SECTION 2

Types of Chemical Reactions

OBJECTIVES

- Define and give general equations for *synthesis, decomposition, single-displacement,* and *double-displacement* reactions.
- Classify a reaction as a synthesis, decomposition, single-displacement, double-displacement, or combustion reaction.
- List three kinds of synthesis reactions and six kinds of decomposition reactions.
- List four kinds of single-displacement reactions and three kinds of double-displacement reactions.
- Predict the products of simple reactions given the reactants.

Thousands of known chemical reactions occur in living systems, in industrial processes, and in chemical laboratories. Often it is necessary to predict the products formed in one of these reactions. Memorizing the equations for so many chemical reactions would be a difficult task. It is therefore more useful and realistic to classify reactions according to various similarities and regularities. This general information about reaction types can then be used to predict the products of specific reactions.

There are several ways to classify chemical reactions, and none are entirely satisfactory. The classification scheme described in this section provides an introduction to five basic types of reactions: synthesis, decomposition, single-displacement, double-displacement, and combustion reactions. In later chapters, you will be introduced to categories that are useful in classifying other types of chemical reactions.

Synthesis Reactions

In a **synthesis reaction,** *also known as a composition reaction, two or more substances combine to form a new compound.* This type of reaction is represented by the following general equation.

$$A + X \longrightarrow AX$$

A and X can be elements or compounds. AX is a compound. The following examples illustrate several kinds of synthesis reactions.

Reactions of Elements with Oxygen and Sulfur

One simple type of synthesis reaction is the combination of an element with oxygen to produce an *oxide* of the element. Almost all metals react with oxygen to form oxides. For example, when a thin strip of magnesium metal is placed in an open flame, it burns with bright white light. When the metal strip is completely burned, only a fine white powder of magnesium oxide is left. This chemical reaction, shown in **Figure 7** on the next page, is represented by the following equation.

$$2Mg(s) + O_2(g) \longrightarrow 2MgO(s)$$