

Red Planet:

Read, Write,
Explore!

Lesson 4: Surviving and Thriving on Mars

Description of Lesson: In this lesson, students will consider what it takes to live happily on Mars. They will consider what Mars is like, and describe things they would need to survive and thrive.

Background:

If we want to visit the planet Mars and stay for any period of time, we have to consider the complexities involved in engineering an interplanetary journey and what a human needs to survive and thrive in a completely different environment. Along with our basic requirements of food, water, clothing, shelter, and oxygen, what else do we use and do everyday that makes us not only able to survive, but keeps us happy and healthy, both mentally and physically, on Earth? These are questions scientists and engineers have when trying to design a space mission involving humans, whether they are simply going into orbit around Earth, staying for awhile in the International Space Station, or traveling farther out into space.

Humans require a lot to keep them alive, and that makes sending humans into space both risky and expensive. A long mission to Mars would not only be dangerous, but very physically and mentally taxing on the participants. Huge amounts of equipment are required to provide radiation protection, oxygen, waste removal, food, and exercise equipment. In space, muscles degrade, bones deteriorate, and the heart shrinks. Just to get to Mars would be an amazing feat for a human.

Once there, the shelter would have to be shielded from harmful radiation (see “Motivation”). Water and energy would have to be generated, and food would have to be grown. A trip to Mars would be for scientific research and that would include bringing transportation, digging equipment, and scientific instruments. To top it all off, some of the equipment would arrive needing assembly!

Does the risk outweigh the benefit? Many would argue, “yes,” yet there are many reasons to push the limits of our capabilities by exploring farther and farther, both on Earth and off.

Motivation:

We always send robots or spacecraft, not people, to the surface of Mars. People need a lot more to keep them happy and healthy. Spacecraft and robots are usually sent instead of people because it’s cheaper and we don’t actually have to bring them back to Earth! Though, it is arguably easier to explore the planet in-depth if we send humans to Mars.

Traveling to Mars is not easy. We can't go to Mars and back anytime we want. For the fastest and most fuel-efficient trip, Earth and Mars only align properly in their orbits about once every two years. If you traveled to Mars with today's technology, it could take between six and nine months. You would need to be prepared to stay until Mars and Earth align again for the trip home. That might take up to another year and a half. Then, it takes another six to nine months to get back! That's a very long time to be away from home. There are weight restrictions on a space mission, so you wouldn't be able to bring all of the things you typically enjoy on Earth because the more supplies you bring, the more fuel you need in your rocket to get them off the ground—and fuel is expensive!

How would you protect yourself from radiation on Mars? Mars' atmosphere is very thin and the planet lacks a global magnetic field. Earth's atmosphere blocks out harmful radiation, like x-rays and ultraviolet rays from the Sun that can damage organic tissue such as skin, organs, and eyes. Earth's magnetic field shields us from fast-moving particles traveling through space, another type of radiation that can damage living cells and harm electronics.

Finally, what would you want to find out about Mars if you went there? What equipment would you need that would help you find out?

MAVEN is a spacecraft that will orbit Mars to help figure out what the components of Mars' atmosphere are, and whether Mars could have supported life at any point in its history. MAVEN, as well as other spacecraft and robot landers, will eventually pave the way for humans to live and study Mars while on Mars!

Recommended additional activities:

The Space Place at NASA game, "Let's Go to Mars," has students load items into a Mars-bound rocket: <http://spaceplace.nasa.gov/mars-adventure/>.

NASA's survival lesson encourages students to first consider essential needs for settlers in Jamestown before having them consider a scenario where astronauts are stranded on the Moon. Rated for Grades 6-9, this lesson may be appropriate for advanced Grade 5 students or augmented for lower levels: http://www.nasa.gov/pdf/166504main_Survival.pdf.

To demonstrate that Mars has very little atmosphere to hold in heat, "Activity One: How Does the Make-up of the Atmosphere Affect Temperature?" from "The Potential Consequences of Climate and Variability and Change" suite of activities may help students understand this concept. A discussion may follow about how Mars has a very thin atmosphere with some greenhouse gases that trap heat, but since the atmosphere is so thin it is not enough to keep it warm: http://strategies.org/wp-content/uploads/2011/12/Blankets_May02.pdf#page=7.

