# Mars Rover Rocket

## Teacher Copy

### Lesson Focus

This lesson focuses on the force (thrust) needed to propel the Mars rover.

This lesson also covers Newton's third law of motion, which is for every action there is an equal and opposite reaction.

### Grade Levels

6-12

### Objectives

During this lesson students will:

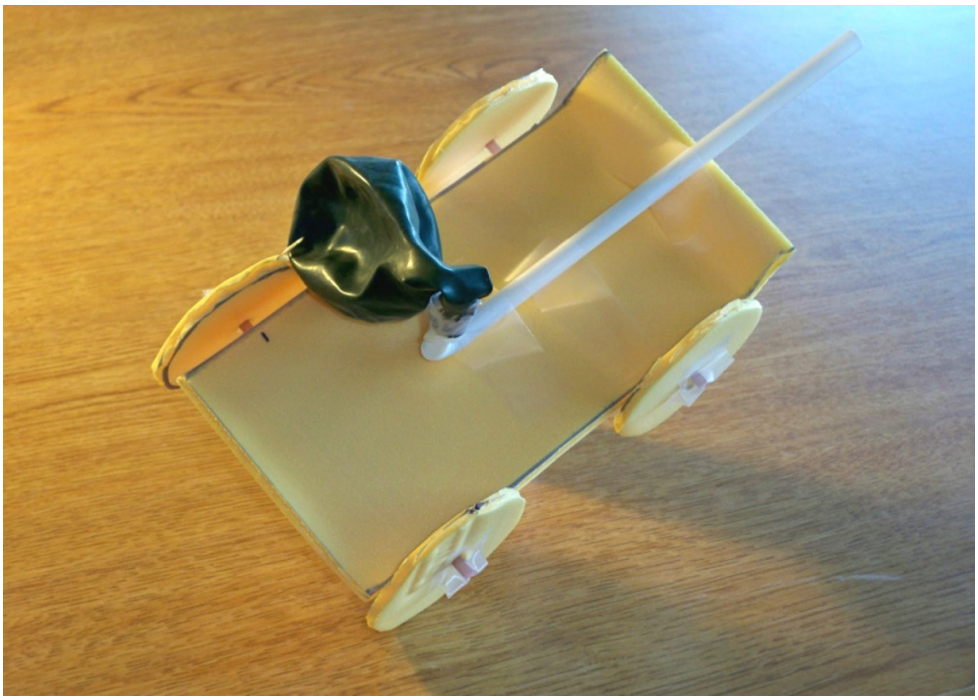
- Build their own balloon-powered Mars rover
- Record observations
- Adjust design
- Communicate results

**Materials** (Supplies for a group of 20 students working in pairs)

1. 10 rolls of Scotch tape (1 roll per pair)
2. 20 drinking straws, 10 with a flexible bend
3. 20 coffee stirrers
4. 10 rocket car templates and wheel templates
5. Styrofoam, foam core, or cardboard to cut out body and wheels
6. 20 scissors
7. 10 balloons
8. 20 pieces of sandpaper
9. 20 pencils

## Procedure

1. Use the car template to cut the body of the vehicle out of Styrofoam.
2. Cut four wheels out of the Styrofoam using the template.
3. Lightly sand the edges of the vehicle.
4. Holding two wheels together, lightly sand the edges. Repeat with other two wheels.
5. Mark 2.5 cm from each end of the car template for the wheel location.
6. Cut two straws 7 cm long and tape them as axle mounts on the marks on the bottom of the car. They should not extend over the edge.
7. Place the wheel template over each wheel and push the pencil through to mark the center for the axle.
8. Push coffee stirrer through the end of the wheel and tape it on one side.
9. Slide the stirrer through the larger straw, put on the other wheel, and attach with tape.
10. Repeat with second set of wheels.
11. Put balloon over the flexible end of the straw and tape tightly.
12. Position the straw in the center of the car and tape it to secure.
13. Straw should extend over the end.
14. Blow up the balloon and measure the circumference (around the center).
15. Do several trials with different circumferences.

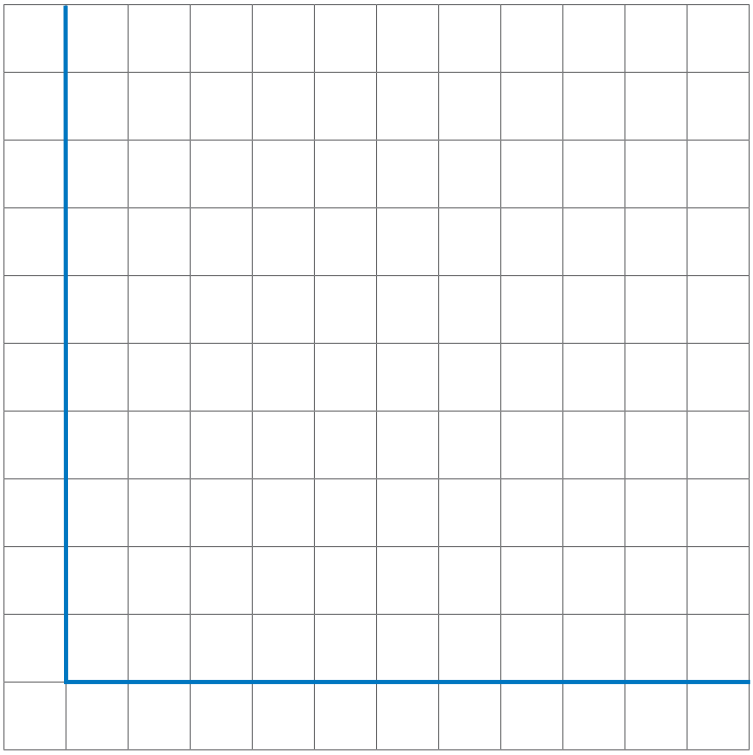


## Data

### Sample Data Table: The Effect of Air Thrust on Mars Rover

| Trial | Circumference (cm) | Distance (cm) | Observations |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |

### Graph



On the x-axis, graph the circumference of the balloon (independent variable).

