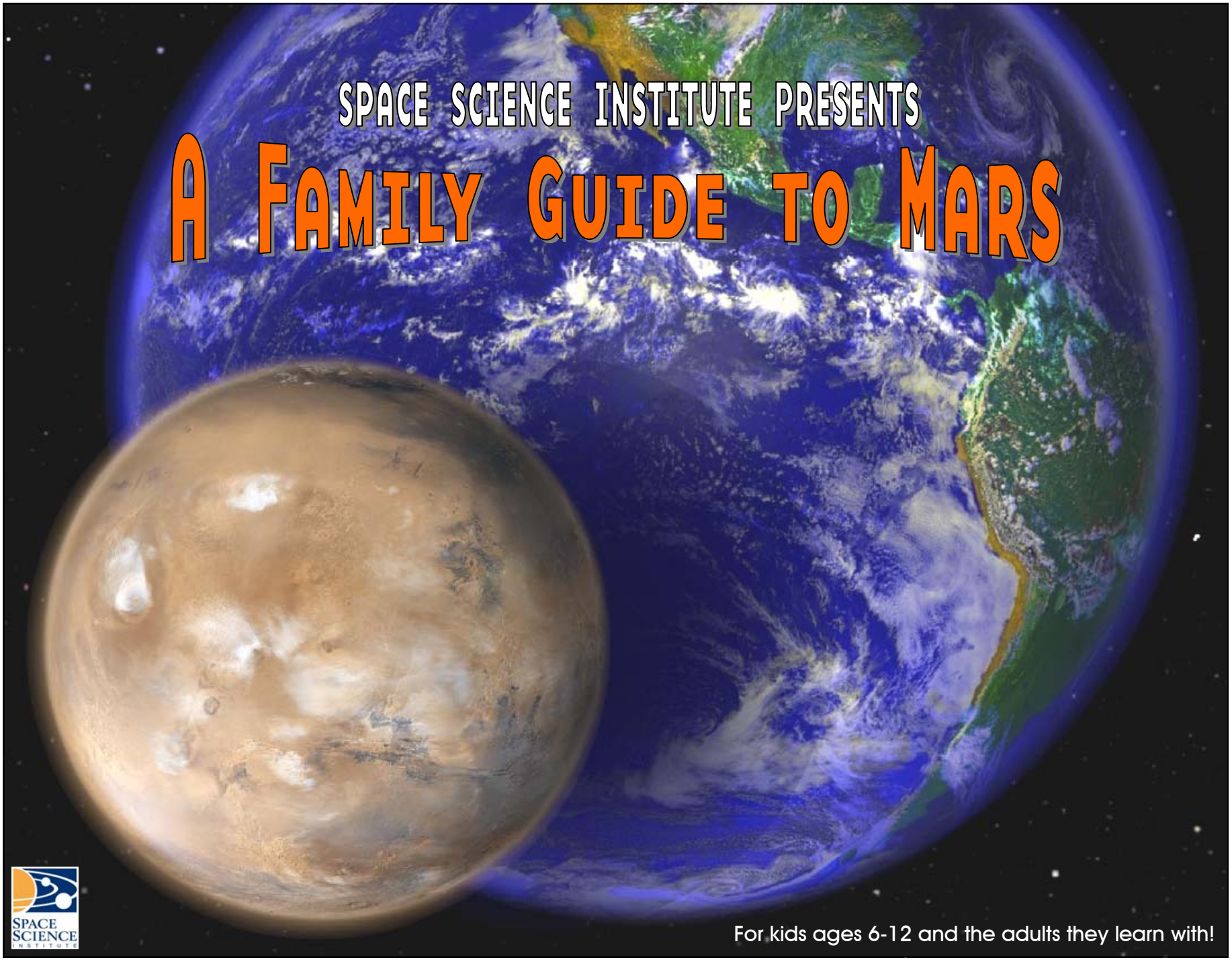

Contact: camorrow@colorado.edu

From the Development Team

Dear Learning Enthusiast,

Welcome to the Family Guide to Mars!

This publication assumes little or no prior knowledge about Mars or astronomy in general.

We invite you to use the diverse activities and resources here to have fun learning about Mars — The Red Planet!

The Guide includes an innovative collection of puzzles, pictures, poetry, and projects, all designed to stimulate enjoyable co-learning experiences between kids aged 6-12 and the caring adults in their lives.

Much learning in life takes place in informal environments outside the classroom. We envision this Guide being of value wherever kids and adults find themselves together and excited about finding out new things.

Before getting started, we strongly urge adults to read the "Tips to Guide Your Child's Enjoyment of Learning" (p. 4). It is very important to realize that being a good learning companion to kids is NOT the same as being the expert who tells all the answers.

Whatever your age or background, we firmly believe that just one significant experience of the joy of discovering something for yourself can vastly enhance your confidence and interest in learning for the rest of your life.

The Guide's content develops and re-enforces four overall themes:

- Comparing Earth and Mars as planets
- The importance of water to life as we know it
- The technology of Mars exploration
- Seeing Mars in Earth's sky

Feel free to jump around — the activities in this guide need not be done sequentially. We encourage you to begin with the Fill-in-the-Blanks Game on p. 22 to warm up your minds and hearts to Mars and its place in the Universe.

Be sure to check out the FAQ at the back of the Guide, which provides general background on Mars, with questions posed as kids tend to ask them. We crafted the "Gee Whiz Facts" to elicit the irresistible urge to tell someone else about them. Look for terms from the Glossary (on p. 47) throughout the Guide — they are marked with an asterisk*.

We want this Family Guide to be the best it can be. We sincerely hope you will explore its riches and tell us about your experience.

The Family Guide to Mars Development Team

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Table of Contents

Tips to Guide Your Child's Enjoyment of Learning

Be a guide on the side

This Family Guide is intended to assist you in sharing the joy of exploration and discovery with the children in your life. It is a wonderful gift to enjoy our minds at play!

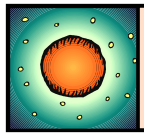
1. Children are naturally curious and enthusiastic to learn about the world around them. *Listen* to their ideas and opinions – they will fascinate you! *Encourage* your child's inclination to *observe*, *wonder*, and *investigate*.

2. The resources and activities in the *Family Guide to Mars* can assist you in making enjoyable connections between Mars and our home planet, Earth. They also provide leads to learning more about the Red Planet.

3. You can be a good teacher, even if learning about Mars is new to you. Good teachers introduce ways to find the answers, rather than presenting themselves as a source of all information.

4. Help your child learn how to ask questions by asking questions yourself. You are a powerful role model. Even if you don't know the answer, you can explore *with* your child to find answers together (see facing page).

5. If you *do* know the answer, it is often valuable to ask leading questions that guide a child to discover something new for themselves.



To help with kids' questions, see FAQ p. 40

6. Encourage your children to use different dimensions of their intelligence to record their impressions and observations. Telling stories, drawing pictures, creating poems or songs, making a photo album or collage, recording a video, and writing in a journal are all ways to remember and share information.

Can People Live on Mars?

When you don't have all the answers...

Child: Can people live on Mars?

Adult: Well let's see... What are some things that people need in order to live?

Child: We need to have food and water.

Adult: Yes. Those are very important. What else?

Child: We need air to breathe.

Adult: Right, people need air with oxygen*.

Child: Does Mars have oxygen?

Adult: I'm not sure, but I think the air is very thin and cold. What else do people need?

Child: Maybe a house for when the weather's bad?

Adult: That makes sense. So does Mars have what people need to live?

Child: Well... we'd have to bring stuff along and we'd probably need spacesuits.

Adult: I bet you're right. Let's go try to find out more about Mars. Where do you think we could look?

Child: Hmm, the computer? The library or the bookstore?

Adult: Those all sound great. Let's get going!

See p. 21 for an activity related to this dialogue!

Meet Rocky — Your Guide to Learning about Mars!

Look for him throughout this Guide, as we learn more about Mars, the fourth planet from the Sun!

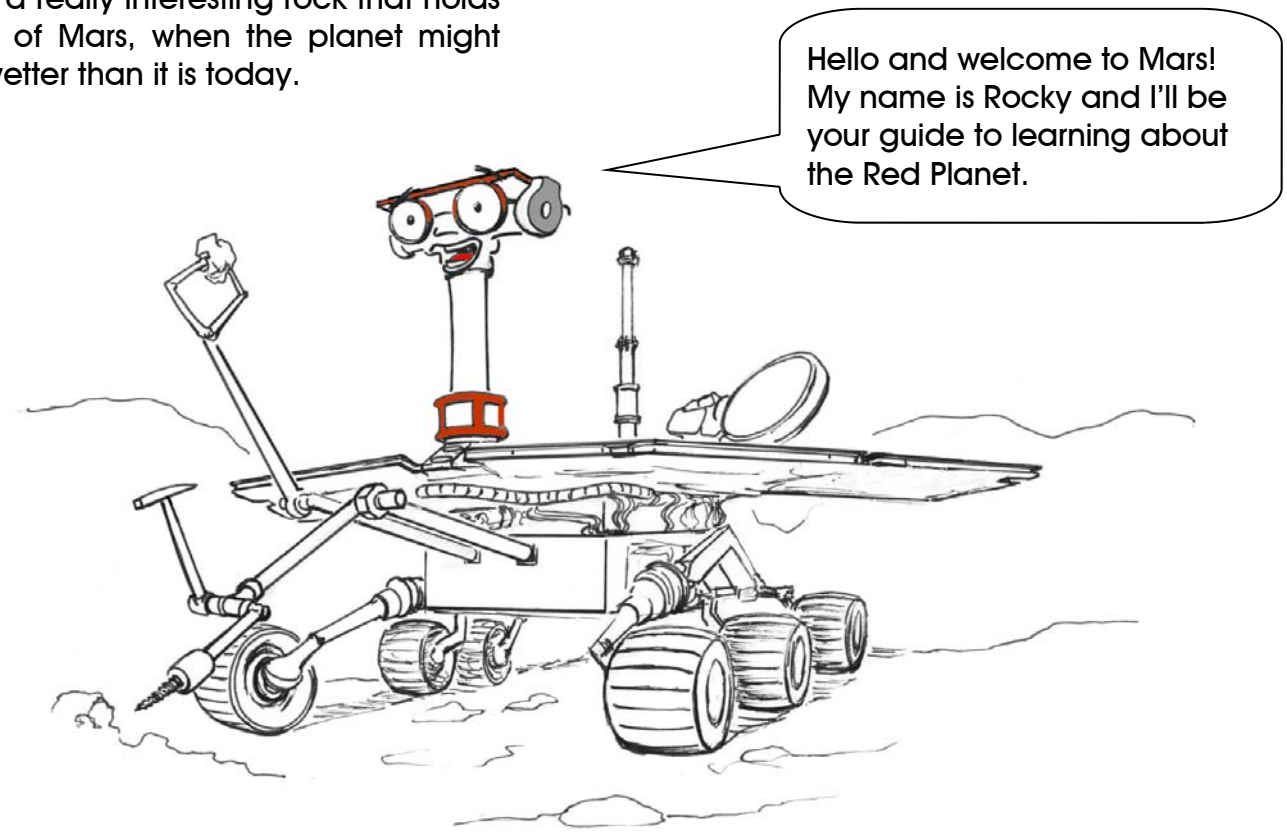
Hello and welcome to Mars! My name's Rocky and I'm a robotic explorer called a *rover**. My job is to roll about on the surface of Mars and help scientists back on Earth learn more about the Red Planet.

Each day, a team of scientists decides where they want me to drive and what interesting rocks they would like me to examine. I look around the scene and make images that tell them a lot about the history of Mars.

Every now and then I find a really interesting rock that holds clues to the early history of Mars, when the planet might have been warmer and wetter than it is today.

When I examine these rocks I wonder if Mars was ever able to support life — even tiny microbes*. It's an important mystery to solve!

I get all of my battery power from sunlight. The number of daylight hours on Mars is about the same as on Earth. It gets very cold at night here on the Red Planet, so I shut down most of my systems and wait for the Sun to come up again.



Why Did the Romans Name Mars for Their God of War?

Ancient cultures gave this wandering red light in the sky special meaning

Since prehistoric times, people in many cultures have gazed at the night sky at the reddish point of light we call Mars.

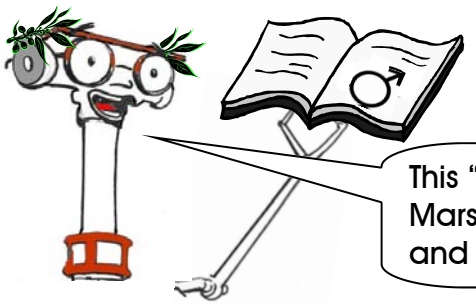
Like other planets* visible to the naked eye, Mars looks much like a bright star, except it does not twinkle, and it appears to shift its position in the sky a little bit from night to night.

Ancient people gave the planets special attention and respect because they *appear* to wander among the stars. Because of Mars' color, ancient cultures called the planet by names like "Red One", "Burning Coal" and "Torch".

Take a look at the sky images on the right. See how one of the points of light appears to move a little from picture to picture? This is a planet!

The ancient Greeks named the red planet Ares, after their god of war. The Romans had some of the same gods as the Greeks, and the Roman name for Ares is Mars.

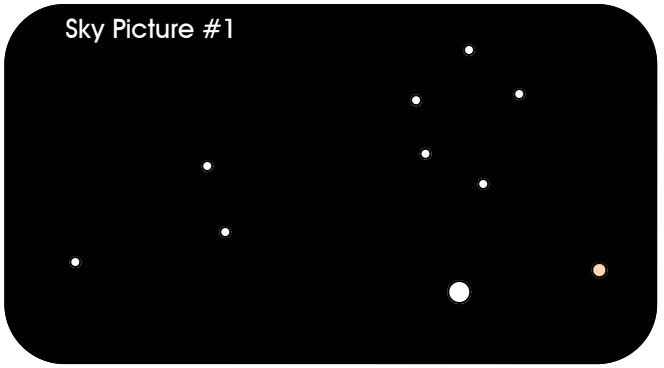
The Romans had a powerful army and a huge empire. They thought of Mars as the father of Romulus and Remus, the mythical founders of Rome. The Romans also named a month on their calendar for Mars — the month of MARCH!



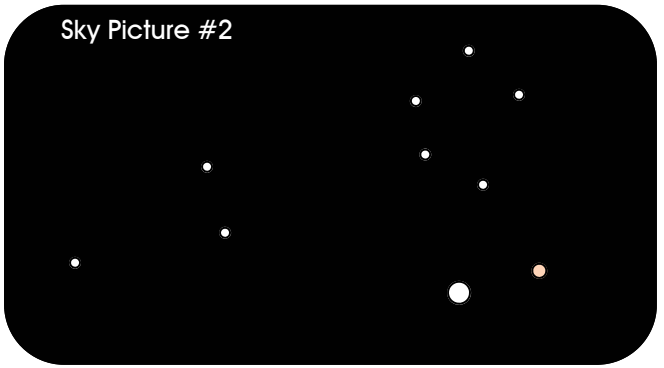
This "circle & arrow" symbol for Mars may represent the spear and shield of a god of war.

Which point of light in the pictures below is "wandering"?

