Mars Information and Activities

Adapted for use in DISCOVER section of Imagine Mars

Getting to Know Mars by Comparison

Mars-Earth Comparison/ Place in Space

- Mars and Earth are small terrestrial planets – spherical and rocky with volcanoes, impact craters, valleys, ice caps, and atmospheres.
- Mars' surface area is equal to about 1/3 the surface of Earth—about equal to the total area of Earth's continents.
- Mars orbits the Sun in about 23 Earth months.
- Mars' orbit is between Earth's orbit and the asteroid belt.
- With the propulsion we know now, it takes a minimum of six months to go to Mars.
- Radio communications take a minimum of 4 minutes and as much as 20 minutes each way depending on where the planets are in their orbits.

Mars and Earth are both terrestrial planets – fairly small and mostly rocky solar system bodies. There are many similarities between Mars and Earth: the overall planet shape is spherical, the mineral contents of the rocks are similar, and both have canyons, ice caps, and volcanoes. There are also many differences between Mars and Earth: Mars is smaller – about one half the diameter of Earth with a surface area comparable to all of Earth's continents (1/3 of Earth's surface area.) Mars has a very thin unbreathable atmosphere of mostly carbon dioxide gas, Mars has no liquid water on the surface, Mars is mostly much colder than Earth, and Mars has two small moons, Phobos and Demos. Some of these differences will make Mars a challenge for humans as they build communities on Mars.

Humans planning Mars settlements will need to know Mars' location and movement in our solar system. Mars orbits the Sun in an area between Earth and the asteroid belt. The planet's motion will affect possible living conditions such as travel time back to Earth, communications delays with Earth, and length of day, year, and seasons on Mars. It takes at least six months to get to Mars and the same time to return to Earth when the planets are in favorable positions in their orbits. Since Mars' orbit takes about 669 Mars days or about 23 Earth months to go around the Sun, Mars will often be a great distance from the Earth, thus communications times vary from 4--20 minutes each direction. This longer orbit time also means that seasons are longer too.

Modeling Sizes of Planets

Modeling the Solar System (Temporarily see hand-out – available by May 2003 on http://ares.jsc.nasa.gov/Education/index.html)
Students compare the relative sizes of the planets using familiar fruits and vegetables.

Solar System Distance Activity (Bead Solar System)

Mars Activity Book: K-12 Classroom Activities
http://mars.jpl.nasa.gov/classroom
Students construct a distance model of the Solar System using string and beads. They convert AU's to centimeters.

Human Solar System

Modeling the Solar System
http://ares.jsc.nasa.gov/education/modelingsolarsystem.pdf
Students construct a distance scale model of our solar system in a long hallway or playing field. They observe that space is mostly empty and speculate on the challenges of traveling to other planets.
(Note: In workshops, we give participants a card with a planet's AU measurement and instruct them to take 4 steps for every AU. It moves more quickly to meet the objectives. Remember to call in the outer planets and the asteroid belt before discussing their observations.)

Earth, Moon, Mars Balloons

Mars Activity Book: K-12 Classroom Activities
http://mars.jpl.nasa.gov/classroom
Students model the comparative sizes and distances of Earth, Moon, and Mars.

Extreme Mars

Gravity, Radiation, Temperature, Atmosphere

- The pull of gravity on an object on Mars is 1/3 of the pull on the same object on Earth.
- Solar radiation on Mars surface is stronger than the radiation that reaches Earth's surface.
- Earth's thick atmosphere protects life on Earth – Mars has a very thin, unbreathable atmosphere that allows more radiation to get to the surface.
- Compared to Earth, Mars is cold.
- Mars is farther from Earth and receives less of the Sun's warming rays.
- There are winds on Mars that blow dust around.
- Mars has seasons just like Earth, but they last about twice as long.
- Some seasonal changes on Mars are dust storms that often occur in the spring and deposits of frozen carbon dioxide (dry ice) that form on the poles in winter.

Humans living on Mars will need to adapt to lower gravity. The gravitational pull on an object at the surface is about one third of the pull on the same object on Earth. An object on Mars will weigh one third of its weight on Earth, but the object (mass) will remain the same. Objects are not weightless on Mars but it means that it will take less effort to lift objects and to jump on Mars. Weight is the pull of gravity on an object (mass), so weight changes with the pull of the gravity of each planet.

The thin Mars atmosphere allows more cosmic and solar radiation to hit the surface of the planet than gets through Earth's thicker atmosphere. Humans, plants, and some of our equipment are adversely affected by radiation, and on Earth we use a variety of methods to protect us from the Sun's harmful rays—sunscreen is one example.

