NASA Pocket Statistics

January 1990

Distribution To NASA Installations

Following is a list of individuals who control the distribution of the NASA POCKET STATISTICS at their respective NASA Installations. Requests for additional copies should be made through the controlling office shown below.

NASA HEADQUARTERS
Ms. Juanita M. Carlton
Executive Support Office, Code DA

AMES RESEARCH CENTER
Mr. Jack D. Stanley, Staff Assistant
to the Associate Director

AMES DRYDEN FLIGHT RESEARCH FACILITY
ATTN: Research Librarian

GODDARD INSTITUTE FOR SPACE STUDIES
Dr. James E. Hansen

GODDARD SPACE FLIGHT CENTER
Ms. Kay Seidenspinner
Code 200

JET PROPULSION LABORATORY
Mr. R. VanBuren
Documentation Review Group

JOHNSON SPACE CENTER
Mr. H. M. Porter
Printing Management Branch, Code JM8

JSC WHITE SANDS TEST FACILITY
Mr. Rob. R. Tillett, Manager

KENNEDY SPACE CENTER and KSC/WLOD
Mr. Hugh W. Harris
Public Information Branch

KSC STS RESIDENT OFFICE
(Vandenberg AFB)
Mr. Ted L. Oglesby, Manager

LANGLEY RESEARCH CENTER
Ms. Margaret W. Hunt
Mail Stop 115

LEWIS RESEARCH CENTER
Mr. Americo F. Forestieri, Director
External Affairs, MS 3-16

MARSHALL SPACE FLIGHT CENTER
Ms. Jan Zielinski, CN24
Management Operations Office

MICHOUD ASSEMBLY FACILITY
Mr. John W. Hill, Manager

NASA RESIDENT OFFICE -- JPL
Mr. Fred W. Bowen, Manager

JOHN C. STENNIS SPACE CENTER
Mr. Roy S. Estess, Director

SLIDELL COMPUTER COMPLEX
Mr. Bobby L. German, Manager

WALLOPS FLIGHT FACILITY
Mr. F. Moore, Director
Management and Operations

Foreword

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

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

ribution. Requests for copies of this document should be sent to NASA Headquarters, Office of Headquarters Operations (Code DA). Changes or deletions to the distribution list may be made by phone to (202) 453-1039.

Published and Distributed by
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
OFFICE OF HEADQUARTERS OPERATIONS, CODE DA
Washington, DC 20546

Contents

Section A

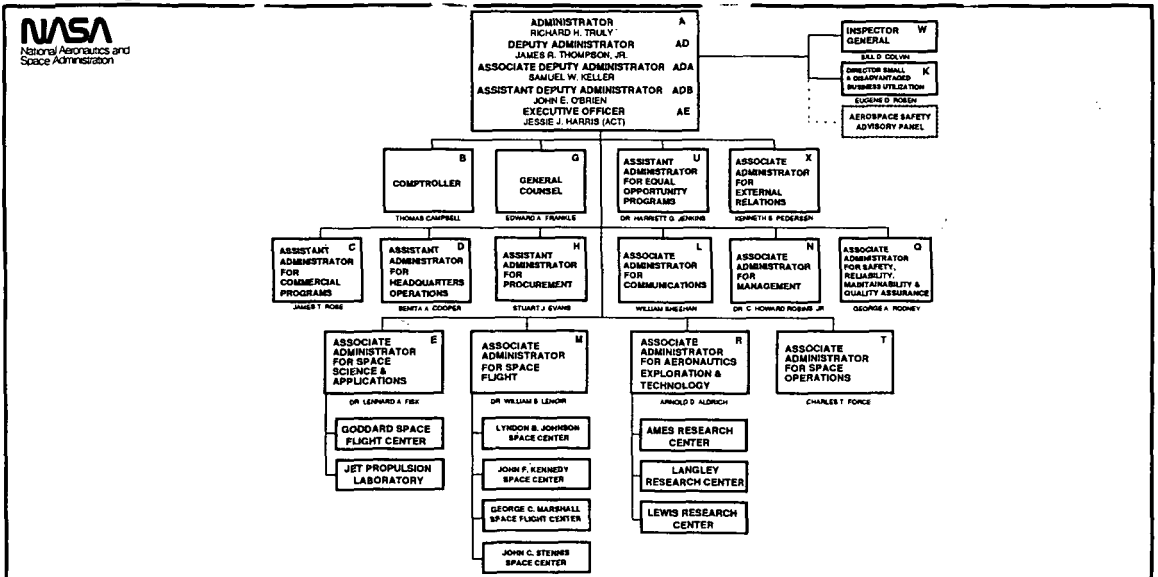
Section B

Section C

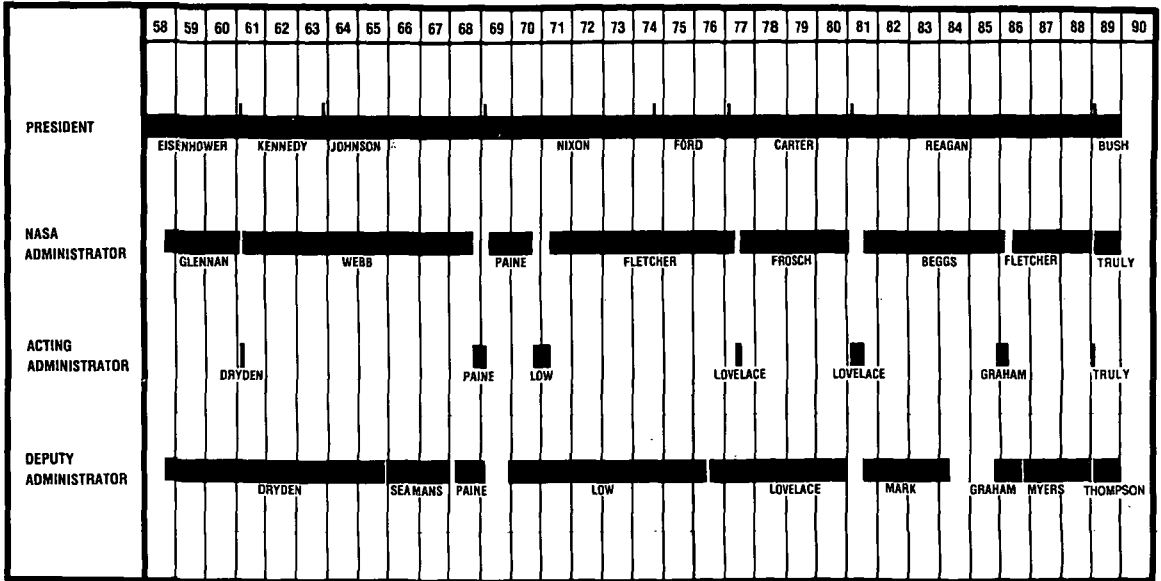
Section A

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

(d) The aeronautical and space activitsies 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

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

DECLARATION OF POLICY AND PURPOSE (Continued)

(8) The most effective utilization of the scientific and engineering resources of the United States, with close cooperation among all interested agencies of the United States in order to avoid unnecessary duplication of effort, facilities, and equipment.

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

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

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

FUNCTIONS OF THE ADMINISTRATION

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

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

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

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

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

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

U.S. National Space Policy

On November 2, 1989, the President approved a national space policy that updates and reaffirms U.S. goals and activities in space. Areas affectd include civil and commercial remote sensing, space transportation, space debris, federal subsidies of commercial space activities, and Space Station Freedom.

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

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

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

GOALS AND PRINCIPLES

A fundamental objective guiding United States space activities has been, and continues to be, space leadership. Leadership in an increasingly competitive international environment does not require United States preeminence in all areas and disciplines of space enterprise. It does require United States preeminence in 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.

. 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.

U.S. National Space Policy

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

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

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

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

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

CIVIL SPACE POLICY

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

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

COMMERCIAL SPACE POLICY

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

NATIONAL SECURITY SPACE POLICY

The United States will conduct those activities in space that are necessary to national defense. Space activities will contribute to national security objectives by (1) deterring, or if necessary, *defending against enemy attack; (2) assuring that forces of hostile* nations cannot prevent our own use of space; (3) negating, if necessary, hostile space systems; and (4) enhancing operations of United States and Allied forces. Consistent with treaty obligations,

the national security space program shall support such functions as command and control, communications, navigation, environmental monitoring, warning, surveillance and force application (including research and development programs which support these functions).

INTER-SECTOR POLICIES

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

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

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

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

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

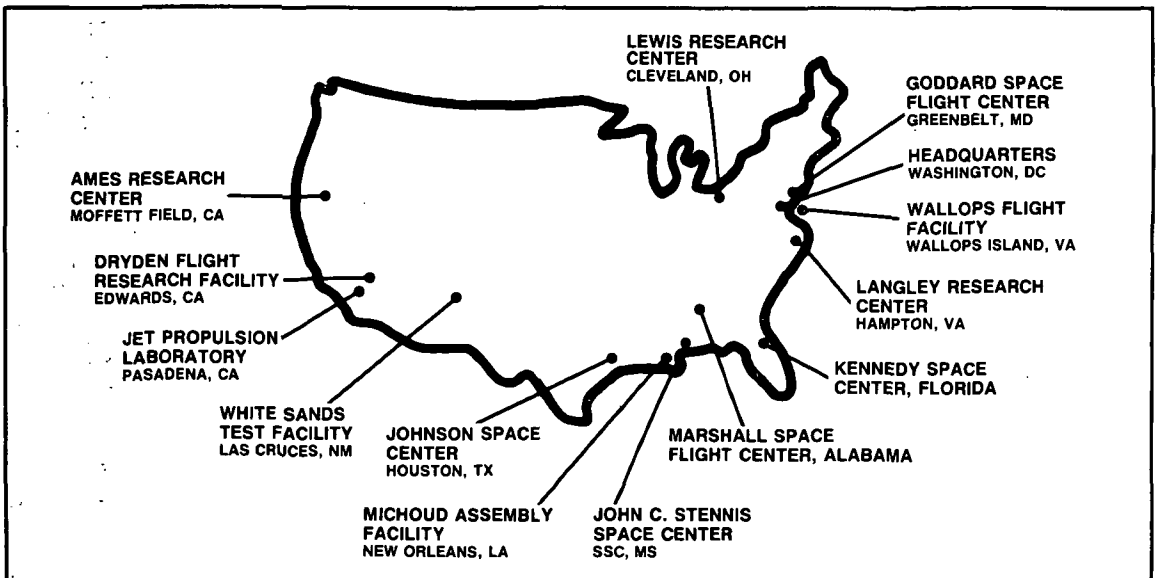
. Assured access to space, sufficient to achieve all United States space goals, is a key element of national space policy. United States space transportation systems must provide a balanced, robust, and flexible capability with sufficient resiliency to allow continued operations despite failures in any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

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

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

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

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.

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.

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.

Lewis was selected by the Office of Management and Budget (OMB) as a Quality Improvement Prototype, which is one of the highest honors a federal government facility can achieve for quality and productivity. The award is part of the Presidents Productivity Improvement Program, which is administered by OMB and is the second year a national award was presented.

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.

NATIONAL SPACE TECHNOLOGY LABORATORIES
NSTL, MS 39529

The NASA National Space Technology Laboratories (NSTL) 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 NSTL is support of Space Shuttle main engine and main orbiter propulsion system testing. Shuttle main engine testing has been under way at NSTL since 1975.

Formerly designated the Mississippi Test Facility, NSTL 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

SOLAR SYSTEM

Planetary science spearheaded accomplishments in 1989 with Voyager 2's exploration of Planet Neptune and departure from the solar systems and the launch of two probes.

NASA scientists discovered last spring that on March 23 an asteroid a half-mile or more in diameter passed within 500,000 miles of Earth, about twice the distance between the Earth and the Moon. In the fall, another asteroid passed within 2.5 million mile of the Earth.

ASTROPHYSICS

In November, NASA launched the Cosmic Background Explorer, an unmanned observer that will measure the cosmic radiation remaining from the "Big Bang" in hopes of developing a clearer picture of the early history of the universe.

Astronomers at the Space Telescope Science Institute, reported unanticipated gas emissions from a "white dwarf" star. White dwarves had been thought to mark the end of some stars' lifespans, precluding such emissions. NASA and science institute scientists are continuing preparations for the Shuttle development in March 1990 of the Hubble Space Telescope, which many astronomers believe will open a new era for the field.

EARTH SCIENCES

In February, NASA announced the selection of scientific instrument investigations for the proposed Earth Observing System, for launch in late 1997. EOS would be an interdisciplinary program conducted with the European and Japanese space agencies using four platforms in polar orbits to examine Earth on a global scale. It would be one of the largest science missions ever undertaken, providing 15 years of comprehensive data on Earth's atmosphere, oceans and land.

This year a NASA satellite gathered further evidence of humans' effect on their environment as the Total Ozone Mapping Spectrometer showed the ozone levels over Antarctica between August and October were as low in 1989 as the record low levels measured in 1987.

Scientists from the Soviet Union, Canada, the United Kingdom and France joined NASA in Kansas over the summer to continue the first field experiment for the International *Satellite Land Surface Climatology Project. The experiment investigated the role of* biological processes in controlling atmosphere-vegetation interactions and investigated the use of satellite and airborne observations to infer how land-surface conditions affect climate.

SPACE PHYSICS

NASA signed a memorandum of understanding with the European Space Agency to conduct a series of missions as part of the International Solar Terrestrial Physics Programme, which will track solar energy from is source, through space and as it reaches and passes the Earth.

NASA launched four suborbital rockets over Canada to measure Earth's electric fields aligned with its magnetic field and possible explain how aurora are created.

NASA has provided a payload instrument (PEGSAT) for flight aboard the experimental air-launched vehicle Pegasus now undergoing flight tests with an anticipated launch date of late January 1990. The instrument will conduct studies of the Earth's magnetic field and ionosphere.

LIFE SCIENCES

U.S. and Soviet scientist confirmed the adverse physiological and biomedical effects of prolonged space flight after analyzing data from the cooperative life sciences experiments flown aboard an unmanned Soviet satellite.

SPACE FLIGHT

In 1989, 25 astronauts orbited the Earth aboard Space Shuttles Discovery, Atlantis and Columbia. As a result, sophisticated interplanetary spacecraft, Magellan and Galileo, are speeding toward orbital encounters with Venus and Jupiter, a new Tracking and Data Relay Satellite has been deployed and experiment data have been sent to investigators nationwide.

The Year In Review

Expendable Launch Vehicles (ELVs) were emptied in 1989 with the successful launches of the Atlas-Centaur/FLTSATCOM and Delta/Cosmic Background Explorer missions.

Among Space Flight highlights, 1989 are:

• January 20: Sixth and final full-scale static test firing of NASA's redesigned Space Shuttle solid rocket motor took place successfully.

• March 13: Space Shuttle Discovery was launched with STS-29 Astronauts Coats, Blaha, Buchli, Springer and Bagian on board to deploy a new Tracking and Data Relay Satellite. Landing was March 18.

• May 4: Space Shuttle Atlantis was launched with STS-30 Astronauts Walker, Grabe, Thagard, Cleave and Lee on board to deploy the Magellan spacecraft on a mission toward Venus. Landing was May 8.

• August 8: Space Shuttle Columbia was launched with STS-28 Astronauts Shaw, Richards, Leetsma, Adamson and Brown on board this dedicated DOD mission. Landing was August 13.

• September 25: NASA successfully launched its final Atlas/Centaur launch vehicle from Cape Canaveral Air Force Station. The payload was a FLTSATCOM Navy communications satellite.

• October 18: Space Shuttle Atlantis was launched with STS-34 Astronauts Williams, McCulley, Baker, Chang-Diaz and Lucid on board to deploy Galileo spacecraft on a mission toward Jupiter. Landing was October 23.

• November 18: NASA successfully launched its Cosmic Background Explorer spacecraft from Vandenberg Air Force Base, Calif., aboard the final NASA-owned Delta launch vehicle.

• November 22: Space Shuttle Discovery was launched with STS-33 Astronauts Gregory, Blaha, Musgrave, Thornton and Carter on board this dedicated DOD mission. Landing was November 27.

SPACE STATION FREEDOM

Major changes in the organization and management of the Space Station Freedom program occurred 1989, as well as a consolidation of the Space Station and Space Flight offices. A major review of the Space Station Freedom project, resulted in modifications to the project and a revised timetable for its development and deployment.

The final agreement between NASA and its international partners, was signed March 14 as the former NASA Administrator James Fletcher and Japanese ambassador to the U.S. H. E. Nobuo Matsunaga signed a memorandum of understanding on cooperation in the detailed design, development, operation and utilization of the space station. Similar agreements with the European Space Agency and Canada were signed in September 1988.

EXPLORATION

On July 20, 1989 President Bush announced a national commitment to an evolutionary program to complete Space Station Freedom, establish a manner lunar outpost, begin the exploration of Mars and eventually to move beyond.

In 1989, the Office of Exploration also initiated a variety of activities to better understand technology needs and science opportunities involved in expanding the human presence beyond Earth orbit. The office continued to develop multiple options for human exploration through the case study framework.

Three case studies were evaluated in 1989: Lunar Evolution, Mars Evolution and Mars Expedition. These case studies refined NASA's understanding and broadened its knowledge of human exploration options, the investments required to support them and the scientific and technological capabilities and benefits they would spawn.

Other key developments in 1989 included:

- Formation of a NASA Advisory Council Exploration Task Force to provide independent advice to NASA and the Office of Exploration.

- Support of and participation in preparation of NASA's "Report of the 90-Day Study on Human Exploration of the Moon and Mars".

- Initiation of an Innovative Studies program designed to encourage innovative concepts and support independent studies that may offer unique capabilities for human exploration. The 20 proposals selected for funding came from groups located in 12 states and included five industry-related firms, two space support-related organizations and 13 universities.

AERONAUTICS AND SPACE TECHNOLOGY

The National Aero-Space Plane (NASP) program, a joint NASA/Department of Defense program, continued technology development that could lead to a unique flight research vehicle, called the X-30, capable of taking off horizontally, accelerate into Earth orbit and returning through the atmosphere to land on a conventional runway.

