

Fungi

Reading Preview

Key Concepts

- What characteristics do fungi share?
- How do fungi reproduce?
- What roles do fungi play in nature?

Key Terms

- fungi • hyphae
- fruiting body • budding
- lichen

Target Reading Skill

Asking Questions Before you read, preview the red headings. In a graphic organizer like the one below, ask a *what* or *how* question for each heading. As you read, write answers to your questions.

Fungi	
Question	Answer
What are fungi?	Fungi are . . .

Lab zone

Discover Activity

Do All Molds Look Alike?

1. Your teacher will give you two sealed, clear plastic bags—one containing moldy bread and another containing moldy fruit.
CAUTION: *Do not open the sealed bags at any time.*
2. In your notebook, describe what you see.
3. Next, use a hand lens to examine each mold. Sketch each mold in your notebook and list its characteristics.
4. Return the sealed bags to your teacher. Wash your hands.

Think It Over

Observing How are the molds similar? How are they different?

A speck of dust lands on a cricket's back. But this is no ordinary dust—it is alive! Tiny glistening threads emerge from the dust and begin to grow into the cricket's moist body. As they grow, the threads release chemicals that slowly dissolve the cricket's tissues. Soon, the cricket's body is little more than a hollow shell filled with a tangle of the threads. Then the threads begin to grow up and out of the dead cricket, producing long stalks with knobs at their tips. When a knob breaks open, it will release thousands of dustlike specks, which the wind can carry to new victims.

What Are Fungi?

The strange cricket-killing organism is a member of the fungi kingdom. Although you may not have heard of a cricket-killing fungus before, you are probably familiar with other kinds of fungi. For example, the molds that grow on stale bread and the mushrooms that sprout in yards are all fungi.

Most **fungi** share several important characteristics. **Fungi are eukaryotes that have cell walls, are heterotrophs that feed by absorbing their food, and use spores to reproduce.** In addition, fungi need moist, warm places in which to grow. They thrive on moist foods, damp tree barks, lawns coated with dew, and even wet bathroom tiles.



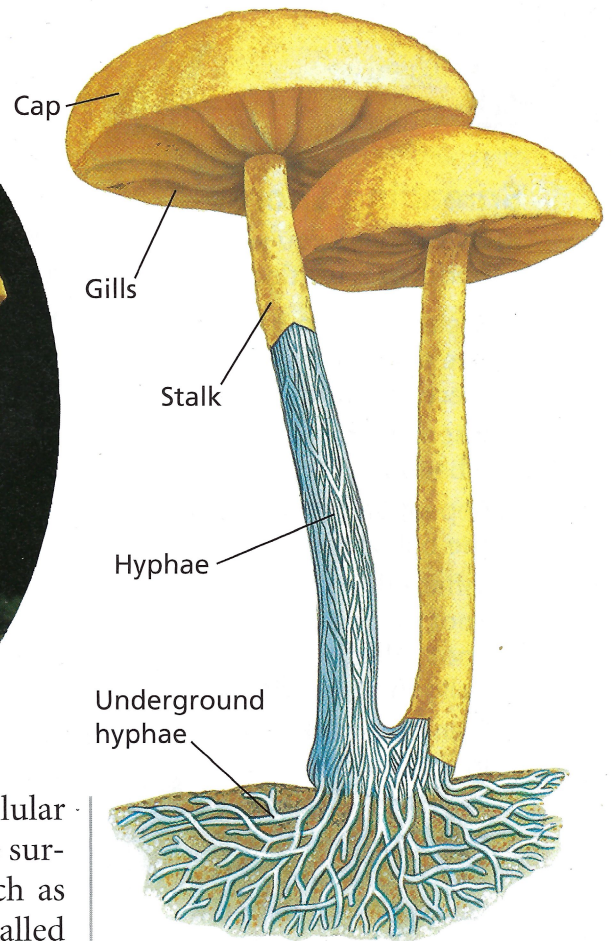
A killer fungus has attacked this bush cricket.

FIGURE 25

Structure of a Mushroom

The hyphae in the stalk and cap of a mushroom are packed tightly to form firm structures. Underground hyphae are arranged loosely.

