

## LEARNING FROM EXPLORING SCIENCE ACTIVITIES & LAB MANUAL

As you look through your Activities & Lab Manual, you will see two different types of activities—activities and labs. Each type ties in with your textbook but in different ways.

### Activities

Reviews and activities are usually short pencil-and-paper exercises designed to reinforce the information that you've learned in the textbook. Sometimes they are a little longer. You can think of many of these as extra section reviews to help you master the material and get ready for the test. Others are extension activities that take you beyond the material in the chapter.

**CHAPTER 5**  
ACTIVITY

Name \_\_\_\_\_

### 5.2 NEWTON'S FIRST LAW

#### Identifying Forces

Fill in the blanks with the correct words to complete a definition of Newton's first law of motion.

1. An object in motion will stay in \_\_\_\_\_ and an object at rest will stay at rest until a(n) \_\_\_\_\_ acts on it.


For Questions 2–4, read each scenario. In Part a for each question, circle the correct answer(s). Then answer the questions in Part b.

2a. Mia pushes a skateboard down a hill. The skateboard will (move / not move) because the forces are (balanced / unbalanced).

2b. If Sofia reaches out to catch the skateboard at the bottom of the hill, what will happen to the skateboard's motion? Explain.

3a. Mia sees Rocky on the skateboard. If she views the skateboard as the reference point, Rocky is (moving / not moving) because the forces on him are (balanced / unbalanced).

3b. If Rocky is riding the skateboard and it suddenly stops when he is not restrained, what will happen to his motion? Explain.



Chapter 5: Laws of Motion

Section 5.2 43

**CHAPTER 4**  
**LAB 4**  
THREE, TWO, ONE, LAUNCH!

Name \_\_\_\_\_

### Relating Force and Mass to Changes in Motion

**ESSENTIAL QUESTION** IS IT POSSIBLE TO PREDICT HOW THE MOTION OF AN OBJECT WILL CHANGE?

**INTRODUCTION**  
You've already seen that changing an object's motion requires a force. If you want to pass a soccer ball to a teammate, you must exert a force on the ball. If you want to slow down a baseball that's been thrown to you, you must exert a force on it. A catapult is one way to exert a force on an object. Perhaps you've seen one of these medieval siege machines in a movie or TV show. Catapults were fearsome weapons! But don't worry—the catapult you'll be making in this activity is quite harmless!

**Questions**

- How will the motion of a projectile change in response to changing force?
- How will the motion of a projectile change in response to changing mass?
- What do simple free-body diagrams of projectiles in motion look like?

**Equipment**

- wooden craft sticks (3)
- rubber bands (2)
- plastic bottle cap
- hot glue gun
- metric measuring tape
- marshmallows, 1 regular and 1 mini



Chapter 4: Forces

Lab 4 189

### Labs

Lab activities explore many exciting topics in science. While each lab activity is built on information in your textbook, the information in the activity may go beyond the textbook as well. You often won't find the right answers in the textbook. In fact, sometimes there is no right answer! The answers to the lab activities will be based on the data that you collect and analyze. You may work with a lab partner, in a small group, or with the entire class. You'll learn to use scientific instruments, collect data, and make models. You'll access online resources and perform tests. You will learn how to ask scientific questions and then go on to answer those questions. These are things that real scientists do every day!

## COMPLETING A LAB ACTIVITY

When it's time to do a lab activity, don't treat it like something to finish as fast as you can. Treat each one as an opportunity to stretch yourself, like a good mental workout.

### Think

Think about what you're doing. Read each step. Make sure that it makes sense. Ask if you aren't certain about what you're supposed to do.

### Sharpen

Sharpen your science skills! Follow the directions carefully. Measure carefully. Record data accurately. And above all, keep thinking!

### Connect

Connect what you are doing in the activity to the textbook chapter. How does what you have just learned help you understand the activity? On the basis of what you have learned previously, how do the steps build on one another?

### Apply

Finally, apply what you discover as you answer the questions. These questions are designed to help you think deeply about science, just as real scientists do. Answer each question completely and thoroughly.

