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#### Chapter 19 Bacteria and Viruses

# **Summary**

#### 19-1 Bacteria

The smallest and most common microorganisms are prokaryotes, which are unicellular organisms that lack a nucleus. Prokaryotes are divided into two kingdoms: Eubacteria and Archaebacteria. Eubacteria live almost everywhere. Eubacteria are usually surrounded by a cell wall, which contains a carbohydrate called peptidoglycan. Inside the cell wall is a cell membrane that surrounds the cytoplasm. Archaebacteria look very similar to eubacteria. Archaebacteria lack the peptidoglycan of eubacteria and have different membrane lipids. Also, the DNA sequences of key archaebacterial genes are more like those of eukaryotes than those of eubacteria. Archaebacteria may be the ancestors of eukaryotes.

Prokaryotes are identified by characteristics such as shape, the chemical nature of their cell walls, the way they move, and the way they obtain energy. Three differently shaped prokaryotes are bacilli, cocci, and spirilla. Bacilli (singular: bacillus) are rodshaped; cocci (singular: coccus) are sphereshaped; and spirilla (singular: spirillum) are spiral or corkscrew-shaped. Two different types of cell walls are found in prokaryotes. A method called Gram staining is used to tell them apart. Gram-positive bacteria appear violet when stained, while Gramnegative bacteria appear pink. Prokaryotes move in a variety of ways.

Most prokaryotes are heterotrophs—organisms that obtain energy by consuming other organisms. Other prokaryotes are autotrophs, organisms that can make their own food. Heterotrophic prokaryotes include chemoheterotrophs and photoheterotrophs. Autotrophic prokaryotes include photoautotrophs and chemoautotrophs.

Prokaryotes release energy by both cellular respiration and fermentation. Organisms that require a constant supply of oxygen to live are called obligate aerobes. Organisms that do not require oxygen are called obligate anaerobes. Organisms that can survive with or without oxygen are called facultative anaerobes.

When a bacterium has grown so that it has nearly doubled, it replicates its DNA and divides in half, producing two identical "daughter" cells. This asexual reproduction is called binary fission. Bacteria are also able to exchange genetic information by a process called conjugation. Many bacteria can form an endospore when conditions are bad.

Bacteria are vital to maintaining the living world. Some are producers that carry out photosynthesis. Others are decomposers that break down dead matter. Some soil bacteria convert natural nitrogen gas into a form plants can use through a process called nitrogen fixation. Humans use bacteria in industry, food production, and other ways.

#### 19–2 Viruses

Viruses are particles of nucleic acid, protein, and, in some cases, lipids. All viruses have one thing in common: They enter living cells and, once inside, use the machinery of the infected cell to produce more viruses. A typical virus is composed of a core of DNA or RNA surrounded by a protein coat. A virus's protein coat is called its capsid. Viruses that infect bacteria are called bacteriophages.

Once the virus is inside a host cell, two different infection processes may occur. In a lytic infection, a virus enters a cell, makes copies of itself, and causes the cell to burst, releasing new virus particles that can attack other cells. The virus uses the materials of the host cell to make copies of its own DNA molecule. In a lysogenic infection, a virus integrates its DNA into the DNA of the host cell, and the viral genetic information replicates along with the host cell's DNA. The viral DNA that is embedded in the host's DNA is called a prophage. The prophage may remain part of the DNA of the host cell for many generations. Eventually, the prophage will remove itself from the host cell DNA and make new virus particles.

Some viruses, called retroviruses, contain RNA as their genetic information. In a retrovirus, the genetic information is copied backward—from RNA to DNA instead of from DNA to RNA. The virus that causes the disease AIDS is a retrovirus.

Viruses must infect a living cell in order to reproduce. Viruses are parasites. Because viruses are not made up of cells and cannot live independently, viruses are not considered to be living things.

# 19-3 Diseases Caused by Bacteria and Viruses

Disease-causing agents are known as pathogens. Bacteria and viruses can cause disease. Not all bacteria are pathogens. Some live in and on the human body and help the body perform essential functions. Other bacteria can produce human diseases such as tuberculosis, strep throat, and tooth decay.

Bacteria produce disease in one of two general ways. Some bacteria damage the cells and tissues of the infected organism directly by breaking down the cells for food. Other bacteria release toxins (poisons) that travel throughout the body interfering with the normal activity of the host.

Many bacterial diseases can be prevented by using a vaccine. A vaccine is a preparation of weakened or killed pathogens. A vaccine can prompt the body to produce immunity to the disease. Immunity is the body's natural way of killing pathogens. When a bacterial infection does occur, antibiotics can be used to fight the disease. Antibiotics are compounds that block the growth and reproduction of bacteria. Animals also suffer from bacterial diseases.

There are various methods to control bacterial growth, including sterilization, disinfectants, and food storage and food processing. Disinfectants include soaps and cleaning solutions. Food storage includes using a refrigerator.

Viruses produce disease by disrupting the body's normal equilibrium. In many viral infections, viruses attack and destroy certain body cells, causing the symptoms of the disease. Viral diseases in humans include the common cold, influenza, AIDS, chickenpox, and measles. Viruses produce other serious diseases in both animals and plants.

Two other viruslike particles can cause disease. Viroids are single-stranded RNA molecules that have no surrounding capsids. Viroids cause disease in plants. Prions are particles that contain only protein—there is no DNA or RNA. Prions cause disease in animals, including humans.

| Ξ           | Key Concepts   |
|-------------|--|
| •           | How do the two groups of prokaryotes differ?   |
| •           | What factors are used to identify prokaryotes?   |
| •           | What is the importance of bacteria?  |
| nt          | roduction (page 471)   |
| 1.          | What are prokaryotes?  |
| 2.          | Is the following sentence true or false? Prokaryotes are much smaller than most eukaryotic cells |
| <b>'</b> Iz | assifying Prokaryotes (pages 471–472)  |
|             | What are the two different groups of prokaryotes?  |
|             | a b  |
| 4.          | Which is the larger of the two kingdoms of prokaryotes?  |
|             | Where do eubacteria live?  |
| 6.          | What protects a prokaryotic cell from injury?  |
| 7.          | Circle the letter of what is within the cell wall of a prokaryote.                               |
|             | <ul><li>a. another cell wall</li><li>c. archaebacteria</li></ul>                                 |
|             | b. cell membrane d. pili   |
| 8.          | What is peptidoglycan?   |
| 9.          | Some eubacteria have a second outside the cell membrane.   |
|             | Circle the letter of each sentence that is true about archaebacteria.                            |
|             | a. Their membrane lipids are different from those of eubacteria.                                 |
|             | <b>b.</b> They lack a cell wall.   |
|             | c. They lack peptidoglycan.  |
|             | d. They look very similar to eubacteria.   |
| Ι.          | What is significant about the DNA sequences of key archaebacterial genes?                        |
|             |  |
|             |  |
|             |  |

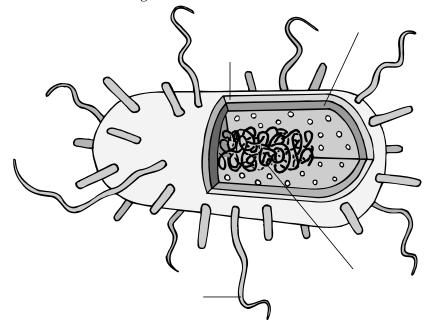
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|-----|-----------------------------------|--------------|------|
| 13. | What are methanogens, and where d | o they live? |      |

### **Identifying Prokaryotes** (page 473)

**14.** Use the following labels to complete the illustration of a typical prokaryote: cell membrane, cell wall, DNA, flagellum.



