

## Force and Motion

### Grade-Level Expectations

The exercises in these instructional tasks address content related to the following science grade-level expectations:

**SI-E-A5** Combine information, data, and knowledge from one or more of the science content areas to reach a conclusion or make a prediction (SI GLE 10)

**PS-E-B2** Explain how the amount and direction of force exerted on an object (e.g., push, pull, friction, gravity) determine how much the object will move (GLE 24)

**PS-E-B4** Explain the effect of varying amounts of force on the motion of an object (GLE 26)

### Contents

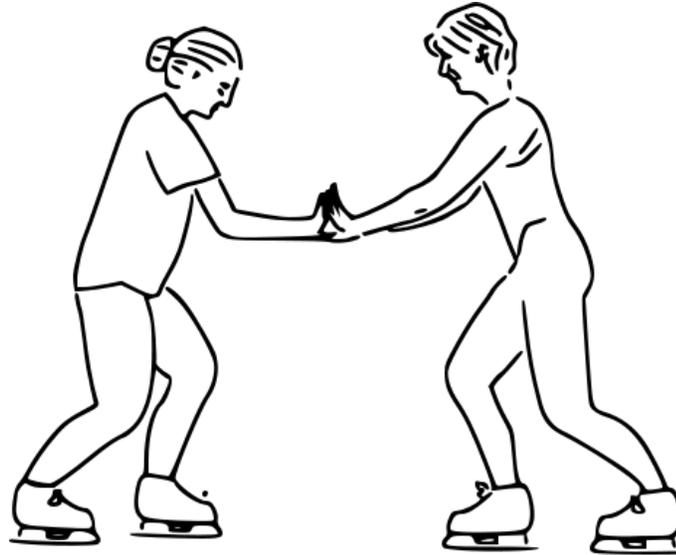
- These instructional tasks contain a set of document- or resource-based exercises to develop comprehension of *the relationship between force and motion*.
- Teachers may choose to use or modify the tasks as part of an instructional lesson or as a formative or summative assessment.
- The printable student version excludes teacher directions.

	Objective(s)
<a href="#">Scaffolding Exercise 1</a>	<ul style="list-style-type: none"> <li>• Analyze a diagram</li> <li>• Describe the effects of force on motion</li> </ul>
<a href="#">Scaffolding Exercise 2</a>	<ul style="list-style-type: none"> <li>• Analyze a diagram</li> <li>• Identify the forces acting upon an object</li> <li>• Explain the effect of forces on the object</li> </ul>
<a href="#">Scaffolding Exercise 3</a>	<ul style="list-style-type: none"> <li>• Interpret the data</li> <li>• Describe the relationship between force and motion</li> <li>• Write a conclusion supported by evidence</li> </ul>
<a href="#">Culminating Exercise</a>	<ul style="list-style-type: none"> <li>• Describe forces acting on an object</li> <li>• Determine ways to alter forces acting on an object</li> <li>• Draw reasonable conclusions</li> </ul>
<a href="#">Scoring Rubric</a>	
<a href="#">Scoring Notes</a>	
<a href="#">Printable Student Version</a>	

## Scaffolding Exercise 1

**Teacher Directions:**

Have students study the information below to respond to the prompt that follows.



