

## Planetary Exploration

SPACECRAFT	MISSION	LAUNCH DATE	ARRIVAL DATE	REMARKS
Venera 1 USSR	Venus Probe	Feb 12, 1961		First Soviet planetary flight; launched from Sputnik 8. Radio contact was lost during flight; spacecraft was not operating when it passed Venus.
Mariner 1 USA	Venus Flyby	Jul 22, 1962		Destroyed shortly after launch when vehicle veered off course.
Sputnik 19 USSR	Venus Probe	Aug 25, 1962		Unsuccessful Venus attempt.
Mariner 2 USA	Venus Flyby	Aug 27, 1962	Dec 14, 1962	First successful planetary flyby. Provided instrument scanning data. Entered solar orbit.
Sputnik 20 USSR	Venus Probe	Sep 1, 1962		Unsuccessful Venus attempt.
Sputnik 21 USSR	Venus Probe	Sep 12, 1962		Unsuccessful Venus attempt.
Sputnik 22 USSR	Mars Probe	Oct 24, 1962		Spacecraft and final rocket stage blew up when accelerated to escape velocity.
Mars 1 USSR	Mars Probe	Nov 1, 1962		Contact was lost when the spacecraft antenna could no longer be pointed towards Earth.
Sputnik 24 USSR	Mars Probe	Nov 4, 1962		Disintegrated during an attempt at Mars trajectory from Earth parking orbit.
Zond 1 USSR	Venus Probe	Apr 2, 1964		Communications lost. Spacecraft went into solar orbit.
Mariner 3 USA	Mars Flyby	Nov 5, 1964		Shroud failed to jettison properly; Sun and Canopus not acquired; spacecraft did not encounter Mars. Transmissions ceased 9 hours after launch. Entered solar orbit.
Mariner 4 USA	Mars Flyby	Nov 28, 1964	Jul 14, 1965	Provided first close-range images of Mars, confirming the existence of surface craters. Entered solar orbit.
Zond 2 USSR	Mars Probe	Nov 30, 1964		Passed by Mars; failed to return data. Went into solar orbit.

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Venera 2 USSR	Venus Probe	Nov 12, 1965	Feb 27, 1966	Passed by Venus, but failed to return data.
Venera 3 USSR	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 USSR	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.
Mariner 5 USA	Venus Flyby	Jun 14, 1967	Oct 19, 1967	Advanced instruments returned data on Venus' surface temperature, atmosphere, and magnetic field environment. Entered solar orbit.
Venera 5 USSR	Venus Probe	Jan 5, 1969	Mar 16, 1969	Entry velocity reduced by atmospheric braking before main parachute was deployed. Capsule entered atmosphere on planet's dark side; transmitted data for 53 minutes while traveling into the atmosphere before being crushed.
Venera 6 USSR	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.
Mariner 6 USA	Mars Flyby	Feb 24, 1969	Jul 31, 1969	Provided high-resolution photos of Martian surface, concentrating on equatorial region. Entered solar orbit.
Mariner 7 USA	Mars Flyby	Mar 27, 1969	Aug 5, 1969	Provided high-resolution photos of Martian surface, concentrating on southern hemisphere. Entered solar orbit.
Venera 7 USSR	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.

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Cosmos 359 USSR	Venus Lander	Aug 22, 1970		Unsuccessful Venus attempt; failed to achieve escape velocity.
Mariner 8 USA	Mars Orbiter	May 8, 1971		Centaur stage malfunctioned shortly after launch.
Cosmos 419 USSR	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 USSR	Mars Orbiter and Lander	May 19, 1971	Nov 27, 1971	Landing capsule separated from spacecraft and made first, unsuccessful attempt to soft land. Lander carried USSR pennant. Orbiter continued to transmit data.
Mars 3 USSR	Mars Orbiter and Lander	May 28, 1971	Dec 2, 1971	Landing capsule separated from spacecraft and landed in the southern hemisphere. Onboard camera operated for only 20 seconds, transmitting a small panoramic view. Orbiter transmitted for 3 months.
Mariner 9 USA	Mars Orbiter	May 30, 1971	Nov 13, 1971	First interplanetary probe to orbit another planet. During nearly a year of operations, obtained detailed photographs of the Martian moons, Phobos and Deimos, and mapped 100 percent of the Martian surface. Spacecraft is inoperable in Mars orbit.
Pioneer 10 USA	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.
Venera 8 USSR	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 USSR	Venus Lander	Mar 31, 1972		Unsuccessful Venus probe; escape stage misfired leaving craft in Earth orbit.