## WORLDVIEW IN THE LABORATORY

When professional scientists work in the laboratory, their worldviews always affect what they're doing. When they draw conclusions, their worldviews are hard at work. Their very reason for doing science comes from their worldviews.

As a student scientist, keep your worldview in mind too. When you do an experiment, think about how it relates to a biblical worldview. Some questions will specifically ask you to apply your worldview to the problem. You will be challenged to think like a Christian as you're doing science.

### READY, SET, EXPLORE!

You can have a lot of fun participating in *Exploring Science* activities this year. You'll learn fascinating things as you complete the activities. After all, you're studying God's creation, and there are lots of fascinating things in our world! We hope these activities will help increase your knowledge of science as well as your love for science and for the God who is the Creator of all. So get ready to explore!





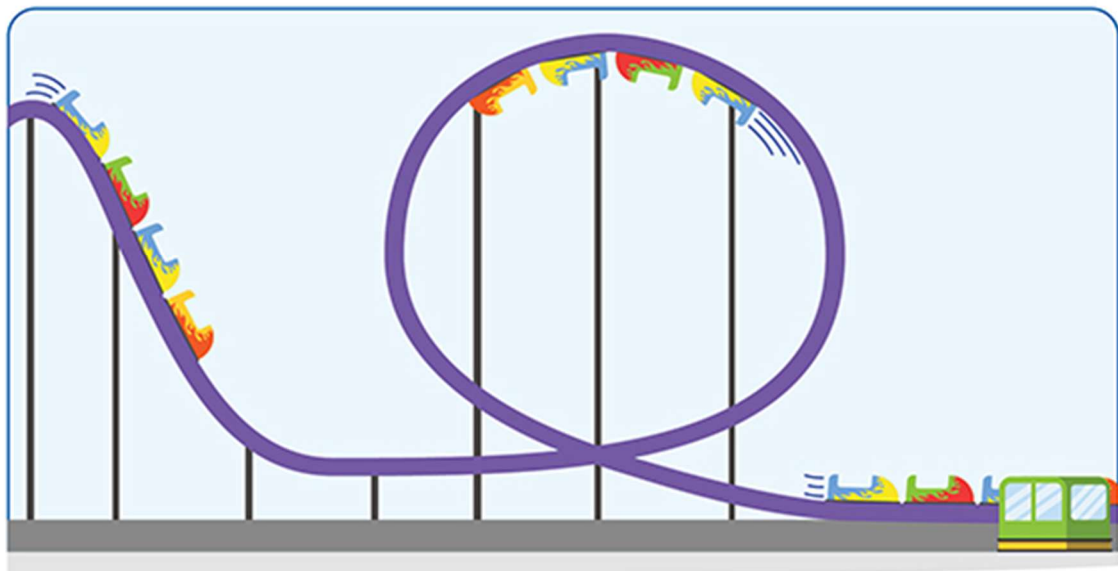
# CHAPTER 4

ACTIVITY

Name \_\_\_\_\_

## 4.1 INTRODUCTION TO FORCES

### Identifying When Forces Are at Work



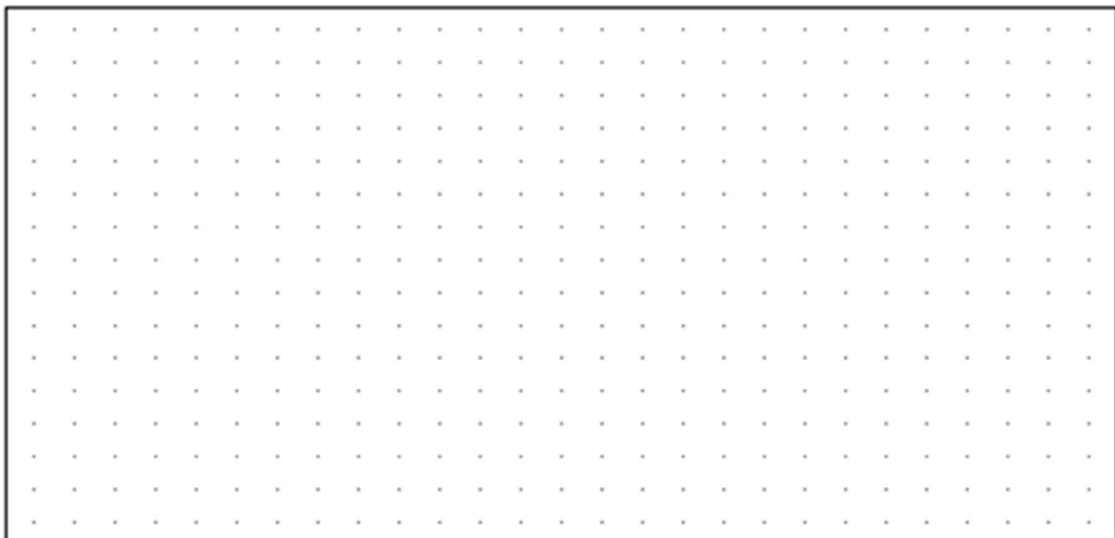
Identify and number three places along the roller-coaster path above where a force will be applied to the roller-coaster car. For each location explain how you know that a force will be applied there.

