

## Kinds of Protists

Would you believe that there is an organism that lives in the forest and looks like a pile of scrambled eggs? This organism exists, and it's a protist.

Slimy masses of protists can look like spilled food. Smears of protists on the walls of a fish tank may look like dirt. Few of the many kinds of protists look alike.

These unique organisms are hard to classify. Scientists are always learning more about protist relationships. So, organizing protists into groups is not easy. One way that protists are grouped is based on shared traits. Using this method, scientists can place protists into three groups: producers, heterotrophs that can move, and heterotrophs that can't move. These groups do not show how protists are related to each other. But these groups do help us understand how protists can differ.

### What You Will Learn

- Describe how protists can be organized into three groups based on their shared traits.
- List an example for each group of protists.

### Vocabulary

algae  
phytoplankton

### READING STRATEGY

**Reading Organizer** As you read this section, make a table comparing protist producers, heterotrophs that can move, and heterotrophs that cannot move.

**algae** eukaryotic organisms that convert the sun's energy into food through photosynthesis but that do not have roots, stems, or leaves (singular, *alga*)

**phytoplankton** the microscopic, photosynthetic organisms that float near the surface of marine or fresh water

### Protist Producers

Many protists are producers. Like plants, protist producers use the sun's energy to make food through photosynthesis. These protist producers are known as **algae** (AL JEE). All algae (singular, *alga*) have the green pigment chlorophyll, which is used for making food. But most algae also have other pigments that give them a color. Almost all algae live in water.

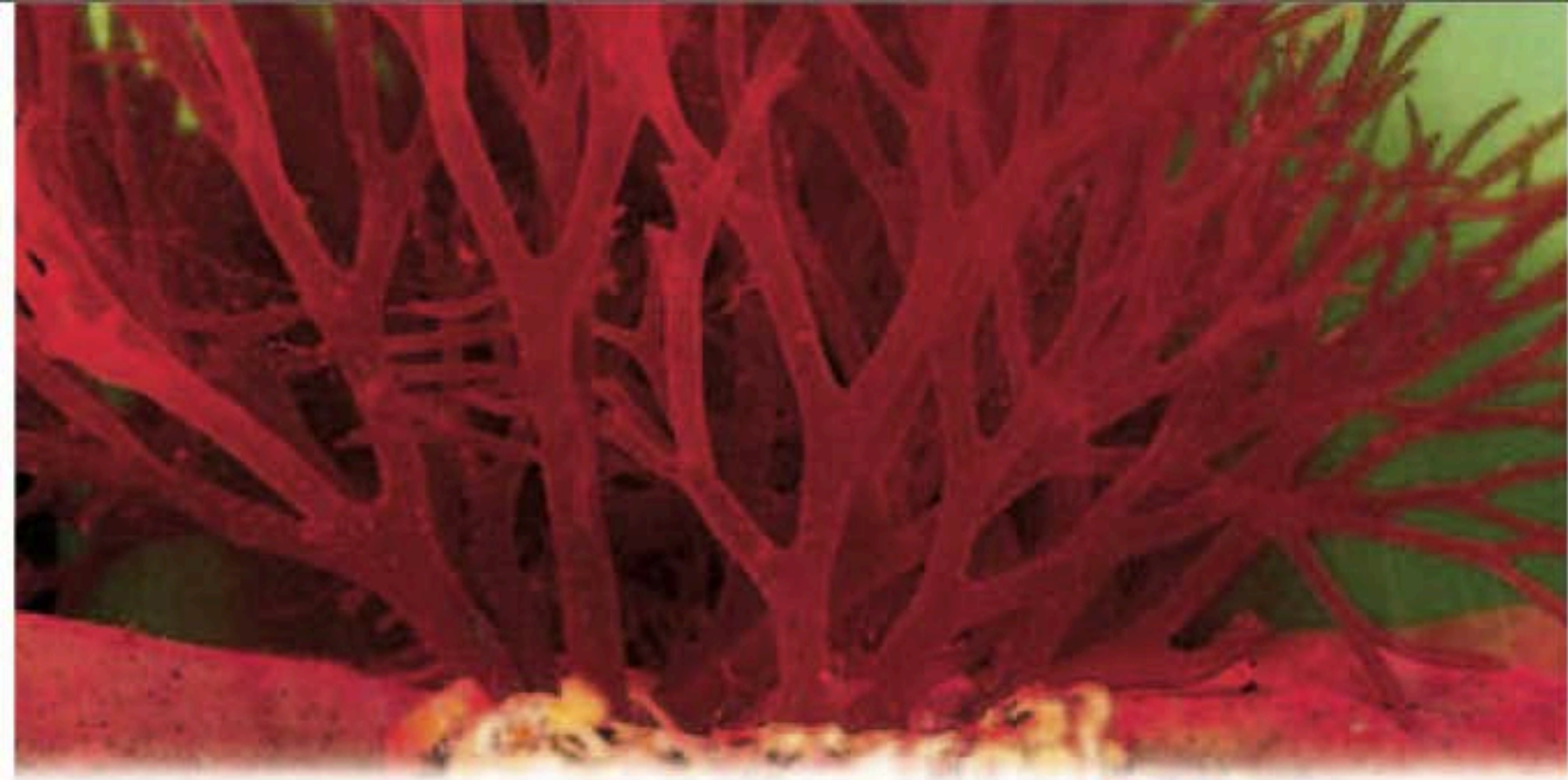
Some algae are made of many cells, as shown in **Figure 1**. Many-celled algae generally live in shallow water along the shore. You may know these algae as *seaweeds*. Some of these algae can grow to many meters in length.

Free-floating single-celled algae are called **phytoplankton** (FIET oh PLANGK tuhn). These algae cannot be seen without a microscope. They usually float near the water's surface. Phytoplankton provide food for most other organisms in the water. They also produce much of the world's oxygen.



**Figure 1** Some kinds of algae, such as this giant kelp, can grow to be many meters in length.





**Figure 2** This *Sebdenia* (seb DEE nee uh) is a red alga.

## Red Algae

Most of the world's seaweeds are red algae. Most red algae live in tropical oceans, attached to rocks or to other algae. Red algae are usually less than 1 m in length. Their cells contain chlorophyll, but a red pigment gives them their color. Their red pigment allows them to absorb the light that filters deep into the clear water of the Tropics. Red algae can grow as deep as 260 m below the surface of the water. An example of a red alga can be seen in **Figure 2**.

**✓ Reading Check** If red algae have chlorophyll in their cells, why aren't they green? (See the Appendix for answers to Reading Checks.)

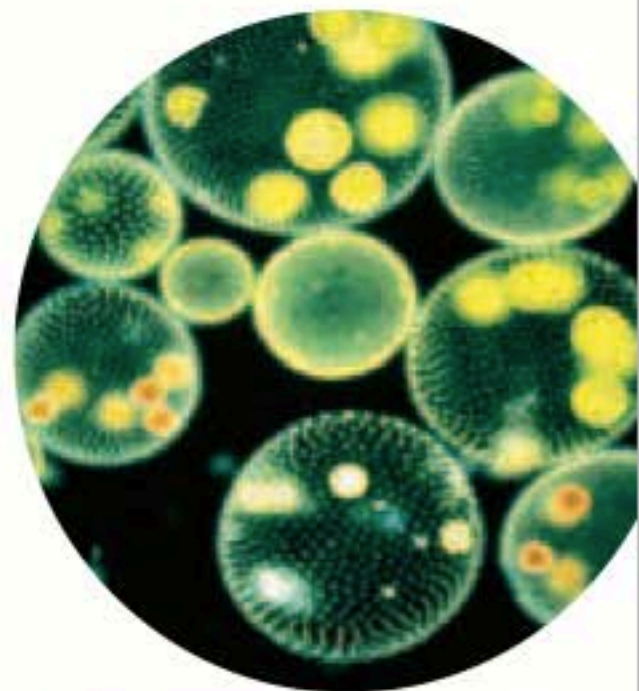
## Green Algae

The green algae are the most diverse group of protist producers. They are green because chlorophyll is the main pigment in their cells. Most live in water or moist soil. But others live in melting snow, on tree trunks, and inside other organisms.

