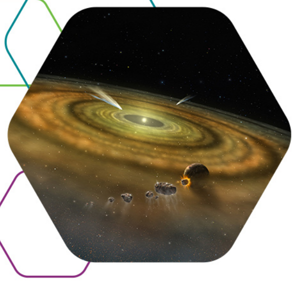

FACILITATOR GUIDE

Mars Rovers

Learning objectives

- Teams of scientists and engineers use rovers and other robotic vehicles to explore distant worlds.
- Rover missions, like those to Mars, are carefully planned here on Earth.
- NASA missions require large teams of people working together.

Materials

- *Mission Control* magnetic program board
- Blue arrow "Advance" command magnets
- Yellow star "Rock Retrieval" command magnets
- Star shaped sample props
- 30 Mars landscape obstacle felt sheets
- *Mars Rover Map*
- Blindfold (optional)
- *Design Your Own Mars Rover* drawing sheets (optional)
- Pencils
- Activity and facilitator guides
- Information sheets
- *Tips for Leading Hands-on Activities*

The Explore Science toolkit comes complete with all necessary materials for this activity. Materials are also readily available to create or restock activity kits. The Mars analog rock kit can be purchased through online retailers. Graphic files can be downloaded from www.nisenet.org.

Safety

Remove or block off any obstacles that could cause a participant to trip or cause harm. Using the blindfold in this activity means participants should be closely monitored. You may choose to skip the blindfold and either have participants playing the part of the **Rover** close their eyes or just listen to the commands.

Advance preparation

Before you begin:

- Set up the rover course with obstacle tiles and prop yellow star rock samples. The course can be designed in any fashion and to accommodate any space constraints you have. You can also follow the *Mars Rover Map* example sheet. The difficulty of the course may be adjusted by adding or minimizing the number of turns for the Rover to make. Easier courses require fewer turns. The felt tiles work best on a carpeted surface. If you're doing this activity on linoleum or another hard surface, tape-down or otherwise secure the tiles.

Notes to the presenter

Begin the activity with participants by brainstorming ideas about how a robotic vehicle on another planet (for example, the Curiosity rover on Mars) might be driven. Remind participants that while rovers are a little like a remote-control car, rover drivers cannot actually use a joystick to direct the rovers. It takes between 4–24 minutes for our data signal to reach Mars. So, instead, the mission team creates a series of commands and then bundles and sends them up to the rover.

This activity is designed for a minimum of two participants. Depending on the size of your group, you may add more **Rovers** sequentially in a line (front to back). The blindfolded **Rovers** should place their hands on the shoulders of the person in front of them for stability, and they can all try to work together.

The **Mission Control** participant will walk through the course first to build the list of commands. While **Mission Control** is building, task the rest of the participants to think about how they would design their own rover. You can use the Design Your Own Mars Rover drawing sheets or just have them discuss what type of instrumentation they think would be necessary to learn about Mars. What might their rover-collected data reveal about Mars? Why do they think this would be important?

Once **Mission Control** has recorded their sequences on their Command Board, the **Rover** can begin. Have the **Rover** line up at the starting line and blindfold them to prevent them from aiding ***Mission Control*** during the command execution. If participants don't wish to use a blindfold, ask them to close their eyes. The **Rover** will proceed along the course by following **Mission Control**'s verbal commands. Remember: the commands cannot be changed from the original commands that **Mission Control** planned. They must be followed exactly. During real robotic missions, the commands are sent all at once. Any changes have to be made in another uplink of commands later.

Remind the participants that accuracy, not speed, is most important in operating a planetary rover. No one will be on Mars to help the rover if it gets stuck. It could take months of planning to back a rover out of a sand dune or away from a crater's edge.

If the participants are not successful in completing the course, **Mission Control** can try to save the **Rover** by creating a new sequence on their Command Board beginning from the place the **Rover** was "stranded." While **Mission Control** builds the new sequence, have participants discuss the repercussions of sending incorrect directions to a rover on Mars. What sort of obstacles exist on Mars? Which ones could end a mission?

Young children may find this game challenging, but often have fun with it, especially if their older siblings are also playing. For young children, you could make some modifications such as setting up a shorter course, allowing them to keep their eyes open, and giving them a chance to start over if they make a mistake. You could also offer younger children a Design Your Own Mars Rover drawing sheet and some crayons to draw a design of their own rover while their older siblings are engaged with the obstacle course activity.

Difficult concepts

No human has ever been to Mars. Mission Control at JPL has to base their actual commands on imagery taken by the rover or other data provided by NASA—they can't actually walk the course! Because of many popular science fiction stories and the common use of the word "Martians" to describe fictional aliens, some visitors may be under the impression that life has already been found on the red planet, but really no life has been discovered there (yet!) Some visitors may also come to the activity with the idea that Mars is red because it is hot. Try saying, "Yes, Mars is red, and that's because iron rich dust reacts with oxygen in the air, producing a red rust color on the surface of the planet. The sky appears red because storms carry the dust into the atmosphere."

Staff training resources

Refer to the *Tips for Leading Hands-on Activities* sheet in your activity materials.

- An activity training video is available at vimeo.com/245834926
- A content training video is available at vimeo.com/245835422
- The NISE Network has a curated list of programs, media, and professional development resources in the NASA Wavelength Digital Library that directly relate to the toolkit. These resources can be viewed and downloaded from nasawavelength.org/users/nisenet.

Credits and rights

This is a classic activity and exists in many forms. NISE Net's adaptation is based on the Rover Races lesson plan developed by Mars Space Flight Facility, Arizona State University. Retrieved from: https://marsed.asu.edu/lesson-plans-rover-races

Images of Curiosity rover; Rover team members; Curiosity selfie; rover wheel; Mission Control; and the space roboticist courtesy NASA/JPL-Caltech.

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