Lesson 14: Lander Design

This lesson is adapted from "Edible Mars Spacecraft," by Amalia Plummer and Tricia Dieck, College of Education, Arizona State University, which was adapted from Jean Settle's "Edible Rockets" and "Edible Space Stations" activities: Jean Settle, Aerospace Education Consultant, 16487 Hollister Crossing Dr., St. Louis, MO 63011.

Purpose: To allow students to apply the understanding they have gained about landers and robotic components through a hands-on experience.

Standards

NCTE/IRA Standards for English Language Arts

Standard 1- Students read a wide range of print and non-print texts...to build and understanding of themselves [and] acquire new information.
Standard 5- Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.
Standard 12- Students use spoken, written, and visual information to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

National Science Education Standards

Science as Inquiry – Content Standard A

1. Abilities necessary to do scientific inquiry.
2. Understanding about scientific inquiry.

Science and Technology – Content Standard E

1. Ability of technological design – students should develop the abilities to identify a simple problem, propose a solution, implement a proposed solution, evaluate a product or design, and communicate a problem, design, and solution.
2. Understanding about science and technology – scientists and engineers often work in teams with different individuals doing different things that contribute to the results.

Overview

A robot is a mechanical device which performs automated tasks, either according to direct human supervision, a pre-defined program or, a set of general guidelines, using artificial intelligence techniques. These tasks either replace or enhance human work, such as in manufacturing, construction or manipulation of heavy or hazardous materials. Every spacecraft ever sent to Mars has been a robot. Each of these robots has had tasks and was built to specifically perform these tasks.

Results from the Mars Exploration Rovers robotic arms and cameras have shown that, long ago, Mars was soaked with liquid water. The rovers found evidence for this as they roved across the surface studying rocks along the way. The 2007 Phoenix lander, however, will be stationary and will dig down into the soil instead of roving along the surface. The rovers showed us liquid water once flowed on Mars, while Phoenix will analyze the soil to study the biological potential of the soil. Phoenix must dig down because any possible biology would have to be under the surface where it is protected from solar radiation, which easily penetrates the thin atmosphere of Mars.

In this activity students will design and built a prototype robot. This activity can be done in small groups or individually. You may decide to have the students work in small groups for the initial design process and then allow each student to begin again from the drawing stage and take it through to the final creation of their prototype robot.

Understandings

1. Simple machines make tasks easier.
2. Simple machines affect our everyday lives.
3. Robots are made up of simple machines.
4. Robots gather different information (data) depending on their design and use.
5. Combining the information (data) gathered by a variety of robots gives us a broader and more in-depth understanding of our Earth and Solar System.

Materials

1. Pictures of landers (included)
2. Science and Technology Subject Area Classroom Module: Let's Talk Robotics ; 15 min NASA*
3. Butcher paper or large tablet paper
4. Materials that students can use to make their robot i.e.: foil, cardboard boxes, wooden sticks, shoe boxes, cardboard tubes, lids, plastic containers, etc…
5. *Optional:* toy robot

* Can be ordered from the NASA online catalog CORE (http://catalog.core.nasa.gov/) or contact the JPL Education Resource Center (http://education.jpl.nasa.gov/erc.html or 909-397-4420) for a free teacher copy

Supplemental Materials

1. Drive a rover the way NASA does at: http://www.marsquestonline.org/
2. Mars Exploration Rovers: Challenges of Getting to Mars; JPL (http://marsrovers.jpl.nasa.gov/gallery/video/)
3. Mars Exploration Rovers; JPL (http://marsrovers.jpl.nasa.gov/gallery/video/animation.html)