NASA's Lewis Research Center, Cleveland is leading an effort to develop "slush" hydrogen as a high-energy NASP propellant. Lewis also tested a Mach 5 engine inlet to verify computer codes used in analysis of the inlet's performance.

Langley Research Center, Hampton, VA., has wind-tunnel tested the performance characteristics of NASP advanced engine concepts at 4 and 8 times the speed of sound.

NASA's high-performance aircraft based at Ames-Dryden Flight Research Facility, Edwards, Calif., made important contributions to the agency's aeronautics research program. The F/A-18 high-Alpha Research Vehicle completed the first phase of a three-part program to validate computer codes and wind tunnel predictions of airflow during high angle-of-attack flight.

The first experimental forward-swept-wing X-29 aircraft wrapped up a highly successful test program after 242 flights that demonstrated its unique wing configuration is practical. The second X-29, modified to fly safely at angels-of-attack up to 70 degrees, also made its first research flight. As part of the NASA/DOD Self-Repairing Flight Control Program, computers aboard Ames-Dryden's F-15 research aircraft correctly identified and isolated a simulated failure in the flight control system.

NASA also continued efforts to enhance the efficiency of commercial air travel. The program was the end result of a major NASA-industry-university effort to develop the aerodynamic, structural, mechanical and acoustical technologies needed to verify the performance of such unique, fuel-efficient propellers.

At NASA's Langley Research Center, scientists and engineers conducted a series of high-speed ground tests to study the effect of heavy rain on the performance of aircraft wings. *Initial results tend to confirm wind tunnel data that there is a loss of wing lift at* extremely high rainfall rates.

Langley officials also announced development of the Takeoff Performance Monitoring System, an innovative new tool to help pilots make the critical go/abort decision during the takeoff role.

Recognizing that U.S. leadership in the production and sale of commercial airliners is being challenged, NASA greatly expanded its research into advanced "composite" structures made from epoxy-type resins and high-strength carbon fiber. Use of such materials in the wings and fuselages of future transport aircraft could significantly reduce their weight, improve their fuel efficiency and reliability.

The Civil Space Technology Initiative addresses near-Earth orbital requirements in areas such as automation and robotics, space power and information technology. Space systems of the next decade will use these technologies for cost-effective and reliable operations in Earth orbit. The Pathfinder program focuses on technology research for future solar system voyages in four broad areas: surface exploration, in-space operations, transfer vehicles and humans in space.

In May, NASA's Ames Research Center, successfully demonstrated a low-cost, parallel-*processing computer that potentially rivals today's most advanced supercomputers. The* research program may allow applications such as structural analysis, artificial intelligence and computational electro-mechanics to run on smaller, more easily-affordable computers.

Scientists at Lewis reached a milestone in the application of high-temperature superconductors in July, when they produced the first electronic circuit able to operate at 33-37 Gigahertz -- three times higher than frequencies previously obtainable.

The Year In Review

Voyager 2's encounter with Neptune gave researchers at the Jet Propulsion Laboratory an opportunity to demonstrate a new "artificial intelligence" computer program to detect and analyze spacecraft and ground data system anomalies. The Spacecraft Health Automated Reasoning Prototype helped to identify a problem in the science data streaming down from Voyager prior to its Neptune fly-by.

NASA is preparing Shuttle Mission 32 to retrieve the Long Duration Exposure Facility that has carried 57 science, technology and applications experiments in Earth orbit since April 1984.

SPACE OPERATIONS

The Tracking and Data Relay Satellite (TDRS-4) was successfully deployed in March from the Shuttle Discovery, marking completion of the TDRS system. The TDRS system covers at least 85 percent of each low-Earth-orbiting spacecraft's orbital period and facilitates a much higher information flow rate between these spacecraft and the ground. NASA concluded an agreement with INTELSTAT, Washington, D.C., for the use of the C-Band capacity on two Tracking and Data Relay Satellites for international telecommunications purposes.

SAFETY, RELIABILITY, MAINTAINABILITY AND QUALITY ASSURANCE

Lockeed Engineering and Science Co., Houston, was named recipient of the NASA 1988-89 Excellence Award for Quality and Productivity.

To encourage more small businesses to improve their quality and productivity processes, NASA established a separate small business category for the 1989-90 Excellence Award program.

The Aerospace Safety Advisory Panel (ASAP) released its annual report in March praising NASA for its work on return-to-flight. The main focus of the ASAP was monitoring and advising NASA and its contractors on the STS recovery program. The report stated that efforts restored the flight program with better management, safety and quality assurance organizations and management communications.

INTERNATIONAL AFFAIRS

NASA's international cooperative activities in 1989 included:

- In October 1989, the Galileo spacecraft to Jupiter was successfully launched. Galileo is an international cooperative project with the Federal Republic of Germany, which provided the orbiter's retropropulsion module to perform mission maneuvers and permit insertion of the spacecraft into Jovian orbit.

- NASA signed a memorandum of understanding with the government of Japan in March, completing the international agreements for the construction and use of Space Station Freedom. Under the agreement, Japan will provide the Japanese Experiment Module *consisting of a pressurized laboratory and an exposed facility. The European Space* Agency and Canada had signed agreements for their participation in the project in September 1988.

- In July, NASA and the German Minister for Research and Technology signed a memorandum of understanding to launch German Spacelab payloads on the Space Shuttle.

- In September, the U.S. government and the government of Japan exchanged diplomatic notes approving cooperation on the Geotail Mission. Geotail is a Japanese-built spacecraft which will make solar-terrestrial physics measurements using Japanese and U.S. science instruments. NASA will launch the spacecraft in 1992.

- In December, NASA and the European Space Agency concluded an agreement for cooperation in the joint Solar Terrestrial Science Programme. This program consists of two missions, the Solar Heliospheric Observatory (SOHO) and Cluster (four spacecrafts that will fly in formation to observe the Earth's plasma environment). Under this agreement, ESA will develop the spacecraft for SOHO and Cluster. NASA will launch and operate SOHO and ESA will launch and operate Cluster. Experiments on the spacecraft will be provided by the U.S. and European scientists.

- Cooperation with the Soviet Union continued to progress under the U.S./USSR Joint Working Groups on Space Biology and Medicine; Solar System Exploration; Space Astronomy and Astrophysics; Solar-Terrestrial Physics and Earth Sciences. Key activities included; a telemedicine spacebridge for Armenia, linking U.S. and Soviet

hospitals; twenty-nine NASA science experiments flown on the September Soviet Biosat mission and two U.S. instruments for flight on the Soviet Spectrum-X astrophysics mission.

• Planning accelerated in 1989 for NASA's Earth Observing System (EOS), the cornerstone of the Mission to Planet Earth. A group of 41 instruments from the U.S., Canada, Japan and Europe was selected this year for flight on EOS and over 500 scientists from 13 countrieshave been identified to participate in the program.

• In February, NASA convened a panel of experts on Earth science and technology, which met in Abingdon, England, and generated 10 projects in the Earth sciences which will be implemented internationally in observance of International Space Year (ISY) in 1992.

COMMERCIAL PROGRAMS

Significant progress was made in 1989 by NASA's Office of Commercial Programs (OCP) in defining an overall program of commercial space development.

The Commercial Programs Advisory Committee conducted a thorough review of commercial space issues and formulated a series of key recommendations for consideration by the nation's leaders.

The document, "Issues in Strategic Planning for Commercial Space Growth," representing inputs from more than 90 industry representatives, addresses overall goals and objectives, the scope of commercial space activities and the role industry, academia and government, explores issues and barriers and suggests federal actions and policy changes.

In 1989, OCP sponsored commercial development payloads on three shuttle missions and funded the first U.S. Commercial launch of a materials science payload. Commercial experiments flown on the shuttle included:

*Protein Crystal Growth, an experiment package flown by the NASA-sponsored Center for Macromolecular Crystallography located at the University of Alabama in Birmingham, was carried aboard STS-29 and will be flown on the STS-32.

*Fluids Experiment Apparatus, flown on STS-30, is scheduled to fly on STS-32. The FEA, a modular microgravity chemistry and physics laboratory, is being flown under a NASA-Rockwell International Corp. joint endeavor agreement (JEA) in the field of floating zone crystal growth and purification research.

*Polymer Morphology, a 3M-developed organic materials processing experiment, was designed to explore the effects of microgravity on polymeric materials as they are processed in space. The experimentwas conducted on STS-34 in October.

NASA in 1989, initiated a grant funding for a commercial sounding rocket program. Consort 1, a package of materials science investigations launched successfully on March 29 atop the commercially provided Starfire rocket at White Sands Missile Range, N.M., was the first flight conducted under this effort.

Consort 2, launched Nov. 15 at White Sands, was only a partial success due to a malfunction in the rocket's guidance package, resulting in termination of the mission as the rocket strayed off course. However, the experiments payload parachuted safely to Earth ans suffered only minor damage. Important payload data was recorded during the brief flight and indicated that the experiment equipment performed flawlessly. The payload will be launched again at a later date.

Other key OCP activities in 1989 included:

*Announcement of new digital, visual-filtering technology, developed by a researcher at NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif., to aid sufferers (mostly elderly) from maculopathy or central spot blindness.

*Introduction of an implantable, rechargeable physiologic sensor to monitor glucose marked a major advance for insulin-dependent diabetics. The sensor is now being developed in a collaborative effort among the Johns Hopkins University Applied Physics Laboratory, Laurel, Md.; the University of New Mexico, Albuquerque; and NASA's Goddard Space Flight Center.

*The collaboration of the Center for Commercial Development of Space Power, Auburn University, Ala., and Maxwell Laboratories, San Diego, to develop a stronger, more efficient power supply for lasers, x-rays, spacecraft and other users. The advance, which will result in commercial uses of the technology on Earth, represents the first

technology spinoff from NASA/industry-supported research at NASA's 16 Centers for Commercial Development of Space.

"NASA's Ames Research Center, Genentech Inc., South San Francisco, Calif.; and Penn State's Center for Cell Research, announced collaboration on a groundbased and Space Shuttle experiment program to increase medical knowledge to treat human bone diseases, organ regeneration and transplantation, and immune and skeletal muscle cell definiciency.

EDUCATIONAL AFFAIRS

The first 17 Designated Space Grant Colleges/Consortia were selected on Aug. 31, 1989, initiating NASA's National Space Grant College and Fellowship Program. These designated colleges/consortia, will receive up to $225,000 in grants and $100,000 in fellowships, beginning in Fiscal Year 1990 for 5 years. The program is designed to create a network of universities capable of contributing to aerospace science and technology and training a highly skilled workforce.

President Bush selected "Endeavour" as the name for the replacement Space Shuttle orbiter on March 20, 1989. The name resulted from a nationwide competition supported by educational projects created by student teams in elementary and secondary schools.

NASA announced the opportunity for educators to participate in the first experiment ever to study the effects of long-term space exposure on living tissue. With the return of the Long Duration Exposure Facility, deployed in Earth orbit in April 1984, 12.5 million tomato seeds, packaged in kits, will be available to teachers in grades 5 through university.

Through a pilot program, NASA Marshall Space Flight Center, has opened its computerized science data bases to the nation's universities to stimulate "cottage industry" space research by professors and entice more students into science and engineering studies.

Three student experiments, selected under the Space Shuttle Student Involvement Program, flew aboard the Space Shuttle in 1989.

In its 8th year, the Space Science Student Involvement Program selected eight national winners in the Space Station category. Top honors, plus a $3,000 scholarship and a computer went to Diane Fogel, Landsdale, Pa., for her proposed experiment to test remedies for bone loss during space flight.

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

During the summer, over 200 educators spent 2 weeks at one of NASA's nine field centers learning the latest in aerospace science, working with educational specialists to fit materials into classroom curriculum.

Over $8 million was awarded to 496 students at 110 universities for advanced study in engineering and space, physical, life and environmental sciences under NASA's Graduate Student Researcher's Program.

In the University Advanced Design Program, 36 universities received 3-year grants to study topics in space and aeronautical missions in the post-Space Station era, such as manned Mars aircraft and delivery systems, long-term space habitat, lunar launch and landing facilities and high-speed civil transport.

Section B

Space Flight Activity

NASA Launch Vehicle Performance

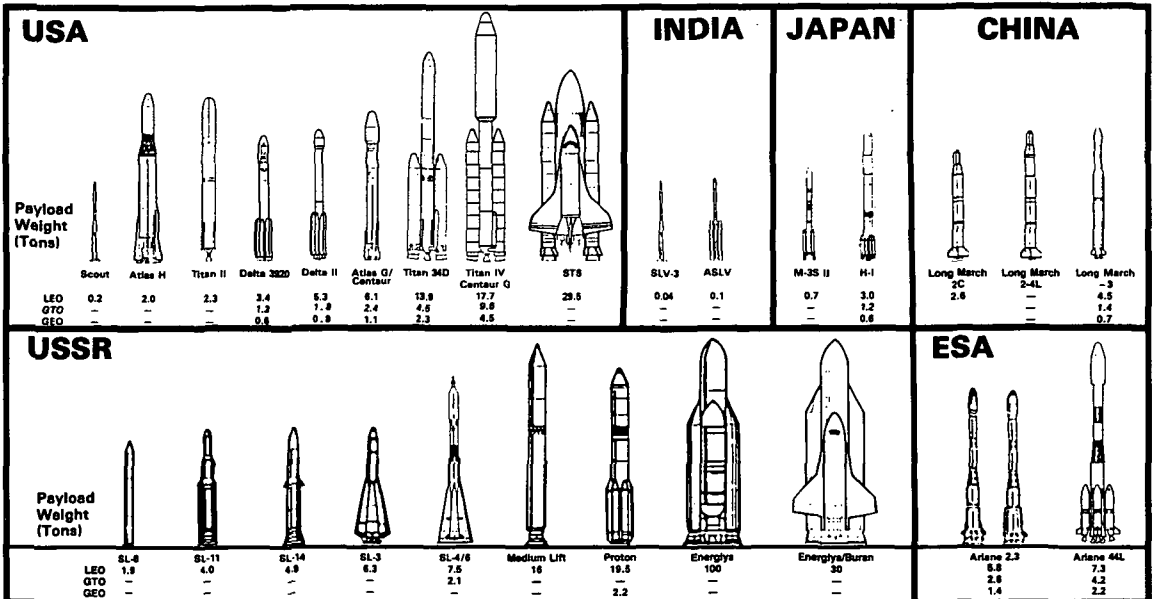
Summary of NASA Launches by Vehicle (Orbital)

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	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	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	0	29
Atlas E/F	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	1	1	1	0	1	1	0	1	0	1	0	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	1	60
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	1	154
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	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	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	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	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	0	63
Shuttle	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	3	4	5	9	1	0	2	5	31
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	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	1	0	0	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	0	11
Titan Centaur	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	2	1	2	0	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	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	7	441

Summary of NASA Launches by Vehicle (Suborbital)

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	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	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	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	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	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	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	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	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	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	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	0	44

Current Worldwide Launch Vehicles



Summary of Announced Launches

Summary of Worldwide Launches

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
Australia	--	--	--	--	--	--	--	--	--	--	1	0	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	10	466
ESA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	2	0	2	4	3	2	2	7	7	30
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	0	10
India	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	0	1	0	0	0	0	0	0	3
Isreal	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	1
Japan	--	--	--	--	--	--	--	--	--	--	--	--	--	1	2	1	0	1	2	1	2	3	2	2	3	1	3	3	2	2	3	2	2	38
MDAC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
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	7	441
PRC	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	0	0	0	3	2	0	1	0	0	1	1	1	3	1	2	2	4	0	23
United Kingdom	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	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	74	2180
TOTAL	2	8	14	19	35	72	55	87	112	118	126	119	110	114	120	106	109	106	125	128	124	124	106	105	123	121	127	129	120	103	110	116	101	3195

Summary of NASA Launches

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	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	6	250
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	0	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	1	28
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	0	92
Foreign	--	--	--	--	--	--	--	--	--	--	--	1	2	2	1	4	1	5	3	2	7	5	1	0	0	2	1	1	0	0	1	0	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	7	441
Suborbital (Includes 3 Cooperative/Reimbursable Launches)	--	--	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	0	44

Summary of Worldwide Payloads

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
TOTAL																																		
3 AMSAT	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3
5 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	0	5
1 ASC	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0	0	0	0	1
2 ASCO	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	0	0	0	0	2
5 Australia	–	–	–	–	–	–	–	–	–	–	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	5
2 Brazil	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	0	0	0	2
9 Canada	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	0	1	0	0	1	0	0	0	2	1	1	1	0	0	0	0	9
5 NASA/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	0	5
45 COMSAT	–	–	–	–	–	–	–	1	1	3	1	3	3	2	2	1	1	2	6	1	3	0	1	3	2	2	2	3	0	0	0	1	1	45
2 Czechoslovakia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	0	0	0	0	0	0	2	2
674 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	9	12	674
6 NASA/ESA	–	–	–	–	–	–	–	–	–	–	–	2	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	6
25 ESA	–	–	–	–	–	–	–	–	–	–	–	1	1	0	0	3	0	0	1	0	2	2	1	0	4	0	2	2	1	0	1	2	2	25
19 France	–	–	–	–	–	–	–	1	1	2	0	0	2	1	1	0	0	0	5	0	1	0	0	0	0	0	1	1	1	1	0	1	1	19
6 NASA/France	–	–	–	–	–	–	–	1	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	6
2 France/Germany	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
9 Germany	–	–	–	–	–	–	–	–	–	–	–	–	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	1	0	0	1	1	2	9
4 NASA/Germany	–	–	–	–	–	–	–	–	–	–	–	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
6 GTE	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	1	0	0	2	0	6
7 Hughes	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	3	2	0	0	0	0	7
11 India	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0	0	0	1	1	3	1	2	0	0	0	0	2	0	11
5 Indonesia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	0	0	0	0	0	1	1	0	0	1	0	0	5
1 Israel	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0	1
1 Italy	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0	0	0	0	0	0	0	0	0	0	0	0	1
5 NASA/Italy	–	–	–	–	–	1	0	0	1	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	5
44 Japan	–	–	–	–	–	–	–	–	–	–	–	–	1	2	1	0	1	2	1	4	2	2	3	1	3	3	2	3	3	2	2	0	0	44
2 Mexico	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	0	0	0	0	2
278 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	2	9	278
6 NATO	–	–	–	–	–	–	–	–	–	–	–	–	1	1	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	6
2 NASA/Netherlands	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
30 NOAA	–	–	–	–	–	–	–	–	–	3	3	2	1	1	1	1	1	1	1	1	1	1	1	2	2	0	2	2	0	1	1	1	0	30
2 NASA/NOAA	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
3 NASA/NRL	–	–	–	–	–	–	–	–	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
1 N. Utah Univ	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0	0	0	0	1
1 PanAmSat	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0	0	0	1
24 PRC	–	–	–	–	–	–	–	–	–	–	–	–	1	1	0	0	0	3	2	0	1	0	0	3	1	1	3	1	3	1	3	0	0	24
10 RCA	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	0	0	1	0	1	2	2	0	1	1	0	0	0	0	0	0	10
4 SBS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	0	1	0	0	0	0	4
1 NASA/Spain	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2 Sweden	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0	0	1	2
11 United Kingdom	–	–	–	–	–	–	–	–	–	–	–	1	1	1	0	0	1	0	0	0	0	1	0	1	0	0	2	0	0	0	0	1	1	11
5 NASA/UK	–	–	–	–	1	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
2564 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	95	2564
6 WU	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	0	0	0	0	1	0	0	2	0	1	0	0	0	0	0	6
3858 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	142	151	161	184	132	133	136	129	3856

