

# 45 The World of Microbes

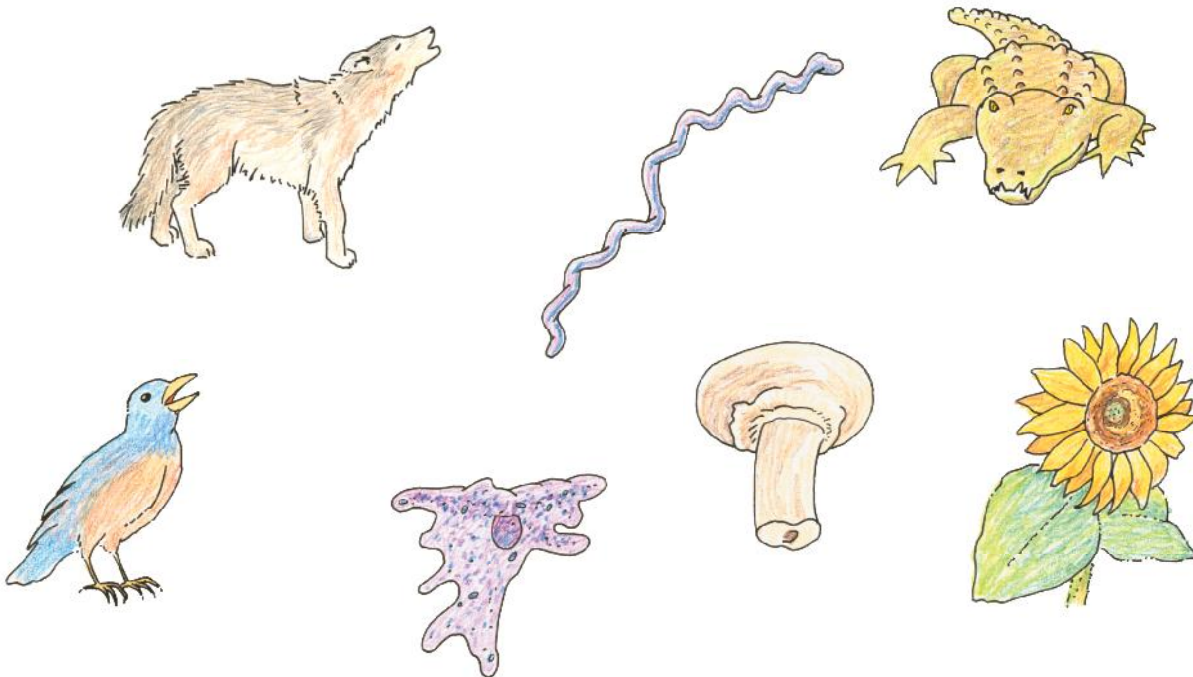


**H**ave you had a cold, flu, or other infectious disease recently? Do you know what caused your illness? Microbes cause most infectious diseases. Microbes include the protists, bacteria, and viruses that you classified in Activity 44, “Who’s Who?” They also include some fungi, such as yeast and the fungi that cause athlete’s foot.

By now you know that *germ* is simply another word for a microbe that causes disease. But you may have also heard the word *microorganism* used. Why, then, do we keep referring to microbes? To find out, you need to know a little more about the differences among the microbes you’ve studied so far (protists, bacteria, and viruses).

## CHALLENGE

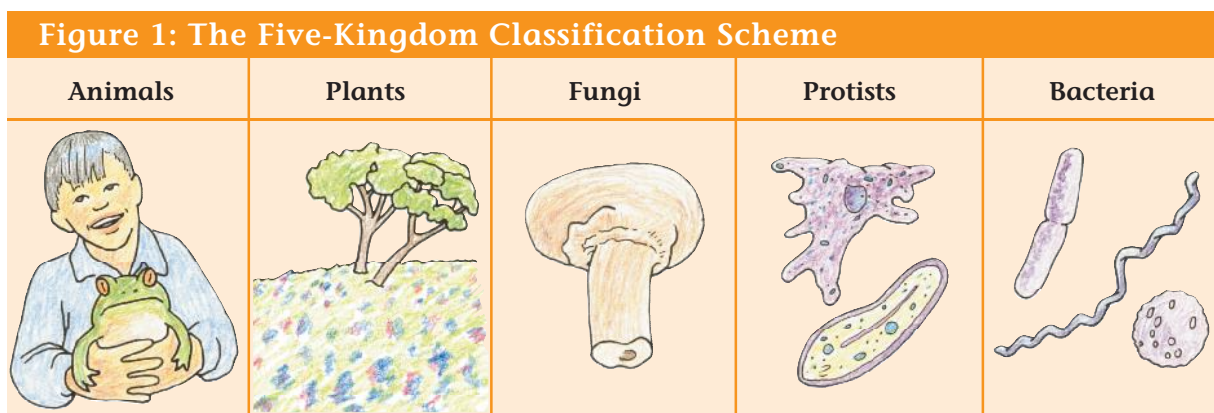
**How do microbes fit into the classification of organisms?**



## READING

### Classifying Organisms

Until recently, scientists classified organisms into five groups, called Kingdoms, as shown in Figure 1. New evidence has led to several alternatives to the five-kingdom system. Classification is a way to make sense of a lot of information. As the information changes, new classification systems evolve. For example, scientists have learned that bacteria can be divided into two very different groups, called Bacteria and Archaea. Still, it is useful for you to think about five different groups of organisms: animals, plants, fungi, protists, and bacteria.



