

# Friction

## BROWARD COUNTY ELEMENTARY SCIENCE BENCHMARK PLAN

### Grade 1—Quarter 3

#### Activity 24

##### SC.C.1.1.1

*The student understands that different things move at different speeds.*

##### SC.C.1.1.2

*The student knows that there is a relationship between force and motion.*

##### SC.H.1.1.1

*The student knows that in order to learn, it is important to observe the same things often and compare them.*

##### SC.H.1.1.3

*The student knows that in doing science, it is often helpful to work with a team and to share findings with others.*

## ACTIVITY ASSESSMENT OPPORTUNITIES

The following suggestions are intended to help identify major concepts covered in the activity that may need extra reinforcement. The goal is to provide opportunities to assess student progress without creating the need for a separate, formal assessment session (or activity) for each of the 40 hands-on activities at this grade level.

1. Ask, *What do you think will happen will happen if you put a heavy can of soup flat side down at the top of the ramp with only one book raising it? Why would that happen?* (The can won't move. The can is too heavy, and there is too much friction, or not enough force, to make it move.) Ask, *How could you make the can move down the ramp?* (Several different ways could work: Turn the can on its rounded side so it rolls down the ramp; put a slippery material such as aluminum foil on the ramp's surface to reduce friction; or increase the force on the can by raising the ramp higher with one or more additional books.)
2. Use the Activity Sheet(s) to assess student understanding of the major concepts in the activity.

In addition to the above assessment suggestions, the questions in bold and tasks that students perform throughout the activity provide opportunities to identify areas that may require additional review before proceeding further with the activity.



# Friction

## OBJECTIVES

Students discover that friction is a force that produces heat and resists motion.

### The students

- ▶ observe the heat produced by friction when they rub their hands together
- ▶ discover that rubbing different objects together produces different amounts of friction
- ▶ infer that an object with smooth surfaces produces less friction than an object with rough surfaces

## SCHEDULE

About 40 minutes

## VOCABULARY

friction  
surface

## MATERIALS

### For each student

- 1 Activity Sheet 24

### For each team of four

- 1 pc aluminum foil, 3 in. (8 cm) square
- 1 board, wooden
- 4 books\*
- 1 pc sandpaper, coarse, 3 in. (8 cm) square
- 8 washers, large, taped together
- 1 pc waxed paper, 3 in. (8 cm) square

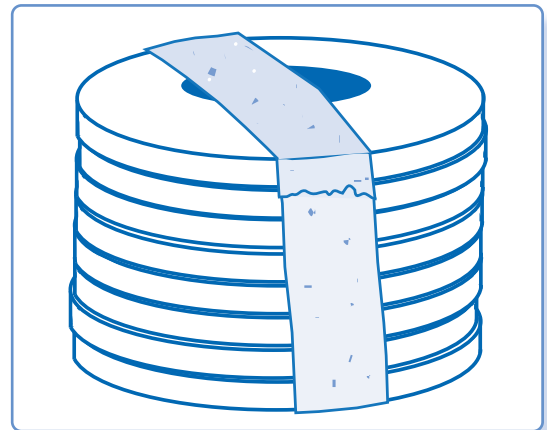
### For the class

- 1 pr scissors\*
- 1 roll tape, masking

\*provided by the teacher

## PREPARATION

- 1 Make a copy of Activity Sheet 24 for each student.
- 2 For each team, stack eight washers and wrap them together tightly with two pieces of masking tape. Make loops of tape with the sticky side outward, and stick one loop lengthwise on each stack of washers. The loop should be about the same length as the length of the washer stack (see Figure 24-1).
- 3 Cut aluminum foil, sandpaper, and waxed paper into squares.
- 4 Thick books such as dictionaries will work best for this activity. You may need to borrow books from the school library. If thick books are not available, blocks of wood will work. The total height of the four books or blocks for each team should be about 8 inches (20 cm).



▲ *Figure 24-1. Tape eight washers together with masking tape, and attach a sticky loop lengthwise to the stack.*

## BACKGROUND INFORMATION

When a force, a push, is used to start a ball rolling, the ball does not roll indefinitely. It slows down and eventually stops because another force—friction—acts on it. **Friction** is a force that opposes motion. It is caused by two objects rubbing against each other.

