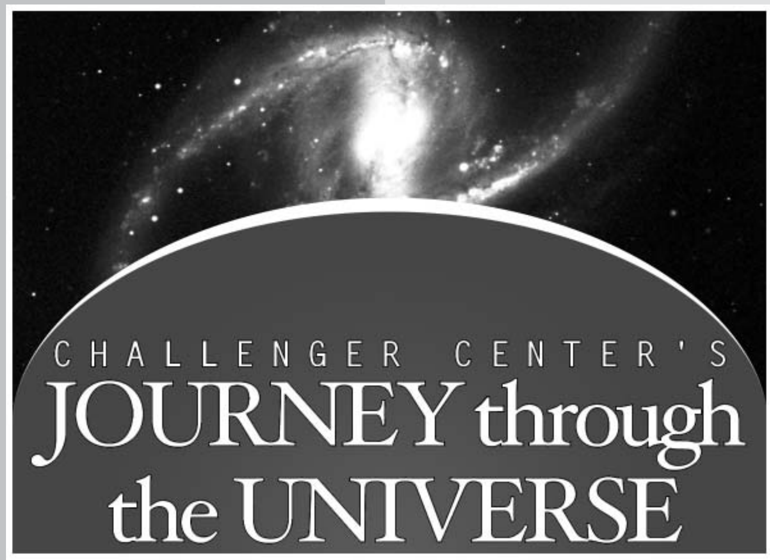

Are There Other Neighborhoods Like Our Own?

Searching for Abodes of Life in the Universe

This lesson is taken from an education module developed for Challenger Center's *Journey through the Universe* program. *Journey through the Universe* takes entire communities to the space frontier.

Start the *Journey* at www.challenger.org/journey.

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January 2001

Grade Level
K-4

How Do We Explore Strange Environments?

Overview

Our neighborhood is our community. Other neighborhoods could be elsewhere in our state, our country, or anywhere on Earth. Now, with people exploring space, perhaps other neighborhoods could even be as far away as the Moon!

Many neighborhoods on Earth are like ours. However, for other kinds of life, a neighborhood could be quite different. For example, consider the neighborhood of a squirrel living in your backyard, or perhaps a spider living somewhere in your home. Other neighborhoods could be on high mountains, on the ocean floor, or—someday—on the Moon.

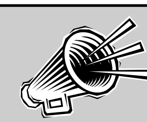
How can we explore some of these other neighborhoods? First, we might want to travel to unusual environments far away, but we might encounter some problems. Such an adventure can be difficult, expensive, and risky. A second method to find out about other places is to make observations from our neighborhood. But even with telescopes, microscopes, and other observational tools, it can be difficult to see and explore many places. Because the Earth is round, we don't have a direct view of most of the Earth. For us in the United States, places like Australia would be impossible for us to explore without leaving our neighborhood. The Moon is so far away that it's hard to see much detail from the Earth.

A third method of exploration is to build a robot and send it to explore harsh environments on the Earth or the Moon. Sending a robot doesn't require sending people, so robots tend to be easier to build, cheaper, and safer.

In building a robot that will explore other neighborhoods, many decisions must be made. For example, the robot could have many different parts, depending on the goals of the mission. They might include:

- Wheels or some other way to move around
- Cameras
- Communication antenna to keep in contact with mission control
- Solar panels to produce electrical power
- Sensors for navigation

ESSENTIAL QUESTION
How might we search for life in neighborhoods that are different from ours?



OBJECTIVES
Students will:
- **Identify the different parts of a robot, rover, or a spacecraft.**
- **Construct a model of a robot to complete an assigned task.**

- Instruments for detecting water or other resources
- Propulsion system to bring it to the environment to be explored
- arm(s), scoops, or other ways to pick up soil and rock samples

The various parts of the robot have to be put together in such a way that they don't interfere with one another. For example, the solar panels shouldn't block the view of the camera. Another consideration is that if the robot is too big, it will be difficult or expensive to transport to the place it is supposed to explore. A final consideration is how to undertake the exploration without needlessly disturbing the place that is being explored-changing it from the unique place that we wanted to explore into some new place that has been changed by us and by our robot.

In this activity, student teams will design, sketch, and build a model of a robot of their choice. Their robot will have a specific mission, and they must design the model in a way that supports the goals of their mission. When completed, the team will present their model to the class.