Inferring What function might underground hyphae perform?



Cell Structure Fungi range in size from tiny unicellular yeasts to large multicellular fungi. The cells of all fungi are surrounded by cell walls. Except for the simplest fungi, such as yeast, the cells of most fungi are arranged in structures called hyphae. **Hyphae** (HY fee) (singular hypha) are the branching, threadlike tubes that make up the bodies of multicellular fungi. The hyphae of some fungi are continuous threads of cytoplasm that contain many nuclei. Substances move quickly and freely through the hyphae.

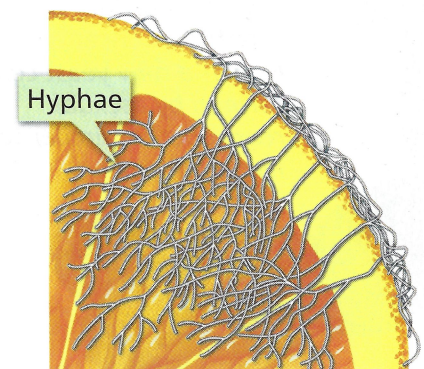
What a fungus looks like depends on how its hyphae are arranged. In some fungi, the threadlike hyphae are loosely tangled. Fuzzy-looking molds that grow on old foods have loosely tangled hyphae. Other fungi have tightly packed hyphae. The stalks and caps of mushrooms are made of hyphae packed so tightly that they appear solid. Underground, however, a mushroom's hyphae form a loose, threadlike maze in the soil.

Obtaining Food Fungi absorb food through hyphae that grow into a food source. First, the fungus grows hyphae into the food source. Then digestive chemicals ooze from the hyphae into the food. The chemicals break down the food into small substances that can be absorbed by the hyphae. As an analogy, imagine yourself sinking your fingers down into a chocolate cake and dripping digestive chemicals out of your fingertips. Then imagine your fingers absorbing the digested particles of the cake!

FIGURE 26

Mold Growing on Food Source

The mold *Penicillium* often grows on old fruits such as oranges. Some of its hyphae grow deep into the food source.




**Reading
Checkpoint**

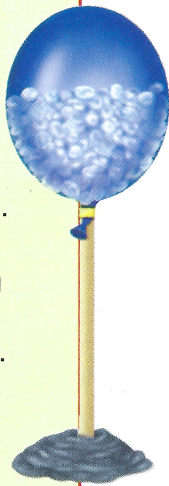
What do the bodies of multicellular fungi consist of?

Spreading Spores

In this activity, you will make a model of a fruiting body.

1. Break a cotton ball into five equal pieces. Roll each piece into a tiny ball.
2. Insert the cotton balls into a balloon.
3. Repeat Steps 1 and 2 until the balloon is almost full.
4. Inflate the balloon. Tie a knot in its neck. Tape the knotted end of the balloon to a stick.
5. Stand the stick upright in a mound of modeling clay.
6.  Pop the balloon with a pin. Observe what happens.

Making Models Draw a diagram of the model you made. Label the stalk, the spore case, and the spores. Use your model to explain why fungi are found just about everywhere.



Reproduction in Fungi

Like it or not, fungi are everywhere. The way they reproduce guarantees their survival and spread. **Fungi usually reproduce by making spores. The lightweight spores are surrounded by a protective covering and can be carried easily through air or water to new sites.** Fungi produce millions of spores, more than can ever survive. Only a few spores will fall where conditions are right for them to grow.

Fungi produce spores in reproductive structures called **fruiting bodies**. The appearances of fruiting bodies vary among different fungi. For some fungi, such as mushrooms, the part of the fungus that you see is the fruiting body. In other fungi, such as bread molds, the fruiting bodies are tiny, stalk-like hyphae that grow upward from the rest of the hyphae. A knoblike spore case at the tip of each stalk contains the spores.

Asexual Reproduction Most fungi reproduce both asexually and sexually. When there is adequate moisture and food, the fungi make spores asexually. Cells at the tips of their hyphae divide to form spores. The spores grow into fungi that are genetically identical to the parent.

