Name _____ Class _____ Date _____

CHAPTER 5 | Elements, Compounds, and Mixtures

SECTION 3

Mixtures

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- How do mixtures differ from elements and compounds?
- How can mixtures be separated?
- What are solutions, and how are they characterized?

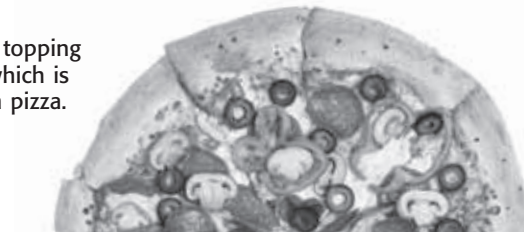
California Science Standards

8.7.c

What Are the Properties of Mixtures?

The illustration in the figure below shows a familiar mixture—a pizza. When you look at a piece of pizza, you can easily see different parts that have different properties. A **mixture** is a combination of two or more substances that are not chemically combined.

You can see each topping on this mixture, which is better known as a pizza.



STUDY TIP

Brainstorm The main focus of this section is mixtures of substances. Brainstorm words and phrases related to mixtures. Record your work in your notebook.

Chemicals can form mixtures. No chemical change happens when a mixture is made. That means that each chemical keeps its same identity. The pepperoni and olives on the pizza don't change when they are mixed. Making a mixture is therefore a physical change. ☑

READING CHECK

1. Identify What kind of change occurs when a mixture forms?

_____

Sometimes, you can see the components of the mixture. For example, if you mix sugar and sand together, you can see the different crystals in the mixture. In other mixtures, such as salt water, you cannot see the individual parts. Even so, there is no chemical reaction. You don't change the salt or the water by making the mixture.

Because the components of a mixture are not changed into new chemicals, they can often be separated easily. The olives and pepperoni can be picked off the pizza by hand. A magnet can pull iron particles out of a mixture of iron and sand. ☑

READING CHECK

2. Explain Why can mixtures often be separated easily?

_____

_____

_____

_____

Other mixtures are not separated so easily. Salt can't simply be picked out of seawater. Salt can be separated from the water in salt water, though, by letting the water evaporate. Heating the seawater speeds up the process.

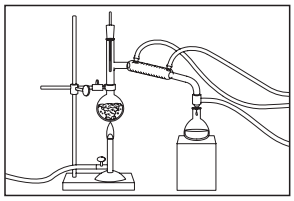
TAKE A LOOK

3. Identify Distillation always requires the addition of energy to convert a substance to a gas. How is energy added in the illustration?

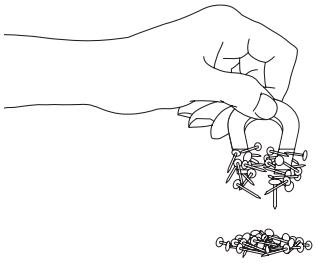
_____

How Can Mixtures Be Separated?

The figure below shows three methods of separating the parts of a mixture.



Distillation is the process that separates a mixture based on boiling points. Water in this mixture evaporates and then condenses as pure water.



A **magnet** can be used to separate a mixture of the elements iron and aluminum. Iron is attracted to the magnet, but the aluminum is not.

Critical Thinking

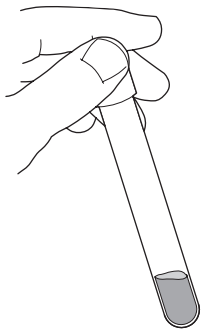
4. Infer How does the separation of blood into several layers in a centrifuge show that blood is a mixture instead of a pure substance?

_____

_____

_____

_____



Blood is separated into its parts by a machine called a **centrifuge**. In the test tube of blood at the left, a layer of plasma rests on top of a layer of red blood cells. A centrifuge separates mixtures by the densities of the components.

Another method of separating the parts of a mixture is to dissolve one of the substances in water, filter the mixture, and then evaporate the water. This is shown below as a diagram called a *flow chart*. The flow chart for the separation of table salt and sulfur is illustrated.

TAKE A LOOK

5. Identify What is not collected in the process shown by the flow chart?

_____

Dissolving In the first step, water is added, and the mixture is stirred. Salt dissolves in water. Sulfur does not. → **Filtering** In the second step, the mixture is poured through a filter. The filter traps the solid sulfur. → **Evaporating** In the third step, the water is evaporated. The salt is left in the evaporating dish on the hot plate.

Do Mixtures Have Fixed Ratios?

A compound is made of elements that are always present in a fixed ratio. For example, water is always two parts hydrogen and one part oxygen.

A mixture, however, does not have a fixed ratio of components. If you make a mixture of salt and water, you can put in a little salt or a lot of salt. Either way, you make a mixture. The figure below compares mixtures and compounds. ☑

Mixtures	Compounds
are made of elements, compounds, or both	are made of elements
keep the original properties of the components	do not have the original properties of the components
do not require heat or electricity for separation of components	require heat or electricity for separation of components
may have any ratio of components	must have a set ratio of components

READING CHECK

6. Compare How does the ratio of components in a mixture compare with the ratio of elements in a compound?

_____

_____

_____

_____

What Is a Solution?

Salt water is an example of a solution. A **solution** is a *homogeneous* mixture. This means that a solution appears to be a single substance. The particles of the substances in a solution are evenly spread out. The appearance and properties are the same throughout the solution.

The process in which particles of substances separate and spread evenly throughout a mixture is known as *dissolving*. In a solution, the component that is present in the largest amount is called the **solvent**. Substances present in smaller amounts are called **solutes**. ☑

Say It

Discuss Read "What Is a Solution?" Then, in small groups, discuss the solvent and solutes in soft drinks.

WATER AS A SOLVENT

Water is a very common solvent. In a salt water solution, water is the solvent, and salt is the solute. Water is the solvent of many of the solutions that you come across in daily life. In fact, your body contains many water solutions—blood plasma, saliva, and tears are all water solutions. Reactions inside cells take place in water solutions. So many different substances dissolve in water that it is often called the "universal solvent." ☑

READING CHECK

7. Identify In a solution, what component is present in the largest amount?

_____

READING CHECK

8. Identify What is called the universal solvent?

_____

TYPES OF SOLUTIONS

Water is not the only solvent, though. Many other liquids dissolve substances, some of which do not dissolve in water. *Hydrocarbon solvents*, such as turpentine, are used to dissolve grease and other substances that don't dissolve in water.

In fact, solvents do not have to be liquids. Gases or even solids are able to acts as solvents by dissolving other substances. The air around you is a solution of oxygen and other gases in nitrogen. Many familiar metals are *alloys*. Alloys, such as bronze, are solid solutions in which a metal is the solvent. Other metal or nonmetal elements are the solutes.

The table below shows some examples of solutions. The key point in forming a solution is that the particles of the components are evenly spread throughout the solution.

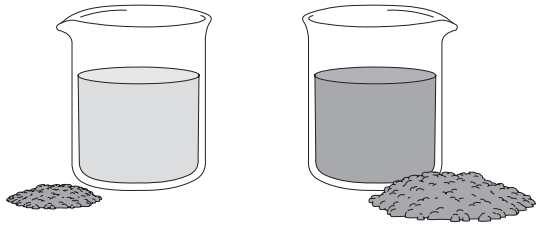
Examples of Solutions in Various States of Matter

State of matter	Example
Gas in a gas	dry air (oxygen in nitrogen)
Gas in a liquid	soft drinks (carbon dioxide in water)
Liquid in a liquid	antifreeze (an alcohol in water)
Solid in a liquid	salt water (salt in water)
Solid in a solid	brass (zinc in copper)

How Much Solute Can Be Added to a Solvent?

A measure of the amount of solute in a given amount of solvent is **concentration**. The concentration of a solution tells the mass of solute in a volume of solution. The units of concentration are grams of solute per milliliter of solvent (g/mL). As more solute is added, the concentration of the solution becomes greater. ☑

Solutions are often described as being concentrated or dilute. A *dilute solution* is one that has a small amount of solute dissolved in the solvent. A *concentrated solution* has more solute in solution. These terms do not tell you the actual concentration of the solution. Rather, they describe a relative concentration.



The dilute solution (left) contains less solute than the concentrated solution (right).

Critical Thinking

9. Apply Ideas If you look at the side of a quarter, you can see layers of different metals. Is the coin a solid solution? Explain.

_____

_____

_____

_____

TAKE A LOOK

10. Identify In each of the example solutions, circle the name of the solute.

READING CHECK

11. Define What two things do you need to know in order to calculate concentration?

_____

_____

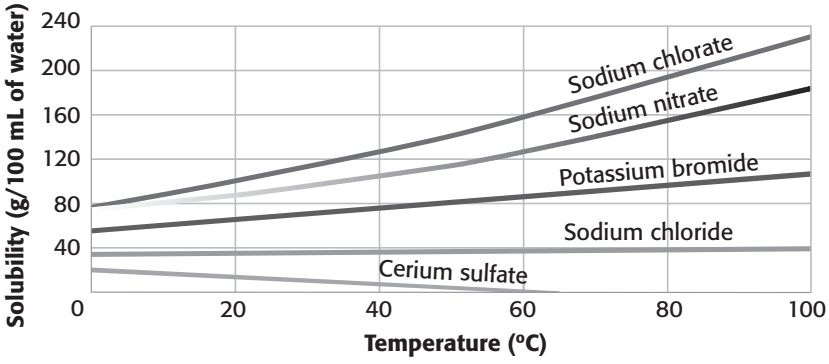
SOLUBILITY

Is there a limit to the amount of solute that can be added to a solution? The answer is yes. Think about how you add sugar to lemonade. As you add some sugar to the lemonade and stir it, the sugar dissolves. If you add more sugar, you make a solution that is more concentrated. Eventually, no matter how much you stir, some sugar remains as a solid at the bottom of the glass.

To find the maximum amount of sugar that you could add to the lemonade, you need to know the solubility of sugar in water. **Solubility** refers to the ability of a solute to dissolve in a solvent at a certain temperature.

For most solids, the solubility in water increases as temperature increases. This is shown on the graph below as a line that slopes upward to the right. However, there are some exceptions. Does the graph show an exception to this rule? Yes, the line for cerium sulfate slopes downward to the right. This means that as the temperature increases, cerium sulfate gets less soluble.

Experiments have determined the solubility of many substances in various solvents. The graph below shows the solubility of several compounds in water.



For most solids, solubility increases as temperature increases. Therefore, the amount of solute that can dissolve increases as the temperature increases. However, some solids, such as cerium sulfate, become less soluble as temperature increases.

Critical Thinking

12. Infer If you keep adding sugar to lemonade, why does the sugar eventually stop dissolving?

_____

_____

_____

Math Focus

13. Read a Graph What is the solubility of sodium chlorate at 60°C?

_____

Name _____ Class _____ Date _____

Section 3 Review

8.7.c

SECTION VOCABULARY

concentration the amount of a particular substance in a given quantity of a mixture, solution, or ore

mixture a combination of two or more substances that are not chemically combined

solubility the ability of one substance to dissolve in another at a given temperature and pressure

Wordwise The root *solute-* means "to free" or "to loosen."

solute in a solution, the substance that dissolves the solute

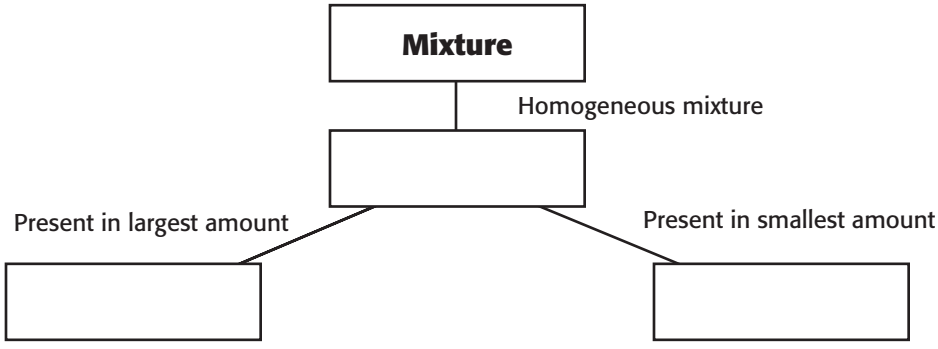
solution a homogeneous mixture throughout which two or more substances are dispersed

solvent in a solution, the substance in which the solute dissolves

1. Identify What are the solvent and solute in a solution containing 100 g of ethanol and 3 g of sucrose?

_____

2. Organize Complete the Concept Map for a mixture shown below.



3. Analyze Processes In a steel factory, iron is melted. Then, other elements, such as carbon and nickel, are added to the melted iron to make steel. What is the reason for melting the iron?

_____

_____

_____

4. Apply Concepts Suppose you added a cup of sugar to hot water, and all of the sugar dissolved. Then the water cooled, and some of the sugar was seen as a solid on the bottom of the beaker. Explain why this happened.

_____

_____

_____