Name _____ Class _____ Date _____

CHAPTER 3 Properties of Matter

SECTION 3

Chemical Properties

BEFORE YOU READ

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

- What are chemical properties of matter?
- What is a chemical change?
- What is the effect of a chemical change?

What Are the Chemical Properties of Matter?

STUDY TIP

Compare Make a table with two columns: Chemical property and Physical property. List the chemical and physical properties that are discussed in this section.

Physical properties are not the only properties that describe matter. **Chemical properties** describe the ability of matter to change into new matter. One chemical property of matter is reactivity. *Reactivity* is the ability of a substance to change into a new substance.

One kind of reactivity is flammability. *Flammability* is the ability of a substance to burn. For example, wood has the chemical property of flammability. You may have seen the result of wood burning in a fireplace or in a campfire. ☑

READING CHECK

1. Fill In Chemical properties of matter describe matter based on its ability to

_____

When wood burns, it becomes several different substances. Ash and smoke are just two of these new substances. The properties of the new substances are different from the original properties of the wood. Ash and smoke cannot burn. Unlike wood, they have the chemical property of nonflammability.

Wood burning in a fire

Ashes after the wood has burned

8.5.a Students know reactant atoms and molecules interact to form products with different chemical properties.

Word Help: Interact to act upon one another

2. Compare In a chemical reaction, how do the chemical properties of the products compare with the chemical properties of the reactants?

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Rusting is another chemical property. Only iron can rust. Iron rusts when it combines with oxygen to form a new substance called iron oxide.

Iron nail with no rust

Iron nail with rust

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COMPARING PHYSICAL AND CHEMICAL PROPERTIES

How can you tell the difference between a physical property and a chemical property? A physical property can be seen or identified because it does not change the identity of a substance. A physical change occurs when silver is pounded or gold is melted to make jewelry. After the change, the silver is still silver and the gold is still gold.

The chemical properties of a substance can't be seen unless you change the identity of the substance. For example, you may not know whether a liquid is flammable until you try to light it. If it burns, it has the chemical property of flammability. However, burning has changed the liquid into new substances.

A substance always has chemical properties. A piece of wood is flammable even when it is not burning. Iron can form rust even though it has not rusted.

Critical Thinking

3. Compare Describe what happens to a substance when a physical property and a chemical property of the substance are observed.

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CHARACTERISTIC PROPERTIES

The properties that are most useful in identifying a substance are called *characteristic properties*. These properties are constant. This means that they do not change. The characteristic properties of a substance can be physical, chemical, or both.

A piece of iron has characteristic properties that help identify it as iron. A good example of this is density. Iron always has the same density when measured at the same temperature and pressure. Iron also rusts.

Scientists can identify a substance by studying its physical and chemical properties. The table below shows some characteristic properties of several liquids.

Property	Rubbing alcohol	Kerosene	Gasoline
Density (g/cm^3)	0.8	0.8	0.8
Ability to dissolve, or mix with water	yes	no	no
Flash point (°C) (The higher the flash point, the more flammable the liquid.)	12	40	−40

Critical Thinking

4. Apply Concepts A scientis measures three properties of liquid. Its density is 0.8 g/cm^3 it does not mix with water, and its flash point is −40°C. Using the table to the right, find the identity of the substance. Explain your answ

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What Happens During a Chemical Change?

When a substance changes into one or more new substances that have new and different properties, a **chemical change** has happened. Chemical changes are not the same as chemical properties. The chemical properties of a substance describe which chemical change can happen to the substance. For example, flammability is a chemical property. Burning is the chemical change that shows this property. ☑

READING CHECK

5. Describe What is a chemical change?

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A chemical change is the process that causes a substance to change into a new substance. You can learn about a substance's chemical properties by observing what chemical changes happen to that substance.

Chemical changes occur more often than you think. For example, a chemical change happens every time you use a battery. Chemical changes also take place within your body when the food you eat is digested. The figure below describes other chemical changes.