Procedures

1. Divide students into groups and have them review the Mission Proposal, which is written on their student worksheet.
2. On a large piece of paper, have students discuss and record all of the features their robot will need to accomplish its mission. They should be able to explain why they chose these features.
3. The cooperative groups will be divided into four-person design teams with the following responsibilities:
   A) Designer: will sketch a design of the robot
   B) Project Manager: will oversee the construction of the model
   C) Writer: will write the description of the completed model
   D) Speaker: will deliver an oral presentation to the class
   E) Everyone: will contribute ideas, bring materials from home, assist where needed, and cooperate with the people on the team
4. Each team will:
   A) Choose a robot to develop;
   B) Brainstorm ideas how to create the robot;
   C) Create a sketch of the design with the parts labeled;
   D) Identify the materials to be used in the construction;
   E) Bring construction materials from home;
   F) Build the model;

MATERIALS

- Paper
- Scissors
- Glue
- Tape
- Art supplies

From home, students will provide assorted modeling materials, such as:

- Plastic food containers
- Styrofoam trays
- One-liter plastic bottle
- Spools
- Broken toys
- Wheels and axles from toys or kits

G) Write a description of their model and how it works and;

H) Provide an oral report to the class.

5. When students are finished, they will present their robot to the rest of the class.

ASSESSMENT

Students' work can be evaluated using the following rubric:

4 Points

- The project accurately and thoroughly addresses all of the following: design is sketched, model is constructed, a description of the completed model is written, an oral presentation is given to the class, and the entire team contributed ideas to the robot.
- Used creative and reasonable ways to solve the most important problem(s).
- Identified how the problem was solved and shows a deep understanding of the problem and solution by thoroughly explaining the elements of the robot's design.

3 Points

- The project accurately and thoroughly addresses three or four of the following: design is sketched, model is constructed, a description of the completed model is written, an oral presentation is given to the class, and the entire team contributed ideas to the robot
- Used creative and reasonable ways to solve the most important problem(s).
- Identified how the problem was solved and explained it briefly.

2 Points

- The project accurately and thoroughly addresses one or two of the following: design is sketched, model is constructed, a description of the completed model is written, an oral presentation is given to the class, and the entire team contributed ideas to the robot
- Identified how the problem was solved but didn't explain it.
- Wrote a brief answer about this but it is not very clear or complete.

1 Point

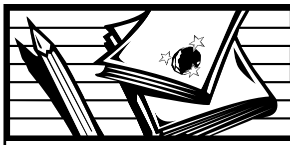
- The project accurately and thoroughly addresses only one of the following: design is sketched, model is constructed, a description of the completed model is written, an oral presentation is given to the class, and the entire team contributed ideas to the robot
- Did not identify how the problem was solved.
- Did not explain why the problem was solved in that manner.

0 Points

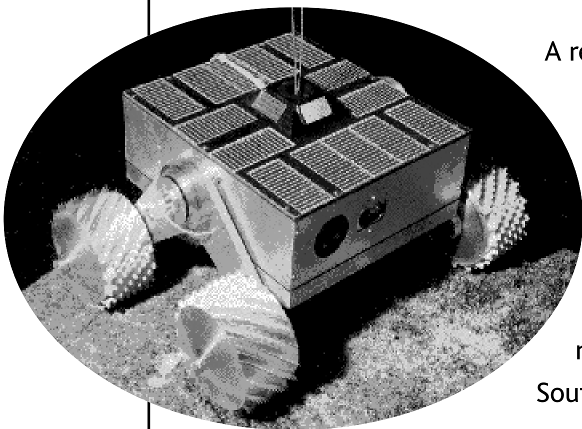
- No description turned in.
- Answers incomplete.
- Off topic or unrelated.
- Writing is unreadable

Transfer and Extension

1. Read *The New Book of Mars* by Nigel Hawkes. The book is filled with excellent photographs and explanations designed to help children understand how scientists are investigating Mars. Robots, spacecraft, and rovers are all in the book.
2. Egg drop. Tell the students that they must design a capsule to hold a rover that will land on the Moon. The rover is carrying delicate scientific instruments so it must land softly. The parameters for the capsule design may be set by the teacher (e.g., size may be no larger than 12" by 12", the capsule must be made from a shoebox, it may or may not use a parachute). It would be too expensive to test the capsule with a real rover, so tell the students that their capsules will be tested with a raw egg. Students may design and construct their capsules at home. On drop day, have the students bring their capsules to school to be loaded with a single raw egg. Drop each capsule from the highest elevation handy, such as the roof of the school or a window of the top floor of the school. (One enterprising teacher even got the local news helicopter to come to the school to drop them over the playground!) If the egg survives the drop without cracking, it was a successful design.
3. The Moon provides resources without ever going there: Tides and light at night. What makes these phenomena resources? What are the benefits of learning more about them?

