		49,687	.46
30.	Ball Corp Boulder, CO		49,345	.46
31.	General Dynamics Corp San Diego, CA		49,058	.46
32.	N S I Technology Sevices Corp Greenbelt, MD		46,947	.44
33.	Sterling Federal Systems Inc Moffett Field, CA		43,579	.41
34.	Bionetics Corp Marshall Space Flight Center, AL		43,174	.40
35.	Cray Research Inc Chippewa Falls, WI		42,977	.40
36.	P R C Inc Washington, DC		41,267	.39
37.	S T Systems Corp Greenbelt, MD	(D)	40,713	.38
38.	Spacehab Corp Washington, DC	(S)	37,886	.35
39.	Metric Constructors Inc Kennedy Space Center, FL		35,596	.33
40.	Raytheon Service Co Annapolis Junction, MD		33,847	.32
41.	Santa Barbara Research Center Goleta, CA		32,367	.30
42.	Fairchild Industries Inc Germantown, MD		31,709	.30
43.	Cortez III Service Corp Cleveland, OH	(D)	31,283	.29
44.	Analex Corp Fairview Park, OH		27,475	.26
45.	Aerojet General Corp Azusa, CA		26,949	.25
46.	Science Application Intl Corp San Diego, CA		26,658	.25
47.	Calspan Corp Moffett Field, CA		26,286	.25
48.	Krug International Corp Houston, TX		24,892	.23
49.	Northrop Worldwide Aircraft Houston, TX		22,208	.21
50.	Air Products & Chemicals Inc Allentown, PA		21,438	.20
51.	Paramax Systems Corp Greenbelt, MD		21,082	.20

Principal Contractors (Business Firms)

One Hundred Contractors (Business Firms) Listed According To Total Awards Received (FY1992)

	Contractor and Principle Place of Contract Performance		Awards (Thousands)	Awards (Percent)
52.	Swales & Associates Inc Greenbelt, MD	(S)	20,690	.19
53.	Grumman Data Systems Corp Houston, TX		19,013	.18
54.	E E R Systems Corp Beltsville, MD	(S) (D)	18,382	.17
55.	Unisys Government Systems Inc Hampton, VA		17,567	.16
56.	Blake Construction Co Inc Greenbelt, MD		17,501	.16
57.	Lockheed Corp Burbank, CA		16,993	.16
58.	Ogden Logistics Services Greenbelt, MD		16,897	.16
59.	Silicon Graphics Inc Mountain View, CA		16,381	.15
60.	Jackson & Tull Inc Greenbelt, MD	(S) (D)	15,860	.15
61.	C B I Services Inc Moffett Field, CA		15,238	.14
62.	Quad S Co Moffett Field, CA	(S)	15,162	.14
63.	Space Transportation Pro Team Huntsville, AL		14,760	.14
64.	Cleveland Electric Illuminating Cleveland, OH		14,627	.14
65.	Ferguson M K Co Cleveland, OH		14,559	.14
66.	Micro Craft Inc Hampton, VA	(S)	14,555	.14
67.	Hernandez Engineering Inc Houston, TX	(S) (D)	14,109	.13
68.	Engineering Design Group Inc Cleveland, OH	(S)	13,856	.13
69.	Wyle Laboratories Hampton, VA		13,148	.12
70.	Virginia Electric & Power Co Hampton, VA		12,835	.12
71.	Digital Equipment Corp Moffett Field, CA		12,800	.12
72.	R M S Technologies Inc Cleveland, OH	(D)	12,730	.12
73.	F D Services Inc Houston, TX		12,677	.12
74.	Johnson Engineering Corp Houston, TX	(S)	12,389	.12
75.	Perkin Elmer Corp Pomona, CA		12,304	.11
76.	Booz Allen & Hamilton Inc Bethesda, MD		11,814	.11
77.	Colejon Mechanical Corp Cleveland, OH	(D)	11,750	.11

Principal Contractors (Business Firms)

One Hundred Contractors (Business Firms) Listed According To Total Awards Received (FY1992)

	Contractor and Principle Place of Contract Performance		Awards (Thousands)	Awards (Percent)
78.	Hughes Danbury Optical Sys Danbury, CT		11,695	.11
79.	Sterling Zero One Inc Moffett Field, CA	(S)	11,640	.11
80.	Advanced Computer Systems Inc. Greenbelt, MD	(S) (D)	11,106	.10
81.	B D M International Inc Columbia, MD		10,939	.10
82.	General Electric U T C JV Evendale, OH		10,924	.10
83.	Computer Sciences Pan Am Serv Slidell, LA		10,596	.10
84.	Allied Signal Inc Tempe, AZ		9,942	.09
85.	Government Micro Resources Chantilly, VA	(S) (D)	9,865	.09
86.	Fairchild Space & Def Corp Greenbelt, MD		9,519	.09
87.	Analytical Services & Mat Inc Hampton, VA	(S) (D)	9,293	.09
88.	Recom Technologies Inc Moffett Field, CA	(S) (D)	9,180	.09
89.	Mason & Hanger Services Inc Hampton, VA		9,166	.09
90.	Ederer Inc Seattle, WA	(S)	8,821	.08
91.	Taft Broadcasting Co Houston Houston, TX	(S)	8,716	.08
92.	Vitro Corp Washington, DC		8,633	.08
93.	L T V Aerospace & Defense Co Dallas, TX		8,424	.08
94.	Boeing Aerospace Operations Inc Moffett Field, CA		8,331	.08
95.	I Net Inc Kennedy Space Center, FL	(S) (D)	8,122	.08
96.	Hughes Aircraft Co El Segundo, CA		7,869	.07
97.	NYMA Inc Greenbelt, MD	(S) (D)	7,747	.07
98.	Stanford Telecommunications Reston, VA	(S)	7,734	.07
99.	Kelsey Seybold Clinic Houston, TX		7,704	.07
100.	Centennial Contractors Entpr Greenbelt, MD		7,511	.07
	Other *		1,041,604	10.01

(S)=Small Business
(D)=Disadvantaged Business
*Includes other Awards over $25,000 and smaller procurements of $25,000 or less.

Educational and Nonprofit Institutions

One Hundred Educational And Nonprofit Institutions Listed According To Total Awards Received*
(FY1992)

	Institution and Principle Place of Performance		Awards (Thousands)	Awards (Percent)
	Total Awards to Educational and Nonprofit Institutions		$957,085	100.00
1.	Stanford Univ Stanford, CA		53,963	5.64
2.	Assn Univ Research & Astron Baltimore, MD	(N)	47,539	4.97
3.	Smithsonian Institution Cambridge, MA	(N)	38,293	4.00
4.	Mass Institute Technology Cambridge, MA		37,085	3.88
5.	Universities Space Research Greenbelt, MD	(N)	31,908	3.33
6.	Univ Calif Berkeley Berkeley, CA		24,497	2.56
7.	C I E S I N Ann Arbor, MI	(N)	23,815	2.49
8.	Mitre Corp Houston, TX	(N)	21,026	2.20
9.	Univ Calif San Diego La Jolla, CA		20,950	2.19
10.	Univ Maryland College Park College Park, MD		20,935	2.19
11.	Univ Arizona Tucson, AZ		18,994	1.99

	Institution and Principle Place of Contract Performance		Awards (Thousands)	Awards (Percent)
12.	Univ Colorado Boulder Boulder, CO		18,919	1.98
13.	U T Calspan Center Aerospace Res Tullahoma, TN	(N)	18,750	1.96
14.	National Academy Sciences Washington, DC	(N)	17,852	1.87
15.	Univ Alabama Huntsville Huntsville, AL		16,578	1.73
16.	Charles Stark Draper Lab Inc Cambridge, MA	(N)	16,561	1.73
17.	New Mexico State Univ Las Cru Palestine, TX		16,491	1.72
18.	Univ Wisconsin Madison Madison, WI		13,888	1.45
19.	Pennsylvania State Univ UP University Park, PA		12,587	1.33
20.	Univ Michigan Ann Arbor Ann Arbor, MI		11,899	1.24
21.	Calif Institute Technology Pasadena, CA		11,477	1.20
22.	Utah State Univ Logan, UT		11,437	1.20
23.	Univ New Hampshire Durham, NH		10,102	1.06
24.	Univ Iowa Iowa City, IA		9,381	.98

Educational and Nonprofit Institutions

One Hundred Educational And Nonprofit Institutions Listed According To Total Awards Received*
(FY1992)