Summary of NASA Orbital Payloads

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	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	5	76
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	5	63
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	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	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	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	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	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	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	2	74
L/V Develop.	--	--	--	--	--	--	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	1	8
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	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	1	10
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	9	279

Summary of NASA Suborbital Payloads

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	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	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	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	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	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	0	3
L/V Develop.	--	--	--	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	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	2	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	0	42

Successful USA And Cooperative Payloads

Summary of USA Payloads

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
AMSAT	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	1	0	0	0	1	0	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	0	5
ASC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0	0	0	1
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	1	45
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	12	675
GTE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	1	1	0	2	0	6
Hughes	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	3	2	0	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	9	279
NOAA	--	--	--	--	--	--	--	--	--	3	3	2	1	1	1	1	1	1	1	1	1	1	1	2	2	0	2	2	0	1	1	1	1	30
N. Utah Univ.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0	0	0	1
PanAmSat	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	1
RCA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	0	0	1	0	1	2	2	0	1	1	0	0	0	10
SBS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	1	0	1	0	0	0	0	0	4
WU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	0	0	0	0	1	0	0	2	0	1	0	0	0	0	0	6
TOTAL	--	7	11	17	36	53	54	72	88	102	78	63	51	30	36	27	22	15	26	27	17	29	17	13	19	17	20	32	33	9	9	18	22	1073

Summary of NASA Cooperative Payloads

	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	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	0	5
ESA	--	--	--	--	--	--	--	--	--	--	--	2	0	0	0	0	0	0	0	0	2	2	0	0	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	0	6
Germany	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0	1	0	1	0	1	0	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	0	5
Netherlands	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
NOAA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
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	0	3
Spain	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	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	0	5
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	0	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 comsat for TV services.

ELEKTRON: Dual satellites to study the radiation belts.

FOTON: Scientific satellite to continue space materials studies.

GORIZONT (Horizon): Geosynchronous comsat for international relay.

GRANAT: Astrophysical orbital observatory

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.

NADEZHDA: Navigation satellite.

OKEAN: Oceanographic satellite to monitor ice conditions.

ORBOL: Joint Soviet/French scientific satellite.

PHOBOS: International project to study Mars and its moon Phobos.

POLYOT: Maneuverable satellite capable of changing orbits.

PROGNOZ (Forecast): Scientific interplanetary satellite.

PROGRESS: Unmanned cargo flight to resupply manned space stations.

PROTON: Scientific satellite to investigate the nature of Cosmic Rays.

RADIO: Small radio relay satellite for use by amateurs.

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

RESURS: Earth resources satellite.

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: Modified Vostok capsule for two and three Cosmonauts.

VOSTOK (East): First manned capsule; placed six Cosmonauts in orbit.

ZOND: Automatic spacecraft development tests. Zond 5 was the first spacecraft to make a circumlunar flight and return safely to Earth.

Unofficial Tabulation of USSR Payloads

TOTAL	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTAL
1 Buran	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	1
2054 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	68	2054
19 Ekran	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	0	2	2	1	2	2	2	1	1	2	2	0	19
4 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	0	4
2 Foton	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	2
19 Gorizont	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	2	1	0	2	2	2	1	2	1	2	3	19
1 Granat	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
23 Intercosmos	--	--	--	--	--	--	--	--	--	--	--	2	2	1	3	2	2	2	2	1	1	2	0	2	0	0	0	0	0	0	0	1	23
3 Iskra	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	2	0	0	0	0	0	0	0	3
2 Kvant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	1	2
24 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	0	24
7 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	0	7
52 Meteor	--	--	--	--	--	--	--	--	--	--	--	--	2	4	4	3	2	5	4	3	4	0	3	2	2	2	1	1	3	1	2	2	2	52
1 Mir	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0	1
130 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	4	130
1 Nadezhda	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
1 Okean	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	1
2 Phobos	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	0	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	0	2
10 Prognoz	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	1	0	1	1	1	1	0	1	0	0	1	0	1	0	0	0	0	10
43 Progress	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	3	4	1	4	2	5	1	2	7	6	4	43
4 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	0	4
8 Radio	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	0	0	6	0	0	0	0	0	0	0	0	8
25 Raduga	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	1	1	1	2	3	1	2	2	2	2	2	1	3	25
5 Resurs	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	5
7 Salyut	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	1	2	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	7
63 Soyuz	--	--	--	--	--	--	--	--	--	--	1	2	5	1	2	0	2	3	4	3	3	5	4	6	3	3	2	3	2	2	3	3	1	63
12 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	0	12
2 Vega	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	0	0	0	0	0	2
15 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	0	15
4 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	0	4
2 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	0	2
10 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	0	0	10
6 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	0	6
2564 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	95	2564

NASA Astronauts

Of the 172 astronauts selected in 12 groups from 1959 to 1989, 122 have flown on 63 manned missions; 85 have flown on 32 Shuttle flights; 10 female astronauts have flown on 12 Shuttle flights.

* = Female

NAME	FLIGHT
ADAMSON, James C.	STS 28
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
BAGIAN, James P.	STS 33, STS 29
*BAKER, Ellen	STS 34
BEAN, Alan F.	Apollo 12, Skylab 3
BLAHA, John E.	STS 33, STS 29
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
BROWN, Mark N.	STS 28
BUCHLI, James F.	STS 51-C, STS 61-A
CARPENTER, M. Scott	Aurora 7
CARR, Gerald P.	Skylab 4
CARTER, Lanier	STS 33
CERNAN, Eugene A.	Gemini IXA, Apollo 10, Apollo 17
CHANG-DIAZ, F. R.	STS 61-C, STS 34
*CLEAVE, Mary L.	STS 61-B, STS 30
COATS, Michael L.	STS 41-D, STS 29
COLLINS, Michael	Gemini X, Apollo 11
COOPER, L. Gordon, Jr.	Faith 7, Gemini V
COVEY, Richard O.	STS 51-I, STS-26
CREIGHTON, John O.	STS 51-G
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, STS 30
GREGORY, F. D.	STS 51-B, STS 33
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
LEE, Mark C	STS 30
LEETSMA, David D.	STS 41-G, STS 28
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, STS 34
MATTINGLY, Thomas K., II	Apollo 16, STS 4, STS 51-C
McBRIDE, Jon A.	STS 41-G
McCANDLESS, Bruce	STS 41-B
McCULLEY, Michael J.	STS 34
McDIVITT, James A.	Gemini IV, Apollo 9
McNAIR, Ronald E.	STS 41-B, STS 51-L
MITCHELL, Edger D.	Apollo 14
MULLANE, Richard M.	STS 41-D, STS-27
MUSGRAVE, Story F.	STS 6, STS 51-F, STS 33

NAME	FLIGHT
NAGEL, Steven R.	STS 51-G, STS 61-A
NELSON, George D.	STS 41-C, STS 61-C, STS-26
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
RICHARDS, Richard N.	STS 28
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, STS 28
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
SPRINGER, Robert C.	STS 29
STAFFORD, Thomas P.	Gemini VI-A, Gemini IXA, Apollo Soyuz, Apollo 10

NASA Astronauts

NAME	FLIGHT
STEWART, Robert L.	STS 41-B, STS 51-J
*SULLIVAN, Kathryn D.	STS 41-G
SWIGERT, John L., Jr.	Apollo 13
THAGARD, Norman E.	STS 7, STS 51-B, STS 30
*THORTON, Kathryn C.	STS 33
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, STS 30
WEITZ, Paul J.	Skylab 2, STS 6
WHITE, Edward H.	Gemini IV
WILLIAMS, Donald E.	STS 51-D, STS 34
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 1B			
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
STS-29 - Discovery	Coats, Blaha, Bagian, Buchi, Springer	119:39:00	598:15:00

Summary Of United States Manned Space Flight

MISSION	CREW MEMBERS	MISSION DURATION	MANHOURS
STS-30 - Atlantis	Walker, Grabe, Thagard, Cleave, Lee	96:57:00	484:35:00
STS-28 - Columbia	Shaw, Richards, Leetsma, Adamson, Brown	121:37:53	608:09:25
STS-34 - Atlantis	Williams, McCulky, Baker, Chang-Diaz, Lucid	119:39:00	607:15:00
STS-33 - Discovery	Gregory, Blaha, Musgrave, Thornton, Carter	112:06:46	560:33:05
Total Flights - 32		4214:47:30	23240:04:06

SUMMARY OF UNITED STATES MANNED SPACE FLIGHT

MISSION	NUMBER OF FLIGHTS	NUMBER OF CREW MEMBERS	MISSION DURATION	MANHOURS
			HR:MIN:SEC	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	32	167	4214:47:30	23240:04:06
US Total	63	269	12075:18:26	45091:53:56

SPACE SHUTTLE SUMMARY

MISSION	NUMBER OF FLIGHTS	NUMBER OF CREW MEMBERS	MISSION DURATION	MANHOURS
			HR:MIN:SEC	HR:MIN:SEC
Atlantis	5	27	484:01:27	3259:16:53
Challenger	10	60	1495:56:20	8978:10:37
Columbia	8	30	1107:26:49	4545:45:42
Discovery	9	50	1127:22:54	6456:50:54
	32	167	4214:47:30	23240:04:06

EXTRAVEHICULAR ACTIVITY (EVA) SUMMARY

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

* 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 Contaminent 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 (MIR) 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 Contaminent 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) Mission Duration: 120 hrs 23 min 42 sec	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
STS-7 (Challenger) Mission Duration: 146 hrs 23 min 59 sec	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

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) Mission Duration: 191 hrs 15 min 55 sec	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
STS 41-C (Challenger) Mission Duration: 167 hrs 41 min	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

Summary Of Shuttle Payloads And Experiments

FLIGHT	LAUNCH DATE	LANDING DATE	CREW	PAYLOADS AND EXPERIMENTS
STS 41-D(Rev) (Discovery)	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
Mission Duration: 144 hrs 56 min 4 sec				
STS 41-G (Challenger)	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.
Mission Duration: 197 hrs 23 min 37 sec				

Summary Of Shuttle Payloads And Experiments

FLIGHT	LAUNCH DATE	LANDING DATE	CREW	PAYLOADS AND EXPERIMENTS
STS 51-A (Discovery)	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/FSS (2) - NASA Diffuse Mixing of Organic Solids (DMOS) - 3M Co. Radiation Monitoring Equipment (RME) - NASA Man. Foot Restraint (MFR) -NASA
Mission Duration: 191 hrs 44 min 56 sec				
STS 51-C (Discovery)	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
Mission Duration: 73 hrs 33 min 27 sec				
STS 51-D (Discovery)	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 - Pras/USC/LA Orthopaedic Hospital Other - Statute of Liberty Replicas (2)
Mission Duration: 167 hrs 54 min				

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)	Deployed: NUSAT - Northern Utah University Spacelab 3 (LM + MPESS) - NASA/ESA
Mission Duration: 168 hrs 8 min 47 sec			MS: Norman E. Thagard (MD) MS: Wm. E. Thornton (MD) PS: Lodewijk Vandenberg (PhD) PS: Taylor Wang (PhD)	GLOMR - DOD
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)	Deployed: Morelos-A/PAM-D - Mexico Arabsat-A/PAM-D - ASCO Telstar 3-D/PAM-D - AT&T
Mission Duration: 169 hrs 39 min			MS: Steven R. Nagel (USAF) MS: Shannon W. Lucid (PhD) PS: Patrick Baudry (France) PS: Prince Sultan Salman Al-Saud (Saudi Arabia)	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

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/UNQ - 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)	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)
Mission Duration: 165 hrs 4 min 49 sec				
STS 61-C (Columbia)	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
Mission Duration: 146 hrs 3 min 51 sec				
STS 51-L (Challenger)	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
Mission Duration: 73 sec				

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*

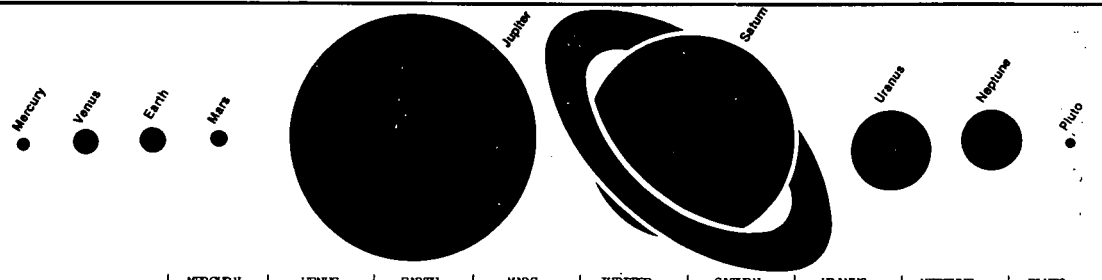
Summary of Shuttle Payloads And Experiments

FLIGHT	LAUNCH DATE	LANDING DATE	CREW	PAYLOADS AND EXPERIMENTS
STS-29 (Discovey) Mission Duration 119 hrs 39 min	Mar 13, 1989 (KSC)	Mar 17, 1989 (EAFB)	Cdr: Michael L. Coats Plt: John E. Blaha MS: James P. Bagian Ms:James F. Buchli MS: Robert C. Springer	Deployed: TDRS-D - TRW/CONTEL/NASA Inertial Upper Stage (IUS) - Boeing/USAF/NASA Orbier Experiments Autonomous Supporting Instrumentation System (OASIS-I) - Lockheed/ISAF/NASA Space Station Heat Pipe Advanced Radiator Element (SHARE) - NASA Air Force Maui Optial System (AMOS) Calibration Test - USAF Chromosme and Plant Cell Division in Space Experiment (CHROMEX) - NASA IMAX Corporation Camera Experiment (IMAX) - IMAX of Canada/NASA Protein Crystal Growth (PCG) - Univ. of Alabama/NASA Shuttle Student Involveent Project: SSIP 82-8 - Ky. Fried Chicken/John C. Vellinger SSIP-9 - Orthopaedic Hosp./USC/Andrew I. Fras
STS-30 (Atlantis) Mission Duration 96 hrs 57 min	May 4, 1989 (KSC)	May 8, 1989 (EAFB)	Cdr: David M. Walker Plt: Ronald J. Grabe MS: Norman E. Thagard MS: Mary L. Cleave MS: Mark C. Lee	Deployed: Magellan Spacecraft/Inertial Upper Stae (IUS) - Martin/JPL/NASA Fluid Experiment Apparatus (FEA) - Rockwell/NASA Air Force Maui Optical Site Calibration (AMOS) - USAF
STS-28 (Columbia Mission Duration 121 hrs 37 min 53 sec	Aug 8, 1989 (KSC)	Aug 13, 1989 (EAFB)	Cdr: Brewster H. Shaw Plt: Richard N. Richards MS: David C. Leetsma MS: James C. Adamson MS: Mark N. Brown	Deployed: DOD Payload - DOD

Summary of Shuttle Payloads And Experiments

FLIGHT	LAUNCH DATE	LANDING DATE	CREW	PAYLOADS AND EXPERIMENTS
STS-34 Atlantis Mission Duration 119 hrs 30 min	Oct 18, 1989 (KSC)	Oct 23, 2989 (EAFB)	Cdr: Donald E. Wiliams Plt: Michael J. McCulley MS: Ellen Baker Ms. Shannon W. Lucid MS: Franklin R. Chang-Diaz	Deployed: Galileo/Inertial Upper Stage (IUS) - Hughes/JPL/AMC Boeing/USAF/NASA Shuttle Solar Backscatter Ultra-Violet Instru (SSBUV) - NASA GSFC Growth Hormone Concenration and Distribution in Plants (GHCD) - Michigan State Univ/NASA IMAX Student Experiment (SE-82-15 - Ygnacio HS/Boeing Polymer Morphology Exp (PM) - NASA Mesoscale Lightning Exp (MLE) - NASA Sensor Tech Exp (STEX) - USAF TAC Air Force Maui Optical Site (AMOS) - USAF
STS-33 Discovery Mission Duration 112 hrs 6 min 46 sec	Nov 22, 1989 (KSC)	Nov 27, 1989 EAFB)	Cdr: Frederick D. Gregory Plt: John E. Blaha MS: Manley L. Carter MS: Franklin Musgrave MS: Kathryn C. Thorton	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°	$23^{\circ}27'$	$25^{\circ}12'$	$3^{\circ}5'$	$26^{\circ}44'$	$97^{\circ}55'$	$28^{\circ}48'$	?
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 (?)	?	?

The Planets

During the first decade of planetary flights, NASA spacecraft were dispatched to scan the other inner planets: Mercury, Venus, and Mars. These worlds, and our own, are known as the terrestrial planets because of their similarity to Earth's rocky composition. In 1972, NASA opened the second decade of planetary exploration with the launch of a Jupiter probe. Interest was shifting to the other planets, giant balls of dense gas quite different from the terrestrial worlds we had previously surveyed. By studying the geology of planets and moons, and comparing the differences and similarities, we are learning more about the origin and history of these worlds and the solar system as a whole.