You are most familiar with animals and plants. They make up two kingdoms. A third kingdom is made up of fungi. The fungi include yeasts (like the one you used in Activity 39, “Cells Alive!”), molds, and mushrooms. Protists and bacteria, like the ones you observed in Activity 43, “Microbes Under View,” belong to two more groups of organisms. Notice that viruses are not included in the figure because they are not considered to be living organisms.

### STOPPING TO THINK 1

Think about all of the slides you have observed. Have you observed cells of organisms from every kingdom? List all the cells you have observed from organisms in each kingdom.



### Protists

Protists are single-celled microbes that have a nucleus. While some protists cause illness, many others are harmless. The *Trypanosoma* that you observed in Activity 43 is closely related to another type of *Trypanosoma* that causes sleeping sickness in people. Species of *Paramecium* are often harmless, living in fresh and salt water, where they feed on bacteria, algae, and other protists. Many types of *Amoeba* are harmless, while others cause illnesses of the digestive system.

### Bacteria

Bacteria are single-celled microbes that do not have a nucleus. Bacteria are also the most common microbes and can be found everywhere—in snow, deserts, lakes, the ocean, and the human body. As you may recall, bacteria are extremely tiny; a thousand bacteria could fit in a cluster on the dot of an “i.” There are more bacterial cells in your digestive system and on your skin than the number of cells that make up your entire body!

While some bacteria, such as *Mycobacterium tuberculosis*, cause diseases, other species of bacteria are helpful. In fact, without bacteria, nothing would ever decompose; the world would be full of dead organisms, from the tiniest microbes to large plants and animals! Bacteria also are important in the preparation of foods and beverages. You may have noticed a statement on some yogurt containers: “contains live and active yogurt cultures.” That’s because yogurt is produced by the fermentation of milk by bacteria! Figure 2 shows the shapes and some information about different kinds of bacteria.

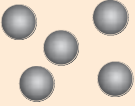


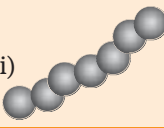

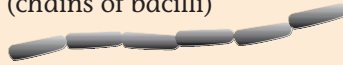



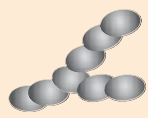
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#### STOPPING TO THINK 2

Would you describe bacteria as being helpful or harmful to people? Explain.

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Figure 2: Some Common Types of Bacteria

Shape	Examples	Ecological Roles
sphere 	<i>Diplococci</i> (pairs of cocci) 	cause pneumonia
	<i>Staphylococci</i> (clusters of cocci) 	are normally present on human skin; some cause boils and infections
	<i>Streptococci</i> (chains of cocci) 	are used to make yogurt and cheese; cause strep throat
rod 	<i>Bacilli</i> (rods)	decompose hay; are used to make cheese, yogurt, pickles, and sauerkraut; are normally present in the human digestive tract; cause diarrhea; cause anthrax in cattle and sheep
	<i>Mycobacteria</i> (chains of bacilli) 	cause tuberculosis; are found normally in soil and water.
curved rod 	<i>Vibrio</i>	cause cholera; help break down sewage
short spirals 	<i>Spirilla</i>	are decomposers in both fresh and salt water
long spirals 	<i>Spirochete</i>	cause syphilis; are decomposers
branched chain 	<i>Actinomyces</i>	produce several antibiotics; were once classified as fungi

*Cocci are spherical bacteria; the singular of cocci is coccus.*



### Viruses: A Group Apart

**Viruses** are not living organisms. Unlike protists, bacteria, and all other living organisms, viruses are not made up of cells. They are unable to grow or reproduce independently or carry out the functions, such as respiration, that living organisms do. Instead, viruses rely on the cells of living organisms for their reproduction. It is for this reason that we say infectious diseases are caused by microbes, and not microorganisms.



**Figure 3: Comparing Average Sizes of Microbes**

*These are relative, not actual, sizes of microbes. An average bacterium is actually much smaller than the virus shown here.*

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### STOPPING TO THINK 3

- a.** Why are viruses not considered to be microorganisms?
  - b.** Look at Figure 3, “Relative Sizes of Microbes.” How do the sizes of protists, bacteria, and viruses compare?
  - c.** Which do you think cannot be seen with a classroom microscope?
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How do we know viruses exist? The existence of viruses was first suggested in 1898, nearly 45 years before they were first seen. In 1895, Dutch scientist Martinus Beijerinck (BY-er-ink) began experimenting with the tobacco plant. He was studying a plant disease that he believed to be infectious. By this time, scientists were familiar with protists and bacteria, so Beijerinck began searching for a bacterium that might be causing this disease. But he could not find one. Yet his experiments demonstrated that the disease could be passed from plant to plant, so he concluded that the disease was caused by a microbe. Since it wasn't a protist or a bacterium, he called it a virus, which means “poison” in Latin.

Viruses are so small that you need an electron microscope to see one. The electron microscope was not invented until the 1930s. As a result, viruses were first seen in 1939. Today, we know that viruses cause many diseases, including the flu, colds, chickenpox, and AIDS.

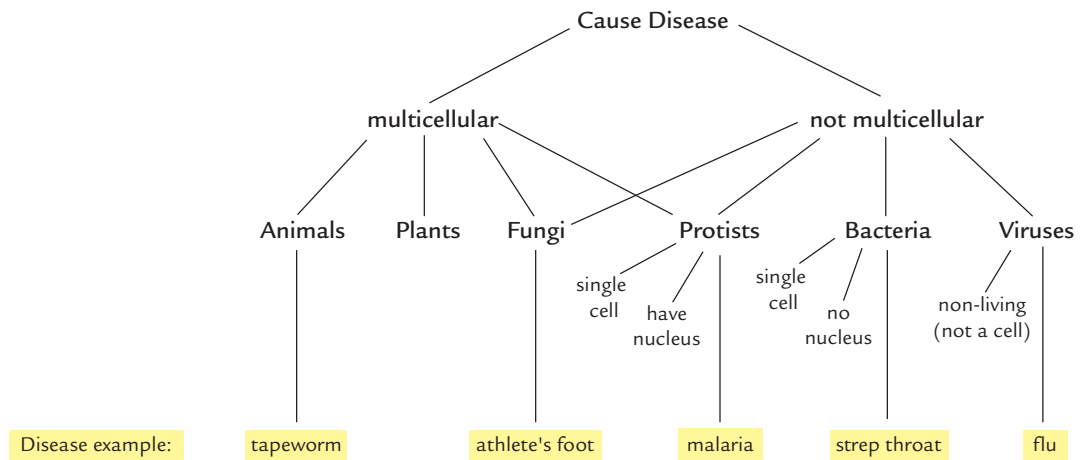


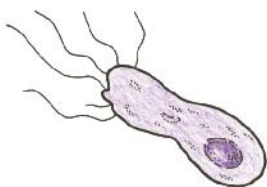
Figure 4: Classifying Disease-Causing Organisms and Viruses

Figure 4 shows the five-kingdom classification plus viruses. Note the examples of diseases caused by members of each group. What do you think the dotted lines mean?



For links to more information about microbes, go the SALI page of the SEPUP website.

## ANALYSIS



1. You have read how microbes can be both helpful and harmful to humans. Do you think a microbe can be *neither* helpful nor harmful? Explain.
2. You decide to examine some pond water under a microscope. With a magnification of 40 (using the 4x objective), you observe a long, cylindrical organism moving across your field of view (see left). As you look more closely, you notice what appears to be a round structure inside of it. Is this organism most likely a protist, bacterium, or virus? Explain how you arrived at your conclusion.

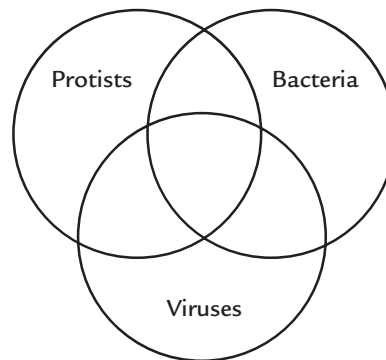


## Activity 45 • The World of Microbes

3. Suppose your school's microscopes did not have 40x objectives, but only 10x objectives. Your friend, who is in high school, uses a 40x objective. Explain what group of microbes he or she can study that you cannot.
4. What are the advantages of using the highest power objective on a microscope? What are the advantages of using the lowest power objective on a microscope? Explain.



5. In your science notebook, draw a larger version of the Venn diagram shown below. Record unique features of each group of microbes in the appropriate space. Record common features among groups in the spaces that overlap. **Hint:** Think about what you have learned about cells in the last few activities.



6. **Reflection:** On a field trip, you visit a laboratory that has an electron microscope. The microscopist (the person who runs the microscope) offers to set up a microbe for you to view. What microbe, or group of microbes, would you choose to view? Why?