

Chapter 6, Section 3, Bacteria, pages 192-203

Information taken from Prentice Hall Science Explorer, Life Science, 2004







SOL LS.4 The student will investigate and understand how organisms can be classified. Key concepts include

- a) The distinguishing characteristics of domains of organisms
- b) The distinguishing characteristics of kingdoms of organisms
- c) The distinguishing characteristics of major phyla of animals and plant divisions; and
- d) The characteristics that define a species.

Objectives: The student will be able to

- Describe ways in which bacteria cells are different from all other organisms' cells
- Name two kingdoms of bacteria, and explain how bacteria reproduce and survive
- List positive roles bacteria play in people's lives

Bacteria surround your body; millions of them live on the surface of your skin and millions of others live inside your body. In fact, there are more bacteria living inside your mouth, than there are people living on Earth. You don't see or feel them because they are very small. They are the smallest and simplest organisms on the planet. Bacteria are found almost everywhere.

			
Bacteria on tooth	Spherical Cocci	Rodlike Bacilli	Spiral shaped Spirilla

What are the three shapes of bacteria?

Although there are many bacteria on Earth, they were not discovered until the late 1600s. Anton van Leeuwenhoek (who looked at pond water and saw animalcules) was probably the first person to see bacteria. He could not see any detail, because his microscope was not strong enough. If he had owned one of the high-powered microscopes in use today, he would have seen the single celled organisms known as bacteria (single bacterium).

Who was the first person to look at bacteria?

The cells of bacteria differ from the cells of other organisms in many ways. Bacteria are prokaryotes. The genetic material in their cells is not contained in a nucleus. Bacteria also do not have some of the other organelles found in the cells of eukaryotes. Prokaryotes, however, have all of the functions needed for life. Each bacterial cell uses energy, grows and develops, responds to its surroundings, and reproduces.

How are bacterial cells different from other cells?

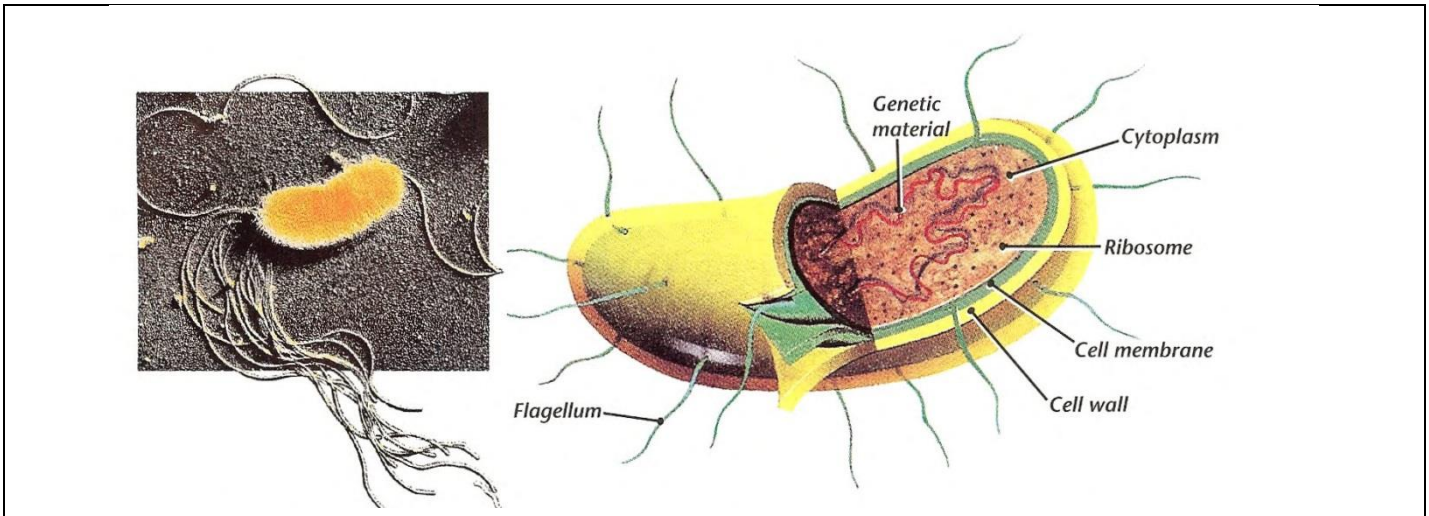
Chapter 6, Section 3, Bacteria, pages 192-203

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Bacteria Cell shapes and structures

