

THE HISTORY OF CELL BIOLOGY

Both living and nonliving things are made of atoms, molecules, and compounds. How are living and nonliving things different? The discovery of the cell was an important step toward answering this question.

THE DISCOVERY OF CELLS

All living things are made up of one or more cells. A **cell** is the smallest unit that can carry on all of the processes of life. Beginning in the 17th century, curious naturalists were able to use microscopes to study objects too small to be seen with the unaided eye. Their studies led them to propose the cellular basis of life.

Hooke

In 1665, English scientist Robert Hooke studied nature by using an early *light microscope*, such as the one in Figure 4-1a. A light microscope is an instrument that uses optical lenses to magnify objects by bending light rays. Hooke looked at a thin slice of cork from the bark of a cork oak tree. “I could exceedingly plainly perceive it to be all perforated and porous,” Hooke wrote. He described “a great many little boxes” that reminded him of the cubicles or “cells” where monks live. When Hooke focused his microscope on the cells of tree stems, roots, and ferns, he found that each had similar little boxes. The drawings that Hooke made of the cells he saw are shown in Figure 4-1b. The “little boxes” that Hooke observed were the remains of dead plant cells, such as the cork cells shown in Figure 4-1c.

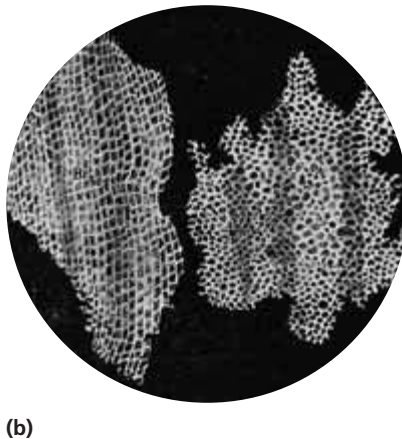


FIGURE 4-1

Robert Hooke used an early microscope (a) to see cells in thin slices of cork. His drawings of what he saw (b) indicate that he had clearly observed the remains of cork cells (300 \times) (c).



OBJECTIVES

- **Name** the scientists who first observed living and nonliving cells.
- **Summarize** the research that led to the development of the cell theory.
- **State** the three principles of the cell theory.
- **Explain** why the cell is considered to be the basic unit of life.

VOCABULARY

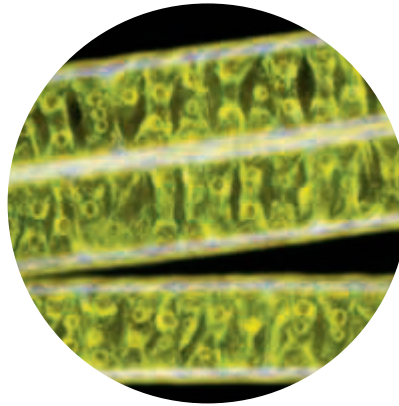
cell
cell theory



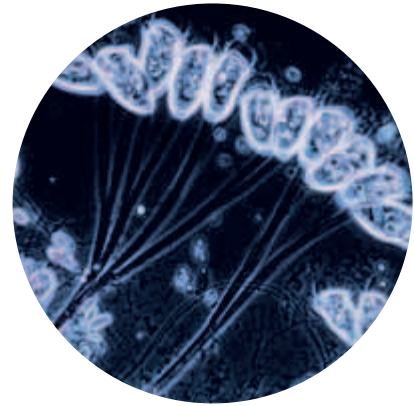
(a)

FIGURE 4-2

Anton van Leeuwenhoek (1632–1723) is shown here with one of his hand-held lenses (a). Leeuwenhoek observed an alga of the genus *Spirogyra* (b) and a protist of the genus *Vorticella* (c).



(b)



(c)

Leeuwenhoek

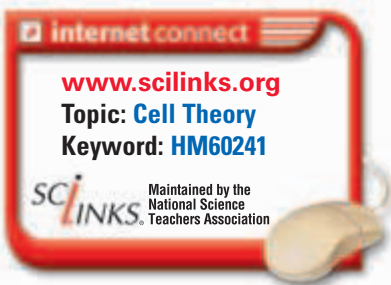
The first person to observe living cells was a Dutch trader named Anton van Leeuwenhoek. Leeuwenhoek made microscopes that were simple and tiny, but he ground lenses so precisely that the magnification was 10 times that of Hooke's instruments. In 1673, Leeuwenhoek, shown in Figure 4-2a, was able to observe a previously unseen world of microorganisms. He observed cells with green stripes from an alga of the genus *Spirogyra*, as shown in Figure 4-2b, and bell-shaped cells on stalks of a protist of the genus *Vorticella*, as shown in Figure 4-2c. Leeuwenhoek called these organisms *animalcules*. We now call them *protists*.

THE CELL THEORY

Although Hooke and Leeuwenhoek were the first to report observing cells, the importance of this observation was not realized until about 150 years later. At this time, biologists began to organize information about cells into a unified understanding. In 1838, the German botanist Matthias Schleiden concluded that all plants were composed of cells. The next year, the German zoologist Theodor Schwann concluded the same thing for animals. And finally, in his study of human diseases, the German physician Rudolf Virchow (1821–1902) noted that all cells come from other cells. These three observations were combined to form a basic theory about the cellular nature of life. The **cell theory** has three essential parts, which are summarized in Table 4-1.

TABLE 4-1 *The Cell Theory*

All living organisms are composed of one or more cells.
Cells are the basic units of structure and function in an organism.
Cells come only from the reproduction of existing cells.



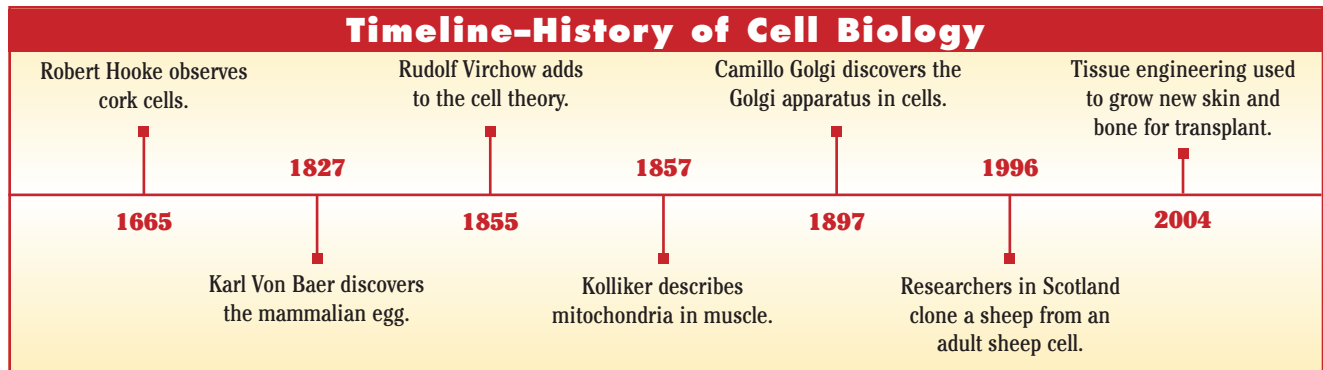


FIGURE 4-3

The study of cell biology began with the discovery of the cell by Robert Hooke in 1665. Since then, constantly improving technology has allowed scientists to unlock the secrets of the cell.

Developments in Cell Biology

The discovery of cells and the development of the cell theory happened at the beginning of a revolutionary time in the history of science. Before the invention of the microscope, many questions about what makes up living and nonliving things could not be answered. Once cells could be observed, these questions could be explored. Scientists could then turn their attention to finding out how cells function. Figure 4-3 lists some of the major events in the history of cell biology.

The Cellular Basis of Life

Microscopes helped biologists clarify our definition of life. All living things share several basic characteristics. All living things consist of organized parts, obtain energy from their surroundings, perform chemical reactions, change with time, respond to their environments, and reproduce.

In addition, living things must be able to separate their relatively constant internal environment from the ever-changing external environment. The ability to maintain a constant internal environment, called *homeostasis*, will be discussed later. Finally, all living things share a common history. All cells share characteristics that indicate that cells are related to other living things.

SECTION 1 REVIEW

1. Describe the major contributions of Hooke and Leeuwenhoek to cell biology.
2. Identify the advance that enabled Leeuwenhoek to view the first living cells.
3. Describe the research that led to the development of the cell theory.
4. State the three fundamental parts of the cell theory.
5. List three major events in the history of cell biology.
6. Name eight characteristics that all living things share.

CRITICAL THINKING

7. **Applying Concepts** If you could go back in time, how would you explain the cell theory to someone who had never heard of cells?
8. **Making Calculations** A biologist photographs a cell in a microscope magnified at 40 times. The cell in the photo is 2 mm in diameter. What is the true diameter of the cell in micrometers (μm)?
9. **Justifying Conclusions** If organisms exist on other planets, would they consist of cells? Defend your answer.