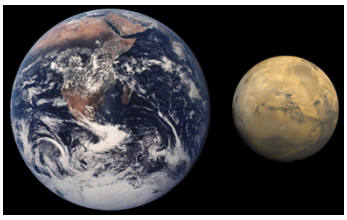
NEW MEXICO MUSEUM OF NATURAL HISTORY & SCIENCE

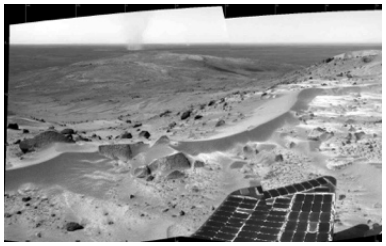
BRIEF GUIDE TO MARS



Earth and Mars: What is different?

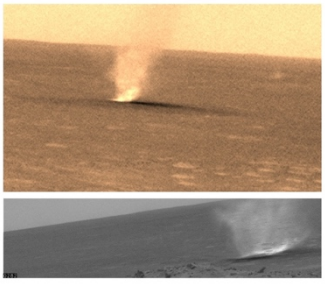
- Mars is the fourth planet from the sun (Earth is the third) and receives about 44% less solar energy than Earth.
- Mars is about one-half the size of Earth.
- Gravity on Mars is about one-third of Earth, so you would weigh about 1/3 as much.
- A Mars day (called a sol) is 24 hours, 37 minutes long. A Mars year is 687 Earth days (about 2 Earth years).
- Mars surface can be divided into two hemispheres. The northern hemisphere is lower in elevation, and the surface is geologically younger volcanic plains; the southern hemisphere is higher in elevation, and the surface is older cratered highlands.
- Mars atmosphere is very thin, similar to Earth 200,000 feet up, and is dominantly CO_2.
- Mars is very cold with an average temperature of -70 degrees, although temperatures can vary from -200 to +70 degrees.
- Mars is very dry. There is no liquid water on the surface due to low atmospheric pressure.

Earth and Mars: What is similar?



- Although smaller, Mars has about the same land area as Earth, because there are no oceans.
- Mars is a geologically diverse planet like Earth. The surface has been affected by volcanism, faults, impact cratering, and the action of wind, water and ice.
- Water ice exists in the polar ice caps and beneath the surface in the polar latitudes. There is evidence that water flowed across the surface early in the history of the planet.
- Mars axial tilt (about 25°) is about the same as Earth (about 23°); therefore, Mars has seasons – but because the Martian year is twice as long as Earth, the seasons are also longer.
- Mars has "weather" (wind, dust storms, dust devils, occasional morning frost and clouds).

Mars is like New Mexico!



- Both have volcanoes, canyons, mountains, sand dunes, and dry arroyos that show signs of past water – and both have red dirt.
- The spring winds on Mars are similar to those in New Mexico.
- Both have dust devils (whirlwinds) that move across the land.
- Both are geologically dynamic.

Why do we study Mars?

- Mars is the most similar planet in many ways to Earth in our Solar System.
- There are plans to send a human mission, and, perhaps, long-term settlement.
- By studying Mars and other similar planets, we learn more about our own planet.

What types of missions have been sent to Mars?

- The USSR sent the first successful Mars orbiter in the 60s.
- NASA sent flyby missions in the 60s, orbiters in the early 70s, two landers (Viking Mission in 1976), then five rovers beginning in the late 1990s to today – Pathfinder Mission (Sojourner Rover) was the first in 1997; then Spirit, Opportunity, Curiosity, and Perseverance Rovers (2000-2020).
- Mars is a difficult target of exploration. From 1960-2018, 57 missions were sent by the USSR, NASA, ESA, Russia, Japan, India and China; about half (26) of the missions failed.

• In 2020, NASA's Perseverance Rover, the United Arab Emirates Mars Hope Orbiter and China's Tianwen-1 Orbiter/Lander all arrived at Mars successfully.
• Perseverance is exploring an ancient delta on Mars. The mission also includes a drone-type helicopter, called Ingenuity, that successfully made the first powered flight on another planet. Ingenuity carried a piece of fabric from the Wright Brothers plane.

What have we learned from Mars Rover Missions so far?

• For the first time, robotic field geologists (directed by geologists on Earth) performed true geological field work on the surface of another planet.
• Spirit and Opportunity traveled over different geological terrain regions, analyzed the chemistry of different types of rocks, and found clear evidence that, early in Martian history, a great deal of water existed for a long time period both beneath and on the surface of Mars.
• Curiosity is giving us our first view of the site of an ancient lake on Mars. Perseverance is the first to visit a river delta deposit and has instruments designed to look for possible chemical signatures of past life. Perseverance will also collect a suite of the very first samples of Martian rock and dirt for eventual return to Earth. Ingenuity has tested the capabilities and usefulness of a helicopter on Mars.
• We now know that Mars has had a complex geological history; more similar to Earth than expected.