Unicellular yeast cells undergo a form of asexual reproduction called **budding**. In budding, no spores are produced. Instead, a small yeast cell grows from the body of a parent cell in a way somewhat similar to the way a bud forms on a tree branch. The new cell then breaks away and lives on its own.

Sexual Reproduction Most fungi can also reproduce sexually, especially when growing conditions become unfavorable. In sexual reproduction, the hyphae of two fungi grow together and genetic material is exchanged. Eventually, a new reproductive structure grows from the joined hyphae and produces spores. The spores develop into fungi that differ genetically from either parent.

Classification of Fungi Figure 28 shows three major groups of fungi. The groups are named for the appearance of their reproductive structures. Additional groups include water species that produce spores with flagella and those that form tight associations with plant roots.

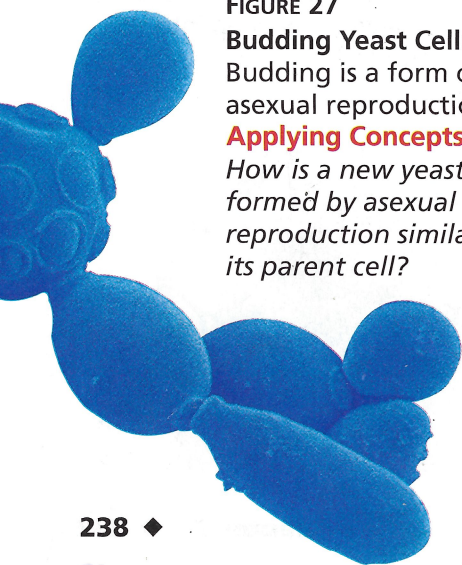
FIGURE 27

Budding Yeast Cells

Budding is a form of asexual reproduction.

Applying Concepts

How is a new yeast cell formed by asexual reproduction similar to its parent cell?



Reading
Checkpoint

What is budding?

The Role of Fungi in Nature

Fungi affect humans and other organisms in many ways. Many fungi provide foods for people. Fungi play important roles as decomposers and recyclers on Earth. Some fungi cause disease while others fight disease. Still other fungi live in symbiosis with other organisms.

Food and Fungi Yeasts, molds, and mushrooms are important food sources. Bakers add yeast to bread dough to make it rise. Yeast cells use the sugar in the dough for food and produce carbon dioxide gas as they feed. The gas forms bubbles, which cause the dough to rise. You see these bubbles as holes in a slice of bread. Molds are used to make foods such as some cheeses. The blue streaks in blue cheese, for example, are actually growths of *Penicillium roqueforti*. People enjoy eating mushrooms in salads and on pizza. You should never pick or eat wild mushrooms, however, because some mushrooms are extremely poisonous.



Protists and Fungi

Video Preview

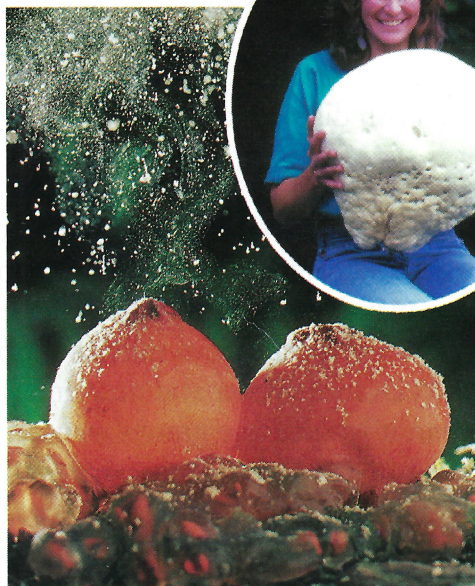
▶ Video Field Trip

Video Assessment

FIGURE 28

Classification of Fungi

Three major groups of fungi include sac fungi, club fungi, and zygote fungi.



▲ Club Fungi

Club fungi produce spores in tiny clublike structures. This group includes mushrooms, rusts, and puffballs, such as these.