1. \_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_
3. \_\_\_\_\_  
\_\_\_\_\_



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Sketch someone playing your favorite sport. Write a brief description of what is happening in the sketch, where forces are being applied, and what changes in motion happen when the forces are applied. Include at least one example of balanced forces.



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# CHAPTER 4

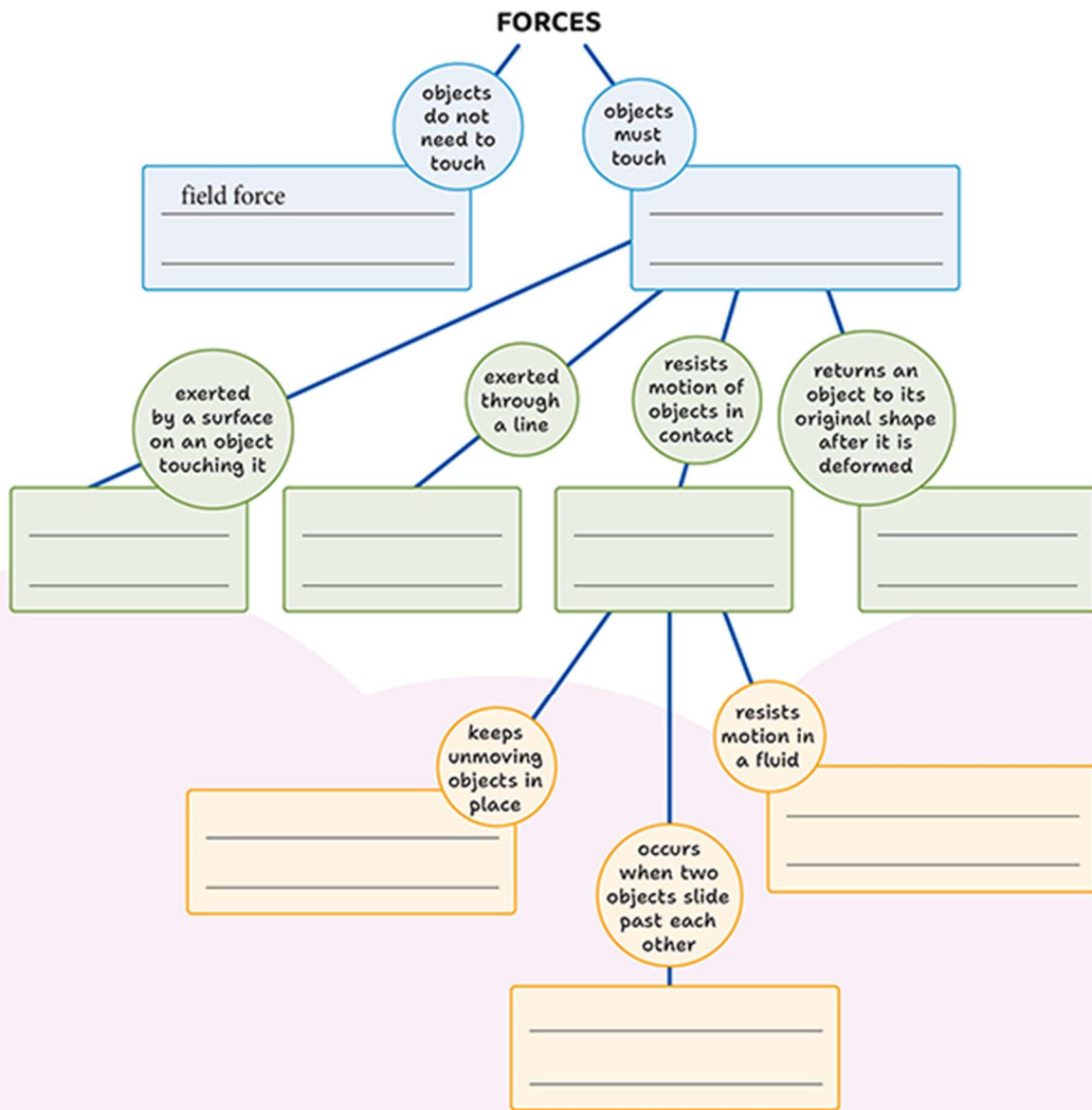
ACTIVITY

Name \_\_\_\_\_

## 4.2 TYPES OF FORCES

### Classifying Forces

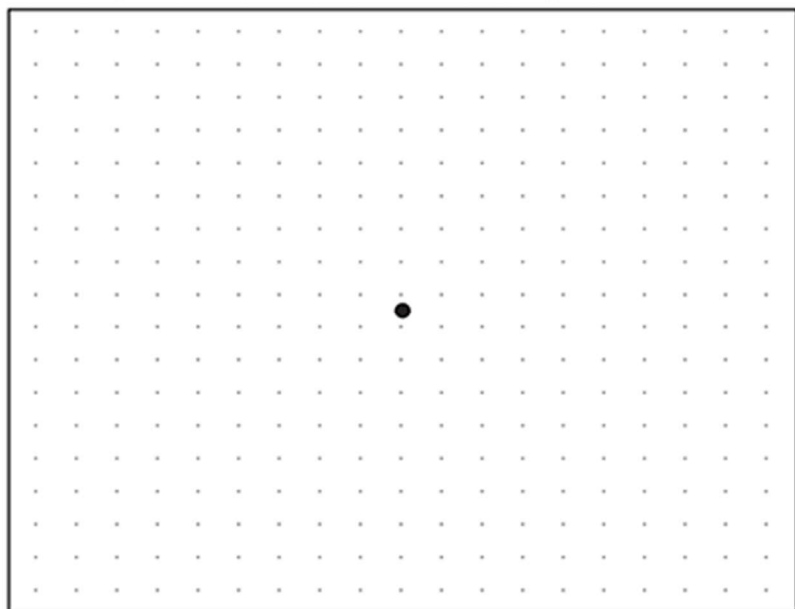