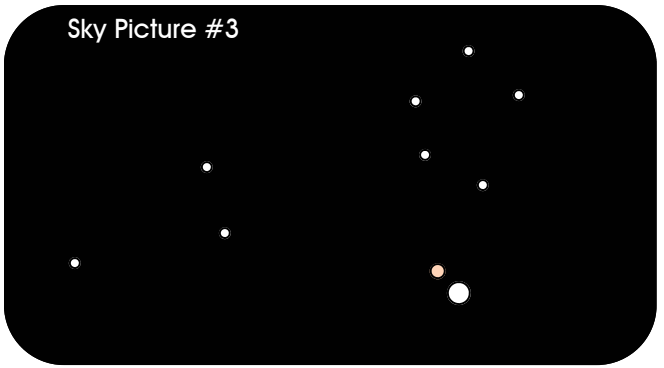
Sky Picture #1



Sky Picture #2

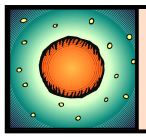


Sky Picture #3



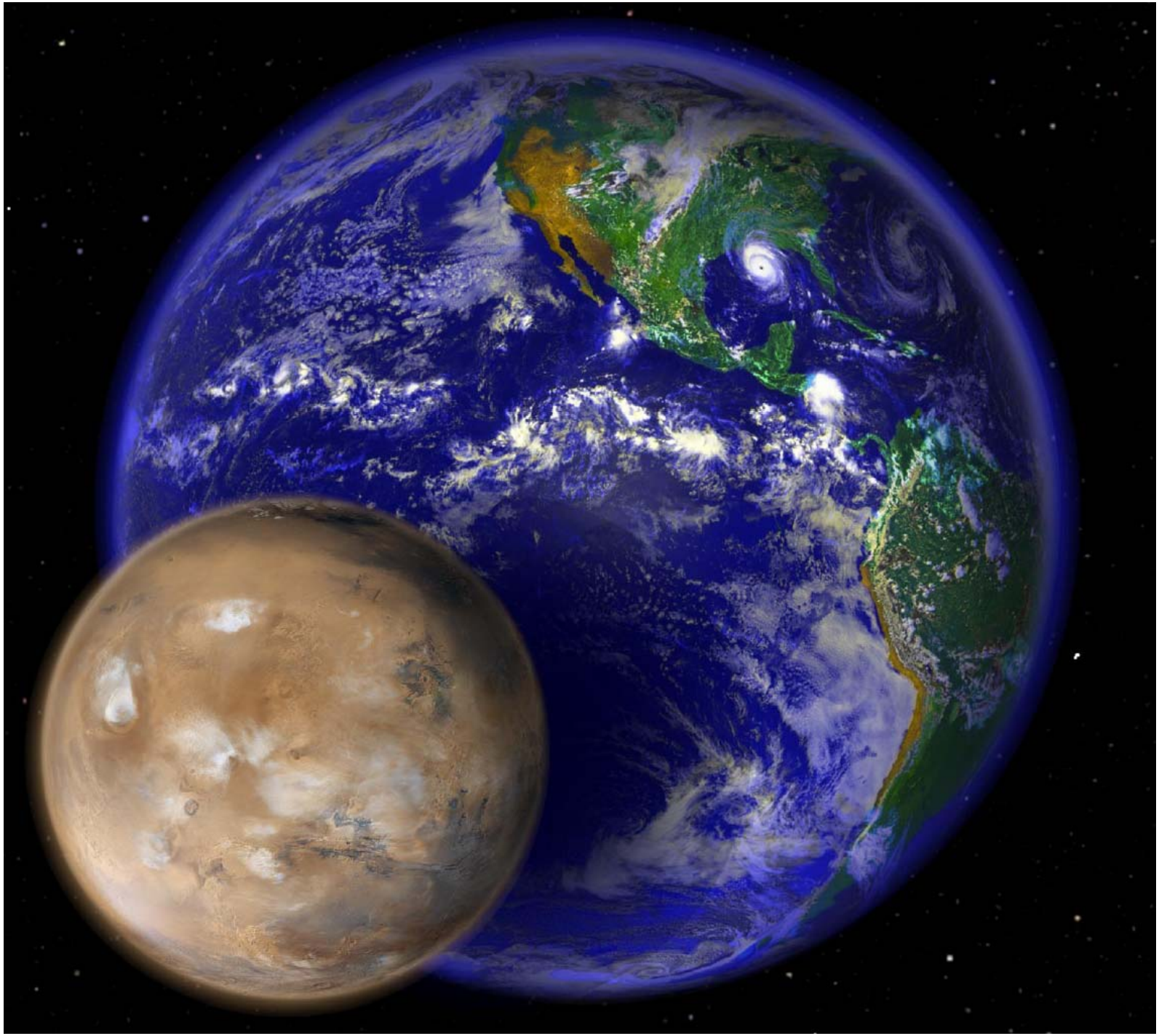
Comparing Earth & Mars

How much do *YOU* know about the Red Planet and the Blue Planet?



For more info see FAQ on p. 40

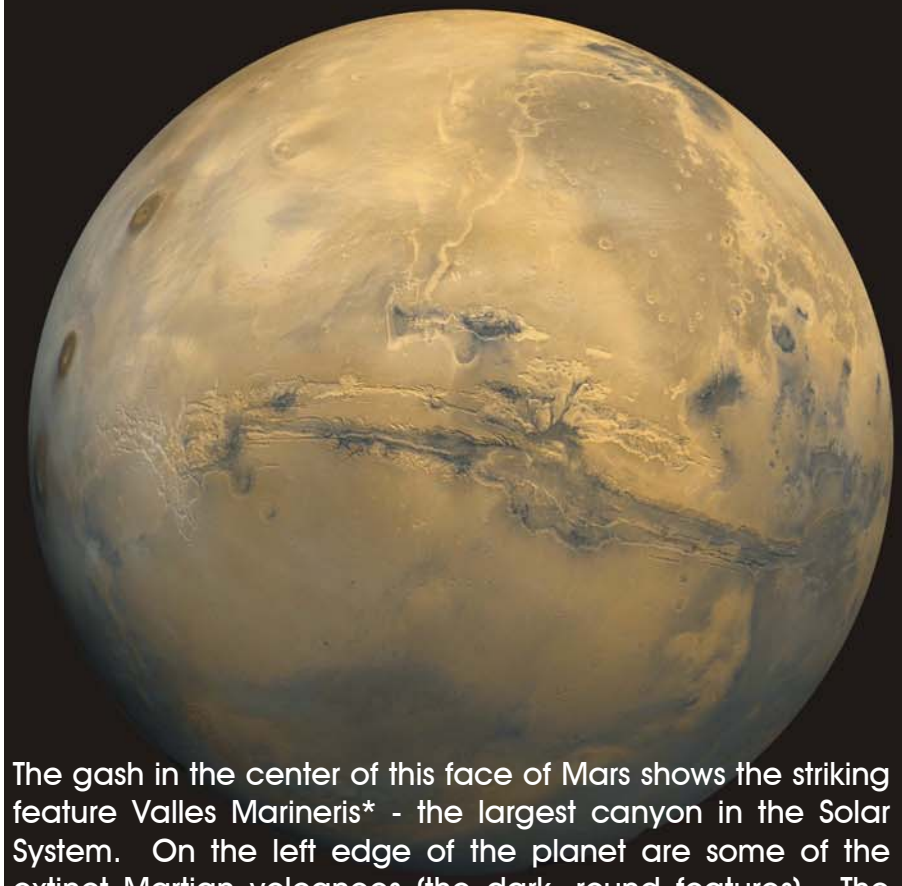
	Earth ⊕	Mars ♂
Distance from Sun	93 million miles (150 million kilometers)	Ranges from 216 million km to 264 million kilometers (see activities pp. 26-27)
Size of Planet (Diameter)	7,926 miles (12,756 kilometers)	4,222 miles (6,794 kilometers) About 1/2 of Earth
Composition	Molten metal core, rocky outer crust	Possibly molten metal core, rocky outer crust
Length of Year	365.25 days (1 year)*	687 Earth days (About 2 Earth years)
Length of Day	24 hours	24 hours, 37 minutes
Moons	One: *Moon* Probably formed billions of years ago from debris left by a giant impact with Earth.	Two: *Phobos* and *Deimos* Possibly captured asteroids*
Water/Ice	Abundant: 70% of Earth's surface is covered by liquid water. Ice caps of frozen water exist at the poles. Also clouds, fog and water vapor in atmosphere.	No liquid water at the surface. Mars is an extremely dry world at present, but does have water in the form of polar caps, ice clouds and ice fog. Large amounts of frozen water lie just beneath the surface near the poles and perhaps elsewhere.
Atmosphere*	Mostly nitrogen (78%) and oxygen* (21%). Some water vapor and other trace gases.	95% carbon dioxide*. Mars has very little oxygen and a very thin atmosphere, so humans would need spacesuits to breathe there.
Weather	Clouds, wind, rain, thunderstorms, hurricanes	Wind, dust storms (some global), ice clouds, fog
Average Surface Temperatures	59° Fahrenheit (15° Celsius)	- 81° Fahrenheit (- 63° Celsius)
Soil	Rocky, sandy and some fertile soil, containing organic material. Organic materials contain carbon and are associated with life.	Mostly rocky and sandy. Some areas appear to have frozen water in the soil. No known organic material.



Two Faces of Mars

Mars has some incredible features. What do you see?

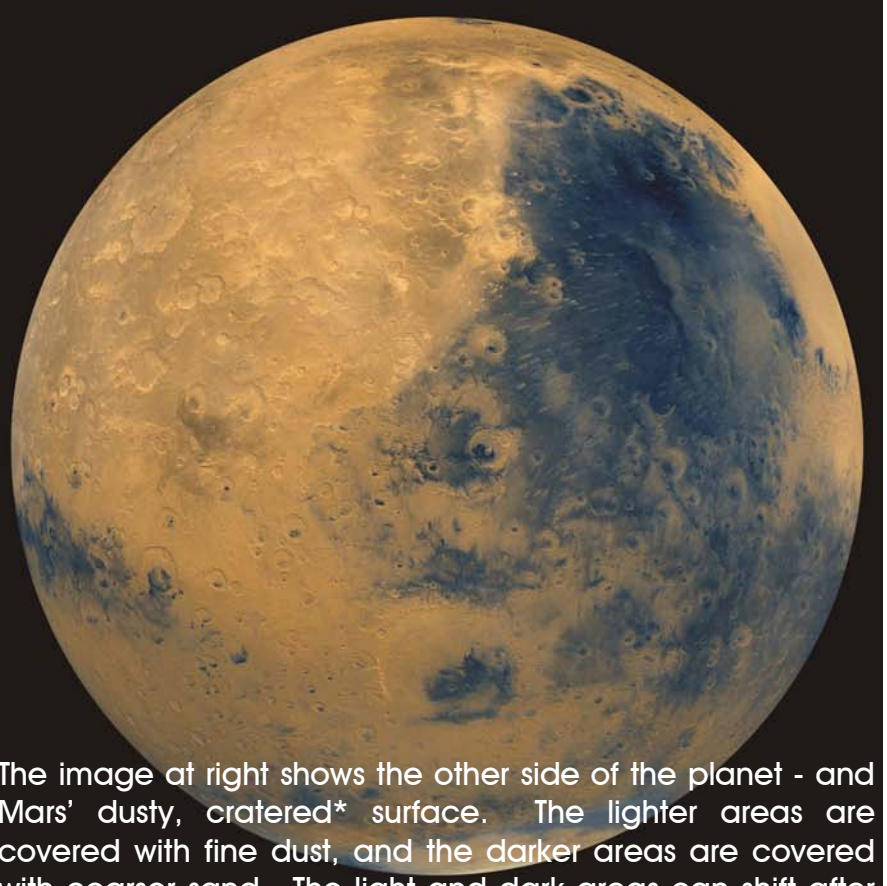
Can you find the huge canyon?



The gash in the center of this face of Mars shows the striking feature Valles Marineris* - the largest canyon in the Solar System. On the left edge of the planet are some of the extinct Martian volcanoes (the dark, round features). The largest volcano in the Solar System, Olympus Mons*, is just over the horizon to the left.

For more images, see Resources #1-3 on p. 44!

Can you find the giant impact crater?



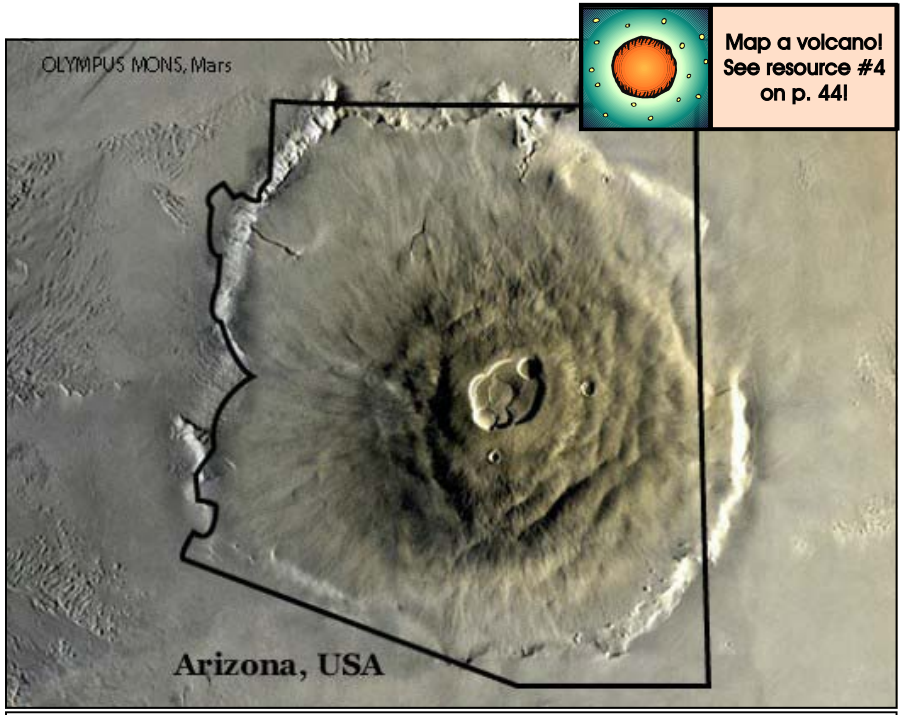
The image at right shows the other side of the planet - and Mars' dusty, cratered* surface. The lighter areas are covered with fine dust, and the darker areas are covered with coarser sand. The light and dark areas can shift after large dust storms.

Hellas Basin, located in the lower center of this image, is the largest impact crater on Mars. It is 2,000 km across and over 7 km deep!

Gigantic Features of Mars

Mars is a smaller planet than Earth, but it has some awesome gigantic features!

Valles Marineris



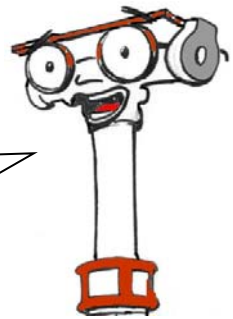
Map a volcano! See resource #4 on p. 44!

Olympus Mons

Valles Marineris* is the largest canyon system in the Solar System. If it were on Earth, it would stretch across the USA.

Olympus Mons is the largest volcano in the Solar System. Its base is about as large as the state of Arizona, and its summit is higher than the tallest mountain on Earth.

How big do you think the Grand Canyon of Arizona would appear in the image on the left? How big would it be in the image on the right?



See FAQ #11 & 12 on pp 42-43 on gigantic features.

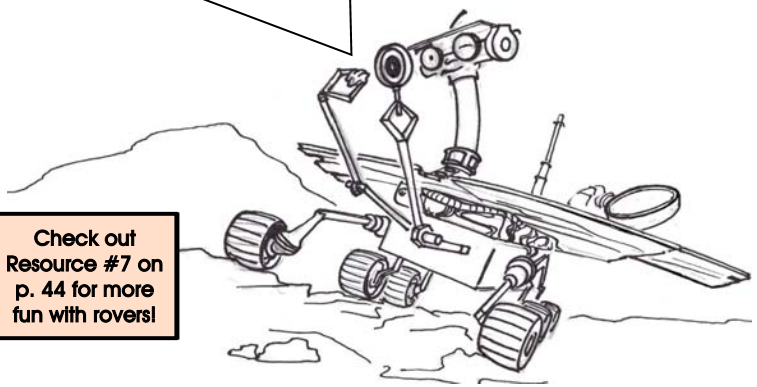
Can you get the rover to the rock?