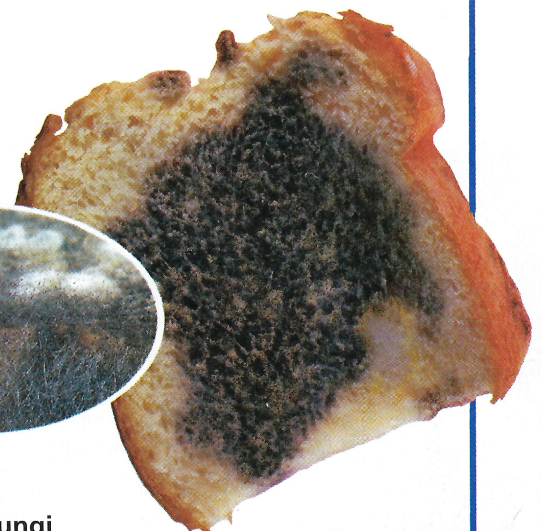
▶ Sac Fungi

Sac fungi produce spores in structures that look like long sacs, such as these. The largest group of fungi, they include yeasts, morels, and truffles.



▲ Zygote Fungi

Zygote fungi produce very resistant spores. This group includes many common fruit and bread molds, like this *Rhizopus*.



Environmental Recycling Like bacteria, many fungi are decomposers. For example, many fungi live in the soil and break down the chemicals in dead plant matter. This process returns important nutrients to the soil. Without fungi and bacteria, Earth would be buried under dead plants and animals!

Disease-Fighting Fungi In 1928, a Scottish biologist named Alexander Fleming was examining petri dishes in which he was growing bacteria. To his surprise, Fleming noticed a spot of a bluish-green mold growing in one dish. Curiously, no bacteria were growing near the mold. Fleming hypothesized that the mold, a fungus named *Penicillium*, produced a substance that killed the bacteria near it.

Fleming's work contributed to the development of the first antibiotic, penicillin. Since the discovery of penicillin, many antibiotics have been isolated from both fungi and bacteria.

Disease-Causing Fungi Many fungi are parasites that cause serious diseases in plants. The sac fungus that causes Dutch elm disease is responsible for killing millions of elm trees in North America and Europe. Corn smut and wheat rust are two club fungi that cause diseases in important food crops. Fungal plant diseases also affect other crops, including rice, cotton, and soybeans, resulting in huge crop losses every year.

Some fungi cause diseases in humans. Athlete's foot fungus causes an itchy irritation in the damp places between toes. Ringworm, another fungal disease, causes an itchy, circular rash on the skin. Because the fungi that cause these diseases produce spores at the site of infection, the diseases can spread easily from person to person. Both diseases can be treated with antifungal medications.

Fungus-Plant Root Associations Some fungi help plants grow larger and healthier when their hyphae grow into, or on, the plant's roots. The hyphae spread out underground and absorb water and nutrients from the soil for the plant. With more water and nutrients, the plant grows larger than it would have grown without its fungal partner. The plant is not the only partner that benefits. The fungi get to feed on the extra food that the plant makes and stores.

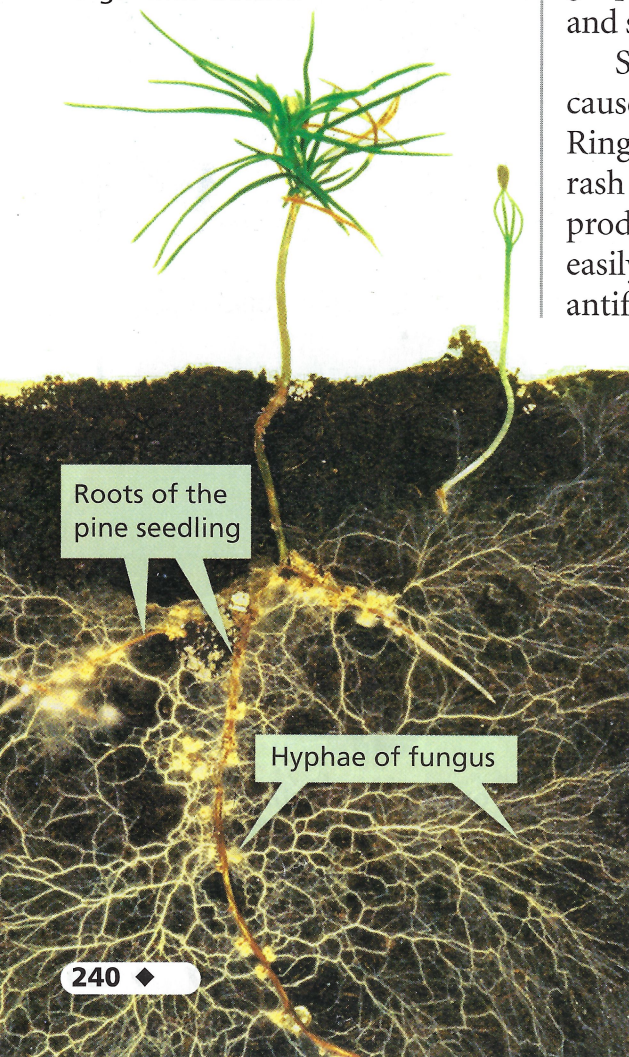
Most plants have fungal partners. Many plants are so dependent on the fungi that they cannot survive without them. For example, orchid seeds cannot develop without their fungal partners.

