

# NASA Missions to Mars

<http://marsprogram.jpl.nasa.gov/programmissions/missions/log/>





Installing SAM instrument into Curiosity Mars Rover

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## [Past Mars Missions](#)



1962-1965

### Mariner 3 and 4

<http://marsprogram.jpl.nasa.gov/programmissions/missions/past/mariner34/>

Between 1962 and 1973, NASA's Jet Propulsion Laboratory designed and built 10 spacecraft named Mariner to explore the inner solar system -- visiting the planets Venus, Mars and Mercury for the first time, and returning to Venus and Mars for additional close observations. Mariner 3 was launched on November 5, 1964, but the shroud encasing the spacecraft atop its rocket failed to open properly and Mariner 3 did **not** get to Mars.

Three weeks later, on November 28, 1964, Mariner 4 was launched successfully on an eight-month voyage to the red planet. **The spacecraft flew past Mars on July 14, 1965, collecting the first close-up photographs of another planet.** The pictures, played back from a small tape recorder over a long period, showed lunar type impact craters (just beginning to be photographed at close range from the Moon), some of them touched with frost in the chill Martian evening. The Mariner 4 spacecraft, expected to survive something like eight months for the Mars encounter, actually lasted about three years in solar orbit, continuing long-term studies of the solar wind environment (and making coordinated measurements with Mariner 5, a sister ship launched to Venus in 1967).



1969

### Mariner 6 and 7

<http://marsprogram.jpl.nasa.gov/programmissions/missions/past/mariner67/>

In 1969, Mariner 6 and Mariner 7 completed the first dual mission to Mars, flying by over the equator and south polar regions and analyzing the Martian atmosphere and surface with remote sensors, as well as recording and relaying hundreds of pictures. By chance, both flew over cratered regions and missed both the giant northern volcanoes and the equatorial grand canyon that was discovered later. Their approach pictures did, however, show that the dark features on the surface long seen from Earth were not canals, as once interpreted in the 1800s.”



1971

### Mariner 8 and 9

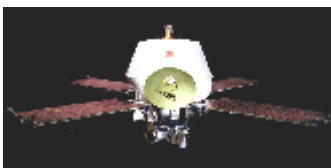
<http://marsprogram.jpl.nasa.gov/programmissions/missions/past/mariner89/>

[http://www.jpl.nasa.gov/news/fact\\_sheets/mariner.pdf](http://www.jpl.nasa.gov/news/fact_sheets/mariner.pdf)

Mariner 8 and 9 were the third and final pair of Mars missions in NASA's Mariner series of the 1960s and early 1970s. Both were designed to be the first Mars orbiters, marking a transition in our exploration of the red planet from flying by the planet to spending time in orbit around it.

Unfortunately, Mariner 8 failed during launch on May 8, 1971. Mariner 9 was launched successfully on May 30, 1971, and became **the first artificial satellite of Mars** when it arrived and went into orbit, where it functioned in Martian orbit for nearly a year. Mariner 9 completed its final transmission October 27, 1972.

Upon arrival, Mariner 9 observed that a great dust storm was obscuring the whole globe of the planet. Ground controllers sent commands to the spacecraft to wait until the storm had abated, the dust had settled, and the surface was clearly visible before compiling its global mosaic of high-quality images of the Martian surface. The storm persisted for a month, but after the dust cleared, Mariner 9 proceeded to reveal a very different planet than expected -- one that boasted gigantic volcanoes and a grand canyon stretching 4,800 kilometers (3,000 miles) across its surface. More surprisingly, the relics of ancient riverbeds were carved in the landscape of this seemingly dry and dusty planet. Mariner 9 exceeded all primary photographic requirements by **photo-mapping 100 percent of the planet's surface**. The spacecraft also provided **the first closeup pictures of the two small, irregular Martian moons: Phobos and Deimos**.





1975-1976

## Viking 1 and 2 Mission to Mars

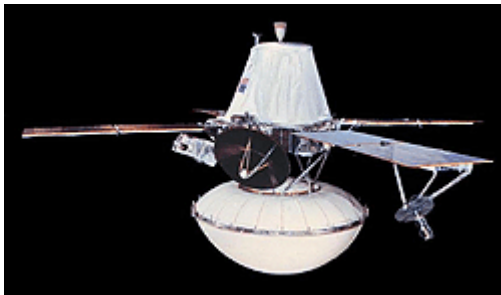
[http://www.nasa.gov/mission\\_pages/viking/index.html](http://www.nasa.gov/mission_pages/viking/index.html)

Thirty years ago [1976], NASA's Viking landers made history by descending from orbit to the surface of the Red Planet. They were **the first probes from Earth to land intact on Mars -- and the first American spacecraft to land on another planetary body since Apollo.**

Viking 1 and its sister ship Viking 2 revealed an alien world comprised of sterile soil and eerie salmon-colored skies. They answered the probing question -- No life on Mars... at least not in the two areas where the spacecraft landed.

<http://mars.jpl.nasa.gov/gallery/video/viking30/index.html>

30 year anniversary movie website (from 2006) (around 6 minutes)



1992-1993

## Mars Observer

<http://marsprogram.jpl.nasa.gov/programmissions/missions/past/observer/>

After a 17-year gap since its last mission to the red planet, the United States launched Mars Observer on September 25, 1992. The spacecraft was based on a commercial Earth-orbiting communications satellite that had been converted into an orbiter for Mars. The payload of science instruments was designed to study the geology, geophysics and climate of Mars.

The mission ended with disappointment on August 22, 1993, when contact was lost with the spacecraft shortly before it was to enter orbit around Mars. Science instruments from Mars Observer are being reflown on two other orbiters, Mars Global Surveyor and 2001 Mars Odyssey.

Later investigation concluded the most probable cause of the mishap was a fuel line rupture during fuel tank pressurization which would have caused the spacecraft to spin uncontrollably. Although none of the primary objectives of the mission were achieved, cruise mode data were collected up to loss of contact.





1996-2006

## Mars Global Surveyor

<http://marsprogram.jpl.nasa.gov/programmissions/missions/past/globalsurveyor/>

<http://marsprogram.jpl.nasa.gov/mgs/overview/>

<http://mars.jpl.nasa.gov/mgs/>

[http://marsprogram.jpl.nasa.gov/files/mep/MGS\\_AeroBox.pdf](http://marsprogram.jpl.nasa.gov/files/mep/MGS_AeroBox.pdf)

Mars Global Surveyor paper model



Artist's concept of Mars  
Global Surveyor

Image credit: NASA/JPL

The Mars Global Surveyor was the first successful U.S. mission launched to Mars since the Viking mission in 1976. After a 20-year absence at the planet, Mars Global Surveyor ushered in a new era of Mars exploration with its [five science investigations](#). Mars Global Surveyor arrived at Mars on September 11, 1997, and has contributed a multitude of findings, including signs of past, persistent water such as an ancient delta and currently active water features in the gullies of canyon walls. After nearly a decade of discovery, MGS went silent in November, 2006.”

Mars Global Surveyor, launched in 1996, operated longer at Mars than any other spacecraft in history, and for more than four times as long as the prime mission originally planned. The spacecraft returned detailed information that has overhauled understanding about Mars. Major findings include dramatic evidence that water still flows in short bursts down hillside gullies, and identification of deposits of water-related minerals leading to selection of a Mars rover landing site.

The Jet Propulsion Laboratory, Pasadena, Calif., manages Mars Global Surveyor for NASA's Science Mission Directorate, Washington. Lockheed Martin Space Systems, Denver, developed and operates the spacecraft.



