CONCEPT 3

Matter can be described based on physical and chemical changes.

Activity

What Changes Are Happening?

Your teacher will give you and a partner a test tube with water and part of an Alka-Seltzer® tablet. The tablet contains baking soda and citric acid. Make a list of the physical properties of the water and tablet. Predict what will happen when the tablet is added to the water. Add the tablet to the water and observe what happens. Which changes do you think are physical changes? Which are chemical changes? Explain.

Physical Changes

physical change change of matter that does not alter its chemical identity or composition

A **physical change** is a change that alters a substance without changing its chemical identity or composition. Crumpling a sheet of aluminum foil into a ball or folding a piece of paper into the shape of a bird are examples of physical changes. The crumpled ball of foil is still aluminum and the folded paper is still paper. **Figure 2.9** shows a familiar physical change.

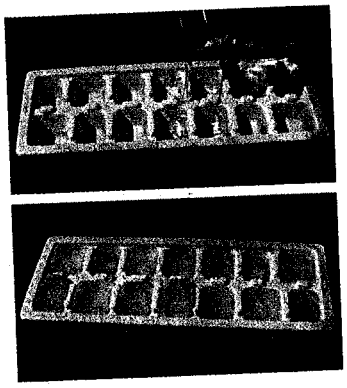

Figure 2.9 Freezing is a physical change.

The freezing of water to form ice is also an example of a physical change—the frozen, solid water is still water. Substances can exist in gas, liquid, or solid forms. These forms are called states. For example, you are most familiar with gold in its solid state. But gold can exist as a liquid or even a gas. However, extreme conditions are needed to change gold into its gas state, because its boiling point is 2856°C, which is hotter than most furnaces can get.

When a substance changes from one state to another, the physical change is known as a *change of state*.

Chemical Changes

chemical change change of matter that produces new substances

During a **chemical change**, or *chemical reaction*, one type of matter changes to produce one or more different types of matter. The matter that is produced has a different identity and different properties from the original matter. The substances that take part in a chemical change are called the *reactants*. The substances that are formed by the chemical change are called the *products*. **Figure 2.10** shows some physical and chemical changes involved in preparing food.

