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Space Administration

Jet Propulsion Laboratory
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NASA's Mars Polar Lander will touch down on Mars on December 3, 1999, in a unique region near the border of the south polar cap. The Lander carries a descent camera (the Mars Descent Imager, or MARDI), an upward-looking lidar for observing clouds, and an integrated payload of scientific instruments (Mars Volatiles and Climate Surveyor, or MVACS) designed to help scientists learn more about the history of Mars' climate.

Where Is the Water on Mars? The atmosphere of Mars today is so cold and thin that liquid water poured on the planet's surface would freeze or evaporate. In Mars' distant past, however, water flowed freely across its surface. Where did the water on Mars go? Did it evaporate to space? Is most of it frozen in the ground and at the poles? Is there liquid water deep beneath the frozen surface? What caused the change in Mars from water-rich to dry? Was the change gradual, over billions of years, or was it sudden, in geologic terms?

Over the next decade, an international fleet of scientifically equipped robotic spacecraft will arrive at the Red Planet searching for answers to these and other questions. The data that will be returned by these spacecraft will tell us much about the forces that shape Mars' weather, now and in the past. A better understanding of the Mars climate will also help us understand the environment in which life did — or did not — develop on Mars, and thus about the potential for life elsewhere in the universe.

The South Pole's Icy, Layered Terrain. After an 11-month journey from Earth, Mars Polar Lander will parachute to a soft landing near Mars' south pole, using small but powerful rocket engines to cushion its descent. For the next three months, the Lander will photograph its surroundings, dig into the Martian surface and analyze the soil, collect weather data, and even listen to Mars. Because it will be late spring and early summer at Mars' south pole, the Sun will not set for those three months — an important factor for the solar-powered Lander. Even with constant sunlight, temperatures will be cool, ranging from –6 to –84 degrees Celsius (21 to –119 degrees Fahrenheit). The ability of the Lander's delicate electronics to withstand these frigid conditions will determine how long it will send us reports from Mars.

Like Earth, Mars has permanent ice caps and seasonal frosts, though the latter on Mars are mainly frozen carbon dioxide (dry ice). Both poles are surrounded by unusual layered terrain — alternating bands of color that may contain different mixtures of dust and ice. Scientists believe these bands were laid down over millions of years as dust was blown through the atmosphere onto the changing polar caps. These layered deposits are thought to be much younger than the ancient terrain that they cover. Like the growth rings of trees, these layered geological bands may help unravel the mystery of recurring climate change on Mars.

Instruments and Measurements. The descent camera, MARDI, will take a series of pictures of the landing site starting 10 seconds after the Lander's parachute opens until touchdown — it will be our first close-up view of the south pole region.

The Lander's primary science objectives are to land on the south polar layered terrain and use its robotic arm to trench down into the surface to search for the presence of water ice and thin layers of dust and ice, which may form even today. The robotic arm will also place soil samples into a set of tiny ovens. Soils heated in the ovens may release gases whose content will be analyzed to learn more about the water and carbon dioxide in the soil. A camera on the robotic arm will record the location of the trenches that are dug, while a camera on the Lander will reveal the geological composition of the landing site and the amounts of water and dust in the atmosphere. The magnetic properties of the Martian surface will be compared to a magnetic calibration target on the Lander. A lidar will measure the altitude of clouds and hazes in the lower atmosphere (2–3 kilometers, or 1–2 miles) by emitting pulses of light and timing their return. The lidar also contains a small microphone, which will listen to the Lander and perhaps catch sounds of Mars itself — such as those of wind and dust storms.

A weather station similar to that carried by the Mars Pathfinder Lander in 1997 will provide daily measurements of temperature, pressure, wind speed and direction, and for the first time ever, humidity. These will be the first surface-based observations of weather in the southern hemisphere of Mars and the first in the polar regions of any planet other than Earth.

The Mars Exploration Program is managed for NASA's Office of Space Science by the Jet Propulsion Laboratory (JPL), California Institute of Technology. JPL's industrial partner is Lockheed Martin Astronautics. Scientific instruments are operated by principal investigators from the Space Research Institute (Russia); the University of California, Los Angeles; and Malin Space Science Systems.

Join us as we explore Mars! Log on to *http://mars.jpl.nasa.gov* to learn the latest news in these historic journeys of adventure.

Points to ponder for educators and students: What causes seasons? Why is a Martian year twice as long as a year on Earth? Why do we need to understand the weather on Mars? Can sound travel in a thin atmosphere? How might layers of soil or ice be formed? What might be in the layers?

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Artist's concept of Mars Polar Lander courtesy of Lockheed Martin Astronautics

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