

Mass, Volume, and Dissolving



What happens to the mass of a solute when the solute is added to a solvent?

INTRODUCTION

What happens to the mass and volume of two substances when the substances are mixed to form a solution? Will the mass and volume of the solute and the solvent remain the same before and after dissolving? In this lesson, you will conduct two inquiries. In the first inquiry, you will make a solution from two liquids of known mass and volume and compare their masses and volumes before and after mixing. In the second inquiry, you and your lab partner will devise a procedure for determining whether any change in mass occurs when salt (sodium chloride) is dissolved in water.

OBJECTIVES FOR THIS LESSON

Predict what happens to the mass and volume of a solute and a solvent when these substances are mixed together to form a solution.

Perform an inquiry to test your predictions.

Design and conduct an inquiry to investigate whether a change in mass occurs when sodium chloride dissolves in water.

Getting Started

- 1.** Previously in the module, you learned that two properties of matter are mass and volume. Why is mass, and not volume, used to measure the amount of matter in an object? Discuss this question with the other members of your group. You will be expected to contribute your ideas to a class discussion about mass and volume.
- 2.** One member of your group should collect the plastic box containing the materials. Check the contents of the plastic box against the materials list.
- 3.** You will be working in pairs. Split the apparatus equally between the pairs in your group.
- 4.** Fill the beaker with water. You will use this water to practice pouring an exact volume of water into a 100-mL graduated cylinder.
- 5.** With your partner, review and practice the correct technique (refer to Figure 2.2 in Lesson 2 and Figure 14.1 in this lesson to ensure an accurate measurement), as follows:
 - A.** One partner chooses an exact volume of water for the other partner to pour into the graduated cylinder.

MATERIALS FOR LESSON 14

For you

- 1 copy of Student Sheet 14.1: Mixing Water and Alcohol
- 1 copy of Student Sheet 14.2: Dissolving a Solid and Measuring Mass
- 1 pair of safety goggles

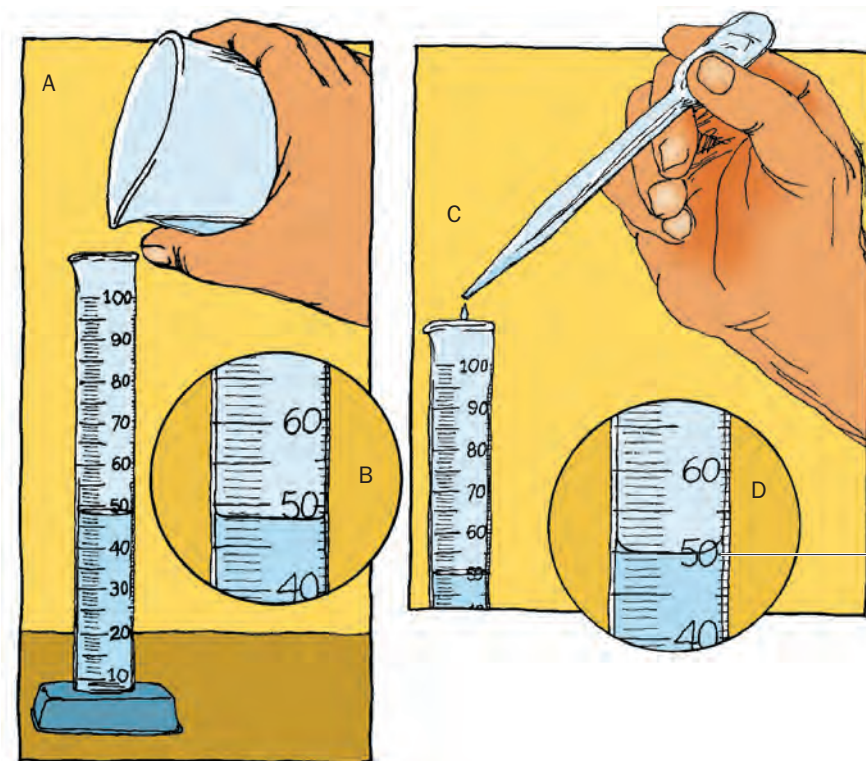
For your group

- 2 250-mL beakers
- 4 100-mL graduated cylinders
- 2 pipettes
- 4 test tubes
- 2 lab scoops
- 2 jars containing sodium chloride
- 2 bottles containing ethyl alcohol (ethanol)
- 4 paper towels
- Access to water
- Access to an electronic balance

- B.** Place the graduated cylinder on a level surface.
- C.** Fill the graduated cylinder to 1.0 or 2.0 mL below the volume you require.
- D.** Using the pipette, slowly add water until you have the exact volume you want.
- 6.** Carefully check your partner's measurement.

SAFETY TIP

Wear your safety goggles throughout both inquiries.



The bottom of the meniscus aligns exactly on the measurement you want.

Figure 14.1 (A) Place the cylinder on a level surface. (B) Fill the cylinder to within 1.0 or 2.0 mL of the volume you want. (C) Slowly add water, using the pipette, until (D) the meniscus aligns exactly at the volume you want.

