

Activity Title: mini Principles of Remote Exploration!

This activity is based on *Principles of Remote Exploration*, an extensive, technology-based sample-analysis mission simulation for middle school students. learners.gsfc.nasa.gov/PREP/

Activity Objective(s): Teams will execute a mini-simulation of a robotic mission, to get the flavor of Mission Planning, including mapping, communication, calibration and simple programming. The ultimate goal is to get the human-robot from one end of the course to the other, and the robot should pick something up (A “lunar rock”) at the end of the course.



Graphic courtesy NASA.

Grade Levels: K - 2

Process Skills: mapping, communication, measuring, graphing, logical thinking

Lesson Duration:

TWO 60 min sessions

Materials and Tools (per group of three students):

Rulers

Graph paper, if available

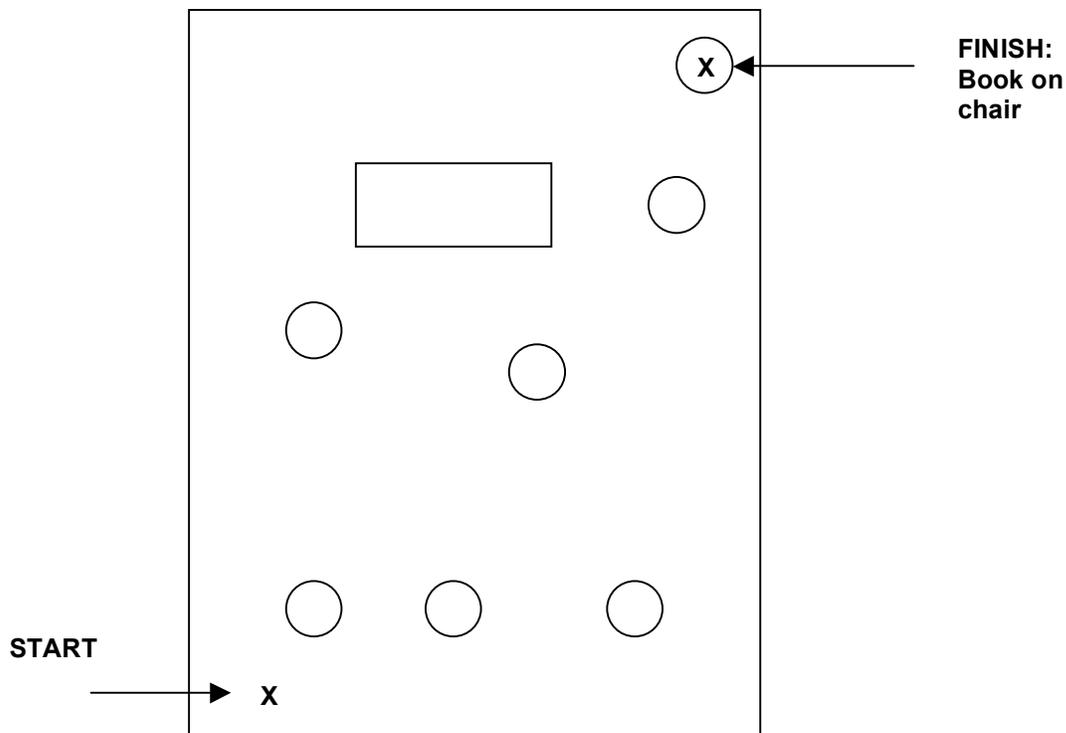
Club Worksheets: (Make copies for each student to put in binder)

1. Mapping
2. Communications
3. Calibration
4. Mission Plan
5. Summary
6. Fun With Engineering at Home, Parts A and B

Club Facilitator or Teacher Notes by Stage: (Based on those running 60-minute Clubs)

SET-UP

Set up a small obstacle course (“landing site”) with a few chairs and/or a table. The course does not have to be too complicated, but you should set it up so that the students must execute at least one right turn and at least one left turn. Set the course up to look as close to the drawing below as possible. If you cannot do that, then you should redraw the map for them (replace the one included in the student pages).