All bacterial have one of three basic shapes; spherical, rodlike, or spiral shaped. The shape of bacteria, help scientists identify the type of bacteria. The shape of a bacterial cell is determined by the chemical makeup of its cell wall. Cell walls surround most bacterial cells. The cell wall helps protect the bacterial cell. Inside the cell wall, is the cell membrane which controls what enters and leaves the bacterial cell. Inside the cell membrane, the cytoplasm contains a gel-like material. Ribosomes (which make proteins) are found in the cytoplasm in bacterial cells. The cell's genetic material, which looks like a thick, tangled string, is also found in the cytoplasm. The genetic material in the bacterium's cytoplasm contains the information for all of the bacterium's functions, such as how to produce proteins on the ribosomes. If you look at the picture, you can see the cell wall, cytoplasm, ribosomes, and genetic material in the bacterium. Another structure you see is a flagellum (fluh gel um, plural flagella). A flagellum is a long, whiplike structure that comes out of the cell membrane and passes through the cell wall. The flagellum helps a bacterial cell move by spinning in place like a propeller. A bacterial cell can have many flagella, one flagella, or none. Most bacteria that do not have flagella cannot move on their own. Instead, they need air, water currents, clothing, and other objects to carry them.



Two kingdoms of bacteria

Archaeobacteria (ancient and primitive bacteria) These organisms have been around for billions of years before the dinosaurs. Some of them are autotrophs (they can make their own food), and some of them are heterotrophs (they cannot make their own food). They live in harsh environments (very hot water [110 degrees Celsius], extremely cold water, or even very salty water). Some even live in the intestines of animals, and in sewage. Archaeobacteria are prokaryotes (organisms whose cells do not contain a nucleus; the structure in the cell that controls all of its activities).

What are the two kingdoms of bacteria?

What are the characteristics of Archaeobacteria?

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Eubacteria Some eubacteria are autotrophs (they can make their own food), and some of them are heterotrophs (they cannot make their own food). Unlike archaeobacteria, most eubacteria do not live in extreme environments. Eubacteria live almost everywhere else. They live in your bodies and on your bodies; on your skin, even in your nose. They are also prokaryotes (organisms whose cells do not contain a nucleus). **Most** eubacteria are **beneficial (helpful) or harmless**. Some bacteria help make food products like yogurt and cheese, but a few others cause diseases like tuberculosis and meningitis.

What are the characteristics of eubacteria?

How are archaeobacteria and eubacteria different?

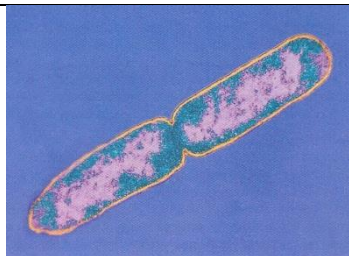
What is a prokaryote?

What is a eukaryote?

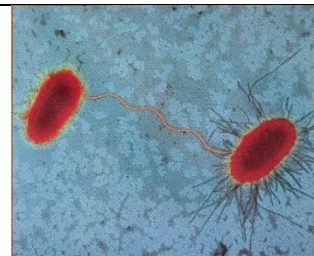
Reproduction in bacteria

When bacteria have plenty of food, the right temperature, and other suitable (good for growth) conditions, they grow and reproduce quickly and often. When conditions are good, some bacteria reproduce once every 20 minutes.

Asexual reproduction Bacteria reproduce by binary fission, a process in which one cell divides to form two identical cells. Binary fission is a form of asexual reproduction. Asexual reproduction is a type of reproduction that needs only one parent and makes offspring that are identical to the parent. In binary fission, the cell first duplicates its genetic material and then divides into two separate cells. Each cell now has its own copy of the parent cell's genetic material as well as some of the parent's ribosomes and cytoplasm. The picture below shows a parent cell forming two new cells by binary fission.



binary fission



conjugation

Sexual reproduction Some bacteria undergo a simple form of sexual reproduction called conjugation. Sexual reproduction involves two parents who combine their genetic material to produce a new organism, which differs from both parents.

What two ways do bacteria reproduce?

How do bacteria reproduce asexually?

Chapter 6, Section 3, Bacteria, pages 192-203

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How do bacteria reproduce sexually?

Survival needs Bacteria are able to survive in many different environments; but they must all have a source of food, a way to break down the food, and ways to survive when conditions in their surroundings are unfavorable.

Obtaining food Some bacteria are autotrophs (organisms able to make their own food). Some use energy from the sun to make their food (photosynthesis), but other autotrophic bacteria use the energy from chemical substances in their environment to make their food.

Other bacteria are heterotrophs that get their food by consuming autotrophs or other heterotrophs. Heterotrophic bacteria may consume a variety of food (milk, meat, decaying leaves, etc.).

Respiration

Bacteria, like all organisms, need energy to carry out their functions, and they get the energy from food. Breaking down food releases energy (respiration). Oxygen is needed to break down the food of most bacteria, but a few kinds of bacteria do not need oxygen for respiration. In fact, those bacteria die if oxygen is present in their surroundings.



