The Kinetic-Molecular Theory of Matter

SECTION 1

Objectives

- State the kinetic-molecular theory of matter, and describe how it explains certain properties of matter.
- List the five assumptions of the kinetic-molecular theory of gases. Define the terms ideal gas and real gas.
- Describe each of the following characteristic properties of gases: expansion, density, fluidity, compressibility, diffusion, and effusion.
- Describe the conditions under which a real gas deviates from "ideal" behavior.

In Chapter 1, you read that matter exists on Earth in the forms of solids, liquids, and gases. Although it is not usually possible to observe individual particles directly, scientists have studied large groups of these particles as they occur in solids, liquids, and gases.

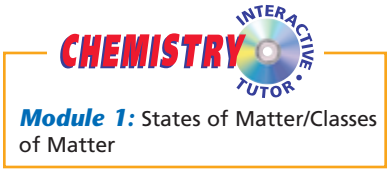
In the late nineteenth century, scientists developed the kinetic-molecular theory of matter to account for the behavior of the atoms and molecules that make up matter. *The* **kinetic-molecular theory** *is based on the idea that particles of matter are always in motion.* The theory can be used to explain the properties of solids, liquids, and gases in terms of the energy of particles and the forces that act between them. In this section, you will study the theory as it applies to gas molecules.

The Kinetic-Molecular Theory of Gases

The kinetic-molecular theory can help you understand the behavior of gas molecules and the physical properties of gases. The theory provides a model of what is called an ideal gas. *An* **ideal gas** *is a hypothetical gas that perfectly fits all the assumptions of the kinetic-molecular theory.*

The kinetic-molecular theory of gases is based on the following five assumptions:

1. *Gases consist of large numbers of tiny particles that are far apart relative to their size.* These particles, usually molecules or atoms, typically occupy a volume that is about 1000 times greater than the volume occupied by an equal number of particles in the liquid or solid state. Thus, molecules of gases are much farther apart than molecules of liquids or solids. Most of the volume occupied by a gas is empty space, which is the reason that gases have a lower density than liquids and solids do. This also explains the fact that gases are easily compressed.
2. *Collisions between gas particles and between particles and container walls are elastic collisions. An* **elastic collision** *is one in which there is no net loss of total kinetic energy.* Kinetic energy is transferred between two particles during collisions. However, the total kinetic energy of the two particles remains the same as long as temperature is constant.



Module 1: States of Matter/Classes of Matter