Fire and Fire Safety

Reading Preview

Key Concepts

- What are the three things necessary to maintain a fire?
- Why should you know about the causes of fire and how to prevent a fire?

Key Terms

- combustion
- fuel

Target Reading Skill

Using Prior Knowledge Before you read, write what you know about fire safety in a graphic organizer like the one below. As you read, continue to write in what you learn.

What You Know
1. A fire needs fuel to burn. 2.

What You Learned
1. 2.

Lab zone Discover Activity

How Does Baking Soda Affect a Fire?

1. Put on your safety goggles.
2. Secure a small candle in a holder or a ball of clay. After instructions from your teacher, use a match to light the candle.
3. Place a beaker next to the candle. Measure 1 large spoonful of baking soda into the beaker. Add about 100 mL of water and stir. Add about 100 mL of vinegar.
4. As soon as the mixture stops foaming, tip the beaker as if you are pouring something out of it onto the flame. **CAUTION:** *Do not pour any liquid on the candle.*
5. Observe what happens to the flame.

Think It Over

Developing Hypotheses The gas produced in the beaker was carbon dioxide, CO_2. Based on the results of this experiment, develop a hypothesis to explain what you observed in Step 5.

The call comes in. Fire! A blaze has been spotted in a warehouse near gasoline storage tanks. Firefighters scramble aboard the ladder truck and the hose truck. Lights flash, sirens blare, and traffic swerves to clear a path for the trucks. The firefighters know from their training that fire is a chemical reaction that can be controlled—but only if they reach it in time.

Firefighters battle a blaze. ▼

Understanding Fire

Fire is the result of **combustion,** a rapid reaction between oxygen and a substance called a fuel. A **fuel** is a material that releases energy when it burns. Common fuels include oil, wood, gasoline, natural gas, and paper. Combustion of these types of fuel always produces carbon dioxide and water. When fuels don't burn completely, products such as smoke and poisonous gases may be produced.

The Fire Triangle Although a combustion reaction is very exothermic and fast, a fire cannot start unless conditions are right. **The following three things are necessary to start and maintain a fire—fuel, oxygen, and heat.**

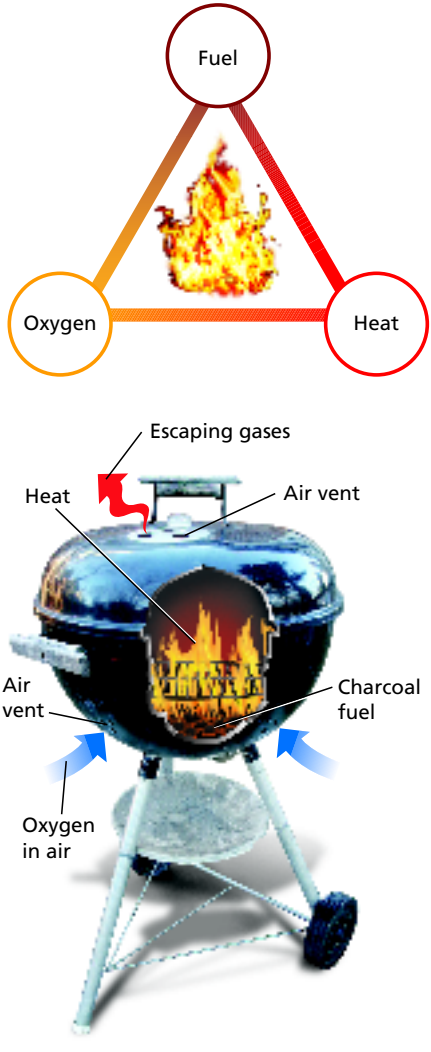
You probably know that oxygen is one of the gases in air. About 20 percent of the air around you is composed of oxygen gas. If air can reach the fuel, so can oxygen. A large fire can create a strong draft that pulls air toward it. As the air around the flame is heated, it rises rapidly. Cooler air flows toward the fire, replacing the heated air and bringing a fresh supply of oxygen. If you stand in front of a fire in a fireplace, you can feel the air flow toward the fire.

Heat is a part of the fire triangle. Fuel and oxygen can be together, but they won't react until something provides the activation energy to start combustion. This energy can come from a lighted match, an electric spark, or the heat from a stove. Once combustion starts, the heat released supplies more activation energy to keep the reaction going.

Once started, a fire can continue burning as long as all components of the fire triangle are available. Coal in abandoned mines under the town of Centralia, Pennsylvania, started burning in 1962. The coal is still burning. Many old airshafts lead into the tunnels. Because some airshafts cannot be located and sealed, air continues to flow into the mines, supporting the fire. Heat and poisonous gases coming up from the fire through cracks in the ground made living in Centralia difficult. Everyone eventually moved away. No one knows how long this fire will continue to burn.