- 15. What are four characteristics used to identify prokaryotes?
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
  - c. \_\_\_\_
  - d. \_\_\_\_\_
- 16. What are each of the differently shaped prokaryotes called?
  - **a.** The rod-shaped are called \_\_\_\_\_\_.
  - **b.** The spherical-shaped are called \_\_\_\_\_\_.
  - c. The corkscrew-shaped are called \_\_\_\_\_\_.
- 17. A method of telling two different types of eubacteria apart by using dyes is called
- **18.** What colors are Gram-positive and Gram-negative bacteria under the microscope when treated with Gram stain?
- 19. What are flagella? \_\_\_\_\_

| Name  | Class Date  |
|---|---|
|   | versity (pages 473–474) table about prokaryotes classified by the way they obtain energy.       |
|   | GROUPS OF PROKARYOTES   |
| Group   | Description   |
|   | Organism that carries out photosynthesis in a manner similar to that of plants                  |
| Chemoautotroph                                  |   |
|   | Organism that takes in organic molecules and then breaks them down                              |
| Photoheterotroph                                |   |
| chlorophyll <i>a</i> ? <b>23.</b> How do the ch | hich group of photoautotrophs contain a bluish pigment and ———————————————————————————————————— |
| <b>24.</b> Complete the                         | table about prokaryotes classified by the way they release energy.  GROUPS OF PROKARYOTES       |
| Group   | Description   |
|   | Organisms that require a constant supply of oxygen  |
| Obligate anaerobes                              |   |
| Facultative anaerob                             | es  |
| Growth and I                                    | Reproduction (page 475)  In the process of binary fission?                                      |
| <b>27.</b> What occurs d                        | uring conjugation?  |
| 28. Is the followin                             | g sentence true or false? Most prokaryotes reproduce by conjugation.                            |

| Naı | Name Class   | Date                              |
|-----|--|-----------------------------------|
| 29. | <b>29.</b> What is an endospore?   |                                   |
|     | Importance of Bacteria (pages 476–477)  30. How do decomposers help the ecosystem recycle nu | trients when a tree dies?         |
|     |  |                                   |
| 31. | 31. What would happen to plants and animals if decomp  | posers did not recycle nutrients? |
| 32. | 32. Why do plants and animals need nitrogen?   |                                   |
| 33. | 33. How does nitrogen fixation help plants?  |                                   |
|     | 34. What kind of relationship do many plants have with                                       |                                   |
| 35. | <b>35.</b> How can bacteria be used to clean up an oil spill? _                              |                                   |
| 36. | <b>36.</b> What have biotechnology companies begun to realiz to extreme environments?        |                                   |
|     |  |                                   |

## **Reading Skill Practice**

Writing a summary can help you remember the information you have read. When you write a summary, write only the most important points. Write a summary of the information under the green heading Decomposers. Your summary should be shorter than the text on which it is based. Do your work on a separate sheet of paper.

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| vanic | Ciabb | Date |

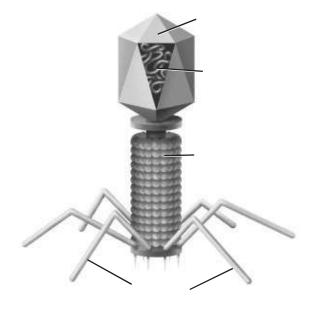
# Section 19–2 Viruses (pages 478–483)

# **C** Key Concepts

- What is the structure of a virus?
- How do viruses cause infection?

### What Is a Virus? (pages 478-479)

- 1. What are viruses? \_\_\_\_\_
- 2. What do all viruses have in common?
- **3.** Is the following sentence true or false? Most viruses are so small that they can be seen only with the aid of a powerful electron microscope. \_\_\_\_\_\_
- **4.** What is the structure of a typical virus? \_\_\_\_\_
- **5.** Complete the illustration of a T4 bacteriophage by labeling the parts.



- **6.** A virus's protein coat is called a(an) \_\_\_\_\_\_.
- 7. How does a typical virus get inside a cell?

| Name                 | <u> </u>  | Class   | Date        |
|----------------------|---|---|-------------|
| 8. Wh                | nat occurs when viruses get in  | side cells?   |             |
| 9. W                 | hy are most viruses highly sp   | ecific to the cells they  | infect?     |
| 10. W                | hat are bacteriophages?   |   |             |
| Vira                 | I Infection (pages 480–48   | 31)   |             |
| <b>11.</b> W         | Thy is a lytic infection given th   | at name?  |             |
| a.<br>b.<br>c.<br>d. | ircle the letter of each sentence. The virus lyses the host cell i The virus embeds its DNA ir The virus's DNA is replicated. A host cell makes copies of the | mmediately.  Into the host's DNA.  Indicate along with the host the virus indefinitely. |             |
|                      | The bacteriophage attaches to the   | e bacterium's   |             |
|                      |   | <b>—</b>  |             |
|                      | The bacteriophage injects its   | into  | o the cell. |
|                      |   | <b>—</b>  |             |
|                      | The cell makes mRNA from the ba   | acteriophage's  | ·           |
|                      |   | <b>—</b>  |             |
|                      | The virus wrecks the cell, causing  | it to   |             |
|                      |   | <b>—</b>  |             |
|                      | The bursting of the cell releases n   | ew bacteriophage  | · )         |
| 14. W                | hat is a prophage?  |   |             |

| Naı | me Class                                   | 5 I | <i>D</i> ate |
|-----|--|-----|--------------|
| Re  | troviruses (page 482)                      |     |              |
| 15. | What are retroviruses?                     |     |              |
| 16. | What happens when retroviruses infect a ce | 11? |              |
|     |  |     |              |

### Viruses and Living Cells (pages 482-483)

- 17. Circle the letter of each reason why some biologists do not consider viruses to be alive.
  - **a.** They can't infect living cells.
  - **b.** They can't evolve.
  - **c.** They can't regulate gene expression.
  - **d.** They can't reproduce independently.
- **18.** Complete the table comparing viruses and cells.

#### **Virus and Cells**

| Characteristic              | Virus                      | Cell   |
|-----------------------------|----------------------------|--|
| Structure                   | DNA or RNA<br>core, capsid | Cell membrane, cytoplasm; eukaryotes also contain nucleus and organelles |
| Reproduction                |                            | Independent cell division either asexually or sexually                   |
| Genetic Code                |                            | DNA  |
| Growth and Development      | No                         |  |
| Obtain and Use<br>Energy    |                            | Yes  |
| Response to the Environment | No                         |  |
| Change Over<br>Time         |                            |  |

| otion 10 2 Di                               | iaaaaaa Cawaaa                | d by Dootorio                |
|---|-------------------------------|------------------------------|
| ection 19–3 Di<br>nd Viruses (pag           | iseases Causeo                | a by bacteria                |
| Key Concepts                                | jes 403–470)                  |                              |
| <ul> <li>How do bacteria cause d</li> </ul> | disease?                      |                              |
| How can bacterial grow                      | th be controlled?             |                              |
| How do viruses cause d                      |                               |                              |
| acterial Disease in H                       | Humans (pages 485–486         | 6)                           |
| <ol> <li>What are pathogens?</li> </ol>     |                               |                              |
| 2. What are the two general                 | •                             |                              |
| a   |                               |                              |
| 1   |                               |                              |
| b   |                               |                              |
| 3. What kind of tissue do th                | ne bacteria that cause tuber  | culosis break down?          |
| <b>4.</b> What are antibiotics?             |                               |                              |
| 5. What do you think is one                 | e of the major reasons for th | ne dramatic increase in life |
| expectancy during the pa                    | ast two centuries?            |                              |
|   |                               |                              |
| ontrolling Bacteria                         | (pages 486–487)               |                              |
| 6. What is sterilization?                   |                               |                              |
| 7. A chemical solution that 1               | kills pathogenic bacteria is  | called a(an)                 |
| 8. Why will food stored at le               | low temperatures keep long    | ger?                         |
|   |                               |                              |

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|-----|--|-------------------------|-----------------------------|
|     | ral Disease in Animals (<br>What is one example of a viral o |                         |                             |
| 11. | Cancer-causing viruses are known                             | vn as                   | ·                           |
|     | ral Disease in Plants (pa                                    | •                       | 11 11 11 11 12              |
| 12. | Why do plant viruses have a dif                              | icult time entering the | e cells they infect?        |
| 13. | How are most plant viruses spre                              | ead?                    |                             |
| Vii | roids and Prions (page 49                                    | <b>90</b> )             |                             |
| 14. | What are viroids?  |                         |                             |
| 15. | A disease-causing particle that ca(an)                       | ontains only protein a  | nd not DNA or RNA is called |

| Name | Class | Date |  |
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|      |       |      |  |

