

# Measuring Volume and Temperature

## Background Information

The amount of space an object takes up is called its volume. A commonly used unit of volume is the liter (L). Smaller volumes can be measured in milliliters (mL). One milliliter is equal to 1/1000 of a liter. In the laboratory, the graduated cylinder is often used to measure the volume of liquids.

Temperature is measured with a thermometer. The unit of measurement for temperature is the degree Celsius ( $^{\circ}\text{C}$ ).

In this investigation, you will practice making measurements of the volume and temperature of a liquid.

## Problem

How can you accurately measure the volume and temperature of a liquid?

## Pre-Lab Discussion

*Read the entire investigation. Then, work with a partner to answer the following questions.*

- 1. Measuring** How many significant figures are there in the measurement shown in Figure 1?

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- 2. Inferring** Why is it important to read the volume of water in a graduated cylinder by using the bottom of the meniscus?

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- 3. Designing Experiments** Why should you leave the thermometer in beaker B when you add ice?

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- 4. Measuring** If each mark on a thermometer represents  $1^{\circ}\text{C}$ , which part of a temperature measurement will be the estimated digit?

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**Materials** (per group)

2 150-mL beakers

2 Celsius thermometers

100-mL graduated cylinder

watch or clock


glass-marking pencil

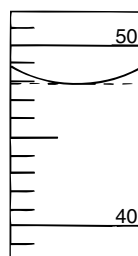
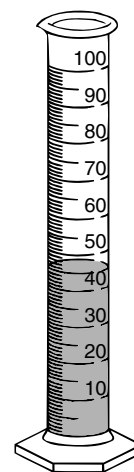
ice cube

**Safety** 

Put on safety goggles and a lab apron. Be careful to avoid breakage when working with glassware. Note all safety alert symbols next to the steps in the Procedure and review the meaning of each symbol by referring to the Safety Symbols on page xiii.

**Procedure****Part A: Measuring the Volume of a Liquid**

-  1. Fill a beaker halfway with water.
2. Pour the water in the beaker into the graduated cylinder.
3. Measure the amount of water in the graduated cylinder. To accurately measure the volume, your eye must be at the same level as the bottom of the meniscus, as shown in Figure 1. The meniscus is the curved surface of the water.
4. Estimate the volume of water to the nearest 0.1 mL. Record this volume in Data Table 1.
5. Repeat Steps 1 through 4, but this time fill the beaker only one-fourth full of water.

**Figure 1****Part B: Measuring the Temperature of a Liquid**

6. Use the glass-marking pencil to label the beakers *A* and *B*.
7. Use the graduated cylinder to put 50 mL of water in each beaker.
8. Place a thermometer in each beaker. In Data Table 2, record the temperature of the water in each beaker.
9. Carefully add one ice cube to the water in beaker *B*. Note and record the time.
10. After 1 minute, observe the temperature of the water in each beaker. Record these temperatures in Data Table 2.
11. After 5 minutes, observe the temperature of the water in each beaker. Record these temperatures in Data Table 2.
12. After the ice in beaker *B* has melted, use the graduated cylinder to find the volume of water in each beaker. Record these volumes in Data Table 3.

## Observations

**DATA TABLE 1**

Measurement	Volume of Water (mL)
Half-filled beaker	
One-fourth filled beaker	

**DATA TABLE 2**

Beaker	Temperature at Beginning	(°C) Temperature After 1 Minute (°C)	Temperature After 5 Minutes (°C)
A			
B			

**DATA TABLE 3**

Beaker	Volume of Water at Beginning (mL)	Volume of Water at End (mL)
A		
B		

## Analysis and Conclusions

1. **Observing** What is the largest volume of a liquid that the graduated cylinder is able to measure? What is the smallest volume that the graduated cylinder is able to measure?

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2. **Analyzing Data** Describe how the temperature of the water in beakers A and B changed during the investigation.

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3. **Analyzing Data** How did the volume of water in beakers A and B change during the investigation? What do you think caused this change?

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4. **Applying Concepts** Would you use a 100-mL graduated cylinder, a 25-mL graduated cylinder, or 10-mL graduated cylinder to measure 8 mL of a liquid? Explain your answer.

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## Go Further

Some liquids do not form a meniscus in a graduated cylinder as water does. Use a 10-mL graduated cylinder to measure 8.0 mL each of water, isopropyl (rubbing) alcohol, and vegetable oil. Observe and draw the meniscus of each liquid. Label your drawings to show how you think the volume of each liquid should be measured. Explain why you think that the volumes should be measured in this way.