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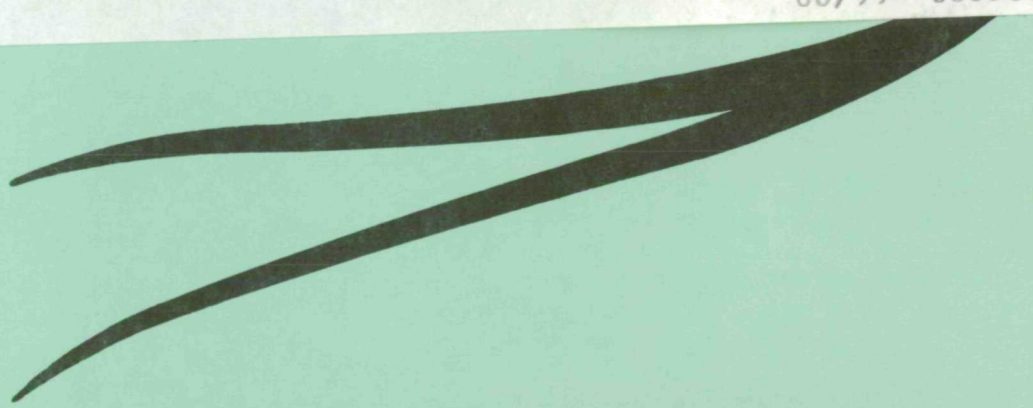

NASA Pocket Statistics

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# Foreword

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

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

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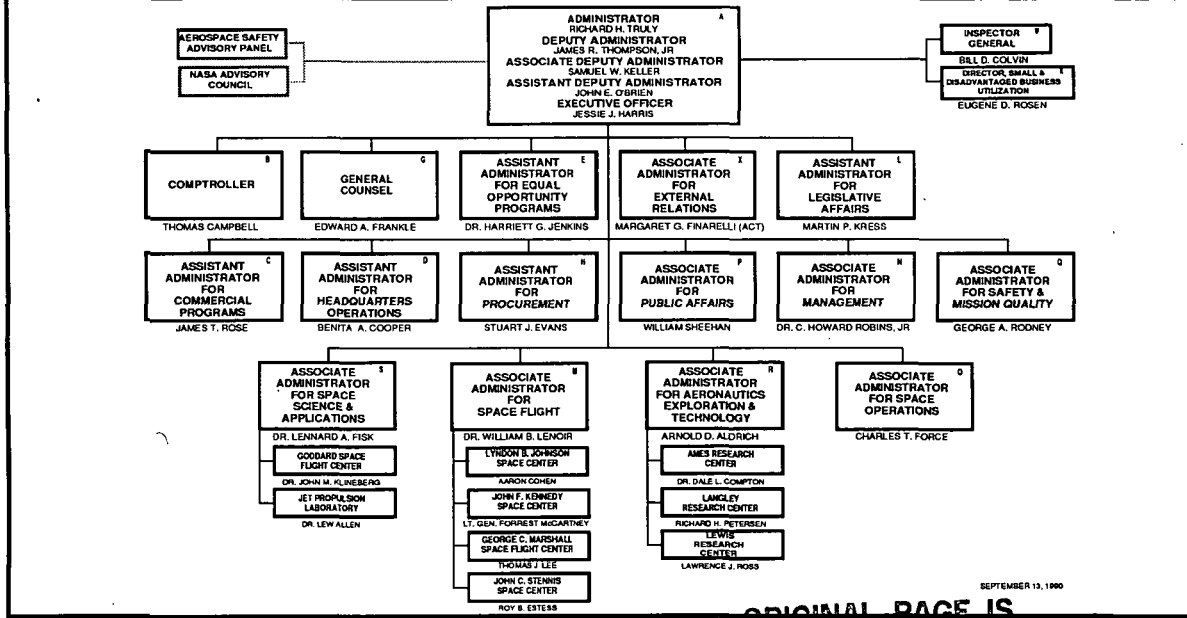
# Contents

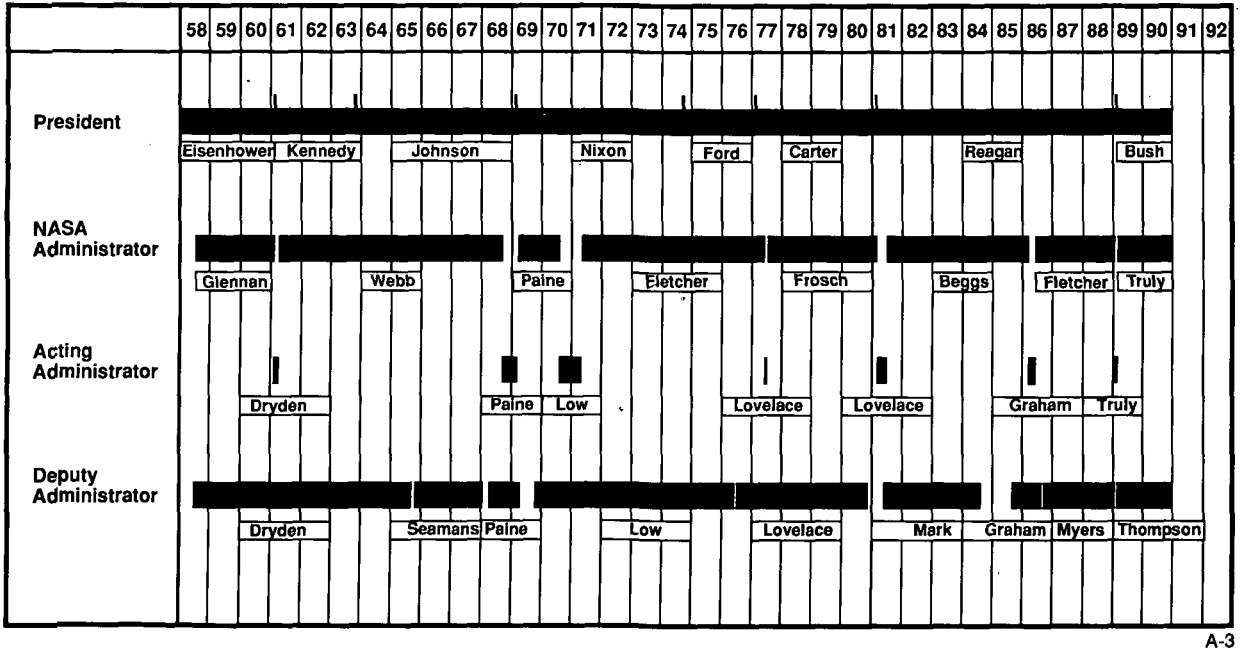
Section A

# 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 encourage to the maximum extent possible the fullest commercial use of space.

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

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

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

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

(4) The establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes;

(5) The preservation of the role of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere;

(6) The making available to agencies directly concerned with national defense of discoveries that have military value or significance, and the furnishing by such agencies, to the civilian agency established to direct and control nonmilitary aeronautical and space activities, of information as to discoveries which have value or significance to that agency;

(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 updated and reaffirmed U.S. goals and activities in space. Areas affected include civil and commercial remote sensing, space transportation, space debris, federal subsidies of commercial space activities, and Space Station Freedom.

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

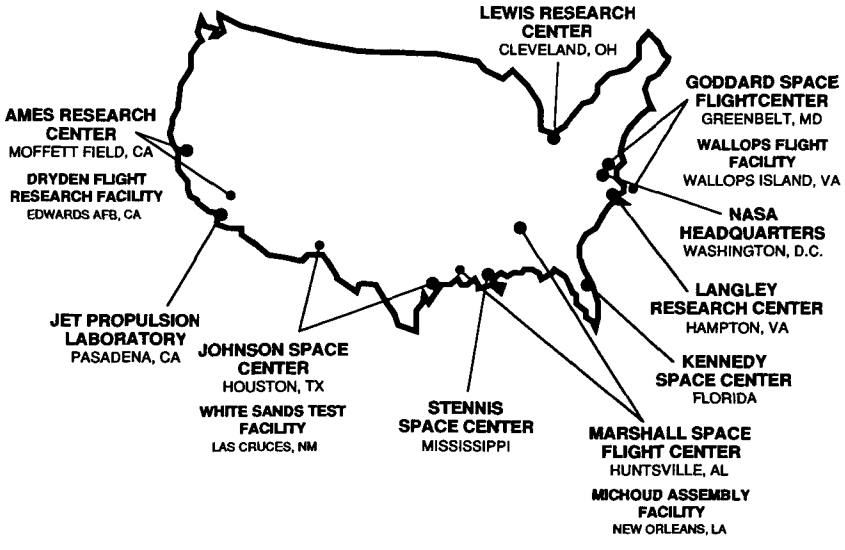
program shall support such functions as command and control, communications, navigation, environmental monitoring, warning, surveillance and force application (including research and development programs which support these functions).

**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 transportation systems. The goals of United States space transportation policy are: (1) to achieve and maintain safe and reliable access to, transportation in, and return from, space; (2) to exploit the unique attributes of manned and unmanned launch and recovery systems; (3) to encourage to the maximum extent feasible, the development and use of United States private sector space transportation capabilities; and (4) to reduce the costs of space transportation and related services.
* Communications advancements are critical to all United States space sectors. To ensure necessary capabilities exist, the United States Government will continue research and development efforts for future advanced space communications technologies.
* The United States will consider and, as appropriate, formulate policy positions *on arms control measures governing activities in space, and will conclude* agreements on such measures only if they are equitable, effectively verifiable, and enhance the security of the United States and 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 of models or small components; a data analysis facility for processing of flight research data; a remotely piloted research vehicles facility and a test range communications and data transmission capability that links NASA's Western Aeronautical Test Range facilities at Ames-Moffett, Crows Landing and Ames-Dryden.

# NASA Installations

**GODDARD SPACE FLIGHT CENTER**
**Greenbelt, MD 20771**

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

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

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

**JET PROPULSION LABORATORY**
**Pasadena, CA 91109**

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

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

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

**LYNDON B. JOHNSON SPACE CENTER**
**Houston, TX 77058**

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

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

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

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

# NASA Installations

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 and 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 (NASP).

**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 President's Productivity Improvement Program, which is administered by OMB.

# NASA Installations

**MARSHALL SPACE FLIGHT CENTER**
**Marshall Space Flight Center, AL 35812**

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

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

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

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

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

**MICHOUD ASSEMBLY FACILITY**
**New Orleans, LA 70189**

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

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

The John C. Stennis Space Center (SSC) scientific community is actively engaged in several research and development programs involving space, oceans and Earth. The complex includes industrial, laboratory and specialized engineering facilities to support the testing of large rocket propulsion systems.

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

**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

NASA's accomplishments for the year 1990, despite several setbacks, were many and varied; ranging from the launch of Hubble Space Telescope to the retrieval of the SEEDS experiment housed on the LDEF to Magellan's intriguing radar images of Earth's sister planet, Venus.

## SPACE SCIENCE AND APPLICATIONS

Hubble Space Telescope (HST) was launched aboard the Space Shuttle Discovery (STS-31) in April to begin gathering data on the origin of the universe. HST's initial optical-engineering test returned a valuable science observation, resolving the star cluster 30 Doradus three to four times better than the best ground-based observation. The discovery in June of a spherical aberration, a misshaping of the primary mirror that prevents the telescope from focusing light to a single, precise point will be repaired during the HST Servicing Mission planned for 1992. Replacement of the Wide Field Planetary Camera (WFPC) with the WFPC-2 will compensate for the current aberration.

Some highlights of HST's mission thus far include the capability of observing objects in visible light much more clearly than ground-based telescopes and extraordinary observations in the ultraviolet wavelengths. The WFPC observed a jet of material streaming away from the Orion Nebula with unprecedented clarity, offering insights into this region of young stars, and the Faint Object Camera has returned the clearest image yet of Pluto, and its moon, Charon. Most dramatically, the WFPC took several hundred pictures as the white spots on Saturn grew into an immense storm that spread around the planet's equator.

The Cosmic Background Explorer (COBE) completed its survey of the entire sky in infrared and microwave radiation and made unprecedented measurements of background radiation that support the Big Bang theory of the origin of the Universe.

In December the Space Shuttle Columbia carried the ASTRO-1 payload, consisting of three ultraviolet telescopes and the Broad-Band X-Ray Telescope, to study the high-energy universe. Astronomers made 394 observations of 135 objects, including Jupiter and its moon Io, a comet, exploding stars, galaxies and quasars. ASTRO-1 also marked the return to flight of the Spacelab payload systems, which last flew in 1985.

The Magellan spacecraft returned radar images of Venus showing geological features unlike anything seen on Earth. Among the images sent back were what scientists called crater farms as well as checkered patterned fault lines running at right angles. Most intriguing were indications that Venus may still be geologically active, though much less so than Earth.

The Ulysses spacecraft, a joint NASA/ESA mission to study the poles of the Sun and interplanetary space above and below the poles, was launched in October by the Space Shuttle Discovery (STS-41).

In February, Galileo flew by Venus, conducting the first infrared imagery and spectroscopy below the planet's cloud deck. In December, Galileo used the Earth's gravity to pick up speed on it's way to its ultimate rendezvous with Jupiter in 1995.

Six of the nine planets were photographed by Voyager 1, the first time such a perspective had ever been seen. Pioneer 11 left the solar system for interstellar space, while Pioneer 10 set a distance record by passing the 50 astronomical-unit milestone, 4.6 billion miles from Earth.

The Combined Release and Radiation Effects Satellite (CRRES), which uses chemical releases to study the Earth's magnetic fields and the plasmas, or ionized gases, that travel through them, was launched in July. Releases from a similar mission, PEGSAT, were seen in the spring over parts of Northern Canada.

# The Year In Review

NASA received approval from Congress to begin the Earth Observing System (EOS), a series of satellites that will use the perspective from space to observe the Earth as a global environmental system.

NASA scientists analyzed global temperatures from the 1980s to offer insights into potential global warming. Though no net trend could be seen within the last decade, observations indicated the 1980s were warmer than the 1970s. NASA's ongoing ozone depletion studies showed the 1990 ozone hole over Antarctica opened as rapidly and covered as wide an area as the record 1987 hole. A co-sponsored airborne expedition also showed local areas of ozone depletion over the Arctic. In October, the Space Shuttle Discovery flew the Shuttle Solar Backscatter Ultraviolet instrument used to calibrate other ozone-detection instruments. To continue global ozone monitoring through the end of the decade, NASA agreed with the Soviet Union to place a Total Ozone Mapping Spectrometer aboard a Soviet Meteor satellite in 1991.

U.S.-Soviet Cooperation extended into the life sciences as the two nations exchanged biomedical data from space flights in 1989 at a September meeting. In addition, specialists from both countries began to analyze data obtained from short- and long-duration missions dealing with bone, muscle and cardiovascular physiology. The Physiological Systems Experiment was flown on STS-41 in October to investigate whether microgravity-induced conditions mimic medical problems on Earth.

Space Science research extended into other areas as well. Space Shuttle middeck payloads included experiments to investigate how protein crystals and how flames spread in the absence of the Earth's gravity. NASA aircraft took measurements that ultimately will be used to build instruments to study global winds and tropical rainfall and studied the chemistry of the lower atmosphere over Canada. Balloon flights observed atmospheric processes and tested balloon designs. In all, NASA conducted approximately 30 suborbital rocket flights and 25 balloon flights in support of space science.

## SPACE FLIGHT

In what will become standard biennial selections, 23 new astronauts candidates were named in 1990, including the first woman to be named as a pilot candidate and the first Hispanic woman to be chosen. The candidates reported for training at Johnson Space Center in July.

The Space Shuttle made significant accomplishments in 1990 with six successful missions being flown, despite a stand-down of 5 months due to hydrogen leaks. Current capabilities of the Shuttle system were expanded during the year with two extended duration missions flown by Shuttle Columbia on missions STS-32 in January and STS-35 in December. The STS-32 mission set a new record as the longest Shuttle mission ever flown with 261 hours logged. The Shuttle Discovery carried two payloads into orbit on missions STS-31 in April which deployed the Hubble Space Telescope and STS-41 in October which deployed the Ulysses spacecraft. Atlantis also made two flights during the year for the Department of Defense on missions STS-36 in February and STS-38 in November.

Some Space Flight Highlights Include:

**Jan. 9:** Space Shuttle Columbia (STS-32) successfully launched SYNCOM IV-5.

**Feb. 28:** Space Shuttle Atlantis flew a successful mission for DoD.

**March 27:** An agreement was signed with General Dynamics to provide Atlas IIAS launch services for the 1995 joint NASA/ESA Solar and Heliospheric Observatory mission.

**April 5:** A Pegasus rocket was dropped from the wing of a B-52 aircraft, launching the PEGSAT satellite.

**April 24:** Space Shuttle Discovery (STS-31) successfully deployed the Hubble Space Telescope.

**May 9:** Scout/Multiple Access Communication Satellite was launched for DoD.

**May 11:** Contract awarded for design, development, test and evaluation of the Space Shuttle Advanced Solid Rocket Motor (ASRM). A companion contract was awarded on May 25 for the design and construction of ASRM facilities.

**June 1:** Delta II launched the joint NASA/Germany Roentgen (ROSAT) Satellite.

**June 7:** NASA announced termination of its Orbital Maneuvering Vehicle program.

**June 13:** The Board of Governors of INTELSAT approved a Space Shuttle rescue mission for the stranded INTELSAT VI satellite.

**July 3:** Umbrella agreement signed in support of the Pegasus and Taurus commercial launch vehicle programs.

**July 25:** Atlas I (Atlas/Centaur-69) launched the Combined Release and Radiation Effects (CRRES) Satellite.

**Aug. 22:** A government/industry board selected the type of rocket engine which will be designed to power the NASA/USAF Advanced Launch System.

**Oct. 6:** Space Shuttle Discovery (STS-41) successfully deployed Ulysses spacecraft.

**Nov. 15:** Space Shuttle Atlantis (STS-38) flew a successful mission for DoD.

**Dec. 2:** Space Shuttle Columbia (STS-35) /Astro-1 mission.

## SPACE STATION FREEDOM

A 1991 fiscal year budget shortfall of more than $550 million, along with a Congressional mandate to significantly reduce out-year spending, prompted NASA to begin a 3-month assessment of the Space Station Freedom program. Ground rules given to the program to aid in this assessment were developed from Congressional language in NASA's FY 1991 Appropriations Bill.

While the restructuring will have an impact on the design, program officials expect to use the results of the integrated systems preliminary design review as a baseline for design changes.

## COMMERCIAL PROGRAMS

NASA initiated a new method of outreach to American business by sponsoring "Technology 2000," the first industrial exposition and conference to showcase the transfer of NASA technology to the private sector.

The Office of Commercial Programs also sponsored the development of the Commercial Experiment Transporter (COMET), a system for launching and recovering commercial spaceborne experiments, to support its increasing commercial payload flight requirements.

Commercial space flight activity in 1990 included six middeck experiments carried on the Space Shuttle, as well as the launch of Consort 3 aboard a Starfire sounding rocket from White Sands Missile Range, New Mexico.

Commercial experiments flown aboard the Shuttle in 1990 include:

- Protein Crystal Growth (PCG) and Fluids Experiment Apparatus (FEA) - STS-32 in January
- The Protein Crystal Growth (PCG) was flown again on STS-31 in April along with the Investigations into Polymer Membrane Processing (IPMP).
- The Polymer Membrane Processing (IPMP) was flown again on STS-41 in October along with the Physiological Systems Experiment.

**EXPLORATION**

NASA made significant advances this year in organizing and developing an approach to carry out President Bush's Space Exploration Initiative (SEI) to return to the Moon permanently and send humans to explore Mars. NASA was named in a new policy issued by the White House, as the principal implementing agency of SEI, with the Departments of Defense and Energy playing major roles in technology development and implementation strategy.

A second policy dealt with an exploratory dialogue on international participation in SEI. This dialogue, with Europe, Japan, Canada, the Soviet Union and others, is expected to occur in 1991.

In May, President Bush announced a goal to land humans on Mars no later than 2019. Shortly thereafter, NASA launched an SEI Outreach effort to collect new and innovative concepts and technologies from across the nation to carry out SEI.

**AERONAUTICS AND SPACE TECHNOLOGY**

NASA conducted a broad range of fundamental and applied aeronautics research programs in 1990. High-speed civil transport studies commissioned by NASA have led to a focused High-Speed Research Program that emphasizes the environmental compatibility of a next-generation supersonic transport. The preliminary results of emissions research show promise that acceptable emission levels can be achieved. Similarly, research indicates that compliance with noise reduction standards is possible.

NASA's Langley Research Center, Hampton, Virginia, flight tested a "hybrid" laminar air flow control system on a Boeing 757 airliner from March through August. A porous experimental section was mounted on the leading edge of the left wing, followed by a run of natural laminar airflow. The results -- laminar flow was achieved over the forward 65 percent of the wing surface -- could lead to significantly reduced fuel consumption and lower operating costs for future U.S. subsonic transports.

Ames-Dryden Flight Research Center, Edwards, California, completed military utility evaluations of the X-29 research aircraft in high angle-of-attack flight at speeds up to 0.6 times the speed of sound. Researchers discovered that small variations in key aerodynamic parameters can yield significant variations in total aircraft characteristics at high flight-angles-of-attack. The result was that the X-29 had better flying qualities than expected, allowing the design of flight control system software overlays to improve roll performance. Predictions show that roll performance near maximum lift may be much better than current fighter aircraft.

In a joint program with the U.S. Air Force, the Ames-Dryden facility successfully demonstrated a self-repairing flight control system concept using NASA's F-15 Highly Integrated Digital Electronic Control aircraft. The system concept included real-time reconfiguration of flight control surfaces, fault

detection and isolation, positive pilot alert and maintenance diagnostics to facilitate repairs. If fully developed, the system could greatly increase the ability of aircraft to survive battle damage and enhance safety during training missions.

The X-30 National Aero-Space Plane (NASP) program, a joint NASA/Department of Defense effort, reached a milestone in May when the five primary NASP contractors merged into a single national contractor team. Combining the technical expertise and top ideas of the contracts has produced a strong team that now uses all the best ideas from industry. NASA unveiled a new configuration for the X-30 NASP flight research vehicle at the end of October. The latest concept, a twin-tailed lifting-body shape, is a design concept from the contractor team.

Langley Research Center conducted flight tests of an automated landing system in October and November. NASA's Boeing 737 research aircraft made 36 landings using an integrated differential navigation system linked to the Global Positioning System constellation of Earth-orbiting satellites. The test data will be useful in designing auto-landing equipment for future spacecraft and will help researchers assess how to reduce risk in automated touchdowns.

After nearly 6 years in Earth orbit, the Long Duration Exposure Facility (LDEF) was retrieved by the crew of STS-32 in January. LDEF's 57 science and technology experiments are providing information about the effects of long-term exposure to the harsh environment of space.

Two prototype planetary robots made their debut during the year. "Ambler" is a six-legged, 12-foot-tall testbed to test technology for robots that may literally walk through rough terrain on the Moon and Mars. "Robby" is a more conventional six-wheeled articulated vehicle. Both robots are equipped with experimental computerized navigation systems that let them travel autonomously according to preprogrammed general instructions.

In April, the Human Performance Research Laboratory (HPRL) at Ames Research Center, Mountain View, California, was dedicated to study the role of people in advanced aviation situations and long-duration space travel. The lab also will study relationships between humans and computers in its Automation Sciences Research Facility, now under construction. NASA announced in November that it has joined the Concurrent Supercomputing Consortium, a group of research organizations that will tackle some of the most demanding computational challenges. As a benefit of membership, NASA will have access to the world's fastest supercomputer, the Touchstone DELTA system, when it becomes operational next spring.

## INTERNATIONAL RELATIONS

NASA's international cooperative activities in 1990 included the launch of three international missions: Ulysses and the Hubble Space Telescope, cooperative missions with ESA, and ROSAT, a cooperative mission with Germany. NASA invited Japan, Canada and Europe to provide two mission specialist astronaut candidates to join the July 1992 astronaut training class. Cooperation with the Soviet Union continued to progress under the U.S./USSR Joint Working Group (JWG) on space biology and medicine; solar system exploration; space astronomy and astrophysics; solar-terrestrial physics and Earth sciences.

NASA and its Soviet counterpart signed an agreement in July to fly NASA's Total Ozone Mapping Spectrometer on a Soviet Meteor-3 spacecraft in 1991. In March, NASA agreed to participate in the Soviet Academy of Sciences' radio telescope project, RADIOASTRON, which will explore fundamental astrophysical phenomena. U.S./USSR officials continued discussions on flying the U.S. X-ray All Sky Monitor and an X-ray Polarimeter on the Soviet Spectrum-X-Gamma high energy astrophysics mission in 1993/1994.

The Atmospheric Boundary Layer Experiment-3, part of NASA's Global Tropospheric Experiment, is a major scientific initiative established to study the underlying science of man's impact on the chemistry and dynamics of the global troposphere.

## SPACE OPERATIONS

The Office of Space Operations provided tracking, communications and data acquisition for three major science missions: the Magellan on its mission to map the surface of Venus; Ulysses, a mission to the Sun, and the Hubble Space Telescope. The fifth Tracking and Data Relay Satellite has essentially been completed and will be ready for launch on a Space Shuttle flight in 1991. The Advanced Tracking and Data Relay Satellite System (ATDRSS) Phase B study contracts were awarded. ATDRSS will ensure the essential continuation of the space network through the year 2012.

## SAFETY AND MISSION QUALITY

The Government Accounting Office reviewed the Office of Safety and Mission Quality (SMQ) and concluded that the office is working well in providing independent oversight, review, assessment and policy development. SMQ made a significant contribution to the successful launch of the Ulysses spacecraft and contingency planning of the Galileo spacecraft flyby. In addition to overall safety planning, the office conducted independent reviews and evaluations of risks posed by the use of onboard nuclear power systems.

The Seventh Annual NASA/Contractors Conference provided a forum for senior NASA and aerospace management to exchange information and experiences on Total Quality Management (TQM) and the continuous improvement process.

## EDUCATIONAL AFFAIRS

NASA adopted the National Education Goals set by the President and the Governors as fundamental guidelines for developing and conducting education programs. As a result, a complementary 10-year plan is being developed.

Astronauts presented the first live lesson from space in December during the STS-35, Astro-1 mission. "Space Classroom, Assignment: The Stars," focused on the electromagnetic spectrum and its relationship to the high-energy astronomy mission. Over 4 million student scientists planted gardens during the spring semester to experiment with tomato seeds flown in space. The Space Exposed Experiment Developed for Students (SEEDS), was one of 57 experiments housed on the LDEF.

In March, NASA debuted the first tractor-trailer mounted mobile teacher resource center that will travel the nation providing lesson materials to teachers who could not otherwise travel to a NASA field center. The mobile center is part of a larger education initiative, project LASER (Learning About Science, Engineering and Research).

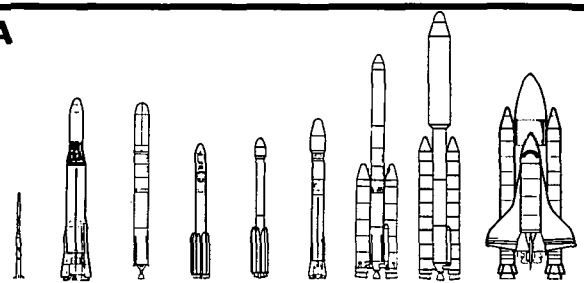
Section B

# Space Flight Activity

# Current Worldwide Launch Vehicles



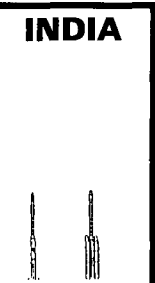
## USA



Payload Weight (Tons)

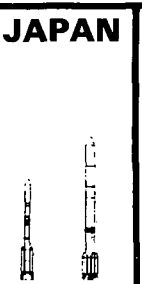
| | Scout | Atlas H | Titan II | Delta 3920 | Delta II | Atlas G/ Centaur | Titan 34D | Titan IV Centaur G | STS |
|---|---|---|---|---|---|---|---|---|---|
| LEO | 0.2 | 2.0 | 2.3 | 3.4 | 5.3 | 6.1 | 13.9 | 17.7 | 29.5 |
| GTO | – | – | – | 1.3 | 1.8 | 2.4 | 4.5 | 9.8 | – |
| GEO | – | – | – | 0.6 | 0.8 | 1.1 | 2.3 | 4.5 | – |

## INDIA



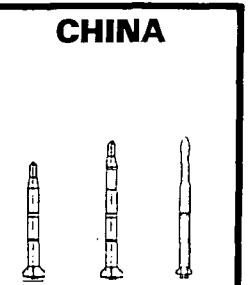
| | SLV-3 | ASLV |
|---|---|---|
| LEO | 0.04 | 0.1 |
| GTO | – | – |
| GEO | – | – |

## JAPAN



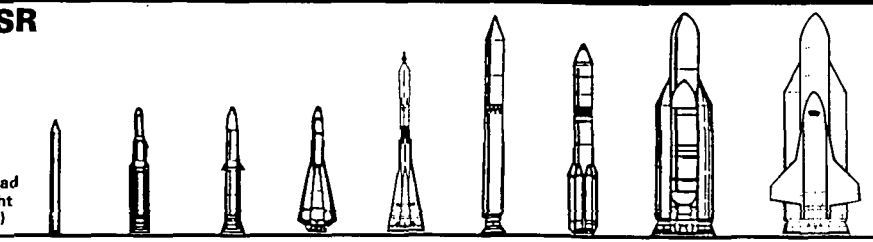
| | M-3S II | H-I |
|---|---|---|
| LEO | 0.7 | 3.0 |
| GTO | – | 1.2 |
| GEO | – | 0.6 |

## CHINA



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

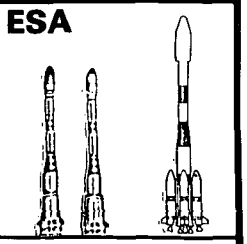
## USSR



Payload Weight (Tons)

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

## ESA



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

# Summary of Announced Launches

| TOTAL | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Australia | – | – | – | – | – | – | – | – | – | – | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 476 DOD | – | 5 | 6 | 11 | 19 | 34 | 27 | 35 | 39 | 42 | 32 | 26 | 19 | 17 | 17 | 13 | 10 | 8 |
| 35 ESA | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 10 France | – | – | – | – | – | – | – | – | 1 | 1 | 2 | 0 | 0 | 2 | 1 | 0 | 0 | 0 |
| 3 India | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 2 Isreal | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 41 Japan | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 2 | 1 | 0 | 1 |
| 5 MDAC | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 3 MMarietta | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 450 NASA | – | 2 | 5 | 5 | 10 | 18 | 11 | 22 | 24 | 31 | 26 | 19 | 21 | 12 | 15 | 18 | 13 | 16 |
| 1 Orbital Sciences | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 28 PRC | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 | 0 | 0 | 0 |
| 1 United Kingdom | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 0 | 0 | 0 |
| 2255 USSR | 2 | 1 | 3 | 3 | 6 | 20 | 17 | 30 | 48 | 44 | 66 | 74 | 70 | 81 | 83 | 74 | 86 | 81 |
| 3311 TOTAL | 2 | 8 | 14 | 19 | 35 | 72 | 55 | 87 | 112 | 118 | 126 | 119 | 110 | 114 | 120 | 106 | 109 | 106 |

## NASA LAUNCHES

| TOTAL | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 256 NASA | – | 2 | 5 | 5 | 10 | 15 | 9 | 20 | 21 | 26 | 18 | 12 | 13 | 6 | 6 | 9 | 9 | 2 |
| 34 Cooperative | – | – | – | – | – | 2 | 0 | 2 | 2 | 0 | 2 | 3 | 2 | 0 | 5 | 1 | 0 | 5 |
| 29 DOD | – | – | – | – | – | – | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| 92 USA | – | – | – | – | – | 1 | 1 | 0 | 1 | 4 | 6 | 3 | 4 | 4 | 3 | 3 | 2 | 4 |
| 39 Foreign | – | – | – | – | – | – | – | – | – | – | – | 1 | 2 | 2 | 1 | 4 | 1 | 5 |
| 450 TOTAL | – | 2 | 5 | 5 | 10 | 18 | 11 | 22 | 24 | 31 | 26 | 19 | 21 | 12 | 15 | 18 | 13 | 16 |

# Summary of Announced Launches

| TOTAL | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Australia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 476 DOD | 9 | 11 | 10 | 12 | 7 | 6 | 5 | 6 | 7 | 10 | 3 | 1 | 5 | 4 | 10 | 10 | 476 |
| 35 ESA | – | – | – | – | 1 | 0 | 2 | 0 | 2 | 4 | 3 | 2 | 2 | 7 | 7 | 5 | 35 |
| 10 France | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| 3 India | – | – | – | – | – | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 2 Isreal | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 0 | 1 | 2 |
| 41 Japan | 2 | 1 | 2 | 3 | 2 | 2 | 3 | 1 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 41 |
| 6 MDAC | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 5 | 6 |
| 3 MMarietta | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 | 3 |
| 449 NASA | 19 | 15 | 14 | 20 | 9 | 7 | 13 | 12 | 15 | 12 | 14 | 5 | 3 | 8 | 7 | 8 | 449 |
| 1 Orbital Sciences | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 |
| 28 PRC | 3 | 2 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 3 | 1 | 2 | 2 | 4 | 0 | 5 | 28 |
| 1 United Kingdom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 2255 USSR | 89 | 99 | 98 | 88 | 87 | 89 | 98 | 101 | 98 | 97 | 97 | 91 | 95 | 90 | 74 | 75 | 2255 |
| 3311 TOTAL | 125 | 128 | 124 | 124 | 106 | 105 | 123 | 121 | 127 | 129 | 120 | 103 | 110 | 116 | 101 | 116 | 3311 |