Many green algae are single-celled organisms. Others are made of many cells. These many-celled species may grow to be 8 m long. Individual cells of some species of green algae live in groups called *colonies*. **Figure 3** shows colonies of *Volvox*.

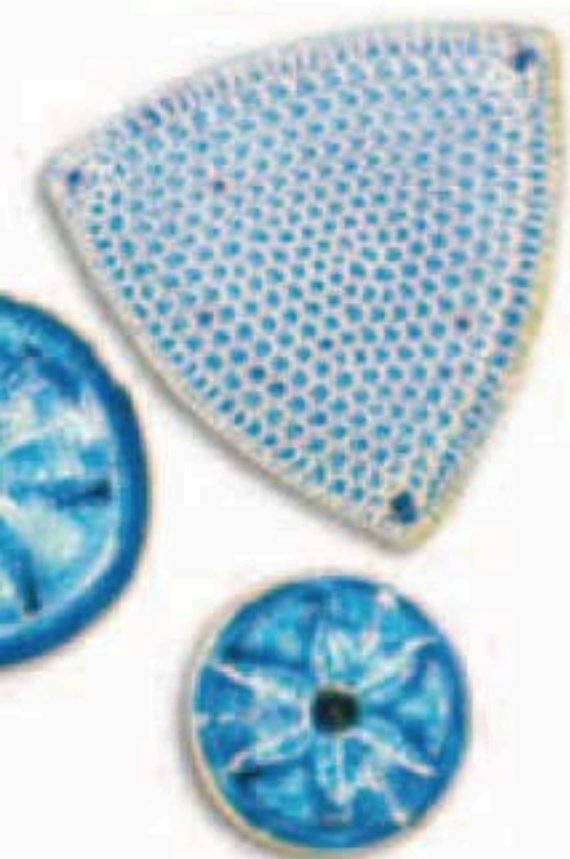
## Brown Algae

Most of the seaweeds found in cool climates are brown algae. They attach to rocks or form large floating beds in ocean waters. Brown algae have chlorophyll and a yellow-brown pigment. Many are very large. Some grow 60 m—as long as about 20 cars—in just one season! Only the tops of these gigantic algae are exposed to sunlight. These parts of the algae make food through photosynthesis. This food is transported to parts of the algae that are too deep in the water to receive sunlight.



**Figure 3** *Volvox* is a green alga that grows in round colonies.





**Figure 4** Although most diatoms are free floating, some cling to plants, shellfish, sea turtles, and whales.

## Diatoms

Diatoms (DIE e TAHMZ) are single celled. They are found in both salt water and fresh water. Diatoms get their energy from photosynthesis. They make up a large percentage of phytoplankton. **Figure 4** shows some diatoms' many unusual shapes. The cell walls of diatoms contain a glasslike substance called *silica*. The cells of diatoms are enclosed in a two-part shell.

## Dinoflagellates

Most dinoflagellates (DIE noh FLAJ uh lits) are single celled. Most live in salt water, but a few species live in fresh water. Some dinoflagellates even live in snow. Dinoflagellates have two whiplike strands called *flagella* (singular, *flagellum*). The beating of these flagella causes the cells to spin through the water. Most dinoflagellates get their energy from photosynthesis, but a few are consumers, decomposers, or parasites.

**✓ Reading Check** Name three places where dinoflagellates live.

## Euglenoids

Euglenoids (yoo GLEE NOYDZ) are single-celled protists. Most euglenoids live in fresh water. They use their flagella to move through the water. Many euglenoids are producers and so make their own food. But when there is not enough light to make food, these euglenoids can get food as heterotrophs. Other euglenoids do not contain chlorophyll and cannot make food. These euglenoids are full-time consumers or decomposers. Because euglenoids can get food in several ways, they do not fit well into any one protist group. **Figure 5** shows the structure of a euglenoid.