Reading Checkpoint **What is heat's role in starting a fire?**

FIGURE 17
The Fire Triangle
The fire triangle can be controlled in the grill below. If any point of the fire triangle is missing, a fire will not continue.
Applying Concepts *How would closing the lower air vents affect the fire?*



Controlling Fire Use your knowledge of chemical reactions to think of ways to control a fire. What if you remove one part of the fire triangle? For example, you can get the fuel away from the flames. You can also keep oxygen from getting to the fuel. Finally, you can cool the combustion reaction.

How do firefighters usually fight fires? They use hoses to spray huge amounts of water on the flames. Water removes two parts of the fire triangle. First, water covers the fuel, which keeps it from coming into contact with oxygen. Second, evaporation of the water uses a large amount of heat, causing the fire to cool. Without heat, there isn't enough energy to continue the combustion. Therefore, the reaction stops.

Home Fire Safety

Every year, fire claims thousands of lives in the United States. **If you know how to prevent fires in your home and what to do if a fire starts, you are better prepared to take action.** You may save your home or even your life! The most common sources of home fires are small heaters, cooking, and faulty electrical wiring. The fires that cause the most deaths start from carelessness with cigarettes.

Fighting Fires You can fight a small fire by using what you know about the fire triangle. For example, carbon dioxide gas can smother a fire by preventing contact between the fuel and oxygen in the air. Therefore, you can put out a small fire on the stove by throwing baking soda on it. Baking soda decomposes when heated and releases carbon dioxide gas. Or, you can use the cover of a saucepan to cut off the flow of oxygen.

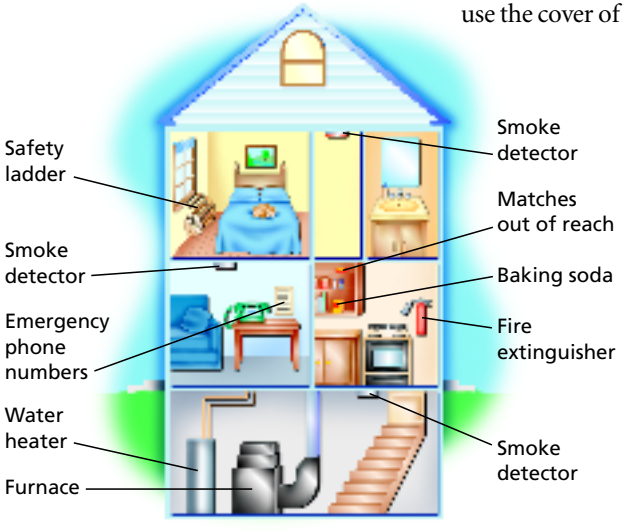


FIGURE 18
A Fire-Safe House
This fire-safe house has many fire-prevention and fire safety features. **Inferring** *Why are smoke detectors located on every floor?*

A small fire is easy to control. You can cool a match enough to stop combustion just by blowing on it. A small fire in a trash can may be doused with a pan of water. If the fire spreads to the curtains, however, even a garden hose might not deliver enough water to put it out.

One of the most effective ways to fight a small fire is with a fire extinguisher. But a fire that is growing as you fight it is out of control. If a fire is out of control, there is only one safe thing to do—get away from the fire and call the fire department.

Preventing Trouble The best form of fire safety is prevention. Figure 18 shows some features of a fire-safe house. You can also check your home to be sure that all flammable items are stored safely away from sources of flames, such as the kitchen stove. Fires can be dangerous and deadly, but many fires can be prevented if you are careful. Understanding the chemistry of fire gives you a way to reduce risk and increase your family's safety.

Reading Checkpoint **How does baking soda put a fire out?**

FIGURE 19
Fire-Prevention Devices
Fire extinguishers and baking soda can be used to interrupt the fire triangle. Smoke detectors can help you identify a fire and escape to safety.

Section 4 Assessment

Target Reading Skill **Previewing Visuals** Review your graphic organizer and revise it based on what you just learned in the section.

Reviewing Key Concepts

1. **a.** **Listing** What three things are required for combustion?
   b. **Explaining** How does the fire triangle help you control fire?
   c. **Applying Concepts** To stop a forest fire, firefighters may remove all the trees in a strip of land that lies in the path of the fire. What part of the fire triangle is affected? Explain.
2. **a.** **Reviewing** Why is it important to know about the causes of fire and how to prevent fires?
   b. **Identifying** What are the three most common causes of home fires?
   c. **Problem Solving** Choose one common cause of home fires. Describe measures that can be taken to prevent fires of this type.

Lab zone **At Home Activity**

Family Safety Plan Work with your family to formulate a fire safety plan. How can fires be prevented in your home? How can fires be put out if they occur? Is there a functioning smoke detector on each floor of the home, especially near the bedrooms? How can the fire department be contacted in an emergency? Design a fire escape route. Make sure all family members know the route as well as a meeting place outside.