## NASA LAUNCHES

| TOTAL | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 256 NASA | 10 | 1 | 3 | 8 | 3 | 1 | 4 | 4 | 4 | 6 | 9 | 1 | 0 | 2 | 6 | 6 | 256 |
| 33 Cooperative | 1 | 2 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 33 |
| 29 DOD | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 0 | 1 | 1 | 2 | 3 | 1 | 4 | 1 | 1 | 29 |
| 92 USA | 4 | 8 | 2 | 4 | 3 | 4 | 7 | 6 | 8 | 4 | 3 | 1 | 1 | 1 | 0 | 0 | 92 |
| 39 Foreign | 3 | 2 | 7 | 5 | 1 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 39 |
| 449 TOTAL | 19 | 15 | 14 | 20 | 9 | 7 | 13 | 12 | 15 | 12 | 14 | 5 | 3 | 8 | 7 | 8 | 449 |

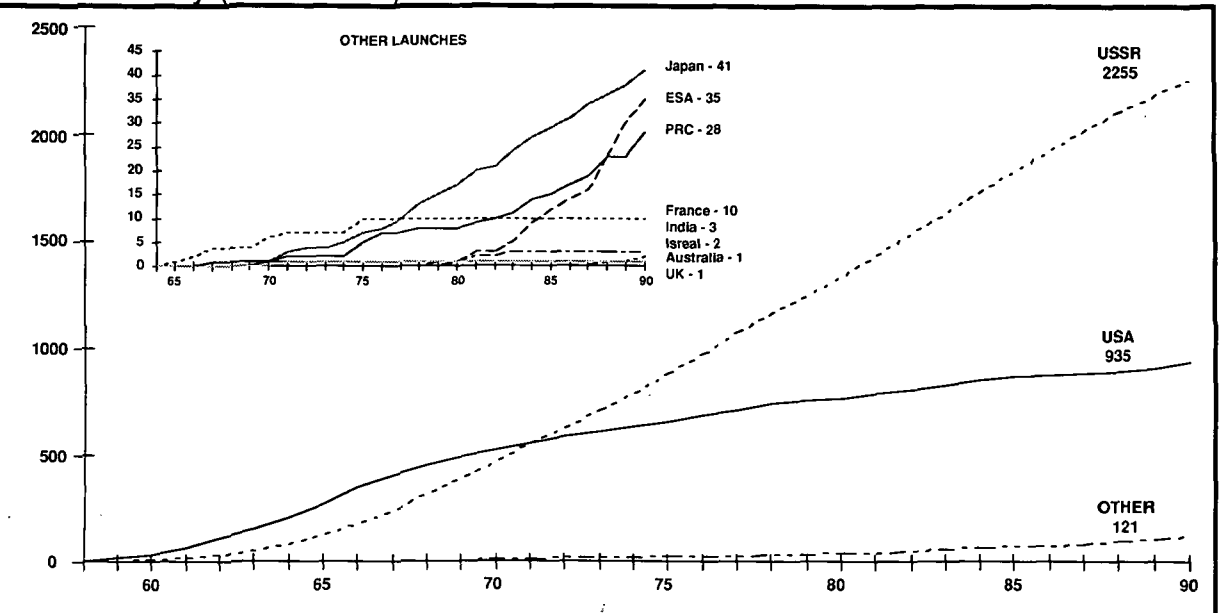
# NASA Launches By Vehicle

| TOTAL | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 Atlas | -- | -- | -- | -- | 2 | 3 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 29 Atlas Agena | -- | -- | -- | -- | 2 | 4 | 0 | 5 | 2 | 9 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 Atlas E/F | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 61 Atlas Centaur | -- | -- | -- | -- | -- | -- | 1 | 1 | 1 | 4 | 4 | 3 | 3 | 0 | 3 | 4 | 3 | 1 |
| 155 Delta | -- | -- | -- | -- | -- | -- | 1 | 4 | 7 | 8 | 12 | 7 | 10 | 7 | 5 | 7 | 5 | 7 |
| 5 Juno II | -- | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 Saturn I | -- | -- | -- | -- | -- | -- | -- | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 Saturn IB | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 3 | 0 |
| 13 Saturn V | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 2 | 4 | 1 | 2 | 2 | 1 | 0 |
| 64 Scout | -- | -- | -- | -- | 2 | 1 | 2 | 6 | 4 | 1 | 2 | 4 | 2 | 2 | 5 | 5 | 1 | 6 |
| 37 Shuttle | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 4 Thor Able | -- | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 Thor Agena | -- | -- | -- | -- | -- | 1 | 0 | 2 | 2 | 2 | 1 | 0 | 2 | 2 | 0 | 0 | 0 | 0 |
| 21 Thor Delta | -- | -- | -- | 2 | 3 | 9 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 Titan II | -- | -- | -- | -- | -- | -- | -- | 1 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 Titan Centaur | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 2 |
| 2 Vanguard | -- | -- | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 450 TOTAL | -- | 2 | 5 | 5 | 10 | 18 | 11 | 22 | 24 | 31 | 26 | 19 | 21 | 12 | 15 | 18 | 13 | 16 |

# NASA Launches By Vehicle

| TOTAL | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 Atlas | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| 29 Atlas Agena | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29 |
| 9 Atlas E/F | – | – | – | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 9 |
| 61 Atlas Centaur | 2 | 3 | 2 | 7 | 2 | 3 | 4 | 2 | 1 | 1 | 3 | 1 | 0 | 0 | 1 | 1 | 61 |
| 154 Delta | 12 | 9 | 9 | 10 | 3 | 3 | 5 | 7 | 7 | 4 | 0 | 1 | 2 | 1 | 1 | 0 | 154 |
| 5 Juno II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| 6 Saturn I | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| 7 Saturn IB | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| 13 Saturn V | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| 64 Scout | 2 | 2 | 1 | 1 | 3 | 0 | 1 | 0 | 1 | 1 | 2 | 1 | 1 | 4 | 0 | 1 | 64 |
| 37 Shuttle | – | – | – | – | – | – | 2 | 3 | 4 | 5 | 9 | 1 | 0 | 2 | 5 | 6 | 37 |
| 4 Thor Able | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| 12 Thor Agena | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| 21 Thor Delta | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 |
| 11 Titan II | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| 7 Titan Centaur | 2 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| 2 Vanguard | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 449 TOTAL | 19 | 15 | 14 | 20 | 9 | 7 | 13 | 12 | 15 | 12 | 14 | 5 | 3 | 8 | 7 | 8 | 449 |

Launch History (Cumulative)



# Summary of Worldwide Payloads

| TOTAL | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Argentina | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 5 Australia | – | – | – | – | – | – | – | – | – | – | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 3 Brazil | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 9 Canada | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 | 0 |
| 29 China | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 | 0 | 0 | 0 |
| 44 Cooperative * | – | – | – | – | – | 2 | 0 | 2 | 3 | 0 | 2 | 3 | 2 | 0 | 6 | 1 | 1 | 7 |
| 2 Czechoslovakia | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 21 France | – | – | – | – | – | – | – | – | 1 | 1 | 2 | 0 | 0 | 2 | 1 | 1 | 0 | 0 |
| 10 Germany | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 0 | 0 | 0 | 1 |
| 12 India | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 6 Indonesia | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 37 International Organizations * | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 | 1 | 1 | 3 | 0 | 0 |
| 2 Isreal | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 1 Italy | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 51 Japan | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 2 | 1 | 0 | 1 |
| 2 Mexico | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 1 Pakistan | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 2660 Soviet Union | 2 | 1 | 3 | 3 | 4 | 20 | 17 | 35 | 66 | 44 | 66 | 74 | 70 | 88 | 96 | 88 | 106 | 95 |
| 2 Sweden | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 16 United Kingdom | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 | 1 | 0 | 0 | 3 |
| 1102 United States * | – | 7 | 11 | 17 | 36 | 53 | 54 | 72 | 88 | 102 | 78 | 63 | 51 | 30 | 36 | 28 | 22 | 15 |
| 4015 TOTAL | 2 | 8 | 14 | 20 | 40 | 75 | 71 | 109 | 158 | 147 | 149 | 141 | 125 | 126 | 144 | 123 | 130 | 122 |

* Separate Breakdown Follows

INTERNATIONAL ORGANIZATIONS

| TOTAL | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 AsiaSat | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 2 ASCO | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 26 ESA | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 | 0 | 0 | 3 | 0 | 0 |
| 1 InMarSat | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 6 NATO | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 | 0 | 0 | 0 |
| 1 PanAmSat | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 37 TOTAL | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 | 1 | 1 | 3 | 0 | 0 |

# Summary of Worldwide Payloads

| TOTAL | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Argentina | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 |
| 5 Australia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 5 |
| 3 Brazil | – | – | – | – | – | – | – | – | – | – | 1 | 1 | 0 | 0 | 0 | 1 | 3 |
| 9 Canada | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 9 |
| 29 China | 3 | 2 | 0 | 1 | 0 | 0 | 3 | 1 | 1 | 3 | 1 | 3 | 1 | 3 | 0 | 5 | 29 |
| 46 Cooperative | 2 | 2 | 2 | 2 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 5 | 46 |
| 2 Czechoslovakia | – | – | – | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 |
| 21 France | 5 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 2 | 21 |
| 10 Germany | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 2 | 1 | 10 |
| 12 India | 1 | 0 | 0 | 0 | 1 | 1 | 3 | 1 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 12 |
| 6 Indonesia | – | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 6 |
| 37 International Organizations | 1 | 1 | 3 | 3 | 1 | 0 | 4 | 1 | 2 | 2 | 3 | 0 | 1 | 3 | 2 | 3 | 37 |
| 2 Isreal | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 0 | 1 | 2 |
| 1 Italy | – | – | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 51 Japan | 2 | 1 | 4 | 4 | 2 | 2 | 3 | 1 | 3 | 3 | 2 | 3 | 3 | 2 | 4 | 7 | 51 |
| 2 Mexico | – | – | – | – | – | – | – | – | – | – | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| 1 Pakistan | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 |
| 2660 Soviet Union | 109 | 121 | 104 | 119 | 101 | 110 | 123 | 119 | 115 | 115 | 118 | 114 | 116 | 107 | 95 | 96 | 2660 |
| 2 Sweden | – | – | – | – | – | – | – | – | – | – | – | 1 | 0 | 0 | 1 | 0 | 2 |
| 16 United Kingdom | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 5 | 16 |
| 1101 United States | 26 | 27 | 17 | 29 | 17 | 13 | 19 | 17 | 22 | 32 | 33 | 9 | 9 | 15 | 22 | 31 | 1101 |
| 4016 TOTAL | 150 | 155 | 133 | 160 | 123 | 126 | 157 | 142 | 151 | 161 | 164 | 132 | 133 | 136 | 129 | 160 | 4016 |

## INTERNATIONAL ORGANIZATIONS

| TOTAL | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 AsiaSat | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 |
| 2 ASCO | – | – | – | – | – | – | – | – | – | – | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| 26 ESA | 1 | 0 | 2 | 2 | 1 | 0 | 4 | 0 | 2 | 2 | 1 | 0 | 1 | 2 | 2 | 1 | 26 |
| 1 InMarSat | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 |
| 6 NATO | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| 1 PanAmSat | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 0 | 0 | 1 |
| 37 TOTAL | 1 | 1 | 3 | 3 | 1 | 0 | 4 | 1 | 2 | 2 | 3 | 0 | 1 | 3 | 2 | 3 | 37 |

# Summary of USA Payloads

## U.S. PAYLOADS

| TOTAL | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 AMSAT | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 0 | 1 |
| 5 AT&T | – | – | – | – | – | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 ASC | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 47 COMSAT | – | – | – | – | – | – | – | – | 1 | 1 | 3 | 1 | 3 | 3 | 2 | 2 | 1 | 1 |
| 690 DOD | – | 5 | 6 | 12 | 23 | 39 | 44 | 50 | 66 | 71 | 57 | 43 | 32 | 18 | 24 | 14 | 11 | 8 |
| 7 GTE | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 8 Hughes | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 286 NASA | – | 2 | 5 | 5 | 13 | 13 | 8 | 21 | 21 | 27 | 15 | 17 | 15 | 8 | 9 | 10 | 9 | 2 |
| 30 NOAA | – | – | – | – | – | – | – | – | – | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 N. Utah Univ | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 11 RCA | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 5 SBS | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 6 WU | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 |
| 1102 TOTAL | – | 7 | 11 | 17 | 36 | 53 | 54 | 72 | 88 | 102 | 78 | 63 | 51 | 30 | 36 | 28 | 22 | 15 |

## COOPERATIVE PAYLOADS

| TOTAL | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 NASA/Canada | – | – | – | – | – | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| 2 NASA/DOD | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 6 NASA/ESA | – | – | – | – | – | – | – | – | – | – | – | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 NASA/France | – | – | – | – | – | – | – | – | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 |
| 2 France/Germany | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 |
| 5 NASA/Germany | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 0 | 0 | 1 | 0 | 1 |
| 5 NASA/Italy | – | – | – | – | – | – | – | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 2 NASA/Netherlands | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 |
| 2 NASA/NOAA | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 |
| 3 NASA/NRL | – | – | – | – | – | – | – | – | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| 1 NASA/Spain | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 |
| 5 NASA/UK | – | – | – | – | – | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 44 TOTAL | – | – | – | – | – | 2 | 0 | 2 | 3 | 0 | 2 | 3 | 2 | 0 | 6 | 1 | 1 | 7 |

# Summary of USA Payloads

## U.S. PAYLOADS

| TOTAL | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 AMSAT | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 |
| 5 AT&T | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 5 |
| 1 ASC | – | – | – | – | – | – | – | – | – | – | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 47 COMSAT | 2 | 6 | 1 | 3 | 0 | 1 | 3 | 2 | 2 | 2 | 3 | 0 | 0 | 1 | 1 | 2 | 47 |
| 690 DOD | 10 | 18 | 12 | 14 | 11 | 8 | 7 | 6 | 8 | 12 | 11 | 5 | 8 | 9 | 12 | 16 | 690 |
| 7 GTE | – | – | – | – | – | – | – | – | – | 2 | 1 | 1 | 0 | 2 | 0 | 1 | 7 |
| 8 Hughes | – | – | – | – | – | – | – | – | 2 | 3 | 2 | 0 | 0 | 0 | 0 | 1 | 8 |
| 285 NASA | 12 | 1 | 3 | 10 | 3 | 1 | 5 | 4 | 6 | 9 | 12 | 1 | 0 | 2 | 9 | 7 | 285 |
| 30 NOAA | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 0 | 2 | 2 | 0 | 1 | 1 | 1 | 0 | 0 | 30 |
| 1 N. Utah Univ | – | – | – | – | – | – | – | – | – | – | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 11 RCA | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 11 |
| 5 SBS | – | – | – | – | – | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 5 |
| 6 WU | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| 1101 TOTAL | 26 | 27 | 17 | 29 | 17 | 13 | 19 | 17 | 22 | 32 | 33 | 9 | 9 | 15 | 22 | 31 | 1101 |

## COOPERATIVE PAYLOADS

| TOTAL | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 NASA/Canada | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| 2 NASA/DOD | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 | 2 |
| 6 NASA/ESA | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| 6 NASA/France | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| 2 France/Germany | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 5 NASA/Germany | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 |
| 5 NASA/Italy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 5 |
| 2 NASA/Netherlands | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 2 NASA/NOAA | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 3 NASA/NRL | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 1 NASA/Spain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 5 NASA/UK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| 44 TOTAL | 2 | 2 | 2 | 2 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 44 |

# Soviet Spacecraft Designations

**BURAN** (Snowstorm): Reusable orbital space shuttle.

**COSMOS:** Designation given to many different activities in space.

**EKRAN** (Screen): Geosynchronous comsat for TV services.

**ELEKTRON**: Dual satellites to study the radiation belts.

**FOTON**: Scientific satellite to continue space materials studies.

**GAMMA**: Radiation detection satellite.

**GORIZONT** (Horizon): Geosynchronous comsat for international relay.

**GRANAT**: Astrophysical orbital observatory.

**INTERCOSMOS**: International scientific satellite.

**ISKRA**: Amateur radio satellite.

**KRISTALL**: Module carrying technical and biomedical instruments to MIR.

**KVANT**: MIR space station astrophysics module.

**LUNA**: Lunar exploration spacecraft.

**MARS**: Spacecraft to explore the planet Mars.

**METEOR**: Polar orbiting meteorological satellite.

**MIR** (Peace): Advanced manned scientific space station in Earth orbit.

**MOLNIYA** (Lightning): Part of the domestic communications satellite system.

**NADEZHDA:** Navigation satellite.

**OKEAN:** Oceanographic satellite to monitor ice conditions.

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

**POLYOT**: Maneuverable satellite capable of changing orbits.

**PROGNOZ** (Forecast): Scientific interplanetary satellite.

**PROGRESS:** Unmanned cargo flight to resupply manned space stations.

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

**RADIO**: Small radio relay satellite for use by amateurs.

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

**RESURS**: Earth resources satellite.

**SALYUT**: Manned scientific space station in Earth orbit.

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

**SPUTNIK**: Early series of satellites to develop manned spaceflight.

**VEGA**: Two spacecraft international project to study Venus and Halley's Comet.

**VENERA:** Spacecraft to explore the planet Venus.

**VOSKHOD:** Modified Vostok capsule for two and three Cosmonauts.

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

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

# Unofficial Tabulation of USSR Payloads

| TOTAL | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Buran | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 2120 Cosmos | – | – | – | – | – | 12 | 12 | 27 | 52 | 34 | 61 | 64 | 55 | 72 | 81 | 72 | 85 | 74 |
| 19 Ekran | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 4 Electron | – | – | – | – | – | – | – | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 Foton | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 1 Gamma | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 22 Gorizont | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 1 Granat | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 23 Intercosmos | – | – | – | – | – | – | – | – | – | – | – | – | 2 | 2 | 1 | 3 | 2 | 2 |
| 3 Iskra | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 1 Kristall | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 2 Kvant | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 24 Luna | – | – | 3 | 0 | 0 | 0 | 1 | 0 | 4 | 5 | 0 | 1 | 1 | 2 | 2 | 1 | 1 | 2 |
| 7 Mars | – | – | – | – | – | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 4 | 0 |
| 54 Meteor | – | – | – | – | – | – | – | – | – | – | – | – | 2 | 4 | 4 | 3 | 2 | 5 |
| 1 Mir | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 136 Molniya | – | – | – | – | – | – | – | – | 2 | 2 | 3 | 3 | 2 | 5 | 3 | 6 | 8 | 7 |
| 2 Nadezhda | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 2 Okean | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 2 Phobos | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 2 Polyot | – | – | – | – | – | – | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 Prognoz | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 | 1 | 0 |
| 47 Progress | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 4 Proton | – | – | – | – | – | – | – | – | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 Radio | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 28 Raduga | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 9 Resurs | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 7 Salyut | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 0 | 1 | 2 |
| 66 Soyuz | – | – | – | – | – | – | – | – | – | – | 1 | 2 | 5 | 1 | 2 | 0 | 2 | 3 |
| 12 Sputnik | 2 | 1 | 0 | 3 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 Vega | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 15 Venera | – | – | – | – | – | – | – | – | 2 | 0 | 1 | 0 | 2 | 1 | 0 | 1 | 0 | 0 |
| 2 Voskhod | – | – | – | – | – | – | – | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 Vostok | – | – | – | – | – | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 Zond | – | – | – | – | – | – | – | 2 | 3 | 0 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 0 |
| 6 No Designation | – | – | – | – | – | 3 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2660 TOTAL | 2 | 1 | 3 | 3 | 4 | 20 | 17 | 35 | 66 | 44 | 66 | 74 | 70 | 88 | 96 | 88 | 106 | 95 |

# Unofficial Tabulation of USSR Payloads

| TOTAL | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Buran | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 0 | 0 | 1 |
| 2120 Cosmos | 85 | 101 | 86 | 96 | 79 | 88 | 94 | 97 | 94 | 94 | 99 | 96 | 97 | 79 | 68 | 66 | 2120 |
| 19 Ekran | -- | 1 | 1 | 0 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 0 | 0 | 19 |
| 4 Electron | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| 3 Foton | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 1 | 1 | 3 |
| 1 Gamma | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 1 |
| 22 Gorizont | -- | -- | -- | 1 | 2 | 1 | 0 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 3 | 3 | 22 |
| 1 Granat | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 0 | 1 |
| 23 Intercosmos | 2 | 2 | 1 | 1 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 23 |
| 3 Iskra | -- | -- | -- | -- | -- | -- | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 1 Kristall | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 1 |
| 2 Kvant | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 0 | 1 | 0 | 2 |
| 24 Luna | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 |
| 7 Mars | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| 54 Meteor | 4 | 3 | 4 | 0 | 3 | 2 | 2 | 2 | 1 | 1 | 3 | 1 | 2 | 2 | 2 | 2 | 54 |
| 1 Mir | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 0 | 0 | 0 | 0 | 1 |
| 136 Molniya | 10 | 7 | 6 | 6 | 5 | 4 | 8 | 5 | 7 | 4 | 8 | 7 | 1 | 7 | 4 | 6 | 136 |
| 2 Nadezhda | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 1 | 2 |
| 2 Okean | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 0 | 1 | 2 |
| 2 Phobos | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 2 | 0 | 0 | 2 |
| 2 Polyot | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 10 Prognoz | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 10 |
| 47 Progress | -- | -- | -- | 4 | 3 | 4 | 1 | 4 | 2 | 5 | 1 | 2 | 7 | 6 | 4 | 4 | 47 |
| 4 Proton | 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 | 0 | 8 |
| 28 Raduga | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 28 |
| 9 Resurs | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 5 | 4 | 9 |
| 7 Salyut | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| 66 Soyuz | 4 | 3 | 3 | 5 | 4 | 6 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | 66 |
| 12 Sputnik | 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 | 0 | 2 |
| 15 Venera | 2 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| 2 Voskhod | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 4 Vostok | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| 10 Zond | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| 6 No Designation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| 2660 TOTAL | 109 | 121 | 104 | 119 | 101 | 110 | 123 | 119 | 115 | 115 | 118 | 114 | 116 | 107 | 95 | 96 | 2660 |

# NASA Astronauts

| NAME | SERVICE | MISSION | POSITION | FLIGHT TIME (HR:MIN:SEC) | EVA (HR:MIN) | TOTAL FLIGHT TIME (HR:MIN:SEC) |
|---|---|---|---|---|---|---|
| Acton, Loren W., PhD | Civ | STS-51F | PS | 190:45:26 | | 190:45:26 |
| Adamson, James C., Lt. Col. | USA | STS-28 | MS | 121:00:09 | | 121:00:09 |
| Akers, Thomas D., Maj. | USAF | STS-41 | MS | 98:11:00 | | 98:11:00 |
| Aldrin, Edwin E., Jr., Col. | USAF Ret | Gemini 12 | Plt | 68:34:31 | 05:37 | 289:53:06 |
| | | Apollo 11 | LMP | 195:18:35 | 02:15 * | |
| Allen, Joseph P. PhD | Civ | STS-5 | MS | 122:14:26 | | 313:59:22 |
| | | STS-51A | MS | 191:44:56 | 12:14 | |
| Al-Saud, Salman | Civ | STS-51G | PS | 169:38:52 | | 169:38:52 |
| Anders, William A., B. Gen. | USAF | Apollo 8 | LMP | 147:00:42 | | 206:00:01 |
| Armstrong, Neil | Civ | Gemini 8 | Cdr | 10:41:26 | | |
| | | Apollo 11 | Cdr | 195:18:35 | 02:32 * | |
| Bagian, James P. MD | Civ | STS-29 | MS | 119:38:52 | | 119:38:52 |
| Baker, Ellen S., MD | Civ | STS-34 | MS | 119:39:24 | | 119:39:24 |
| Bartoe, John-David F., PhD | Civ | STS-51F | PS | 190:45:26 | | 190:45:26 |
| Baudry, Patrick, Lt. Col. | FAF | STS-51G | PS | 169:38:52 | | 169:38:52 |
| Bean, Alan F., Capt | USN Ret | Apollo 12 | LMP | 244:36:25 | 07:45 * | 1671:45:29 |
| | | Skylab 3 | Cdr | 1427:09:04 | 02:45 | |
| Blaha, John E., Col | USAF | STS-29 | Plt | 119:38:52 | | 239:45:41 |
| | | STS-33 | Plt | 120:06:49 | | |
| Bluford, Guion S., Col | USAF | STS-8 | MS | 145:08:43 | | 313:53:34 |
| | | STS-61A | MS | 168:44:51 | | |
| Bobko, Karol J., Col | USAF | STS-6 | Plt | 120:23:42 | | 386:03:43 |
| | | STS-51D | Cdr | 167:55:23 | | |
| | | STS-51J | Cdr | 97:44:38 | | |
| Bolden, Charles F., Col | USMC | STS 61-C | Plt | 146:03:51 | | 267:19:56 |
| | | STS-31 | Plt | 121:16:05 | | |
| Borman, Frank, Col. | USAF Ret | Gemini 7 | Cdr | 330:35:31 | | 477:36:13 |
| | | *Apollo 8* | *Cdr* | 147:00:42 | | |

*Lunar Surface EVA

| NAME | SERVICE | MISSION | POSITION | FLIGHT TIME (HR:MIN:SEC) | EVA (HR:MIN) | TOTAL FLIGHT TIME (HR:MIN:SEC) |
|---|---|---|---|---|---|---|
| Brand, Vance D. | Civ | Apollo Soyuz | CMP | 217:28:23 | | 763:54:44 |
| | | STS-5 | Cdr | 122:14:26 | | |
| | | STS-41B | Cdr | 191:15:55 | | |
| | | STS-35 | Cdr | 215:06:00 | | |
| Brandenstein, Daniel C., Capt | USN | STS-8 | Plt | 145:08:43 | | 575:48:12 |
| | | STS-51G | Cdr | 169:38:52 | | |
| | | STS-32 | Cdr | 120:06:49 | | |
| Bridges, Roy D., Col | USAF | STS-51-F | Plt | 190:45:26 | | 190:45:26 |
| Brown, Mark F., Lt. Col | USAF | STS-28 | MS | 121:00:09 | | 121:00:09 |
| Buchli, James F., Col | USMC | STS-51C | MS | 73:33:23 | | 361:57:06 |
| | | STS-61A | MS | 168:44:51 | | |
| | | STS-29 | MS | 119:38:52 | | |
| Cabana, Robert D., Lt. Col. | USMC | STS-41 | Plt | 98:11:00 | | 98:11:00 |
| Carpenter, M. Scott, Cdr. | USN Ret | Aurora 7 | Cdr | 4:56:05 | | 4:56:05 |
| Carr, Gerald P., Col | USMC Ret | Skylab 4 | Cdr | 2017:15:32 | 15:48 | 2017:15:32 |
| Carter, Manley, Cdr. | USN | STS-33 | MS | 120:06:49 | | 120:06:49 |
| Casper, John H., Col | USAF | STS-36 | Plt | 106:18:23 | | 106:18:23 |
| Cenker, Robert J. | Civ | STS-61C | PS | 146:03:51 | | 146:03:51 |
| Cernan, Eugene A., Capt. | USN Ret | Gemini 9A | Plt | 72:21:00 | 02:08 | 566:16:32 |
| | | Apollo 10 | LMP | 192:03:23 | | |
| | | Apollo 17 | Cdr | 301:51:59 | 22:04 * | |
| Chang-Diaz, Franklin R., PhD | Civ | STS-61C | MS | 146:03:51 | | 265:43:15 |
| | | STS-34 | MS | 119:39:24 | | |
| Cleave, Mary L., PhD | Civ | STS-61B | MS | 165:04:49 | | 262:02:20 |
| | | STS-30 | MS | 96:56:25 | | |
| Coats, Michael L., Capt. | USN | STS-41D | Plt | 144:56:04 | | 264:34:56 |
| | | STS-29 | Cdr | 119:38:52 | | |
| *Collins, Michael, M. Gen* | *USAF* | *Gemini 10* | *Plt* | *70:46:39* | *01:30* | *266:11:14* |
| | | Apollo 11 | CMP | 195:18:35 | | |

*Lunar Surface EVA

# NASA Astronauts

| NAME | SERVICE | MISSION | POSITION | FLIGHT TIME (HR:MIN:SEC) | EVA (HR:MIN) | TOTAL FLIGHT TIME (HR:MIN:SEC) |
|---|---|---|---|---|---|---|
| Conrad, Charles (Pete), Capt | USN Ret | Gemini 5 | Plt | 190:55:14 | | 1179:28:36 |
| | | Gemini 11 | Cdr | 71:17:08 | | |
| | | Apollo 12 | Cdr | 244:36:25 | 07:45 * | |
| | | Skylab 2 | Cdr | 672:49:49 | 05:51 | |
| Cooper, L. Gordon, Jr., Col. | USAF Ret | Faith 7 | Plt | 34:19:49 | | 226:18:03 |
| | | Gemini 5 | Cdr | 190:55:14 | | |
| Covey, Richard O., Col | USAF | STS-51I | Plt | 170:17:42 | | 485:12:53 |
| | | STS-26 | Plt | 97:00:11 | | |
| | | STS-38 | Cdr | 117:55:00 | | |
| Creighton, John O., Capt | USN | STS-51G | Plt | 169:38:52 | | 275:57:15 |
| | | STS-36 | Cdr | 106:18:23 | | |
| Crippen, Robert L, Capt | USN | STS-1 | Plt | 54:20:32 | | 565:48:11 |
| | | STS-7 | Cdr | 146:23:59 | | |
| | | STS-41C | Cdr | 167:40:07 | | |
| | | STS-41G | Cdr | 197:23:33 | | |
| Cutbertson, Frank L. | | STS-38 | Plt | 117:55:00 | | 117:55:00 |
| Cunningham, Walter | Civ | Apollo 7 | LMP | 260:09:03 | | 260:09:03 |
| Duke, Charles M., B. Gen. | USAF | Apollo 16 | LMP | 265:51:05 | 20:14 * | 265:51:05 |
| Dunbar, Bonnie J., PhD | Civ | STS-61A | MS | 168:44:51 | | 429:45:28 |
| | | STS-32 | MS | 261:00:37 | | |
| Durrance, Samuel T. | | STS-35 | PS | 215:06:00 | | 215:06:00 |
| Eisele, Donn F., Col. | USAF Ret | Apollo 7 | CMP | 260:09:03 | | 260:09:03 |
| England, Anthony W., PhD | Civ | STS-51F | MS | 190:45:26 | | 190:45:26 |
| Engle, Joe H., Col | USAF | STS-2 | Cdr | 54:13:13 | | 244:30:55 |
| | | STS-51I | Cdr | 170:17:42 | | |
| Evans, Ronald R., Capt | USN Ret | Apollo 17 | CMP | 301:51:59 | 01:06 | 301:51:59 |
| Fabian, John M. Col. | USAF | STS-7 | MS | 146:23:59 | | 316:02:51 |
| | | STS-51G | MS | 169:38:52 | | |
| Fisher, Anna L., MD | Civ | STS-51A | MS | 191:44:56 | | 191:44:56 |
| Fisher, William F., MD | Civ | STS-51I | MS | 170:17:42 | 11:51 | 170:17:42 |
| Fullerton, C. Gordon, Col. | USAF | STS-3 | Plt | 192:04:45 | | 382:50:11 |
| | | STS-51F | Cdr | 190:45:26 | | |
| Furrer, Reinhard, PhD | Civ | STS-61A | PS | 186:44:51 | | 186:44:51 |
| Gardner, Dale A., | USN | STS-8 | MS | 145:08:43 | | 336:53:39 |
| | | STS-51A | MS | 191:44:56 | 12:14 | |
| Gardner, Guy S., Lt. Col. | USAF | STS-27 | Plt | 105:05:37 | | 320:11:37 |
| | | STS-35 | Plt | 215:06:00 | | |
| Garn, E. J. "Jake" | Civ | STS-51D | PS | 167:55:23 | | 167:55:23 |
| Garneau, Marc, PhD | Civ | STS-41G | PS | 197:23:33 | | 197:23:33 |
| Garriott, Owen K., PhD | Civ | Skylab 3 | Plt | 1427:09:04 | 13:44 | 1674:56:28 |
| | | STS-9 | MS | 247:47:24 | | |
| Gemar, Charles D. | | STS-38 | MS | 117:55:00 | | 117:55:00 |
| Gibson, Edward G., PhD | Civ | Skylab 4 | Plt | 2017:15:32 | 15:20 | 2017:15:32 |
| Gibson, Robert L., Cdr. | USN | STS-41B | Plt | 191:15:55 | | 442:25:23 |
| | | STS-61C | Cdr | 146:03:51 | | |
| | | STS-27 | Cdr | 105:05:37 | | |
| Glenn, John H., Jr., Col | USMC Ret | Friendship 7 | Cdr | 4:55:23 | | 4:55:23 |
| Gordon, Richard F., Jr., Capt. | USN Ret | Gemini 11 | Plt | 71:17:08 | 01:57 | 315:53:33 |
| | | Apollo 12 | CMP | 244:36:25 | | |
| Grabe, Ronald J., Col | USAF | STS-51J | Plt | 97:44:38 | | 194:42:09 |
| | | STS-30 | Plt | 96:56:25 | | |
| Gregory, Frederick D., Col | USAF | STS-51B | Plt | 168:08:46 | | 288:13:35 |
| | | STS-33 | Cdr | 120:06:49 | | |
| Griggs, S. David | Civ | STS-51D | MS | 167:55:23 | 03:10 | 167:55:23 |
| Grissom, Virgil I., Lt. Col. | USAF | **Liberty Bell | Plt | 15:37 | | 5:08:37 |
| | | Gemini 3 | Cdr | 4:53:00 | | |
| Haise, Fred W. | Civ | Apollo 13 | LMP | 142:54:41 | | 142:54:41 |
| Hart, Terry J | Civ | STS-41C | MS | 167:40:07 | | 167:40:07 |