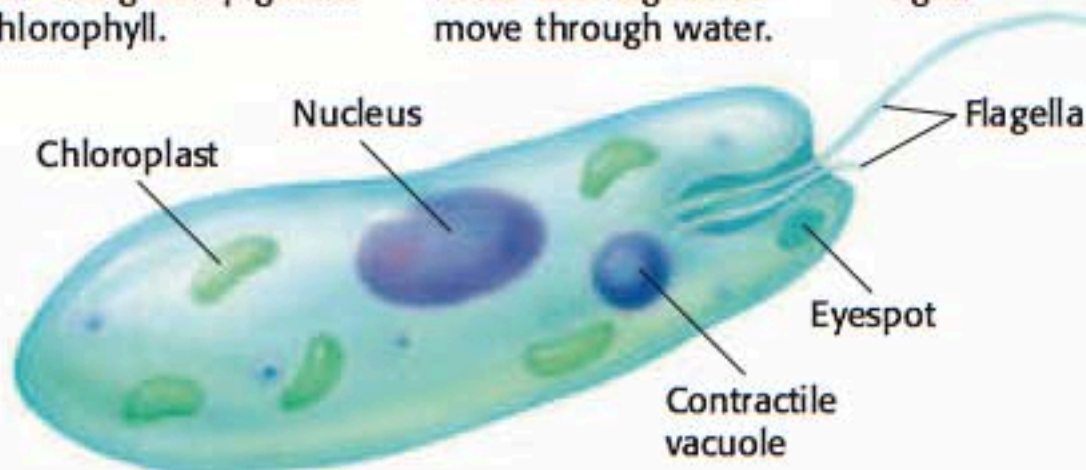
### Figure 5 The Structure of Euglenoids

Photosynthesis takes place in **chloroplasts**. These structures contain the green pigment chlorophyll.

Most euglenoids have two **flagella**, one long and one short. Euglenoids use flagella to move through water.

Euglenoids can't see, but they have **eyespot**s that sense light.

A special structure called a **contractile vacuole** holds excess water and removes it from the cell.





## Figure 6 Amoebic Movement

1 An amoeba extends a new pseudopod from part of its cell.

2 The rest of the cell flows into the new pseudopod.

3 Other pseudopodia retract.



## Heterotrophs That Can Move

Some heterotrophic protists have special traits that allow them to move. Other heterotrophic protists cannot move on their own. Those that can move are usually single-celled consumers or parasites. These mobile protists are sometimes called *protozoans* (PROHT oh ZOH uhnz).

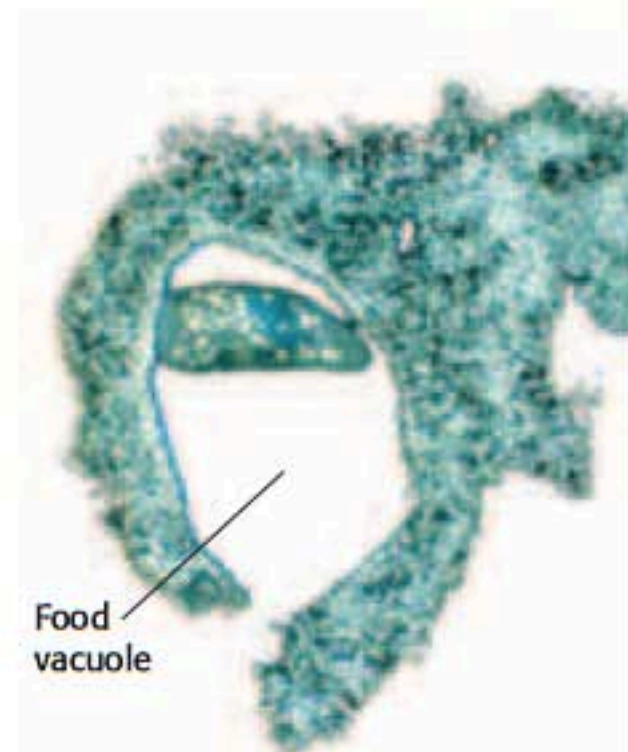
### Amoebas

Amoebas (uh MEE buhs) and similar amoeba-like protists are soft, jellylike protozoans. They are found in both fresh and salt water, in soil, and as parasites in animals. Although amoebas look shapeless, they are highly structured cells. Amoebas have contractile vacuoles to get rid of excess water. Many amoebas eat bacteria and small protists. But some amoebas are parasites that get food by invading other organisms. Certain parasitic amoebas live in human intestines and cause amoebic dysentery (uh MEE bik DIS uhN TER ee). This painful disease causes internal bleeding.