Pick up letters from the rocks along your path to spell out an important message about the Red Planet.

MESSAGE

See FAQ #6 on p. 41 for a clue.

Mars is a dry desert world. My cameras have spied a fascinating rock just outside this maze of boulders. The rock might contain vital clues about past and present Mars. Can *you* get me to the rock?



Check out Resource #7 on p. 44 for more fun with rovers!

Check out the Frequently Asked Questions about Mars on page 40!

Compare the Sizes of Mars, Earth, and Moons

These images show the relative sizes of Earth and its Moon.

Earth

Moon

Make a scale model of how far the Moon is from Earth:

- Cut out Earth and the Moon.
- Place them 3.8 meters (12 ½ ft) apart.

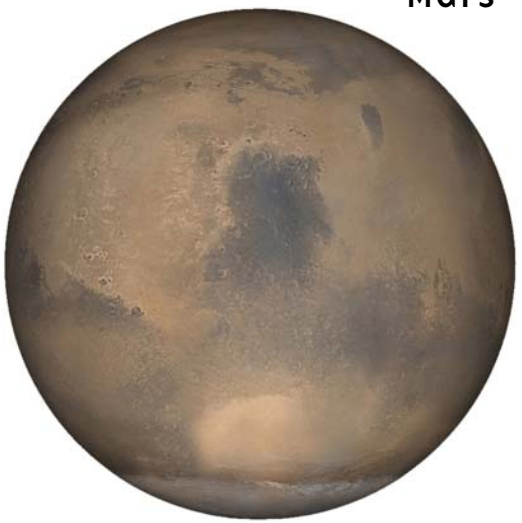
Where did the Moon come from?

The width of the Moon is about 1/4 of Earth's diameter. It is thought to have formed from material ejected from Earth by a tremendous collision early in our planet's history. The object that hit Earth was destroyed, but was probably about the size of Mars.

Compare the Sizes of Mars, Earth, and Moons

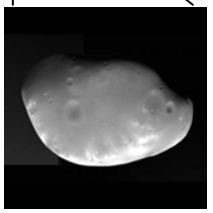
These images show the relative sizes of Mars and its two tiny moons.

Mars



· Phobos

· Deimos



Phobos and Deimos: The tiny moons of Mars.
At proper scale, they would be even smaller than the dots shown.
Their names mean "fear" and "dread". Yikes!

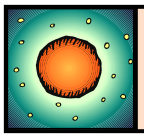
Make a scale model of how far Phobos and Deimos are from Mars:

- Cut out Mars and its two moons.
- Place Phobos 9 cm (3 ½ in) from Mars.
- Place Deimos 23 cm (9 in) from Mars.

The Moon orbits Earth one time each month. Deimos orbits Mars in 30 hours. Phobos orbits Mars in just 7 hours. That's less than one Earth day!

Where did the moons of Mars come from?

The moons of Mars are mere specks compared to their planet. Phobos and Deimos are probably asteroids* that were caught by the Red Planet's gravity.



For more info on the moons of Mars, check out FAQ #15 on p. 43!

Amaze your friends and family!

Check out the Gee Whiz! Facts about Mars on page 39.

Kids Name Our Robotic Explorers!

What would YOU name a Mars rover?

Take a look at Resources #14-15 on p. 45!

How do the robot adventurers we send to Mars get their names?

For the **Pathfinder** mission of 1997, NASA and the Planetary Society held an essay contest for kids 5 to 18 years old to name the little rover* that would scoot around the surface of Mars. Students from all over the world submitted essays about a woman from history whom they considered to be a heroine.

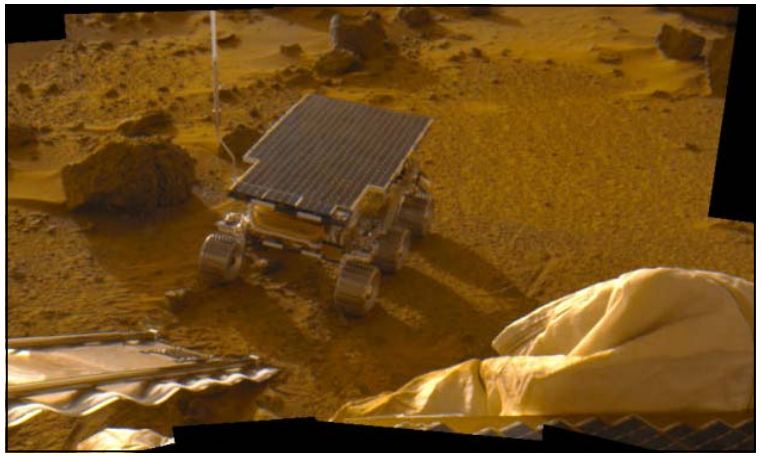
12-year-old Valerie Ambroise of Bridgeport, Connecticut wrote the winning essay about Sojourner Truth, an African-American woman who devoted her life to ending slavery in America - and later, to women's rights. NASA named the Pathfinder rover **Sojourner**.

In 2003, NASA launched two rovers to the Red Planet. Sofi Collis, a 9-year-old from Scottsdale, Arizona submitted the winning essay. She chose the names **Spirit** and **Opportunity** for the robots.

What would <u>you</u> name a spacecraft headed for the Red Planet?

My Rover Would Be Called:

_____



The **Sojourner** rover rolls down its ramp to begin exploring in 1997. This is a REAL picture from the surface of Mars!

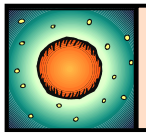
An artist's impression of one of the 2003 rovers, which are named **Spirit** and **Opportunity**.

The Technology of Mars Exploration

Telescopes, orbiters, rovers, landers, airplanes, balloons...

Earth Orbiting Telescope

Four of the seven machines shown on these two pages have explored Mars. Three of them have not yet been used. Can you tell which is which?



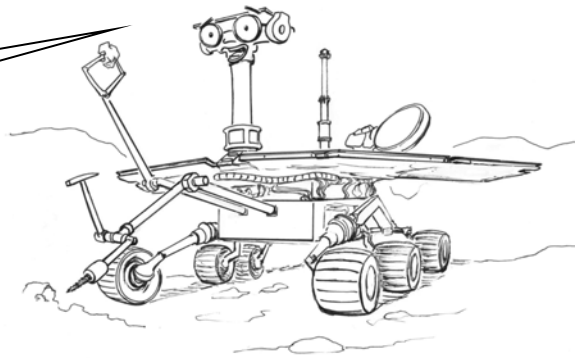
Look on p. 49 to find out more about these machines.

Orbiter (Mars Satellite)

Powerful observatories like the Hubble Space Telescope can observe the Red Planet from Earth orbit. Every couple of years — when Mars is close to Earth — we can send spacecraft to orbit the planet, land on it, and roll around on the surface (like Rocky!)

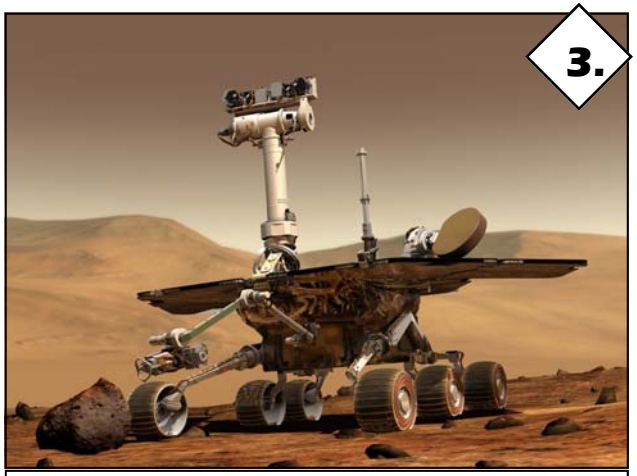
In the future, NASA hopes to send other types of missions, like balloons, airplanes, and even a mission that will gather a sample of Mars and blast it back to Earth so that scientists can study it up close in a laboratory.

Wow! All these machines are my relatives! Would you like to create your own Mars explorer? Look on page 24 to build a Mars Rover you can eat!



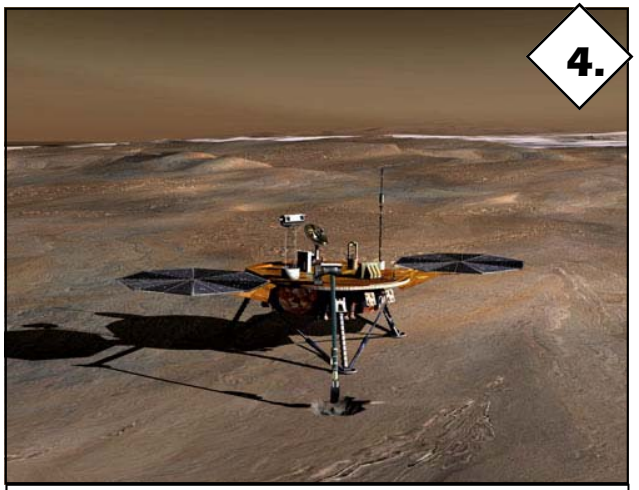
The Technology of Mars Exploration

Artists' conceptions - See p.49 for information about each numbered image.

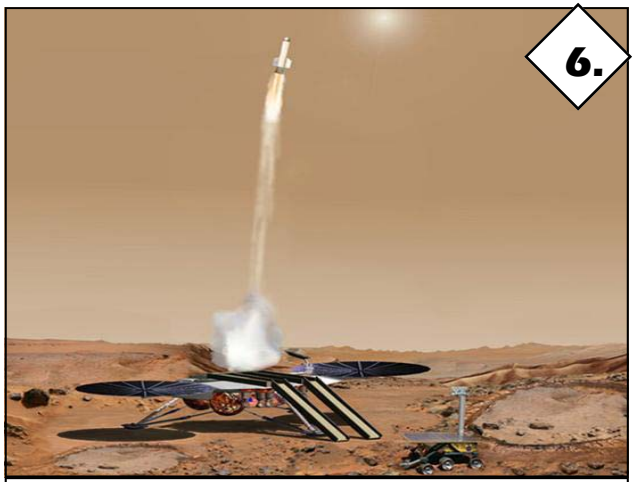


Rover★

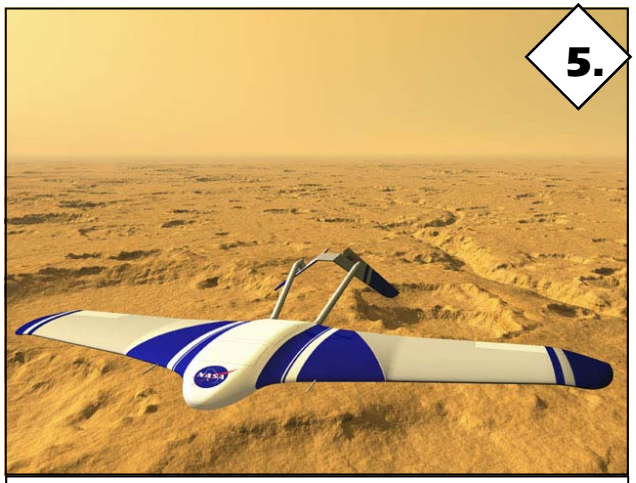
Balloon



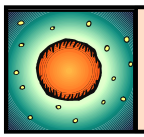
Lander



Sample Return Mission



Mars Airplane



For news on Mars missions, see Resource #12 on p. 45!

Evidence of Water on Mars

Can you match the labels in the center with the correct pictures?

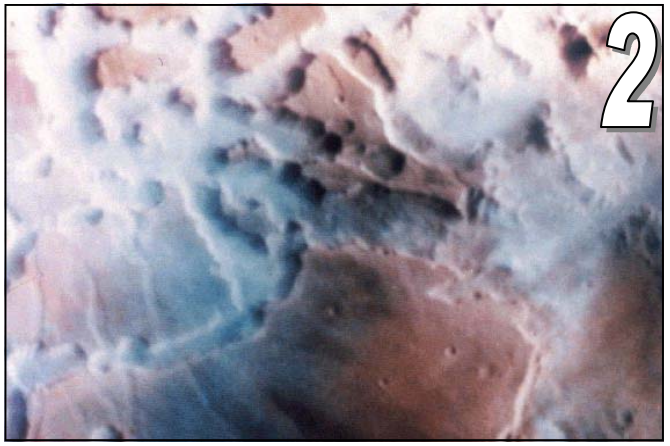
Water ice on Mars, covered by a layer of carbon dioxide* snow.

ICE CLOUDS

Image # _____

GULLIES

Image # _____



Early morning in a part of Valles Marineris*.

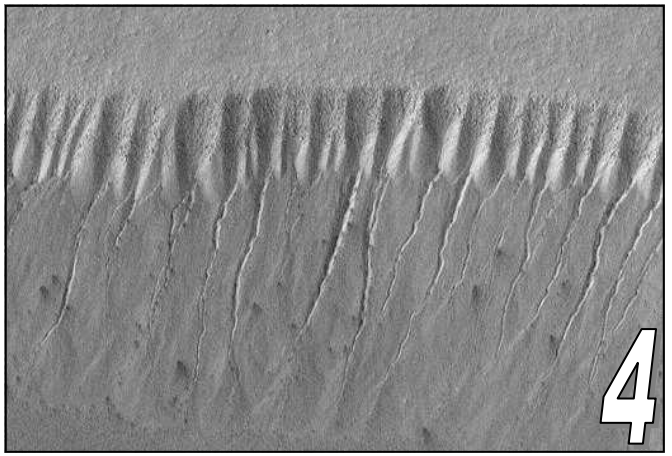
POLAR ICE CAP

Image # _____

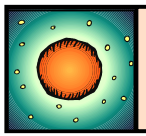
FOG

Image # _____

High in the morning sky on Mars. Image taken by the Mars Pathfinder lander.



These crater* wall patterns may have been caused by liquid water.