Inquiry 14.1

Mixing Water and Alcohol

PROCEDURE

1. Put exactly 50.0 mL of water into one of the 100-mL graduated cylinders.
2. Put exactly 50.0 mL of ethyl alcohol into the other 100-mL graduated cylinder.
3. Measure the mass of each cylinder and its contents. Record your results in Table 1 on Student Sheet 14.1.
4. Predict what you think the volume will be after you mix the water and the ethyl alcohol. Predict what you think the mass will be after you mix the water and the ethyl alcohol.
5. Record your predictions in Table 1.
6. Test your predictions by carefully pouring the ethyl alcohol into the 100-mL cylinder containing the water (see Figure 14.2). Allow a minute for the ethyl alcohol to drain completely from the graduated cylinder. Gently tap the cylinder with your finger to speed up the process. Take care to avoid spills.

SAFETY TIP

If you spill the ethyl alcohol, immediately tell your teacher.

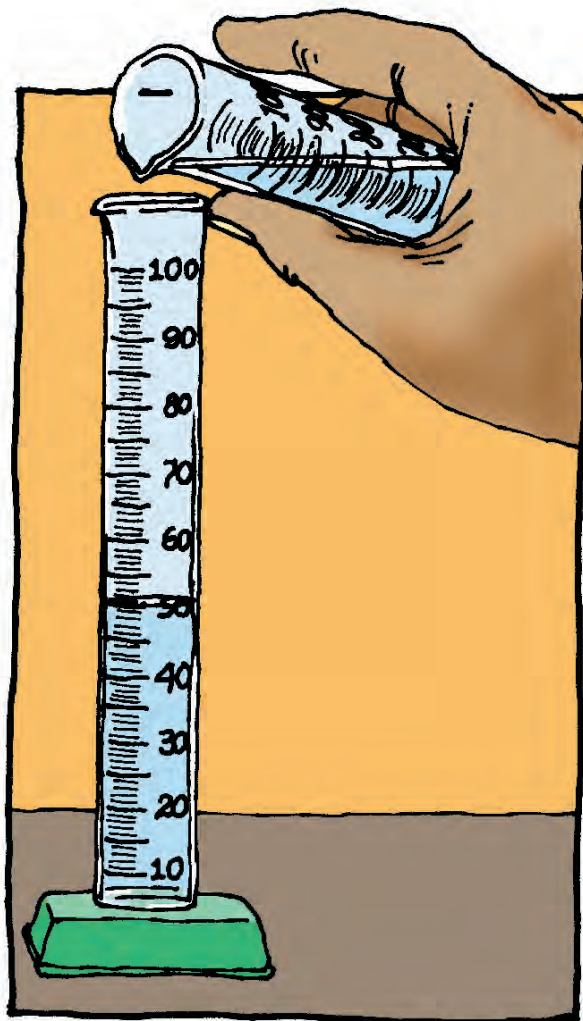


Figure 14.2 Carefully mix the two liquids. Allow a minute for the ethyl alcohol to drain completely from the cylinder. Gently tap the cylinder with your finger to speed up the process. Take care to avoid spills.

- 7.** Measure the volume of the mixture. Measure the combined mass of both of the graduated cylinders and the mixture. In Table 1, record your measurements and calculate any differences in mass and volume before and after mixing. Empty the graduated cylinder.
- 8.** Answer the following questions on the student sheet: What type of mixture was formed when you mixed the water and the ethyl alcohol? What happened to the volume? What happened to the mass?
- 9.** Write your results in the class results table (on the board or transparency).
- 10.** Compare your results with those of the rest of the class. What conclusions can you reach? Write your answer on the student sheet. Be prepared to explain your conclusions during a class discussion.
- 11.** Put the ethanol-water mixture in the appropriate container.

Inquiry 14.2

Dissolving a Solid and Measuring Mass

PROCEDURE

- 1.** You and your lab partner will design an inquiry to determine what happens to the mass of sodium chloride and water when sodium chloride is dissolved in water. The following questions may help you in the design process:
 - A. *What do you need to measure?*
 - B. *What apparatus should you use? (You may use any of the materials that are in the plastic box.)*
 - C. *How much solute and solvent will you use? (Remember to consider the solubility of the sodium chloride.)*
 - D. *What precautions should you take to obtain accurate measurements?*
 - E. *How will you record your results?*

- 2.** Write your procedure on Student Sheet 14.2. If you have any problems, discuss them with your teacher.
- 3.** Conduct the inquiry.
- 4.** Record your results on the student sheet. Compare them with those obtained by other pairs.
- 5.** Clean and dry your apparatus. Return it to the plastic box.
- 6.** What can you conclude from this experiment? Write your answer on the student sheet.
- 7.** Participate in a class discussion about the procedure you used, your results, and your conclusions.

REFLECTING ON WHAT YOU'VE DONE

Answer these questions in your science notebook:

- A. What have you discovered by doing these two inquiries?*
- B. What happens to the mass of two types of matter when they are mixed together to form a solution (for example, when a solid is dissolved in a liquid)?*
- C. Does the same rule apply to volume?*
- D. How do your results compare with what you already know about what happens to the mass and volume of matter during phase change?*