

**In this chapter, you will be able to**

- describe and explain the properties of water, and demonstrate an understanding of its importance as a universal solvent;
- explain the formation of solutions involving various solutes in water and nonpolar solutes in non-aqueous solvents;
- use the terms solute, solvent, solution, electrolyte, concentration, standard solution, stock solution, and dilution;
- solve solution concentration problems using a variety of units;
- develop the technological skills for the preparation of solutions;
- determine qualitative properties of solutions;
- provide examples of solutions involving all three states;
- provide consumer and commercial examples of solutions, including those in which the concentration must be precisely known;
- explain the origins of pollutants in natural water.

# The Nature and Properties of Solutions

Is there such a thing as pure, natural water? Certainly it can't be found in the oceans. In Samuel Taylor Coleridge's classic poem, *The Rime of the Ancient Mariner*, written in 1798, an old seafarer describes the desperation of becalmed sailors, drifting without fresh water under the fierce sun, driven mad with thirst:

*Water, water, everywhere,  
Nor any drop to drink.*

Drinking the water of the sea, which is rich in dissolved solutes, can be fatal. Today, seagoing ships carry distillation equipment to convert salt water into drinking water by removing most of those solutes.

Fresh water from lakes and rivers, which we depend on for drinking, cooking, irrigation, electric power generation, and recreation, is also impure. Even direct from a spring, fresh water is a solution that contains dissolved minerals and gases. So many substances dissolve in water that it has been called "the universal solvent." Many household products, including soft drinks, fruit juices, vinegar, cleaners, and medicines, are aqueous (water) solutions. ("Aqueous" comes from the Latin *aqua* for "water," as in aqueduct and aquatics.) Our blood plasma is mostly water, and many substances essential to life are dissolved in it, including glucose and carbon dioxide.

The ability of so many materials to dissolve in water also has some negative implications. Human activities have introduced thousands of unwanted substances into water supplies. These substances include paints, cleaners, industrial waste, insecticides, fertilizers, salt from highways, and other contaminants. Even the atmosphere is contaminated with gases produced when fossil fuels are burned. Rain, falling through these contaminants, may become acidic. Learning about aqueous solutions and the limits to purity will help you understand science-related social issues forming around the quality of our water.

## Reflect on your Learning

1. (a) List some substances that can dissolve in water.  
(b) Classify the substances into two or more categories.
2. Are there any types of substances that generally do not dissolve in water? Why not?
3. Both table salt and table sugar dissolve in water to produce clear, colourless solutions. Using your present knowledge, what is similar in the formation of these two solutions? What is different?