

Taking a Trip to Mars with Mars

Question: How technology is used in space exploration?

Kentucky Core Content:

SC-M-2.3.1 Earth is the third planet from the Sun in a system that includes the moon, the Sun, eight other planets and their moons, and smaller objects such as asteroids and comets. The Sun, an average star, is the central and largest body in the solar system.

Scientific Inquiry

2.1 Scientific Ways of Thinking and Working

Communicate (e.g., write, graph) designs, procedures, observations, and results of scientific investigations.

Application/Connections

Science and Technology

Describe how science helps drive technology and technology helps drive science. Because perfectly designed solutions do not exist, technological solutions have intended benefits and unintended consequences.

Objectives:

Students will be able to:

- Observe the obstacles that can occur on a trip to Mars, examples are the time constraints of communication, the terrain, the possibility of getting stuck in a crater.
- Observe the terrain and discuss what could have caused some of the marks and craters on the surface.
- Observe the advantages of how technology can bring us closer to a far, far away planet.

In this activity, students will:

- learn to program Lego Mindstorm RCX
- learn to operate a robot remotely
- learn how to look at something remotely and make predictions on what caused it to develop into what is seen on the camera
- draw the surface area looking through a camera and then later actually seeing what the surface and all the surrounding looks like
- how to use time (seconds) to calibrate the amount of degrees for a specific turn angle

Materials:

Class:

Lego Mindstorm Robot assembled as a Mars Land Rover, including camera.
PC with Lego Mindstorm, camera and Red Rover software installed. (Red Rover software is available through computer science dept.)
A plastic container used to create the Mars surface.
Handout- Information on the terrain of Mars.

Group:

Paper or calculator for calculating the degrees of a turn.
Paper to draw what is seen through the camera on the Land Rover.

Procedure/Time:

This activity will take approximately three to five class periods.

Procedure:

First class-

Instructor

1. Explanation of the importance of programming correctness. Explanation that the performance of the program is only as good as the programmer's instructions.
2. Initiate the class to write instructions for the instructor to get out of the classroom (note: make sure that the classroom door is closed). This is used to explain the first processing of a computer program.
3. After the students have written the instructions, the instructor will read and perform exactly what the student has written on the paper for the instructions. Walking to the door, opening the door and walking out of the classroom, etc.

Student

1. As a group or individual write the instructions for the instructor to walk to the door and get out of the classroom.

Second class-

Instructor

1. Prior to class have constructed the Land Rover, including the installation of the camera. Also have all the required software loaded on the PC. Have folders on the computer setup for each class to hold their programs which they will create with Lego Mindstorm. Have copies of handout on Mars.
2. Determine how the individual groups will operate the mission-
 - Navigator – the person who will operate the controls on the Red Rover display screen.
 - Terrain topographer – the person who will be graphing the terrain that the camera is displaying.
 - Programmer – the person who will physically constructs the conditional programs on the computer. After programming is complete, the programmer will assist with watching the controls for sensor conditions needing a required programming to be performed.
 - Researcher – the person who will make observations of the terrain using the information on the handout as a guide to instruct the navigator the next area to probe and keeps track of the amount of time left on the exploration.
3. Determine the time for each groups exploration.
4. Discussion of the planet Mars: the terrain- if the rocks on Mars are too large to go over then go around; the time constraints- 8 to 20 minutes (one way) depending on where they are in orbit.
5. Introduce the Land Rover and the sensitivity of the movements needed to complete the mission to Mars, how random guesses do not work when in an unknown environment. Reminding that navigator should LOOK, THINK then MOVE.
6. Introduce the controls of the Land Rover: how to use the control panel and how to create programs for different conditions that the groups might run into (example: what happens if the touch sensor receives contact- what should the Land Rover do- keep going, stop and turn around, stop and backup 10 seconds; what happens if the light sensor gets to a certain value)
7. Discussion of the importance of pre-programmed controls (time constraints vs. one or two clicks of the buttons on the control panel).
8. While some students are testing their programs have others read about the Mars terrain.

Student

1. As a group, decide on the placement of the light sensor and the touch sensor and be able to justify why the placement should be at that location.
2. As a group, decide on the values that will be too low for the light sensor and the value that will be too high for the light sensor. Then create a program on paper to handle if these values were to occur-- (why on paper first—to hash out the programming issues).
3. Create program on computer.
4. Read about the Mars terrain or test the program.

