

Describing Matter

Reading Preview

Key Concepts

- What kinds of properties are used to describe matter?
- What are elements, and how do they relate to compounds?
- What are the properties of a mixture?

Key Terms

- matter • chemistry
- substance • physical property
- chemical property • element
- atom • chemical bond
- molecule • compound
- chemical formula • mixture
- heterogeneous mixture
- homogeneous mixture
- solution

Target Reading Skill

Building Vocabulary

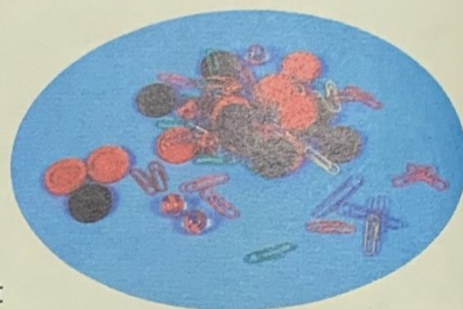
A definition states the meaning of a word or phrase by telling its most important feature or function. After you read the section, use what you have learned to write a definition of each Key Term in your own words.

Lab
zone

Discover Activity

What Is a Mixture?

1. Your teacher will give you a handful of objects, such as checkers, marbles, and paper clips of different sizes and colors.
2. Examine the objects. Then sort them into at least three groups. Each item should be grouped with similar items.
3. Describe the differences between the unsorted handful and the sorted groups of objects. Then make a list of the characteristics of each sorted group.

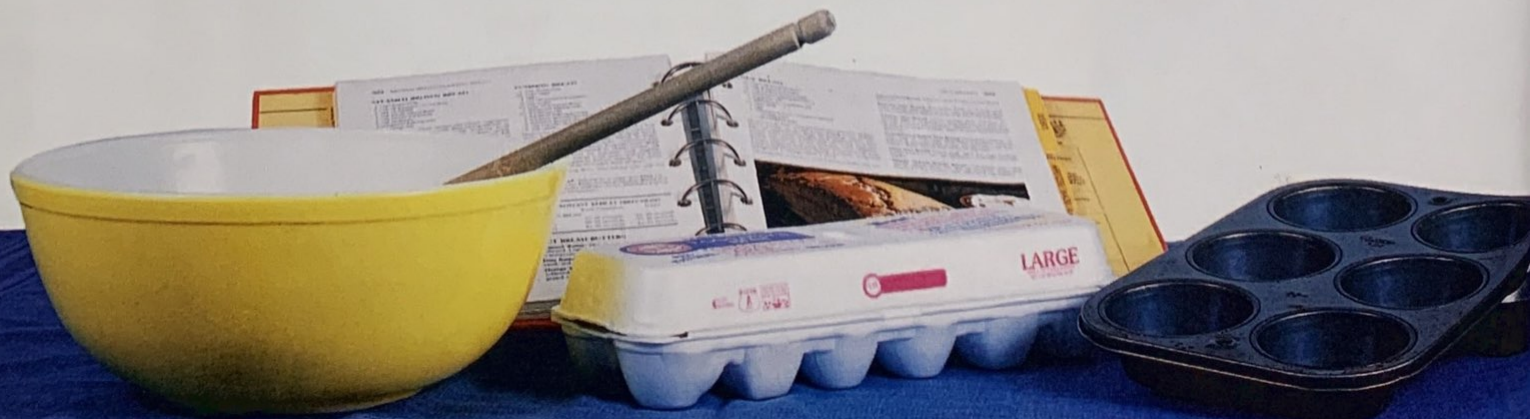


Think It Over

Forming Operational Definitions The unsorted handful of objects represents a mixture. Your sorted groups represent substances. Using your observations, infer what the terms *mixture* and *substance* mean.

You have probably heard the word *matter* many times. Think about how often you hear the phrases “As a matter of fact, ...” or “Hey, what’s the matter?” In science, this word has a specific meaning. **Matter** is anything that has mass and takes up space. All the “stuff” around you is matter, and you are matter too. Air, plastic, metal, wood, glass, paper, and cloth—all of these are matter.

▼ Paper, ceramic, wood, metal, and foam are all forms of matter.



Properties of Matter

Even though air and plastic are both matter, no one has to tell you they are different materials. Matter can have many different properties, or characteristics. Materials can be hard or soft, rough or smooth, hot or cold, liquid, solid, or gas. Some materials catch fire easily, but others do not burn. **Chemistry** is the study of the properties of matter and how matter changes.

