

SUGGESTED REFERENCES

- **Extrasolar Planets**, by Ron Miller
- **Roving Mars: Spirit, Opportunity, and the Exploration of the Red Planet**, by Steven Squyres
- <http://en.wikipedia.org/wiki/Mars> and http://en.wikipedia.org/wiki/Exploration_of_Mars
From Wikipedia, the free encyclopedia, two websites covering the atmosphere, geology and geography of Mars. Also covered: the orbital characteristics of Mars, its tiny moons, life on Mars, Mars in fiction and the exploration of Mars.
- http://starchild.gsfc.nasa.gov/docs/StarChild/solar_system_level1/mars.html
From the "StarChild" service at NASA's Goddard Space Flight Center, an introduction to Mars written for young people. Information available at two levels.
- <http://www.dustbunny.com/afk/planets/mars/>
From the "Astronomy for Kids" website, a handy summary of Mars.
- <http://nssdc.gsfc.nasa.gov/planetary/factsheet/marsfact.html>
NASA's Mars fact sheet.
- http://en.wikipedia.org/wiki/Extraterrestrial_life
From Wikipedia, the free encyclopedia, a comprehensive summary of the scientific search for extraterrestrial life being carried out directly and indirectly.
- <http://curious.astro.cornell.edu/seti.php>
From the "Ask an Astronomer" site at Cornell University, a good summary of the Search for Extra-Terrestrial Intelligence and Life in the Universe.
- <http://www.ucmp.berkeley.edu/help/timeform.html>
From the University of California at Berkeley, a web-based geological time machine to help in understanding the various sub-divisions of geological time on the Earth.
- <http://school.discovery.com/lessonplans/programs/earthspast/>
From Discovery Education's Lesson Plans Library, a very helpful guide to the teaching of Earth's dramatic history.

NATIONAL SCIENCE EDUCATION STANDARDS

Grades 5-8:

Earth Science

Earth in the Solar System

Science and Technology

Understanding about Science and Technology

Grades 9-12:

Physical Science

Motions and Forces

Science and Technology

Understanding about Science and Technology

*Source: *National Science Education Standards, 1996, National Academy Press*

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SCIENCE SCREEN REPORT

VOLUME 36 ISSUE 5

RED PLANET "Mars"

& QUEST "The Search for Extra-terrestrial Life"



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SYNOPSIS

Mars has some features that would be considered normal to someone from Earth, a 24.5 hour day and daytime temperatures just above freezing. It has planet-wide dust storms, the largest volcano in the solar system and the largest geologic fault.

Mars once had water flowing on its surface and was capable of supporting life. Today, scientists detect no evidence of life. But there are other places in the Solar System such as Jupiter's moon Europa, which might be capable of supporting life. But the question remains, is Earth the only place in the Solar System where life exists?

CURRICULUM UNITS

- ASTRONOMY
- PHYSICAL SCIENCE
- PHYSICS
- INTEGRATED SCIENCE

RUNNING TIME

2 X 10:00

BACKGROUND

Mars, 228 million kilometers from the Sun, orbits the Sun in 687 days. It has a diameter a little over half the size of Earth and it is one-ninth the mass. Both planets have similar axial tilts and the Martian day is 24.5 hours.

The afternoon high temperatures are just above freezing, but the overnight temperatures can drop to -100 degrees Celsius. Just after daybreak, the frost and mist disperse and the sky turns pink with Martian dust. Although the atmosphere lacks oxygen, winds are light and variable. When the Sun sets, the temperatures plummet and ice clouds appear.

Mars has several unique geologic features including: the largest canyon in the Solar System, the Mariner Valley and Olympus Mons, the largest volcano.

Early in its history, volcanic activity probably made Mars warmer and wetter than it is today. The Oceanus Borealis probably filled much of the northern hemisphere. Volcanic gases thickened the atmosphere and increased temperatures. As eruptions melted sub-surface ice and the rains fell, Mars may have flowed with water. There is geologic evidence everywhere. In 2003, the Mars Rovers confirmed that there was once liquid water on the surface.