# Chapter 19 Bacteria and Viruses

# **Vocabulary Review**

| Matching | In the space provided, | writ | te the letter of the definition that best matches each term.  |
|----------|------------------------|------|---|
| 1.       | lysogenic infection    | a.   | spiral-shaped bacterium   |
| 2.       | eubacteria             | b.   | pathogen that causes disease in animals by forming a  |
| 3.       | chemoautotroph         | C    | protein clump rod-shaped bacterium  |
| 4.       | toxin                  |      | organism that must take in organic molecules for both   |
| 5.       | prion                  |      | energy and a supply of carbon   |
| 6.       | bacteriophage          | e.   | a particle of nucleic acid, protein, and in some cases, lipids  |
| 7.       | coccus                 | f.   | process in which viral DNA becomes part of a host   |
| 8.       | chemoheterotroph       |      | cell's DNA  |
| 9.       | antibiotic             | g.   | disease-causing agent   |
| 10.      | virus                  |      | spherical bacterium   |
| 11.      | prokaryote             | i.   | process in which a host cell bursts after being invaded by a virus                                    |
| 12.      | spirillum              | j.   | organism consisting of one cell that lacks a nucleus  |
| 13.      | prophage               | k.   | process in which a bacterium replicates its DNA and   |
| 14.      | pathogen               | 1    | divides in half   |
| 15.      | lytic infection        |      | organism that obtains energy from inorganic molecules spore formed by bacteria when growth conditions |
| 16.      | endospore              | 111. | become unfavorable  |
| 17.      | bacillus               | n.   | virus that infects bacteria   |
| 18.      | binary fission         |      | viral DNA that is embedded in the host's DNA  |
| 19.      | obligate anaerobe      | p.   | substance produced by some bacteria that poisons host cells   |
| 20.      | vaccine                | q.   | preparation of weakened or killed pathogens   |
|          |                        | r.   | compound that can destroy bacteria  |
|          |                        | s.   | organism that can live only in an oxygen-free environment   |
|          |                        | t.   | the larger of the two kingdoms of prokaryotes   |
|          |                        |      |   |

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#### **Chapter 20** Protists

# Summary

### 20-1 The Kingdom Protista

The kingdom Protista is a diverse group. Protists are eukaryotes that are not members of the kingdoms Plantae, Animalia, or Fungi. Most protists are unicellular. The first eukaryotic organisms on Earth were protists.

Protists, which first appeared about 1.5 billion years ago, were the first group of eukaryotes to evolve. One explanation for the way the first eukaryotes developed from prokaryotes has been credited to Lynn Margulis. Margulis's hypothesis states that the first eukaryote—and the first protist—was formed by a symbiosis among several prokaryotes. Evidence to support this hypothesis includes structural similarities between certain eukaryotic organelles and bacteria.

Because protists are such a diverse group, scientists don't always agree on how to classify them. One way to classify protists is according to the way they obtain nutrition. There are animal-like protists, plantlike protists, and funguslike protists.

# 20–2 Animal-like Protists: Protozoans

Animal-like protists—also called protozoans—are heterotrophs. The four phyla of animal-like protists are classified according to the way they move.

Animal-like protists that swim using flagella are classified in the phylum Zoomastigina. They are called zooflagellates. Members of the phylum Sarcodina move by means of temporary projections of cytoplasm known as pseudopods. Sarcodines use pseudopods for feeding and movement. Sarcodines called amoebas have thick pseudopods. The phylum Ciliophora is named for cilia, which are short hairlike projections similar to flagella. Ciliates use cilia for feeding and movement. Some of the

best-known ciliates belong to the genus *Paramecium*. Members of the phylum Sporozoa are parasites and do not move on their own. Sporozoans reproduce by means of sporozoites.

Some animal-like protists cause serious diseases. The sporozoan *Plasmodium* causes malaria. The zooflagellate *Trypanosoma* causes African sleeping sickness. Some animal-like protists are beneficial to organisms. *Trichonympha* lives within the digestive system of termites and helps termites digest wood.

# 20-3 Plantlike Protists: Unicellular Algae

Plantlike protists are commonly called algae. Plantlike protists include four phyla that contain unicellular organisms. One of the key traits used to classify algae is the photosynthetic pigments they contain. Chlorophyll includes three forms. Each form absorbs a different wavelength of light. Many algae also have compounds called accessory pigments that absorb light at different wavelengths than chlorophyll.

Euglenophytes—members of the phylum Euglenophyta—are plantlike protists that have two flagella but no cell wall. Euglenophytes have chloroplasts, but in most other ways they are like the protozoans called zooflagellates.

Chrysophytes—members of the phylum Chrysophyta—are a diverse group of plant-like protists that have gold-colored chloroplasts. Diatoms—members of the phylum Bacillariophyta—produce thin, delicate cell walls rich in silicon. Silicon (Si) is the main component of glass. These walls are shaped like a petri dish or a flat pillbox.

Dinoflagellates—members of the phylum Pyrrophyta—generally have two flagella. About half of the dinoflagellates are photosynthetic. The other half live as heterotrophs.

Plantlike protists play a major ecological role on Earth by being a considerable part of the phytoplankton. Phytoplankton are made up of the population of small photosynthetic organisms found near the surface of the ocean. Many protists grow rapidly in regions where sewage is dumped into water. When the amount of waste is excessive, algae grow into enormous masses called algal blooms.

# 20–4 Plantlike Protists: Red, Brown, and Green Algae

Three phyla of plantlike protists contain mostly multicellular organisms. The most important differences among these phyla are their photosynthetic pigments. Red algae—members of phylum Rhodophyta—are able to live at great depths due to their efficiency in harvesting light energy. Red algae contain chlorophyll *a* and reddish accessory pigments called phycobilins.

Brown algae—members of the phylum Phaeophyta—contain chlorophyll a and c as well as a brown accessory pigment called fucoxanthin. The largest alga is giant kelp, a brown alga that grows to be more than 60 meters in length.

Green algae—members of the phylum Chlorophyta—share many characteristics with plants. They share the same photosynthetic pigments, chlorophyll *a* and *b*. Both plants and green algae have cellulose in their cell walls. Also, green algae are like plants in that they store food in the form of starch. These shared characteristics lead scientists to hypothesize that the ancestors of modern land plants looked like green algae. Green algae include the unicellular *Chlamydomonas*. Several species of green algae live in multicellular colonies. *Ulva*, called "sea lettuce," is a true multicellular green alga.

The life cycles of many algae include both a diploid and a haploid generation. The process of switching back and forth between haploid stages and diploid stages in a life cycle is called alternation of generations.

Algae produce much of Earth's oxygen through photosynthesis. Algae are a major food source in the oceans. People also use algae for food. Industry uses algae in making plastics and other products.

### 20-5 Funguslike Protists

Funguslike protists are like fungi in that they are heterotrophs that absorb food from dead or decaying organic matter. Unlike most true fungi, though, funguslike protists have centrioles. They also lack the chitin cell walls of true fungi.

Slime molds are funguslike protists that play key roles in recycling organic material. At one stage of their life cycle, slime molds look just like amoebas. At other stages, they form moldlike clumps that produce spores, almost like fungi. In cellular slime molds, individual cells remain distinct during every phase of the life cycle. They spend most of their lives as free-living cells. In acellular slime molds, cells fuse to form large cells with many nuclei. These structures are known as plasmodia. Fruiting bodies, or sporangia, spring up from a plasmodium.

Water molds, or oomycetes, are members of the phylum Oomycota. Oomycetes thrive on dead or decaying organic matter in water. Some oomycetes are plant parasites on land.

Slime molds and water molds are important recyclers of organic material. Some funguslike protists can cause diseases in plants. An oomycete caused a disease in the Irish potato crop in 1845 and 1846, leading to mass starvation.