### Amoebic Movement

Amoebas and amoeba-like protists move with pseudopodia (soo doh POH dee uh). *Pseudopodia* means "false feet." To move, an amoeba stretches a pseudopod out from the cell. The cell then flows into the pseudopod. **Figure 6** shows how an amoeba uses pseudopodia to move.

Amoebas and amoeba-like protists use pseudopodia to catch food, too. When an amoeba senses a food source, it moves toward the food. The amoeba surrounds the food with its pseudopodia. This action forms a *food vacuole*. Enzymes move into the vacuole to digest the food, and the digested food passes into the amoeba. **Figure 7** shows an amoeba catching food. To get rid of wastes, an amoeba reverses the process. A waste-filled vacuole is moved to the edge of the cell and is released.



**Figure 7** An amoeba engulfs its prey with its pseudopodia.





**Figure 8** Radiolarians are amoeba-like protists that have shells.

## Shelled Amoeba-Like Protists

Not all amoeba-like protists look shapeless. Some have an outer shell. *Radiolarian* (RAY dee oh LER ee uhn) shells look like glass ornaments, as shown in **Figure 8**. *Foraminiferans* (fuh RAM uh NIF uhr uhnz) have snail-like shells. These protists move by poking pseudopodia out of pores in the shells.

**✓ Reading Check** Name two shelled, amoeba-like protists.

## Zooflagellates

Zooflagellates (ZOH uh FLAJ uh LAYTS) are protists that wave flagella back and forth to move. Some zooflagellates live in water. Others live in the bodies of other organisms.

Some zooflagellates are parasites that cause disease. The parasite *Giardia lamblia* (jee AWR dee uh LAM blee uh) can live in the digestive tract of many vertebrates. One form of *G. lamblia* lives part of its life in water. People who drink water infected with *G. lamblia* can get severe stomach cramps.

