

## PREPARATION

### Overview

In the first project, **Wheeled Robot Vehicle**, students will be introduced to robotic locomotion by building a wheeled vehicle using gears and pulleys.

The second project, **Walking Robot Vehicle**, challenges students to build a walking version of a robotic vehicle.



#### Project 1: Wheeled Robot Vehicle

**Prep Time:** 15 minutes

**Teaching Time:** 20 minutes

#### Materials:

|                       |                           |
|-----------------------|---------------------------|
| 4 - #6 axles          | 4 - 2x2 plates            |
| 1 - #10 axle          | 4 - 2x4 plate             |
| 4 - #2 beams          | 2 - 1x6 plates            |
| 4 - #4 beams          | 1 - medium pulley         |
| 3 - #6 beams          | 1 - small pulley          |
| 2 - #16 beams         | 4 - medium tires and hubs |
| 1 - medium-sized belt | 1 - 9 volt battery pack   |
| 9 - bushings          | 1 - 9 volt leash          |
| 2 - crown gears       | 1 - 9 volt motor          |
| 2 - 8 spur gears      |                           |

**Preparation Tips:** Have a magazine available as an obstacle for the robot vehicle to drive over.



#### Project 2: Walking Robot Vehicle

**Prep Time:** 15 minutes

**Teaching Time:** 20 minutes

#### Materials:

|                   |                         |
|-------------------|-------------------------|
| 2 - #6 axles      | 4 - connector pegs      |
| 5 - #8 axles      | 2 - crown gears         |
| 1 - #12 axle      | 7 - 1x4 plates          |
| 1 - axle extender | 4 - 1x6 plates          |
| 6 - #4 beams      | 5 - small pulleys       |
| 2 - #8 beams      | 5 - medium pulleys      |
| 2 - #12 beams     | 1 - 9 volt motor        |
| 2 - #16 beams     | 1 - 9 volt leash        |
| 1 - belt          | 1 - 9 volt battery pack |
| 12 - bushings     | 2 - worm gears          |

**Preparation Tips:** Be sure that the pulleys are oriented as described!

1-800-466-9927

The Write Source, Inc 1270 Creek St, Suite 10, Webster, NY 14580  
info@thewritesource.net

## BACKGROUND

### Terms

WHEELED VEHICLE  
WALKING VEHICLE  
LOCOMOTION  
SOJOURNER  
LUNOKHOD I  
DANTE II  
GE QUADRUPED

### About Robotic Locomotion!

In unit one, students started exploring the definition of the word "robot." The topic of this unit is *robotic locomotion*!

No matter how you define a robot, it is important that they be able to move about in some fashion. One common use of robots is to send them to explore places too dangerous for

people! Whether in the depths of a volcano or on the surface of Mars, robot vehicles are very important!

Two methods of locomotion are wheels and walking. Space probes have commonly used wheeled vehicles in robots like the Soviet probe Lunokhod I (explored the moon's surface) and America's Sojourner (explored Mars surface).



Wheels can be found on many different robots. They allow robotic vehicles to roll over obstacles and travel great distances. As a simple machine, they are incorporated into many robotic designs, however, rough uneven terrain can be a problem for wheeled robots.

Walking vehicles that can step over obstacles are an alternative when the terrain is too rough for a wheeled robot to travel over.



DANTE II, a robot designed to explore volcanoes uses 8-legs to

walk! The GE Quadruped was developed as a 4-legged walking truck to carry heavy loads over rough ground.

### "WOW"

Host a contest so students can compare rolling and walking motions. Two teams will compete; one will run a three-legged race and the other will roll the same distance.

1. Lay out two courses of the same length. One course should be flat and in a straight line. The other should take a series of turns.

2. Pair off students and organize them into two teams. One team will lay down and roll the flat

course. Pairs from the other group will tackle the second course in a three-legged race.



3. After every student has a time, compare the best times. Ask students which means of locomotion was faster: rolling the distance or walking the distance in a three legged race?

4. Have the two groups trade courses. Record all times and identify the quickest times!

Have fun!

