

A large green geometric shape on the left side of the cover, consisting of a vertical line, a horizontal line, and a diagonal line connecting the top of the vertical line to the left end of the horizontal line.

 **POWER BASICS**®

Biology

Robert Taggart

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UNIT 2

Simple Organisms



LESSON 8: Archaeobacteria and Eubacteria

GOAL: To learn about archaeobacteria and eubacteria

WORDS TO KNOW

anaerobic	flagella
antibiotics	gram-negative
archaeobacteria	gram-positive
bacilli (singular <i>bacillus</i>)	microscopic
bacteria (singular <i>bacterium</i>)	nucleoid
binary fission	prokaryote
cocci (singular <i>coccus</i>)	spirilla (singular <i>spirillum</i>)
eubacteria	viruses

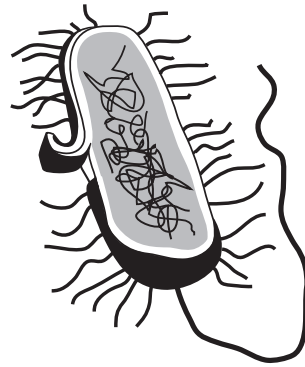
The Oldest Life-Forms

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 archaeobacteria (or “old bacteria”) and the eubacteria (or “true bacteria”).

Archaeobacteria

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

Archaeobacteria 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, archaeobacteria are not harmed by **antibiotics**, medicines that kill disease-causing bacteria.

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

Another type of archaeobacteria 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 archaeobacteria 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 archaeobacteria.

■ 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 archaeobacteria.

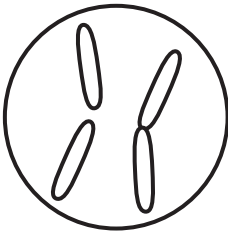
You may be most familiar with bacteria that cause diseases. Bacteria cause strep throat, tetanus, pneumonia, tuberculosis, and some sexually transmitted diseases. Most bacteria, however, are harmless. Many have positive uses and are even essential to life.



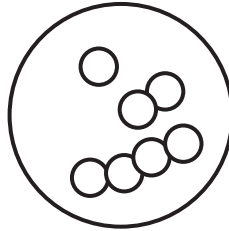
Bacteria are everywhere around you. To reduce the risk of bacterial infections, wash your hands well with soap and water or use an antibacterial hand sanitizer before you eat.

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

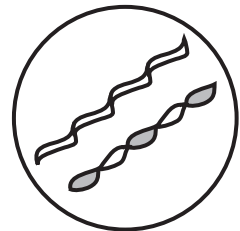
- Rod-shaped cells are called **bacilli**. (The singular is *bacillus*.)
- Round or oval cells are called **cocci**. (The singular is *coccus*.)
- Spiral cells are called **spirilla**. (The singular is *spirillum*.)



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

 **POWER BASICS**®

Biology

Teacher's Guide

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Unit 2: Simple Organisms

Unit 2 introduces Earth's simplest organisms: bacteria, protists, and fungi. Lesson 8 gives an overview of archaeobacteria and eubacteria, with a brief introduction to viruses. Lesson 9 discusses the protist kingdom, including plantlike protists, animallike protists, and funguslike protists. Lesson 10 presents the role, structure, and diversity of fungi.

Lesson 8—Archaeobacteria and Eubacteria

Goal: To learn about archaeobacteria and eubacteria

WORDS TO KNOW

anaerobic	cocci (singular <i>coccus</i>)	nucleoid
antibiotics	eubacteria	prokaryote
archaeobacteria	flagella	spirilla (singular <i>spirillum</i>)
bacilli (singular <i>bacillus</i>)	gram-negative	viruses
bacteria (singular <i>bacterium</i>)	gram-positive	
binary fission	microscopic	