Soured milk smells bad because bacteria have formed smelly new substances in it.

The Statue of Liberty is made of copper, which is orange-brown. But this copper is green because of its interactions with moist air. These interactions are chemical changes that form copper compounds. Over time, the compounds turn the statue green.

TAKE A LOOK

6. Identify What property of milk told the girl that the milk had soured?

_____

A fun way to see what happens during a chemical change is to bake a cake. A cake recipe combines different substances. Eggs, cake mix, oil, and water are mixed to form a batter. When the batter is baked, you end up with a substance that is very different from the original batter.

The heat of the oven and the mixture of ingredients cause a chemical change. The result is a cake. The cake has properties that are different from the properties of the raw ingredients alone.

Critical Thinking

7. Apply Concepts How do you know that baking a cake causes a chemical change?

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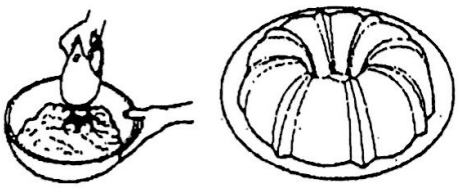

Cake mix batter becomes a cake.

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SIGNS OF CHEMICAL CHANGES

A change in color, odor, or texture may show that a chemical change has happened. Many chemical changes produce or absorb heat.

An increase in temperature happens when a chemical change releases, or gives off, heat. Wood burning is a good example of a chemical change that gives off heat.

Some chemical changes cause a substance to absorb, or gain, heat. Sugar is broken down into carbon and water when it is heated. ☑

READING CHECK

8. Identify What are four changes that indicate that a chemical change has occurred?

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MATTER AND CHEMICAL CHANGES

When matter has a chemical change, the identity of the matter changes. Chemical changes can be reversed only by other chemical changes. For example, water can be made by heating a mixture of hydrogen and oxygen. Hydrogen and oxygen are produced when an electric current is passed through water. The electric current supplies the energy needed to pull the hydrogen away from the oxygen.

PHYSICAL VERSUS CHEMICAL CHANGES

Sometimes it is hard to decide whether a physical change or a chemical change has happened to an object. Ask yourself whether something new formed as a result of the change?

Physical changes do not change the matter that makes up an object. Ice melts into water and water freezes into ice. The water does not change in the process. The only changes that happened were to its physical properties.

Chemical changes change the matter that makes up a substance. A chemical change would change water into another substance. ☑

READING CHECK

9. Describe How can you tell that a physical rather than a chemical change has occurred?

_____

_____

REVERSING CHANGES

Many physical changes, like freezing, melting, and boiling, can be reversed easily. Remember that the substance does not become another substance.

This is very different from a chemical change. During a chemical change, the substance does become another substance. Many chemical changes cannot be reversed easily. For example, ashes and smoke cannot be unburned to make wood.

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Section 3 Review

~~8.5.a, 8.5.c, 8.5.d~~

SECTION VOCABULARY

chemical change a change that occurs when one or more substances change into entirely new substances with new chemical properties	**chemical property** a property of matter that describes a substance's ability to participate in chemical reactions

1. **Describe** How is a chemical property different from a chemical change?

_____

_____

2. **Explain** Why is reactivity not a physical property?

_____

_____

3. **Identify** What can be absorbed or produced as the result of a chemical reaction?

_____

4. **Complete** Fill in the type of change for each description in the table below.

Type of change	Description of change
	rusting
	boiling
	freezing
	burning

5. **Identify** What are four things that indicate that a chemical change probably happened?

_____

_____

6. **Identify and Explain** Originally, the Statue of Liberty was copper colored. After many years, it turned green. What kind of change happened? Explain your answer.

_____

_____

7. **Identify** A burning candle is observed. Heat is felt above the flame, black smoke is seen rising from the wick, and wax melts. What caused each change?

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