*Lunar Surface EVA

** Suborbital Flight

# NASA Astronauts

| NAME | SERVICE | MISSION | POSITION | FLIGHT TIME (HR:MIN:SEC) | EVA (HR:MIN) | TOTAL FLIGHT TIME (HR:MIN:SEC) |
|---|---|---|---|---|---|---|
| Hartsfield, Henry W. | USAF Ret | STS-4 | Plt | 169:09:40 | | 482:50:35 |
| | | STS-41D | Cdr | 144:56:04 | | |
| | | STS-61A | Cdr | 168:44:51 | | |
| Hauck, Frederick H., Capt | USN | STS-7 | Plt | 146:23:59 | | 435:09:06 |
| | | STS-51A | Cdr | 191:44:56 | | |
| | | STS-26 | Cdr | 97:00:11 | | |
| Hawley, Steven A., PhD | Civ | STS-41D | MS | 144:56:04 | | 412:16:00 |
| | | STS-61C | MS | 146:03:51 | | |
| | | STS-31 | MS | 121:16:05 | | |
| Henize, Karl G., PhD | Civ | STS-51F | MS | 190:45:26 | | 190:45:26 |
| Hilmers, David C., Lt. Col. | USMC | STS-51J | MS | 97:44:38 | | 301:03:11 |
| | | STS-26 | MS | 97:00:11 | | |
| | | STS-36 | MS | 106:18:23 | | |
| Hoffman, Jeffery A., PhD | Civ | STS-51D | MS | 167:55:23 | 03:10 | 383:01:23 |
| | | STS-35 | MS | 215:06:00 | | |
| Irwin, James B., Col | USAF Ret | Apollo 15 | LMP | 295:11:53 | 18:35 * | 295:11:53 |
| Ivins, Marsha S. | Civ | STS-32 | MS | 261:00:37 | | 261:00:37 |
| Jarvis, Gregory B | Civ | STS-51L | PS | N/A | | N/A |
| Kerwin, Joseph P., Capt | USN Ret | Skylab 2 | Plt | 672:49:49 | 03:30 | 672:49:49 |
| Lee, Mark C. Maj | USAF | STS-30 | MS | 96:56:25 | | 96:56:25 |
| Leetsma, David C., Cdr | USN | STS-41G | MS | 197:23:33 | 03:29 | 318:23:42 |
| | | STS-28 | MS | 121:00:09 | | 121:00:09 |
| Lenoir, William B., PhD | Civ | STS-5 | MS | 122:14:26 | | 122:14:26 |
| Lichtenberg, Bryon K., PhD | Civ | STS-9 | PS | 247:47:24 | | 247:47:24 |
| Lind, Don Leslie, PhD | Civ | STS-51B | MS | 168:08:46 | | 168:08:46 |
| Lounge, John M. | Civ | STS-51I | MS | 170:17:42 | | 482:23:53 |
| | | STS-26 | MS | 97:00:11 | | |
| | | STS-35 | MS | 215:06:00 | | |

*Lunar Surface EVA

| NAME | SERVICE | MISSION | POSITION | FLIGHT TIME (HR:MIN:SEC) | EVA (HR:MIN) | TOTAL FLIGHT TIME (HR:MIN:SEC) |
|---|---|---|---|---|---|---|
| Lousma, Jack R., Col | USMC | Skylab 3 | Plt | 1427:09:04 | 10:59 | 1619:13:49 |
| | | STS-3 | Cdr | 192:04:45 | | |
| Lovell, James A., Jr., Capt | USN Ret | Gemini 7 | Plt | 330:35:31 | | 715:05:25 |
| | | Gemini 12 | Cdr | 94:34:31 | | |
| | | Apollo 8 | CMP | 147:00:42 | | |
| | | Apollo 13 | Cdr | 142:54:41 | | |
| Low, G. David | Civ | STS-32 | MS | 261:00:37 | | 261:00:37 |
| Lucid, Shannon W., PhD | Civ | STS-51G | MS | 169:38:52 | | 289:18:16 |
| | | STS-34 | MS | 119:39:24 | | |
| Mattingly, Thomas K., Capt | USN | Apollo 16 | CMP | 265:51:05 | 01:24 | 508:34:08 |
| | | STS-4 | Cdr | 169:09:40 | | |
| | | STS-51C | Cdr | 73:33:23 | | |
| McAuliffe, S. Christa | Civ | STS-51L | PS | N/A | | N/A |
| McBride, Jon A., Cdr | USN | STS-41G | Plt | 197:23:33 | | 197:23:33 |
| McCandless, Bruce, Capt. | USN | STS-41B | MS | 121:16:05 | 11:37 | 121:16:05 |
| McCulley, Michael, Cdr | USN | STS-34 | Plt | 119:39:24 | | 119:39:24 |
| McDivitt, James A., B. Gen | USAF Ret | Gemini 4 | Cdr | 97:56:11 | | 338:57:05 |
| | | Apollo 9 | Cdr | 241:00:54 | | |
| McNair, Ronald E., PhD | Civ | STS-41B | MS | 191:15:55 | | 191:15:55 |
| | | STS-51L | MS | N/A | | |
| Meade, Carl J. | | STS-38 | MS | 117:55:00 | | 117:55:00 |
| Melnick, Bruce E., Cdr | USCG | STS-41 | MS | 98:11:00 | | 98:11:00 |
| Merbold, Ulf, PhD | Civ | STS-9 | PS | 247:47:24 | | 247:47:24 |
| Messerschmid, Ernest, PhD | Civ | STS-61A | PS | 168:44:51 | | 168:44:51 |
| Mitchell, Edger D., Capt | USN Ret | Apollo 14 | LMP | 216:01:57 | 09:23 * | 216:01:57 |
| Mullane, Richard M., Col | USAF | STS-41D | MS | 144:56:04 | | 356:20:04 |
| | | STS-27 | MS | 105:05:37 | | |
| | | STS-36 | MS | 106:18:23 | | |

*Lunar Surface EVA

# NASA Astronauts

| NAME | SERVICE | MISSION | POSITION | FLIGHT TIME (HR:MIN:SEC) | EVA (HR:MIN) | TOTAL FLIGHT TIME (HR:MIN:SEC) |
|---|---|---|---|---|---|---|
| Musgrave, F. Story, MD, PhD | Civ | STS-6 | MS | 120:23:42 | 03:54 | 431:15:57 |
| | | STS-51F | MS | 190:45:26 | | |
| | | STS-33 | MS | 120:06:49 | | |
| Nagel, Steven R., Col. | USAF | STS-51G | MS | 169:38:52 | | 338:23:43 |
| | | STS-61A | Plt | 168:44:51 | | |
| Nelson, Bill | Civ | STS-61C | PS | 146:03:51 | | 146:03:51 |
| Nelson, George D., PhD | Civ | STS-41C | MS | 167:40:07 | 10:06 | 410:44:09 |
| | | STS-61C | MS | 146:03:51 | | |
| | | STS-26 | MS | 97:00:11 | | |
| Neri Vela, Rodolpho, PhD | Civ | STS-61B | PS | 165:04:49 | | 165:04:49 |
| O'Connor, Bryan O., Col | USMC | STS-61B | Plt | 165:04:49 | | 165:04:49 |
| Ockels, Wubbo J., PhD | Civ | STS-61A | PS | 168:44:51 | | 168:44:51 |
| Onizuka, Ellison S., Lt. Col | USAF | STS-51C | MS | 73:33:23 | | 73:33:23 |
| | | STS-51L | MS | N/A | | |
| Overmyer, Robert F., Col | USMC | STS-5 | Plt | 122:14:26 | | 290:23:12 |
| | | STS-51B | Cdr | 168:08:46 | | |
| Pailes, William A., Maj | USAF | STS-51J | PS | 97:44:38 | | 97:44:38 |
| Parise, Ronald A. | | STS-35 | PS | 215:06:00 | | 215:06:00 |
| Parker, Robert A., PhD | Civ | STS-9 | MS | 247:47:24 | | 462:53:24 |
| | | STS-35 | MS | 215:06:00 | | |
| Payton, Gary E., Maj | USAF | STS-51C | PS | 73:33:23 | | 73:33:23 |
| Peterson, Donald H. | USAF Ret | STS-6 | MS | 120:23:42 | 03:54 | 120:23:42 |
| Pogue, William R., Col. | USAF Ret | Skylab 4 | Plt | 2017:15:32 | 13:34 | 2017:15:32 |
| Resnik, Judith A., PhD | Civ | STS-41D | MS | 144:56:04 | | 144:56:04 |
| | | STS-51L | MS | N/A | | |
| Richards, Richard N., Cdr | USN | STS-28 | Plt | 121:00:09 | | 219:11:09 |
| | | STS-41 | Cdr | 98:11:00 | | |
| Ride, Sally K., PhD | Civ | STS-7 | MS | 146:23:59 | | 343:47:32 |
| | | STS-41G | MS | 197:23:33 | | |

*Lunar Surface EVA

| NAME | SERVICE | MISSION | POSITION | FLIGHT TIME (HR:MIN:SEC) | EVA (HR:MIN) | TOTAL FLIGHT TIME (HR:MIN:SEC) |
|---|---|---|---|---|---|---|
| Roosa, Stuart A., Col | USAF Ret | Apollo 14 | CMP | 216:10:57 | | 216:10:57 |
| Ross, Jerry L., Lt. Col | USAF | STS-61B | MS | 165:04:49 | 12:20 | 270:10:26 |
| | | STS-27 | MS | 105:05:37 | | |
| Schirra, Walter M., Jr., Capt | USN Ret | Sigma 7 | Plt | 9:13:11 | | 295:13:38 |
| | | Gemini 6A | Cdr | 25:51:24 | | |
| | | Apollo 7 | Cdr | 260:09:03 | | |
| Schmitt, Harrison H., PhD | Civ | Apollo 17 | LMP | 301:51:59 | 22:04 * | 301:51:59 |
| Schweickart, Russell | Civ | Apollo 9 | LMP | 241:00:54 | 01:07 | 241:00:54 |
| Scobee, Francis R. (Dick) | USAF Ret | STS-41C | Plt | 167:40:07 | | 167:40:07 |
| | | STS-51L | Cdr | N/A | | |
| Scott, David R., Col | USAF Ret | Gemini 8 | Plt | 10:41:26 | | 546:54:13 |
| | | Apollo 9 | CMP | 241:00:54 | 01:01 | |
| | | Apollo 15 | Cdr | 295:11:53 | 19:08 * | |
| Scully-Power, Paul D. | Civ | STS-41G | PS | 197:23:33 | | 197:23:33 |
| Seddon, M. Rhea, MD | Civ | STS-51D | MS | 167:55:23 | | 167:55:23 |
| Shaw, Brewster H., Col | USAF | STS-9 | Plt | 247:47:24 | | 533:52:22 |
| | | STS-61B | Cdr | 165:04:49 | | |
| | | STS-28 | Cdr | 121:00:09 | | |
| Shepard, Alan B., Jr.. R. Adm | USN Ret | **Freedom 7 | Plt | 15:22 | | 216:17:19 |
| | | Apollo 14 | Cdr | 216:01:57 | 09:23 * | |
| Shepherd, William M., Capt | USN | STS-27 | MS | 105:05:37 | | 203:16:37 |
| | | STS-41 | MS | 98:11:00 | | |
| Shriver, Loren J., Col | USAF | STS-51C | Plt | 73:33:23 | | 194:49:28 |
| | | STS-31 | Cdr | 121:16:05 | | |
| Slayton, Donald K., Maj | USAF Ret | Apollo Soyuz | CMP | 217:28:23 | | 217:28:23 |
| Smith, Michael J., Cdr | USN | STS-51L | Plt | N/A | | N/A |
| Spring, Sherwood C., Lt. Col | USA | STS-61B | MS | 165:04:49 | 12:20 | 165:04:49 |
| Springer, Robert C., Col | USMC | STS-29 | MS | 119:38:52 | | 237:33:52 |
| | | STS-38 | MS | 117:55:00 | | |

* *Suborbital Flight

*Lunar Surface EVA

# NASA Astronauts

| NAME | SERVICE | MISSION | POSITION | FLIGHT TIME (HR:MIN:SEC) | EVA (HR:MIN) | TOTAL FLIGHT TIME (HR:MIN:SEC) |
|---|---|---|---|---|---|---|
| Stafford, Thomas P., Lt. Gen | USAF Ret | Gemini 6A | Plt | 25:51:24 | | 507:44:10 |
| | | Gemini 9A | Cdr | 72:21:00 | | |
| | | Apollo 10 | Cdr | 192:03:23 | | |
| | | Apollo Soyuz | Cdr | 217:28:23 | | |
| Stewart, Robert L., Col | USA | STS-41B | MS | 191:15:55 | 11:37 | 289:00:33 |
| | | STS-51J | MS | 97:44:38 | | |
| Sullivan, Kathryn D., PhD | Civ | STS-41G | MS | 197:23:33 | 03:29 | 318:39:38 |
| | | STS-31 | MS | 121:16:05 | | |
| Swigert, John L., Jr. | Civ | Apollo 13 | CMP | 142:54:41 | | 142:54:41 |
| Thagard, Norman E., MD | Civ | STS-7 | MS | 148:23:59 | | 411:30:16 |
| | | STS-51B | MS | 168:08:46 | | |
| | | STS-30 | MS | 96:56:25 | | |
| Thornton, Kathryn | Civ | STS-33 | MS | 120:06:49 | | 120:06:49 |
| Thornton, William E., MD | Civ | STS-8 | MS | 145:08:43 | | 313:17:29 |
| | | STS-51B | MS | 168:08:46 | | |
| Thuot, Pierre J., Lt. Cdr | USG | STS-36 | MS | 106:18:23 | | 106:18:23 |
| Truly, Richard H., Capt | USN | STS-2 | Plt | 54:13:13 | | 199:21:56 |
| | | STS-8 | Cdr | 145:08:43 | | |
| van den Berg, Lodewijk, PhD | Civ | STS-51B | PS | 168:08:46 | | 168:08:46 |
| van Hoften, James D., PhD | Civ | STS-41C | MS | 167:40:07 | 10:06 | 377:57:49 |
| | | STS-51I | MS | 170:17:42 | 11:51 | |
| Walker, Charles D. | Civ | STS-41D | PS | 144:56:04 | | 477:56:16 |
| | | STS-51D | PS | 167:55:23 | | |
| | | STS-61B | PS | 165:04:49 | | |
| Walker, David M., Capt | USN | STS-51A | Plt | 191:44:56 | | 288:42:27 |
| | | STS-30 | Cdr | 96:56:25 | | |
| Wang, Taylor G., PhD | Civ | STS-51B | PS | 168:08:46 | | 168:08:46 |
| Weitz, Paul J., Capt | USN Ret | Skylab 2 | Plt | 672:49:49 | 01:44 | 793:13:31 |
| | | STS-6 | Cdr | 120:23:42 | | |
| Wetherbee, James, Cdr | USN | STS-32 | Plt | 261:00:37 | | 261:00:37 |
| White, Edward H., Lt. Col | USAF | Gemini 4 | Plt | 97:56:11 | 00:23 | 97:56:1 |
| Williams, Donald E., Capt | USN | STS-51D | Plt | 167:55:23 | | 287:34:4 |
| | | STS-34 | Cdr | 119:39:24 | | |
| Worden, Alfred M., Col | USAF Ret | Apollo 15 | CMP | 295:11:53 | 00:39 | 295:11:5 |
| Young, John W., Capt | USN Ret | Gemini 3 | Plt | 4:53:00 | | 835:41:3 |
| | | Gemini 10 | Cdr | 70:46:39 | | |
| | | Apollo 10 | CMP | 192:03:23 | | |
| | | Apollo 16 | Cdr | 265:51:05 | 20:14 * | |
| | | STS-1 | Cdr | 54:20:32 | | |
| | | STS-9 | Cdr | 247:47:24 | | |

*Lunar Surface EVA

# Shuttle Approach And Landing Tests

| LIGHT | FLIGHT DATE | WEIGHT (kg. | DESCRIPTION OF FLIGHT |
|---|---|---|---|
| aptive Inert light 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. |
| aptive Inert light 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. |
| aptive Inert light 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. |
| aptive Inert light 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. |
| aptive Inert light 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. |
| aptive Active light 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. |
| aptive Active light 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. |
| aptive Active light 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. |
| ree 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. |
| ee 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. |
| ee 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. |
| ee 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. |
| ee 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) | CREW HOURS (HR:MIN:SEC) |
|---|---|---|---|
| MERCURY REDSTONE (Suborbital) | | | |
| *Freedom 7 | Shepard | 15:22 | 15:22:00 |
| *Liberty Bell 7 | Grissom | 15:37 | 15:37:00 |
| Total Flights - 2 | | 30:59 | 30:59 |
| MERCURY ATLAS (Orbital) | | | |
| Friendship 7 | Glenn | 4:55:23 | 4:55:23 |
| Aurora 7 | Carpenter | 4:56:05 | 4:56:05 |
| Sigma 7 | Schirra | 9:13:11 | 295:13:38 |
| Faith 7 | Cooper | 34:19:49 | 226:18:03 |
| Total Flights - 4 | | 53:24:28 | 53:24:28 |
| TOTAL MERCURY FLIGHTS - 6 | | 53:55:27 | 53:55:27 |
| GEMINI TITAN | | | |
| Gemini 3 | Grissom, Young | 4:53:00 | 9:46:00 |
| Gemini 4 | McDivitt, White | 97:56:11 | 195:52:22 |
| Gemini 5 | Cooper, Conrad | 190:55:14 | 381:50:28 |
| Gemini 6A | Schirra, Stafford | 25:51:24 | 51:42:48 |
| Gemini 7 | Borman, Lovell | 330:35:31 | 661:11:02 |
| 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 GEMINI FLIGHTS - 10 | | 969:52:04 | 1939:44:08 |
| 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 | 7506:01:51 |
| TOTAL APOLLO - 11 | | 2502:00:37 | 7506:01:51 |
| SKYLAB SATURN IB | | | |
| Skylab 2 | Conrad, Kerwin, Weitz | 672:49:49 | 2018:29:27 |
| Skylab 3 | Bean, Garriott, Lousma | 1427:09:04 | 4281:27:12 |
| Skylab 4 | Carr, E. Gibson, Pogue | 2017:15:32 | 6051:46:36 |
| TOTAL SKYLAB FLIGHTS - 3 | | 4117:14:25 | 12351:43:15 |
| APOLLO SATURN IB | | | |
| ASTP | Stafford, Brand, Slayton | 217:28:23 | 652:25:09 |

# Summary of United States Manned Space Flight

| MISSION | CREW MEMBERS | MISSION DURATION (HR:MIN:SEC) | CREW HOURS (HR:MIN:SEC) |
|---|---|---|---|
| STS-1 - Columbia | Young, Crippen | 54:20:32 | 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 | 169:09:40 | 338:19:20 |
| STS-5 - Columbia | Brand, Overmyer, Allen, Lenoir | 122:14:26 | 488:57:44 |
| STS-6 - Challenger | Weitz, Bobko, Peterson, Musgrave | 120:23:42 | 481:34:48 |
| STS-7 - Challenger | Crippen, Hauch, Ride, Fabian, Thagard | 146:23:59 | 731:59:55 |
| STS-8 - Challenger | Truly, Brandenstein, D. Gardner, Bluford, W. Thornton | 145:08:43 | 725:43:35 |
| STS-9 - Columbia | Young, Shaw, Garriott, Parker, Lichtenberg, Merbold | 247:47:24 | 1486:44:24 |
| STS-41B - Challenger | Brand, Gibson, McCandless, McNair, Stewart | 191:15:55 | 956:19:35 |
| STS-41C - Challenger | Crippen, Scobee, van Hoften, G. Nelson, Hart | 167:40:07 | 838:20:35 |
| STS-41D - Discovery | Hartsfield, Coats, Resnik, Hawley, Mullane, C. Walker | 144:56:04 | 869:36:24 |
| STS-41G - Challenger | Crippen, McBride, Ride, Sullivan, Leetsma, Garneau, Scully-Power | 197:23:33 | 1381:44:51 |
| STS-51A - Discovery | Hauck, D. Walker, Gardner, A. Fisher, Allen | 191:44:56 | 958:44:40 |
| STS-51C - Discovery | Mattingly, Shriver, Onizuka, Buchli, Payton | 73:33:23 | 367:46:55 |
| STS-51D - Discovery | Bobko, Williams, Seddon, Hoffman, Griggs, C. Walker, Garn | 167:55:23 | 1175:27:41 |
| STS-51B - Challenger | Overmyer, Gregory, Lind, Thagard, W. Thornton, van den Berg, Wang | 168:08:46 | 1177:01:22 |
| STS-51G - Discovery | Brandenstein, Creighton, Lucid, Fabian, Nagel, Baudry, Al-Saud | 169:38:52 | 1187:32:04 |
| STS-51F - Challenger | Fullerton, Bridges, Musgrave, England, Henize, Acton, Bartoe | 190:45:26 | 1335:18:02 |
| STS-51I - Discovery | Engle, Covey, van Hoften, Lounge, W. Fisher | 170:17:42 | 851:28:30 |
| STS-51J - Atlantis | Bobko, Grabe, Hilmers, Stewart, Pailes | 97:44:38 | 488:53:10 |
| STS-61A - Challenger | Hartsfield, Nagel, Buchli, Bluford, Dunbar, Furrer, Messerschmid, Ockels | 168:44:51 | 1349:58:48 |
| STS-61B - Atlantis | Shaw, O'Connor, Cleave, Spring, Ross, Neri Vela, C. Walker | 165:04:49 | 1155:33:43 |
| STS-61C - Columbia | R. Gibson, Bolden, Chang-Diaz, Hawley, G. Nelson, Cenker, B. Nelson | 146:03:51 | 1022:26:57 |
| STS-51L - Challenger | Scobee, Smith, Resnik, Onizuka, McNair, Jarvis, McAuliffe | N/A | N/A |
| STS-26 - Discovery | Hauck, Covey, Lounge, Hilmers, G. Nelson | 97:00:11 | 485:00:55 |
| STS-27 - Atlantis | R. Gibson, Gardner, Mullane, Ross, Shepherd | 105:05:37 | 525:28:05 |
| STS-29 - Discovery | Coats, Blaha, Bagian, Buchi, Springer | 119:38:52 | 598:14:20 |
| STS-30 - Atlantis | Walker, Grabe, Thagard, Cleave, Lee | 96:56:25 | 484:47:35 |
| STS-28 - Columbia | Shaw, Richards, Leetsma, Adamson, Brown | 121:00:09 | 605:00:45 |
| STS-34 - Atlantis | Williams, McCully, Baker, Chang-Diaz, Lucid | 119:39:24 | 598:17:00 |
| STS-33 - Discovery | Gregory, Blaha, Musgrave, K. Thornton, Carter | 120:06:49 | 600:34:05 |
| STS-32 - Columbia | Brandenstein, Wetherbee, Dunbar, Ivins, Low | 261:00:37 | 1305:03:05 |
| STS-36 - Atlantis | Creighton, Casper, Hilmers, Mullane, Thuot | 106:18:23 | 531:31:55 |
| STS-31 - Discovery | Shriver, Bolden, McCandless, Hawley, Sullivan | 121:16:05 | 606:20:25 |
| STS-41- Discovery | Richards, Cabana, Melnick, Shepard, Akers | 98:11:00 | 490:45:00 |
| STS-38 - Atlantis | Covey, Springer, Meade, Culbertson, Gemar | 117:55:00 | 589:35:00 |
| STS-35 - Columbia | Brand, Lounge, Hoffman, Parker, G. Gardner, Parise, Durrance | 215:06:00 | 1290:36:00 |
| TOTAL SHUTTLE FLIGHTS - 38 | | 5363:57:12 | 28681:54:13 |

# Summary Of Shuttle Payloads And Experiments

| FLIGHT | LAUNCH DATE | LANDING DATE | CREW | PAYLOADS AND EXPERIMENTS |
|---|---|---|---|---|
| STS-1<br>(Columbia)<br>Mission Duration: 54 hrs 20 min 32 sec | Apr 12, 1981<br>(KSC) | Apr 14, 1981<br>(DFRF) | Cdr: John W. Young<br>Plt: Robert L. Crippen | Development Flight Instrumentation (DFI)<br>Passive Optical Sample Assembly (POSA)<br>Aerodynamic Coefficient Identification Package (ACIP) |
| STS-2<br>(Columbia)<br>Mission Duration: 54 hrs 13 min 13 sec | Nov 12, 1981<br>(KSC) | Nov 14, 1981<br>(DFRF) | Cdr: Joe Henry Engle<br>Plt: Richard H. Truly | OSTA-1<br>Development Flight Instrumentation (DFI)<br>Induced Environment Containment Monitor (IECM)<br>Aerodynamic Coefficient Identification Package (ACIP)<br>OEX Tile Gap Heating Effects<br>OEX Catalytic Surface Effects<br>OEX Dynamic, Acoustic, and Thermal Environment (DATE) Experiment |
| STS-3<br>(Columbia)<br>Mission Duration: 192 hrs 4 min 45 sec | Mar 22, 1982<br>(KSC) | Mar 30, 1982<br>(White Sands) | Cdr: Jack R. Lousma<br>Plt: Charles G. Fullerton | OSS-1<br>Monodisperse Latex Reactor (MIR) Experiment<br>Electrophoresis Equip. Verification Test (EEVT)<br>Tile Gap Heating Effects Experiment<br>Catalytic Surface Effects Experiment<br>Dynamic, Acoustic, and Thermal Environment (DATE) Experiment<br>Development Flight Instrumentation (DFI)<br>Induced Environment Containment Monitor (IECM)<br>Aerodynamic Coefficient Identification Package (ACIP)<br>Get-Away Special (GAS) Test Canister<br>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) | Jun 27, 1982 (KSC) | Jul 4, 1982 (DFRF) | Cdr: Thomas K. Mattingly II<br>Plt: Henry W. Hartsfield, Jr. | DOD Payload - 82-1<br>Monodisperse Latex Reactor (MIR) Experiment - NASA<br>Continuous Flow Electrophoresis System (CFES - NASA<br>Tile Gap Heating Effects Experiment - NASA<br>Catalytic Surface Effects Experiment - NASA<br>Dynamic, Acoustic, and Thermal Environment (DATE) Exp - NASA<br>Development Flight Instrumentation (DFI) - NASA<br>Induced Environment Containment Monitor (IECM) - NASA<br>Aerodynamic Coefficient Identification Package (ACIP) - NASA<br>Get-Away Special - Utah State University<br>Student Experiments:<br>Effects of Diet/Exercise/Zero Gravity on Lipoprotein Profiles<br>Effects of Space Travel on Trivalent Chromium in the Body |
| Mission Duration: 169 hrs 09 min 40 sec | | | | |
| STS-5 (Columbia) | Nov 11, 1982 (KSC) | Nov 16, 1982 (DFRF) | Cdr: Vance DeVoe Brand<br>Plt: Robert F. Overmyer<br>MS: Joseph P. Allen | Deployed:<br>SBS-C - Satellite Business Systems<br>Telesat-E -Telesat Canada, Ltd. |
| Mission Duration: 122 hrs 14 min 26 sec | | | MS: William B. Lenoir | Tile Gap Heating Effects Experiment - NASA<br>Catalytic Surface Effects Experiment - NASA<br>Dynamic, Acoustic, and Thermal Environment (DATE) Exp - NASA<br>Atmospheric Luminosities Investigation (Glow Experiment) - NASA<br>Development Flight Instrumentation (DFI) - NASA<br>Aerodynamic Coefficient Identification Package (ACIP) - NASA<br>Get-Away Special - ERNO, West Germany<br>Student Experiments:<br>Formation of Crystals in Weightlessness<br>Growth of Porifera in Zero-Gravity<br>Convection in Zero-Gravity |

# Summary Of Shuttle Payloads And Experiments

| FLIGHT | LAUNCH DATE | LANDING DATE | CREW | PAYLOADS AND EXPERIMENTS |
|---|---|---|---|---|
| STS-6<br>(Challenger)<br><br>Mission Duration: 120 hrs 23 min 42 sec | Apr 4, 1983<br>(KSC) | Apr 9, 1983<br>(DFRF) | Cdr: Paul J. Weitz<br>Plt: Karol J. Bobko<br>MS: Donald H. Peterson<br>MS: Story Musgrave | Deployed:<br>TDRS-A/IUS - Spacecom/USAF<br>Continuous Flow Electrophoresis System (CFES) - NASA<br>Monodisperse Latex Reactor (MLR) - NASA<br>Nighttime/Daytime Optical Survey of Lightning (NOSL) - NASA<br>Aerodynamic Coefficient Identification Package (ACIP) - NASA<br>Get-Away Specials:<br>G-005 - Asahi Shimban, Japan<br>G-049 - USAF Academy<br>G-381 - Park Seed Company, South Carolina |
| STS-7<br>(Challenger)<br><br>Mission Duration: 146 hrs 23 min 59 sec | Jun 18, 1983<br>(KSC) | Jun 24, 1983<br>(DFRF) | Cdr: Robert L. Crippen<br>Plt: Frederick H. Hauck<br>MS: John M. Fabian<br>MS: Sally K. Ride<br>MS: Norman E. Thagard | Deployed:<br>Telesat-F (ANIK C-2)/PAM-D - Telesat, Canada<br>Palapa-B1/PAM-D - Perumtel, Indonesia<br>Shuttle Pallet Satellite (SPAS-01) - MBB, Germany<br>OSTA-2 - NASA<br>Continuous Flow Electrophoresis System (CFES) - NASA<br>Monodisperse Latex Reactor (MLR) - NASA<br>Get-Away Specials:<br>G-002 - Kayser Threde, West Germany<br>G-009 - Purdue University<br>G-012 - RCA/Camden New Jersey Schools<br>G-033 - California Institute of Technology<br>G-088 - Edsyn, Inc.<br>G-305 - USAF/NRL<br>G-345 - GSFC/NRL |

# Summary Of Shuttle Payloads And Experiments

| FLIGHT | LAUNCH DATE | LANDING DATE | CREW | PAYLOADS AND EXPERIMENTS |
|---|---|---|---|---|
| STS-8<br>(Challenger)<br><br>Mission Duration: 145 hrs 8 min 43 sec | Aug 30, 1983<br>(KSC) | Sep 5, 1983<br>(DFRF) | Cdr: Richard H. Truly<br>Plt: Daniel C. Brandenstein<br>MS: Dale A. Gardner<br>MS: Guion S. Bluford, Jr.<br>MS: William E. Thornton, MD | Deployed:<br>INSAT-1B/PAM-D - India<br>Payload Flight Test Article (PFTA) - NASA<br>Radiation Monitoring Equipment (RME) - NASA<br>Heat Pipe - NASA<br>Oxy. Interaction on Materials (OIM)- NASA<br>Investigation of STS Atmospheric Luminosities (ISAL) - NASA<br>Animal Enclosure - NASA<br>Continuous Flow Electrophoresis System (CFES) - NASA/MDAC<br>Modular Auxiliary Data System (MADS) - NASA<br>Aerodynamic Coefficient Identification Package (ACIP) - NASA<br>Get-Away Specials:<br>G-0346 - Cosmic Ray Upset Experiment (CRUX) -GSFC/Neupert<br>G-0347 - Photographic Film Evaluation Exp - GSFC/Adolphsen<br>G-0348 - Contamination Monitor - GSFC/McIntosh<br>G-0475 - Asahi/Shimban, Japan<br>Student Experiment - Biofeedback SE81-1<br>Other - Postal Covers |
| STS-9<br>(Columbia)<br><br>Mission Duration: 247 hrs 47 min 24 sec | Nov 28, 1983<br>(KSC) | Dec 8, 1983<br>(DFRF) | Cdr: John W. Young<br>Plt: Brewster W. Shaw<br>MS: Owen K. Garriott<br>MS: Robert A. R. Parker<br>PS: Byron K. Lichtenberg<br>PS: Ulf Merbold (ESA) | Spacelab-1 (Long Module) + Pallet - ESA/NASA<br>Spacelab Attach Hardware, TK. set, Misc - ESA/NASA<br>STS Operator - NASA |