We have meteorites on Earth identified as coming from Mars. How do we know that?

• They are dated as younger than the asteroids and therefore from a dynamic, geologically evolving planet.
• They contain pockets of atmospheric gas that are identical in composition to the Mars atmosphere as measured by landers.

Why do we need to send landers, rovers or sample return missions if we already have Mars meteorites?

• We don't know where those rocks originally came from on the planet.
• We need to sample rock types at known locations, compare their compositions with rocks from other locations on Mars, and study the general geology of many regions in order to build up a geological history of the planet.
• A sample return mission is an important next step. The absolute age of the rock and a complete chemical analysis can only be done in laboratories on Earth.

What is New Mexico's connection with Mars missions?

• The New Mexico Museum of Natural History & Science is one of only two museums nationwide (along with the Smithsonian Air & Space Museum) with a direct connection to both the Spirit/Opportunity and Perseverance Rover/Ingenuity helicopter missions through museum scientist, Dr. Larry Crumpler.
• During the active surface operations of the Spirit/Opportunity Rovers, the long-term planning for these rovers were done out of an office in the NM Museum of Natural History & Science.
• One of only 13 high school teams selected nationwide by NASA to work with the Spirit/Opportunity Rover mission was from Laguna-Acoma Jr.-Sr. high school in New Mexico.
• Scientists on the Curiosity Rover include researchers from the University of New Mexico and Los Alamos, and the instruments ChemCam (on Curiosity Rover) and SuperCam (on Perseverance Rover) were designed, built, and directed by Los Alamos scientists.
• Our Museum scientist was part of the original development team for Ingenuity and has specialized in on-the-ground geological mapping of Mars through the rover's cameras and instruments.

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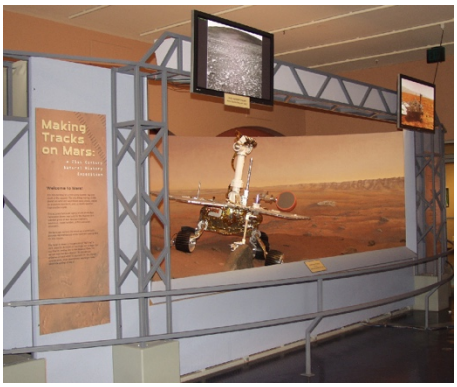
MARS IN THE MUSEUM

What is the basic theme of the Museum's Space Science wing?

• Space science research being done in New Mexico and/or space science research being done by New Mexican scientists.
• Selected themes related to NM include: Mars Rover missions, Apollo 17, Archaeoastronomy (Chaco Canyon Sun Dagger), and Pluto and the New Horizons mission.
• Expansion of the archaeastronomy and Mars research and an exhibit on exoplanet research (much of which is being done in NM) is also planned.

What Information about Mars can you find in the New Mexico Museum of Natural History & Science?



Mars Exhibit

• This museum was given special permission from NASA and JPL (Jet Propulsion Lab) to build a full-scale detailed replica of the Spirit/Opportunity Rover.

• The Mars exhibit includes: Spirit/Opportunity Rover full-scale replica with artist conception terrain surround; interactive rover camera; and kiosks showcasing the planet, the mission, and the rover instruments.

• The Mars exhibit also includes: a case highlighting minerals known on Earth and identified on Mars.
• And we have a piece of Mars! A Mars meteorite is on display under a microscope.

Perseverance and Ingenuity on Mars

• A monitor in the Mars exhibit shows updates on both Curiosity and Perseverance missions.
• Special educational events and programs on Perseverance and the helicopter Ingenuity will be offered in the coming years at the museum for visitors, students, and teachers.
• "Field Reports from Mars" is an ongoing portion of the Museum website (under the Science Menu, click on Space Science) with entries by Dr. Crumpler on the Mars missions and his work on those missions.
• Archived reports allow you to review all 5000 sols (Mars days) of the Spirit/Opportunity Rover mission.
• Current reports will allow website visitors to continue to follow the experiences of Perseverance and Ingenuity as they explore Mars.
• A wide range of educational resources including NASA website links, activities, and coloring sheets are available on the Museum website. Go to "Perseverance Mars Rover" (under the Education menu, click on Science@Home).

For questions about this Brief Guide, contact:
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