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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 is based on the NASA Mission Operation Report (MOR) System, HQMI 8610.1B. All launches of the Scout class and larger vehicles are counted as a major NASA launch, regardless of the mission objective. Vehicle and spacecraft development flights are also counted as major NASA launches. The MOR system rates each mission either successful or unsuccessful; NASA has no partial success category. Shuttle missions are counted as one launch and one payload where free flying payloads are not involved. Satellites deployed from the cargo bay and placed in a separate orbit or trajectory are counted as an additional payload.

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WASHINGTON, DC 20546

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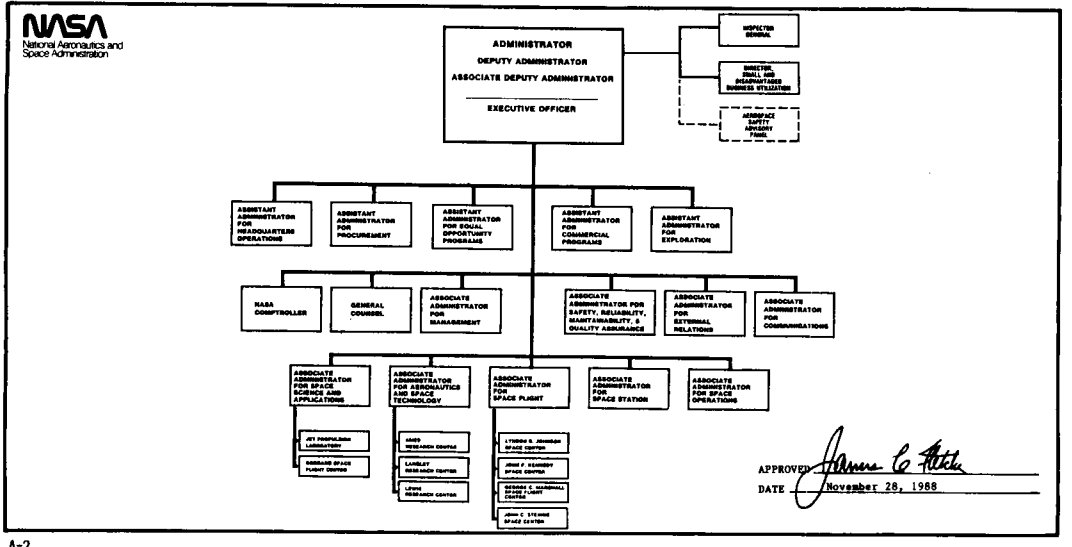
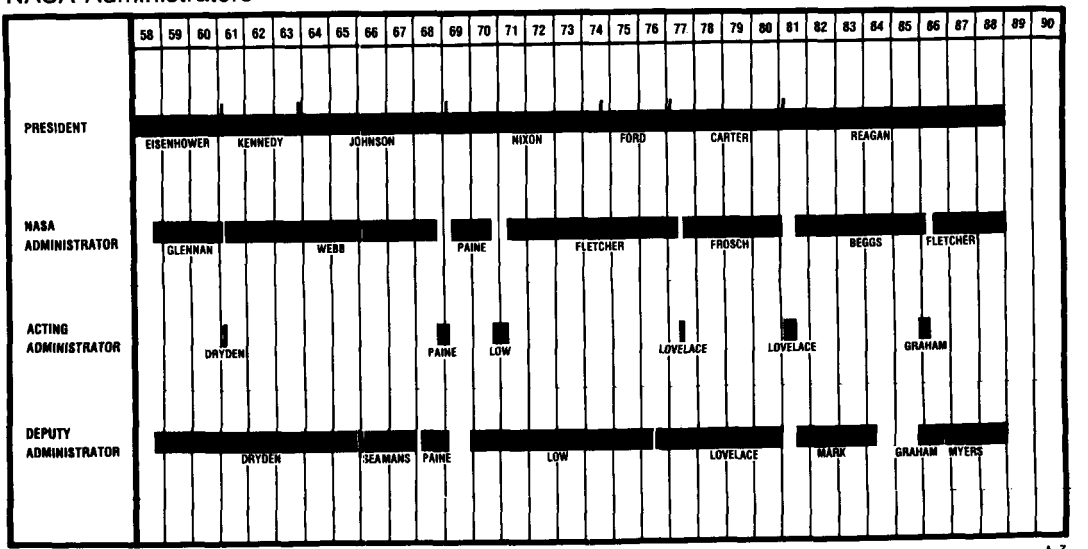
Section A

Administration And Organization

NASA Organization Chart



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 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;

(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.

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

DECLARATION OF POLICY AND PURPOSE (Continued)

(d) 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.

(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 the development of advanced automobile propulsion systems.

(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 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).

U.S. National Space Policy

The President approved on January 5, 1988, a revised national space policy that will set the direction of U.S. efforts in space for the future. The resulting Presidential Directive reaffirms the national commitment to the exploration and use of space in support of our national well being. It acknowledges that 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 sectors to avoid unnecessary duplication and promote attainment of United States space goals.

GOALS AND PRINCIPLES

The directive states that 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 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 directive states that 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.

  - 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 without direct Federal subsidy. These commercial activities must be consistent with national security interests, and international and domestic legal obligations.

  - 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 its space and space-related programs.

U.S. National Space Policy

CIVIL SPACE POLICY

The directive states that:

. 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:

- to expand knowledge of the Earth, its environment, the solar system, and the universe:

- to create new opportunities for use of the space environment through the conduct of appropriate research and experimentation in advanced technology and systems;

- to develop space technology for civil applications and, wherever appropriate, make such technology available to the commercial sector;

- to preserve the United States preeminence in critical aspects of space science, applications, technology, and manned space flight;

- to establish a permanently manned presence in space; and

- to engage in international cooperative efforts that further United States space goals.

COMMERCIAL SPACE POLICY

The directive states that 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 directive further states that 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, and surveillance (including research and development programs which support these functions).

U.S. National Space Policy

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 their 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 without direct Federal subsidy.

- The directive states that the United States Government will (1) encourage the development of commercial systems which image the Earth from space competitive with or superior to foreign-operated civil or commercial systems; (2) discuss remote sensing issues and activities with foreign governments operating or regulating the private operation of remote sensing systems; and (3) continue a research and development effort for future advanced, remote sensing technologies. Commercial applications of such technologies will not involve direct Federal subsidy.

- The directive further states that 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 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 without direct Federal subsidy; and (4) to reduce the costs of space transportation and related services.

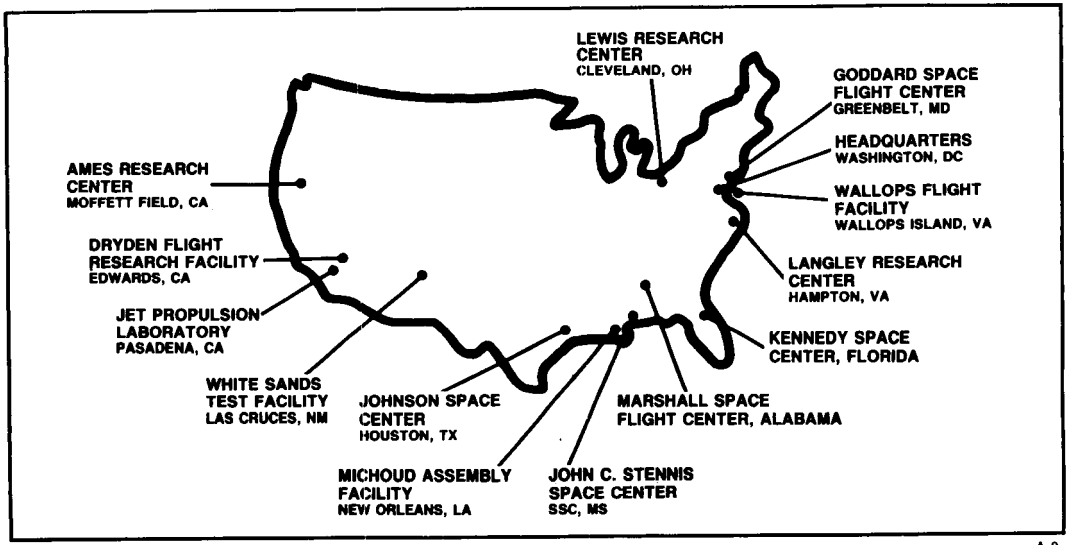
- The directive also states that communications advancements are critical to all United States space sectors. To ensure necessary capabilities exist, the directive states that the United States Government will continue research and development efforts for future advanced space communications technologies. These technologies, when utilized for commercial purposes, will be without direct Federal subsidy.

- The directive states that it is the policy of the United States to control or prohibit, as appropriate, exports of equipment and/or technology that would make a significant contribution to a foreign country's strategic military missile programs. Certain United States friends and allies will be exempted from this policy, subject to appropriate non-transfer and end-use assurances.

- The directive also states that the United States will consider and, as appropriate, formulate policy positions on arms control measures governing activities in space, and will conduct negotiations on such measures only if they are equitable, effectively verifiable, and enhance the security of the United States and its allies.

- The directive further states that 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.

NASA Installations



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 1940 as an aircraft research laboratory by the National Advisory Committee for Aeronautics (NACA) and 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 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.

Its 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 on 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.

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.

NASA Installations

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.

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 1960s 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 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 launch of unmanned vehicles.

NASA Installations

LANGLEY RESEARCH CENTER
Hampton, VA 23665-5225

Langley's primary mission is the research and development of advanced concepts and technology for future aircraft and spacecraft systems, with particular emphasis on environmental effects, performance, range, safety and economy. Examples of this research are projects involving flight simulation, composite structural materials and automatic flight control systems.

Work continues in the development of technology for avionic systems for reliable operation in terminal areas of the future. Efforts continue to improve supersonic flight capabilities for both transport and military aircraft. The center works with the general aviation industry to help solve problems concerning aircraft design and load requirements and to improve flight operations.

Langley's newest major project is developing technology for the National Aero-Space Plane.

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.

Aircraft propulsion activities in the early days of the jet age were to develop aircraft which would fly higher, faster and farther. Today's goals are fuel conservation, quieter flight and cleaner exhaust.

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.

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
SSC, MS 39529

The NASA John C. Stennis Space Center (SSC) scientific community is actively engaged in several research and development programs involving space, oceans and Earth.

The complex includes industrial, laboratory and specialized engineering facilities to support the testing of large rocket propulsion systems.

The main mission of SSC is support of Space Shuttle main engine and main orbiter propulsion system testing. Shuttle main engine testing has been under way at SSC since 1975.

Formerly designated the National Space Technology Laboratories (NSTL), SSC was given full field installation status by NASA in 1974 because of its significant achievements and unique capabilities in space applications and Earth resources activities.

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 projects which use suborbital rocket vehicles to accommodate approximately 50 scientific missions each year.

Wallops manages and coordinates NASA's Scientific Balloon Projects using thin film, helium filled balloons to provide approximately 45 scientific missions each year.

The Year In Review

SPACE FLIGHT

NASA had eight launches in 1988, including two Space Shuttle flights and six expendable rocket launches, all successful. It was the year that American returned to space flight.

Space Transportation System

In January, after completion of acceptance tests at Stennis Space Center, the Space Shuttle main engines were shipped to Kennedy Space Center for installation on the orbiter Discovery. Also, work began to improve the Shuttle Landing Facility at Kennedy.

Two new abort landing sites were brought on line in northwestern Africa, one located near Ben Guerir, Morocco and the other at Banjul, The Gambia.

In April, a telescoping pole was chosen as the egress method for the Space Shuttle's crew escape system.

Three full-duration test firings of the redesigned solid rocket motor were conducted at Morton Thiokol's Wasatch Facility near Brigham City, Utah. For the third test, the motor was extensively flawed to demonstrate the fail-safe characteristics of the redesign.

On September 29, America returned to space with the launch of STS-26. The Tracking and Data Relay Satellite was deployed during the mission. On December 2 the orbiter Atlantis was launched. The STS-27 mission was a dedicated Department of Defense mission.

Expendable Launch Vehicles

NASA launched six unmanned expendable launch vehicles during the year:

- February 8 — Delta 181/Thrusted Vector — a Strategic Defense Initiative Organization payload.
- March 25 — Scout/San Marco D/L — an international satellite designed to study Earth's lower atmosphere.
- April 25 — Scout/SCOS-3 — a pair of Navy navigation satellites.
- June 15 -- Scout/Navy Nova II -- an advanced Navy navigation satellite.
- August 24 — Scout/SCOS-4 — a pair of Navy navigation satellites.
- September 24 -- Atlas/NOAA-H — a National Oceanic and Atmospheric Administration meteorological spacecraft.

SPACE SCIENCE AND APPLICATIONS

Earth Science and Applications

The NASA-convened international Ozone Trends Panel produced a report which implicates chlorofluorocarbons as the cause of the annual austral ozone hole in the Antarctica stratosphere. Congressional committees were told that global warming as a result of the "greenhouse effect" needed to be dealt with in a scientific manner. A multi-disciplinary team of NASA and other American scientists concluded that the global warming issue is a serious scientific concern. NASA outlined some preliminary steps to be taken including the creation of a global environmental database from existing scientific data.

Life Sciences

A study committee charged with developing a program in space life sciences, prepared a report entitled "Exploring the Living Universe: Strategic plan for NASA Life Science." The report may become a blueprint for NASA's Space Life Sciences program, focusing on the health and safety of human spaceflight crews.

The Year In Review

Space Physics

Three of the five instruments carried on the San Marco D/L spacecraft were U.S., one was Italian and another was German. The satellite returned significant space plasma data.

Astrophysics

The Hubble Space Telescope, slated for launch in 1989, underwent comprehensive ground system tests to exercise the complete data system. HST will allow astronomers to penetrate deep into the universe in visible and ultraviolet light.

NASA launched three huge balloon-borne payloads in Canada to search for cosmic rays, including those that could provide evidence of galaxies made of antimatter.

Solar System

The Magellan spacecraft, scheduled for launch in April 1989, was delivered to the Kennedy Space Center. It will map the surface of Venus, obtaining radar images of 70-90 percent of the planet.

Galileo, scheduled for launch in October 1989, underwent additional minor modifications associated with its most recent Venus-Earth-Earth Gravity Assist (VEEGA) trajectory.

MIT scientists, analyzing data acquired while flying aboard NASA's Kiuper Airborne Observatory, discovered an atmosphere around Pluto.

SPACE STATION

The Space Station was named "Freedom" by President Reagan. Final agreements were signed with foreign partners to develop the permanently inhabited, Earth-orbital space facility, concluding more than 2 years of negotiations on international participation.

Negotiations of 10-year contracts with the four primary contractors to design and build Freedom's manned base and polar platform was completed and the NASA/industry team proceeded to develop detailed requirements to guide design work beginning early next year.

OFFICE OF SPACE OPERATIONS

NASA'S tracking and communications capabilities were bolstered by the successful launch and deployment of the TDRS-3. A contractor was selected to provide communications hardware and software for a second TDRSS ground terminal at White Sands. The facility will provide a backup for the existing White Sands ground station and help handle NASA's increased mission support requirements in the 1990's.

NASA's Deep Space Network (DSN) is supporting the Soviet Union's mission to the Martian moon Phobos. In addition, the DSN will be part of a special deep-space communications system fashioned for the August 1989 encounter of Neptune by the Voyager 2 spacecraft, launched in 1977. To receive the close-up pictures and other data transmitted by Voyager 2, the DSN complex at Goldstone, California, has been linked by satellite to the National Radio Astronomy Observatory's Very Large Array (VLA) in Socorro, NM. Adding the VLA's 27 radio telescopes to DSN will more than double the ability to capture Voyager's signal.

AERONAUTICS AND SPACE TECHNOLOGY

Aeronautics

NASA's Aeronautics Program focuses on long-range research and technology development to benefit future U.S. civil and military aircraft development. The results of these efforts expand U.S. capabilities in civil and military aviation and contribute significantly to the nation's aviation leadership and national security. Aeronautical products are the principal positive contributor to the U.S. balance of trade.

The Year In Review

The National Aero-Space Plane Program is a joint NASA-DOD program. The conceptual design phase has been completed and the program is now in the vehicle technology development phase.

NASA's Lewis Research Center and its industrial advanced turboprop team were the recipients of the 1987 Robert J. Collier Trophy. NASA was selected for developing the technology for and testing of advanced turboprop propulsion systems that offer dramatic reductions in fuel usage for future subsonic transport aircraft.

The world's fastest supercomputer, a Cray Y-MP, was installed in the Numerical Aerodynamic Simulation Facility at the Ames Research Center. A flight research program involving the use of a vortex flap on the leading edge of a NASA F-106B research aircraft wing has shown the potential for a 30 percent improvement in the aircraft's lift-to-drag ratio and improvements in stability, control and maneuverability. The NASA/U.S. Air Force experimental forward-swept-wing X-29 aircraft flew its 200th research mission.

Space Technology

NASA's space research and technology development program provides advanced technology to ensure continued U.S. leadership in civil space programs.

The Civil Space Technology Initiative (CSTI) program focuses on enhancing technologies for reliable, low-cost access to Earth orbit and supports effective operations and science missions.

Project Pathfinder is a research and technology development program to enable a broad set of space missions and strengthen the technology base of the United States' civil space program.

The academic sector has been encouraged to participate in the strengthening of the U.S. space technology base through programs such as the University Space Engineering Research program. Nine U.S. universities were selected to be NASA's first University Space Engineering Research Centers.

A NASA-developed, computer-generated display system will aid close-in spacecraft maneuvers.

NASA and the AIAA sponsored the First International Symposium on Space Automation and Robotics, providing a forum for an open dialogue on the increasingly vital technologies of automation and robotics.

COMMERCIAL PROGRAMS

NASA's efforts to encourage an expanded involvement by the U.S. private sector in the civil space program grew significantly as the commercial use of space received new policy emphasis and the Space Shuttle returned to flight. Key developments included:

- The flight of two commercially-developed payloads aboard Discovery during the STS-26 mission.
- Establishment of the Commercial Programs Advisory Committee, a new NASA Advisory Council subcommittee composed of 18 senior corporate and university executives.
- Signing of a space systems development agreement providing for six Space Shuttle flights of a middeck augmentation module.
- Signing of agreements providing for access to NASA-controlled facilities in support of commercial launch operations.
- Award of a commercial launch services contract for the launch of a materials science payload.
- Startup of seven new Centers for the Commercial Development of Space.

- Signing of a memorandum of understanding supporting the commercial development of telemedicine services for Space Station Freedom.

- Publication of an invitation for private sector expressions of interest in the commercial use of jettisoned Space Shuttle external tanks.

NASA's Technology Utilization program observed its 25th year as efforts increased to further expand NASA's nationwide network supporting technology transfer to the private sector. Significant developments in technology applications included a cooperative effort to use space technology to develop a device to improve the sight of people with low vision and a joint project to seek ways to improve laboratory identification and monitoring of cancer cells.

OFFICE OF EXPLORATION

The ultimate Exploration Office goal is to provide recommendations and alternatives for a future national decision on a focused program for human exploration of the solar system. The office established various exploration groups at both Headquarters and the NASA field centers and outlined their responsibilities. The office then tested the organizational structure by examining three exploration strategies as they applied to test exploration case studies. The strategies and case studies examined were:

- Human Expeditions — an approach which emphasizes a significant, visible, successful effort to establish the first human presence on another solar system body. Missions to Mars and to one of its moons, Phobos, were used as case studies to test this strategy.

- Science Outpost — a strategy which emphasizes advancing scientific knowledge and operational experience by building and maintaining an extraterrestrial outpost such as a permanent observatory. For this strategy, the Exploration Office used the case study of establishing an observatory on the far side of the Moon.

- Evolutionary Expansion — a methodical program to open the inner solar system for exploration, space science research, extraterrestrial resource development and permanent human presence. The office used the case study of a lunar outpost to examine this strategy, which later would build towards a Mars Outpost.

The results of the past year's efforts were detailed in a report entitled "Beyond Earth's Boundaries - Human Exploration of the Solar System in the 21st Century."

INTERNATIONAL AFFAIRS

The highlight of 1988 was the signing of the multilateral, intergovernmental space station agreement (IGA). This umbrella agreement sets the broad principles of the rights and obligations of the partners, including the legal regime within which the program will operate.

Two space station bilateral memoranda of understanding also were signed. These memoranda focus on programmatic and technical aspects of the cooperation and establish the management mechanisms necessary to implement the program.

At the Moscow summit in May 1988, the United States and the Soviet Union agreed to expand space science cooperation. They agreed to exchange flight opportunities for scientific instruments to fly on each other's spacecraft and to exchange results of independent national studies of future unmanned solar system exploration missions as a means of assessing prospects for further U.S.-Soviet cooperation on such missions.

Senior management officials from 17 space agencies and organizations, as well as approximately 60 Earth observation officials and scientists, participated in the International Space Year (ISY) Mission to Planet Earth Conference. The officials agreed to establish a Space

The Year In Review

Agency Forum on International Space Year to exchange information and ideas on ISY programs, and endorsed Mission to Planet Earth as a major theme for ISY.

NASA continued sounding rocket and scientific balloon missions to study Supernova 1987A from Australia, since the supernova is only visible from Earth's southern hemisphere.

SAFETY RELIABILITY, MAINTAINABILITY AND QUALITY ASSURANCE

An ad hoc committee, composed of both government and independent safety experts, completed a report that reviewed safety risk management in the National Space Transportation System. The report stated that there has been "a positive change in attitudes" by NASA and its contractors towards safety, that roles and responsibilities have been clarified; and safety risk assessments improved.

NASA Administrator Dr. James C. Fletcher proclaimed October 25 as "NASA Quality Day" reaffirming the agency's dedication to excellence and to recognize NASA's reliance on the creative and imaginative contributions of its work force.

The Rocketdyne Division of Rockwell International Corp. was named NASA's recipient of the 1987 Excellence Award for Quality and Productivity. Rocketdyne's primary responsibility is the design, development and production of Shuttle main engines.

EDUCATIONAL AFFAIRS

Over 60,000 teachers requested entry packets for U.S. student participation in the national competition to name NASA's replacement Space Shuttle orbiter. In addition, requests for unofficial entry packets were granted to 99 teachers in 29 other countries.

Two student experiments, selected under the Space Science Student Involvement Program, flew aboard the Shuttle Discovery. Also, the Space Science Student Involvement Program selected seven national winners in the Space Station category.

The Aerospace Education Service Project continues to be one of NASA's most popular education programs. Over 1.2 million students and 28,000 teachers were reached through school visits, classroom lectures and teacher workshops.

NASA enhanced student and teacher services by opening the NASA SPACELINK computer information access system. Accessed by modem over regular phone lines, over 4,000 participants have registered with the system which received 60 to 70 calls per day for NASA information and aerospace educational materials.

NASA and the American Society for Engineering Education celebrated a 25-year partnership in conducting the Summer Faculty Fellowship Program, which allows university faculty the opportunity to spend 10 weeks in cooperative research with scientists and engineers at NASA field centers.

The Minority Graduate Program, a component of NASA's Graduate Student Researcher's Program, is designed to increase minority participation in graduate study and research. University principal investigators, working on NASA research grants, assist in locating promising graduate students.

The National Space Grant College and Fellowship Program is designed to create a network of universities capable of contributing to aerospace science and technology and training a highly skilled future workforce.

Section B

Space Flight Activity

NASA Launch Vehicle Performance

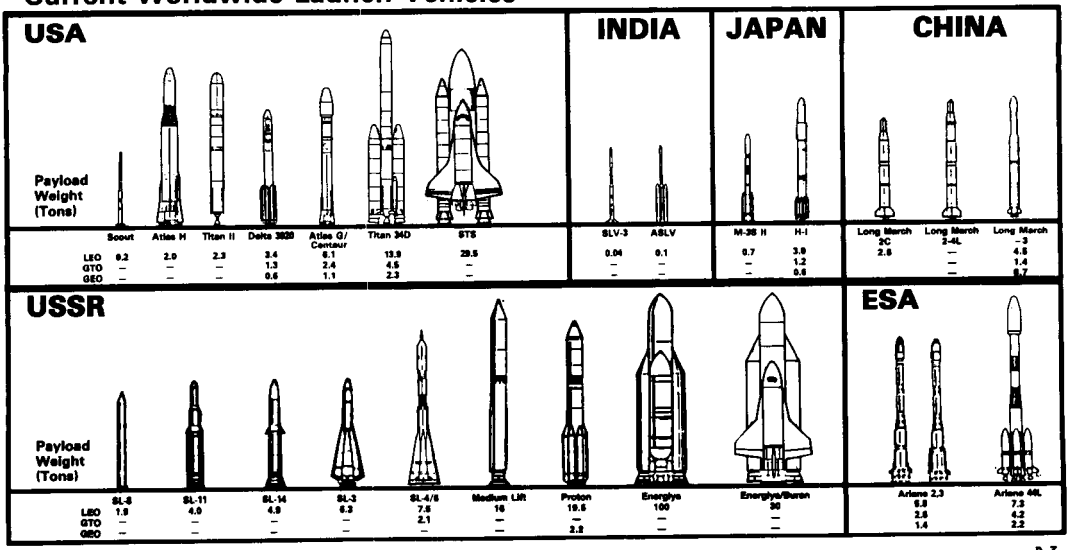
SUMMARY OF NASA LAUNCHES BY VEHICLE (ORBITAL)

	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	TOTAL
Atlas	—	—	—	—	2	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Atlas Agena	—	—	—	—	2	4	0	5	2	9	6	1	0	0	0	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	9
Atlas Centaur	—	—	—	—	—	—	1	1	1	4	4	3	3	0	3	4	3	1	2	3	2	7	2	3	4	2	1	1	3	1	0	0	59
Delta	—	—	—	—	—	—	1	4	7	8	12	7	10	7	5	7	5	7	12	9	9	10	3	3	5	7	7	4	0	1	2	1	153
Juno II	—	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Saturn I	—	—	—	—	—	—	—	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Saturn IB	—	—	—	—	—	—	—	—	—	1	0	2	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Saturn V	—	—	—	—	—	—	—	—	—	—	1	2	4	1	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
Scout	—	—	—	—	2	1	2	6	4	1	2	4	2	2	5	5	1	6	2	2	1	1	3	0	1	0	1	1	2	1	1	4	63
Shuttle	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	3	4	5	9	1	0	2	26
Thor Able	—	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Thor Agena	—	—	—	—	1	0	2	2	2	1	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
Thor Delta	—	—	—	2	3	9	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	21
Titan II	—	—	—	—	—	—	—	1	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
Titan Centaur	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	1	2	0	0	0	0	0	0	0	0	0	0	0	7
Vanguard	—	—	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
TOTAL	—	2	5	5	10	18	11	22	24	31	26	19	21	12	15	18	13	16	19	15	14	20	9	7	13	12	15	12	14	5	3	8	434

SUMMARY OF NASA LAUNCHES BY VEHICLE (SUBORBITAL)

	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	TOTAL
Atlas	—	—	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Atlas Centaur	—	—	—	—	—	—	—	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Little Joe	—	—	3	1	1	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
Redstone	—	—	—	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Saturn I	—	—	—	—	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Saturn IB	—	—	—	—	—	—	—	—	—	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Scout	—	—	—	2	1	1	1	3	0	1	1	2	0	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	16
Thor	—	—	—	—	—	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Titan II	—	—	—	—	—	—	—	—	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL	—	—	4	4	8	5	3	7	2	4	1	2	0	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	44

Current Worldwide Launch Vehicles



	Scout	Atlas H	Titan II	Delta 3920	Atlas G/ Centaur	Titan 34D	STS
LEO	0.2	2.0	2.3	3.4	6.1	13.9	29.5
GTO	–	–	–	1.3	2.4	4.5	–
GEO	–	–	–	0.6	1.1	2.3	–

	SLV-3	ASLV
LEO	0.04	0.1
GTO	–	–
GEO	–	–

	M-3S II	H-I
LEO	0.7	3.9
GTO	–	1.2
GEO	–	0.8

	Long March 2C	Long March 3-4L	Long March -3
LEO	2.6	–	4.5
GTO	–	–	1.4
GEO	–	–	0.7

	SL-8	SL-11	SL-14	SL-3	SL-4/6	Medium Lift	Proton	Energiya	Energiya/Buran
LEO	1.9	4.0	4.9	6.3	7.5	16	19.5	100	30
GTO	–	–	–	–	2.1	–	–	–	–
GEO	–	–	–	–	–	–	2.2	–	–

	Ariane 2,3	Ariane 44L
LEO	5.8	7.3
GTO	2.6	4.2
GEO	1.4	2.2

Summary of Announced Launches

SUMMARY OF WORLDWIDE LAUNCHES

	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	TOTAL
Australia	—	—	—	—	—	—	—	—	—	—	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
DOD	—	5	6	11	19	34	27	35	39	42	32	26	19	17	17	13	10	8	9	11	10	12	7	6	5	6	7	10	3	1	5	4	456
ESA	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0	2	0	2	4	3	2	2	7	23
France	—	—	—	—	—	—	—	—	1	1	2	0	0	2	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	10
India	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	0	1	0	0	0	0	0	3
Israel	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Japan	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	1	0	1	2	1	2	3	2	2	3	1	3	3	2	2	3	2	36
NASA	—	2	5	5	10	18	11	22	24	31	26	19	21	12	15	18	13	16	19	15	14	20	9	7	13	12	15	12	14	5	3	8	434
PRC	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	0	0	0	3	2	0	1	0	0	1	1	1	3	1	2	2	4	23
UK	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
USSR	2	1	3	3	6	20	17	30	48	44	66	74	70	81	83	74	86	81	89	99	98	88	87	89	98	101	98	97	97	91	95	90	2106
TOTAL	2	8	14	19	35	72	55	87	112	118	127	119	110	114	120	106	109	106	125	128	124	124	106	105	123	121	127	129	120	103	110	116	3094

SUMMARY OF NASA LAUNCHES

	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	TOTAL
NASA	—	2	5	5	10	15	9	20	21	26	18	12	13	6	6	9	9	2	10	1	3	8	3	1	4	4	4	6	9	1	0	2	244
Cooperative	—	—	—	—	—	2	0	2	2	0	2	3	2	0	5	1	0	5	1	2	1	2	0	0	0	0	1	0	0	0	0	1	32
DOD	—	—	—	—	—	—	1	0	0	1	0	0	0	0	0	1	1	0	1	2	1	1	2	2	2	0	1	1	2	3	1	4	27
USA	—	—	—	—	—	1	1	0	1	4	6	3	4	4	3	3	2	4	4	8	2	4	3	4	7	6	8	4	3	1	1	1	92
Foreign	—	—	—	—	—	—	—	—	—	—	—	1	2	2	1	4	1	5	3	2	7	5	1	0	0	2	1	1	0	0	1	0	39
TOTAL	—	2	5	5	10	18	11	22	24	31	26	19	21	12	15	18	13	16	19	15	14	20	9	7	13	12	15	12	14	5	3	8	434
Suborbital	—	—	4	4	8	5	3	7	2	4	1	2	0	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	*44