On the y-axis, graph the cm for how far the rover traveled (dependent variable).

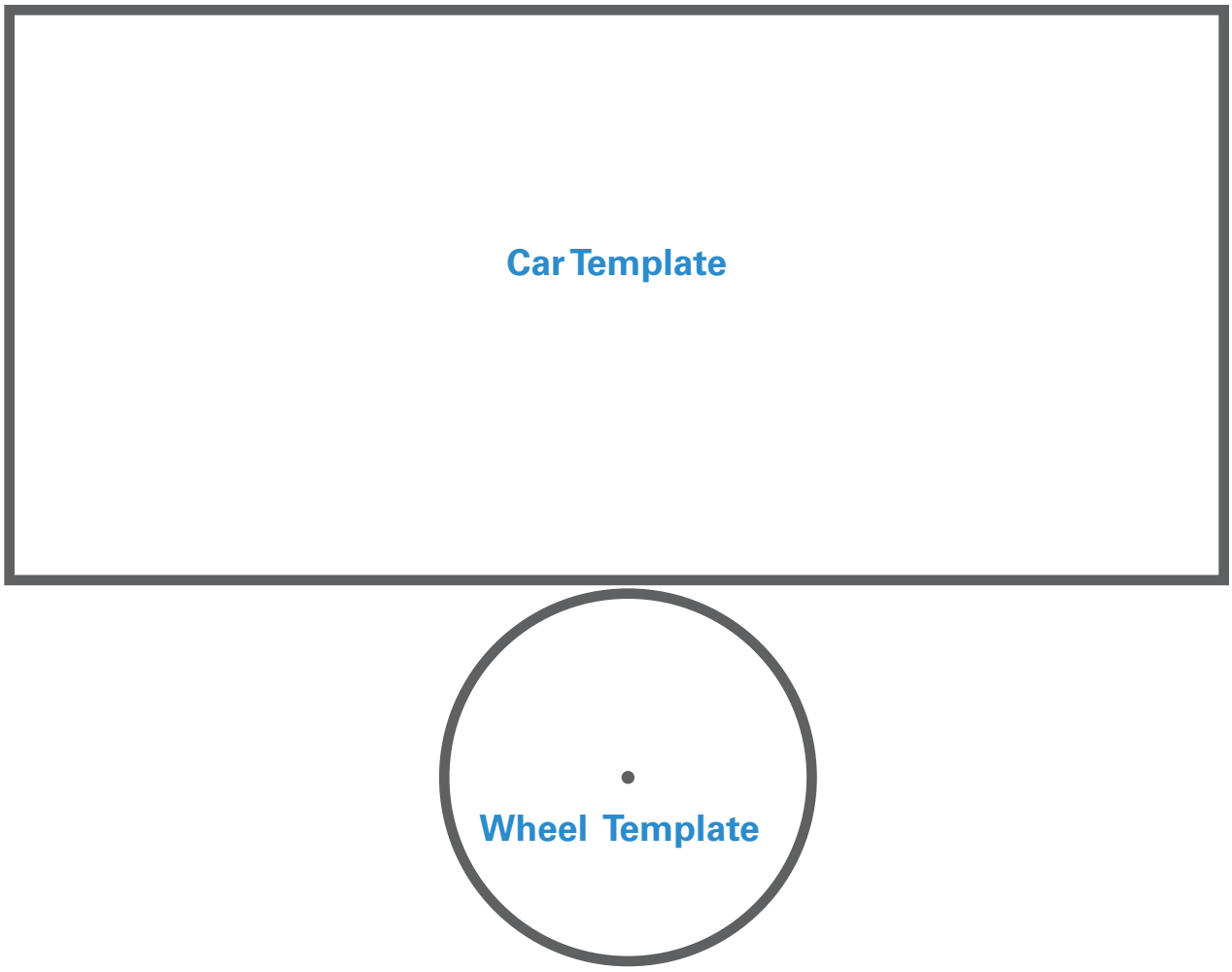
## Questions

### Grades 6-8

1. Did your graph make a straight line? What do you theorize the result would be if you blew up the balloon to a circumference of 80 cm?
2. What amount of air made your rover easiest to control? Go the farthest distance?
3. What other variables could introduce errors into your experiment?
4. How would you improve the design of this lab? What part of it gave you the most problems? How would you fix it?

### Grades 9-12

1. Did your graph make a straight line? What can you theorize from your limited data?
2. Is the rover system open or closed? Why?
3. What is the independent variable and the dependent variable?
4. Which goes on the x-axis and which on the y-axis?
5. How does this lab illustrate Newton's third law of motion?
6. What factors could give you a different graph than your fellow students?
7. How would you improve the design of this lab? What gave you the most problems? How would you fix it?


Car Template


Wheel Template

## Alignment to Curriculum Frameworks

### NGSS Engineering Practices

- **MS-PS2-2.** Plan an investigation individually and collaboratively, and in the design: Identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how much data is needed to support a claim.
- **MS-PS2-5.** Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation.
- **MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.

### Common Core – ELA

- **RST.6-8.3.** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.