# Defining Heat

SECTION 2

## SECTION OBJECTIVES

- **Explain heat as the energy transferred between substances that are at different temperatures.**
- **Relate heat and temperature change on the macroscopic level to particle motion on the microscopic level.**
- **Apply the principle of energy conservation to calculate changes in potential, kinetic, and internal energy.**

## HEAT AND ENERGY

Thermal physics often appears mysterious at the macroscopic level. Hot objects become cool without any obvious cause. To understand thermal processes, it is helpful to shift attention to the behavior of atoms and molecules. Mechanics can be used to explain much of what is happening at the molecular, or microscopic, level. This in turn accounts for what you observe at the macroscopic level. Throughout this chapter, the focus will shift between these two viewpoints.

What happens when you immerse a warm fruit juice bottle in a container of ice water, as shown in **Figure 7**? As the temperatures of the bottle and of the juice decrease, the water's temperature increases slightly until both final temperatures are the same. Energy is transferred from the bottle of juice to the water because the two objects are at different temperatures. This energy that is transferred is defined as **heat.**

**heat**

*the energy transferred between objects because of a difference in their temperatures*

The word *heat* is sometimes used to refer to the *process* by which energy is transferred between objects because of a difference in their temperatures. This textbook will use *heat* to refer only to the energy itself.

### Energy is transferred between substances as heat

From a macroscopic viewpoint, energy transferred as heat tends to move from an object at higher temperature to an object at lower temperature. This is similar to the mechanical behavior of objects moving from a higher gravitational potential energy to a lower gravitational potential energy. Just as a pencil will drop from your desk to the floor but will not jump from the floor to your desk, so energy will travel spontaneously from an object at higher temperature to one at lower temperature and not the other way around.

**Figure 7**
Energy is transferred as heat from objects with higher temperatures (the fruit juice and bottle) to those with lower temperatures (the cold water).