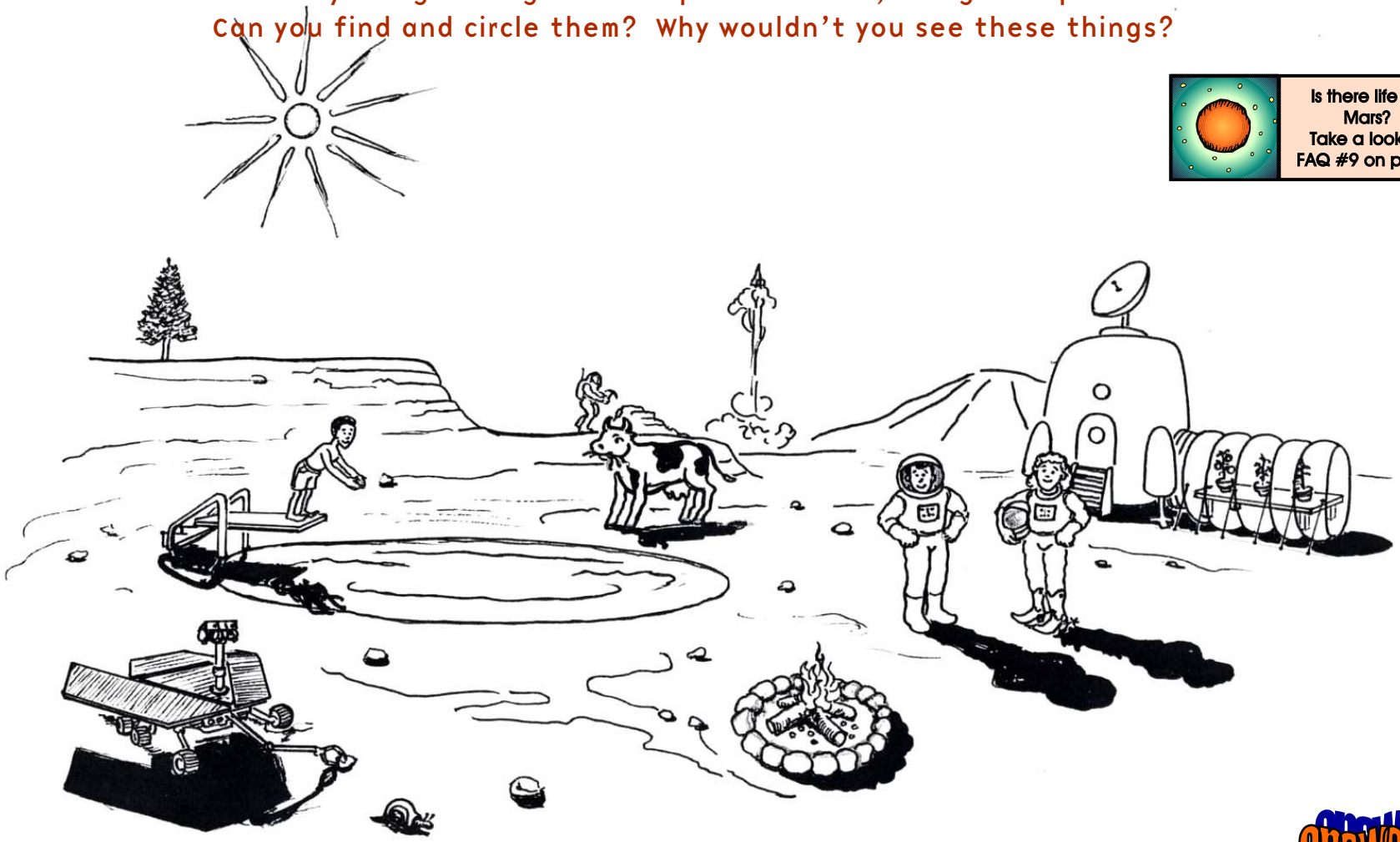
More on water: see FAQ #10 on p. 421

ANSWERS:

Ice Clouds –3 Gullies—4 Polar Ice Cap—1 Fog—2

What's Wrong with This Picture of Mars?

There are seven wacky things wrong with the picture below, things not possible see on Mars.
Can you find and circle them? Why wouldn't you see these things?



Is there life on Mars?
Take a look at FAQ #9 on p. 42!

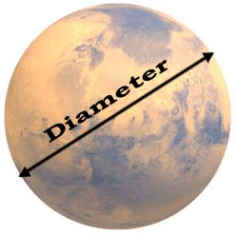
answers

Campfire - There is not enough oxygen* for fires to burn on Mars.
Woman Astronaut - Without her helmet and wearing cowboy boots, she is unprotected from the extreme cold and the thin, carbon dioxide* air of Mars.
Diving Boy - He has no spacesuit to protect him from the cold, thin, carbon dioxide atmosphere.
Pool of Water - Liquid water would either freeze due to Mars' cold temperatures, or boil away due to its extremely thin atmosphere.
Grazing Cow - Cows, like humans, need oxygen and protection from the Martian cold. A dairy cow on Mars is "udderly" ridiculous!
Snail - Same goes for snails... no snail spacesuit means no air to breathe and no protection from the cold, thin atmosphere.
Tree - Trees need carbon dioxide, which Mars air mostly is, but without liquid water, and with the freezing temperatures, trees cannot live.

Red Planet Fill-in-the-Blanks Game

Fill in the blanks with the words from the **WORD LIST**!

Mars is called the _____ Planet because its surface has a rusty color. It is the _____ planet from the Sun. The diameter of Mars is only about [half or twice] (circle one) the Earth's diameter even though Mars has Olympus Mons*, the largest _____ in the Solar System, on its surface.



Mars also has the largest canyon in the Solar System called _____. This canyon is as long as the distance between the east and west coasts of the U.S. In places, the canyon is as deep as the distance between Earth's surface and a jet airplane at cruising altitude (30,000 feet)!

Mars _____ on its axis at about the same rate as Earth, so the Martian day is also about 24 hours long. Mars takes about ____ Earth-years* to orbit the _____. So, if you were _____ years old on Earth [insert your age], then you would only be about _____ years old in Mars years [insert your own answer].

Mars has two small, odd-shaped moons   called _____ and _____. They both _____ around Mars in only hours!

Mars is less massive than Earth so it has a [weaker or stronger] (circle one) gravitational field. If you weighed _____ pounds on Earth [insert your weight], then you would only weigh about 1/3rd of that on Mars (= _____ pounds). Of course, this doesn't mean there

Red Planet Fill-in-the-Blanks Game

would be any less of you on Mars, but only that the Martian gravity* would pull down on you with 1/3rd the force. Just think how high you could jump!

Mars has a very thin _____ made up mostly of carbon dioxide*. It would be impossible to breathe on Mars without a special _____to protect you. The atmospheric pressure on Mars is the same as being 100,000 feet above Earth's surface!

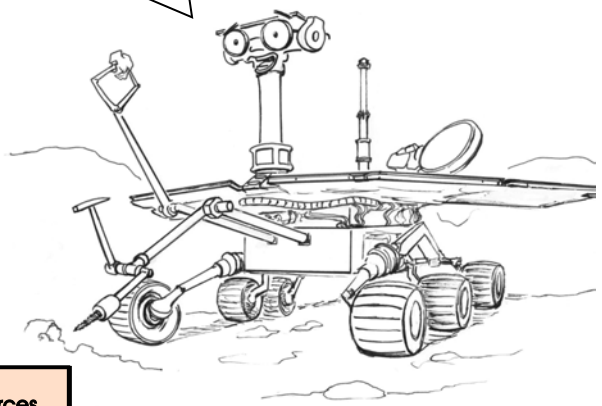
_____is sending many new robotic missions to explore Mars' surface and atmosphere*. Right now, the Mars Global Surveyor mission in orbit around Mars is sending back the most remarkable images of Mars ever seen! In 2003, NASA sent two large robotic _____ to explore the Martian surface. Would you like to make the long and risky voyage to Mars one day?

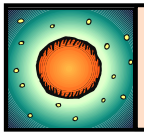
WORD LIST

Cross out the words as you use them...

SPACESUIT ORBIT
TWO PHOBOS ATMOSPHERE
VOLCANO NASA SUN
ROTATES 4TH DEIMOS
RED VALLES MARINERIS ROVERS

Read a cool poem about walking on Mars, on page 34!





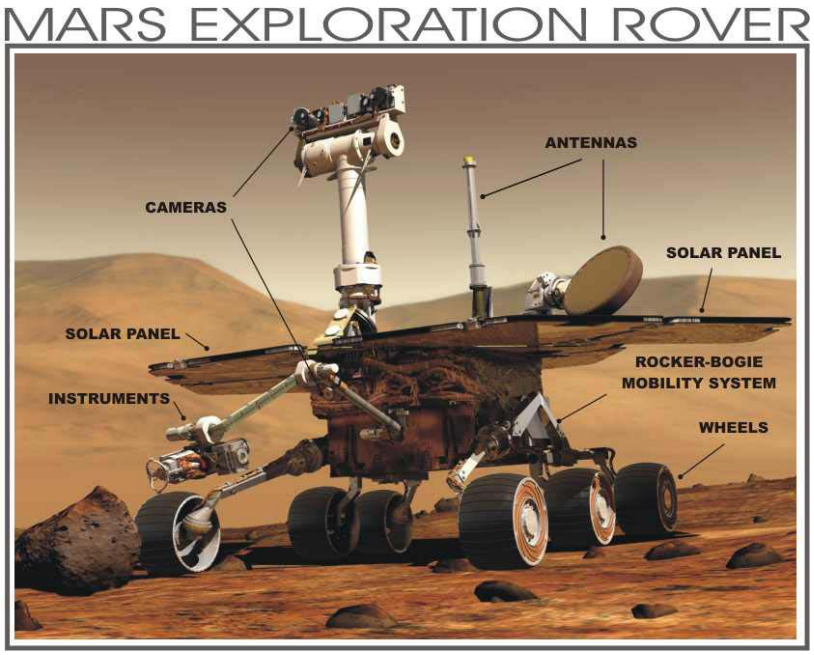
See Resources #8, 9 & 11 on p. 45!

Build a Mars Rover you Can eat!

C. Morrow's adaptation of "Edible Mars Spacecraft" by Sheri Klug

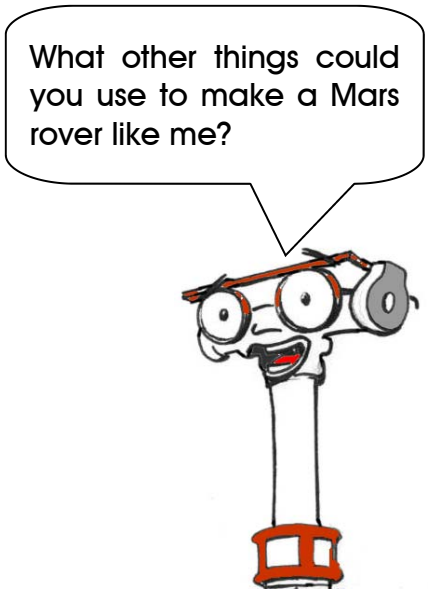
Suggested Materials to Build Your Edible Rover*

- 3 graham crackers
- 1 roll of Smarties®
- 6 creme wafer cookies
- 1-2 large marshmallows
- 1 snack-size Kit Kat®
- 1 straw
- 1 container of frosting (to help glue components together)
- 1 peppermint patty
- 6 Rolo® candies or peanut butter cups
- 7 toothpicks
- 1-2 gumdrops
- scissors
- 1 plastic knife
- 1 sturdy paper plate or cardboard sheet for building platform
- paper towels

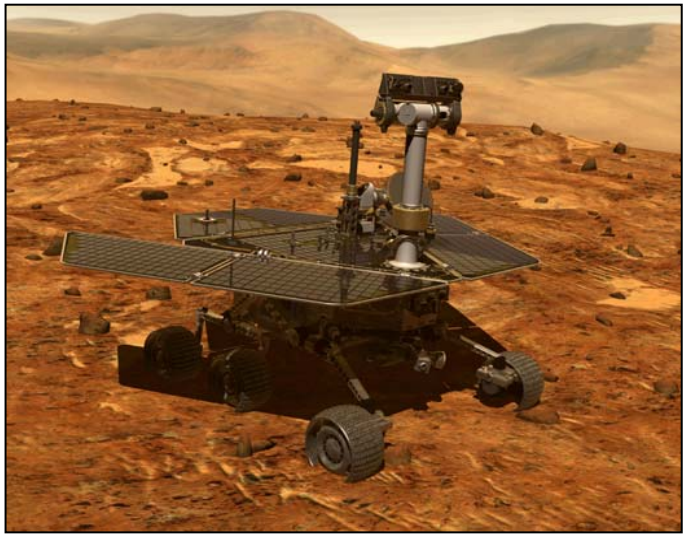


Use the rover diagram to fill in the components the rover will need to complete its mission.

ROVER CAPABILITY	NEEDED TECHNOLOGY OR INSTRUMENT	WHAT PIECE OF CANDY WILL YOU USE?
a. Rolls on a hard surface		
b. Receives commands from Earth. Sends data and images back to Earth		
c. Makes panoramic images of the environment		
d. Makes scientific measurements of rocks or soil (What do you want to know?)		
e. Powers itself using the light of the Sun		



Build a Mars Rover you Can eat!



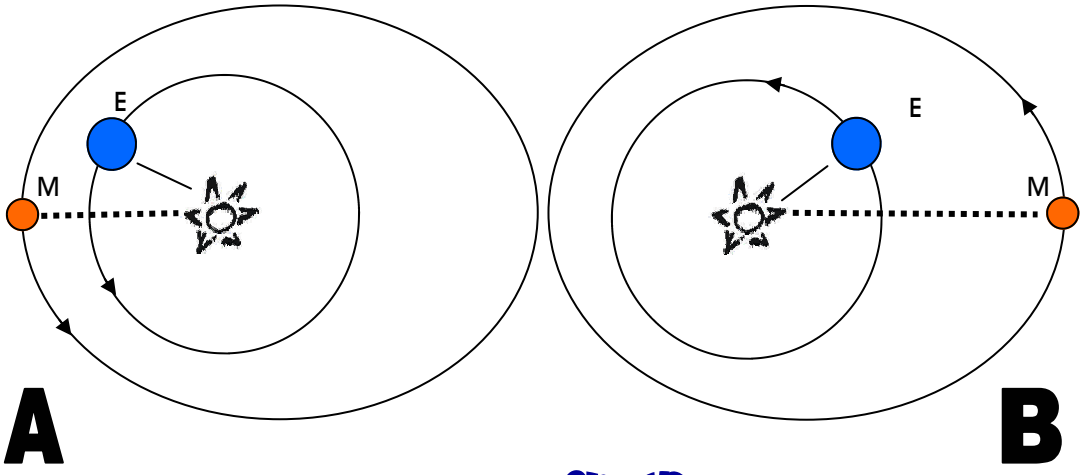
Draw and Label a Picture of the Rover You Built!

How Old Are You in Martian Years?

Adapted from Kinesthetic Astronomy: The Sky Time Lesson by C. A. Morrow and M. Zawaski

Both Earth and Mars orbit around the Sun. Earth takes 1 year; Mars takes longer.

Each planet also rotates around its own axis. Earth takes 1 day; Mars takes a bit longer.



	Earth	Mars
Average Distance from Sun	1 AU	1.5 AU
Rotation Period	24 hours	24.6 hours
Orbital Period	1 year	About 2 years
Tilt of Axis	23.5°	25°

*1 AU is the average distance between Earth and the Sun.

questions

1. Which planet orbits **farther** from the Sun? Does this make it generally **colder or warmer** on Mars compared to Earth?

2. Which of these two planets keeps about the **same distance** from the Sun as it orbits? Which one does not?

3. How long is the day on Mars? How does this compare to an Earth day?

4. How long is the Martian year*? How does this compare to an Earth year?

HOW OLD WOULD YOU BE IN MARTIAN YEARS?

answers

1. *Mars orbits farther from the Sun. It gets less light energy from the Sun, making it generally colder.*

2. *Earth's orbit around the Sun is an almost perfect circle. So during Earth's orbit, the planet stays almost exactly the same distance from the Sun.*

   Mars' orbit around the Sun is a stretched circle (an ellipse). So there ARE times during Mars' orbit when the planet is closer to the Sun, and times when it is farther away (see the figure above.)