Friction results when two surfaces touch and slide against each other. The size of the friction force—that is, the amount of friction resulting from two objects pressing against each other—depends on how hard they press together (their weight) and what they are made of. All surfaces contain tiny bumps and grooves, no matter how smooth they appear to be. Surfaces such as sandpaper have many large bumps and crevices. These irregularities tend to cause more friction than smoother surfaces like glass or polished metal. However, sliding something over even a very smooth surface will cause friction because the tiny bumps and crevices rub and catch on each other as they slide past.

### ▼ Activity Sheet 24

#### Friction

1. Make a ramp one-book high. Stick the washer stack on the square to be tested. Put it at the top of the ramp. If it does not start to slide, add another book to make the ramp steeper. Keep adding books until the washer stack starts to slide. Write the number of books needed in the data chart. Repeat with the other two squares.

Surface	Number of Books Needed to Make the Washers Slide
Aluminum foil	1
Waxed paper	2
Sandpaper	4

2. Which surface caused the most friction? How do you know?  
The sandpaper caused the most friction. It took four books to make the washers slide.
3. Which surface caused the least friction? How do you know?  
The aluminum foil caused the least friction. It took only one book to make the washers slide.

## Guiding the Activity

- 1 Instruct students to touch their cheeks with the palms of their hands and notice how warm their hands are. Then have students rub the palms of their hands together quickly for several seconds and immediately touch their cheeks again. Ask, **Did you notice any difference in how your hands felt when you touched your cheeks the second time?**

Explain to students that their hands felt warmer when they were rubbed together because of friction. Write the word *friction* on the board and read it aloud. Tell students that **friction** is the force caused when two things rub against each other. Rubbing two things together produces heat. Explain that this is why students' hands felt warmer after they were rubbed.

## Additional Information

*Students will probably have noticed that their hands felt warmer after they were rubbed together. Accept all answers.*

## Guiding the Activity

- 2 Ask, **What happens to a ball when it rolls across a floor?**

Explain that friction slows down or stops a moving object. Have students brainstorm some of the different ways they feel the forces of friction every day. Write their responses on the board.

- 3 Write the word *surface* on the board and read it aloud. Tell students that the amount of friction that is caused when two things rub against each other depends on their surfaces. A **surface** is the outside or top of something. Ask, **What covers the surface of your body?**

Explain that all surfaces have tiny bumps and dents that they cannot see. Smooth surfaces have smaller bumps than rough surfaces have. When two surfaces are rubbed together, the bumps and dents push and pull on each other to cause friction. Tell students that they are going to experiment to learn how different surfaces cause friction.

- 4 Form students into teams of four. Distribute a board, a taped stack of washers, four thick books, and squares of aluminum foil, waxed paper, and sandpaper to each team. Give each student a copy of **Activity Sheet 24**.

Ask, **How can you make a tilted ramp with these materials?**

Ask, **What do you think will happen if you put an object with a smooth surface at the top of the ramp?**

Explain that an object slides down a ramp because it is being pulled down by a force. When students slide down a playground slide, they too are being pulled down by a force.

### Additional Information

*Guide the discussion so students recognize that the ball slows down and then stops rolling.*

*Students may mention that when they push something along the floor, the force of friction makes it harder to move the object. When they ride their bike on a level sidewalk and stop pedaling, the force of friction between the bike tires and the sidewalk eventually slows them down to a stop. When they walk, the friction of their shoes against the ground helps them push off and get going.*

*skin*

*Accept all responses. Students will probably suggest putting one end of the board on top of a book.*

*Accept all responses. Students will probably suggest that the object will slide down the ramp.*

## Guiding the Activity

Ask, **Do you think an object with a rough surface will slide down the ramp?**

Ask, **What do you think you can do to make a rough object slide down the ramp?**

Tell students that they can add more books to make the ramp steeper. Explain that when you make the ramp steeper, you add more force that pulls the object down the slide. The stronger force can overpower the force of friction.

