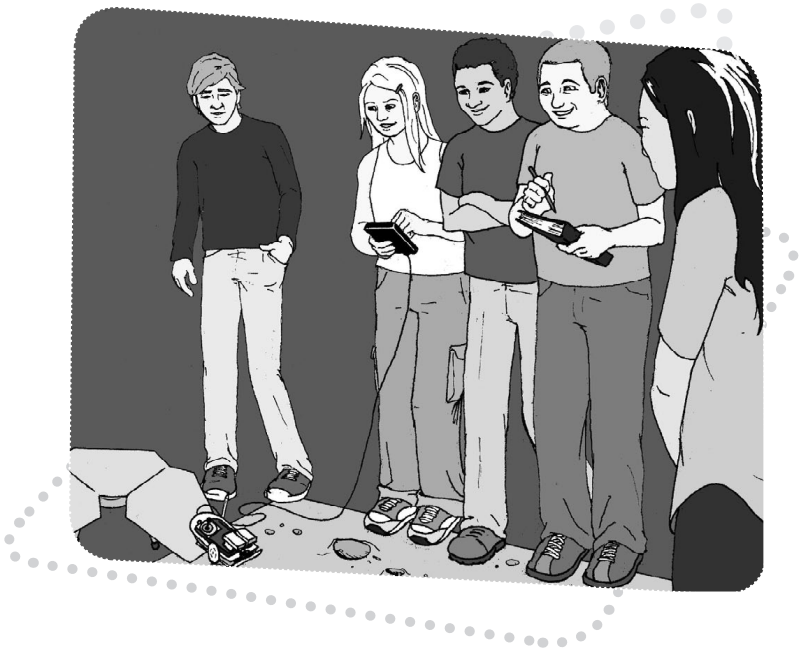
| Name: | | | Date: |
|---|---|---|---|
| **MISSION** | **9** | **Mission to Mars** | ***Materials*** |

Your robot has been selected for the next mission to Mars. All initial robot movements after landing have to be preprogrammed. After that, if you've successfully completed all previous missions, you're now ready to take full direct control of your robot to explore Mars.



## You need:

- ❏ 1 Norland Calculator Robot and 1 Graphing Calculator
- ❏ 1 Submini Coupler
- ❏ 1 84-inch Data Cable



| Name: | | | Date: |
|---|---|---|---|
| **MISSION** | **9** | **Mission to Mars** | ***Instructions*** |

Upon landing, your robot needs to be preprogrammed to drive off the Mars landing vehicle and lay out a two-meter long transect line. At the end of the line, the robot needs to trace out the perimeter of a one-meter-square rock sampling area. Place a marker at each corner of this sample area.

You are now ready to convert your robot to explorer mode. You have your choice of two programs. EXPLORE below uses the arrow keys on the calculator and allows remote wire-control of four motions: forward, backward, left, and right. EXPLORE2 (page 69) uses the number pad and controls nine different motions.
Enter one of the two programs into your calculator.

```
Program:EXPLORE
   ClrHome
   Lbl 1 A
   getKey->X
   If X=24: Goto 2
   If X=25: Goto 1
   If X=26: Goto 3
   If X=34: Goto 4
   If X=105: Goto 5

   Goto A
   Lbl 1  1
   ClrHome
   Output (4,5, "FOR
   EWARD")
   Send ({122,100})

   Get (R)
   Goto A
   Lbl 2
   ClrHome
   Output (4,7, "LEF
   T")
   Send ({102,42})
   Get (R)
   Goto A
   Lbl 3
   ClrHome
   Output (4,6, "RIG
   HT")
   Send ({120,42})
   Get (R)
   Goto A
   Lbl 4
   ClrHome
   Output (4,5, "BAC
   KWARD")
   Send ({100,100})

   Get (R)
   Goto A
   Lbl 5
   Stop
```

Remove the calculator from the robot. Use the submini coupler to connect the 84-inch data cable to the cable coming from the robot. Connect your calculator to the other end of the 84-inch data cable. To move forward press the up arrow (or [8] for EXPLORE2). To repeat a movement, simply press the key again. To end either program press [ENTER]. Practice driving and maneuvering your Mars robot rover.