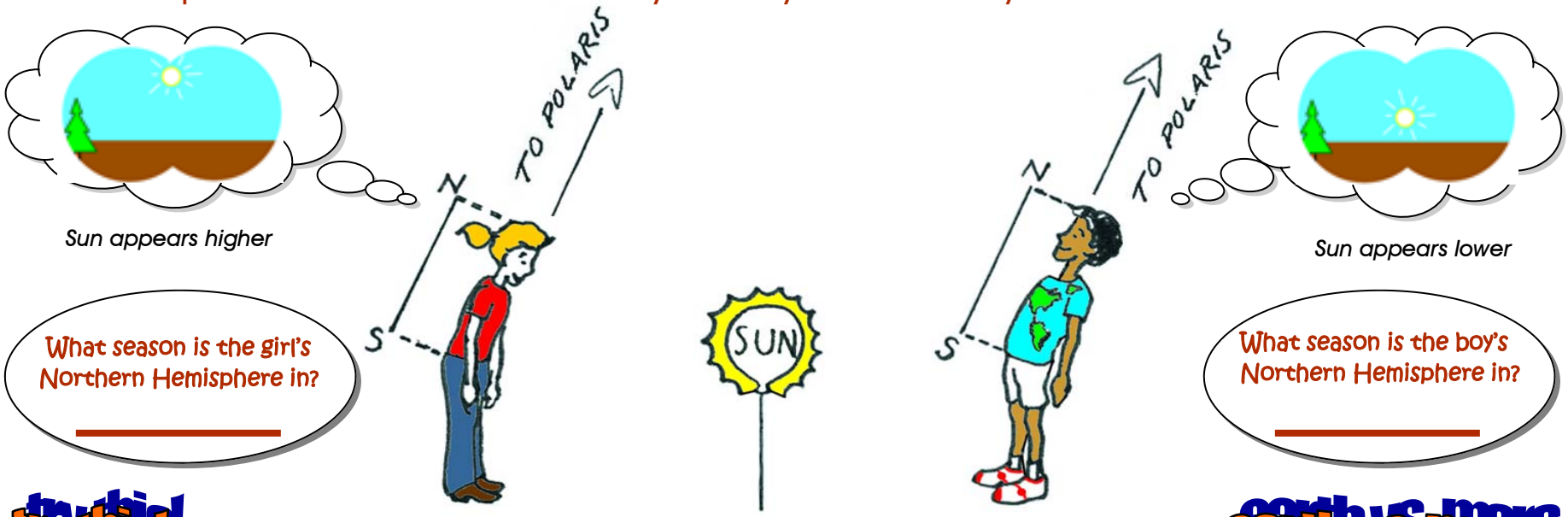
3. *A Martian day (called a "sol") is 24.6 hours long. An Earth day is 24 hours long. So a Mars day is 37 minutes longer than an Earth day.*

4. *One Martian year is about two Earth years long.*

   You would be only half as old in Mars years.
   Can you calculate your Martian age?

Does Mars Have Seasons Like Earth?

Adapted from Kinesthetic Astronomy: The Sky Time Lesson by C. A. Morrow and M. Zawaski



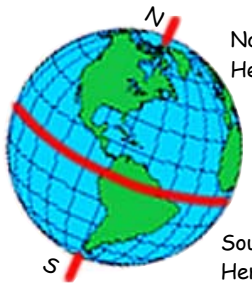
The kids do NOT represent the real size and distance of Earth compared to the Sun!
If the Sun were a large grapefruit, Earth would be the size of a pencil tip, 50 feet (15 m) away!

try this!

1. Pretend your body is Earth in orbit around the Sun. Let a helium balloon be the Sun.
2. The top of your head is Earth's North Pole. Pick a point on the ceiling to be the North Star (Polaris). Tilt your head towards Polaris, like the kids in the drawing.
3. Try to "orbit" the Sun while keeping your head tilted toward Polaris.

hint...

When your Northern Hemisphere* is tilted away from the Sun, will the Sun appear higher or lower in the sky?

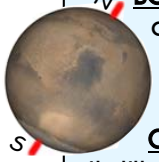


The hemisphere of the planet tilted **away** from the Sun is in winter. The Sun appears lower in the sky, giving fewer daylight hours, less time to heat the planet's surface, thus making colder temperatures.

ANSWERS:

For their northern hemispheres, the girl is in summer; the boy is in winter. For the Southern Hemisphere the girl is in winter and the boy is in*

earth vs. mars



MARS HAS SEASONS TOO !

Seasons on Mars are a result of **BOTH** the effects of its tilt and its changing distance from the Sun.

Earth's seasons result **ONLY** from the effects of its tilt. Earth's orbit is nearly a perfect circle, so Earth's distance from the Sun stays almost exactly the same throughout the year.

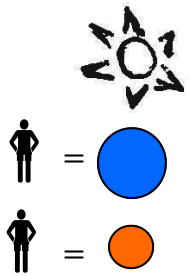
Like Earth, Mars is also tilted. But unlike Earth, Mars' distance from the Sun DOES affect its seasons, because Mars' orbit is a stretched circle (an ellipse).

Why is Mars so Bright in the Night Sky Every Two Years?

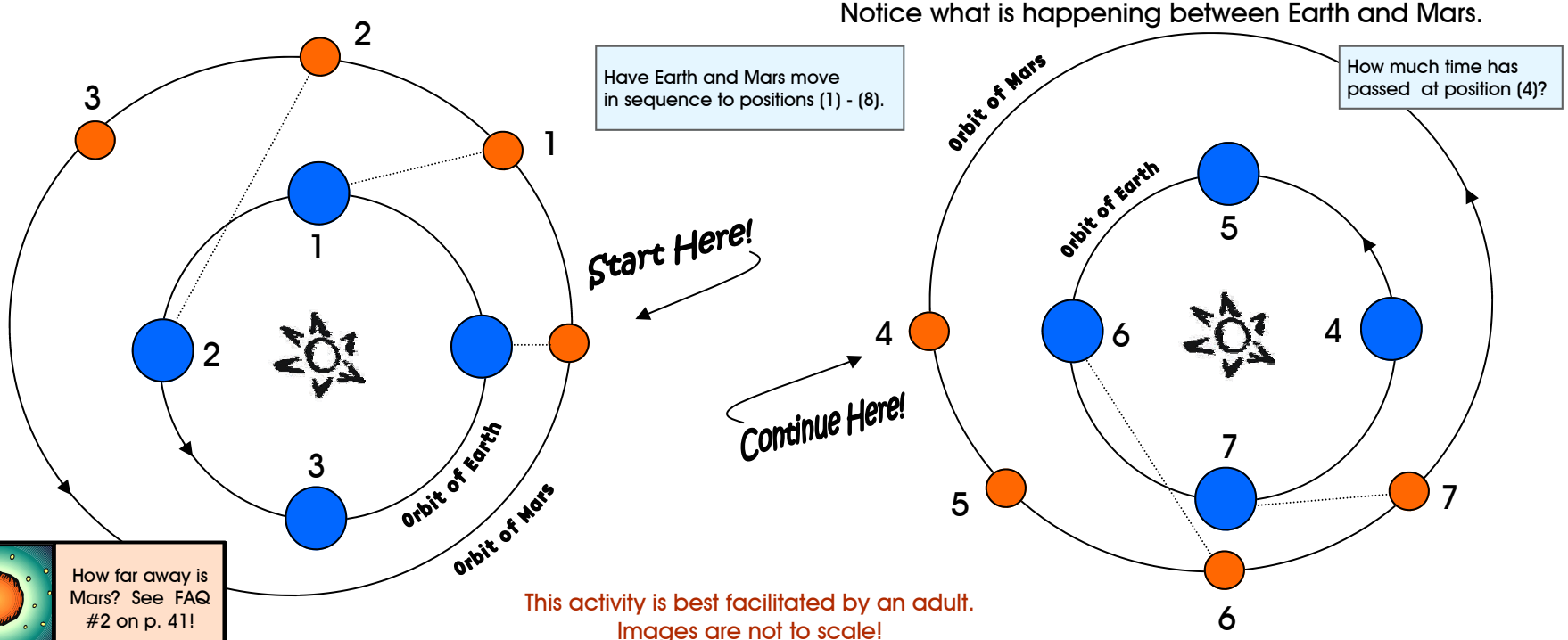
Adapted from Kinesthetic Astronomy by C. A. Morrow and M. Zawaski

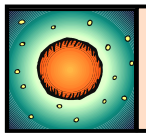
Earth orbits once around the Sun in one year. Mars takes two years to go around the Sun. Let's see what happens if we start Earth and Mars in a line with the Sun and move forward in time.

1. Choose a central object to be the Sun.
2. Let one person be Earth.
3. Let another person be Mars.
4. Have the two people stand in the starting position for Earth and Mars as shown below.



5. Next have Earth move 1/4 of the way around the Sun to position (1). How much time has passed? [3 months.] How far does Mars move? [Only half as much as Earth = 1/8 of the way around the Sun to position (1).]
6. Have Earth and Mars keep moving around the Sun in sequence to positions (2)-(4) — Position (4) is on the diagram below. Each time Earth moves another 1/4, Mars moves another 1/8.
7. How much time has passed at position (4)? [1 year*.] Would people on Earth be able to see Mars in the night sky? [No, the planets are on opposite sides of the Sun.]
8. Keep moving through positions (5)-(7) as shown below. Notice what is happening between Earth and Mars.





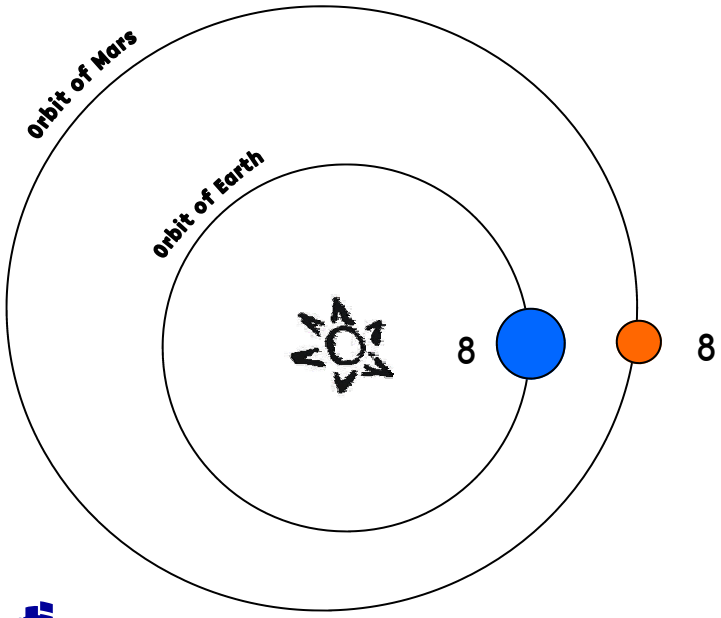
How far away is Mars? See FAQ #2 on p. 41!

This activity is best facilitated by an adult.
Images are not to scale!

Why is Mars so Bright in the Night Sky Every Two Years?

Adapted from Kinesthetic Astronomy by C. A. Morrow and M. Zawaski

After about 2 years, Earth and Mars make another close encounter as Earth overtakes Mars on the inside track (see position (8) below).



question

In the (8) position, can Earthlings see Mars in their night sky? Would Mars be brighter or dimmer in position (8) compared to other orbital positions?

answer

Yes - Earthlings could see Mars in the night sky at position (8). Mars would be at its brightest because it is closest to Earth.

Why Do We Launch Mars Missions Every Two Years?

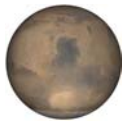
Every two years Earth overtakes Mars on an "inside-track" orbit around the Sun. This close approach between Earth and Mars presents the opportunity for launching new Mars missions. Of course, you would want to launch from Earth before position (8) because it takes 7-9 months to get to Mars.

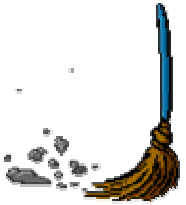
Try your hand at an animated launch activity!

Check out:
www.marsquestonline.org/tour/rovers/flytomars

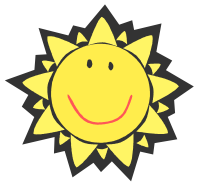
Reveal a Secret Message about Mars!

Use the key on the next page to fill in the blanks beneath each picture.

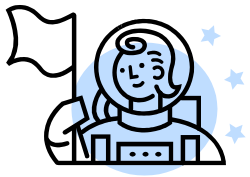
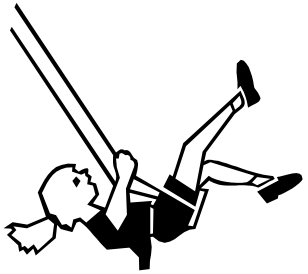




_____ is _____ because of rust - the iron oxide in the _____.



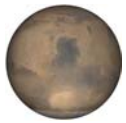
_____ shines on planet Mars. From _____ we see it bright as _____!

If you should visit _____ one day, you'll need a _____ to run and _____.

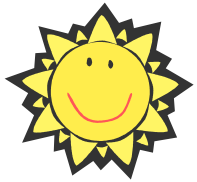
Use this Key to Decode the Secret Message

 = EARTH

 = MARS

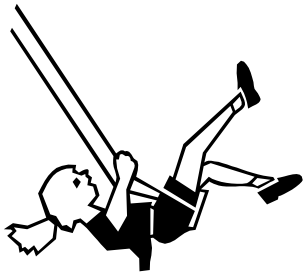
 = SUIT

 = DUST

 = SUNLIGHT

 = RED

 = STARS

 = PLAY

Jamie on Mars

by Preston Dyches

Jamie lives in the American southwest — a land of red rocks and desert sand. He hears at school that Mars will be especially bright in the night sky during the next month or so and decides to lead his family on an excursion to view it. Jamie cannot help but let his imagination run free with the dream of visiting the Red Planet one day...

Jamie took a deep breath and stepped out onto the dusty red plain. Finally the day was here. At last Jamie was old enough to go outside the habitat in a spacesuit! Before today he always had to stay inside the rover when his parents took him for trips on the surface of Mars. But not today, no way!

Jamie's mom and dad were right behind him, but they stayed a few steps behind so he could explore on his own. All he could see in front of him was the barren and beautiful red planet he loved. And now he could reach out and touch it with his own gloves.

The family lived at Marsbase with about two hundred other people. Most were scientists and engineers, and some had families with kids. Jamie's parents were geologists, which meant they studied rocks and soil to learn more about the history of Mars. Jamie hoped to be a geologist too.

What to do first? They were just going for a short hike around the base so that Jamie could get used to his suit. He tried a jump, and sailed up a few feet into the air. His boots landed with a crunch on the cold dry soil. This was fun!

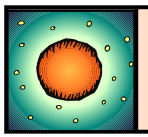
Jamie made his way over to a big rock and pulled out his microscope to examine it in detail. He could see tiny grains stuck together. Mom and dad said this was a kind of rock that formed in water, long ago in Mars' past. The planet they lived on was cold and dry now, but early in its history it may have had liquid water on its surface.

Just then, the Martian family felt a low rumble through their boots. Startled, Jamie looked to his parents for an answer. "What's going on?" His dad pointed to the sky just above a nearby ridge. Jamie turned his gaze in time to spot a plume of fire rising into the butterscotch-colored sky. Atop the flame was a gleaming white rocket. "Heading for the space station on the moon, Phobos?" Jamie asked as he stared at the rocket and its pillar of white smoke.

