

# 1.2

## KEY CONCEPT

# Bacteria are single-celled organisms without nuclei.

### BEFORE, you learned

- Organisms come in all shapes and sizes
- All living things share common characteristics
- Living things may be divided into six kingdoms

### NOW, you will learn

- About the simplest living things
- About bacteria and archaea
- That bacteria may help or harm other organisms

## VOCABULARY

- bacteria p. 16
- archaea p. 18
- producer p. 19
- decomposer p. 19
- parasite p. 19

## THINK ABOUT

### Where are bacteria?

Bacteria are the simplest form of life. But that doesn't mean they're not important or numerous. As you look about the room you're sitting in, try to think of places where you might find bacteria. In fact, bacteria are on the walls, in the air, on the floor, and on your skin. It's hard to think of a place where you wouldn't find bacteria. The photograph shows a magnification of bacteria living on a sponge. The bacteria are magnified  $580\times$ . There are hundreds of millions of bacteria on your skin right now. And there are trillions of bacteria that live inside your intestines and help you digest food.



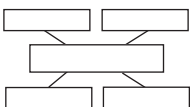
## Bacteria and archaea are the smallest living things.

The names of the organisms belonging in the kingdoms Archaea and Bacteria are probably unfamiliar. Yet you actually encounter these organisms every day. Bacteria are everywhere: on your skin, in the ground, in puddles and ponds, in the soil, and in the sea. About 300 species of bacteria are living in your mouth right now.

**Bacteria** are the simplest kind of life known on Earth. All bacteria are composed of just one cell without a nucleus. Their genetic material is contained in a single loop within the cell. A bacterium reproduces using binary fission.

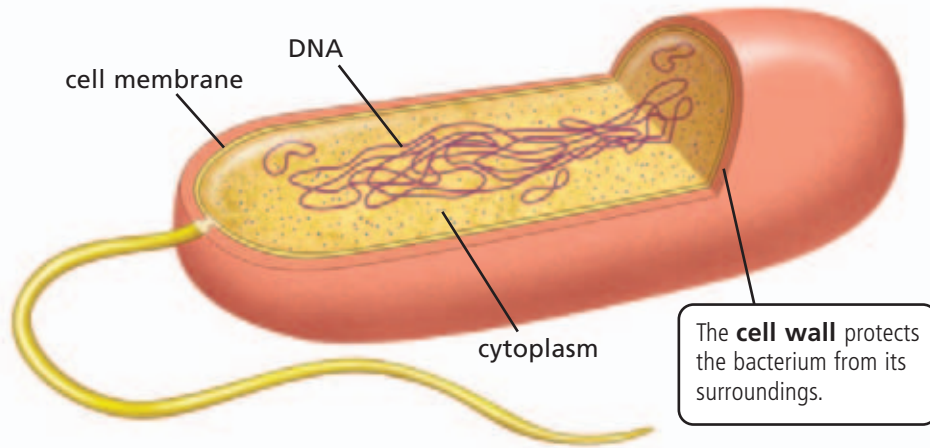
### MAIN IDEA WEB

Make a web of the important terms and details about the main idea: *Bacteria and archaea are the smallest living things.* Be sure to include how bacteria are classified.



## Bacteria

All bacteria are single cells without nuclei.



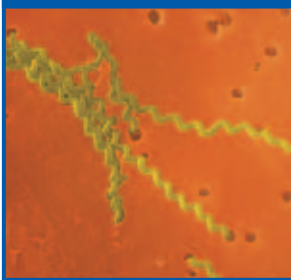
Bacterial cells are different from the cells of other organisms. A bacterial cell is about 1/10 to 1/20 the size of a typical cell from organisms such as animals, plants, fungi, or protists. These four groups include organisms made up of cells with true nuclei. The nucleus is a structure that is enclosed by a membrane and that holds the genetic material.

Despite their small size, bacteria are simple only when compared with more complex cells. Bacteria are much more complex than viruses, because they have many internal structures that viruses do not have. For example, one important feature of most bacteria is a covering called a cell wall, which surrounds and protects the soft cell membrane like a rain jacket. Bacterial cells contain many large molecules and structures that are not found in viruses.

### READING TIP

The plural of *bacterium* is *bacteria*, and the plural of *nucleus* is *nuclei*.