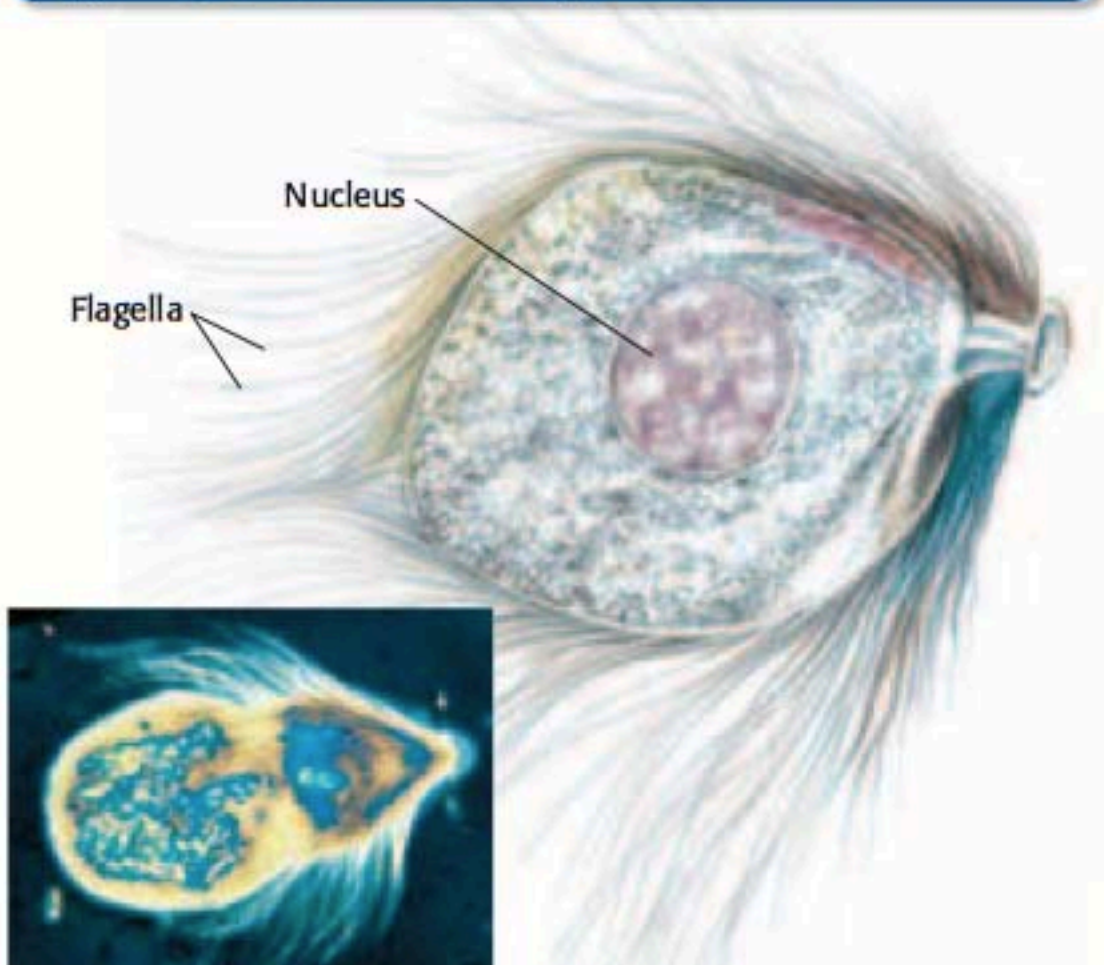
Some zooflagellates live in mutualism with other organisms. In *mutualism*, one organism lives closely with another organism. Each organism helps the other live. The zooflagellate in **Figure 9** lives in the gut of termites. This zooflagellate digests the cell walls of the wood that the termites eat. Both organisms benefit from the arrangement. The protist helps the termite digest wood. The termite gives the protist food and a place to live.

### CONNECTION TO Geology

**Shell Deposits** Foraminif-erans have existed for more than 600 million years. During this time, shells of dead foraminiferans have been sinking to the bottom of the ocean. Millions of years ago, foraminiferan shells formed a thick layer of sediment of limestone and chalk deposits. The chalk deposits in England that are known as the White Cliffs of Dover formed in this way. Use geology books to find examples of sedimentary rocks formed from protist shells. Make a poster that explains the process by which shells become sedimentary rock.