# Summary Of Shuttle Payloads And Experiments

| FLIGHT | LAUNCH DATE | LANDING DATE | CREW | PAYLOADS AND EXPERIMENTS |
|---|---|---|---|---|
| STS 41-B<br>(Challenger)<br><br>Mission Duration: 191 hrs 15 min 55 sec | Feb 3, 1984<br>(KSC) | Feb 11, 1984<br>(KSC) | Cdr: Vance D. Brand<br>Plt: Robert L. Gibson<br>MS: Bruce McCandless<br>MS: Robert L. Stewart<br>MS: Ronald E. McNair | Deployed:<br>Westar VI/PAM-D - Western Union<br>Palapa-B2/PAM-D - Indonesia<br>Integrated Rendezvous Target (IRT) - NASA<br>Acoustic Containerless Experiment System (ACES) - NASA-OSSA/JSC<br>SPAS-01A - MBB, Germany<br>Isoelectric Focusing Experiment (IEF) - NASA-OSSA/MSFC<br>Radiation Monitoring Equipment (RME) - NASA<br>Monodisperse Latex Reactor (MLR) - NASA/OSSA<br>Cinema 360 - Cinema 360, Inc.<br>Manned Maneuvering Unit (MMU) - NASA<br>Manipulation Foot Restraint (MFR) - NASA<br>Cargo Bay Storage Assembly (CBSA) - NASA<br>Get-Away Specials:<br>G004 - Utah State University/Aberdeen University<br>G008 - AIAA/Utah State Univ/Brighton High School<br>G051 - Arc Discharge Lamp Test - GTE Laboratories, Inc.<br>G309 - CRUX - Air Force Space Test Program<br>G349 - Goddard Space Flight Center<br>Student Experiment - SE81-40 - Arthritis, Dan Weber - Pfizer/GD |
| STS 41-C<br>(Challenger)<br><br>Mission Duration: 167 hrs 40 min 07 sec | Apr 6, 1984<br>(KSC) | Apr 13, 1984<br>(DRFB) | Cdr: Robert L. Crippen<br>Plt: Francis R. Scobee<br>MS: Terry J. Hart<br>MS: James D. Van Hoften<br>MS: George D. Nelson | Deployed:<br>Long Duration Exposure Facility (LDEF-1) - NASA/Langley<br>Solar Max Mission Flight Support System - NASA/GSFC<br>Manned Maneuvering Unit Flight Support System - NASA<br>Manned Foot Restraint - NASA<br>Cinema 360 - Cinema 360, Inc.<br>IMAX - IMAX/NASA<br>Radiation Monitoring Experiment (RME) - NASA<br>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<br>Plt: Michael L. Coats<br>MS: Richard M. Mullane<br>MS: Steven A. Hawley<br>MS: Judith A. Resnik<br>PS: Charles D. Walker | Deployed:<br>SBS-D/PAM-D - Satellite Business Systems<br>Syncom IV-2/Unique Upper Stage - Hughes Comm. Service, Inc.<br>Telstar 3-C/PAM-D - AT&T Co.<br>OAST-1/MPESS - NASA<br>CFES III (Cont. Flow Electp. Sys.) - MDAC<br>IMAX - IMAX<br>RME (Radiation Monitor Exp.) - NASA<br>Clouds Photo Experiment - USAF<br>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<br>Plt: Jon A. McBride<br>MS: Kathryn D. Sullivan<br>MS: Sally K. Ride<br>MS: David D. Leetsma<br>PS: Marc D. Garneau<br>PS: Paul D. Scully-Power | Deployed:<br>Earth Radiation Budget Satellite (ERBS) - NASA<br>OSTA-3/Pallet - NASA<br>LFC/ORS/MPESS - NASA<br>IMAX - IMAX<br>RME (Radiation Monitor Exp.) - NASA<br>APE (Auroral Photog. Exp.) - USAF<br>TLD (Thermo. Lum. Dosimeter) - Hungary<br>CANEX (Canadian Experiment) - Canada<br>Get-Away Specials:<br>G007 - Stud. Exp., Radio Trans. Exp. - Ala. Space & Rocket Cntr<br>G013 - Halogen Lamp Ex. (HALEX) - Kayser-Threde/ESA<br>G032 - Physics of Solids/Liquids - Asahi Corp., Japan<br>G038 - Vapor Deposition - McShane/MSFC<br>G074 - Fuel System Test - MDAC<br>G306 - Trapped Ions in Space - Naval Res Lab/USNA<br>G469 - Cosmic Ray Upset Exp. - NASA/GSFC/IBM<br>G518 - Physics and Mat'l Process. - Utah State U. |
| Mission Duration: 197 hrs 23 min 33 sec | | | | |

# Summary Of Shuttle Payloads And Experiments

| FLIGHT | LAUNCH DATE | LANDING DATE | CREW | PAYLOADS AND EXPERIMENTS |
|---|---|---|---|---|
| STS 51-A<br>(Discovery)<br><br>Mission Duration: 191 hrs 44 min 56 sec | Nov 8, 1984<br>(KSC) | Nov 16, 1984<br>(KSC) | Cdr: Frederick H. Hauck<br>Plt: David M. Walker<br>MS: Joseph P. Allen<br>MS: Anna L. Fisher<br>MS: Dale A. Gardner | Deployed:<br>Telesat-H/PAM-D - Telesat, Canada<br>Syncom IV-1/Unique Upper Stage - Hughes Comm. Services, Inc.<br>Satellite Retrieval Pallets (2) - NASA/MDAC<br>MMU/FSS (2) - NASA<br>Diffuse Mixing of Organic Solids (DMOS) - 3M Co.<br>Radiation Monitoring Equipment (RME) - NASA<br>Man. Foot Restraint (MFR) -NASA |
| STS 51-C<br>(Discovery)<br><br>Mission Duration: 73 hrs 33 min 23 sec | Jan 24, 1985<br>(KSC) | Jan 27, 1985<br>(KSC) | Cdr: Thomas K. Mattingly<br>Plt: Loren J. Shriver<br>MS: Ellison S. Onizuka<br>MS: James F. Buchli<br>PS: Gary E. Payton | Deployed:<br>DOD/Inertial Upper Stage - DOD<br>Aggregation of Red Cells (ARC) Mid-deck Exp. - Univ. of Sydney |
| STS 51-D<br>(Discovery)<br><br>Mission Duration: 167 hrs 55 min 23 sec | Apr 12, 1985<br>(KSC) | Apr 19, 1985<br>(KSC) | Cdr: Karol J. Bobko (USAF)<br>Plt: Donald E. Williams (USN)<br>PS: Charles D. Walker (MDAC)<br>PS: E. J. Garn (Senator)<br>MS: M. Rhea Seddon (MD)<br>MS: S. David Griggs (NAR)<br>MS: Jeffrey A. Hoffman (PhD) | Deployed:<br>Telesat-I/PAM-D - Telesat Canada, Ltd<br>Syncom IV-3/UUS - Hughes Comm. Services, Inc.<br>American Flight Echocardiograph - NASA<br>Continuous Flow Electrophoresis Sys. (CFES III) - MDAC/NASA<br>Image Intensifier Investigation - NASA<br>Informal Science Study (Toys in Space) - Houston Museum/Nat. Sci.<br>Phase Partitioning Experiment (PPE) - NASA<br>Get Away Specials (GAS):<br>G035 - Physics of Solids & Liquids - Asahi, Japan<br>G471 - Cap. Pump Loop Experiment - GSFC<br>Student Experiments:<br>SE 82-03 - Statoliths in Corn Rt Caps - Ambery/Martin Marietta<br>SE 83-03 - Effect of Weightlessness on Aging of Brain Cells - Pras/USC/LA Orthopaedic Hospital<br>Other - Statute of Liberty Replicas (2) |

# ummary 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)<br>Plt: F. D. Gregory (USAF)<br>MS: Don L. Lind (PhD)<br>MS: Norman E. Thagard (MD)<br>MS: Wm. E. Thornton (MD)<br>PS: Lodewijk Vandenberg (PhD)<br>PS: Taylor Wang (PhD) | Deployed:<br>NUSAT - Northern Utah University<br>Spacelab 3 (LM + MPESS) - NASA/ESA<br>GLOMR - DOD |
| Mission Duration: 168 hrs 08 min 46 sec | | | | |
| STS 51-G (Discovery) | Jun 17, 1985 (KSC) | Jun 24,1985 (EDW) | Cdr: Daniel Brandenstein (USN)<br>Plt: John O. Creighton (USN)<br>MS: John M. Fabian (USAF)<br>MS: Steven R. Nagel (USAF)<br>MS: Shannon W. Lucid (PhD)<br>PS: Patrick Baudry (France)<br>PS: Prince Sultan Salman Al-Saud (Saudi Arabia) | Deployed:<br>Morelos-A/PAM-D - Mexico<br>Arabsat-A/PAM-D - ASCO<br>Telstar 3-D/PAM-D - AT&T<br>Spartan-1/MPESS - NASA/GSFC/NRL<br>Fr. Echocardiograph Exp (FEE) - CNES, France<br>Fr. Postural Exp. (FPE) - CNES, France<br>Auto. Dir. Solid. Furn (ADSF) - NASA/MSFC<br>High-Prec. Track. Exp. (HPTE) - USAF<br>Getaway Specials (GAS):<br>G025 - Dyn. Behavior of Liq. Props.- W.Germany<br>G027 - Slipcasting under Micro-G - W.Germany<br>G028 - Func'l Study of MnBi - W.Germany<br>G034 - Bio/Phys. Sci. Stud. Exp. - El Paso/Ysleta, TX<br>G314 - Space Ultra. Rad. Env. (SURE) - USAF/NRL<br>G471 - Cap. Pump Loop Exp. - GSFC |
| Mission Duration: 169 hrs 38 min 52 sec | | | | |

# Summary Of Shuttle Payloads And Experiments

| FLIGHT | LAUNCH DATE | LANDING DATE | CREW | PAYLOADS AND EXPERIMENTS |
|---|---|---|---|---|
| STS 51-F<br>(Challenger)<br><br>Mission Duration: 190 hrs 45 min 26 sec | Jul 29, 1985<br>(KSC) | Aug 6, 1985<br>(EDW) | Cdr: Chas. Fullerton (USAF)<br>Plt: Roy D. Bridges (USAF)<br>MS: F. Story Musgrave (M.D.)<br>MS: Anthony W. England (PhD)<br>MS: Karl G. Henize (PhD)<br>PS: Loren W. Acton (Lockheed)<br>PS: John-David Bartoe (USN) | Deployed:<br>Plasma Diagnostics Package - NASA<br>Spacelab-2 - NASA/ESA<br>Shuttle Amateur Radio Experiment - AMSAT<br>Space Life Sciences Training Program - NASA |
| STS 51-I<br>(Discovery)<br><br>Mission Duration: 170 hrs 17 min 42 sec | Aug 27, 1985<br>(KSC) | Sep 3, 1985<br>(EDW) | Cdr: Joe H. Engle (USAF)<br>Plt: Richard O. Covey (USAF)<br>MS: James van Hoften (PhD)<br>MS: John M. Lounge<br>MS: William F. Fisher (MD) | Deployed:<br>AUSSAT-1/PAM-D - Australia<br>ASC-1/PAM-D - American Satellite Co.<br>SYNCOM IV-4/UNQ - Hughes Comm Services, Inc.<br>Physical Vapor Transport of Organic Solids (PVTOS) - 3M Corp<br>SYNCOM IV-3 Repair Equipment - NASA/Hughes |
| STS 51-J<br>(Atlantis)<br><br>Mission Duration: 97 hrs 44 min 38 sec | Oct 3, 1985<br>(KSC) | Oct 7, 1985<br>(EDW) | Cdr: Karol Bobko (USAF)<br>Plt: Ronald J. Grabe (USAF)<br>MS: Robert C. Stewart (USA)<br>MS: David C. Hilmers (USMC)<br>PS: William A. Pailes (USAF) | DOD Mission |
| STS 61-A<br>(Challenger)<br><br>Mission Duration: 168 hrs 44 min 51 sec | Oct 30, 1985<br>(KSC) | Nov 6, 1985<br>(EDW) | Cdr: Henry Hartsfield (USAF)<br>Plt: Steven Nagel (USAF)<br>MS: Bonnie Dunbar (PhD)<br>MS: James Buchli (USMC)<br>MS: Guion Bluford (USAF)<br>PS: Ernst Messerschmid (PhD, German)<br>PS: Reinhard Furrer (PhD, German)<br>PS: Wubbo Ockels (PhD, Dutch) | Deployed:<br>GLOMR GAS - DOD<br>Spacelab D-1 (Long Module + Unique Support Structure) - DFVLR<br>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)<br>Plt: Bryan D. O'Connor (USMC)<br>MS: Mary L. Cleave (PhD)<br>MS: Sherwood C. Spring (USA)<br>MS: Jerry L. Ross (USAF)<br>PS: Rudolfo Neri Vela (PhD)<br>PS: Charles Walker (MDAC) | Deployed:<br>Morelos-B/PAM-D - Mexico<br>Aussat-2/PAM-D - Australia<br>Satcom KU-2/PAM-DII - RCA<br>OEX Target - NASA<br>EASE/ACCESS/MPESS - NASA/MIT<br>IMAX Payload Bay Camera - IMAX/NASA<br>Continuous Flow Electrophoresis Sys (CFES III) - MDAC/3M/NASA<br>Diffusive Mixing of Organic Solutions (DMOS) - 3M Company<br>Morelos Payload Specialist Experiments (MPSE) - Mexican Gov't<br>Getaway Special:<br>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)<br>Plt: C. F. Bolden, Jr. (USMC)<br>MS: F R. Chang-Diaz (PhD)<br>MS: George D. Nelson (PhD)<br>MS: Steven A. Hawley (PhD)<br>PS: Robert J. Cenker (RCA)<br>PS: C. William Nelson (Cong) | Deployed:<br>SATCOM KU-1/PAM-D2 - RCA<br>Materials Science Lab (MSL-2) - NASA<br>Hitchhiker G-1 (HHG-1) - NASA<br>GAS Bridge Assembly (12 GAS cans) - NASA<br>Getaway Special (G-470) - Dept. of Agriculture<br>Infrared Imaging Experiment (IR-IE) - NASA<br>Initial Blood Storage Experiment (IBSE) - NASA<br>Comet Halley Active Monitoring Program (CHAMP) - NASA<br>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)<br>Plt: Michael J. Smith (USN)<br>MS: Judith A. Resnik (PhD)<br>MS: Ellison S. Onizuka (USAF)<br>MS: Ronald E. McNair (PhD)<br>PS: Gregory Jarvis (Hughes)<br>PS: S. Christa McAuliffe (Teacher) | TDRS-B/IUS - NASA/Spacecom<br>Spartan-Halley/MPESS - NASA/U. of Col.<br>Comet Halley Active Monitor Prog (CHAMP) - NASA/Lockheed/U.Col.<br>Fluid Dynamics Experiment (FDE) - Hughes<br>Radiation Monitoring Experiment (RME) - NASA<br>Phase Partitioning Experiment (PPE) - NASA<br>Teacher in Space Project (TISP) - NASA<br>Shuttle Student Involvement Program (SSIP) - NASA |
| Mission Duration: N/A | | | | |

# Summary Of Shuttle Payloads And Experiments

| FLIGHT | LAUNCH DATE | LANDING DATE | CREW | PAYLOADS AND EXPERIMENTS |
|---|---|---|---|---|
| STS-26<br>(Discovery) | Sep 29, 1988<br>(KSC) | Oct 3, 1988<br>(EAFB) | Cdr. Frederick H. Hauck<br>Plt: Richard O. Covey<br>MS: John M. Lounge<br>MS: David C. Hilmers<br>MS: George D. Nelson | Deployed:<br>TDRS-C - TRW CONTEL/NASA<br>Inertial Upper Stage (IUS) - Boeing/USAF/NASA<br>Orbiter Exp Auto Support Ins Sys (OASIS) - Lockheed/USAF/NASA<br>Automated Directional Solidification Furnace (ASDF) - NASA<br>Aggregation of Red Blood Cells (ARC) - NASA<br>Earth Limb Radiance Experiment (ELRAD) - NASA<br>Isoelectric Focusing Experiment (IEF) - NASA<br>Infrared Communication Flight Exp (IRCFE) - Wilton Ind./NASA<br>Mesoscale Lightning Exp (MLE) - NASA<br>Protein Crystal Growth (PCG) - U of Alabama/NASA<br>Phased Partitioning Experiment (PPE) - NASA<br>Physical Vapor Transport of Organic Solids (PVTOS) - 3M/NASA<br>Shuttle Student Involvement Projects:<br>SSIP 82-4 - MDAC/Lloyd Bruce<br>SSIP 82-5 - Union College/R. Caboli |
| Mission Duration: 97 hrs 00 min 11 sec | | | | |
| STS-27<br>(Atlantis) | Dec 2, 1988<br>(KSC) | Dec 6, 1988<br>(EAFB) | Cdr: Robert L. Gibson<br>Plt: Guy S. Gardner<br>MS: Richard M. Mullane<br>MS: Jerry L. Ross<br>MS: William M. Shepherd | Deployed:<br>DOD Payload - DOD |
| Mission Duration: 105 hrs 05 min 37 sec | | | | |

# Summary of Shuttle Payloads And Experiments

| FLIGHT | LAUNCH DATE | LANDING DATE | CREW | PAYLOADS AND EXPERIMENTS |
|---|---|---|---|---|
| STS-29 (Discovey) | Mar 13, 1989 (KSC) | Mar 17, 1989 (EAFB) | Cdr: Michael L. Coats<br>Plt: John E. Blaha<br>MS: James P. Bagian<br>Ms:James F. Buchli<br>MS: Robert C. Springer | Deployed:<br>TDRS-D - TRW/CONTEL/NASA<br>Inertial Upper Stage (IUS) - Boeing/USAF/NASA<br>Orbier Experiments Autonomous Supporting Instrumentation System (OASIS-I) - Lockheed/ISAF/NASA<br>Space Station Heat Pipe Advanced Radiator Element (SHARE) - NASA<br>Air Force Maui Optial System (AMOS) Calibration Test - USAF<br>Chromosome and Plant Cell Division in Space Experiment (CHROMEX) - NASA<br>IMAX Corporation Camera Experiment (IMAX) - IMAX of Canada/NASA<br>Protein Crystal Growth (PCG) - Univ. of Alabama/NASA<br>Shuttle Student Involveent Project:<br>SSIP 82-8 - Ky. Fried Chicken/John C. Vellinger<br>SSIP-9 - Orthopaedic Hosp./USC/Andrew I. Fras |
| Mission Duration 119 hrs 38 min 52 sec | | | | |
| STS-30 (Atlantis) | May 4, 1989 (KSC) | May 8, 1989 (EAFB) | Cdr: David M. Walker<br>Plt: Ronald J. Grabe<br>MS: Norman E. Thagard<br>MS: Mary L. Cleave<br>MS: Mark C. Lee | Deployed:<br>Magellan Spacecraft/Inertial Upper Stae (IUS) - Martin/JPL/NASA<br>Fluid Experiment Apparatus (FEA) - Rockwell/NASA<br>Air Force Maui Optical Site Calibration (AMOS) - USAF |
| Mission Duration 96 hrs 56 min 25 sec | | | | |
| STS-28 (Columbia | Aug 8, 1989 (KSC) | Aug 13, 1989 (EAFB) | Cdr: Brewster H. Shaw<br>Plt: Richard N. Richards<br>MS: David C. Leetsma<br>MS: James C. Adamson<br>MS: Mark N. Brown | Deployed:<br>DOD Payload - DOD |
| Mission Duration 121 hrs 00 min 09 sec | | | | |

# Summary of Shuttle Payloads And Experiments

| FLIGHT | LAUNCH DATE | LANDING DATE | CREW | PAYLOADS AND EXPERIMENTS |
|---|---|---|---|---|
| STS-34 (Atlantis) | Oct 18, 1989 (KSC) | Oct 23, 1989 (EAFB) | Cdr: Donald E. Williams<br>Plt: Michael McCulley<br>MS: Ellen S. Baker<br>MS: Franklin R. Chang-Diaz<br>MS: Shannon W. Lucid | Deployable Payload<br>Galileo/IUS<br>Attached PLB Payload<br>Shuttle Solar Backscatter Ultraviolet (SSBUV)<br>GAS (Get Away Special)<br>Zero Gravity Growth of Ice Crystals<br>Crew Compartment Payload<br>Polymer Morphology<br>Growth Hormone Concentration & Distribution in Plants<br>Senor Technology Experiment<br>IMAX Camera<br>Mesoscale Lightning Experiment |
| Mission Duration: 119 hrs 39 mins 24 secs | | | | |
| STS-33 (Discovery) | Nov 22, 1989 (KSC) | Nov 27, 1989 (EAFB) | Cdr: Frederick D. Gregory<br>Plt: John E. Blaha<br>MS: Manley L. Carter<br>MS: Franklin Musgrave<br>MS: Kathryn C. Thornton | DOD Mission |
| Mission Duration: 120 hrs 6 mins 49 secs | | | | |

# Summary of Shuttle Payloads And Experiments

| FLIGHT | LAUNCH DATE | LANDING DATE | CREW | PAYLOADS AND EXPERIMENTS |
|---|---|---|---|---|
| STS-32 | Jan 09, 1990 | Jan 20, 1990 | Cdr: Daniel C. Brandenstein | Deployable Payload |
| (Columbia) | (KSC) | (EAFB) | Plt: James D. Wetherbee | Syncom IV-5 |
| | | | MS: Bonnie J. Dunbar | Returned Cargo |
| | | | MS: Marsha S. Ivins | LDEF (deployed on STS-41C) |
| | | | MS: G. David Low | Crew Compartment Payload |
| Mission Duration: 261 hrs 0 mins 37 secs | | | | American Flight Echocardiograph (AFE) |
| | | | | Air Force Maui Optical Site Calibration Test (AMOS) |
| | | | | Characterization of Neurospora Circadian Rhythms (CNCR |
| | | | | Fluids Experiment Apparatus |
| | | | | IMAX Camera |
| | | | | Latitude/Longitude Locator (L3) |
| | | | | Mesoscale Lightning Experiment |
| | | | | Protein Crystal Growth (PCG) |
| | | | | Special Payload Mission Kits |
| | | | | Remote Manipulator System (RMS) |
| | | | | Gally |
| | | | | MADS |
| STS-36 | Feb 28, 1990 | Apr 14, 1990 | Cdr: John D. Creighton | DOD Mission |
| (Atlantis) | (KSC) | (DFRF) | Plt: John H. Casper | |
| | | | MS: David C. Hilmers | |
| | | | MS: Richard M. Mullane | |
| | | | MS: Pierre J. Thuot | |
| Mission Duration: 106 hrs 18 mins 23 secs | | | | |

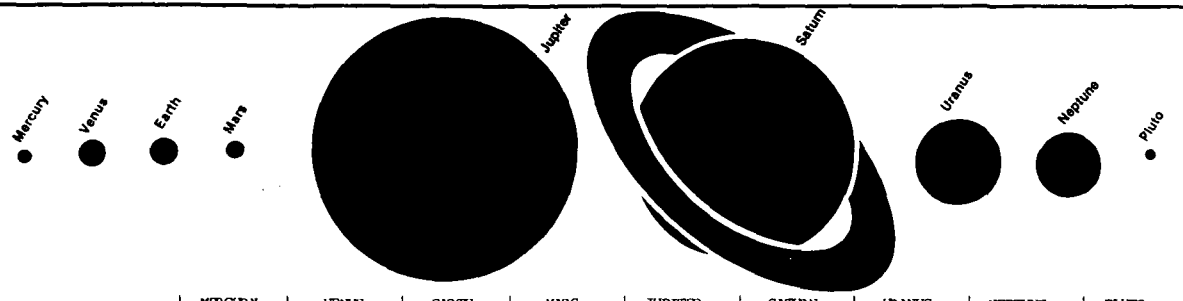
# Summary of Shuttle Payloads And Experiments

| FLIGHT | LAUNCH DATE | LANDING DATE | CREW | PAYLOADS AND EXPERIMENTS |
|---|---|---|---|---|
| STS-31 (Discovery) | Apr 24, 1990 (KSC) | Apr 29, 1990 (EAFB) | Cdr: Loren J. Shriver<br>Plt: Charles F. Bolden<br>MS: Bruce McCandless<br>MS: Steven A. Hawley<br>MS: Kathryn D. Sullivan | Deployable Payload<br>Hubble Space Telescope (HST)<br>Attached PLB Payload<br>IMAX Cargo Bay Camera (ICBC)<br>Ascent Particle Monitor (APM)<br>Crew Compartment Payload<br>Air Force Maui Optical Site Calibration Test (AMOS)<br>IMAX Camera<br>Investigation into Polymer Membrane Processing (IPMP<br>Protein Crystal Growth (PCG)<br>Radiation Monitoring Experiment (RME)<br>Investigation of Arc and Ion Behavior in Microgravit<br>(Student Experiment 82-16)<br>Special Payload Mission Kits<br>Remote Manipulator System (RMS)<br>Gally<br>HST EVA Tools |
| Mission Duration: 121 hrs 16 mins 5 secs | | | | |
| STS-41 (Discovery) | Oct 06, 1990 (KSC) | Oct 10, 1990 (DFRF) | Cdr: Richard N. Richards<br>Plt: Robert D. Cabana<br>MS: Bruce E. Melnick<br>MS: William M. Shepherd<br>MS: Thomas D. Akers | Deployable Payload<br>Ulysses<br>Secondary Payloads<br>Shuttle Solar Backscatter Ultraviolet (SSBUV)<br>Intelsat Solar Array Coupon (ISAC)<br>Air Force Maui Optical Site (AMOS)<br>Chromosome and Plant Cell Division in Space (CHROME)<br>Voice Command System (VCS)<br>Solid Surface Combustion Experiment (SSCE)<br>Investigation into Polymer Membrane Processing (IPM<br>Physiological Systems Experiment (PSE)<br>Radiation Monitor Experiment (RME-III) |
| Mission Duration: 98 hrs 11 mins | | | | |

# Summary of Shuttle Payloads And Experiments

| FLIGHT | LAUNCH DATE | LANDING DATE | CREW | PAYLOADS AND EXPERIMENTS |
|---|---|---|---|---|
| STS-38 (Atlantis) | Nov 15, 1990 (KSC) | Nov 20, 1990 (KSC) | Cdr: Richard O. Covey<br>Plt: Frank L. Culbertson<br>MS: Robert C. Springer<br>MS: Carl J. Meade<br>MS: Charles D. Gemar | DOD Mission |
| Mission Duration: 117 hrs 55 mins | | | | |
| STS-35 (Columbia) | Dec 02, 1990 (KSC) | Dec 11, 1990 (DFRF) | Cdr: Vance Brand<br>Plt: Guy S. Gardner<br>MS: John M. Lounge<br>MS: Jeffrey A. Hoffman<br>MS: Robert A. R. Parker<br>PS: Ronald A. Parise<br>PS: Samuel T. Durrance | Primary Payload<br>Astro-1<br>Middeck Experiments<br>Air Force Maui Optical Site (AMOS)<br>Shuttle Amateur Radio Experiment (SAREX-II)<br>Ultraviolet Plume Instrument (UVPI) |
| Mission Duration: 215 hrs 6 mins | | | | |

# 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 h 18 mins Retrograde |
| Inclination of Axis | Near 0° | 3° | 23°27' | 25°12' | 3°5' | 26°44' | 97°55' | 28°48' | ? |
| Inclination of Orbit to Ecliptic | 7° | 3.4° | 0° | 1.9° | 1.3° | 2.5° | 0.8° | 1.8° | 17.2° |
| Eccentricity of Orbit | .206 | .007 | .017 | .093 | .048 | .056 | .047 | .009 | .254 |
| Equatorial Diameter (Kilometers) | 4,878 | 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 within 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 suntit 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 6, 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.

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.

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 1989 the space shuttle deployed the Magellan spacecraft, which is currently mapping the surface of Venus. Magellan returned radar images in 1990 that showed geological features unlike anything seen on Earth. One area scientists called crater farms; another area was covered by a checkered pattern of closely spaced fault lines running at right angles. Most intriguing were indications that Venus still may be geologically active. Magellan will continue to map the entire surface of Venus and observe evidence of volcanic eruptions into 1991.

# The Planets

**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 was formed.

**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 the atomic particles of 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 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

iological activities were occurring, the same results could be explained by the planet's soil hemistry. There was a notable absence of evidence that organic molecules exist on Mars.

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

loth Viking landers became weather stations, recording wind velocity and direction, emperatures, and atmospheric pressure. As days became weeks, the Martian weather hanged 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 uring winter. Wind speeds near hurricane force were measured by both weather stations uring global dust storms. Viking 2 photographed light patches of frost, probably water ice, uring its second winter on Mars.

he Martian atmosphere is primarily carbon dioxide. Present in small percentages are nitrogen, xygen and argon, with trace amounts of krypton and xenon. Martian air contains only about /1000 as much water as Earth's but even this small amount can condense out and form clouds *hich ride high in the atmosphere, or swirl around the slopes of towering Martian volcanoes.* ocal patches of early morning fog can form in valleys. There is evidence that in the past, a enser Martian atmosphere may have allowed water to flow on the planet. Physical features losely resembling shorelines, gorges, riverbeds and islands suggest that great rivers once xisted on the planet. Mars has two small, irregularly shaped moons, Phobos and Deimos, with ncient, cratered surfaces.

ll four Viking spacecraft, two orbiters and two landers, exceeded by large margins their design ietime of 90 days. The four spacecraft were launched in 1975 and began Mars operation in 976. The first to fail was Orbiter 2 which stopped operating on July 24, 1978 when its attitude ontrol gas was depleted because of a leak. Lander 2 operated until April 12, 1980 when it was hut down due to battery degeneration. Orbiter 1 operated until August 7, 1980, when it too used he 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 launched 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 cloud tops. Pioneer 11 followed a year later. Voyagers 1 and 2 were launched in 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 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 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 in the *Jovian polar regions similar to Earth's northern lights. 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 it has large amounts of water in its composition. In October 1989, Galileo began its round about trip to Jupiter, where it dropped 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. In 1990 the Hubble Space Telescope took several hundred pictures of Saturn showing white spots on the planet growing into an immense storm that spread around the planet's equator.

The Voyager 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 lar constituent of Titan's atmosphere is methane. The surface temperature of Titan appears to b 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 ethan* 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 progres 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 observation of the Uranian system.

Uranus, third largest of the planets, is the odd-ball of the solar system. Unlike the other plan 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 Su

Voyager found that the planet's magnetic field does not follow the usual north-south axis four 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 percent 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 cloud tops measure -200 degrees Celsius (-329 degrees Fahrenheit)

# The Planets

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 and "electroglow." About 8,000 kilometers (5,000 miles) below Uranus's cloud tops 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 miles per hour and six previously unknown moons. It was discovered 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 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.

## THE SPACE EXPLORATION INITIATIVE

President Bush has a challenging vision of America's future in space -- A Space Exploration Initiative (SEI) that will enable the American people to journey together toward a permanent human presence beyond Earth orbit. The SEI will take us back to the Moon, this time to stay, and then to Mars. By first establishing a permanent base on the Moon, we will learn about living and working on another planetary surface, under harsh conditions. Then we will launch both robotic and human missions to Mars to thoroughly study the planet, and especially to search for signs of life -- both past and present.

By advancing our technological competitiveness, ensuring our leadership position in the global marketplace, and ultimately improving our balance of trade through promoting innovative high-technology research and development, the SEI will help achieve our national goals.

The SEI will advance science as well. The Moon is an ideal location for astronomical observations, planetary geology, and life sciences research. On Mars, scientists will be able to learn more about planetary evolution, climate change, and the origin of life. Whether life has ever evolved on Mars is a major scientific question that cannot be answered until human crews thoroughly search the planet for any signs of life forms. By learning more about the Moon and Mars, scientists will better understand the evolution of our solar system and the history and nature of our own planet.

The SEI will draw on the collective expertise of government, academia, and industry. New ideas are being solicited from private companies and academic institutions for advanced technologies ranging from propulsion to energy production to waste recycling and life support. An outreach program is now underway to solicit bold new concepts that may enable quicker, cheaper, and better missions to the Moon and Mars. All federally funded research that could contribute to the SEI is being reviewed. By means of an organized synthesis process, the innovative ideas collected through the outreach program will be analyzed, alternative architectures defined, technologies identified for demonstration, and early milestones identified.

The SEI provides an opportunity for the American people to work together toward a national goal, landing men and women on Mars no later than 2019, sharing the excitement of expanding human presence in space, learning more about our solar system and our own planet as we move beyond Earth orbit, and reaping the benefits of space technology for all of humankind.