Benchmarks for Science Literacy, Project 2061 (Grades 3-5)

The Nature of Technology

Technology and Science: Technology extends the ability of people to change the world: to cut, shape, or put together materials; to move things from one

place to another; and to reach farther with their hands, voices, senses, and minds. The changes may be for survival needs such as food, shelter, and defense; for communication and transportation; or to gain knowledge and express ideas. 3A/E4

The Living Environment

Interdependence of Life: Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful. 5D/E4

Common Core for English Language Arts

Writing

- *W.3.2., 4.2, 5.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.*
- *W.3.3., 4.3, 5.3 Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.*
- *W.3.7., 4.7, 5.7 Conduct short research projects that build knowledge about a topic.*
- *W.4.9., 5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.*

Speaking and Listening

- *SL.3.2. Determine the main ideas and supporting details of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.*

Lesson Time: Two to three 45-minute periods

Choose one or more of the following books to read aloud:

- Bennett, Jeffrey. 2006. *Max Goes to Mars*. Boulder, Colo.: Big Kid Science. (Grades 2 and up and including all side material)
- Getz, David. 1997. *Life on Mars*. New York: Henry Holt and Company, LLC. (Grades 3 and up)
- Asimov, Isaac. 2002. *Mars*. New York: Prometheus Books. (Grades 4 and up) pp 23-25
- Ride, Sally and Tam O'Shaughnessy. 2006. *The Mystery of Mars*. San Diego: Sally Ride Science. (Grades 3 and up) p 45
- Scott, Elaine. 2008. *Mars and the Search for Life*. New York: Clarion Books. (Grades 5-9) pp 47-51

Choose one or more of the following books as a classroom resource:

- Asimov, Isaac. 2002. *Mars*. New York: Prometheus Books. (Grades 4 and up)
- Kobasa, Paul ed. 2007. *Solar System and Space Exploration Library: Mars*. Chicago. (Grades 3 and up) pp 56-59
- Ride, Sally and Tam O'Shaughnessy. 2006. *The Mystery of Mars*. San Diego: Sally Ride Science. (Grades 2 and up)

- Schorer, Lonnie. 2010. *Kids to Space Club: Are We There Yet?* Ontario: Apogee Books. (Grades 3 and up) pp 46, 76, 100, 110, 114, 118, 122, 130, 144, 152
- Scott, Elaine. 2008. *Mars and the Search for Life*. New York: Clarion Books. (Grades 5-9)

Materials:

- One or more of the books listed to read aloud
- One or more of the classroom resource books
- Graphic organizer from Lesson 1

Procedure:

- Read one or more of the books listed to the class.
- Organize the class into small groups of three. Pass each student back his or her Graphic Organizer from Lesson 1.
- Tell students that their job is to figure out everything they would need for an extended stay on Mars.
- Pass out the Graphic Organizer, “Needs V. Wants,” to each student.
- Working with a group of three or four, have students decide what they will research on Mars (looking for life, studying signs of water, geology, etc.), and what they would need to do the research and to live happily on Mars. Then, have students fill out the “Needs V. Wants” Graphic Organizer.
- Travel to each group and challenge them to think deeply about the problem.
- Have an open discussion with the class about needs and wants on the trip. Some things they want to bring may be useful for entertainment. Some things may be entertaining, but not practical to bring. Have students suggest and debate trade-offs, and give them time to edit their “Needs V. Wants” list. You may want to provide a set of clean copies of the “Needs V. Wants” Graphic Organizer.
- Have each student draw and illustrate a detailed plan for a trip and three-month stay on Mars, and include what they would accomplish when they got there and what they would bring. If students do not finish this in class, assign it as homework.
- Follow up the next day by asking students to share their work with the class.

Example Discussion Questions:

- Where would you live and what would you need in your living space? Think about what you need at your own house.
- Do you plan to work the entire time you’re on Mars? What do you think would happen if you worked all day, every day?
- What do you need or use every day that you couldn’t live without?
- Does Mars have oxygen? Could you breathe?
- What do you do for fun on Earth that you would want to do on Mars? Would it be challenging to do this on Mars?
- What could you live without that you could leave at home?

- What equipment would you need to do research on Mars? Would you need to travel around to do the research?
- How do you communicate with Earth when you are on Mars?
- How do you create power on Mars to run your electronics and equipment?

Extension activity (Grades 4 or 5): Give students a reasonable weight limit, such as 20 pounds, for their personal effects. Use props and a scale to see if they can come in at the limit. Examples of props could include: clothes, shoes, a laptop and charger (with known weight to avoid damage), books, toys, playing cards, travel board games, shampoo and conditioner bottles, bars of soap, notebooks and colored pencils, snack bars, a hairdryer, a brush, a comb, etc. Pre-weigh your items to ensure they exceed the weight limit so students have to make a choice of what to bring and what to leave home.

Extension activity (Grade 5): Have students consider where on the planet they would like to land and why. Students might consider things like: the amount of daylight to produce solar power; the weather; where they are most likely to find signs of life; whether the area has a magnetic field that might somewhat protect against the solar wind; whether the area they want to visit is dark part of the year (like Antarctica or the Arctic Circle is on Earth); etc. This could be a longer-term research project.



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Needs V. Wants

Names:

Directions: With your group, decide what you want to research when you go to Mars. Then, decide what you would need and want to bring to Mars in order to live and work. Record your group's ideas here (continue on next page if you run out of room).

On Mars, I would like to research:

I will...

Need	Want

Need	Want

When I land on Mars and first go outside my spaceship...

I will need to bring...

I will wear...

I will feel....

I will see...

I will notice....

Draw a picture of yourself on Mars below:

