

## section 1 Composition of Matter

### What You'll Learn

- what are substances and mixtures
- how to identify elements and compounds
- the difference between solutions, colloids, and suspensions

### Mark the Text

**Underlining** Look for different descriptions of matter as you read each paragraph. Underline these descriptions. Read the underlined descriptions again after you've finished reading the section.

### ● Before You Read

Matter is all around you. You breathe matter, sit on it, and drink it every day. What words would you use to describe different kinds of matter?

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### ● Read to Learn

#### Pure Substances

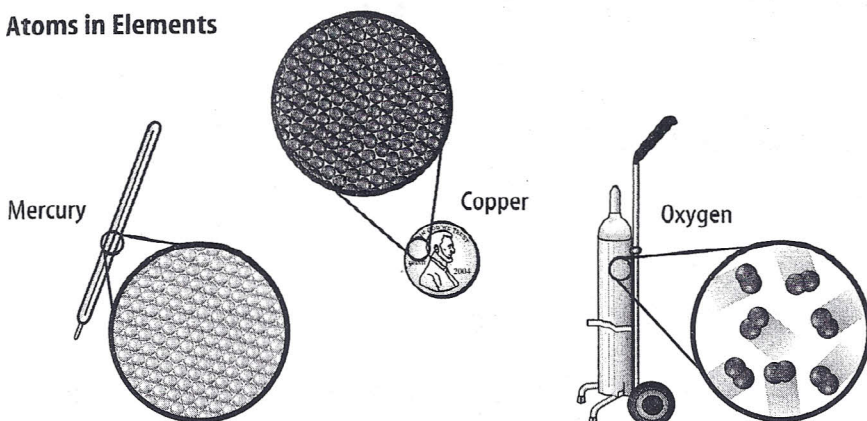
Have you ever seen a print that looked like a real painting? Did you have to touch it to find out? The smooth or rough surface told you whether it was a painting or a print. Each material has its own properties. The properties of materials can be used to classify them into categories.

Materials are made of a pure substance or of a mixture of substances. A substance is a type of matter that is always made of the same material or materials. A substance can be either an element or a compound. Some substances you might recognize are helium, aluminum, water, and salt.

#### What are elements?

All substances are made of atoms. A substance is an element if all the atoms in the substance are the same. The graphite in your pencil is an element. The copper coating on most pennies is an element, too. In graphite, all atoms are carbon atoms. In copper, all atoms are copper atoms. The metal under the copper coating of a penny is another element, zinc. There are about 90 elements found on Earth. More than 20 other elements have been made in laboratories. Most of the 20 human-made elements are unstable. They exist for only a short time in laboratories. You may recognize the elements that are shown in the figure on the next page.

## Atoms in Elements



## What are compounds?

A **compound** is a substance with two or more elements that are combined in a fixed proportion. A common compound is water. Water is made up of the elements hydrogen and oxygen. Each water molecule contains two hydrogen atoms and one oxygen atom. A molecule is the smallest particle of a compound that has all the properties of the compound. Chalk is another compound. It contains calcium, carbon, and oxygen. Each chalk molecule contains one calcium atom, one carbon atom, and three oxygen atoms.

Can you imagine putting a silvery metal and a greenish-yellow poisonous gas on your food? Table salt is a compound that fits this description. Another name for table salt is sodium chloride. It is made up of sodium, a silvery metal, and chlorine, a greenish-yellow poisonous gas. Many compounds look different from the elements in them. The table lists some common compounds and the elements in them.

Some Common Compounds	
Compound	Elements in the Compound
Water (clear liquid)	Hydrogen (clear gas) Oxygen (clear gas)
Table salt (white solid)	Sodium (silvery metal) Chlorine (green-yellow gas)
Carbon dioxide (clear gas)	Carbon (black solid) Oxygen (clear gas)
Table sugar (white solid)	Carbon (black solid) Hydrogen (clear gas) Oxygen (clear gas)

## Mixtures

Is pizza one of your favorite foods? Do you like soft drinks? If so, you like two foods that are mixtures. A mixture is a material made up of two or more substances that can easily be separated.

## Picture This

- Determine** What are the elements in each object shown in the figure?