Endospore formation

Sometimes the conditions in the environment are not good for the growth of bacteria. Bacteria are able to survive harsh environmental conditions by forming endospores. An endospore is a small rounded thick-walled, resting cell that forms inside a bacterial cell. The endospore contains the cell's genetic material and some of its cytoplasm. Endospores can resist freezing, heating, and drying; and they can survive for many years. Endospores are also light – a breeze can lift and carry them to new places. If an endospore lands in a place where conditions are suitable, it opens up and the bacterium can begin to grow and multiply.

What do bacteria need to survive?

Do all bacteria need oxygen to break down their food?

How do bacteria survive harsh environmental conditions?

What is an endospore?

Bacteria and the living world

Most of the time when you think of bacteria, you think of things that are harmful, things that cause disease or infection. Most bacteria are not harmful; in fact most bacteria are helpful. Helpful bacteria make foods

Name _____ Block _____

Chapter 6, Section 3, Bacteria, pages 192-203

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like cheese, yogurt, apple, cider, olives, pickles, soy sauce, sourdough bread, and sauerkraut. Bacteria also help us by making things like vinegar, buttermilk, sour cream, yogurt, and cheese. Some bacteria however, cause food to spoil when they break down the chemicals in foods. Spoiled food usually smells or tastes bad and can make you very sick. Today we use heat, refrigeration, drying, salting, or even smoking of foods, to help preserve them and prevent bacteria from spoiling them.



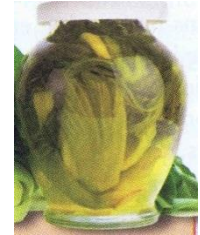
Cheese



Sourdough bread



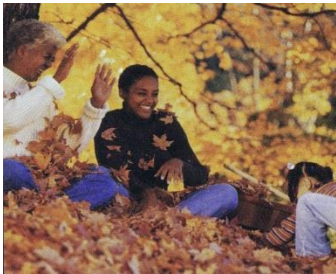
Soy sauce



Pickled vegetables

Environmental recycling

When you recycle plastic glass or other materials you have something in common with heterotrophic eubacteria. These bacteria which live in the soil are decomposers; organisms that break down large chemicals in dead organisms into small chemicals. Decomposers are often called nature's recyclers because they return basic chemicals to the environment for other living organisms to reuse.



Bacteria break down leaves,



break down and help clean up oil spills, and



help digest food.

Illness and health

Many of you have had a disease caused by bacteria such as strep throat or food poisoning. Diseases that can pass from one organism to another are called infectious diseases. Infectious diseases can spread by direct contact: touching, hugging, or kissing. Infectious diseases can also be spread by indirect contact such as breathing in moisture from a person's sneeze or sharing food and beverages. Some bacteria harm people because they produce a poison known as a toxin. Many years ago bacterial diseases killed millions of people. Today, many bacterial diseases are cured with medications known as antibiotics. An antibiotic is a chemical that can kill bacteria without harming a person's own cells.

What are some of the ways bacteria help/benefit us?

Name _____ Block _____

Chapter 6, Section 3, Bacteria, pages 192-203

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How do bacteria harm us?

What is an infectious disease?

What is a toxin?

What is an antibiotic?

More - Study guide questions

Circle the letter of the choice that best completes the statement or answers the question and write the answer on the line.

- _____ 1 Which kingdom includes only prokaryotes?
A archaeobacteria **B** protists **C** plants **D** fungi
- _____ 2 Which shape describes some bacterial cells?
F threadlike **G** bulletlike **H** rodlike **J** bricklike
- _____ 3 Which of the following is found in the cytoplasm of bacterial cells?
A cell membrane **B** nucleus **C** genetic material **D** flagella
- _____ 4 What is a characteristic of archaeobacteria?
F Most are disease-causing. **H** They use sun to produce food and energy.
G They live just about everywhere. **J** They thrive in extreme environments.
- _____ 5 What process results in genetically different bacteria?
A binary fission **B** respiration **C** conjugation **D** asexual reproduction
- _____ 6 The process of breaking down food to release its energy is called
F conjugation. **G** respiration. **H** binary fission. **J** nutrition.
- _____ 7 Endospores form during
A binary fission. **B** sunlight hours. **C** respiration. **D** harsh environmental conditions.
- _____ 8 What important role do bacteria called decomposers play?
F They return basic chemicals to the environment. **H** They kill harmful bacteria.
G They slow down food spoilage. **J** They produce vitamins.
- _____ 9 Which of the following is NOT a role of bacteria that live in human bodies?
A digesting food **C** making vitamins
B preventing disease-causing bacteria from entering body systems **D** preventing diabetes