1996-1998

## Mars Pathfinder

<http://marsprogram.jpl.nasa.gov/programmissions/missions/past/pathfinder/>

<http://marsprogram.jpl.nasa.gov/MPF/>

[http://www.jpl.nasa.gov/news/fact\\_sheets/mpf.pdf](http://www.jpl.nasa.gov/news/fact_sheets/mpf.pdf)

<http://www2.jpl.nasa.gov/files/misc/mpfland.pdf>



*Science instruments:* Alpha Proton X-ray Spectrometer, three Cameras (also technology experiments)  
Mars Pathfinder was originally designed as a technology demonstration of a way to deliver an instrumented lander and a free-ranging robotic rover to the surface of the red planet. Pathfinder not only accomplished this goal but also returned an unprecedented amount of data and outlived its primary design life. The rover was named *Sojourner*, which means traveler, named after Sojourner Truth, the abolitionist and champion of women's rights, chosen from a contest of 3500 entries from students all over the world—the winner was Valerie Ambrose, age 12, of Bridgeport, CT.



1998-1999

## Mars Climate Orbiter

<http://marsprogram.jpl.nasa.gov/programmissions/missions/past/climorb/>

Mars Climate Orbiter was designed to function as an interplanetary weather satellite and a communications relay for Mars Polar Lander. The orbiter carried two science instruments: a copy of an atmospheric sounder on the Mars Observer spacecraft lost in 1993, and a new, lightweight color imager combining wide- and medium-angle cameras.

Mars Climate Orbiter was lost on arrival September 23, 1999. Engineers concluded that the spacecraft entered the planet's atmosphere too low and probably burned up.

Why did it enter too low? It was a math mistake. A 125 million dollar math mistake that should have been caught. One team was using the metric measure of newtons for some calculations and the other team was using pounds of force. (That is why teachers always want you to label your answers in math problems!!)

[http://articles.cnn.com/1999-09-30/tech/9909\\_30\\_mars.metric\\_1\\_mars-orbiter-climate-orbiter-spacecraft-team?\\_s=PM:TECH](http://articles.cnn.com/1999-09-30/tech/9909_30_mars.metric_1_mars-orbiter-climate-orbiter-spacecraft-team?_s=PM:TECH)

<http://www.wired.com/thisdayintech/2010/11/1110mars-climate-observer-report/>



1999

## Mars Polar Lander/Deep Space 2

### Mars Polar Lander

*Launch:* January 3, 1999

### Deep Space 2

*Mass:* 3,572 grams (7.9 pounds)

*Science instruments:* Sample collection/water detection experiment, soil thermal experiment, atmospheric descent accelerometer, impact accelerometer

Mars Polar Lander was an ambitious mission to set a spacecraft down on the frigid terrain near the edge of Mars' south polar cap and dig for water ice with a robotic arm. Piggybacking on the lander were two small probes called Deep Space 2 designed to impact the Martian surface to test new technologies.

Mars Polar Lander and Deep Space 2 were lost at arrival December 3, 1999.



2007-2008

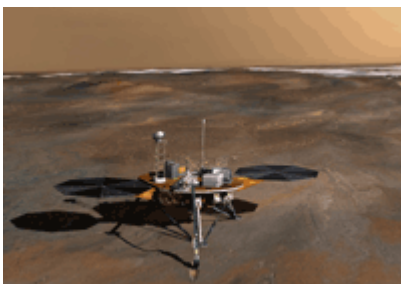
## Mars Phoenix

<http://marsprogram.jpl.nasa.gov/programmissions/missions/past/phoenix/>

The Phoenix mission is the first chosen for NASA's Scout program, an initiative for smaller, lower-cost, competed spacecraft. Named for the resilient mythological bird, Phoenix uses a lander that was intended for use by 2001's Mars Surveyor lander prior to its cancellation. It also carries a complex suite of instruments that are improved variations of those that flew on the lost Mars Polar Lander.

In the continuing pursuit of water on Mars, the polar regions are a good place to probe, as water ice is found there. Phoenix will land farther north than any previous mission, at a latitude equivalent to that of northern Alaska. During the course of its three-month mission, Phoenix will dig down to an ice-rich layer that scientists calculate lies within inches of the surface. It will check samples of soil and ice for evidence about whether the site was ever hospitable to life.

.Although Phoenix was never designed to withstand Martian winter...scientists had hoped the craft might be able to maintain enough power to reawaken when sunlight returned in the spring. But after successfully sending back 5 months of data on Mars polar conditions, the stationary Phoenix went silent, probably after ice build up on the solar arrays during the Mars winter season made it unable to collect enough sunlight to keep it powered. In its time on Mars, the lander made several important finds, including verification that [there is water ice in Mars's surface soil](#). Phoenix also saw [snow falling on Mars](#) and found mineral deposits indicating that temperatures occasionally rise above freezing, important for the prospect of life on the red planet.



## **Current Mars Missions**



### Launched 2001 - Mars Space Odyssey

<http://marsprogram.jpl.nasa.gov/programmissions/missions/present/odyssey/>  
<http://marsprogram.jpl.nasa.gov/odyssey/>

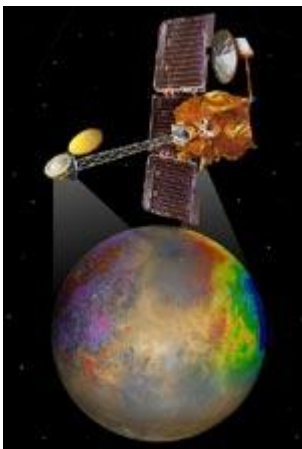
Mars Odyssey is part of NASA's Mars Exploration Program, a long-term effort of robotic exploration of the red planet. The opportunity to go to Mars comes around every 26 months, when the alignment of Earth and Mars in their orbits around the sun allows spacecraft to travel between the two planets with the least amount of energy.

Still in orbit around Mars, NASA's 2001 Mars Odyssey spacecraft has collected more than 130,000 images and continues to send information to Earth about Martian geology, climate, and mineralogy.

Measurements by Odyssey have enabled scientists to create maps of minerals and chemical elements and identify regions with buried water ice. Images that measure the surface temperature have provided spectacular views of Martian topography. Odyssey helped find the landing site selection for the Phoenix Scout Mission, launched in 2007 and for the future mission, the Mars Science Laboratory rover "Curiosity."

The three primary instruments carried by 2001 Mars Odyssey are:

- [THEMIS \(Thermal Emission Imaging System\)](#), for determining the distribution of minerals, particularly those that can only form in the presence of water;
- [GRS \(Gamma Ray Spectrometer\)](#), for determining the presence of 20 chemical elements on the surface of Mars, including hydrogen in the shallow subsurface (which acts as a proxy for determining the amount and distribution of possible water ice on the planet); and,
- [MARIE \(Mars Radiation Environment Experiment\)](#), for studying the radiation environment.





## Launched 2003 and 2004 - Mars Exploration Rovers

### *Spirit and Opportunity*

<http://marsprogram.jpl.nasa.gov/programmissions/missions/present/2003/>

<http://marsrovers.jpl.nasa.gov/home/index.html>

In January 2004, two robotic geologists named Spirit and Opportunity landed on opposite sides of the red planet. With far greater mobility than the 1997 Mars Pathfinder rover, these robotic explorers have trekked for miles across the Martian surface, conducting field geology and making atmospheric observations. Carrying identical, sophisticated sets of science instruments, both rovers have found evidence of ancient Martian environments where intermittently wet and habitable conditions existed.



## Launched 2003 – extended mission to 2014

### Mars Express

<http://marsprogram.jpl.nasa.gov/programmissions/missions/present/express/>

<http://sci.esa.int/science-e/www/area/index.cfm?fareaid=9>


(ESA is the European Space Agency)

NASA is participating in a mission of the European Space Agency and the Italian Space Agency called Mars Express, which has been exploring the atmosphere and surface of Mars from polar orbit since arriving at the red planet in 2003. The spacecraft carries a science payload derived in part from European instruments lost on the ill-fated Russian Mars '96 mission, as well as a communications relay to support lander missions.

The mission's main objective is to search for sub-surface water from orbit. Seven scientific instruments on the orbiting spacecraft have conducted rigorous investigations to help answer fundamental questions about the geology, atmosphere, surface environment, history of water, and potential for life on Mars. Examples of discoveries - still debated by scientists -- by Mars Express are evidence of recent glacial activity, explosive volcanism, and methane gas.