Complete the graphic organizer below by filling in each blank with one of the following terms: contact force, drag, elastic force, field force, friction, normal force, sliding friction, static friction, tension. The first blank has been filled in for you.



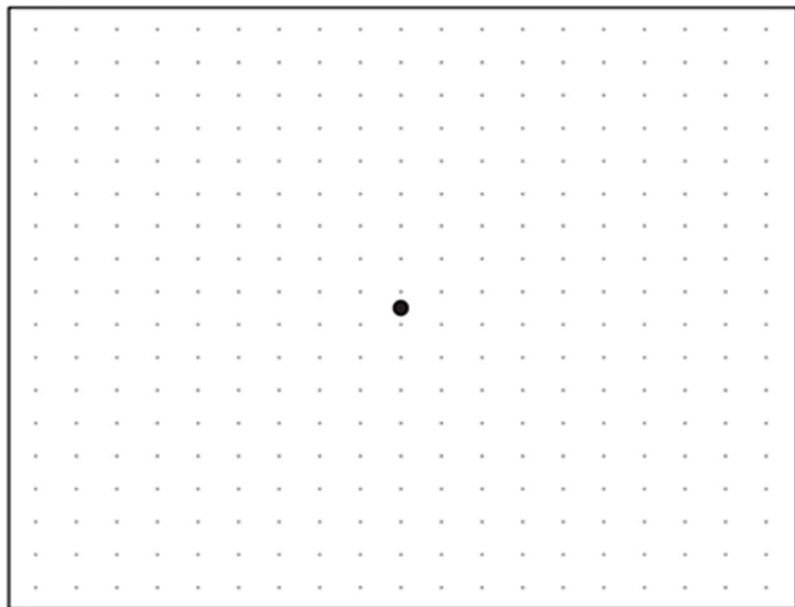
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For each question below, use the drawing area to create a free-body diagram for the scenario. Not all of the forces have been identified for you! Label the vectors. *Hint:* Think about what you have learned about balanced and unbalanced forces.