**ACTiViTy**

**Figure 9** The Structure of Flagellates





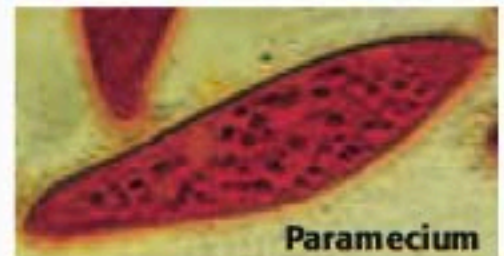
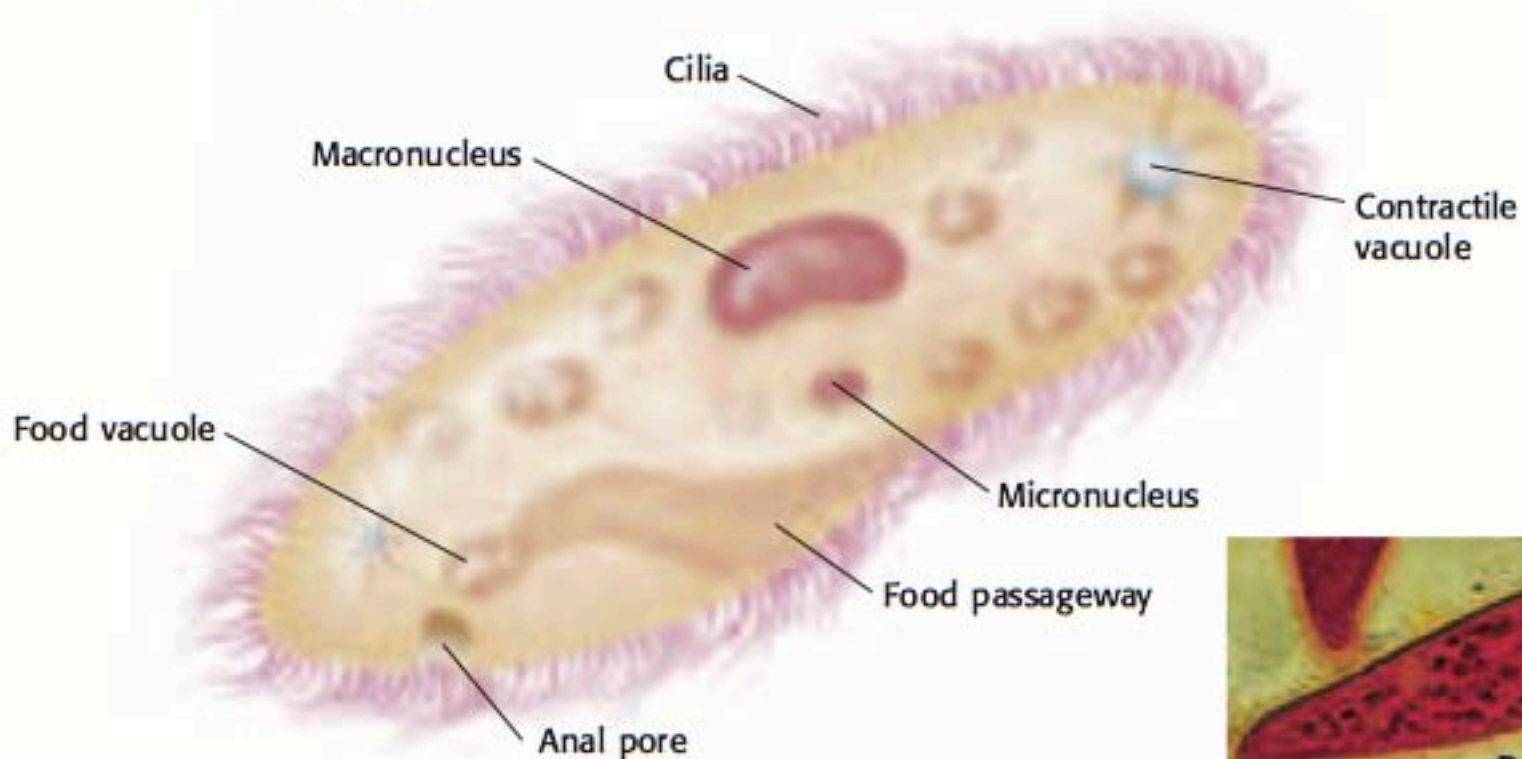
## Figure 10 The Structure of a Paramecium

Members of the genus *Paramecium* eat by using cilia to sweep food into a **food passageway**.

Food enters a **food vacuole**, where enzymes digest the food.

Food waste is removed from the cell through the **anal pore**.

A **contractile vacuole** pumps out excess water.



## Ciliates

Ciliates (SIL ee its) are complex protists. They have hundreds of tiny, hairlike structures known as *cilia*. The cilia move a protist forward by beating back and forth. Cilia can beat up to 60 times a second! Ciliates also use their cilia for feeding. The cilia sweep food toward the protist's food passageway. The best-known genus of ciliates is *Paramecium*, shown in **Figure 10**.

The cell of a paramecium has two kinds of nuclei. A large nucleus called a *macronucleus* controls the functions of the cell. A smaller nucleus, the *micronucleus*, passes genes to another paramecium during sexual reproduction.

## Heterotrophs That Can't Move

Not all protist heterotrophs have features that help them move. Some of these protists are parasites that do not move about. Others can move only at certain phases in their life cycle.