	Institution and Principle Place of Contract Performance		Awards (Thousands)	Awards (Percent)
25.	Southwest Research Institute San Antonio, TX	(N)	9,145	.96
26.	Univ Washington Seattle, WA		9,113	.95
27.	Cornell Univ Ithaca, NY		8,726	.91
28.	S E T I Institute Moffett Field, CA	(N)	8,573	.90
29.	Univ Alaska Fairbanks Fairbanks, AK		8,552	.89
30.	Univ Calif Los Angeles Los Angeles, CA		8,330	.87
31.	Univ Texas Austin Austin, TX		8,127	.85
32.	Johns Hopkins Univ Baltimore, MD		8,027	.84
33.	San Jose State Univ Moffett Field, CA		7,752	.81
34.	Univ Hawaii Honolulu, HI		7,631	.80
35.	Univ Virginia Charlottesville, VA		7,344	.77
36.	Case Western Reserve Univ Cleveland, OH		7,081	.74
37.	Wheeling Jesuit College Wheeling, WV		6,956	.73
38.	Univ Houston Houston, TX		6,918	.72
39.	Univ Chicago Chicago, IL		6,474	.68
40.	Columbia Univ New York, NY		6,416	.67
41.	Univ Houston Clear Lake Houston, TX		6,307	.66
42.	Oklahoma State Univ Stillwater, OH		6,182	.65
43.	Battelle Memorial Institute Columbus, OH	(N)	5,980	.63
44.	Ohio Aerospace Institute Brook Park, OH	(N)	5,747	.60
45.	Texas A & M Univ El Paso, TX		5,656	.59
46.	Harvard Univ Cambridge, MA		5,258	.55
47.	Princeton Univ Princeton, NJ		5,207	.54
48.	Auburn Univ Auburn Auburn, AL		5,104	.53
49.	Carnegie Mellon Univ Pittsburgh, PA		4,775	.50
50.	Univ Calif Santa Barbara Santa Barbara, CA		4,685	.49

Educational and Nonprofit Institutions

One Hundred Educational And Nonprofit Institutions Listed According To Total Awards Received*
(FY1992)

	Institution and Principle Place of Contract Performance		Awards (Thousands)	Awards (Percent)
51.	Oregon State Univ Corvallis, OR		4,579	.48
52.	Eloret Institute Moffett Field, CA	(N)	4,452	.47
53.	Ohio State Univ Columbus, OH		4,434	.46
54.	Univ Alabama Birmingham Birmingham, AL		4,255	.44
55.	Virginia Polytechnic Institute Blacksburg, VA		4,084	.43
56.	North Carolina State Univ Raleigh, NC		4,070	.43
57.	Old Dominion Univ Norfolk, VA		3,955	.41
58.	Univ Florida Gainesville, FL		3,867	.40
59.	Washington Univ St Louis St. Louis, MO		3,829	.40
60.	Purdue Univ West Lafayette, IN		3,751	.39
61.	Univ Illinois Urbana Urbana, IL		3,653	.38
62.	Georgia Institute Technology Atlanta, GA		3,610	.38
63.	American Instit Aero & Astro New York, NY	(N)	3,441	.36
64.	Cleveland State Univ Cleveland, OH		3,435	.36
65.	West Virginia Univ Morgantown, WV		3,397	.36
66.	Univ Southern Calif Los Angeles, CA		3,389	.35
67.	Hampton City Hampton, VA	(N)	3,345	.35
68.	Research Triangle Instit Hampton, VA	(N)	3,333	.35
69.	Colorado State Univ Fort Collins, CO		3,271	.34
70.	MCAT Institute Moffett Field, CA	(N)	3,065	.32
71.	Univ Calif Irvine Irvine, CA		3,022	.32
72.	George Washington Univ Washington, DC		3,007	.31
73.	Univ Minnesota Minnpl St Paul Minneapolis, MN		2,924	.31
74.	North Carolina A & T State Univ Greensboro, NC		2,883	.30
75.	Univ Idaho Moscow, ID		2,785	.29
76.	Rensselaer Poly Inst N Y Troy, NY		2,621	.27

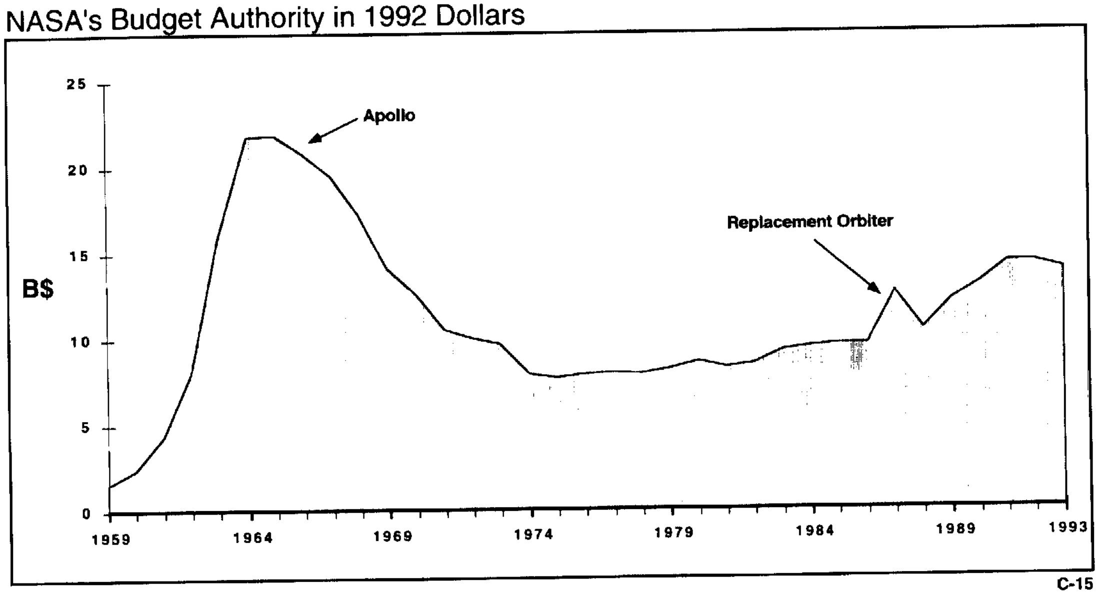
Educational and Nonprofit Institutions

One Hundred Educational And Nonprofit Institutions Listed According To Total Awards Received*
(FY1992)

	Institution and Principle Place of Contract Performance		Awards (Thousands)	Awards (Percent)
77.	Univ Corp Atmospheric Research Boulder, CO	(N)	2,597	.27
78.	Arizona State Univ Tempe, AZ		2,459	.26
79.	S R I International Corp Menlo Park, CA	(N)	2,407	.25
80.	Univ Texas Dallas Dallas, TX		2,359	.25
81.	Howard Univ Washington, DC		2,318	.24
82.	Rice Univ Houston, TX		2,294	.24
83.	Univ Miami Miami, FL		2,263	.24
84.	Univ Cincinnati Cincinnati, OH		2,213	.23
85.	Florida State Univ Tallahassee, FL		2,206	.23
86.	Hampton Univ Hampton, VA		2,163	.23
87.	Florida A & M Univ Tallahassee, FL		2,137	.22
88.	Aerospace Corp El Segundo, CA	(N)	2,125	.22
89.	Environmental Res Instit Mich Ann Arbor, MI	(N)	2,057	.22
90.	Univ Calif Davis Davis, CA		2,044	.21
91.	Boston Univ Boston, MA		2,022	.21
92.	Univ Toledo Toledo, OH		1,960	.20
93.	Clarkson Univ Potsdam, NY		1,947	.20
94.	Univ Pittsburgh Pittsburgh, PA		1,940	.20
95.	Vanderbilt Univ Irvine, CA		1,931	.20
96.	Florida Atlantic Univ Boca Raton, FL		1,739	.18
97.	Univ Central Florida Orlando, FL		1,684	.18
98.	Morehouse College Atlanta, GA		1,673	.17
99.	Univ Rochester Rochester, NY		1,650	.17
100.	College William & Mary Williamsburg, VA		1,645	.17
	Other**		109,702	11.46

* Excludes JPL
** Includes other Awards over $25,000 and smaller procurements of $25,000 or less.

