Chapter

In this chapter, you will be able to

- identify chemical substances and reactions in everyday use or of environmental significance;
- define atomic number, mass number, and atomic mass, and explain how these concepts relate to isotopes and radioisotopes;
- demonstrate an understanding of the periodic law, and describe how electron arrangements and forces in atoms can explain trends in the periodic table;
- compare and explain the reactivity of a series of elements, and relate this reactivity to their position in the periodic table;
- construct, analyze, and interpret graphs of properties that display trends within the periodic table.

The Nature of Matter

It is possible to argue that chemistry has been responsible for some of the hazards of modern life. We are, after all, seeing environmental damage resulting from resource extraction, we are discovering the toxic effects of some products, and we are experiencing increasing difficulty disposing of our garbage, most of which is artificially produced, thanks to chemistry. However, to argue that way would be to ignore the underlying truth: Chemistry has been fundamental to the development of society as we know it. We now have cleaner fuel, more durable and safer paints, easy-care clothing, inexpensive fertilizers, life-saving pharmaceuticals, corrosion-resistant tools and machinery, and unusual new materials that we are using in interesting new ways (Figure 1). All of this innovation has made our lives better to some degree.

Chemistry is just another way to say "the understanding of the nature of matter." In order to further their understanding, chemists through the ages have relied upon scientific inquiry, carrying out investigations and making careful observations. The periodic table is an elegant way of summing up many of those investigations and our knowledge about matter and its constituents, the elements. The observations that went into the creation of the periodic table also helped to create the modern atomic theory. In turn, we can explain many of the patterns in the properties of the elements in terms of atomic theory. In this chapter, we will discuss the patterns used to classify the elements, and consider how these patterns are explained by atomic theory.

Reflect on Learning

- 1. (a) Based on your current understanding of the atom, what are the constituents of an atom, and how are they arranged? According to this model, how do the atoms of the various elements differ from each other?
 - (b) Based on your model of the atom, explain the organization of the elements in the periodic table.
- 2. What patterns in properties are you aware of among the elements of the periodic table? Suggest some explanations for these patterns, using your model of the atom.
- 3. (a) In what ways has the periodic table been useful to you in previous chemistry courses?
 - (b) Examine the periodic table at the end of this text. Identify some differences between this table and the ones you used in previous grades. Speculate about how these differences might help you in this course.