FIGURE 29

Fungus-Plant Root Associations

An extensive system of fungal hyphae has grown in association with the roots of the pine seedling in the middle.

Classifying What type of symbiosis do these two organisms exhibit?



Roots of the pine seedling

Hyphae of fungus

FIGURE 30

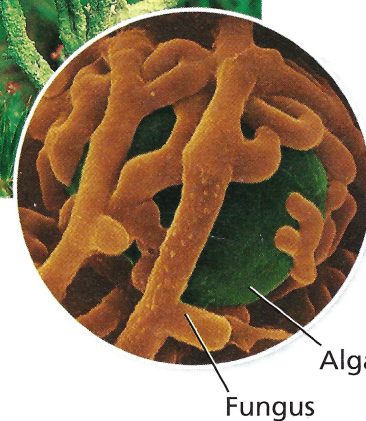
Lichens

The British soldier lichen consists of a fungus and an alga. The inset shows how entwined the alga is among the fungus's hyphae.

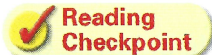


Lichens A **lichen** (LY kun) consists of a fungus and either algae or autotrophic bacteria that live together in a mutualistic relationship. You have probably seen some familiar lichens—irregular, flat, crusty patches that grow on tree barks or rocks. The fungus benefits from the food produced by the algae or bacteria. The algae or bacteria, in turn, obtain shelter, water, and minerals from the fungus.

Lichens are often called “pioneer” organisms because they are the first organisms to appear on the bare rocks in an area after a volcanic eruption, fire, or rock slide has occurred. Over time, the lichens break down the rock into soil in which other organisms can grow. Lichens are also useful as indicators of air pollution. Many species of lichens are very sensitive to pollutants and die when pollution levels rise. By monitoring the growth of lichens, scientists can assess the air quality in an area.



For: Links on fungi
Visit: www.SciLinks.org
Web Code: scn-0133



Reading
Checkpoint

What two organisms make up a lichen?

Section 4 Assessment

Target Reading Skill Asking Questions Use the answers to the questions you wrote about the headings to help you answer the questions below.

Reviewing Key Concepts

- a. Listing** List three characteristics that a bread mold shares with a mushroom.

b. Comparing and Contrasting How are the cells of a bread mold arranged? How are the cells of a mushroom arranged?

c. Summarizing How does the cell structure of a fungus help it obtain food?
- a. Reviewing** What role do spores play in the reproduction of fungi?

b. Sequencing Outline the steps by which fungi produce spores by sexual reproduction.

c. Inferring Why is it advantageous to a fungus to produce millions of spores?

- a. Identifying** Name six roles that fungi play in nature.

b. Predicting Suppose all the fungi in a forest disappeared. What do you think the forest would be like without fungi?

Writing in Science

Wanted Poster Design a “Wanted” poster for a mold that has been ruining food in your kitchen. Present the mold as a “criminal of the kitchen.” Include detailed descriptions of the mold’s physical characteristics, what it needs to grow, how it grows, and any other details that will help your family identify this mold. Propose ways to prevent new molds from growing in your kitchen.