MERCURY

Obtaining the first closeup views of Mercury was the primary objective of the Mariner 10 space probe, launched from Kennedy Space Center in November 1973. After a journey of nearly 5 months, which included a flyby of Venus, the spacecraft passed with 805 kilometers (500 miles) of the solar system's innermost planet on March 29, 1974.

Mariner 10 photographs revealed an ancient, heavily cratered surface on Mercury, and showed huge cliffs crisscrossing the planet. These apparently were created when Mercury's interior cooled and shrank, compressing the planet's crust. The cliffs are as high as 2 kilometers (1.2 miles) and as long as 1500 kilometers (932 miles).

Instruments onboard Mariner 10 discovered that the planet has a weak magnetic field and a trace of atmosphere composed chiefly of argon, neon and helium. The spacecraft reported temperatures ranging from 510 degrees Celsius (950 degrees Fahrenheit) on Mercury's sunlit side to -210 degrees Celsius (-346 degrees Fahrenheit) on the dark side.

It takes 59 Earth days for Mercury to make a single rotation. It spins at a rate of about 10 kilometers (about 6 miles) per hour, measured at the equator.

Mercury appears to have a crust of light silicate rock. Scientists believe it has a heavy iron-rich core that makes up about half of its volume.

Mariner 10 made two additional flybys of Mercury - on September 21, 1974 and March 16, 1975.

VENUS

The Mariner 2 space probe, launched August 27, 1962, was the first of more than a dozen successful American and Soviet missions to study the mysterious planet.

Mariner 2 passed within 34,762 kilometers (21,600 miles) of Venus on December 14, 1962, and became the first spacecraft to scan another planet. Its instruments made measurements of Venus for 42 minutes. Mariner 5, launched in June 1967, flew within 4,023 kilometers (2,500 miles) of Venus. Its instruments measured the planet's magnetic field, ionosphere, radiation belts and temperatures. On its way to Mercury, Mariner 10 flew by Venus and returned ultraviolet pictures showing cloud circulation patterns in the Venusian atmosphere.

On December 4, 1978 the Pioneer Venus Orbiter became the first spacecraft placed in orbit around the planet. Five days later, the Pioneer Venus Multiprobe entered the Venusian atmosphere at different locations above the planet. Four independent probes and a main body radioed data about the planet's atmosphere during this descent toward the surface.

Approximately 97 percent of Venus' atmosphere is carbon dioxide. Venus' atmosphere acts like a greenhouse, permitting solar radiation to reach the surface but trapping the heat which would ordinarily be radiated back into space. As a result, surface temperatures are 482 degrees Celsius (900 degrees Fahrenheit), hot enough to melt lead.

The Planets

Radar aboard the Pioneer Venus orbiter provided a means of seeing through Venus' dense cloud cover and determining surface features over much of the planet. Among the features determined are two continent-like highland areas, one located in the equatorial region and the other to the north.

There is evidence of two major active volcanic areas. The concentration of lightning over these two regions suggests frequent volcanic activity at both places. Discovery of active volcanism on Venus makes it the third solar system body known to be volcanically active. The others are Earth and the Jovian satellite Io.

Venus' predominant weather pattern is a highspeed circulation of clouds which are made up of sulfuric acid. These speeds reach as high as 362 kilometers (225 miles) per hour. The circulation is in the same direction - east to west - as Venus' slow retrograde rotation.

NASA's Pioneer-Venus orbiter continues to circle the planet. It is expected to send data about Venus to Earth for years to come. In May the space shuttle deployed the magellan spacecraft, which will map the surfae of Venus.

EARTH

From our journeys into space, we have learned much about our home planet - Earth. The first American satellite, Explorer 1, was launched from Cape Canaveral on January 31, 1958. It discovered an intense radiation zone, now called the Van Allen Radiation Region, surrounding Earth. Since then, other research satellites have revealed that our planet's magnetic field is distorted into a teardrop shape by the solar wind - the stream of charged particles continuously ejected from the Sun. Earth's magnetic field does not fade off into space but has definite boundaries. Our upper atmosphere, once believed calm and quiescent, seethes with activity, swelling by day and contracting by night. It is affected by the changes in solar activity and contributes to weather and climate on Earth.

Satellites positioned about 35,000 kilometers (22,000 miles) out in space play a major role every day in local weather forecasting. Their watchful electronic eyes warn us of dangerous storms. Continuous global monitoring provides a vast amount of useful data, as well as contributing to a better understanding of Earth's complex weather machine. From their unique vantage point in space, spacecraft can survey the Earth's resources and monitor the planet's health.

As viewed from space, Earth's distinguishing characteristics are its blue waters and white clouds. Enveloped by an ocean of air consisting of 78 percent nitrogen and 21 percent oxygen, the planet is the only one in our solar system known to harbor life. Circling the Sun at an average distance of 149 million kilometers (93 million miles), Earth is the third planet from the Sun and the fifth largest in the solar system.

Its rapid spin and molten nickel-iron core give rise to an extensive magnetic field, which, coupled with the atmosphere, shields us from nearly all of the harmful radiation coming from the Sun and other stars. Most meteors burn up in Earth's atmosphere before they can strike the surface. The planet's active geological processes have left no evidence of the ancient pelting it almost certainly received soon after it formed.

The Earth has a single natural satellite -- the Moon.

MOON

The Apollo program left us a large legacy of lunar materials and data. Six two-man crews landed on and explored the lunar surface between 1969 and 1972. They returned a collection of rocks and soil weighing 382 kilograms (842 pounds) and consisting of more than 2,000 separate samples. From this material and other studies, scientists have constructed a history of the Moon dating back to its infancy. Rocks collected from the lunar highlands date about 4.0 to 4.3 billion years old. It's believed that the solar system formed about 4.6 billion

years ago. The first few million years of the Moon's existence were so violent that few traces of this period remain. As a molten outer layer gradually cooled and solidified into different kinds of rock, the Moon was bombarded by huge asteroids and smaller objects and their collisions with the Moon created huge basins hundreds of kilometers across.

This catastrophic bombardment died away about 4 billion years ago, leaving the lunar highlands covered with huge overlapping craters and a deep layer of shattered and broken rock. Heat produced by the decay of radioactive elements began to melt the inside of the Moon at depths of about 200 kilometers (124 miles) below its surface. Then, from about 3.8 to 3.1 billion years ago, great floods of lava rose from inside the Moon and poured out over its surface, filling in the large impact basins to form the dark parts of the Moon - called maria or seas. Explorations show that there has been no significant volcanic activity on the Moon for more than 3 billion years and, since then, the lunar surface has been altered only by the rare impacts of large meteorites and by the atomic particles from the Sun and stars.

MARS

Mariner 4, launched in late 1964, flew past Mars on July 14, 1965, to within 9,656 kilometers (6,000 miles) of the surface. Returning 22 close-up pictures, it found no evidence of artificial canals or flowing water. Mariners 6 and 7 followed during the summer of 1969, returning about 200 pictures showing a diversity of surface conditions. Earlier atmospheric data were confirmed and refined. On May 30, 1971, Mariner 9 was launched on a mission to study the Martian surface from orbit. It arrived five and a half months after liftoff, only to find Mars in the midst of a planet-wide dust storm which made surface photography impossible for several weeks. After the storm cleared, Mariner 9 began returning the first of 7,000 pictures which revealed previously unknown Martian features, including evidence that rivers, and possibly seas, could have once existed on the planet.

In August and September 1975, two Viking spacecraft, each consisting of an orbiter and a lander - were launched from Kennedy Space Center, Florida on a mission designed to answer several questions, including: is there life on Mars?

The results sent back by the two unmanned laboratories, which soft-landed on the planet, were inconclusive. Small samples of the red Martian soil were specially treated in three different experiments designed to detect biological processes. While some of the tests indicated biological activities were occurring, the same results could be explained by the planet's soil chemistry. There was a notable absence of evidence that organic molecules exist on Mars.

Photos sent from the Plain of Chryse, where Viking 1 landed on July 20, 1976, show a bleak, rusty red landscape. A panorama returned by the robot explorer pictures a gently rolling plain, littered with rocks and graced by rippled sand dunes. Fine red dust from the Martian soil gives the sky a pinkish hue. Viking 2 landed on the Plain of Utopia, arriving several weeks after its twin. The landscape it viewed is more rolling than that seen by Viking 1, and there are no dunes visible.

Both Viking landers became weather stations, recording wind velocity and direction, temperatures, and atmospheric pressure. As days became weeks, the Martian weather changed little. The highest atmospheric temperature recorded by either lander was -21 degrees Centigrade (-17 degrees Fahrenheit) at the Viking 1 site in midsummer. The lowest temperature, -124 degrees Celsius (-19 degrees Fahrenheit), was recorded at the more northerly Viking 2 site during winter. Wind speeds near hurricane force were measured by both weather stations during global dust storms. Viking 2 photographed light patches of frost, probably water ice, during its second winter on Mars.

The Martian atmosphere is primarily carbon dioxide. Present in small percentages are nitrogen, oxygen and argon, with trace amounts of krypton and xenon. Martian air contains only about 1/1000 as much

water as Earth's but even this small amount can condense out and form clouds which ride high in the atmosphere, or swirl around the slopes of towering Martian volcanoes. Local patches of early morning fog can form in valleys.

There is evidence that in the past, a denser Martian atmosphere may have allowed water to flow on the planet. Physical features closely resembling shorelines, gorges, riverbeds and islands suggest that great rivers once existed on the planet.

Mars has two small, irregularly shaped moons, Phobos and Deimos, with ancient, cratered surfaced.

All four Viking spacecraft, two orbiters and two landers, exceeded by large margins their design lifetime of 90 days. The four spacecraft were launched in 1975 and began Mars operation in 1976. The first to fail was Orbiter 2 which stopped operating in 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. Orbiter 1 operated until August 7, 1980, when it too used the last of its attitude control gas. Lander 1 ceased operating on November 13, 1983.

JUPITER

In March 1972, NASA dispatched the first of four space probes to survey the colossal worlds of gas and their moons of rock and ice. For each probe, Jupiter was the first port of call.

Pioneer 10, which lifted off from Kennedy Space Center March 2, 1972, was the first spacecraft to penetrate the Asteroid Belt and travel to the outer regions of the solar system. In December 1973, it returned the first closeup pictures of Jupiter as it flew within 132,252 kilometers (81,168 miles) of the planet's banded cloudtops. Pioneer 11 followed a year later. Voyagers 1 and 2 were launched in the summer of 1977 and returned spectacular photographs of Jupiter and its 16 satellites during flybys in 1979.

During their visits these exploring spacecraft found Jupiter to be a whirling ball of liquid hydrogen, topped with a uniquely colorful atmosphere which is mostly hydrogen and helium. It contains small amounts of methane, ammonia, ethane, acetylene, phosphene, germanium tetrahydride and possibly hydrogen cyanide. Jupiter's clouds also contain ammonia and water crystals. Scientists believe it likely that between the planet's frigid cloud tops and the warmer hydrogen ocean that lies below, there are regions where methane, ammonia, water and other gases could react to form organic molecules. Because of Jupiter's atmospheric dynamics, however, these organic compounds, if they exist, are probably short lived.

The Great Red Spot, observed for centuries through Earth-based telescopes, is a tremendous atmospheric storm, similar to Earth's hurricanes, which rotates counterclockwise.

Our space probes detected lightning in Jupiter's upper atmosphere and observed auroral emissions similar to Earth's northern lights in the Jovian polar regions.

Voyager 1 returned the first evidence of a ring encircling Jupiter. Photographs returned by the spacecraft and its companion Voyager 2 showed a narrow ring too faint to be seen by Earth's telescopes.

Largest of the solar system's planets, Jupiter rotates at a dizzying pace, once every 9 hours 55 minutes 30 seconds. It takes the massive planet almost 12 Earth years to complete a journey around the Sun. The planet is something of a mini solar system, with 16 known moons orbiting above its clouds.

One of the most remarkable findings of the Voyager mission was the discovery of active volcanoes on the Galilean moon Io. It was the first time volcanic eruptions were observed on a world other than

Earth. The Voyager cameras identified at least eight active volcanoes on the moon. Plumes extended as far as 250 kilometers (155 miles) above the moon's surface. The satellite's pizza-colored surface, rich in hues of oranges and yellow, is probably the result of sulfur-rich materials which have been brought to the surface by volcanic activity. Europa, approximately the same size as the Earth's Moon, is the brightest Galilean satellite. Its surface displays a complex array of streaks that indicate the crust has been fractured.

Like Europa, the other two Galilean moons (Ganymede and Callisto) are frozen worlds of ice and rock. Ganymede is the largest satellite in the solar system, larger than the planet Mercury. It is composed of about 50 percent water or ice and the rest rock. Callisto, only slightly smaller than Ganymede, has the lowest density of any Galilean satellite, implying that is has large amounts of water in its composition. In October 1989, Galileo began its round about trip to Jupiter, where it will drop a probe into the Jovian atmosphere in the first direct study of the solar system's largest planet.

SATURN

No planet in the solar system is adored like Saturn. Its exquisite ring system is unrivalled. Like Jupiter, Saturn is composed mostly of hydrogen. But in contrast to the vivid colors and wild turbulence found in Jupiter's clouds, Saturn has a more subtle, butterscotch hue and its markings are often muted by high altitude haze.

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

The spacecraft discovered that there are actually thousands of ringlets encircling Saturn. These rings are composed of countless low-density particles orbiting individually around the equator at progressive distances from the planet's cloud tops. Analysis of radio waves passing through the rings showed that the particles vary widely in size, ranging from dust to boulders. Most of the material is ice and frosted rock.

Radio emissions quite similar to the static heard on an AM car radio during an electrical storm were detected by the Voyager spacecraft. These emissions are typical of lightning but are believed to be coming from the planet's ring system rather than its atmosphere. No lightning was observed in Saturn's atmosphere. But as they had at Jupiter, the Voyager spacecraft saw a version of Earth's northern and southern lights near Saturn's poles.

The probes also studied Saturn's moon, detected undiscovered moons, found some that share the same orbit, and determined that Titan has a nitrogen-based atmosphere.

A large constituent of Titan's atmosphere is methane. The surface temperature of Titan appears to be around the "triple" point of methane, meaning methane may be present on Titan in all three states: liquid, gaseous, and solid (ice). Methane, therefore, may play the same role on Titan that water plays on Earth.

Although the spacecraft's cameras could not peer through the dense haze that obscures the surface of Titan, measurements indicate Titan may be a place where rain or snow falls from methane clouds and rivers of methane cut through methane glaciers.

Continuing photochemistry due to solar radiation may be converting Titan's methane to ethane, acetylene, ethylene, and, in combination with nitrogen, hydrogen cyanide. The latter is a building block to amino acids. Titan's temperature is believed to be too low to permit progress beyond this stage of organic chemistry. However, this condition may be similar to that which occurred in the atmosphere of the primeval Earth between 3 and 4 billion years ago.

URANUS

Four and a half years after visiting Saturn, the Voyager 2 spacecraft completed the first close-up observation of the Uranian system.

Uranus, third largest of the planets, is the odd-ball of the solar system. Unlike the other planets, it lies tipped on its side with its north and south poles alternately facing the sun during its 84-year swing around the solar system. During Voyager's flyby, the south pole faced the sun.

Voyager found that the planet's magnetic field does not follow the usual north-south axis found on the other planets. Instead, it is tilted 60 degrees, and offset from the planet's center.

Uranus's atmosphere consists mainly of hydrogen, with about 12 per cent helium and small amounts of ammonia, methane and water vapor. Wind speeds range up to 200 meters per second (447 mph), and blow from the west instead of the east as previously expected. Temperatures near the cloudtops measure -200 degrees C. (-329 degrees F.)

The sunlit south pole is shrouded in a kind of photo-chemical "smog" believed to be a combination of acetylene, ethane and other sunlight-generated chemicals. Surrounding the planet's atmosphere and extending thousands of kilometers into space is a mysterious ultraviolet sheen called an "electroglow."

About 8,000 kilometers (5,000 miles) below Uranus's cloudtops there is thought to be a scalding ocean of water and dissolved ammonia some 10,000 kilometers (6,000 miles) deep. Beneath this ocean is an earth-sized molten core of heavier materials.

Voyager discovered 10 new moons orbiting Uranus, each about 40-170 kilometers (24-102 miles) in diameter. The planet's five known moons, Titania, Ariel, Miranda, Umbriel and Oberon, range in size from 480-1600 kilometers (300-1000 miles) across. The half-ice, half-rock spheres are a geological showcase, featuring 12-mile-high mountains, jagged cliffs and canyons, crater-pocked plains and winding valleys possibly carved out by glaciers.

The planet was thought to have 9 dark rings; Voyager found 11. In contrast to Saturn's rings, which are composed of bright grain-sized particles, Uranus's rings are made up of boulder-sized chunks.

NEPTUNE

Voyager 2 completed its Grand Tour of the solar system on August 25, 1989, when it swept to within about 1,280 kilometers (800 miles) of Neptune. The planet has two known moons, Nereid and Triton. Voyager 2's close up view of Neptune showed a bright blue planet with winds up to 1,500 mph and six previously unknown moons. It was disovered that Triton, the coldest known body in the solar system, is one of the geologically most active with four ice volcanoes. Neptune is the fourth largest of the planets and is believed to be a twin of Uranus, and is 2.8 billion miles from earth.

PLUTO

Pluto is the most distant of the planets, yet the eccentricity of its orbit periodically carries it inside that of Neptune's. The orbit also is highly inclined, well above and below the orbital plane of the other planets.

Pluto appears to be little more than a celestial snowball. Its diameter is calculated to be between 3,000 and 3,500 kilometers (1,864 and 2,175 miles), about the same as Earth's moon. Ground-based observations indicate that its surface is covered with methane ice.

The planet has one known satellite, Charon. There are no plans to send a probe to Pluto.

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 25, 1989 (Neptune)	Investigated the Jupiter, Saturn, and Uranus planetary systems. Provided first close-up photographs of Uranus and its moons. Used gravity-assist at Uranus to continue on to Neptune. Swept within 1280 Km of Neptune on August 25, 1989. The spacecraft will continue into interstellar space.
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) Jan 1989 (Mars)	International two-spacecraft project to study Mars and its moon Phobos. Phobos 1 was disabled by a ground controller error. Phobos 2 entered Mars orbit in January 1989 to study the Martian surface, atmosphere, and magnetic field. On March 27, 1989 communication with Phobos was lost and efforts to contact the craft were discontinued.

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 1	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		DOWN JULY 16, 1989			41.5	Provided data on energetic particles, radiation, and magnetic storms. Also recorded the first micrometeorite penetration of a sensor.
Little Joe 2 (S)	Little Joe (L/V #1A) (S)	Nov 4		SUBORBITAL FLIGHT				Suborbital test of Mercury Capsule to test the escape system. Vehicle functioned perfectly, but escape rocket ignited several seconds too late. (WFF)
Pioneer P-3 (U)	Atlas-Able (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

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)
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 I (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. (WFP)
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. (WFP)
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)
RFD-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.
RFD-2 (S)	Scout (S)	Oct 9		SUBORBITAL FLIGHT			217.6	Reentry flight carried AEC 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. (WSMC)
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

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 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
Explorer 25 (S) 1964 076B			115.2	2401	524	81.3	34.0	density relationships in the upper atmosphere. (WSMC)
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		DOWN AUG 9, 1989			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. (WFF)
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 GATV (S) 1966 103A	Titan II (S) A-Agena (S)	Nov 11 Nov 11		LANDED NOV 15, 1966 DOWN DEC 23, 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.
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 TEIR 2 as secondary payload.
TEIR 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
PAC (S) 1969 068B				DOWN APR 28, 1977			117.9	Delta stage.
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
Oscar 5 (S) 1970 008B			115.0	1475	1432	101.5	9.1	direct and stored modes. Oscar (Australia), carried piggy-back, 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.

MISSION/ Intl Desig	LAUNCH VEHICLE	LAUNCH DATE	PERIOD (Mins.)	CURRENT ORBITAL PARAMETERS (km) Apogee	Perigee	Incl (deg)	WEIGHT (kg)	REMARKS (All Launches from BSMC, 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 CITI (S)	Scout (S)	Sep 30		SUBORBITAL FLIGHT			134.0	Reentry test of radio blackout.
OFO 1 (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, deploy 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		AREOCENTRIC 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. (WFP)
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. (WFP)
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. (WFP)
BIC (S)	Scout 166C (S)	Sep 20		SUBORBITAL FLIGHT			31.7	Barium Ion Cloud Project to study Earth's magnetic field. Cooperative with Germany. (WFP)
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.
TEIR4 (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

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)
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

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)
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)

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)
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)

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)
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
INTASAT (S) 1974 089B			114.8	1457	1439	101.6	20.4	worldwide observations of ionospheric total electron counts. Cooperative with Spain. Oscar - provide
OSCAR (S) 1974 089C			114.8	1457	1438	101.6	28.6	communications for amateur radio enthusiasts around the world. (WSMC)
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)

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 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. First analysis of surface material on another planet.
LANDER (S) 1975 075C				LANDED ON MARS JUL 20, 1976			571.5	
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 Sep 3, 1976. Returned excellent scientific data.
Lander 1975 083A				LANDED ON MARS SEP 3, 1976			571.5	
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)

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)
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. (WPF)
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
OSCAR-8 (S) 1978 026B			103.0	908	896	98.9	27.3	mineral deposits. Carried Lewis Research Center Plasma Interaction Experiment (PIX-I) and AMSAT Oscar Amateur
PIX-I (S) 1978 026C			CURRENT ELEMENTS NOT MAINTAINED				34.0	Radio communications relay satellite.
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 [illegible], 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

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)
SAGE/AEM-2 (S) 1979 013A	Scout (S)	Feb 18		DOWN APRIL 11, 1989			127.0	Stratospheric Aerosol and Gas Experiment Applications Explorer Mission, to map vertical profiles of ozone, aerosol, nitrogen dioxide, and Rayleight molecular extinction around the globe. (WFF)
FLTSATCOM B (S) 1979 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-198C (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		DOWN DEC 2, 1989			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) (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

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)
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	Delta (S)	Aug 3						Dual spacecraft to study the Earth's electromagnetic fields. (WSMC)
1981 070A (S)			410.4	23339	495	89.4	424.0	
1981 070B (S)				DOWN FEB 19, 1983			420.0	
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

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)
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 DERF 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.

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 DFRF JUL 4, 1982					Fourth and last manned orbital test flight of the Space Transportation System with Thomas K. (Ken) Mattingly II and Henry W. Hartsfield to verify the combined performance of the 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 DFRF 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
TDRS-A (S) 1983 026B		Apr 4	1436.3	35804	35776	2.3	17014.0	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.
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
Telesat-F (S) 1983 059B		Jun 18	1436.0	35791	35782	0.0	4443.4	communications satellites. Telesat (Canada-Reimbursable)
Palapa-B-1 (S) 1983 059C		Jun 18	1436.1	35788	35783	0.0	4521.5	and Palapa (Indonesia - Reimbursable). Carried out
SPAS-01 (S) 1983 059F		Jun 18		RETRIEVED JUN 24, 1983				experiments including launching and recovering SPAS 01 (FRG). Mission duration 146 hours 23 minutes 59 seconds.
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.
INSAT-B (S) 1983 089B		Aug 31	1436.2	35819	35755	0.1	3391.0	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.
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.
WESTAR 6 (U) 1984 011B		Feb 3		DOWN NOV 16, 1984 (51-A)			3309.0	Stewart. Deployed WESTAR (Western Union-Reimbursable), and Palapa B-2 (Indonesia-Reimbursable). Both PAM's failed;
IRT (S) 1984 011C		Feb 3		DOWN FEB 11, 1984			234.0	both satellites retrieved on 51-A mission. Rendezvous tests performed with IRT, using deflated target. Evaluated
Palapa B-2 (U) 1984 011D		Feb 6		DOWN NOV 16, 1984 (51-A)			3419.0	Manned Maneuvering Unit (MMU) and Manipulator Foot Restraint (MFR). First STS landing at KSC. Mission duration 191 hours 15 minutes 55 seconds.
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
UoSAT (S) 1984 021B			98.4	691	674	98.1	52.0	multispectral scanner and thematic mapper. UoSAT sponsored by AMSAT. NOAA 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 41-C (S)	Shuttle (S)	Apr 6		LANDED AT DFRF APR 13, 1984				Fifth Challenger flight with Robert L. Crippen, Frances R.
1984 034A	(Challenger)							Scobee, Terry J. Hart, George D. Nelson and James D. Van
LDEF (S)		Apr 6	94.0	470	467	28.5	9670.0	Hoften. LDEF deployed; SMM retrieved and repaired in Cargo
1984 034B								Bay, redeployed Apr 12. Mission duration 167 hrs 41 min.
Intelsat V-G F-9	A-Centaur	Jun 9		DOWN OCT 24, 1984			1928.2	Advanced series of spacecraft to provide increased
(U)	(AC-62) (U)							telecommunications capacity for Intelsat's global network.
1984 057A								Carried Maritime Communications Services (MCS) package for
								INMARSAT. Vehicle failed to place satellite in useful
								orbit. Reimbursable.
AMPTE	Delta (S)	Aug 16						Three active magnetospheric particle tracer explorers:
CCE (S)			939.4	49817	974	3.8	242.0	Charge Composition Explorer (CCE) provided by The U.S.; Ion
1984 088A								Release Module (IRM) provided by The Federal Republic of
IRM (S)			2653.4	113818	402	27.0	605.0	Germany (FGR); and United Kingdom; Subsatellite (UKS)
1984 088B								provided by The United Kingdom; to study the transfer
UKS (S)								of mass from the solar wind to the magnetosphere.
1984 088C			2659.6	113417	1002	26.9	77.0	International Cooperative.
STS 41-D (S)	Shuttle (S)	Aug 30		LANDED AT EAFB SEP 5, 1984				First Discovery flight with Henry W. Hartsfield, Michael L.
1984 093A	(Discovery)							Coats, Richard M. Mullane, Steven A. Hawley, Judith A.
SBS-4 (S)		Aug 31	1436.1	35793	35781	0.0	3344.0	Resnik, and Charles D. Walker. Deployed SBS (Commercial-
1984 093B								Reimbursable), LEASAT (Commercial-Reimbursable) and Telstar
Syncom IV-2 (S)		Aug 31	1436.0	35788	35782	0.7	6889.0	(AT&T-Reimbursable), carried out experiments including
1984 093C								OAST-1 solar array structural testing. Mission duration
Telstar 3-C (S)		Sep 1	1436.1	35791	35782	0.0	3402.0	144 hours 56 minutes 4 seconds.
1984 093D								
Galaxy C (S)	Delta 176	Sep 21	1436.2	35792	35783	0.0	519.0	Hughes Communication, Inc., Communications Satellite.
1984 101A	(S)							Reimbursable.
STS 41-G (S)	Shuttle (S)	Oct 5		LANDED AT KSC OCT 13, 1984				Sixth Challenger flight with Robert L. Crippen, Jon A.
1984 108A	(Challenger)							McBride, Kathryn D. Sullivan, Sally K. Ride, David C.
ERBS (S)		Oct 5	96.8	607	599	57.0	2449.0	Leestma, Paul D. Scully-Power, and Marc Garneau (Canada).
1984 108B								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.
NOVA III (S)	Scout	Oct 11	108.9	1200	1149	90.0	173.7	Improved Transit Navigation Satellite for U.S. Navy.
1984 110A	S-208C (S)							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
Syncom IV-1 (S) 1984 113C		Nov 10	1436.0	35890	35679	0.9	6889.0	B-2 and Westar 6 (Launched on 41-B). Mission duration 191 hours 44 minutes 56 seconds.
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.
DOD (S) 1985 010B				ELEMENTS NOT AVAILABLE				Payton. Unannounced payload for DOD. (Reimbursable). Mission duration 73 hours 33 minutes 27 seconds.
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.
Telesat-I (S) 1985 028B		Apr 13	1436.0	35796	35777	0.3	3350.0	Hoffman, Charles D. Walker, and E.J. "Jake" Garn (U.S. Senator). Deployed Syncom (Hughes-Reimbursable) and
Syncom IV-3 (S) 1985 028C		Apr 12	1436.2	35809	35768	1.4	6889.0	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.
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.
NUSAT (S) 1985 034B				DOWN DEC 15, 1986			47.6	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.

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 SOOS-I 1985 066A (S) 1985 066B (S)	Scout S-209C (S)	Aug 2	107.9 107.9	1257 1258	1002 1002	89.9 89.9	64.2 64.2	Two Navigation Satellites for U.S. Navy. Reimbursable. (WSMC)
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.

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 (MORELOS), 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) 1985 114B (S)	Scout S-207C (S)	Dec 12	94.6	691	311	37.1		Air Force instrumented test vehicle. (Dual Payload) Reimbursable. (WFF)
				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 P87-11 (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.
SOOS-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	93.4	615	263	3.0	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					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					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					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					1712.0	Operational environmental satellite for NOAA. Carried Search and Rescue instruments provided by Canada and France. Reimbursable. (WSMC)
STS-26 (S) 1988 091A	Shuttle (S) (Discovery)	Sep 29		LANDED AT EAFB OCT 3, 1988				Sixth Discovery flight with Frederick H. Hauck, Richard O. Covey, John M. Lounge, David C. Hilmers, and George D.
TDRS-3 (S) 1988 091B		Sep 29	1434.8	35803	35719	0.1	2224.9	Nelson. Deployed TDRS-3. Performed experiment activities for commercial and scientific middeck experiments. Mission Duration 97 hours.
STS-27 1988 106A	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.
DOD 1988 106B								
1989								**1989**
STS-29 1989 021A	Shuttle (S) (Discovery)	Mar 13		LANDED AT EAFB MAR 18, 1989				Eighth Discovery flight with Michael L. Coats, John E. Blaha, James Bagian, James F. Buchli, Robert Springer.
TDRS-D 1989 021B			1436.1	35808	35768	0.0	2224	Deployed a new Tracking and Data Relay Satellite. Performed commercial and scientific experiments. Mission Duration 119 hrs and 39 min.

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-30 1989-033A Magellan 1989 033B	Shuttle (S) (Atlantis)	May 4		LANDED AT EAFB MAY 8, 1989 TRANS-VENUS TRAJECTORY				Fourth Atlantis flight with David M. Walker, Ronald J. Grabe, Mary L. Cleve, Mark C. Lee, Noman E. Thagard. Deployed the "Magellan" spacecraft on a mission toward Venus. Performed commercial and scientific middeck experiments. Mission Duration 96 hrs 57 min.
STS-28 1989 061A DOD	Shuttle (S) (Columbia)	Aug 8		LANDED AT EAFB AUG 13, 1989				Ninth Columbia flight with Brewster H. Shaw, Richard N. Richards, David C. Leetsma, James C. Adamson, Mark N. Brown. DOD Mission. Mission Duration 12 hrs 37 min 53 sec
FLTSATCOM 1989 077A	Altas/ Centaur (S)	Sep 25	1736.2	35299	35776	4.8	1863	Navy Communications Satellit to provide communications between aircraft, ships and ground stations for DOD.
STS-34 1989 084A Galileo 1989 084B	Shuttle (S) (Atlantis)	Oct 18		LANDED AT EAFB OCT 23, 1989 ELEMENTS NOT AVAILABLE				Fifth Atlantis flight with Donald E. Williams, Michael J. Michael J. McCulley, Ellen Baker, Shannon N. Lucid, Franklin Chang-Diaz. Deployed the Galileo spacecraft on a mission toward Jupiter. Performed experiment activities for commercial and scientific middeck experiments. Mission Duration 119 hrs 39 min
COBE 1989 089A	Delta 2 (S)	Nov 18	102.8	895	886	99.0	2206	Cosmic Background Explorer Spacecraft primary mission objectives include: 1) obtain definitive measurements of the spectrum and angular structure of the primeval cosmic background radiation and 2) search for cosmologically significant far infrared background radiation such as might come from the earliest stars and galaxies. The COBE mission will provide the most comprehensive observations to date of the radiative content of the universe.
STS-33 1989 090A DOD Payload 1989 090B	Shuttle (S) (Discovery)	Nov 23		LANDED AT EAFB NOV 28, 1989 ELEMENTS NOT AVAILABLE				Ninth Discovery flight with Frederick Gregory, John E. Blake, Manley L. Carter, Franklin S. Musgrave and Kathryn C. Thorton. DOD dedicated mission. Mission duration 112 hours and 6 minutes 46 seconds.

Section C

Procurement, Funding And Manpower

NASA Contract Awards By State

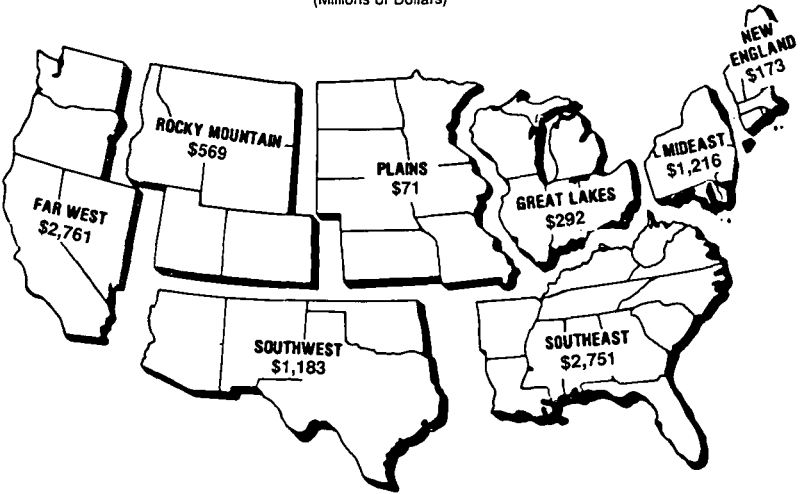
(FY 1989)

STATE	TOTAL (Thousands)	BUSINESS (Thousands)	EDUCATIONAL & NONPROFIT (Thousands)
TOTAL	$9,026,144	$8,386,980	$639,164
Alabama	698,959	681,125	17,834
Alaska	3,484	101	3,383
Arizona	29,008	10,477	18,531
Arkansas	190	15	175
California	2,727,664	2,594,135	133,529
Colorado	137,546	120,975	16,571
Connecticut	81,080	79,191	1,889
Delaware	2,421	1,361	1,060
District of Columbia	70,758	45,735	25,023
Florida	1,232,891	1,226,551	6,340
Georgia	22,546	17,190	5,356
Hawaii	6,337	242	6,095
Idaho	1,692	—	1,692
Illinois	23,989	12,091	11,898
Indiana	19,210	13,955	5,255
Iowa	13,960	661	13,299
Kansas	24,669	23,278	1,391
Kentucky	1,668	966	702
Louisiana	307,612	305,439	2,173
Maine	777	61	716
Maryland	753,116	699,927	53,189
Massachusetts	79,392	21,493	57,899
Michigan	20,693	6,338	14,355
Minnesota	7,107	4,393	2,714
Mississippi	85,353	82,516	2,837
Missouri	24,107	20,430	3,677
Montana	490	218	272
Nebraska	717	26	691
Nevada	818	460	358
New Hampshire	9,009	3,760	5,249
New Jersey	126,355	122,365	3,990
New Mexico	48,292	39,066	9,226
New York	63,381	41,445	21,936
North Carolina	12,318	1,620	10,698
North Dakota	111	—	111
Ohio	182,877	158,746	24,131
Oklahoma	4,503	196	4,307
Oregon	6,139	2,808	3,331
Pennsylvania	199,492	184,752	14,740
Rhode Island	2,105	655	1,450
South Carolina	2,120	1,327	793
South Dakota	554	128	426
Tennessee	29,523	24,421	5,102
Texas	1,101,607	1,024,001	77,606
Utah	428,591	427,062	1,529
Vermont	477	477	—
Virginia	357,901	327,574	30,327
Washington	26,884	22,311	4,573
West Virginia	413	149	264
Wisconsin	45,050	34,767	10,283
Wyoming	188	—	188

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 1989
(Millions of Dollars)



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

Procurement Activity

TOTAL PROCUREMENT BY INSTALLATION
(FY 1989)

INSTALLATION	AWARDS (Millions)	PERCENT
Marshall Space Flight Center	2,649.4	24.4
Johnson Space Center	2,304.0	21.2
Goddard Space Flight Center	1,606.7	14.8
Kennedy Space Center	1,179.5	10.8
NASA Resident Office/JPL	1,063.3	9.8
Lewis Research Center	542.5	5.0
Headquarters	600.0	5.5
Ames Research Center	450.6	4.1
Langley Research Center	384.0	3.5
Stennis Space Center	96.4	0.9
TOTAL	$10,876.4	100.0

AWARDS TO BUSINESS FIRMS BY TYPE OF EFFORT
(FY 1989)

CATEGORY	NUMBER OF CONTRACTS	TOTAL (Millions)
Research and Development	1,712	3,355.9
Aeronautics and Space Technology	713	648.1
Space Science and Applications	399	463.4
Space Flight	116	1,407.9
Space Operations	68	330.9
Space Station	24	202.9
Commercial Programs	43	8.9
Other R&D	35	17.5
Other Space R&D	314	276.3
Services	1,365	3,078.2
Supplies and Equipment	1,904	1,952.9
TOTAL	4,981	$8,387.0*

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

	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89
Total Business	5,967.4	6,652.9	6,356.0	6,540.5	7,274.9	8,567.6
(Small Business)	(556.2)	(644.7)	(671.3)	(786.3)	(801.4)	(857.3)
Educational	222.6	256.9	276.6	315.4	370.3	464.2
Nonprofit	98.6	103.1	119.0	119.1	129.5	180.0
JPL	533.1	724.6	891.3	1,005.6	979.9	1,058.1
Government	494.3	525.1	489.7	594.9	734.6	543.2
Outside U.S.	38.1	35.4	47.1	34.3	55.9	63.3
Total	7,354.1	8,298.0	8,179.7	8,609.8	9,545.1	10,876.4

*Included in Government

Principal Contractors (Business Firms)

ONE HUNDRED CONTRACTORS (BUSINESS FIRMS) LISTED
ACCORDING TO TOTAL AWARDS RECEIVED
FISCAL YEAR 1989
(S=Small Business/D=Disadvantaged Business)

	CONTRACTOR & PRINCIPAL PLACE OF CONTRACT PERFORMANCE		AWARDS (THOUSANDS)	PERCENT
	TOTAL AWARDS TO BUSINESS FIRMS		$8,567,576	100.00
1.	ROCKWELL INTERNATIONAL CORP Downey, CA		1,691,857	19.75
2.	LOCKHEED SPACE OPERATIONS CO Kennedy Space Center, FL		552,297	6.45
3.	MCDONNELL DOUGLAS CORP Huntington Beach, CA		506,009	5.91
4.	THIOKOL CORP Brigham City, UT		419,712	4.90
5.	MARTIN MARIETTA CORP New Orleans, LA		354,973	4.14
6.	GENERAL ELECTRIC CO King of Prussia, PA		299,894	3.50
7.	ROCKWELL SPACE OPERATIONS INC Houston, TX		286,755	3.35
8.	BOEING CO Marshall Space Flight, AL		235,805	2.75
9.	LOCKHEED ENGRG & SCIENCE CO Houston, TX		216,514	2.53
10.	FORD AEROSPACE CORP Palo Alto, CA		196,254	2.29
11.	U S B I BOOSTER PRODUCTION CO Huntsville, AL		196,037	2.29
12.	T R W INC Redondo Beach, CA		193,362	2.26
13.	COMPUTER SCIENCES CORP Greenbelt, MD		191,937	2.24
14.	E G & G FLORIDA INC Kennedy Space Center, FL		186,833	2.18
15.	BOEING COMPUTER SUPPORT SERVICES Marshall Space Flight, AL		158,394	1.85
16.	BENDIX FIELD ENGINEERING CORP Columbia, MD		$156,021	1.82
17.	LOCKHEED MISSILES & SPACE CO Sunnyvale, CA		145,071	1.69
18.	UNITED TECHNOLOGIES CORP West Palm Beach, FL		133,105	1.55
19.	INTERNATIONAL BUSINESS MACHINES Houston, TX		101,718	1.19
20.	GRUMMAN AEROSPACE CORP Reston, VA		80,192	.94
21.	SVERDRUP TECHNOLOGY INC Middleburgh Heights, OH		65,479	.76
22.	PAN AMERICAN WORLD SERVICES INC Stennis Space Center, MS		60,074	.70
23.	TELEDYNE INDUSTRIES INC Marshall Space Flight, AL		52,407	.61
24.	CONTEL CORP Gaithersburg, MD		51,007	.60
25.	CRAY RESEARCH INC Chippewa Falls, WI		48,226	.56
26.	BOEING TECHNICAL OPERATIONS INC Houston, TX		41,358	.48
27.	PLANNING RESEARCH CORP Hampton, VA		39,323	.46
28.	FAIRCHILD INDUSTRIES INC Germantown, MD		37,528	.44
29.	AEROJET GENERAL CORP Sacramento, CA		37,469	.44
30.	N S I TECHNOLOGY SERVICES CORP Moffett Field, CA		35,564	.42
31.	ORBITAL SCIENCES CORP Denver, CO	(S)	34,800	.41

Principal Contractors (Business Firms)

	CONTRACTOR & PRINCIPAL PLACE OF CONTRACT PERFORMANCE		AWARDS (THOUSANDS)	PERCENT
32.	UNISYS CORP Greenbelt, MD		34,048	.40
33.	ATLIS FEDERAL SERVICES INC Moffett Field, CA		31,471	.37
34.	PERKIN ELMER CORP Danbury, CT		31,388	.37
35.	GENERAL DYNAMICS CORP San Diego, CA		30,821	.36
36.	BAMSI INC Marshall Space Flight, AL	(D)	30,283	.35
37.	RAYTHEON SERVICE CO Greenbelt, MD		30,098	.35
38.	BIONETICS CORP Marshall Space Flight, AL	(S)	29,914	.35
39.	S T SYSTEMS CORP Greenbelt, MD	(S)(D)	29,606	.35
40.	L T V AEROSPACE & DEFENSE CO Dallas, TX		25,400	.30
41.	GRUMMAN DATA SYSTEMS CORP Marshall Space Flight, AL		22,566	.26
42.	BALL CORP Boulder, CO		21,188	.25
43.	KRUG INTERNATIONAL CORP Houston, TX		20,747	.24
44.	WYLE LABORATORIES Hampton, VA		18,848	.22
45.	AIR PRODUCTS & CHEMICALS INC Allentown, PA		18,814	.22
46.	NORTHROP WORLDWIDE AIRCRAFT Houston, TX		17,676	.21
47.	LOCKHEED CORP Burbank, CA		17,089	.20
48.	ENGINEERING & ECONOMICS RES Beltsville, MD	(S)(D)	17,079	.20

	CONTRACTOR & PRINCIPAL PLACE OF CONTRACT PERFORMANCE		AWARDS (THOUSANDS)	PERCENT
49.	CORTEZ III SERVICE CORP Cleveland, OH	(S)(D)	16,531	.19
50.	CAE LINK CORP Houston, TX		15,595	.18
51.	ANALEX CORP Cleveland, OH	(S)	15,319	.18
52.	COMMUNICATIONS SATELLITE CORP Clarksburg, MD		14,869	.17
53.	QUAD S CO Moffett Field, CA	(S)	14,854	.17
54.	KLATE HOLT CO Hampton, VA	(S)	14,681	.17
55.	SYSTOLIC SYSTEMS INC Moffett Field, CA	(D)	14,555	.17
56.	SCIENCE APPLICATION INT'L CORP McLean, VA		14,530	.17
57.	MICRO CRAFT INC Tullahoma, TN	(S)	13,950	.16
58.	BARRIOS TECHNOLOGY INC Houston, TX	(S)	13,717	.16
59.	DIGITAL EQUIPMENT CORP Greenbelt, MD		13,271	.15
60.	HONEYWELL FEDERAL SYSTEMS INC Kennedy Space Center, FL		12,117	.14
61.	CALSPAN CORP Moffett Field, CA		11,871	.14
62.	COMPUTER SCIENCES PAN AM SERVICES Slidell, LA		11,423	.13
63.	CLEVELAND ELECTRIC ILLUMINATING Cleveland, OH		11,361	.13
64.	VIRGINIA ELECTRIC & POWER CO Hampton, VA		10,982	.13
65.	COLEJON MECHANICAL CORP Cleveland, OH	(S)(D)	10,626	.12

Principal Contractors (Business Firms)

	CONTRACTOR & PRINCIPAL PLACE OF CONTRACT PERFORMANCE		AWARDS (THOUSANDS)	PERCENT
66.	GULFSTREAM AEROSPACE CORP Savannah, GA		10,482	.12
67.	OMNIPLAN CORP Houston, TX	(S)(D)	10,413	.12
68.	ADVANCED TECHNOLOGY INC Marshall Space Flight, AL		10,372	.12
69.	WARNER R E & ASSOCIATES Lorain, OH	(S)	9,640	.11
70.	STELLACOM INC Houston, TX	(S)	9,620	.11
71.	ELECTRONIC DATA SYSTEMS CORP Bethesda, MD		9,551	.11
72.	JOHNSON ENGINEERING CORP Houston, TX	(S)	9,536	.11
73.	S Y R E JV Moffett Field, CA		9,477	.11
74.	VITRO CORP Washington, DC		8,704	.10
75.	HUGHES AIRCRAFT CO Torrance, CA		8,682	.10
76.	ALLIED SIGNAL INC Phoenix, AZ		8,522	.10
77.	BOOZ ALLEN & HAMILTON INC Bethesda, MD		8,227	.10
78.	A R C PROFESSIONAL SERVICES INC Hampton, VA		8,119	.09
79.	B D M INTERNATIONAL INC Columbia, MD		7,955	.09
80.	ENGINEERING DESIGN GROUP INC Edwards, CA		7,853	.09
81.	ALPHA BUILDING CORP Houston, TX	(S)	7,774	.09
82.	OSTERLAND G R CO Cleveland, OH	(S)	$7,682	.09
83.	R M S TECHNOLOGIES INC Greenbelt, MD	(S)(D)	7,667	.09

	CONTRACTOR & PRINCIPAL PLACE OF CONTRACT PERFORMANCE		AWARDS (THOUSANDS)	PERCENT
84.	OGDEN LOGISTICS SERVICES Greenbelt, MD		7,563	.09
85.	ANALYTICAL SERVICES & MAT INC Tabb, VA	(S)(D)	7,528	.09
86.	AMERICAN TELEPHONE & TELEGRAPH Greenbelt, MD		7,289	.09
87.	KELSEY SEYBOLD CLINIC Houston, TX		7,279	.08
88.	PIONEER CONTRACT SERVICES INC Houston, TX	(S)	7,196	.08
89.	GENERAL SOFTWARE CORP Landover, MD	(S)(D)	7,130	.08
90.	HARROP CONSTRUCTION CO INC Houston, TX	(S)	7,091	.08
91.	SWALES & ASSOCIATES INC Greenbelt, MD	(S)	6,997	.08
92.	GENERAL MOTORS CORP Indianapolis, IN		6,866	.08
93.	I T T CORP Fort Wayne, IN		6,838	.08
94.	CONTROL DATA CORP Greenbelt, MD		6,725	.08
95.	DYNAMIC ENGINEERING INC Newport News, VA	(S)	6,604	.08
96.	D K ASSOCIATES INC Cleveland, OH	(S)	6,359	.07
97.	POTOMAC ELECTRIC POWER CO Greenbelt, MD		6,240	.07
98.	AMDAHL CORP Sunnyvale, CA		6,231	.07
99.	W & J CONSTRUCTION CORP Kennedy Space Center, FL		5,971	.07
100.	DATAMAX COMPUTER SYSTEMS INC Edwards, CA	(S)	5,756	.07
	OTHER*		828,374	9.67

*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 1989
(N=Nonprofit Institution)

	INSTITUTION & PRINCIPAL PLACE OF PERFORMANCE		AWARDS (THOUSANDS)	PERCENT
	TOTAL AWARDS TO EDUCATIONAL & NONPROFIT INSTITUTIONS		$644,218	100.00
1.	STANFORD UNIV Stanford, CA		41,785	6.49
2.	ASSN UNIV RESEARCH & ASTRON Baltimore, MD	(N)	27,318	4.24
3.	UNIV CALIFORNIA BERKELEY Berkeley, CA		24,560	3.81
4.	UNIVERSITIES SPACE RESEARCH Houston, TX	(N)	23,404	3.63
5.	MITRE CORP Houston, TX	(N)	20,345	3.16
6.	MASS INSTITUTE TECHNOLOGY Cambridge, MA		19,425	3.02
7.	NEW MEXICO STATE UNIV LAS CRUCES Palestine, TX		19,348	3.00
8.	SOUTHWEST RESEARCH INSTITUTE San Antonio, TX	(N)	18,289	2.84
9.	UNIV ARIZONA Tucson, AZ		16,209	2.52
10.	SMITHSONIAN INSTITUTION Cambridge, MA	(N)	15,890	2.47
11.	NATIONAL ACADEMY SCIENCES Washington, DC	(N)	13,698	2.13
12.	CHARLES STARK DRAPER LAB INC Cambridge, MA	(N)	13,465	2.09
13.	UNIV COLORADO BOULDER Boulder, CO		13,283	2.06
14.	UNIV MARYLAND COLLEGE PARK College Park, MD		12,995	2.02
15.	UNIV IOWA Iowa City, IA		12,427	1.93
16.	UNIV CALIFORNIA SAN DIEGO LA JOLLA, CA		12,058	1.87
17.	UNIV MICHIGAN ANN ARBOR Ann Arbor, MI		12,030	1.87
18.	UNIV ALABAMA HUNTSVILLE Huntsville, AL		11,427	1.77
19.	UNIV WISCONSIN MADISON Madison, WI		9,441	1.47
20.	PENNSYLVANIA STATE UNIV UP University Park, PA		8,166	1.27
21.	CALIFORNIA INSTITUTE TECHNOLOGY Pasadena, CA		7,757	1.20
22.	CASE WESTERN RESERVE UNIV Cleveland, OH		6,775	1.05
23.	UNIV TEXAS AUSTIN Austin, TX		6,612	1.03
24.	UNIV CHICAGO Chicago, IL		6,445	1.00
25.	UNIV CALIFORNIA LOS ANGELES Los Angeles, CA		6,141	.95
26.	UNIV HAWAII Honolulu, HI		6,095	.95
27.	OLD DOMINION UNIV Norfolk, VA		5,613	.87
28.	OHIO STATE UNIV Columbus, OH		5,391	.84
29.	CORNELL UNIV Ithaca, NY		5,301	.82
30.	UNIV SOUTHERN CALIFORNIA Los Angeles, CA		5,288	.82
31.	UNIV HOUSTON CLEAR LAKE Houston, TX		5,192	.81

Educational And Nonprofit Institutions

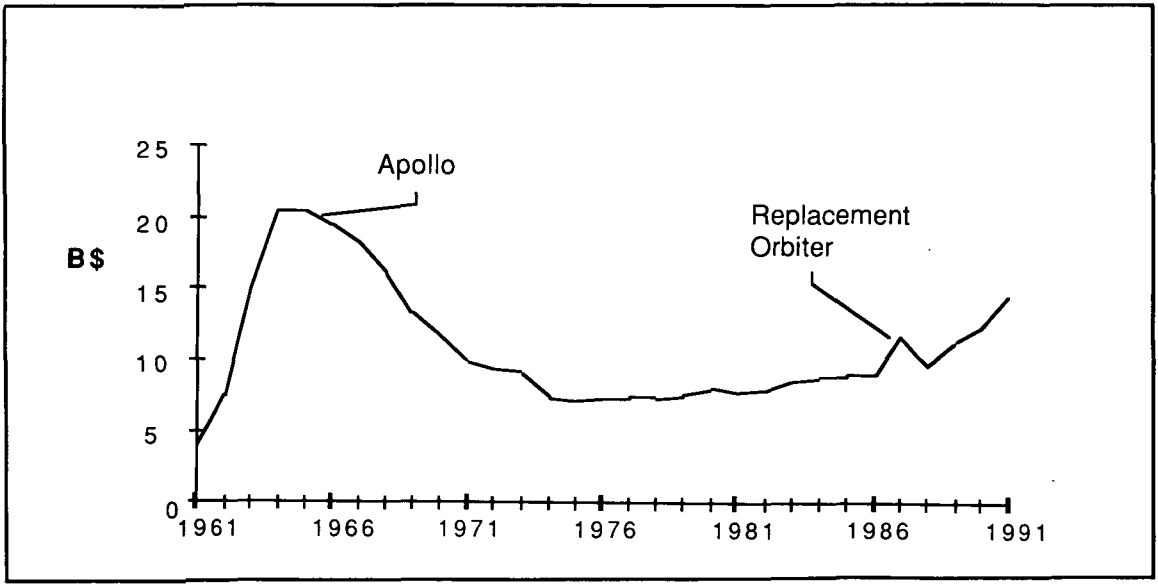
	INSTITUTION & PRINCIPAL PLACE OF PERFORMANCE		AWARDS (THOUSANDS)	PERCENT
32.	UNIV NEW HAMPSHIRE Durham, NH		4,896	.76
33.	JOHNS HOPKINS UNIV Baltimore, MD		4,484	.70
34.	TEXAS A & M UNIV El Paso, TX		4,447	.69
35.	HARVARD UNIV Cambridge, MA		4,400	.68
36.	BATTELLE MEMORIAL INSTITUTE Columbus, OH	(N)	4,107	.64
37.	VIRGINIA POLYTECHNIC INSTITUTE Blacksburg, VA		4,058	.63
38.	UNIV WASHINGTON Seattle, WA		4,043	.63
39.	COLUMBIA UNIV New York, NY		3,944	.61
40.	SAN JOSE STATE UNIV Moffett Field, CA		3,812	.59
41.	RESEARCH TRIANGLE INSTITUTE Reasearch Triangle Park, NC	(N)	3,710	.58
42.	CARNEGIE MELLON UNIV Pittsburgh, PA		3,697	.57
43.	NORTH CAROLINA STATE UNIV Raleigh, NC		$3,647	.57
44.	UNIV ILLINOIS URBANA Urbana, IL		3,608	.56
45.	HAMPTON CITY Hampton, VA	(N)	3,580	.56
46.	PRINCETON UNIV Princeton, NJ		3,481	.54
47.	OKLAHOMA STATE UNIV Stillwater, OK		3,465	.54
48.	GEORGIA INSTITUTE TECHNOLOGY Atlanta, GA		3,418	.53
49.	UNIV ALASKA FAIRBANKS Fairbanks, AK		3,383	.53
50.	UNIV VIRGINIA Charlottesville, VA		3,314	.51
51.	UNIV HOUSTON Houston, TX		3,249	.50
52.	PURDUE UNIV West Lafayette, IN		3,189	.50
53.	GEORGE WASHINGTON UNIV Washington, DC		2,897	.45
54.	WASHINGTON UNIV ST LOUIS St. Louis, MO		2,879	.45
55.	AEROSPACE CORP. El Segundo, CA	(N)	2,786	.43
56.	CLEVELAND STATE UNIV Cleveland, OH		2,783	.43
57.	RENSSELAER POLY INST N Y Troy, NY		2,696	.42
58.	UNIV MINNESOTA MINNPL ST PAUL Minneapolis, MN		2,674	.42
59.	VANDERBILT UNIV Nashville, TN		2,663	.41
60.	AMERICAN INSTIT AERON & ASTRO New York, NY	(N)	2,661	.41
61.	UNIV ALABAMA BIRMINGHAM Birmingham, AL		2,659	.41
62.	ELORET INSTITUTE Moffett Field, CA	(N)	2,262	.35
63.	AUBURN UNIV AUBURN Auburn, AL		2,211	.34
64.	S E T I INSTITUTE Moffett Field, CA	(N)	$2,112	.33
65.	UNIV TEXAS DALLAS Richardson, TX		2,110	.33
66.	OREGON STATE UNIV Corvallis, OR		2,078	.32
67.	S R I INTERNATIONAL CORP Menlo Park, CA	(N)	1,972	.31

