Two Kinds of Cells

All cells have cell membranes, organelles, cytoplasm, and DNA. But there are two basic types of cells—cells without a nucleus and cells with a nucleus. Cells with no nucleus are prokaryotic (proh KAR ee AHT ik) cells. Cells that have a nucleus are eukaryotic (yoo KAR ee AHT ik) cells. Prokaryotic cells are further classified into two groups: bacteria (bak TIR ee uh) and archaea (AHR kee uh).

Prokaryotes: Bacteria and Archaea

Bacteria and archaea are prokaryotes (pro KAR ee OHTS). Prokaryotes are single-celled organisms that do not have a nucleus or membrane-bound organelles.

Bacteria

The most common prokaryotes are bacteria (singular, bacterium). Bacteria are the smallest cells known. These tiny organisms live almost everywhere. Bacteria do not have a nucleus, but they do have DNA. A bacteria’s DNA is a long, circular molecule, shaped like a twisted rubber band. Bacteria have no membrane-covered organelles. But they do have ribosomes. Ribosomes are tiny, round organelles made of protein and other material.

Bacteria also have a strong, weblike exterior cell wall. This wall helps the cell retain its shape. A bacterium’s cell membrane is just inside the cell wall. Together, the cell wall and cell membrane allow materials into and out of the cell.

Some bacteria live in the soil and water. Others live in, or on, other organisms. For example, you have bacteria living on your skin and teeth. You also have bacteria living in your digestive system. These bacteria help the process of digestion. A typical bacterial cell is shown in Figure 6.

**Figure 6** This diagram shows the DNA, cell membrane, and cell wall of a bacterial cell. The flagellum helps the bacterium move.
Archaea

The second kind of prokaryote are the archaea (singular, archaeon). Archaea are similar to bacteria in some ways. For example, both are single-celled organisms. Both have ribosomes, a cell membrane, and circular DNA. And both lack a nucleus and membrane-bound organelles. But archaea differ from bacteria in some way, too. For example, archaeal ribosomes are different from bacterial ribosomes.

Archaea are similar to eukaryotic cells in some ways, too. For example, archaeal ribosomes are more like the ribosomes of eukaryotic cells. But archaea also have some features that no other cells have. For example, the cell wall and cell membranes of archaea are different from the cell walls of other organisms. And some archaea live in places where no other organisms could live.

Three types of archaea are heat-loving, salt-loving, and methane-making. Methane is a kind of gas frequently found in swamps. Heat-loving and salt-loving archaea are sometimes called extremophiles. Extremophiles live in places where conditions are extreme. They live in very hot water, such as in hot springs, or where the water is extremely salty. Figure 7 shows one kind of methane-making archaea that lives deep in the ocean near volcanic vents. The temperature of the water from those vents is extreme: it is above the boiling point of water at sea level.

Reading Check What is one difference between bacteria and archaea?
**Eukaryotic Cells and Eukaryotes**

Eukaryotic cells are the largest cells. Most eukaryotic cells are still microscopic, but they are about 10 times larger than most bacterial cells. A typical eukaryotic cell is shown in Figure 8.

Unlike bacteria and archaea, eukaryotic cells have a nucleus. The nucleus is one kind of membrane-bound organelle. A cell’s nucleus holds the cell’s DNA. Eukaryotic cells have other membrane-bound organelles as well. Organelles are like the different organs in your body. Each kind of organelle has a specific job in the cell. Together, organelles, such as the ones shown in Figure 8, perform all the processes necessary for life.

All living things that are not bacteria or archaea are made of one or more eukaryotic cells. Organisms made of eukaryotic cells are called *eukaryotes*. Many eukaryotes are multicellular. *Multicellular* means “many cells.” Multicellular organisms are usually larger than single-cell organisms. So, most organisms you see with your naked eye are eukaryotes. There are many types of eukaryotes. Animals, including humans, are eukaryotes. So are plants. Some protists, such as amoebas, are single-celled eukaryotes. Other protists, including some types of green algae, are multicellular eukaryotes. Fungi are organisms such as mushrooms or yeasts. Mushrooms are multicellular eukaryotes. Yeasts are single-celled eukaryotes.

**Reading Check** How are eukaryotes different from prokaryotes?

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**Figure 8** Organelles in a Typical Eukaryotic Cell

- Nucleus
- Lysosome
- Golgi complex
- Endoplasmic reticulum
- Ribosome
- Mitochondrion
- Cell membrane

For another activity related to this chapter, go to [go.hrw.com](http://go.hrw.com) and type in the keyword HL5CELW.
Using Key Terms

1. In your own words, write a definition for the term organelle.

2. Use the following terms in the same sentence: prokaryotic, nucleus, and eukaryotic.

Understanding Key Ideas

3. Cell size is limited by the
   a. thickness of the cell wall.
   b. size of the cell’s nucleus.
   c. cell’s surface area–to-volume ratio.
   d. amount of cytoplasm in the cell.

4. What are the three parts of the cell theory?

5. Name three structures that every cell has.

6. Give two ways in which archaea are different from bacteria.

Critical Thinking

7. Applying Concepts You have discovered a new single-celled organism. It has a cell wall, ribosomes, and long, circular DNA. Is it a eukaryote or a prokaryote cell? Explain.

8. Identifying Relationships You are looking at a cell under a microscope. It is a single cell, but it also forms chains. What characteristics would this cell have if the organism is a eukaryote? If it is a prokaryote? What would you look for first?

Interpreting Graphics

The picture below shows a particular organism. Use the picture to answer the questions that follow.

Flagellum

9. What type of organism does the picture represent? How do you know?

10. Which structure helps the organism move?

11. What part of the organism does the letter A represent?