Mars is mostly cold by Earth standards. The extreme temperatures range from -125 degrees C (-190°F) in the cold winter nights to 25 degrees C (75°F) at the Sun-warmed surface on summer days. Because the atmosphere is so thin, it does not hold much of the Sun's warming rays, thus the air is much colder than the surface rocks on summer days. Another reason Mars is colder than Earth is that it does not receive as much heat from the Sun since Mars is significantly further away from the Sun than Earth.

Mars has a thin atmosphere that has less than one percent of the air molecules that Earth's atmosphere contains. The atmosphere is made almost entirely of carbon dioxide gas that humans can not breathe -- but plants could use. There are trace gasses in the atmosphere as well as a little water vapor that forms wispy clouds. The water vapor can freeze on rocks and soil forming thin white frost. Often in spring, strong winds develop that stir up the fine dust from Mars' surface. These dust storms can fill the sky with gritty dust and sometimes cover the entire planet in a reddish cloud. The thin Mars atmosphere does not hold much of the Sun's warmth so Mars is mostly very cold. However, the air near the planet surface is warmed by the Sun and, just like on Earth, the warm air rises causing upwelling thermal currents. Sometimes the wind currents cause swirling dust devils – like mini tornados that cruise across the Mars terrain. Orbiter images show the tracks of these dust devils. Similar dust devils are found in the dry deserts of the US. Sometimes there

are fairly high wind speeds on Mars but since the atmosphere is so thin the force of the wind is not like a high wind on Earth.

Mars has seasons, just like Earth, that are caused by the difference in the amount of the Sun's rays that hit the north and south hemispheres due to the tilt of the planet as it orbits the Sun. The seasons last longer on Mars, about twice as long as seasons on Earth, because Mars' orbit around the Sun takes about twice as long as Earth's orbit. Some of the seasonal changes on Mars are the dust storms and the changes in the deposition and sublimation (solid ice changing directly into gas) of ice on the ice caps.

Weight on Mars

http://mpfwww.jpl.nasa.gov/mep/science/weight.html

Beans in Space

Lunar and Planetary Institute Educator Resources-Health in Space
http://www.lpi.usra.edu/education/explore/space_health/space_stations/beans.shtml
Students explore the idea that mass stays the same in space while weight changes in various gravities.

UV Man & UV Man in Space

Lunar and Planetary Institute Educator Resources-Health in Space
http://www.lpi.usra.edu/education/resources/exploration/health_in_space.shtml
Students develop an awareness of solar energy and how we can protect ourselves from being exposed to too much UV radiation. Students then continue the investigation to explore the importance of Earth's protective blanket and consider ways to protect human beings living beyond Earth's atmosphere.

On The Surface

Water/Ice/Geography/Geology/Soil

- Water flowed on Mars long ago but there is no liquid water on the surface now.
- Mars has water ice in the ice caps and probably below the surface in other areas.
- Mars has frozen carbon dioxide (dry ice) at the south pole and in winter at the north pole.
- Water will be an important resource for human habitation of Mars.
- Mars has inactive volcanoes, impact craters, deep canyons, low flat plains, old highlands, and flow channels that are dry.
- Wind erosion is the major active geologic process working on Mars now.
- No life has been found on Mars.
- Rocks, soils, air, and ice are potential resources for humans on Mars.
- Mars is a dusty place because there is fine reddish-brown soil almost everywhere on the surface.

Long ago, water probably flowed on the surface of Mars. Scientists see evidence of past water from the shapes of canyons and dried up streams in images sent to Earth by our Mars orbiting space craft. Our twin Mars rovers have found evidence of past water in the minerals found in surface rock samples. There is no surface liquid water on Mars at this time.

Mars has ice caps at both its north and south poles. The north polar cap consists almost entirely of water ice with a thin coating of frozen carbon dioxide (dry ice) in winter. The south polar cap consists of a deep layer of water ice. Next, a fairly thick layer of carbon dioxide ice is on top of the water ice and that layer is topped by a thin coating of frozen carbon dioxide in winter.

Data from orbiting space craft have indicated that there probably is a large amount of water frozen below the surface of the planet. Future Mars missions will seek ice under the surface by digging and analyzing samples. This potential subsurface ice could prove to be a valuable, accessible resource for human habitation. Water is essential for all life as we know it and will be an important resource if it is found in useable quantities on Mars.

The outer crust of Mars is made of rocks, dust, and some ice. There are many familiar landforms on the surface of Mars that allow scientists to understand some of the processes that shape the surface. Planetary geologists compare what we know about Earth with what the robotic spacecraft test and observe on Mars, thus the scientists can identify the geologic processes that are active now on Mars or were active in the past.