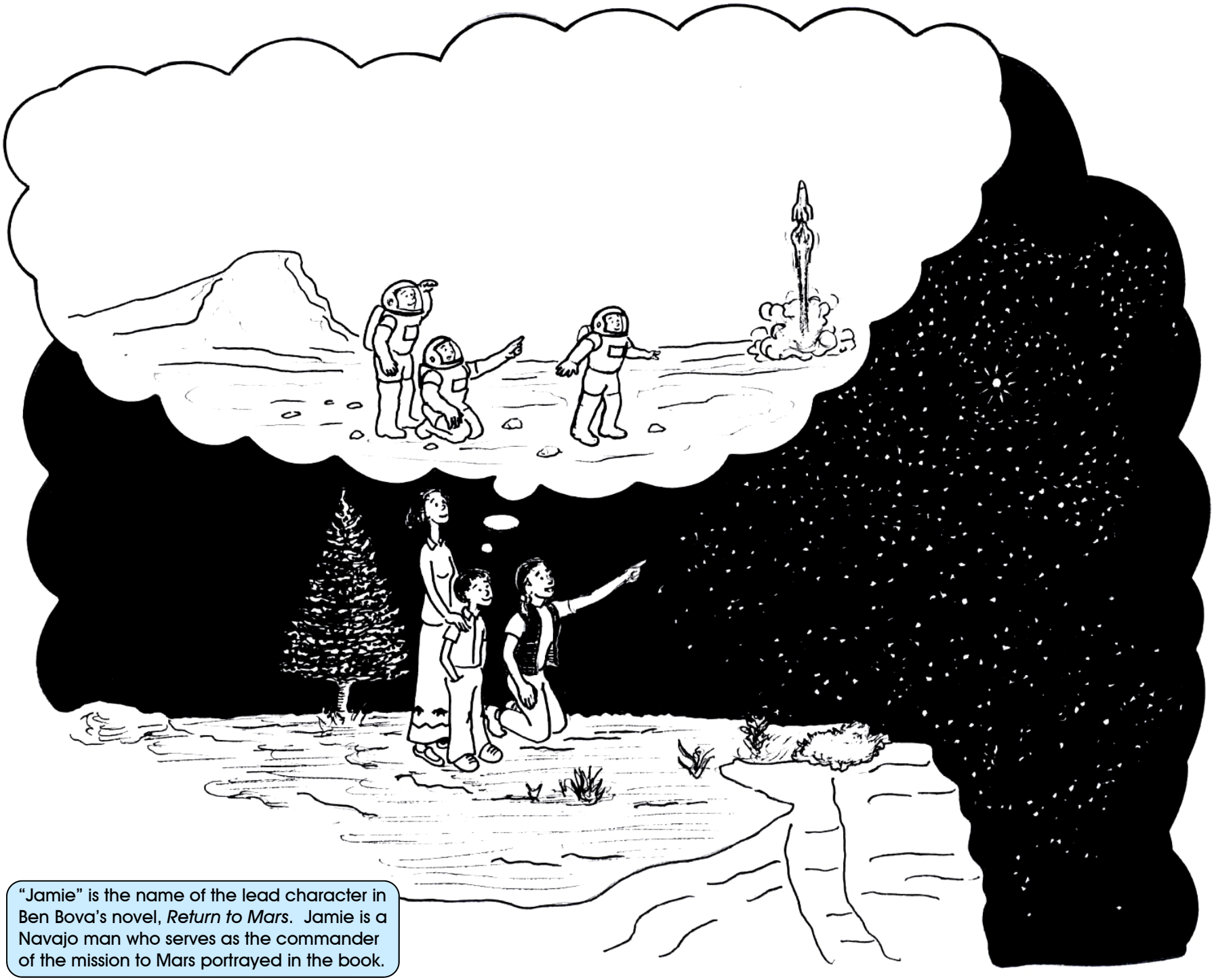
"What was that Jamie?" His mom's voice was loud and clear, but it wasn't coming though the earphones in his helmet. "Jamie? Did you say something about photos? It's kind of dark for that, don't you think?"

Suddenly he realized that he was not on Mars, not really anyway. But he had been there in his imagination and seen that it was a real place. It was a whole world, with its own rocks and mountains and valleys and weather. No people lived there yet, but maybe someday.

He and his parents stood on the mesa gazing at the sky for a long time that evening, but one bright red gem held Jamie's fascination. Mars. It was as real as could be. And he would never again look at it in the same way.



For more about people who explore Mars, see resources #8, 9 & 11 on p. 45!



"Jamie" is the name of the lead character in Ben Bova's novel, *Return to Mars*. Jamie is a Navajo man who serves as the commander of the mission to Mars portrayed in the book.

We'll Walk on Mars

by Cheri Morrow

A planet red, reflecting light
We see with our own eyes tonight.
Another world – we call it Mars –
Appears to wander through the stars.

Those stars might be too far away,
But we could visit Mars one day.
It's fourth in orbit 'round the Sun –
Another place to walk and run.

We'll journey 'round the Martian sphere –
It's half the distance we'd go here –
On Earth we'd travel twice as far
To come back 'round to where we are.

The Martian air – so cold and thin –
With nowhere near the oxygen
To let us breathe without spacesuits,
Complete with helmets, gloves, and boots.

The Martian land – so dry and bare –
We won't find liquid water there:
No plants, no creepy-crawly things,
No life with fins nor legs nor wings.

So some will say to search down deep
Where maybe bits of water seep
And microscopic things alive
May have the gumption to survive.

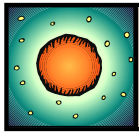
We'll see a canyon – deep and vast –
That tells of Mars' mysterious past:
This valley's length would be at least
The U-S-A from west to east!

We'll climb a huge volcano dome;
The long and gentle slopes we'll roam,
With cliffs around the base so high –
As high as earthly jet planes fly!

We'll hike along a crater's rim
Until the light of day grows dim,
And think about the rock that hit
Whose impact made this giant pit.

Then maybe we'll return to Earth,
Or maybe we will give new birth
To life on Mars like you and me,
So Earthlings would then Martians be.

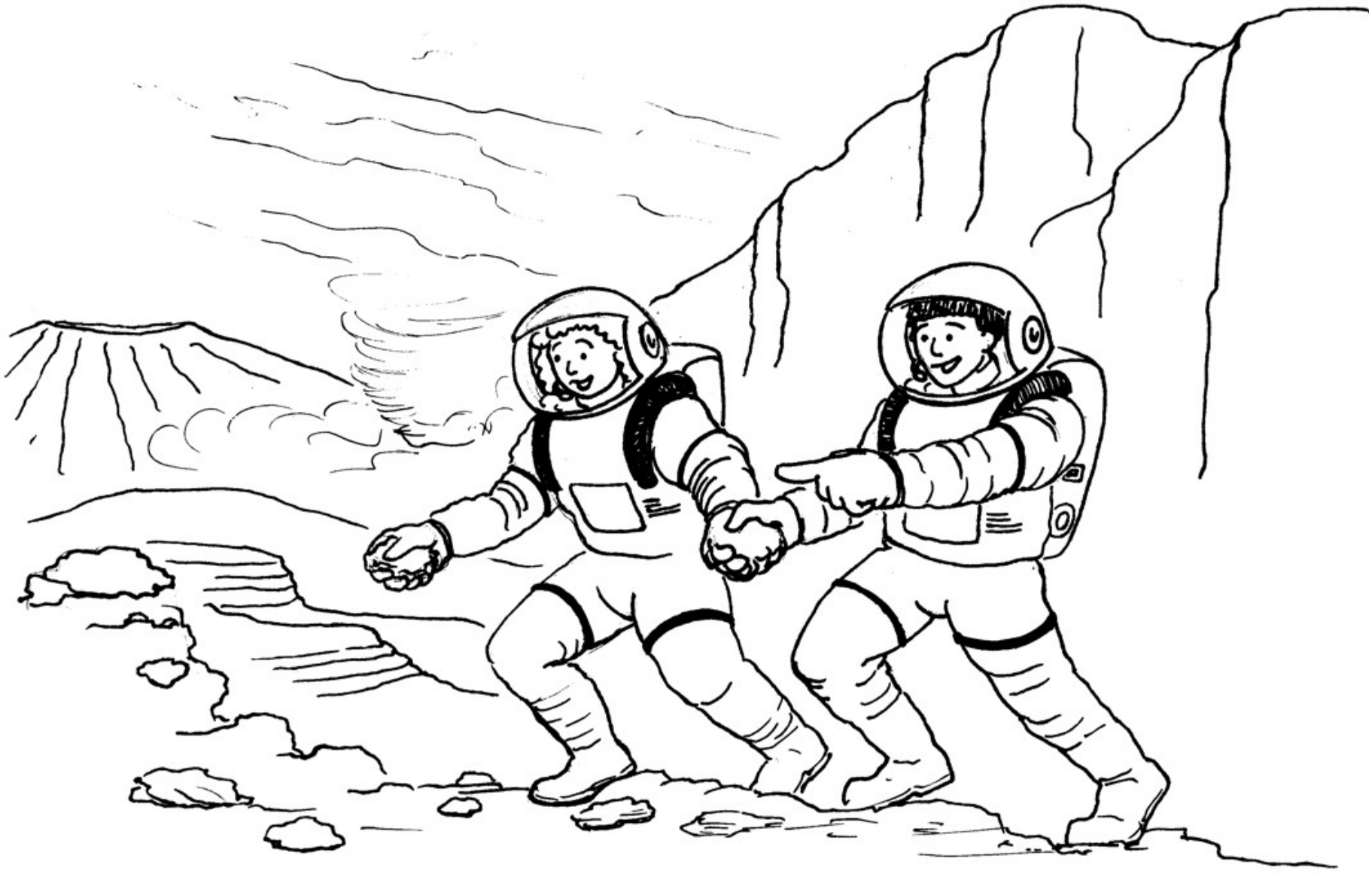
Write your own poem or use these words to create a song about Mars!



For a cool Mars website, see Resource #5 on p. 451

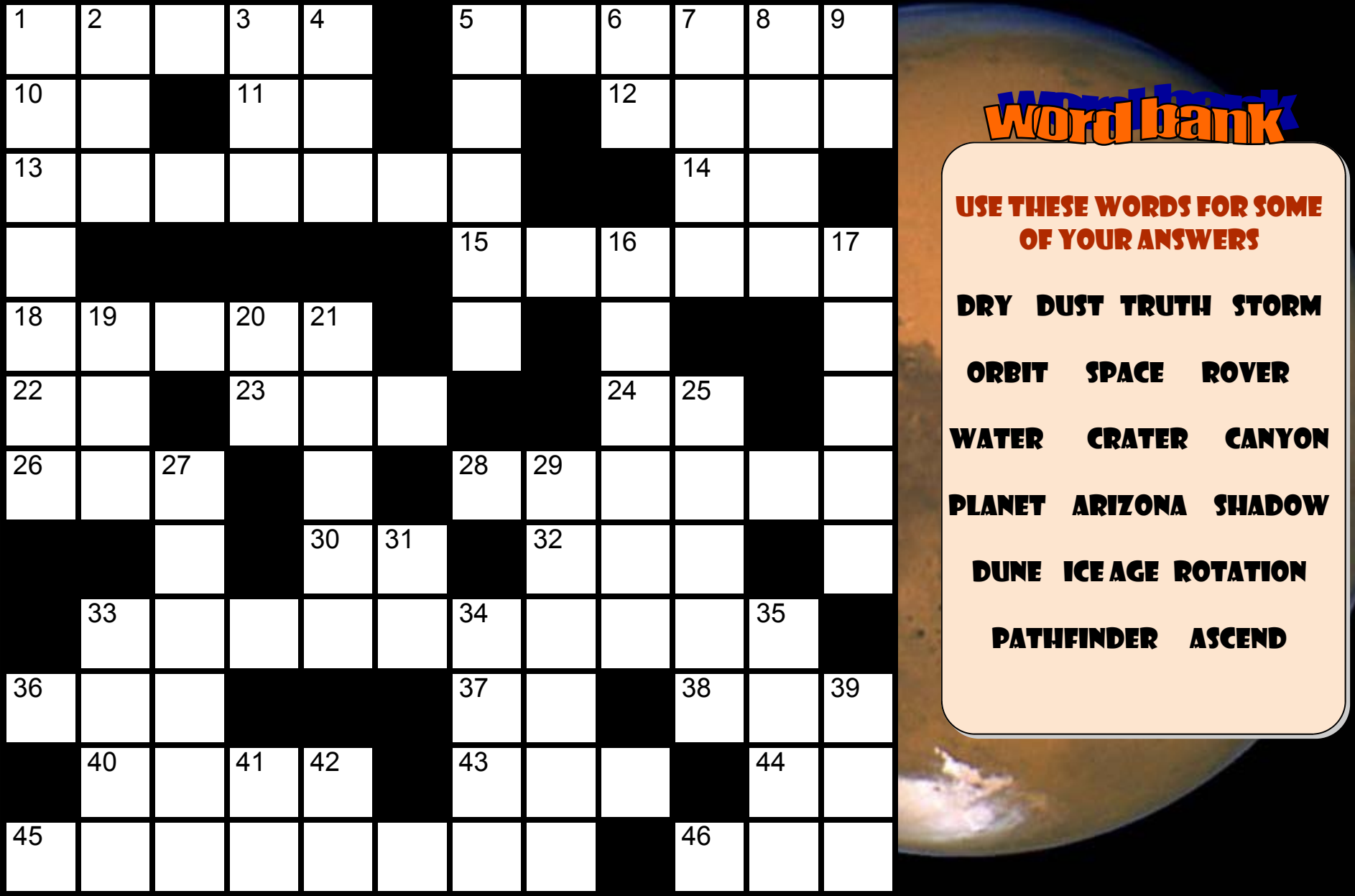
Color Us!

What colors would you see on Mars? Check out the color pictures in this Guide, look for clues on pages 32, 39 and 41 or go online to find you own images of the RED Planet!



Mars Crossword Puzzle

by Cheri Morrow



Word bank

USE THESE WORDS FOR SOME OF YOUR ANSWERS

DRY DUST TRUTH STORM

ORBIT SPACE ROVER

WATER CRATER CANYON

PLANET ARIZONA SHADOW

DUNE ICE AGE ROTATION

PATHFINDER ASCEND

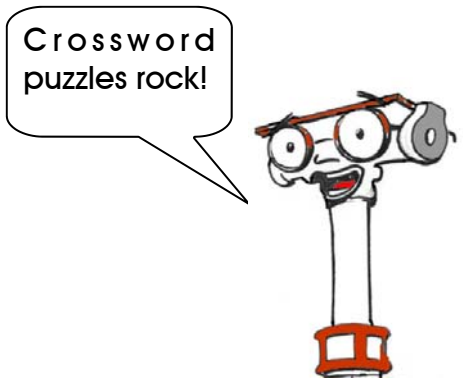
Contact: camorrow@colorado.edu

across

1. On Earth, a _ _ _ _ _ may bring rain, thunder, and lightning. On Mars, it may bring fast winds full of dust — a dust _ _ _ _ _.
5. A moon casts a _ _ _ _ _ _on a planet during a solar eclipse.
10. Abbreviation for "each".
11. The innermost moon of Jupiter. Also the most volcanically active body in the Solar System.
12. Sand _ _ _ _ or _ _ _ _ buggy.
13. This US state is home to the Grand Canyon. On Mars, the base of **Olympus Mons** - the largest volcano in the Solar System is as large as this state.
14. South Carolina (abbreviation).
15. If a rock from outer space hits a planet or moon, it makes a _ _ _ _ _ _.
18. The Moon is in _ _ _ _ _ around Earth. **Phobos** and **Deimos** are moons in _ _ _ _ _ around Mars.
22. Opposite of "yes".
23. The Martian land is _ _ _ and bare. We won't find liquid water there.
24. Clockwise (abbreviation).
26. A tiny taste of a drink.
28. Every 100,000 years or so, Earth has an _ _ _ _ _ _ when much of the planet is covered with ice and snow.
30. _ _ be or not to be. That is the question.
32. _ _ _ s in your pants.
33. The name of the spacecraft that landed on Mars and provided a base for the **Sojourner** rover. Also, one who discovers a way through unexplored regions.
36. Plural of man.
37. New York (abbreviation).
38. Mars is sometimes called the _ _ _ Planet because of its rusty color.
40. Southeast Planetarium Association (abbreviation).
43. It weighs a _ _ _! (2,000 pounds).
44. Just _ _ it!
45. Earth rotates once around in 24 hours. Mars has almost exactly the same length of day. So, Earth and Mars have almost exactly the same rate of _ _ _ _ _ _ _ _.
46. Cloudiness close to the ground. It can exist on Mars too!

down

1. Both Earth and Mars have these. On Earth they last 3 months each: summer, fall, winter, spring. On Mars they last 6 months each.
2. Black, gooey stuff used to help pave roads.
3. French for rice.
4. What a cow says.
5. _ _ _ _ _ exploration is what we're doing when we send missions to Mars.
6. Short for advertisement.
7. Mars has lots of reddish _ _ _ _ that is like powder.
8. _ _ _ _ upon a time...
9. I, me, mine. _ _, us, ours.
16. Opposite of descend.
17. One of these robotic Mars trucks is named **Spirit**. Another _ _ _ _ _ is called **Opportunity**. **Pathfinder's** _ _ _ _ _ was named for Sojourner Truth, a woman who worked to free slaves and further women's rights.
19. French for "king".
20. Short for "identification".
21. **Sojourner** _ _ _ _ _ is the name of the woman who worked to free slaves in America and for whom the Pathfinder rover was named. OR Opposite of a lie.
25. We won't find liquid _ _ _ _ _ on the surface of Mars. It would freeze or evaporate quickly because of the cold, thin atmosphere.
27. Mars is the Red _ _ _ _ _ _.
29. The largest _ _ _ _ _ _ in the Solar System is on Mars. It is called **Valles Marineris**, and it would stretch all the way across the USA if it were on Earth. The Grand _ _ _ _ _ _ is in Arizona.
31. The Wizard _ _ Oz.
33. Mexican money.
34. Caterpillars change _ _ _ _ butterflies.
35. Do again.
39. A pet with four legs and a bark.
41. Short for papa.
42. Look _ _ me!