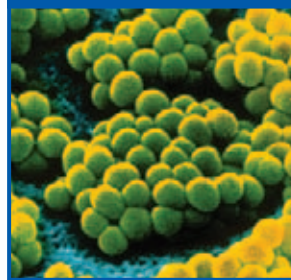
#### Spiral Bacteria



#### Rod Bacteria



#### Round Bacteria



Scientists often classify bacteria by their external shapes.

- Spiral-shaped bacteria occur in single strands.
- Rod-shaped bacteria may occur singly or in chains.
- Round-shaped bacteria may occur singly or in pairs, chains, or clusters.

### CHECK YOUR READING

Name two features that all bacteria share.

## Archaea and bacteria are found in many environments.



Find out more about the many different types of bacteria.

Two types of single-celled organisms do not have nuclei. Bacteria are the most common and can be found in nearly every environment. Archaea are similar in size to bacteria, but share more characteristics with the cells of complex organisms like plants and animals.

### Archaea

**Archaea** (AHR-kee-uh) are single-celled organisms that can survive in the largest range of environments. These environments may be very hot, very cold, or contain so much of a substance such as salt that most living things would be poisoned. As a result, scientists often group archaea according to where they live.

**Methanogens** take their name from methane, the natural gas they produce. These archaea die if they are exposed to oxygen. They may live in the dense mud of swamps and marshes, and in the guts of animals such as cows and termites.

**Halophiles** live in very salty lakes and ponds. Some halophiles die if their water is not salty enough. When a salty pond dries up, so do the halophiles. They can survive drying and begin dividing again when water returns to the pond.

**Thermophiles** are archaea that thrive in extreme heat or cold. They may live in hot environments such as hot springs, near hot vents deep under the sea, or buried many meters deep in the ice.

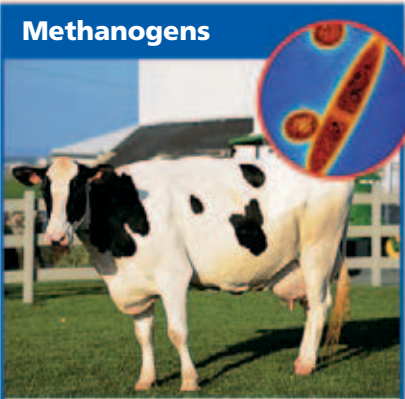
#### READING TIP

The word halophile is formed using the root word *halo-* which means "salt," and the suffix *-phile* which means "love." Therefore, a *halophile* is a "salt lover."

### Archaea

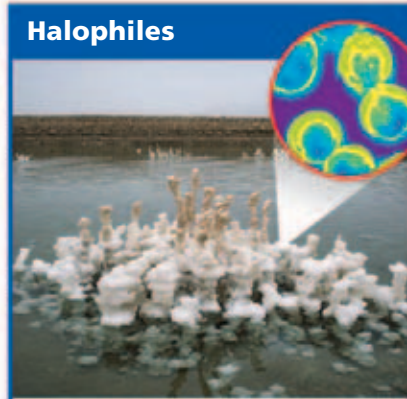
Archaea are organisms that can live in extreme environments.

#### Methanogens



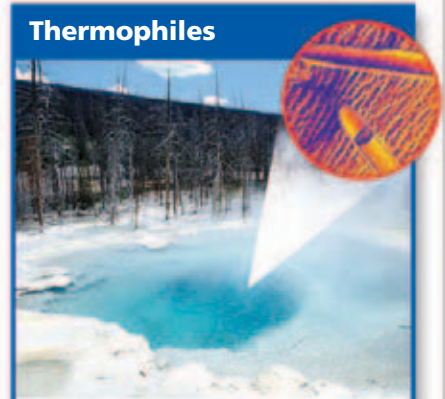
Methanogens maybe found in a cows' stomach where they help with digestion.

#### Halophiles



Halophiles can be found in extremely salty bodies of water such as the Dead Sea.

#### Thermophiles



Thermophiles may be found in hot geysers such as this one in Yellowstone National Park.



## Bacteria

Most single-celled organisms without a nuclei are classified as bacteria. Bacteria are found in almost every environment and perform a variety of tasks. Some bacteria contain chlorophyll. Using sunlight for energy, these bacteria are an important food source in oceans. These bacteria also release oxygen gas, which animals need to breathe.

