

Different Size, Same Shape

OBJECTIVES

Students experiment with objects of the same shape and material but of different sizes, in order to discover whether size is a factor that affects buoyancy.

The students

- ▶ investigate whether objects of the same material and shape but of different sizes float or sink
- ▶ observe that size does not affect the buoyancy of an object
- ▶ confirm the importance of material as a factor affecting an object's buoyancy

SCHEDULE

About 40 minutes

MATERIALS

For each student

- 1 Activity Sheet 3

For each team of two

- 1 container, plastic, 1-gal
- 1 cube, aluminum, large
- 1 cube, aluminum, small
- 1 cube, lucite, large
- 1 cube, lucite, small
- 1 cube, milky plastic, large
- 1 cube, milky plastic, small
- 1 cube, wooden, large
- 1 cube, wooden, small

For the class

- 1 chart, Sink or Float? (from Activity 2)
- newspaper*
- paper towels*
- water, tap*

*provided by the teacher

PREPARATION

- 1 Make a copy of Activity Sheet 3 for each student.
- 2 Fill each plastic container two-thirds full with water.
- 3 Each team of two will need several sheets of newspaper, a couple of paper towels, a 1-gal plastic container of water, a large and a small aluminum cube (gray), a large and a small lucite cube (clear), a large and a small milky plastic cube (white), and a large and a small wooden cube (brown).

BACKGROUND INFORMATION

Because the buoyancy of a solid cube of material depends on its density, which does not vary with the size of the object, changing the size of a cube does not affect whether it will sink or float. For example, a small branch and a huge log from the same tree will both float; a pebble and a boulder will both sink to the bottom of a lake.

In this activity, shape and material densities are constant properties of each pair of cubes. The only difference is in their sizes. Whether cubes of wood and milky plastic are large or small, their materials are less dense than water and therefore will float. Whether cubes

of aluminum and lucite are large or small, their materials are denser than water and therefore will sink.

Students should remember that objects with the same size and shape but of different materials differed in their buoyancy. This activity will reinforce their understanding of the importance of material as a factor that affects buoyancy, while at the same time enabling them to exclude size as an additional factor.

▼ Activity Sheet 3

Different Size, Same Shape

1. Predict whether each cube will sink or float. Record your predictions in the chart. Test the cubes. Record your observations.

Type of Cube	Prediction: Sink or Float?	Observation: Sink or Float?
Large gray cube	Accept all	sinks
Small gray cube	predictions.	sinks
Large brown cube		floats
Small brown cube		floats
Large white cube		floats
Small white cube		floats
Large clear cube		sinks
Small clear cube		sinks

2. Does the size of an object affect its buoyancy? no
3. Which factor affected whether a cube floated or sank?
The type of material the cube was made of helped make it float or sink. Some cubes were made of heavy material and sank. Other cubes were made of lighter material and floated.

Guiding the Activity

1

Divide the class into teams of two. Give each team a large and a small aluminum cube (gray), a large and a small lucite cube (clear), a large and a small milky plastic cube (white), and a large and a small wooden cube (brown). Ask, **What is the same about all these cubes?**

Instruct students to arrange the cubes on their desk in pairs, so that cubes of the same color are together. Tell students to look only at one pair of cubes. Ask, **What is the same about the two cubes?**

What is different about the two cubes?

Have students look at all four pairs of cubes. Ask, **Are all eight cubes made of the same material?**

Additional Information

They are all the same shape—cubes.

They are the same shape and color and are made of the same material.

Their sizes are different. One is larger (or smaller) than the other.

No. Each pair is made of a different material.