True for Earth or Mars or Both?

Each of the statements below is true, but some are only for one planet. Is it Earth or Mars? Use the facts in this Guide to help you decide! Place an "E" next to facts that are true for only Earth, and place an "M" next to facts that are true only for Mars. If it's true for both planets, place a "B" in the blank. Watch out, some are tricky!

Earth = E **Mars = M** **Both = B**

1. _____ Has oceans of liquid water.
2. _____ Home to the largest volcano in the Solar System.
3. _____ Its atmosphere is mostly carbon dioxide*.
4. _____ This planet has frozen polar caps.
5. _____ Fourth planet from the Sun.
6. _____ Has seasons.
7. _____ This planet is generally much colder.
8. _____ Takes 365 days to go around the Sun.
9. _____ This planet has a much thicker atmosphere.
10. _____ You would need a spacesuit to play outside here.
11. _____ Has mountains, valleys and volcanoes.
12. _____ People have been to this planet.
13. _____ This planet has two small moons.
14. _____ You would weigh less on this planet.
15. _____ Orbits the Sun.
16. _____ You would expect to find plants and animals here.

ANSWERS:
1-E, 2-M, 3-M, 4-B, 5-M, 6-B, 7-M, 8-E,
9-E, 10-M, 11-B, 12-E, 13-M, 14-M, 15-B, 16-E

Gee Whiz! Facts about Mars

Take a look at Resource #17 on p. 46!

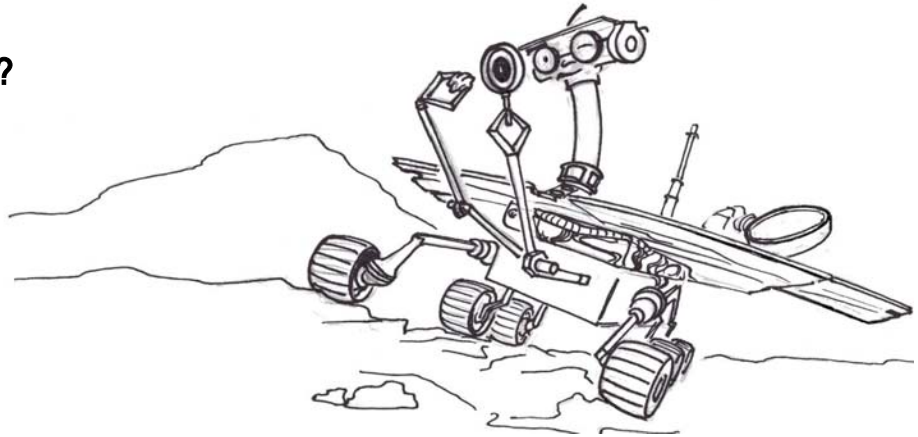
1. Mars has the largest volcano in the Solar System. Olympus Mons* is almost three times higher than Mount Everest! [see FAQ 11]
2. Mars has the largest canyon in the Solar System. If the Valles Marineris canyon existed on Earth, it would stretch all the way across the USA! [FAQ 12].
3. The entire surface of Mars is the same area as the total dry-land surface of Earth.
4. The Martian air is as thin as the air at 100,000 feet above Earth's surface! The air pressure is only about 1/100th of Earth's. [FAQ 8]
5. Because of the thin air of Mars, liquid water would boil at 10°C — just 10°C (18°F) degrees above freezing! On Earth at sea level, water boils at 100°C (212°F). [FAQ 10]
6. The temperatures on Mars range from about 68°F to –220°F! [FAQ 6]
7. Surface winds on Mars can reach speeds of up to 100 miles per hour. While this is hurricane strength on Earth, the atmosphere on Mars is so thin that you would feel only a breeze.
8. There is so much powdery-fine dust in Mars' atmosphere that the sky is usually yellowish-brown!
9. Some dust storms on Mars can cover the entire planet for weeks
10. If all the water vapor in the atmosphere of Mars rained down on one spot, it would only amount to a small puddle!
11. Mars scientists currently believe there is a great deal of frozen water at the poles and beneath the surface of Mars. They are actively pursuing the question of how much there is. [FAQ 10].
12. You could jump almost three times higher on Mars because of its weaker gravity! [FAQ 5]
13. The gravity on the two tiny moons of Mars (Phobos and Deimos) is so weak that an average pitcher could easily throw a baseball into orbit! [FAQ 15].
14. Navigating a spacecraft to Mars is like threading the eye of a needle from 15 miles away with only 6 possible course adjustments.
15. The notion that Mars was covered with vegetation and life was proven wrong by the first spacecraft to fly by Mars. Mariner IV took the first close-up images of Mars in 1965. [FAQ 9]
16. We have found meteorites on Earth that came from Mars. [FAQs 13-14].

Frequently Asked Questions about Mars

You be the teacher! Have your friends or family read the questions on this page
YOU FIND THE ANSWERS!

Here are the topics/questions covered in this section:

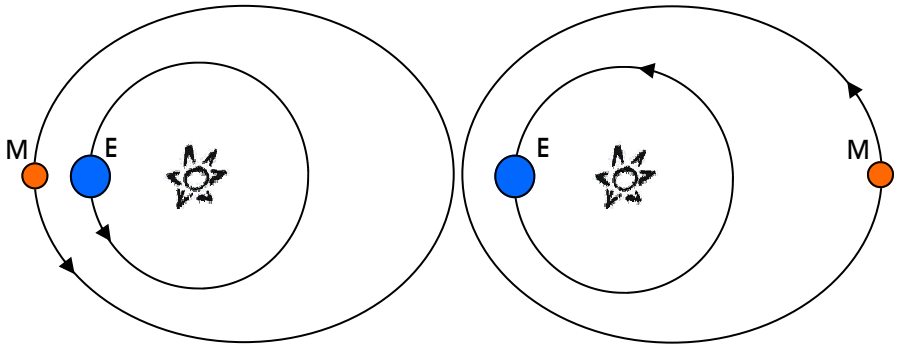
1. Where is Mars?
2. How far away is Mars?
3. How old would I be if I lived on Mars?
4. How big is Mars?
5. How high could I jump on Mars?
6. How hot/cold is Mars?
7. Why is Mars red?
8. Could I breathe on Mars?
9. Is there life on Mars?
10. Why doesn't Mars have oceans?
11. Why are volcanoes so big on Mars?
12. Why is Valles Marineris so deep?
13. How can a rock from Mars land on Earth?
14. How do we know if a rock is from Mars?
15. Why does Mars have TWO moons and how big are they?
16. How long does it take to get to Mars?



1. **Where is Mars?** Mars is the 4th planet* from the Sun. The Sun is a star located at the center of our solar system. Earth and Mars are just two of nine planets that orbit around the Sun. Our Sun is one of about 100 billion stars in the Milky Way. Outer space is even bigger yet because the Milky Way is only one of an estimated 100 billion galaxies in the Universe!

2. **How far away is Mars?** The distance between Mars and Earth at nearest approach is 50-60 million kilometers (30-37 million miles), and the farthest distance between Mars and Earth is about 400 million kilometers (250 million miles). The distance between Mars and Earth varies, for two reasons:

As shown below, Earth and Mars are closest to each other when they are lined up on the same side of the Sun, and farthest away when they are on opposite sides of the Sun.



The orbit of Mars around the Sun is a stretched circle (an ellipse), unlike Earth's orbit, which is more circular. Mars' elliptical orbit around the Sun sometimes results in Mars being closer to the Sun, and sometimes farther away. This affects the distance between Mars and Earth.

3. **How old would I be if I lived on Mars?** A year* on Mars is about 2 Earth years. This is because Mars takes about twice as long to orbit the Sun. You would be half as old in Martian years! In fact, Mars has seasons. They last twice as long as seasons on Earth.

4. **How big is Mars?** Even though Mars has very large features compared to Earth (such as Valles Marineris*, the largest canyon in the Solar System), Mars is actually smaller than Earth. The diameter of Mars is only about 60% of the diameter of the Earth (see the table on page 8).

5. **How high could I jump on Mars?** The surface gravity* on Mars is a bit more than 1/3 that of Earth. This would allow a person on Mars to dunk a basketball in a basket that is a bit less than 3 times higher than it would be on Earth! (Of course people on Mars would be wearing space suits that would weigh them down, but they would still be able to jump higher on Mars.)

6. **How hot/cold is Mars?** This is just like asking how hot/cold is Earth. It depends...Are you on the surface? Or high up in the atmosphere? Are you in daytime or nighttime? Are you in winter or summer? Are you near the equator or near the poles? There are many different factors influencing the temperature at any given place and time on Mars.

Mars is in general much, much colder than Earth because it is significantly farther from the Sun. The global average surface temperature on Mars is - 63°C (- 81°F), compared to 15°C (59°F) for Earth. The warmest temperature on Mars can reach 20°C (68°F), the coldest is –140°C (-220°F).

Because of Mars' thin atmosphere, changes in temperature with time of day or with height above the surface are much more extreme. At the Mars Pathfinder landing site, the surface temperature changes from 4°C (40°F) at your feet to –19°C (–3°F) at the top of your head. Wow!

7. **Why is Mars red?** The surface of Mars is made of rock and dust that have rusted (sort of like the reddish-brown rust on an old car.) Oxygen* from the air combined with iron in the rocks to form another kind of substance, called iron oxide. This material gives the planet its ruddy color.

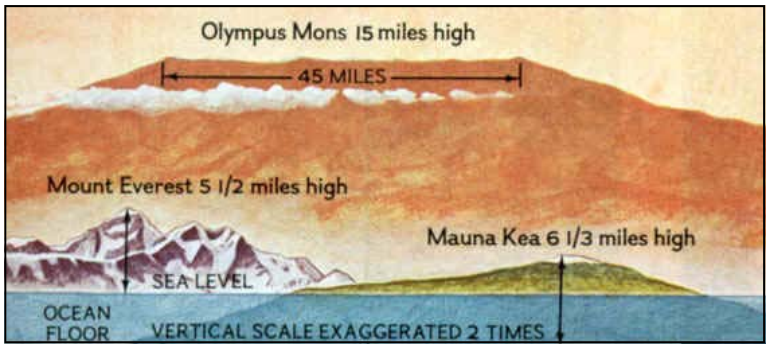
8. **Could I breathe on Mars?** No. The atmosphere of Mars is mainly carbon dioxide* (95%), and only 0.1% oxygen*. Earth's air is 21% oxygen, 0.035% carbon dioxide, and 78% nitrogen. Therefore, people on Mars would need to have a source of oxygen to breathe.

9. **Is there life on Mars?** There is strong evidence that in the past Mars had running liquid water — So it is possible that life arose on Mars and is now extinct. We're not sure yet.

If there's any life on Mars today, it would probably be a simple microbe*. Conditions are way too harsh for anything very complex.

It's far too cold for liquid water to exist on Mars today (see below), and most scientists agree that liquid water is the one thing you absolutely MUST have for life as we know it to exist. If there is liquid water below the surface, there's a chance some hardy microbes could be lurking down there somewhere.

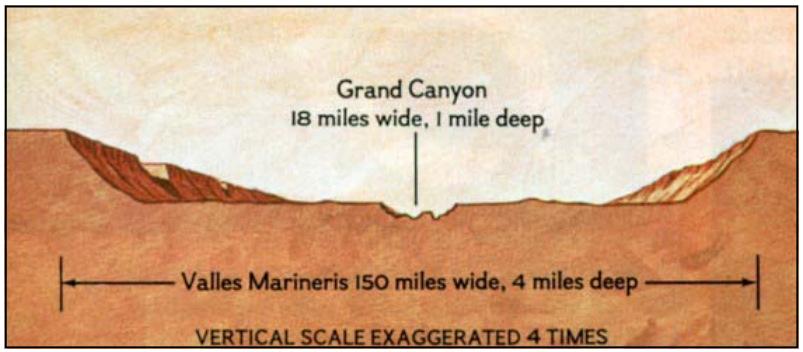
10. **Why doesn't Mars have oceans?** It's far too cold and the atmosphere is much too thin for liquid water to exist on the surface of Mars for very long. It would either freeze due to the cold temperature or boil away due to the low atmospheric pressure. The only place it might be warm enough for liquid water to exist is below the planet's surface. How far below the surface is a matter of active debate and research.



11. **Why are volcanoes so big on Mars?** Olympus Mons is the largest volcano in the Solar System, at 25 km high (15 miles), 700 km across (430 miles). It is three times higher than Earth's tallest feature, Mount Everest, and its base would completely cover a state like Colorado or Arizona! Olympus Mons has gentle slopes but its base is surrounded by a cliff that's 25,000 to 30,000 feet high — as high as jet planes fly on Earth!

The volcanoes on Mars – including Olympus Mons*- are very large compared to volcanoes on Earth due to the lack of plate tectonics (plate movement) on Mars. Unlike Mars, Earth's crust consists of moving plates. As the plates slowly drift over a hot spot of magma welling up from below, a chain of small volcanoes like the Hawaiian Islands is created. On Mars, one big volcano is created because the volcanoes there remain stationary over their sources of magma, so they grew in one place.

12. **Why is Valles Marineris so deep?** Unlike the Grand Canyon on Earth, Valles Marineris was not carved by running water. How Valles Marineris came to be remains a problem for science to solve. We know that complex forces above ground and far below combined to create this giant gash in the Martian surface. Somehow the surface pulled apart, forming the main portion of the canyon system.



Massive landslides are also present in the canyon and side canyons. The Grand Canyon of Arizona would only be as big as one of the small side canyons.

Valles Marineris is the largest canyon system in the Solar System - 4,000 km (2500 miles) long by 500 km (310 miles) wide by 7 km (4 miles) deep. If this canyon system existed on Earth, it would stretch across the USA! Valles Marineris is 3 times deeper than the Grand Canyon on Earth. It stretches 20%, or one-fifth, of the entire distance around Mars.