Lesson 9—Protists

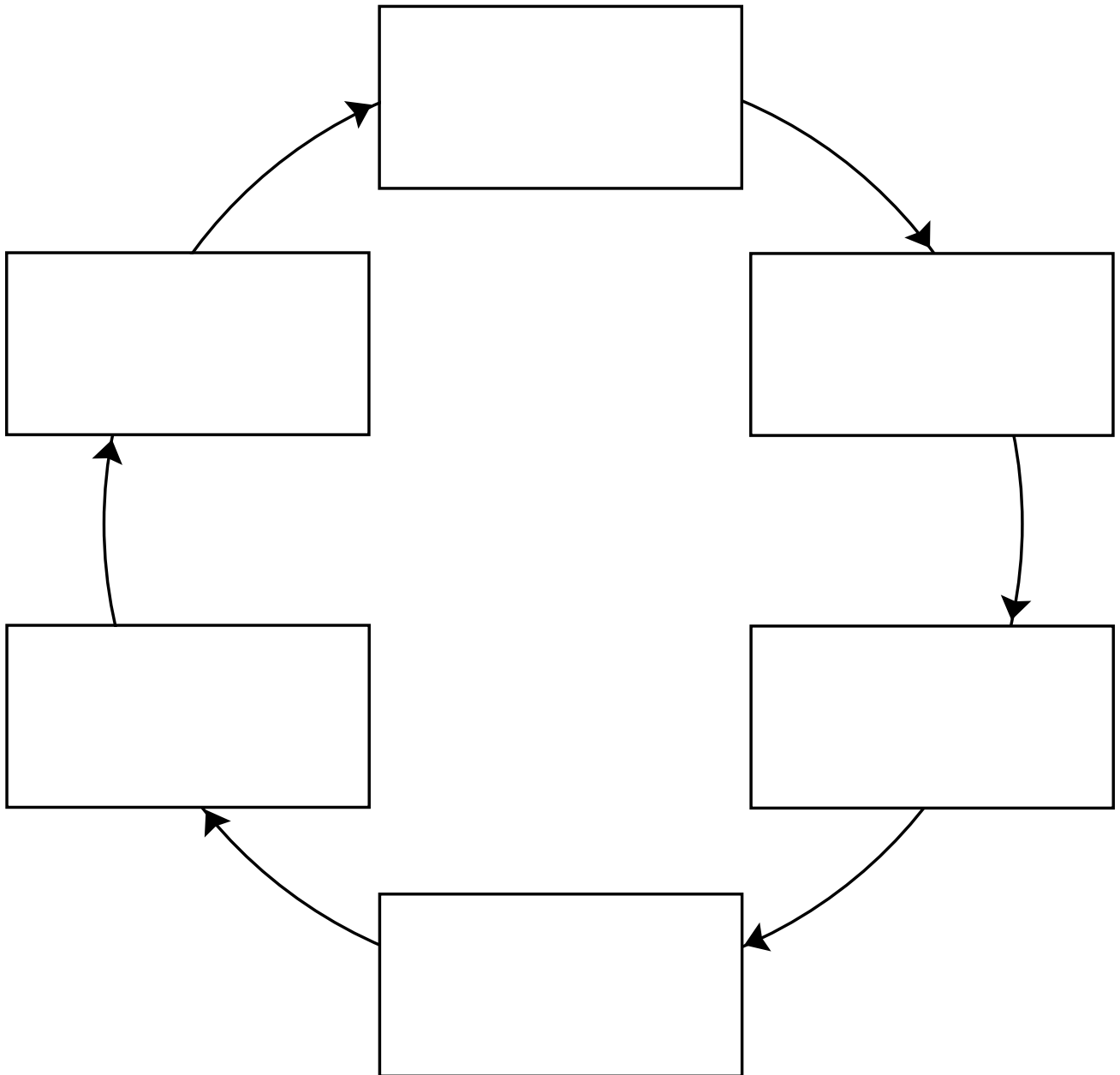
Goal: To learn about the different classes of protists

WORDS TO KNOW

algae (singular <i>alga</i>)	parasites	pseudopod
algal bloom	plasmodium	spores
cilia	protist	toxin
eukaryote	protozoans	

Cycle

Write the important stages of the cycle in the boxes. Add or delete boxes as needed.



 **POWER BASICS⁺ PLUS**

Biology

Workbook

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NAME: _____



UNIT 2 • ACTIVITY 23

Monera—Archaeobacteria and Eubacteria

On the line next to the definition in Column A, write the letter of the word it defines from Column B.

Column A

Column B

- | | |
|--|---------------------------|
| _____ 1. This is a cell without a nucleus. | a. archaeobacteria |
| _____ 2. These are hairlike strands that move simple organisms around. | b. antibiotics |
| _____ 3. These are spiral cells. | c. bacilli |
| _____ 4. These are ancient bacteria. | d. cocci |
| _____ 5. These are round or oval cells. | e. eubacteria |
| _____ 6. These are true bacteria. | f. flagella |
| _____ 7. These bacteria can be stained with Gram's stain. | g. gram-positive bacteria |
| _____ 8. These are rod-shaped cells. | h. nucleoid |
| _____ 9. This is the area that contains the DNA in a cell that has no nucleus. | i. prokaryote |
| _____ 10. These are medicines that kill disease-causing bacteria. | j. spirilla |





UNIT 2 • ACTIVITY 24

The Bacteria Around Us

Bacteria can be found everywhere. Even when you think you have cleaned an area, some bacteria will remain. In this activity, you will choose four different places to test to see if there are any bacteria present. You will watch the bacteria grow (or not). You will write and draw what you see.

