# Chapter 5 Understanding the Properties of Elements

## What You Will Learn

In this chapter, you will learn how to...

- **explain** how different atomic models evolved over time
- **describe** the current model of the atom
- **explain** the relationship between the atomic structure of an element and the position of the element in the periodic table
- **compare** and **contrast** the physical properties of elements within a group and between groups in the periodic table

## Why It Matters

The development of important products depends on understanding the properties of elements. In the periodic table, elements are organized in a way that highlights significant patterns in their properties. This organization reflects the relationship between the atomic structure of each element and the position of the element in the periodic table.

## Skills You Will Use

In this chapter, you will learn how to...

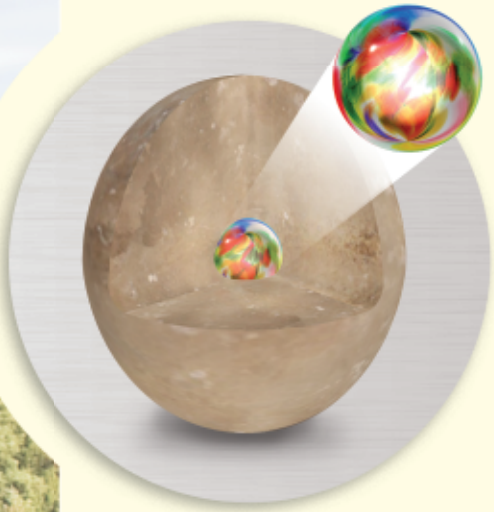
- **investigate** the physical and chemical properties of elements and relate these to the elements' positions in the periodic table


What do deodorant and this family's trailer have in common? Both contain the element aluminum! Although aluminum is much less expensive than precious metals like gold, its properties make it extremely valuable. Aluminum is used in thousands of products that range from antacids to airplanes. To better understand what determines the properties of elements like aluminum, the basic structure of an atom needs to be considered.

# Activity 5-1

## The Atomic "Black Box"

The term "black box" is often used to describe a complex system that cannot be directly studied—like the atom. Indirect observations allow scientists to infer how the "black box" works. Since the atom is so small, scientists who discovered the atom had to do so without ever seeing it. In this activity, you will design experiments to infer what is inside a clay ball. How do you think the clay ball could represent an atom?



This clay ball with an object inside represents a "black box."

### Materials

- modelling clay
- thin stir sticks
- simple objects (such as coins, marbles, nuts, bolts, washers, and thimbles)

### Procedure

1. In pairs, choose one object and conceal it in modelling clay. Add enough clay to make a smooth ball, about 5 cm in diameter.
2. Form groups of four with another pair of students. The clay ball from the other pair represents the "black box" that you are to analyze.
3. Before starting your analysis, develop a strategy. How will you probe the clay ball with the stir stick to determine what is inside? Keep in mind that you cannot open the ball.
4. Using your planned strategy, probe the clay ball by poking the stir stick through the clay. After 3 to 4 min, you and your partner should make a drawing of what you believe is in the clay ball. The creators of the "black box" will then reveal the object to show if you are correct.

### Questions

1. Look up the meaning of the word *inference* in a dictionary. In what ways did you have to make inferences to identify what was inside the clay ball?
2. In what ways do you think identifying the object inside the clay ball represents a model of how scientists have studied the atom?
3. What advice would you give a friend who is going to do this activity?

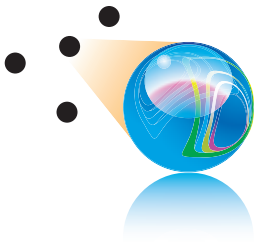
# Study Toolkit

These strategies will help you use this textbook to develop your understanding of science concepts and skills.
To find out more about these and other strategies, refer to the Study Toolkit Overview, which begins on page 561.

Reading Effectively

## Visualizing

Visualizing means forming an image in your mind based on what you are reading. The table below maps out how a reader might visualize this text from page 180: Dalton referred to the atom as a small, hard, indestructible sphere that is the smallest particle of an element.

| Steps | How an Image Forms in My Mind |
|---|---|
| **1.** Start with an aspect of the text that is familiar. | "Small, hard, indestructible sphere" makes me think of a marble. |
| **2.** Look for details to make your image more accurate. | "The smallest particle of an element" helps me to visualize the marble as being really small. |
| **3.** Once you have created an image, make a sketch. |  |

### Use the Strategy

While reading about Thomson's atomic model on page 181, visualize how Thomson described the atom.

Word Study

## Suffixes

One strategy to figure out the meaning of a new word is to break it down into parts. First, determine the base word. Then check to see if there is a suffix, or an ending after the base word. Some suffixes indicate number or tense, and some change the meaning of the base word. The table below shows some examples.

| Suffix and Meaning (in a science context) | Sample Base Word | Base Word + Suffix = New Meaning |
|---|---|---|
| *-al:* of, relating to | environment | *environmental:* relating to the environment |
| *-ic:* relating to or characterized by | atom | *atomic:* relating to an atom |
| *-ity:* state or quality | reactive | *reactivity:* the quality of being reactive |

### Use the Strategy

Identify words from Section 5.1 that end with one of the suffixes listed above. Record the base word and predict the definition of the new word. Compare your predictions with those of a partner.

Reading Effectively

## Asking Questions

While reading, stop periodically to ask *who, what, where, why, when,* and *how* questions. Then continue reading to see if your questions are answered by the text. When they are not, check your understanding. This process raises your level of thinking, and helps you make connections beyond the text.

Reread the paragraph on page 176. Here are questions that you might ask while reading:

- *Who* discovered aluminum?
- *What* are its properties?
- *Where* is it found?
- *Why* is it less expensive than gold today?
- *How* can knowing its properties lead to new products?

### Use the Strategy

While reading the paragraph on page 179, ask at least three questions. As you read the rest of the section, record any answers you find. Follow up on unanswered questions with a partner.