

Exploring Microorganisms



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*You'll often see a variety of organisms
in just one drop of water!*

INTRODUCTION

In Lesson 4, you created your own pond ecosystem. Soon you will revisit your pond to observe any new developments. This lesson will prepare you to make those observations. During this lesson, you will observe four types of microorganisms and decide whether their characteristics are more animal-like or plant-like. You also will draw and label the microorganisms and estimate their lengths. You will create a cartoon featuring one of the microorganisms you observe. You will learn about the effects that microorganisms have had on our world. Finally, you will read about a kingdom of organisms whose benefits to humans are often misunderstood—kingdom Monera.

OBJECTIVES FOR THIS LESSON

Make a list of things you already know about microorganisms.

Observe four species of living microorganisms called protists and identify their animal-like and plant-like characteristics.

Observe, draw, and estimate the length of four protists.

Create a cartoon using an *Amoeba*, *Euglena*, or *Paramecium* as the main character.

Read about the importance of microorganisms in history.

Read about the kingdom Monera and its significance to humans.

Update your organism photo cards for *Amoeba*, *Euglena*, and *Paramecium*.

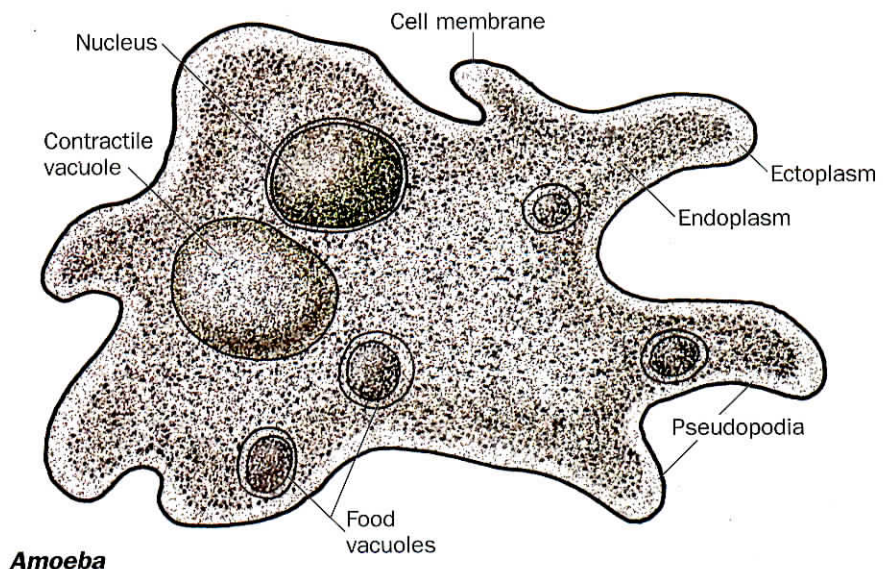
THE FINE ART OF NAMING ORGANISMS

One of the first microorganisms that scientists viewed through a microscope was a squirmy little creature they named “amoeba.” Latin and Greek were the languages used by scientists in the Western world at that time, late in the 17th century. The name “amoeba” is based on the Latin and Greek words for “to change.” Scientists thought the name was appropriate because the amoeba’s shape was always changing.

Although the meaning of *amoeba* is pretty straightforward, learning how to write the word properly can be confusing. For example, because the English language does not contain the Greek sound represented by the letters “oe,” the English spelling of amoeba has never been consistent. Depending on what you are reading, you may see this word appear as *Amoeba*, *Amaeba*, *Ameba*, *amoeba*, or *ameba*!

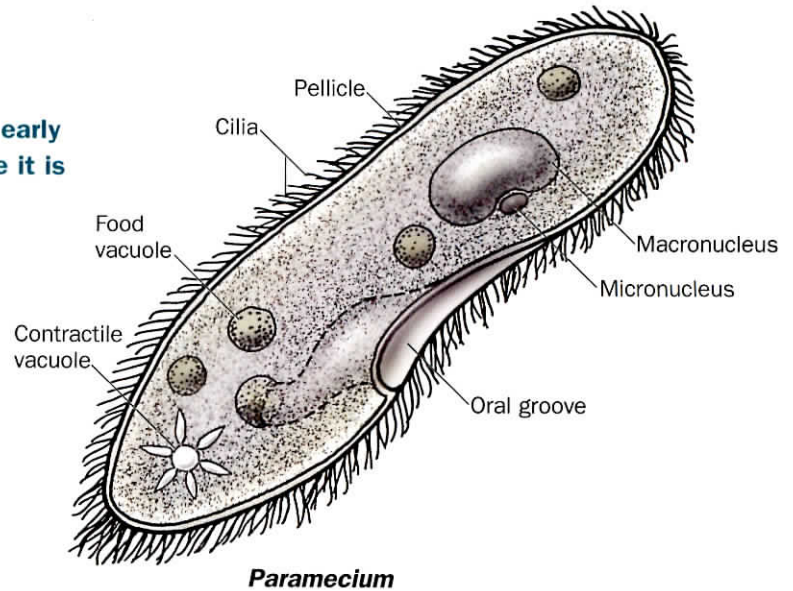
Adding to the confusion is the fact that the genus name *Amoeba*, which is capitalized and italicized, has also become this organism’s common name, amoeba, which is neither capitalized nor italicized. Furthermore, when talking about more than one of these microorganisms, some people use the Latin plural form, amoebae, but others use the English plural, amoebas.

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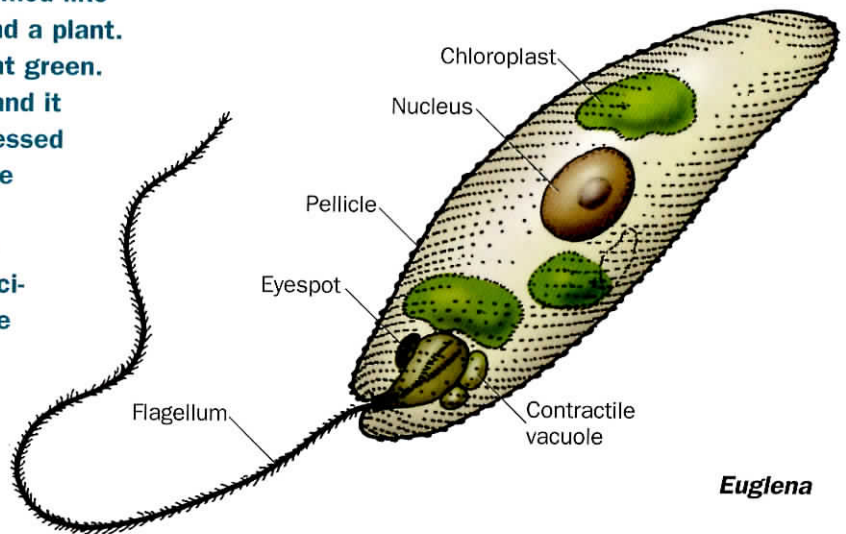


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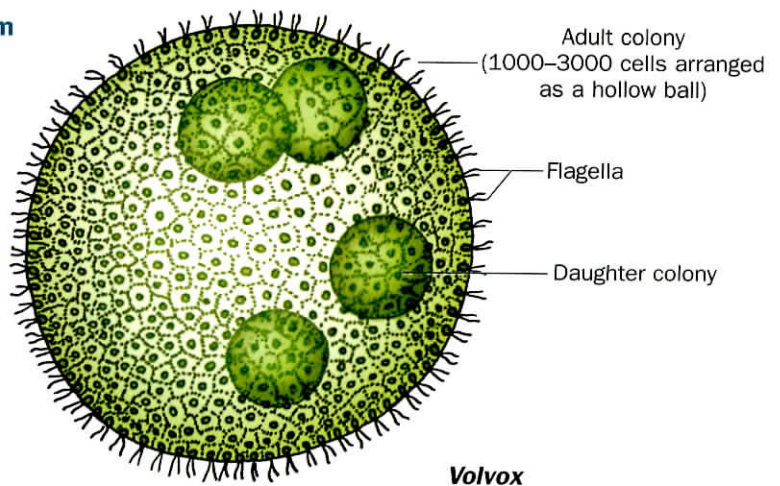
Another microorganism named by early scientists was *Paramecium*. Because it is shaped like a slipper, they named it using the Greek word for “oval.” People now use “paramecium” (no capital letter, no italics) as the common name for this organism. The most common plural form is “paramecia.” Paramecia are found in fresh water around the world. They are among the most complex of all single-celled organisms.



A third freshwater organism named by early scientists seemed like a cross between an animal and a plant. Like many plants, it was bright green. But it moved like an animal, and it did not have a cell wall. Impressed by this microbe’s ability to use its tiny eyespot to find the brightest areas in its environment, scientists gave it the scientific name *Euglena*, from the Greek words that mean “true pupil of the eye.” *Euglena* is found in ponds and pools of water. It is especially common in waters rich in chemicals.



The twisting, turning spheres that scientists named *Volvox* (from the Latin verb “to roll”) seemed part animal, part plant. For many years, scientists classified *Volvox* as an animal. *Volvox* and the other microorganisms described above are now classified in a group separate from plants and animals—the kingdom Protista. This kingdom includes a diverse lot of mostly single-celled, aquatic organisms that have a well-defined nucleus. Since these organisms are in the kingdom Protista, they are commonly referred to as “protists.”



Getting Started

1. With your group, list in your science notebook five things you already know about microorganisms.
2. Discuss your list with the class.
3. With your class, read the Introduction and “The Fine Art of Naming Organisms” at the beginning of this lesson.

MATERIALS FOR LESSON 11

For you

- 1 copy of Student Sheet 11.2: Template for Protist Drawings
- 1 box of colored pencils

For your group

- 2 copies of Inquiry Master 11.3B: Scoring Rubric for Protist Cartoons
- 1 set of organism photo cards
- 2 compound light microscopes
- 2 depression slides
- 2 coverslips
- 2 transparent rulers
- 2 metric rulers, 30 cm (12")
- 8 strands of cotton
- 1 *Amoeba*
- 1 *Paramecium*
- 1 *Euglena*
- 1 *Volvox*
- 1 *Amoeba* slide
- 1 *Paramecium* slide
- 1 *Euglena* slide
- 1 *Volvox* slide

Inquiry 11.1

Exploring Living Protists

PROCEDURE

- 1.** Take the following steps to obtain, observe, and record information about the four living protists your teacher has made available. You may observe the protists in any order you wish.
 - A.** Have one student from your pair take a slide and coverslip to the center where your teacher has placed the containers of protists, the plastic pipettes, and cotton balls.
 - B.** Place two or three strands of cotton in the depression on the slide. The cotton helps confine the protists to a smaller area.
 - C.** Use a plastic pipette to obtain a sample of water from one of the culture containers. Check to see if there are any special instructions for obtaining the protists. The instructions will be on the label of the container or on a nearby card.
 - D.** Transfer the protists to the slide by squeezing a single drop of water from the pipette into the slide's depression. Add a coverslip. Return to your seat and place the slide on the microscope stage.
 - E.** With your partner, locate the protist under a magnification of 100 \times . If you cannot find the protist, clean your slide, then go back and obtain another drop of water. Center one of the protists in the field of view and switch to a magnification of 400 \times , as seen in Figure 11.1. If you cannot keep the microbe in the field of view under 400 \times , switch back to 100 \times .
 - F.** Identify as many of the organelles as you can that are labeled in the illustrations in "The Fine Art of Naming Organisms."



Figure 11.1 This student is using the fine adjustment knobs to focus on a microbe under high magnification.

- G.** On a new page in your science notebook, create a table like Table 11.1 to record observations about the protists. Make your table the size of a full page.
- H.** Try to determine how the protist moves. Identify any structures that seem to help it move.
- I.** With your partner, decide which of the protist's features and behaviors are animal-like and which are plant-like. List these in the table.
- J.** When you have finished observing a protist, fill a plastic pipette with water from the appropriate culture container. Hold the slide over the water in the culture container while you use the plastic pipette to squirt the water from the container over the slide, as shown in Figure 11.2. This should wash the protists back into the culture container. Be careful not to allow cotton fibers to get into the container.
- 2.** Rinse the slide and coverslip with tap water. Lay them on a dry paper towel and flip them over several times until they are dry. Continue working with the other protists until you are finished.

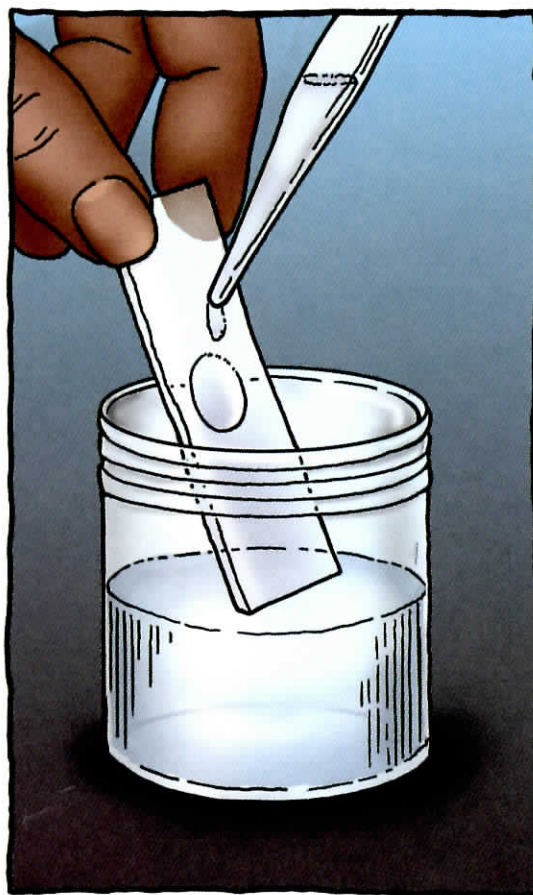


Figure 11.2 Hold the slide over the culture container with one hand while squirting water over the top of the slide with a pipette in the other hand.

Table 11.1 Observations of Microorganisms

Protist	Animal-like Features	Plant-like Features	Structures/Methods of Movement
<i>Amoeba</i>			
<i>Paramecium</i>			
<i>Euglena</i>			
<i>Volvox</i>			

Inquiry 11.2

Observing and Drawing Protists From Prepared Slides

PROCEDURE

1. Follow these steps to prepare scientific drawings from prepared slides of the four protists—*Amoeba*, *Paramecium*, *Euglena*, and *Volvox*.
 - A. Take turns with your partner to observe each of the four protists and draw each on Student Sheet 11.2: Template for Protist Drawings. Use the magnification that allows you to see the structures of the protist most clearly. You may draw the protists in any order.
 - B. Title each drawing with the appropriate name. Label all of the organelles you can identify. Use your metric ruler to draw the lines for labels. Follow all guidelines for scientific drawings.
 - C. As you did in Lesson 2, use the transparent ruler to measure the diameter of the field of view at both 100 \times and 400 \times . Use those measurements to help you estimate the length of each of the four protists. Record the estimated lengths in millimeters in the appropriate place on your student sheet.
 - D. As you complete each drawing, trade slides or switch seats with a pair of students that has finished using a slide of a different protist.
2. When you have completed your drawings, follow your teacher's directions for cleaning up.
3. With your group, update your organism photo cards for *Amoeba*, *Euglena*, and *Paramecium*. (Note that there is no organism photo card for *Volvox*.)



Figure 11.3 Students have different styles when working with the microscope. Notice that the microscope in this photo is in a different position than the one in Figure 11.1.

Inquiry 11.3

Creating a Protist Cartoon

PROCEDURE

1. Create a cartoon with either an *Amoeba*, *Euglena*, or *Paramecium* as the central character.
2. Your cartoon must be accurately drawn and should show details of at least four organelles, such as flagella, cilia, pseudopods, nuclei, vacuoles, cell membranes (or pellicles), contractile vacuoles, oral grooves, and eyespots (stigmata).
3. Make your caption humorous, focusing on at least one major characteristic of the protist.
4. Make a draft copy in pencil; use colored pencils for your final version. You will complete this assignment at home. If available, you may use a computer to create a background and labels for your final cartoon.
5. Your teacher will tell you when your cartoon is due. Use the rubric in Table 11.2 to evaluate your cartoon before you turn it in. Your teacher will use this rubric, or one similar to it, to assess your work and will inform you of the point values for each box within the rubric.

Table 11.2 Scoring Rubric for Protist Cartoon

Requirements	Exemplary (Pts.)	Satisfactory (Pts.)	Needs Improvement (Pts.)	No Attempt (Pts.)
Cartoon clearly shows which protist is featured.				
At least four organelles are drawn accurately.				
Caption contains information about at least one feature of the protist.				
The caption, although humorous, is based on accurate information.				
Cartoon is neatly done and suitable for posting.				
			Total Points =	

REFLECTING ON WHAT YOU'VE DONE

- 1.** On the basis of what you have learned in this lesson, respond to the following in your science notebook:
 - A. What are some of the characteristics you noticed while observing the four protists?
 - B. Why do you think these protists are not classified as animals or plants?
- 2.** Revisit the list you developed during “Getting Started.” Discuss with your group what should be revised.
- 3.** Based on what you learned in the reading selections “Mighty Microbes” and “Welcome to the Monera Kingdom!” answer the following questions in your science notebook:
 - C. Why is the misuse of antibacterial products and antibiotics potentially dangerous?
 - D. What are at least four ways in which microorganisms are beneficial to humans?

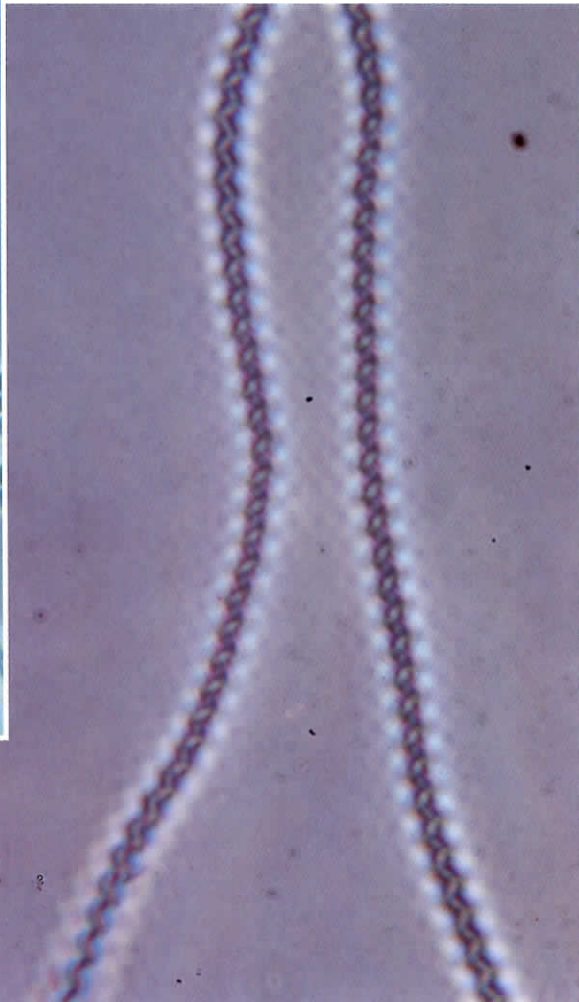
WELCOME TO THE MONERA KINGDOM!



Oscillatoria

No, the Monera kingdom isn't some faraway territory ruled by a king and queen. It's a fairly recent classification of life form. To belong to the Monera kingdom, an organism has to be missing something that's found in all other life forms: a nuclear membrane which encloses an organism's genetic material, or DNA.

Bacteria, a large group of one-celled organisms found all over the planet, belong to the Monera kingdom. Organisms previously classified as blue-green algae, such as *Oscillatoria*



Spirulina

and *Spirulina*, also are monerans because scientists have found that they are more similar to bacteria than to algae. Some scientists also place viruses in the Monera kingdom, because they, too, lack a membrane around their nucleus.

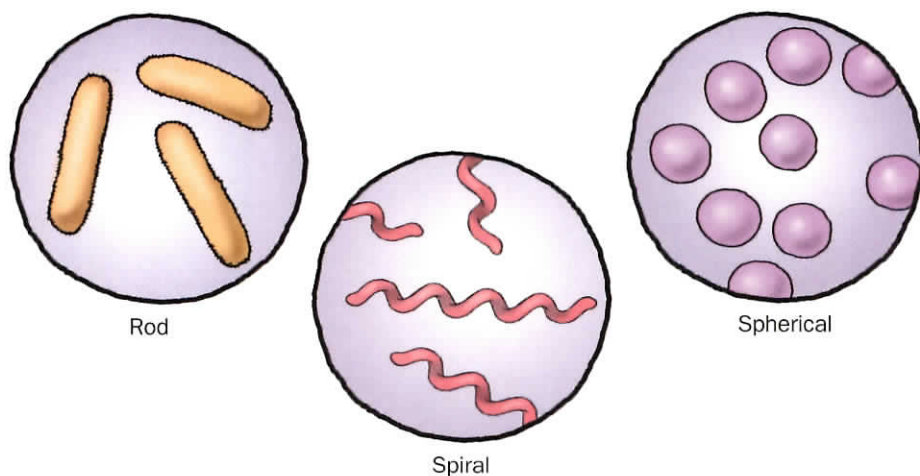
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BOTH PHOTOS COURTESY OF CAROLINA BIOLOGICAL SUPPLY COMPANY

There's No Escape!

But bacteria are the Monera kingdom's real claim to fame.

You can't get away from bacteria. They're everywhere—in the soil, air, and water. They're also in plants and animals. Without a microscope, you can't see individual bacteria cells. Yet despite their small size, bacteria aren't all alike. There are three main types, distinguished by their different shapes—rod, spiral, and spherical.



We all know that certain bacteria (often called “germs”) can make us sick. For example, strep throat is caused by a bacterium called *Streptococcus*. Because of this and their very small size, bacteria aren't normally used as specimens in middle-school classrooms. To see bacteria in detail requires much more powerful microscopes, such as electron microscopes.

Did you also know that there are many more harmless—and even beneficial—bacteria than there are harmful ones? That's right! Some kinds of bacteria live in our digestive system. They help us process our food. Some of the intestinal gas we find so offensive forms when bacteria feed on undigested waste in our large intestine.

Another kind of bacteria lives in the roots of peas, beans, and other plants. These bacteria help put nitrogen into the soil. Without nitrogen, many plants would not survive.

So, don't think of bacteria as lowly members of the Monera kingdom. They perform many useful jobs. What's more, for about 2 billion years, they were the only life form on Earth. Once upon a time, bacteria ruled! Because they are so numerous and powerful, many people think they still do. □



The small knobby spheres on the root of this pea plant contain bacteria that fix nitrogen the plant can use.

MIGHTY MICROBES



JED KIRSCHBAUM, THE BALTIMORE SUN

Dr. Leleng Isaacs (left) in her lab with students at Goucher College

It's hard to believe that something visible only through a microscope could change the course of history. But it's true—and that something is microbes.

Microbes are tiny organisms that live in the air, in water, and on just about any surface. According to Dr. Leleng Isaacs, microbes have shaped the history of Earth and of human beings.

Dr. Isaacs is a microbiologist—a scientist who studies tiny life forms. She has been studying microbes for many years and is writing a book about their impact on history. She and other scientists agree that humans are alive today because of microbes.

Microbes: The First Life Forms

When Earth was very young, the only life forms were microbes. They were invisible to the naked eye. But, Dr. Isaacs says, being invisible did not keep them from being very creative. For instance, scientists believe that one type of microbe, a blue-green alga, was the first to undergo photosynthesis. These algae used energy from the Sun to produce glucose from carbon dioxide and water. Glucose provides plants with the sources of energy they need to perform life activities. As glucose was formed by these early algae, oxygen was released into Earth's atmosphere.

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According to Dr. Isaacs, in a way, microbes also were the first polluters, and oxygen was the first pollutant. But in this case, polluting was a good thing. The oxygen that was released into the atmosphere helped create the ozone layer. That layer protects Earth from dangerous radiation. Without it, new life forms—including humans—could not have evolved.

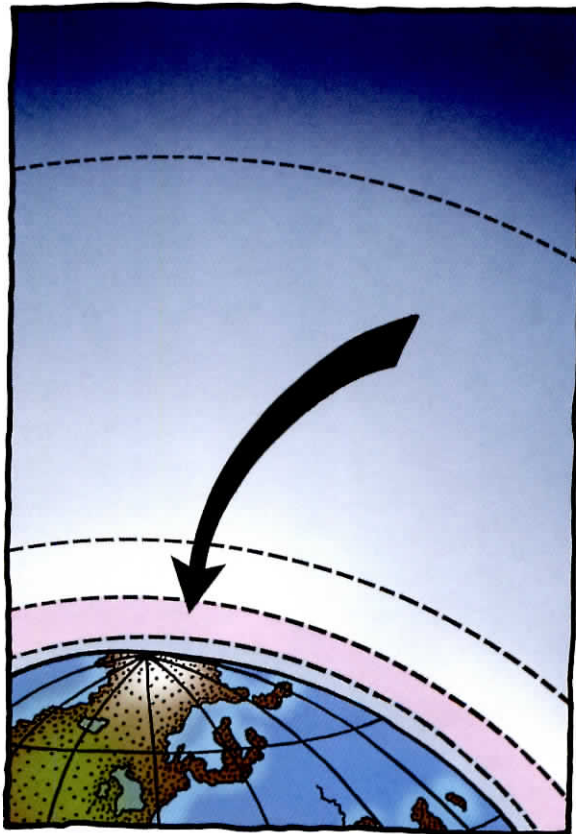
Bad Microbes, Good Microbes

Some microbes cause diseases that can kill entire populations. This is particularly apt to happen when microbes are carried into a new area whose inhabitants have had no exposure to the disease. For example, when Europeans first came to the Western Hemisphere, they brought diseases that had existed in Europe for a long time but which had not been present in

the Americas. Some of those diseases, such as smallpox, infected the native peoples living in North and South America. Many natives died because they had no immunity to those diseases. Microbes helped to wipe out mighty civilizations such as the Incas.

Today, we see similar threats from microbes. The human immunodeficiency virus (HIV), for instance, has infected hundreds of millions of people around the world. The disease it causes, acquired immune deficiency syndrome (AIDS), is spreading fast. Scientists are working hard to find a vaccine that will prevent AIDS.

At the same time, microbes can do a lot of good. Many antibiotics are made from bacteria and other microbes. You probably have taken penicillin or amoxicillin when you have had strep throat. Those medicines are made



This 15-km layer of ozone, indicated by the arrow, helps protect us from the harmful rays of the Sun. (The Earth and the layers of atmosphere are not drawn to scale.)



DWIGHT R. KUHN

Penicillin, discovered in a mold called Penicillium by Alexander Fleming in 1928, was called the first wonder drug.

from mold, a type of fungus. Before the discovery of antibiotics in 1928, thousands of people died every year from diseases caused by bacteria.

Too Much of a Good Thing

In TV ads, makers of soap and cleaning products brag that their products are “antibacterial.” They say that’s a good thing. Dr. Isaacs disagrees. She says overuse of antibacterial

products and antibiotics is actually dangerous. Microbes can quickly become resistant to them. Then, scientists have to struggle to find newer, more effective medicines. Dr. Isaacs’s advice? Use good old soap and water.

For Dr. Leleng Isaacs, microbiology is a fascinating field of study. Microbes are always changing and creating new challenges for scientists. She urges you to look into a microscope and discover the exciting world of microbes. □