Designing a Mars Rover
Lesson Plan

Grade Level: 6-8	**Curriculum Focus:** Space Exploration	**Lesson Duration:** Two class periods

Objectives

- Consider the type of surface transportation that would be necessary for a mission to Mars
- Think about ways to overcome the challenges to exploration presented by the characteristics of the Martian surface and its surrounding space.

Materials

- Video on *unitedstreaming*: *Destination: Mars*

  Search for this video by using the video title (or a portion of it) as the keyword.

  Selected clips that support this lesson plan:

  1. Part One: Destination: Mars
     - Physical Features of Mars
     - Preparing for the First Manned Trip to Mars
     - Developing the Technology to Support a Journey to Mars
  2. Part Two: Destination: Mars
     - Landing on Mars
     - On the Surface of Mars
     - Terraforming: Living on Mars

- Images of the surface of the planet Mars
- Research materials about Mars
- Computer with Internet access
- Paper, pencils, markers, and other materials to create sketches of their rovers

Procedures

1. Ask your students to imagine that they have just been hired to design a new vehicle for traveling around on Mars's rocky surface.

2. Begin by showing them images of the various kinds of terrain their vehicle will have to traverse (mountains, rock fields, deep gorges).
3. Remind them, too, that they need to consider the vehicle's fuel source, weight, durability, size, special features, and flexibility.
4. Review with students what they have learned about the planet Mars, challenging them to identify any characteristics of the planet's surface or surrounding space that would present problems for a designer of a Mars surface-exploration vehicle.
5. Allow time for students to do further research on Mars to discover any other facts that might prove useful to them in completing their assignment.
6. Divide the class into groups; then ask each group to sketch its idea for a new Mars rover and write a description of how it works.
7. When the groups have completed their sketches and descriptions, have them choose one student from each group to present what the group has designed.
8. Have each group select another group member to serve as its delegate to a "NASA committee" for selecting which vehicle to build.
9. Ask the committee members to deliberate the merits of each design, and then vote on a winner. (No delegate may vote for its own group's entry.)

Discussion Questions

1. Debate the pros and cons of having a consortium of nations working toward a manned flight to Mars instead of the single-nation model seen so often in the past in the efforts of the United States and Russia to explore space.
2. Meteors, meteoroids, and meteorites are three terms that describe rocks from space under different conditions. Though these terms are not synonymous, they are often used interchangeably. Give proper definitions for each of these terms, then explain which one applies to the alleged Mars rock discovered in Antarctica by NASA scientists.
3. The people chosen to go to Mars will be out of reach of the Earth, completely on their own. While all the people will be astronauts, should they have various fields of specialty, like botany, engineering, or geology, or should each person be a jack-of-all-trades? If we send people with different professional backgrounds, which professions are most desirable?
4. Is it realistic to expect just four people to compose the entire crew? Imagine having to spend more than two years with the same four people, isolated from all other human beings. The psychological effects would surely be overwhelming. Can you think of activities that might help these people overcome their monotony? Why do you think a four-person model was selected for the Mars missions, as opposed to a two- or three- or five-person model? What would be the consequences of waiting until a larger group could go safely?
5. Because of the fact that Mars may have once supported primitive life forms like bacteria, it's irresistible to imagine more advanced beings living there. What if you were one of the first explorers from Earth to arrive on Mars? Assuming you could communicate with any Martians

you encountered, how would you explain why you had ventured to their planet to conduct experiments? Consider the encounters throughout history between explorers and the people they "discovered" as you formulate your answer. Would you have the "right" to visit Mars and conduct experiments there?

6. Inevitably, with any new space exploration endeavor, some citizens question the wisdom and fairness of spending billions of dollars that could otherwise be directed toward solving innumerable problems right here on Earth. Analyze both sides of the issue to determine where you stand. Compare your viewpoint with those of your classmates, teachers, and family members. Do you see any response patterns correlating to gender, age, education, or profession?

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- 3 points: Student develops a careful, detailed sketch; clear verbal description; sketch and description take into consideration the special requirements of the Martian surface and surroundings.
- 2 points: Student develops an adequate sketch; verbal description incomplete; sketch and description take into consideration the special requirements of the Martian surface and surroundings.
- 1 point: Student develops a sketch lacking in detail; verbal description incomplete; sketch and description fail to take into consideration some important special requirements of the Martian surface and surroundings.

Vocabulary

centrifuge

Definition: A machine that whirls, creating artificial gravity.

Context: During training, astronauts and cosmonauts ride on a spinning centrifuge to test their ability to withstand large g-forces.

g-force

Definition: The feeling of increased weight that results from acceleration.

Context: As astronauts accelerate toward space during the launch from Cape Canaveral, they may experience up to seven g's of acceleration, creating a crushing force that makes them feel seven times heavier than they normally feel.

meteor

Definition: A streak of light in the night sky produced by the passage though the Earth's atmosphere of one of the countless small particles of solid matter in the solar system.

Context: NASA scientists discovered a space rock, which they claim may have been knocked off the surface of Mars, traveling through the solar system and then entering the Earth's atmosphere as a meteor.

permafrost

Definition: A permanently frozen layer of soil in arctic regions.

Context: If all of the frozen water locked up as permafrost in the Martian soil were to melt, Mars would be covered with an ocean to a depth of 600 feet.

terraforming

Definition: Changing the environmental conditions on another planet to resemble those of Earth.

Context: In order to provide a replenishing food source, astronauts will use terraforming to release the carbon dioxide from Martian rocks needed for plants to grow.

Academic Standards

National Academy of Sciences

The National Science Education Standards provide guidelines for teaching science as well as a coherent vision of what it means to be scientifically literate for students in grades K-12. To view the standards, visit http://books.nap.edu.

This lesson plan addresses the following science standards:

- Earth and Space Science: Earth in the solar system

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit http://www.mcrel.org/compendium/browse.asp.

This lesson plan addresses the following national standards:

- Technology: Understands the relationships among science, technology, society, and the individual.
- Science—Space Science: Understands essential ideas about the composition and structure of the universe and the Earth's place in it.
- Science—Earth Science: Understands Earth's composition and structure.
- Science—Life Science: Understands relationships among organisms and their physical environment.

Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- http://school.discovery.com/teachingtools/teachingtools.html