

Mars

Though details of Mars' surface are difficult to see from Earth, telescope observations show seasonally changing features and white patches at the poles. For decades, people speculated that bright and dark areas on Mars were patches of vegetation, that Mars could be a likely place for life-forms, and that water might exist in the polar caps. When the Mariner 4 spacecraft flew by Mars in 1965, many were shocked to see photographs of a bleak, cratered surface. Mars seemed to be a dead planet. Later missions, however, have shown that Mars is a complex member of the solar system and holds many mysteries yet to be solved.

Mars is a rocky body about half the size of Earth. As with the other terrestrial planets — Mercury, Venus, and Earth — the surface of Mars has been altered by volcanism, impacts, crustal movement, and atmospheric effects such as dust storms.

Mars has two small moons, Phobos and Deimos, that may be captured asteroids. Potato-shaped, they have too little mass for gravity to make them spherical. Phobos, the innermost moon, is heavily cratered, with deep grooves on its surface.

Like Earth, Mars experiences seasons because of the tilt of its rotational axis (in relation to the plane of its orbit). Mars' orbit is slightly elliptical, so its distance to the Sun changes, affecting the martian seasons. Mars' seasons last longer than those of Earth. The polar ice caps on Mars grow and recede with the seasons; layered areas near the poles suggest that the planet's climate has changed more than once. Volcanism in the highlands and plains was active more than 3 billion years ago, but some of the giant shield volcanoes are younger, having formed between 1 and 2 billion years ago. Mars has the largest volcanic mountain in the solar system, Olympus Mons, as well as a spectacular equatorial canyon system, Valles Marineris.

Mars has no global magnetic field, but NASA's Mars Global Surveyor orbiter found that areas of the martian crust in the southern hemisphere are highly magnetized. Evidently these are traces of a magnetic field that remain in the planet's crust from about 4 billion years ago.

Scientists believe that Mars experienced huge floods about 3.5 billion years ago. Though we do not know where the ancient flood water came from, how long it lasted, or where it went, recent missions to Mars have uncovered intriguing hints. In 2002, NASA's Mars Odyssey orbiter detected hydrogen-rich polar deposits, indicating large quantities of water ice close to the surface. Further observations found hydrogen in other areas as well. If water ice permeated the entire planet, Mars could have substantial subsurface layers of frozen water. In 2004, the Mars

Exploration Rover named Opportunity found structures and minerals indicating that liquid water was once present at its landing site. The rover's twin, Spirit, also found the signature of ancient water near its landing site halfway around Mars from Opportunity's location.

The cold temperatures and thin atmosphere on Mars don't allow liquid water to exist at the surface for long, and the quantity of water required to carve Mars' great channels and flood plains is not evident today. Unraveling the story of water on Mars is important to unlocking its climate history, which will help us understand the evolution of all the planets. Water is believed to be an essential ingredient for life; evidence of past or present water on Mars is expected to hold clues about whether Mars could ever have been a habitat for life. In 2008, NASA's Phoenix Mars Lander found water ice in the martian arctic, which was expected. Phoenix also observed precipitation — snow falling from clouds — and soil chemistry experiments have led scientists to believe that the Phoenix landing site had a wetter and warmer climate in the recent past (the last few million years). It is unsettled whether Phoenix's soil samples contained any carbon-based organic compounds. More extensive surveys must wait until NASA's 2011 Mars Science Laboratory mission, with its large rover (named Curiosity), which will examine martian rocks and soils to determine the geologic processes that formed them and learn more about the present and past habitability of the planet.

FAST FACTS

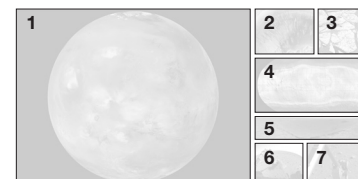
Namesake	Roman god of war
Mean Distance from the Sun	227.94 million km (141.63 million mi)
Orbit Period	1.8807 Earth years (686.98 Earth days)
Orbit Eccentricity (Circular Orbit = 0)	0.0934
Orbit Inclination to Ecliptic	1.8 deg
Inclination of Equator to Orbit	25.19 deg
Rotation Period	24.62 hr
Successive Sunrises	24.660 hr
Equatorial Radius	3,397 km (2,111 mi)
Mass	0.10744 of Earth's
Density	3.934 g/cm ³ (0.714 of Earth's)
Surface Gravity	0.38 of Earth's
Atmosphere Primary Components	carbon dioxide, nitrogen, argon
Temperature Range	-87 to -5 deg C (-125 to 23 deg F)
Known Moons*	2
Rings	0

*As of September 2009.

SIGNIFICANT DATES

- 1877 — Asaph Hall discovers the two moons of Mars, Phobos and Deimos.
- 1965 — NASA's Mariner 4 sends back 22 photos of Mars, the world's first close-up photos of a planet beyond Earth.
- 1976 — Viking 1 and 2 land on the surface of Mars.
- 1997 — Mars Pathfinder lands and dispatches Sojourner, the first wheeled rover to explore the surface of another planet.
- 2002 — Mars Odyssey begins its mission to make global observations and find buried water ice on Mars.
- 2004 — Twin Mars Exploration Rovers named Spirit and Opportunity land on Mars and find the strongest evidence yet obtained that the red planet once had underground liquid water and water flowing on the surface.
- 2006 — Mars Reconnaissance Orbiter begins returning high-resolution images as it studies the history of water on Mars.
- 2008 — Phoenix lands on Mars to study the history of water and search for complex organic molecules; confirms the presence of water ice near the north pole.

ABOUT THE IMAGES



1 Water-ice clouds, polar ice, polar regions, and geological features can be seen in this full-disk image of Mars.

- 2** Gullies may be a sign that water has recently flowed.
- 3** Sphere-like grains that once may have formed in water appear blue in this false-color image taken by Mars rover Opportunity near its landing site.
- 4** False color (blue) shows where water ice is buried beneath the martian surface in this Mars Odyssey map.
- 5** A view of Endurance Crater, near where Mars rover Opportunity landed in Meridiani Planum.
- 6** Mars rover Spirit uses its robotic arm to examine a rock named Adirondack.
- 7** Phoenix photographed its robotic arm in preparation for a test of a mechanism to gather shavings of frozen soil.

FOR MORE INFORMATION

solarsystem.nasa.gov/mars