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|-------------|------------------------------------|--------------|---|--------------|----------------------|
|             |                                    |              |   |              |                      |
| _           | _                                  |              |   | _            |                      |
| _           |                                    | -1 The       | Kingdom Pro                                     | otista       | (pages 497–498)      |
|             | <b>Key Concept</b> What are protis | ts?          |   |              |                      |
|             | nat Is a Proti                     |              |   |              |                      |
| <b>1.</b> V | Vhat is a protist?                 |              |   |              |                      |
| 2. (        | <br>Circle the letter of           | each senten  | ce that is true about proti                     | ists.        |                      |
| a           | . All are unicellu                 | ılar.        |   |              |                      |
| b           | . All cells have a                 | nucleus.     |   |              |                      |
| c           | . All cells have r                 | nembrane-bo  | ound organelles.                                |              |                      |
| d           | I. All are multice                 | llular.      |   |              |                      |
| 3. V        | Vhy are some org                   | ganisms that | consist of thousands of c                       | ells conside | ered to be protists? |
| <b>4.</b> T | -                                  | ic organisms | age 498) on Earth werelis's hypothesis about wh |              |                      |
| -           |                                    |              |   |              |                      |
|             | assification of Complete the tabl  |              |   | <b>.</b>     |                      |
| Gro         | oup                                | Method of C  | Obtaining Food                                  |              |                      |
|             |                                    | Consume ot   | her organisms                                   |              |                      |
| Pla         | ıntlike protists                   |              |   |              |                      |
| <br>  Fur   | nguslike protists                  |              |   |              |                      |

| Name | (                           | Class | Date                            |  |
|------|-----------------------------|-------|---------------------------------|--|
|      | egories of protists based o | 3     | obtain food reflect about these |  |
|      |                             |       |                                 |  |

# **Reading Skill Practice**

By looking at illustrations in textbooks, you can help yourself remember better what you have read. Look carefully at Figure 20–1 on page 497. What important idea do these photographs communicate? Do your work on a separate sheet of paper.

| Naı | me                        | Class   | Date                           |
|-----|---------------------------|---|--------------------------------|
| Se  | ection 20–2               | Animal-like Proti   | sts: Protozoans                |
| (pa | ages 499–505)             |   |                                |
| •   | _                         | uishing features of the major phy<br>protists harm other living things? | <del>-</del>                   |
| Int | troduction (page 4        | 99)   |                                |
|     |                           | re all animal-like protists called?                                     |                                |
| 2.  | How are the four phyl     | a of animal-like protists distingu                                      | ished from one another?        |
|     |                           |   |                                |
|     | ooflagellates (pag        |   |                                |
| 3.  | . What kind of protists a | are classified in the phylum Zooi                                       | nastigina?                     |
| 4.  | . How many flagella do    | es a zooflagellate have?  |                                |
| 5.  | Zooflagellates reprodu    | ice asexually by means of   |                                |
| 6.  | Is the following senten   | nce true or false? Some zooflagell                                      | ates have a sexual life cycle. |
| Sa  | rcodines (page 500        | <b>)</b> )  |                                |
|     |                           | ers of the phylum   | ·                              |
| 8.  | . What are pseudopods?    | ?   |                                |
| 9.  | . What do sarcodines us   | se pseudopods for?  |                                |
| 10  | What is amoehoid mor      | vement?   |                                |
| 10. |                           | venient:  |                                |
| 11. | . What is a food vacuole  | 2?  |                                |
| 12  | How do amochas cant       | ure and digest food?  |                                |
| 14, | . 110 w ao amocoas capt   | are and argest rood:  |                                |
|     |                           |   |                                |
| 13. | Amoebas reproduce by      | y means of  |                                |

### Ciliates (pages 501–502)

- **14.** Ciliates are members of the phylum \_\_\_\_\_\_.
- **15.** What are cilia? \_\_\_\_\_
- **16.** What do ciliates use cilia for?

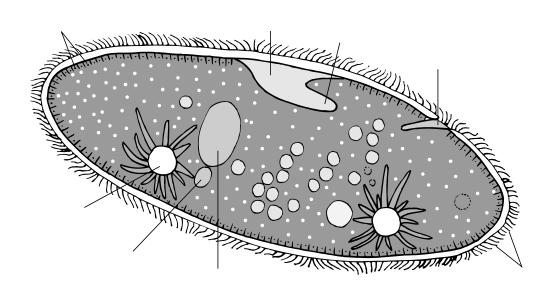
Match the ciliate structure with its description.

#### Structure

- \_\_\_\_\_ **17.** Trichocysts
- \_\_\_\_\_ 18. Macronucleus
- \_\_\_\_\_ **19.** Micronucleus
- \_\_\_\_\_ **20.** Gullet
- \_\_\_\_\_ **21.** Anal pore
- **\_\_\_\_\_ 22.** Contractile vacuole

#### Description

- **a.** Indentation on one side of a ciliate into which food is swept
- **b.** Smaller nucleus containing a "reserve copy" of the cell's genes
- c. Small, bottle-shaped structures used for defense
- **d.** Region of cell membrane where wastecontaining food vacuoles fuse
- **e.** Larger nucleus containing multiple copies of most of the cell's genes
- **f.** Cavity in cytoplasm specialized to collect and pump out water
- **23.** Label the illustration of a paramecium.



- **24.** What is conjugation?
- **25.** Within a large population, how does conjugation benefit ciliates? \_\_\_\_\_

| Name  | Class                                  | Date                             |
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| •   |  |                                  |
| Sporozoans (page 502)   | 11                                     |                                  |
| <b>26.</b> Sporozoans are members of the  |  |                                  |
| 27. Circle the letter of each sentence  | <del>-</del>                           |                                  |
| <ul><li>a. They are parasitic.</li><li>b. They do not move on their contents.</li></ul> | c. All have only                       |                                  |
| <b>b.</b> They do not move on their   | own. <b>u.</b> They reprodu            | ace by means of sporozones.      |
| Animal-like Protists and  |  |                                  |
| <b>28.</b> What causes malaria?   |  |                                  |
| <b>29.</b> Complete the flowchart about   | the cycle of malarial infe             | ection.                          |
| An infected <i>Anopheles</i> mosquito bites   | a human and deposits <i>Plas</i>       | modium spores into the           |
|   |  |                                  |
|   | <u> </u>                               |                                  |
|   | <b>\</b>                               |                                  |
| The spores travel to the  | ······································ |                                  |
|   | <b>V</b>                               |                                  |
| Infected liver cells burst, releasing par   | rasites that infect                    | cells.                           |
| , 31  |  |                                  |
|   | <b>*</b>                               |                                  |
| The human experiences the sympton   | ns of                                  |                                  |
|   | <u> </u>                               |                                  |
| A mosquito bites the infected human   | and picks up the                       | cells.                           |
|   |  |                                  |
| <b>Ecology of Animal-like P</b>   | rotists (page 505)                     |                                  |
| <b>30.</b> Is the following sentence true of  | or false? Some animal-lil              | ke protists recycle nutrients by |
| breaking down dead organic n  | natter                                 |                                  |
| <b>31.</b> How does the zooflagellate <i>Tri</i>  | <i>chonympha</i> make it possi         | ble for termites to eat wood?    |
|   |  |                                  |
|   |  |                                  |
|   |  |                                  |
|   |  |                                  |
|   |  |                                  |

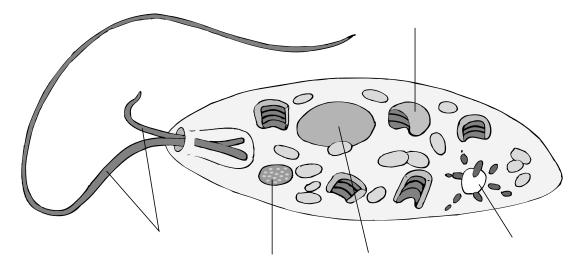
| _   | ection 20–3 Plantlike Protists: Unicellular lgae (pages 506–509)                         |
|-----|--|
| _   | Key Concepts   |
|     | What is the function of chlorophyll and accessory pigments in algae?                     |
| •   | What are the distinguishing features of the major phyla of unicellular algae?            |
| Int | roduction (page 506)   |
|     | Plantlike protists are commonly called   |
|     | Is the following sentence true or false? Algae include only multicellular organisms.     |
|     | lorophyll and Accessory Pigments (page 506)  |
| 3.  | In the process of photosynthesis, what substances trap the energy of sunlight?           |
|     |  |
| 4.  | How does water affect the sunlight that passes through it?                               |
| 5.  | Why does the dim blue light that penetrates deep into the sea contain little energy that |
|     | chlorophyll a can use?   |
|     |  |
| 6.  | How have various groups of algae adapted to conditions of limited light?                 |
|     |  |
| 7.  | What are accessory pigments?   |
|     |  |
| 8.  | Why are algae such a wide range of colors?   |
|     |  |
| Eu  | glenophytes (page 507)   |
| 9.  | Euglenophytes are members of the phylum  |
| 10. | Circle the letter of each sentence that is true about euglenophytes.                     |
|     | a. They are remarkably similar to zooflagellates.  |
|     | <b>b.</b> They possess chloroplasts.   |
|     | c. They have a cell wall.  |
|     | <b>d.</b> They have two flagella.  |

