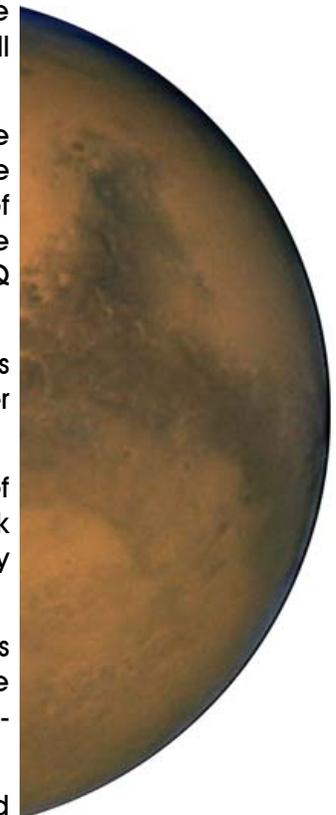


GEE WHIZ! FACTS ABOUT MARS



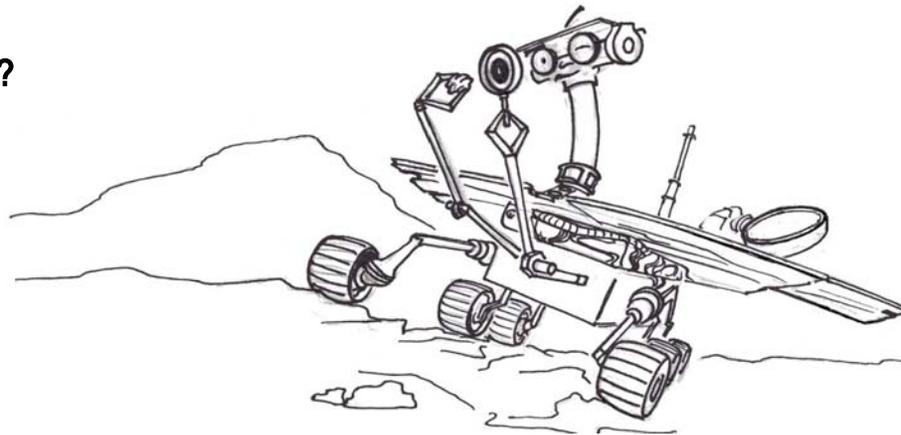
1. Mars has the largest volcano in the Solar System. Olympus Mons* is almost three times higher than Mount Everest! [see FAQ 11]
2. Mars has the largest canyon in the Solar System. If the Valles Marineris canyon existed on Earth, it would stretch all the way across the USA! [FAQ 12].
3. The entire surface 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:

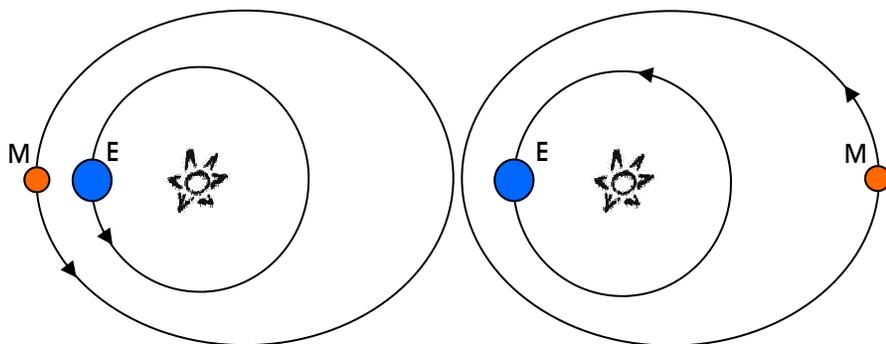
1. Where is Mars?
2. How far away is Mars?
3. How old would I be if I lived on Mars?
4. How big is Mars?
5. How high could I jump on Mars?
6. How hot/cold is Mars?
7. Why is Mars red?
8. Could I breathe on Mars?
9. Is there life on Mars?
10. Why doesn't Mars have oceans?
11. Why are volcanoes so big 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.