1. A standing student exerts a force of 400 N on the ground.



2. A student pushes a bicycle to the right with 100 N of force. The ground exerts a friction force of 5 N.





Name \_\_\_\_\_

### 4.3 GRAVITY

#### Understanding Gravity

Fill in the blanks in the paragraph below to complete the summary of gravity.

Gravity is a \_\_\_\_\_ force that exists between all objects that have \_\_\_\_\_. The effect of Earth's gravity on an object is usually referred to as \_\_\_\_\_. The strength of the gravitational force between two objects is affected by the \_\_\_\_\_ of the objects and the \_\_\_\_\_ between them. These factors are part of a formula called the \_\_\_\_\_, discovered by Isaac Newton. Of the two factors, \_\_\_\_\_ has a much greater effect than \_\_\_\_\_. Objects do not have to travel far from a planet like Earth in order to experience a much-reduced force of gravity, also called \_\_\_\_\_.

Gravity is a part of God's good design for life on Earth. Take a moment to reflect on some of the things that gravity makes possible. Then use the space below to write a brief thank-you note to God for His amazing gift of gravity. Be sure to include specific examples of things you are thankful for and the way gravity makes them possible.

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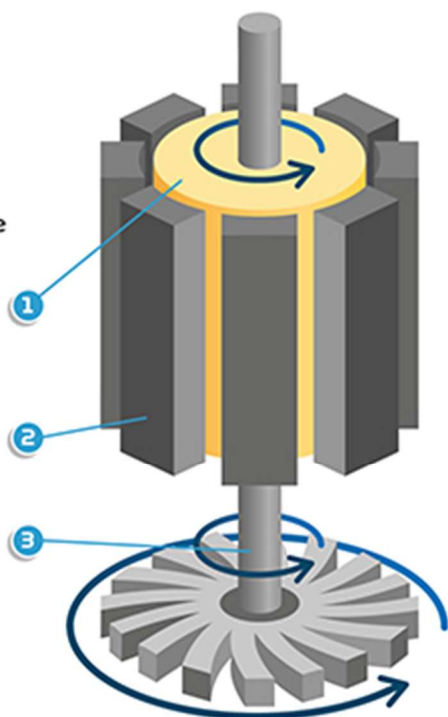
Name \_\_\_\_\_

## 4.4 ELECTROMAGNETISM

### Generating Electricity

Label the parts of the electrical generator shown on the right. Then answer Questions 4–5 about the generator.

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_



4. Does the generator in the image produce electricity by spinning a magnet inside coiled wires or by spinning coiled wires inside a magnet? Explain your answer.

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5. Describe three ways that the necessary rotation inside the generator could be produced.

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# PINE STREET POST



## FORCES

Use this box to record the big idea of the chapter. Summarize the main point in two to four sentences.



Use this box to record the other important topics in the chapter. Summarize these points using bullet points or numbers.

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## TRENDING-TERMS

Under Key Terms, record three to four key terms from the chapter along with their definitions. Under Difficult Terms, write down any words that you don't fully understand.

### Key Terms

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### Difficult Terms

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## ASK ROCKY

DEAR ROCKY,  
I don't get it!  
How can an object be moving if no unbalanced force is acting on it?




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## ART SPACE

Use this box to draw and label an activity that shows the forces acting on an object. State whether the forces are balanced or unbalanced.

### QUESTIONS FOR ROCKY



Use this space to ask Rocky any questions you have about what you've learned!

DEAR ROCKY,

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## PINE STREET POSTSCRIPT



Use this space for creative headlines, doodles, extra space, or anything else you'd like to help you remember important information!