Stage 1.1: Set the Stage (Approx 15 minutes)

- Display and read the Robots storybook found at <http://www.nasa.gov/audience/forstudents/k-4/stories/ames-robots-storybook.html>

- Explain to the students that many of NASA's missions are conducted by robots. Although some robots have the ability to make decisions based on data they receive from sensors, the original program given to the robots are written by humans. Humans tell robots what to do and how to execute their missions. Today, the teams will conduct a mini, robotic Discovery Mission.

The Discovery Mission Challenge

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

A NASA mission has several parts, and you will be responsible for carrying out each component of the mission. Before your robot begins to traverse the lunar surface, you will have to complete the following activities:

- Map the “landing site” – your team will make a scale map that you will use to determine the path that your robot should take. You will mark out a route for the robot on this map, and then you will translate this path into a program for the robot.
- Learn to communicate with your rover – you will develop a simple language to pass commands to 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 traverse the path you have drawn on the map.
- Calibrate your robot – you must determine how your robots motions translate into standard units. For example, ONE robot step will equal how many centimeters? You will use this information to tell the robot how to traverse the route you have planned on the map.
- Program the robot – you will use the commands that you developed and the calibration to make a command set that will tell the robot how to traverse the path you have drawn on the map.

Next session, your robot will get the opportunity to execute the program you have written at the “landing site.” Your mission will be complete when your robot picks up a piece of “lunar ice.”

- Break the students into three-person teams. Each member of the team should choose a role for today's robotic mission:
 1. **Robot (BOT):** One of the students in the team should volunteer to be the robot. The BOT will be the person who actually walks

through the course, following the instructions of her/his team. The team should give their robot a name.

2. **Communicator (COM):** One of the team members will be the person who communicates with the robot once it has “landed.” This person will read commands to the robot.
3. **Mapper (MAP):** One team member will chart the robot’s progress on the “landing site” map. This is an important job for the *Improve* phase. If the robot has problems on the first attempt, the team will use these notes on the map to determine how to change the robot’s course on the second attempt.

Stage 1.2: Pre-Mission Activities (About 30 minutes)

Logistics Note: Mapping, Communication and Calibration can be done at the same time, so that while one group is mapping the “landing site,” the other groups can be developing their command language and calibrating their robot.

Mapping

Review and become familiar with the “landing site” map provided by the teacher.

Communication

Review the commands that they will use with their robot. These commands are one word, plus perhaps a number. The commands are:

- FORWARD 1, 2, 3 or 4 (number of steps)
- TURN RIGHT
- LEFT
- REACH OUT
- PICK UP LUNAR ROCK

Calibration

The BOT will practice executing the commands. Examine how much distance the BOT covers. For example, when s/he executes a FORWARD 3 command how far do they move? Measure.

Programming

Once Mapping, Communication and Calibration are complete, the teams chart the course for their BOT. First, they draw their chosen course on the map. Then they use their calibration data to determine what command sequence they must use to get the BOT through the course. One command will be given at a time.

Stage 1.3: Closure for Session 1 (5 minutes)

The Summary Sheets will be handed out next week, at the end of the Discovery Mission. Bring the students into a brief discussion to assess their progress at this point. Ideally, they will have a completed program for their BOT and will be ready to drop the BOT at the starting point to begin their mission next session. If they are not this far along, they can use the first part of the next session to finish programming their BOT. Send them home with “Fun with Engineering at Home, Part A.”

Session 2

SET-UP

The landing site (obstacle course) must be reconstructed exactly as it was in Session 1.

Stage 2.1: Mission Readiness review (10 minutes)

Assemble the students in their teams. Ask each team to share their calibration results. They should show the graph they have made of the BOT's movements.

Discussion Questions

Does each BOT have the same calibration factor? (That is, ONE BOT step equals how many centimeters?) Why or Why not?

Why must we convert the BOT's steps into standard units?

If suddenly you were asked to work with a new BOT, would you have to change any of your calculations? If so, what would change? Why?

Stage 2.2: Mission Execution (5 minutes per team)

- Missions should begin as soon as a team is ready to go, but no later than 30 minutes into the period.
- The BOT is placed at the starting point. COM delivers the commands one at a time. MAP keeps track of the BOT's progress. If the BOT successfully executes the command and stops where the team wanted it, the next command is delivered. If BOT is not where the team wanted it, they go back to the command and make adjustments thus getting a second chance.
- Students **IMPROVE** by examining their maps and making corrections to their command sequence.

