

Prepare for a Mission

DESIGN challenge

To execute a mini-simulation of a robotic mission with a goal to command a human-robot through a set course to retrieve a piece of lunar ice.



OBJECTIVE

To demonstrate an understanding of the Engineering Design Process while utilizing each stage to successfully complete a team challenge.

PROCESS SKILLS

Mapping, communication, measuring, logical thinking

MATERIALS

Rulers or meter sticks

Blindfolds

“Prize” as lunar ice sample

STUDENT PAGES

Design Challenge

Ask, Imagine and Plan

Experiment and Record

PRE-ACTIVITY SET-UP

Set up a small obstacle course with a few chairs, waste paper baskets, and/or a table. The course does not have to be too complicated, but set it up so students will have to take at least one right turn and one left turn. Also, give the students enough obstacles so there is more than one path to take to the “finish”. An area of about 25 square meters is recommended.

Please note: This activity will require two 60-90 minute sessions to complete. Make sure to set up the obstacle course exactly the same for both sessions. Also, the student acting as the robot will need to be blindfolded for this activity. Please take time to discuss with your students about assisting or “spotting” their blindfolded peer.

MOTIVATE

- Explain to the students that many of NASA's missions are conducted by robots. Ask students to draw their ideas of what a robot looks like and compare the differences.

SET THE STAGE:

ASKIMAGINE &PLAN

- Share the *Design Challenge* with the students. Remind students to take the time to ask questions about the challenge and imagine a solution.
- Students must draw their chosen course on the map and include at least one right turn and one left turn. Map should be approved before proceeding to next step.
- Let students practice commands to use with their robot. These commands are simple words, plus a number for steps taken.

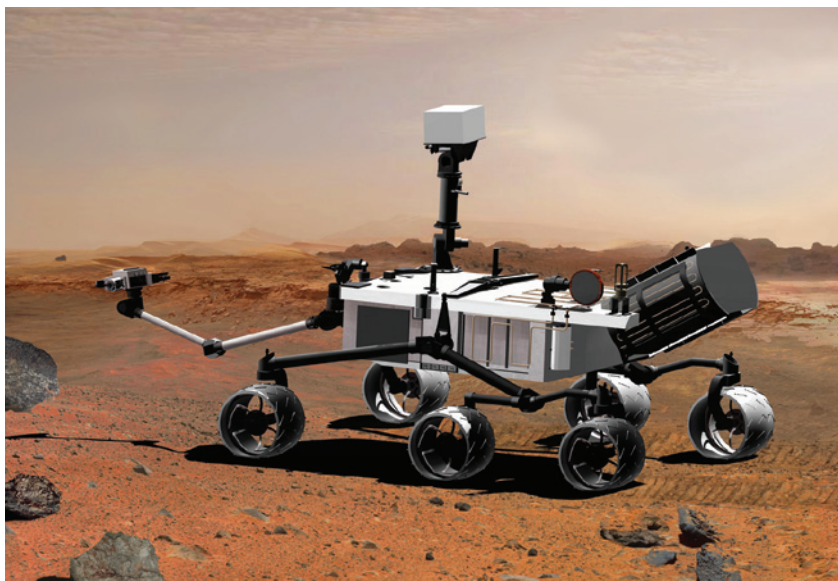


CREATE

- Students will define the robot's route through the lunar landing site and count the number of steps needed for each command. They will then create a command sequence to use for their robot that matches the route they have planned on their maps.

EXPERIMENT

- Student teams must navigate the lunar landing site, using the command sequence each team designed. Have students cut out the commands into strips of paper and designate one student per team to deliver each command. Designate another team member to run a stopwatch. Position the robots at the start and have the teams sitting or standing aside from the obstacle course. The students designated to deliver commands are to deliver one command at a time – one student walks to the robot, delivers one



command, then returns to the team. Robot performs the command. The next student then walks to the robot and delivers the command, returns, etc. Only one command is delivered at a time to represent one line of code sent over a radio signal. The rest of the team cannot deliver another command until they have determined if the robot has successfully executed that command. Have each team record how much time it takes to successfully complete the task when the robot picks up the “lunar ice”.