Guiding the Activity

2

To review, ask, **Which of these cubes did you test for buoyancy in the previous activity?**

Remind students that the large cubes are all the same size and shape but are made of different materials (see Figure 3-1). Ask, **What was the factor you found that affects whether those cubes sank or floated in water?**

Point out to students that now they are going to look for another factor that might affect an object's tendency to sink or float in water. Ask, **Do you think the size of these cubes will affect their buoyancy?**

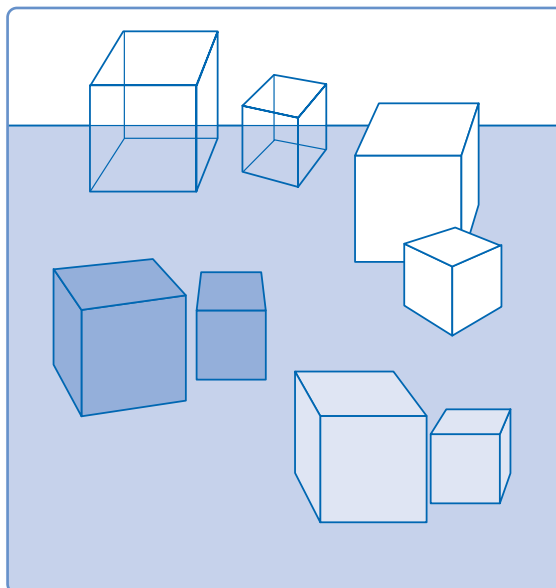
Tell students that they will perform an experiment to find out the answer to this question.

3

Give each student a copy of **Activity Sheet 3**. Instruct students to predict which objects will sink and which will float and to record their predictions on the activity sheet.

Additional Information

the large ones



▲ *Figure 3-1. Each pair of cubes is the same shape and material but composed of two different-sized cubes.*

the type of material they are made of

Accept all answers. Students may say yes, recalling that materials of different weights affected the buoyancy of the large cubes in the previous activity. They may note that the small cubes in each pair are lighter in weight than the large cubes. Do not confirm or deny their guesses at this point.

Point out to them that they are only testing one factor in this activity—size.

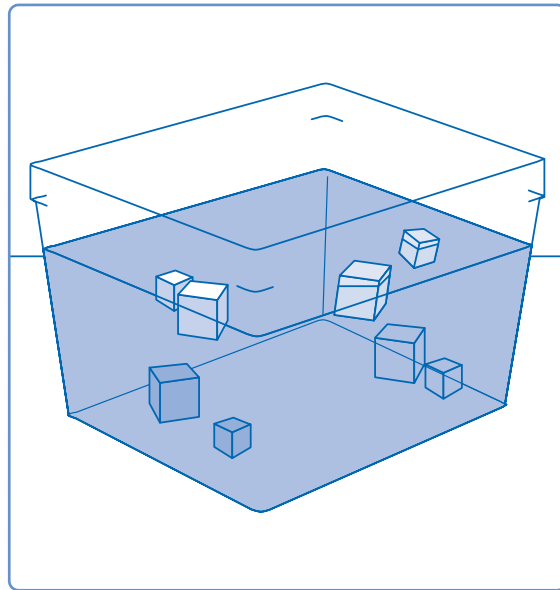
Students should recall Activity 2 and predict that the large gray and clear cubes will sink and the large brown and white cubes will float.

Guiding the Activity

Give each team of two several sheets of newspaper and have them spread them out over their desk or table. Give each team a plastic container of water and a couple of paper towels.

Instruct teams to test their predictions (see Figure 3-2) and record their observations in the chart on the activity sheet.

Additional Information



▲ *Figure 3-2. All wooden and milky plastic cubes float; all aluminum and lucite cubes sink.*

4 Ask students, **Which cubes float?**

Ask, **Does the size of these cubes matter in terms of their buoyancy?**

Ask, **Which cubes sink?**

Ask, **Does the size of these cubes matter in terms of their buoyancy?**

5 Ask students, **Why do you think some cubes float?**

Ask, **Why do the other cubes sink?**

Have students compare the weights of the small cubes by holding them in their palms.

Lead students to conclude that it is not simply the total weight of the cube, but the heaviness of the material in general that affects buoyancy.

The two brown cubes and the two white cubes float.