To live on Mars, humans will need to identify and understand the wide variety of landforms and terrains that make up the geography of Mars. Two of the major landforms that were identified from the early space craft data were volcanoes and impact craters. Volcanoes are the highest mountains on Mars – reaching 25 kilometers above the surrounding plains. Four relatively young volcanoes dominate the Tharsis bulge – a large area on the equator of Mars that is topographically very high relative to the mean level for the planet. No volcanic eruptions have occurred recently. There are many more

volcanoes, some very old, found across Mars. The dominant rock type identified thus far is lava rock, similar to the basalt lava flows here on Earth. Impact craters, holes in the ground caused by meteors and comets hitting the surface, dot the surface of Mars. Some are huge like Hellas basin – 2,300 kilometers in diameter and 4 kilometers below the mean elevation. Of course there are thousands of smaller craters that are found mostly in the highland region that dominates the southern hemisphere. Humans living on Mars will have to learn to negotiate the rugged cratered terrain.

Scientists established a longitude and latitude grid for Mars just like our geographic system that delineates Earth's hemispheres. There is a very obvious difference in the northern and southern hemispheres of Mars. The northern hemisphere is topographically mostly low and very flat with only a few craters. Scientists think this area is fairly young geologically. The southern highlands are topographically higher and heavily cratered—lots of craters indicate an old surface that has been exposed to impacts for a very long time without geologic resurfacing from erosion, deposition, or other processes.

Other landforms identified on Mars include mesas, buttes, cliffs, layered rocks, and sand dunes. There are many features that indicate past water flow and powerful water erosion such as dry channels, canyons, and stream networks. Possible lake beds have also been identified in craters and low plains. Of course water features would be very important to scientists seeking possible past life on Mars. The features that point to water flow or long time standing water also help to focus NASA's robotic exploration of the planet. However, the prominent surface processes operating on Mars now and for a long time in the past are wind erosion and deposition. Almost all images of the surface have sand dunes or some other indication of the power of wind acting over a very long time. Scientists also see features in Mars images that look just like Earth glaciers—rivers of ice and rock.
Geography on Earth also involves crops and living natural resources but on Mars no living life forms have been found. If anything is living on Mars it would likely be microbes—the microscopic organisms that are invisible yet all around us on Earth. There are useful resources on Mars in the rocks, soil, air, and ice. Humans will have a wild terrain to explore and resources to use on Mars.

Mars is a dusty place. There is reddish-brown fine soil that blows around in the atmosphere and coats most of the surfaces we observe on Mars. This dust was likely formed from several processes: impacts that pulverized surface rocks, volcanic ash eruptions, and wind and water erosion. Some of the soil has types of salts and other chemicals that could make the soil hazardous. As humans live on Mars they will continually learn to deal with the fine dust that gets into everything.

Making and Mapping Volcanoes – Lava Layering

Destination Mars!
http://ares.jsc.nasa.gov/Education/activities/destmars/destmars.htm
Students are introduced to lava layering as they construct a volcano. Then they investigate an "unknown" volcano to record its history.

Cake Batter Lava (Viscosity)
Exploring Planets in the Classroom-Hands on Activities Hawai'i Space Grant College
http://www.spacegrant.hawaii.edu/class_acts/CakeLavaTe.html
Students use cake batter to simulate surface lava flows.

Gelatin Volcanoes
Exploring Planets in the Classroom-Hands on Activities Hawai'i Space Grant College
http://www.spacegrant.hawaii.edu/class_acts/GelVolTe.html
Students develop an awareness of how magma moves inside volcanoes, what dikes look like underground, and why Hawaiian volcanoes have rift zones by watching red food coloring injected into gelatin.

Impact Craters-Holes in the Ground! Activity B: Making Craters in Dry Materials
Exploring Meteorite Mysteries
http://ares.jsc.nasa.gov/Education/Activities/ExpMetMys/ExpmetMys.htm
Students manipulate the variables of velocity and mass to investigate crater formation.

Mud Splat Craters
Mars Activity Book: K-12 Classroom Activities
http://mars.jpl.nasa.gov/classroom
Students observe crater formation in mud to introduce the idea of fluidized craters as seen on the surface of Mars.

How Does Flowing Water Shape a Planet's Surface?
The Great Martian Floods and the Pathfinder Landing Site
http://marsprogram.jpl.nasa.gov/education/modules/webpages/module2.htm
http://marsprogram.jpl.nasa.gov/education/modules/webpages/activity5.htm
Comparisons of Water Flowing on Mars and Earth
Using a stream table filled with inexpensive diatomaceous earth, students develop an eye for features associated with flowing water. They compare shapes made by the flowing water and landforms on Mars to determine whether water could have flowed across the Martian surface.

