

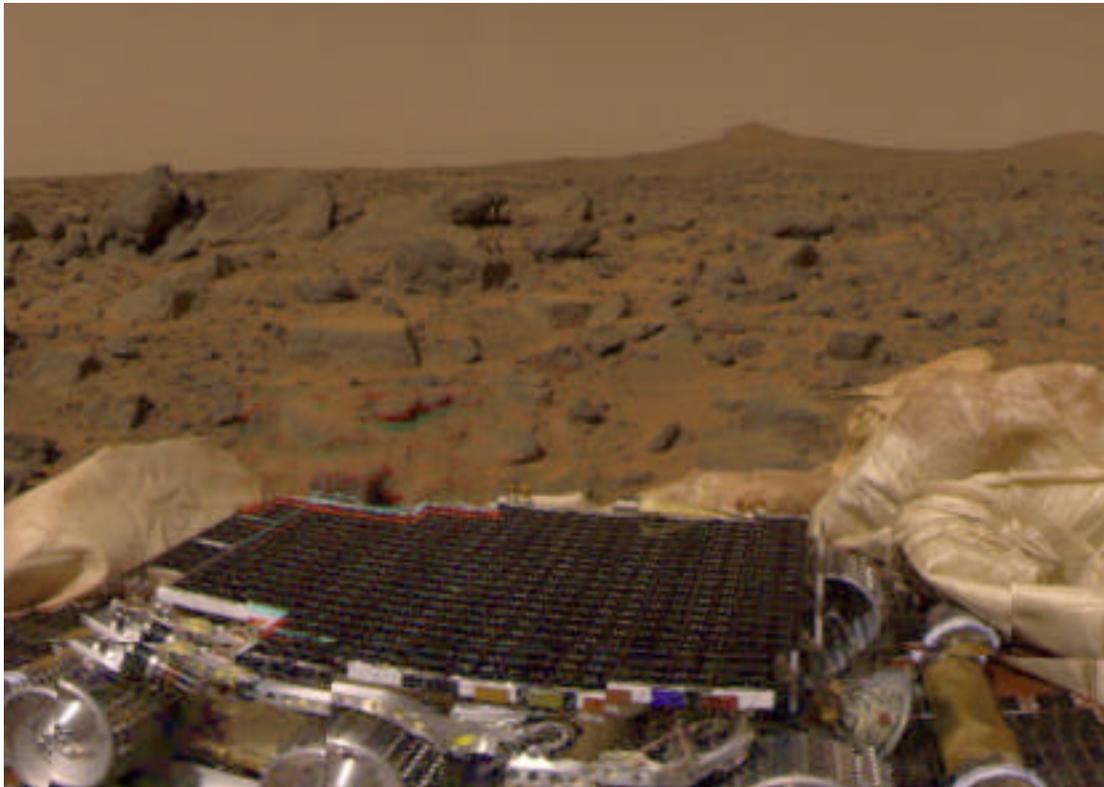


Mars Magic★

Teacher's Guide



Mars, the **red planet**, has fascinated people for centuries. Recently the red planet has been visited by a whole series of new probes such as Pathfinder and Sojourner. In this presentation, *Mars Magic!*, we hope to introduce the red planet to your students on several different levels. First, we will find Mars in the night sky and discover its various motions. Then we will look back and see where many of today's notions of "martians" may have arisen. We will progress to the surveys taken by the Viking probes during the 1970's which gave many answers and a whole slew of new questions. We will also examine the "Face on Mars", "Canals", "Canyons", "Volcanoes", and "River beds"; some are real, some are not. We will see how Pathfinder and Mars Global Surveyor have explored these questions. The program ends with an examination of some **3-D Images** using 3-D glasses!



Sojourner still on Pathfinder at Sagan Memorial Station, Mars, July 4, 1997.