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| 11. | What is an eyespot, and what is its function?          |
|     |  |
| 12. | Euglenas have a tough, intricate membrane called a(an) |
| 13. | How do euglenas reproduce?                             |

**14.** Label the illustration of a euglena.



### Chrysophytes (page 507)

- $\textbf{15.} \ \ \text{The yellow-green algae and the golden-brown algae are members of the phylum}$
- **16.** What color are the chloroplasts of chrysophytes? \_\_\_\_\_
- **17.** Circle the letter of each sentence that is true about chrysophytes.
  - **a.** The cell walls of some contain the carbohydrate pectin.
  - **b.** They reproduce sexually but not asexually.
  - **c.** They generally store food in the form of oil.
  - d. Some form threadlike colonies.

### Diatoms (page 507)

- 18. Diatoms are members of the phylum \_\_\_\_\_
- **19.** Circle the letter of each sentence that is true about diatoms.
  - **a.** They are very rare in almost all environments.
  - **b.** Their cell walls are rich in silicon.
  - **c.** They are shaped like a petri dish or flat pillbox.
  - **d.** They are among the most abundant organisms on Earth.

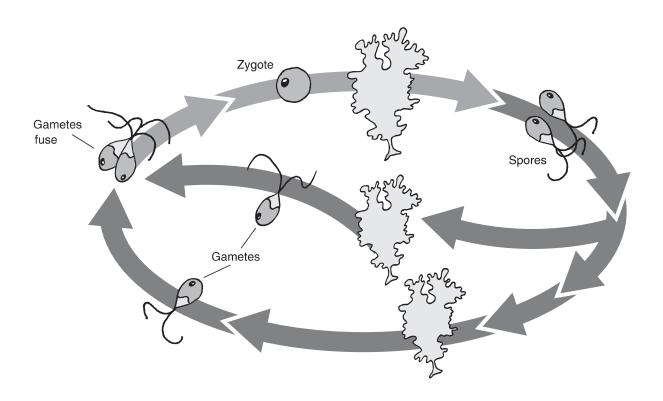
| Nar | me                                | Class                         | Date                      |
|-----|-----------------------------------|-------------------------------|---------------------------|
| Dir | noflagellates (page 50            | <b>)</b> 8)                   |                           |
|     | . Dinoflagellates are member      |                               | ·                         |
| 21. | . How do dinoflagellates obt      | ain nutrition?                |                           |
|     |                                   |                               |                           |
| 22. | Circle the letter of each sen     | tence that is true about dinc | oflagellates.             |
|     | a. They generally have one        | e flagellum.                  |                           |
|     | <b>b.</b> Many species are lumino | escent.                       |                           |
|     | c. Most reproduce by bina         | ry fission.                   |                           |
| Fcc | ology of Unicellular              | Algae (pages 508_509)         |                           |
|     | . How do plantlike protists r     | _                             | of aquatic life possible? |
| 24. | What are phytoplankton?           |                               |                           |
| 25. | . What are algal blooms?          |                               |                           |
| 26. | How can an algal bloom be         | harmful?                      |                           |
| _0. | . 110W can an angar broom be      |                               |                           |
|     |                                   |                               |                           |
|     |                                   |                               |                           |

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| Section 20-                | -4 Plan            | tlike Prot            | ists: Red         | . Brown.                |
| nd Green                   |                    |                       |                   | , ,                     |
| Key Concepts               |                    |                       | - ,               |                         |
|                            |                    | eatures of the majo   | r phyla of multi  | cellular algae?         |
| How do multice             | 0                  | •                     | 1 7               | C                       |
| ntroduction (              | page 510)          |                       |                   |                         |
| 1. What are seawee         |                    |                       |                   |                         |
| . What are the mo          | st important d<br> | lifferences among t   | the three phyla o | of multicellular algae? |
| ed Algae (pag              | e 510)             |                       |                   |                         |
| 3. Red algae are me        | embers of the p    | phylum                | ·                 |                         |
| . Why are red alga         | ne able to live a  | at great depths? _    |                   |                         |
| <b>5.</b> What pigments of | do red algae co    | ontain?               |                   |                         |
| 6. Which color of li       | ght are phycol     | bilins especially go  | ood at absorbing  | ?                       |
| a. red                     | <b>b.</b> green    | c. yellow             | <b>d.</b> blue    |                         |
| . Circle the letter of     | of each sentend    | ce that is true abou  | t red algae.      |                         |
| a. They can grow           | w in the ocean     | at depths up to 26    | 0 meters.         |                         |
| <b>b.</b> Most are unic    | ellular.           |                       |                   |                         |
| c. All are red or          | reddish-brow       | n.                    |                   |                         |
| <b>d.</b> Coralline alga   | ıe play an imp     | ortant role in coral  | reef formation.   |                         |
| A .                        |                    |                       |                   |                         |
| rown Algae (               |                    | - o hl                |                   |                         |
| B. Brown algae are         |                    | 1 2                   |                   |                         |
| 9. What pigments o         | ao brown aiga      | e contain?            |                   |                         |
| latch each structure ข     | •                  | tion.                 |                   |                         |
| Structu                    | re Des             | scription             |                   |                         |
| <b>10.</b> Hold            | dfast a. F         | Flattened stemlike s  | structure         |                         |
| <b>11.</b> Stipe           | e <b>b.</b> C      | Gas-filled swelling   |                   |                         |
| <b>12.</b> Blad            |                    | Structure that attacl | nes alga to the b | ottom                   |
| <b>13.</b> Blad            | lder <b>d.</b> L   | Leaflike structure    |                   |                         |

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|---|---|--|--|--|--|--|
| 14. Where are brown algae commonly found growing? |   |  |  |  |  |  |
| 15.   | What is the largest known alga?   |  |  |  |  |  |
|   | een Algae (pages 511-512)  Green algae are members of the phylum                                    |  |  |  |  |  |
| 17.   | What characteristics do green algae share with plants?  |  |  |  |  |  |
| 18.   | What do scientists think is the connection between mosses and green algae?                          |  |  |  |  |  |
| 19.   | The freshwater alga <i>Spirogyra</i> forms long threadlike colonies called                          |  |  |  |  |  |
| 20.   | How can the cells in a <i>Volvox</i> colony coordinate movement?                                    |  |  |  |  |  |
| 21.   | "Sea lettuce" is a multicellular alga known as  |  |  |  |  |  |
| Re  | production in Green Algae (pages 512–514)   |  |  |  |  |  |
| 22.   | What occurs in the process known as alternation of generations?                                     |  |  |  |  |  |
| 23.   | The unicellular <i>Chlamydomonas</i> reproduces asexually by producing                              |  |  |  |  |  |
|   | Circle the letter of each sentence that is true about sexual reproduction in <i>Chlamydomonas</i> . |  |  |  |  |  |
|   | a. If conditions become unfavorable, cells release gametes.   |  |  |  |  |  |
|   | <b>b.</b> Paired gametes form a diploid zygote.   |  |  |  |  |  |
|   | c. A zygote quickly grows into an adult organism.   |  |  |  |  |  |
|   | <b>d.</b> The gametes are called male and female.   |  |  |  |  |  |
| 25.   | Complete the table about the generations in an organism's life cycle.                               |  |  |  |  |  |
|   | GENERATIONS IN A LIFE CYCLE   |  |  |  |  |  |

| Generation | Definition             | Diploid or Haploid? |
|------------|------------------------|---------------------|
|            | Gamete-producing phase |                     |
|            | Spore-producing phase  |                     |