No, they both float.

The two gray cubes and the two clear cubes sink.

No, they both sink.

Students should infer that the cubes that float are made of a material that is buoyant enough to float.

Students should infer that the cubes that sink are made of a material that is not buoyant enough to float.

They should notice that, just as with the large cubes, the gray and clear cubes are heavier than the brown or white cubes.

Guiding the Activity

6

Refer students to the Sink or Float? chart. Ask, **Should we add size as a factor that affects buoyancy to our chart?**

Review with the students the first (and only) entry on the Sink or Float? chart. Point out that their experiments in this activity prove once again that the type of material an object is made of is an important factor that affects whether it will sink or float in water.

Have students complete the activity sheet.

Additional Information

no

REINFORCEMENT

Have students repeat the activity, putting first just the small cubes in the container of water, then just the large cubes. Have them note that, in both trials, only the milky plastic and wooden cubes floated. Elicit that material, not size, affected the cubes' buoyancy.

Assessment Opportunity

This Reinforcement also may be used as an ongoing assessment of students' understanding of science concepts and skills.

SCIENCE JOURNALS

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

CLEANUP

Tell students to pour out the water in the containers. Have them air dry the containers and the cubes and return them to the kit.

SCIENCE AT HOME

Encourage students to find objects of different sizes but made of the same material and compare their tendencies to sink or float. Pairs of vegetables, such as large and small carrots, apples, potatoes, or green beans, might be available for their experiments. Have students share their results with the class.

Connections

Science Challenge

Let students investigate the buoyancy of two objects of the same material that are the same weight but of different sizes. For this activity, each team will need two 50-g chunks of clay, two containers of water, and the arm of a balance. Tie a length of string to the center of the balance arm so that it can be suspended in air. Direct students as follows: Make one of the chunks of clay into a tightly packed ball. Loosely roll the other chunk of clay so that it is larger than the first ball. Tie a length of string around each ball, and attach one ball to each end of the balance arm. Both balls should hang at the same distance from the arm. Place the containers of water in such a way that you can dip one ball into each container. What happens when you lower both balls into the water at the same time? Which ball seems to be lighter in the water, the larger one or the smaller one? (Students will observe that the larger ball seems lighter than the more tightly packed ball.) Explain that the pockets of air trapped in the larger ball increase its buoyancy. Even though both balls are the same weight, the loosely packed ball has greater buoyancy.

Science Extension

Let students repeat the activity sheet investigation with a variety of other objects of the same shape and material but of different sizes. Possible objects to test include different sizes of rubber balls, lumps of clay, pencils, coins, and milk cartons. Students will observe that as long as the shape and material are the same, size does not affect whether an object will sink or float.

Science and the Arts

Demonstrate for students how to enlarge a drawing by means of a grid. You will need graph paper of two different scales. Using the smaller scale paper, draw a simple outline. Then show students how to enlarge the drawing by transferring it to the larger scale paper. Box by box, copy each part of the small drawing onto the corresponding box in the larger grid. The end result will be a drawing that is the same shape but a different size. Provide students with graph paper, and let them make their own drawings and enlarge them.

Science, Technology, and Society

- ▶ Ask students whether any of them has ever made models, such as a model airplane, ship, or car. Invite students to share their model-building experiences, telling about the degree of detail used in the model and relating the size of the model to the actual object. Explain that when engineers and designers are working on a new type of car, for example, they usually begin by making small-scale models of the new design before making a full-scale prototype. Encourage students to find out about the use of models in design and manufacturing and how the designers use the model to create a full-scale version.
- ▶ At the other extreme, miniaturization has reduced the size of components used in such equipment as computers and television sets, thereby reducing the size of the equipment. Suggest that students choose one item to research, such as the computer. Ask students to find out the size of the first models, advances in technology that have enabled the size to be reduced, and how present-day models compare with earlier models in such areas as size, memory (in the case of computers), efficiency, and other factors.