Add simulated equipment and sensors to the top of your robot: high gain antenna, solar array, sundial, instrument deployment device, low gain antenna, pancam, etc. Attach a Velcro strip to the front of the robot for retrieving Mars rocks.

| Name: | | | Date: |
|---|---|---|---|
| **MISSION** | **9** | **Mission to Mars** | ***Challenge & Questions*** |

## Challenge:

Mars is millions of miles away from Earth and even at the speed of light a command takes several minutes to reach the Mars Rovers. Likewise, to learn the results of a command takes several minutes.

Your teacher will place rocks in the Mars rock sample area and you will need to avoid obstacles and retrieve rock samples without looking. (Mission controllers on Earth can't instantly "see" the reaction of the Mars Rover when they give a command.) Have a partner direct you where to navigate your robot. Return the rock samples to the Mars landing vehicle. Rocks that are the furthest away are worth more points. Record your results below.

## Mission Data:

| Trails | Points for Rocks Recovered |
|---|---|
| A | |
| B | |
| C | |
| Total | |
| Average | |

## Questions:

1. The Spirit and Opportunity Mars rovers have six wheels. What are the advantages and disadvantages of this configuration compared to your robot?

2. When the Spirit rover first moved off of the Mars Lander, it traveled 3 meters in 78 seconds. Compare this speed to the speed of your robot in meters per second.

3. The satellite, Voyager I, is beyond our solar system. When it was $7.555 \times 10^9$ miles away from Earth, how long did it take for a signal to reach Voyager and an acknowledgement signal to be received back on Earth? Answer in hours and use 186,000 miles per second as the speed of light.

You'll need to have some students make a cardboard Mars landing vehicle and some fuzzy "rock" that can be picked up by Velcro. For information on the Mars Exploration Rover Mission, see: *http://marsrovers.jpl.nasa.gov/home/* and *http://en.wikipedia.org/wiki/Mars_Exploration_Rover*.

For **questions 1**, six wheels generally make a vehicle more stable and in the case of the Mars Exploration Rovers, with extra steering motors front and rear, they enable the Rovers to turn in place, a full 360 degrees. (Also see Drive system at the Web site above.) For **question 2**, answers will vary. For **question 3**, the answer is approximately 22.57 hours.

```
Program: EXPLORE2
   ClrHome
   Lb1 A
   getKey->X
   If X=73: Goto 1
   If X=93: Goto 2
   If X=82: Goto 3
   If X=84: Goto 4
   If X=74: Goto 5
   If X=94: Goto 6
   If X=72: Goto 7
   If X=92: Goto 8
   If X=83: Goto 9
   If X=105:Goto 1
   0
   Goto A
   Lb1  1
   ClrHome
   Output (4,5, "FORE
   WARD")
   Send ({122,99})
   Get (R)
   Goto A
   Lbl 3
   ClrHome
   Output (4,7, "LEF
   T")
   Send ({102,43})
   Get (R)
   Goto A
   Lbl 4
   ClrHome
   Output (4,6, "RIG
   HT")
   Send ({120,42})
   Get (R)
   Goto A
   Lbl 2
   ClrHome
   Output (4,5, "BAC
   KWARD")
   Send ({100,99})
   Get (R)
   Goto A
   Lbl 5
   ClrHome
   Output (4,5, "FOR
   RIGHT")
   Send ({120,22})
   Get (R)
   Goto A
   Lbl 6
   ClrHome
   Output (4,4, "BAC
   KRIGHT")
   Send ({120,67})
   Get (R)
   Goto A
   Lbl 7
   ClrHome
   Output (4,5, "FOR
   LEFT")
   Send ({102,22})
   Get (R)
   Goto A
   Lbl 8
   ClrHome
   Output (4,5, "BAC
   KLEFT")
   Send ({102,67})
   Get (R)
   Goto A
   Lbl 9
   ClrHome
   Output (4,6, "DEF
   ENCE")
   Send ({120,99})
   Get (R)
   Send ({102,99})
   Get (R)
   Goto A
   Lbl 10
   Stop
```

For the CHALLENGE activity, two 84-inch cables connected together are useful for extended range. The 84-inch data cable (7.5 foot CBR **I/O** cable) can be found at:

*http://epsstore.ti.com*

Follow links to TI-83 or TI84 accessories