Rover Traverse

Suggested Grade Level: 3–9

Summary

- Students will model the steps needed to guide a planetary rover.
- Students will design a rover traverse that will avoid obstacles and reach a rock target.

Standards

- NM Science Content Standards: Strand I, Scientific Thinking and Practice; Strand III, Science and Society
- National Science Education Standard: Standard E, Abilities of Technological Design; Standard G, Nature of Science
- National Math Education Standards: Communication, Measurement

Background Information

The Mars Exploration Rovers (MER) were designed to be robotic field geologists. Scientists on Earth can study Mars by using the rovers. Many people think that planetary rovers are driven minute by minute by commands from Earth, but the distance between Earth and Mars makes this impossible. Depending on the distance between the two planets, which varies as they orbit around the sun, it can take 5 to 20 minutes one-way for a radio transmission. Instead of real-time commands, the rovers move (traverse) across the surface in three steps: by (1) receiving a series of commands from Earth (this is called an uplink), (2) following those commands, and then (3) sending a series of images, data, and other observations back to Earth (in a daily downlink). There is enough on-board intelligence built into the MER rovers to enable them to stop before they hit a rock or go over a cliff. Their automatic navigation programming enables them to plot out a safe course and drive themselves to a given destination. However, they can also be given explicit commands during a downlink about distance and direction to drive, when to turn toward another direction, and when to stop. This is the style of rover traverse that this activity is designed to model.

Materials

- Classroom-size area with several chairs and/or tables and/or boxes scattered throughout in the pattern shown on the Rover Traverse Command Sheet
- Two rocks or other targets located at sites A and B on the Rover Traverse Command Sheet
- Blindfold materials
- Rover Traverse Command Sheet included with this activity

- Clipboard and pencil
- Plywood sheet measuring at least 4 feet by 4 feet, rocks (optional for older students)
- Programmable LegoTM MindstormTM kit or a similar type of programmable rover model (optional for older students)

Preparation

1. Prepare an open area in your classroom or in a common room such as a library, gym, or auditorium that is a minimum of 10 (student) steps long by 10 steps wide in size.

2. Collect and set up the chairs/tables/boxes and rocks/targets for the activity. You can follow the suggested obstacle course shown in the Rover Traverse Command Sheet or you can make up a new obstacle course within the same area.

3. Print and photocopy the Rover Traverse Command Sheet for all student teams.

4. For the programmable rover model, prepare a plywood sheet or other solid flat surface (4 feet X 4 feet or larger) that can be used by a wheeled model. Small boxes or books can be used as obstacles. Two small rocks can be used as the targets. A team of students can modify and prepare a programmable rover model as a project prior to the activity.

Introduction for Students

You are going to model a rover mission to Mars. What do rovers do? How would you drive a rover on another planet? What information would be necessary for the rover to have in order to reach a specific rock target?

Procedure

This can be done as two separate activities depending upon student level. The activity for younger students uses the students themselves as the rover. The activity for older students could also include a programmable rover model.

1. Each team should choose a student who will play the part of the rover and a student who will play the part of the antenna. Only the antenna can communicate with the rover.

2. The rest of the team consists of the mission scientists and engineers who work together to plot out a course for the rover (out of hearing of the rover and antenna). The science/engineering team must plan a series of commands that will move the rover (who is blindfolded) from the starting point to either rock A or rock B.

3. The rover is pre-programmed (i.e., told) with two pieces of information: (1) it is to precisely follow the command sequence transmitted by the antenna; and (2) if it runs into an obstacle it is to stop and await a new command sequence. The rover should move slowly and carefully.

4. The only choice for commands are L or R (for left or right) or a number of steps (from one to 10). The rover always moves forward in whatever direction it is facing when given a number of steps, and a single command cannot include both a turn and a number of steps.

5. Only 10 or fewer commands can be planned as the Rover Command Sequence. For example, the command sequence could be: 3, L, 10, R, 5, L, 2, R, 5, L.

6. The team decides on the commands and writes them into the Rover Command Sequence on the Rover Traverse Command Sheet. The rover should be positioned at the starting point and blindfolded. The antenna reads the commands aloud to the rover one or two or three at a time (depending on the ability of the student rover to remember the commands). The antenna cannot add any other information and must read the command sequence as it is written.

7. Once the command sequence is written down and is being transmitted to the rover, no changes can be made in it.

8. For older students, this activity could be done using a programmable rover such as the LegoTM MindstormTM vehicle or some similar kit. The same obstacle course should be laid out using small rocks and books or small boxes as obstacles on a plywood board. The programmable rover can be constructed to resemble the MER rovers and programmed with a limited series of commands using seconds (rather than steps) and direction of travel.