# USA Planetary Space Flights

| SPACECRAFT | MISSION | LAUNCH DATE | ARRIVAL DATE | REMARKS |
|---|---|---|---|---|
| Mariner 1 | Venus Flyby | Jul 22, 1962 | | Destroyed shortly after launch when vehicle veered off course. |
| Mariner 2 | Venus Flyby | Aug 27, 1962 | Dec 14, 1962 | First successful planetary flyby. Provided instrument scanning data. Entered solar orbit. |
| Mariner 3 | Mars Flyby | Nov 5, 1964 | | Shroud failed to jettison properly; Sun and Canpous not acquired; 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)<br>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)<br>Mar 29, 1974 (Mercury)<br>Sep 21, 1974 (Mercury)<br>Mar 16, 1975 (Mercury) | First dual-planet mission. Used gravity of Venus to attain Mercury encounter. Provided first ultraviolet photographs of Venus; returned close-up photographs and detailed data of Mercury. Transmitter was turned off March 24, 1975, when attitude control gas was depleted. Craft inoperable in solar orbit. |
| Viking 1 | Mars Orbiter and Lander | Aug 20, 1975 | Jul 19, 1976 (in orbit)<br>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)<br>Sep 3, 1976 (landed) | Landed on the 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)<br>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)<br>Aug 25, 1981 (Saturn)<br>Jan 24, 1986 (Uranus)<br>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 1260 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. |

# USA Planetary Space Flights

| SPACECRAFT | MISSION | LAUNCH DATE | ARRIVAL DATE | REMARKS |
|---|---|---|---|---|
| Pioneer Venus 2 | Venus Probe | Aug 8, 1978 | Dec 9, 1978 | Dispatched heat-resisting probes to penetrate the atmosphere at widely separated locations and measured temperature, pressure, and density down to the planet's surface. Probes impacted on the surface. |
| Magellan | Venus Radar Mapping | May 4, 1989 | Aug 1990 | Returned radar images that showed geological features unlike anything seen on Earth. One area scientists called crater farms; another area was covered by a checkered pattern of closely spaced fault lines running at right angles. Most intriguing were indications that Venus still may be geologically active. Will continue to map the entire surface and observe evidence of volcanic eruption into 1991. |
| Galileo | Jupiter Orbiter and Probe | Oct 18, 1989 | Dec 8, 1990 (Earth)<br>Feb 1991 (Venus) | A sophisticated two-part spacecraft; an Orbiter will be inserted into orbit around Jupiter to remotely sense the planet, its satellites and the Jovian magnetosphere and a Probe will descent into the atmosphere of Jupiter to make in situ measurements of its nature. Galileo flew by Venus, conducting the first infrared imagery and spectroscopy below the planet's cloud deck and used the Earth's gravity to speed it on its way to Jupiter. |

# 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<br>Jul 25, 1973 | Feb 10, 1974<br>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<br>Aug 9, 1973 | Mar 12, 1974<br>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<br>Dec 21, 1984 | Jun 11, 1985 (Venus)<br>Mar 6, 1985 (Halley)<br>Jun 15, 1985 (Venus)<br>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<br>Jul 12, 1988 | Jan 1989 (Mars)<br>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. |

# 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)<br>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. |

# NASA Major Launch Record



| MISSION/ Intl Desig | LAUNCH VEHICLE | LAUNCH DATE | PERIOD (Mins.) | CURRENT ORBITAL PARAMETERS (km) Apogee | Perigee | Incl (deg) | WEIGHT (kg) | REMARKS (All Launches from ESMC, unless otherwise noted) |
|---|---|---|---|---|---|---|---|---|
| **1958** | | | | | | | | **1958** |
| Pioneer I (U) Eta I | Thor Able I (U) | Oct 11 | | DOWN OCT 12, 1958 | | | 34.2 | Measure magnetic fields around Earth or Moon. Error in burnout velocity and angle; did not reach Moon. Returned 43 hours of data on extent of radiation band, hydromagnetic oscillations of magnetic field, density of micrometeors in interplanetary space, and interplanetary magnetic field. |
| Beacon I (U) | Jupiter C (U) | Oct 23 | | DID NOT ACHIEVE ORBIT | | | 4.2 | Thin plastic sphere (12-feet in diameter after inflation) to study atmosphere density at various levels. Upper stages and payload separated prior to first-stage burnout. |
| Pioneer II (U) | Thor Able I (U) | Nov 8 | | DID NOT ACHIEVE ORBIT | | | 39.1 | Measurement of magnetic fields around Earth or Moon. Third stage failed to ignite. Its brief data provided evidence that equatorial region about Earth has higher flux and higher energy radiation than previously considered. |
| Pioneer III (U) Theta 1 | Juno II (U) | Dec 6 | | DOWN DEC 7, 1958 | | | 5.9 | Measurement of radiation in space. Error in burnout velocity and angle; did not reach Moon. During its flight, discovered second radiation belt around Earth. |
| **1959** | | | | | | | | **1959** |
| Vanguard II (U) Alpha 1 | Vanguard (SLV-4) (U) | Feb 17 | 123.8 | 3140 | 558 | 32.9 | 9.4 | Sphere (20 inches in diameter) to measure cloud cover. First Earth photo from satellite. Interpretation of data difficult because satellite developed precessing motion. |
| Pioneer IV (S) Nu 1 | Juno II (S) | Mar 3 | | HELIOCENTRIC ORBIT | | | 6.1 | Measurement of radiation in space. Achieved Earth-Moon trajectory; returned excellent radiation data. Passed within 37,300 miles of the Moon on Mar 4, 1959. |
| Vanguard (U) (SLV-5) (U) | Vanguard | Apr 13 | | DID NOT ACHIEVE ORBIT | | | 10.6 | Payload consisted of two independent spheres: A contained precise magnetometer to map Earth's magnetic field, B was a 30-inch inflatable sphere for optical tracking. Second stage failed because of damage at stage separation. |
| Vanguard (U) | Vanguard (SLV-6) (U) | Jun 22 | | DID NOT ACHIEVE ORBIT | | | 9.8 | Magnesium alloy sphere (20 inches in diameter), to measure solar-Earth heating process which generates weather. Faulty second-stage pressure valve caused failure. |
| Explorer (S-I) (U) | Juno II (U) | Jul 16 | | DID NOT ACHIEVE ORBIT | | | 41.5 | To measure Earth's radiation balance. Destroyed by Range Safety Officer 5-1/2 seconds after liftoff; failure of power supply to guidance system. |

| MISSION/ Intl 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 APR 26, 1959 | | | 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) TA 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) Pota 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) | Scout (S) | Feb 16 | | DOWN APR 9, 1964 | | | 6.8 | 12-foot sphere to determine density of Earth's atmosphere. |
| Delta 1 | Atlas (S) | Feb 21 | | SUBORBITAL FLIGHT | | | 1315.0 | First spacecraft orbited by all-solid rocket. (WFF) |
| Mercury (MA-2) (S) | | | | | | | | 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) | Thor-Delta (S) | Mar 25 | | DOWN JUN 1968 | | | 35.8 | Injected into highly elliptical orbit. Provided information on solar winds, hydromagnetic shock waves, and reaction of the Earth's magnetic field to solar flares. |
| Kappa 1 | | | | | | | | |
| 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) | 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. |
| Mu 1 | | | | | | | | |
| 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. |

# ASA Major Launch Record



| SSION/ tl 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) |
|---|---|---|---|---|---|---|---|---|
| rcury (MA-5) ) 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. |
| 62 | | | | | | | | 1962 |
| ho (AVT-1) (S) | Thor (S) | Jan 15 | | SUBORBITAL FLIGHT | | | 256.0 | Suborbital Communications Test. Canister ejection and opening successful, but 135-foot sphere ruptured. |
| nger I(I (U) pha 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. |
| ros IV (S) ta 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. |
| rcury (MA-6) riendship 7) (S) mma 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. |
| entry I (U) | Scout (S) | Mar 1 | | SUBORBITAL FLIGHT | | | | Launch vehicle development test/Reentry test. Desired speed not achieved. (WPF) |
| )-I (S) :a 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. |
| )be B (P-21a) | Scout (S) | Mar 29 | | SUBORBITAL FLIGHT | | | | Suborbital vehicle test/scientific geoprobe. Reached an altitude of 3,910 miles; provided electron density measurements. (WPF) |
| ger 4 (U) 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. |
| urn Test r-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. (WFF |
| Tiros VI (S) A-Psi 1 | Thor-Delta (S) | Sep 18 | 98.1 | 679 | 653 | 58.3 | 127.5 | Provide coverage of 1962 hurricane season. Returned high quality cloud cover photographs. |
| Alouette I (S) B-Alpha 1 | Thor-Agena B (S) | Sep 29 | 105.3 | 1025 | 989 | 80.5 | 145.2 | Designed and built by Canada to measure variations in ionosphere electron density distribution. Returned excellent data to 13 Canadian, British, and U.S. stations (Cooperative with Canada) |
| Explorer 14 (S-3a)(S) B-Gamma 1 | Thor-Delta (S) | Oct 2 | | DOWN JUL 1, 1966 | | | 40.4 | Monitor trapped corpuscular radiation, solar particles, cosmic radiation, and solar winds. Placed into a highly elliptical orbit; excellent data received. |

# ASA Major Launch Record



| SSION/ tl 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) |
|---|---|---|---|---|---|---|---|---|
| gma 7(MA-8) (S) 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. |
| nger V (U) 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. |
| plorer 15 -3b) (S) Lambda 1 | Thor-Delta (S) | Oct 27 | | DOWN OCT 5, 1967 | | | 44.5 | Study location, composition, and decay rate of artificial radiation belt created by high altitude nuclear explosion over the Pacific Ocean. Despin device failed; considerable useful data transmitted. |
| turn (SA-3) ) | 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. |
| lay I (S) 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. |
| plorer 16 -55b) (S) 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. (WFF) |
| 63 | | | | | | | | 1963 |
| ncom I (U) 63 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. |
| turn Test A-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. |
| plorer 17 -6) (S) 63 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. |
| lstar II (S) 3A | 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. 1963 |
| :cury (Faith 7) 63 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 mocku Reimbursable. |
| Tiros VII (S) 1963 024A | Thor-Delta (S) | Jun 19 | 95.8 | 560 | 557 | 58.2 | 134.7 | Continued meteorological satellite development. Furnishe over 30,000 useful cloud cover photographs, including pictures of Hurricane Ginny in early stages in mid-Octobe |
| 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 ablati 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 conducte |
| 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 observe interplanetary space over extended period of sola cycle. Discovered region of high-energy radiation beyond Van Allen belts; reported stationary shock wave created 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 clou cover pictures using inexpensive ground stations. |
| 1964 | | | | | | | | 196 |
| 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 300 one-way voice transmissions or 12 two-way narrowband communication. Completed more than 230 demonstrations ar tests; also obtained over 600 hours of radiation data. |

# ASA Major Launch Record



| SSION/ tl 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) |
|---|---|---|---|---|---|---|---|---|
| cho II (S) 964 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) |
| aturn I (SA-5) S) 964 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. |
| nger VI (U) 964 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. |
| eacon Explorer A -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. |
| iel II (UK) (S) 964 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) |
| emini I (S) 964 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. |
| re 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. |
| ollo Abort 001 (S) | Little Joe (S) | May 13 | | SUBORBITAL FLIGHT | | | | Vehicle development test to demonstrate Apollo spacecraft atmospheric abort system capabilities. (White Sands) |
| turn I (SA-6) ) 964 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. |
| ntaur Test III -3 (S) | Atlas Centaur (S) | Jun 30 | | SUBORBITAL FLIGHT | | | | Launch vehicle development test; performance and guidance evaluation. |
| RT 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) |
| nger VII (S) 964 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 a 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 mor than 27,000 excellent photos; APT system supplied daytim 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 properl 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 |

| 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



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|---|---|---|---|---|---|---|---|---|
| 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 du 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 sui 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. |

| 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 Alouette II (S) 1965 098A | Thor-Agena (S) | Nov 29 | 120.5 119.3 | 2905 2801 | 502 500 | 79.8 79.8 | 98.9 146.5 | Make related studies of ionospheric composition and temperature variations. Provided excellent data from regions of the ionosphere never before investigated. Cooperative with Canada. (WSMC) |
| Gemini VII (S) 1965 100A | Titan II (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)<br>1965 101A | Scout 139<br>(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)<br>1965 104A | Titan II<br>(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)<br>1965 105A | Delta 35<br>(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<br>A-004 (S) | Little Joe<br>(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)<br>1966 008A | Delta 36<br>(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<br>(AS-201) (S) | Saturn IB<br>(S) | Feb 26 | | SUBORBITAL FLIGHT | | | 20820.1 | Launch Vehicle development flight; carried unmanned Apollo spacecraft. |
| ESSA II (S)<br>1966 016A | Delta 37<br>(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 weathe satellite system. Reimbursable. (WSMC) |
| Gemini VIII (U)<br>1966 020A | Titan II<br>(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 vehicle and terminated mission early; EVA not accomplished. First Pacific Ocean landing. Mission Duration 10 hours 41 minutes 26 seconds. |
| GATV (S)<br>1966 019A | A-Agena<br>(S) | Mar 16 | | DOWN SEP 15, 1967 | | | | |

| ISSION/ ntl 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) |
|---|---|---|---|---|---|---|---|---|
| entaur Test AC-8) (U) 966 030A | A-Centaur (U) | Apr 8 | | DOWN MAY 5, 1966 | | | 784.7 | Launch vehicle development flight; carried Surveyor model. Second Centaur engine firing unsuccessful. |
| AO I (U) 966 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. |
| imbus II (S) 966 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) |
| emini 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. |
| xplorer 32 (S) 966 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. |
| urveyor I (S) 966 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. |
| emini IXA (U) 966 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, |
| ATV (U) 966 046A | Atlas (S) | Jun 1 | | DOWN JUN 11, 1966 | | | | docking not achieved. EVA successful, but evaluation of AMU not achieved. Mission Duration 72 hours 21 minutes. |
| OO III (S) 966 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. |
| V-3 (S) 966 052A | Scout (S) | Jun 9 | 143.0 | 4711 | 647 | 40.8 | 173.0 | Radiation Research Satellite. USAF Reimbursable. (WPF) |
| ageos I (S) 966 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) |
| xplorer 33 (S) 966 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. |
| oollo Saturn -203 (S) 966 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 8' |
| GATV (S) 1966 065A | A-Agena (S) | Jul 18 | | DOWN DEC 29, 1966 | | | | minutes; umbilical EVA of 27 minutes. Mission duration 70 hours 46 minutes 39 seconds. |
| 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 |
| GATV (S) 1966 080A | A-Agena (S) | Sep 12 | | DOWN DEC 30, 1966 | | | | and standup EVA performed and well as tethered spacecraft experiment. Mission Duration 71 hrs 17 min 8 sec. |
| 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 |

| MISSION/ Intl Desig | LAUNCH VEHICLE | LAUNCH DATE | PERIOD (Mins.) | CURRENT ORBITAL PARAMETERS (km) Apogee | Perigee | Incl (deg) | WEIGHT (kg) | REMARKS (All Launches from ESMC, unless otherwise noted) |
|---|---|---|---|---|---|---|---|---|
| Gemini XII (S) 1966 104A | Titan II (S) | Nov 11 | | LANDED NOV 15, 1966 | | | 3762.1 | Last manned Gemini flight with James A. Lovell, Jr. and Edwin E. Aldrin, Jr. Rendezvous and docking achieved. Two EVA's performed. Mission duration 94 hours 35 minutes 31 seconds. |
| GATV (S) 1966 103A | A-Agena (S) | Nov 11 | | DOWN DEC 23, 1966 | | | | |
| ATS I (S) 1966 110A | A-AGENA (S) | Dec 7 | 1250.5 | 35251 | 28888 | 14.0 | 703.1 | Perform various communication, meteorology, and control technology experiments and carry out scientific measurements of orbital environment. Experiments results outstanding. Spin-scan cloud camera photographed changing weather patterns; air-to-ground and air-to-air communications demonstrated for first time. |
| Biosatellite I (U) 1966 114A | Delta (S) | Dec 14 | | DOWN FEB 15, 1967 | | | 426.4 | Carried biological specimens to determine effects of space environment on life processes. Reentry vehicle separated but retro rocket failed, leaving capsule in orbit. No useful scientific data obtained. |
| 1967 | | | | | | | | 1967 |
| Intelsat II F-2 (S) 1967 001A | Delta 44 (S) | Jan 11 | | CURRENT ELEMENTS NOT MAINTAINED | | | 87.1 | Comsat commercial communication satellite. Reached intended location on February 4. Reimbursable. |
| ESSA IV (S) 1967 006A | Delta 45 (S) | Jan 26 | 113.4 | 1437 | 1324 | 102.0 | 131.5 | Replaced ESSA II in TOS system. Provided daily coverage of local weather systems to APT receivers. Shutter malfunction rendered one camera inoperative. Reimbursable. (WSMC) |
| Lunar Orbiter III (S) 1967 008A | A-Agena (S) | Feb 5 | | DOWN OCT 9, 1967 | | | 385.6 | Photographed lunar landing sites from lunar orbit; also returned 600,000 sq.mi. of front and 250,000 sq.mi. of back side lunar photography; provided gravitational field and lunar environment data. |
| OSO III (S) 1967 020A | Delta 46 (S) | Mar 8 | | DOWN APR 4, 1982 | | | 284.4 | Carried 9 experiments to study structure, dynamics and chemical composition of outer solar atmosphere through X-ray, visible, and UV radiation measurements. |
| Intelsat II F-3 (S) 1967 026A | Delta 47 (S) | Mar 22 | | CURRENT ELEMENTS NOT MAINTAINED | | | 87.1 | Comsat commercial communication satellite. Completed Intelsat II system. Reimbursable. |

# NASA Major Launch Record

| MISSION/ Intl Desig | LAUNCH VEHICLE | LAUNCH DATE | PERIOD (Mins.) | CURRENT ORBITAL PARAMETERS (km) Apogee | Perigee | Incl (deg) | WEIGHT (kg) | REMARKS (All Launches from ESMC, unless otherwise noted) |
|---|---|---|---|---|---|---|---|---|
| ATS 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 Itali 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 stu 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. (WSM |
| 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 an interplanetary fields at lunar distances. Lunar orbit achieved. Results indicated no shock front precedes Moon no magnetic field, no radiation belts or evidence of luna ionosphere. |

| 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) |
|---|---|---|---|---|---|---|---|---|
| IGO 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. (WFP) |
| DIS 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 solar wind, magnetic fields, and cosmic rays. Carried |
| TEIR-1 (S) 1967 123B | | | | DOWN APR 28, 1968 | | | 20.0 | TTS-1, first NASA piggyback payload. |
| **1968** | | | | | | | | 196 |
| 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' radiation belts; first evidence of electric fields in bow shock. |
| Explorer 37 (S) 1968 017A | Scout (S) | Mar 5 | | DOWN NOV 16, 1990 | | | 89.8 | Solar Explorer to provided data on selected solar X-ray a ultraviolet emissions. NRL/NASA Cooperative. (WPF |
| 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 perform 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. (WPF |
| 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) Secor 10 (U) | Thor-Agena (U) | May 18 | | DID NOT ACHIEVE ORBIT | | | 571.5 20.4 | Experimental meteorological satellite; also carried Seco 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. |

| MISSION/ ntl 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) |
|---|---|---|---|---|---|---|---|---|
| xplorer 39 (S) 968 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) |
| xplorer 40 (S) 968 066B | | | 118.0 | 2506 | 678 | 80.7 | 69.4 | |
| TS IV (U) 968 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. |
| SSA VII (S) 968 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) |
| AM CII (S) | Scout (S) | Aug 22 | | SUBORBITAL FLIGHT | | | 122.0 | Measure electron and ion concentrations during reentry. (WFF) |
| ntelsat III F-1 U) | Delta (U) | Sep 18 | | DID NOT ACHIEVE ORBIT | | | 286.7 | Comsat commercial communications satellite. Vehicle failure. Reimbursable. |
| SRO IA (S) 968 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) |
| pollo 7 (S) 968 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. |
| ioneer IX (S) 968 100A | Delta (S) | Nov 8 | | HELIOCENTRIC ORBIT | | | 66.7 | Deep space probe to collect scientific data on the electromagnetic and plasma properties of interplanetary space. Carried TETR 2 as secondary payload. |
| ETR 2 (S) 968 100B | | | | DOWN SEP 19, 1979 | | | | |
| EOS A (S) 968 109A | Delta (S) | Dec 5 | | DOWN OCT 28, 1975 | | | 108.8 | Study interplanetary magnetic fields and solar cosmic ray particles. ESRO Reimbursable. |
| AO II (S) 968 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. |
| SSA VIII (S) 968 114A | Delta 62 (S) | Dec 15 | 114.6 | 1461 | 1411 | 101.5 | 136.1 | Meteorological satellite for ESSA. Reimbursable. (WFF) |
| ntelsat III F-2 S) 968 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. |

| ISSION/ ntl 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) |
|---|---|---|---|---|---|---|---|---|
| GO VI (S) 969 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) |
| xplorer 41 (S) 969 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) |
| iosatellite III U) 969 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. |
| pollo 11 (S) 969 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. |
| ntelsat III F-5 U) 969 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. |
| SO VI (S) 969 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 |
| AC (S) 969 068B | | | | DOWN APR 28, 1977 | | | 117.9 | Delta stage. |
| TS V (U) 969 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. |
| ioneer E (U) ETR 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. |
| RO 1B (S) 969 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 a 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** | | | | | | | | 197 |
| 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 pigg 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 objectiv 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. Pressu lost in SM oxygen system; mission aborted; LM used for li support. Mission Duration 142 hours 54 minutes 41 second |
| 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. |

| SSION/ tl 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) |
|---|---|---|---|---|---|---|---|---|
| telsat III F-8 ) '70 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. |
| ynet 2 (U) '70 062A | Delta (S) | Aug 19 | | CURRENT ELEMENTS NOT MAINTAINED | | | 242.7 | Communication satellite for the United Kingdom. Telemetary terminated following apogee motor failure. Reimbursable. |
| M CIII (S) | Scout (S) | Sep 30 | | SUBORBITAL FLIGHT | | | 134.0 | Reentry test of radio blackout. |
| O I (S) '70 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 |
| S (S) '70 094B | | | | DOWN FEB 7, 1971 | | | 21.0 | controls balance. Radiation Meteoroid Spacecraft (RMS) provided data on radiation belts. (WFF) |
| O 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.* |
| OS A (S) '70 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) |
| plorer 42 (S) '70 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) |
| 71 | | | | | | | | 1971 |
| telsat IV F-2 ) '71 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. |
| pllo 14 (S) '71 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 |
| ? (S) '71 008B | SM | | | IMPACTED MOON FEB 4, 1971 | | | | Mauro area on Feb 5; performed EVA, deployed lunar experiments, returned lunar samples. P&P Subsatellite spring-launched from SM in lunar orbit. Mission duration 216 hours 1 minute 57 seconds. |
| TOSAT 2 (S) '71 009A | Delta 82 (S) | Feb 2 | 1435.8 | 41063 | 30496 | 8.7 | 242.7 | Second communications satellite for NATO. Reimbursable |
| plorer 43 (S) '71 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. |
| S B (S) '71 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. (WFF |
| Explorer 44 (S) 1971 058A | Scout (S) | Jul 8 | | DOWN DEC 15, 1979 | | | 115.0 | Solar radiation spacecraft to monitor Sun's X-ray and ultraviolet emissions. Cooperative with NRL. (WFF |
| Apollo 15 (S) 1971 063A | Saturn V (S) | Jul 26 | | LANDED AUG 7, 1971 | | | 51655.0 | Fourth manned lunar landing with David R. Scott, Alfred M Worden, and James B. Irwin. Landed at Hadley Rille on Ju 30; performed EVA with Lunar Roving Vehicle; deployed experiments. Mission Duration 295 hrs 11 min 53 sec. |
| P&P Subsat (S) 1971 063D | SM | Aug 4 | | SELENOCENTRIC ORBIT | | | 36.3 | |
| CAS/EOLE (S) 1971 071A | Scout (S) | Aug 16 | 100.2 | 870 | 662 | 50.1 | 85.0 | Obtain data on winds, temperatures, and pressures using instrumented balloons launched from Argentina and a satellite. Cooperative with France. (WFF |
| BIC (S) | Scout 166C (S) | Sep 20 | | SUBORBITAL FLIGHT | | | 31.7 | Barium Ion Cloud Project to study Earth's magnetic field. Cooperative with Germany. (WFF |
| OSO H (S) 1971 083A | Delta (S) | Sep 29 | | DOWN JUL 9, 1974 | | | 635.0 | Observe active physical processes on the Sun and how it influences the Earth and its space environment. |
| TETR4 (S) 1971 083B | | | | DOWN SEP 21, 1978 | | | 20.4 | |
| ITOS B (U) 1971 091A | Delta 86 (U) | Oct 21 | | DOWN JUL 21, 1972 | | | 31.7 | To augment NOAA's satellite world-wide weather observatio 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. |

# ASA Major Launch Record



| SION/ :l 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) |
|---|---|---|---|---|---|---|---|---|
| '2 | | | | | | | | 1972 |
| elsat IV F-4 '2 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. |
| S A-2 (S) '2 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) |
| neer 10 (S) '2 012A | A-Centaur (S) | Mar 2 | | SOLAR SYSTEM ESCAPE TRAJECTORY | | | 258.0 | Jupiter Flyby. First spacecraft to flyby Jupiter and return scientific data. |
| -1 (S) '2 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) |
| llo 16 (S) '2 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 |
| Subsat (S) '2 031D | SM | Apr 16 | | IMPACTED MOON MAY 29, 1972 | | | 36.3 | 20. Deployed camera and experiments; performed EVA with lunar roving vehicle. Deployed P&P Subsatellite in lunar orbit. Mission Duration 265 hours 51 minutes 59 seconds. |
| elsat IV F-5 '2 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. |
| S-A (S) 2 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) |
| lorer 46 (S) 2 061A | Scout (S) | Aug 13 | | DOWN NOV 2, 1979 | | | 206.4 | Meteoroid Technology Satellite to measure meteoroid penetration rates and velocity. (WFF) |
| 3 (S) 2 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. |
| nsit (S) 2 069A | Scout (S) | Sep 2 | 100.2 | 816 | 721 | 90.0 | 94.0 | Navigation Satellite for U.S. Navy. Reimbursable. (WSMC) |
| lorer 47 (S) 2 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 observatio capabilities. Oscar, amateur radio satellite, carried as |
| OSCAR (S) 1972 082B | | Oct 15 | 114.9 | 1453 | 1446 | 101.7 | 15.9 | piggyback. Reimbursable. (WSMC |
| 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 i bulbous dome to study gamma rays. Launched by Italian cr 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 | | | | | | | | 19 |
| Pioneer G (S) 1973 019A | A-Centaur (S) | Apr 5 | | SOLAR SYSTEM ESCAPE TRAJECTORY | | | 259.0 | Investigate interplanetary medium beyond the orbit of Ma 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-o manned missions. |

| 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 infligh 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 energ 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 enviromental satellite to provide Earth imaging in visible and IR spectrum. First weather observe 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 goo 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) |

| ISSION/ ntl 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) |
|---|---|---|---|---|---|---|---|---|
| NS A (S) 974 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) |
| estar B (S) 974 075A | Delta (S) | Oct 10 | 1442.0 | 35917 | 35886 | 4.4 | 571.5 | Domestic communications satellite for Western Union. Reimbursable. |
| K-5 (S) 974 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) |
| TOS-G (S) 974 089A | Delta 104 (S) | Nov 15 | 114.9 | 1456 | 1443 | 101.6 | 345.0 | ITOS-G - To augment NOAA's satellite world-wide weather observation capabilities. Reimbursable. Intasat - Conduct worldwide observations of ionospheric total electron counts. Cooperative with Spain. Oscar - provide communications for amateur radio enthusiasts around the world. (WSMC) |
| NTASAT (S) 974 089B | | | 114.8 | 1457 | 1439 | 101.6 | 20.4 | |
| SCAR (S) 974 089C | | | 114.8 | 1457 | 1438 | 101.6 | 28.6 | |
| ntelsat IV F-8 S) 974 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. |
| kynet II-B (S) 974 094A | Delta (S) | Nov 22 | 1434.5 | 35773 | 35736 | 7.7 | 435.0 | Communication satellite for the United Kingdom. Reimbursable. |
| elios A (S) 974 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. |
| ymphonie A (S) 974 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. |
| 975 | | | | | | | | 1975 |
| andsat 2 (S) 975 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) |
| MS-B (S) 975 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. |
| ntelsat 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. |
| EOS C (S) 975 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 ar 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 Kubasc 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. (WFF) |
| Palapa A (S) 1976 066A | Delta 125 (S) | Jul 8 | 1435.9 | 36028 | 35537 | 2.3 | 573.8 | Communication Satellite for Indonesia. Reimbursable. |
| Comstar B (S) 1976 073A | A-Centaur (AC-40) (S) | Jul 22 | | GEOSYNCHRONOUS ORBIT | | | 1490.1 | Second domestic communications satellite for Comsat. Reimbursable. |
| TIOS 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



| ISSION/ ntl 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) |
|---|---|---|---|---|---|---|---|---|
| oyager 2 (S) 977 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. |
| IRIO (S) 977 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. |
| oyager 1 (S) 977 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. |
| SA/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. |
| ntelsat 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. |
| SEE A/B | Delta 135 | Oct 22 | | | | | | Dual payload International Sun Earth Explorer to study |
| 977 102A (S) | (S) | | | | DOWN SEP 26, 1987 | | 329.0 | interaction of interplanetary medium with Earth's immediate |
| 977 102B (S) | | | | | DOWN SEP 26, 1987 | | 157.7 | envirorment. Cooperative with ESA. |
| ransat (S) | Scout | Oct 27 | 106.9 | 1101 | 1060 | 89.9 | 93.9 | Improved Transit navigation satellite for the U.S. Navy. |
| 977 106A | S-200C (S) | | | | | | | Reimbursable. (WSMC) |
| eteosat (S) | Delta 136 | Nov 22 | 1437.2 | 35875 | 35741 | 7.0 | 695.3 | ESA Meteorological satellite; Europe's contribution to the |
| 977 108A | (S) | | | | | | | Global Atmospheric Research Program (GARP). Reimbursable. |
| S/Japan (S) | Delta 137 | Dec 14 | 1455.9 | 36185 | 36159 | 5.3 | 677.0 | Experimental communication satellite for Japan. |
| 977 118A | (S) | | | | | | | Reimbursable. |
| 978 | | | | | | | | 1978 |
| ntelsat IVA F-3 S) | 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. |
| 978 002A | | | | | | | | |

# 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 (S) Intelsat's global network. Reimbursable. |
| BSE/Japan (S) 1978 039A | Delta 140 (S) | Apr 7 | 1433.7 | 37702 | 33775 | 4.5 | 665.0 | Japan's Broadcasting Satellite/Experimental for conducting TV broadcast experiments. Reimbursable. |
| HCMM/AEM-A (S) 1978 041A | Scout (S) | Apr 26 | DOWN DEC 22, 1981 | | | | 134.3 | Heat Capacity Mapping Mission to test the feasibility of measuring variations in the Earth's temperatures. (WSMC) |
| OTS-B (S) 1978 044A | Delta 141 (S) | May 11 | 1436.1 | 35802 | 35722 | 4.1 | 865.0 | Orbital Test Satellite to conduct communications experiments for ESA. Reimbursable. |
| Pioneer Venus-A (Orbiter) (S) 1978 051A | A-Centaur (S) | May 20 | ELEMENTS NOT AVAILABLE | | | | 582.0 | One of two Pioneer flights to Venus in 1978; was placed in orbit around Venus for remote sensing and direct measurements of the planet and its surrounding environment |
| GOES-C/NOAA (S) 1978 062A | Delta 142 (S) | Jun 16 | 1436.0 | 35795 | 35775 | 4.7 | 635.0 | Part of NOAA's global network of geostationary environmental satellites to provide Earth imaging, monito 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. |

# ASA Major Launch Record



| SSION/ t1 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) |
|---|---|---|---|---|---|---|---|---|
| OS-B/ESA (S) 78 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. |
| oneer/Venus-B ultiprobe) (S) 78 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. |
| EE-C (S) 78 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. |
| os-N (S) 78 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) |
| mbus-G (S) 78 098A<br>MEO<br>78 098B | Delta (S) | Oct 24 | 104.0<br><br>104.0 | 970<br><br>970 | 925<br><br>925 | 99.4<br><br>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) |
| AO-B (S) 78 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. |
| TO IIIC (S) 78 106A | Delta 146 (S) | Nov 18 | 1436.1 | 35792 | 35782 | 3.2 | 706.0 | Third-generation communications satellite for NATO. Reimbursable |
| lesat D (S) 78 116A | Delta 147 (S) | Dec 15 | 1442.9 | 36022 | 35818 | 1.3 | 887.2 | Fourth domestic communications satellite for Canada. Reimbursable. |
| 79 | | | | | | | | 1979 |
| THA (S) 79 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. (WF |
| 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 | | DOWN SEP 23, 1990 | | | 154.5 | Measure ultra-heavy cosmic ray particles and study low-energy cosmic X-rays. UK Reimbursable. (WF |
| 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. (WSM |
| *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 dat 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. (WSM |
| RCA-C (U) 1979 101A | Delta 150 (S) | Dec 6 | 789.0 | 35495 | 8314 | 10.5 | 895.4 | Third RCA domestic communications satellite. Contact lo shortly after apogee motor firing. Reimbursable. |
| **1980** | | | | | | | | **19** |
| 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; fai 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, monit the space environment, and relay meteorological data. Reimbursable. |

# ASA Major Launch Record



| SSION/ tl 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) |
|---|---|---|---|---|---|---|---|---|
| LTSATCOM D (S) 980 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. |
| S-A (S) 980 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. |
| NTELSAT V-A F-2 ) 980 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. |
| 981 | | | | | | | | 1981 |
| OMSTAR D (S) 981 018A | A-Centaur (AC-42) (S) | Feb 21 | 1436.2 | 35794 | 35784 | 1.9 | 1484.0 | Fourth domestic communications satellite for Comsat. Reimbursable. |
| S-1 (S) 981 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. |
| VA-1 (S) 981 044A | Scout S-192C (S) | May 15 | | ELEMENTS NOT AVAILABLE | | | 166.9 | Improved Transit satellite for the Navy's operational navigation system. Reimbursable. (WSMC) |
| ES E (S) 981 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. |
| telsat V-B F-1 ) 81 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. |
| AA-C (S) 81 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) |
| namics Explorer and B | Delta (S) | Aug 3 | | | | | | Dual spacecraft to study the Earth's electromagnetic fields. (WSMC) |
| 81 070A (S) | | | 410.4 | 23339 | 495 | 89.4 | 424.0 | |
| 81 070B (S) | | | | DOWN FEB 19, 1983 | | | 420.0 | |
| ISATCOM E (U) 81 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 switche 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 |
| UoSAT 1 (S) 1981 100B | | | | DOWN OCT 13, 1989 | | | 52.0 | other chemicals in the atmosphere. Carried UoSat-Oscar 9 (UK) Amateur Radio Satellite as secondary payload. |
| STS 2 (S) 1981 111A | Shuttle (S) (Columbia) | Nov 12 | | LANDED AT DFRF NOV 14, 1981 | | | | Second Manned orbital test flight of the Space Transportation System with Joe H. Engle and Richard H. Truly to verify the combined performance of the Shuttle vehicle. OSTA-1 payload demonstrated capability to condu scientific research in the attached mode. Mission durati 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 | | | | | | | | 198 |
| 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 Shutt vehicle. OSS-1 scientific experiments conducted from the cargo bay. Mission duration 192 hours 4 minutes 45 second |
| Insat 1-A (U) 1982 031A | Delta 161 (S) | Apr 10 | 1434.2 | 35936 | 35562 | 0.1 | 1152.1 | Multipurpose telecommunications/meteorology spacecraft fo India. Reimbursable. |

# ASA Major Launch Record



| SSION/ tl 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) |
|---|---|---|---|---|---|---|---|---|
| star V (S) 82 058A | Delta 162 (S) | Jun 8 | 1436.2 | 35796 | 35778 | 0.1 | 1105.0 | Western Union domestic communications satellite. Reimbursable. |
| S 4 (S) 82 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 40 seconds. |
| ndsat D (S) 82 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) |
| lesat G (S) 82 082A | Delta 164 (S) | Aug 25 | 1436.0 | 35796 | 35776 | 0.0 | 1238.3 | Commercial communications satellite for Canada. Reimbursable. |
| telsat V-E F-5 ) 82 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. |
| A-E (S) 82 105A | Delta 165 (S) | Oct 27 | 1436.2 | 35791 | 35784 | 0.0 | 1116.3 | RCA domestic communications satellite. Reimbursable. |
| S 5 (S) 82 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. |
| S-C (S) 82 110B | | Nov 11 | 1436.1 | 35788 | 35786 | 0.0 | 3344.8 | |
| lesat-E (S) 82 110C | | Nov 12 | 1436.1 | 35794 | 35779 | 0.0 | 4443.4 | |
| 83 | | | | | | | | 1983 |
| AS (S) 83 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. |
| K II (S) 83 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 coverag 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, Kar 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 resoluti 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 fo 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 |
| Telesat-F (S) 1983 059B | | Jun 18 | 1436.0 | 35791 | 35782 | 0.0 | 4443.4 | woman astronaut), and Norman E. Thagard. Deployed two 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 experiments including launching and recovering SPAS 01 |
| SPAS-01 (S) 1983 059F | | Jun 18 | | RETRIEVED JUN 24, 1983 | | | | (FRG). Mission duration 146 hours 23 minutes 59 seconds. |
| AP 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. |