So why did the surface water disappear? As the planet became less volcanically active, the atmosphere was no longer replenished with gases. Much of the atmosphere leaked into space because of weak gravity. The seas dried and the remaining water froze beneath the surface. Most of Mars is now a desert, with iron oxides coloring the sand red. Occasionally, dust storms blanket the planet for weeks at a time.

As water became frozen on Mars, why did liquid water continue to remain on Earth? The supernova that caused the formation of the Solar System provided Earth with the elements necessary for life to survive and the Earth ended up just the right distance from the Sun to give life a good chance of surviving.

After Earth formed, there was no liquid water or free oxygen in the atmosphere. The planet had to cool before water condensed from the clouds of gas released from volcanic eruptions. The atmosphere formed from gases originating in the interior of the planet.

How did life first arise on Earth? Some popular explanations include: extraterrestrial origin from comets "seeding" the planet and abiogenesis, life arising from non-life, possibly in the volcanic hot springs at the bottom of the oceans. Fossil evidence gives us some clues, but there is not enough evidence for scientists to agree on a primary theory.

Once living organisms did get established on Earth, they mostly survived anaerobically. There wasn't much free oxygen in the atmosphere until millions of years later. Some organisms began to carry out photosynthesis and release large amounts of oxygen into the atmosphere. Organisms that could take advantage of the oxygen and use it to release chemical energy were able to live almost anywhere on Earth.

While we still search for clues about the origin of life on Earth, we also look for evidence of life in other places. Earth lives in the middle of the habitable zone of the Solar System. Mars and Venus lie at the edges. Venus is too close to the Sun; Mars is too far away. There is one other place in the Solar System where liquid water remains, Jupiter's moon Europa. The entire planet is covered with ice, but scientists think underneath the ice lays a vast ocean. There is evidence of volcanic vents on the ocean floor. Around these vents, feeding on chemical nutrients, simple life forms could survive.

Beyond the Solar System, Astronomers have discovered hundreds of extra-solar planets the size of Jupiter and smaller. Most are too hostile for life to survive. The Terrestrial Planet Finder spacecraft has as its primary mission the goal of finding the small, rocky planets that live in the habitable zone of other solar systems. Until we discover these planets, we will not know whether or not we are alone.

ADVANCED ORGANIZERS

Prior to viewing this program, students should have some understanding of the following Benchmarks for Science Literacy, Oxford University Press which are excerpted and, in some cases, abbreviated below. Refer to the Benchmarks for more information.

Benchmark 4: The Physical Setting

Section A - The Universe

Know by Grade 8

- Nine planets of very different size, composition, and surface features move around the Sun in nearly circular orbits. Some planets have a great variety of moons and even flat rings of rock and ice particles orbiting around them. Some of these planets and moons show evidence of geologic activity.

Know by Grade 12

- Increasingly sophisticated technology is used to learn about the universe. Visual, radio, and x-ray telescopes collect information from across the entire spectrum of electromagnetic waves; computers handle an avalanche of data and increasingly complicated computations to interpret them; space probes send back data and materials from the remote parts of the solar system

Section G - Forces of Nature

Know by Grade 8

- The Sun's gravitational pull holds the Earth and other planets in their orbits, just as the planets' gravitational pull keeps their moons in orbit around them.

**Benchmarks can be found at www.project2061.org/tools/benchol/bolintro.htm*

CRITICAL THINKING EXERCISES

1. DESCRIBE how the Terrestrial Planet Finder spacecraft will find rocky planets in other solar systems.
2. DISCUSS scientific explanations for the origin of life on Earth.
3. EXPLAIN why conditions favor the formation and continued success of life on Earth.
4. EXPLAIN how it might be possible for life to exist on Jupiter's moon Europa.
5. EXPLAIN why Mars is referred to as the "Red Planet."
6. DESIGN a rover that could successfully be controlled remotely.

VOCABULARY

Axial tilt

Black smokers

Magma

Stromatolites

Elliptical orbit

Nebula

Iron oxide

Wobble

Supernova

Spectrum

Comet

Hot springs

Prokaryotes

CAREER POSSIBILITIES

- PHYSICIST
- ASTROPHYSICIST
- ASTRONOMER
- ENGINEER
- ASTRONAUT
- GEOLOGIST
- BIOLOGIST