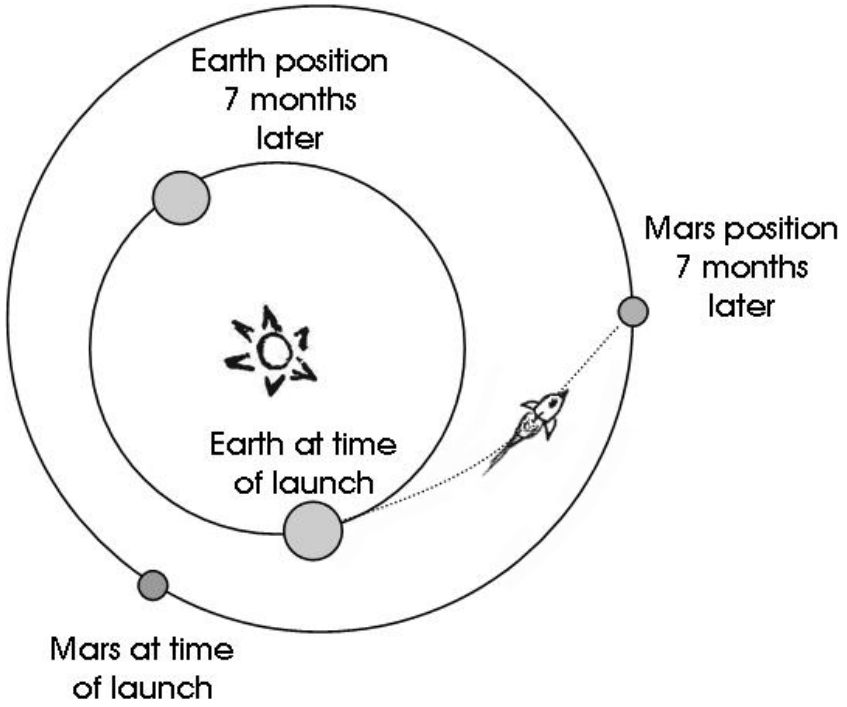
13. **How can a rock from Mars land on Earth?** From time to time, asteroids* and comets impact Mars with enough force to launch rocks from the impact site into space. After millions of years, these rocks can land on Earth as "Mars meteorites." Ounce for ounce, these rare lumps of rock are worth more than the most precious gems or metals.

14. **How do we know if a rock is from Mars?** Tiny bubbles of gas trapped in the rock match exactly the mixture of gases in Mars' atmosphere as measured by the Viking spacecraft which landed there in 1976.

15. **Why does Mars have TWO moons and how big are they?** Phobos and Deimos are probably captured asteroids. Earth's Moon most likely formed from a giant collision with another body long ago. The little moons of Mars probably did not form at the same time as their planet. Most likely each was snared by the gravity of Mars when it passed too close to the Red Planet.

Both moons are shaped like potatoes —
Phobos is 13 x 11 x 9 km (8 x 7 x 6 miles) and Deimos is 7 x 6 x 5 km (4 x 4 x 3 miles).

16. **How long does it take to get to Mars?** With current technology, it takes about 7 months. Mars and Earth come fairly close together in their orbits about every 26 months. This is when both planets are on the same side of the Sun. A rocket is launched from Earth toward a point in Mars' orbit so that the spacecraft arrives just as the planet gets there.



Fun Mars Resources

After sharing this guide with your family, you are probably wondering where you can learn more and where you can find activities on your favorite topics.

Explore these four areas, and keep the fun going!

- Look at Beautiful Images
- Share Fun Activities
- Explore with Background Resources
- Read a Book About Mars
- Get Some Teaching Tools

Look at Beautiful Images

See Images of Mars! These collections include many of the most vivid and compelling images from the exploration of Mars.

1. Welcome to the Planets
Check out canyons, volcanoes, craters and more, complete with audio captions.
http://pds.jpl.nasa.gov/planets/welcome/mars.htm

2. NASA's Planetary Photojournal
View amazing pictures of Mars and close-ups of its exotic features taken by the Mars Global Surveyor and Mars Odyssey spacecraft.
http://photojournal.jpl.nasa.gov/

3. Space Telescope Science Institute's Photojournal
See our closest view of Mars in 60,000 years as captured by the Hubble Space Telescope.
http://oposite.stsci.edu/pubinfo/SolarSystemT.html#Mars

Share Fun Activities

4. Make a Map of a Volcano
The Space Place: Make a Topographic Map
People who study and climb mountains on Earth use special maps that show the high and low places. Pretend it's your job to make maps of Mars' mountains, volcanoes, and valleys. What kinds of explorers would use your maps?
http://spaceplace.jpl.nasa.gov/srtm_makemap.htm

5. Explore Mars with *MarsQuest Online*
This exciting web learning experience offers information about the Red Planet, resources, and interactive simulations. Fly over Mars, explore its features, drive a rover the way NASA does, and think about the mysteries about searching for life on Mars.
http://www.marsquestonline.org

6. Do Exciting At-Home Activities about Mars
Check out great activities to do at home, answers to Mars questions by kids like you, web site links, and a special report from Bill Nye, the Science Guy.
http://athena.cornell.edu/kids/

7. Drive a Rover at the Mars Stations
Red Rover Goes to Mars
This Planetary Society site lets visitors become rover operators at several stations around the world. Sign up to join the fun, and drive a rover model on-line.
http://redrovergoestomars.org/drive.html

Explore with Background Resources

8. Learn about Exciting Careers
The Mars Millennium Project has information about Mars and topics related to issues of living and working on Mars. People with a wide variety of jobs in the arts, engineering, astronomy, and other sciences describe their careers, their creative process, and their unique ideas for a future community on Mars.
http://www.planetary.org/html/mmp

9. Imagine a Crewed Missions to Mars
The logistics of a crewed mission to Mars are complex to say the least. Before setting out into the solar system on our way to the Red Planet, there are a seemingly endless number of factors to take into consideration. Look here to find out why.
http://nssdc.gsfc.nasa.gov/planetary/mars/mars_crew.html

10. See a Piece of Mars
There are 29 known meteorites from Mars that have landed on Earth. Scientists take many measurements and analyze the meteorites to help answer questions like these: Why are they from Mars? How did they get here? Why aren't they red? What do they tell us about Mars?
http://www-curator.jsc.nasa.gov/curator/antmet/marsmets/contents.htm

11. Meet the Mars Exploration Team
Many men and women around the country are part of the Mars Team. Read about the jobs of some of these people. You can even take a look at their Field Journals.
http://quest.arc.nasa.gov/mars/team/

12. Get Mars News
This NASA Website is one-stop-shopping for all of the upcoming missions to Mars. You'll also find issues of a Martian newsletter, Mars Exploration Educational Outreach programs, and links to other sites. Watch this site for all of the latest news and updates.
http://www.jpl.nasa.gov/mars/

13. Learn the Real Story
Phil Plait's *Bad Astronomy*
Sometimes, ideas we believe to be "common knowledge" about astronomy are actually misconceptions perpetuated by movies, television, and news in print. The Bad Astronomy web pages are devoted to airing out myths and misconceptions in astronomy and related topics.
www.badastronomy.com

14. Watch a Movie from Mars
Mars Pathfinder Rover Movies
Here you'll find 15 short movies of real rovers in action on Mars. You can even see Sojourner using its Alpha Proton X-Ray Spectrometer (APXS).
http://mars.jpl.nasa.gov/MPF/ops/rvrmovie.html

15. Go Behind-the-Scenes of the Rover Mission
To Mars with MER
This website is a companion to the exciting behind-the-scenes documentary series To Mars with MER, about NASA's Mars Exploration Rover (MER) project. Using video, online resources and hands-on activities simulating key moments of the MER mission, this website and the broadcast programs showcase fascinating new science along with cutting-edge engineering and high technology, as it happens. Plus, hear the stories of the men and women involved in making the mission happen. See To Mars with MER on public television and NASA TV (online).
http://passporttoknowledge.com/mars

Get Some Teaching Tools

16. Get Hands-on Lesson Plans
You'll be making Martian maps, designing and building rockets and land rovers, analyzing the latest geological and meteorological data from Mars, and terra-forming the Red Planet with these great teaching tools.
http://quest.arc.nasa.gov/mars/teachers/tg/index.html

17. Imagine Mars
The Imagine Mars Project Web site is your portal to simple lesson plans and resources to launch K-12 students' on an exciting journey. Participation can be as simple or as complex as you want it to be.
http://imaginemars.jpl.nasa.gov/index2.html

18. ASU Mars K-12 Education Program
This website contains activities of the Arizona Mars K-12 Education Program, which has been conducting outreach since 1992 and is the longest–established Mars K-12 education project.
http://marsed.asu.edu/

Read a Book About Mars

Touchdown Mars! by Peggy Wethered, Ken Edgett, and Michael Chesworth, New York: C.P. Putnam's Sons, 2000, *ISBN: 0-399-23214-1*
Ages 4-8
The first-person narrative and fun watercolor illustrations put children in an astronaut's role. The book is an alphabetical journey from Earth to Mars. By reading aloud and identifying familiar objects in the pictures with an adult, younger children can learn their ABC's.

Destination: Mars by Seymour Simon, New York: HarperCollins, 2000, *ISBN: 0-688-15770X*
Ages 4-8
This book introduces the environment and physical details of Mars and discredits some popular notions like Martian canals and space creatures. It is enriched with photos and findings from the Mars Orbiter Camera, the Hubble Space Telescope, and the Pathfinder lander.

The Adventures of Sojourner: The Mission to Mars that Thrilled the World by Susi Trautmann Wunsch, New York: Mikaya Press, 1998, *ISBN: 0—9650493-6-1*
Ages 8-12
Readers follow the Pathfinder mission, from its conception and the construction of the Sojourner rover to the data sent to Earth about rocks, soil, and weather on Mars. Full color photographs and plenty of illustrations accompany this exciting true story.

The Mystery of Mars by Sally Ride and Tam O'Shaughnessy, New York: Crown Publishers, 1999, *ISBN: 0-517-70971-6*
Ages 9-12
Readers will enjoy a large collection of close-up Mars images from the Viking, Pathfinder, and Mars Global Surveyor missions. The authors, one of whom is Sally Ride, the first American female astronaut, compare the formation of Earth and Mars and show how conditions on Earth favored the formation of life. Appealing to young girls is a scenario involving a future Mars voyager, who is a woman.

A Look at Mars ("Out of this World" Series) by Ray Spangenburg and Kit Moser, New York: Franklin Watts, 2000, *ISBN: 0-531-16513-2*
Ages 10 and up
Mars's cultural influence on religious, artistic, and literary views are discussed in this survey of Mars. The conversational style of this book takes readers from ancient observation through modern space missions. Vivid color illustrations, text boxes, charts, and a timeline of discovery tie the information together.

Mars: Uncovering the Secrets of the Red Planet by Paul Raeburn, Washington, D. C.: National Geographic Society, 2000, *ISBN: 0-7922-7614-0*
Ages 12 and up
The National Geographic Society's state-of the-art book reports on Mars and the technology that allows its exploration. Stunning 2-D photographs and an 8-page 3-D panorama of the Martian landscape at the Pathfinder landing site comprise the 135+ photographs. More than a picture book, the text is illuminated by the images to give an in-depth study of Mars.

Glossary of Mars Related Terms

Asteroid: A small object made of rock and/or metal that orbits the Sun. Most asteroids orbit in a belt between Mars and Jupiter. Phobos and Deimos are probably asteroids that came too close to Mars and were caught by the planet's gravity.

Atmosphere: The layer of gases that surrounds a planet. Earth has an atmosphere of nitrogen and oxygen. Mars has a very thin carbon dioxide atmosphere.

Crater: A rounded bowl-shaped depression, made by the impact of a space rock, like a comet or asteroid.

Carbon Dioxide: A molecule made of one carbon and two oxygen atoms. Mars' atmosphere is mostly carbon dioxide gas. Carbon dioxide frost requires temperatures below –125°C (-193°F)

Gravity: A force that pulls objects together. We feel gravity as weight. Gravity holds you to Earth's surface. The gravity on Mars is less than that of Earth, so you would weigh less, even though you wouldn't look any different.

Hemisphere: One half of a planet. On Mars the southern hemisphere is covered with lots of craters and mountains, while the northern hemisphere is smoother and has far fewer craters.

Microbe: A microscopic form of life. Bacteria are an example of microbes on Earth. Scientists want to learn whether microbes live (or ever lived) on Mars.

Oxygen: An element. Earth's atmosphere has 21% oxygen, which is what we breathe. Mars has almost no oxygen in its thin atmosphere.

Olympus Mons: A giant volcano on Mars - the largest volcano in the Solar System. Olympus Mons is three times taller than Mt. Everest on Earth.

Planet: A large body that orbits the Sun. Mars and Earth are both planets.

Rover: A wheeled robot that scientists sent to other planets to help them study what other worlds are like. *Spirit* and *Opportunity* are the names of NASA's latest robotic rovers.

Valles Marineris: A huge crack in the surface of Mars - the largest canyon in the Solar System. Valles Marineris dwarfs the Grand Canyon in Arizona.

Year: The amount of time it takes for a planet to make one trip around the Sun. Earth takes 365 days to go around, so our year is 365 days long. A year on Mars is 687 "Earth days" long. That's almost two "Earth years"!

Acknowledgements

Development Team
Dr. Cherilynn Morrow
Preston Dyches
Brad McLain
Amy Wilkerson

Original Illustrations
Andrew Sanchez

Science Consultants Steve Lee, Tony Colaprete

Special Thanks To Todd Clancy, Mike Wolff, William Farrand , Brad Sandor

Reviewers TBD

Field Testing TBD

Funded by

With additional support from:

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Abbreviations: r= right, l=left, c=center, tr=top right, tl=top left, br=bottom right, bl=bottom left, t=top, a=all

NASA/JPL: Cover & pp. 9a; 10a; 11t; 14r; 15r; 17a; 19tr, c ,bl; 20tr, bl; 29r; 32t; 38bl; 42tr; 43tl

NASA/JPL/Maas Digital: 1br; 19 tl; 24a; 25r

NASA/JPL/Malin Science Systems: 15l; 20tl, br; 27r; 36br; 38br

NASA Goddard Space Flight Center: 14r

NASA/Space Telescope Science Institute: 39a

NASA Langley Research Center: 19br

James Harold/SSI: 4a; 25l

Acknowledgements

— Images from Technology of Exploration, pp. 18-19 —

Find out about all the past missions to Mars at:
http://mars.jpl.nasa.gov/missions/

1. Earth Orbiting Telescope: The Hubble Space Telescope was launched in 1990 and has made many incredible discoveries, as well as the best images of Mars ever taken from Earth. Visit www.hubblesite.org for images and info.

2. Orbiter: The Mars Global Surveyor spacecraft has been orbiting Mars since 1997 and has produced incredibly detailed images of the Martian surface. See the home page for this mission at http://mars.jpl.nasa.gov/mgs/.

3. Rover: Follow the exploits of the twin Mars Exploration Rovers, NASA's latest robotic Mars explorers. Visit http://marsrovers.jpl.nasa.gov/home.

4. Lander: NASA successfully landed two Viking landers on Mars in 1976. This is an artist's rendering of an upcoming mission called Phoenix Scout. In 2008, it will land in the water-ice-rich northern polar region, dig with a robotic arm into arctic terrain for clues on the history of water, and search for environments suitable for microbes.
See http://phoenix.lpl.arizona.edu/

5. Mars Airplane: NASA selected the ARES Mars airplane for study as a potential mission for 2007-8. The Phoenix Scout mission was selected instead of ARES, but this mission or one like it could still fly at a later date.
Visit http://marsairplane.larc.nasa.gov/ and http://mars.jpl.nasa.gov/missions/airplanes.html

6. Sample Return Mission: NASA envisions sending a Sample Return Mission to Mars after 2014. Scientists expect to learn a great deal about the Mars by examining samples of its rocks and soil in laboratories on Earth. Visit http://mars.jpl.nasa.gov/missions/samplereturns.html for more information.

7. Balloon: This is an artist's impression of a Future Mars Balloon mission. Balloons can fly one hundred times closer to the surface of Mars than orbiters and can travel a thousand times further than rovers in a comparable period, thus providing views of much broader areas of the surface. See: http://mars.jpl.nasa.gov/missions/balloons.html for more.