17 Questions to Make You Think About Mars!

1. Which planets are larger than Mars? Smaller than Mars?
2. What makes Mars red?
3. Mars has numerous craters on its surface. Why does Mars have more craters than Earth, but less than the Moon?
4. Mars has polar ice caps that get bigger and smaller over a regular time period. What does this tell you about the weather on Mars?
5. Mars has many dry river beds on its surface. Obviously there was liquid water on Mars long ago. Today there is no liquid water at all; where it went is a mystery. What do you think some of the possible answers might be?
6. Is Mars warmer or colder than Earth? Why?
7. Mars was named after the Roman God of War. Why do you think it was named after that particular mythical god?
8. Name as many space probes as you can that have visited Mars.
9. What is the difference between a “space probe” and a “space ship”?
10. Does Mars have more or less gravity than Earth?
11. How many moons does Mars have?
12. What are the moons' names?
13. What do many scientists believe Mars' moons actually are?
14. The word *planet* means *wandering star*. Why were these objects called that?
15. Mars has air, but if you visited Mars you could not breathe its air. Why not?
16. Have scientists found any evidence that martians really exist?
17. The temperature on Mars gets very cold every night (-120° F or -84° C). Why do you suppose Mars cools off so much at night compared to Earth?



Earth and Mars

Let's Compare the Facts



	Earth	Mars
Distance from the Sun	92,900,000 miles 149,600,000 kilometers	141,600,000 miles 227,940,000 kilometers
Diameter	7,927 miles 12,756 kilometers	4,197 miles 6,794 kilometers
Circumference @ Equator	24,903.4 miles 40,078.15 kilometers	13,185.25 miles 21,344 kilometers
Mass (Earth=1)	1	0.107
Density (water=1)	5.52	3.93
Gravity (Earth=1)	1	0.38
Volume (Earth=1)	1	0.151
Length of Year	365.25 days 1 year	686.98 days 1.88 earth years
Length of Day	24 hours	24 hours 37 minutes
Orbital Speed	66,800 mph 107,400 kph	54,100 mph 87,000 kph
Atmosphere	Nitrogen/Oxygen	Carbon Dioxide
Winter Temperature	-70° to 40° F (-57° to 4° C)	-193° F (-125° C)
Summer Temperature	50° to 120° F (10° to 49° C)	72° F (22° C)
Tilt of Axis to the Orbital Plane	23.45°	23.98°
Albedo	0.37	0.15
Number of Moons	1	2

Earth and Mars Let's Compare Problem Solvers ?

Answer the following questions and problems using the "Let's Compare Chart" on page 3.

1. How many more miles is Mars from the Sun than Earth?
2. How much would a 100 pound person weigh on Mars?
3. How much would you weigh on Mars? (Hint: multiply your weight X 0.38)
4. How many Marses would fit inside Earth? (Hint: divide Earth volume by Mars volume)
5. Travelling at 55 mph, how many hours would it take you to drive non-stop around Mars? Around Earth? (Hint: divide *circumference in miles* by 55)

Exobiology: Martians ! ?

Did you ever wonder what an alien might actually look like? Scientists have. In fact, they have developed a whole new science that has become known as *exobiology*. Exobiology is the study of what real alien creatures might look and behave like. Scientists set the criterion for the environment they live on (their planet), and see how the imaginary creature would likely adapt to the environment.

For example, planets with less gravity would likely allow creatures to grow taller, thinner, and less muscular; while planets with more gravity would make creatures shorter, stouter, and definitely more muscular. If a planet were very cold, creatures would have to have adaptations to help keep them warm, perhaps like fur or fat. If a planet were very hot, creatures would have to adapt to ways of keeping cool. Whether the atmosphere is thick or thin would create different adaptations regarding lung size, sense of smell, and protection from harmful ultraviolet rays from the Sun. How much water is available would also affect the alien. Just think about how camels survive the desert versus fish in the sea; how would they survive in each other's environments? They are definitely adapted to two very different Earth environments, aliens would be just as diverse.

