

8 Measuring Volume



In the last activity, you compared the density of several solids to water. In the next three activities, you will learn how to determine density and use it to identify a substance. You will begin by learning how to measure the volume of an object. **Volume** is the amount of space a material takes up. The material can be a solid, liquid, or a gas. You use volume measurements in your daily life to describe amounts of things such as one gallon of gas, two liters of soda, or one quart of milk. The metric system units scientists use to measure volume are the liter (L) and the cubic meter (m^3). Smaller volumes are often measured in milliliters (mL) or cubic centimeters (cm^3). The table on the next page shows metric units used to measure mass, length, and volume that you will use in this unit along with the English units commonly used in the United States.

In this activity, you will focus on measuring the volume of solid objects using two different methods—measurement and calculation and water displacement. This will prepare you to determine the volume of the metallic solids from the mixture.

CHALLENGE



How do you measure the volume of a solid object?

What volume of liquid is currently in the measuring cup? This glass measuring cup, commonly found in home kitchens, measures volume in both English and metric units.



Units of Measurement		
	Common Metric Units	Common English Units
Length	Centimeter (cm) Meter (m) Kilometer (km)	Inch (in) Foot (ft) Yard (yd) Mile (Mi)
Mass	Gram (g) Kilogram (kg)	Ounce (oz) Pound (lb)
Volume	Milliliter (ml) Liter (l) Cubic centimeter (cm ³) Cubic meter (m ³)	Cup (c) Quart (qt) Gallon (g)

MATERIALS



For each group of four students

- 1 set of six objects:
 - light gray cube
 - dark gray cube
 - light gray cylinder
 - dark gray cylinder
 - light gray bar
 - dark gray bar



For each pair of students

- 1 pair of plastic forceps
- 1 50-mL graduated cylinder
- 1 pipette
- 1 calculator
- supply of water
- paper towels



For each student

- 1 pair of goggles
- 1 metric ruler
- Student Sheets 8.1a and 8.1b, “Two Methods to Measure Volume”



SAFETY

Review the procedure and decide on appropriate safety measures for working with the unknown solids. If you do not know what material an object is made from, assume it is hazardous until you prove otherwise.

PROCEDURE

1. Record on Student Sheet 8.1a, “Two Methods to Measure Volume,” the letter on your group’s cup of objects.
2. Remove the six objects from the cup so that you can observe each one.
3. Predict the order of the six objects from least to greatest volume. Record your predicted order in your notebook.
4. Watch your teacher demonstrate how to measure the volume of an object using two methods:
 - measurement and calculation
 - water displacement
5. Divide the six objects into two sets so that each pair in your group gets either the light gray set or the dark gray set. Each pair will begin by measuring the volumes of the three objects in one set.
6. Decide which method listed in Step 4 above is best for determining the volume of each object.
7. Determine the volume of each object. Record your data and calculations on Student Sheet 8.1b.
8. Exchange objects with the other pair of students in your group, and repeat Steps 6 and 7.
9. Compare your data for each object with the results found by the other pair of students in your group. If you think any of your results are inaccurate, repeat your measurements and calculations.
10. Based on your data, list the six objects from least to greatest volume. Record the measured volume of each of the six objects in your notebook.

ANALYSIS

1. Choose one of the objects from Student Sheet 8.1b. Which method—water displacement or measurement and calculation—did you use to determine its volume? Explain why you chose that method.
2. Look at the way you ordered the objects by volume in Step 3. Compare this with the measured volumes you recorded in your notebook in Step 10. Were they the same? Explain.
3. Copy the three lists of measurements shown below. Pay close attention to the units that follow each number.

List 1	List 2	List 3
150 mL	2 mL	1 L
11 mL	801 mL	999 mL
200 mL	27 cm ³	998 cm ³

- a. Cross out the smallest volume in each list.
- b. Circle the largest volume in each list.
4. How would you measure the volume of:
 - a. a cardboard shoebox?
 - b. a plastic pen?
 - c. an irregularly shaped stone?
 - d. a child's wooden block?
 - e. some orange juice?
 - f. the two metallic solids from your mixture?
5. In this activity, you were working with unidentified materials. Explain the safety steps you took when working with the solids.
6. How would you explain volume to a 10-year-old?
 - Include at least two examples that would be familiar to a child and that would clarify your explanation.
 - Include a diagram to help you explain your ideas.