# ASA Major Launch Record



| SSION/ tl 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) |
|---|---|---|---|---|---|---|---|---|
| lstar 3A (S) 83 077A | Delta 171 (S) | Jul 28 | 1436.1 | 35796 | 35778 | 0.0 | 635.0 | AT&T communications satellite. Reimbursable. |
| S 8 (S) 83 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. |
| SAT-B (S) 83 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. |
| A G (S) 83 094A | Delta 172 (S) | Sep 8 | 1436.2 | 35797 | 35778 | 0.0 | 1121.3 | RCA domestic communications satellite. Reimbursable. |
| laxy 2 (S) 83 098A | Delta 173 (S) | Sep 22 | 1436.2 | 35799 | 35782 | 0.0 | 579.0 | Hughes Communications Satellite. Reimbursable. |
| S-9 (S) acelab-1 83 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. |
| 84 | | | | | | | | 1984 |
| S 41-B (S) 84 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. |
| STAR 6 (U) 84 011B | | Feb 3 | | RETRIEVED NOV 16, 1984 (51-A) | | | 3309.0 | Stewart. Deployed WESTAR (Western Union-Reimbursable), and Palapa B-2 (Indonesia-Reimbursable). Both PAM's failed; |
| T (S) 84 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 |
| lapa B-2 (U) 84 011D | | Feb 6 | | RETRIEVED 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. |
| NOSAT 5 (S) 84 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 |
| SAT (S) 84 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 | | RETRIEVED JAN 20, 1990 (STS-32) | | | 9670.0 | Hoften. LDEF deployed; SMM retrieved and repaired in Car |
| 1984 034B | | | | | | | | Bay, redeployed Apr 12. Mission duration 167:40:07 . |
| 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 fo |
| | | | | | | | | 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.; I |
| 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 |
| 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 Telst |
| 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 hrs 23 min 33 sec |
| 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 B-2 and Westar 6 (Launched on 41-B). Mission duration 191 hours 44 minutes 56 seconds. |
| Syncom IV-1 (S) 1984 113C | | Nov 10 | 1436.0 | 35890 | 35679 | 0.9 | 6889.0 | |
| NATO III-D (S) 1984 115A | Delta 177 (S) | Nov 13 | 1436.1 | 35788 | 35783 | 3.2 | 761.0 | Fourth in a series of communication satellites for NATO. Reimbursable. |
| NOAA-9 (S) 1984 123A | Atlas-E (S) | Dec 12 | 102.2 | 863 | 839 | 99.1 | 1712.0 | Advanced TIROS-N spacecraft to provide continuous coverage of the Earth and provide high-accuracy worldwide meteorological data. NOAA. Reimbursable. (WSMC) |
| 1985 | | | | | | | | 1985 |
| STS 51-C (S) 1985 010A | Shuttle (S) (Discovery) | Jan 24 | | LANDED AT KSC JAN 27, 1984 | | | | Third Discovery flight with Thomas K. Mattingly, Loren J. Shriver, Ellison S. Onizuka, James F. Buchli, and Gary E. Payton. Unannounced payload for DOD. (Reimbursable). Mission duration 73 hours 33 minutes 23 seconds |
| DOD (S) 1985 010B | | | | ELEMENTS NOT AVAILABLE | | | | |
| Intelsat V-A F-10 (S) 1985 025A | A-Centaur (AC-36) (S) | Mar 22 | 1436.1 | 35807 | 35768 | 0.0 | 1996.7 | First in a series of improved Commercial Communication Satellites for Intelsat. Reimbursable. |
| STS 51-D (S) 1985 028A | Shuttle (S) (Discovery) | Apr 12 | | LANDED AT KSC APR 19, 1985 | | | | Fourth Discovery flight with Karol J. Bobko, Donald F. Williams, M. Rhea Seddon, S. David Griggs, Jeffrey A. Hoffman, Charles D. Walker, and E.J. "Jake" Garn (U.S. Senator). Deployed Syncom (Hughes-Reimbursable) and Telesat (Canada-Reimbursable). Syncom Sequencer failed to start, despite attempts by crew; remained inoperable until restarted by crew of 51-I. Mission duration 167 hrs 54 min. |
| Telesat-I (S) 1985 028B | | Apr 13 | 1436.0 | 35796 | 35777 | 0.3 | 3350.0 | |
| Syncom IV-3 (S) 1985 028C | | Apr 12 | 1436.2 | 35809 | 35768 | 1.4 | 6889.0 | |
| STS 51-B (S) 1985 034A | Shuttle (S) (Challenger) | Apr 29 | | LANDED AT DFRF MAY 6, 1985 | | | | Sixth Challenger flight with Robert F. Overmyer, Frederick D. Gregory, Don Lind, Norman E. Thagard, William E. Thornton, Lodewijk Vanderberg, and Taylor Wang. Spacelab-3 mission to conduct applications, science, and technology experiments. Deployed Northern Utah Satellite (NUSAT). Global Low Orbiting Message Relay Satellite (GLOMR) failed to deploy and was returned. Mission duration 167 hours 55 minutes 23 seconds |
| Spacelab-3 1985 034A | | | | | | | | |
| NUSAT (S) 1985 034B | | | | DOWN DEC 15, 1986 | | | 47.6 | |

# NASA Major Launch Record



| MISSION/ Intl Desig | LAUNCH VEHICLE | LAUNCH DATE | PERIOD (Mins.) | CURRENT ORBITAL PARAMETERS (km) Apogee | Perigee | Incl (deg) | WEIGHT (kg) | REMARKS (All Launches from ESMC, unless otherwise noted) |
|---|---|---|---|---|---|---|---|---|
| STS 51-G (S) 1985 048A | Shuttle (S) (Discovery) | Jun 17 | | LANDED AT EAFB JUN 24, 1985 | | | | Fifth Discovery flight with Daniel C. Brandenstein, John 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 168 hours 08 minutes 46 seconds |
| 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 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) | Scout S-209C (S) | Aug 2 | 107.9 | 1257 | 1002 | 89.9 | 64.2 | Two Navigation Satellites for U.S. Navy. Reimbursable. (WSMC) |
| 1985 066B (S) | | | 107.9 | 1258 | 1002 | 89.9 | 64.2 | |
| STS 51-I (S) 1985 076A | Shuttle (S) (Discovery) | Aug 27 | | LANDED AT EAFB SEP 3, 1985 | | | | Sixth Discovery flight with Joe H. Engle, Richard O. Covey, James D. VanHoften, William F. Fisher, John M. Lounge. Deployed Aussat (Australia-Reimbursable), ASC (American Satellite Co.-Reimbursable), and Syncom IV-4 (Hughes - Reimbursable). After reaching Geosynchronous Orbit, Syncom IV-4 ceased functioning. Repaired Syncom IV-3 (Launched by 51-D). Mission duration 170 hours 17 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. |

| SSION/ tl 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) |
|---|---|---|---|---|---|---|---|---|
| S 51-J (S) OD) 85 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. |
| S 61-A (S) acelab D-1 85 104A OMR (S) 85 104B | Shuttle (S) (Challenger) | Oct 30 | | LANDED AT EAFB NOV 6, 1985 DOWN DEC 26, 1986 | | | 267.6 | 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. |
| S 61-B (S) 85 109A RELOS-B (S) 85 109B ssat-2 (S) 85 109C tcom (S) 85 109D X Target 85 109E | 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. |
| | | Nov 27 | 1436.1 | 35794 | 35780 | 1.1 | 4539.6 | |
| | | Nov 27 | 1436.2 | 35794 | 35780 | 0.0 | 4569.1 | |
| | | Nov 28 | 1436.2 | 35796 | 35781 | 0.0 | 7225.3 | |
| | | | | DOWN MAR 2, 1987 | | | | |
| -16 85 114A (S) 85 114B (S) | Scout S-207C (S) | Dec 12 | 94.6 | 691 DOWN AUG 9, 1987 | 311 | 37.1 | | Air Force instrumented test vehicle. (Dual Payload) Reimbursable. (WFF) |
| 86 | | | | | | | | 1986 |
| S 61-C (S) 86 003A COM (S) 86 003B | 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. |
| | | 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)<br>TDRS-B (U) | Shuttle (U)<br>(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)<br>1986 069A | Delta (U) | Sep 5 | | DOWN SEP 28, 1986 | | | | Carried DOD experiment. Reimbursable |
| NOAA-G (S)<br>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)<br>Polar Bear<br>1986 088A | Scout (S)<br>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)<br>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 | | | | | | | | 198 |
| GOES-H (S)<br>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<br>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)<br>(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 short after launch; destruct signal sent at 70.7 seconds into flight. An electrical transient, caused by lighting stri on launch vehicle, most probable cause of loss. Reimbursable. |
| SOOS-2<br>1987 080A (S)<br>1987 080B (S) | Scout (S)<br>S204C | Sep 16 | 107.2<br>107.2 | 1175<br>1181 | 1017<br>1014 | 90.3<br>90.3 | 64.5<br>64.5 | Two transit navigation satellites in a stacked configuration for the U.S. Navy. Reimbursable. (WSMC) |

# ASA Major Launch Record



| SSION/ tl 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) |
|---|---|---|---|---|---|---|---|---|
| 88 | | | | | | | | 1988 |
| D (SDI) (S) 88 008A | Delta 181 (S) | Feb 8 | 90.1 | 333 | 223 | 28.6 | | Strategic Defense Initiative Organization (SDIO) Payload. Reimbursable. |
| n Marco D/L(S) 38 026A | Scout (S) S-206C | Mar 25 | | DOWN DEC 6, 1988 | | | 273 | Explore the relationship between solar activity and meteorological phenomena. Cooperative with Italy. (San Marco) |
| OS-3 38 033A (S) 38 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) |
| va II 38 052A | Scout (S) S-213C | Jun 16 | | | | | 170.5 | Improved Transit Navigation Satellite for the U.S. Navy. Reimbursable. (WSMC) |
| OS-4 38 074A (S) 38 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) |
| AA-H (S), 38 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) |
| S-26 (S) 38 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. Nelson. Deployed TDRS-3. Performed experiment activities for commercial and scientific middeck experiments. Mission Duration 97 hours 00 minutes 11 seconds |
| RS-3 (S) 38 091B | | Sep 29 | 1434.8 | 35803 | 35719 | 0.1 | 2224.9 | |
| S-27 38 106A ) 38 106B | Shuttle (S) (Atlantis) | Dec 2 | | LANDED AT EAFB DEC 6, 1988 | | | | Third Atlantis flight with Robert L. Gibson, Guy S. Gardner, Richard M. Mullane, Jerry L. Ross and William M. Shepherd. DOD Mission. Mission Duration 105 hours 05 minutes 37 seconds |
| 89 | | | | | | | | 1989 |
| S-29 89 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. Deployed a new Tracking and Data Relay Satellite. Performed commercial and scientific experiments. Mission Duration 119 hours 38 minutes 52 seconds |
| TDRS-D 89 021B | | | 1436.1 | 35808 | 35768 | 0.0 | 2224 | |

# 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 note |
|---|---|---|---|---|---|---|---|---|
| STS-30<br>1989 33A<br>Magellan<br>1989 33B | Shuttle (S)<br>(Atlantis) | May 4 | LANDED AT EAFB MAY 8, 1989<br>TRANS-VENUS TRAJECTORY | | | | | Fourth Atlantis flight with David M. Walker, Ronald J. Grabe, Mary L. Cleve, Mark C. Lee, Norman E. Thagard. Deployed the Magellan spacecraft on a mission toward Venus. Performe commercial and scientific middeck experiments. Mission Duration: 96 hrs 56 mins 25 secs. |
| STS-28<br>1989 61A | Shuttle (S)<br>(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: 121 hours 00 minutes 09 seconds. |
| *FLTSATCOM*<br>1989 77A | Atlas/<br>Centaur (S) | Sep 25 | 1436.2 | 35898 | 35677 | 4.1 | 1863 | *Navy Communications satellite to provide* communications between aircraft, ships and ground stations for DOD. |
| STS-34<br>1989 84A<br>Galileo<br>1989 84B | Shuttle (S)<br>(Atlantis) | Oct 18 | LANDED AT EAFB OCT 23, 1989<br>ELEMENTS NOT AVAILABLE | | | | | Fifth Atlantis flight with Donald E. Williams, Michael J. McCulley, Ellen Baker, Shannon N. Lucid and Franklin Chang-Diaz. Deployed the Galileo spacecraft on a mission toward Jupiter. Performed experiment activities for commercial and scientific middeck experiments. Mission Duration: 119 hours 39 minutes 24 seconds. |
| COBE<br>1989 89A | Delta 2 (S) | Nov 18 | 102.6 | 889 | 877 | 99.0 | 2206 | Cosmic Background Explorer spacecraft to provid the most comprehensive observations to date of the radiative content of the universe. |
| STS-33<br>1989 90A<br>DOD<br>1989 90B | Shuttle (S)<br>(Discovery) | Nov 23 | LANDED AT EAFB NOV 28, 1989<br>ELEMENTS NOT AVAILABLE | | | | | Ninth Discovery flight with Frederick Gregory, John E. Blaha, Manly L. Carter, Franklin S. Musgrave and Kathryn C. Thorton. DOD Mission. Mission Duration: 120 hours 6 minutes 49 seconds. |

| SSION/ TL 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) |
|---|---|---|---|---|---|---|---|---|
| S-32 90 2A NCOM IV-5 90 2B | Shuttle (S) (Columbia) | Jan 9 | 1436.1 | LANDED AT EAFB JAN 20, 1990 35799 | 35744 | 3.0 | 6953.46 | Tenth Columbia flight with Daniel C. Brandenstein, James D. Wetherbee, Bonnie J. Dunbar, Marsha S. Ivins and G. David Low. Deployed SYNCOM IV-5, a geostationary communications satellite also known as LEASAT, for the U.S. Navy. Also retrieved the Long Duration Exposure Facility (LDEF) deployed on STS-41C Apr 6, 1984. Mission Duration: 261 hours 37 seconds. |
| S-36 90 19A D 90 19B | Shuttle (S) (Atlantis) | Feb 28 | | LANDED AT EAFB MAR 4, 1990 ELEMENTS NOT AVAILABLE | | | | Sixth Atlantis flight with John D. Creighton, John H. Casper, David C. Hilmers, Richard M. Mullane and Pierre J. Thuot. DOD Mission. Mission Duration: 106 hrs 18 mins 23 secs. |
| GSAT 90 28A | Pegasus (S) (Orb Sci) | Apr 5 | 95.6 | 645 | 453 | 94.1 | | A 50-foot rocket (Pegasus), dropped from the wing of a B-52 aircraft flying over the Pacific Ocean, launched the PEGSAT satellite in the first demonstration flight of the Pegasus launch vehicle. The PEGSAT science investigations are part of the Combined Release and Radiation Effects Satellite (CRRES), a joint NASA/DOD program. |
| S-31 90 37A T 90 37B | Shuttle (S) (Discovery) | Apr 24 | 97.0 | LANDED AT EAFB APR 29, 1990 619 | 610 | 28.5 | 11355.4 | Tenth Discovery flight with Loren J. Shriver, Charles F. Bolden, Bruce McCandless, Steven A. Hawley, Kathryn D. Sullivan. Deployed the Edwin P. Hubble Space Telescope (HST) astronomical observatory. Designed to operate above the Earth's turbulent and obscuring atmosphere, HST will observe celestial objects at ultraviolet, visible and near-infrared wavelengths. Joint NASA/ESA mission. Mission Duration: 121 hours 16 minutes 05 seconds. |
| CSAT 90 43A/B | Scout M-1 (S) | May 9 | 98.5 | 765 | 605 | 3.0 | 89.9 | Two Multiple Access Communications Satellites (MACSATs) to provide global store-and-forward message relay capability for DOD Users. (VAFB) |

# NASA Major Launch Record

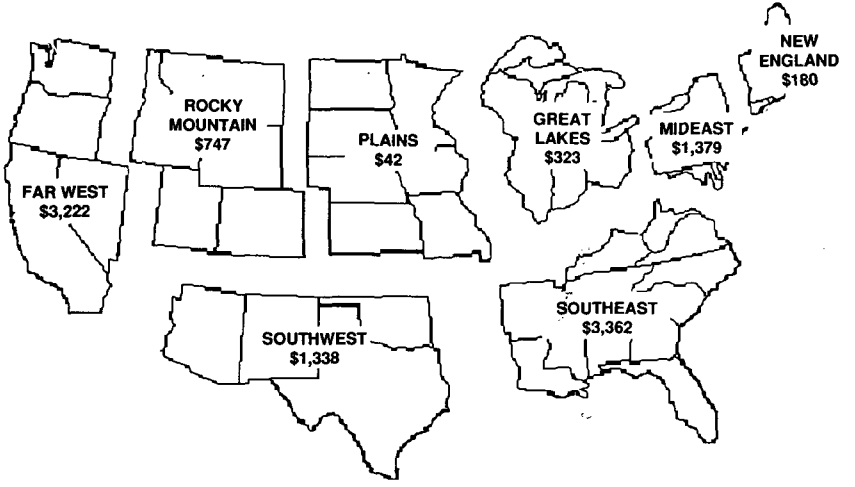


| MISSION/ INTL DESIG | LAUNCH VEHICLE | LAUNCH DATE | PERIOD (Mins) | CURRENT ORBITAL PARAMETERS (km) Apogee | Perigee | Incl (deg) | WEIGHT (kg) | REMARKS (All Launches from ESMC, unless otherwise noted) |
|---|---|---|---|---|---|---|---|---|
| ROSAT 1990 49A | Delta 2 (S) (MacDac) | Jun 1 | 96.1 | 578 | 560 | 53.0 | 2421.18 | Roentgen Satellite (ROSAT), an Explorer class scientific satellite configured to accommodate a large x-ray telescope, to study x-ray emissions from non-solar celestial objects. International cooperative program. |
| CRRES 1990 65A | Atlas/ Centaur (S) | Jul 25 | 591.0 | 33575 | 323 | 18.2 | | Combined Release and Radiation Effects Satellite (CRRES) which uses chemical releases to study the Earth's magnetic fields and the plasmas, or ionized gases, that travel through them. Joint NASA/DOD program. |
| STS-41 1990 90A Ulysses 1990 90B | Shuttle (S) (Discovery) | Oct 6 | | LANDED AT EAFB OCT 10, 1990 HELIOCENTRIC ORBIT | | | 20079.51 | Eleventh Discovery flight with Richard N. Richards, Robert D. Cabana, Bruce E. Melnick, William M. Shepard and Thomas D. Akers. Deployed the *Ulysses* spacecraft, a joint NASA/ESA mission to study the poles of the Sun and interplanetary space above and below the poles. Mission Duration: 98 hours 11 minutes. |
| STS-38 1990 97A DOD 1990 97B | Shuttle (S) (Atlantis) | Nov 15 | | LANDED AT KSC NOV 20, 1990 *ELEMENTS NOT AVAILABLE* | | | | Seventh Atlantis flight with Richard O. Covey, Robert C. Springer, Carl J. Meade, Frank L. Culbertson and Charles D. Gemar. DOD Mission. Mission Duration: 117 hours 55 minutes. |
| STS-35 1990 106A | Shuttle (S) (Columbia) | Dec 2 | | LANDED AT EAFB DEC 11, 1990 | | | | Eleventh Columbia flight with Vance D. Brand, John M. Lounge, Jeffrey A. Hoffman, Robert A. Parker, Guy S. Gardner, Ronald A. Parise and Samuel T. Durrance. Carried Astro-1, a Space Shuttle attached payload to acquire high priority astrophysical data on a variety of celestial objects. Mission Duration: 215 hour 6 minutes. |

Section C

# Procurement, Funding and Manpower

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




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

# NASA Contract Awards By State

| (FY 1990) STATE | TOTAL (THOUSANDS) | BUSINESS (THOUSANDS) | EDUCATIONAL & NONPROFIT (THOUSANDS) |
|---|---|---|---|
| Alabama | 1,121,914 | 1,101,162 | 20,752 |
| Alaska | 7,702 | 21 | 7,681 |
| Arizona | 28,028 | 6,543 | 21,485 |
| Arkansas | 197 | 15 | 182 |
| California | 3,147,758 | 2,994,879 | 152,879 |
| Colorado | 235,470 | 217,749 | 17,721 |
| Connecticut | 67,116 | 64,906 | 2,210 |
| Delaware | 2,216 | 513 | 1,703 |
| District of Columbia | 81,666 | 56,491 | 25,175 |
| Florida | 1,340,936 | 1,331,263 | 9,673 |
| Georgia | 16,653 | 10,807 | 5,846 |
| Hawaii | 7,204 | 324 | 6,880 |
| Idaho | 1,717 | --- | 1,717 |
| Illinois | 25,226 | 13,085 | 12,141 |
| Indiana | 19,455 | 14,729 | 4,726 |
| Iowa | 5,187 | 327 | 4,860 |
| Kansas | 8,727 | 7,497 | 1,230 |
| Kentucky | 2,493 | 1,444 | 1,049 |
| Louisiana | 359,370 | 358,130 | 1,240 |
| Maine | 673 | 45 | 628 |
| Maryland | 802,463 | 740,078 | 62,385 |
| Massachusetts | 96,398 | 26,302 | 70,096 |
| Michigan | 24,234 | 8,964 | 15,270 |
| Minnesota | 7,362 | 4,239 | 3,123 |
| Mississippi | 103,907 | 100,174 | 3,733 |
| Missouri | 19,794 | 16,440 | 3,354 |
| Montana | 772 | 326 | 446 |
| Nebraska | 717 | 56 | 661 |
| Nevada | 976 | 729 | 24 |
| New Hampshire | 12,517 | 3,218 | 9,29 |
| New Jersey | 186,176 | 181,017 | 5,15 |
| New Mexico | 54,456 | 47,996 | 6,46 |
| New York | 77,776 | 52,128 | 25,64 |
| North Carolina | 12,206 | 2,405 | 9,80 |
| North Dakota | 62 | --- | 6 |
| Ohio | 214,031 | 186,394 | 27,63 |
| Oklahoma | 4,041 | 531 | 3,51 |
| Oregon | 5,128 | 2,505 | 2,62 |
| Pennsylvania | 228,605 | 214,149 | 14,45 |
| Rhode Island | 3,018 | 606 | 2,41 |
| South Carolina | 1,202 | 207 | 99 |
| South Dakota | 432 | 85 | 34 |
| Tennessee | 29,535 | 23,203 | 6,33 |
| Texas | 1,250,982 | 1,175,035 | 75,94 |
| Utah | 509,201 | 507,139 | 2,06 |
| Vermont | 480 | 364 | 11 |
| Virginia | 371,805 | 338,219 | 33,58 |
| Washington | 68,013 | 60,426 | 7,58 |
| West Virginia | 1,526 | 144 | 1,38 |
| Wisconsin | 40,200 | 26,993 | 13,20 |
| Wyoming | 259 | --- | 25 |
| TOTAL | $10,607,982 | $9,900,002 | $707,98 |

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

# Procurement Activity

## TOTAL PROCUREMENT BY INSTALLATION
## (FY 1990)

| INSTALLATION | AWARDS (MILLIONS) | PERCENT |
|---|---|---|
| TOTAL | $12,565.2 | 100.0 |
| Marshall Space Flight Center | 3,154.6 | 25.1 |
| Johnson Space Center | 2,760.4 | 22.0 |
| Goddard Space Flight Center | 1,823.6 | 14.4 |
| Kennedy Space Center | 1,275.9 | 10.2 |
| NASA Resident Office/JPL | 1,138.5 | 9.1 |
| Lewis Research Center | 730.6 | 5.8 |
| Headquarters | 686.5 | 5.5 |
| Ames Research Center | 482.8 | 3.8 |
| Langley Research Center | 399.7 | 3.2 |
| Stennis Space Center | 112.6 | .9 |

## AWARDS TO BUSINESS FIRMS BY TYPE OF EFFORT
(FY 1990)

| CATAGORY | NUMBER OF CONTRACTS | TOTAL (MILLIONS) |
|---|---|---|
| TOTAL | 5,080 | 9,900.1* |
| Research and Development | 1,822 | 3,885.3 |
| Aeronautics & Space Technology | 825 | 931.0 |
| Space Science & Applications | 364 | 404.4 |
| Space Flight | 102 | 1,390.1 |
| Space Operations | 67 | 378.0 |
| Commercial Programs | 28 | 43.6 |
| Space Station | 22 | 401.3 |
| Other Space R&D | 375 | 316.4 |
| Other R&D | 39 | 20.5 |
| Services | 1,393 | 3,627.5 |
| ADP & Telecommunication | 125 | 361.6 |
| Maint., Repair & Rebldg. of Equip. | 210 | 1,041.8 |
| Operation of Gov't-owned Facilities | 41 | 366.0 |
| Professional, Admin. & Mgmt Support | 186 | 934.4 |
| Utilities & Housekeeping | 100 | 227.5 |
| Constr. of Structures & Facilities | 152 | 332.3 |
| Maint., Repair, Alter. of Real Prop. | 244 | 147.7 |
| Other Services | 335 | 216.2 |
| Supplies and Equipment | 1,865 | 2,387.3 |
| Ammunition & Explosives | 7 | 151.2 |
| Space Vehicles | 44 | 1,209.9 |
| Engines, Turbines & Components | 13 | 719.7 |
| Commun., Detection, & Coherent Radiation Equip. | 125 | 28.2 |
| Electrical & Electronic Equip. Components | 63 | 15.3 |
| Instruments & Laboratory Equipment | 363 | 34.8 |
| ADP Equip, software, Supplies& Support Equip. | 791 | 163.9 |
| Fuels, Lubricants, Oils & Waxes | 30 | 22.6 |
| Other Supplies & Equipment | 429 | 41.7 |

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

# Distribution of NASA Procurements

(In Millions of Dollars)

**Fiscal Years 1961 - 1990**

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

| | FY 73 | FY 74 | FY 75 | FY 76 | FY 7T | FY 77 | FY 78 | FY 79 | FY 80 | FY 81 | FY 82 | FY 83 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Business | 2,063.8 | 2,116.6 | 2,255.0 | 2,536.1 | 663.2 | 2,838.1 | 2,953.8 | 3,416.4 | 3,868.3 | 4,272.8 | 4,805.6 | 5,586.0 |
| (Small Business) | (155.3) | (181.2) | (216.0) | (218.3) | (68.4) | (255.0) | (281.5) | (325.4) | (384.6) | (409.4) | (430.1) | (482.3) |
| Educational | 111.7 | 97.8 | 111.4 | 123.0 | 27.7 | 125.5 | 137.2 | 147.2 | 177.0 | 192.5 | 187.0 | 211.3 |
| Nonprofit | 26.4 | 39.3 | 33.0 | 32.0 | 7.6 | 32.0 | 42.8 | 50.8 | 82.2 | 155.1 | 108.8 | 102.5 |
| JPL | 202.3 | 215.2 | 234.5 | 263.7 | 63.6 | 289.0 | 283.8 | 338.6 | 397.2 | 410.8 | 426.3 | 454.9 |
| Government | 235.2 | 208.6 | 198.3 | 222.4 | 63.9 | 223.2 | 216.0 | 221.4 | 271.8 | 321.9 | 308.1 | 394.2 |
| Outside U.S. | 34.0 | 34.1 | 34.2 | 27.4 | 3.8 | 24.5 | 26.0 | 37.4 | 46.1 | 55.2 | 47.9 | 47.9 |
| Total | 2,673.4 | 2,713.6 | 2,866.4 | 3,204.6 | 829.8 | 3,532.3 | 3,659.6 | 4,211.8 | 4,842.6 | 5,408.3 | 5,883.7 | 6,796.8 |

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

*Included in Government

# rincipal Contractors (Business Firms)

**One Hundred Contractors (Business Firms) Listed According To Total Awards Received (FY 1990)**

| CONTRACTOR AND PRINCIPLE PLACE OF CONTRACT PERFORMANCE | AWARDS (THOUSANDS) | AWARDS PERCENT |
|---|---|---|
| TAL AWARDS TO BUSINESS FIRMS | $10,071,530 | 100.00 |
| ROCKWELL INTERNATIONAL CORP<br>Downey, CA | 1,746,840 | 17.34 |
| MCDONNELL DOUGLAS CORP<br>Huntington Beach, CA | 850,639 | 8.45 |
| LOCKHEED SPACE OPERATIONS CO<br>Kennedy Space Center, FL | 583,473 | 5.79 |
| MARTIN MARIETTA CORP<br>New Orleans, LA | 507,292 | 5.04 |
| THIOKOL CORP<br>Brigham City, UT | 498,437 | 4.95 |
| GENERAL ELECTRIC CO<br>King of Prussia, PA | 401,589 | 3.99 |
| BOEING CO<br>Marshall Space Flight, AL | 398,881 | 3.96 |
| ROCKWELL SPACE OPERATIONS INC<br>Houston, TX | 308,708 | 3.07 |
| LOCKHEED MISSILES & SPACE CO<br>Marshall Space Flight, FL | 293,908 | 2.92 |
| T R W INC<br>Redondo Beach, CA | 241,408 | 2.40 |
| LOCKHEED ENGRG & SCIENCE CO<br>Houston, TX | 233,702 | 2.32 |
| U S B I BOOSTER PRODUCTION CO<br>Huntsville, AL | 232,860 | 2.31 |
| E G & G FLORIDA INC<br>Kennedy Space Center, FL | 191,087 | 1.90 |
| COMPUTER SCIENCES CORP<br>Greenbelt, MD | 182,613 | 1.81 |

| CONTRACTOR AND PRINCIPLE PLACE OF CONTRACT PERFORMANCE | | AWARDS (THOUSANDS) | AWARDS PERCENT |
|---|---|---|---|
| 15. FORD AEROSPACE CORP<br>Houston, TX | | $174,485 | 1.73 |
| 16. BOEING COMPUTER SUPPORT SERV<br>Marshall Space Flight, AL | | 164,616 | 1.63 |
| 17. BENDIX FIELD ENGINEERING CORP<br>Columbia, MD | | 155,960 | 1.55 |
| 18. UNITED TECHNOLOGIES CORP<br>West Palm Beach, FL | | 136,099 | 1.35 |
| 19. INTERNATIONAL BUSINESS MACHINES<br>Houston, TX | | 101,521 | 1.01 |
| 20. GRUMMAN AEROSPACE CORP<br>Reston, Va | | 85,637 | .85 |
| 21. SVERDRUP TECHNOLOGY INC<br>Middleburgh Heights, OH | | 79,373 | .79 |
| 22. TELEDYNE INDUSTRIES INC<br>Marshall Space Flight, AL | | 73,426 | .73 |
| 23. CONTEL CORP<br>Gaithersburg, MD | | 64,952 | .64 |
| 24. PAN AMERICAN WORLD SERV INC<br>Stennis Space Center, MS | | 64,794 | .64 |
| 25. CAE LINK CORP<br>Houston, TX | | 53,038 | .53 |
| 26. FAIRCHILD INDUSTRIES INC<br>Germantown, MD | | 44,340 | .44 |
| 27. CRAY RESEARCH INC<br>Chippewa Falls, WI | | 43,135 | .43 |
| 28. BAMSI INC<br>Marshall Space Flight, AL | (D) | 38,367 | .38 |
| 29. N S I TECHNOLOGY SERV CORP<br>Moffett Field, CA | | 37,597 | .37 |

# Principal Contractors (Business Firms)

**One Hundred Contractors (Business Firms) Listed According To Total Awards Received (Cont)**
**(FY 1990)**

| CONTRACTOR AND PRINCIPLE PLACE OF CONTRACT PERFORMANCE | | AWARDS (THOUSANDS) | AWARDS PERCENT |
|---|---|---|---|
| 30. UNISYS CORP Greenbelt, MD | | $37,003 | .37 |
| 31. BIONETICS CORP Marshall Space Flight, AL | (S) | 36,398 | .36 |
| 32. ORBITAL SCIENCES CORP Denver, CO | (S) | 34,848 | .35 |
| 33. GENERAL DYNAMICS CORP San Diego, CA | | 33,696 | .33 |
| 34. S T SYSTEMS CORP Greenbelt, MD | (S) (D) | 32,693 | .32 |
| 35. STODDARD HAMILTON AIRCRAFT Arlington, WA | (S) | 32,575 | .32 |
| 36. STERLING SOFTWARE INC Moffett Field, CA | | 32,180 | .32 |
| 37. PLANNING RESEARCH CORP Washington, DC | | 29,732 | .30 |
| 38. RAYTHEON SERVICE CO Greenbelt, MD | | 29,701 | .29 |
| 39. GRUMMAN DATA SYSTEMS CORP Marshall Space Flight, AL | | 27,976 | .28 |
| 40. CORTEZ III SERVICE CORP Cleveland, OH | (S) (D) | 27,357 | .27 |
| 41. AEROJET GENERAL CORP Nimbus, CA | | 24,966 | .25 |
| 42. HARRIS SPACE SYSTEMS CORP Rockledge, FL | | 24,642 | .24 |
| 43. KRUG INTERNATIONAL CORP Houston, TX | | 24,010 | .24 |
| 44. HUGHES DANBURY OPTICAL SYS Danbury, CT | | 23,337 | .23 |
| 45. AIR PRODUCTS & CHEMICALS INC Allentown, PA | | $19,558 | .19 |
| 46. BALL CORP Boulder, CO | | 19,465 | .19 |
| 47. NORTHROP WORLDWIDE AIRCRAFT Houston, TX | | 19,235 | .19 |
| 48. LOCKHEED CORP Burbank, CA | | 17,880 | .18 |
| 49. HONEYWELL FEDERAL SYSTEMS INC Kennedy Space Center, FL | | 17,540 | .17 |
| 50. ANALEX CORP Fairview Park, OH | | 17,437 | .17 |
| 51. DIGITAL EQUIPMENT CORP Greenbelt, MD | | 17,044 | .17 |
| 52. JOHNSON ENGINEERING CORP Houston, TX | (S) | 16,378 | .16 |
| 53. BOEING AEROSPACE OPERATN INC Houston, TX | | 16,361 | .16 |
| 54. SCIENCE APPLICATION INTL CORP Washington, DC | | 15,728 | .16 |
| 55. ENGINEERING & ECONOMICS RES Beltsville, MD | (S) (D) | 15,604 | .15 |
| 56. WYLE LABORATORIES Hampton, VA | | 15,458 | .15 |
| 57. SILICON GRAPHICS INC Mountain View, CA | (S) | 15,242 | .15 |
| 58. SYSTOLIC SYSTEMS INC Moffett Field, CA | (S) (D) | 15,137 | .15 |
| 59. CALSPAN CORP Moffet Field, CA | | 15,120 | .15 |