### CHECK YOUR READING

What are some common traits of bacteria and archaea?

Bacteria without chlorophyll perform different tasks. Some bacteria break down parts of dead plants and animals to help recycle matter. Some bacteria release chemicals into the environment, providing a food source for other organisms. Scientists often group bacteria by the roles they play in the environment. Three of the most common roles are listed below.

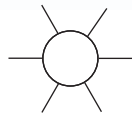
Bacteria that transform energy from sunlight into energy that can be used by cells are called **producers**. These bacteria are a food source for organisms that cannot make their own food.

**Decomposers** get energy by breaking down materials in dead or decaying organisms. Decomposers help other organisms reuse materials found in decaying matter.

**Parasites** live in very close relationships either inside or on the surface of other organisms. Parasites harm their host organisms or host cells. Other bacteria live in close relationships with host organisms but are helpful to their hosts, or do not affect them.

### VOCABULARY

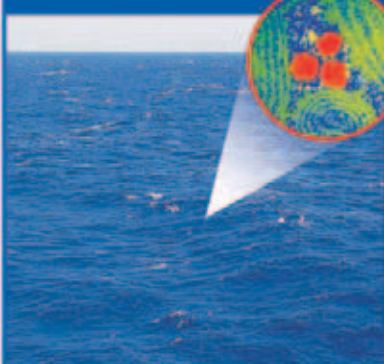
Be sure to add description wheels for *producer*, *decomposer*, and *parasite* to your notebook.



## Bacteria

Three roles bacteria play in the environment are shown below.

### Producers



Cyanobacteria in Earth's oceans provide oxygen for animals to breathe.

### Decomposers



Some bacteria break down dead wood into materials used by other organisms.

### Parasites



*Staphylococcus* bacteria cause infections such as these boils in humans.

## Bacteria may help or harm other organisms.

Some bacteria, such as producers and decomposers, are helpful to other organisms. But other bacteria can be harmful. These bacteria can cause diseases in animals and plants.

### Helpful Bacteria

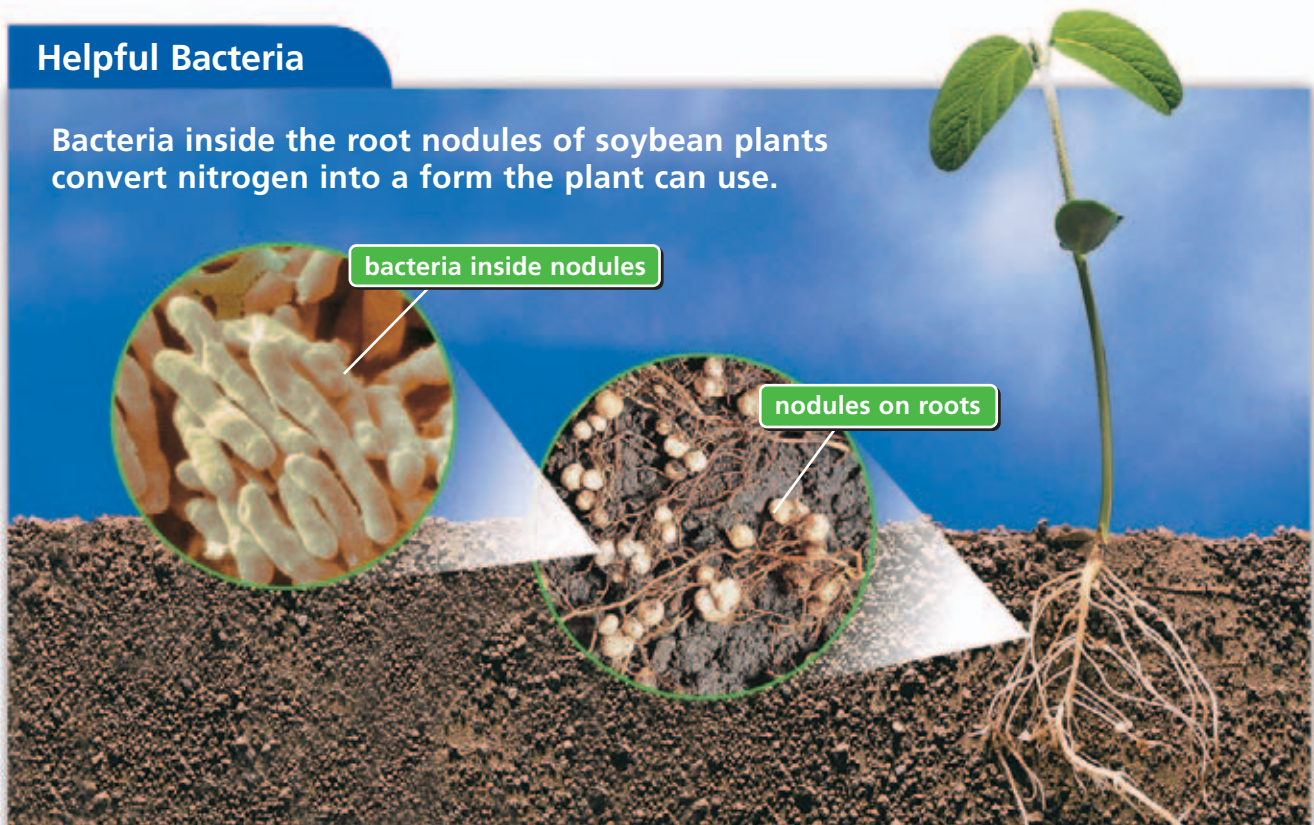
One shovelful of ordinary soil contains trillions of bacteria, and every fallen leaf or dead animal is covered with bacteria. These bacteria break down the matter in dead bodies and waste materials. Broken-down materials may become available for other organisms to build their bodies.