## Spore-Forming Protists

Many spore-forming protists are parasites. They absorb nutrients from their hosts. They have no cilia or flagella, and they cannot move on their own. Spore-forming protists have complicated life cycles that usually include two or more hosts. For example, the spore-forming protist that causes malaria uses both mosquitoes and humans as hosts.

## CONNECTION TO Social Studies

**Malaria** *Plasmodium vivax* is a spore-forming protist that causes malaria. People get malaria in tropical areas when they are bitten by mosquitoes carrying *P. vivax*. Malaria can be treated with drugs, but many people do not have access to these drugs. Millions of people die from malaria each year. Research malaria rates in different parts of the world, and give a presentation of your findings to the class.

**ACTIVITY**



**Figure 11** Parasitic water molds attack various organisms, including fish.




## INTERNET ACTIVITY

For another activity related to this chapter, go to [go.hrw.com](http://go.hrw.com) and type in the keyword **HL5PROW**.

### Water Molds

Water molds are also heterotrophic protists that can't move. Most water molds are small, single-celled organisms. Water molds live in water, moist soil, or other organisms. Some of them are decomposers and thus eat dead matter. But many are parasites. Their hosts can be living plants, animals, algae, or fungi. A parasitic water mold is shown in **Figure 11**.

 **Reading Check** Name two ways that water molds get food.

### Slime Molds

Slime molds are heterotrophic protists that can move only at certain phases of their life cycle. They look like thin, colorful, shapeless globs of slime. Slime molds live in cool, moist places in the woods. They use pseudopodia to move and to eat bacteria and yeast. They also decompose small bits of rotting organic matter by surrounding small pieces of the matter and then digesting them.

Some slime molds live as a giant cell that has many nuclei and a single cytoplasm at one stage of life. As long as food and water are available, the cell will continue to grow. One cell may be more than 1 m across! Other slime molds live as single-celled individuals that can come together as a group when food or water is hard to find.

When environmental conditions are stressful, slime molds grow stalklike structures with rounded knobs at the top, as shown in **Figure 12**. The knobs contain spores. *Spores* are small reproductive cells covered by a thick cell wall. The spores can survive for a long time without water or nutrients. As spores, slime molds cannot move. When conditions improve, the spores will develop into new slime molds.

**Figure 12** The spore-containing knobs of a slime mold are called sporangia (spoh RAN jee uh).





## SECTION Review

### Summary

- Protists can be organized into the following groups: producers, heterotrophs that can move, and heterotrophs that cannot move.
- Protist producers make their own food through photosynthesis. They are known as *algae*, and most live in water. Free-floating single-celled algae are phytoplankton.
- Red algae, green algae, brown algae, diatoms, dinoflagellates, and some euglenoids are producers.
- Heterotrophic protists cannot make their own food. They are consumers, decomposers, or parasites. Those that can move are sometimes called *protozoans*.
- Amoeba-like protists, shelled amoeba-like protists, flagellates, and ciliates are heterotrophs that can move.
- Spore-forming protists, water molds, and slime molds are protists that cannot move or can move only in certain phases of their life cycle.

### Using Key Terms

1. Use the following terms in the same sentence: *phytoplankton* and *algae*.

### Understanding Key Ideas

2. Which of the following kinds of protists are producers?
  - a. diatoms
  - b. amoebas
  - c. slime molds
  - d. ciliates
3. How do many amoeba-like protists eat?
  - a. They secrete digestive juices onto food.
  - b. They produce food from sunlight.
  - c. They engulf food with pseudopodia.
  - d. They use cilia to sweep food toward them.
4. Give an example of one protist from each of the three groups of protists.
5. Explain why it makes sense to group protists based on shared traits rather than by how they are related to each other.

### Critical Thinking

6. **Making Comparisons** How do protist producers, heterotrophs that can move, and heterotrophs that can't move differ?

7. **Making Inferences** You learned how shelled amoeba-like protists move. How do you think they get food into their shells in order to eat?

### Interpreting Graphics

Use the photo below to answer the questions that follow.



8. How does this protist move?
9. Identify what kind of protist is shown. To do so, first make a list of the kinds of protists that this organism could not be.

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