POWER BASICS®

Biology

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UNIT 2

Simple Organisms

LESSON 8: Archaebacteria and Eubacteria

GOAL: To learn about archaebacteria and eubacteria

WORDS TO KNOW

anaerobic
antibiotics
archaebacteria
bacilli (singular *bacillus*)
bacteria (singular *bacterium*)
binary fission
cocci (singular *coccus*)
eubacteria
flagella
gram-negative
gram-positive
microscopic
nucleoid
prokaryote
spirilla (singular *spirillum*)
viruses

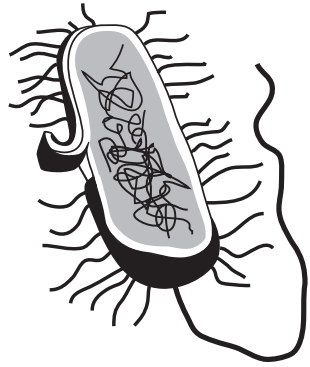
The Oldest Life-Forms

Bacteria were probably the first life-forms on Earth. They are living things, but they are neither plants nor animals. These single-celled organisms lack most of the structures present in plant and animal cells. Yet they are still the most numerous and successful organisms on Earth. They can survive in any environment. They are found on the tops of the highest mountains and at the bottom of the deepest oceans. Some live in extremely salty water. Some live in rocks and ice. Some live in the roots of plants, or in the intestines of animals. There are more of them in your mouth right now than there are people in the world! But you have probably never seen one. This is because bacteria are **microscopic.** They are so small they can only be seen when magnified by a microscope.

These organisms have a cell wall, but do not have a true nucleus. The name for this kind of cell is **prokaryote,** which means "before nucleus." Instead of a nucleus, these cells have a **nucleoid.** This is a region of cytoplasm where the cell's DNA is found. DNA is usually in one long

strand. Some have **flagella,** or hairlike strands of protein that are used for movement. Some prokaryotes also have an extra capsule on the outside. This capsule helps protect the cell.

Scientists use the cell wall to identify different types of bacteria. They apply a special dye to the cell wall. If the cell wall reacts to the dye and turns purple, the cell is **gram-positive.** If it does not react, it is **gram-negative.**



Prokaryotic Cell

TIP

The terms *gram-positive* and *gram-negative* come from the name of Christian Gram, the scientist who first developed this way of identifying bacteria.

Bacteria are grouped into two kingdoms, the archaebacteria (or "old bacteria") and the eubacteria (or "true bacteria").

Archaebacteria

The **archaebacteria** are the oldest living things. They first developed about 3.8 billion years ago. At that time, Earth's atmosphere did not contain oxygen. Archaebacteria gave off oxygen as a product of photosynthesis. Eventually, there was enough oxygen in the atmosphere for other life-forms to develop.

Archaebacteria may produce oxygen, but many of them are **anaerobic**—that is, they cannot survive when oxygen is present. However, they can survive in conditions that would kill other organisms. Unlike eubacteria, archaebacteria are not harmed by **antibiotics,** medicines that kill disease-causing bacteria.

One type of archaebacteria lives in extremely hot, acidic water. These organisms die of cold when the temperature drops to 55˚C (131˚ F).

Another type of archaebacteria dies in the presence of oxygen. These organisms produce energy by converting carbon dioxide into methane gas. They live in areas where they are protected from oxygen, such as the mud at the bottom of swamps, or in the intestines of animals.

A third type of archaebacteria lives in extremely salty conditions. These organisms are found in places like the Dead Sea, where no plants or animals can survive—not even seaweed grows there! The pinkish color sometimes seen near the shore of very salty lakes is caused by large concentrations of these archaebacteria.

PRACTICE 21: The Oldest Life-Forms

Look at the list of terms below. Fill in each line with the letter of the term that correctly completes each of the following statements.

a. anaerobic **c.** gram-positive **e.** nucleoid
b. flagella **d.** gram-negative

1. Scientists stain cell walls to see if the cell is _____ or _____.
2. Instead of a nucleus, prokaryotes have a(n) _____.
3. Some prokaryotes use hairlike structures called _____ to move.
4. Prokaryotes that cannot survive in oxygen are called _____.

Eubacteria

The other kingdom of bacteria is the **eubacteria,** which means "true bacteria." These are the organisms most people mean when they talk about bacteria. They are much more common than archaebacteria.