Cities use bacteria to break down sewage. Bacteria in sewage-treatment plants live on the material dissolved in liquid sewage. After the bacteria have finished, the water is clean enough to sterilize. Then water can be released into rivers or oceans. Other bacteria are used to clean up oil spills by decomposing oil suspended on the ocean's surface.

Bacteria can also change materials that do not come from living things and make them available for other organisms. For example, some bacteria can convert nitrogen gas to nitrogen compounds. This process, called nitrogen fixation, makes nitrogen available to plants in a form that is useful to them. Plants use this nitrogen in making proteins, which are an important part of every cell.

### Helpful Bacteria

Bacteria inside the root nodules of soybean plants convert nitrogen into a form the plant can use.



Like bacteria, certain types of archaea are helpful to other organisms. All animals that eat plants such as grass depend on archaea. Methanogens help break down the cellulose in cell walls. Termites and cows are two examples of animals that can digest cellulose because of the archaea in their stomachs.

**CHECK YOUR READING**

Name two helpful roles that bacteria can play in the environment.

## Harmful Bacteria

Not all bacteria are helpful to other organisms. Scientists first discovered that bacteria cause some diseases in the late 1800s. Much of the scientific research into harmful bacteria developed because bacteria cause disease in humans. Tuberculosis, cholera, and infant diarrhea are examples of disease caused by bacteria. Bacteria also may cause disease in many animals and in plants.

Bacteria can cause the symptoms of disease in three ways.

- They can invade parts of the body, multiplying in body tissues and dissolving cells.
- They can poison the body with chemicals they produce and release.
- They can poison the body with chemicals that are part of the bacteria itself.

One way to fight bacterial disease is with vaccinations. Vaccines help individual organisms prepare to fight diseases they might encounter in the future. Humans, as well as cats and dogs, get vaccinations for bacterial diseases. A similar approach helps wildlife managers keep salmon safe from bacterial kidney disease.



Bacterial wilt causes disease in this pumpkin.

## 1.2 Review

### KEY CONCEPTS

1. Explain why bacteria are classified as living cells but viruses are not.
2. Name two main groups of bacteria.
3. Describe three ways that bacteria affect other organisms.

### CRITICAL THINKING

4. **Visualize** Draw a diagram of a bacterium. Label the parts of the cell.
5. **Predict** Where in your neighborhood would you find most of the bacteria that cause decomposition?

### CHALLENGE

6. **Analyze** Parasitic bacteria do not usually kill their hosts, at least not for a long period of time. Why is it better for parasites not to kill their hosts?