Materials

- petri dish with agar solution
- wax pencil
- four cotton swabs
- distilled water
- magnifying glass
- small metric ruler

Procedure

1. Use the wax pencil to divide the petri dish into four quarters. You will do this by drawing on the bottom of the petri dish and labeling each quarter 1, 2, 3, and 4.
2. Take a cotton swab and dip the end in distilled water. Rub the swab against a surface, such as a chair, a doorknob, or a toilet seat.
3. Open the lid of the petri dish, and rub the cotton swab that you just used on one quarter of the agar solution. Replace the lid as soon as you are done. Be sure to keep track of what surface you swabbed and where you placed the sample on the petri dish.
4. Do this three more times using different surfaces. Use a different swab each time.
5. Keep the lid on the petri dish between rubbings. Keep the petri dish in a warm, dark location.
6. Check the petri dish for the next three days. Use the magnifying glass to see if bacteria are growing. Try to not take the lid off the petri dish to look at the bacteria.
7. On a separate sheet of paper, make a table like the one below for each surface.

Surface: _____

Day 1	Day 2	Day 3
Size: _____	Size: _____	Size: _____
Shape: _____	Shape: _____	Shape: _____
Color: _____	Color: _____	Color: _____
Drawing:	Drawing:	Drawing:

On a separate sheet of paper, answer the following questions.

1. Why did you choose those surfaces?
2. The bacteria that grew the most came from which surface? Why do you think that happened?
3. What are some ways to get rid of bacteria?
4. Why was it important to keep the lid on the petri dish?

**UNIT 2 • ACTIVITY 28****Mushroom Lab**

The body of most fungi lives below the surface of an object. This is true for mushrooms. One mushroom organism can cover many, many acres of land, but only a small part may be visible. The part of the mushroom that is visible is the part you eat. This is the sporangium, which is the sexually reproductive part of the mushroom.

In this lab, you will look at an edible mushroom. The cap of the mushroom is the very top. It usually grows out of a ring, which is attached to the stalk. The stalk rises from the cup of the mushroom, which grows up out of the ground. When it is immature, this cup is called a *button*. The gills of the mushroom are found on the underside of the cap. The mycelium is a loose network of hyphae, the threadlike objects that form the body of the mushroom.

Materials

- mushroom
- hand lens
- scalpel or sharp knife

Safety Consideration

Use extra care when handling the scalpel or sharp knife.

Procedure

1. Look at your mushroom, and make a drawing of it. Label the stalk, gills, cup, cap, and ring.
2. Carefully use the scalpel or sharp knife to cut the mushroom in half from top to bottom.
3. Next, cut the cap off at the ring where it meets the stalk.
4. Pull some of the stem apart with your fingertips, and look at the structure of the organism with the hand lens. Can you see the hyphae? Observe how they form a mycelium.
5. Use the hand lens to look at the gills of the mushroom.
6. Use the hand lens to look at the stalk of the mushroom. Make a drawing of what you see.

Comprehension Questions

1. What is the purpose of the gills? _____

2. Why do mushrooms have spores? _____

NAME: _____



UNIT 2 • ACTIVITY 29

Mushroom Model

Use the Internet or a reference book to find a picture of a mature mushroom. Remember there are several parts to the visible mushroom:

- stalk
- gills
- cup
- cap
- ring

In addition, remember that the gills of a mature mushroom contain spores. The body of the mushroom is composed of hyphae that tangle together to form a mycelium.

In the three-dimensional medium of your choice (for instance, plasticine, clay, wood, or other medium), create a mushroom model. Be sure to label all the parts of the mushroom clearly. Be creative! In the space below, sketch a plan for your model and jot down ideas.



 **POWER BASICS⁺ PLUS**

Biology

Test Pack

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BIOLOGY • PRETEST

Circle the letter of the correct answer to each of the following questions.