Edible Rocks
Exploring Meteorite Mysteries
http://ares.jsc.nasa.gov/Education/Activities/ExpMetMys/ExpmetMys.htm
Students observe and describe physical characteristics of an edible sample in preparation for describing rock or meteorite samples. Helps student focus on observation and description.

Exploring Soils – Lesson 2: Tricky Terrain –Investigating Planetary Soils
Destination Mars!
http://ares.jsc.nasa.gov/Education/activities/destmars/destmars.htm

Mapping the Surface of a Planet

Mapping the Surface of a Planet--student guide
http://marsed.asu.edu/pages/pdfs/MappingStudentGuidev200.pdf
Mapping the Surface of a Planet -- teacher guide
http://marsed.asu.edu/pages/pdfs/MappingTeacherGuidev200.pdf
Image for lesson one
http://marsed.asu.edu/pages/pdfs/ActivityOneImage.pdf
** more images may be borrowed from Paige Valderrama [paigev@asu.edu]

Exploration

Why Explore?
Destination Mars!
http://ares.jsc.nasa.gov/Education/activities/destmars/destmars.htm
Students review the seven traditional reasons why people explore while working in teams to summarize and illustrate the ideas.

Extreme Solar System Exploration Timeline Activity
http://solarsystem.nasa.gov/education
Students are introduced to solar system exploration missions as they construct a timeline using the Solar System Exploration Timeline 2003-2006 mini-poster and NASA internet resources. The timeline display then serves as a visual reminder of coming events.

Strange New Planet
Mars Activity Book: K-12 Classroom Activities
http://mars.jpl.nasa.gov/classroom http://mars.jpl.nasa.gov/classroom/pdfs/MSIP-MarsActivities.pdf (see page 16)
Students make multi-sensory observations, gathering data and simulating remote sensing missions.

Exploring Crustal Material from a Mystery Planet
Mars Activity Book: K-12 Classroom Activities
http://mars.jpl.nasa.gov/classroom
Students observe crustal material samples and infer the history of the "mystery" planet.

Dancing with the Planets (or just Mars)
Destination Mars!
http://ares.jsc.nasa.gov/Education/activities/destmars/destmars.htm
Students use their knowledge of the solar system to create a dramatic group demonstration.
(NOTE: This could be used as an assessment and includes broader information than given in the published activity.)

Alka-Seltzer Rockets
Mars Activity Book: K-12 Classroom Activities
http://mars.jpl.nasa.gov/classroom or
http://marsprogram.jpl.nasa.gov/classroom/pdfs/MSIP-MarsActivities.pdf
Using baking soda and vinegar, students propel an object across the floor, introducing the idea of how things move through space-Newton's Third Law of Motion.

Soda Straw Rockets
Mars Activity Book: K-12 Classroom Activities
http://mars.jpl.nasa.gov/classroom
Students construct rockets on soda straws and then launch by blowing through the straw.

Rover Races

Mars Activity Book: K-12 Classroom Activities
http://mars.jpl.nasa.gov/classroom
Students learn the challenges of operating a planetary rover and develop solutions in a participatory activity.

Mars Pathfinder: Egg Drop and Landing

Mars Activity Book: K-12 Classroom Activities
http://mars.jpl.nasa.gov/classroom
Students design, build, and test a system to land on the surface of Mars without breaking the cargo, an egg.

Mars Bound! Mission to the Red Planet

Arizona State Mars Education
http://marsed.asu.edu/activities.php
Students use realistic techniques to plan a mission to Mars. Teacher Guide, Student Guide, and game parts are printed from PDF (scroll down on site for Mars Bound! PDF files)

Mars URL Links for Instructional Resources

Imagine Mars
http://imaginemars.jpl.nasa.gov/index1.html
Participants focus on their own community as they develop a creative expression of a possible future community on Mars.

Home page NASA Mars Program at Jet Propulsion Lab
http://mars.jpl.nasa.gov/

Arizona State University Mars Outreach
Mars activities, Mars Bound, student research possibilities
http://marsed.asu.edu/

Arizona State University Mars activity packet
http://marsprogram.jpl.nasa.gov/classroom/pdfs/MSIP-MarsActivities.pdf

JSC Destination: Mars Activity Packet
http://ares.jsc.nasa.gov/Education/activities/destmars/destmars.htm

http://www.exploremarsnow.org/

Mars Concept Maps
Center for Mars Exploration-NASA Ames Research Center
http://cmex-www.arc.nasa.gov/CMEX/index.html
Up to date exploration images of Mars

Mars Unearthed – 3-D images of Mars
http://www.marsunearthed.com/