Process/Closure

The students will experience the challenges and occasional frustrations of commanding a rover on the surface of another planet. The rover is a machine and can only do what it has been engineered and programmed to do. What are some things this rover could do better than a human astronaut? What are some things a human astronaut could do better or more easily than this robotic explorer?

Extension/Enrichment

Students can create their own obstacle course of targets and obstacles and repeat the Rover Traverse activity.

The teacher can create the obstacle course and the student teams must draw the map of the course on their Rover Traverse Command Sheet.

A scale map could be prepared using graph paper. In this case, the science/ engineering team should plan the series of commands using only the map and not by viewing the traverse area.

After practicing within the classroom, a more realistic Mars surface obstacle course could be prepared on the school grounds (using red dirt and lava rocks) and rover traverse teams could compete in front of an audience for prizes.

Credits

Activity for younger students created by Jayne Aubele and Larry Crumpler, New Mexico Museum of Natural History & Science. Activity for older students created by Joseph Aragon, Laguna–Acoma High School. A different rover traverse activity called Rover Races can be found in NASA's Mars Activities: Teacher Resources and Classroom Activities.

MARS FACTS

One of the most popular series of Mars science fiction ever written was the "John Carter of Mars" series of novels written by Edgar Rice Burroughs, also the creator of Tarzan. In the first novel of theseries, John Carter travels to Mars by focusing mentally on the planet in the night sky while he is camped at the source of the Little Colorado River in east-central Arizona, just across the border from Quemado, NM.

Rover Team Name: _____

Command Sheet for Rover Traverse

Possible Commands:

(Choose only one command for each sequence number)

L=turn to your left

R=turn to your right

1=one step forward

2=two steps forward

3=three steps forward

4=four steps forward

5=five steps forward

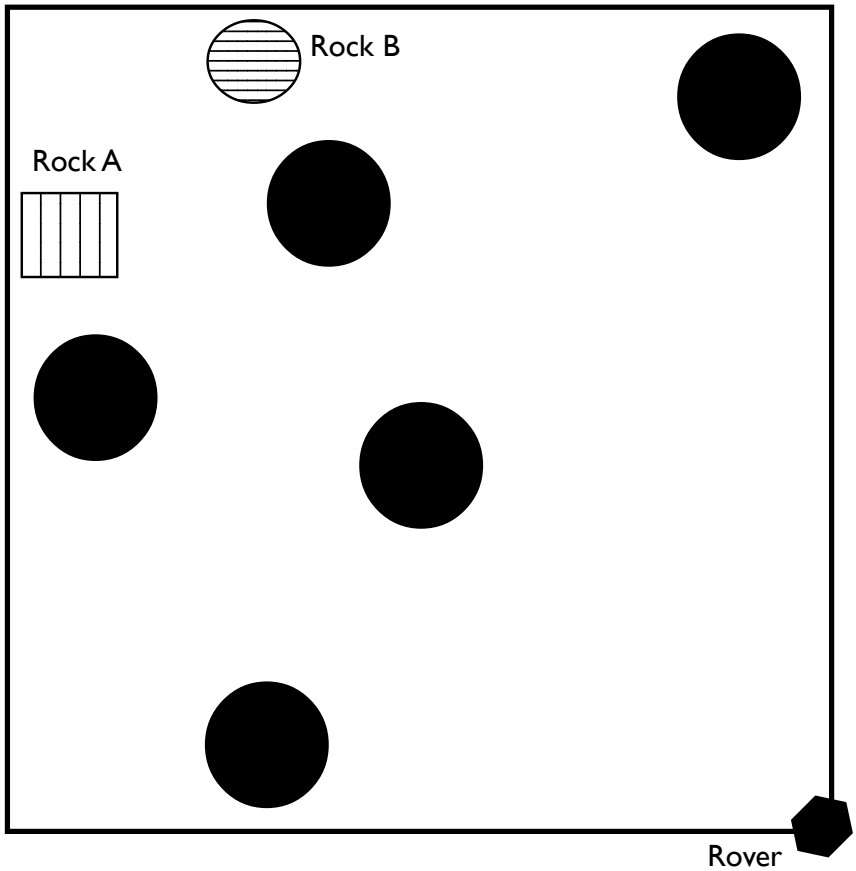
6=six steps forward

7=seven steps forward

8=eight steps forward

9=nine steps forward

10=ten steps forward



Map of Landing Site

Rover Command Sequence to Get to Rock A or Rock B

command sequence number	1	2	3	4	5	6	7	8	9	10
command										