1. What are lipids?
 - a. sugars and starches
 - b. the molecules that make up fats and oils
 - c. proteins that are involved in chemical reactions in organisms
 - d. the basic units of proteins

2. What is the largest, most visible structure in most cells?
 - a. the Golgi complex
 - b. the lysosomes
 - c. the mitochondria
 - d. the nucleus

3. How many pairs of chromosomes are found in the human cell?
 - a. 7
 - b. 19
 - c. 23
 - d. 27

4. In peas, green pea pods are dominant over yellow ones. If you cross a green homozygous variety with a yellow variety, what will the F₂ generation look like?
 - a. all green
 - b. all yellow
 - c. half green and half yellow
 - d. three quarters green and one quarter yellow

5. What is the most important characteristic of a species?
 - a. Individuals must be able to interbreed and produce fertile offspring.
 - b. Individuals must belong to the same population.
 - c. Individuals must possess the same genotype.
 - d. Individuals must possess the same phenotype.

UNIT 2 TEST • SIMPLE ORGANISMS

Circle the letter of the correct answer to each of the following questions.

1. What were probably the earliest life forms on Earth?

- a. algae
 - b. bacteria
 - c. diatoms
 - d. viruses
-

2. What is the name for cells that do not have a nucleus?

- a. prokaryotic
 - b. nuclear
 - c. eukaryotic
 - d. bacterial
-

3. How do most bacteria reproduce?

- a. by spores
 - b. by seeds
 - c. by diffusion
 - d. by binary fission
-

4. Which of the following are the three most common eubacteria shapes?

- a. spiral, circle, and sphere
 - b. spiral, rod, and sphere
 - c. rod, rectangle, and circle
 - d. sphere, spiral, and rectangle
-

5. Which of the following diseases is caused by bacteria?

- a. measles
- b. influenza
- c. botulism
- d. strep throat

-
6. What is an algal bloom?
- the flowering of certain water plants when exposed to algae
 - the flowering tip of multicellular algae
 - a rapid growth of algae
 - a type of algae that lives on flowering water plants
-
7. What is red tide?
- an algal bloom of certain dinoflagellates that contain a red pigment
 - an algal bloom of diatoms that contain a red pigment
 - a kind of red algae that lives in snow
 - a kind of red seaweed
-
8. What is the name for a protozoan that attaches itself to another organism and uses the host organism for food?
- ciliate
 - dinoflagellate
 - parasite
 - pseudopod
-
9. What type of algae are commonly known as seaweed?
- blue-green algae
 - brown algae
 - green algae
 - red algae
-
10. What is the name for the foot-like extension of cytoplasm some protozoans use to move?
- flagellum
 - cilium
 - pseudopod
 - fingers

-
11. What makes single-celled protists different from bacteria?
- They have DNA.
 - They have a nucleus.
 - They have cell walls.
 - They have flagella.
-
12. What do paramecia use to move?
- flagella
 - pseudopods
 - cilia
 - fingers
-
13. What is a community of slime molds called?
- colony
 - plasmodium
 - sporangia
 - algae
-
14. What is the basic structure in a fungus called?
- hypha
 - mycelium
 - spore
 - yeast
-
15. What type of growth is actually an association between a fungus and algae?
- ameba
 - lichen
 - mycelium
 - mushroom

16. How do fungi reproduce?

- a. through seeds
 - b. through budding off
 - c. through spores
 - d. through eggs
-

17. What is one important role fungi play in the ecosystem?

- a. decomposers
 - b. producers
 - c. first-order consumers
 - d. scavengers
-

18. What do fungi release into the organism they feed on in order to digest it?

- a. an acid
 - b. an alkaline
 - c. an enzyme
 - d. a nutrient
-

19. Which of the following human conditions is caused by a fungus?

- a. polio
 - b. athlete's foot
 - c. malaria
 - d. strep throat
-

20. Which of the following organisms is a fungus?

- a. ameba
- b. bacterium
- c. mushroom
- d. alga

BIOLOGY • POSTTEST

Circle the letter of the correct answer to each of the following questions.

1. What are enzymes?
 - a. sugars and starches
 - b. the molecules that make up fats and oils
 - c. proteins that are involved in chemical reactions in organisms
 - d. the basic units of proteins

2. Which of the following is true about the nucleus?
 - a. It starts and controls cell division.
 - b. It is surrounded by the nucleolus.
 - c. It processes glucose.
 - d. It is the site of protein synthesis.

3. What is the term for a region of DNA that codes for a single protein or group of proteins?
 - a. a gene
 - b. a nitrogen base
 - c. a nucleotide
 - d. RNA

4. What is the term for traits that are governed by more than one gene?
 - a. codominant traits
 - b. dominant traits
 - c. polygenic traits
 - d. recessive traits

5. Which of the following situations will likely lead to speciation?
 - a. Individuals from one population breed with individuals from a second population.
 - b. Two populations occupy the same habitat type.
 - c. Two populations are physically separated from each other.
 - d. Members of the same population develop different color patterns.