Educational And Nonprofit Institutions

	INSTITUTION & PRINCIPAL PLACE OF PERFORMANCE		AWARDS (THOUSANDS)	PERCENT
68.	UNIV CINCINNATI Cincinnati, OH		1,954	.30
69.	ARIZONA STATE UNIV Tempe, AZ		1,812	.28
70.	UNIV NEW MEXICO Albuquerque, NM		1,740	.27
71.	UNIV IDAHO Moscow, ID		1,692	.26
72.	NORTH CAROLINA A & T STATE UNIV Greensboro, NC		1,679	.26
73.	ENVIRONMENTAL RES INSTIT MICH Ann Arbor, MI	(N)	1,635	.25
74.	STATE UNIV NEW YORK ALBANY Albany, NY		1,634	.25
75.	BOSTON UNIV Boston, MA		1,552	.24
76.	UNIV CALIFORNIA DAVIS Davis, CA		1,499	.23
77.	FOOTHILL COLLEGE Moffett Field, CA		1,439	.22
78.	COLORADO STATE UNIV Fort Collins, CO		1,430	.22
79.	UNIV FLORIDA Gainesville, FL		1,414	.22
80.	NORTHWESTERN UNIV EVANSTON Evanston, IL		1,394	.22
81.	CLARKSON UNIV Potsdam, NY		1,393	.22
82.	BROWN UNIV Providence, RI		1,388	.22
83.	FLORIDA STATE UNIV Tallahassee, FL		1,352	.21
84.	COLLEGE WILLIAM & MARY Williamsburg, VA		1,329	.21
85.	UNIV CALIFORNIA IRVINE Irvine, CA		1,325	.21
86.	UNIV MASS AMHERST Amherst, MA		1,303	.20
87.	UNIV CALIFORNIA SAN FRANCISCO Moffett Field, CA		1,283	.20
88.	RICE UNIV Houston, TX		1,282	.20
89.	UNIV MIAMI Coral Gables, FL		1,262	.20
90.	UNIV AKRON Akron, OH		1,237	.19
91.	UNIV PITTSBURGH Pittsburgh, PA		1,217	.19
92.	ALABAMA A & M UNIV Normal, AL		1,205	.19
93.	UNIV CALIFORNIA SANTA BARBARA Santa Barbara, CA		1,162	.18
94.	HAMPTON UNIV Hampton, VA		1,148	.18
95.	U T CALSPAN CTR AEROSPACE RES Tullahoma, TN	(N)	1,101	.17
96.	INSTITUTE TECHNOLOGY DEVELOP Jackson, MS	(N)	1,100	.17
97.	MCAT INSTITUTE Moffett Field, CA	(N)	1,091	.17
98.	INDIANAPOLIS CENTER ADV RES Indianapolis, IN	(N)	1,056	.16
99.	PUBLIC SERV SATELLITE CONSORT Washington, DC	(N)	1,051	.16
100.	UNIV TOLEDO Toledo, OH		1,028	.16
	OTHER**		69,483	10.79

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

NASA's Budget Authority in 1990 Dollars



Financial Summary

(In Millions of Dollars) AS OF 30 SEP 89

FISCAL YEAR	TOTAL APPROPRIATIONS	TOTAL DIRECT OBLIGATIONS	OUTLAYS					
			TOTAL	RESEARCH & DEVELOPMENT	SPACE FLIGHT, CONTROL & DATA COMMUNICATIONS	CONSTRUCTION OF FACILITIES	RESEARCH & PROGRAM MANAGEMENT	TRUST FUNDS
1959	330.90	298.70	145.50	34.00	--	24.80	86.70	--
1960	523.90	486.90	401.00	255.70	--	54.30	91.00	--
1961	966.70	908.30	744.30	487.70	--	98.20	159.10	--
1962	1,825.30	1,691.70	1,257.00	935.60	--	114.30	207.10	--
1963	3,674.10	3,448.80	2,552.40	2,308.40	--	225.30	18.70	--
1964	5,100.00	4,864.80	4,171.00	3,317.40	--	437.70	415.90	--
1965	5,250.00	5,500.70	5,092.90	3,984.50	--	530.90	577.50	--
1966	5,175.00	5,350.50	5,933.00	4,741.10	--	572.50	619.40	--
1967	4,968.00	5,011.70	5,425.70	4,487.20	--	288.60	649.90	--
1968	4,588.90	4,520.40	4,723.70	3,946.10	--	126.10	651.50	--
1969	3,995.30	4,045.20	4,251.70	3,530.20	--	65.30	656.20	--
1970	3,749.20	3,858.90	3,753.10	2,991.60	--	54.30	707.20	--
1971	3,312.60	3,324.00	3,381.90	2,630.40	--	43.70	707.80	--
1972	3,310.10	3,228.60	3,422.90	2,623.20	--	50.30	749.40	--
1973	3,407.60	3,154.00	3,315.20	2,541.40	--	44.70	729.10	--
1974	3,039.70	3,122.40	3,256.20	2,421.60	--	75.10	759.50	--
1975	3,231.20	3,265.90	3,266.50	2,420.40	--	85.30	760.80	--
1976	3,551.80	3,604.80	3,669.00	2,748.80	--	120.90	799.30	--
TQ	932.20	918.80	951.40	730.70	--	25.80	194.90	--
1977	3,819.10	3,858.10	3,945.30	2,980.70	--	105.00	859.60	--
1978	4,063.70	4,000.30	3,983.10	2,988.70	--	124.20	870.20	--
1979	4,561.20	4,557.50	4,196.50	3,138.80	--	132.70	925.00	--
1980	5,243.40	5,098.10	4,851.60	3,701.40	--	140.30	1,009.90	--
1981	5,522.70	5,606.20	5,421.20	4,223.00	--	146.80	1,051.40	--
1982	6,020.00	5,946.70	6,035.40	4,796.40	--	109.00	1,130.00	--
1983	6,837.70	6,723.90	6,663.90	5,316.20	--	108.10	1,239.60	--
1984	7,228.10	7,135.20	7,047.60	2,791.80	2,914.60	108.00	1,232.40	--
1985	7,546.70	7,638.40	7,317.70	2,118.20	3,707.00	170.00	1,322.50	--
1986	7,764.20	7,463.00	7,403.50	2,614.80	3,267.40	188.90	1,332.40	--
1987	10,796.00	8,603.70	7,591.40	2,435.20	3,597.30	149.00	1,408.90	--
1988	9,116.60	9,914.70	9,091.60	2,915.80	4,362.20	165.90	1,647.70	--
1989	11,008.90	11,315.80	11,051.50	3,922.40	5,030.20	190.10	1,908.30	0.50

Research And Development Funding By Program

(In Millions of Dollars) As of 30 Sep 89

	FY 1989	FY 1988	FY 1987	FY 1986	FY 1985	FY 1984	FY 1983	FY 1982	FY 1981	FY 1980	FY 1979	FY 1978	FY 1977 & Prior
SPACE STATION	884.6	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	660.4	585.8	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	(87.6)	(66.5)	(72.0)	(77.3)	(55.6)	(111.0)	(—)	(—)	(—)	(—)	(—)	(—)	(—)
Upper Stages	(131.6)	(142.2)	(152.0)	(113.6)	(135.8)	(157.7)	(—)	(—)	(—)	(—)	(—)	(—)	(—)
Payload Oper & Support Eqt	(53.1)	(74.1)	(34.1)	(54.2)	(54.5)	(59.6)	(—)	(—)	(—)	(—)	(—)	(—)	(—)
Eng & Tech Base (ETB)/DTMS	(160.6)	(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	(47.7)	(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 Systens	(80.4)	(64.3)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)
Tethered Satellite Program	(26.4)	(12.1)	(10.6)	(15.0)	(15.8)	(3.3)	(—)	(—)	(—)	(—)	(—)	(—)	(—)
Orbital Maneuvering Veh (OMV)	(73.0)	(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	660.4	585.8	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	16.3	18.8	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	27.8	29.3	23.6	16.0	—	—	—	—	—	—	—	—	—
TOTAL OCP	44.1	48.1	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 89

	FY 1989	FY 1988	FY 1987	FY 1986	FY 1985	FY 1984	FY 1983	FY 1982	FY 1981	FY 1980	FY 1979	FY 1978	FY 1977 & Prior
AERONAUTICS AND SPACE TECHNOLOGY													
Current Programs													
Space Research & Technology	273.9	217.1	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.	384.6	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
Tranatmosphric Res. & Tech.	68.5	51.9	44.4	—	—	—	—	—	—	—	—	—	—
Energy Tech. Applications	—	—	—	—	—	—	—	—	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	727.0	589.2	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	18.6	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	22.1	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 89

	FY 1989	FY 1988	FY 1987	FY 1986	FY 1985	FY 1984	FY 1983	FY 1982	FY 1981	FY 1980	FY 1979	FY 1978	FY 1977 & Prior
SPACE SCIENCE AND APPLICATIONS													
Current Programs													
Physics & Astronomy	715.3	596.2	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	405.9	323.5	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	78.1	72.2	70.2	65.0	61.9	57.6	55.6	39.5	42.2	43.8	40.1	33.3	145.8
Space Applications	578.2	557.4	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	1,777.5	1,549.3	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	103.3	63.6	68.1	59.6	55.0	23.6	33.1	23.6	17.8	5.5	5.2	4.7	229.2
TOTAL PROGRAM	4,237.6	3,254.9	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	-45.9	+19.3	-26.0	+19.0	-2.7	-54.3	+27.3	+17.9	+2.0	+3.0	—	+1.4	+301.0
Appropriation	4,191.7	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		(1.1)	(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 89

	FY 1989	FY 1988	FY 1987	FY 1986	FY 1985	FY 1984	FY 1983	FY 1982	FY 1981	FY 1980	FY 1979	FY 1978	FY 1977 & Prior
Headquarters	402.8	332.8	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	293.4	261.7	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	718.4	510.9	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	579.4	490.3	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	563.8	334.8	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	112.9	90.5	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	242.7	199.0	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	386.8	257.3	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	835.9	760.9	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	17.3	16.7	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	-5.1	—	—	-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	89.3	—	—	—	—	—	—	—	—	—	—	—	—
TOTAL PROGRAM	4,237.6	3,254.9	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	-45.9	+19.3	-26.0	+19.0	-2.7	-54.3	+27.3	+17.9	+2.0	+3.0	—	+1.4	+301.0
Appropriation	4,191.7	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		(1.1)	(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 89

	FY 1989	FY 1988	FY 1987	FY 1986	FY 1985	FY 1984
SPACE FLIGHT						
Shuttle Prod & Oper Cap	1,123.0	1,092.4	3,501.4	1,354.7	1,478.1	1,637.2
Space Transportation Ops	2,377.3	1,825.5	1,636.9	1,633.2	1,308.6	1,431.7
TOTAL OSF	3,500.3	2,917.9	5,138.3	2,987.9	2,786.7	3,068.9
SPACE TRACKING & DATA SYSTEMS	1040.5	969.3	764.7	658.2	792.2	673.9
OPERATING ACCOUNT	13.8	8.7	17.5	15.6	15.3	9.0
TOTAL PROGRAM	4,554.6	3,895.9	5,920.5	3,661.7	3,594.2	3,751.8
Approp Trans & Adjust	-190.4	+12.4	-105.5	+19.1	+7.6	+39.8
Appropriation	4,364.2	*5,815.0	3,680.8	3,601.8	3,791.6	
Lapsed Unoblig Bal Incl		(.4)	(.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

(In Millions of Dollars)

As of 30 Sep 89

	FY 1989	FY 1988	FY 1987	FY 1986	FY 1985	FY 1984
Headquarters	153.5	364.4	332.7	204.5	259.5	227.6
Ames Research Center	16.7	15.4	16.	15.6	10.3	
Goddard Space Flight Center	492.6	467.1	415.9	432.2	431.0	
Jet Propulsion Laboratory	122.1	132.1	128.0	117.4	111.9	97.3
Johnson Space Center	1,013.9	909.7	1,960.4	1,083.7	1,308.0	1,360.5
Kennedy Space Center	803.4	720.2	656.0	493.4	490.5	
Langley Research Center	14.3	.1	.3	.4	.6	.2
Lewis Research Center	9.4	3.7	5.0	4.3	2.0	
Marshall Space Flight Center	1,526.6	1,263.9	1,653.5	1,655.4	1,437.0	1,379.0
Stennis Space Center	21.5	19.3	16.1	12.3	1.1	
Station 17	-12.4	—	—	-277.6	-480.6	-247.7
Undistributed	393.0	90.3	736.3	—	—	—
TOTAL PROGRAM	4,554.6	3,895.9	5,920.5	3,661.7	3,594.2	3,751.8
Approp Transfer & Adjust	-190.4	+12.4	-105.5	+19.1	+7.6	+39.8
Appropriation	4,364.2	3,908.3	5,815.0	3,680.8	3,601.8	3,791.6
Lapsed Unoblig Bal Incl		(.4)	(.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 89

	FY 89	FY 88	FY 87	FY 86	FY 85	FY 84	FY 83	FY 82	FY 81	FY 80	FY 79	FY 78	FY 77	76/TQ	FY 75	FY 74	FY 73
Ames Research Center	--	16.00	16.60	7.80	14.20	14.70	--	--	13.60	2.90	9.10	--	4.40	2.60	3.70	--	3.20
Dryden Flight Research Fac.	--	10.50	--	--	--	--	3.50	--	--	--	--	0.40	0.80	--	--	--	--
Goddard Space Flight Center	3.10	8.60	8.00	3.60	2.10	--	2.60	--	--	--	5.60	4.50	--	--	1.90	1.30	0.60
Jet Propulsion Laboratory	--	--	12.00	9.20	12.80	5.50	--	1.80	2.80	--	4.60	3.10	--	--	9.20	1.30	0.50
Kennedy Space Center	--	--	--	--	--	--	--	1.10	0.60	4.80	--	1.70	2.60	--	--	--	9.70
Langley Research Center	0.90	--	11.30	4.70	13.80	10.70	13.60	2.90	22.00	7.10	5.30	1.60	6.10	1.60	3.20	4.00	4.30
Lewis Research Center	--	17.60	--	--	--	12.90	4.80	1.20	8.70	5.70	5.80	0.80	2.70	--	3.70	--	10.00
Johnson Space Center	7.80	--	7.80	--	--	--	--	3.00	--	--	--	2.00	2.20	--	0.70	--	0.60
Marshall Space Flight Ctr.	12.50	--	--	--	1.60	--	--	--	4.00	6.30	--	--	--	--	3.80	--	--
Stennis Space Center	--	--	--	--	--	--	--	--	--	--	--	0.60	--	--	--	--	--
Wallops Flight Facility	--	--	--	--	--	--	2.10	--	--	1.10	--	--	--	--	1.10	0.90	0.60
Various Locations	--	6.40	19.30	17.40	14.00	--	--	9.80	32.00	1.70	--	1.10	--	--	7.70	3.70	--
Facility Planning & Design	22.00	16.00	17.00	11.80	12.00	9.20	8.20	10.00	9.70	13.90	10.60	11.70	12.60	12.50	10.80	13.50	7.90
Large Aero Fac	--	--	--	--	--	--	--	--	--	45.70	56.10	37.00	31.00	--	--	--	--
Minor Construction	9.00	8.00	6.80	5.90	4.90	4.60	3.70	2.30	3.90	3.50	4.20	6.00	2.90	6.20	4.60	4.60	1.70
Repair	22.90	24.40	21.80	19.50	17.90	17.30	13.70	12.80	14.80	12.00	--	--	--	--	--	--	--
Envir Compl & Rest. Program	26.00	23.90	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Rehab & Mods *	30.90	31.00	30.10	24.30	21.40	21.40	18.90	17.60	17.30	19.70	14.10	18.90	17.80	23.00	14.80	14.80	11.60
Space Station Facilities	--	--	12.70	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Shuttle Facilities	58.40	17.20	7.10	36.50	38.10	48.70	28.10	32.80	9.90	27.90	30.90	64.70	30.30	46.60	76.50	56.50	27.80
Shuttle Payload Facility	--	--	--	3.90	6.70	13.10	1.70	--	1.50	4.30	--	7.30	4.40	--	--	--	--
Unallocated Plans & Design	--	--	--	--	--	--	3.50	--	--	--	--	--	--	--	--	--	--
Aero. Facils Revitalization	52.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Advanced Launch System Fac.	15.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trust Fund	15.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL PROGRAM	276.00	179.60	170.50	144.60	159.50	158.10	104.40	95.30	140.80	156.60	146.30	161.40	117.80	92.50	141.70	100.60	78.50
Approp Trans & Adjust	14.10	-1.30	298.80	-11.30	-9.50	-2.60	-6.90	-25.80	-25.80	-0.50	1.20	-0.50	0.30	0.40	-1.50	0.50	-1.20
Approp & Availability	290.10	178.30	469.30	133.30	150.00	155.50	97.50	95.80	115.00	156.10	147.50	160.90	118.10	92.90	140.20	101.10	77.30

*Included in Various Locations Prior to FY 1972.