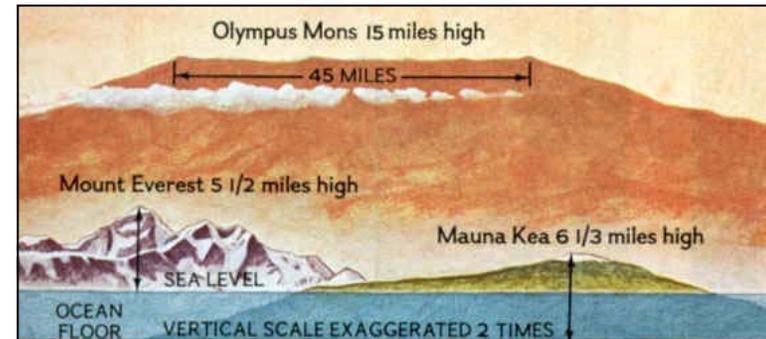
8. **Could I breathe on Mars?** No. The atmosphere of Mars is mainly carbon dioxide* (95%), and only 0.1% oxygen*. Earth's air is 21% oxygen, 0.035% carbon dioxide, and 78% nitrogen. Therefore, people on Mars would need to have a source of oxygen to breathe.

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.

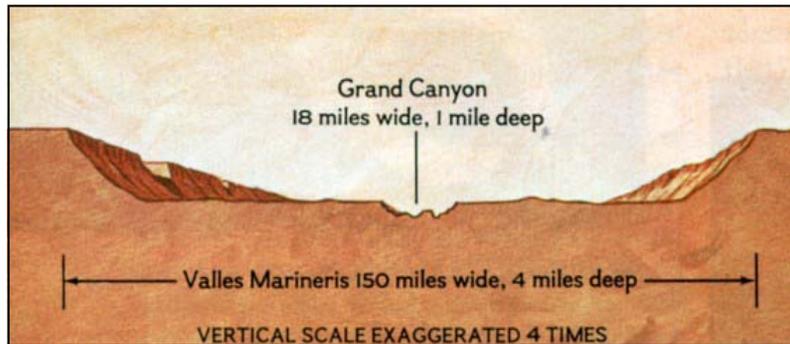
10. **Why doesn't Mars have oceans?** It's far too cold and the atmosphere is much too thin for liquid water to exist on the surface of Mars for very long. It would either freeze due to the cold temperature or boil away due to the low atmospheric pressure. The only place it might be warm enough for liquid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

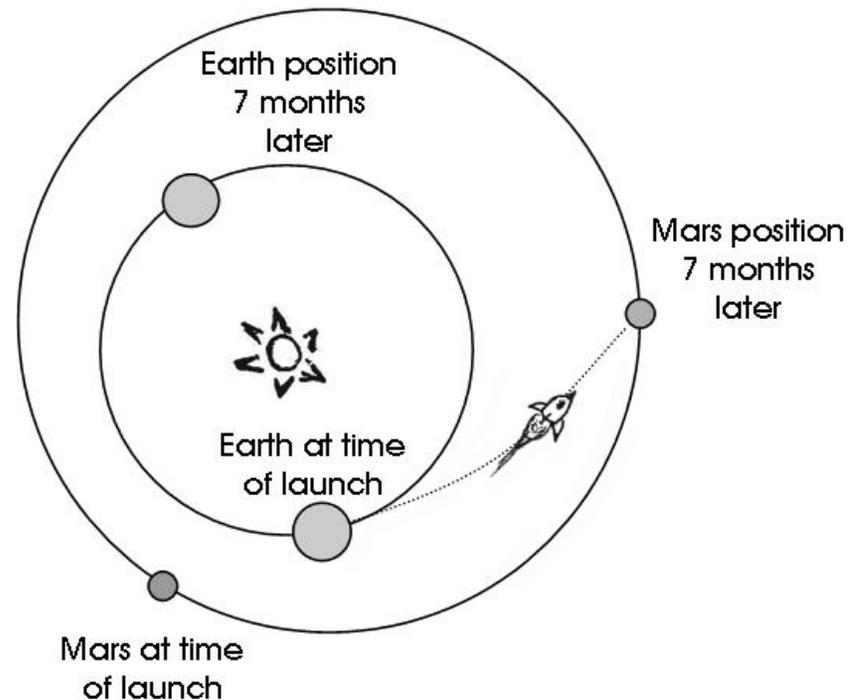
14. How do we know if a rock is from Mars? Tiny bubbles of gas trapped in the rock match exactly the mixture of gases in Mars' atmosphere as measured by the Viking spacecraft which landed there in 1976.

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/tgj/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"!

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