Introduction to Cells

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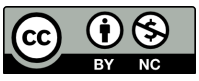

CHAPTER 1

Introduction to Cells

Lesson Objectives

- Explain how cells are observed.
- Define the three main parts of the cell theory.
- Explain the levels of organization in an organism.

Check Your Understanding

- What are the five main characteristics of living things?
- Name the four main classes of organic molecules that are building blocks of life.

Vocabulary

- organ
- organ system
- tissue

What are cells?

In the chapter *What is a Living Organism?*, you learned that living things are made of big molecules called proteins, lipids, carbohydrates, and nucleic acids. When these big molecules come together, they form a cell. A **cell** is the smallest unit of an organism that is still considered living (see the onion cells in **Figure** 1.1). 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 tiny that you cannot see them without the help of a microscope. It was not until 1665 that English scientist Robert Hooke invented a basic light microscope and observed cells for the first time. You may use light microscopes in the classroom. You can use a light microscope to see cells. But many structures in the cell are too small to see with a light microscope. So, what do you do if you want to see the tiny structures inside of cells?

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 tiniest parts (**Figure** 1.2).

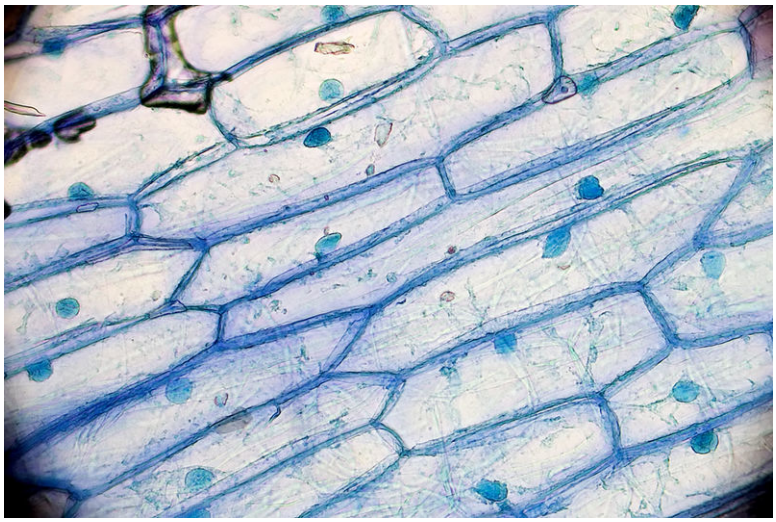

FIGURE 1.1

The outline of onion cells are visible under a light microscope.

Without electron microscopes, we would not know what the inside of a cell looked like. The only problem with using an electron microscope is that it only works with dead cells. Scientists and students still use light microscopes to study living cells.

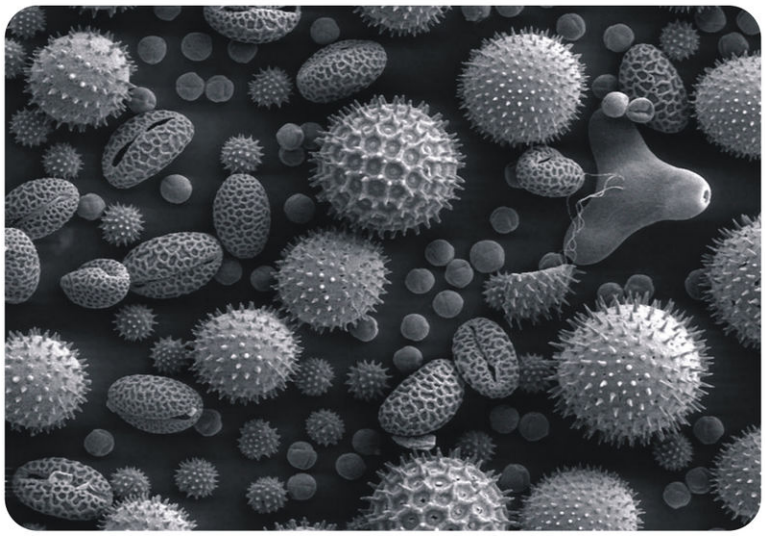

FIGURE 1.2

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

How to Correctly Use a Microscope can be viewed at http://www.youtube.com/watch?v=jP9HtcAvGDk (1:43).

MEDIA

Click image to the left for more content.

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 are composed of only one cell (**Figure** 1.3) and divide in half 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, cell theory.

Cell theory states that:

1. All organisms are composed of cells.
2. Cells are alive and 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 contradicted it.