NASA's Budget Authority in 1992 Dollars



Financial Summary

(In Millions Of Dollars)

As Of September 30, 1992

Fiscal Year	Total Appropriations	Total Direct Obligations	Outlays: Total	Outlays: Research & Development	Outlays: Space Flight, Control & Data Communications	Outlays: Construction Of Facilities	Outlays: Research & Program Management	Outlays: Trust Funds	Outlays: Office Of Inspector General
1959	330.90	298.70	145.50	34.00	--	24.80	86.70	--	--
1960	523.90	486.90	401.00	255.70	--	54.30	91.00	--	--
1961	966.70	908.30	744.30	487.70	--	98.20	159.10	--	--
1962	1,825.30	1,691.70	1,257.00	935.60	--	114.30	207.10	--	--
1963	3,674.10	3,448.40	2,552.40	2,308.40	--	225.30	18.70	--	--
1964	5,100.00	4,864.80	4,171.00	3,317.40	--	437.70	415.90	--	--
1965	5,250.00	5,500.70	5,092.90	3,984.50	--	530.90	577.50	--	--
1966	5,175.00	5,350.50	5,933.00	4,741.10	--	572.50	619.40	--	--
1967	4,968.00	5,011.70	5,425.70	4,487.20	--	288.60	649.90	--	--
1968	4,588.90	4,520.40	4,723.70	3,946.10	--	126.10	651.50	--	--
1969	3,995.30	4,045.20	4,251.70	3,530.20	--	65.30	656.20	--	--
1970	3,749.20	3,858.90	3,753.10	2,991.60	--	54.30	707.20	--	--
1971	3,312.60	3,324.00	3,381.90	2,630.40	--	43.70	707.80	--	--
1972	3,310.10	3,228.60	3,422.90	2,623.20	--	50.30	749.40	--	--
1973	3,407.60	3,154.00	3,315.20	2,541.40	--	44.70	729.10	--	--
1974	3,039.70	3,122.40	3,256.20	2,421.60	--	75.10	759.50	--	--
1975	3,231.20	3,265.90	3,266.50	2,420.40	--	85.30	760.80	--	--
1976	3,551.80	3,604.80	3,669.00	2,748.80	--	120.90	799.30	--	--
TQ	932.20	918.80	951.40	730.70	--	25.80	194.90	--	--
1977	3,819.10	3,858.10	3,945.30	2,980.70	--	105.00	859.60	--	--
1978	4,063.70	4,000.30	3,983.10	2,988.70	--	124.20	870.20	--	--
1979	4,558.80	4,557.50	4,196.50	3,138.80	--	132.70	925.00	--	--
1980	5,243.40	5,098.10	4,851.60	3,701.40	--	140.30	1,009.90	--	--
1981	5,522.70	5,606.20	5,421.20	4,223.00	--	146.80	1,051.40	--	--
1982	6,020.00	5,946.70	6,035.40	4,796.40	--	109.00	1,130.00	--	--

Financial Summary

(In Millions Of Dollars)

As Of September 30, 1992

Fiscal Year	Total Appropriations	Total Direct Obligations	Outlays: Total	Outlays: Research & Development	Outlays: Space Flight, Control & Data Communications	Outlays: Construction Of Facilities	Outlays: Research & Program Management	Outlays: Trust Funds	Outlays: Office Of Inspector General
1983	6,817.70	6,723.90	6,663.90	5,316.20	--	108.10	1,239.60	--	--
1984	7,242.60	7,135.20	7,047.60	2,791.80	2,914.60	108.80	1,232.40	--	--
1985	7,552.20	7,638.40	7,317.70	2,118.20	3,707.00	170.00	1,322.50	--	--
1986	7,764.20	7,463.00	7,403.50	2,614.80	3,267.40	188.90	1,332.40	--	--
1987	10,621.00	8,603.70	7,591.40	2,436.20	3,597.30	149.00	1,408.90	--	--
1988	9,001.50	9,914.70	9,091.60	2,915.80	4,362.20	165.90	1,647.70	--	--
1989	10,897.50	11,315.80	11,051.50	3,922.40	5,030.20	190.10	1,908.30	0.50	--
1990	12,295.70	13,068.93	12,428.83	5,094.30	5,116.52	218.42	1,991.09	1.00	7.50
1991	14,014.62	13,973.54	13,877.64	5,765.48	5,590.28	326.31	2,185.06	1.02	9.49
1992	14,316.05	14,159.75	13,961.42	6,578.85	5,117.51	463.03	1,788.05	1.54	12.44

Research and Development Funding By Program

(In Millions of Dollars)	FY 1992	FY 1991	FY 1990	FY 1989	FY 1988	FY 1987	FY 1986	FY 1985	FY 1984	FY 1983	FY 1982	FY 1981	FY 1980	FY 1979	FY 1978	FY 1977 & Prior
Space Station	1,976.71	1,875.39	1,723.70	884.60	387.39	414.50	197.80	153.60	--	--	--	--	--	--	--	--
Space Flight																
Space Shuttle	--	--	--	--	--	--	--	--	--	1,696.20	2,098.10	1,994.70	1,870.30	1,637.60	1,348.80	4,599.70
Space Transp Cap Dev	559.49	594.62	546.02	660.40	585.80	522.30	390.00	387.80	446.10	1,771.50	902.20	676.20	446.60	299.70	263.80	3,946.20
STS Oper Capability Dev	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(278.80)	(201.50)	(223.50)	(112.90)	(89.90)	(65.40)	(65.40)
Spacelab	(99.20)	(129.30)	(118.58)	(87.60)	(66.50)	(72.00)	(77.30)	(55.60)	(111.00)	(--)	(--)	(--)	(--)	(--)	(--)	(--)
Upper Stages	(59.70)	(82.40)	(79.70)	(131.60)	(142.20)	(152.00)	(113.60)	(135.80)	(157.70)	(--)	(--)	(--)	(--)	(--)	(--)	(--)
Payload Oper & Support Eqt	(110.86)	(93.42)	(58.54)	(53.10)	(74.10)	(34.10)	(54.20)	(54.50)	(59.60)	(--)	(--)	(--)	(--)	(--)	(--)	(--)
Eng & Tech Base (ETB)/DTMS	(210.80)	(208.50)	(181.60)	(160.60)	(133.90)	(133.40)	(105.50)	(105.60)	(93.10)	(70.20)	(182.90)	(183.50)	(172.60)	(177.20)	(171.90)	(1,050.70)
Advanced Programs	(34.55)	(35.20)	(29.70)	(47.70)	(46.40)	(37.70)	(19.40)	(20.50)	(21.40)	(12.60)	(9.70)	(8.80)	(13.00)	(7.00)	(10.00)	(188.80)
Advanced Launch Systems	(27.98)	(--)	(--)	(80.40)	(64.30)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)
Advanced Transportation Tech.	(--)	(23.90)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)
Tethered Satellite Program	(16.40)	(21.90)	(27.30)	(26.40)	(12.10)	(10.60)	(15.00)	(15.80)	(3.30)	(--)	(--)	(--)	(--)	(--)	(--)	(--)
Orbital Maneuvering Veh (OMV)	(--)	(--)	(50.60)	(73.00)	(46.30)	(82.50)	(5.00)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)
STS Operations	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(1,409.90)	(508.10)	(260.40)	(148.10)	(25.60)	(16.50)	(--)
Skylab	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(2,427.10)
Apollo Soyuz Test Project	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(214.20)
Expendable Launch Vehicles	--	--	--	--	--	--	--	--	--	82.90	31.10	54.40	67.40	73.60	136.50	2,274.60
Completed Programs	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22,020.10
Apollo	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(20,443.60)
Gemini	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(1,280.70)
Others	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(295.80)
Total OSF	559.49	594.62	546.02	660.40	585.80	522.30	390.00	387.80	446.10	3,550.60	3,031.40	2,725.30	2,384.30	2,010.90	1,749.10	32,840.60
Commercial Programs																
Technology Utilization	32.08	24.05	23.40	16.30	18.80	15.50	10.40	9.40	9.00	9.00	8.00	8.80	12.00	9.10	9.10	75.30
Commercial Use of Space	113.63	62.79	32.41	27.80	29.30	23.60	16.00	--	--	--	--	--	--	--	--	--
Total OCP	145.71	86.84	55.81	44.10	48.10	39.10	26.40	9.40	9.00	9.00	8.00	8.80	12.00	9.10	9.10	75.30