Third class-

Instructor

1. Prior to class have those students that have not programmed their conditions for the light and touch sensor determined, also, have the Mars surface completed for exploration.
2. Have handouts about the Mars terrain for those that completed programming last class. And have the other students complete their programming and test the programming.
3. Review the controls on the instrument panel.
4. Review job duties.
5. Have the Mars surface sectioned off so that you start each group at a different location, keeping track of which group started where.

Student

1. Read about the Mars terrain or test program.
2. Upon all groups completion of the programming, mission will begin.

Assessment:

Students will be assessed through class participation, answers to questions on activity sheets and through class discussion.

Teachers Notes

Preparation for the Mission:

After a few minutes we will discuss your decision on the following:

1. Decide on the placement of the light sensor and the touch sensor. Make sure that when making your decision that you will be able to justify why the placement should be at that location.
 - Where would you like to place the light sensor? Why in that location?
 - Where would you like to place the touch sensor? Why in that location?
2. Decide on what would need to be done if the value for the light sensor is too low and if the value for the light sensor is too high.
 - What action would you want the Land Rover to perform if the light sensor was extremely low?
 - What action would you want the Land Rover to perform if the light sensor was extremely high?
3. Decide on what would need to be done if the touch sensor is activated.

- What action would you want the Land Rover to perform if the touch sensor was activated?
 - Would you want the Land Rover to react differently in another situation?
4. Create a program to handle the following events:
- How do you want the Land Rover to react to light sensor at extremely low level?
 - How do you want the Land Rover to react to light sensor at extremely high level?
 - How do you want the Land Rover to react if the touch sensor is activated?
 - Is there another way you would like the touch sensor to react?

Use the box below to draw what you see on Mars. When drawing the objects that you see try to place them in the box in a way if you wanted to return back to that object you could just pick up your diagram and get back to that location.



Questions for group discussion:

1. What was the importance of why you wrote your programs down on paper before actually going to the computer and programming?
2. What was the main obstacle that your group had to overcome when using the camera on the Land Rover as your only eyes?
3. Why use robots to go to Mars to explore? Explain some advantages and disadvantages.
4. Did it matter about the placement of the touch sensor or the light sensor on the Land Rover? Explain why?
5. How accurate was your topographical design of Mars?
6. What features would you add to the Land Rover?

Taking a Trip to Mars with Legos

JOB DESCRIPTIONS/ RESPONSIBILITIES

Everyone in your group is decision-makers for this trip to Mars. However, at the time of the mission each person in the group will have a job to do. Each of these positions on this exploration to Mars is very important for the operation to be successful. These positions and job duties are:

1. **Navigator** – the person who will operate the controls on the Red Rover display screen.
2. **Terrain topographer** – the person who will be mapping the terrain of Mars, creating a record of the information that the camera is displaying, which will be used if needed later to return to that location.
3. **Programmer** – the person who will physically constructs the conditional programs on the computer. After programming is complete, the programmer will assist with watching the controls for sensor conditions needing a required programming to be performed.
4. **Researcher** – the person who will make observations of the terrain using the information on the handout as a guide to instruct the navigator the next area to probe and keeps track of the amount of time left on the exploration.

Navigator: _____

Programmer: _____

Researcher: _____

Terrain Topographer: _____

Preparation for the Mission:

After a few minutes we will discuss your decision on the following:

1. Decide on the placement of the light sensor and the touch sensor. Make sure that when making your decision that you will be able to justify why the placement should be at that location.

a. Where would you like to place the light sensor? Why in that location?