Connect to Investigation 2-C on pages 126–127

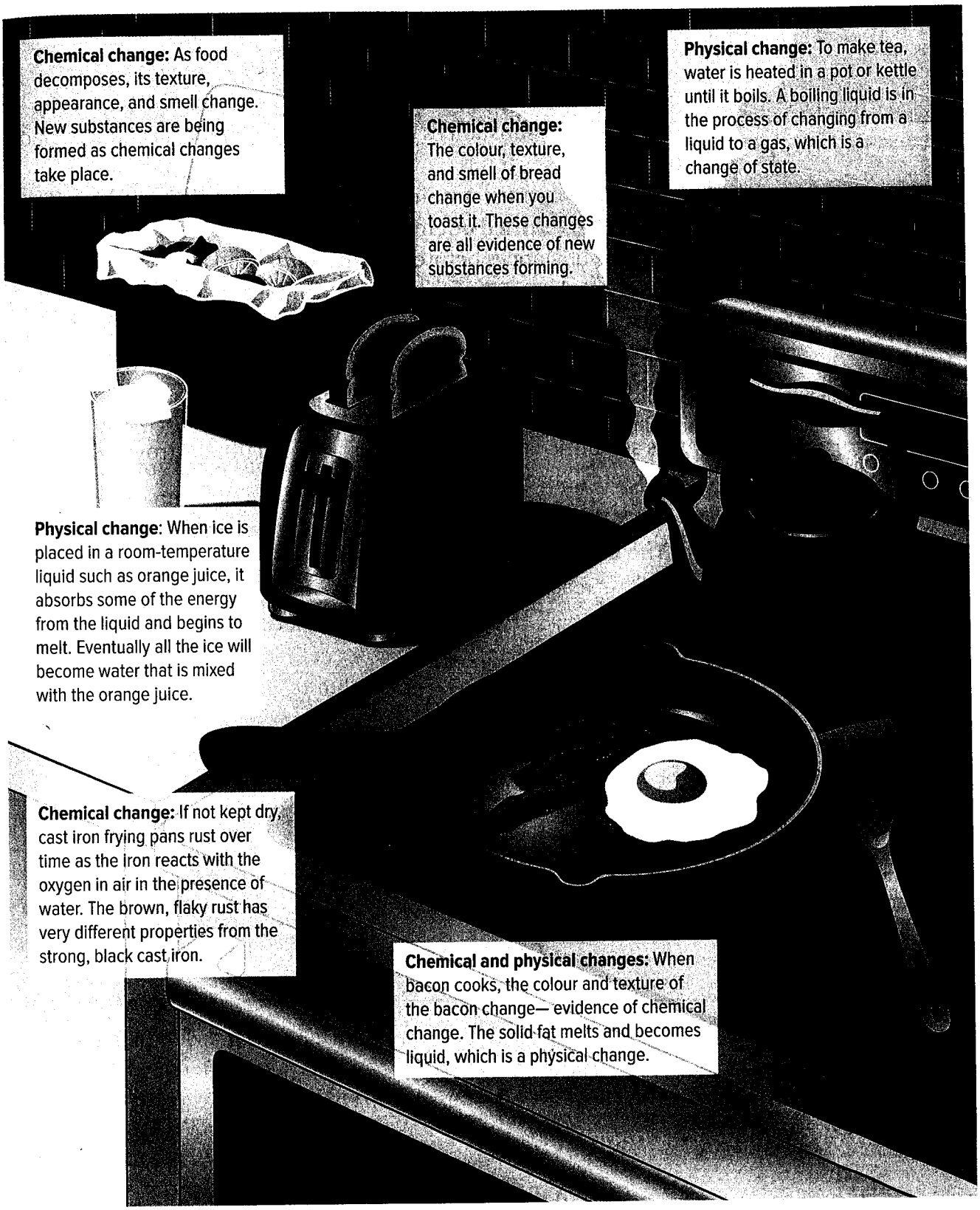

Figure 2.10 Even a simple task like preparing a meal involves many physical and chemical changes. **What are some other chemical or physical changes that take place in a kitchen? List one of each not shown in the illustration.**

Law of Conservation of Mass

Early scientists experimented with chemical changes by heating, burning, and mixing matter. These studies included measuring the masses of substances before and after chemical changes had occurred.

French scientist Antoine Lavoisier (1743–1794) and his wife Marie-Anne carried out many chemical reactions, measuring the mass of substances before (the *reactants*) and after (the *products*). **Figure 2.11** shows an example of one of these experiments. Over and over again, the Lavoisiers observed that mass did not change when a chemical reaction took place. The mass of the reactants was always equal to the mass of the products. This observation was summarized as the *law of conservation of mass*. According to this scientific law, mass is neither created nor destroyed during a chemical reaction—it is conserved.

Connect to Investigation 2-D on pages 128–129

The Law of Conservation of Mass

mass of reactants = mass of products

In any chemical reaction, the total mass of the products is the same as the total mass of the reactants.

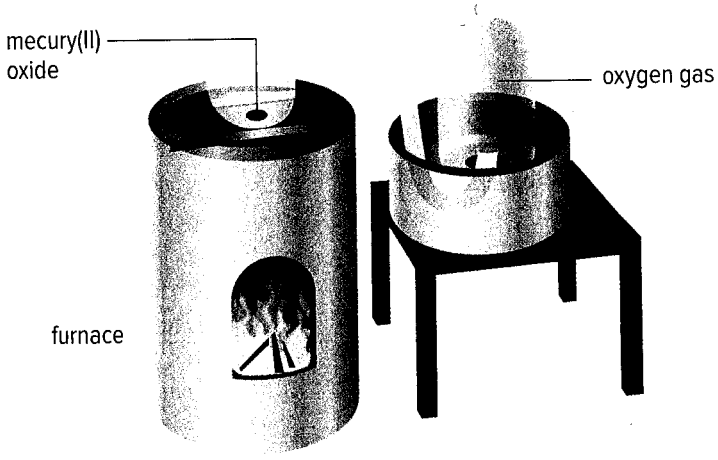

Figure 2.11 Lavoisier sealed a powdery, red-coloured chemical called mercury(II) oxide in a container. After intense heating, the red powder was changed to silvery liquid mercury and oxygen gas. The mass after the reaction was the same as the mass before the reaction.

Before you leave this page . . .

1. What is the main difference between a physical change and a chemical change?
2. State the law of conservation of mass in your own words.
3. In Lavoisier's experiments, why was it important that the container be sealed? Explain your answer.