Think about the environment on Mars and design an imaginary creature that you think could live there. Explain how it is adapted to the martian environment. Here are a list of martian characteristics to consider:

Cold Thin Atmosphere of carbon dioxide No Surface Water Windy
Low Gravity Frequent Dust Storms Lots of Iron in Soil No Clouds

Draw a Picture of *Your Martian*

in the Box and describe why he/she could live on Mars:





Sojourner on Mars, '97

Space Probes to Mars

Mariner 4: The first successful mission to Mars, *Mariner 4* went on a fly-by mission to Mars in 1964. It took 22 pictures.

Mariners 6 & Mariner 7: Launched in 1969 these two probes flew by Mars and together recorded 201 images revealing wind and water erosion, and dry ice at polar caps. They also measured atmospheric temperatures, density, and composition.

Mariner 9: The first space probe to orbit another planet (Mars!) in 1971. It tracked a huge dust storm for months. After the storm cleared, it took over 7,300 images and mapped about 90% of the surface of Mars.

Viking 1 & Viking 2: Two space probes that both orbited and landed on Mars in 1976. Each probe had two parts--an orbiter and a lander. They sent back a wealth of information concerning weather, geology, life (they didn't find any), the atmosphere, water, mapping, and pictures.

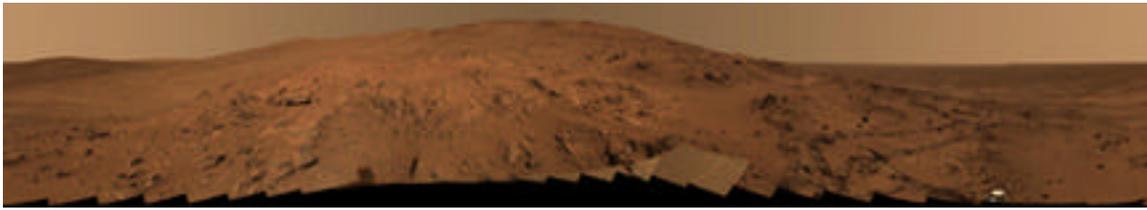
Mars Observer: Launched in September 1992, contact with the Mars Observer was lost when tried to enter orbit around Mars in August 1993.

Pathfinder & Sojourner: A space probe that landed on Mars on July 4, 1997. It used a unique landing technique of bouncing with a set of inflated air-bags. Once stopped, the air-bags deflated and the probe opened up revealing six-wheeled rover named *Sojourner*. Together *Pathfinder* and *Sojourner* sent back thousands of pictures and huge amounts of information regarding the geology of it's landing site on Mars.

Mars Global Surveyor: Launched on November 7, 1996, *Mars Global Surveyor* reached Mars on September 12, 1997. MGS is an orbital mission designed to make a high resolution map of the surface of Mars.

Mars Climate Observer: This probe arrived at Mars in September 1999 and was due to enter orbit and study Mars' climate and weather, but due to a simple math error (two groups of scientists who were working separately on this orbital insertion did their computations using different measuring units--one English units, one metric units) the probe burned up in the atmosphere.

Mars Polar Lander: This probe was due to land in Mars' southern polar region in December 1999, but it apparently crashed and was completely disabled.



Lookout Point, Mars--Spirit Rover 2005

Spirit & Opportunity: These two rovers landed on Mars in January 2004. The two probes landed on nearly opposite sides of Mars. The probes were designed to search for signs of water, either on Mars directly, or evidence that it was once there long ago. Both probes have found ample evidence that Mars was once very wet. They have explored craters, hills, rocks, soil, sand, and even meteorites found on Mars! The two rovers were designed to last for three months, and were still operating in August 2005--that's 20 months after launch!

Mars Express: The European Space Agency's probe sent to Mars to search for water and other sub-surface minerals using sophisticated radar. With a 20 foot long radar antenna, it can map through the surface of Mars to depths of 3 miles (5 kilometers) underground.