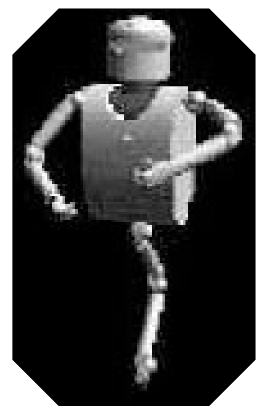


Mission Proposal
Student Worksheet



A recent exploration of the Moon by the Lunar Prospector spacecraft revealed evidence that water, in the form of ice, may exist at the Moon's South Pole. The water would be found in parts of craters that are forever shielded from the Sun's heat. The discovery of water would mean that future human explorers of the Moon could use the water for drinking, to make oxygen to breathe, and to make rocket fuel. NASA wants to better understand how much water may exist, using an unmanned mission to the Moon's South Pole.

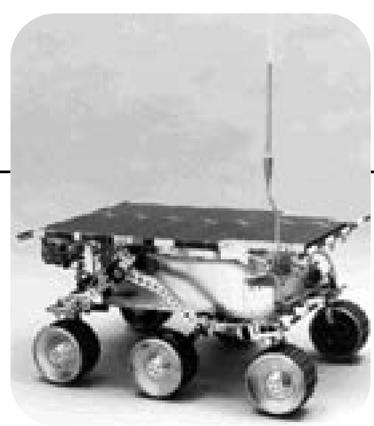
Your four-person design team must decide to create one of the following models:
A) The spacecraft that will carry the rover to the Moon and land it safely on the Moon's surface
B) The rover that will locate the polar ice
C) The part of the robot that will scoop up ice and rock samples



Follow the steps below to help you design and create your model.

1. First, decide which of you will take on each of the following jobs:
   A) Designer – will sketch the design of the model
   B) Project Manager – will oversee the construction of the model
   C) Writer – will write the description of the completed model
   D) Speaker – will prepare an oral presentation to the class

Everyone will contribute ideas, bring materials from home, assist where needed, and cooperate with the other people on the team.



2. With your group, chose which model you will make, and brainstorm ideas for your model. What will it need to have on it to make its mission a success? Record all of your ideas on a big sheet of paper, and write down your best ones in the space below.

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3. Have your Designer sketch your model, with all of the parts labeled, on a separate sheet of paper.

4. From your sketch, decide what materials you will need to construct a 3-D model of your design. Figure out who can bring what materials, and go home and collect them.

5. As a team, put your model together. The Project Manager will help make sure that it gets completed in the time allowed by your teacher.

6. When the model is complete, your Writer should write a description of your robot, rover, or spacecraft. Using the description as a guide, the Speaker will share the design and its features with the rest of the class.

Challenger Center Programs

The internationally acclaimed **Challenger Learning Center** Network currently consists of state-of-the-art, innovative educational simulators located at 49 sites across 29 states, Canada, and the United Kingdom. Staffed by master teachers, the core of each Center is a two-room simulator consisting of a space station, complete with communications, medical, life, and computer science equipment, and a mission control room patterned after NASA's Johnson Space Center. See *www.challenger.org* for information.

A joint initiative of Challenger Center for Space Science Education, the Smithsonian Institution, and NASA, ***Voyage — A Journey through our Solar System*** is a space science exhibition project that includes permanent placement of a scale model solar system on the National Mall in Washington, DC, and at locations all over the world. See *www.voyageonline.org* for information.

Space Day℠ launches new *Design Challenges* created by Challenger Center each school year. The inquiry-based challenges are designed to inspire students in grades 4-8 to create innovative solutions that could aid future exploration of our solar system. See *www.spaceday.org* for information.

Challenger Center's ***Journey through the Universe*** program provides under-served communities with diverse national resources, including K-12 curriculum materials, teacher workshops, classroom visits by scientists from all over the country, and Family Science Nights. See *www.challenger.org/journey* for information.

The **MESSENGER** spacecraft (MErcury Surface, Space ENvironment, GEochemistry and Ranging) is to be launched in 2004 and go into Mercurian orbit in 2009. Challenger Center is one of the partner organizations charged with MESSENGER education and public outreach activities. See *www.messenger.jhuapl.edu* for information.

Through the Challenger Center **Speakers Bureau, Voyages Across the Universe**, staff members speak to student audiences of 30-1,000, conduct workshops for 100-300 educators, give keynote and featured presentations at conferences, as well as conduct Family Science Nights at the National Air and Space Museum, and other facilities across the nation, for audiences of 300-1,000 parents, students, and teachers. See *www.challenger.org/speakers* for information.