Initially, Mars Express also carried a small lander called Beagle 2, named for the ship in which Charles Darwin set sail to explore uncharted areas of the Earth in 1831. The lander was lost on arrival in December, 2003.



 Launched 2005 - Mars Reconnaissance Orbiter  
<http://marsprogram.jpl.nasa.gov/programmissions/missions/present/2005/>  
<http://mars.jpl.nasa.gov/mro/index.cfm>

<http://mars.jpl.nasa.gov/mro/files/mro/MRO-060303.pdf>  
fact sheet

NASA launched a multipurpose spacecraft named Mars Reconnaissance Orbiter on Aug. 12, 2005 to advance our understanding of Mars through detailed observation, to examine potential landing sites for future surface missions and to provide a high-data-rate communications relay for those missions.

Mission overview:

- ❖ Mars Reconnaissance Orbiter will study the history of water on Mars
- ❖ Mars Reconnaissance Orbiter will be able to look at small-scale features
- ❖ Mars Reconnaissance Orbiter will be a powerful communications and navigation link





Will be Launched Fall of 2011 and planned to arrive 2012

## Mars Science Laboratory

<http://marsprogram.jpl.nasa.gov/programmissions/missions/present/msl/>

<http://mars.jpl.nasa.gov/msl/>

<http://mars.jpl.nasa.gov/msl/news/pdfs/MSL-200608.pdf>

fact sheet

**NASA Mars Rover Will Check for Ingredients of Life** : One of the jobs for the biggest science instrument on NASA's next Mars rover will be to check for the carbon-based molecular building blocks of life.



## Future Mars Missions



*Launch Window: Nov 18-Dec 7, 2013*

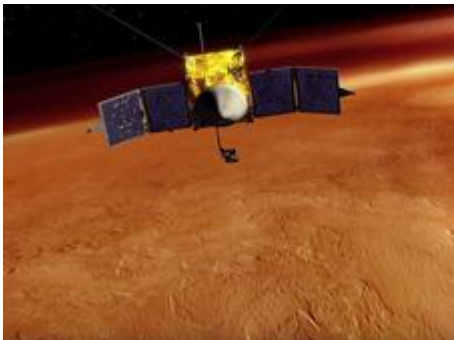
*Mars Orbit Insertion: ~Sep 16, 2014*

## Mars MAVEN

<http://marsprogram.jpl.nasa.gov/programmissions/missions/future/maven/>

[http://www.nasa.gov/mission\\_pages/maven/main/index.html](http://www.nasa.gov/mission_pages/maven/main/index.html)

MAVEN --the Mars Atmosphere and Volatile Evolution mission, scheduled for launch in late 2013-- will be the first Mars mission devoted to understanding the martian upper atmosphere. The goal of MAVEN is to determine the role that loss of atmospheric gas played in changing the Martian climate through time. Where did the atmosphere—and the water—go? It will measure the current rate of atmosphere escape into space and it will gather enough information to allow understanding of the processes backward in time.





Launch Window: January 2016

ExoMars Demonstration Landing: October 2016

Mars Orbit Insertion: October, 2016

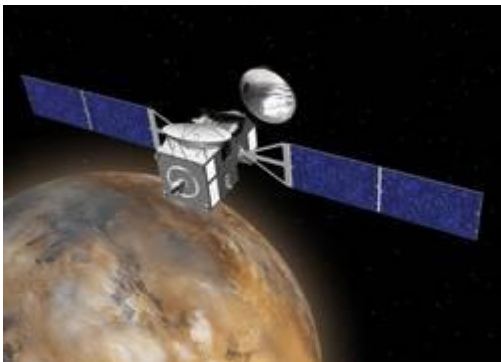
### **ExoMars/Trace Gas Orbiter**

<http://marsprogram.jpl.nasa.gov/programmissions/missions/future/exomarstgo/>

<http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=46048>

The ExoMars/Trace Gas Orbiter mission is a joint mission being developed by the European Space Agency (ESA) and NASA/JPL. This mission would be the first in a series of joint missions to Mars for ESA and NASA. The two space agencies signed the Mars Exploration Joint Initiative agreement in 2009.