Time

Two 60-minute sessions

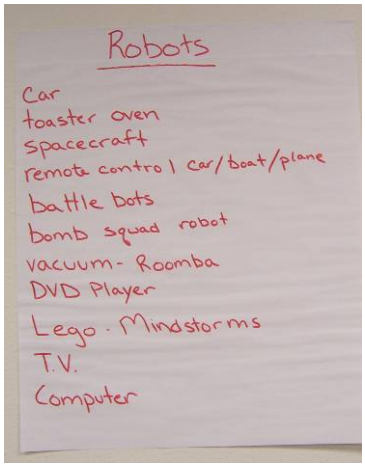
Directions

1. Review what simple machines are and how they help us in our daily lives with the students. Let the students share examples. *You can review the material in the background section at the beginning of the MarsBots learning module or in Lesson10: Simple Machines for more information on simple machines.*

2. Lead the students in a discussion about robots and landers that have been used in exploration (Pathfinder, Vikings I and II, the Mars Exploration Rovers, Phoenix, and the Mars Science Lab) and how they are all actually robots, controlled by the scientists here on Earth millions of miles away. *See the information about robots in the Background section of the MarsBots Learning Module. Robotic exploration is important because we are able to send robots into very harsh environments where humans are not able to go. Robotic planetary missions include scientific instruments to conduct experiments to determine surface and atmospheric compositions. The Phoenix lander will conduct several experiments to determine if the building blocks for life are present in the Martian artic and study the history of water on Mars. Have the students tell a revealing story about how our understanding of another planet is limited by using information (data) from just one source.*

3. This activity can be done in small groups or individually. You may decide to have the students work in small groups for the initial design process and then allow each student to begin again from the drawing stage and take it through to the final creation of their prototype robot.

4. Ask the students to brainstorm examples of robots. Record the student's responses on the board or a large piece of paper. *If you anticipate difficulties (with brainstorming ideas), gather materials that are part of this unit to use as a lead in for this lesson. This may mean the students view portions of videos that you have already used.*



5. Tell the students that they are now going to create a drawing of a robotic lander that must have a power source and be able to do the following tasks:
    - Conduct a scientific experiment
    - Receive and send messages to scientists back on Earth
    - Take pictures (panoramic)
    - Test something –students must decide what their robot is testing

The students must label the parts of their robot on their drawing as well as any other detail that they feel should be noted.

6. Each group (or student if not working cooperatively) will then present their drawing to the class. Display each group's illustration.

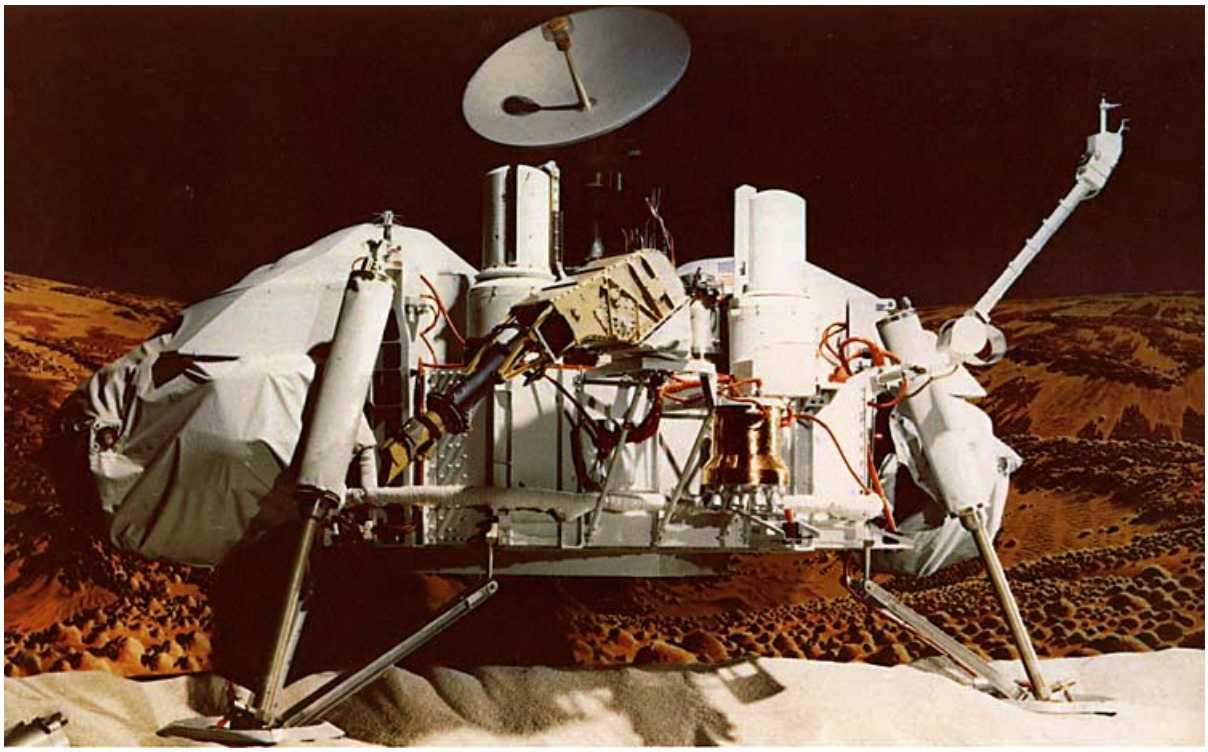
7. The students will now begin the process of building their prototype lander. Provide materials for the students to build their lander. Display final projects alongside the drawings.