*Includes 3 Cooperative/Reimbursable Launches

Summary Of Worldwide Payloads

SUMMARY OF WORLDWIDE PAYLOADS

	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	TOTAL
ASCO	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	0	0	0	2
Australia	—	—	—	—	—	—	—	—	—	—	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	5
Brazil	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	0	0	2
Canada	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	0	1	0	0	1	0	0	0	2	1	1	1	0	0	0	9
Czechoslovakia	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0	0	0	0	0	0	0	0	0	0	1
ESA	—	—	—	—	—	—	—	—	—	—	—	1	1	0	0	3	0	0	1	0	2	2	1	0	4	0	2	2	1	0	1	2	23
France	—	—	—	—	—	—	—	—	1	1	2	0	0	2	1	1	0	0	5	0	1	0	0	0	0	0	0	1	1	1	0	2	19
France/Germany	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Germany	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0	0	0	1	0	0	0	0	0	0	0	0	2	1	0	0	1	1	7
India	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0	0	0	1	1	3	1	2	0	0	0	0	2	11
Indonesia	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	0	0	0	0	0	1	1	0	0	1	0	5
Israel	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Italy	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0	0	0	0	0	0	0	0	0	0	0	1
Japan	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	1	0	1	2	1	4	4	2	2	3	1	3	3	2	3	3	2	40
Luxembourg	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Mexico	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	0	0	0	2
NASA/Cooperative	—	—	—	—	—	2	0	2	3	0	2	3	2	0	6	1	1	6	1	2	2	2	0	0	1	0	2	0	0	0	0	1	39
NATO	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	0	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	6
PRC	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	0	0	0	3	2	0	1	0	0	3	1	1	3	1	3	1	4	25
Sweden	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0	0	1
United Kingdom	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	0	0	3	0	0	0	0	1	0	1	0	0	2	0	0	0	1	11
USA	—	7	11	17	36	53	54	72	88	102	78	63	51	30	36	28	22	15	26	27	17	29	17	13	19	17	22	32	33	9	9	18	1051
USSR	2	1	3	3	4	20	17	35	66	44	66	74	70	88	96	88	106	95	109	121	104	119	101	110	123	119	115	115	118	114	116	107	2469
TOTAL	2	8	14	20	40	75	71	109	158	147	149	141	125	126	144	123	130	122	150	155	133	160	123	126	157	141	151	162	164	132	133	141	3733

Summary of NASA Payloads

SUMMARY OF NASA ORBITAL PAYLOADS

	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	TOTAL
Manned Flight	—	—	—	—	5	1	0	4	4	12	1	4	4	1	2	2	4	0	1	0	0	0	0	0	2	3	4	5	9	1	0	2	71
Manned	—	—	—	—	3	1	0	0	4	6	1	4	4	1	2	2	3	0	1	0	0	0	0	0	2	3	4	5	9	1	0	2	58
Unmanned	—	—	—	—	2	0	0	4	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
Applications	—	—	—	—	—	—	—	—	—	2	2	2	1	0	0	0	0	1	1	1	0	2	2	0	0	0	0	1	0	0	0	0	15
Communications	—	—	—	1	0	1	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Earth Obs	—	—	—	2	1	3	2	1	2	1	0	0	1	2	0	2	0	0	2	0	0	3	0	0	0	1	0	0	0	0	0	0	23
Bioscience	—	—	—	—	—	—	—	—	—	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Lunar/Planetary	—	2	1	1	2	4	0	4	3	5	5	5	3	0	3	2	2	0	4	0	2	2	0	0	0	0	0	0	0	0	0	0	50
Physics/Astron	—	—	4	1	4	3	3	7	6	4	5	5	4	1	3	3	3	1	4	0	1	2	1	1	3	0	0	1	2	0	0	0	72
L/V Dev	—	—	—	—	—	—	1	1	2	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Space Tech	—	—	—	—	1	1	0	1	3	0	0	0	0	2	0	1	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	12
Tracking	—	—	—	—	—	—	—	—	1	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	9
TOTAL	—	2	5	5	13	13	8	21	21	27	15	17	15	8	9	10	9	2	12	1	3	10	3	1	5	4	6	9	12	1	0	3	270

SUMMARY OF NASA SUBORBITAL PAYLOADS

	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	TOTAL
Manned Flight	—	—	4	2	7	2	3	2	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
Manned	—	—	—	—	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Unmanned	—	—	4	2	5	2	3	2	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
Communications	—	—	—	—	—	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Physics/Astron	—	—	—	—	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
L/V Dev	—	—	—	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Space Tech	—	—	—	—	—	—	—	3	1	1	1	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
TOTAL	—	—	4	4	10	4	3	6	2	4	1	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42

Successful USA And Cooperative Payloads

SUMMARY OF USA PAYLOADS

	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	TOTAL
ASC	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0	0	0	1
AMSAT	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3
AT&T	—	—	—	—	—	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	5
COMSAT	—	—	—	—	—	—	—	—	1	1	3	1	3	3	2	2	1	1	2	6	1	3	0	1	3	2	2	2	3	0	0	1	44
DOD	—	5	6	12	23	39	44	50	66	71	57	43	32	18	24	14	11	8	10	18	12	14	11	8	7	6	8	12	11	5	8	10	663
GTE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	1	0	2	6
Hughes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	3	2	0	0	0	7
NASA	—	2	5	5	13	13	8	21	21	27	15	17	15	8	9	10	9	2	12	1	3	10	3	1	5	4	6	9	12	1	0	3	270
NOAA	—	—	—	—	—	—	—	—	—	3	3	2	1	1	1	1	1	1	1	1	1	1	1	2	2	0	2	2	0	1	1	1	30
N. Utah U.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0	0	0	1
PanAmSat	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
RCA	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	0	0	1	0	1	2	2	0	1	1	0	0	10
SBS	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	0	1	0	0	0	0	4
WU	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	0	0	0	0	1	0	0	2	0	1	0	0	0	0	6
TOTAL	—	7	11	17	36	53	54	72	88	102	78	63	51	30	36	28	22	15	26	27	17	29	17	13	19	17	22	32	33	9	9	18	1051

SUMMARY OF NASA COOPERATIVE PAYLOADS

	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	TOTAL
Canada	—	—	—	—	—	1	0	0	1	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	5
ESA	—	—	—	—	—	—	—	—	—	—	—	2	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	6
France	—	—	—	—	—	—	—	—	1	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	6
Germany	—	—	—	—	—	—	—	—	—	—	—	—	1	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	4
Italy	—	—	—	—	—	—	—	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5
Netherlands	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2
Spain	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
United Kingdom	—	—	—	—	—	1	0	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Naval Res Lab	—	—	—	—	—	—	—	—	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
NOAA	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
TOTAL	—	—	—	—	—	2	0	2	3	0	2	3	2	0	6	1	1	6	1	2	2	2	0	0	1	0	2	0	0	0	0	1	39

Soviet Spacecraft Designations

ASTRON: Ultraviolet telescope jointly designed by the USSR and France.

BURAN (Snowstorm): Reusable orbital space shuttle.

COSMOS: Designation given to many different activities in space.

COSPAS/SARSAT: International search and rescue satellite system.

EKRAN (Screen): Geosynchronous communications satellite for relay of central TV services.

ELEKTRON: Dual satellites to study the radiation belts.

FOTON: Scientific satellite to continue space materials studies.

GORIZONT (Horizon): Geosynchronous communications satellite for international relays.

INTERCOSMOS: "International" scientific satellite.

ISKRA: Amateur radio satellite.

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 domestic communications satellite system.

OKEAN: Oceanographic satellite to monitor ice conditions.

OREOL: Joint Soviet/French scientific satellite to study physical phenomena in the upper atmosphere and the nature of the polar lights.

PHOBOS: International project consisting of two unmanned probes to study Mars and its moon Phobos.

POLYOT: Maneuverable satellite capable of changing orbits.

PROGNOZ (Forecast): Scientific satellite to study interplanetary and interstellar space.

PROGRESS: Unmanned cargo flight to resupply manned space stations.

PROTON: Scientific satellite to investigate the nature of Cosmic Rays and high and super-high energy.

RADIO: Small radio relay satellite for use by amateurs.

RADUGA (Rainbow): Geosynchronous communications satellite for telephone, telegraph, and domestic TV.

SOYUZ (Union): Manned spacecraft for flight in Earth orbit.

SALYUT: Manned scientific space station in Earth orbit.

SPUTNIK: Early series of satellites to develop manned spaceflight.

VENERA: Spacecraft to explore the planet Venus.

VOSKHOD: Adaptation of the Vostok capsule to accommodate two and three Cosmonauts. First EVA performed during Voskhod II flight.

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.

Unofficial Tabulation Of USSR Payloads

	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	TOTAL
Buran	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
Cosmos	--	--	--	--	--	12	12	27	52	34	61	64	55	72	81	72	85	74	85	101	86	96	79	88	94	97	94	94	99	96	97	79	1986
Ekran	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	0	2	2	1	2	2	2	1	1	2	2	19
Electron	--	--	--	--	--	--	--	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Foton	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
Gorizont	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	2	1	0	2	2	2	1	2	1	2	16
Intercosmos	--	--	--	--	--	--	--	--	--	--	--	--	2	2	1	3	2	2	2	2	1	1	2	0	2	0	0	0	0	0	0	0	22
Iskra	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	2	0	0	0	0	0	0	3
Kvant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	1
Luna	--	--	3	0	0	0	1	0	4	5	0	1	1	2	2	1	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	24
Mars	--	--	--	--	--	1	0	0	0	0	0	0	0	0	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Meteor	--	--	--	--	--	--	--	--	--	--	--	--	2	4	4	3	2	5	4	3	4	0	3	2	2	2	1	1	3	1	2	2	50
Mir	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0	1
Molniya	--	--	--	--	--	--	--	--	2	2	3	3	2	5	3	6	8	7	10	7	6	6	5	4	8	5	7	4	8	7	1	7	126
Okran	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
Phobos	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	2
Polyot	--	--	--	--	--	--	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Prognoz	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	1	0	1	1	1	1	0	1	0	0	1	0	1	0	0	0	10
Progress	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	3	4	1	4	2	5	1	2	7	6	39
Proton	--	--	--	--	--	--	--	--	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Radio	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	0	0	6	0	0	0	0	0	0	0	8
Raduga	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	1	1	1	2	3	1	2	2	2	2	2	1	22
Salyut	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	1	2	0	1	1	0	0	0	0	1	0	0	0	0	0	0	7
Soyuz	--	--	--	--	--	--	--	--	--	--	1	2	5	1	2	0	2	3	4	3	3	5	4	6	3	3	2	3	2	2	3	3	62
Sputnik	2	1	0	3	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
Vega	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	0	0	0	0	2
Venera	--	--	--	--	--	--	--	--	2	0	1	0	2	1	0	1	0	0	2	0	0	2	0	0	2	0	2	0	0	0	0	0	15
Vostok	--	--	--	--	--	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Voskhod	--	--	--	--	--	--	--	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Zond	--	--	--	--	--	--	--	2	3	0	0	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
No Designation	--	--	--	--	--	3	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
TOTAL	2	1	3	3	4	20	17	35	66	44	66	74	70	88	96	88	106	95	109	121	104	119	101	110	123	119	115	115	118	114	116	107	2469

NASA Astronauts

Of the 172 astronauts selected in 12 groups from 1959 to 1987, 111 have flown on 58 manned missions; 74 have flown on 27 Shuttle flights; 8 female astronauts have flown on 9 Shuttle flights.

* = Female

NAME	FLIGHT
ALDRIN, Edwin E., Jr.	Gemini XII, Apollo 11
ALLEN, Joseph P.	STS 5, STS 51-A
ANDERS, William A.	Apollo 8
ARMSTRONG, Neil	Gemini VIII, Apollo 11
BEAN, Alan F.	Apollo 12, Skylab 3
BLUFORD, Guion S., Jr.	STS 8, STS 61-A
BOBKO, Karol J.	STS 6, STS 51-D, STS 51-J
BOLDEN, C. F., Jr.	STS 61 C
BORMAN, Frank	Gemini VII, Apollo 8
BRAND, Vance DeVoe	STS 5, STS 41-B, Apollo Soyuz
BRANDENSTEIN, Daniel C.	STS 8, STS 51-G
BRIDGES, Roy D.	STS 51-F
BUCHLI, James F.	STS 51-C, STS 61-A
CARPENTER, M. Scott	Aurora 7
CARR, Gerald P.	Skylab 4
CERNAN, Eugene A.	Gemini IXA, Apollo 10, Apollo 17
CHANG-DIAZ, F. R.	STS 61-C
*CLEAVE, Mary L.	STS 61-B
COATS, Michael L.	STS 41-D
COLLINS, Michael	Gemini X, Apollo 11
COOPER, L. Gordon, Jr.	Faith 7, Gemini V
CONRAD, Charles, Jr., (Pete)	Gemini V, Gemini XI, Apollo 12, Skylab 2
COVEY, Richard O.	STS 51-I, STS-26
CREIGHTON, John O.	STS 51-G

NAME	FLIGHT
CRIPPEN, Robert L.	STS 1, STS 7, STS 41-C, STS 41-G
CUNNINGHAM, Walter	Apollo 7
DUKE, Charles M.	Apollo 16
*DUNBAR, Bonnie	STS 61-A
EISELE, Donn F.	Apollo 7
ENGLAND, Anthony W.	STS 51-F
ENGLE, Joe Henry	STS 2, STS 51-I
EVANS, Ronald R.	Apollo 17
FABIAN, John M.	STS 7, STS 51-G
FULLERTON, Charles G.	STS-3, STS 51-F
*FISHER, Anna L.	STS 51-A
FISHER, William F.	STS 51-I
GARDNER, Dale A.	STS 8, STS 51-A
GARDNER, Guy S.	STS-27
GARRIOTT, Owen K.	Skylab 3, STS 9
GIBSON, Edward G.	Skylab 4
GIBSON, Robert L.	STS 41-B, STS 61-C, STS-27
GLENN, John H., Jr.	Friendship 7
GORDON, Richard F., Jr.	Gemini XI, Apollo 12
GRABE, Ronald J.	STS 51-J
GREGORY, F. D.	STS 51-B
GRIGGS, S. David	STS 51-D
GRISSOM, Virgil I.	Liberty Bell 7, Gemini III

NASA Astronauts

NAME	FLIGHT
HAISE, Fred W.	Apollo 13
HART, Terry J.	STS 41-C
HARTSFIELD, Henry W., Jr.	STS 4, STS 41-D, STS 61-A
HAUCK, Frederick H.	STS 7, STS 51-A, STS-26
HAWLEY, Steven A.	STS 41-D, STS 61-C
HENIZE, Karl G.	STS 51-F
HILMERS, David C.	STS 51-J, STS-26
HOFFMAN, Jeffrey, A.	STS 51-D
IRWIN, James B.	Apollo 15
KERWIN, Joseph P.	Skylab 2
LEETSMA, David D.	STS 41-G
LENOIR, William B.	STS 5
LIND, Don L.	STS 51-B
LOUNGE, John M.	STS 51-I, STS-26
LOUSMA, Jack R.	Skylab 3, STS 3
LOVELL, James A., Jr.	Gemini VII, Gemini XII, Apollo 8, Apollo 13
*LUCID, Shannon W.	STS 51-G
MATTINGLY, Thomas K., II	Apollo 16, STS 4, STS 51-C
McBRIDE, Jon A.	STS 41-G
McCANDLESS, Bruce	STS 41-B
McDIVITT, James A.	Gemini IV, Apollo 9
McNAIR, Ronald E.	STS 41-B, STS 51-L
MITCHELL, Edgar D.	Apollo 14
MULLANE, Richard M.	STS 41-D, STS-27
MUSGRAVE, Story F.	STS 6, STS 51-F
NAGEL, Steven R.	STS 51-G, STS 61-A
NELSON, George D.	STS 41-C, STS 61-C, STS-26

NAME	FLIGHT
O'CONNOR, Bryan D.	STS 61-B
ONIZUKA, Ellison S.	STS 51-C, STS 51-L
OVERMYER, Robert F.	STS 5, STS 51-B
PARKER, Robert A. R.	STS 9
PETERSON, Donald H.	STS 6
POGUE, William R.	Skylab 4
*RESNIK, Judith A.	STS 41-D, STS 51-L
*RIDE, Sally K.	STS 7, STS 41-G
ROOSA, Stuart A.	Apollo 14
ROSS, Jerry L.	STS 61-B, STS-27
SCHIRRA, Walter M., Jr.	Sigma 7, Gemini VI-A, Apollo 7
SCHMITT, Harrison H. (Jack)	Apollo 17
SCHWEICKART, Russell	Apollo 9
SCOBEE, Francis R.	STS 41-C, STS 51-L
SCOTT, David R.	Gemini VIII, Apollo 9, Apollo 15
*SEDDON, Rhea M.	STS 51-D
SHAW, Brewster W.	STS 9, STS 61-B
SHEPARD, Alan B., Jr.	Freedom 7, Apollo 14
SHEPHERD, William M.	STS-27
SHRIVER, Loren J.	STS 51-C
SLAYTON, Donald K.	Apollo Soyuz
SMITH, Michael J.	STS 51-L
SPRING, Sherwood C.	STS 61-B
STAFFORD, Thomas P.	Gemini VI-A, Gemini IXA, Apollo Soyuz, Apollo 10
STEWART, Robert L.	STS 41-B, STS 51-J
*SULLIVAN, Kathryn D.	STS 41-G
SWIGERT, John L., Jr.	Apollo 13

NASA Astronauts

NAME	FLIGHT
THAGARD, Norman E.	STS 7, STS 51-B
THORNTON, William E.	STS 8, STS 51-B
TRULY, Richard H.	STS 2, STS 8
van HOFTEN, James D.	STS 41-C, STS 51-I
WALKER, David M.	STS 51-A
WEITZ, Paul J.	Skylab 2, STS 6
WHITE, Edward H.	Gemini IV
WILLIAMS, Donald E.	STS 51-D
WORDEN, Alfred M.	Apollo 15
YOUNG, John W.	Gemini III, Gemini IX, Apollo 10, Apollo 16, STS 1, STS 9

PAYLOAD SPECIALISTS - Not a NASA Astronaut, Payload Specialists are career scientists or engineers selected by their employer, or country for their expertise in conducting a specific experiment or commercial venture on a Space Shuttle mission.

NAME	FLIGHT
ACTON, Loren W.	STS 51-F
AL-SAUD, Prince Sultan Salman	STS 51-G
BARTOE, John-David	STS 51-F
BAUDRY, Patrick	STS 51-G
CENKER, Roberet J.	STS 61-C
FURRER, Reinhard	STS 61-A
GARN, E. Jake	STS 51-D
GARNEAU, Marc D.	STS 41-G
JARVIS, Gregory	STS 51-L
LICHTENBERG, Byron K.	STS 9
*McAULIFFE, S. Christa	STS 51-L
MERBOLD, Ulf	STS 9
MESSERSCHMID, Ernst	STS 61-A
NELSON, C. William	STS 61-C
NERI-VELA, Rudolpho	STS 61-B
OCKELS, Wubbo	STS 61-A
PAILES, William A.	STS 51-J
PAYTON, Gary E.	STS 51-C
SCULLY-POWER, Paul D.	STS 41-G
van den BERG, Lodewijk	STS 51-B
WALKER, Charles D.	STS 41-D, STS 51-D, STS 61-B
WANG, Taylor	STS 51-B

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. 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. 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.

Summary Of United States Manned Space Flight

MISSION	CREW MEMBERS	MISSION DURATION HR:MIN:SEC	MANHOURS HR:MIN:SEC
MERCURY REDSTONE (Suborbital)			
Freedom 7	Shepard	00:15:22	00:15:22
Liberty Bell 7	Grissom	00:15:37	00:15:37
Total Flights - 2		00:30:59	00:30:59
MERCURY ATLAS (Orbital)			
Friendship 7	Glenn	04:55:23	04:55:23
Aurora 7	Carpenter	04:56:05	04:56:05
Sigma 7	Schirra	09:13:11	09:13:11
Faith 7	Cooper	34:19:49	34:19:49
Total Flights - 4		53:24:28	53:24:28
TOTAL MERCURY - 6 Flights		53:55:27	53:55:27
GEMINI TITAN			
Gemini 3	Grissom, Young	04:53:00	09:46:00
Gemini 4	McDivitt, White	97:56:11	195:52:22
Gemini 5	Cooper, Conrad	190:55:14	381:50:28
Gemini 7	Borman, Lovell	330:35:31	661:11:02
Gemini 6A	Schirra, Stafford	25:51:24	51:42:48
Gemini 8	Armstrong, Scott	10:41:26	21:22:52
Gemini 9A	Stafford, Cernan	72:21:00	144:42:00
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 Flights - 10		969:52:04	1939:44:08

MISSION	CREW MEMBERS	MISSION DURATION HR:MIN:SEC	MANHOURS 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	244:36:25	733:49:15
Apollo 13	Lovell, Swigert, Haise	142:54:41	428:44:03
Apollo 14	Shepard, Roosa, Mitchell	216:01:57	648:05:51
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 - 11		2502:00:37	7506:01:51
SKYLAB SATURN 1B			
Skylab 2	Conrad, Kerwin, Weitz	672:49:49	2018:29:27
Skylab 3	Bean, Garriott, Lousma	1427:09:04	4281:27:12
Skylab 4	Carr, Gibson, Pogue	2017:15:32	6051:46:36
Total Flights - 3		4117:14:25	12351:43:15
APOLLO SATURN IB			
Apollo Soyuz Test Project	Stafford, Brand, Slayton	217:28:23	652:25:09

Summary Of United States Manned Space Flight

MISSION	CREW MEMBERS	MISSION DURATION HR:MIN:SEC	MANHOURS HR:MIN:SEC
SPACE TRANSPORTATION SYSTEM			
STS-1 - Columbia	Young, Crippen	54:20:32	108:41:04
STS-2 - Columbia	Engle, Truly	54:13:13	108:26:26
STS-3 - Columbia	Lousma, Fullerton	192:04:45	384:09:30
STS-4 - Columbia	Mattingly, Hartsfield	169:04:45	338:09:30
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, Hauck, Ride, Fabian, Thagard	146:23:59	731:59:55
STS-8 - Challenger	Truly, Brandenstein, Gardner, Bluford, Thornton	145:08:43	725:43:35
STS-9 - Columbia	Young, Shaw, Garriott, Parker, Lichtenberg, Merbold	247:47:24	1486:44:24
STS 41-B - Challenger	Brand, Gibson, McCandless, McNair, Stewart	191:15:55	956:19:35
STS 41-C - Challenger	Crippen, Scobee, van Hoften, Nelson, Hart	167:40:07	838:20:35
STS 41-D - Discovery	Hartsfield, Coats, Resnik, Hawley, Mullane, C. Walker	144:56:04	869:36:24
STS 41-G - Challenger	Crippen, McBride, Ride, Sullivan, Leestma, Garneau, Scully-Power	197:23:37	1381:45:19
STS 51-A - Discovery	Hauck, D. Walker, Gardner A. Fisher, Allen	191:44:56	958:44:40
STS 51-C - Discovery	Mattingly, Shriver, Onizuka, Buchli, Payton	73:33:27	367:47:15
STS 51-D - Discovery	Bobko, Williams, Seddon, Hoffman, Griggs, Walker, Garn	167:54:00	1175:18:00
STS 51-B - Challenger	Overmyer, Gregory, Lind, Thagard, Thornton, van den Berg, Wang	168:08:47	1177:01:29
STS 51-G - Discovery	Brandenstein, Creighton, Lucid, Fabian, Nagel, Baudry, Al-Saud	169:39:00	1187:33:00
STS 51-F - Challenger	Fullerton, Bridges, Musgrave, England, Henize, Acton, Bartoe	190:45:26	1335:18:02
STS 51-I - Discovery	Engle, Covey, van Hoften, Lounge, W. Fisher	170:27:42	852:18:30
STS 51-J - Atlantis	Bobko, Grabe, Hilmers, Stewart, Pailes	97:14:38	486:13:10
STS 61-A - Challenger	Hartsfield, Nagel, Buchli, Bluford, Dunbar, Ferrer, Messerschmid, Ockels	168:44:51	1349:58:48
STS 61-B - Atlantis	Shaw, O'Connor, Cleave, Spring, Ross, Neri-Vela, C. Walker	165:04:49	1155:33:43
STS 61-C - Columbia	Gibson, Bolden, Chang-Diaz, Hawley, G. Nelson, Cenker, B. Nelson	146:03:51	1022:27:39
STS 51-L - Challenger	Scobee, Smith, Resnik, Onizuka, McNair, Jarvis, McAuliffe	00:01:13	00:08:31
STS-26 - Discovery	Hauck, Covey, Lounge, Hilmers, Nelson	97:00:00	485:00:00
STS-27 - Atlantis	Gibson, Gardner, Mullane Ross, Shepherd	105:06:00	525:30:00
Total Flights - 27		3864:25:52	20979:21:36

Summary Of United States Manned Space Flight

SUMMARY OF UNITED STATES MANNED SPACE FLIGHT

MISSION	NUMBER OF FLIGHTS	NUMBER OF CREW MEMBERS	MISSION DURATION HR:MIN:SEC	MANHOURS HR:MIN:SEC
Mercury Redstone	2	2	00:30:59	00:30:59
Mercury Atlas	4	4	53:24:28	53:24:28
Gemini Titan	10	20	969:52:04	1939:44:08
Apollo Saturn I	1	3	260:09:03	780:27:09
Apollo Saturn V	10	30	2241:51:34	6725:34:42
Skylab	3	9	4117:14:25	12351:43:15
ASTP	1	3	217:28:23	652:25:09
STS	27	142	3864:25:52	20979:21:36
US Total	58	213	11724:56:48	43483:11:26

SPACE SHUTTLE SUMMARY

MISSION	NUMBER OF FLIGHTS	NUMBER OF CREW MEMBERS	MISSION DURATION HR:MIN:SEC	MANHOURS HR:MIN:SEC
Atlantis	3	17	367:25:27	2167:16:53
Challenger	10	60	1495:56:20	8978:10:37
Columbia	7	25	985:48:56	3937:36:17
Discovery	7	40	1015:15:09	5896:17:49
	25	132	3662:19:52	19968:51:36

EXTRAVEHICULAR ACTIVITY (EVA) SUMMARY

MISSION	ASTRONAUT	DURATION HR:MIN
Gemini 4	White	:23
Gemini 9	Cernan	2:08
Gemini 10	Collins	1:30
Gemini 11	Gordon	1:57
Gemini 12	Aldrin	5:37
Apollo 9	Scott	1:01
	Schweickart	1:07
Apollo 11	Armstrong*	2:32
	Aldrin*	2:15
Apollo 12	Conrad*	7:45
	Bean*	7:45
Apollo 14	Shepard*	9:23
	Mitchell*	9:23
Apollo 15	Worden	:39
	Scott*	19:08
	Irwin*	18:35
Apollo 16	Mattingly	1:24
	Young*	20:14
	Duke*	20:14
Apollo 17	Evans	1:06
	Cernan*	22:04
	Schmitt*	22:04
Skylab 2	Conrad	5:51
	Kerwin	3:30
	Weitz	1:44
Skylab 3	Bean	2:45
	Garriott	13:44
	Lousma	10:59
Skylab 4	Carr	15:48
	Gibson	15:20
	Pogue	13:34
STS-6	Musgrave	3:54
	Peterson	3:54
STS 41-B	McCandless	11:37
	Stewart	11:37
STS 41-C	Nelson	10:06
	van Hoften	10:06
STS 41-G	Leestma	3:29
	Sullivan	3:29
STS 51-A	Allen	12:14
	Gardner	12:14
STS 51-D	Griggs	3:10
	Hoffman	3:10
STS 51-I	van Hoften	4:31
	W. Fisher	4:31
STS 61-B	Spring	12:12
	Ross	12:12

* Lunar Surface EVA

Summary Of Shuttle Payloads And Experiments

FLIGHT	LAUNCH DATE	LANDING DATE	CREW	PAYLOADS AND EXPERIMENTS
STS-1 (Columbia) Mission Duration: 54 hrs 20 min 32 sec	Apr 12, 1981 (KSC)	Apr 14, 1981 (DFRF)	Cdr: John W. Young Plt: Robert L. Crippen	Development Flight Instrumentation (DFI) Passive Optical Sample Assembly (POSA) Aerodynamic Coefficient Identification Package (ACIP)
STS-2 (Columbia) Mission Duration: 54 hrs 13 min 13 sec	Nov 12, 1981 (KSC)	Nov 14, 1981 (DFRF)	Cdr: Joe Henry Engle Plt: Richard H. Truly	OSTA-1 Development Flight Instrumentation (DFI) Induced Environment Containment Monitor (IECM) Aerodynamic Coefficient Identification Package (ACIP) OEX Tile Gap Heating Effects OEX Catalytic Surface Effects OEX Dynamic, Acoustic, and Thermal Environment (DATE) Experiment
STS-3 (Columbia) Mission Duration: 192 hrs 4 min 45 sec	Mar 22, 1982 (KSC)	Mar 30, 1982 (White Sands)	Cdr: Jack R. Lousma Plt: Charles G. Fullerton	OSS-1 Monodisperse Latex Reactor (MLR) Experiment Electrophoresis Equip. Verification Test (EEVT) Tile Gap Heating Effects Experiment Catalytic Surface Effects Experiment Dynamic, Acoustic, and Thermal Environment (DATE) Experiment Development Flight Instrumentation (DFI) Induced Environment Containment Monitor (IECM) Aerodynamic Coefficient Identification Package (ACIP) Get-Away Special (GAS) Test Canister Student Experiment - Insects in Flight Motion Study

Summary Of Shuttle Payloads And Experiments

FLIGHT	LAUNCH DATE	LANDING DATE	CREW	PAYLOADS AND EXPERIMENTS
STS-4 (Columbia) Mission Duration: 169 hrs 4 min 45 sec	Jun 27, 1982 (KSC)	Jul 4, 1982 (DFRF)	Cdr: Thomas K. Mattingly II Plt: Henry W. Hartsfield, Jr.	DOD Payload - 82-1 Monodisperse Latex Reactor (MLR) Experiment - NASA Continuous Flow Electrophoresis System (CFES - NASA Tile Gap Heating Effects Experiment - NASA Catalytic Surface Effects Experiment - NASA Dynamic, Acoustic, and Thermal Environment (DATE) Exp - NASA Development Flight Instrumentation (DFI) - NASA Induced Environment Containment Monitor (IECM) - NASA Aerodynamic Coefficient Identification Package (ACIP) - NASA Get-Away Special - *Utah State University* Student Experiments: Effects of Diet/Exercise/Zero Gravity on Lipoprotein Profiles Effects of Space Travel on Trivalent Chrominum in the Body
STS-5 (Columbia) Mission Duration: 122 hrs 14 min 26 sec	Nov 11, 1982 (KSC)	Nov 16, 1982 (DFRF)	Cdr: Vance DeVoe Brand Plt: Robert F. Overmyer MS: Joseph P. Allen MS: William B. Lenoir	Deployed: SBS-C - Satellite Business Systems Telesat-E -Telesat Canada, Ltd. Tile Gap Heating Effects Experiment - NASA Catalytic Surface Effects Experiment - NASA Dynamic, Acoustic, and Thermal Environment (DATE) Exp - NASA Atmospheric Luminosities Investigation (Glow Experiment) - NASA Development Flight Instrumentation (DFI) - NASA Aerodynamic Coefficient Identification Package (ACIP) - NASA Get-Away Special - ERNO, West Germany Student Experiments: Formation of Crystals in Weightlessness Growth of Porifera in Zero-Gravity Convection in Zero-Gravity