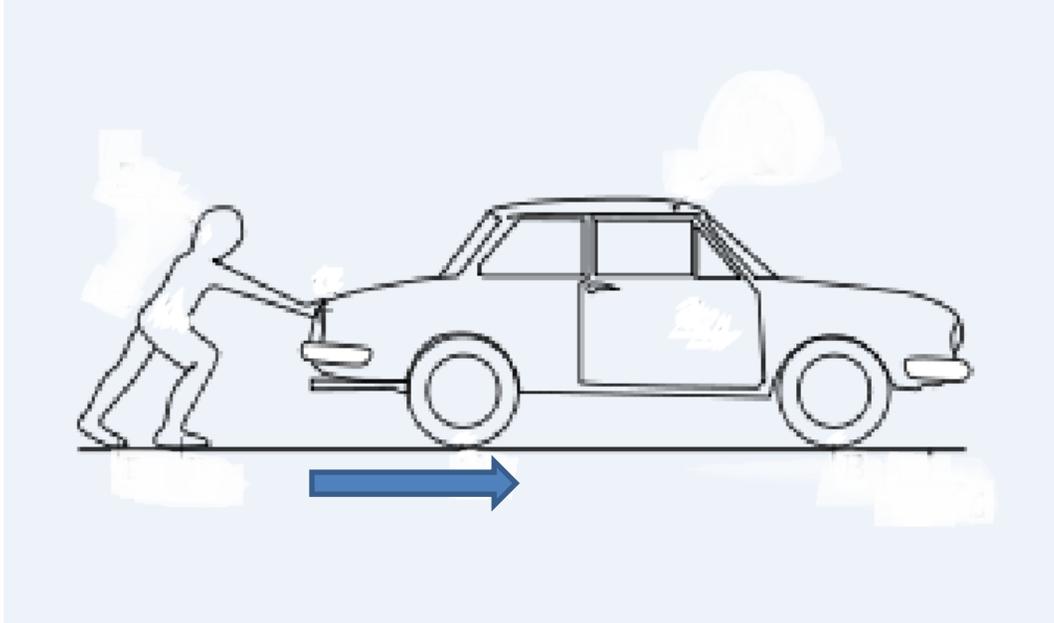
The students in the diagram are wearing ice skates and are standing on a surface of ice with the palms of their hands touching and their arms bent. The ice surface offers little resistance.

If both push toward each other at the same time by straightening their arms out, describe how the students will move as a result and why they will move as you described.

## Scaffolding Exercise 2

**Teacher Directions:**

Have students study the information below to respond to the prompt that follows.



In the image above, the man is pushing on his car to try and move it out of the road. The arrow shows the direction of the pushing force. There are two other forces that are acting on the car.

Identify the two forces, other than the man, acting on the car and explain the effect and direction of those forces.

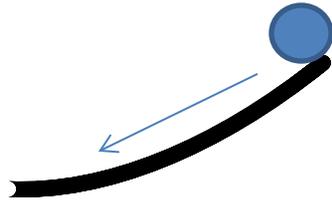
A girl is practicing with her skateboard on ramps to see which one allows her to jump a greater distance off the ramp. She tested the ramps and collected the data in the table below.

Height of the Ramp (cm)	Distance Jumped (cm)	Distance Jumped (cm)	Distance Jumped (cm)	Distance Jumped (cm)
	Trial 1	Trial 2	Trial 3	Trial 4
Ramp A: 91	244	304	335	304
Ramp B: 76	274	213	274	305

Use the data table to respond to the following prompts.

- A. Which ramp allowed the girl to leave the ramp with more force? Write a conclusion and support it with evidence.
- B. Describe **three** ways one of the ramps can be changed. Explain how each change affects the force and motion of objects jumping off the ramp?

Kaleb rolls a ball down a tube as shown below. It travels 43 centimeters from the bottom of the tube.



- A. Describe two changes Kaleb could try to make the ball roll farther?
- B. Describe how your changes affect the forces acting on the ball to make it roll further.

### Rubric

**Key Elements:**

- A. Response includes two correct changes that could make the ball roll faster.
- B. Response describes how each change affects the forces acting upon the ball.

**2 Points**

Response includes both key elements.  
Response contains no scientific errors.

**1 Point**

Response includes one of the key elements.  
Response may include scientific errors.

**0 Point**

Response does not include any key elements.