The properties and changes of any type of matter depend on its makeup. Some types of matter are substances and some are not. In chemistry, a **substance** is a single kind of matter that is pure, meaning it always has a specific makeup—or composition—and a specific set of properties. For example, table salt has the same composition and properties no matter where it comes from—seawater or a salt mine. On the other hand, think about the batter for blueberry muffins. It contains flour, butter, sugar, salt, blueberries, and other ingredients shown in Figure 1. While some of the ingredients, such as sugar and salt, are pure substances, the muffin batter is not. It consists of several ingredients that can vary with the recipe.

Every form of matter has two kinds of properties—physical properties and chemical properties. A physical property of oxygen is that it is a gas at room temperature. A chemical property of oxygen is that it reacts with iron to form rust. You'll read more about physical and chemical properties in the next two pages.

FIGURE 1

Substances or Not?

Making muffin batter involves mixing together different kinds of matter. The batter itself is not a pure substance. **Classifying** Why are salt, sugar, and baking soda pure substances?

Pure Substances

Table salt, table sugar, and baking soda are pure substances.

Not Substances

Flour, baking powder, milk, eggs, and fruit are not pure substances.



FIGURE 2

Physical Properties

The physical properties of matter help you identify and classify matter in its different forms.

Applying Concepts Why is melting point a physical property?



▲ **Physical State**

Above 0°C, these icicles of solid water will change to liquid.



▲ **Flexibility**

Metal becomes a shiny, flexible toy when shaped into a flat wire and coiled.



◀ **Texture and Color**
Bumpy texture and bright colors are physical properties of this hungry chameleon.

Lab zone Skills Activity

Interpreting Data

Melting point is the temperature at which a solid becomes a liquid. Boiling point is the temperature at which a liquid becomes a gas. Look at the data listed below. Identify each substance's physical state at room temperature (approximately 20°C). Is it a gas, a liquid, or a solid? Explain your conclusions.

Substance	Melting Point (°C)	Boiling Point (°C)
Water	0	100
Ethanol	-117	79
Propane	-190	-42
Table salt	801	1,465

Physical Properties of Matter A **physical property** is a characteristic of a pure substance that can be observed without changing it into another substance. For example, a physical property of water is that it freezes at a temperature of 0°C. When liquid water freezes, it changes to solid ice, but it is still water. Hardness, texture, and color are some other physical properties of matter. When you describe a substance as a solid, a liquid, or a gas, you are stating another physical property. Whether or not a substance dissolves in water is a physical property, too. Sugar will dissolve in water, but iron will not. Stainless steel is mostly iron, so you can stir sugar into your tea with a stainless steel spoon.

Physical properties can be used to classify matter. For example, two properties of metals are luster and the ability to conduct heat and electricity. Some metals, such as iron, can be attracted by a magnet. Metals are also flexible, which means they can be bent into shapes without breaking. They can also be pressed into flat sheets and pulled into long, thin wires. Other materials such as glass, brick, and concrete will break into small pieces if you try to bend them or press them thinner.

FIGURE 3

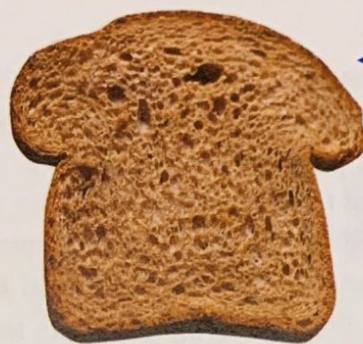
Chemical Properties

The chemical properties of different forms of matter cannot be observed without changing a substance into a new substance.



◀ **Flammability**
Wood fuels a fire, producing heat, gases, and ash.

Ability to React ▶
Iron can form rust, turning a once shiny car into a crumbling relic.

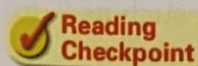


◀ **New Substances, New Properties**
Gases produced during baking create spaces in freshly made bread.



Chemical Properties of Matter Unlike physical properties of matter, some properties can't be observed just by looking at or touching a substance. A **chemical property** is a characteristic of a pure substance that describes its ability to change into different substances. To observe the chemical properties of a substance, you must try to change it to another substance. Like physical properties, chemical properties are used to classify substances. For example, a chemical property of methane (natural gas) is that it can catch fire and burn in air. When it burns, it combines with oxygen in the air and forms new substances, water and carbon dioxide. Burning, or flammability, is a chemical property of methane as well as the substances in wood or gasoline.

One chemical property of iron is that it will combine slowly with oxygen in air to form a different substance, rust. Silver will react with sulfur in the air to form tarnish. In contrast, a chemical property of gold is that it does *not* react easily with oxygen or sulfur. Bakers make use of a chemical property of the substances in bread dough. With the help of yeast added to the dough, some of these substances can produce a gas, which causes the bread to rise.



Reading Checkpoint What must you do in order to observe a chemical property of a substance?