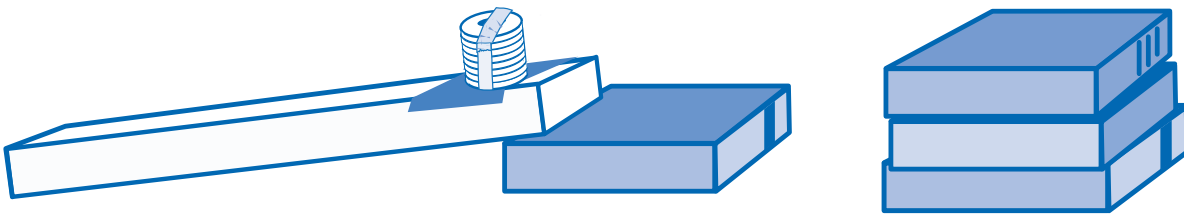
- 5 Instruct students to make a ramp one-book high. Have them stick the washer stack to the center of the aluminum foil square and place it at the top of the ramp (see Figure 24-2). If the foil with the washer stack does not start to slide on its own, have students add a second book to make the slide steeper. Tell them to keep adding books to make the ramp steeper until the washer stack starts to slide. Have them write the number of books needed to start the slide in the chart on the activity sheet.

## Additional Information

*Accept all responses. Students may suggest that a rough object will not slide down the ramp.*

*Accept all responses. Students may suggest that using another book to make the ramp steeper will make a rough object slide down it.*

*Tell students to keep the aluminum foil as wrinkle-free as possible. Wrinkles increase friction.*



▲ *Figure 24-2. A ramp made from a board and one book. The washer stack is in position.*

## Guiding the Activity

- 6 Instruct students to carefully pull the washer stack off the aluminum foil square and stick the stack onto the center of the waxed paper square. Starting with a one-book ramp, they should place the washer stack on waxed paper at the top of the ramp to test the waxed paper surface and record their results on the data chart.
- 7 Instruct students to carefully pull the washer stack off the waxed paper square and stick it onto the center of the *smooth* side of the sandpaper square (so the rough side will be against the board). Starting with a one-book ramp, they should again place the washer stack at the top of the ramp to test the sandpaper surface and record their results on the data chart.
- 8 Have students answer the questions on the activity sheet.

## Additional Information

### REINFORCEMENT

Have students repeat the experiment using different surfaces. For example, they can place the washer stack on pieces of paper towel, fabric, and foam rubber.

### SCIENCE JOURNALS

Have students place their completed activity sheets in their science journals.

### CLEANUP

Have students remove and discard the sticky loop from the washer stack. The foil and waxed paper squares can be discarded. The washer stacks, sandpaper squares, and boards should be returned to the kit. Books should be piled in a designated place and returned to the library.

## Connections

### Science Challenge

- ▶ Bring into the classroom a variety of objects that make it easier for people to move along different surfaces. Skis, ice skates, a wheelchair, roller skates, a bicycle, a skateboard, snowshoes, and a paddleboard are possibilities. If the objects are not available, you can use photographs. Explain, or have students discuss and explain, how each object makes it easier to move. Students can identify one surface on which each object can be used to help move and one surface on which it would make it harder to move.
- ▶ Challenge students to minimize friction on a playground slide for the fastest, smoothest ride down the slide. Provide a variety of materials for them to sit on, such as carpet scraps, cardboard, plastic bags, fabrics, and a rubber mat. Have students predict which materials, including their own clothing, would create the least amount of friction. Next, ask pairs of students to test the materials by having one student slide down and another time the ride until the slider's feet touch the ground. Ask students which of the materials creates the fastest ride and why.

### Science Extension

Have seated students cover their shoes with plastic bags and shuffle their feet on the floor. How do the bags affect movement on an uncarpeted floor? Now have them put several rubber bands around their shoes. How do the rubber bands affect movement on the floor? Have students discuss why movement was different.

### Science, Technology, and Society

Ask students to describe what it is like to walk through water in a swimming pool. Have them explain why it is difficult. (The water and their body push against each other and create friction.) Elicit their ideas about why fish and boats can move easily through water. If necessary prompt them to think about the shape of fish and boats. Have students suggest ways their own bodies could be shaped so that they would move more easily through the water.