**26.** Complete the life cycle of *Ulva* by labeling the sporophyte, the male gametophyte, and the female gametophyte. Also, label the places where the processes of fertilization, mitosis, and meiosis occur.



|                | •  | A 1   |       |      |
|----------------|----|-------|-------|------|
| <b>Ecology</b> | ot | Algae | (page | 515) |

| 27. | Why have algae been called | l the "grasses" | of the sea? |  |
|-----|----------------------------|-----------------|-------------|--|
|     | )                          | 0               |             |  |

| 28. | 28. Through photosynthesis, algae produce mu | ch of Earth's                         |
|-----|--|---------------------------------------|
| -0. | io. Through photosynthesis, argue produce ma | : : : : : : : : : : : : : : : : : : : |

| Se  | ection 20-5 Funguslike Protists (pages 516-520)   |
|-----|---|
|     | Key Concepts  |
| •   | What are the similarities and differences between funguslike protists and fungi?        |
| •   | What are the defining characteristics of the slime molds and water molds?               |
| Int | troduction (page 516)   |
| 1.  | How are funguslike protists like fungi?   |
|     |   |
| 2.  | How are funguslike protists unlike most true fungi?                                     |
|     |   |
| Sli | me Molds (pages 516–518)  |
|     | What are slime molds?   |
|     |   |
| 4.  | Cellular slime molds belong to the phylum   |
| 5.  | Is the following sentence true or false? Cellular slime molds spend most of their lives |
|     | as free-living cells  |
| 6.  | What do cellular slime molds form when their food supply is exhausted?                  |
|     |   |
|     |   |
| 7.  | What structure does a cellular slime mold colony produce, and what is that structure's  |
|     | function?   |
|     |   |
| 8.  | Acellular slime molds belong to the phylum  |
|     | What is a plasmodium?   |
|     |   |
|     |   |
| 10. | The plasmodium eventually produces sporangia, which in turn produce haploid             |
|     | ·   |
| W   | ater Molds (pages 518–519)  |
| 11. | Water molds, or oomycetes, are members of the phylum                                    |
| 12. | Water molds produce thin filaments known as   |

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| 13. | . What are zoosporangia?   |                         |                                   |
|     |  |                         |                                   |
| 14. | Where are male and female nuc  | clei produced in water  | 1                                 |
|     |  |                         |                                   |
| 15. | Fertilization in water molds occ   | curs in the             |                                   |
|     | ology of Funguslike Pro Why aren't there bodies of dead walk through?  | d animals and plants li | ittering the woods and fields you |
|     | - The state of the |                         |                                   |
| 17. | . What are examples of plant dis   | eases that water molds  | s cause?                          |
|     | ater Molds and the Pot  What produced the Great Potat  | " 3                     | e 520)                            |
|     |  |                         |                                   |
| 19. | ——————————————————————————————————————   |                         |                                   |
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| Chap   | ter 20 | Protists |   |
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# **Vocabulary Review**

| <b>Matching</b> In the space pro        | vided, write the letter of the description that best matches each organism.  |
|---|--|
| <b>1.</b> sarcodines <b>2.</b> ciliates | <b>a.</b> unicellular algae that produce thin, delicate cell walls rich in silicon                                       |
| 3. euglenophytes                        | <b>b.</b> funguslike protists that look just like amoebas at one stage of their life cycles                              |
| 4. diatoms                              | c. plantlike protists that share many characteristics with plants  |
| 5. brown algae                          | d. protozoans that use pseudopods for feeding and movement   |
| 6. green algae                          | <b>e.</b> funguslike protists that thrive on dead or decaying organic matter in water                                    |
| 7. slime molds                          | f. unicellular algae that have two flagella but no cell wall   |
| 8. water molds                          | <b>g.</b> protozoans that include those belonging to the genus <i>Paramecium</i>   |
|   | h. multicellular algae that contain fucoxanthin  |
| 9. Any organism that is 1               | not a plant, an animal, a fungus, or a prokaryote is a(an)   mic projection used in feeding and movement is called a(an) |
| 11. The disease                         | is caused by the sporozoan <i>Plasmodium</i> .   |
| light at different wave                 | pounds called pigments that absorb lengths than chlorophyll.   |
| near the surface of the                 | are the population of small, photosynthetic organisms found ocean.   |
| <b>14.</b> The process of switchi       | ng back and forth between haploid and diploid stages in a life   |
| cycle is known as                       | of generations.  |
|   | ith many nuclei produced by an acellular slime mold is called  |
| a(an)                                   |  |

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#### Chapter 21 Fungi

## Summary

### 21-1 The Kingdom Fungi

Fungi are eukaryotic heterotrophs that have cell walls. The cell walls of fungi are made up of chitin, a complex carbohydrate. Fungi do not ingest their food, as animals do. Instead, fungi digest food outside their bodies and then absorb it. Many fungi feed by absorbing nutrients from decaying matter. Some fungi are parasites.

All fungi except for yeasts are multicellular. Multicellular fungi are composed of thin filaments called hyphae. Each hypha is only one cell thick. The bodies of multicellular fungi are composed of many hyphae tangled together into a thick mass called a mycelium. The fruiting body of a fungus—such as the above-ground part of a mushroom—is a reproductive structure growing from the mycelium in the soil beneath it.

Most fungi reproduce both asexually and sexually. Asexual reproduction can occur when cells or hyphae break off and begin to grow on their own. Some fungi also produce spores. In some fungi, spores are produced in structures called sporangia. Sporangia are found at the tips of hyphae called sporangiophores. Sexual reproduction in fungi usually involves two different mating types.

Spores of fungi are found in almost every environment. Many fungi produce dry, almost weightless spores that are easily scattered in the wind.

### 21-2 Classification of Fungi

Fungi are classified according to their structure and method of reproduction. The four main groups of fungi are the common molds (phylum Zygomycota), the sac fungi (phylum Ascomycota), the club fungi (phylum Basidiomycota), and the imperfect fungi (Deuteromycota).

The common molds—zygomycetes grow on meat, cheese, and bread. Zygomycetes have a life cycle that includes a zygospore. A zygospore is a resting spore that contains zygotes formed during the sexual phase of the mold's life cycle. The zygomycetes include the black bread mold, Rhizopus stolonifer. Black bread mold has two different kinds of hyphae. The rootlike hyphae that penetrate the bread's surface are rhizoids. The stemlike hyphae that run along the surface of bread are stolons. During the sexual phase in the bread mold, hyphae from different mating types fuse to produce gamete-forming structures called gametangia.

Sac fungi—ascomycetes—have a reproductive structure called an ascus, which contains spores. Sac fungi include the large cup fungi as well as the unicellular yeasts. The life cycle of an ascomycete includes both asexual and sexual reproduction. In asexual reproduction, tiny spores called conidia form at the tips of specialized hyphae called conidiophores. In sexual reproduction, haploid hyphae from two different mating types (+ and –) grow close together and produce a fruiting body. An ascus forms within the fruiting body. Two nuclei of different mating types fuse within the ascus to form a diploid zygote. Yeasts are unicellular ascomycetes. The process of asexual reproduction in yeasts is called budding.

The club fungi—basidiomycetes—have a specialized reproductive structure that resembles a club. The cap of the fruiting body of a basidiomycete—such as the familiar mushroom—is composed of tightly packed hyphae. The lower side of the cap is composed of gills, which are thin blades of tissue lined with basidia. A basidium is a spore-bearing structure. Two nuclei in each basidium fuse to form a diploid zygote cell. The zygote cell undergoes meiosis, forming clusters of spores called basidiospores. A single mushroom can produce billions of basidiospores. Club fungi include mushrooms, shelf fungi, and puffballs.

The imperfect fungi—deuteromycetes—include those fungi that are not placed in other phyla because researchers have never been able to observe a sexual phase in their life cycles. Most imperfect fungi look like ascomycetes, though others are similar to basidiomycetes or zygomycetes. An example of an imperfect fungus is *Penicillium notatum*, a mold that grows on fruit. It is the source of the antibiotic penicillin.