Led by ESA, a new spacecraft carrying a demonstration lander would arrive at Mars in 2016. The lander is designed to demonstrate the European capability of entry, descent, and landing at Mars. The orbiter would conduct an exhaustive survey of trace gases in the Mars atmosphere, in order to understand their atmospheric lifetimes and the location and nature of subsurface sources that produce gases, such as methane.



Launch window May 2018

### **Mars 2018 Mission**

<http://marsprogram.jpl.nasa.gov/programmissions/missions/future/mars2018/>

<http://solarsystem.nasa.gov/missions/profile.cfm?Sort=Chron&StartYear=2010&EndYear=2019&MCode=Mars2018>

The Mars 2018 Mission is a proposed NASA Mars rover mission that would launch in 2018, and carry with it the European Space Agency's (ESA's) ExoMars rover. The rovers would land together on the surface of Mars in 2019. They would use a "sky crane" landing system similar to that used for the Curiosity rover. The NASA rover is intended to be designed as a solar-powered rover.

The goal of the proposed NASA rover would be to collect and cache samples of interest for a potential return to Earth by a [future mission](#). It will study rocks to look for scientifically exciting samples, including those that might have the potential to have preserved signs of past life on Mars. It would be designed to collect a few dozen such

samples from several locations near its landing site. To collect the rock samples, the rover would use coring tools. Once the samples are collected and sealed in canisters, the rover would drive to a safe location and place the canisters for possible later pick-up by a future mission with a "fetch" rover.



## Mars – Beyond 2020

<http://marsprogram.jpl.nasa.gov/programmissions/missions/future/futureMissions/>

### **Other NASA Mars Sites**

<http://marsprogram.jpl.nasa.gov/programmissions/overview/>

Overview of NASA's Mars exploration program

<http://marsprogram.jpl.nasa.gov/allaboutmars/>

All About Mars

<http://marsprogram.jpl.nasa.gov/participate/students/>

Mars for Students

<http://quest.nasa.gov/vft/>

Virtual Field Trip to Mars

<http://imaginemars.jpl.nasa.gov/index1.html>

Imagine Mars

<http://www2.jpl.nasa.gov/snc/>

Mars meteorites found on Earth

### **Other NASA fun sites**

HER <http://quest.nasa.gov/>

Many fun NASA explorations ,activities and games for students

For Fun:

NASA Kids Club

<http://www.nasa.gov/audience/forkids/kidsclub/flash/index.html>

Games include Buzz Lightyear and Picture Switcher

NASA: For students: Grades K-4: games & stories

<http://www.nasa.gov/audience/forstudents/k-4/index.html>

NASA: Games from SpacePlace

<http://spaceplace.nasa.gov/en/kids/games.shtml>

Games include: How old do I look, Black Hole Rescue, Slyder and others

Wild Weather Adventure is fun when to play with 2 players

Nanosat Flingman was a favorite of some 4th Graders

NASA: SpacePlace from JPL (Jet Propulsion Lab at CalTech)

<http://spaceplace.jpl.nasa.gov/en/kids/>

NASA: StarChild Learning Center for Young Astronauts

<http://starchild.gsfc.nasa.gov/docs/StarChild/StarChild.html>

NASA: Mars for Kids/Mars Exploration Program

[http://marsprogram.jpl.nasa.gov/funzone\\_flash.htm](http://marsprogram.jpl.nasa.gov/funzone_flash.htm)

NASA: Science Fun & Games

<http://science.hq.nasa.gov/kids/index.html>

<http://eo.ucar.edu/webweather/games.html>

Cloud Matching Game and Cloud Concentration Game

<http://www.spaceday.org/index.php/Games.html>

Games from Lockheed Martin Space Day

NASA: International Space Station Virtual Tour

In the right-hand column, Click on "Take a Virtual Tour..."

[http://www.nasa.gov/mission\\_pages/station/main/index.html](http://www.nasa.gov/mission_pages/station/main/index.html)