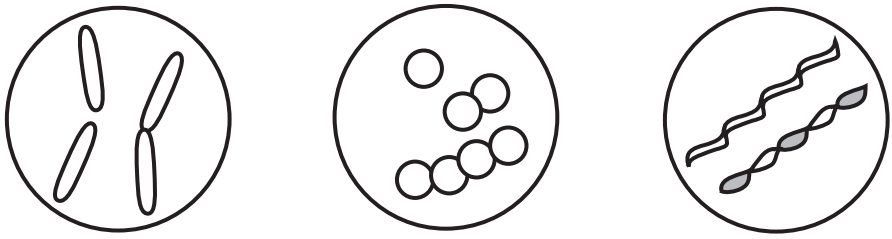
You may be most familiar with bacteria that cause diseases. Bacteria cause strep throat, tetanus, pneumonia, tuberculosis, and some sexually transmitted diseases. Most bacteria, however, are harmless. Many have positive uses and are even essential to life.

IN REAL LIFE

Bacteria are everywhere around you. To reduce the risk of bacterial infections, wash your hands well with soap and water or use an antibacterial hand sanitizer before you eat.

Eubacteria come in many shapes and forms. However, three shapes are most common: rod-shaped, round, and spiral.

- Rod-shaped cells are called **bacilli.** (The singular is *bacillus.*)
- Round or oval cells are called **cocci.** (The singular is *coccus.*)
- Spiral cells are called **spirilla.** (The singular is *spirillum.*)



Bacilli **Cocci** **Spirilla**

Most bacteria are able to move themselves from one place to another. Different bacteria have different ways of moving. Most move by spinning their flagella. Some produce a slimy substance that they can glide along. Some bacteria do not move at all.

Like other living things, bacteria also reproduce. Most bacteria reproduce by **binary fission.** The cell makes a copy of its own DNA. Then the cell divides, and a new bacterial cell wall forms. Binary fission results in two identical daughter cells. Bacteria can reproduce very quickly. When conditions are right, they can divide once every 20 minutes.

Harmful Bacteria

Some bacteria cause diseases in humans, such as cholera and pneumonia. Some cause food poisoning, while other bacteria cause acne. They can

cause diseases in plants, such as blight or cankers. Because bacteria can reproduce so quickly, just one or two bacteria can quickly become thousands of bacteria.

However, most bacteria that cause food poisoning are destroyed by heat. Cooking food properly kills these bacteria. Most disease-causing bacteria can be destroyed by antibiotics. Unfortunately, many bacteria are changing to become resistant to antibiotics. Scientists must find new ways to combat these resistant bacteria.

IN REAL LIFE

Marcia had a sore throat. She made a doctor's appointment to see if she had a bacterial infection. A friend offered her some antibiotics. Marcia knew that some bacteria have become resistant to antibiotics. The main reason is because people take antibiotics when they do not need them. She refused her friend's offer and waited until she saw the doctor.

Helpful Bacteria

Some bacteria can cause diseases. But most bacteria are not harmful. In fact, they have many important uses.

- Bacteria take nitrogen from the atmosphere and change it to a form that plants can use.
- Bacteria break down dead organisms, returning their nutrients to the soil.
- Bacteria in your stomach crowd out harmful bacteria and help you digest your food.
- Bacteria in water treatment plants help break down sewage.
- Bacteria take carbon dioxide from the air and replace it with oxygen.

- Bacteria are essential for making cheese and yogurt.
- Bacteria are used in oil spills to break oil molecules into less dangerous forms.
- Scientists use bacteria to produce medicines and for genetic engineering.

PRACTICE 22: Eubacteria

Circle the letter of the answer that correctly completes each of the following statements.

1. Eubacteria that are shaped like rods are called _____.
   a. bacilli
   b. cocci
   c. spirilla

2. Bacteria that cause food poisoning can be killed by _____ the food.
   a. eating
   b. freezing
   c. cooking

3. Bacteria take _____ from the atmosphere and change it so that plants can use it.
   a. methane
   b. oxygen
   c. nitrogen

4. Some bacteria are becoming _____ to antibiotics.
   a. resistant
   b. identical
   c. harmful

Viruses

Bacteria cause some diseases. But other diseases are caused by **viruses.** These are tiny particles, even smaller than bacteria. Scientists are