Fourth planet from the Sun. It is much smaller than Venus or Earth, with a mass 0.11 that of Earth. Mars is slightly pear-shaped, with a low, level northern hemisphere, which is comparatively uncratered and geologically 'young', and a heavily cratered 'ancient' southern hemisphere.

**Mean distance from the Sun** 227.9 million km/141.6 million mi

**Equatorial diameter** 6,780 km/4,210 mi

**Rotation period** 24 hours 37 minutes

**Year** 687 Earth days

**Atmosphere** 95% carbon dioxide, 3% nitrogen, 1.5% argon, and 0.15% oxygen. Red atmospheric dust from the surface whipped up by winds of up to 450 kph/280 mph accounts for the light pink sky. The surface pressure is less than 1% of the Earth's atmospheric pressure at sea level.

**Surface** The landscape is a dusty, red, eroded lava plain. Mars has white polar caps (water ice and frozen carbon dioxide) that advance and retreat with the seasons.

**Satellites** Two small satellites: Phobos and Deimos.

There are four enormous volcanoes near the equator, of which the largest is Olympus Mons, 24 km/15 mi high, with a base 600 km/375 mi across, and a crater 65 km/40 mi wide. To the east of the four volcanoes lies a high plateau cut by a system of valleys, Valles Marineris, some 4,000 km/2,500 mi long, up to 200 km/120 mi wide and 6 km/4 mi deep; these features are apparently caused by faulting and wind erosion. Recorded temperatures vary from $-100^\circ C/-148^\circ F$ to $0^\circ C/32^\circ F$.

Mars may approach Earth to within 54.7 million km/34 million mi. The first human-made object to orbit another planet was Mariner 9, launched in 1971 (see Mariner). The two Viking probes, which landed in 1976, provided more information.

In December 1996 NASA launched the Mars Pathfinder, which made a successful landing on Mars in July 1997 on a flood plain called Ares Vallis. After initial technical problems, its 0.3-m/1-ft rover, Sojourner, began to explore the Martian landscape and to transmit data back to Earth. Pathfinder sent its final transmission on 27 September 1997.

In May 1997 US scientists announced that Mars was becoming increasingly cold and cloudy. Images from the Hubble Space Telescope showed that dust storms had covered areas of the planet that had been dark features in the early 20th century, including one section as large as California, USA.

The Mars Global Surveyor, launched on 7 November 1996, entered Martian orbit in September 1997. Its data revealed that Mars's magnetic field is a mere 800th that of the Earth. In February 1999, the spacecraft established its orbit for mapping the surface of the planet. In 2001, it located two regions on the surface rich in haematite, providing further evidence for the existence of water at some time in
the planet’s history. On 31 January 2001, Mars Global Surveyor completed its primary mission and then went into an extended mission phase, continuing to send data back to Earth until transmission failed in November 2006.

NASA’s Mars Climate Orbiter to monitor weather on Mars was launched from Cape Canaveral, Florida, in December 1998. It was expected to reach its destination in September 1999. However, a measurement error caused the probe to fly too close to Mars and break up. Workers at Lockheed Martin Astronautics in Colorado had given force data in units of pounds, but navigators at NASA’s Jet Propulsion Laboratory had assumed the numbers were in the metric force units of newtons.

NASA launched its Mars Polar Lander in January 1999, which was designed to search for ice with a shovel and send back sounds from an attached microphone. It arrived near Mars on schedule, but in December 1999 it apparently burned up or crashed, ending the US$165 million mission, and provoking criticism of NASA’s Mars exploration programme.

In December 2000 New Zealand scientists revealed that they had managed to grow vegetables, including potato and asparagus, in soil taken from Martian meteorites, and that they grew better than vegetables grown in New Zealand farming soil. This supports the contention that human beings can successfully exploit resources on other planets.

The NASA orbiter 2001 Mars Odyssey was launched in April 2001, and discovered water in the form of subsurface ice at Mars’s south pole in March 2002. It remains operational and holds the record for the longest-active spacecraft on or around another planet.

The European Space Agency’s Mars Express was launched on 2 June 2003 and has discovered methane and water ice during orbits of that planet. It carried a lander for soil collection, Beagle 2, which descended to the surface on 25 December 2003 but communications were immediately lost. The orbiter continues its observations.

NASA announced in July 2000 its plans to land another robot-controlled rover on Mars, after the success of Sojourner in 1997. The Mars Exploration Rover Mission consisted of two spacecraft launched on 10 June and 7 July 2003, each carrying a rover. Named Spirit and Opportunity, the twin rovers successfully landed on, respectively, 3 January and 24 January 2004. They found traces of water formerly present, and NASA extended their activity long beyond their original three-month mission. Spirit’s communications failed in March 2010 and attempts to contact it were abandoned in May 2011. Opportunity continued to explore. The next NASA rover, the Mars Science Laboratory was successfully landed on Mars in August 2012 and dispatched the rover Curiosity on an exploration of at least two years.

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