Construction Of Facilities Funding

(In Millions of Dollars)

AS OF 30 SEP 89

	FY 72	FY 71	FY 70	FY 69	FY 68	FY 67	FY 66	FY 65	FY 64	FY 63	FY 62	FY 61	FY 60	FY 59
Ames Research Center	6.50	1.10	0.30	0.40	4.20	--	2.80	5.80	11.30	14.30	6.30	0.60	6.10	3.80
Dryden Flight Research Facility	--	--	0.90	--	--	--	--	--	2.50	1.80	--	--	1.80	--
Electronics Research Center	--	--	--	--	--	7.40	5.20	10.40	1.60	--	--	--	--	--
Goddard Space Flight Center	0.70	1.40	0.70	--	0.60	0.70	2.40	2.30	17.70	21.30	11.50	9.40	14.00	3.90
Jet Propulsion Laboratory	--	1.90	--	--	3.10	0.30	0.90	3.60	3.00	11.40	3.50	8.60	7.70	--
Johnson Space Center	--	1.10	--	0.90	0.60	11.80	4.00	17.30	33.90	24.50	--	--	--	--
Kennedy Space Center	15.60	0.30	10.50	7.40	20.40	34.60	7.20	87.80	273.40	332.80	115.60	27.80	4.00	--
Langley Research Center	--	0.60	5.60	--	--	6.40	8.40	3.30	9.70	9.80	6.90	12.30	4.50	10.80
Lewis Research Center	0.80	0.70	0.30	--	2.10	16.20	0.90	0.80	20.40	45.50	1.10	9.50	6.60	8.00
Marshall Space Flight Center	--	1.30	--	--	0.90	--	1.80	12.00	28.20	40.50	30.70	26.10	--	--
Michoud Assembly Facility	--	--	--	0.40	0.50	0.50	0.30	6.20	7.30	28.50	--	--	--	--
Stennis Space Center	--	--	1.40	--	--	--	--	58.40	102.90	77.10	--	--	--	--
Nuclear Rocket Dev Station	--	--	--	--	--	--	--	--	4.10	11.50	--	--	--	--
Pacific Launch Operations	--	--	--	--	--	--	--	0.30	--	--	0.60	0.40	1.10	--
Wallops Flight Facility	--	--	0.50	0.50	0.70	0.20	1.00	1.70	0.50	4.10	11.30	2.00	--	16.10
Various Locations	0.70	22.50	26.40	20.80	3.50	6.50	15.10	28.30	211.50	129.90	159.00	28.00	52.40	5.10
Facility Planning & Design	3.40	5.40	3.50	1.00	5.40	5.40	5.00	8.80	10.40	12.90	9.80	--	--	--
Rehab & Mods *	7.80	(17.50)	--	--	--	--	--	--	--	--	--	--	--	--
Shuttle Facilities	18.50	--	--	--	--	--	--	--	--	--	--	--	--	--
Other	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL PROGRAM	54.00	35.30	50.10	31.40	42.00	90.00	55.00	247.00	738.40	765.90	356.40	124.80	98.20	47.70
Approp Trans & Adjust	-1.30	-11.30	3.10	-9.60	-6.10	-7.10	5.00	15.90	-58.40	10.30	-40.40	-2.00	-13.60	0.30
Appropr & Availability	52.70	25.00	53.20	21.80	35.90	82.90	60.00	262.90	680.00	776.20	316.00	122.80	84.60	48.00

*Included in Various Locations Prior to FY 1972

Research And Program Management Funding

(In Millions of Dollars)

AS OF 30 SEP 89

	FY 89	FY 88	FY 87	FY 86	FY 85	FY 84	FY 83	FY 82	FY 81	FY 80	FY 79	FY 78	FY 77	76/TQ	FY 75	FY 74	FY 73
1/																	
Headquarters	255.20	205.60	142.50	124.00	122.20	114.00	111.90	115.90	96.40	88.70	84.60	83.40	78.40	93.50	68.90	63.00	61.20
Ames Research Center	178.30	165.30	134.00	123.50	122.30	114.90	107.20	76.60	72.20	67.40	62.80	57.70	53.10	63.90	48.60	46.40	42.40
Dryden Flight Research Fac.	--	--	--	--	--	--	--	24.40	22.60	20.20	18.90	18.20	17.20	19.70	13.20	12.20	11.70
Goddard Space Flight Center	255.90	244.00	216.10	200.50	198.30	191.40	183.90	169.10	142.50	133.70	127.80	123.50	114.30	136.60	104.80	97.30	95.70
Kennedy Space Center	269.90	243.40	200.00	192.20	185.10	176.40	164.90	156.00	150.20	135.50	126.40	116.30	110.10	128.00	95.90	94.40	92.40
Langley Research Center	188.70	178.50	153.70	145.00	147.60	139.20	132.70	126.60	120.80	113.80	106.60	100.70	94.70	115.70	88.60	83.30	78.60
Lewis Research Center	196.40	181.90	151.70	143.10	137.40	128.50	118.80	106.40	99.80	94.80	87.50	84.70	83.30	102.40	80.30	79.60	61.20
Johnson Space Center	302.70	283.30	228.00	206.90	216.10	201.90	195.20	230.50	176.30	164.70	153.00	146.20	139.10	165.20	121.30	117.60	110.60
Marshall Space Flight Center	256.00	239.90	213.10	195.00	199.70	190.90	184.30	172.10	165.30	156.60	149.00	143.60	140.20	170.00	129.10	137.50	137.20
Stennis Space Center	23.50	20.60	12.40	11.20	10.70	6.30	6.60	5.50	4.90	2.80	1.30	0.10	0.70	0.50	1.60	--	--
Station 17	--	--	--	-0.10	-7.60	-7.60	-8.10	--	--	--	--	--	--	--	--	--	--
Space Nuclear Sys Office	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.10	--
Wallops Flight Facility	--	--	--	--	--	--	--	--	20.00	17.80	15.90	15.10	13.30	17.00	12.40	11.60	10.80
TOTAL PROGRAM	1,926.60	1,763.00	1,451.50	1,341.30	1,331.80	1,255.90	1,197.40	1,183.10	1,071.10	996.00	933.80	889.50	844.40	1,012.50	764.70	744.00	
Lapsed Unoblg Bal	--	--	1.00	0.20	0.50	0.20	--	0.20	0.30	0.20	0.30	0.30	0.30	0.60	0.20	0.60	7.60
Approp Trans & Adjust	-71.60	-266.90	-27.50	20.50	--	--	--	--	--	--	--	--	--	--	-4.90	--	--
Appropriation	1,998.20	1,495.70	1,425.00	1,362.00	1,332.30	1,256.10	1,197.40	1,183.30	1,071.40	996.20	934.10	889.80	844.60	1,013.10	760.00	744.60	729.40

1/ Includes NASA Pasadena Office

Research And Program Management Funding

(In Millions of Dollars)

AS OF 30 SEP 89

	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
1/														
Headquarters	61.60	64.90	63.20	60.80	57.10	57.40	54.40	69.30	56.10	51.30	26.00	13.90	8.50	5.70
Ames Research Center	42.20	40.60	37.60	34.00	33.80	33.80	33.20	31.80	26.90	25.60	22.90	19.90	17.80	16.30
2/														
Electronics Research Center	--	--	19.10	17.20	15.40	12.20	6.40	3.20	0.50	--	--	--	--	--
Dryden Flight Research Center	11.70	11.10	10.30	9.70	9.50	9.50	9.40	10.50	9.40	7.50	7.20	5.10	4.30	3.30
Goddard Space Flight	*96.50*	*93.10*	*86.40*	*73.20*	*68.30*	*71.10*	*64.40*	*93.30*	*61.90*	*52.80*	*39.10*	*20.40*	*15.50*	*1.80*
Kennedy Space Center	92.60	98.30	97.60	95.80	93.10	92.70	82.00	40.80	26.80	18.80	6.40	--	--	--
Langley Research Center	80.20	75.30	69.80	63.00	62.20	64.30	63.50	59.00	52.10	51.80	46.60	39.10	33.00	31.40
Lewis Research Center	*82.50*	*78.00*	*73.90*	*67.90*	*66.20*	*66.30*	*66.40*	*69.30*	*58.50*	*53.40*	*45.20*	*35.80*	*31.20*	*27.80*
Johnson Space Center	113.00	111.10	106.60	98.90	95.70	95.70	86.50	88.70	64.70	51.00	24.10	9.20	--	--
Marshall Space Flight Center	138.90	145.10	125.70	116.30	126.20	128.70	128.40	138.70	124.30	112.60	89.20	68.60	5.10	--
Pacific Launch Operations	--	--	--	--	--	--	0.60	0.90	0.90	0.60	0.10	--	--	--
Space Nuclear Systems Office	2.20	2.40	2.30	2.10	2.00	2.00	1.80	1.70	1.50	1.00	0.30	--	--	--
Western Support Office	--	--	--	--	1.00	3.20	4.90	5.00	4.40	3.40	1.40	5.70	0.50	--
Wallops Flight Facility	10.90	10.30	9.70	9.10	8.80	9.70	9.30	11.10	8.80	8.90	7.10	5.00	2.70	1.30
		3/												
TOTAL PROGRAM	732.30	730.20	702.20	648.00	639.30	646.60	611.20	623.30	496.80	438.70	315.60	222.70	118.60	87.60
	0.30	0.20	0.40	0.10	0.10	0.90	0.60	--	--	--	--	--	--	--
Approp Trans & Adjust	2.10	-7.70	-12.60	-44.90	-11.40	-7.50	-27.80	0.20	-2.80	--	--	--	--	--
Appropriation	734.70	722.70	690.00	603.20	628.00	640.00	584.00	623.50	494.00	438.70	315.60	222.70	118.60	87.60

1/Includes NASA Pasadena Office
2/ERC was closed on June 30, 1970
3/Includes $10 million for basic institutional and other requirements for agencies resident at MTF/Slidell
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 1989

	FY 89	FY 88	FY 87	FY 86	FY 85	FY 84	FY 83	FY 82	FY 81	FY 80	FY 79	FY 78	FY 77	FY 76	FY 75	FY 74	FY 73
NASA HQ	1,867	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
ARC	2,217	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
DFRF 1/	—	—	—	—	—	—	—	—	491	499	498	514	546	566	544	531	509
GSFC 2/	3,860	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
KSC	2,504	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
LRC	3,003	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
LRC	2,832	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
JSC	3,704	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
MSFC	3,703	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
JSSC	203	159	147	137	135	129	128	119	113	111	108	108	94	72	76	—	—
WFF	—	—	—	—	—	—	—	—	400	406	409	429	426	437	441	447	434
TOTAL	23,893	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	25	—	—	—	—
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

9/30/89

Permanent, Other and Total Paid Employees*	OAST			OSSA	OSF				HQ	Total NASA	JPL
	ARC	LARC	LERC	GSFC	KSC	JSC	MSFC	SSC			
Permanent Employees	2,151	2,864	2,749	3,735	2,423	3,578	3,609	183	1,727	23,019	--
Other than Permanent Employees	66	139	83	125	81	126	94	20	140	874	--
Total	2,217	3,003	2,832	3,860	2,504	3,704	3,703	203	1,867	23,893	5,752

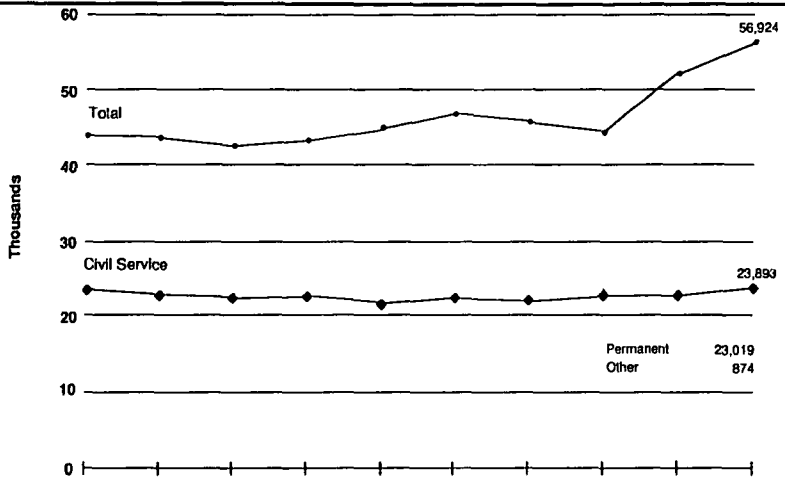
Permanent Employee Occupational Breakdown	ARC	LARC	LERC	GSFC	KSC	JSC	MSFC	SSC	HQ	Total NASA	JPL**
S & E	1,164	1,363	1,509	2,014	1,434	2,340	2,351	98	502	12,775	3,564
Prof'l Admin.	307	287	270	750	392	576	597	52	854	4,085	826
Clerical	223	284	258	435	328	452	481	31	360	2,852	602
Tech. Support	138	917	234	458	266	201	180	2	5	2,401	374
Wage System	319	13	478	78	3	9	0	0	6	906	386
Total	2,151	2,864	2,749	3,735	2,423	3,578	3,609	183	1,727	23,019	

Support Service Contractor Workforce (FY 89 Man-Year Equivalents) **	ARC	LARC	LERC	GSFC	KSC	JSC	MSFC	SSC	HQ	Total NASA
Total	1,954	1,792	1,544	3,802	10,643	9,796	1,474	1,207	819	33,031

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

Total NASA Workforce

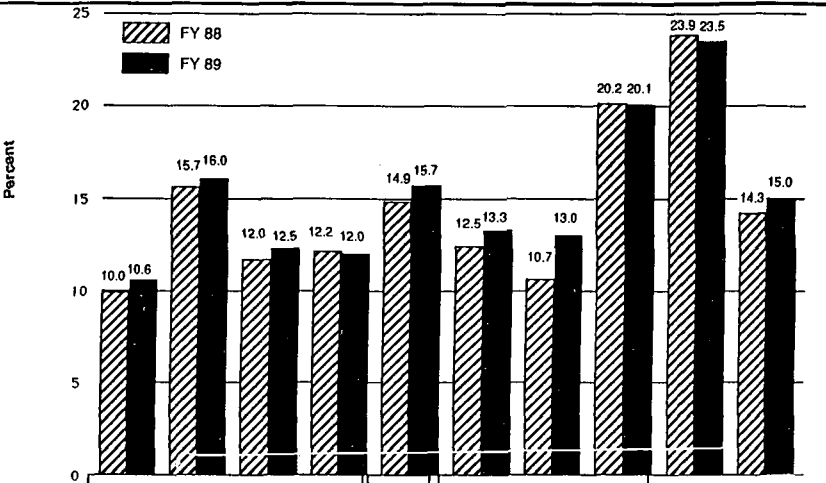
End FY 80 - FY 89



	FY 80	FY 81	FY 82	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89
Civil Service	23,470	22,739	22,310	22,534	21,870	22,316	21,960	22,646	22,823	23,893
Contractor	20,294	20,700	20,089	20,662	22,865	24,468	23,687	21,733	29,401	33,031
Total	43,764	43,439	42,399	43,196	44,735	46,784	45,647	44,379	52,224	56,924

Minorities As Percent Of Permanent Employees

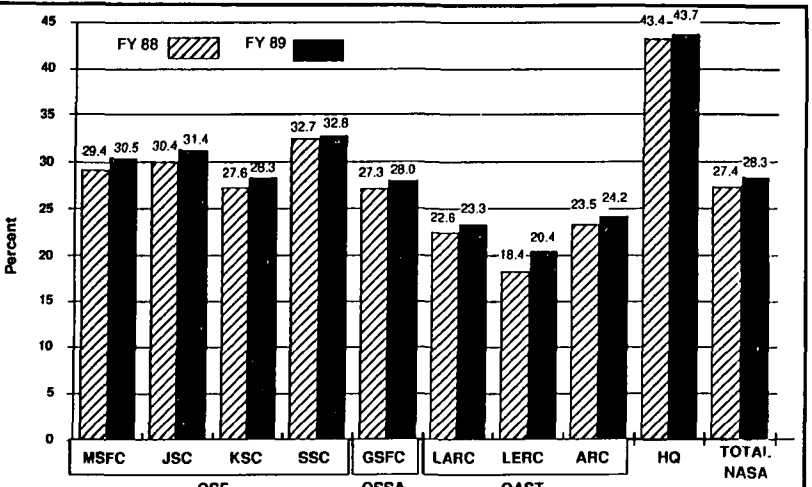
By Installation
FY 88 - FY 89



Total Minorities	MSFC	JSC	KSC	SSC	GSFC	LARC	LERC	ARC	HQ	TOTAL NASA
	OSF				OSSA		OAST			
FY 89	382	574	302	22	585	380	358	433	406	3,442
FY 88	333	533	268	18	541	355	284	425	395	3,152
FY 80	173	463	169	7	468	319	228	355	312	2,494

Women As Percent Of Permanent Employees

by Installation
End FY 88- FY 89



Total Women	MSFC	JSC	KSC	SSC	GSFC	LARC	LERC	ARC	HQ	TOTAL NASA
FY 89	1,101	1,122	685	60	1,044	667	561	520	755	6,515
FY 88	983	1,034	618	48	990	642	488	494	718	6,015
FY 80	692	755	474	27	875	541	429	411	608	4,812

National Aeronautics and
Space Administration