Research and Development Funding By Program

As of September 30, 1992

	FY 1992	FY 1991	FY 1990	FY 1989	FY 1988	FY 1987	FY 1986	FY 1985	FY 1984	FY 1983	FY 1982	FY 1981	FY 1980	FY 1979	FY 1978	FY 1977 & Prior
Aeronautics and Space Technology																
Current Programs																
Space Research & Technology	299.90	277.90	273.77	273.70	217.10	164.50	148.10	141.00	130.30	121.20	106.90	107.80	111.80	98.30	88.70	432.30
Aeronautical Research & Tech	543.70	500.10	433.36	384.60	320.20	360.50	324.30	328.30	309.70	274.50	261.10	268.80	308.30	264.10	228.00	1,021.40
Transatmospheric Res & Tech	4.08	93.79	58.29	68.50	51.90	44.40	--	--	--	--	--	--	--	--	--	--
Energy Tech. Applications	--	--	--	--	--	--	--	--	--	--	--	1.90	3.00	5.00	7.50	20.80
Prior Programs																
Apollo Applications Expr	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.00
Chemical & Solar Power	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	62.30
Basic Research	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	193.60
Space Vehicle Systems	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	332.20
Electronic Systems	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	272.00
Human Factor Systems	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	151.30
Space Power & Elec Prop Sys	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	385.40
Nuclear Rockets	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	512.80
Chemical Propulsion	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	365.40
Aeronautical Vehicles	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	451.20
Nuclear Power & Propulsion	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	44.10
Mission Analysis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16.00
Total OAST	847.68	869.38	765.42	726.80	589.20	569.40	472.40	469.30	440.00	395.70	368.00	378.50	423.10	367.40	324.20	4,261.80
Space Tracking & Data Systems																
Tracking and Data Acquisition	21.73	19.75	19.08	18.60	17.70	16.90	15.30	14.70	14.10	496.30	401.30	339.80	332.10	299.90	276.30	3,852.80
Safety, Reliability, Maintainability & Quality Assurance																
Standards & Practices	33.18	32.59	22.35	22.10	13.90	11.90	7.50	4.80	4.60	3.00	3.00	2.10	3.80	9.00	9.00	24.20
University Space Science & Technology Academic Program																
Academic Programs	44.24	37.43	23.00	--	--	--	--	--	--	--	--	--	--	--	--	--
Minority University Res. Prog	21.73	16.98	14.03	--	--	--	--	--	--	--	--	--	--	--	--	--
Total U.S.S.&T.A.P.	65.97	54.41	37.03	--	--	--	--	--	--	--	--	--	--	--	--	--

Research and Development Funding By Program

(In Millions of Dollars)

	FY 1992	FY 1991	FY 1990	FY 1989	FY 1988	FY 1987	FY 1986	FY 1985	FY 1984	FY 1983	FY 1982	FY 1981	FY 1980	FY 1979	FY 1978	FY 1977 & Prior
Space Science and Applications																
Current Programs																
Physics & Astronomy	1,025.34	954.94	847.11	712.10	596.20	528.50	554.60	654.70	558.60	480.80	318.20	320.00	335.60	281.80	223.10	2,196.30
Planetary Exploration	524.74	469.91	380.85	405.90	323.50	362.20	349.10	286.50	216.10	180.00	205.00	174.10	219.40	181.90	146.70	3,550.20
Life Sciences	145.00	135.60	104.70	78.10	72.10	70.20	65.00	61.90	57.60	55.60	39.50	42.20	43.80	40.10	33.30	145.70
Space Applications	881.15	835.07	632.05	578.30	557.40	550.60	478.40	367.60	309.50	311.40	325.00	325.70	328.50	271.90	232.10	2,092.60
Prior Programs																
Manned Space Science	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	46.40
Launch Vehicle Development	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	614.40
Bioscience	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	257.80
Space Flight Operations	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.00	58.30
Payload, Plan & Prog Integ	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(4.00)	(58.30)
Total OSSA	2,576.23	2,395.52	1,964.71	1,774.40	1,549.20	1,511.50	1,447.10	1,370.70	1,141.80	1,027.80	887.70	862.00	927.30	775.70	639.20	8,961.70
Exploration	3.46	3.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--
University Affairs	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	229.20
Operating Account	587.65	89.11	93.56	103.50	63.70	68.10	59.90	55.00	23.60	33.10	23.60	17.80	5.50	5.20	4.70	79.70
Total Program	6,817.81	6,023.52	5,227.69	4,234.50	3,254.90	3,153.70	2,616.40	2,465.30	2,079.20	5,515.50	4,723.00	4,334.30	4,088.10	3,477.20	3,011.60	50,325.30
Approp Trans & Adjustment	-413.81	0.00	-7.00	32.10	159.4	12.00	21.90	2.80	-34.30	7.30	17.90	2.00	3.00	0.00	1.40	301.00
Appropriation	6,404.00	6,023.52	5,220.69	4,266.60	3,414.30	3,165.70	2,683.30	2,468.10	2,044.90	5,522.80	4,740.90	4,336.30	4,091.10	3,477.20	3,013.00	50,626.30
Lapse Unoblig Bal Incl	--	(1.32)	(1.68)	(0.5)	(1.1)	(4.4)	(0.3)	(0.2)	(0.3)	(0.2)	(0.3)	(0.6)	(0.1)	(0.3)	(0.3)	--

Note: Unobligated Balances Lapsed at the end of the second year of accountability.

Research and Development Funding By Location

As of September 30, 1992

	FY 1992	FY 1991	FY 1990	FY 1989	FY 1988	FY 1987	FY 1986	FY 1985	FY 1984	FY 1983	FY 1982	FY 1981	FY 1980	FY 1979	FY 1978	FY 1977 & Prior
Headquarters	738.61	645.77	471.79	403.50	332.80	258.20	175.80	150.30	141.80	218.40	152.60	136.00	132.50	115.30	95.00	2,253.90
Ames Research Center	429.65	357.72	314.20	295.10	261.70	291.10	241.50	223.50	196.80	180.60	162.90	141.00	147.50	140.40	115.50	1,183.10
Dryden Flight Research Facility	--	--	--	--	--	--	--	--	--	--	11.90	18.40	16.60	13.10	18.60	242.00
Electronics Research Center	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	82.50
Goddard Space Flight Center	1,077.57	1,047.81	930.64	743.70	510.90	488.80	522.60	447.10	361.60	816.30	744.00	567.60	550.90	515.50	493.00	6,400.10
Jet Propulsion Laboratory	772.25	734.97	575.29	581.60	490.30	466.80	451.90	347.80	253.70	308.20	316.40	262.80	320.50	236.80	201.40	3,017.90
Johnson Space Center	1,400.89	1,173.60	1,049.33	572.60	334.80	331.00	249.50	235.20	174.90	1,593.00	1,557.30	1,524.70	1,398.30	1,161.80	970.60	15,423.30
Kennedy Space Center	265.04	209.80	150.68	116.20	90.50	57.30	71.10	49.00	55.70	529.30	420.50	365.40	300.60	234.90	170.00	2,503.20
Langley Research Center	375.02	308.15	260.81	245.90	199.00	221.10	175.20	177.70	140.40	131.90	130.50	143.30	168.20	138.20	157.10	2,322.90
Lewis Research Center	653.06	559.20	500.26	393.70	257.30	286.80	257.10	325.10	305.80	269.90	178.40	163.30	170.40	148.50	133.60	2,864.60
Marshall Space Flight Center	957.86	968.32	959.89	870.00	760.90	730.10	465.30	503.20	443.50	1,702.10	1,238.50	1,005.90	888.20	785.20	630.90	13,293.10
NASA Pasadena Office	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.40
Pacific Launch Operations	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.30
Space Nuclear Systems Office	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	436.50
Station 17	--	--	--	-5.10	--	--	-3.80	-4.70	-4.70	-242.80	-200.00	-14.00	-31.70	-38.80	--	--
Stennis Space Cneter	24.39	18.18	14.80	17.30	16.70	22.50	10.20	11.10	9.70	8.60	10.00	8.70	9.30	9.20	10.00	21.50
Wallops Flight Facility	--	--	--	--	--	--	--	--	--	--	--	11.20	16.80	17.10	15.90	156.30
Western Support Office	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	119.70
Undistributed	123.45	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Program	6,817.81	6,023.52	5,227.69	4,234.50	3,254.90	3,153.70	2,616.40	2,465.30	2,079.20	5,515.50	4,723.00	4,334.30	4,088.10	3,477.20	3,011.60	50,325.30
Approp Trans & Adjustment	-413.81	0.00	-7.00	32.10	159.40	12.00	21.90	2.80	-34.30	7.30	17.90	2.00	3.00	0.00	1.40	301.00
Appropriation	6,404.00	6,023.52	5,220.69	4,266.60	3,414.30	3,165.70	2,638.30	2,468.10	2,044.9	5,522.80	4,740.90	4,336.30	4,091.10	3,477.2	3,013.00	50,626.30
Lapse Unoblig Bal Incl	--	(1.32)	(1.68)	(0.5)	(1.1)	(4.4)	(0.3)	(0.2)	(0.3)	(0.2)	(0.3)	(0.6)	(0.1)	(0.3)	(0.3)	--