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Pioneer 11 USA	Jupiter/Saturn Flyby	Apr 5, 1973	Dec 2, 1974 (Jupiter) Sep 1, 1979 (Saturn)	The successful encounter of Jupiter by Pioneer 10 permitted Pioneer 11 to be retargeted in flight to fly by Jupiter and encounter Saturn. Still operating in the outer Solar System.
Mars 4 & 5 USSR	Mars Orbiters and Landers	Jul 21, 1973 Jul 25, 1973	Feb 10, 1974 Feb 12, 1974	Pair of spacecraft launched to Mars. Mars 4 retro rockets failed to fire, preventing orbit insertion. As it passed the planet, Mars 4 returned one swath of pictures and some radio occultation data. Mars 5 was successfully placed in orbit, but operated only a few days, returning photographs of a small portion of southern hemisphere of Mars.
Mars 6 & 7 USSR	Mars Orbiters and Landers	Aug 5, 1973 Aug 9, 1973	Mar 12, 1974 Mar 9, 1974	Second pair of spacecraft launched to Mars. Mars 6 lander module transmitted data during descent, but transmissions abruptly ceased when the landing rockets were fired. Mars 7 descent module was separated from the main spacecraft due to a problem in the operation of one of the onboard systems, and passed by the planet.
Mariner 10 USA	Venus/Mercury Flyby	Nov 3, 1973	Feb 5, 1974 (Venus) Mar 29, 1974 (Mercury) Sep 21, 1974 (Mercury) Mar 16, 1975 (Mercury)	First dual-planet mission. Used gravity of Venus to attain Mercury encounter. Provided first ultraviolet photographs of Venus; returned close-up photographs and detailed data of Mercury. Transmitter was turned off March 24, 1975, when attitude control gas was depleted. Spacecraft is inoperable in solar orbit.
Venera 9 USSR	Venus Orbiter and Lander	Jun 8, 1975	Oct 22, 1975	First spacecraft to transmit a picture from the surface of another planet. The lander's signals were transmitted to Earth via the orbiter. Utilized a new parachute system, consisting of six chutes. Signals continued from the surface for nearly 2 hrs 53 mins.
Venera 10 USSR	Venus Orbiter and Lander	Jun 14, 1975	Oct 25, 1975	During descent, atmospheric measurements and details of physical and chemical contents were transmitted via the orbiter. Transmitted pictures from the surface of Venus.

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Viking 1 USA	Mars Orbiter and Lander	Aug 20, 1975	Jul 19, 1976 (in orbit) Jul 20, 1976 (landed)	First U.S. attempt to soft land a spacecraft on another planet. Landed on the Plain of Chryse. Photographs showed an orange-red plain strewn with rocks and sand dunes. Both Orbiters took a total of 52,000 images during their mission; approximately 97% percent of the surface was imaged. Orbiter 1 operated until August 7, 1980, when it used the last of its attitude control gas. Lander 1 ceased operating on Nov 13, 1983.
Viking 2 USA	Mars Orbiter and Lander	Sep 9, 1975	Aug 7, 1976 (in orbit) Sep 3, 1976 (landed)	Landed on the Plain of Utopia. Discovered water frost on the surface at the end of the Martian winter. The two Landers took 4,500 images of the surface and provided over 3 million weather reports. Orbiter 2 stopped operating on July 24, 1978, when its attitude control gas was depleted because of a leak. Lander 2 operated until April 12, 1980, when it was shut down due to battery degeneration.
Voyager 2 USA	Tour of the Outer Planets	Aug 20, 1977	Jul 9, 1979 (Jupiter) Aug 25, 1981 (Saturn) Jan 24, 1986 (Uranus) Aug 25, 1989 (Neptune)	Investigated the Jupiter, Saturn and Uranus planetary systems. Provided first close-up photographs of Uranus and its moons. Used gravity-assist at Uranus to continue on to Neptune. Swept within 1280 km of Neptune on August 25, 1989. The spacecraft will continue into interstellar space.
Voyager 1 USA	Tour of Jupiter and Saturn	Sep 5, 1977	Mar 5, 1979 (Jupiter) Nov 12, 1980 (Saturn)	Investigated the Jupiter and Saturn planetary systems. Returned spectacular photographs and provided evidence of a ring encircling Jupiter. Continues to return data enroute toward interstellar space.
Pioneer Venus 1 USA	Venus Orbiter	May 20, 1978	Dec 4, 1978	Mapped Venus' surface by radar, imaged its cloud systems, explored its magnetic environment and observed interactions of the solar wind with a planet that has no intrinsic magnetic field. Provided radar altimetry maps for nearly all of the surface of Venus, resolving features down to about 50 miles across. Still operating in orbit around Venus.
Pioneer Venus 2 USA	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.