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## Think it Over

- Infer** How do you know that the water molecules from a faucet and the water molecules from a river are the same?

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## Picture This

- Infer** Which of the following combine to make water? Circle the correct answer.

- two liquids
- two gases
- a liquid and a gas



### ✓ Reading Check

4. **Explain** How can you tell that a pizza is a heterogeneous mixture?

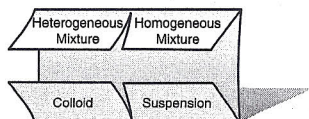
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### FOLDABLES™

- A Classify** Make the following Foldable to help you classify heterogeneous and homogeneous mixtures, colloids, and suspensions.



### ✓ Reading Check

5. **Explain** Why is soda in an unopened bottle a homogeneous mixture?

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## What are heterogeneous mixtures?

Mixtures are different from compounds in several ways. One difference is that mixtures do not always contain the same proportions of the substances that make them up. For example, a pizza chef might put more cheese on one pizza than on another pizza. When you look at a pizza, you easily can see the different ingredients. A mixture in which different materials can be identified easily is called a **heterogeneous** (he tuh ruh JEE nee us) **mixture**. Granite, concrete, and pizza are some examples of heterogeneous mixtures. ✓

You may be wearing a heterogeneous mixture. Some fabrics are labeled as permanent-press. These fabrics resist wrinkles. Permanent-press fabric contains fibers of two materials. The materials are polyester and cotton. The amounts of polyester and cotton can change from one piece of fabric to another. Look at the labels on some of your clothes. See if some contain different amounts of polyester and cotton.

You probably cannot tell that permanent-press fabric is a heterogeneous mixture by looking at it. It looks like it is made up of only one material. However, you might be able to see the mixture with a microscope. Under a microscope, the polyester fibers probably would look different from the cotton fibers.

Many of the substances around you are heterogeneous mixtures. Some have materials that are easy to see, such as those in pizza. Others have materials that are not easy to tell apart, such as the fibers in permanent-press fabrics. In fact, some of the parts of heterogeneous mixtures can be mixtures themselves. For example, the cheese in pizza is a mixture, but you cannot see the materials. Cheese contains many compounds, such as milk, proteins, butterfat, and food coloring.

## What are homogeneous mixtures?

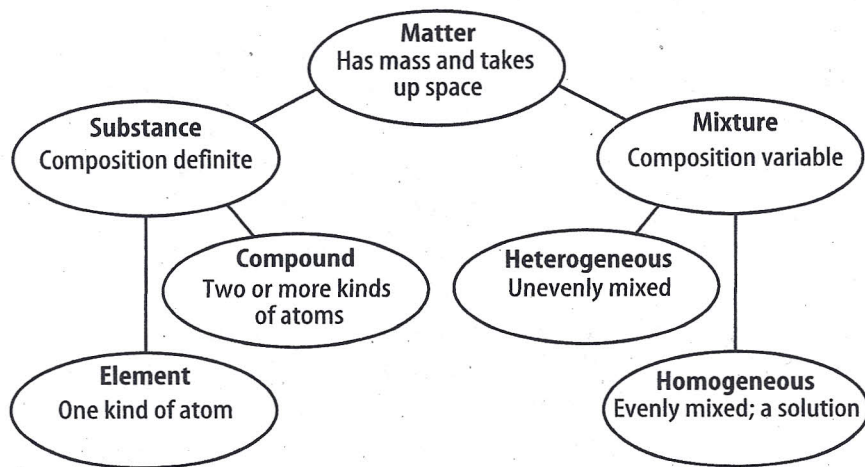
Remember the soft drink you had with your pizza? Soft drinks are mixtures. They contain water, sugar, flavorings, coloring, and carbon dioxide gas.

Soft drinks in sealed bottles are homogeneous mixtures. A **homogeneous** (hoh muh JEE nee us) **mixture** contains two or more substances blended evenly throughout. You cannot see the different substances in a homogeneous mixture. However, when a soft drink is poured into a glass, the carbon dioxide gas forms bubbles. You then can see that the gas is separate from the other ingredients. When this happens, the soda becomes a heterogeneous mixture. ✓



## What is a solution?

Vinegar is another homogeneous mixture. It looks clear, but it contains particles of acetic acid mixed with water. Homogeneous mixtures, such as soft drinks and vinegar, also are known as solutions. A **solution** is a homogeneous mixture of particles so small that they cannot be seen with a microscope and will never settle to the bottom of their container. Solutions stay constantly and evenly mixed. Look at the diagram. It summarizes the differences between substances and mixtures.