Extensions

Landers could be constructed using edible materials (graham crackers, cookies, candies, icing, pretzels etc...)

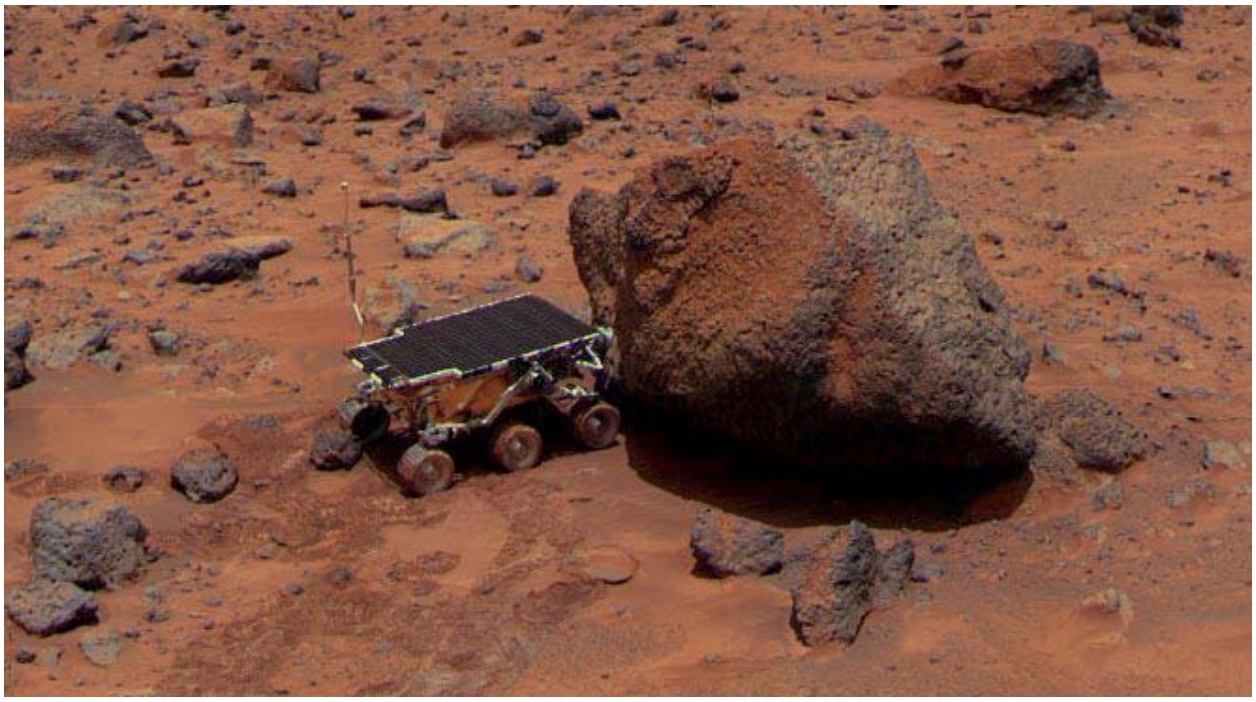
Students could write a newspaper article describing their lander and purpose.