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Venera 11 USSR	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 USSR	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 USSR	Venus Orbiter and Lander	Oct 31, 1981	Mar 1, 1982	Provided first soil analysis from Venusian surface. Transmitted eight color pictures via orbiter. Measured atmospheric chemical and isotopic composition, electric discharges, and cloud structure. Operated for 57 minutes.
Venera 14 USSR	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 USSR	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 USSR	Venus Orbiter	Jun 7, 1983	Oct 16, 1983	Provided computer mosaic images of a strip of the northern continent. Soviet and U.S. geologists cooperated in studying and interpreting these images.
Vega 1 & 2 USSR	Venus/Halley	Dec 15, 1984 Dec 21, 1984	Jun 11, 1985 (Venus) Mar 6, 1986 (Halley) Jun 15, 1985 (Venus) Mar 9, 1986 (Halley)	International two-spacecraft project using Venusian gravity to send them on to Halley's Comet after dropping the Venusian probes. The Venus landers studied the atmosphere and acquired a surface soil sample for analysis. Each lander released a helium-filled instrumented balloon to measure cloud properties. The other half of the Vega payloads, carrying cameras and instruments, continued on to encounter Comet Halley.

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Phobos 1 & 2 USSR	Mars/Phobos	Jul 7, 1988 Jul 12, 1988	Jan 1989 (Mars) Jan 1989 (Mars)	International two-spacecraft project to study Mars and its moon Phobos. Phobos 1 was disabled by a ground control error. Phobos 2 was successfully inserted into Martian orbit in January 1989 to study the Martian surface, atmosphere, and magnetic field. On March 27, 1989, communications with Phobos 2 were lost and efforts to contact the spacecraft were unsuccessful.
Magellan USA	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 USA	Jupiter Orbiter and Probe	Oct 18, 1989	Dec 8, 1990 (Earth) Feb 1991 (Venus)	A sophisticated two-part spacecraft; an Orbiter will be inserted into orbit around Jupiter to remotely sense the planet, its satellites and the Jovian magnetosphere and a Probe will descend into the atmosphere of Jupiter to make in situ measurements of its nature. Galileo flew by Venus, conducting the first infrared imagery and spectroscopy below the planet's cloud deck and used the Earth's gravity to speed it on its way to Jupiter.
Mars Observer USA	Mars Orbiter	Sep 25, 1992		Communication was lost with the Mars Observer on August 21, 1993, 3 days before the orbit insertion burn.
Galileo Probe USA	Jupiter Orbiter	Oct 18, 1989	Dec 7, 1995	A Planetary Probe was released from the Galileo Spacecraft with seven instruments: a helium abundance detector, an atmospheric structure instrument, a neutral mass spectrometer, a radiometer, a nephelometer, a lightning detector and an energetic particle detector. When the probe enters the Jupiter atmosphere the Galileo spacecraft will have been maneuvered overhead to receive the telemetry signals.

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Mars Global Surveyor (MGS)	Remote-sensing Orbiter	Nov. 7, 1996		Provide mapping of soil and atmospheric composition from two different orbits. After 180 days of high apogee atmospheric mapping the Surveyor will be "aerobraking" into a lower orbit to map the surface features. The mapping will be done by a thermal emission spectrometer, a laser altimeter and three linescan cameras at visual wavelengths. The telemetry signals from the spacecraft will enable estimation of Martian atmospheric profile.
Mars Pathfinder	Mars Lander	Dec. 4, 1996		Pathfinder along with a small rover named Sojourner, on board, will land on the surface of Mars cushioned by balloons. The lander and rover are both solar powered with backup batteries. The lander has three instruments: an Imager for the Mars Pathfinder (IMP), Atmospheric Structure Instrument/Meteorology package (ASI/MET); the rover houses an Alpha, Proton, X-ray Spectrometer (APXS), and color cameras. The lander has one-gigabyte of memory to store and transmit data from its instruments as well as from the instruments on the rover.