Note: Unobligated Balances Lapsed at the end of the second year of accountability

Space Flight, Control And Data Communications Funding By Program

(In Millions of Dollars)

As of September 30, 1992

	FY 1992	FY 1991	FY 1990	FY 1989	FY 1988	FY 1987	FY 1986	FY 1985	FY 1984
Space Flight									
Shuttle Prod & Oper Cap	1,260.75	1,295.07	1,189.84	1,116.55	1,092.40	3,326.38	1,354.70	1,478.10	1,637.20
Space Transportation Ops	2,943.86	2,976.73	2,628.41	2,604.26	1,825.50	1,737.50	1,633.20	1,308.60	1,431.70
Total OSF	4,204.61	4,271.80	3,818.25	3,720.81	2,917.90	5,063.44	2,987.90	2,786.70	3,068.90
Space Tracking & Data Systems	884.73	973.91	897.97	813.45	969.30	764.70	658.20	792.20	673.90
Operating Account	262.76	10.13	9.39	13.79	8.70	17.38	15.62	15.30	9.00
Total Program	5,352.10	5,255.84	4,725.61	4,548.05	3,895.90	5,845.52	3,661.72	3,594.20	3,751.80
Approp Trans & Adjustment	-195.03	1,063.29	-170.71	-83.85	12.40	-284.50	27.52	7.60	34.30
Appropriation	5,157.07	6,319.13	4,554.90	4,464.20	3,908.30	5,561.02	3,689.24	3,601.80	3,786.10
Lapse Unoblig Bal Incl	--	(0.41)	(0.82)	(0.90)	(0.40)	(0.30)	(0.3)	(0.2)	(0.5)

Note: Unobligated Balances Lapsed at the end of the second year of accountability.

Space Flight, Control And Data Communications Funding By Location

(In Millions of Dollars) As of September 30, 1992

	FY 1992	FY 1991	FY 1990	FY 1989	FY 1988	FY 1987	FY 1986	FY 1985	FY 1984
Headquarters	117.50	220.77	160.73	159.30	364.40	336.97	204.50	259.50	227.60
Ames Research Center	22.86	21.78	18.70	16.70	15.40	16.30	18.00	15.60	10.30
Goddard Space Flight Center	623.08	672.11	635.73	549.92	467.10	415.90	330.00	432.20	431.00
Jet Propulsion Laboratory	176.35	151.75	154.72	124.97	132.10	128.00	117.40	111.90	97.30
Johnson Space Center	1,220.78	1,188.35	1,130.53	1,054.62	909.70	2,475.65	1,083.70	1,308.00	1,360.50
Kennedy Space Center	1,101.91	941.36	857.80	828.37	720.20	660.62	511.52	493.40	490.50
Langley Research Center	0.63	2.05	2.05	14.30	0.10	0.25	0.40	0.60	0.20
Lewis Research Center	58.39	121.87	54.63	10.90	3.70	5.00	3.30	4.30	2.00
Marshall Space Flight Center	1,837.63	1,904.33	1,683.63	1,779.81	1,263.90	1,734.05	1,655.40	1,437.00	1,379.00
Station 17	--	--	--	-12.40	--	--	-277.60	-480.60	-247.70
Stennis Space Center	48.11	31.47	27.09	21.56	19.30	16.09	15.10	12.30	1.10
Undistributed	144.86	--	--	--	--	56.69	--	--	--
Total Program	5,352.10	5,255.84	4,725.61	4,548.05	3,895.90	5,845.52	3,661.72	3,594.20	3,751.80
Approp Trans & Adjustment	-195.03	1,063.29	-170.71	-83.85	12.40	-284.50	27.52	7.60	34.30
Appropriation	5,157.07	6,319.13	4,554.90	4,464.20	3,908.30	5,561.02	3,689.24	3,601.80	3,786.10
Lapse Unoblig Bal Incl	--	(0.41)	(0.82)	(0.90)	(0.40)	(0.30)	(0.3)	(0.2)	(0.5)

Note: Unobligated Balances Lapsed at the end of the second year of accountability.

Construction of Facilities Funding

(In Millions of Dollars)	FY 92	FY 91	FY 90	FY 89	FY 88	FY 87	FY 86	FY 85	FY 84	FY 83	FY 82	FY 81	FY 80	FY 79	FY 78	FY 77	76/TQ
Ames Research Center	--	--	12.7	--	16.0	18.9	7.8	14.2	14.7	--	--	13.6	2.9	9.1	--	4.4	2.6
Dryden Flight Research Fac.	--	12.8	--	--	12.7	--	--	--	--	3.5	--	--	--	--	0.4	0.8	--
Goddard Space Flight Center	22.0	16.6	15.9	6.2	8.6	8.0	3.6	2.1	--	2.6	--	--	--	5.6	4.5	--	--
Jet Propulsion Laboratory	5.5	29.8	5.3	--	--	11.5	9.2	13.7	5.5	--	1.8	2.8	--	4.6	3.1	--	--
Johnson Space Center	7.0	11.0	2.8	7.8	--	7.6	--	--	--	--	3.0	--	--	--	2.0	2.2	--
Kennedy Space Center	5.3	--	11.3	--	--	--	--	--	--	--	1.1	0.6	4.8	--	1.7	2.6	--
Langley Research Center	--	4.6	--	7.4	--	11.3	4.6	13.8	10.5	13.5	2.9	22.0	7.1	5.3	1.6	6.1	1.6
Lewis Research Center	--	16.0	--	--	17.0	--	--	--	12.9	4.8	1.2	8.7	5.7	5.8	0.8	2.7	--
Marshall Space Flight Center	5.2	--	--	12.6	--	--	--	1.6	--	--	--	4.0	6.3	--	--	--	--
Stennis Space Center	--	3.8	--	--	--	--	--	--	--	--	--	--	--	--	0.6	--	--
Wallops Flight Facility	3.5	5.5	--	--	--	--	--	--	--	2.1	--	--	1.1	--	--	--	--
Various Locations	5.7	17.6	2.6	--	6.4	16.9	17.4	14.0	--	--	9.8	32.0	1.7	--	1.1	--	--
Facility Planning & Design	34.0	28.0	26.3	22.0	16.0	17.0	11.8	12.0	9.1	8.2	10.0	9.7	13.9	10.6	11.7	12.6	12.5
Large Aero Fac	--	--	--	--	--	--	--	--	--	--	--	--	45.7	56.1	37.0	31.0	--
Minor Construction	12.9	11.0	10.0	9.0	7.4	6.8	5.9	4.9	4.7	3.7	2.3	3.9	3.5	4.2	6.0	2.9	6.2
Repair	31.7	28.2	28.0	22.5	22.9	22.1	19.5	17.9	17.2	13.8	12.8	14.8	12.0	--	--	--	--
Envir Compl & Rest. Program	36.0	32.0	30.0	26.0	23.9	--	--	--	--	--	--	--	--	--	--	--	--
Rehab & Mods *	34.8	32.9	35.0	31.2	31.5	29.8	24.3	21.5	21.4	18.9	17.6	17.3	19.7	14.1	18.9	17.8	23.0
Space Station Facilities	35.0	13.0	49.8	--	--	12.5	--	--	--	--	--	--	--	--	--	--	--
Shuttle Facilities	369.4	164.5	117.6	66.1	17.2	6.9	36.1	37.6	49.2	28.1	33.0	9.9	27.9	30.9	64.7	30.3	46.6
Shuttle Payload Facility	--	--	--	--	--	--	3.8	6.7	13.2	1.7	--	1.5	4.3	--	7.3	4.4	--
Unallocated Plans & Design	--	--	--	--	--	--	--	--	--	0.5	--	--	--	--	--	--	--
Aero. Facils Revitalization	42.3	32.6	64.1	46.0	--	--	--	--	--	--	--	--	--	--	--	--	--
Advanced Launch System Fac.	--	--	--	15.0	--	--	--	--	--	--	--	--	--	--	--	--	--
Trust Fund	--	--	--	15.0	--	--	--	--	--	--	--	--	--	--	--	--	--
Wake Shield Facility	--	3.0	2.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Future Software Program	6.0	4.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Earth Science Info Network	3.4	1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
JSC Visitor Center	--	10.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Deferred Rehab & Major Maint.	11.8	20.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
National Tech. Transfer Center	13.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chris Columbus Center	20.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Indp Software Valid/Verif.	10.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Space Dynamics Laboratory	10.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL PROGRAM	525.0	497.9	413.6	286.8	179.6	169.3	144.0	160.0	158.4	101.4	95.5	140.8	156.6	148.3	161.4	117.8	92.5
Approp Trans & Adjust	0.0	0.0	187.7	3.3	-1.3	300.0	-10.7	-10.0	-2.9	-3.9	0.3	-25.8	-0.5	1.2	-0.5	0.3	0.4
Approp & Availability	525.0	497.9	601.3	290.1	178.3	469.3	133.3	150.0	155.5	97.5	95.8	115.0	156.1	147.5	160.9	118.1	92.9

*Included in Various Locations Prior to FY 1972.

Construction of Facilities Funding

As of September 30, 1992

	FY 75	FY 74	FY 73	FY 72	FY 71	FY 70	FY 69	FY 68	FY 67	FY 66	FY 65	FY 64	FY 63	FY 62	FY 61	FY 60	FY 59
Ames Research Center	3.7	--	3.2	6.5	1.1	0.3	0.4	4.2	--	2.8	5.8	11.3	14.3	6.3	0.6	6.1	3.8
Dryden Flight Research Facility	--	--	--	--	--	0.9	--	--	--	--	--	2.5	1.8	--	--	1.8	--
Electronics Research Center	--	--	--	--	--	--	--	--	7.4	5.2	10.4	1.6	--	--	--	--	--
Goddard Space Flight Center	1.9	1.3	0.6	0.7	1.4	0.7	--	0.6	0.7	2.4	2.3	17.7	21.3	11.5	9.4	14.0	3.9
Jet Propulsion Laboratory	9.2	1.3	0.5	--	1.9	--	--	3.1	0.3	0.9	3.6	3.0	11.4	3.6	8.6	7.7	--
Johnson Space Center	0.7	--	0.6	--	1.1	--	0.9	0.6	11.8	4.0	17.3	33.9	24.5	--	--	--	--
Kennedy Space Center	--	--	9.7	15.6	0.3	10.5	7.4	20.4	34.6	7.2	87.8	273.4	332.8	115.6	27.8	4.0	--
Langley Research Center	3.2	4.0	4.3	--	0.6	5.6	--	--	6.4	8.4	3.3	9.7	9.8	6.9	12.3	4.5	10.8
Lewis Research Center	3.7	--	10.0	0.8	0.7	0.3	--	2.1	16.2	0.9	0.8	20.4	45.5	1.1	9.6	6.6	8.0
Marshall Space Flight Center	3.8	--	--	--	1.3	--	--	0.9	--	1.8	12.0	28.2	40.5	30.7	26.1	--	--
Stennis Space Center	--	--	--	--	--	1.4	--	--	--	--	58.4	102.9	77.1	--	--	--	--
Wallops Flight Facility	1.1	0.9	0.6	--	--	0.5	0.5	0.7	0.2	1.0	1.7	0.5	4.1	11.3	2.0	--	16.1
Michoud Assembly Facility	--	--	--	--	--	--	0.4	0.5	0.5	0.3	6.2	7.3	28.5	--	--	--	--
Nuclear Rocket Dev Station	--	--	--	--	--	--	--	--	--	--	--	4.1	11.5	--	--	--	--
Pacific Launch Operations	--	--	--	--	--	--	--	--	--	--	0.3	--	--	0.6	0.4	1.1	--
Various Locations	7.7	3.7	--	0.7	22.5	26.4	20.8	3.5	6.5	15.1	28.3	211.5	129.9	159.0	28.0	52.4	5.1
Facility Planning & Design	10.8	13.5	7.9	3.5	5.4	3.5	1.0	5.4	5.4	5.0	8.8	10.4	12.9	9.8	--	--	--
Minor Construction	4.6	4.6	-	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Rehab & Mods *	14.8	14.8	11.6	7.9	(17.5)	--	--	--	--	--	--	--	--	--	--	--	--
Shuttle Facilities	76.5	56.5	27.8	18.3	--	--	--	--	--	--	--	--	--	--	--	--	--
Other	--	--	1.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL PROGRAM	141.7	100.6	78.5	54.0	36.3	50.1	31.4	42.0	90.0	55.0	247.0	738.4	765.9	356.4	124.8	98.2	47.7
Approp Trans & Adjust	-1.5	0.5	-1.2	-1.3	-11.3	3.1	-9.6	-6.1	-7.1	5.0	15.9	-58.4	10.3	-40.4	-2.0	-13.6	0.3
Appropr & Availability	140.2	101.1	77.3	52.7	25.0	53.2	21.8	35.9	82.9	60.0	262.9	680.0	776.2	316.0	122.8	84.6	48.0

*Included in Various Locations Prior to FY 1972

Research and Program Management Funding

(In Millions of Dollars)

	FY 92	FY 91	FY 90	FY 89	FY 88	FY 87	FY 86	FY 85	FY 84	FY 83	FY 82	FY 81	FY 80	FY 79	FY 78	FY 77	76/TQ
Headquarters (1)	171.6	283.0	259.0	255.2	205.6	142.5	124.0	122.2	114.0	111.9	115.9	96.4	88.7	84.6	83.4	78.4	93.5
Ames Research Center	159.0	211.5	187.9	178.3	165.3	134.0	123.5	122.3	114.9	107.2	76.6	72.2	67.4	62.8	57.7	53.1	63.9
Dryden Flight Research Fac	--	--	--	--	--	--	--	--	--	--	24.4	22.6	20.2	18.9	18.2	17.2	19.7
Goddard Space Flight Center	250.8	304.4	266.5	255.9	244.0	216.1	200.5	198.3	191.4	183.9	169.1	142.5	133.7	127.8	123.5	114.3	136.6
Johnson Space Center	247.5	346.0	325.2	302.7	283.3	228.0	206.9	216.1	201.9	195.2	230.5	176.3	164.7	153.0	146.2	139.1	165.2
Kennedy Space Center	155.5	299.5	277.9	269.9	243.7	200.0	192.2	185.1	176.4	164.9	156.0	150.2	135.5	126.4	116.3	110.1	128.0
Langley Research Center	172.9	214.6	198.7	188.7	178.2	153.7	145.0	147.6	139.2	132.7	126.6	120.8	113.8	106.6	100.7	94.7	115.7
Lewis Research Center	172.4	230.4	206.3	196.4	182.0	151.7	143.1	137.4	128.5	118.8	106.4	99.9	94.8	87.5	84.7	83.3	102.4
Marshall Space Flight Center	231.8	293.9	276.8	256.0	239.9	213.1	195.0	199.7	190.9	184.3	172.1	165.3	156.6	149.0	143.6	140.2	170.0
Stennis Space Center	14.5	28.3	25.1	23.5	20.6	12.4	11.2	10.7	6.3	6.6	5.5	4.9	2.8	1.3	0.1	0.7	0.5
Station 17	--	--	--	--	--	--	-0.1	-7.6	-7.6	-8.1	--	--	--	--	--	--	--
Wallops Flight Facility	--	--	--	--	--	--	--	--	--	--	--	20.0	17.8	15.9	15.1	13.3	17.0
TOTAL PROGRAM	1,576.0	2,211.6	2,023.4	1,926.6	1,762.6	1,451.5	1,341.3	1,331.8	1,255.9	1,197.4	1,183.1	1,071.1	996.0	933.8	889.5	844.4	1,012.5
Lapsed Unoblig Bal	1.6	0.6	--	--	--	1.0	0.2	0.5	0.2	--	0.2	0.3	0.2	0.3	0.3	0.2	0.6
Approp Trans & Adjust	664.7	-0.3	-41.2	-71.6	-266.9	-27.5	20.5	--	--	--	--	--	--	--	--	--	--
Appropriation	2,242.3	2,211.9	1,982.2	1,855.0	1,495.7	1,425.0	1,362.0	1,332.3	1,256.1	1,197.4	1,183.3	1,071.4	996.2	934.1	889.8	844.6	1,013.1