### 21-3 Ecology of Fungi

All fungi are heterotrophs. Many fungi are saprobes, which are organisms that obtain food from decaying organic matter. Others are parasites, and still others live in symbiosis with other species.

Fungi play an essential role in maintaining equilibrium in nearly every ecosystem. Fungi do this by recycling nutrients as they break down the bodies and wastes of other organisms. Many fungi feed by releasing digestive enzymes that break down organic material into simple molecules. Fungi food includes wastes and dead organisms. In

breaking down this material, fungi promote the recycling of nutrients and essential chemicals. Without such decomposers, the energy-rich compounds that organisms accumulate would be lost forever.

Parasitic fungi cause serious plant and animal diseases. A few cause diseases in humans. Fungal diseases in plants include corn smut and wheat rust. Fungal diseases in humans include athlete's foot and ringworm, thrush, and yeast infections of the female reproductive tract.

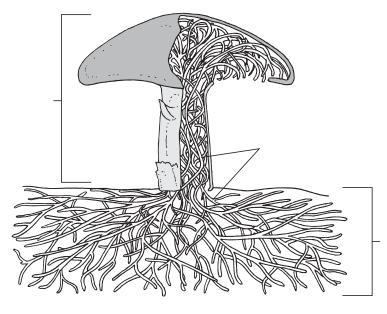
Some fungi form symbiotic relationships in which both partners benefit, such as lichens and mycorrhizae. Lichens are not single organisms. Rather, lichens are symbiotic associations between a fungus and a photosynthetic organism. The photosynthetic organism in a lichen is either a green alga or a cyanobacterium, or both. The alga or cyanobacterium provides the fungus with a source of energy by carrying out photosynthesis. The fungus, in turn, provides the photosynthetic organism with water and minerals. The fungus also shades the alga or cyanobacterium from intense sunlight.

Mutualistic associations of plant roots and fungi are called mycorrhizae. The plant's roots are woven into a partnership with the web of fungal hyphae. The hyphae of fungi aid plants in absorbing water and minerals. In addition, the fungi release enzymes that free nutrients from the soil. The plants, in turn, provide the fungi with the products of photosynthesis. The presence of mycorrhizae is essential for the growth of many plants. Mycorrhizal associations were an adaptation that was critical in the evolution of plants.

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|     |  |                                |                 |
|     |  |                                |                 |
| Se  | ection 21-1 The  | Kingdom Fungi                  | (pages 527–529) |
| •   | <ul><li>Key Concepts</li><li>What are the defining charac</li><li>What is the internal structure</li><li>How do fungi reproduce?</li></ul> | _                              |                 |
| WI  | hat Are Fungi? (page 52  | 27)                            |                 |
| 1.  | . Circle the letter of each senten   | ce that is true about fungi.   |                 |
|     | <b>a.</b> They are heterotrophs.   |                                |                 |
|     | <b>b.</b> They have cell walls.  |                                |                 |
|     | <b>c.</b> They are photosynthetic.   |                                |                 |
| _   | <b>d.</b> They are eukaryotic.   |                                | 11 1            |
|     | The cell walls of fungi are made   | 1                              |                 |
| 3.  | . How do fungi digest their foo  | u:                             |                 |
| 4.  | Is the following sentence true   | or false? Some fungi are paras | sites           |
| Str | ructure and Function o   | of Fungi (pages 527-528)       |                 |
| 5.  | . Which group of fungi are not   | multicellular?                 |                 |
| 6.  | . What are hyphae?   |                                |                 |
| 7   | . How thick is each hypha?   |                                |                 |
|     | In some fungi, what divides the  |                                |                 |
|     |  | ) [                            | 9               |
| 9.  | . What is a mycelium?  |                                |                 |
|     |  |                                |                 |
|     |  |                                |                 |
| 10. | . Why is a mycelium well suited  | d to absorb food?              |                 |
|     |  |                                |                 |
| 44  | TATI ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) (   | 2                              |                 |
| 11. | . What is a fruiting body of a fu  | ingus?                         |                 |
|     |  |                                |                 |

| Name                                   | Class            | Date |  |
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| <b>12.</b> What is a fairy ring, and w | hy does it form? |      |  |
|  |                  |      |  |
|  |                  |      |  |

13. Label the parts of the fungus.



# Reproduction in Fungi (pages 528-529)

| 14. Is the following sentence true or false? Most fungi can reproduce only a | asexually. |
|--|------------|
|--|------------|

| some fungi, spores are produced in structures called                               |
|--|
| here are sporangia found in a fungus?  |
| avual reproduction in funci usually involves two different                         |
| exual reproduction in fungi usually involves two different  That is a gametangium? |
| h<br>  |

| Nar | me Class Date  |
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| 20. | How does a zygote form in fungal sexual reproduction?                                  |
|     |  |
|     |  |
|     |  |
|     |  |
| 21. | Circle the letter of each sentence that is true about sexual reproduction in fungi.    |
|     | <b>a.</b> The zygote is often the only diploid cell in the fungus's entire life cycle. |
|     | <b>b.</b> Mating types are called male and female.                                     |
|     | c. Gametes of both mating types are about the same size.                               |
|     | <b>d.</b> One mating type is a "+" (plus) and the other is a "-" (minus).              |
| Но  | w Fungi Spread (page 529)  |
| 22. | Is the following sentence true or false? The spores of many fungi scatter easily       |
|     | in the wind  |
| 23. | For a fungal spore to grow, where must it land?  |
|     |  |
|     |  |
|     |  |
|     |  |
|     |  |

| Name | Class | Date |  |
|------|-------|------|--|

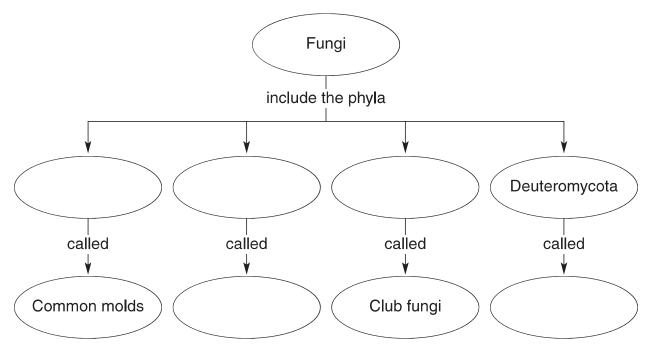
# Section 21-2 Classification of Fungi (pages 530-536)

# **Service** Key Concept

• What are the characteristics of the four main phyla of fungi?

### **Introduction** (page 530)

1. Complete the concept map about the four main groups of fungi.



### The Common Molds (pages 530-531)

| 2. | What are zygomycetes? |  |
|----|-----------------------|--|
|    |                       |  |
|    |                       |  |

| 3. | The resting spore formed of | during the sexual | phase of the mold' | s life cycle is called a(ar | 1) |
|----|-----------------------------|-------------------|--------------------|-----------------------------|----|
|    |                             |                   |                    |                             |    |

| 4. | Is the following sentence true or false? The hyphae of zygomycetes are generally |
|----|--|
|    | divided by cross walls   |

| 5. | . What is the common name for <i>Rhizopus st</i> | tolonifer? |  |
|----|--|------------|--|
| 0. | • Willat 15 the common hame for ranzopus si      |            |  |