Summary Of Shuttle Payloads And Experiments

FLIGHT	LAUNCH DATE	LANDING DATE	CREW	PAYLOADS AND EXPERIMENTS
STS-6 (Challenger)	Apr 4, 1983 (KSC)	Apr 9, 1983 (DFRF)	Cdr: Paul J. Weitz Plt: Karol J. Bobko MS: Donald H. Peterson MS: Story Musgrave	Deployed: TDRS-A/IUS - Spacecom/USAF Continuous Flow Electrophoresis System (CFES) - NASA Monodisperse Latex Reactor (MIR) - NASA Nighttime/Daytime Optical Survey of Lightning (NOSL) - NASA Aerodynamic Coefficient Identification Package (ACIP) - NASA Get-Away Specials: G-005 - Asahi Shimban, Japan G-049 - USAF Academy G-381 - Park Seed Company, South Carolina
Mission Duration: 120 hrs 23 min 42 sec				
STS-7 (Challenger)	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	Deployed: Telesat-F (ANIK C-2)/PAM-D - Telesat, Canada Palapa-B1/PAM-D - Perumtel, Indonesia Shuttle Pallet Satellite (SPAS-01) - MBB, Germany OSTA-2 - NASA Continuous Flow Electrophoresis System (CFES) - NASA Monodisperse Latex Reactor (MIR) - NASA Get-Away Specials: G-002 - Kayser Threde, West Germany G-009 - Purdue University G-012 - RCA/Camden New Jersey Schools G-033 - California Institute of Technology G-088 - Edsyn, Inc. G-305 - USAF/NRL G-345 - GSFC/NRL
Mission Duration: 146 hrs 23 min 59 sec				

Summary Of Shuttle Payloads And Experiments

FLIGHT	LAUNCH DATE	LANDING DATE	CREW	PAYLOADS AND EXPERIMENTS
STS-8 (Challenger) Mission Duration: 145 hrs 8 min 43 sec	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, MD	Deployed: INSAT-1B/PAM-D - India Payload Flight Test Article (PFTA) - NASA Radiation Monitoring Equipment (RME) - NASA Heat Pipe - NASA Oxy. Interaction on Materials (OIM)- NASA Investigation of STS Atmospheric Luminosities (ISAL) - NASA Animal Enclosure - NASA Continuous Flow Electrophoresis System (CFES) - NASA/MDAC Modular Auxiliary Data System (MADS) - NASA Aerodynamic Coefficient Identification Package (ACIP) - NASA Get-Away Specials: G-0346 - Cosmic Ray Upset Experiment (CRUX) -GSFC/Neupert G-0347 - Photographic Film Evaluation Exp - GSFC/Adolphsen G-0348 - Contamination Monitor - GSFC/McIntosh G-0475 - Asahi/Shimban, Japan Student Experiment - Biofeedback SE81-1 Other - Postal Covers
STS-9 (Columbia) Mission Duration: 247 hrs 47 min 24 sec	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 (ESA)	Spacelab-1 (Long Module) + Pallet - ESA/NASA Spacelab Attach Hardware, TK. set, Misc - ESA/NASA STS Operator - NASA

Summary Of Shuttle Payloads And Experiments

FLIGHT	LAUNCH DATE	LANDING DATE	CREW	PAYLOADS AND EXPERIMENTS
STS 41-B (Challenger)	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	Deployed: Westar VI/PAM-D - Western Union Palapa-B2/PAM-D - Indonesia Integrated Rendezvous Target (IRT) - NASA Acoustic Containerless Experiment System (ACES) - NASA-OSSA/JSC SPAS-01A - MBB, Germany Isoelectric Focusing Experiment (IEF) - NASA-OSSA/MSFC Radiation Monitoring Equipment (RME) - NASA Monodisperse Latex Reactor (MLR) - NASA/OSSA Cinema 360 - Cinema 360, Inc. Manned Maneuvering Unit (MMU) - NASA Manipulation Foot Restraint (MFR) - NASA Cargo Bay Storage Assembly (CBSA) - NASA Get-Away Specials: G004 - Utah State University/Aberdeen University G008 - AIAA/Utah State Univ/Brighton High School G051 - Arc Discharge Lamp Test - GTE Laboratories, Inc. G309 - CRUX - Air Force Space Test Program G349 - Goddard Space Flight Center Student Experiment - SE81-40 - Arthritis, Dan Weber - Pfizer/GD
Mission Duration: 191 hrs 15 min 55 sec				
STS 41-C (Challenger)	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	Deployed: Long Duration Exposure Facility (LDEF-1) - NASA/Langley Solar Max Mission Flight Support System - NASA/GSFC Manned Maneuvering Unit Flight Support System - NASA Manned Foot Restraint - NASA Cinema 360 - Cinema 360, Inc. IMAX - IMAX/NASA Radiation Monitoring Experiment (RME) - NASA Student Experiment - Honeycomb construction by bee colony
Mission Duration: 167 hrs 41 min				

Summary Of Shuttle Payloads And Experiments

FLIGHT	LAUNCH DATE	LANDING DATE	CREW	PAYLOADS AND EXPERIMENTS
STS 41-D(Rev) (Discovery) Mission Duration: 144 hrs 56 min 4 sec	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	Deployed: SBS-D/PAM-D - Satellite Business Systems Syncom IV-2/Unique Upper Stage - Hughes Comm. Service, Inc. Telstar 3-C/PAM-D - AT&T Co. OAST-1/MPESS - NASA CFES III (Cont. Flow Electp. Sys.) - MDAC IMAX - IMAX RME (Radiation Monitor Exp.) - NASA Clouds Photo Experiment - USAF Student Experiment - SE82-14 - Murphy/RI
STS 41-G (Challenger) Mission Duration: 197 hrs 23 min 37 sec	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	Deployed: Earth Radiation Budget Satellite (ERBS) - NASA OSTA-3/Pallet - NASA LFC/ORS/MPESS - NASA IMAX - IMAX RME (Radiation Monitor Exp.) - NASA APE (Auroral Photog. Exp.) - USAF TLD (Thermo. Lum. Dosimeter) - Hungary CANEX (Canadian Experiment) - Canada Get-Away Specials: G007 - Stud. Exp., Radio Trans. Exp. - Ala. Space & Rocket Cntr G013 - Halogen Lamp Ex. (HALEX) - Kayser-Threde/ESA G032 - Physics of Solids/Liquids - Asahi Corp., Japan G038 - Vapor Deposition - McShane/MSFC G074 - Fuel System Test - MDAC G306 - Trapped Ions in Space - Naval Res Lab/USNA G469 - Cosmic Ray Upset Exp. - NASA/GSFC/IBM G518 - Physics and Mat'l Process. - Utah State U.

Summary Of Shuttle Payloads And Experiments

FLIGHT	LAUNCH DATE	LANDING DATE	CREW	PAYLOADS AND EXPERIMENTS
STS 51-A (Discovery) Mission Duration: 191 hrs 44 min 56 sec	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	Deployed: Telesat-H/PAM-D - Telesat, Canada Syncom IV-1/Unique Upper Stage - Hughes Comm. Services, Inc. Satellite Retrieval Pallets (2) - NASA/MDAC MMU/PSS (2) - NASA Diffuse Mixing of Organic Solids (DMOS) - 3M Co. Radiation Monitoring Equipment (RME) - NASA Man. Foot Restraint (MFR) -NASA
STS 51-C (Discovery) Mission Duration: 73 hrs 33 min 27 sec	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	Deployed: DOD/Inertial Upper Stage - DOD Aggregation of Red Cells (ARC) Mid-deck Exp. - Univ. of Sydney
STS 51-D (Discovery) Mission Duration: 167 hrs 54 min	Apr 12, 1985 (KSC)	Apr 19, 1985 (KSC)	Cdr: Karol J. Bobko (USAF) Plt: Donald E. Williams (USN) PS: Charles D. Walker (MDAC) PS: E. J. Garn (Senator) MS: M. Rhea Seddon (MD) MS: S. David Griggs (NAR) MS: Jeffrey A. Hoffman (PhD)	Deployed: Telesat-I/PAM-D - Telesat Canada, Ltd Syncom IV-3/UUS - Hughes Comm. Services, Inc. American Flight Echocardiograph - NASA Continuous Flow Electrophoresis Sys. (CFES III) - MDAC/NASA Image Intensifier Investigation - NASA Informal Science Study (Toys in Space) - Houston Museum/Nat. Sci. Phase Partitioning Experiment (PPE) - NASA Get Away Specials (GAS): G035 - Physics of Solids & Liquids - Asahi, Japan G471 - Cap. Pump Loop Experiment - GSFC Student Experiments: SE 82-03 - Statoliths in Corn Rt Caps - Amberg/Martin Marietta SE 83-03 - Effect of Weightlessness on Aging of Brain Cells - Fras/USC/LA Orthopaedic Hospital Other - Statute of Liberty Replicas (2)

Summary Of Shuttle Payloads And Experiments

FLIGHT	LAUNCH DATE	LANDING DATE	CREW	PAYLOADS AND EXPERIMENTS
STS 51-B (Challenger)	Apr 29, 1985 (KSC)	May 6, 1985 (DFRF)	Cdr: R. F. Overmyer (USMC) Plt: F. D. Gregory (USAF) MS: Don L. Lind (PhD) MS: Norman E. Thagard (MD) MS: Wm. E. Thornton (MD) PS: Lodewijk Vandenberg (PhD) PS: Taylor Wang (PhD)	Deployed: NUSAT - Northern Utah University Spacelab 3 (LM + MPESS) - NASA/ESA GLOMR - DOD
Mission Duration: 168 hrs 8 min 47 sec				
STS 51-G (Discovery)	Jun 17, 1985 (KSC)	Jun 24,1985 (EDW)	Cdr: Daniel Brandenstein (USN) Plt: John O. Creighton (USN) MS: John M. Fabian (USAF) MS: Steven R. Nagel (USAF) MS: Shannon W. Lucid (PhD) PS: Patrick Baudry (France) PS: Prince Sultan Salman Al-Saud (Saudi Arabia)	Deployed: Morelos-A/PAM-D - Mexico Arabsat-A/PAM-D - ASCO Telstar 3-D/PAM-D - AT&T Spartan-1/MPESS - NASA/GSFC/NRL Fr. Echocardiograph Exp (FEE) - CNES, France Fr. Postural Exp. (FPE) - CNES, France Auto. Dir. Solid. Furn (ADSF) - NASA/MSFC High-Prec. Track. Exp. (HPTE) - USAF Getaway Specials (GAS): G025 - Dyn. Behavior of Liq. Props.- W.Germany G027 - *Slipcasting under Micro-G - W.Germany* G028 - Func'l Study of MnBi - W.Germany G034 - Bio/Phys. Sci. Stud. Exp. - El Paso/Ysleta, TX G314 - Space Ultra. Rad. Env. (SURE) - USAF/NRL G471 - Cap. Pump Loop Exp. - GSFC
Mission Duration: 169 hrs 39 min				

Summary Of Shuttle Payloads And Experiments

FLIGHT	LAUNCH DATE	LANDING DATE	CREW	PAYLOADS AND EXPERIMENTS
STS 51-F (Challenger) Mission Duration: 190 hrs 45 min 26 sec	Jul 29, 1985 (KSC)	Aug 6, 1985 (EDW)	Cdr: Chas. Fullerton (USAF) Plt: Roy D. Bridges (USAF) MS: F. Story Musgrave (M.D.) MS: Anthony W. England (PhD) MS: Karl G. Henize (PhD) PS: Loren W. Acton (Lockheed) PS: John-David Bartoe (USN)	Deployed: Plasma Diagnostics Package - NASA Spacelab-2 - NASA/ESA Shuttle Amateur Radio Experiment - AMSAT Space Life Sciences Training Program - NASA
STS 51-I (Discovery) Mission Duration: 170 hrs 27 min 42 sec	Aug 27, 1985 (KSC)	Sep 3, 1985 (EDW)	Cdr: Joe H. Engle (USAF) Plt: Richard O. Covey (USAF) MS: James van Hoften (PhD) MS: John M. Lounge MS: William F. Fisher (MD)	Deployed: AUSSAT-1/PAM-D - Australia ASC-1/PAM-D - American Satellite Co. SYNCOM IV-4/UNO - Hughes Comm Services, Inc. Physical Vapor Transport of Organic Solids (PVTOS) - 3M Corp SYNCOM IV-3 Repair Equipment - NASA/Hughes
STS 51-J (Atlantis) Mission Duration: 97 hrs 14 min 38 sec	Oct 3, 1985 (KSC)	Oct 7, 1985 (EDW)	Cdr: Karol Bobko (USAF) Plt: Ronald J. Grabe (USAF) MS: Robert C. Stewart (USA) MS: David C. Hilmers (USMC) PS: William A. Pailes (USAF)	DOD Mission
STS 61-A (Challenger) Mission Duration: 168 hrs 44 min 51 sec	Oct 30, 1985 (KSC)	Nov 6, 1985 (EDW)	Cdr: Henry Hartsfield (USAF) Plt: Steven Nagel (USAF) MS: Bonnie Dunbar (PhD) MS: James Buchli (USMC) MS: Guion Bluford (USAF) PS: Ernst Messerschmid (PhD, German) PS: Reinhard Furrer (PhD, German) PS: Wubbo Ockels (PhD, Dutch)	Deployed: GLOMR GAS - DOD Spacelab D-1 (Long Module + Unique Support Structure) - DFVLR Material Experiment Assembly (MEA) - NASA

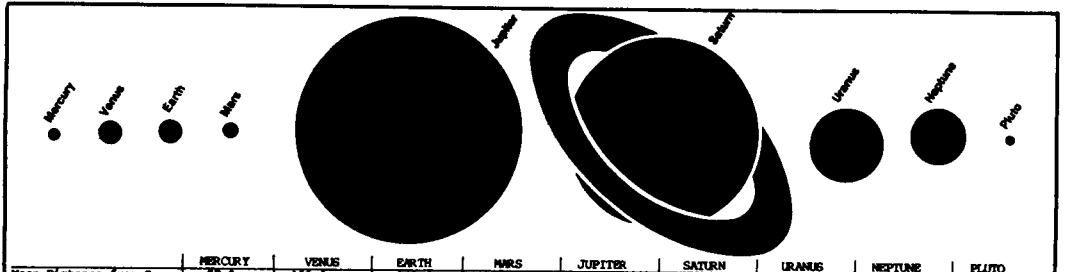
Summary Of Shuttle Payloads And Experiments

FLIGHT	LAUNCH DATE	LANDING DATE	CREW	PAYLOADS AND EXPERIMENTS
STS 61-B (Atlantis) Mission Duration: 165 hrs 4 min 49 sec	Nov 26, 1985 (KSC)	Dec 3, 1985 (EAFB)	Cdr: Brewster H. Shaw (USAF) Plt: Bryan D. O'Connor (USMC) MS: Mary L. Cleave (PhD) MS: Sherwood C. Spring (USA) MS: Jerry L. Ross (USAF) PS: Rudolfo Neri Vela (PhD) PS: Charles Walker (MDAC)	Deployed: Morelos-B/PAM-D - Mexico Aussat-2/PAM-D - Australia Satcom KU-2/PAM-DII - RCA OEX Target - NASA EASE/ACCESS/MPESS - NASA/MIT IMAX Payload Bay Camera - IMAX/NASA Continuous Flow Electrophoresis Sys (CFES III) - MDAC/3M/NASA Diffusive Mixing of Organic Solutions (DMOS) - 3M Company Morelos Payload Specialist Experiments (MPSE) - Mexican Gov't Getaway Special: G479 - Primary Surface Mirrors/Metallic Crys (Telesat, Canada)
STS 61-C (Columbia) Mission Duration: 146 hrs 3 min 51 sec	Jan 12, 1986 (KSC)	Jan 18, 1986 (KSC)	Cdr: Robert L. Gibson (USN) Plt: C. F. Bolden, Jr. (USMC) MS: F R. Chang-Diaz (PhD) MS: George D. Nelson (PhD) MS: Steven A. Hawley (PhD) PS: Robert J. Cenker (RCA) PS: C. William Nelson (Cong)	Deployed: SATCOM KU-1/PAM-D2 - RCA Materials Science Lab (MSL-2) - NASA Hitchhiker G-1 (HHG-1) - NASA GAS Bridge Assembly (12 GAS cans) - NASA Getaway Special (G-470) - Dept. of Agriculture Infrared Imaging Experiment (IR-IE) - NASA Initial Blood Storage Experiment (IBSE) - NASA Comet Halley Active Monitoring Program (CHAMP) - NASA Shuttle Student Involvement Program (SSIP) - NASA
STS 51-L (Challenger) Mission Duration: 73 sec	Jan 28, 1986 (KSC)	Jan 28, 1986	Cdr: Francis R. Scobee (USAF) Plt: Michael J. Smith (USN) MS: Judith A. Resnik (PhD) MS: Ellison S. Onizuka (USAF) MS: Ronald E. McNair (PhD) PS: Gregory Jarvis (Hughes) PS: S. Christa McAuliffe (Teacher)	TDRS-B/IUS - NASA/Spacecom Spartan-Halley/MPESS - NASA/U. of Col. Comet Halley Active Monitor Prog (CHAMP) - NASA/Lockheed/U.Col. Fluid Dynamics Experiment (FDE) - Hughes Radiation Monitoring Experiment (RME) - NASA Phase Partitioning Experiment (PPE) - NASA Teacher in Space Project (TISP) - NASA Shuttle Student Involvement Program (SSIP) - NASA

Summary Of Shuttle Payloads And Experiments

FLIGHT	LAUNCH DATE	LANDING DATE	CREW	PAYLOADS AND EXPERIMENTS
STS-26 (Discovery) Mission Duration 97 hrs	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	Deployed: TDRS-C - TRW CONTEL/NASA Inertial Upper Stage (IUS) - Boeing/USAF/NASA Orbiter Exp Auto Support Ins Sys (OASIS) - Lockheed/USAF/NASA Automated Directional Solidification Furnace (ASDF) - NASA Aggregation of Red Blood Cells (ARC) - NASA Earth Limb Radiance Experiment (ELRAD) - NASA Isoelectric Focusing Experiment (IEF) - NASA Infrared Communication Flight Exp (IRCFE) - Wilton Ind./NASA Mesoscale Lightning Exp (MLE) - NASA Protein Crystal Growth (PCG) - U of Alabama/NASA Phased Partitioning Experiment (PPE) - NASA Physical Vapor Transport of Organic Solids (PVTOS) - 3M/NASA Shuttle Student Involvement Projects: SSIP 82-4 - MDAC/Lloyd Bruce SSIP 82-5 - Union College/R. Caboli
STS-27 (Atlantis) Mission Duration 10 hrs 6 mins	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	Deployed: DOD Payload - DOD

The Planets



	MERCURY	VENUS	EARTH	MARS	JUPITER	SATURN	URANUS	NEPTUNE	PLUTO
Mean Distance from Sun (Million of Kilometers)	57.9	108.2	149.6	227.9	778.3	1,427	2,870	4,497	5,900
Period of Revolution	88 days	224.7 days	365 days	687 days	11.86 yrs	29.46 yrs	84 yrs	165 yrs	248 yrs
Rotation Period	59 days	243 days Retrograde	23 hrs 56 mins	24 hrs 37 mins	9 hrs 55 mins	10 hrs 40 mins	17.2 hrs Retrograde	18 hrs 30 mins (?)	6 days 9 hrs 18 mins Retrograde
Inclination of Axis	Near 0°	3°	23°27'	25°12'	3°5'	26°44'	97°55'	28°48'	?
Inclination of Orbit to Ecliptic	7°	3.4°	0°	1.9°	1.3°	2.5°	0.8°	1.8°	17.2°
Eccentricity of Orbit	.206	.007	.017	.093	.048	.056	.047	.009	.254
Equatorial Diameter (Kilometers)	4,880	12,100	12,756	6,794	143,200	120,000	51,800	49,500 (?)	3,000 (?)
Atmosphere (Main Components)	Virtually None	Carbon Dioxide	Nitrogen Oxygen	Carbon Dioxide	Hydrogen Helium	Hydrogen Helium	Helium Hydrogen Methane	Hydrogen Helium Methane	None Detected
Satellites	0	0	1	2	16	21	15	2	1
Rings	0	0	0	0	1	1,000 (?)	11 (?)	?	?

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 Canopus not acquired; did not encounter Mars. Entered solar orbit.
Mariner 4	Mars Flyby	Nov 28, 1964	Jul 14, 1965	Provided first close-range pictures of Martian surface. 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 18, 1971	Mapped the whole planet; provided detailed photos of Phobos and Deimos. Craft 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.
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.

USA Planetary Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
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 on March 24, 1975, when attitude control gas was depleted. Craft 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. Orbiter 1 operated until August 7, 1980, when it used the last of its attitude control gas. Lander 1, ceased operating on November 13, 1983.
Viking 2	Mars Orbiter and Lander	Sep 9, 1975	Aug 7, 1976 (in orbit) Sep 3, 1976 (landed)	Landed on Plain of Utopia. Discovered water frost on the surface at the end of the Martian winter. 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 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. Neptune encounter planned for August 1989. The spacecraft will then continue into interstellar space.
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.

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 lost during flight; 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 attempt at Mars trajectory from Earth parking orbit.
Zond 1	Venus Probe	Apr 2, 1964		Communications lost; spacecraft went into solar orbit.
Zond 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.
Venera 5	Venus Probe	Jan 5, 1969	Mar 16, 1969	Entry velocity was reduced by atmospheric braking before deployment of main parachute. Capsule entered the atmosphere on the planet's dark side; transmitted data for 53 minutes while traveling into the atmosphere before being crushed.

USSR Planetary Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
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 canopy 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 orbiter 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	Lander separated from parent capsule and landed in the southern hemisphere. A TV camera transmitted 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.
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; as it passed the planet, it returned one swath of pictures and some radio occultation data. Mars 5 was successfully placed in orbit, but only operated only a few days. Returned photographs showing small portion of southern hemisphere.

USSR Planetary Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
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 measurements of the Martian atmosphere during descent. Telemetry ceased abruptly when the landing rockets were fired. Soviet report of Mars 7 said "the descent module was separated from the station because of a hitch in the operation of one of the onboard system, 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 hours 53 minutes.
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 orbiter. Transmitted pictures from the surface.
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.
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 127 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.

USSR Planetary Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Vega 1 & 2	Venus/Halley	Dec 15, 1984 Dec 21, 1984	Jun 11, 1985 (Venus) Mar 6, 1985 (Halley) Jun 15, 1985 (Venus) Mar 9, 1985 (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) Apr 1989 (Phobos) Jan 1989 (Mars) Apr 1989 (Phobos)	International two-spacecraft project to study Mars and its moon Phobos. Phobos 1 was disabled by a ground controller error. Phobos 2 will enter Mars orbit in January 1989 to study the Martian surface, atmosphere, and magnetic field. In May, the spacecraft will be lowered to within 100 feet of Phobos' surface, where a lander will be released to analyze soil samples. Other instruments include a TV scanner, radio sounder, and laser to examine samples of Phobos' surface.

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 cutoff 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.
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	Rough 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	Rough 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 Moon.
Ranger 5	Rough 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 Moon; entered solar orbit.

USA Lunar Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Ranger 6	Lunar Photo	Jan 30, 1964	Feb 2, 1964	TV cameras failed; no data returned. Impacted in 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 Sea of Clouds area.
Ranger 8	Lunar Photo	Feb 17, 1965	Feb 20, 1965	Transmitted high quality photographs before impacting in Sea of Tranquility area.
Ranger 9	Lunar Photo	Mar 21, 1965	Mar 24, 1965	Transmitted high quality photographs before impacting in 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 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 Ranger 8 landing point, and surface debris tossed out at impact. Impacted Moon on Oct 11, 1967.
Lunar Orbiter 3	Lunar Orbiter	Feb 4, 1967	Feb 8, 1967	Photographed lunar landing sites; provided gravitational field and lunar environment data. Impacted Moon on October 9, 1967.

USA Lunar Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
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 first pictures of the lunar south pole. Impacted the Moon on October 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 some stereo pictures of the surface and of rocks that were of special interest. Provided first observation of artificial light from Earth.

USSR Lunar Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Luna 1	Lunar Impact	Jan 2, 1959		Intended to impact on the Moon; carried instruments for measuring radiation. Passed the Moon and went into solar orbit. This was only Russia's 4th space launch.
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 the Moon and send back pictures of the far side. Equipped with a TV processing and transmission system, returned pictures of far side including a composite full view of the far side. Reentered April 29, 1960.
Sputnik 25	Lunar Probe	Jan 4, 1963		Unsuccessful lunar attempt.
Luna 4	Lunar Orbiter	Apr 2, 1963		Attempt to solve problems of soft landing instrument containers. Contact lost as it passed by the Moon. Barycentric orbit.
Luna 5	Lunar Lander	May 9, 1965	May 12, 1965	First soft landing attempt. Retrorocket malfunctioned; spacecraft impacted in Sea of Clouds.
Luna 6	Lunar Lander	Jun 8, 1965		During midcourse correction maneuver, engine failed to switch off. Spacecraft missed the Moon and went into solar orbit.
Zond 3	Lunar Probe	Jul 18, 1965		Photographed lunar far side and transmitted them 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.
Luna 9	Lunar Lander	Jan 31, 1966	Feb 3, 1966	First successful soft landing; first TV transmission from the 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.

USSR Lunar Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
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.
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.

USSR Lunar Space Flights

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
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 and 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.
Luna 20	Lunar Sample Return	Feb 14, 1972		Soft landed in Sea of Crises. Used "photo-telemetric device" to relay pictures of the 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 February 25, 1972.
Luna 21	Lunar Rover	Jan 8, 1973	Jan 15, 1973	Carrying improved equipment and additional instruments, the second Lunokhod rover soft landed on the edge of the Sea of Serenity. Lunar surface pictures were transmitted and experiments performed. Ceased operating on the 5th lunar day.
Luna 22	Lunar Orbiter	May 29, 1974	Jun 2, 1974	Initially placed in circular lunar orbit; orbit was lowered to obtain TV panoramas of high quality and good resolution. Simultaneously, altimeter readings were taken and chemical rock composition 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 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.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
1958								**1958**
Pioneer I (U) Eta I	Thor Able I (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 (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) Theta 1	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	123.8	3140	558	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 Mar 4, 1959.
Vanguard (U) (SLV-5) (U)	Vanguard	Apr 13		DID NOT ACHIEVE ORBIT			10.6	Payload consisted of two independent spheres: A contained precise magnetometer to map Earth's magnetic field, 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.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Explorer 6 (S-2) (S) Delta 1	Thor-Able (S)	Aug 7		DOWN PRIOR TO JULY 1961			64.4	Carried instruments to study particles and meteorology. It 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 (S)	Sep 9		SUBORBITAL FLIGHT				Suborbital test of the Mercury Capsule. Capsule recovered successfully after reentry test.
Vanguard III (S) ETA 1	Vanguard (SLV-7) (S)	Sep 18	127.6	3521	514	33.4	45.4	Solar-powered magnesium sphere with magnetometer boom; provided a comprehensive survey of the Earth's magnetic field, surveyed location of lower edge of Van Allen radiation belts, and provided an accurate count of micrometeorite impacts. Last transmission Dec 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	99.7	946	538	50.3	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 (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 (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.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
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.
Tiros I (S) Beta 2	Thor-Able (S)	Apr 1	98.7	717	673	48.4	122.5	First successful weather-study satellite. Demonstrated that satellites can 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. Vehicle broke up after first-stage burnout.
Echo A-10 (U)	Thor-Delta (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 (S)	Jul 1		SUBORBITAL FLIGHT				Launch Vehicle Development Test; first complete Scout vehicle. (WFF)
Mercury (MA-1) (U)	Atlas (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 (S)	Aug 12		DOWN MAY 24, 1968			75.3	First passive communications satellite (100-foot sphere). Reflected a pre-taped radio message from President Eisenhower across the Nation, demonstrating feasibility of global radio communications via satellite.
Pioneer (P-30) (U)	Atlas-Able (U)	Sep 25		DID NOT ACHIEVE ORBIT			175.5	Highly instrumented probe, in lunar orbit, to investigate the environment between the Earth and Moon. Second stage failed due to malfunction in oxidizer system.
Scout II (S)	Scout (S)	Oct 4		SUBORBITAL FLIGHT				Launch Vehicle Development Test; second complete Scout vehicle, reached altitude of 3,500 mi. (WFF)
Explorer 8 (S-30) (S) Xi 1	Juno II (S)	Nov 3	106.1	1689	405	49.9	40.8	Contained instrumentation for detailed measurements of the ionosphere. Confirmed 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 (S)	Nov 23	97.2	668	583	48.5	127.0	Test of experimental television techniques and infrared equipment for global meteorological information system.
Explorer (S-56) (U)	Scout (U)	Dec 4		DID NOT ACHIEVE ORBIT			6.4	12-foot sphere to determine density of Earth's atmosphere. Second stage failed to ignite. (WFF)

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Pioneer (P-31) (U)	Atlas-Able (U)	Dec 15		DID NOT ACHIEVE ORBIT			175.9	Highly instrumented probe, in lunar orbit, to investigate environment between Earth and 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.
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 (S)	Feb 16		DOWN APR 9, 1964			6.8	12-foot sphere to determine density of Earth's atmosphere. First spacecraft orbited by all-solid rocket. (WFF)
Mercury (MA-2) (S)	Atlas (S)	Feb 21		SUBORBITAL FLIGHT			1315.0	Suborbital test of Mercury Capsule; upper part of Atlas strengthened by 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. Malfunction following booster separation resulted in loss of payload telemetry and third and fourth 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 (S)	Mar 25		DOWN JUN 1986			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 (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	105.8	1578	485	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 ability of 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	Manned suborbital flight with Alan B. Shepard, Jr. Pilot and spacecraft recovered after 15 minute 22 second flight.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
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 (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 (S)	Jul 12	100.1	801	730	47.9	129.3	Development of meteorological satellite system. Provided excellent quality photographs and infrared data. Photographed many tropical storms during 1961 hurricane season and credited with discovering Hurricane Esther.
Liberty Bell 7 (S)	Mercury-Redstone-4 (S)	Jul 21		SUBORBITAL FLIGHT LANDED JUL 21, 1961			1470.0	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 (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 (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 (U)	Aug 25		DOWN AUG 28, 1961			84.8	Evaluate launch vehicle; investigate micrometeoroid impact and penetration. Initial orbit lower than planned. (WFF)
Mercury (MA-4) (S) A-Alpha 1	Atlas (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 (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 propulsion system of the S-1 booster; verification of aerodynamic and 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 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 (U)	Nov 18		DOWN NOV 20, 1961			306.2	Flight test spacecraft systems designed for future lunar and interplanetary missions. Inoperative roll gyro prevented Agena restart resulting in a low Earth orbit.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Mercury (MA-5) (S) A-Iota 1	Atlas (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 (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 (U)	Jan 26		HELIOCENTRIC ORBIT			329.8	Rough land instrumented capsule on Moon. Booster malfunction resulted in spacecraft missing Moon by 22,862 miles and going into solar orbit. TV pictures unusable.
Tiros IV (S) Beta 1	Thor-Delta (S)	Feb 8	100.1	824	700	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 (S)	Feb 20		LANDED FEB 20, 1962			1354.9	First U.S. manned orbital flight. John H. Glenn, Jr. made three orbits of Earth. Capsule and pilot recovered after 21 minutes in the water. Mission Duration 4 hours 55 minutes 23 seconds.
Reentry I (U)	Scout (S)	Mar 1		SUBORBITAL FLIGHT				Launch vehicle development test/Reentry test. Desired speed not achieved. (WFF)
OSO-I (S) Zeta 1	Thor-Delta (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 on 75 solar flares.
Probe B (P-21a) (S)	Scout (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 (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 effect on upper region of the atmosphere (Project High Water).

NASA Major Launch Record

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Ariel I (S) Omicron 1	Thor-Delta (S)	Apr 26		DOWN MAY 24, 1976			59.9	Carried six British experiments to study ionosphere, solar radiation, and cosmic rays. First International Satellite. Cooperative with UK.
Centaur Test 1 (AC-1) (U)	Atlas-Centaur (U)	May 8		SUBORBITAL FLIGHT				Launch vehicle development test. Centaur exploded before separation.
Aurora 7 (MA-7) (S) Tau 1	Atlas (S)	May 24		LANDED MAY 24, 1962			1349.5	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 1	Thor-Delta (S)	Jun 19	99.8	916	583	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 (S)	Jul 10	157.8	5651	938	44.8	77.1	First privately built satellite to conduct communication experiments. First telephone and television experiments transmitted. Reimbursable.
Echo (AVT-2) (S)	Thor (S)	Jul 18		SUBORBITAL FLIGHT			256.0	Suborbital communications test. Inflation successful; radar indicated sphere surface not as smooth as planned.
Mariner I (P-37) (U)	Atlas-Agena (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 (S)	Aug 27		HELIOCENTRIC ORBIT			202.8	Second Venus flyby. First successful interplanetary probe. Passed Venus on Dec 14 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 (U)	Aug 31		SUBORBITAL FLIGHT				Reentry test at 28,000 fps: late third stage ignition; desired speed not achieved. (WFF)
Tiros VI (S) A-Psi 1	Thor-Delta (S)	Sep 18	98.1	679	653	58.3	127.5	Provide coverage of 1962 hurricane season. Returned high quality cloud cover photographs.
Alouette I (S) B-Alpha 1	Thor-Agena B (S)	Sep 29	105.3	1025	989	80.5	145.2	Designed and built by Canada to measure variations in 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 (S)	Oct 2		DOWN JUL 1, 1966			40.4	Monitor trapped corpuscular radiation, solar particles, cosmic radiation, and solar winds. Placed into a highly elliptical orbit; excellent data received.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Sigma 7(MA-8) (S) B-Delta 1	Atlas (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 hrs 13 min 11 sec.
Ranger V (U) B-Eta 1	Atlas-Agena (S)	Oct 18		HELIOCENTRIC ORBIT			342.5	Rough land instrumented capsule on 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 1	Thor-Delta (S)	Oct 27		CURRENT ELEMENTS NOT MAINTAINED			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 (S)	Dec 13	185.1	7440	1318	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 (S)	Dec 16	104.2	1166	747	52.0	100.7	Measure micrometeoroid puncture hazard to structural skin samples. First statistical sample; flux level found to lie between estimated extremes. (WPF)
1963								**1963**
Syncom I (U) 1963 004A	Thor-Delta (S)	Feb 14		CURRENT ELEMENTS NOT MAINTAINED			39.0	First test of communication satellite in geosynchronous orbit. Initial communication tests successful; all contact 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 (S-6) (S) 1963 009A	Thor-Delta (S)	Apr 3		DOWN NOV 24, 1966			183.7	Measure density, composition, pressure and temperature of Earth's atmosphere. Discovered belt of neutral helium around Earth.
Telstar II (S) 013A	Thor-Delta (S)	May 7	225.3	10807	968	42.8	79.4	Conduct wideband communication experiments. Color and black and white television successfully transmitted to Great Britain and France. Reimbursable.
Mercury (Faith 7) (S) 1963 015A	Atlas (S)	May 15		LANDED MAY 16, 1963			1360.8	Orbital Manned flight with L. Gordon Cooper, Jr. Various tests and experiments performed. Capsule reentered after 22 orbits. Mission Duration 34 hrs 19 min 49 sec.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
RPD-1 (S)	Scout (S)	May 22		SUBORBITAL FLIGHT			217.6	Suborbital reentry flight test; carried AEC Reactor mockup. Reimbursable.
Tiros VII (S) 1963 024A	Thor-Delta (S)	Jun 19	95.8	560	557	58.2	134.7	Continued meteorological satellite development. Furnished over 30,000 useful cloud cover photographs, including pictures of Hurricane Ginny in early stages in mid-October.
CRL (USAF) (S) 1963 026A	Scout (S)	Jun 28		DOWN DEC 14, 1983			99.8	Cambridge Research Lab geophysics experiment test. (Reimbursable)
Reentry III (U)	Scout (U)	Jul 20		SUBORBITAL FLIGHT				Suborbital reentry flight demonstration test of an ablation material at reentry speeds. Vehicle failed. (WFF)
Syncom II (S) 1963 031A	Thor-Delta (S)	Jul 26		CURRENT ELEMENTS NOT MAINTAINED			39.0	Geosynchronous communication satellite test. Voice, teletype, facsimile, and data transmission tests 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 046A	Thor-Delta (DSV-3C) (S)	Nov 27		DOWN DEC 30, 1965			62.6	First in a series of Interplanetary Monitoring Platforms to observe interplanetary space over extended period of solar cycle. Discovered region of high-energy radiation beyond Van Allen belts; reported stationary shock wave created by interaction of the solar wind and geomagnetic field.
Centaur Test II (AC-2) (S) 1963 047A	Atlas-Centaur (S)	Nov 27	105.8	1585	473	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 053A	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 054A	Delta 22 (DSV-3B) (S)	Dec 21	98.9	719	687	58.5	120.2	Continued meteorological satellite development; initial flight testing of Automatic Picture Transmission (APT) camera system which made it possible to obtain local cloud cover pictures using inexpensive ground stations.
1964								**1964**
Relay II (S) 1964 003A	Delta 23 (DSV-3B) (S)	Jan 21	194.7	7511	1990	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.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Echo II (S) 1964 004A	Thor-Agena (S)	Jan 25		DOWN JUN 7, 1969			348.4	Rigidized sphere, 135 feet in diameter, to conduct passive communication experiments (radio, teletype, and facsimile tests). Good experiment results obtained; data exchanged with USSR. (WSMC)
Saturn I (SA-5) (S) 1964 005A	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/LH_2 fueled second stage (S-IV). 1,146 measurements taken.
Ranger VI (U) 1964 007A	Atlas-Agena (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 and conduct laser and Doppler shift geodetic tracking experiments. Vehicle third stage malfunctioned.
Ariel II (UK) (S) 1964 015A	Scout 127 (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 018A	Titan II (S)	Apr 8	89.2	328.2	160.9	32.6	3175.2	Qualification of Gemini spacecraft configuration and Gemini launch vehicle combination in launch environment through orbital insertion phase.
Fire I (S)	Atlas (S)	Apr 14		SUBORBITAL FLIGHT			1995.8	Reentry Test to study the heating environment encountered by a body entering Earth's atmosphere at high speed.
Apollo Abort A-001 (S)	Little Joe (S)	May 13		SUBORBITAL FLIGHT				Vehicle development test to demonstrate Apollo spacecraft atmospheric abort system capabilities. (White Sands)
Saturn I (SA-6) (S) 1964 025A	Saturn I (S)	May 28	88.5	225.2	199.5	31.8	17644.9	Vehicle development test. First flight of unmanned model of the Apollo spacecraft. 106 measurements obtained.
Centaur Test III AC-3 (S)	Atlas Centaur (S)	Jun 30		SUBORBITAL FLIGHT				Launch vehicle development test; performance and guidance evaluation.
SERT I (S)	Scout (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 041A	Atlas-Agena (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.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Reentry IV (S)	Scout (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 047A	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 051A	Scout 123 (S)	Aug 25	103.7	1007	858	79.9	44.5	Ionosphere Explorer to obtain radio soundings of upper ionosphere as part of the Topside Sounder program.
Nimbus I (S) 1964 052A	Thor-Agena 386 (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 photos; APT system supplied daytime photos to low-cost ground stations.
OGO I (U) 1964 054A	Atlas-Agena (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 057A	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 060A	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, but provided good data.
RPD-2 (S)	Scout (S)	Oct 9		SUBORBITAL FLIGHT			217.6	Reentry flight carried ABC Reactor Mockup. Reimbursable.
Explorer 22 (S) 1964 064A	Scout 123 (S)	Oct 10	104.5	1060	877	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. (NSMC)
Mariner III (U) 1964 073A	Atlas-Agena (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 074A	Scout S-123 (S)	Nov 6		DOWN JUN 29, 1983			133.8	Provided data on meteoroid penetration and resistance of various materials to penetration. (WFF)

NASA Major Launch Record

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Explorer 24 (S) 1964 076A	Scout 135 (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 atmosphere. (WSMC)
Explorer 25 (S) 1964 076B			115.2	2401	524	81.3	34.0	
Mariner IV (S) 1964 077A	Atlas Agena (S)	Nov 28		HELIOCENTRIC ORBIT			260.8	Second of two 1964 Mars flyby launches. Encounter occurred on Jul 14, 1965, with closest approach at 6,118 miles of the planet. Transmitted 22 pictures.
Apollo Abort A-002 (S)	Little Joe (S)	Dec 8		SUBORBITAL FLIGHT			42593.0	First test of Apollo emergency detection system at abort altitude. (White Sands)
Centaur (AC-4)(S) 1964 082A	A-Centaur (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 084A	Scout (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 Crew. (WFF)
Explorer 26 (S) 1964 086A	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 (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 004A	Delta 28 (S)	Jan 22	119.0	2568	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 007A	Delta (S)	Feb 3	93.4	456	428	32.8	244.9	Second in a series to measure frequency and energy of solar electromagnetic radiation in ultraviolet, X-ray and gamma-ray regions of spectrum.
Pegasus I (S) 1965 009A	Saturn I (SA-9) (S)	Feb 16		DOWN SEP 17, 1978			1451.5	Obtained scientific and engineering data on magnitude and direction of meteoroids in near-Earth orbit.
Ranger VIII (S) 1965 010A	Atlas-Agena (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 Sea of Tranquility; flight time 64.54 hours.
Centaur Test (AC-5) (U)	A-Centaur (U)	Mar 2		SUBORBITAL FLIGHT			2548.0	Vehicle development test; Atlas stage failed 4 seconds after liftoff.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Ranger IX (S) 1965 023A	Atlas Agena (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 024A	Titan II (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 53 minutes.
Intelsat 1 (F-1) (S) 1965 028A	Delta 30 (S)	Apr 6		CURRENT ELEMENTS NOT MAINTAINED			38.5	First operational satellite for Comsat Corp., to provide commercial trans-Atlantic communications. Reimbursable.
Explorer 27 (S) 1965 032A	Scout 136 (S)	Apr 29	107.8	1317	931	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 (S)	May 22		SUBORBITAL FLIGHT			2005.8	Second Reentry Test to study heating environment encountered by a body entering Earth's atmosphere at high speed.
Pegasus II (S) 1965 039A	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 042A	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 Earth's magnetosphere.
Gemini IV (S) 1965 043A	Titan II (S)	Jun 3		LANDED JUN 7, 1965			3537.6	Second manned Gemini flight with James A. McDivitt and Edward H. White. During flight, White donned pressure suit and performed EVA using ZIP (Zero-G Integral Propulsion) Unit. EVA duration 22 minutes. Mission Duration 97 hours 56 minutes 11 seconds.
Tiros X (S) 1965 051A	Delta 32 (S)	Jul 1	100.3	817	728	98.6	127.0	First U.S. Weather Bureau-funded Tiros; obtained maximum coverage of 1965 hurricane and typhoon season.
Pegasus III (S) 1965 060A	Saturn I (SA-10) (S)	Jul 30		DOWN AUG 4, 1969			1451.5	Final micrometeoroid detection experiment. Results of Pegasus program indicated flux of small particles was less than expected, flux of large particles more than expected, and flux of medium-sized particles about as predicted.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Scout Test (S) Secor (S) 1965 063A	Scout S-131R (S)	Aug 10	122.2	2418	1136	69.2	20.0	Vehicle development test. Carried U.S. Army Secor geodetic satellite. Reimbursable.
Centaur Test (AC-6) (S) 1965 064A	A-Centaur (S)	Aug 11		BARYCENTRIC ORBIT			952.6	Vehicle development test. Carried Surveyor dynamic model. Direct-ascent test for guidance evaluation.
Gemini V (S) 1965 068A REP 1965 068C	Titan II (S)	Aug 21		LANDED AUG 29, 1965 DOWN AUG 27, 1965			3175.2	Manned orbital flight with L. Gordon Cooper and Charles Conrad, Jr. Ejected rendezvous evaluation POD (REP) for simulated rendezvous maneuvers; participated in communications and other on-board experiments. Mission Duration 190 hours 56 minutes 14 seconds.
OSO-C (U)	Delta (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 081A	Thor-Agena (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. 19 experiments returned useful data. (WSMC)
Gemini VI (U)	Atlas-Agena (U)	Oct 25		DID NOT ACHIEVE ORBIT				Agena target vehicle. Simultaneous countdown of Gemini spacecraft and Atlas/Agena Target Vehicle. Telemetry lost 375 seconds after launch of target vehicle; Gemini launch terminated at T-42 minutes.
Explorer 29 (S) 1965 089A	Delta (S)	Nov 6	120.3	2273	1114	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 093A	Scout 138 (S)	Nov 18	100.4	881	676	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 098B	Thor-Agena (S)	Nov 29	120.5	2905	502	79.8	98.9	Make related studies of ionospheric composition and temperature variations. Provided excellent data from regions of the ionosphere never before investigated. Cooperative with Canada. (WSMC)
Alouette II (S) 1965 098A			119.3	2801	500	79.8	146.5	
Gemini VII (S) 1965 100A	Titan II (S)	Dec 4		LANDED DEC 18, 1965			3628.8	Fourth manned mission with Frank Borman and James A. Lovell, Jr. Astronauts flew part of mission without pressure suits. Mission Duration 330 hrs 35 min 31 sec.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
French 1A (S) 1965 101A	Scout 139 (S)	Dec 6	99.2	728	716	75.9	71.7	Study VLF wave propagation in the ionosphere and magnetosphere and measure electron densities. Cooperative with France. (WSMC)
Gemini VI-A (S) 1965 104A	Titan II (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 field, Solar physics, and high-energy charged particles and magnetic fields.
1966								**1966**
Apollo Abort A-004 (S)	Little Joe (II #5) (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 008A	Delta 36 (S)	Feb 3	99.9	819	688	97.9	138.3	Sun-synchronous orbit permitted satellite to view weather in each area of the globe each day, photographing a given area. First Advanced Vidicon Camera System provided valuable information about weather patterns and conditions. Reimbursable. (WSMC)
Reentry V (S)	Scout (S)	Feb 9		SUBORBITAL FLIGHT			95.0	Test to investigate heating environment of body reentering 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 016A	Delta 37 (S)	Feb 28	113.4	1413	1352	101.0	131.5	Provided direct readout of cloud cover photos to local users. Along with ESSA I, completed initial global weather satellite system. Reimbursable. (WSMC)
Gemini VIII (U) 1966 020A	Titan II (S)	Mar 16		LANDED MAR 17, 1966			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 docked spacecraft to tumble. Astronauts separated vehicles and terminated mission early; EVA not accomplished. First Pacific Ocean landing. Mission Duration 10 hours 41 minutes 26 seconds.
GATV (S) 1966 019A	A-Agena (S)	Mar 16		DOWN SEP 15, 1966				

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Centaur Test (AC-8) (U) 1966 030A	A-Centaur (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 031A	A-Agena (S)	Apr 8	100.8	799	788	35.0	1769.0	Carried four experiments to study UV, X-ray and gamma-ray regions. Primary battery malfunctioned.
Nimbus II (S) 1966 040A	Thor-Agena (S)	May 14	108.0	1175	1092	100.4	413.7	Provided global weather photography on 24-hour basis for meteorological research and operational use. (WSMC)
Gemini IX (U)	A-Agena (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 044A	Delta 38 (S)	May 25		DOWN FEB 22, 1985			224.5	Atmosphere Explorer; carried 8 experiments to measure temperatures, composition, density and pressures in upper atmosphere.
Surveyor I (S) 1966 045A	A-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 lunar surface to maximum depth of 1 inch.
Gemini IXA (U) 1966 047A	Titan II (S)	Jun 3		LANDED JUN 6, 1966			3750.3	Seventh manned mission with Thomas P. Stafford and Eugene A. Cernan. Target vehicle shroud failed to separate, docking not achieved. EVA successful, but evaluation of AMU not achieved. Mission Duration 72 hours 21 minutes.
GATV (U) 1966 046A	Atlas (S)	Jun 1		DOWN JUN 11, 1966				
OGO III (S) 1966 049A	A-Agena (S)	Jun 7		CURRENT ELEMENTS NOT MAINTAINED			514.8	Carried 21 experiments to obtain correlated data on geophysical and solar phenomena in Earth's atmosphere. First 3-axis stabilization in highly elliptical orbit.
OV-3 (S) 1966 052A	Scout (S)	Jun 9	143.0	4711	647	40.8	173.0	Radiation Research Satellite. USAF Reimbursable. (WPF)
Pageos I (S) 1966 056A	Thor-Agena (S)	Jun 23	177.6	5443	2735	84.4	56.7	Sphere, 100 feet in diameter, to determine location of continents, land masses, and other geographic points by world-wide triangulation network of stations. (WSMC)
Explorer 33 (S) 1966 058A	Delta (S)	Jul 1		CURRENT ELEMENTS NOT MAINTAINED			93.4	Interplanetary Monitoring Platform to study, at lunar distance, Earth's magnetosphere and magnetic tail. Planned anchored lunar orbit not achieved; useful data obtained from Earth orbit.
Apollo Saturn AS-203 (S) 1966 059A	Saturn IB (S)	Jul 5		DOWN JUL 5, 1966			26535.4	Launch vehicle development flight; evaluate S-IVB stage vent and restart capability.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Gemini X (S) 1966 066A	Titan II (S)	Jul 18		LANDED JUL 21, 1966			3762.6	Manned mission with John W. Young and Michael Collins. Performed first docked vehicle maneuvers; standup EVA of 87 minutes; umbilical EVA of 27 minutes. Mission duration 70 hours 46 minutes 39 seconds.
GATV (S) 1966 065A	A-Agena (S)	Jul 18		DOWN DEC 29, 1966				
Lunar Orbiter I (S) 1966 073A	A-Agena (S)	Aug 10		DOWN OCT 29, 1966			385.6	Photograph landing sites for Apollo and Surveyor from lunar orbit. Photographed over 2 million square miles of Moon's surface; took first two photos of Earth from distance of the Moon. Demonstrated maneuverability in lunar orbit.
Pioneer VII (S) 1966 075A	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 and spacecraft development flight to test Command Module heat shield and obtain launch vehicle and spacecraft data.
Gemini XI (S) 1966 081A	Titan II (S)	Sep 12		LANDED SEP 15, 1966			3798.4	Manned mission with Charles Conrad, Jr. and Richard F. Gordon, Jr. Rendezvous and docking achieved. Umbilical and standup EVA performed and well as tethered spacecraft experiment. Mission Duration 71 hrs 17 min 8 sec.
GATV (S) 1966 080A	A-Agena (S)	Sep 12		DOWN DEC 30, 1966				
Surveyor II (U) 1966 084A	A-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 spacecraft into tumbling mode. Spacecraft crashed southeast of crater Copernicus after 62.8 hour flight.
ESSA III (S) 087A	Delta 41 (S)	Oct 2	114.5	1484	1383	101.1	147.4	Replaced ESSA I in Tiros Operational Satellite (TOS) 1966 system. Sophisticated cameras and sensors provided valuable information about world's weather patterns and conditions. Reimbursable (WSMC)
Centaur Test (AC-9) (S) 1966 095A	A-Centaur (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 096A	Delta 42 (S)	Oct 26	717.7	37023	3326	17.0	87.1	Comsat commercial communications satellite. Apogee motor malfunction resulted in elliptical orbit. Reimbursable.
Lunar Orbiter II (S) 1966 100A	A-Agena (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.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Gemini XII (S) 1966 104A	Titan II (S)	Nov 11		LANDED NOV 15, 1966			3762.1	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 35 minutes 31 seconds.
GATV (S) 1966 103A	A-Agena (S)	Nov 11		DOWN DEC 23, 1966				
ATS I (S) 1966 110A	A-AGENA (S)	Dec 7	1250.5	35251	28888	14.0	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 first time.
Biosatellite I (U) 1966 114A	Delta (S)	Dec 14		DOWN FEB 15, 1967			426.4	Carried biological specimens to determine effects of space environment on life processes. Reentry vehicle separated but retro rocket failed, leaving capsule in orbit. No useful scientific data obtained.
1967								**1967**
Intelsat II F-2 (S) 1967 001A	Delta 44 (S)	Jan 11		CURRENT ELEMENTS NOT MAINTAINED			87.1	Comsat commercial communication satellite. Reached intended location on February 4. Reimbursable.
ESSA IV (S) 1967 006A	Delta 45 (S)	Jan 26	113.4	1437	1324	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. (WSMC)
Lunar Orbiter III (S) 1967 008A	A-Agena (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 020A	Delta 46 (S)	Mar 8		DOWN APR 4, 1982			284.4	Carried 9 experiments to study structure, dynamics and chemical composition of outer solar atmosphere through X-ray, visible, and UV radiation measurements.
Intelsat II F-3 (S) 1967 026A	Delta 47 (S)	Mar 22		CURRENT ELEMENTS NOT MAINTAINED			87.1	Comsat commercial communication satellite. Completed Intelsat II system. Reimbursable.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
AIS II (U) 1967 031A	A-Agena (U)	Apr 6		DOWN SEP 2, 1969			324.3	Test gravity gradient control system; microwave communications, meteorological cameras, and 8 scientific experiments. Second stage failed to restart resulting in elliptical orbit. Limited data obtained.
Surveyor III (S) 1967 035A	A-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 used for pressing, digging, trenching, scooping, and depositing surface material in view of camera. Returned over 6,300 photos including pictures of Earth during lunar eclipse.
ESSA V (S) 1967 036A	Delta 48 (S)	Apr 20	113.5	1419	1352	101.8	147.4	Replaced ESSA III in TOS System. Furnished daily global coverage of weather systems. Reimbursable. (WSMC)
San Marco II (S) 1967 038A	Scout S-153 (S)	Apr 26		DOWN OCT 14, 1967			129.3	First satellite launch attempt from mobile sea-based platform in the Indian Ocean; launched conducted by Italian crew. Spacecraft provided continuous equatorial air density measurements. Cooperative with Italy.
Lunar Orbiter IV (S) 1967 041A	A-Agena (S)	May 4		DOWN OCT 6, 1967			385.6	Lunar orbit achieved. Photographed 99% of Moon's front side and additional back side areas.
Ariel III (S) 1967 042A	Scout (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 051A	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)
ESRO II-A (U)	Scout (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 060A	A-Agena (S)	Jun 14		HELIOCENTRIC ORBIT			244.9	Venus flyby. Returned data on planet's atmosphere, radiation, and magnetic field environment.
Surveyor IV (U) 1967 068A	A-Centaur (AC-11) (S)	Jul 14		IMPACTED MOON ON JUL 17, 1967			1037.4	Lunar soft landing mission. All systems normal until 2 seconds before retro rocket burnout (2-1/2 minutes before touchdown) when signal was abruptly lost.
Explorer 35 (S) 1967 070A	Delta (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 Moon, no magnetic field, no radiation belts or evidence of lunar ionosphere.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
OGO IV (S) 1967 073A	Thor-Agena (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 075A	A-Agena (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 083A	Delta (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 084A	A-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 (F-4) (S) 1967 094A	Delta 52 (S)	Sep 28		CURRENT ELEMENTS NOT MAINTAINED			87.1	Comsat commercial communications satellite to provide *24-hour transoceanic service. Reimbursable.*
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 solar influence upon Earth. Obtained first pictures made of Sun in extreme ultraviolet.
RAM C-1 (S)	Scout (S)	Oct 19		SUBORBITAL FLIGHT			116.6	Reentry test to investigate communications problems on reentry. (WFF)
ATS III (S) 1967 111A	A-Agena (S)	Nov 5	1436.1	35842	35733	12.1	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	A-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 surface and landing 8 feet from original site, performing first rocket-powered takeoff from lunar surface.
Apollo 4 (S) 1967 113A	Saturn V (S)	Nov 9		DOWN NOV 9, 1967			45506.0	Launch vehicle/spacecraft development flight. First launch of Saturn V; carried unmanned Apollo Command/Service Module.
ESSA VI (S) 1967 114A	Delta 54 (S)	Nov 10	114.8	1483	1407	102.1	129.7	Replaced ESSA II and ESSA IV in the TOS system; used in central analysis of global weather. Reimbursable. (WSMC)

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Pioneer VIII (S) 1967 123A	Delta (S)	Dec 13		HELIOCENTRIC ORBIT			65.8	Third in series of interplanetary probes to provide data on solar wind, magnetic fields, and cosmic rays. Carried
TETR-1 (S) 1967 123B				DOWN APR 28, 1968			20.0	TTS-1, first NASA piggyback payload.
1968								**1968**
Surveyor VII (S) 1968 001A	A-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 Earth.
Explorer 36 (S) 1968 002A	Delta (S)	Jan 11	112.2	1572	1079	105.8	212.3	GEOS spacecraft to provide precise information about size and shape of Earth and strength of and variations in gravitational field; part of National Geodetic Program. (WSMC)
Apollo 5 (S) 1968 007A	Saturn IB (S)	Jan 22		DOWN JAN 24, 1968			42,506.0	First flight test of Lunar Module; verified ascent and descent stages, propulsion systems and restart operations.
OGO V (S) 1968 014A	A-Agena (S)	Mar 4		CURRENT ELEMENTS NOT MAINTAINED			611.0	Provided measurements of energy characteristics in Earth's radiation belts; first evidence of electric fields in bow shock.
Explorer 37 (S) 1968 017A	Scout (S)	Mar 5	95.4	638	439	59.4	89.8	Solar Explorer to provided data on selected solar X-ray and ultraviolet emissions. NRL/NASA Cooperative. (WFF)
Apollo 6 (U) 1968 025A	Saturn V (U)	Apr 4		DOWN APR 4, 1968			42856.0	Launch vehicle and spacecraft development flight. Launch vehicle engines malfunctioned; spacecraft systems performed normally. Mission judged unsuccessful.
Reentry VI (S)	Scout (S)	Apr 27		SUBORBITAL FLIGHT			272.0	Turbulent heating experiment to obtain heat transfer measurements at 20,000 FPS. (WFF)
ESRO IIB (S) 1968 041A	Scout (S)	May 17		DOWN MAY 8, 1971			89.1	Carried 7 experiments to study solar and cosmic radiation in lower Van Allen belt. Cooperative with ESRO. (WSMC)
Nimbus B (U)	Thor-Agena (U)	May 18		DID NOT ACHIEVE ORBIT			571.5	Experimental meteorological satellite; also carried Secor
Secor 10 (U)							20.4	10 (DOD) secondary payload. Booster malfunctioned; destruct signal sent by range safety officer. (WSMC)
Explorer 38 (S) 1968 055A	Delta 57 (S)	Jul 4	224.2	5865	5828	120.8	275.4	Radio Astronomy Explorer to monitor low-frequency radio signals originating in our own solar system and Earth's magnetosphere and radiation belts.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Explorer 39 (S) 1968 066A	Scout (S)	Aug 8		DOWN JUN 22, 1981			9.3	Dual payload (Air Density/Injun) to continue the detailed scientific study of density and radiation characteristics of Earth's upper atmosphere. (WSMC)
Explorer 40 (S) 1968 066B			118.0	2506	678	80.7	69.4	
ATS IV (U) 1968 068A	A-Centaur (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 069A	Delta 58 (S)	Aug 16	114.9	1471	1429	101.5	147.4	Replace ESSA V as the primary stored data satellite in the TOS system. Reimbursable. (WSMC)
RAM CII (S)	Scout (S)	Aug 22		SUBORBITAL FLIGHT			122.0	Measure electron and ion concentrations during reentry. (WFF)
Intelsat III F-1 (U)	Delta (U)	Sep 18		DID NOT ACHIEVE ORBIT			286.7	Comsat commercial communications satellite. Vehicle failure. Reimbursable.
ESRO IA (S) 1968 084A	Scout (S)	Oct 3		DOWN JUN 26, 1970			85.8	Carried 8 experiments to measure energies and pitch angles of particles impinging on polar ionosphere during magnetic storms and quiet periods. Cooperative with ESRO. (WSMC)
Apollo.7 (S) 1968 089A	Saturn IB (S)	Oct 11		LANDED OCT 22, 1968			51,655.0	First manned flight of 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 (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 secondary payload.
TETR 2 (S) 1968 100B				DOWN SEP 19, 1979				
HEOS A (S) 1968 109A	Delta (S)	Dec 5		DOWN OCT 28, 1975			108.8	Study interplanetary magnetic fields and solar cosmic ray particles. ESRO Reimbursable.
OAO II (S) 1968 110A	A-Centaur (AC-16) (S)	Dec 7	100.1	768	759	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	101.5	136.1	Meteorological satellite for ESSA. Reimbursable. (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.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Apollo 8 (S) 1968 118A	Saturn V (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 close-up look at Moon during 10 lunar orbits. Mission Duration 147 hrs 0 min 42 sec.
1969								**1969**
OSO V (S) 1969 006A	Delta (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 009A	Delta 65 (S)	Jan 30	127.9	3489	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 011A	Delta 66 (S)	Feb 5		CURRENT ELEMENTS NOT MAINTAINED			286.7	Second increment of Comsat's operational commercial communication satellite system. Reimbursable.
Mariner VI (S) 1969 014A	A-Centaur (AC-20) (S)	Feb 25		HELIOCENTRIC ORBIT			411.8	Mars flyby; provided high resolution photos of Martian surface. Closest approach was 2,120 miles on July 31.
ESSA IX (S) 1969 016A	Delta 67 (S)	Feb 26	115.2	1503	1423	101.6	157.4	Ninth and last in the TOS series of meteorological satellites. Reimbursable.
Apollo 9 (S) 1969 018A	Saturn V (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 lunar module. Performed rendezvous, docking, and EVA. Mission Duration 241 hours 1 minute 54 seconds.
Mariner VII (S) 1969 030A	A-Centaur (AC-19) (S)	Mar 27		HELIOCENTRIC ORBIT			411.8	Mars flyby; provided high resolution photos of Martian surface. Closest approach was 2,190 miles on August 5.
Nimbus III (S) 1969 037A	Thor-Agena (S)	Apr 14	107.3	1130	1069	99.9	575.6	Provided night and day global meteorological measurements from space. Secor (DOD) provided geodetic position determination measurements.
Secor 13 (S) (WSMC) 1969 037B			107.2	1127	1067	99.9	20.4	
Apollo 10 (S) 1969 043A	Saturn V (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 hours 3 minutes.
Intelsat III F-4 (S) 1969 045A	Delta (S)	May 21		CURRENT ELEMENTS NOT MAINTAINED			143.8	Third increment of Comsat's operational commercial communication satellite system. Reimbursable.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
OGO VI (S) 1969 051A	Thor-Agena (S)	Jun 5		DOWN OCT 12, 1979			631.8	Last in the OGO series to provide measurements of energy characteristics in Earth's radiation belts; first evidence of electric fields in bow shock. (WSMC)
Explorer 41 (S) 1969 053A	Delta 69 (S)	Jun 21		DOWN DEC 23, 1972			78.7	Seventh Interplanetary Monitoring Platform to continue the study of the environment within and beyond the Earth's magnetosphere. (WSMC)
Biosatellite III (U) 1969 056A	Delta (S)	Jun 28		DOWN JUL 7, 1969			696.3	Conduct intensive experiments to evaluate the effects of weightlessness with a pigtail monkey onboard. Spacecraft deorbited after 9 days because monkey's metabolic condition was deteriorating rapidly. Monkey expired 8 hours after recovery presumably from a massive heart attack brought on by dehydration. Mission judged unsuccessful.
Apollo 11 (S) 1969 059A	Saturn V (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, deployed TV camera and EASEP experiments, performed EVA, returned lunar soil samples. *Mission Duration 195 hours 18 minutes 35 seconds.*
Intelsat III F-5 (U) 1969 064A	Delta (U)	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.
OSO VI (S) 1969 068A	Delta (S)	Aug 9		DOWN MAR 7, 1981			173.7	Continuing study of Sun's X-rays, gamma rays, and radio emissions. Carried PAC experiment to stabilize spent Delta stage.
PAC (S) 1969 068B				DOWN APR 28, 1977			117.9	
ATS V (U) 1969 069A	A-Centaur (AC-18) (S)	Aug 12	1464.5	38298	34383	9.5	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 (U)	Aug 27		DID NOT ACHIEVE ORBIT			67.1 18.1	Deep space probe to study magnetic disturbances in interplanetary space. Vehicle malfunctioned; destroyed 8 min 3 sec into powered flight by range safety officer.
ESRO 1B (S) 1969 083A	Scout (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. (WSMC)

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
GRS-A (S) 1969 097A	Scout (S)	Nov 7	115.1	2538	379	102.8	72.1	Study inner Van Allen belt and auroral zones of the Northern Hemisphere. Cooperative with Germany. (WSMC)
Apollo 12 (S) 1969 099A	Saturn V (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 Nov 19; 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 25 seconds.
Skynet A (S) 1969 101A	Delta (S)	Nov 21		ELEMENTS NOT AVAILABLE			242.7	Communication satellite for the United Kingdom. Reimbursable.
1970								**1970**
Intelsat III F-6 (S) 1970 003A	Delta (S)	Jan 14		CURRENT ELEMENTS NOT MAINTAINED			155.1	Part of Comsat's operational commercial communication satellite system. Reimbursable.
ITOS I (S) 1970 008A	Delta (S)	Jan 23	115.0	1477	1432	101.5	306.2	Second generation meteorological satellite to provide daytime and nighttime cloud cover observations in both direct and stored modes.
Oscar 5 (S) 1970 008B			115.0	1475	1432	101.5	9.1	Oscar (Australia), carried piggyback, used by radio amateurs throughout the world. WSMC)
SERT II (U) 1970 009A	Thor-Agena (S)	Feb 3	106.0	1046	1038	99.3	503.5	Ion engine test. Fell short of mission duration objective by less than 1 month. (WSMC)
NATOSAT I (S) 1970 021A	Delta 77 (S)	Mar 20	1436.2	36491	35086	9.4	242.7	Communications satellite for NATO. Reimbursable
Nimbus D (S) 1970 025A	Thor-Agena (S)	Apr 8	107.1	1097	1086	99.7	619.6	Stabilized, Earth-oriented platform to test advanced systems for collecting meteorological and geological data.
TOPO 1 (S) 1970 025B			106.9	1085	1082	99.5	21.8	TOPO, carried as piggyback, for triangulation exercises. (WSMC)
Apollo 13 (U) 1970 029A	Saturn V (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 032A	Delta (S) (S)	Apr 22		CURRENT ELEMENTS NOT MAINTAINED			290.3	Part of Comsat's operational commercial communication satellite system. Reimbursable.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Intelsat III F-8 (U) 1970 055A	Delta (S)	Jul 23	1408.2	36650	33823	12.2	290.3	Part of Comsat's operational commercial communication satellite system. Malfunctioned during apogee motor firing; failed to achieve desired orbit. Reimbursable.
Skynet 2 (U) 1970 062A	Delta (S)	Aug 19		CURRENT ELEMENTS NOT MAINTAINED			242.7	Communication satellite for the United Kingdom. Telemetary terminated following apogee motor failure. Reimbursable.
RAM CIII (S)	Scout (S)	Sep 30		SUBORBITAL FLIGHT			134.0	Reentry test of radio blackout.
OFO I (S) 1970 094A	Scout (S)	Nov 9		DOWN MAY 9, 1971			132.9	Orbiting Frog Otolith (OFO) in which frogs were used to study effects of weightlessness on the inner ear, which controls balance. Radiation Meteoroid Spacecraft (RMS) provided data on radiation belts. (WFF)
RMS (S) 1970 094B				DOWN FEB 7, 1971			21.0	
OAO B (U)	A-Centaur (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.
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. (WSMC)
Explorer 42 (S) 1970 107A	Scout 175C (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 006A	A-Centaur (S)	Jan 25		ELEMENTS NOT AVAILABLE			1387.1	Fourth generation satellite to provide increased capacity for Comsat's global commercial communications network. Reimbursable.
Apollo 14 (S) 1971 008A	Saturn V (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 Feb 5; performed EVA, deployed lunar experiments, returned lunar samples. P&F Subsatellite spring-launched from SM in lunar orbit. Mission duration 216 hours 1 minute 57 seconds.
P&F (S) 1971 008B	SM			IMPACTED MOON FEB 4, 1971				
NATOSAT 2 (S) 1971 009A	Delta 82 (S)	Feb 2	1435.8	41063	30496	8.7	242.7	Second communications satellite for NATO. Reimbursable
Explorer 43 (S) 1971 019A	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 024A	Delta (S)	Mar 31	113.5	1423	1354	88.2	264.0	Study electron production and loss, and large scale transport of ionization in ionosphere. Cooperative with Canada. (WSMC)

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
San Marco C (S) 1971 036A	Scout 173C (S)	Apr 24		DOWN NOV 29, 1971			163.3	Study atmospheric drag, density, neutral composition, and temperature. Cooperative with Italy. (San Marco)
Mariner H (U)	A-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	A-Centaur (AC-23) (S)	May 30		HELIOCENTRIC ORBIT			997.9	Second Mariner Mars '71 Orbiter mission to map the Martian surface. Achieved orbit around Mars on Nov 13, 1971. Transmitted 6,876 pictures.
PAET (S)	Scout (S)	Jun 20		SUBORBITAL FLIGHT			62.1	Test to determine structure and composition of an atmosphere from a probe entering at high speed. (WFF)
Explorer 44 (S) 1971 058A	Scout (S)	Jul 8		DOWN DEC 15, 1979			115.0	Solar radiation spacecraft to monitor Sun's X-ray and ultraviolet emissions. Cooperative with NRL. (WFF)
Apollo 15 (S) 1971 063A	Saturn V (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; performed EVA with Lunar Roving Vehicle; deployed experiments. Mission Duration 295 hrs 11 min 53 sec.
P&F Subsat (S) 1971 063D	SM	Aug 4		SELENOCENTRIC ORBIT			36.3	
CAS/BOLE (S) 1971 071A	Scout (S)	Aug 16	100.2	870	662	50.1	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 166C (S)	Sep 20		SUBORBITAL FLIGHT			31.7	Barium Ion Cloud Project to study Earth's magnetic field. Cooperative with Germany. (WFF)
OSO H (S) 1971 083A	Delta (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 083B				DOWN SEP 21, 1978			20.4	
ITOS B (U) 1971 091A	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. (WSMC)
Explorer 45 (S) 1971 096A	Scout (S)	Nov 15	322.8	18149	272	3.2	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 (S)	Dec 11		DOWN DEC 12, 1978			102.4	Study interactions between plasma and charged particle streams in the atmosphere. Cooperative with UK. (WSMC)
Intelsat IV F-3 (S) 1971 116A	A-Centaur (S)	Dec 20	1454.6	36645	35649	3.9	1387.1	Fourth generation satellite to provide increased capacity for Comsat's global commercial communications network. Reimbursable.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
1972								**1972**
Intelsat IV F-4 (S) 1972 003A	A-Centaur (S)	Jan 22	1438.0	35851	35797	5.3	1387.1	Fourth generation satellite to provide increased capacity for Comsat's global commercial communications network. Reimbursable.
HEOS A-2 (S) 1972 005A	Delta (S)	Jan 31		DOWN AUG 2, 1974			117.0	Carried 7 experiments provided by various European organizations to investigate particles and micrometeorites in space. Reimbursable. (WSMC)
Pioneer 10 (S) 1972 012A	A-Centaur (S)	Mar 2		SOLAR SYSTEM ESCAPE TRAJECTORY			258.0	Jupiter Flyby. First spacecraft to flyby Jupiter and return scientific data.
TD-1 (S) 1972 014A	Delta (S)	Mar 11		DOWN JAN 9, 1980			470.8	Western European satellite to obtain data on high-energy emissions from stellar and galactic sources. ESRO Reimbursable. (WSMC)
Apollo 16 (S) 1972 031A	Saturn V (S)	Apr 16		LANDED APR 27, 1972			51655.0	Fifth manned lunar landing mission with John W. Young, Ken Mattingly, and Charles M. Duke. Landed at Descartes on Apr 20. Deployed camera and experiments; performed EVA with lunar roving vehicle. Deployed P&F Subsatellite in lunar orbit. Mission Duration 265 hours 51 minutes 59 seconds.
P&F Subsat (S) 1972 031D	SM	Apr 16		IMPACTED MOON MAY 29, 1972			36.3	
Intelsat IV F-5 (S) 1972 041A	A-Centaur (S)	Jun 13	1438.3	35852	35807	6.3	1387.1	Fourth generation satellite to provide increased capacity for Comsat's global commercial communications network. Reimbursable.
ERTS-A (S) 1972 058A	Delta (S)	Jul 23	103.1	909	899	99.1	941.0	Demonstrate remote sensing technology of Earth's surface on a global scale and on a repetitive basis. (WSMC)
Explorer 46 (S) 1972 061A	Scout (S)	Aug 13		DOWN NOV 2, 1979			206.4	Meteoroid Technology Satellite to measure meteoroid penetration rates and velocity. (WFF)
OAO 3 (S) 1972 065A	A-Centaur (S)	Aug 21	99.4	735	726	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 069A	Scout (S)	Sep 2	100.2	816	721	90.0	94.0	Navigation Satellite for U.S. Navy. Reimbursable. (WSMC)
Explorer 47 (S) 1972 073A	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.

NASA Major Launch Record

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ITOS D (S) 1972 082A	Delta 91 (S)	Oct 15	114.9	1453	1447	101.7	345.0	To augment NOAA's satellite world-wide weather observation capabilities. Oscar, amateur radio satellite, carried as piggyback. Reimbursable. (WSMC)
OSCAR (S) 1972 082B		Oct 15	114.9	1453	1446	101.7	15.9	
Telesat A (ANIK) (S) 1972 090A	Delta 92 (S)	Nov 9	1457.5	36257	36150	4.6	544.3	First of a series of domestic communications satellites for Canada. Reimbursable.
Explorer 48 (S) 1972 091A	Scout 170C (S)	Nov 15		DOWN AUG 20, 1980			186.0	Small Astronomy Satellite; carried gamma ray telescope in bulbous dome to study gamma rays. Launched by Italian crew from San Marco.
ESRO IV (S) 1972 092A	Scout (S)	Nov 21		DOWN APR 15, 1974			114.0	Carried five experiments to investigate the ionosphere, near magnetosphere, auroral, and solar particles. Reimbursable. (WSMC)
Apollo 17 (S) (AS-512/CSM-114/LM-12) 1972 096A	Saturn V (S)	Dec 7		LANDED DEC 19, 1972			51655.0	Sixth and last manned lunar landing mission with Eugene A. Cernan, Ronald E. Evans, and Harrison H. (Jack) Schmitt. Landed at Taurus-Littrow on Dec 11. 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 097A	Delta (S)	Dec 11	107.1	1100	1087	99.6	716.8	Stabilized, Earth-oriented platform to test advanced systems for collecting meteorological and geological data. (WSMC)
AEROS (German A-2) (S) 1972 100A	Scout (S)	Dec 16		DOWN AUG 22, 1973			125.7	Study state and behavior of upper atmosphere and ionosphere. Cooperative with Germany. (WSMC)
1973								**1973**
Pioneer G (S) 1973 019A	A-Centaur (S)	Apr 5		SOLAR SYSTEM ESCAPE TRAJECTORY			259.0	Investigate interplanetary medium beyond the orbit of Mars, the Asteroid Belt, and the near-Jupiter environment.
Telesat B (ANIK-2) (S) 1973 023A	Delta 94 (S)	Apr 20	1443.0	35973	35870	5.1	544.3	Second domestic communications satellite for Canada. Reimbursable.
Skylab Workshop (S) 1973 027A	Saturn V (S)	May 14		DOWN JUL 11, 1979			71500.0	Unmanned launch of first U.S. Space Station. Workshop incurred damage during launch. Repaired during follow-on manned missions.

NASA Major Launch Record

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Skylab 2 206/CSM-116 (S) 1973 032A	Saturn IB (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 hull and reduce temperatures within workshop; freed solar wing that was jammed with debris. Mission duration 672 hours 49 minutes 49 seconds.
Explorer 49 (S) 1973 039A	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 (U)	Jul 16		DID NOT ACHIEVE ORBIT			333.8	To augment NOAA's satellite world-wide weather observation capabilities. Vehicle second stage malfunctioned. Reimbursable. (WSMC)
Skylab 3 207/CSM-117 (S) 1973 050A	Saturn IB (S)	Jul 28		LANDED SEP 25, 1973			29750.0	Second manned visit to Skylab Workshop with Alan L. Bean, Owen K. Garriot, and Jack R. Lousma. Performed systems and operational tests, conducted experiments, deployed thermal shield. Mission Duration 1427 hours 9 minutes 4 seconds.
Intelsat IV F-7 (S) 1973 058A	A-Centaur (AC-31) (S)	Aug 23	1466.3	38057	34693	5.7	1387.1	Fourth generation satellite to provide increased capacity for Comsat's global commercial communications network. Reimbursable.
Explorer 50 (S) 1973 078A	Delta 98 (S)	Oct 25		ELEMENTS NOT AVAILABLE			397.2	Last Interplanetary Monitoring Platform to investigate Earth's radiation environment.
Transit (S) 1973 081A	Scout (S)	Oct 30	105.3	1133	887	89.9	95.0	Navigation satellite for the U.S. Navy. Reimbursable. (WSMC)
Mariner 10 (Mariner/Venus/ Mercury) (S) 1973 085A	A-Centaur (AC-34) (S)	Nov 3		HELIOCENTRIC ORBIT			504.0	Venus and Mercury flyby mission; first dual planet mission. Photographed Earth and the Moon on its flight to Venus; Venus encounter (at 5,800 km) on Feb 5; Mercury encounter (at 704 km) on Mar 29, 1974; second Mercury encounter (at 48,069 km) on Sep 21, 1974; third Mercury encounter (at 327 km) on Mar 16, 1975. Engineering tests conducted before attitude control gas was depleted and transmitter commanded off on Mar 24, 1975.
ITOS F (S) 1973 086A	Delta 98 (S)	Nov 6	116.1	1508	1499	101.9	345.0	To augment NOAA's satellite world-wide weather observation capabilities. Reimbursable. (WSMC)

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Skylab 4 (S) 1973 090A	Saturn IB (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 2017 hours 15 minutes 32 seconds.
Explorer 51 (S) 1973 101A	Delta (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 002A	Delta (U)	Jan 18		DOWN JAN 25, 1974			435.5	Communication satellite for the United Kingdom. Short circuit in electronics package caused vehicle failure. Reimbursable.
Centaur Proof Flight (U)	Titan III E Centaur (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 009A	Scout S-190C (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 013A	Scout (S)	Mar 8	100.6	890	688	97.9	91.6	Three-axis stabilized spacecraft to demonstrate technology involved in design and manufacture of this type platform for use on small spacecraft. Reimbursable. (WSMC)
Westar A (S) 1974 022A	Delta 101 (S)	Apr 13	1441.6	35942	35846	4.1	571.5	Domestic communications satellite for Western Union. Reimbursable.
SMS A (S) 1974 033A	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 fixed geosynchronous orbit about the Equator. Cooperative with NOAA.
ATS F (S) 1974 039A	Titan III C Centaur (S)	May 30	1412.0	35433	35195	8.8	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 040A	Scout (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 055A	Scout (S)	Jul 16		DOWN SEP 25, 1975			125.7	German-built satellite to study the state and behavior of upper atmosphere and ionosphere. Reimbursable. (WSMC)

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ANS A (S) 1974 070A	Scout 189C (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 075A	Delta (S)	Oct 10	1442.0	35917	35886	4.4	571.5	Domestic communications satellite for Western Union. Reimbursable.
UK-5 (S) 1974 077A	Scout 187C (S)	Oct 15		DOWN MAR 14, 1980			130.3	Measure spectrum, polarization and pulsar features of non-solar X-ray sources. Cooperative with UK. (San Marco)
ITOS-G (S) 1974 089A	Delta 104 (S)	Nov 15	114.9	1456	1443	101.6	345.0	ITOS-G - To augment NOAA's satellite world-wide weather observation capabilities. Reimbursable. Intasat - Conduct worldwide observations of ionospheric total electron counts. Cooperative with Spain. Oscar - provide communications for amateur radio enthusiasts around the world. (WSMC)
INTASAT (S) 1974 089B			114.8	1457	1439	101.6	20.4	
OSCAR (S) 1974 089C			114.8	1457	1438	101.6	28.6	
Intelsat IV F-8 (S) 1974 093A	A-Centaur (AC-32) (S)	Nov 21	1443.1	35946	35901	3.6	1387.1	Fourth generation satellite to provide increased capacity for Comsat's global commercial communications network. Reimbursable.
Skynet II-B (S) 1974 094A	Delta (S)	Nov 22	1434.5	35773	35736	7.7	435.0	Communication satellite for the United Kingdom. Reimbursable.
Helios A (S) 1974 097A	Titan III Centaur (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	1435.0	36658	34871	3.6	402.0	Joint French-German communications satellite to serve North and South America, Europe, Africa and the Middle East. Reimbursable.
1975								**1975**
Landsat 2 (S) 1975 004A	Delta (S)	Jan 22	103.1	913	901	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 011A	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)	A-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.
GEOS C (S) 1975 027A	Delta (S)	Apr 9	101.7	857	816	115.0	340.0	Oceanographic and geodetic satellite to measure ocean topography, sea state, and other features. (WSMC)

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Explorer 53 (S) 1975 037A	Scout S194C (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 038A	Delta 109 (S)	May 7	1439.6	35867	35842	3.8	544.3	Third domestic communications satellite for Canada. Reimbursable.
Intelsat IV F-1 (S) 1975 042A	A-Centaur (AC-35) (S)	May 22	1450.8	36120	36028	3.6	1387.1	Fourth generation satellite to provide increased capacity for COMSAT's commercial communications network. Last of the IV series. Reimbursable.
Nimbus F (S) 1975 052A	Delta (S)	Jun 12	107.4	1111	1100	99.6	827.0	Stabilized, Earth-oriented platform to test advanced systems for collecting meteorological and geological data. (WSMC)
OSO I (S) 1975 057A	Delta (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 066A	Saturn IB (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 with Aleksey Leonov and Valeriy Kubasov on July 17, 1975. Mission Duration 217 hrs 28 min 23 sec.
COS B (S) 1975 072A	Delta 113 (S)	Aug 8		CURRENT ELEMENTS NOT MAINTAINED			277.5	Cosmic ray satellite to study extraterrestrial gamma radiation. ESA Reimbursable. (WSMC)
Viking A (S) 1975 075A	Titan III Centaur (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.
LANDER (S) 1975 075C				LANDED ON MARS JUL 20, 1976			571.5	First analysis of surface material on another planet.
Symphonie B (S) 1975 077A	Delta 114 (S)	Aug 29	1440.5	35879	35864	8.1	402.0	Second joint French-German communications satellite to serve North and South America, Europe, Africa and the Middle East. Reimbursable.
Viking B (S) 1975 083A	Titan III Centaur (S)	Sep 9		AEROCENTRIC ORBIT			2324.7	Second Mars Orbiter and Lander mission to conduct systematic investigation of Mars. Soft landed on Mars on
Lander 1975 083A				LANDED ON MARS SEP 3, 1976			571.5	Sep 3, 1976. Returned excellent scientific data.
Intelsat IVA F-1 (S) 1975 091A	A-Centaur (AC-36) (S)	Sep 25	1441.1	35896	35870	3.6	1515.0	Improved satellite with double the capacity of previous Intelsats for Comsat's global commercial communications network. Reimbursable.
Explorer 54 (S) 1975 096A	Delta 115 (S)	Oct 6		DOWN MAR 12, 1976			675.0	Atmosphere Explorer to investigate the chemical processes and energy transfer mechanisms which control Earth's atmosphere. (WSMC)

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Transit (S) 1975 099A	Scout S-195C (S)	Oct 12	96.8	677	529	90.4	161.9	Second in a series of improved navigation satellite for U.S. Navy. Reimbursable. (WSMC)
SMS-C/GOES A (S) 1975 100A	Delta 116 (S)	Oct 16	1435.6	35780	35771	7.6	628.0	First operational satellite in NOAA's geosynchronous weather satellite system. Reimbursable.
Explorer 55 (S) 1975 107A	Delta (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.
Dual Air Density Explorer (U)	Scout S-196C (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	1445.9	36074	35880	3.7	867.7	First RCA domestic communications satellite. Reimbursable.
1976								**1976**
Helios B (S) 1976 003A	Titan III Centaur (S)	Jan 15		HELIOCENTRIC ORBIT			374.7	Carried 11 scientific instruments to study the Sun. Cooperative with Germany.
CTS (S) 1976 004A	Delta (S)	Jan 17	1436.3	35859	35732	8.2	347.0	Experimental high-powered communication satellite for communication in remote areas. Cooperative with Canada.
Intelsat IVA F-2 (S) 1976 010A	A-Centaur (AC-37) (S)	Jan 29	1444.6	35965	35941	3.8	1515.0	Second improved satellite with double the capacity of previous Intelsats for Comsat's global commercial communications network. Reimbursable.
Marisat A (S) 1976 017A	Delta 120 (S)	Feb 19	1436.2	35800	35776	6.5	655.4	Comsat Maritime Satellite to provide rapid, high-quality communications between ships at sea and home offices. Reimbursable.
RCA B (S) 1976 029A	Delta 121 (S)	Mar 26	1406.1	36536	35973	3.2	867.7	Second RCA domestic communications satellite. Reimbursable.
NATO IIIA (S) 1976 035A	Delta 122 (S)	Apr 22	1436.0	35788	35783	6.1	670.0	Third-generation communications satellite for NATO. Reimbursable
LAGEOS (S) 1976 039A	Delta (S)	May 4	225.4	5945	5837	109.9	411.0	Solid, spherical passive satellite to provide a reference point for laser ranging experiments. (WSMC)
Comstar 1A (S) 1976 042A	A-Centaur (AC-38) (S)	May 13	1442.6	35925	35902	3.6	1490.1	First domestic communications satellite for Comsat. Reimbursable.
Air Force P76-5 (S) 1976 047A	Scout S-179C (S)	May 22	105.5	1049	985	99.6	72.6	Evaluate propagation effects of disturbed plasmas on radar and communications systems. Reimbursable. (WSMC)

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Marisat B (S) 1976 053A	Delta 124 (S)	Jun 9	1436.1	35799	35776	5.4	655.47	Second Comsat Maritime Satellite to provide rapid, high-quality communications between ships at sea and home offices. Reimbursable.
Gravity Probe A (S)	Scout S-193C (S)	Jun 18		SUBORBITAL FLIGHT			102.5	Scientific probe to test Einstein's Theory of Relativity. (WFF)
Palapa A (S) 1976 066A	Delta 125 (S)	Jul 8	1435.9	36028	35537	2.3	573.8	Communication Satellite for Indonesia. Reimbursable.
Comstar B (S) 1976 073A	A-Centaur (AC-40) (S)	Jul 22		GEOSYNCHRONOUS ORBIT			1490.1	Second domestic communications satellite for Comsat. Reimbursable.
ITOS H (S) 1976 077A	Delta 126 (S)	Jul 29	116.2	1519	1503	101.8	345.0	Second generation satellite for NOAA's world-wide weather observation. Reimbursable. (WSMC)
TIP III (S) 1976 089A	Scout S-197C (S)	Sep 1		DOWN MAY 30, 1981			166.0	Improved Transit Navigation Satellite for the U.S. Navy. Reimbursable. (WSMC)
Marisat C (S) 1976 101A	Delta 127 (S)	Oct 14	1436.2	35797	35780	6.9	655.4	Third Comsat Maritime Satellite to provide rapid, high-quality communications between ships at sea and home offices. Reimbursable.
1977								1977
NATO IIIB (S) 1977 005A	Delta 128 (S)	Jan 27	1436.0	35790	35779	5.7	670.0	Third-generation communications satellite for NATO. Reimbursable.
Palapa B (S) 1977 018A	Delta 129 (S)	Mar 10		GEOSYNCHRONOUS ORBIT			573.8	Second Communication Satellite for Indonesia. Reimbursable.
GEOS/ESA (U) 1977 029A	Delta 130 (U)	Apr 20	734.1	38475	2682	26.6	571.5	ESA scientific satellite; carried seven experiments to investigate Earth's magnetosphere. Malfunction during second stage/third stage spinup placed GEOS in unusable orbit. Reimbursable.
Intelsat IVA F-4 (S) 1977 041A	A-Centaur (AC-39) (S)	May 26	1436.2	35802	35774	2.5	1515.0	Improved satellite with double the capacity of previous Intelsats for Comsat's global commercial communications network. Reimbursable.
GOES/NOAA (S) 1977 048A	Delta (S)	Jun 16	1436.3	35824	35754	5.8	635.0	Visible/infrared spin-scan radiometer provided day and night global weather pictures for NOAA. Reimbursable.
GMS (S) 1977 065A	Delta 132 (S)	Jul 14	1436.2	35796	35779	6.0	669.5	Operational weather satellite; Japan's contribution to Global Atmosphere Research Program (GARP). Reimbursable.
HEAO A (S) 1977 075A	A-Centaur (S)	Aug 12		DOWN MAR 15, 1979			2551.9	High Energy Astronomy Observatory to study and map X-rays and gamma rays.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Voyager 2 (S) 1977 076A	T-IIIE Centaur (S)	Aug 20		SOLAR SYSTEM ESCAPE TRAJECTORY			2086.5	Investigate the Jupiter and Saturn planetary systems and the interplanetary medium between Earth and Saturn. Jupiter flyby occurred on July 9, 1979; Saturn flyby occurred on Aug 25, 1981; Uranus flyby occurred on Jan 24, 1986; Neptune flyby planned for Aug 24, 1989.
SIRIO (S) 1977 080A	Delta 133 (S)	Aug 25	1435.6	35793	35759	1.9	398.0	Italian scientific satellite to study propagation characteristics of radio waves transmitted at super high frequencies during adverse weather. Reimbursable.
Voyager 1 (S) 1977 084A	T-IIIE Centaur (S)	Sep 5		HELIOCENTRIC ORBIT			2086.5	Investigate the Jupiter and Saturn planetary systems and the interplanetary medium between Earth and Saturn. Jupiter flyby occurred on Mar 5, 1979; Saturn flyby occurred on Nov 12, 1980; departed Saturn at a high angle to the ecliptic plane to observe 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.
Intelsat IVA F-5 (U)	A-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.
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 study interaction of interplanetary medium with Earth's immediate environment. Cooperative with ESA.
Transat (S) 1977 106A	Scout S-200C (S)	Oct 27	106.9	1101	1060	89.9	93.9	Improved Transit navigation satellite for the U.S. Navy. Reimbursable. (WSMC)
Meteosat (S) 1977 108A	Delta 136 (S)	Nov 22	1437.2	35875	35741	7.0	695.3	ESA Meteorological satellite; Europe's contribution to the Global Atmospheric Research Program (GARP). Reimbursable.
CS/Japan (S) 1977 118A	Delta 137 (S)	Dec 14	1455.9	36185	36159	5.3	677.0	Experimental communication satellite for Japan. Reimbursable.
1978								**1978**
Intelsat IVA F-3 (S) 1978 002A	A-Centaur (AC-46) (S)	Jan 6	1436.2	35792	35783	1.9	1515.0	Provide increased telecommunications capacity for Intelsat's global network. Reimbursable.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
IUE-A (S) 1978 012A	Delta (S)	Jan 26	1436.1	43036	28536	30.9	698.5	International Ultraviolet Explorer to obtain high resolution data of stars and planets in the ultraviolet region of the spectrum. Cooperative with ESA.
FLTSATCOM-A (S) 1978 016A	A-Centaur (AC-44) (S)	Feb 9	1436.5	35807	35774	6.1	1863.3	Provide communications capability for USAF and USN for fleet relay and fleet broadcast. Reimbursable.
Landsat-C (S) 1978 026A	Delta (S)	Mar 5	103.1	917	897	98.8	900.0	Third Earth Resources Technology Satellite to study 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.
OSCAR-8 (S) 1978 026B			103.0	908	896	98.9	27.3	
PIX-I (S) 1978 026C				CURRENT ELEMENTS NOT MAINTAINED			34.0	
Intelsat IVA F-6 (AC-48) (S) 1978 035A	A-Centaur	Mar 31	1437.6	35860	35769	1.7	1515.0	Provide increased telecommunications capacity for (S) Intelsat's global network. Reimbursable.
BSE/Japan (S) 1978 039A	Delta 140 (S)	Apr 7	1433.7	37702	33775	4.5	665.0	Japan's Broadcasting Satellite/Experimental for conducting TV broadcast experiments. Reimbursable.
HCMM/AEM-A (S) 1978 041A	Scout (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 044A	Delta 141 (S)	May 11	1436.1	35802	35722	4.1	865.0	Orbital Test Satellite to conduct communications experiments for ESA. Reimbursable.
Pioneer Venus-A (Orbiter) (S) 1978 051A	A-Centaur (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 062A	Delta 142 (S)	Jun 16	1436.0	35795	35775	4.7	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.
Seasat-A (S) 1978 064A	Atlas-F (S)	Jun 26	100.4	779	775	108.0	2300.0	Demonstrate techniques for global monitoring of oceanographic phenomena and features. After 106 days of returning data, contact was lost with the satellite when a short circuit drained all power from batteries. (WSMC)
Comstar C (S) 1978 068A	A-Centaur (AC-41) (S)	Jun 29	1451.7	36168	36012	1.7	1516.0	Third domestic communications satellite for Comsat. Reimbursable.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
GEOS-B/ESA (S) 1978 071A	Delta 143 (S)	Jul 14	1449.1	36066	36016	6.9	575.0	Positioned on magnetic field lines to study magnetosphere and correlate data with ground station, balloon, and sounding rocket measurements. Reimbursable.
Pioneer/Venus-B (Multiprobe) (S) 1978 078A	A-Centaur (AC-51) (S)	Aug 8		PROBES LANDED DEC 9, 1978			904.0	Second Pioneer flight to Venus in 1978 to determine 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, but the day probe continued to transmit for 68 minutes after impact.
ISEE-C (S) 1978 079A	Delta 144 (S)	Aug 12		HELIOCENTRIC ORBIT			479.0	Monitored 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. Cooperative with ESA.
Tiros-N (S) 1978 096A	Atlas-F (S)	Oct 13	101.8	851	836	99.0	1405.0	Third generation polar orbiting environmental spacecraft to provide improved meteorological and environmental data. Operated by NOAA. (WSMC)
Nimbus-G (S) 1978 098A	Delta (S)	Oct 24	104.0	970	925	99.4	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, Delta vehicle released lithium over Northern Scandinavia and barium over Northern Alaska as part of Project CAMEO (Chemically Active Material Ejected in Orbit). (WSMC)
CAMEO 1978 098B			104.0	970	925	99.4		
HEAO-B (S) 1978 103A	A-Centaur (S)	Nov 13		DOWN MAR 25, 1982			3152.0	Second High Energy Astronomical Observatory; carried 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	1436.1	35792	35782	3.2	706.0	Third-generation communications satellite for NATO. Reimbursable
Telesat D (S) 1978 116A	Delta 147 (S)	Dec 15	1442.9	36022	35818	1.3	887.2	Fourth domestic communications satellite for Canada. Reimbursable.
1979								**1979**
SCATHA (S) 1979 007A	Delta 148 (S)	Jan 30	1415.7	42425	28348	5.5	658.6	Spacecraft Charging at High Altitudes (SCATHA) carried 12 experiments to investigate electrical static discharges that affect satellites. USAF Reimbursable.

NASA Major Launch Record

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SAGE/AEM-2 (S) 1979 013A	Scout (S)	Feb 18	94.2	506	456	55.0	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 038A	A-Centaur (AC-47) (S)	May 4	1436.1	35837	35736	4.7	1876.1	Provide communications capability for USAF and USN for fleet relay and fleet broadcast. Reimbursable.
UK-6 (S) 1979 047A	Scout S-199C (S)	Jun 2	95.6	564	526	55.0	154.5	Measure ultra-heavy cosmic ray particles and study low-energy cosmic X-rays. UK Reimbursable. (WFF)
NOAA-6 (S) 1979 057A	Atlas-F (S)	Jun 27	101.0	813	797	98.5	1405.0	To provide continuous coverage of the Earth and provide high-accuracy worldwide meteorological data. NOAA Reimbursable. (WSMC)
WESTAR C (S) 1979 072A	Delta 149 (S)	Aug 9	1436.2	35793	35782	0.0	571.5	Domestic communications satellite for Western Union. Reimbursable.
HEAO 3 (S) 1979 082A	A-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 094A	Scout (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	789.0	35495	8314	10.5	895.4	Third RCA domestic communications satellite. Contact lost shortly after apogee motor firing. Reimbursable.
1980								**1980**
FLTSATCOM C (S) 1980 004A	A-Centaur (AC-49) (S)	Jan 17	1436.1	35804	35767	4.3	1864.7	Provide communications capability for USAF and USN for fleet relay and fleet broadcast. Reimbursable.
SMM-A (S) 1980 014A	Delta 151 (S)	Feb 14	94.3	488	483	28.5	2315.0	Solar Maximum Mission carried seven instruments to study solar activity during the maximum of solar flares and related phenomena.
NOAA-7 (U) 1980 043A	Atlas-F (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. NOAA Reimbursable. (WSMC)
GOES D (S)	Delta 152	Sep 9	1436.2	35795	35780	4.1	832.0	Part of NOAA's global network of geostationary 1980 074A environmental satellites to provide Earth imaging, monitor the space environment, and relay meteorological data. Reimbursable.

NASA Major Launch Record

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FLTSATCOM D (S) 1980 087A	A-Centaur (AC-52) (S)	Oct 30	1436.2	35811	35765	4.0	1863.8	Provide communications capability for USAF and USN for fleet relay and fleet broadcast. Reimbursable.
SBS-A (S) 1980 091A	Delta 153 (S)	Nov 15	1436.1	35797	35777	0.7	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.
INTELSAT V-A F-2 (S) 1980 098A	A-Centaur (AC-54) (S)	Dec 6	1436.2	35810	35765	0.0	1928.2	Advanced series of spacecraft to provide increased telecommunications capacity for Intelsat's global network. Reimbursable.
1981								**1981**
COMSTAR D (S) 1981 018A	A-Centaur (AC-42) (S)	Feb 21	1436.2	35794	35784	1.9	1484.0	Fourth domestic communications satellite for Comsat. Reimbursable.
STS-1 (S) 1981 034A	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 Shuttle vehicle. Mission duration 54 hours 20 minutes 32 seconds.
NOVA-1 (S) 1981 044A	Scout S-192C (S)	May 15		ELEMENTS NOT AVAILABLE			166.9	Improved Transit satellite for the Navy's operational navigation system. Reimbursable. (WSMC)
GOES E (S) 1981 049A	Delta 154 (S)	May 22	1436.1	35792	35782	1.2	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.
Intelsat V-B F-1 (S) 1981 050A	A-Centaur (AC-56) (S)	May 23	1436.2	35809	35768	0.0	1928.2	Advanced series of spacecraft to provide increased telecommunications capacity for Intelsat's global network. Reimbursable.
NOAA-C (S) 1981 059A	Atlas-F (S)	Jun 23	101.8	855	835	99.1	1405.0	To provide continuous coverage of the Earth and provide high-accuracy worldwide meteorological data. NOAA Reimbursable. (WSMC)
Dynamics Explorer A and B 1981 070A (S) 1981 070B (S)	Delta (S)	Aug 3	410.4	23339 DOWN FEB 19, 1983	495	89.4	424.0 420.0	Dual spacecraft to study the Earth's electromagnetic fields. (WSMC)
FLTSATCOM E (U) 1981 073A	A-Centaur (AC-59) (S)	Aug 6	1460.0	36284	36222	4.6	1863.8	Provide communications capability for USAF and USN for fleet relay and fleet broadcast. Reimbursable.

NASA Major Launch Record

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SBS-B (S) 1981 096A	Delta 156 (S)	Sep 24	1436.1	35789	35785	0.0	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.
SME (S) 1981 100A	Delta (S)	Oct 6	94.7	504	502	97.7	437.0	Solar Mesosphere Explorer, an atmospheric-research satellite to study reactions between sunlight, ozone, and other chemicals in the atmosphere. Carried UoSat-Oscar 9 (UK) Amateur Radio Satellite as secondary payload.
UoSAT 1 (S) 1981 100B			94.0	470	469	97.6	52.0	
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 H. Engle and Richard H. Truly to verify the combined performance of the Shuttle vehicle. OSTA-1 payload demonstrated capability to conduct scientific research in the attached mode. Mission duration 54 hours 13 minutes 13 seconds.
RCA-D (S) 1981 114A	Delta 158 (S)	Nov 19	1436.2	35791	35785	0.1	1081.8	Fourth RCA domestic communications satellite. Reimbursable.
Intelsat V F-3 (S) 1981 119A	A-Centaur (AC-55) (S)	Dec 15	1436.3	35809	35771	0.0	1928.2	Advanced series of spacecraft to provide increased telecommunications capacity for Intelsat's global network. Reimbursable.
1982								**1982**
RCA C' (S) 1982 004A	Delta 159 (S)	Jan 16	1436.3	35795	35784	0.1	1081.8	RCA domestic communications satellite. Reimbursable.
Westar IV (S) 1982 014A	Delta 160 (S)	Feb 25	1436.2	35796	35778	0.1	1072.0	Second generation domestic communications satellite for Western Union. Reimbursable.
Intelsat V-D F-4 (S) 1982 017A	A-Centaur (AC-58) (S)	Mar 4	1436.1	35808	35767	0.0	1928.2	Advanced series of spacecraft to provide increased telecommunications capacity for Intelsat's global network. Reimbursable.
STS 3 (S) 1982 022A	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 Shuttle vehicle. OSS-1 scientific experiments conducted from the cargo bay. Mission duration 192 hours 4 minutes 45 seconds.
Insat 1-A (U) 1982 031A	Delta 161 (S)	Apr 10	1434.2	35936	35562	0.1	1152.1	Multipurpose telecommunications/meteorology spacecraft for India. Reimbursable.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Westar V (S) 1982 058A	Delta 162 (S)	Jun 8	1436.2	35796	35778	0.1	1105.0	Western Union domestic communications satellite. Reimbursable.
STS 4 (S) 1982 065A	Shuttle (S) (Columbia)	Jun 27	LANDED AT DRFR 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 Shuttle vehicle. Carried first operational Getaway Special canister for Utah State University and payload DOD 82-1. Mission duration 169 hours 4 minutes 45 seconds.
Landsat D (S) 1982 072A	Delta 163 (S)	Jul 16	98.8	702	698	98.3	1942.0	Earth Resources Technology Satellite to provide continuing Earth remote sensing data. Instruments included a multispectral scanner and thematic mapper. (WSMC)
Telesat G (S) 1982 082A	Delta 164 (S)	Aug 25	1436.0	35796	35776	0.0	1238.3	Commercial communications satellite for Canada. Reimbursable.
Intelsat V-E F-5 (S) 1982 097A	A-Centaur (AC-60) (S)	Sep 28	1436.1	35805	35769	0.1	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.
RCA-E (S) 1982 105A	Delta 165 (S)	Oct 27	1436.2	35791	35784	0.0	1116.3	RCA domestic communications satellite. Reimbursable.
STS 5 (S) 1982 110A	Shuttle (S) (Columbia)	Nov 11	LANDED AT DRFR NOV 16, 1982					First operational flight of STS with Vance Brand, Robert Overmyer, Joseph Allen and William Lenoir. Two satellites deployed: SBS-C (Commercial Reimbursable) and Telesat-C (Canada Reimbursable). Demonstrated ability to conduct routine space operations. Mission duration 122 hours 14 minutes 26 seconds.
SBS-C (S) 1982 110B		Nov 11	1436.1	35788	35786	0.0	3344.8	
Telesat-E (S) 1982 110C		Nov 12	1436.1	35794	35779	0.0	4443.4	
1983								**1983**
IRAS (S) 1983 004A	Delta 166 (S)	Jan 25	102.9	905	887	99.1	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 sources and infrared sky maps. Lewis Research Center Plasma Interaction Experiment (PIX), to investigate interactions between high voltage systems and space environment, activated by Delta after IRAS separation. Cooperative with the Netherlands.
PIX II (S) 1983 004B			102.4	886	855	100.1		

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
NOAA-8 (S) 1983 022A	Atlas-E (S)	Mar 28	101.2	825.5	805	98.6	1712.0	Advanced Tiros-N spacecraft to provide continuous coverage of the Earth and provide high-accuracy worldwide meteorological data. NOAA Reimbursable. (WSMC)
STS 6 (S) 1983 026A	Shuttle (S) (Challenger)	Apr 4		LANDED AT DFRF APR 9, 1983				Second operational flight of the STS with Paul Weitz, Karol Bobko, Donald Peterson, and 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 026B		Apr 4	1436.3	35804	35776	2.3	17014.0	
RCA F (S) 1983 030A	Delta 167 (S)	Apr 11	1436.1	35790	35781	0.1	1116.3	RCA domestic communications satellite. Reimbursable.
GOES 6 (S) 1983 041A	Delta (S)	Apr 28	1436.4	35891	35776	0.1	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.
Intelsat V-F F-6 (S) 1983 047A	A-Centaur (AC-61) (S)	May 19	1436.2	35810	35765	0.0	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.
EXOSAT (S) 1983 051A	Delta 169 (S)	May 26		DOWN MAY 6, 1986			500.0	ESA X-ray satellite to provide continuous observations of X-ray sources. Reimbursable. (WSMC)
STS 7 (S) 1983 059A	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 (Canada-Reimbursable) and Palapa (Indonesia - Reimbursable). Carried out experiments including launching and recovering SPAS 01 (FRG). Mission duration 146 hours 23 minutes 59 seconds.
Telesat-F (S) 1983 059B		Jun 18	1436.0	35791	35782	0.0	4443.4	
Palapa-B-1 (S) 1983 059C		Jun 18	1436.1	35788	35783	0.0	4521.5	
SPAS-01 (S) 1983 059F		Jun 18		RETRIEVED JUN 24, 1983				
AF P83-1 (S) 1983 063A	Scout S-205 (S)	Jun 27	100.9	834	765	82.0	112.6	Air Force HILAT satellite to evaluate propagation effects of disturbed plasmas on radar and communication systems. Reimbursable. (WSMC)
Galaxy 1 (S) 1983 065A	Delta 170 (S)	Jun 28	1436.2	35797	35782	0.0	519.0	Hughes Communications, Inc. communications satellite. Reimbursable.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
Telstar 3A (S) 1983 077A	Delta 171 (S)	Jul 28	1436.1	35796	35778	0.0	635.0	AT&T communications satellite. Reimbursable.
STS 8 (S) 1983 089A	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 (India-Reimbursable), performed tests and experiments. Mission duration 145 hours 8 minutes 43 seconds.
INSAT-B (S) 1983 089B		Aug 31	1436.2	35819	35755	0.1	3391.0	
RCA G (S) 1983 094A	Delta 172 (S)	Sep 8	1436.2	35797	35778	0.0	1121.3	RCA domestic communications satellite. Reimbursable.
Galaxy 2 (S) 1983 098A	Delta 173 (S)	Sep 22	1436.2	35799	35782	0.0	579.0	Hughes Communications Satellite. Reimbursable.
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 multidiscipline 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 011A	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 (Western Union-Reimbursable), and Palapa B-2 (Indonesia-Reimbursable). Both PAM's failed; both satellites retrieved on 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 011B		Feb 3		DOWN NOV 16, 1984 (51-A)			3309.0	
IRT (S) 1984 011C		Feb 3		DOWN FEB 11, 1984			234.0	
Palapa B-2 (U) 1984 011D		Feb 6		DOWN NOV 16, 1984 (51-A)			3419.0	
LANDSAT 5 (S) 1984 021A	Delta 174 (S)	Mar 1	98.8	702	697	98.2	1947.0	Earth resources technology satellite to provide continuing Earth remote sensing data. Instruments included a multispectral scanner and thematic mapper. UoSAT sponsored by AMSAT. NOAA Reimbursable. (WSMC)
UoSAT (S) 1984 021B			98.4	691	674	98.1	52.0	

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
STS 41-C (S) 1984 034A	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. LDEF deployed; SMM retrieved and repaired in Cargo Bay, redeployed Apr 12. Mission duration 167 hrs 41 min.
LDEF (S) 1984 034B		Apr 6	94.0	470	467	28.5	9670.0	
Intelsat V-G F-9 (U) 1984 057A	A-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.
AMPTE CCE (S) 1984 088A	Delta (S)	Aug 16	939.4	49817	974	3.8	242.0	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 (FGR); and United Kingdom; Subsatellite (UKS) provided by The United Kingdom; to study the transfer of mass from the solar wind to the magnetosphere. International Cooperative.
IRM (S) 1984 088B			2653.4	113818	402	27.0	605.0	
UKS (S) 1984 088C			2659.6	113417	1002	26.9	77.0	
STS 41-D (S) 1984 093A	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 A. Hawley, Judith A. Resnik, and Charles D. Walker. Deployed SBS (Commercial-Reimbursable), LEASAT (Commercial-Reimbursable) and Telstar (AT&T-Reimbursable), carried out experiments including OAST-1 solar array structural testing. Mission duration 144 hours 56 minutes 4 seconds.
SBS-4 (S) 1984 093B		Aug 31	1436.1	35793	35781	0.0	3344.0	
Syncom IV-2 (S) 1984 093C		Aug 31	1436.0	35788	35782	0.7	6889.0	
Telstar 3-C (S) 1984 093D		Sep 1	1436.1	35791	35782	0.0	3402.0	
Galaxy C (S) 1984 101A	Delta 176 (S)	Sep 21	1436.2	35792	35783	0.0	519.0	Hughes Communication, Inc., Communications Satellite. Reimbursable.
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 Earth; performed scientific experiments using OSTA-3 and other instruments. Mission duration 197 hours 23 minutes 37 seconds.
ERBS (S) 1984 108B		Oct 5	96.8	607	599	57.0	2449.0	
NOVA III (S) 1984 110A	Scout S-208C (S)	Oct 11	108.9	1200	1149	90.0	173.7	Improved Transit Navigation Satellite for U.S. Navy. Reimbursable. (WSMC)

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All launches from ESMC, unless otherwise noted)
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.
Telesat-H (S) 1984 113B		Nov 9	1436.1	35795	35788	0.0	3420.0	Deployed Telesat (Canada-Reimbursable) and Syncom IV-1 (Hughes-Reimbursable). Retrieved and returned Palapa B-2 and Westar 6 (Launched on 41-B). Mission duration 191 hours 44 minutes 56 seconds.
Syncom IV-1 (S) 1984 113C		Nov 10	1436.0	35890	35679	0.9	6889.0	
NATO III-D (S) 1984 115A	Delta 177 (S)	Nov 13	1436.1	35788	35783	3.2	761.0	Fourth in a series of communication satellites for NATO. Reimbursable.
NOAA-9 (S) 1984 123A	Atlas-E (S)	Dec 12	102.2	863	839	99.1	1712.0	Advanced TIROS-N spacecraft to provide continuous coverage of the Earth and provide high-accuracy worldwide meteorological data. NOAA. Reimbursable. (WSMC)
1985								**1985**
STS 51-C (S) 1985 010A	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. Unannounced payload for DOD. (Reimbursable). Mission duration 73 hours 33 minutes 27 seconds.
DOD (S) 1985 010B				ELEMENTS NOT AVAILABLE				
Intelsat V-A F-10 (S) 1985 025A	A-Centaur (AC-36) (S)	Mar 22	1436.1	35807	35768	0.0	1996.7	First in a series of Improved Commercial Communication Satellites for Intelsat. Reimbursable.
STS 51-D (S) 1985 028A	Shuttle (S) (Discovery)	Apr 12		LANDED AT KSC APR 19, 1985				Fourth Discovery flight with Karol J. 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 (Hughes-Reimbursable) and Telesat (Canada-Reimbursable). Syncom Sequencer failed to start, despite attempts by crew; remained inoperable until restarted by crew of 51-I. Mission duration 167 hrs 54 min.
Telesat-I (S) 1985 028B		Apr 13	1436.0	35796	35777	0.3	3350.0	
Syncom IV-3 (S) 1985 028C		Apr 12	1436.2	35809	35768	1.4	6889.0	
STS 51-B (S) Spacelab-3 1985 034A	Shuttle (S) (Challenger)	Apr 29		LANDED AT DFRF MAY 6, 1985				Sixth Challenger flight with Robert F. Overmyer, Frederick D. Gregory, Don Lind, Norman E. Thagard, William E. Thornton, Lodewijk Vanderberg, and Taylor Wang. Spacelab-3 mission to conduct applications, science, and technology experiments. Deployed Northern Utah Satellite (NUSAT). Global Low Orbiting Message Relay Satellite (GLOMR) failed to deploy and was returned. Mission duration 168 hours 8 minutes 47 seconds.
NUSAT (S) 1985 034B				DOWN DEC 15, 1986			47.6	

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
STS 51-G (S) 1985 048A	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 (Mexico - Reimbursable), ARABSAT (ASCO-Reimbursable) and TELSTAR (AT&T-Reimbursable). Deployed and retrieved SPARTAN 1. Mission duration 169 hours 39 minutes.
MORELOS-A (S) 1985 048B		Jun 17	1436.2	35793	35782	0.0	3443.0	
ARABSAT-A (S) 1985 048C		Jun 18	1436.2	35807	35768	0.0	3499.0	
TELSTAR 3-D (S) 1985 048D		Jun 19	1436.1	35804	35770	0.0	3437.0	
SPARTAN 1 (S) 1985 048E		Jun 20		RETRIEVED JUN 24, 1985			2051.0	
Intelsat VA F-11 (S) 1985 055A	A-Centaur (AC-64) (S)	Jun 29	1436.1	35802	35772	0.0	1996.7	Second in a series of improved Commercial Communications Satellites for Intelsat. Reimbursable.
STS 51-F (S) Spacelab-2 1985 063A	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. Deployed Plasma Diagnostic Package (PDP) which was retrieved 6 hours later. Mission duration 190 hours 45 minutes 26 seconds.
PDP (S) 1985 063B				RETRIEVED JUL 29, 1985				
Navy SCOS-I 1985 066A (S)	Scout S-209C (S)	Aug 2	107.9	1257	1002	89.9	64.2	Two Navigation Satellites for U.S. Navy. Reimbursable. (WSMC)
1985 066B (S)			107.9	1258	1002	89.9	64.2	
STS 51-I (S) 1985 076A	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 (Australia-Reimbursable), ASC (American Satellite Co.-Reimbursable), and Syncom IV-4 (Hughes - Reimbursable). After reaching Geosynchronous Orbit, Syncom IV-4 ceased functioning. Repaired Syncom IV-3 (Launched by 51-D). Mission duration 170 hours 27 minutes 42 seconds.
Aussat-1 (S) 1985 076B		Aug 27	1436.2	35794	35781	0.0	3445.5	
ASC (S) 1985 076C		Aug 27	1436.1	35796	35777	0.1	3406.1	
Syncom IV-4 (U) 1985 076D		Aug 29	1436.1	36493	35079	1.4	6894.7	
Intelsat VA F-12 (S) 1985 087A	A-Centaur (AC-65) (S)	Sep 28	1436.1	35802	35772	0.0	1996.7	Third in a series of improved commercial Communications Satellites for Intelsat. Reimbursable.

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
STS 51-J (S) (DOD) 1985 092A	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 hrs 14 min 38 sec.
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 to conduct scientific experiments. Deployed GLOMR. 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	
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 (MUREOS), Charles D. Walker (MDAC). Deployed MORELOS (Mexico-Reimbursable), Aussat (Australia-Reimbursable), and Satcom (RCA-Reimbursable). 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	35794	35780	1.1	4539.6	
Aussat-2 (S) 1985 109C		Nov 27	1436.2	35794	35780	0.0	4569.1	
Satcom (S) 1985 109D		Nov 28	1436.2	35796	35781	0.0	7225.3	
OEX Target 1985 109E				DOWN MAR 2, 1987				
AF-16 1985 114A (S)	Scout S-207C (S)	Dec 12	94.6	691	311	37.1		Air Force instrumented test vehicle. (Dual Payload) Reimbursable. (WFF)
1985 114B (S)				DOWN AUG 9, 1987				
1986								**1986**
STS 61-C (S) 1986 003A	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 (RCA-Reimbursable). 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 003B		Jan 12	1436.2	35795	35780	0.0	7225.3	

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
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. Christa McAuliffe (Teacher). Approximately 73 seconds into flight, the Shuttle exploded.
GOES-G (U)	Delta (U)	May 5		DID NOT ACHIEVE ORBIT			840.0	Provide systematic worldwide weather coverage for NOAA. Vehicle failed. Reimbursable.
DOD (U) 1986 069A	Delta (U)	Sep 5		DOWN SEP 28, 1986				Carried DOD experiment. Reimbursable
NOAA-G (S) 1986 073A	Atlas-E (S)	Sep 17	101.2	823	804	98.7	1712.00	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. (WSMC)
AF P87-II (S) Polar Bear 1986 088A	Scout (S) S-199	Nov 13	104.9	1018	957	89.5		Scientific satellite to study atmospheric effects on electromagnetic propagation. USAF Reimbursable. (WSMC)
FLTSATCOM (F-7) (S) 1986 096A	A-Centaur (AC-66) (S)	Dec 4	1436.2	35875	35703	4.3	1128.5	Provide communications between aircraft ships, and ground stations for DOD. Reimbursable.
1987								**1987**
GOES-H (S) 1987 022A	Delta 179 (S)	Feb 26	1436.3	35796	35783	0.1	840.0	Operational environmental satellite to provide systematic worldwide weather coverage. NOAA Reimbursable.
PALAPA B2-P 1987 029A	Delta 180	Mar 20	1436.2	35788	35788	0.0	652.0	Provide communication coverage over Indonesia and the Asian countries. Reimbursable.
FLTSATCOM (F-6) (U)	A-Centaur 67 (U)	Mar 26		DID NOT ACHIEVE ORBIT			1038.7	Part of worldwide communications system between aircraft, ships, and ground stations for DOD. Telemetry lost shortly after launch; destruct signal sent at 70.7 seconds into flight. An electrical transient, caused by lighting strike on launch vehicle, most probable cause of loss. Reimbursable.
SOOB-2 1987 080A (S) 1987 080B (S)	Scout (S) S204C	Sep 16	107.2 107.2	1175 1181	1017 1014	90.3 90.3	64.5 64.5	Two transit navigation satellites in a stacked configuration for the U.S. Navy. Reimbursable. (WSMC)

NASA Major Launch Record

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from ESMC, unless otherwise noted)
1988								**1988**
DOD (SDI) (S) 1988 008A	Delta 181 (S)	Feb 8	90.1	333	223	28.6		Strategic Defense Initiative Organization (SDIO) Payload. Reimbursable.
San Marco D/L(S) 1988 026A	Scout (S) S-206C	Mar 25		DOWN DEC 6, 1988			273	Explore the relationship between solar activity and meteorological phenomena. Cooperative with Italy. (San Marco)
SOOS-3 1988 033A (S) 1988 033B(S)	Scout (S) S-211C	Apr 25	 108.6 108.7	 1302 1316	 1017 1018	 90.4 90.4	129.6	Two Transit navigation satellites in a stacked configuration for the U.S. Navy. Reimbursable. (WSMC)
Nova II 1988 052A	Scout (S) S-213C	Jun 16	103.8	1105	773	90.1	170.5	Improved Transit Navigation Satellite for the U.S. Navy. Reimbursable. (WSMC)
SOOS-4 1988 074A (S) 1988 074B (S)	Scout (S) S-214C	Aug 25	 107.4 107.4	 1176 1178	 1032 1032	 90.0 90.0	128.2	Two Transit navigation satellites in a stacked configuration for the U.S. Navy. Reimbursable. (WSMC)
NOAA-H (S) 1988 089A	Atlas-E (S)	Sep 24	102.1	865	849	98.9	1712.0	Operational environmental satellite for NOAA. Carried Search and Rescue instruments provided by Canada and France. Reimbursable. (WSMC)
STS-26 (S) 1988 091A TDRS-3 (S) 1988 091B	Shuttle (S) (Discovery)	Sep 29 Sep 29	 1434.8	LANDED AT EAFB OCT 3, 1988 35803	 35719	 0.1	 2224.9	Seventh 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.
STS-27 (S) 1988 106A DOD 1988 106B	Shuttle (S) (Atlantis)	Dec 2		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 hrs 6 min.