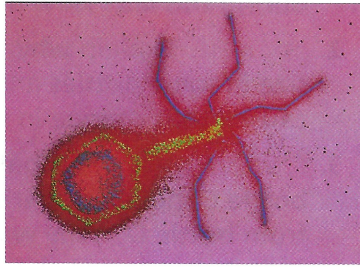
1 Viruses

Key Concepts

- The only way in which viruses are like organisms is that they can multiply.
- All viruses have two basic parts: an outer coat that protects the virus and an inner core made of genetic material.
- Once inside a cell, a virus's genetic material takes over many of the cell's functions. The genetic material instructs the cell to produce the virus's proteins and genetic material. These proteins and genetic material then assemble into new viruses.
- Resting, drinking plenty of fluids, and eating well-balanced meals may be all you can do while you recover from a viral disease.

Key Terms

virus
host
parasite
bacteriophage



2 Bacteria

Key Concepts

- Bacteria are prokaryotes. The genetic material in their cells is not contained in a nucleus.
- Bacteria must have a source of food and a way of breaking down the food to release its energy.
- When bacteria have plenty of food, the right temperature, and other suitable conditions, they thrive and reproduce frequently.
- Bacteria are involved in oxygen and food production, environmental recycling and cleanup, and in health maintenance and medicine production.

Key Terms

bacteria
flagellum
binary fission
asexual reproduction
sexual reproduction

conjugation
endospore
pasteurization
decomposer

3 Protists

Key Concepts

- Like animals, animal-like protists are heterotrophs, and most are able to move from place to place to obtain food.
- Like plants, algae are autotrophs.
- Like fungi, funguslike protists are heterotrophs, have cell walls, and use spores to reproduce.

Key Terms

protist
protozoan
pseudopod
contractile vacuole
cilia

symbiosis
mutualism
algae
spore

4 Fungi

Key Concepts

- Fungi are eukaryotes that have cell walls, are heterotrophs that feed by absorbing their food, and use spores to reproduce.
- Fungi usually reproduce by making spores. The lightweight spores are surrounded by a protective covering and can be carried easily through air or water to new sites.
- Many fungi provide foods for people. Fungi play important roles as decomposers and recyclers on Earth. Some fungi cause disease while others fight disease. Still other fungi live in symbiosis with other organisms.

Key Terms

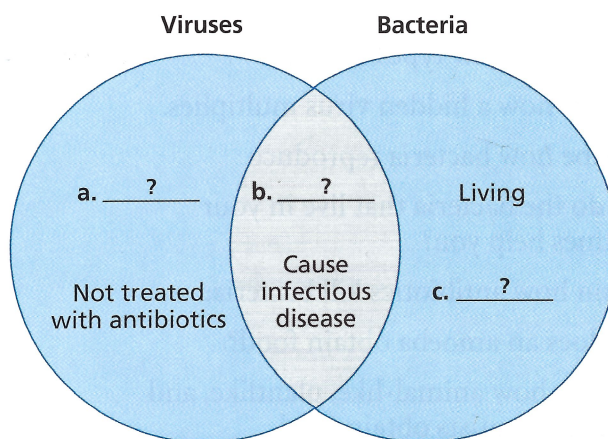
fungi
hyphae
fruiting body

budding
lichen



Organizing Information

Comparing and Contrasting Copy the Venn diagram comparing viruses and bacteria onto a separate sheet of paper. Then complete it and add a title. (For more information on Comparing and Contrasting, see the Skills Handbook.)



Reviewing Key Terms

Choose the letter of the best answer.

- Bacteriophages are viruses that attack and destroy
 - other viruses.
 - bacteria.
 - plants.
 - humans.
- Which part of a virus determines which host cells it can infect?
 - nucleus
 - ribosomes
 - flagellum
 - surface proteins
- Most bacteria are surrounded by a rigid protective structure called the
 - cell wall.
 - cell membrane.
 - protein coat.
 - flagellum.
- Which of the following characteristics describes all protists?
 - They are unicellular.
 - They can be seen with the unaided eye.
 - Their cells have nuclei.
 - They are unable to move on their own.
- A lichen is a symbiotic association between
 - fungi and plant roots.
 - algae and fungi.
 - algae and bacteria.
 - protozoans and algae.

