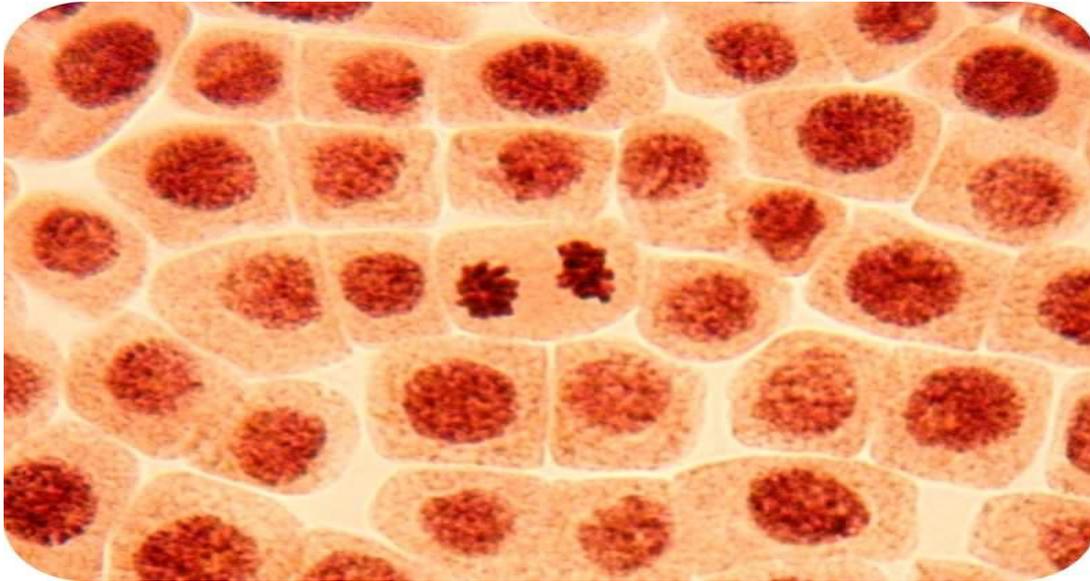


# CHAPTER 3

# Cell Theory

## Learning Objectives

- Explain how cells are observed.
- Define cell. Describe the general role of a cell.
- State the three main parts of the cell theory.
- Summarize the structure-function relationship of a cell.
- Explain the levels of organization in an organism.



### What are you made of?

Cells make up all living things, including your own body. This picture shows a typical group of cells. But not all cells look alike. Cells can differ in shape and sizes. The shape of a cell often determines its function, so cells of your blood have different shapes than cells found in the brain.

### Introduction to Cells

A **cell** is the smallest structural and functional unit of an organism. Some organisms, like bacteria, consist of only one cell. Big organisms, like humans, consist of trillions of cells. Compare a human to a banana. On the outside, they look very different, but if you look close enough you'll see that their cells are actually very similar.

### Observing Cells

Most cells are so small that you cannot see them without the help of a **light microscope**. It was not until 1665 that English scientist Robert Hooke invented a basic light microscope and observed cells for the first time, by looking at a piece of cork.

1. Why do cells have different shapes?

2. Define cell.

3. What type of organisms consist of only one cell?

4. Who was the first person to see cells and in what year?

In the 1950s, scientists developed more powerful microscopes. A light microscope sends a beam of light through a specimen, or the object you are studying. A more powerful microscope, called an **electron microscope**, passes a beam of electrons through the specimen. Sending electrons through a cell allows us to see its smallest parts, even the parts inside the cell. Without electron microscopes, we would not know what the inside of a cell looked like.

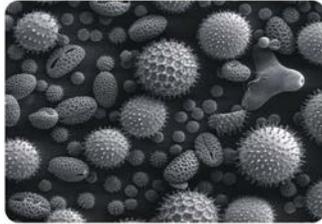


FIGURE 1.2

An electron microscope allows scientists to see much more detail than a light microscope, as with this sample of pollen.

## Cell Theory

In 1858, after using microscopes much better than Hooke's first microscope, Rudolf Virchow developed the hypothesis that cells only come from other cells. For example, bacteria, which are single-celled organisms, divide in half (after they grow some) to make new bacteria. In the same way, your body makes new cells by dividing the cells you already have. In all cases, cells only come from cells that have existed before. This idea led to the development of one of the most important theories in biology, the **cell theory**.

Cell theory states that:

1. All organisms are composed of cells.
2. Cells are the basic living units of organization in all organisms.
3. All cells come from other cells.

As with other scientific theories, many hundreds, if not thousands, of experiments support the cell theory. Since Virchow created the theory, no evidence has ever been identified to contradict it.

## Specialized Cells

Although cells share many of the same features and structures, they also can be very different. Each cell in your body is designed for a specific task. In other words, the cell's function is partly based on the cell's structure. For example:

- Red blood cells are shaped with a pocket that traps oxygen
- Nerve cells are long and stringy in order to form a line of communication with other nerve cells,
- Skin cells are flat and fit tightly together to protect your body.

5. How is an electron microscope different from a light microscope?

6. What was Rudolf Virchow's hypothesis?

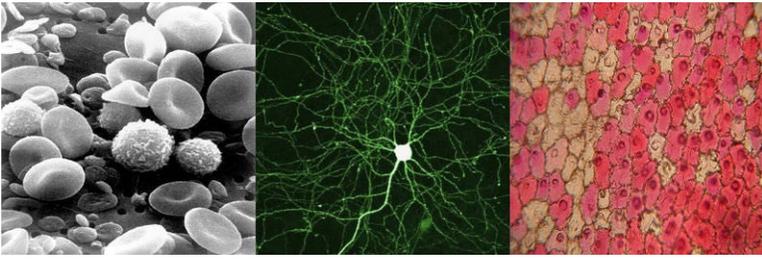
7. How do cells make new cells?

8. According to the cell theory, cells are the basic units of what?

9. How did a hypothesis become a theory?

10. What is the purpose of the pocket shape of blood cells?

11. Describe the shape of skin cells.



**FIGURE 1.3**

Red blood cells (*left*) are specialized to carry oxygen in the blood. Neurons (*cen-ter*) are shaped to conduct electrical im-pulses to many other nerve cells. These epidermal cells (*right*) make up the “skin” of plants. Note how the cells fit tightly together.

### Levels of Organization

While cells are the basic units of an organism, groups of cells can perform a job together. These cells are called specialized because they have a special job. Specialized cells can be organized into **tissues**. For example, your liver cells are organized into liver tissue. Your liver tissue is further organized into an organ, your liver. **Organs** are formed from two or more specialized tissues working together to perform a job. All organs, from your heart to your liver, are made up of an organized group of tissues.

These organs are part of a larger system, the **organ systems**. For example, your brain works together with your spinal cord and other nerves to form the nervous system. This organ system must be organized with other organ systems, such as the circulatory system and the digestive system, for your body to work. Organ systems work together to form the entire organism. There are many levels of organization in living things.

### Summary

- Cells were first observed under a light microscope, but today’s electron microscopes allow scientists to take a closer look at the inside of cells.
- Cell theory says that:
  - All organisms are composed of cells.
  - Cells are alive and the basic living units of organization in all organisms.
  - All cells come from other cells.

12. What is the job of a neuron?  
(See Fig 11.3)

13. Define organ:

14. Provide an example of an organ found in your body.

15. Provide an example of an organ system.