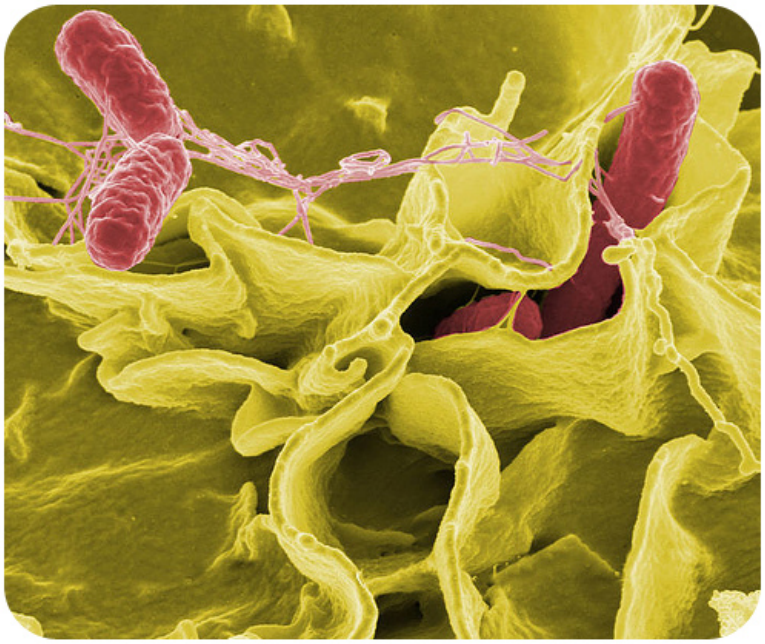

FIGURE 1.3

Bacteria (pink) are an example of an organism consisting of only one cell.

Levels of Organization

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.

For example:

- Red blood cells (**Figure** 1.4) are shaped with a pocket that traps oxygen and brings it to other body cells.
- Nerve cells, which can quickly send the feeling of touching a hot stove to your brain, are long and stringy in order to form a line of communication with other nerve cells, like a wire (**Figure** 1.5).

- Skin cells (**Figure** 1.6) are flat and fit tightly together to protect your body.

An animation comparing the size of red blood cells and skin cells to other structures can be found at http://learn.genetics.utah.edu/content/begin/cells/scale/.

As you can see, cells are shaped in ways that help them do their jobs. Multicellular (many-celled) organisms have many types of specialized cells in their bodies.

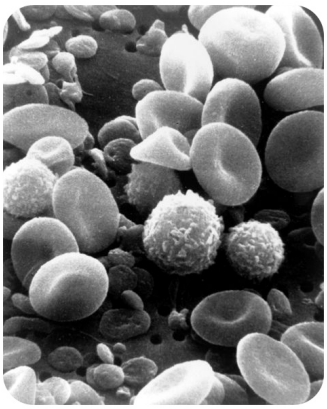

FIGURE 1.4

Red blood cells are specialized to carry oxygen in the blood.

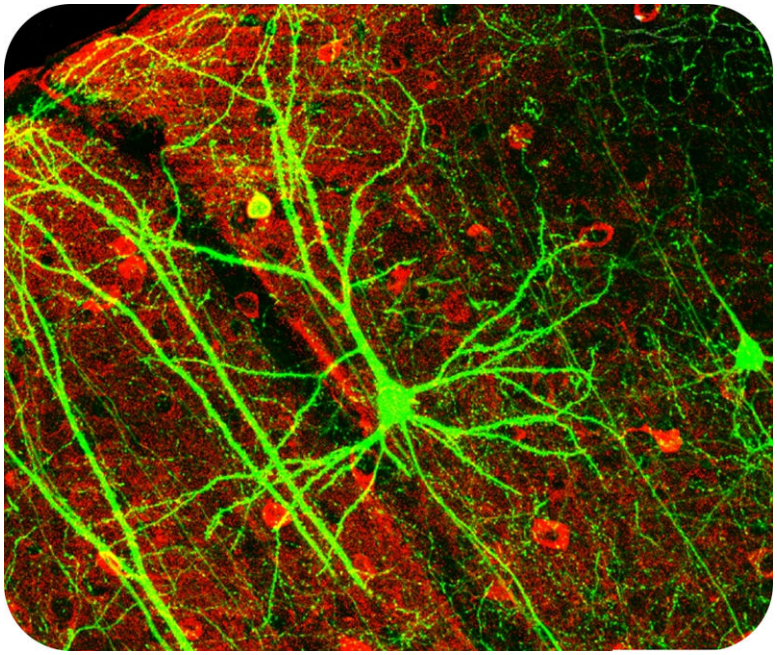

FIGURE 1.5

Neurons are shaped to conduct electrical impulses to many other nerve cells.

While cells are the basic units of an organism, groups of cells can be specialized, or perform a specific job. Specialized cells can be organized into tissues. For example, your liver cells are organized into liver tissue, which is organized into an organ, your liver. Organs are formed from two or more specialized tissues working together to perform a job that helps your body work. 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,