Stage 2.3: Challenge Closure

- Hand out the Summary Sheets (please collect one per team and save in a folder for NASA).

Stage 2.4: Previewing Next Week (Approx 5 minutes)

- The Moon is a very harsh environment. There is no atmosphere to protect astronauts and their equipment from solar radiation and the extreme temperature swings between night and day. Next week, we will begin to find ways to protect astronauts from those extreme temperature changes.

1. Mapping

Goal: To produce a map of the “landing site”

The map, on the next page, will represent the landing site in the room. Follow the steps below to create your landing site map.

Step 1: Where is the table on your map? Color the table on your map green.

Step 2: Where are the chairs on your map? Color the chairs red on your map.

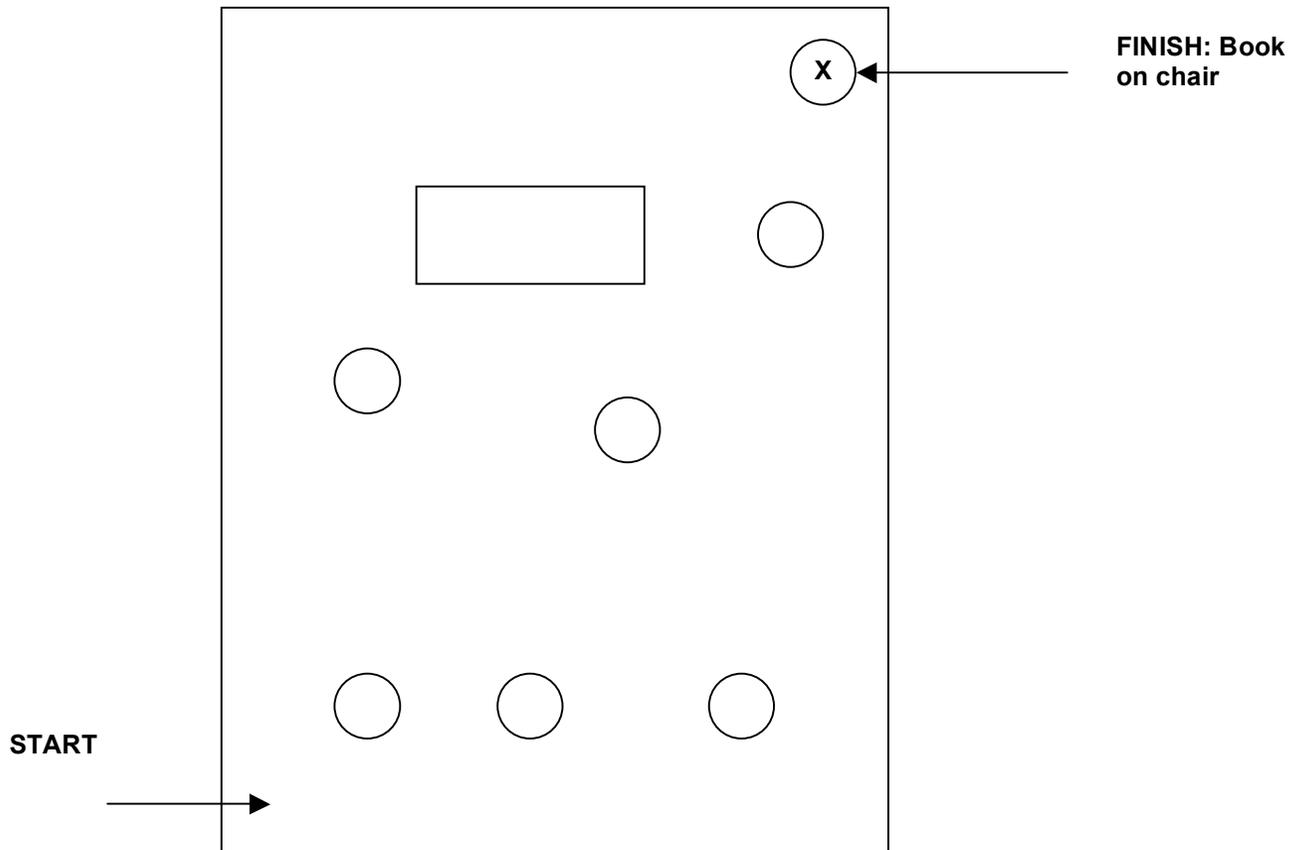
Step 3: Is there a wastebasket on your map? Color the wastebasket yellow.