## Picture This

6. **Identify** In the diagram, highlight the words that explain the difference between a substance and a mixture.

## What are colloids?

Milk is an example of a special mixture called a colloid. A **colloid** (KAH loyd) is a type of mixture with particles that are larger than those in solutions, but not heavy enough to settle to the bottom of their container. Remember how a pizza was still a pizza even if the proportion of its ingredients were changed? Milk is similar to a pizza in that way. Milk contains water, fat, and proteins, but like any mixture, these substances can be in different proportions. What makes milk a colloid is that these ingredients form large particles, but they are not heavy enough to settle.

Paint is an example of a liquid colloid. Gases and solids can also be colloids. For example, fog and smoke are colloids. Fog is made up of liquid water particles suspended in air. Smoke contains solids suspended in air.

## Do colloids and solutions look the same?

One way to tell the difference between a colloid and a solution is by how each looks. Fog looks white because its particles are large enough to scatter light. Sometimes it is not easy to tell that a liquid is a colloid. For example, some shampoos and gelatins are colloids called gels that look almost clear.

## Think it Over

7. **Give an Example** Name a colloid that you can see through.
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### Think it Over

8. **Infer** Why would a dam cause suspended particles to settle out of river water?

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### Applying Math

9. **Comparison** Which type of mixture has the largest particles? Explain how you know.

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## How do you identify colloids?

You can tell if a liquid is a colloid by shining a beam of light through it. You cannot see a light beam as it passes through a solution. But you easily can see a light beam in a colloid because its large particles scatter light. Small particles in solutions do not scatter light. Have you ever noticed how fog scatters the light from a car's headlights? The scattering of light by particles in a colloid is known as the **Tyndall effect**.

## What are suspensions?

Some mixtures are neither solutions nor colloids. One example is muddy pond water. If pond water stands long enough, some mud particles will fall to the bottom. The water becomes clearer. Pond water is a suspension. A **suspension** is a heterogeneous mixture containing a liquid in which you can see particles settle.

## Where do suspensions occur in nature?

A river is an example of how a suspension settles. Rivers move quickly when they go through narrow channels. They pick up soil and debris as they go. The soil and debris is suspended in the water. As long as the water in the river moves fast enough, the suspended soil does not settle. When the river slows, the particles fall out of the suspension and settle on the bottom of the river. This also happens when rivers flow into large bodies of water such as lakes or oceans. After many years, the soil builds up and forms a delta made up of mud and debris. Dams also can cause soil suspended in river water to settle. Look at the table to compare the properties of different types of mixtures.

Comparing Solutions, Colloids, and Suspensions

Description	Solutions	Colloids	Suspensions
Settle upon standing?	no	no	yes
Separate using filter paper?	no	no	yes
Particle size	0.1–1 nm	1–100 nm	>100 nm
Scatter light?	no	yes	yes



## ● After You Read

### Mini Glossary

**colloid:** a type of mixture with particles that are larger than those in solutions, but not heavy enough to settle to the bottom of their container

**compound:** a substance with two or more elements that are combined in the same proportion

**element:** a substance in which all the atoms are the same

**heterogeneous mixture:** a mixture in which different materials can be identified easily

**homogeneous mixture:** a mixture that contains two or more substances blended evenly throughout

**solution:** a homogeneous mixture of particles so small that they cannot be seen with a microscope and that will never settle to the bottom of their container

**substance:** a type of matter that is always made of the same material or materials

**suspension:** a heterogeneous mixture containing a liquid in which you can see particles settle

**Tyndall effect:** the scattering of light by particles in a colloid

1. Review the terms and their definitions in the Mini Glossary. The oxygen that you breathe is made up of tiny particles that are actually two atoms of oxygen bonded together. Would you say that oxygen is an element or a compound? Explain.

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2. Fill in the blanks with an example of each type of matter.