CHALLENGE CLOSURE

Engage students in the following questions:

- Did each team pick the same route or were there several routes to get to the lunar ice? Which route worked the best?
- Why did you have to deliver each command separately? How does it relate to communicating with robots in space?

PREVIEWING NEXT SESSION

Ask teams to think about how a spacecraft might land on the Moon safely. Ask them to think about why it does not make sense to use a parachute on the Moon. Answer: There is no air on the Moon to fill up the parachute.

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Prepare for a Mission
Teacher page

The Discovery Mission

Every NASA mission has several parts leading to its success. When leading a remote mission on another planet or moon, NASA scientists and engineers must plan every step of the mission carefully. When



using robots or rovers, each mission team calibrates and programs these machines to accomplish the mission objective, such as to travel to certain locations on that planet or moon. In addition, NASA must use radio signals to send their commands. So a mission on a distant planet could take minutes to hours to days to communicate to that robot.





The Challenge:

Your team has been chosen to operate a robotic Discovery Mission on the surface of the Moon. You will be given a specific starting location, and your robot must move through a lunar landscape to the location of the “lunar ice” without bumping into any “lunar boulders” or other obstacles. To successfully complete the Discovery Mission, your robot must pick up a piece of “lunar ice.”

DESIGN challenge

To execute a mini-simulation of a robotic mission with a goal to command a human-robot through a set course to retrieve a piece of lunar ice.

Before your robot begins to move on the lunar surface, you will have to complete the following activities:

- 1. Designate your robot** - One student in each team must volunteer to be the robot. The robot will be the person who actually walks through the course, blindfolded, following the instructions of her/his team. The team should give their robot a name.
- 2. Map the robot's route** – Using the map in your worksheets, mark out a route for the robot.
- 3. Learn to communicate with your robot** – Each team must develop commands for your robot. You will practice these commands until you and the robot are comfortable with them. These will be the commands that you will give the robot to travel through the path you have drawn on the map.
- 4. Program the robot** – Use the commands that you practiced to tell the robot how to navigate the path you have drawn on the map.

Prepare for a Mission
Student page

ASK IMAGINE & PLAN

STEP 1 - Designate your robot.

One person from your team must volunteer to be the robot.