# Principal Contractors (Business Firms)

**One Hundred Contractors (Business Firms) Listed According to Total Awards Received (Cont) (FY 1990)**

| CONTRACTOR AND PRINCIPLE PLACE OF CONTRACT PERFORMANCE | | | AWARDS (THOUSANDS) | AWARDS PERCENT |
|---|---|---|---|---|
| 60. QUAD S CO<br>Moffett Field, CA | (S) | | $15,004 | .15 |
| 61. BATESON J W CO INC<br>Houston, TX | | | 14,883 | .15 |
| 62. INDUSTRIAL AMELCO JV<br>Marshall Space Flight, AL | (S) | | 14,724 | .15 |
| 63. OGDEN LOGISTICS SERVICES<br>Greenbelt, MD | | | 13,815 | .14 |
| 64. PIONEER CONTRACT SERVICES INC<br>Houston, TX | (S) | | 13,731 | .14 |
| 65. BARRIOS TECHNOLOGY INC<br>Houston, TX | (S) | | 13,404 | .13 |
| 66. MICRO CRAFT INC<br>Tullahoma, TN | (S) | | 12,801 | .13 |
| 67. FLUOR CONSTRUCTORS INTL INC<br>Stennis Space Flight, AL | | | 11,961 | .12 |
| 68. VIRGINIA ELECTRIC & POWER CO<br>Hampton, Va | | | 11,680 | .12 |
| 69. UNIVERSAL CONSTRUCTION CO INC<br>Marshall Space Flight, AL | | | 11,545 | .11 |
| 70. COLEJON MECHANICAL CORP<br>Cleveland, OH | (S) | (D) | 11,371 | .11 |
| 71. COMMUNICATIONS SATELLITE CORP<br>Clarksburg, MD | | | 11,182 | .11 |
| 72. WARNER R E & ASSOCIATES<br>Lorain, OH | (S) | | 11,008 | .11 |
| 73. BOOZ ALLEN & HAMILTON INC<br>Bethesda, MD | | | 10,801 | .11 |
| 74. L T V AEROSPACE & DEFENSE CO<br>Dallas, TX | | | 10,743 | .11 |
| 75. ADVANCED TECHNOLOGY INC<br>Marshall Space Flight, AL | | | $10,607 | .11 |
| 76. CLEVELAND ELECTRIC ILLUMINATG<br>Cleveland, OH | | | 10,421 | .10 |
| 77. VITRO CORP<br>Washington, DC | | | 10,202 | .10 |
| 78. B D M INTERNATIONAL INC<br>Columbia, MD | | | 9,455 | .09 |
| 79. HERNANDEZ ENGINEERING INC<br>Houston, TX | (S) | (D) | 8,982 | .09 |
| 80. C B I NA CON INC<br>Hampton, VA | | | 8,946 | .09 |
| 81. CATES CONSTRUCTION INC<br>Edwards, CA | | | 8,611 | .09 |
| 82. DICKMAN NOURSE INC<br>Moffett Field, CA | | | 8,544 | .08 |
| 83. R M S ASSOCIATES INC JV<br>Linthicum, MD | | (D) | 8,466 | .08 |
| 84. GENERAL MOTORS CORP<br>Indianapolis, IN | | | 8,384 | .08 |
| 85. STELLACOM INC<br>Houston, TX | (S) | | 8,260 | .08 |
| 86. MASON & HANGER SERVICES INC<br>Hampton, VA | | | 8,251 | .08 |
| 87. COMPUTER SCIENCES PAN AM SERV<br>Slidell, LA | | | 8,214 | .08 |
| 88. KELSEY SEYBOLD CLINIC<br>Houston, TX | | | 8,070 | .08 |
| 89. OSTERLAND G R CO<br>Cleveland, OH | (S) | | 8,056 | .08 |

# Principal Contractors (Business Firms)

**One Hundred Contractors(Business Firms) Listed According to Total Awards Received (FY 1990)**

| CONTRACTOR AND PRINCIPLE PLACE OF CONTRACT PERFORMANCE | | AWARDS (THOUSANDS) | PERCENT |
|---|---|---|---|
| 90. DYNAMIC ENGINEERING INC Newport News, VA | (S) | $7,968 | .08 |
| 91. JACKSON & TULL INC Greenbelt, MD | (S) (D) | 7,965 | .08 |
| 92. CENTENNIAL CONTRACTORS INC Greenbelt, MD | | 7,360 | .07 |
| 93. HUGHES AIRCRAFT CO Torance, CA | | 7,362 | .07 |
| 94. S Y R E JV Moffett Field, Ca | | 7,279 | .07 |
| 95. SCIENCE SYSTEMS APLICATIONS Seabrook, MD | (S) (D) | 7,108 | .07 |
| 96. PERKIN ELMER CORP Pomona, CA | | 7,059 | .07 |
| 97. R M S TECHNOLOGIES INC Cleveland, OH | (S) (D) | 7,058 | .07 |
| 98. W & J CONSTRUCTION CORP Kennedy Space Center, FL | | 6,964 | .07 |
| 99. HERCULES INC Magna, UT | | 6,945 | .07 |
| 100. EATON CORP Farmingdale, NY | | 6,830 | .07 |
| OTHER* | | 976,432 | 9.70 |

*(S=Small Business/D=Disadvantaged Business)*

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

# Educational and Nonprofit Institutions

**One Hundred Educational and Nonprofit Institutions Listed According to Total Awards Received * (FY 1990)**

| *INSTITUTION AND PRINCIPLE* PLACE OF PERFORMANCE | | AWARDS (THOUSANDS) | PERCENT |
|---|---|---|---|
| TOTAL AWARDS TO EDUCATIONAL & NONPROFIT INSTITUTIONS | | $714,166 | 100.00 |
| 1. STANFORD UNIV Stanford, CA | | 49,144 | 6.88 |
| 2. ASSN UNIV RESEARCH & ASTRON *Baltimore, MD* | (N) | 31,592 | 4.42 |
| 3. SMITHSONIAN INSTITUTION Cambridge, MA | (N) | 26,465 | 3.71 |
| 4. UNIVERSITIES SPACE RESEARCH Houston, TX | (N) | 24,099 | 3.37 |
| 5. MITRE CORP Houston, TX | (N) | 22,805 | 3.19 |
| 6. MASS INSTITUTE OF TECHNOLOGY Cambridge, MA | | 21,242 | 2.97 |
| 7. UNIV CALIFORNIA BERKELEY Berkeley, CA | | 19,403 | 2.72 |
| 8. UNIV ARIZONA Tucson, AZ | | 18,887 | 2.64 |
| 9. UNIV MARYLAND COLLEGE PARK College Park, MD | | 17,920 | 2.51 |
| 10. NEW MEXICO STATE UNIV LAS CRU Palestine, TX | | 16,455 | 2.30 |
| 11. UNIV ALABAMA HUNTSVILLE Huntsville, AL | | 15,818 | 2.21 |
| 12. CHARLES STARK DRAPER LAB INC Cambridge, MA | (N) | 13,622 | 1.91 |
| 13. UNIV COLORADO BOULDER Boulder, CO | | 12,717 | 1.78 |
| 14. UNIV CALIF SAN DIEGO La Jolla, CA | | 12,688 | 1.78 |

# Educational and Nonprofit Institutions

**One Hundred Educational And Nonprofit Institutions Listed According to Total Awards Received (Cont)* (FY 1990)**

| INSTITUTION AND PRINCIPLE PLACE OF PERFORMANCE | | AWARDS (THOUSANDS) | AWARDS PERCENT |
|---|---|---|---|
| 15. UNIV WISCONSIN MADISON<br>Madison, WI | | 12,458 | 1.74 |
| 16. SOUTHWEST RESEARCH INSTITUTE<br>San Antonio, TX | | 11,775 | 1.65 |
| 17. NATIONAL ACADEMY SCIENCES<br>Washington, DC | (N) | 10,894 | 1.53 |
| 18. UNIV MICHIGAN ANN ARBOR<br>Ann Arbor, MI | (N) | 10,420 | 1.46 |
| 19. CALIF INSTITUTE TECHNOLOGY<br>Pasadena, CA | | 9,632 | 1.35 |
| 20. UNIV NEW HAMPSHIRE<br>Durham, NH | | 8,384 | 1.17 |
| 21. PENNSYLVANIA STATE UNIV UP<br>University Park, Pa | | 7,872 | 1.10 |
| 22. UNIV ALASKA FAIRBANKS<br>Fairbanks, AK | | 7,681 | 1.08 |
| 23. CASE WESTERN RESERVE UNIV<br>Cleveland, OH | | 7,573 | 1.06 |
| 24. UNIV HOUSTON CLEAR LAKE<br>Houston, TX | | 7,400 | 1.04 |
| 25. UNIV CALIF LOS ANGELES<br>Los Angeles, CA | | 7,337 | 1.03 |
| 26. UNIV WASHINGTON<br>Seattle, WA | | 7,151 | 1.00 |
| 27. UNIV HAWAII<br>Honolulu, HI | | 6,880 | .96 |
| 28. UNIV TEXAS AUSTIN<br>Austin TX | | 6,785 | .95 |
| 29. UNIV CHICAGO<br>Chicago, IL | | 6,244 | .87 |
| 30. CORNELL UNIV<br>Ithaca, NY | | 5,968 | .84 |
| 31. BATELLE MEMORIAL INSTITUTE<br>Columbus, OH | (N) | 5,566 | .78 |
| 32. COLUMBIA UNIV<br>New York, NY | | 5,500 | .77 |
| 33. UNIV SOUTHERN CALIF<br>Los Angeles, CA | | 5,453 | .76 |
| 34. SAN JOSE STATE UNIV<br>Moffett Field, CA | | 5,175 | .72 |
| 35. UNIV VIRGINIA<br>Charlottesville, VA | | 5,054 | .71 |
| 36. UNIV HOUSTON<br>Houston, TX | | 4,919 | .69 |
| 37. JOHNS HOPKINS UNIV<br>Baltimore, MD | | 4,918 | .69 |
| 38. OHIO STATE UNIV<br>Columbus, OH | | 4,638 | .65 |
| 39. OLD DOMINION UNIV<br>Norfolk, VA | | 4,279 | .60 |
| 40. UNIV IOWA<br>Iowa City, IA | | 4,149 | .58 |
| 41. PRINCETON UNIV<br>Princeton, NJ | | 4,123 | .58 |
| 42. VIRGINIA POLYTECHNIC INSTITUTE<br>Blacksburg, VA | | 4,120 | .58 |
| 43. UNIV ILLINOIS URBANA<br>Urbana, IL | | 3,974 | .56 |
| 44. NORTH CAROLINA STATE UNIV<br>Raleigh, NC | | 3,951 | .55 |

**One Hundred Educational And Nonprofit Institutions Listed According to Total Awards Received (Cont)* (FY 1990)**

| | INSTITUTION AND PRINCIPLE PLACE OF PERFORMANCE | | AWARDS (THOUSANDS) | PERCENT |
|---|---|---|---|---|
| 45. | GEORGIA INSTITUTE TECHNOLOGY<br>Atlanta, GA | (N) | $3,908 | .55 |
| 46. | HARVARD UNIV<br>Cambridge, MA | (N) | 3,884 | .54 |
| 47. | AMERICAN INSTIT AERON & ASTRO<br>New York, NY | (N) | 3,844 | .54 |
| 48. | S E T I INSTITUTE<br>Moffett Field, CA | (N) | 3,648 | .51 |
| 49. | HAMPTON CITY<br>Hampton, VA | | 3,491 | .49 |
| 50. | S R I INTERNATIONAL CORP<br>Menlo Park, CA | (N) | 3,477 | .48 |
| 51. | TEXAS A & M UNIV<br>el Paso, TX | (N) | 3,399 | .48 |
| 52. | RESEARCH TRIANGLE INSTITUTE<br>Research Triangle, NC | | 3,255 | .46 |
| 53. | ELORET INSTITUTE<br>Moffett Field, Ca | | 3,199 | .45 |
| 54. | UNIV MINNESOTA MINNPL ST PAUL<br>Minneapolis, MN | | 3,108 | .44 |
| 55. | UNIV ALABAMA BIRMINGHAM<br>Birmingham, AL | | 3,061 | .43 |
| 56. | AUBURN UNIV AUBURN<br>Auburn, AL | | 3,051 | .43 |
| 57. | CLEVELAND STATE UNIV<br>Cleveland, OH | | 2,836 | .40 |
| 58. | CARNEGIE MELLON UNIV<br>Pittsburgh, PA | | 2,822 | .40 |
| 59. | SAGINAW VALLEY STATE UNIV<br>University Center, MI | | 2,800 | .39 |
| 60. | OKLAHOMA STATE UNIV<br>Stillwater, OK | | 2,754 | .39 |
| 61. | WASHINGTON UNIV ST LOUIS<br>St. Louis, MO | | 2,739 | .38 |
| 62. | VANDERBILT UNIV<br>Nashville, TN | | 2,702 | .38 |
| 63. | UNIV FLORIDA<br>Gainesville, FL | | 2,698 | .38 |
| 64. | GEORGE WASHINGTON UNIV<br>Washington, DC | | 2,574 | .36 |
| 65. | UNIV CALIF SANTA BARBARA<br>Santa Barbara, CA | | 2,444 | .34 |
| 66. | COLORADO STATE UNIV<br>Fort Collins, CO | | 2,379 | .33 |
| 67. | PURDUE UNIV<br>West Lafayette, IN | | 2,315 | .32 |
| 68. | UNIV CINCINNATI<br>Cincinnati, OH | | 2,248 | .31 |
| 69. | HAMPTON UNIV<br>Hampton, VA | | 2,198 | .31 |
| 70. | AEROSPACE CORP<br>El Segundo, CA | (N) | 2,172 | .30 |
| 71. | UNIV TEXAS DALLAS<br>Dallas, TX | | 2,155 | .30 |
| 72. | NORTH CAROLINA A & T STATE UNIV<br>Greensboro, NC | | 2,130 | .30 |
| 73. | PUBLIC SERV SATELLITE CONSORT<br>Washington, DC | (N) | 2,106 | .29 |
| 74. | OREGON STATE UNIV<br>Corvallis, OR | | 2,057 | .29 |

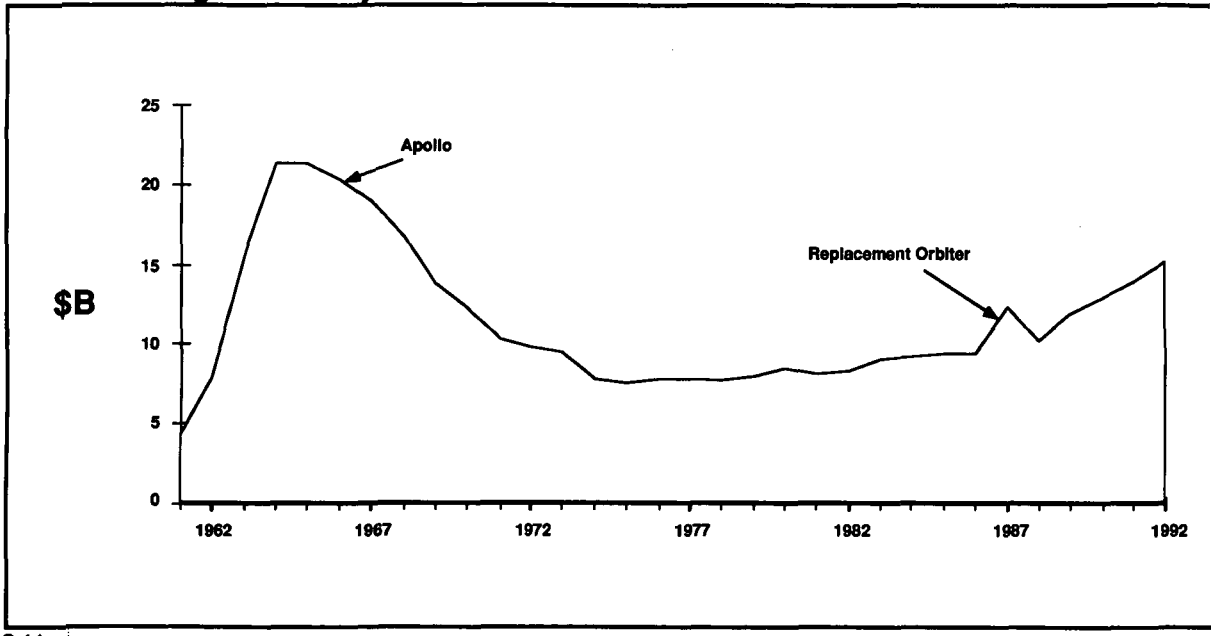
## One Hundred Educational and Nonprofit Institutions Listed According to Total Awards Received (Cont)* (FY 1990)

| | INSTITUTION AND PRINCIPLE PLACE OF PERFORMANCE | | AWARDS (THOUSANDS) | AWARDS PERCENT |
|---|---|---|---|---|
| 85. | ARIZONA STATE UNIV<br>Tempe, AZ | | 1,964 | .28 |
| 86. | UNIV PITTSBURGH<br>Pittsburgh, PA | | 1,930 | .27 |
| 87. | CLARKSON UNIV<br>Potsdam, NY | | 1,889 | .26 |
| 88. | RENSSELAER POLY INST NY<br>Troy, NY | | 1,849 | .26 |
| 89. | RICE UNIV<br>Houston, TX | | 1,842 | .26 |
| 90. | UNIV MIAMI<br>Miami, FL | | 1,836 | .26 |
| 91. | UNIV MASS AMHERST<br>Amherst, MA | | 1,830 | .26 |
| 92. | UNIV IDAHO<br>Moscow, ID | | 1,726 | .24 |
| 93. | UNIV CORP ATMOSPHERIC RESRCH<br>Boulder, CO | (N) | 1,663 | .23 |
| 94. | STATE UNIV NEW YORK STONY BROOK<br>Stony Brook, NY | | 1,654 | .23 |
| 95. | MCAT INSTITUTE<br>Moffett Field, CA | (N) | 1,608 | .23 |
| 96. | UNIV CALIF IRVINE<br>Irvine, CA | | 1,549 | .22 |
| 97. | UNIV NEW MEXICO<br>Albuquerque, NM | | 1,546 | .22 |
| 98. | STATE UNIV NEW YORK ALBANY<br>Albany, NY | | 1,476 | .21 |
| 99. | UNIV CALIF DAVIS<br>Davis, CA | | 1,462 | .20 |
| 90. | UNIV TENNESSEE KNOXVILLE<br>Tullahoma, TN | | 1,449 | .20 |
| 91. | FOOTHILL COLLEGE<br>Moffett field, CA | | 1,446 | .20 |
| 92. | INSTITUTE TECHNOLOGY DEVELOP<br>Jackson, MS | (N) | 1,410 | .20 |
| 93. | UNIV CENTRAL FLORIDA<br>Orlando, FL | | 1,410 | .20 |
| 94. | OHIO AEROSPACE INSTITUTE<br>Brook Park, OH | (N) | 1,354 | .19 |
| 95. | UTAH STATE UNIV<br>Logan, UT | | 1,352 | .19 |
| 96. | BROWN UNIV<br>Providence, RI | | 1,327 | .19 |
| 97. | UNIV AKRON<br>Akron, OH | | 1,320 | .18 |
| 98. | HOWARD UNIV<br>Washington, DC | | 1,267 | .18 |
| 99. | UNIV DELAWARE<br>Newark, DE | | 1,253 | .18 |
| 100. | UNIV DENVER<br>Denver, CO | | 1,233 | .17 |
| | Other** | | 84,967 | 11.90 |

*Excludes JPL

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

# NASA's Budget Authority in 1991 Dollars



# Financial Summary

(In Millions of Dollars)

| FY | TOTAL APPROPRIATIONS | TOTAL DIRECT OBLIGATIONS | OUTLAYS | | | | | AS OF SEP 1990 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | TOTAL | RESEARCH & DEVELOPMENT | SFC & D COMMUNICATIONS | CONSTRUCTION OF FACILITIES | RESEARCH & PROGRAM MANAGEMENT | TRUST FUNDS | OFFICE OF INS. GEN. |
| 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 | - | 66.30 | 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 | 3,258.20 | 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 | 4,083.70 | 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 | - |
| 1990 | 12,397.87 | 13,068.93 | 12,428.83 | 5,094.30 | 5,116.52 | 218.42 | 1,991.09 | 1.00 | 7.50 |

# Research And Development Funding By Program

| (In Millions of Dollars) | FY 1990 | FY 1989 | FY 1988 | FY 1987 | FY 1986 | FY 1985 | FY 1984 | FY 1983 | FY 1982 | FY 1981 | FY 1980 | FY 1979 | As Of September 1990 FY 1978 | FY 1977 & Prior |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SPACE STATION** | 1,723.70 | 884.60 | 387.40 | 414.50 | 197.80 | 153.60 | – | – | – | – | – | – | – | – |
| **SPACE FLIGHT** | | | | | | | | | | | | | | |
| Space Shuttle | – | – | – | – | – | – | – | 1,696.20 | 2,098.10 | 1,994.70 | 1,870.30 | 1,637.60 | 1,348.80 | 4,599.90 |
| Space Transp Cap Dev | 546.10 | 660.40 | 585.80 | 522.30 | 390.00 | 387.80 | 446.10 | 1,771.50 | 902.20 | 676.20 | 446.60 | 299.70 | 263.80 | 3,946.30 |
| STS Oper Capability Dev | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (278.80) | (201.50) | (223.50) | (112.90) | (89.90) | (65.40) | (65.40) |
| Spacelab | (93.70) | (87.60) | (66.50) | (72.00) | (77.30) | (55.60) | (111.00) | (--) | (--) | (--) | (--) | (--) | (--) | (--) |
| Upper Stages | (79.70) | (131.60) | (142.20) | (152.00) | (113.60) | (135.80) | (157.70) | (--) | (--) | (--) | (--) | (--) | (--) | (--) |
| Payload Oper & Support Eqt | (58.40) | (53.10) | (74.10) | (34.10) | (54.20) | (54.50) | (59.60) | (--) | (--) | (--) | (--) | (--) | (--) | (--) |
| Eng & Tech Base (ETB)/DTMS | (181.60) | (160.60) | (133.90) | (133.40) | (105.50) | (105.60) | (93.10) | (70.20) | (182.90) | (183.50) | (172.60) | (177.20) | (171.90) | (1,050.80) |
| Advanced Programs | (29.70) | (47.70) | (46.40) | (37.70) | (19.40) | (20.50) | (21.40) | (12.60) | (9.70) | (8.80) | (13.00) | (7.00) | (10.00) | (188.80) |
| Advanced Launch Systems | (--) | (80.40) | (64.30) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) |
| Tethered Satellite Program | (27.30) | (26.40) | (12.10) | (10.60) | (15.00) | (15.80) | (3.30) | (--) | (--) | (--) | (--) | (--) | (--) | (--) |
| Orbital Maneuvering Veh (OMV | (75.70) | (73.00) | (46.30) | (82.50) | (5.00) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) |
| STS Operations | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (1,409.90) | (508.10) | (260.40) | (148.10) | (25.60) | (16.50) | (--) |
| Skylab | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (2,427.10) |
| Appollo Soyuz Test Project | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (214.20) |
| Expendable Launch Vehicles | – | – | – | – | – | – | – | 82.90 | 31.10 | 54.40 | 67.40 | 73.60 | 136.50 | 2,276.80 |
| Completed Programs | – | – | – | – | – | – | – | – | – | – | – | – | – | 22,020.50 |
| Apollo | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (20,444.00) |
| Gemini | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (1,280.70) |
| Others | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (295.80) |
| **TOTAL OSF** | 546.10 | 660.40 | 585.80 | 522.30 | 390.00 | 387.80 | 446.10 | 3,550.60 | 3,031.40 | 2,725.30 | 2,384.30 | 2,010.90 | 1,749.10 | 32,843.50 |
| **COMMERCIAL PROGRAMS** | | | | | | | | | | | | | | |
| Technology Utilization | 23.40 | 16.30 | 18.80 | 15.50 | 10.40 | 9.40 | 9.00 | 9.00 | 8.00 | 8.80 | 12.00 | 9.10 | 9.10 | 75.30 |
| Commercial Use of Space | 32.40 | 27.80 | 29.30 | 23.60 | 16.00 | – | – | – | – | – | – | – | – | – |
| **Total OCP** | 55.80 | 44.10 | 48.10 | 39.10 | 26.40 | 9.40 | 9.00 | 9.00 | 8.00 | 8.80 | 8.812.0 | 9.10 | 9.10 | 75.30 |

# Research And Development Funding By Program

(In Millions of Dollars)

| | FY 1990 | FY 1989 | FY 1988 | FY 1987 | FY 1986 | FY 1985 | FY 1984 | FY 1983 | FY 1982 | FY 1981 | FY 1980 | FY 1979 | As Of September 1990 FY 1978 | FY 1977 & Prior |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AERONAUTICS AND SPACE TECHNOLOGY** | | | | | | | | | | | | | | |
| **Current Programs** | | | | | | | | | | | | | | |
| Space Research & Technology | 273.80 | 273.70 | 217.10 | 164.50 | 148.10 | 141.00 | 130.30 | 121.20 | 106.90 | 107.80 | 111.80 | 98.30 | 88.70 | 431.60 |
| Aeronautical Research & Tech | 431.60 | 384.60 | 320.20 | 360.50 | 324.30 | 328.30 | 296.70 | 274.50 | 261.10 | 268.80 | 306.30 | 264.10 | 228.00 | 1,022.00 |
| Transatmospheric Res & Tech | 58.30 | 68.50 | 51.90 | 44.40 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Energy Tech. Applications | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1.90 | 3.00 | 5.00 | 7.50 | 20.80 |
| **Prior Programs** | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Apollo Applications Expr | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1.00 |
| Chemical & Solar Power | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 62.30 |
| Basic Research | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 193.50 |
| Space Vehicle Systems | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 332.30 |
| Electronic Systems | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 272.00 |
| Human Factor Systems | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 151.30 | -- |
| Space Power & Elec Prop Sys | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 385.40 |
| Nuclear Rockets | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 512.90 |
| Chemical Propulsion | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 365.40 |
| Aeronautical Vehicles | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 451.20 |
| Nuclear Power & Propulsion | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 44.10 |
| Mission Analysis | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 16.00 |
| TOTAL OAST | 763.70 | 726.80 | 589.20 | 569.40 | 472.40 | 469.30 | 427.00 | 395.70 | 368.00 | 378.50 | 423.10 | 367.40 | 324.20 | 4,261.90 |
| **SPACE TRACKING & DATA SYSTEMS** | | | | | | | | | | | | | | |
| Tracking and Data Acquisition | 19.10 | 18.60 | 17.70 | 16.90 | 15.30 | 14.70 | 14.10 | 496.30 | 401.30 | 339.80 | 332.10 | 299.90 | 276.30 | 3,852.90 |
| **SAFETY, RELIABILITY, MAINTAINABILITY & QUALITY ASSURANCE** | | | | | | | | | | | | | | |
| Standards and Practices | 22.30 | 22.10 | 13.90 | 11.90 | 7.50 | 4.80 | 4.60 | 3.00 | 3.00 | 2.10 | 3.80 | 9.00 | 9.00 | 24.20 |
| **UNIVERSITY SPACE SCIENCE & TECHNOLOGY ACADEMIC PROGRAM** | | | | | | | | | | | | | | |
| Academic Programs | 23.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Minority University Res. Prog. | 14.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| TOTAL U.S.S.&T.A.P. | 37.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

# Research And Development Funding By Program

| (In Millions of Dollars) | FY 1990 | FY 1989 | FY 1988 | FY 1987 | FY 1986 | FY 1985 | FY 1984 | FY 1983 | FY 1982 | FY 1981 | FY 1980 | FY 1979 | As Of September 1990 FY 1978 | FY 1977 & Prior |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SPACE SCIENCE AND APPLICATIONS** | | | | | | | | | | | | | | |
| Current Programs | | | | | | | | | | | | | | |
| Physics & Astronomy | 847.10 | 712.10 | 596.20 | 528.50 | 554.60 | 654.70 | 558.60 | 480.80 | 318.20 | 320.00 | 335.60 | 281.80 | 223.10 | 2,191.20 |
| Planetary Exploration | 380.90 | 405.90 | 323.50 | 362.20 | 349.10 | 286.50 | 216.10 | 180.00 | 205.00 | 174.10 | 219.40 | 181.90 | 146.70 | 3,550.90 |
| Life Sciences | 104.70 | 78.10 | 72.10 | 70.20 | 65.00 | 61.90 | 57.60 | 55.60 | 39.50 | 42.20 | 43.80 | 40.10 | 33.30 | 145.80 |
| Space Applications | 632.00 | 578.30 | 557.40 | 550.60 | 478.40 | 367.60 | 309.50 | 311.40 | 325.00 | 325.70 | 328.50 | 271.90 | 232.10 | 2,093.20 |
| Prior Programs | | | | | | | | | | | | | | |
| Manned Space Science | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 46.40 |
| Launch Vehicle Development | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 614.40 |
| Bioscience | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 257.80 |
| Space Flight Operations | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 4.00 | 58.30 |
| Payload, Plan & Prog Integ | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (--) | (4.00) | (58.30) |
| **TOTAL OSSA** | 1,964.70 | 1,774.40 | 1,549.20 | 1,511.50 | 1,447.10 | 1,370.70 | 1,141.80 | 1,027.80 | 887.70 | 862.00 | 927.30 | 775.70 | 639.20 | 8,958.00 |
| **UNIVERSITY AFFAIRS** | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 229.20 |
| **OPERATING ACCOUNT** | 95.20 | 103.50 | 63.60 | 68.10 | 59.60 | 55.00 | 23.60 | 33.10 | 23.60 | 17.80 | 5.50 | 5.20 | 4.70 | 229.20 |
| **TOTAL PROGRAM** | 5,227.60 | 4,234.50 | 3,254.80 | 3,153.70 | 2,616.10 | 2,465.30 | 2,066.20 | 5,515.50 | 4,723.00 | 4,334.30 | 4,088.10 | 3,477.20 | 3,011.60 | 50,474.20 |
| Approp Trans & Adjustment | 54.20 | -45.90 | 19.30 | -26.00 | 19.00 | -2.70 | -54.30 | 27.30 | 17.90 | 2.00 | 3.00 | 0.00 | 1.40 | 301.00 |
| **Appropriation** | 5,281.80 | 4,188.60 | 3,274.10 | 3,127.70 | 2,635.10 | 2,462.60 | 2,011.90 | 5,542.80 | 4,740.90 | 4,336.30 | 4,091.10 | 3,477.20 | 3,013.00 | 50,775.20 |
| Laps Unoblg Bal Incl | -- | (0.50) | (1.10) | (4.40) | (3.00) | (2.00) | (3.00) | (2.00) | (3.00) | (6.00) | (1.00) | (3.00) | (3.00) | -- |

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

# esearch And Development Funding By Location

Millions of Dollars)

As of September 1990

| | FY 1990 | FY 1989 | FY 1988 | FY 1987 | FY 1986 | FY 1985 | FY 1984 | FY 1983 | FY 1982 | FY 1981 | FY 1980 | FY 1979 | FY 1978 | FY 1977 & Prior |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| adquarters | 465.60 | 403.50 | 332.80 | 258.20 | 175.80 | 150.30 | 141.80 | 218.40 | 152.60 | 136.00 | 132.50 | 115.30 | 95.00 | 2,254.50 |
| es Research Center | 311.30 | 295.10 | 261.70 | 292.10 | 241.50 | 223.50 | 196.80 | 180.60 | 162.90 | 141.00 | 147.50 | 140.40 | 115.50 | 1,183.30 |
| yden Flight Research Facility | -- | -- | -- | -- | -- | -- | -- | -- | 11.90 | 18.40 | 16.60 | 13.10 | 18.60 | 242.00 |
| ctronics Research Center | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 82.50 |
| ddard Space Flight Center | 915.30 | 743.70 | 510.90 | 488.80 | 522.60 | 447.10 | 361.60 | 816.30 | 744.00 | 567.60 | 552.00 | 516.80 | 492.90 | 6,400.30 |
| t Propulsion Laboratory | 571.80 | 581.60 | 490.30 | 466.80 | 451.90 | 347.80 | 253.70 | 308.20 | 316.40 | 262.80 | 320.50 | 236.80 | 201.40 | 3,018.40 |
| hnson Space Center | 1,014.20 | 572.60 | 334.80 | 331.00 | 249.50 | 235.20 | 174.90 | 1,593.00 | 1,557.20 | 1,524.50 | 1,398.30 | 1,161.80 | 970.70 | 15,424.00 |
| nnedy Space Center | 149.90 | 116.20 | 90.50 | 57.30 | 71.10 | 49.00 | 55.70 | 529.30 | 420.50 | 365.40 | 300.60 | 234.90 | 170.00 | 2,503.50 |
| ngley Research Center | 258.60 | 245.90 | 199.00 | 221.10 | 175.20 | 177.70 | 140.40 | 131.90 | 130.50 | 143.30 | 168.20 | 138.20 | 157.10 | 2,323.50 |
| wis Research Center | 483.20 | 393.70 | 257.30 | 286.80 | 257.10 | 325.10 | 292.80 | 269.90 | 178.40 | 163.30 | 170.40 | 148.50 | 133.60 | 2,868.30 |
| rshall Space Flight Center | 945.10 | 870.00 | 760.90 | 730.10 | 465.30 | 503.20 | 443.50 | 1,702.10 | 1,238.50 | 1,005.90 | 888.20 | 785.20 | 630.90 | 13,292.20 |
| SA Pasadena Office | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 4.40 |
| nnis Space Center | 15.10 | 17.30 | 16.70 | 22.50 | 10.20 | 11.10 | 9.70 | 8.60 | 10.10 | 8.90 | 9.30 | 9.20 | 10.00 | 21.50 |
| cific Launch Operations | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0.30 |
| ace Nuclear Systems Office | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 436.50 |
| ition 17 | -- | -5.10 | -- | -- | -3.80 | -4.70 | -4.70 | -242.80 | -200.00 | -14.00 | -31.70 | -38.80 | -- | -- |
| ilops Flight Facility | -- | -- | -- | -- | -- | -- | -- | -- | 11.20 | 15.70 | 15.80 | 15.90 | 156.30 | -- |
| stem Support Office | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 119.70 |
| distributed | 97.50 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| TAL PROGRAM | 5,277.60 | 4,234.50 | 3,254.90 | 3,153.70 | 3,616.40 | 2,465.30 | 2,066.20 | 5,515.50 | 4,723.00 | 4,334.30 | 4,088.10 | 3,477.20 | 3,011.60 | 50,331.20 |
| prop Trans & Adjustment | 54.20 | -45.90 | 19.30 | -26.00 | 19.00 | -2.70 | -54.30 | 27.30 | 17.90 | 2.00 | 3.00 | 0.00 | 1.40 | 301.00 |
| propriation | 5,281.80 | 4,188.60 | 3,274.20 | 3,127.70 | 2,635.40 | 2,462.60 | 2,011.90 | 5,542.80 | 4,740.90 | 4,336.30 | 4,091.10 | 3,477.20 | 3,013.00 | 50,632.20 |
| se Unoblig Bal Incl | | (.50) | (1.10) | (4.40) | (.30) | (.20) | (.30) | (.20) | (.30) | (.60) | (.10) | (.30) | (.30) | |

# Space Flight,Control And Data Communications By Program

| (In Millions of Dollars) | FY 1990 | FY 1989 | FY 1988 | FY 1987 | FY 1986 | As Of September 1990 FY 1985 | FY 1984 |
|---|---|---|---|---|---|---|---|
| **SPACE FLIGHT** | | | | | | | |
| Shuttle Prod & Oper Cap | 1,189.80 | 1,123.00 | 1,092.40 | 3,501.40 | 1,354.70 | 1,478.10 | 1,637.20 |
| Space Transportation Ops | 2,628.40 | 2,377.30 | 1,825.50 | 1,636.90 | 1,633.20 | 1,308.60 | 1,431.70 |
| **TOTAL OSF** | 3,818.20 | 3,500.30 | 2,917.90 | 5,138.30 | 2,987.90 | 2,786.70 | 3,068.90 |
| **SPACE TRACKING & DATA SYSTEMS** | 898.00 | 1,040.50 | 969.30 | 764.70 | 658.20 | 792.20 | 673.90 |
| **OPERATING ACCOUNT** | 9.40 | 13.80 | 8.70 | 17.50 | 15.60 | 15.30 | 9.00 |
| **TOTAL PROGRAM** | 4,725.60 | 4,554.60 | 3,895.90 | 5,920.50 | 3,661.70 | 3,594.20 | 3,751.80 |
| Approp Trans & Adjustment | -182.50 | -190.40 | 12.40 | -180.50 | 19.10 | 7.60 | 39.80 |
| **Appropriation** | 4,543.10 | 4,364.20 | 3,908.30 | 5,740.00 | 3,680.80 | 3,601.80 | 3,791.60 |
| Lapse Unoblig Bal Incl | -- | (0.90) | (0.40) | (0.30) | (0.30) | (0.20) | (0.50) |

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

# pace Flight,Control And Data Communications By Location

| (In Millions of Dollars) | FY 1990 | FY 1989 | FY 1988 | FY 1987 | FY 1986 | As Of September 1990 FY 1985 | FY 1984 |
|---|---|---|---|---|---|---|---|
| Headquarters | 160.30 | 153.50 | 364.40 | 332.70 | 204.50 | 259.50 | 227.6 |
| Ames Research Center | 18.70 | 16.70 | 15.40 | 16.30 | 18.00 | 15.60 | 10.30 |
| Goddard Space Flight Center | 609.30 | 492.60 | 467.10 | 415.90 | 330.00 | 432.20 | 431.00 |
| Jet Propulsion Laboratory | 153.50 | 122.10 | 132.10 | 128.00 | 117.40 | 111.90 | 97.30 |
| Johnson Space Center | 1,101.80 | 1,013.90 | 909.70 | 1,960.40 | 1,083.70 | 1,308.00 | 1,360.50 |
| Kennedy Space Center | 850.50 | 803.40 | 720.20 | 656.00 | 511.50 | 493.40 | 490.5 |
| Langley Research Center | 6.20 | 14.30 | 0.10 | 0.30 | 0.40 | 0.60 | 0.20 |
| Lewis Research Center | 47.90 | 9.40 | 3.70 | 5.00 | 3.30 | 4.30 | 2.00 |
| Marshall Space Flight Center | 1,616.00 | 1,526.60 | 1,263.90 | 1,653.50 | 1,655.40 | 1,437.00 | 1,379.00 |
| Stennis Space Flight Center | 24.70 | 21.50 | 19.30 | 16.10 | 15.10 | 12.30 | 1.10 |
| Station 17 | -- | -12.40 | -- | -- | -277.60 | -480.60 | -247.70 |
| Undistributed | 136.70 | 393.00 | -- | 736.30 | -- | -- | -- |
| TOTAL PROGRAM | 4,725.60 | 4,554.60 | 3,895.90 | 5,920.50 | 3,661.70 | 3,594.20 | 3,751.80 |
| Approp Trans & Adjustment | -182.50 | -190.40 | 12.40 | -180.00 | 19.10 | 7.60 | 39.80 |
| Appropriation | 4,543.10 | 4,364.20 | 3,908.30 | 5,740.00 | 3,680.80 | 3,601.80 | 3,791.60 |
| Lapse Unoblig Bal Incl | -- | (0.90) | (0.40) | (0.30) | (0.30) | (0.20) | (0.50) |

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

# Construction of Facilities Funding

| (In Millions of Dollars) | FY 90 | FY 89 | FY 88 | FY 87 | FY 86 | FY 85 | FY 84 | FY 83 | FY 82 | FY 81 | FY 80 | FY 79 | FY 78 | As of September 1990 FY 77 | TQ | FY 75 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ames Research Center | 13.00 | – | 16.00 | 18.80 | 7.80 | 14.20 | 14.70 | – | – | 13.60 | 2.90 | 9.10 | – | 4.40 | 2.60 | 3.70 |
| Dryden Flight Research Fac. | – | – | 12.70 | – | – | – | – | 3.50 | – | – | – | – | 0.40 | 0.80 | – | – |
| Goddard Space Flight Center | 16.40 | 6.20 | 8.60 | 8.00 | 3.60 | 2.10 | – | 2.60 | – | – | – | 5.60 | 4.50 | – | – | 1.90 |
| Jet Propulsion Laboratory | 5.30 | – | – | 11.70 | 9.20 | 13.70 | 5.50 | – | 1.80 | 2.80 | – | 4.60 | 3.10 | – | – | 9.20 |
| Kennedy Space Center | 10.30 | – | – | 0.80 | – | – | – | – | 1.10 | 0.60 | 4.80 | – | 1.70 | 2.60 | – | – |
| Langley Research Center | 6.80 | 7.40 | – | 11.30 | 4.70 | 13.80 | 10.50 | 13.50 | 2.90 | 22.00 | 7.10 | 5.30 | 1.60 | 6.10 | 1.60 | 3.20 |
| Lewis Research Center | – | – | 17.00 | – | – | – | 12.90 | 4.80 | 1.20 | 8.70 | 5.70 | 5.80 | 0.80 | 2.70 | – | 3.70 |
| Johnson Space Center | 2.80 | 7.80 | – | 7.80 | – | – | – | – | 3.00 | – | – | – | 2.00 | 2.20 | – | 0.70 |
| 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 |
| Various Locations | 2.60 | – | 6.40 | 17.00 | 17.40 | 14.00 | – | – | 9.80 | 32.00 | 1.70 | – | 1.10 | – | – | 7.70 |
| Facility Planning & Design | 26.30 | 22.00 | 16.00 | 17.00 | 11.80 | 12.00 | 9.10 | 8.20 | 10.00 | 9.70 | 13.90 | 10.60 | 11.70 | 12.60 | 12.50 | 10.80 |
| Large Aero Fac | – | – | – | – | – | – | – | – | – | – | 45.70 | 56.10 | 37.00 | 31.00 | – | – |
| Minor Construction | 10.00 | 9.00 | 7.30 | 6.60 | 6.00 | 4.90 | 4.70 | 3.70 | 2.30 | 3.90 | 3.50 | 4.20 | 6.00 | 2.90 | 6.20 | 4.60 |
| Repair | 27.20 | 22.90 | 22.90 | 21.70 | 19.50 | 17.90 | 17.20 | 13.60 | 12.60 | 14.80 | 12.00 | – | – | – | – | – |
| Envir Compl & Rest. Program | 30.00 | 26.00 | 23.90 | – | – | – | – | – | – | – | – | – | – | – | – | – |
| Rehab & Mods * | 35.00 | 30.90 | 31.60 | 30.20 | 24.30 | 21.50 | 21.40 | 18.90 | 17.60 | 17.30 | 19.70 | 14.10 | 18.90 | 17.80 | 23.00 | 14.80 |
| Space Station Facilities | 49.10 | – | – | 12.50 | – | – | – | – | – | – | – | – | – | – | – | – |
| Shuttle Facilities | 122.20 | 65.00 | 17.20 | 6.90 | 36.20 | 37.70 | 48.70 | 28.10 | 32.80 | 9.90 | 27.90 | 30.90 | 64.70 | 30.30 | 48.60 | 76.50 |
| Shuttle Payload Facility | – | – | – | – | 3.80 | 6.70 | 13.20 | 1.80 | – | 1.50 | 4.30 | – | 7.30 | 4.40 | – | – |
| Unallocated Plans & Design | – | – | – | – | – | – | – | 1.80 | – | – | – | – | – | – | – | – |
| Aero. Facils Revitalization | 54.40 | 46.00 | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| Advanced Launch System Fa | – | 15.00 | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| Trust Fund | – | 15.00 | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| Wake Shield Facility | 2.20 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| TOTAL PROGRAM | 413.60 | 285.70 | 179.60 | 170.50 | 144.30 | 160.10 | 157.90 | 102.80 | 95.30 | 140.80 | 156.60 | 146.30 | 161.40 | 117.80 | 92.50 | 141.70 |
| Approp Trans & Adjust | 178.40 | 4.40 | -1.30 | 298.80 | -11.00 | -10.10 | -2.40 | -5.30 | 0.50 | -25.80 | -0.50 | 1.20 | -0.50 | 0.30 | 0.40 | -1.50 |
| Approp & Availability | 592.00 | 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 |

*Included in Various Locations Prior to FY 1972.

# onstruction of Facilities Funding

(In Millions of Dollars)

| | FY 74 | FY 73 | FY 72 | FY 71 | FY 70 | FY 69 | FY 68 | FY 67 | FY 66 | FY 65 | FY 64 | FY 63 | FY 62 | FY 61 | FY 60 | FY 59 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ames Research Center | – | 3.20 | 6.50 | 1.10 | 0.30 | 0.40 | 4.20 | – | 2.60 | 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 | 1.30 | – | – | – | – | – | – | 7.40 | 5.20 | 10.40 | 1.60 | – | – | – | – | – |
| Goddard Space Flight Center | 1.30 | 0.60 | 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 | – | 0.50 | – | 1.90 | – | – | 3.10 | 0.30 | 0.90 | 3.60 | 3.00 | 11.40 | 3.60 | 8.60 | 7.70 | – |
| Johnson Space Center | 4.00 | 0.60 | – | 1.10 | – | 0.90 | 0.60 | 11.80 | 4.00 | 17.30 | 33.90 | 24.50 | – | – | – | – |
| Kennedy Space Center | – | 9.70 | 15.60 | 0.30 | 10.50 | 7.40 | 20.40 | 34.60 | 7.20 | 67.80 | 273.40 | 332.80 | 115.60 | 27.80 | 4.00 | – |
| Langley Research Center | – | 4.30 | – | 0.60 | 5.60 | – | – | 8.40 | 8.40 | 3.30 | 9.70 | 9.80 | 6.90 | 12.30 | 4.50 | 10.80 |
| Lewis Research Center | – | 10.00 | 0.80 | 0.70 | 0.30 | – | 2.10 | 16.20 | 0.90 | 0.80 | 20.40 | 45.50 | 1.10 | 9.60 | 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 | 0.90 | – | – | – | – | 0.40 | 0.50 | 0.50 | 0.30 | 6.20 | 7.30 | 28.50 | – | – | – | – |
| Stennis Space Center | 3.70 | – | – | – | 1.40 | – | – | – | – | 58.40 | 102.90 | 77.10 | – | – | – | – |
| Nuclear Rocket Dev Station | 13.50 | – | – | – | – | – | – | – | – | – | 4.10 | 11.50 | – | – | – | – |
| Pacific Launch Operations | – | – | – | – | – | – | – | – | – | 0.30 | – | – | 0.60 | 0.40 | 1.10 | – |
| Wallops Flight Facility | 4.60 | 0.60 | – | – | 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 | 26.30 | 211.50 | 129.90 | 159.00 | 26.00 | 52.40 | 5.10 |
| Facility Planning & Design | – | 7.90 | 3.40 | 5.40 | 3.50 | 1.00 | 5.40 | 5.40 | 5.00 | 8.80 | 10.40 | 12.90 | 9.80 | – | – | – |
| Rehab & Mods * | 14.80 | 11.60 | 7.80 | (17.50) | – | – | – | – | – | – | – | – | – | – | – | – |
| Shuttle Facilities | – | 28.80 | 18.50 | – | – | – | – | – | – | – | – | – | – | – | – | – |
| Other | 56.50 | 1.70 | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| TOTAL PROGRAM | 100.60 | 78.50 | 54.00 | 36.30 | 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 | 0.50 | -1.20 | -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 |
| Approp & Availability | 101.10 | 77.30 | 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)

| 1/ | FY 90 | FY 89 | FY 88 | FY 87 | FY 86 | FY 85 | FY 84 | FY 83 | FY 82 | FY 81 | FY 80 | FY 79 | FY 78 | FY 77 | TQ | FY 75 | FY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Headquarters | 259.10 | 255.10 | 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 |
| Ames Research Center | 187.70 | 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 |
| Dryden Flight Research Fac. | - | - | - | - | - | - | - | - | 24.40 | 22.60 | 20.20 | 18.90 | 18.20 | 17.20 | 19.70 | 13.20 | 12 |
| Goddard Space Flight Center | 266.40 | 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 |
| Kennedy Space Center | 277.80 | 269.90 | 243.70 | 200.00 | 192.20 | 185.10 | 178.40 | 164.90 | 156.00 | 150.20 | 135.50 | 126.40 | 116.30 | 110.10 | 128.00 | 95.90 | 94 |
| Langley Research Center | 198.80 | 188.70 | 178.20 | 153.70 | 145.00 | 147.60 | 139.20 | 132.70 | 126.60 | 120.80 | 113.80 | 108.60 | 100.70 | 94.70 | 115.70 | 88.60 | 83 |
| Lewis Research Center | 206.30 | 196.30 | 182.00 | 151.70 | 143.10 | 137.40 | 128.50 | 118.80 | 106.40 | 99.90 | 94.80 | 87.50 | 84.70 | 83.30 | 102.40 | 80.30 | 79 |
| Johnson Space Center | 325.20 | 302.70 | 283.30 | 228.00 | 208.90 | 218.10 | 201.90 | 195.20 | 230.50 | 176.30 | 164.70 | 153.00 | 146.20 | 139.10 | 165.20 | 121.30 | 117 |
| *Marshall Space Flight Center* | 276.80 | 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 |
| Stennis Space Center | 25.10 | 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 |
| Wallops Flight Facility | - | - | - | - | - | - | - | - | - | 20.00 | 17.80 | 15.90 | 15.10 | 13.30 | 17.00 | 12.40 | 11 |
| TOTAL PROGRAM | 2,023.20 | 1,926.40 | 1,762.60 | 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 |
| Lapsed Unoblig Bal | 0.20 | - | - | 1.00 | 0.20 | 0.50 | 0.20 | - | 0.20 | 0.30 | 0.20 | 0.30 | 0.30 | 0.20 | 0.60 | 0.20 | 0 |
| Approp Trans & Adjust | -71.90 | -71.60 | -266.90 | -27.50 | 20.50 | - | - | - | - | - | - | - | - | - | - | -4.90 | |
| Appropriation | 1,951.50 | 1,855.00 | 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 |

1/ Includes NASA Pasadena Office

# Research and Program Management Funding

(In Millions of Dollars) As of September 1990

| | FY 73 | FY 72 | FY 71 | FY 70 | FY 69 | FY 68 | FY 67 | FY 66 | FY 65 | FY 64 | FY 63 | FY 62 | FY 61 | FY 60 | FY 59 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/ | | | | | | | | | | | | | | | |
| Headquarters | 61.20 | 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 | 42.40 | 42.20 | 40.60 | 37.60 | 34.00 | 33.80 | 33.80 | 33.20 | 31.80 | 28.90 | 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 | 11.70 | 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 | 95.70 | 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 | 92.40 | 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 | 78.60 | 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 | 81.20 | 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 | 110.60 | 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 | 137.20 | 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 | 10.80 | 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 | 721.60 | 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 |
| | 7.60 | 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 | 729.40 | 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* | FY 1990 | FY 1989 | FY 1988 | FY 1987 | FY 1986 | FY 1985 | FY 1984 | FY 1983 | As Of September 1990 FY 1982 | FY 1981 |
|---|---|---|---|---|---|---|---|---|---|---|
| NASA HQ | 1,996 | 1,867 | 1,829 | 1,648 | 1,468 | 1,553 | 1,526 | 1,638 | 1,614 | 1,638 |
| ARC 1/ | 2,205 | 2,217 | 2,169 | 2,161 | 2,153 | 2,159 | 2,145 | 2,138 | 2,164 | 1,652 |
| DFRF | -- | -- | -- | -- | -- | -- | -- | -- | -- | 491 |
| GSFC2/ | 3,873 | 3,860 | 3,727 | 3,746 | 3,785 | 3,738 | 3,647 | 3,794 | 3,746 | 3,431 |
| KSC | 2,466 | 2,504 | 2,330 | 2,278 | 2,120 | 2,165 | 2,131 | 2,180 | 2,199 | 2,224 |
| LaRC | 2,961 | 3,003 | 2,966 | 2,979 | 2,932 | 2,949 | 2,952 | 3,032 | 2,916 | 3,028 |
| LeRC | 2,728 | 2,832 | 2,716 | 2,716 | 2,642 | 2,782 | 2,702 | 2,751 | 2,667 | 2,782 |
| JSC | 3,615 | 3,704 | 3,498 | 3,463 | 3,362 | 3,449 | 3,352 | 3,411 | 3,445 | 3,498 |
| MSFC | 3,619 | 3,703 | 3,429 | 3,478 | 3,361 | 3,386 | 3,286 | 3,464 | 3,440 | 3,479 |
| NASA Pasadena Office | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| JSSC | 192 | 203 | 159 | 147 | 137 | 135 | 129 | 128 | 119 | 113 |
| WFF | -- | -- | -- | -- | -- | -- | -- | -- | -- | 400 |
| TOTAL | 23,625 | 23,893 | 22,823 | 22,646 | 21,960 | 22,316 | 21,870 | 22,534 | 22,310 | 22,736 |

| | FY1980 | FY 1979 | FY 1978 | FY 1977 | FY 1976 | FY 1975 | FY 1974 | FY 1973 |
|---|---|---|---|---|---|---|---|---|
| NASA HQ | 1,658 | 1,534 | 1,606 | 1,619 | 1,708 | 1,673 | 1,734 | 1,747 |
| ARC 1/ | 1,713 | 1,713 | 1,691 | 1,645 | 1,724 | 1,754 | 1,776 | 1,740 |
| DFRF | 499 | 498 | 514 | 546 | 566 | 544 | 531 | 509 |
| GSFC2/ | 3,535 | 3,562 | 3,641 | 3,666 | 3,808 | 3,871 | 3,936 | 3,852 |
| KSC | 2,291 | 2,264 | 2,234 | 2,270 | 2,404 | 2,377 | 2,408 | 2,516 |
| LaRC | 3,094 | 3,125 | 3,167 | 3,207 | 3,407 | 3,472 | 3,504 | 3,389 |
| LeRC | 2,901 | 2,907 | 2,964 | 3,061 | 3,168 | 3,181 | 3,172 | 3,368 |
| JSC | 3,616 | 3,563 | 3,617 | 3,640 | 3,796 | 3,877 | 3,886 | 3,896 |
| MSFC | 3,646 | 3,677 | 3,808 | 4,014 | 4,336 | 4,337 | 4,574 | 5,287 |
| NASA Pasadena Office | -- | -- | -- | -- | -- | 35 | 39 | 39 |
| JSSC | 111 | 108 | 108 | 94 | 72 | 76 | -- | -- |
| WFF | 406 | 409 | 429 | 426 | 437 | 441 | 447 | 434 |
| TOTAL | 23,470 | 23,360 | 23,779 | 24,188 | 25,426 | 25,638 | 26,007 | 26,777 |

*Includes Temporary Personnel
Excludes Employees in the Youth Program

1/Includes DFRF After FY 1981
2/Includes WFF After 1981

**Onboard At End Of Fiscal Year***

| | FY 1972 | FY 1971 | FY 1970 | FY 1969 | FY 1968 | FY 1967 | FY 1966 | FY 1965 | FY 1964 |
|---|---|---|---|---|---|---|---|---|---|
| NASA Headquarters | 1,755 | 1,895 | 2,187 | 2,293 | 2,310 | 2,373 | 2,336 | 2,135 | 2,158 |
| Ames Research Center | 1,844 | 1,968 | 2,033 | 2,117 | 2,197 | 2,264 | 2,310 | 2,270 | 2,204 |
| Dryden Flight Research Facility | 539 | 579 | 583 | 601 | 622 | 642 | 662 | 669 | 619 |
| Electronics Research Center | -- | -- | 592 | 951 | 950 | 791 | 555 | 250 | 33a/ |
| Goddard Space Flight Center | 4,178 | 4,459 | 4,487 | 4,295 | 4,073 | 3,997 | 3,958 | 3,774 | 3,675 |
| Kennedy Space Center | 2,568 | 2,704 | 2,895 | 3,058 | 3,044 | 2,867 | 2,669 | 2,464 | 1,625 |
| Langley Research Center | 3,592 | 3,830 | 3,970 | 4,087 | 4,219 | 4,405 | 4,485 | 4,371 | 4,330 |
| Lewis Research Center | 3,866 | 4,083 | 4,240 | 4,399 | 4,583 | 4,956 | 5,047 | 4,897 | 4,859 |
| Johnson Space Center | 3,935 | 4,298 | 4,539 | 4,751 | 4,956 | 5,064 | 4,889 | 4,413 | 4,277 |
| Marshall Space Flight Center | 5,555 | 6,060 | 6,325 | 6,639 | 6,935 | 7,602 | 7,740 | 7,719 | 7,679 |
| NASA Pasadena Office | 40 | 44 | 72 | 80 | 79 | 91 | 85 | 19 | b/ |
| Pacific Launch Operations | -- | -- | -- | -- | -- | -- | c/ | 21 | 22 |
| Space Nuclear Systems Office | 45 | 89 | 103 | 104 | 108 | 113 | 115 | 116 | 112 |
| Wallops Flight Facility | 465 | 497 | 522 | 554 | 565 | 576 | 563 | 554 | 530 |
| Western Support Office | -- | -- | -- | -- | d/ | 119 | 294 | 377 | 376 |
| TOTAL | 28,382 | 30,506 | 32,548 | 33,929 | 34,641 | 35,860 | 35,708 | 34,049 | 32,499 |

| | FY 1963 | FY 1962 | FY 1961 | FY 1960 | FY 1959 |
|---|---|---|---|---|---|
| NASA Headquarters | 2,001 | 1,477 | 735 | 587 | 429 |
| Ames Research Center | 2,116 | 1,658 | 1,471 | 1,421 | 1,464 |
| Dryden Flight Research Facility | 616 | 538 | 447 | 408 | 340 |
| Electronics Research Center | 25a/ | -- | -- | -- | -- |
| Goddard Space Flight Center | 3,487 | 2,755 | 1,599 | 1,255 | 398 |
| Kennedy Space Center | 1,181 | 339 | -- | -- | -- |
| Langley Research Center | 4,220 | 3,894 | 3,338 | 3,203 | 3,624 |
| Lewis Research Center | 4,697 | 3,800 | 2,773 | 2,722 | 2,809 |
| Johnson Space Center | 3,345 | 1,786 | 794 | in GSFC | -- |
| Marshall Space Flight Center | 7,332 | 6,843 | 5,948 | 370 | -- |
| NASA Pasadena Office | -- | -- | -- | -- | -- |
| Pacific Launch Operations | 17 | -- | -- | -- | -- |
| Space Nuclear Systems Office | 96 | 39 | 4 | -- | -- |
| Wallops Flight Facility | 493 | 421 | 302 | 229 | 171 |
| Western Support Office | 308 | 136 | 60 | 37 | -- |
| TOTAL | 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 Was Merged Under KSC

d/Effective In 1968, WSO Was Disestablished And Elements Merged With NaPO

# Employment Summary

9/30/90

Full - Time Permanent and Other Employees*

| | OAET | | | OSSA | OSF | | | | HQ | Total NASA | JPL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ARC | LARC | LERC | GSFC | KSC | JSC | MSFC | SSC | | | |
| Full - Time Permanent Employees | 2,205 | 2,961 | 2,728 | 3,873 | 2,466 | 3,615 | 3,619 | 192 | 1,966 | 23,625 | -- |
| Other than Permanent Employees | 74 | 152 | 92 | 119 | 76 | 112 | 115 | 14 | 187 | 941 | -- |
| Total | 2,279 | 3,113 | 2,820 | 3,992 | 2,542 | 3,727 | 3,734 | 206 | 2,153 | 24,566 | 5,920 |

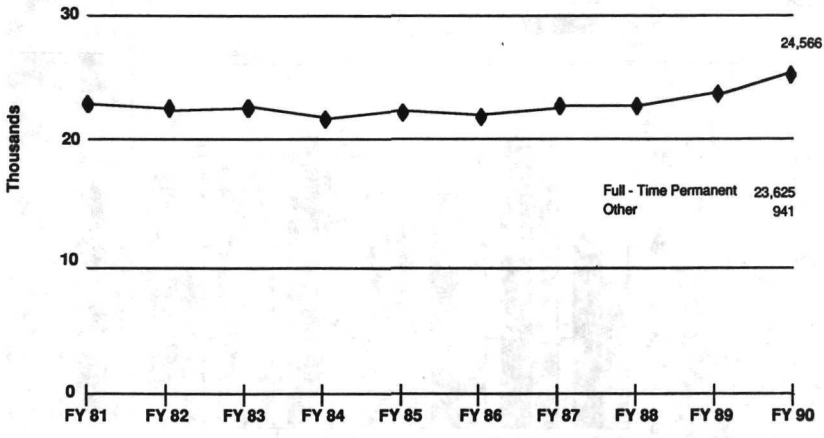
Full - Time Permanent Employee Occupational Breakdown

| | ARC | LARC | LERC | GSFC | KSC | JSC | MSFC | SSC | HQ | Total NASA | JPL** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S & E | 1,183 | 1,434 | 1,500 | 2,136 | 1,468 | 2,360 | 2,376 | 103 | 571 | 13,131 | 3,664 |
| Prof'l Admin. | 345 | 304 | 284 | 786 | 406 | 611 | 605 | 55 | 970 | 4,366 | 878 |
| Clerical | 216 | 281 | 243 | 434 | 319 | 446 | 466 | 32 | 415 | 2,852 | 607 |
| Tech. Support | 139 | 930 | 297 | 442 | 268 | 189 | 172 | 2 | 7 | 2,446 | 385 |
| Wage System | 322 | 12 | 404 | 75 | 5 | 9 | 0 | 0 | 3 | 830 | 386 |
| Total | 2,205 | 2,961 | 2,728 | 3,873 | 2,466 | 3,615 | 3,619 | 192 | 1,966 | 23,625 | |

* Does Not Include Non-Ceiling Employees

# Total NASA Civil Service Workforce

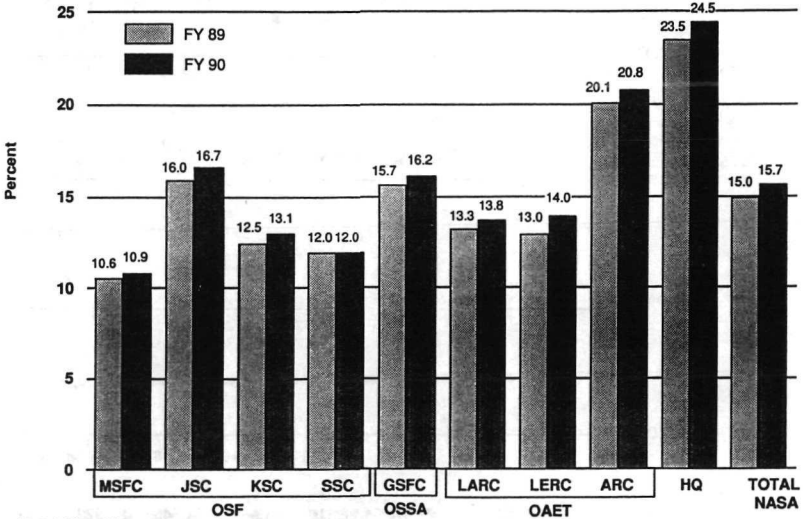
By Installation
End FY 1981-1990




| | FY 81 | FY 82 | FY 83 | FY 84 | FY 85 | FY 86 | FY 87 | FY 88 | FY 89 | FY 90 |
|---|---|---|---|---|---|---|---|---|---|---|
| All Employees | 22,739 | 22,310 | 22,534 | 21,870 | 22,316 | 21,960 | 22,646 | 22,823 | 23,893 | 24,566 |

# Minorities as Percent of Permanent Employees

By Installation
FY 1989-1990

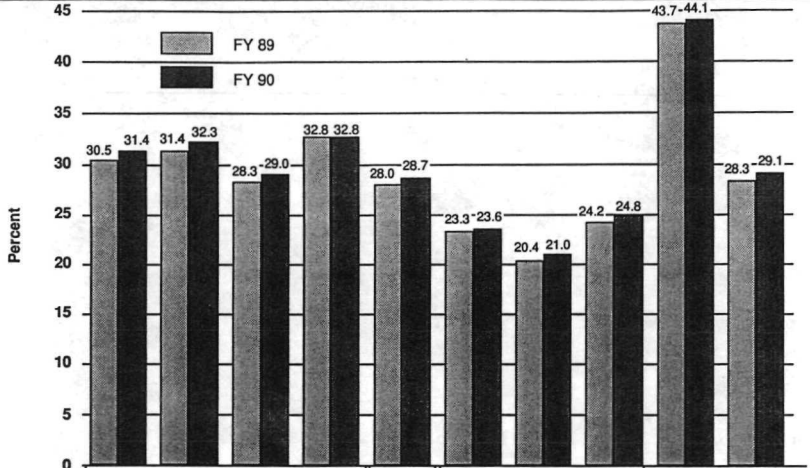



**Total Minorities**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **FY 90** | 396 | 604 | 322 | 23 | 629 | 410 | 381 | 459 | 482 | 3,706 |
| **FY 89** | 382 | 574 | 302 | 22 | 585 | 380 | 358 | 433 | 406 | 3,442 |
| **FY 81** | 198 | 431 | 171 | 8 | 450 | 311 | 227 | 359 | 317 | 2,472 |

# Women as Percent of Permanent Employees

By Installation
FY 1989-1990




| Total Women | MSFC | JSC | KSC | SSC | GSFC | LARC | LERC | ARC | HQ | TOTAL NASA |
|---|---|---|---|---|---|---|---|---|---|---|
| FY 90 | 1,138 | 1,167 | 716 | 63 | 1,112 | 699 | 572 | 547 | 867 | 6,881 |
| FY 89 | 1,101 | 1,122 | 685 | 60 | 1,044 | 667 | 561 | 520 | 755 | 6,515 |
| FY 81 | 710 | 717 | 474 | 28 | 821 | 531 | 417 | 404 | 609 | 4,711 |


National Aeronautics and
Space Administration