**6.** Complete the table about the kinds of hyphae of black bread mold.

#### KINDS OF HYPHAE

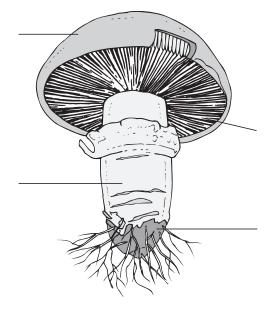
| Kind     | Description   |
|----------|---|
| Rhizoids |   |
| Stolons  |   |
|          | Hyphae that push up into the air and form sporangia at their tips |

| Name                               | Class                            | Date                              |
|------------------------------------|----------------------------------|-----------------------------------|
| 7. Complete the flowchart abo      | out sexual reproduction in z     | ygomycetes.                       |
| Two hyphae from different mating   | types come together, forming _   | ·                                 |
|                                    | •                                |                                   |
| Haploid gametes from the matin     |                                  | gotes, which make up a single     |
|                                    |                                  |                                   |
| The zygospore eventually germin    | nates, and a(an)                 | emerges.                          |
|                                    |                                  |                                   |
| The sporangium reproduces asex     | cually by releasing              | ·                                 |
| kingdom Fungi.                     | rue or false? Ascomycetes n      | nake up the largest phylum in the |
| 11. Complete the flowchart abo     | out sexual reproduction in a     | ascomycetes.                      |
| Gametangia from two different r    | nating types                     | together.                         |
|                                    | <b>Y</b>                         |                                   |
| That fusion produces hyphae tha    | t contain haploid                | ·                                 |
| The N + N hyphae produce a fru     | iting body, inside of which the  | forms.                            |
|                                    | <b>*</b>                         |                                   |
| Within the ascus, meiosis and mito | osis occur to produce cells know | n as                              |
|                                    |                                  |                                   |
| In a favorable environment, an asc | cospore germinates and grows ir  | nto a haploid                     |

| Name   | Class           | Date                       |
|--|-----------------|----------------------------|
| 12. Is the following sentence true or false                  | e? Yeasts are n | nulticellular ascomycetes. |
| 13. Why are yeasts classified as ascomyo                     | cetes?          |                            |
| 14. What process do yeasts carry out to o                    | 0,5             | ,                          |
| mixture such as bread dough?  The Club Fungi (pages 534–536) |                 |                            |
| 15. From what does the phylum Basidio                        | mycota get its  | name?                      |

**16.** Label the parts of a mushroom.

17. Where are basidia found on a basidiomycete? \_



18. The cap of a basidiomycete is composed of tightly packed \_\_\_\_\_\_\_\_.
19. Is the following sentence true or false? The remarkable growth of mushrooms overnight is caused by cell enlargement. \_\_\_\_\_\_\_
20. Circle the letter of each example of basidiomycetes.

a. puffballs
b. shelf fungi
c. rusts
d. yeasts

21. Why should you never pick or eat any mushrooms found in the wild?

| Naı | me   | Class                     | Date                   |
|-----|--|---------------------------|------------------------|
| 22. | Complete the flowchart about reprodu           | ction in basidiomycetes.  |                        |
| A   | basidiospore germinates to produce a haploi    | d primary                 | ·                      |
|     |  | <b>\</b>                  |                        |
| Т   | he mycelia of different mating types fuse to p |                           | ·                      |
|     |  | <b>\</b>                  |                        |
| A   | fruiting body pushes above ground, forming     | a(an)                     | at the soil's surface. |
|     |  | <b>\</b>                  |                        |
| Ţ   | wo nuclei in each basidium fuse to form a dip  |                           |                        |
|     |  | <b>\</b>                  |                        |
| E   | ach zygote undergoes meiosis, forming cluste   | ers of diploid            |                        |
| Th  | e Imperfect Fungi (page 536)                   |                           |                        |
| 23. | The phylum Deuteromycota is compos             | ed of what fungi?         |                        |
|     |  |                           |                        |
|     |  |                           |                        |
| 24. | What is <i>Penicillium notatum</i> , and where | does it grow naturally? _ |                        |
| 25. | What is produced from <i>Penicillium nota</i>  | atum?                     |                        |
|     |  |                           |                        |

## **Reading Skill Practice**

You can often increase your understanding of what you've read by making comparisons. A compare-and-contrast table helps you to do this. On a separate sheet of paper, make a table to compare the four main groups of fungi you read about in Section 21–2. For more information about compare-and-contrast tables, see Organizing Information in Appendix A of your textbook.

| Na: | Jame  | _ Class              | Date                            |  |
|-----|---|----------------------|---------------------------------|--|
| S   | Section 21–3 Ecolog   | y of Fungi           | (pages 537–542)                 |  |
|     | Key Concepts  |                      |                                 |  |
| •   | What is the main role of fungi in na  | atural ecosystems?   |                                 |  |
| •   | What problems do parasitic fungi of   | cause?               |                                 |  |
| •   | What kinds of symbiotic relationsh  | nips do fungi form   | with other organisms?           |  |
| ΑI  | All Fungi Are Heterotrophs  | (page 537)           |                                 |  |
| 1.  | 1. Fungi cannot manufacture their ow  | n food because the   | y are                           |  |
| 2.  | 2. What are saprobes?   |                      |                                 |  |
|     |   |                      |                                 |  |
|     | ungi as Decomposers (page s   |                      |                                 |  |
|     | 3. Fungi recycle nutrients breaking do  |                      |                                 |  |
| 4.  | How do fungi break down leaves, fruit, and other organic material into simple |                      |                                 |  |
|     | molecules?  |                      |                                 |  |
|     |   |                      |                                 |  |
|     |   |                      |                                 |  |
| Fu  | ungi as Parasites (pages 538–5  | i <b>39</b> )        |                                 |  |
| 5.  | 5. Parasitic fungi cause serious plant a                                      | nd animal            |                                 |  |
| 6.  | <b>6.</b> Circle the letter of each example of a                              | a fungal plant disea | ase.                            |  |
|     | <b>a.</b> wheat rust <b>b.</b> corn smut                                      | c. thrush d. m       | ildews                          |  |
| 7.  | 7. Rusts are members of the phylum $_{-}$                                     |                      |                                 |  |
| 8.  | 8. What two kinds of plants do wheat  | rusts need to comp   | blete their life cycle?         |  |
|     |   |                      |                                 |  |
|     |   |                      |                                 |  |
| 9.  | 9. One deuteromycete can infect the an  | reas between the h   | uman toes, causing an infection |  |
|     | known as  | ·                    |                                 |  |
| 10. | <b>0.</b> What happens when the fungus tha body?                              |                      | oot infects other areas of the  |  |
|     | ~~~;  |                      |                                 |  |
|     |   |                      |                                 |  |

| Nar | me Class Date   |
|-----|---|
| -   | mbiotic Relationships (pages 540–542) Lichens and mycorrhizae are both examples of what kind of symbiotic relationship? |
| 12. | What are lichens?   |
| 13. | What is the photosynthetic organism in a lichen?  |
| 14. | Where do lichens grow?  |
| 15. | What benefits do the fungus and the photosynthetic organism derive from the association in a lichen?                    |
|     |   |
| 16. | What are mycorrhizae?   |
| 17. | Why is the presence of mycorrhizae essential for the growth of many plants?   |
|     |   |

| Name | Class | Date |  |
|------|-------|------|--|

# Chapter 21 Fungi

# **Vocabulary Review**

| Mat      | tching In the space provided  | write the letter that best matches each term.  |  |  |  |
|----------|---|--|--|--|--|
|          | <ol> <li>spore</li> <li>rhizoids</li> <li>stolons</li> <li>gametangia</li> <li>zygospore</li> <li>sporangiophore</li> <li>sporangium</li> </ol> | <ul> <li>a. spores are produced in these sructures</li> <li>b. a rootlike hypha found in fungi</li> <li>c. a haploid reproductive cell</li> <li>d. gamete-forming structures</li> <li>e. a resting spore that contains zygotes</li> <li>f. stemlike hyphae that are found on the surface</li> <li>g. specialized hyphae where sporangia are found</li> </ul> |  |  |  |
| 8.<br>9. | The bodies of multicellular thick mass called a(an)   | posed of thin filaments called  fungi are composed of many hyphae tangled together into a  |  |  |  |
| 10.      | A(An) the mycelium.   | body is a fungal reproductive structure growing from   |  |  |  |
| 11.      | The process of asexual repr   | oduction in yeasts is called   |  |  |  |
| 12.      | 2. The spore-bearing structure of a club fungus is called the   |  |  |  |  |
|          | 3. The phylum composed of fungi that have never been observed to have a sexual phase in their life cycles is the fungi.                         |  |  |  |  |
| 14.      | 4. Organisms that obtain food from decaying organic matter are called   |  |  |  |  |
| 15.      | A(An)photosynthetic organism.   | is a symbiotic association between a fungus and a  |  |  |  |