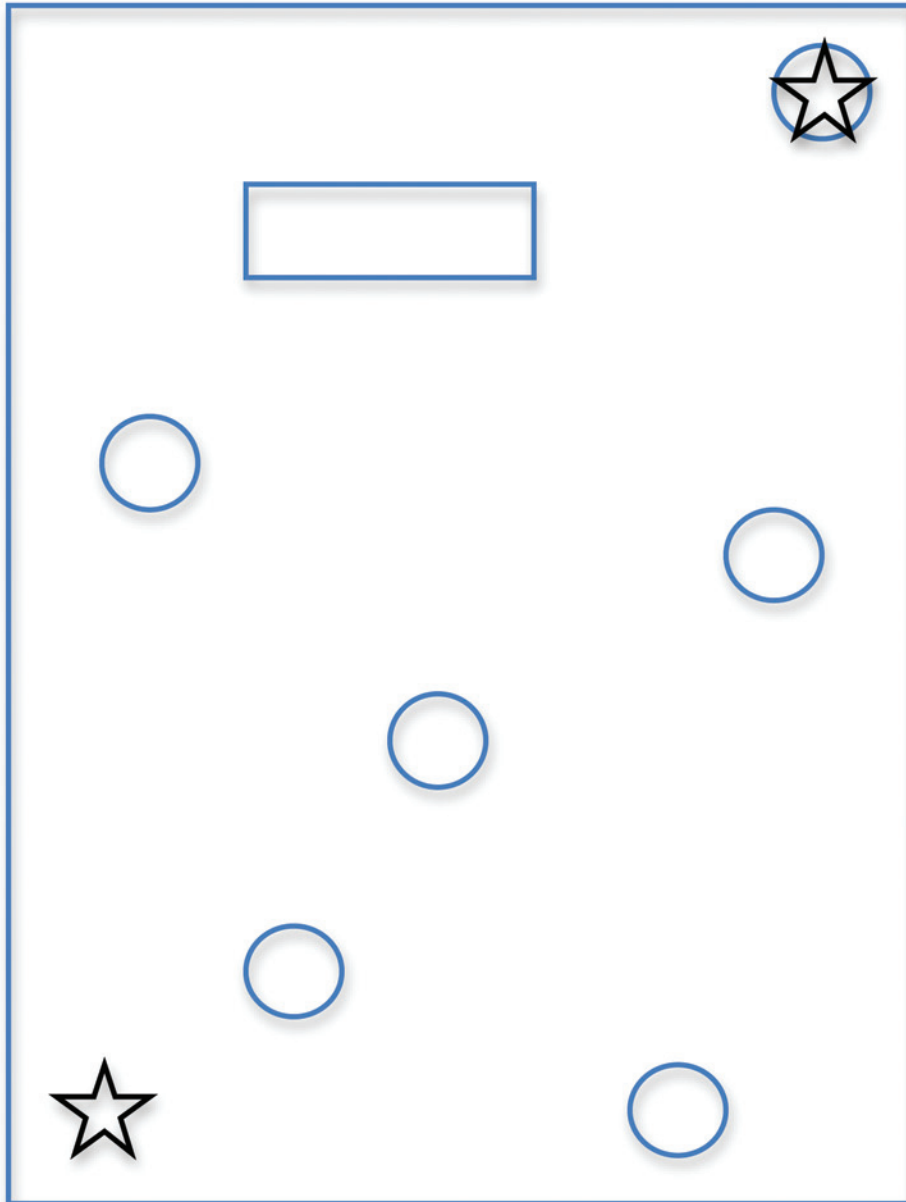
STEP 2 - Mapping

On the next page is a map for the Discovery Mission. Using a pencil, draw arrows on your map and create a route your robot will take to get to the lunar ice sample. You must include at least one right turn and one left turn.



Create the route for your robot within the diagram below.

Finish



Start

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Student page

Approved by: _____

STEP 3 – Communicate with your robot



When you program a robot, you must use simple words and be specific in your directions. If you want your robot to go forward, how many steps should the robot go?

Practice the words below with your robot and see if your robot follows the commands correctly.

Sample Command for Robot	Action by robot
MOVE FORWARD TWO STEPS	Walk forward two steps.
MOVE BACKWARD ONE STEP	Walk backward one step.
TURN RIGHT	Turn to the right.
TURN LEFT	Turn to the left.
PICK UP LUNAR ICE	Pick up the lunar ice sample.

Were any of these commands difficult for your robot to execute? If so, which ones?

Suggest a better command to use with your robot.



STEP 4 - Program your robot

Review the map with the route your team has created for your robot. Now your team needs to create commands for your robot to match your route. Write down one command that matches each arrow on your map.

Command Sequence

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

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Experiment & Record

Execute the Discovery Mission!

It is time to let your Robot explore the Moon!