Step 4: Using a pencil, draw small arrows on your map that shows the route you will take to navigate the landing site. You must include one right turn and one left turn.

What areas within the landing site may be more difficult for your robot to navigate?

What steps will you take to ensure that your robot navigates the course accurately based on this map?

Your Team's Map



2. Communications

Below is the language to use with your BOT. These commands are simple words, and sometimes followed by a number.

The commands are:

- **FORWARD 1, 2, 3 or 4 (number of steps)**
- **TURN RIGHT**
- **LEFT**
- **REACH OUT**
- **PICK UP LUNAR ROCK**

If a command is not in the list, you may not use it once the robot has “landed.”

3. Calibration

The BOT will practice the commands. How far does it go?

FORWARD 1	CM
FORWARD 2	CM
FORWARD 3	CM
FORWARD 4	CM

Try again.

FORWARD 1	CM
FORWARD 2	CM
FORWARD 3	CM
FORWARD 4	CM

Was it the same?

4. Mission Plan

Goal: Chart your BOT's trip through the "landing site." Develop a plan that results in a Command Sequence using your command language.

- Use the map of the "landing site" to determine the best path for the BOT to take to get from the Starting point to the Finish, where the "lunar rock" awaits.
- Now develop a Command Sequence, using your command language, that will result in your BOT getting from the Starting point, to the Finish, and then picking up the "lunar rock."

GOOD LUCK!

Command Sequence	
1.	15.
2.	16.
3.	17.
4.	18.
5.	19.
6.	20.
7.	21.
8.	22.
9.	23.
10.	24.
11.	25.
12.	26.
13.	27.
14.	28.

5. Summary

What was the most challenging aspect of completing this Discovery Mission?

What would you do differently the next time?

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Team Name: _____

Fun with Engineering at Home

Activity 8: mini Principles of Remote Exploration!

Today we conducted a simulated , robotic Discovery Mission. We practiced many of the very same activities that NASA scientists and engineers do when planning and executing a mission, such as Mapping, Calibration, Communication and Programming.

Home Challenge: During this week, why not try to do a Discovery Mission at home? You could rearrange some chairs and maybe a table to set up the Landing Site. You could help you family members understand why making a good map is important, and why you must calibrate your BOT. You could even blindfold the BOT to make it more challenging! If you have a big family or are doing this with lots of friends, you could break into teams and race to the end. Maybe the “lunar rock” could be something fun, like a treat!

These are the steps:

- Mapping: make the map of the Landing Site (you'll need a ruler)
- Communication: develop a command language and practice with the BOT
- Calibration: calibrate your BOT's steps (you'll need a ruler)
- Programming: plan a route through the Landing Site and program it using your command language.
- Mission Execution: BOT traverses the Landing Site, following the commands.

HAVE FUN!!

Team Name: _____

Fun with Engineering at Home – Part B

Activity 8: mini Principles of Remote Exploration!

The Discovery Mission

Today we conducted a simulated, robotic Discovery Mission. Now consider what challenges would face living humans instead of mechanical robots: aside from air and water there are extreme temperature variations on the Moon because the Moon lacks an atmosphere.

Home Challenge: During this week consider the ways in which we deal with this problem on Earth. Research on the web and/or talk with family and friends. List three ways we protect ourselves from extreme cold on Earth. List three ways we protect ourselves from extreme heat.

Protect against Cold:

- _____

- _____

- _____

Protect against Heat:

- _____

- _____

- _____

On the Moon: Which of the ways that you described above as working on Earth will work on the on the Moon, and why?

- _____

HAVE FUN!!