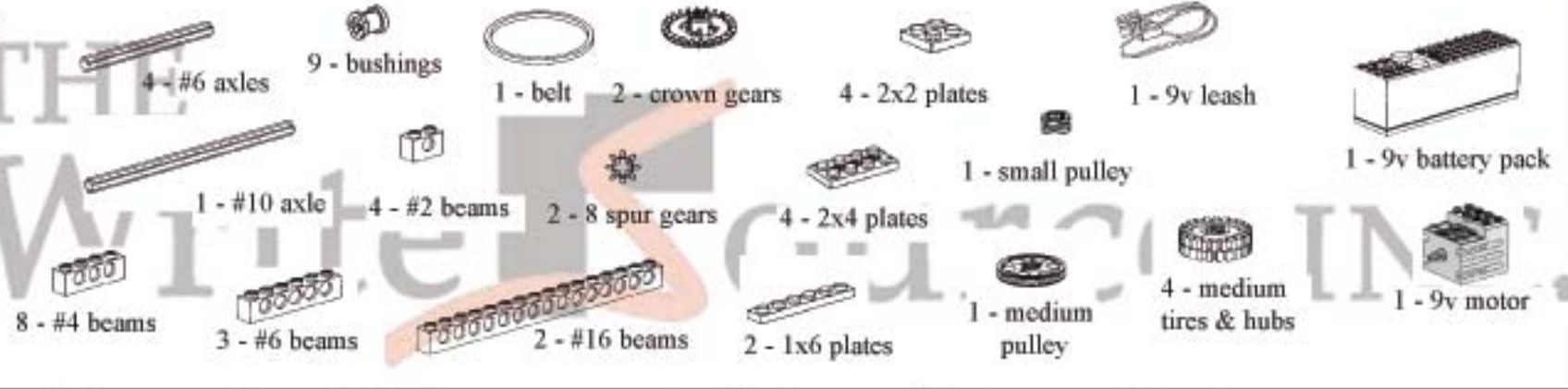
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## PROJECT 1: Wheeled Robot Vehicle #0006

Name: \_\_\_\_\_

**Make  
sure  
you  
have:**

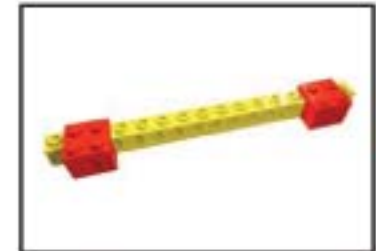


### Build... *Your In School and After School Solution*

1. Collect three #6 beams and place them side by side, about three cm apart, with the ends pointing toward you. Insert a #10 axle through the central hole. Between the beams, to the right, add a medium pulley and a bushing. The pulley should be next to the center beam, and the bushing should be up against the beam on the right.



3. Time to build one side of the robot vehicle. Place a #16 in front of you. Put a 2x2 plate one stud from each end of the beam, with the plate hanging over the right side of the beam. Attach a #2 beam under each extending plate.



2. Connect an 8 spur gear to the #10 axle ends on either side of the beams. Center a #4 beam onto the middle #6 beams. Set this assembly aside.



4. Put two #4 beams on top of a 2x4 plate. Insert, and roughly center, a #6 axle through the central beam holes. Fix the axle into place with bushings on either side. On the left side, add a crown gear with the teeth pointing away from the beams. On the right side, add a medium (3 cm diameter) tire.



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Project #1: Wheeled Robot Vehicle (contd.) #0006

5. You are going to repeat the previous step, but without the crown gear. Place two #4 beams on top of a 2x4 plate. Insert, and center a #6 axle through the central beam holes. Fix the axle into place with bushings on either side. On the right side, add a medium (3 cm diameter) tire.



6. Center the wheel assembly with the crown gear, beneath the first 2x2 plate-beam combination. Place the second wheel assembly without the crown gear, on the second 2x2 plate-beam combination. The wheels and 2x2 beams should face to the right. Set this aside.



7. Build a second vehicle wheel assembly. This time, the wheels and #2 beams should face to the left (in a mirror image fashion), and the crown gear should be on the the second wheel assembly instead of the first.



Set these wheel assemblies aside.

8. Pick up the assembly from step two with the medium pulley. Place a belt around the medium pulley.



9. Carefully attach this assembly to the underside of the left wheel assembly. The first #6 beam should be flush to the #4 beam on the wheel assembly. The second #6 beam should be under the eighth stud of the #16 beam. The third #6 beam should be flush to the second #4 beam.



10. Attach the right wheel assembly in a similar manner as the first. Both 8 spur gears should mesh with the crown gears.



Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Project #1: Wheeled Robot Vehicle (contd.) #0006

11. Connect the #16 beams and the #4 beam with a 1x6 plate, at the eighth stud on each wheel assembly. Put a second 1x6 plate connecting the ninth studs.



12. Put a small pulley on a 9 volt motor. Attach a leash to the motor.



13. Place the motor on the 1x6 plates. Carefully connect the belt from the medium pulley to the small pulley.

Connect the leash to a power source and drive your robot vehicle!



### Try this...

1. Try running your robot vehicle over an obstacle (a magazine for example). How did it perform? Identify a change you can make to help it explore other planets.

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2. Reflect on your robot vehicle's robotic qualities. Do you think your model is a true robot?

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3. In your own words, explain why wheeled locomotion for a robot is important.

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4. Research and identify two examples of wheeled robots.

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Name:

Date: