

Cellular Structure and Function

section 1 Cell Discovery and Theory

● Before You Read

Have you ever looked at anything through a magnifying glass or a microscope? Describe on the lines below how the magnifying glass or microscope changed the object. In this section you will learn about some important discoveries made using microscopes.

MAIN Idea

The microscope led to the discovery of cells.

What You'll Learn

- the principles of the cell theory
- how compound light microscopes differ from electron microscopes
- how prokaryotic and eukaryotic cells differ

● Read to Learn

History of the Cell Theory

A cell is the basic structural and functional unit of all living things. The human body consists of trillions and trillions of cells. But cells are too small to see with the human eye. The invention of the microscope allowed scientists to discover that cells existed.

In 1665, an English scientist named Robert Hooke made a simple microscope. He used the microscope to look at a piece of cork, which is the dead cells of oak bark. Hooke saw small, box-shaped structures in the cork, which he called *cellulae*. Today, we call them cells.

In the late 1600s, Anton van Leeuwenhoek (LAY vun hook), a Dutch scientist, made another microscope. He examined pond water, milk, and other substances. He was surprised to find living organisms in these substances.

What discoveries led to the cell theory?

In 1838, German scientist Matthias Schleiden studied plants under microscopes. He concluded that all plants are composed of cells. Another German scientist, Theodor Schwann, declared that animal tissues were made up of cells. ✓

Mark the Text

Focus As you read, underline or highlight the main ideas in each paragraph.

Reading Check

1. **Compare** What is one thing that plants and animals have in common?

Picture This

2. Highlight the principle in the cell theory that resulted from the discoveries of Matthias Schleiden and Theodor Schwann.

What is the cell theory?

Scientists continued to learn more about cells. Scientist Rudolf Virchow proposed that cells divide to form new cells. He suggested that every cell came from a cell that already existed. The observations and ideas of the various scientists who studied cells are summarized as the cell theory. The **cell theory** is a fundamental idea of modern biology and includes the principles listed in the table below.

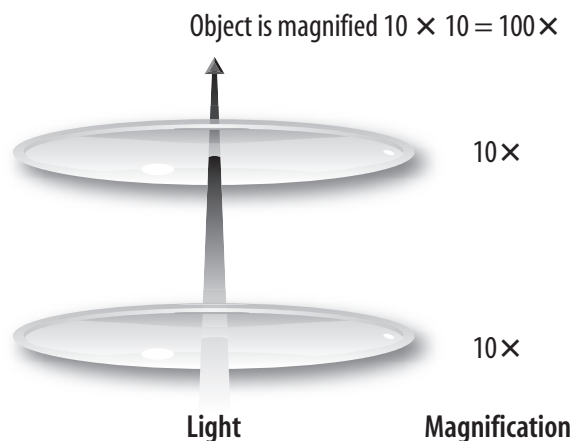
| The Cell Theory | |
|--|--|
| Principle | Explanation |
| 1. All living organisms are made up of one or more cells. | An organism can have one or many cells. Most plants and animals have many cells. |
| 2. The cell is the basic unit of organization in living organisms. | Even in complex organisms such as humans, the cell is the basic unit of life. |
| 3. All cells come from living cells. Cells pass copies of their genetic material on to their daughter cells. | Cells contain hereditary information that passes from cell to cell during cell division. |

Microscope Technology

The development of the microscope made the discovery of cells possible. Improvements made to early microscopes have helped scientists learn much more about cells.

What is a compound light microscope?

The modern compound light microscope uses a series of glass lenses to magnify, or enlarge, an object. When visible light passes through each lens, it magnifies the image of the previous lens. For example, two lenses that each magnify an image $10\times$ result in a microscope that magnifies the object $100\times$, as shown in the figure below.



Picture This

3. Calculate If each lens in this example magnified the image $20\times$, what is the total magnification? (Show your work.)

What is an electron microscope?

The best compound light microscopes only magnify an image about 1000×. Scientists needed more powerful microscopes to learn more about cells. The electron microscope was invented in the 1940s. It doesn't use lenses. Instead, the transmission electron microscope (TEM) uses magnets to aim a beam of electrons at the image to be magnified. Some TEMs can magnify an image 500,000×.

The scanning electron microscope (SEM) was a further improvement in technology. It produces a three-dimensional image of the cell. One problem with both the TEM and SEM is that only nonliving cells can be examined. A more recent invention, the scanning tunneling electron microscope (STM), can magnify living cells.

Basic Cell Types

Cells have different sizes, shapes, and functions, but all cells have a plasma membrane. A **plasma membrane** is a boundary that helps control what enters and leaves the cell.

Some basic functions are common to most cells. For example, most cells have some form of genetic material that provides instructions for making substances that the cell needs. In addition, all cells break down molecules to generate energy.

What are the two categories of cells?

Scientists group cells into two broad categories based on their internal structures. These categories are prokaryotic cells and eukaryotic cells.

Simple cells that have no specialized structures are known as **prokaryotic** (pro kar ee AW tik) **cells**. Cell functions in these simple cells occur in the plasma membrane. Most unicellular organisms, such as bacteria, are prokaryotic cells. Thus, they are called prokaryotes. Prokaryotic cells are believed to be similar to the first cells on Earth.

Eukaryotic (yew kar ee AW tik) cells are the other category of cells. They are usually larger and more complex.

Eukaryotic cells contain a nucleus and other structures called organelles. **Organelles** are specialized structures that carry out specific functions. The **nucleus** contains the genetic material for the cell. Organisms that are made up of eukaryotic cells are called eukaryotes. Eukaryotes can be unicellular or multicellular.



Think it Over

4. Draw Conclusions

What is an advantage of viewing living cells?



Think it Over

5. Compare

Which cells are more complex? (Circle your answer.)

- a. prokaryotic cells
- b. eukaryotic cells