Mars Odyssey: A probe that visited Mars and completed its prime mission in the summer of 2004. It was sent to Mars to: 1) monitor conditions that might one day be hazardous for human explorers, things such as weather, and radiation; 2) find out what Mars is made of chemically and geologically speaking; and 3) to search for water beneath the Martian soil. It was highly successful in all three ventures.

Mars Reconnaissance: This probe was launched in the summer of 2005. It will carry the highest resolution camera ever taken to Mars. The camera will take very detailed pictures of specific areas of interest on Mars from orbit.



Mars Reconnaissance
launched summer 2005



Mars Web Sites:

NASA Mars Exploration: <http://mars.jpl.nasa.gov/>

Spirit & Opportunity Rovers: <http://marsrovers.jpl.nasa.gov/home/index.html>

Mars Global Surveyor Probe: <http://mpfwww.jpl.nasa.gov/mgs/index.html>

Mars Express Probe: <http://mars.jpl.nasa.gov/express/>

Mars Odyssey Probe: <http://mars.jpl.nasa.gov/odyssey/>

Mars Reconnaissance Probe: <http://mars.jpl.nasa.gov/mro/>

Face on Mars: <http://www.aspsky.org/html/tnl/25/25.html>

Evidence of Life on Mars: <http://www.jsc.nasa.gov/pao/flash/marslife/index.html>

Pathfinder Home page: <http://mars.jpl.nasa.gov/index1.html>

Jet Propulsion Laboratory: <http://www.jpl.nasa.gov/>

Nine Planets: <http://seds.lpl.arizona.edu/nineplanets/nineplanets/nineplanets.html>

Mars Exploration Homepage: <http://cmex-www.arc.nasa.gov/>

Mars Educational Resources for Teachers:

<http://cmex-www.arc.nasa.gov/Education/Resources/Resources.html>

The Whole Mars Catalog: <http://www.reston.com/astro/mars/catalog.html>

Rocky 7 The Next Generation Mars Rover: <http://wundow.wustl.edu/rocky7/>

Exobiology: http://cmex-www.arc.nasa.gov/Exo_Strat/exo_strat.html

Hubble Space Telescope--What's New?

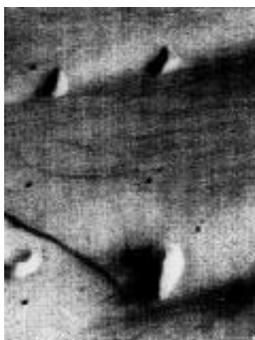
<http://opposite.stsci.edu/pubinfo/whats-new.html>

The "Face on Mars" Debate

In 1976, the two Viking space probes arrived in orbit around Mars. Not long after the mission began, scientists noticed a picture of a mile long rectangular hill in the region of Mars known as Cydonia. The hill was unusual because in the late afternoon light, the shadows made it resemble a human face. The scientists knew it for what it is, a rocky hill that just happens to have weathered in a manner to resemble a face, similar to New Hampshire's "Old Man of the Mountains".



New Hampshire's Old Man of the Mountains



Cydonian Pyramids?



A Smiley Face?



Soon some people were saying it was evidence of a lost civilization on Mars. Nearby a series of small mountains were noticed that resembled "pyramids". This was more evidence to prove that Mars once had real martians! Or so they claimed. Later others found a Viking picture of a crater that resembles a "Smiley Face".

Questions:

1. Do you think these pictures prove that an ancient civilization once flourished on Mars?
2. Where do we often see human forms appear in nature that just appear that way by random, like New Hampshire's "Old Man of the Mountains"?
3. How could we prove or disprove this martian question once and for all?

The mystery is already beginning to unravel. In 1998 scientists who work with *Mars Global Surveyor* pointed the probes high-resolution cameras at the enigmatic "Face on Mars" which can be seen below on the right. Compare the new picture with the earlier *Viking* image. Higher Resolution and different lighting make the landform appear quite differently.

What do you think?