Lander Images

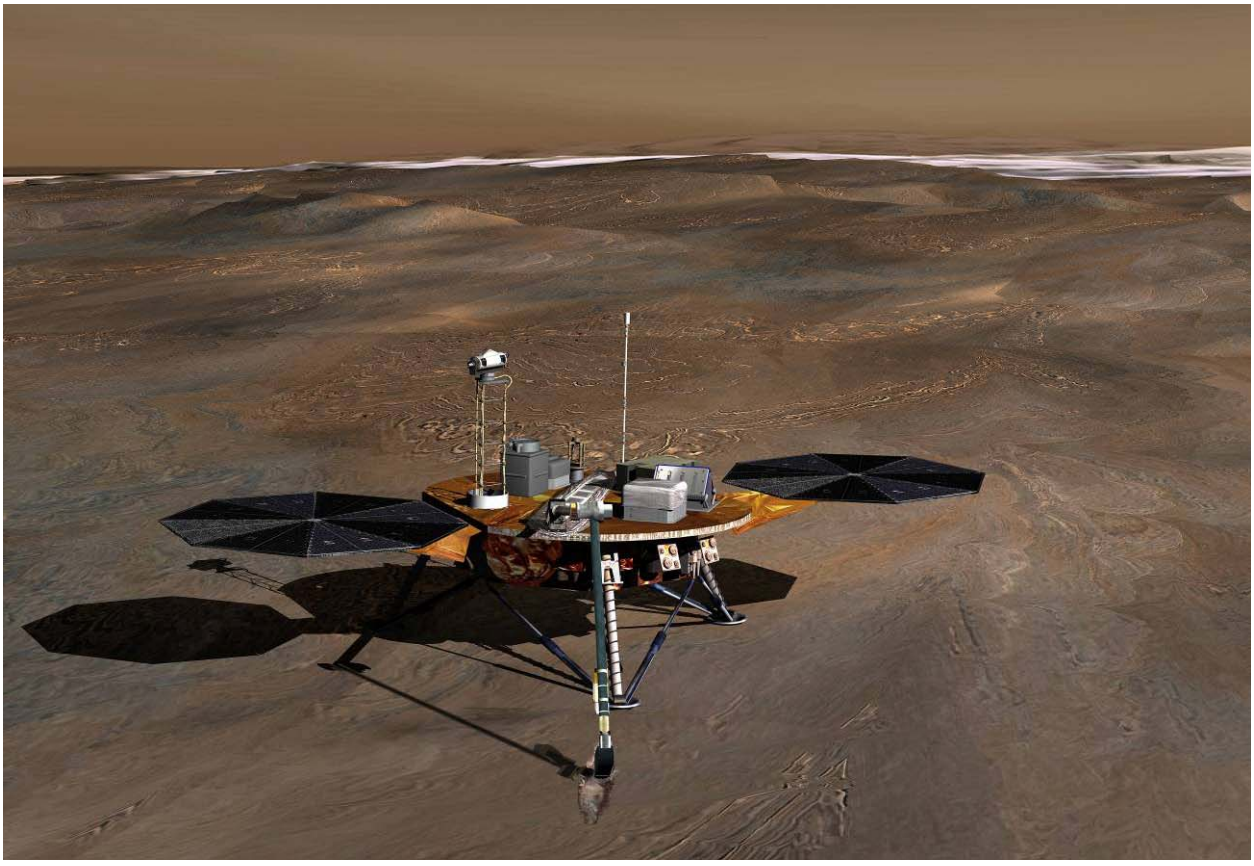


Viking Lander

Mars Exploration Rover



Mars Pathfinder- Sojourner Rover



Phoenix Mars Lander