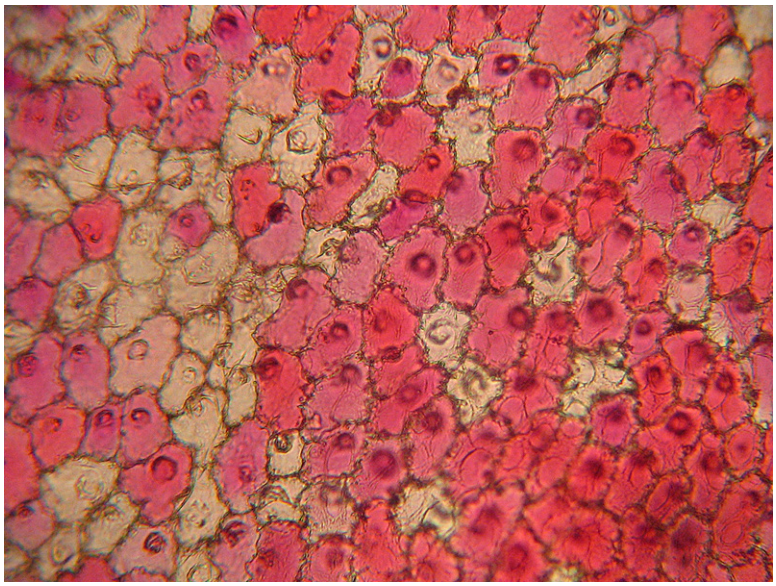

FIGURE 1.6

These epidermal cells make up the "skin" of plants. Note how the cells fit tightly together.

such as the circulatory system and the digestive system, for your body to work. Organ systems work together to form the entire organism. As you can see (**Figure** 1.7), there are many levels of organization in living things.

Lesson 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; and
  - All cells come from other cells.
- Cells are organized into tissues, which are organized into organs, which are organized into organ systems, which are organized to create the whole organism.

Review Questions

Recall

1. What scientific tool was used to first observe cells?
2. What are the three main parts of the cell theory?

Apply Concepts

3. Put the following in the correct order from simplest to most complex: organ, cell, tissue, organ system.
4. What type of microscope would be best for studying the structures found inside of cells?

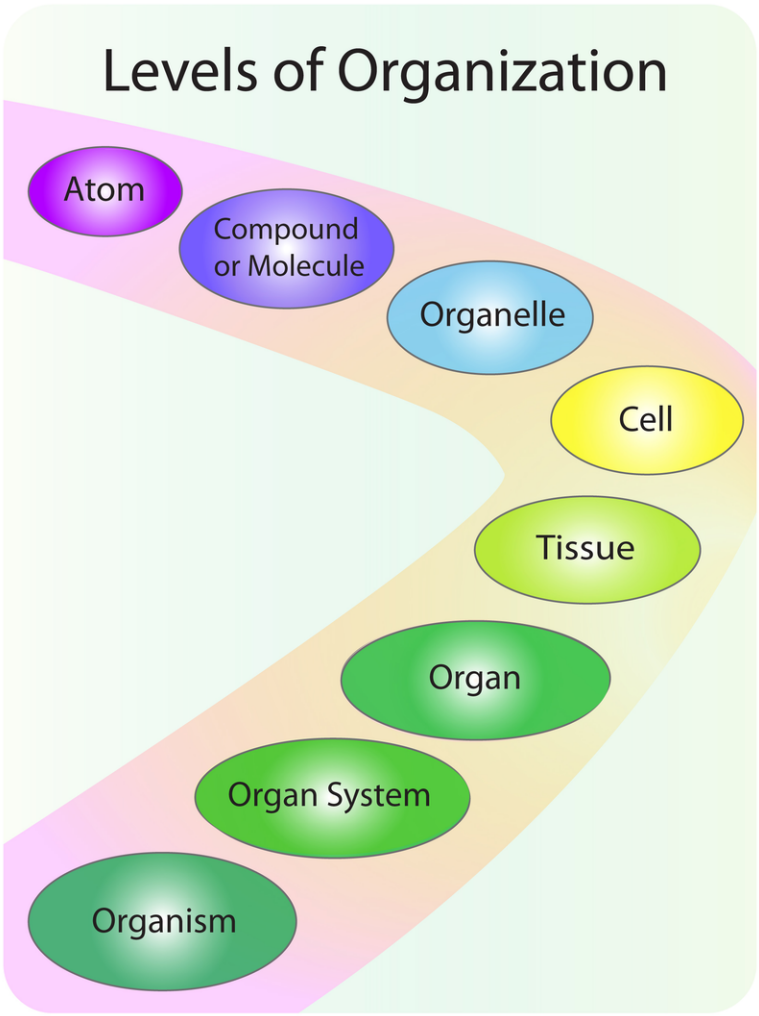

FIGURE 1.7

Levels of Organization, from the atom to the organism.

Think Critically

5. According to the cell theory, can we create a new cell in laboratory by putting different molecules together? Why or why not?

Further Reading / Supplemental Links

- Baeuerle, Patrick A. and Landa, Norbert. *The Cell Works: Microexplorers.* Barron's; 1997, Hauppauge, New York.
- Sneddon, Robert. *The World of the Cell: Life on a Small Scale.* Heinemann Library; 2003, Chicago.
- Wallace, Holly. *Cells and Systems.* Heinemann Library; 2001, Chicago.

Points to Consider

- Do you think there would be a significant difference between bacterial cells and your brain cells? What might they be?
- Do you think a bacterial cell and a brain cell have some things in common? What might they be?
- Do you think cells have organs like we do? How would that benefit cells?

References

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