

## Lesson 13: Phoenix's Robotic Arm

**Purpose: To simulate remote operation of robotics in order to deepen student understanding of programming and communications in space exploration.**

### Standards

#### NCTE/IRA Standards for English Language Arts

- Standard 4-** Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a wide variety of audiences and for different purposes.
- Standard 12-** Students use spoken, written, and visual information to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

#### National Science Education Standards

##### Science as Inquiry – Content Standard A

1. Abilities necessary to do scientific inquiry.
2. Understanding about scientific inquiry.

##### Science and Technology – Content Standard E

1. Abilities of technological design – student abilities should include oral, written, and pictorial communication of the design process.
2. Understanding about science and technology – tools help scientists make better observations, measurements, and equipment for investigations.

### Overview

Of all the instruments onboard the Phoenix lander, the robotic arm is the most critical to the success of the mission. The robotic arm makes it possible to analyze soil and ice samples by bringing them to the lander deck where the scientific instruments are located. Because of the vast distance between the Earth and Mars, spacecraft cannot be operated in real-time. It takes commands approximately 10 to 15 minutes to travel between Earth and Mars. Mission planners must write a sequence of concise and specific commands on Earth to send to the lander on Mars. Mission planners must be very careful and very specific about what they want the robotic arm to do if they are to be successful. In this activity, students will simulate sending commands to operate a

robotic arm to complete a task. Similar to the Program It! activity, students will again have to be specific in their commands, but will only be allowed to use one word commands.

### Understandings

1. Robots are made up of simple machines.
2. Robots gather different information (data) depending on their design and use.
3. Combining the information (data) gathered by a variety of robots gives us a broader and more in-depth understanding of our Earth and Solar System.

### Materials

1. Blindfolds, 1 per pair of students
2. Various objects such as a paper cup, a ruler, a book, chalk, a block

### Time

Approximately 45 minutes

### Directions

1. Discuss the Phoenix's robotic arm and its importance to the mission. *More information on the Phoenix Mars Mission can be found on the internet at <http://phoenix.lpl.arizona.edu>.*
2. Pair up students into teams of an Engineer and a Robotic arm.
3. Blindfold the student portraying the Phoenix Robotic arm.



4. Arrange objects in front of the Robotic arm.
5. On the chalkboard, write a task, such as “Pick up the block and place it on the book.”
6. The second student is the Engineer. The Engineer is not allowed to touch the objects, but rather must follow the directions using the Robotic arm.
7. The Engineer gives a verbal direction to the Robotic arm to locate the object and manipulate it as instructed. The Engineer is allowed to use only one-word commands, such as “forward,” “up,” “close.”
8. Count the number of commands it takes to complete the task.
9. Students reverse rolls and repeat activity.

### **Extension**

If desired, pairs may compete with each other to complete the task with the fewest number of directions.