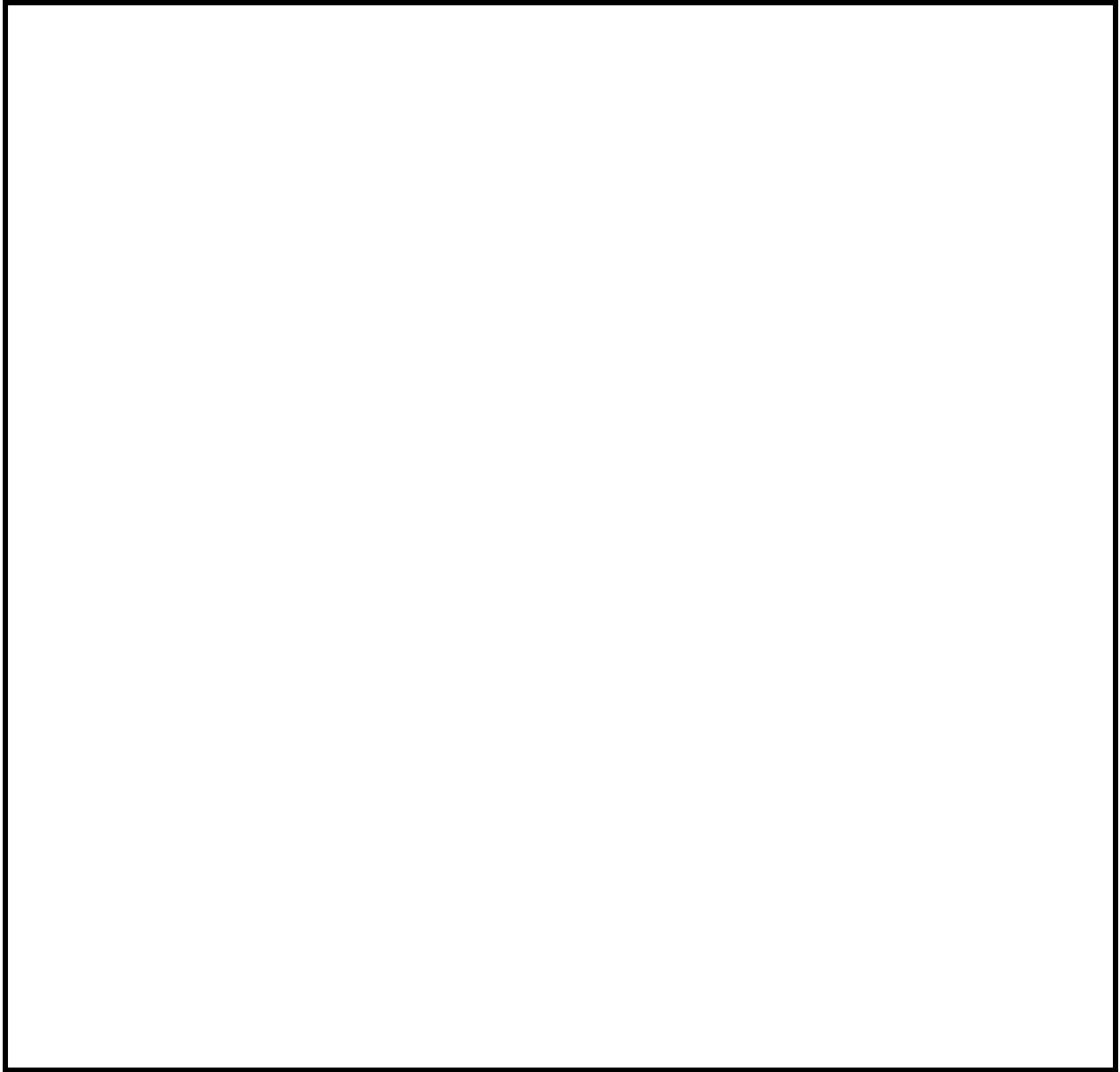
b. Where would you like to place the touch sensor? Why in that location?

2. Decide on what would need to be done if the value for the light sensor is too low and if the value for the light sensor is too high.

3. What action would you want the Land Rover to perform if the light sensor was extremely low?

4. What action would you want the Land Rover to perform if the light sensor was extremely high?
5. Decide on what would need to be done if the touch sensor is activated.
6. What action would you want the Land Rover to perform if the touch sensor was activated?
7. Would you want the Land Rover to react differently in another situation?
8. Create a program to handle the following events:
 - a. How do you want the Land Rover to react to light sensor at extremely low level?
 - b. How do you want the Land Rover to react to light sensor at extremely high level?
 - c. How do you want the Land Rover to react if the touch sensor is activated?
 - a. Is there another way you would like the touch sensor to react?

Use the box below to draw what you see on Mars. When drawing the objects that you see try to place them in the box in a way if you wanted to return back to that object you could just pick up your diagram and get back to that location.



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6. What features would you add to the Land Rover?