## CHAPTER 4 LAB 4

THREE, TWO, ONE, LAUNCH!

Name \_\_\_\_\_

### Relating Force and Mass to Changes in Motion

**ESSENTIAL QUESTION** IS IT POSSIBLE TO PREDICT HOW THE MOTION OF A PROJECTILE WILL CHANGE?

#### INTRODUCTION

You've already seen that changing an object's motion requires a force. If you want to pass a soccer ball to a teammate, you must exert a force on the ball. If you want to slow down a baseball that's been thrown to you, you must exert a force on it. A catapult is one way to exert a force on an object. Perhaps you've seen one of these medieval siege machines in a movie or TV show. Catapults were fearsome weapons! But don't worry—the catapult you'll be making in this activity is quite harmless!

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- How will the motion of a projectile change in response to changing mass?
- What do simple free-body diagrams of projectiles in motion look like?

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- wooden craft sticks (8)
- rubber bands (5)
- plastic bottle cap
- hot glue gun
- metric measuring tape
- marshmallows, 1 regular and 1 mini



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## PROCEDURE

Follow the directions to make a catapult like the one shown on the previous page.

- A** Stack six craft sticks together. Twist a rubber band around each end of the stack.
- B** Place two more craft sticks at right angles to the stack, one on top of it and the other below it. Secure these two sticks to the stack with a pair of rubber bands wrapped around the intersection of the crossed sticks. The wrapped rubber bands should make an X shape, as seen in the image. An extra pair of hands may make this task easier!
- C** Press the top and bottom sticks together on one side of the stacked sticks. Secure the two sticks together with a rubber band. We'll refer to this as the front of your catapult.
- D** Use a spot of hot glue to attach the bottle cap to the opposite end of the top stick. We will refer to this as the launch arm of your catapult. Do not attach the cap at the very end of the launch arm! You will need a small tab of exposed stick for triggering your catapult.

While the glue is setting, let's think about what you'll be testing in this activity. Instead of launching massive stones or pots full of flaming oil at invaders, you'll be launching marshmallows. There are two ways to change the motion of a projectile. One way is to change the mass of the projectile. The other way is to change the amount of force exerted on the projectile when it is launched. You will use a mini marshmallow as a projectile with a small mass and a regular marshmallow as a projectile with large mass.

1. State a hypothesis about the distance a marshmallow projectile will travel as the launch force increases.

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2. State a hypothesis about the distance a marshmallow projectile will travel as its mass increases.

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- E** Clear an area of the floor and lay out your measuring tape. Place the front end of your catapult on the floor at the beginning of the tape with the launch arm facing up. The front of the catapult should be pointed toward the end of the tape. Choose one student from your group to launch marshmallows with the catapult. You will also need someone to act as a spotter and someone to record data. You may swap duties between tests, but not between trials.

We will first test what happens when a small mass (a mini marshmallow) is launched using a small initial force.

- F** Place a mini marshmallow in the cap. While holding down the front of the catapult, use a finger to press the launch arm downward about 1.0 cm. We will consider this the small initial launch force. Release the tab to launch the marshmallow.
- G** The spotter should observe where the marshmallow lands and note the distance to the landing point on the measuring tape. Measure only to the initial landing point. Do not include any extra distance traveled by the marshmallow if it bounces or rolls away from the initial impact.
- H** Record the distance in Table 1.
- I** Repeat Steps F–H four more times.
- J** Repeat Steps F–I three more times with the following modifications:
  - ✓ For the second test, use a large initial launch force by pressing the catapult tab down about 1.5 cm. Record the results in Table 2.
  - ✓ For the third test, replace the mini marshmallow with a regular marshmallow and use a small launch force. Record the results in Table 3.
  - ✓ For the fourth test, use the regular marshmallow and a large launch force. Record the results in Table 4.
  - ✓ For the third and fourth tests, lay the regular marshmallow on its side in the bottle cap to keep it from rolling out.

### ANALYSIS

- K** Calculate the average distance to the nearest centimeter for each set of trials and record the values in Tables 1–4.

### CONCLUSIONS

3. Which launch force helped the marshmallows travel farther, the small force or the large force? Support your answer with evidence from your data.

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