If the statement is true, write *true*. If it is false, change the underlined word or words to make the statement true.

- Active viruses enter a cell and immediately begin to multiply.
- During conjugation, one bacterium transfers genetic material to another bacterial cell.
- Plantlike protists are called protozoans.
- Bacteria form endospores to survive unfavorable conditions in their surroundings.
- Most fungi are made up of threadlike structures called spores.

Writing in Science

Informational Pamphlet Create a pamphlet to teach young children about fungi. Explain where fungi live, how they feed, and the roles they play. Include illustrations as well.

Discovery
CHANNEL
SCHOOL™

Protists and Fungi

Video Preview
Video Field Trip

▶ Video Assessment

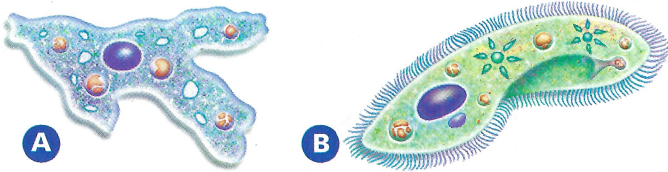
Review and Assessment

Checking Concepts

11. Explain why a certain virus will attach to only one type or a few types of cells.
12. Describe how a hidden virus multiplies.
13. Describe how bacteria reproduce.
14. How do the bacteria that live in your intestines help you?
15. Explain how antibiotics kill bacteria.
16. How does an amoeba obtain food?
17. Compare how animal-like, plantlike, and funguslike protists obtain food.
18. How does sexual reproduction occur in fungi?

Thinking Critically

19. **Comparing and Contrasting** Describe the similarities and differences between active and hidden viruses.
20. **Problem Solving** Bacteria will grow in the laboratory on a gelatin-like substance called agar. Viruses will not grow on agar. If you needed to grow viruses in the laboratory, what kind of substance would you have to use? Explain your reasoning.
21. **Comparing and Contrasting** Identify the organisms below. Describe the method by which each obtains food.



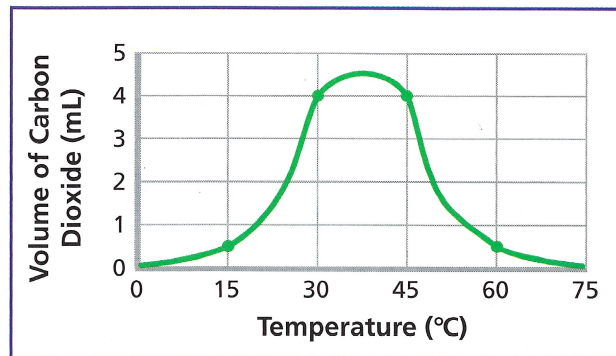
22. **Predicting** If all algae suddenly disappeared from Earth's waters, what would happen to living things on Earth? Explain your answer.
23. **Making Judgments** You see an advertisement for a new, powerful fungicide guaranteed to kill most fungi on contact. What should people take into consideration before choosing to buy this fungicide?

Applying Skills

Use the graph to answer Questions 24–27.

When yeast is added to bread dough, the yeast cells produce carbon dioxide, which causes the dough to rise. The graph below shows how temperature affects the amount of carbon dioxide that is produced.

Temperature and Carbon Dioxide Production



24. **Interpreting Data** Based on the graph, at what temperature does yeast produce the most carbon dioxide?
25. **Inferring** Use the graph to explain why yeast is dissolved in warm water, rather than in cold water, when it is used to make bread.
26. **Predicting** Based on the graph, would you expect bread dough to rise if it were placed in a refrigerator (which is kept at about 2°C to 5°C)? Explain.
27. **Drawing Conclusions** Explain how temperature affects the amount of carbon dioxide that the yeast cells produce.

Lab
zone

Chapter Project

Performance Assessment Create a poster that summarizes your experiment for the class. In your poster, include your hypothesis and describe the conditions that produced the best mushroom growth. Use diagrams and graphs to display your results. Did the project raise any new questions about mushrooms for you? If so, how could you answer those questions?