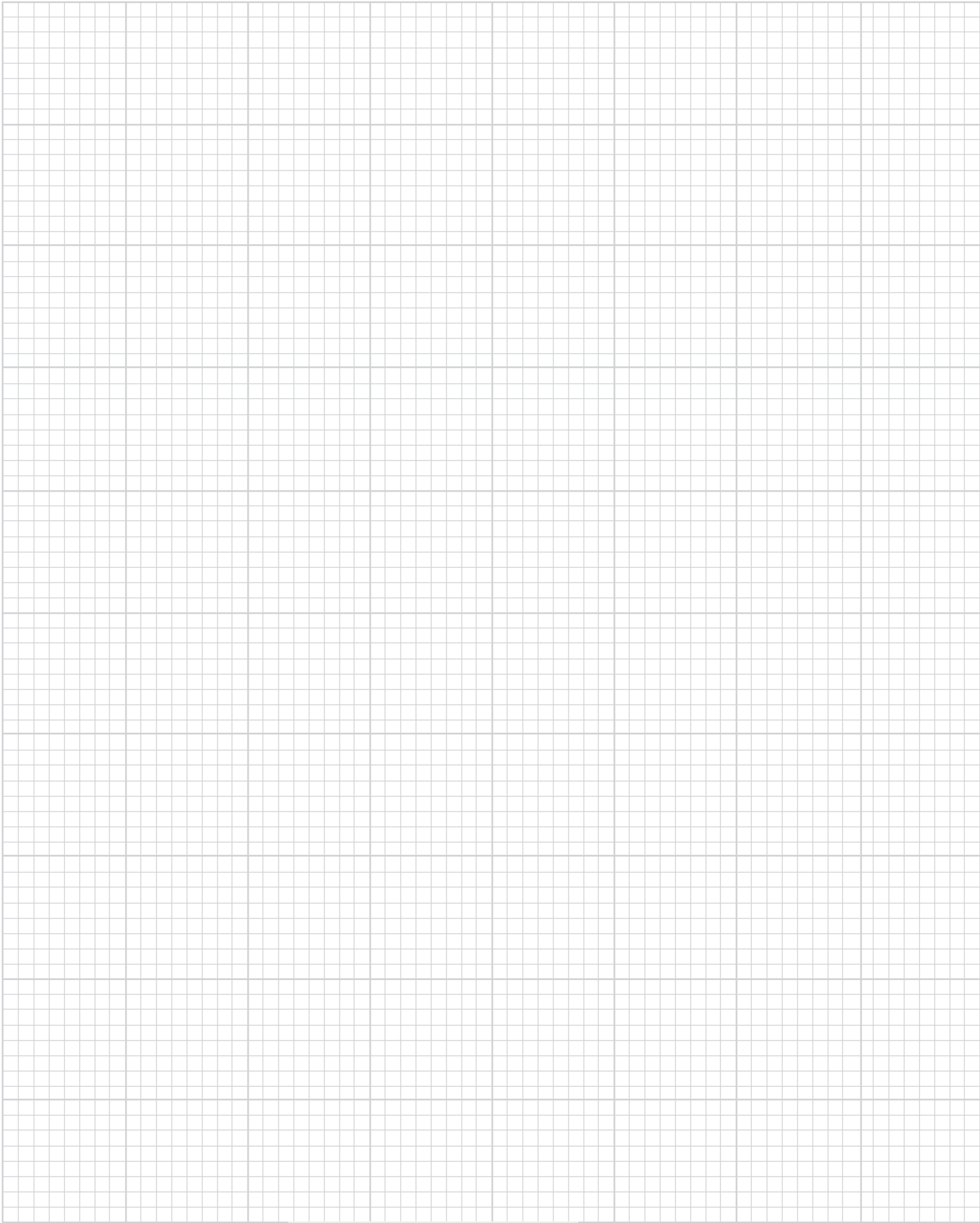
You planned your route and practiced your commands. Now complete the mission. Take the complete command sequence your team designed and cut each command out of the page as separate pieces of paper. Designate two team members to deliver the commands to the Robot and divide those sheets of paper amongst them. Another team member or your teacher can use a stopwatch to time how long it takes for the Robot to reach the Lunar ice sample. Record each team's time in the next page to compare how long the mission took for each team!



Discovery Mission Data Table

Team Name	Time (seconds)
1.	
2.	
3.	
4.	
5.	

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Student page



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