## Scoring Notes

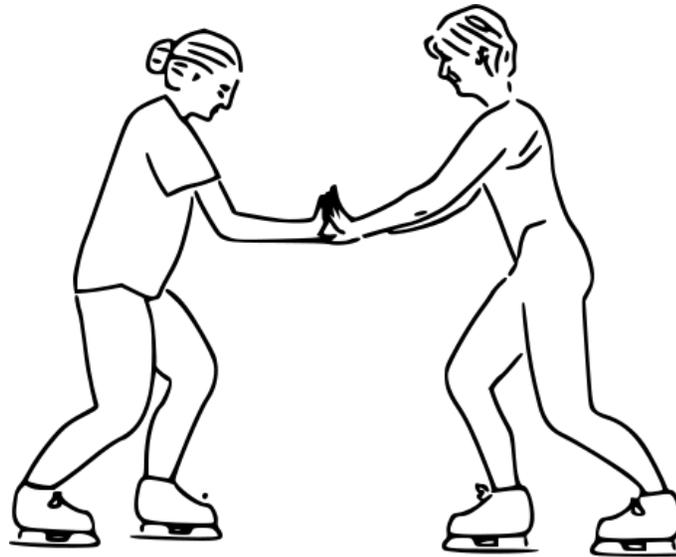
The following are examples only. All reasonable, valid responses should be accepted.

Possible changes to make the ball roll further:

- Kaleb could tilt the tube to a higher angle (incline). If the incline angle of the tube is higher, the force of gravity and the greater incline cause the ball to roll with more force, faster and farther.
- Kaleb could use a ball of a smaller diameter. If a smaller ball is used, it reduces the friction as the ball rolls and allows the ball to roll faster and farther.
- Kaleb could change the type of material of the tube. If the tube is smoother, the friction is reduced as the ball rolls and the ball rolls faster and farther.
- Kaleb could use a ball with a smoother outside surface. If a smoother ball is used, it reduces the friction as the ball rolls and allows the ball to roll faster and farther.

**Printable  
Student Version**

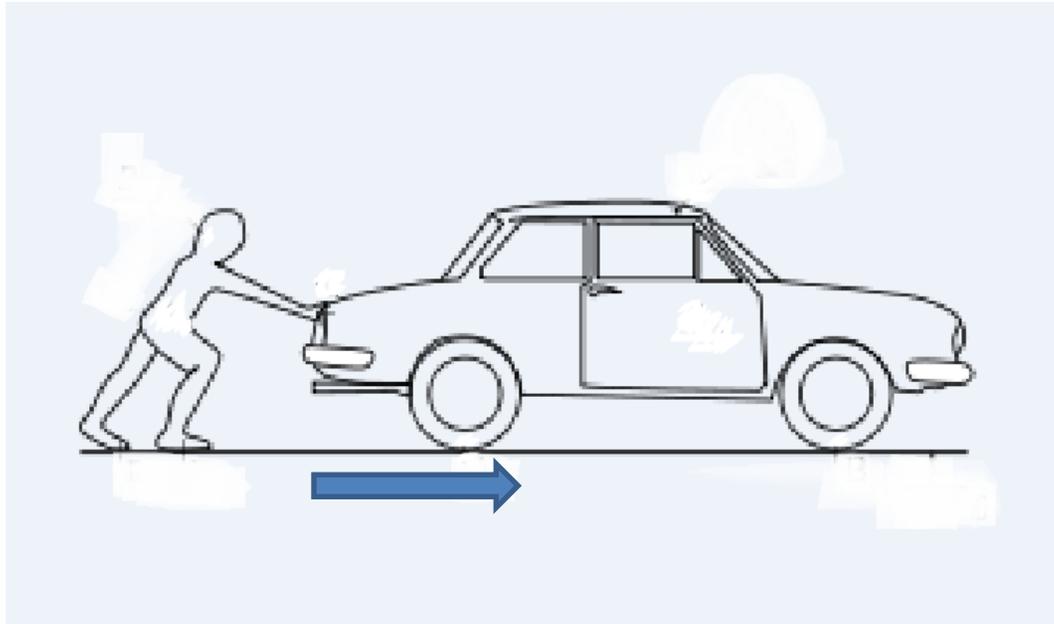
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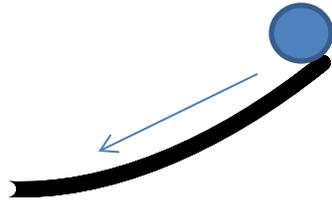
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