Section C

Procurement, Funding And Manpower

NASA Contract Awards By State

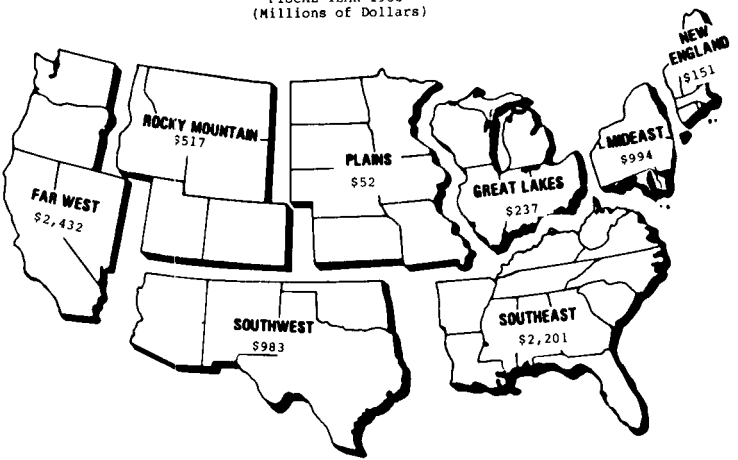
(FY 1988)

STATE	TOTAL (Thousands)	BUSINESS (Thousands)	EDUCATIONAL & NONPROFIT (Thousands)
TOTAL	$7,577,228	$7,086,632	$490,596
Alabama	546,789	531,699	15,090
Alaska	2,807	52	2,755
Arizona	21,061	7,604	13,457
Arkansas	239	83	156
California	2,411,400	2,313,603	97,797
Colorado	86,641	71,793	14,848
Connecticut	76,060	73,385	2,675
Delaware	3,621	2,827	794
District of Columbia	56,739	33,739	23,000
Florida	873,427	867,646	5,781
Georgia	15,700	11,057	4,643
Hawaii	6,890	412	6,478
Idaho	643	3	640
Illinois	15,229	5,871	9,428
Indiana	11,745	7,969	3,776
Iowa	7,861	130	7,731
Kansas	20,712	19,192	1,520
Kentucky	649	33	616
Louisiana	332,207	330,546	1,661
Maine	452	2	450
Maryland	661,290	616,948	44,342
Massachusetts	63,989	20.315	43,674
Michigan	17,642	6,717	10,925
Minnesota	8,964	7,104	1,860
Mississippi	84,976	82,761	2,215
Missouri	13,376	10,670	2,706
Montana	339	32	307
Nebraska	535	—	535
Nevada	511	453	58
New Hampshire	7,398	1,969	5,429
New Jersey	112,331	108,876	3,455
New Mexico	45,559	38,196	7,363
New York	54,992	36,352	18,640
North Carolina	6,254	611	5,643
North Dakota	90	—	90
Ohio	159,626	140,095	19,531
Oklahoma	3,406	49	3,357
Oregon	2,906	1,566	1,340
Pennsylvania	105,174	95,466	9,708
Rhode Island	2,544	578	1,966
South Carolina	896	218	678
South Dakota	485	96	389
Tennessee	21,494	16,357	5,137
Texas	913,120	864,011	49,109
Utah	429,151	427,413	1,738
Vermont	530	417	113
Virginia	318,312	296,702	21,610
Washington	17,547	12,532	5,015
West Virginia	260	49	211
Wisconsin	32,363	22,433	9,930
Wyoming	226	—	226

NOTE: Excludes smaller procurements, generally those of less than $25,000; 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*

FISCAL YEAR 1988
(Millions of Dollars)



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

Procurement Activity

TOTAL PROCUREMENT BY INSTALLATION
(FY 88)

INSTALLATION	AWARDS (Millions)	PERCENT
Marshall Space Flight Center	2,428.3	25.5
Johnson Space Center	1,806.4	18.9
Goddard Space Flight Center	1,356.3	14.2
Kennedy Space Center	1,069.2	11.2
NASA Resident Office/JPL	986.0	10.3
Lewis Research Center	417.9	4.4
Headquarters	660.7*	6.9
Ames Research Center	431.5	4.5
Langley Research Center	297.3	3.1
Stennis Space Center	91.5	1.0
TOTAL	$9,545.1	100.0

*Includes $176.5 million in reimbursable funds to U.S. Treasury for TDRSS

AWARDS TO BUSINESS FIRMS BY TYPE OF EFFORT
(FY 1988)

CATEGORY	NUMBER OF CONTRACTS	TOTAL (Millions)
Research and Development	1,672	$2,923.7
Aeronautics and Space Technology	688	424.9
Space Science and Applications	407	426.4
Space Flight	115	1,530.5
Space Tracking and Data Systems	82	211.6
Space Station	15	105.7
Commercial Programs	41	3.4
Energy R&D	3	1.1
Other Space R&D	321	220.1
Services	1,439	2,733.0
Supplies and Equipment	1,755	1,438.2
TOTAL	4,866	$7,094.9*

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

Distribution Of NASA Procurements

(In Millions of Dollars)

	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
Total Business	5,967.4	6,652.9	6,356.0	6,540.5	7,274.9
(Small Business)	(556.2)	(644.7)	(671.3)	(786.3)	(801.4)
Educational	222.6	256.9	276.6	315.4	370.3
Nonprofit	98.6	103.1	119.0	119.1	129.5
JPL	533.1	724.6	891.3	1,005.6	979.9
Government	494.3	525.1	489.7	594.9	734.6
Outside U.S.	38.1	35.4	47.1	34.3	55.9
Total	7,354.1	8,298.0	8,179.7	8,609.8	9,545.1

*Included in Government

Principal Contractors (Business Firms)

ONE HUNDRED CONTRACTORS (BUSINESS FIRMS) LISTED
ACCORDING TO TOTAL AWARDS RECEIVED
FISCAL YEAR 1988
(S=Small Business/D=Disadvantaged Business)

	CONTRACTOR & PRINCIPAL PLACE OF CONTRACT PERFORMANCE	AWARDS (THOUSANDS)	PERCENT
	TOTAL AWARDS TO BUSINESS FIRMS	$7,274,866	100.00
1.	ROCKWELL INTERNATIONAL CORP Downey, CA	1,714,205	23.56
2.	LOCKHEED SPACE OPERATIONS CO Kennedy Space Center, FL	474,338	6.52
3.	MORTON THIOKOL INC Brigham City, UT	422,798	5.81
4.	MARTIN MARIETTA CORP New Orleans, LA	341,047	4.69
5.	MCDONNELL DOUGLAS CORP Huntington Beach, CA	299,103	4.11
6.	BOEING CO Marshall Space Flight, AL	260,333	3.58
7.	GENERAL ELECTRIC CO Princeton, NJ	211,157	2.90
8.	U S B I BOOSTER PRODUCTION CO Huntsville, AL	190,700	2.62
9.	LOCKHEED ENGRG & SCIENCE CO Houston, TX	177,776	2.44
10.	E G & G FLORIDA INC Kennedy Space Center, FL	155,505	2.14
11.	ALLIED SIGNAL AEROSPACE CO Columbia, MD	152,060	2.09
12.	COMPUTER SCIENCES CORP Greenbelt, MD	151,449	2.08
13.	T R W INC Redondo Beach, CA	142,715	1.96
14.	LOCKHEED MISSILES & SPACE CO Sunnyvale, CA	140,823	1.94
15.	FORD AEROSPACE CORP Palo Alto, CA	137,372	1.89
16.	UNITED TECHNOLOGIES CORP West Palm Beach, FL	91,463	1.26
17.	INTERNATIONAL BUSINESS MACHINES Houston, TX	87,262	1.20
18.	CONTEL CORP Gaithersburg, MD	75,658	1.04
19.	GRUMMAN AEROSPACE CORP Reston, VA	74,134	1.02
20.	PAN AMERICAN WORLD SERVICES INC Stennis Space Center, MS	69,977	.96
21.	PLANNING RESEARCH CORP Hampton, VA	46,785	.64
22.	BOEING TECHNICAL OPERATIONS INC Houston, TX	41,830	.57
23.	TELEDYNE INDUSTRIES INC Marshall Space Flight, AL	39,972	.55
24.	BAMSI INC (S)(D) Marshall Space Flight, AL	39,878	.55
25.	SVERDRUP TECHNOLOGY INC Middleburgh Heights, OH	37,964	.52
26.	RAYTHEON SERVICE CO Greenbelt, MD	37,725	.52
27.	PERKIN ELMER CORP Danbury, CT	30,972	.43
28.	CRAY RESEARCH INC Chippewa Falls, WI	30,715	.42
29.	ORBITAL SCIENCES CORP (S) Denver, CO	26,038	.36
30.	M S I TECHNOLOGY SERVICES CORP Moffett Field. CA	25,123	.35

*Includes awards to RCA Corp.

Principal Contractors (Business Firms)

	CONTRACTOR & PRINCIPAL PLACE OF CONTRACT PERFORMANCE		AWARDS (THOUSANDS)	PERCENT
31.	STERLING FEDERAL SYSTEMS INC Moffett Field, CA		24,930	.34
32.	FAIRCHILD INDUSTRIES INC Germantown, MD		24,151	.33
33.	GENERAL DYNAMICS CORP San Diego, CA		22,817	.31
34.	UNISYS CORP Greenbelt, MD		22,645	.31
35.	AEROJET GENERAL CORP Sacramento, CA		22,159	.30
36.	KLATE HOLT CO Hampton, VA	(S)	20,274	.28
37.	WYLE LABORATORIES Hampton, VA		20,259	.28
38.	BALL CORP Boulder, CO		19,611	.27
39.	W & J CONSTRUCTION CORP Kennedy Space Center, FL		19,301	.27
40.	LOCKHEED CORP Marietta, GA		18,519	.25
41.	L T V AEROSPACE & DEFENSE CO Dallas, TX		16,789	.23
42.	CONTINENTAL CONSTRUCTION CORP Edwards, CA	(S)	16,491	.23
43.	KRUG INTERNATIONAL CORP Houston, TX		16,240	.22
44.	GRUMMAN DATA SYSTEMS CORP Marshall Space Flight, AL		16,166	.22
45.	NORTHROP WORLDWIDE AIRCRAFT Houston, TX		15,954	.22
46.	ENGINEERING & ECONOMICS RES Beltsville, MD	(S)(D)	15,047	.21
47.	AIR PRODUCTS & CHEMICALS INC Allentown, PA		14,876	.20
48.	SINGER CO Houston, TX		14,272	.20
49.	ZERO ONE SYSTEMS INC Moffett Field, CA	(S)(D)	13,111	.18
50.	S T SYSTEMS CORP Hyattsville, MD	(S)(D)	12,777	.18
51.	DIGITAL EQUIPMENT CORP Moffett Field, CA		12,764	.18
52.	CORTEZ III SERVICE CORP Cleveland, OH	(S)(D)	12,465	.17
53.	MICRO CRAFT INC Tullahoma, TN	(S)	11,904	.16
54.	BARRIOS TECHNOLOGY INC Houston, TX	(S)(D)	11,868	.16
55.	VIRGINIA ELECTRIC & POWER CO Hampton, VA		11,033	.15
56.	BIONETICS CORP Kennedy Space Center, FL	(S)	11,027	.15
57.	WARNER R E & ASSOCIATES Lorain, OH	(S)	10,924	.15
58.	R M S TECHNOLOGIES INC Greenbelt, MD	(S)(D)	10,816	.15
59.	SCIENCE APPLICATIONS RES JV Lanham, MD	(D)	10,616	.15
60.	ELECTRONIC DATA SYSTEMS CORP Bethesda, MD		10,528	.14
61.	COMPUTER SCIENCES PAN AM SERV Slidell, LA		10,374	.14
62.	ANALEX CORP Cleveland, OH	(S)	10,082	.14
63.	O R I INC Rockville, MD		9,614	.13
64.	COMMUNICATIONS SATELLITE CORP Clarksburg, MD		9,431	.13
65.	CLEVELAND ELECTRIC ILLUMINATING Cleveland, OH		9,405	.13
66.	ENGINEERING DESIGN GROUP INC Cleveland, OH	(S)	9,366	.13

Principal Contractors (Business Firms)

	CONTRACTOR & PRINCIPAL PLACE OF CONTRACT PERFORMANCE		AWARDS (THOUSANDS)	PERCENT
67.	COLEJON MECHANICAL CORP Cleveland, OH	(S)(D)	9,358	.13
68.	ARVIN INDUSTRIES INC Moffett Field, CA		8,956	.12
69.	HAMMOND CONSTRUCTION INC Cleveland, OH	(S)	8,826	.12
70.	BLAKE CONSTRUCTION CO INC Greenbelt, MD		8,744	.12
71.	S Y R E JV Moffett Field, CA		8,502	.12
72.	NEW TECHNOLOGY INC Marshall Space Flight, AL	(S)(D)	8,483	.12
73.	HONEYWELL INFORMATION SYSTEMS McLean, VA		8,451	.12
74.	CONTROL DATA CORP Hampton, VA		8,346	.11
75.	SCIENCE APPLICATION INTL CORP La Jolla, CA		8,301	.11
76.	BOOZ ALLEN & HAMILTON INC Bethesda, MD		8,073	.11
77.	LATHROP F P CONSTRUCTION CO Moffett Field, CA		8,055	.11
78.	HUGHES AIRCRAFT CO Torrance, CA		7,482	.10
79.	QUAD S CO Marshall Space Flight, AL	(S)	7,395	.10
80.	JOHNSON ENGINEERING CORP Houston, TX	(S)	7,134	.10
81.	T S INFOSYSTEMS INC Lanham, MD	(S)(D)	7,097	.10
82.	AMERICAN TELEPHONE & TELEGRAPH Greenbelt, MD		7,071	.10
83.	ALPHA BUILDING CORP Houston, TX	(S)	6,873	.09
84.	G E INTERNATIONAL SERV CORP Moffett Field, CA		6,746	.09
85.	STELLACOM INC Houston, TX	(S)	6,597	.09
86.	COMPUTER TECHNOLOGY ASSOCIATES Lanham, MD	(S)(D)	6,338	.09
87.	B D M CORP Columbia, MD		6,208	.09
88.	CAHABA CONSTRUCTION CO Houston, TX		6,164	.08
89.	R M S ASSOCIATES INC JV Linthicum, MD	(D)	6,092	.08
90.	D K ASSOCIATES INC Cleveland, OH	(S)	6,073	.08
91.	SWALES & ASSOCIATES INC Greenbelt, MD	(S)	5,874	.08
92.	OSTERLAND G R CO Cleveland, OH	(S)	5,643	.08
93.	CANADIAN COMMERICAL CORP Winnipeg, Canada		5,610	.08
94.	NORTHERN TELECOM INC Richardson, TX		5,603	.08
95.	OMNIPLAN CORP Houston, TX	(S)(D)	5,468	.08
96.	POTOMAC ELECTRIC POWER CO Greenbelt, MD		5,424	.07
97.	GENERAL MOTORS CORP Indianapolis, IN		5,412	.07
98.	GENERAL SOFTWARE CORP Landover, MD	(S)(D)	5,344	.07
99.	KELSEY SEYBOLD CLINIC Houston, TX		5,241	.07
100.	DATAMAX COMPUTER SYSTEMS INC Edwards, CA	(S)	5,224	.07
	OTHER*		773,175	10.63

*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*
FISCAL YEAR 1988
(N=Nonprofit Institution)

	INSTITUTION & PRINCIPAL PLACE OF PERFORMANCE		AWARDS (THOUSANDS)	PERCENT
	TOTAL AWARDS TO EDUCATIONAL & NONPROFIT INSTITUTIONS		$499.882	100.00
1.	STANFORD UNIV Stanford, CA		27,674	5.54
2.	ASSN UNIV RESEARCH & ASTRON Baltimore, MD	(N)	23,696	4.74
3.	NEW MEXICO STATE UNIV LAS CRUCES Palestine, TX		19,231	3.85
4.	UNIVERSITIES SPACE RESEARCH Columbia, MD	(N)	16,957	3.39
5.	MASS INSTITUTE TECHNOLOGY Cambridge, MA		14,279	2.86
6.	UNIV CALIFORNIA BERKELEY Berkeley, CA		13,633	2.73
7.	NATIONAL ACADEMY SCIENCES Washington, DC	(N)	12,866	2.57
8.	UNIV ARIZONA Tucson, AZ		12,001	2.40
9.	UNIV COLORADO BOULDER Boulder, CO		11,847	2.37
10.	SMITHSONIAN INSTITUTION Cambridge, MA	(N)	11,447	2.29
11.	SOUTHWEST RESEARCH INSTITUTE San Antonio, TX	(N)	11,361	2.27
12.	CHARLES STARK DRAPER LAB INC Cambridge, MA	(N)	10,604	2.12
13.	UNIV MARYLAND COLLEGE PARK College Park, MD		9,718	1.94
14.	UNIV ALABAMA HUNTSVILLE Huntsville, AL		9,527	1.91
15.	UNIV WISCONSIN MADISON Madison, WI		9,232	1.85
16.	UNIV MICHIGAN ANN ARBOR Ann Arbor, MI		8,996	1.80
17.	UNIV CALIFORNIA SAN DIEGO La Jolla, CA		8,605	1.72
18.	CALIFORNIA INSTITUTE TECHNOLOGY Pasadena, CA		7,890	1.58
19.	CASE WESTERN RESERVE UNIV Cleveland, OH		7,802	1.56
20.	UNIV IOWA Iowa City, IA		7,019	1.40
21.	UNIV HAWAII Honolulu, HI		6,496	1.30
22.	UNIV CALIF LOS ANGELES Los Angeles, CA		5,873	1.18
23.	PENNSYLVANIA STATE UNIV UP University Park, PA		5,365	1.07
24.	UNIV CHICAGO Chicago, IL		5,362	1.07
25.	UNIV NEW HAMPSHIRE Durham, NH		5,011	1.00
26.	UNIV HOUSTON CLEAR LAKE Houston, TX		5,004	1.00
27.	HARVARD UNIV Cambridge, MA		4,791	.96
28.	UNIV WASHINGTON Seattle, WA		4,681	.94
29.	UNIV TEXAS AUSTIN Austin, TX		4,441	.89
30.	UNIV SOUTHERN CALIF Los Angeles, CA		4,343	.87

Educational And Nonprofit Institutions

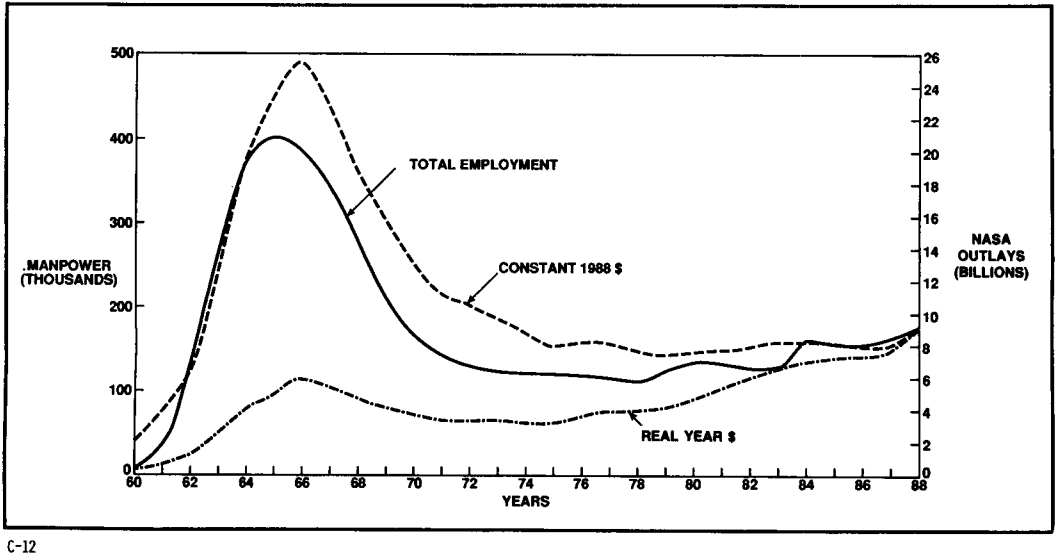
	INSTITUTION & PRINCIPAL PLACE OF PERFORMANCE		AWARDS (THOUSANDS)	PERCENT
31.	COLUMBIA UNIV New York, NY		3,733	.75
32.	OLD DOMINION UNIV Norfolk, VA		3,731	.75
33.	JOHNS HOPKINS UNIV Baltimore, MD		3,722	.74
34.	OHIO STATE UNIV Columbus, OH		3,705	.74
35.	UNIV CHILE Santiago Chile, CL		3,670	.73
36.	VIRGINIA POLYTECHNIC INSTITUTE Blacksburg, VA		3,474	.70
37.	CORNELL UNIV Ithaca, NY		3,323	.67
38.	TEXAS A & M UNIV College Station, TX		3,287	.66
39.	HAMPTON CITY Hampton, VA	(N)	3,166	.63
40.	AMERICAN INSTIT AERON & ASTRO New York, NY	(N)	3,109	.62
41.	PRINCETON UNIV Princeton, NJ		2,959	.59
42.	OKLAHOMA STATE UNIV Stillwater, OK		2,904	.58
43.	SAN JOSE STATE UNIV Moffett Field, CA		2,776	.56
44.	UNIV ALASKA FAIRBANKS Fairbanks, AK		2,755	.55
45.	GEORGIA INSTITUTE TECHNOLOGY Atlanta, GA		2,746	.55
46.	GEORGE WASHINGTON UNIV Washington, DC		2,698	.54
47.	UNIV HOUSTON Houston, TX		2,657	.53
48.	BATTELLE MEMORIAL INSTITUTE Moffett Field, CA	(N)	2,580	.52
49.	UNIV ILLINOIS URBANA Urbana, IL		2,502	.50
50.	CLEVELAND STATE UNIV Cleveland, OH		2,236	.45
51.	WASHINGTON UNIV ST LOUIS St. Louis, MO		2,234	.45
52.	MITRE CORP McLean, VA	(N)	2,192	.44
53.	UNIV VIRGINIA Charlottesville, VA		2,167	.43
54.	PURDUE UNIV West Lafayette, IN		2,126	.43
55.	ELORET INSTITUTE Moffett Field, CA	(N)	2,060	.41
56.	CARNEGIE MELLON UNIV Pittsburgh, PA		2,043	.41
57.	UNIV MINNESOTA MINNPL ST PAUL Minneapolis, MN		1,892	.38
58.	S R I INTERNATIONAL CORP Menlo Park, CA	(N)	1,869	.37
59.	NORTH CAROLINA STATE UNIV Raleigh, NC		1,860	.37
60.	AUBURN UNIV AUBURN Auburn, AL		1,838	.37
61.	RESEARCH TRIANGLE INSTITUTE Research Triangle Park, NC	(N)	1,794	.36
62.	S E T I INSTITUTE Moffett Field, CA	(N)	1,783	.36
63.	UNIV FLORIDA Gainesville, FL		1,696	.34
64.	NERAC INC Storrs, CT	(N)	$1,685	.34
65.	VANDERBILT UNIV Nashville, TN		1,681	.34
66.	ARIZONA STATE UNIV Tempe, AZ		1,659	.33

Educational And Nonprofit Institutions

	INSTITUTION & PRINCIPAL PLACE OF PERFORMANCE		AWARDS (THOUSANDS)	AWARDS PERCENT
67.	HAMPTON UNIV Hampton, VA		1,646	.33
68.	BROWN UNIV Providence, RI		1,636	.33
69.	UNIV TEXAS DALLAS Dallas, TX		1,604	.32
70.	HOWARD UNIV Washington, DC		1,526	.31
71.	ENVIRONMENTAL RES INSTIT MICH Ann Arbor, MI	(N)	1,494	.30
72.	CLARKSON UNIV Potsdam, NY		1,485	.30
73.	UNIV CALIF SANTA BARBARA Santa Barbara, CA		1,377	.28
74.	RENSSELAER POLY INST N Y Troy, NY		1,343	.27
75.	RICE UNIV Houston, TX		1,318	.26
76.	NATIONAL ACADEMY PUBLIC ADMIN Washington, DC	(N)	1,265	.25
77.	UNIV CALIF IRVINE Irvine, CA		1,244	.25
78.	FLORIDA STATE UNIV Tallahassee, FL		1,235	.25
79.	COLORADO STATE UNIV Fort Collins, CO		1,219	.24
80.	UNIV TEXAS HEALTH SCI CTR HOUSTON Houston, TX		1,203	.24
81.	UNIV TENNESSEE KNOXVILLE Tullahoma, TN		1,170	.23
82.	UNIV MIAMI Miami, FL		1,159	.23
83.	OREGON STATE UNIV Corvallis, OR		1,125	.23
84.	PUBLIC SERV SATELLITE CONSORT Washington, DC	(N)	1,099	.22
85.	U T CALSPAN CTR AEROSPACE RES Tullahoma, TN	(N)	1,083	.22
86.	UNIV CALIF DAVIS Davis, CA		1,075	.22
87.	UNIV AKRON Akron, OH		1,040	.21
88.	ALABAMA A & M UNIV Normal, AL		1,016	.20
89.	INSTITUTE TECHNOLOGY DEVELOP Jackson, MS	(N)	1,015	.20
90.	COLLEGE WILLIAM & MARY Williamsburg, VA		1,002	.20
91.	UNIV RESEARCH FOUNDATION Greenbelt, MD	(N)	993	.20
92.	FOOTHILL COLLEGE Moffett Field, CA		950	.19
93.	UNIV CALIF SAN FRANCISCO Moffett Field, CA		941	.19
94.	STATE UNIV NEW YORK STONY BRK Stony Brook, NY		913	.18
95.	STATE UNIV NEW YORK ALBANY Albany, NY		905	.18
96.	YALE UNIV New Haven, CT		905	.18
97.	UTAH STATE UNIV Logan, UT		881	.18
98.	UNIV UTAH Salt Lake City, UT		857	.17
99.	UNIV PITTSBURGH Pittsburgh, PA		826	.17
100.	CALSPAN U B RESEARCH CENTER Cheektowaga, NY	(N)	822	.16
	OTHER**		62,446	12.49

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

Total Budget/Total Employment



Financial Summary

(In Millions of Dollars) As of 30 Sep 88

FISCAL YEAR	TOTAL APPROPRIATIONS	TOTAL DIRECT OBLIGATIONS	OUTLAYS TOTAL	RESEARCH & DEVELOPMENT	SPACE FLIGHT, CONTROL & DATA COMMUNICATIONS	CONSTRUCTION OF FACILITIES	RESEARCH & PROGRAM MANAGEMENT
1959	330.9	298.7	145.5	34.0	—	24.8	86.7
1960	523.6	486.9	401.0	255.7	—	54.3	91.0
1961	966.7	908.3	744.3	487.0	—	98.2	159.1
1962	1,825.3	1,691.7	1,257.0	935.6	—	114.3	207.1
1963	3,674.1	3,448.4	2,552.4	2,308.4	—	225.3	18.7
1964	5,100.0	4,864.8	4,171.0	3,317.4	—	437.7	415.9
1965	5,250.0	5,500.7	5,092.9	3,984.5	—	530.9	577.5
1966	5,175.0	5,350.5	5,933.0	4,741.1	—	572.5	619.4
1967	4,968.0	5,011.7	5,425.7	4,487.2	—	288.6	649.9
1968	4,588.9	4,520.4	4,723.7	3,946.1	—	126.1	651.5
1969	3,995.3	4,045.2	4,251.7	3,530.2	—	65.3	656.2
1970	3,749.2	3,858.9	3,753.1	2,991.6	—	54.3	707.2
1971	3,312.6	3,324.0	3,381.9	2,630.4	—	43.7	707.8
1972	3,310.1	3,228.6	3,422.9	2,623.2	—	50.3	749.4
1973	3,407.6	3,154.0	3,315.2	2,541.4	—	44.7	729.1
1974	3,039.7	3,122.4	3,256.2	2,421.6	—	75.1	759.5
1975	3,231.2	3,265.9	3,266.5	2,420.4	—	85.3	760.8
1976	3,551.8	3,604.8	3,669.0	2,748.8	—	120.9	799.3
TQ	932.2	918.8	951.4	730.7	—	25.8	194.9
1977	3,819.1	3,858.1	3,945.3	2,980.7	—	105.0	859.6
1978	4,063.7	4,000.3	3,983.1	2,988.7	—	124.2	870.2
1979	4,561.2	4,557.5	4,196.5	3,138.8	—	132.7	925.0
1980	5,243.4	5,098.1	4,851.6	3,701.4	—	140.3	1,009.9
1981	5,522.7	5,606.2	5,421.2	4,223.0	—	146.8	1,051.4
1982	6,020.0	5,946.7	6,035.4	4,796.4	—	109.0	1,130.0
1983	6,837.7	6,723.9	6,663.9	5,316.2	—	108.1	1,239.6
1984	7,228.1	7,135.2	7,047.6	2,791.8	2,914.6	108.8	1,232.4
1985	7,546.7	7,638.4	7,317.7	2,118.2	3,707.0	170.0	1,322.5
1986	7,764.2	7,463.0	7,403.5	2,614.8	3,267.4	188.9	1,332.4
1987	10,796.0	8,603.7	7,591.4	2,435.2	3,597.3	149.0	1,408.9
1988	9,116.6	9,914.7	9,091.6	2,915.8	4,362.2	165.9	1,647.7

Research And Development Funding By Program

(In Millions of Dollars)

As of 30 Sep 88

	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	387.3	414.5	197.8	153.6	—	—	—	—	—	—	—	
SPACE FLIGHT												
Space Shuttle		—	—	—	—	1,696.2	2,098.1	1,994.7	1,870.3	1,637.6	1,348.8	4,599.9
Space Transp Cap Dev	*589.3*	*522.3*	*390.0*	*387.8*	*446.1*	*1,771.5*	*902.2*	*676.2*	*446.6*	*299.7*	*263.8*	*3,946.3*
STS Oper Capability Dev	(—)	(—)	(—)	(—)	(—)	(278.8)	(201.5)	(223.5)	(112.9)	(89.9)	(65.4)	(65.4)
Spacelab	(66.5)	(72.0)	(77.3)	(55.6)	(111.0)	(—)	(—)	(—)	(—)	(—)	(—)	(—)
Upper Stages	(142.2)	(152.0)	(113.6)	(135.8)	(157.7)	(—)	(—)	(—)	(—)	(—)	(—)	(—)
Payload Oper & Support Eqt	(77.6)	(34.1)	(54.2)	(54.5)	(59.6)	(—)	(—)	(—)	(—)	(—)	(—)	(—)
Eng & Tech Base (ETB)/DTMS	(133.9)	(133.4)	(105.5)	(105.6)	(93.1)	(70.2)	(182.9)	(183.5)	(172.6)	(177.2)	(171.9)	(1,050.8)
Advanced Programs	(46.4)	(37.7)	(19.4)	(20.5)	(21.4)	(12.6)	(9.7)	(8.8)	(13.0)	(7.0)	(10.0)	(188.8)
Advanced Launch Systems	(64.3)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)
Tethered Satellite Program	(12.1)	(10.6)	(15.0)	(15.8)	(3.3)	(—)	(—)	(—)	(—)	(—)	(—)	(—)
Orbital Maneuvering Veh (OMV)	(46.3)	(82.5)	(5.0)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)
STS Operations	(—)	(—)	(—)	(—)	(—)	(1,409.9)	(508.1)	(260.4)	(148.1)	(25.6)	(16.5)	(—)
Skylab	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(2,427.1)
Apollo Soyuz Test Project	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(214.2)
Expendable Launch Vehicles	—	—	—	—	—	82.9	31.1	54.4	67.4	73.6	136.5	2,276.8
Completed Programs	—	—	—	—	—	—	—	—	—	—	—	2,020.5
Apollo	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(20,444.0)
Gemini	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(1,280.7)
Others	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(295.8)
TOTAL OSF	589.3	522.3	390.0	387.8	446.1	3,550.6	3,031.4	2,725.3	2,384.3	2,010.9	1,749.1	32,843.5
COMMERCIAL PROGRAMS												
Technology Utilization	17.5	15.5	10.4	9.4	9.0	9.0	8.0	8.8	12.0	9.1	9.1	75.3
Commercial Use of Space	55.6	23.6	16.0	—	—	—	—	—	—	—	—	—
TOTAL OCP	73.2	39.1	26.4	9.4	9.0	9.0	8.0	8.8	12.0	9.1	9.1	75.3

Research And Development Funding By Program

(In Millions of Dollars) As of 30 Sep 88

	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	219.4	164.5	148.1	141.0	130.3	121.2	106.9	107.8	111.8	98.3	88.7	431.6
Aeronautical Research & Tech.	320.2	360.5	324.3	328.3	296.7	274.5	261.1	268.8	308.3	264.1	228.0	1,022.0
Energy Tech. Applications	51.8	44.4	--	--	--	--	--	1.9	3.0	5.0	7.5	20.8
Prior Programs												
Apollo Applications Expr.	--	--	--	--	--	--	--	--	--	--	--	1.0
Chemical & Solar Power	--	--	--	--	--	--	--	--	--	--	--	62.3
Basic Research	--	--	--	--	--	--	--	--	--	--	--	193.6
Space Vehicle Systems	--	--	--	--	--	--	--	--	--	--	--	332.3
Electronic Systems	--	--	--	--	--	--	--	--	--	--	--	272.0
Human Factor Systems	--	--	--	--	--	--	--	--	--	--	151.3	
Space Power & Elec. Prop. Sys	--	--	--	--	--	--	--	--	--	--	--	385.4
Nuclear Rockets	--	--	--	--	--	--	--	--	--	--	--	512.9
Chemical Propulsion	--	--	--	--	--	--	--	--	--	--	--	365.4
Aeronautical Vehicles	--	--	--	--	--	--	--	--	--	--	--	451.2
Nuclear Power & Propulsion	--	--	--	--	--	--	--	--	--	--	--	44.1
Mission Analysis	--	--	--	--	--	--	--	--	--	--	--	16.0
TOTAL OAST	591.4	569.4	472.7	469.3	427.0	395.7	368.0	378.5	423.1	367.4	324.2	4,261.9
SPACE TRACKING & DATA SYSTEMS												
Tracking and Data Acquisition	17.7	16.9	15.3	14.7	14.1	496.3	401.3	339.8	332.1	299.9	276.3	3,852.9
SAFETY, RELIABILITY, MAINTAINABILITY & QUALITY ASSURANCE												
Standards & Practices	13.9	11.9	7.5	4.8	4.6	3.0	3.0	2.1	3.8	9.0	9.0	24.2

Research And Development Funding By Program

(In Millions of Dollars) As of 30 Sep 88

	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	539.2	528.5	554.6	654.7	558.6	480.8	318.2	320.0	335.6	281.8	223.1	2,191.2
Planetary Exploration	325.0	362.2	349.1	286.5	216.1	180.0	205.0	174.1	219.4	181.9	146.7	3,550.9
Life Sciences	69.5	70.2	65.0	61.9	57.6	55.6	39.5	42.2	43.8	40.1	33.3	145.8
Space Aplications	608.7	550.6	478.4	367.6	309.5	311.4	325.0	325.7	328.5	271.9	232.1	2,093.2
Prior Programs												
Manned Space Science	--	--	--	--	--	--	--	--	--	--	--	46.4
Launch Vehicle Development	--	--	--	--	--	--	--	--	--	--	--	614.4
Bioscience	--	--	--	--	--	--	--	--	--	--	--	257.8
Space Flight Operations	--	--	--	--	--	--	--	--	--	--	4.0	58.3
Payload, Plan & Prog Integ	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	(4.0)	(58.3)
TOTAL OSSA	1,542.4	1,511.5	1,447.1	1,370.7	1,141.8	1,027.8	887.7	862.0	927.3	775.7	639.2	8,958.0
UNIVERSITY AFFAIRS	--	--	--	--	--	--	--	--	--	--	--	229.2
OPERATING ACCOUNT	64.8	68.1	59.6	55.0	23.6	33.1	23.6	17.8	5.5	5.2	4.7	229.2
TOTAL PROGRAM	3,279.9	3,153.7	2,616.4	2,465.3	2,066.2	5,515.5	4,723.0	4,334.3	4,088.1	3,477.2	3,011.6	50,331.2
Approp Trans & Adjustment	-5.7	-26.0	+19.0	-2.7	-54.3	+27.3	+17.9	+2.0	+3.0	--	+1.4	+301.0
Appropriation	3,274.2	3,127.7	2,635.4	2,462.6	2,011.9	5,542.8	4,740.9	4,336.3	4,091.1	3,477.2	3,013.0	50,632.2
Lapsed Unoblig Bal Incl		(4.4)	(.3)	(.2)	(.3)	(.2)	(.3)	(.6)	(.1)	(.3)	(.3)	

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

Research And Development Funding By Location

(In Millions of Dollars)

As of 30 Sep 88

	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	329.9	258.2	175.8	150.3	141.8	218.4	152.6	136.0	132.5	115.3	95.0	2,254.5
Ames Research Center	252.1	291.1	241.5	223.5	196.8	180.6	162.9	141.0	147.5	140.4	115.5	1,183.3
Dryden Flight Research Facility	—	—	—	—	—	—	11.9	18.4	16.6	13.1	18.6	242.0
Electronics Research Center	—	—	—	—	—	—	—	—	—	—	—	82.5
Goddard Space Flight Center	500.7	488.8	522.6	447.1	361.6	816.3	744.0	567.6	552.0	516.8	492.9	6,400.3
Jet Propulsion Laboratory	476.7	466.8	451.9	347.8	253.7	308.2	316.4	262.8	320.5	236.8	201.4	3,018.4
Johnson Space Center	327.6	331.0	249.5	235.2	174.9	1,593.0	1,557.2	1,524.5	1,398.3	1,161.8	970.7	15,424.0
Kennedy Space Center	87.9	57.3	71.1	49.0	55.7	529.3	420.5	365.4	300.6	234.9	170.0	2,503.5
Langley Research Center	196.5	221.1	175.2	177.7	140.4	131.9	130.5	143.3	168.2	138.2	157.1	2,323.5
Lewis Research Center	254.9	286.8	257.1	325.1	292.8	269.9	178.4	163.3	170.4	148.5	133.6	2,868.3
Marshall Space Flight Center	680.6	730.1	465.3	503.2	443.5	1,702.1	1,238.5	1,005.9	888.2	785.2	630.9	13,292.2
NASA Pasadena Office	—	—	—	—	—	—	—	—	—	—	—	4.4
Stennis Space Center	16.6	22.5	10.2	11.1	9.7	8.6	10.1	8.9	9.3	9.2	10.0	21.5
Pacific Launch Operations	—	—	—	—	—	—	—	—	—	—	—	.3
Space Nuclear Systems Office	—	—	—	—	—	—	—	—	—	—	—	436.5
Station 17	—	—	-3.8	-4.7	-4.7	-242.8	-200.0	-14.0	-31.7	-38.8	—	—
Wallops Flight Facility	—	—	—	—	—	—	11.2	15.7	15.8	15.9	156.3	—
Western Support Office	—	—	—	—	—	—	—	—	—	—	—	119.7
Undistributed	156.4	—	—	—	—	—	—	—	—	—	—	—
TOTAL PROGRAM	3,279.9	3,153.7	2,616.4	2,465.3	2,066.2	5,515.5	4,723.0	4,334.3	4,088.1	3,477.2	3,011.6	50,331.2
Approp Trans & Adjust	-5.7	-26.0	+19.0	-2.7	-54.3	+27.3	+17.9	+2.0	+3.0	—	+1.4	+301.0
Appropriation	3,274.2	3,127.7	2,635.4	2,462.6	2,011.9	5,542.8	4,740.9	4,336.3	4,091.1	3,477.2	3,013.0	50,632.2
Lapsed Unoblig Bal Incl		(4.4)	(.3)	(.2)	(.3)	(.2)	(.3)	(.6)	(.1)	(.3)	(.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 30 Sep 88

	FY 1988	FY 1987	FY 1986	FY 1985	FY 1984
SPACE FLIGHT					
Shuttle Prod & Oper Cap	1,092.4	3,501.4	1,354.7	1,478.1	1,637.2
Space Transportation Ops	1,825.5	1,736.9	1,633.2	1,308.6	1,431.7
TOTAL OSF	2,917.9	5,238.3	2,987.9	2,786.7	3,068.9
SPACE TRACKING & DATA SYSTEMS	969.3	764.7	658.2	792.2	673.9
OPERATING ACCOUNT	8.7	17.5	15.6	15.3	9.0
TOTAL PROGRAM	3,895.9	6,020.5	3,661.7	3,594.2	3,751.8
Approp Trans & Adjust	+12.4	-205.5	+19.1	+7.6	+39.8
Appropriation	3,908.3	*5,815.0	3,680.8	3,601.8	3,791.6
Lapsed Unoblig Bal Incl		(.3)	(.3)	(.2)	(.5)

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

Space Flight, Control And Data Communications Funding By Location

As of 30 Sep 88

(In Millions of Dollars)

	FY 1988	FY 1987	FY 1986	FY 1985	FY 1984
Headquarters	363.2	289.1	204.5	259.5	227.6
Ames Research Center	15.4	19.8	18.0	15.6	10.3
Goddard Space Flight Center	430.4	348.9	330.0	432.2	431.0
Jet Propulsion Laboratory	126.6	122.9	117.4	111.9	97.3
Johnson Space Center	898.0	870.8	1,083.7	1,308.0	1,360.5
Kennedy Space Center	711.3	598.4	511.5	493.4	490.5
Langley Research Center	.1	1,774.5	.4	.6	.2
Lewis Research Center	3.7	4.0	3.3	4.3	2.0
Marshall Space Flight Center	1,237.6	973.8	1,655.4	1,437.0	1,379.0
Stennis Space Center	19.3	22.0	15.1	12.3	1.1
Station 17		0	-277.6	-480.6	-247.7
Undistributed	90.3	996.3	—	—	—
TOTAL PROGRAM	3,895.9	6,020.5	3,661.7	3,594.2	3,751.8
Approp Transfer & Adjust	+12.4	-205.5	+19.1	+7.6	+39.8
Appropriation	3,908.3	5,815.0	3,680.8	3,601.8	3,791.6
Lapsed Unoblig Bal Incl		(.3)	(.3)	(.2)	(.5)

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

Construction Of Facilities Funding

(In Millions of Dollars) As of 30 Sep 88

	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	FY 75	FY 74	FY 73
ARC	16.0	16.6	7.8	14.3	14.7	—	—	13.6	2.9	9.1	—	4.4	2.6	3.7	—	3.2
DFRF	10.5	—	—	—	—	3.6	—	—	—	—	.4	.3	—	—	—	—
GSFC	8.6	8.0	3.6	2.2	—	2.6	—	—	—	5.6	4.5	—	—	1.9	1.3	.6
JPL	—	12.0	9.4	12.2	5.6	—	1.8	2.8	—	4.6	3.1	—	—	9.2	1.3	.5
KSC	17.2	—	—	—	—	—	1.1	.6	4.8	—	1.7	2.6	—	—	—	9.7
LaRC	—	11.3	4.6	13.8	11.2	13.8	2.9	22.1	7.1	5.4	1.7	6.0	1.6	3.2	4.0	4.3
LeRC	17.6	—	—	—	13.0	4.7	1.2	8.7	5.7	5.8	.8	2.8	—	3.7	—	10.0
JSC	—	7.8	—	—	—	—	3.0	—	—	—	2.0	2.2	—	.7	—	.6
MSFC	—	—	—	1.6	—	—	—	4.0	6.3	—	—	—	—	3.8	—	—
SSC	—	—	—	—	—	—	—	—	—	—	.6	—	—	—	—	—
WFF	—	—	—	—	—	2.1	—	—	1.1	—	—	—	—	1.1	.9	.6
Various Loc.	6.4	19.3	16.7	13.8	—	—	9.8	32.1	1.7	—	1.1	—	—	7.7	3.7	—
FP&D	16.0	17.0	11.8	12.0	9.2	8.2	10.0	9.7	13.9	10.6	11.7	12.6	12.5	10.8	13.5	7.9
Large Aero Fac	—	—	—	—	—	—	—	—	45.7	56.1	37.0	31.0	—	—	—	—
Minor Const.	8.0	6.9	6.0	5.0	4.8	3.7	2.3	3.9	3.5	4.2	6.0	2.9	6.2	4.6	4.6	1.7
Envir. Comp. & Restortion Prog.	23.9															
Repair	24.4	21.7	19.5	17.9	17.4	13.8	12.8	14.8	12.0	—	—	—	—	—	—	—
Rehab & Mods *	31.0	30.2	24.3	21.5	21.5	18.9	17.6	17.2	19.7	14.1	18.9	17.8	23.0	14.8	14.8	11.6
SSF	—	12.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SF	—	7.1	36.5	38.8	48.7	28.6	33.8	10.0	28.1	30.9	64.7	30.3	46.6	76.5	56.5	27.8
SPF	—	—	3.9	6.7	13.2	1.7	—	1.6	4.3	—	7.3	4.4	—	—	—	—
Unallocated Plans & Design	—	—	—	—	—	2.7	—	—	—	—	—	—	—	—	—	—
TOTAL PROGRAM	179.6	170.5	133.3	160.4	159.3	104.4	96.3	141.1	156.8	146.4	161.5	117.8	92.5	141.7	100.6	78.5
Approp Trans & Adjust	-1.3	+298.8	—	-10.4	-3.8	-6.9	-.5	-26.1	-.7	+1.1	-.6	+.3	.4	-1.5	+.5	-1.2
Approp & Availability	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	140.2	101.1	77.3

* Included in Various Locations Prior to FY 1972.

Construction Of Facilities Funding

(In Millions of Dollars)

As of 30 Sep 88

	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
ARC	6.5	1.1	.3	.4	4.2	—	2.8	5.8	11.3	14.3	6.3	.6	6.1	3.8
DFRF	—	—	.9	—	—	—	—	—	2.5	1.8	—	—	1.8	—
ERC	—	—	—	—	—	7.4	5.2	10.4	1.6	—	—	—	—	—
GSFC	.7	1.4	.7	—	.6	.7	2.4	2.3	17.7	21.3	11.5	9.4	14.0	3.9
JPL	—	1.9	—	—	3.1	.3	.9	3.6	3.0	11.4	3.6	8.6	7.7	—
JSC	—	1.1	—	.9	.6	11.8	4.0	17.3	33.9	24.5	—	—	—	—
KSC	15.6	.3	10.5	7.4	20.4	34.6	7.2	87.8	273.4	332.8	115.6	27.8	4.0	—
LaRC	—	.6	5.6	—	—	6.4	8.4	3.3	9.7	9.8	6.9	12.3	4.5	10.8
LeRC	.8	.7	.3	—	2.1	16.2	.9	.8	20.4	45.5	1.1	9.6	6.6	8.0
MSFC	—	1.3	—	—	.9	—	1.8	12.0	28.2	40.5	30.7	26.1	—	—
MAF	—	—	—	.4	.5	.5	.3	6.2	7.3	28.5	—	—	—	—
SSC	—	—	1.4	—	—	—	—	58.4	102.9	77.1	—	—	—	—
NRDS	—	—	—	—	—	—	—	—	4.1	11.5	—	—	—	—
PLO	—	—	—	—	—	—	—	.3	—	—	.6	.4	1.1	—
WFF	—	—	.5	.5	.7	.2	1.0	1.7	.5	4.1	11.3	2.0	—	16.1
Various Loc.	.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
FP&D	3.4	5.4	3.5	1.0	5.4	5.4	5.0	8.8	10.4	12.9	9.8	—	—	—
Rehab & Mods *	7.8	(17.6)	—	—	—	—	—	—	—	—	—	—	—	—
Shuttle Facil.	18.5	—	—	—	—	—	—	—	—	—	—	—	—	—
Other	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TOTAL PROGRAM	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	-1.3	-11.3	+3.1	-9.6	-6.1	-7.1	+5.0	+15.9	-58.4	+10.3	-40.4	-2.0	-13.6	+.3
Approp & Availability	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)

As of 30 Sep 88

	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	FY 75
Hdqtrs 1/	205.6	142.5	124.0	122.2	112.4	111.7	117.9	96.4	89.5	84.5	81.1	78.7	93.5	68.9
ARC	165.5	134.0	123.5	120.3	113.9	107.2	76.6	72.2	67.4	67.4	57.8	53.0	63.8	48.6
DFRF	—	—	—	—	—	—	24.4	22.6	20.4	19.1	18.2	17.3	19.7	13.2
GSFC	244.0	216.1	200.5	196.8	191.4	183.9	169.1	142.5	133.5	127.9	123.9	114.5	137.0	104.8
KSC	243.4	200.0	192.2	184.5	176.0	164.9	156.0	150.2	133.2	123.3	113.8	109.7	128.1	95.9
LaRC	178.6	153.7	145.0	147.1	139.2	132.7	126.6	120.8	114.0	106.6	102.0	95.2	116.3	88.6
LeRC	181.9	151.7	143.1	137.4	128.5	118.8	106.4	99.9	94.8	87.5	84.9	83.6	102.5	80.3
JSC	283.5	228.0	206.9	214.8	201.0	195.2	235.5	176.0	164.7	152.9	146.7	138.9	165.2	121.3
MSFC	239.9	213.1	195.0	198.1	190.9	184.3	172.1	165.0	155.9	149.0	143.4	138.5	167.2	129.1
SSC	20.6	12.4	11.2	10.2	6.3	6.6	5.5	4.9	4.5	2.7	1.8	2.2	1.6	1.6
Station 17	—	-.1	-7.6	-.1	-7.6	-7.6	-8.1	—	—	—	—	—	—	—
SNSO	—	—	—	—	—	—	—	—	—	—	—	—	—	—
WFF	—	—	—	—	—	—	—	20.0	17.7	15.8	15.0	13.2	17.0	12.4
TOTAL PROGRAM	1,763.0	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	764.7
Lapsed Unoblig Bal	-.4	1.0	.2	.5	.2	—	.2	.3	.2	.3	.3	.2	.6	.2
Approp Trans & Adjust	-266.9	-27.5	+20.5	—	—	—	—	—	—	—	—	—	—	-4.9
Appropriation	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	760.0

1/ Includes NASA Pasadena Office

Research And Program Management Funding

As of 30 Sep 88

(In Millions of Dollars)

	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
Hdqtrs 1/	63.0	61.6	61.6	64.9	63.2	60.8	57.1	57.4	54.4	69.3	57.1	51.3	26.0	13.9	8.5	5.7
ARC	46.4	42.4	42.2	40.6	37.6	34.0	33.8	33.8	33.2	31.8	29.9	25.6	22.9	19.9	17.8	16.3
ERC 2/	12.2	11.6	—	—	19.1	17.2	15.4	12.2	6.4	3.2	.5	—	—	—	—	—
DFRF	97.5	95.7	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
GSFC	93.6	91.1	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
KSC	83.8	78.6	92.6	98.3	97.6	95.8	93.1	92.7	82.0	40.8	29.8	18.8	6.4	—	—	—
LaRC	79.8	81.2	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
LeRC	118.0	110.6	82.5	78.0	73.9	67.9	66.2	66.3	66.4	69.3	61.5	53.4	45.2	35.8	31.2	27.8
JSC	136.6	137.2	113.0	111.1	106.6	98.9	95.7	95.7	86.5	88.7	64.7	51.0	24.1	9.2	—	—
MSFC	—		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	—
PLO	—	—	—	—	—	—	—	—	.6	.9	.9	.6	.1	—	—	—
Station 17	1.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SNSO	—		2.2	2.4	2.3	2.1	2.0	2.0	1.8	1.7	1.5	1.0	.3	—	—	—
WSO			—	—	—	—	1.0	3.2	4.9	5.0	4.4	3.4	1.4	5.7	.5	—
WFF	11.5	10.7	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
TOTAL PROGRAM	744.0	721.8	732.3	730.2 3/	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	.6	7.6	.3	.2	.4	.1	.1	.9	.6							
Approp Trans & Adjust	—	—	+2.1	-7.7	-12.6	-44.9	-11.4	-7.5	-27.8	+.2	-2.8					
Appropriation	744.6	729.4	734.7	722.7	690.0	603.2	628.0	640.0	584.0	623.5	494.0					

1/ Includes NASA Pasadena Office
2/ Electronics Research Center (ERC) was closed on June 30, 1970
3/ Includes $10 million for basic institutional and other requirements for agencies resident at MTF/Slidell
Pacific Launch Operations (PLO)
Space Nuclear Systems Office (SNSO)
Western Support Office (WSO)

Personnel Summary

Onboard At End Of Fiscal Year*

As of 30 September 1988

	FY 88	FY 87	FY 86	FY 85	FY 84	FY 83	FY 82	FY 81	FY 80	FY 79	FY 78	FY 77	FY 76	FY 75	FY 74	FY 73
NASA Headquarters	1,829	1,648	1,468	1,553	1,526	1,636	1,614	1,638	1,658	1,534	1,606	1,619	1,708	1,673	1,734	1,747
Ames Research Center 1/	2,169	2,161	2,153	2,159	2,145	2,138	2,164	1,652	1,713	1,713	1,691	1,645	1,724	1,754	1,776	1,740
Dryden Flight Research Facility	--	--	--	--	--	--	--	491	499	498	514	546	566	544	531	509
Goddard Space Flight Center 2/	3,727	3,746	3,785	3,738	3,647	3,794	3,746	3,431	3,535	3,562	3,641	3,666	3,808	3,871	3,936	3,852
Kennedy Space Center	2,330	2,278	2,120	2,165	2,131	2,180	2,199	2,224	2,291	2,264	2,234	2,270	2,404	2,377	2,408	2,516
Langley Research Center	2,966	2,979	2,932	2,949	2,952	3,032	2,916	3,028	3,094	3,125	3,167	3,207	3,407	3,472	3,504	3,389
Lewis Research Center	2,716	2,716	2,642	2,782	2,702	2,751	2,667	2,782	2,901	2,907	2,964	3,061	3,168	3,181	3,172	3,368
Johnson Space Center	3,498	3,463	3,362	3,449	3,352	3,411	3,445	3,498	3,616	3,563	3,617	3,640	3,796	3,877	3,886	3,896
Marshall Space Flight Center	3,429	3,478	3,361	3,386	3,286	3,464	3,440	3,479	3,646	3,677	3,808	4,014	4,336	4,337	4,574	5,287
NASA Pasadena Office	--	--	--	--	--	--	--	--	--	--	--	--	--	35	39	39
John C. Stennis Space Center	159	147	137	135	129	128	119	113	111	108	108	94	72	76	--	--
Wallops Flight Facility	--	--	--	--	--	--	--	400	406	409	429	426	437	441	447	434
TOTAL	22,823	22,646	21,960	22,316	21,870	22,534	22,310	22,736	23,470	23,360	23,779	24,188	25,426	25,638	26,007	26,777

* Includes Temporary Personnel

Excludes Employees in the Youth Programs

1/ Includes DFRF After FY 81

2/ Includes WFF After FY 81

Personnel Summary

Onboard At End Of Fiscal Year*

	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
NASA Headquarters	1,755	1,895	2,187	2,293	2,310	2,373	2,336	2,135	2,158	2,001	1,477	735	587	429
Ames Research Center	1,844	1,968	2,033	2,117	2,197	2,264	2,310	2,270	2,204	2,116	1,658	1,471	1,421	1,464
Dryden Flight Research Facility	539	579	583	601	622	642	662	669	619	616	538	447	408	340
Electronics Research Center	—	—	592	951	950	791	555	250	33 a/	25 a/	—	—	—	—
Goddard Space Flight Center	4,178	4,459	4,487	4,295	4,073	3,997	3,958	3,774	3,675	3,487	2,755	1,599	1,255	398
Kennedy Space Center	2,568	2,704	2,895	3,058	3,044	2,867	2,669	2,464	1,625	1,181	339	—	—	—
Langley Research Center	3,592	3,830	3,970	4,087	4,219	4,405	4,485	4,371	4,330	4,220	3,894	3,338	3,203	3,624
Lewis Research Center	3,866	4,083	4,240	4,399	4,583	4,956	5,047	4,897	4,859	4,697	3,800	2,773	2,722	2,809
Johnson Space Center	3,935	4,298	4,539	4,751	4,956	5,064	4,889	4,413	4,277	3,345	1,786	794	in GSFC	—
Marshall Space Flight Center	5,555	6,060	6,325	6,639	6,935	7,602	7,740	7,719	7,679	7,332	6,843	5,948	370	—
NASA Pasadena Office	40	44	72	80	79	91	85	19	b/	—	—	—	—	—
Pacific Launch Operations	—	—	—	—	—	—	c/	21	22	17	—	—	—	—
Space Nuclear Systems Office	45	89	103	104	108	113	115	116	112	96	39	4	—	—
Wallops Flight Facility	465	497	522	554	565	576	563	554	530	493	421	302	229	171
Western Support Office	—	—	—	—	d/	119	294	377	376	308	136	60	37	—
TOTAL	28,382	30,506	32,548	33,929	34,641	35,860	35,708	34,049	32,499	29,934	23,686	17,471	10,232	9,235

* Includes Temporary Personnel

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

Employment Summary

September 30, 1988

Permanent, Other and Total Paid Employees*	OAST			OSSA	OSF						
	ARC	LARC	LERC	GSFC	KSC	JSC	MSFC	SSC	HQ	Total NASA	JPL
Permanent Employees	2,101	2,840	2,649	3,626	2,236	3,399	3,340	147	1,653	21,991	--
Other than Permanent Employees	68	126	67	101	94	99	89	12	176	832	--
Total	2,169	2,966	2,716	3,727	2,330	3,498	3,429	159	1,829	22,823	5,628

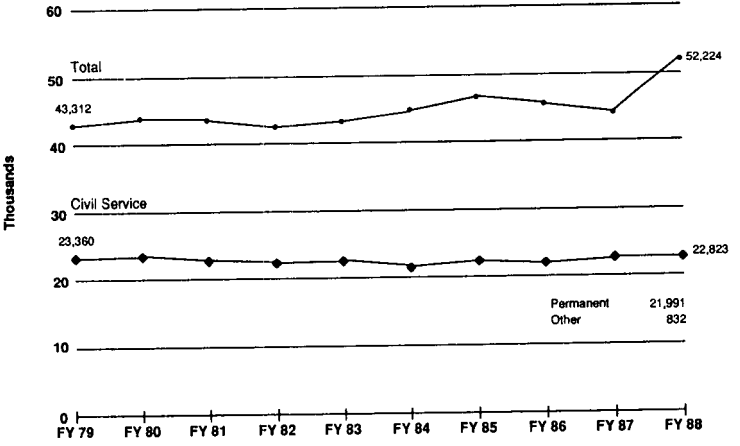
Permanent Employee Occupational Breakdown	ARC	LARC	LERC	GSFC	KSC	JSC	MSFC	SSC	HQ	Total NASA	JPL**
S & E	1,102	1,310	1,392	1,901	1,314	2,204	2,106	75	462	11,866	3,448
Prof'l Admin.	288	275	255	703	394	525	572	41	828	3,881	806
Clerical	227	287	244	431	300	461	468	29	354	2,801	598
Tech. Support	142	909	228	468	223	202	194	2	4	2,372	391
Wage System	342	59	530	123	5	7	0	0	5	1,071	385
Total	2,101	2,840	2,649	3,626	2,236	3,399	3,340	147	1,653	21,991	

Support Service Contractor Manpower (FY 88 Man-Year Equivalents)**	ARC	LARC	LERC	GSFC	KSC	JSC	MSFC	SSC	HQ	Total NASA
Total	1,928	1,720	1,246	3,300	9,364	8,590	1,231	1,213	809	29,401

* Does Not Include Non-Ceiling Employees ** Approximate Distribution

Total NASA Workforce

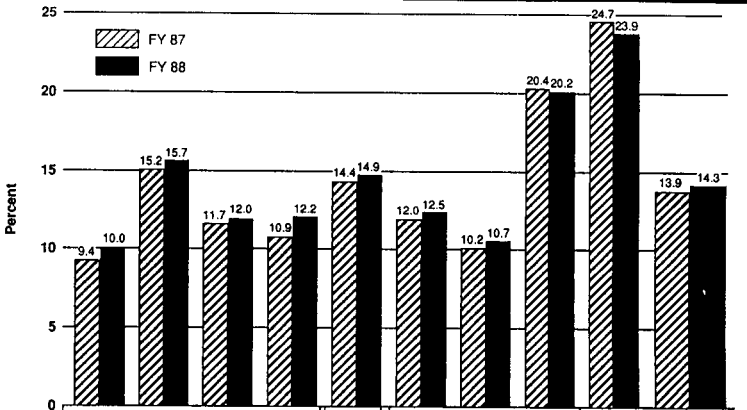
END FY 79 - FY 88



	FY 79	FY 80	FY 81	FY 82	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88
Civil Service	23,360	23,470	22,739	22,310	22,534	21,870	22,316	21,960	22,646	22,823
Contractor	19,952	20,294	20,700	20,089	20,662	22,865	24,468	23,687	21,733	29,401
Total	43,312	43,764	43,439	42,399	43,196	44,735	46,784	45,647	44,379	52,224

Minorities As Percent Of Permanent Employees

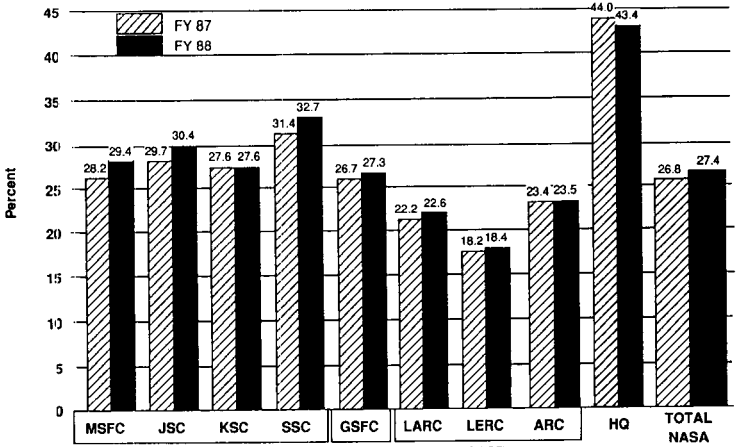
By Installation
FY 87 - FY 88



Total Minorities	MSFC	JSC	KSC	SSC	GSFC	LARC	LERC	ARC	HQ	TOTAL NASA
FY 88	333	533	268	18	541	355	284	425	395	3,152
FY 87	318	510	257	15	527	341	271	425	378	3,042

Women As Percent Of Permanent Employees

by Installation
End FY 87 - FY 88



Total Women	MSFC	JSC	KSC	SSC	GSFC	LARC	LERC	ARC	HQ	TOTAL NASA
FY 88	983	1,034	618	48	990	642	488	494	718	6,015
FY 87	955	996	604	43	973	633	484	487	674	5,849

National Aeronautics and
Space Administration

(NASA-TM-101283) NASA POCKET STATISTICS N89-70502
(NASA) 141 p

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