(1) Includes NASA Pasadena Office

Research and Program Management Funding

As of Setpember 30, 1992

	FY 75	FY 74	FY 73	FY 72	FY 71	FY 70	FY 69	FY 68	FY 67	FY 66	FY 65	FY 64	FY 63	FY 62	FY 61	FY 60	FY 59
Headquarters (1)	68.9	63.0	61.2	61.6	64.9	63.2	60.8	57.1	57.4	54.4	69.3	56.1	51.3	26.0	13.9	8.5	5.7
Ames Research Center (2)	48.6	46.4	42.4	42.2	40.6	37.6	34.0	33.8	33.8	33.2	31.8	26.9	25.6	22.9	19.9	17.8	16.3
Dryden Flight Research Center	13.2	12.2	11.7	11.7	11.1	10.3	9.7	9.5	9.5	9.4	10.5	9.4	7.5	7.2	5.1	4.3	3.3
Electronics Research Center	--	--	--	--	--	19.1	17.2	15.4	12.2	6.4	3.2	0.5	--	--	--	--	--
Goddard Space Flight	104.8	97.3	95.7	96.5	93.1	86.4	73.2	68.3	71.1	64.4	93.3	61.9	52.8	39.1	20.4	15.5	1.8
Johnson Space Center	121.3	117.6	110.6	113.0	111.1	106.6	98.9	95.7	95.7	86.5	88.7	64.7	51.0	24.1	9.2	--	--
Kennedy Space Center	95.9	94.4	92.4	92.6	98.3	97.6	95.8	93.1	92.7	82.0	40.8	26.8	18.8	6.4	--	--	--
Langley Research Center	88.6	83.3	78.6	80.2	75.3	69.8	63.0	62.2	64.3	63.5	59.0	52.1	51.8	46.6	39.1	33.0	31.4
Lewis Research Center	80.3	79.6	81.2	82.5	78.0	73.9	67.9	66.2	66.3	66.4	69.3	58.5	53.4	45.2	35.8	31.2	27.8
Marshall Space Flight Center	129.1	137.5	137.2	138.9	145.1	125.7	116.3	126.2	128.7	128.4	138.7	124.3	112.6	89.2	68.6	5.1	--
Stennis Space Center	1.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pacific Launch Operations	--	--	--	--	--	--	--	--	--	0.6	0.9	0.9	0.6	0.1	--	--	--
Space Nuclear Systems Office	--	1.1	--	2.2	2.4	2.3	2.1	2.0	2.0	1.8	1.7	1.5	1.0	0.3	--	--	--
Wallops Flight Facility	12.4	11.6	10.8	10.9	10.3	9.7	9.1	8.8	9.7	9.3	11.1	8.8	8.9	7.1	5.0	2.7	1.3
Western Support Office	--	--	--	--	--	--	--	1.0	3.2	4.9	5.0	4.4	3.4	1.4	5.7	0.5	--
TOTAL PROGRAM	764.7	744.0	721.8	732.3 (3)	730.2	702.2	648.0	639.3	646.6	611.2	623.3	496.8	438.7	315.6	222.7	118.6	87.6
Lapsed Unoblig Bal	0.2	0.6	7.6	0.3	0.2	0.4	0.1	0.1	0.9	0.6	--	--	--	--	--	--	--
Approp Trans & Adjust	-4.9	--	--	2.1	-7.7	-12.6	-44.9	-11.4	-7.5	-27.8	0.2	-2.8	--	--	--	--	--
Appropriation	760.0	744.6	729.4	734.7	722.7	690.0	603.2	628.0	640.0	584.0	623.5	494.0	438.7	315.6	222.7	118.6	87.6

(1) Includes NASA Pasadena Office
(2) ERC was closed on June 30, 1970
(3) Includes $10 million for basic institutional and other requirements for agencies resident at MTF/Slidell

Personnel Summary

Onboard At End Of Fiscal Year*

	FY59	FY60	FY61	FY62	FY63	FY64	FY65
Headquarters	429	587	735	1,477	2,001	2,158	2,135
Ames Research Center	1,464	1,421	1,471	1,658	2,116	2,204	2,270
Dryden Flight Research Facility (1)	340	408	447	538	616	619	669
Electronics Research Center	--	--	--	--	25 (a)	33 (a)	250
Goddard Space Flight Center	398	1,255	1,599	2,755	3,487	3,675	3,774
Johnson Space Center	--	in GSFC	794	1,786	3,345	4,277	4,413
Kennedy Space Center	--	--	--	339	1,181	1,625	2,464
Langley Research Center	3,624	3,203	3,338	3,894	4,220	4,330	4,371
Lewis Research Center	2,809	2,722	2,773	3,800	4,697	4,859	4,897
Marshall Space Flight Center	--	370	5,948	6,843	7,332	7,679	7,719
NASA Pasadena Office	--	--	--	--	--	-- (b)	19
Pacific Launch Operations Office	--	--	--	--	17	22	21
Space Nuclear Systems Office	--	--	4	39	96	112	116
Stennis Space Center	--	--	--	--	--	--	--
Wallops Flight Facility (2)	171	229	302	421	493	530	554
Western Support Office	--	37	60	136	308	376	377
Total	9,235	10,232	17,471	23,686	29,934	32,499	34,049

	FY66	FY67	FY68	FY69	FY70	FY71	FY 72
Headquarters	2,336	2,373	2,310	2,293	2,187	1,895	1,755
Ames Research Center	2,310	2,264	2,197	2,117	2,033	1,968	1,844
Dryden Flight Research Facility (1)	662	642	622	601	583	579	539
Electronics Research Center	555	791	950	951	592	--	--
Goddard Space Flight Center	3,958	3,997	4,073	4,295	4,487	4,459	4,178
Johnson Space Center	4,889	5,064	4,956	4,751	4,539	4,298	3,935
Kennedy Space Center	2,669	2,867	3,044	3,058	2,895	2,704	2,568
Langley Research Center	4,485	4,405	4,219	4,087	3,970	3,830	3,592
Lewis Research Center	5,047	4,956	4,583	4,399	4,240	4,083	3,866
Marshall Space Flight Center	7,740	7,602	6,935	6,639	6,325	6,060	5,555
NASA Pasadena Office	85	91	79	80	72	44	40
Pacific Launch Operations Office	-- (c)	--	--	--	--	--	--
Space Nuclear Systems Office	115	113	108	104	103	89	45
Stennis Space Center	--	--	--	--	--	--	--
Wallops Flight Facility (2)	563	576	565	554	522	497	465
Western Support Office	294	119	-- (d)	--	--	--	--
Total	35,708	35,860	34,641	33,929	32,548	30,506	28,382

	FY73	FY74	FY75	FY76	FY77	FY78	FY79	FY80	FY81
Headquarters	1,747	1,734	1,673	1,708	1,619	1,606	1,534	1,658	1,638
Ames Research Center	1,740	1,776	1,754	1,724	1,645	1,691	1,713	1,713	1,652
Dryden Flight Research Facility	509	531	544	566	546	514	498	499	491
Electronics Research Center	--	--	--	--	--	--	--	--	--
Goddard Space Flight Center	3,852	3,936	3,871	3,808	3,666	3,641	3,562	3,535	3,431
Johnson Space Center	3,896	3,886	3,877	3,796	3,640	3,617	3,563	3,616	3,498
Kennedy Space Center	2,516	2,408	2,377	2,404	2,270	2,234	2,264	2,291	2,224
Langley Research Center	3,389	3,504	3,472	3,407	3,207	3,167	3,125	3,094	3,028
Lewis Research Center	3,368	3,172	3,181	3,168	3,061	2,964	2,907	2,901	2,782
Marshall Space Flight Center	5,287	4,574	4,337	4,336	4,014	3,808	3,677	3,646	3,479
NASA Pasadena Office	39	39	35	--	--	--	--	--	--
Pacific Launch Operations Office	--	--	--	--	--	--	--	--	--
Space Nuclear Systems Office	--	--	--	--	--	--	--	--	--
Stennis Space Center	--	--	76	72	94	108	108	111	113
Wallops Flight Facility	434	447	441	437	426	429	409	406	400
Western Support Office	--	--	--	--	--	--	--	--	--
Total	26,777	26,007	25,638	25,426	24,188	23,779	23,360	23,470	22,736

NOTES:

* Includes Other Than Permanent

(1) Included in ARC After FY 1981
(2) Included in GSFC After FY 1981

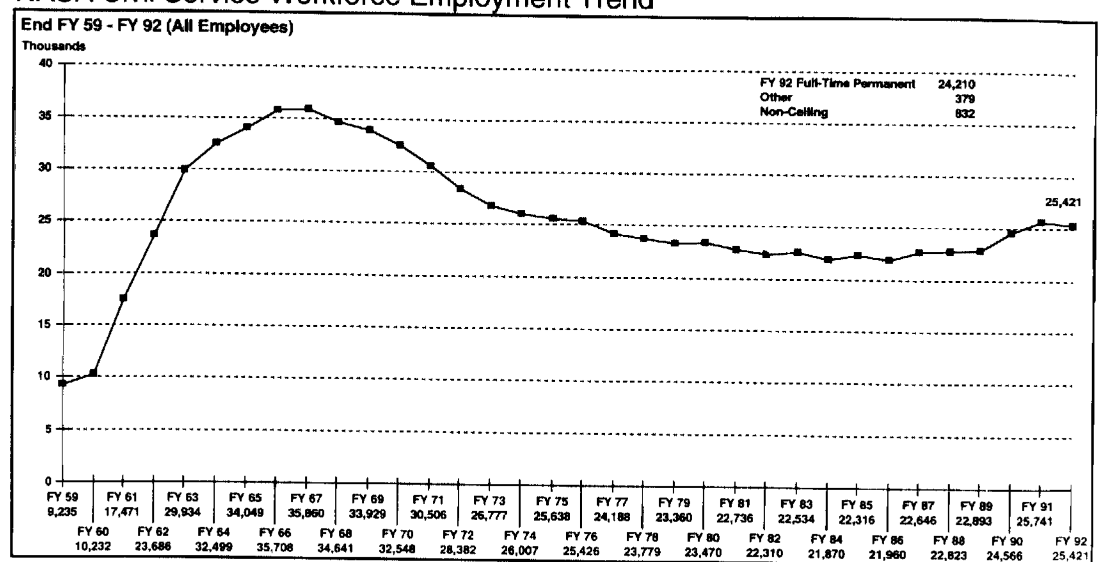
(a) Figures for North Eastern Office
(b) Prior Years Figures Included in WSO
(c) Effective in 1966, PLOO Activity Was Merged Under KSC
(d) Effective in 1968, WSO Was Disestablished and Elements Merged With NaPO

Personnel Summary

Year-End Strength

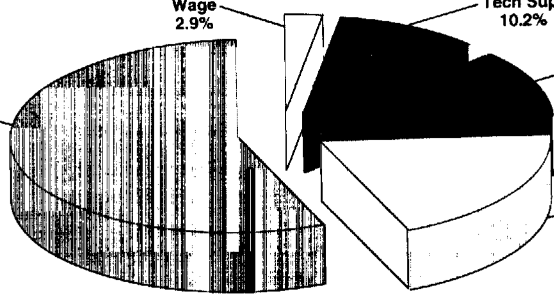
	FY82	FY83	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91	FY92
Headquarters	1,431	1,492	1,396	1,383	1,362	1,532	1,653	1,727	1,966	2,092	2,143
Ames Research Center	2,041	2,033	2,043	2,052	2,072	2,079	2,101	2,151	2,205	2,263	2,243
Goddard Space Flight Center	3,621	3,666	3,541	3,629	3,679	3,648	3,626	3,735	3,873	3,999	3,964
Johnson Space Center	3,268	3,235	3,227	3,330	3,269	3,349	3,399	3,578	3,615	3,677	3,631
Kennedy Space Center	2,104	2,084	2,067	2,081	2,051	2,188	2,236	2,423	2,466	2,571	2,546
Langley Research Center	2,801	2,904	2,821	2,827	2,814	2,851	2,840	2,864	2,961	2,969	2,953
Lewis Research Center	2,485	2,632	2,624	2,715	2,598	2,663	2,649	2,749	2,728	2,835	2,799
Marshall Space Flight Center	3,332	3,351	3,223	3,284	3,260	3,384	3,340	3,609	3,619	3,788	3,715
Stennis Space Center	103	106	108	122	123	137	147	183	192	222	216
NASA Permanent	21,186	21,505	21,050	21,423	21,228	21,831	21,991	23,019	23,625	24,416	24,210
Other Than Permanent	1,124	1,029	820	893	732	815	832	874	941	1,325	1,211
NASA Total	22,310	22,534	21,870	22,316	21,960	22,646	22,823	23,893	24,566	25,741	25,421

NASA Civil Service Workforce Employment Trend



Occupational Summary

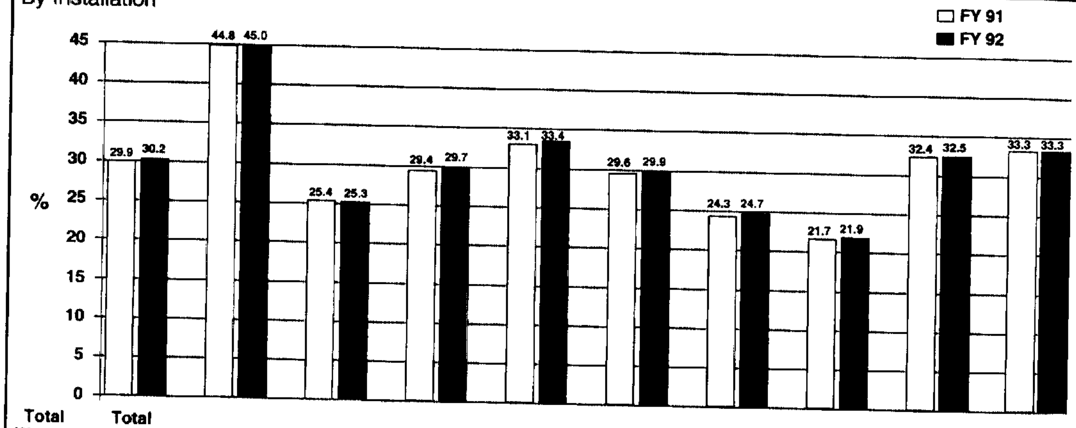
Permanent Personnel - 9/30/92



Occupation	Total NASA	HQ	ARC	GSFC	JSC	KSC	LaRC	LeRC	MSFC	SSC
S&E	13,567	589	1,203	2,235	2,385	1,550	1,433	1,593	2,455	124
Prof'l Admin	4,689	1,113	367	822	647	416	326	312	631	55
Clerical	2,772	435	208	435	417	300	268	223	451	35
Tech. Support	2,471	5	171	407	176	274	918	340	178	2
Wage System	711	1	294	65	6	6	8	331	0	0
Total	24,210	2,143	2,243	3,964	3,631	2,546	2,953	2,799	3,715	216

Women as Percent of Permanent Employees

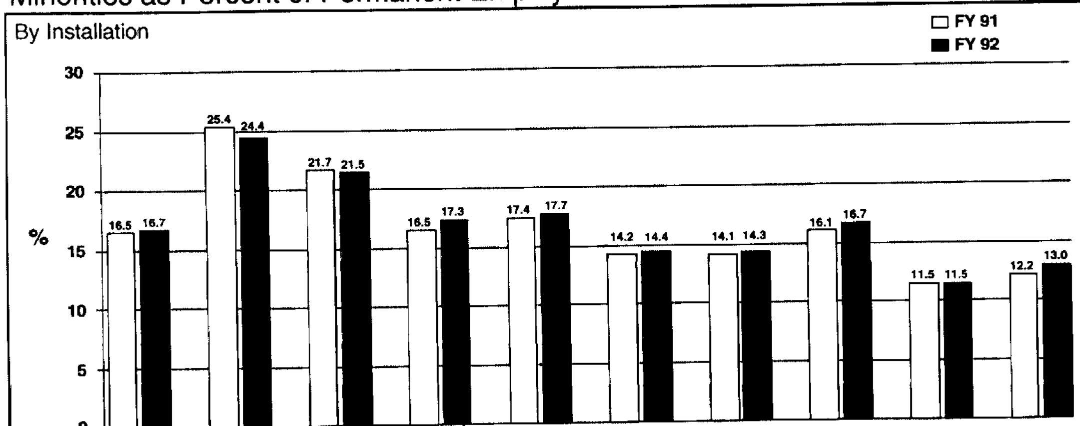
By Installation



Total Women	Total NASA	HQ	ARC	GSFC	JSC	KSC	LaRC	LeRC	MSFC	SSC
FY 92	7,302	964	567	1,176	1,212	760	728	614	1,209	72
FY 91	7,301	938	574	1,176	1,216	761	721	615	1,226	74
FY 83	4,874	612	412	875	724	495	570	433	722	31

Minorities as Percent of Permanent Employees

By Installation



Total Minorities	Total NASA	HQ	ARC	GSFC	JSC	KSC	LaRC	LeRC	MSFC	SSC
FY 92	4,048	523	483	686	644	367	423	468	426	28
FY 91	4,025	532	491	661	641	364	418	456	435	27
FY 83	2,614	334	327	476	425	192	331	236	215	8