

Sarcodines

Word Origins

The word *pseudonym* means “false name.” L2

Use Visuals

Figure 20-4 Ask students: Which animal-like protist phylum includes *Amoeba proteus*? (Sarcodina) Why do you think an amoeba is often described as “shape-shifting”? (It has no permanent shape. It changes its shape as it pushes out projections called pseudopods.) What is the function of the food vacuole? (It temporarily stores and digests food.)

L1 L2

Build Science Skills

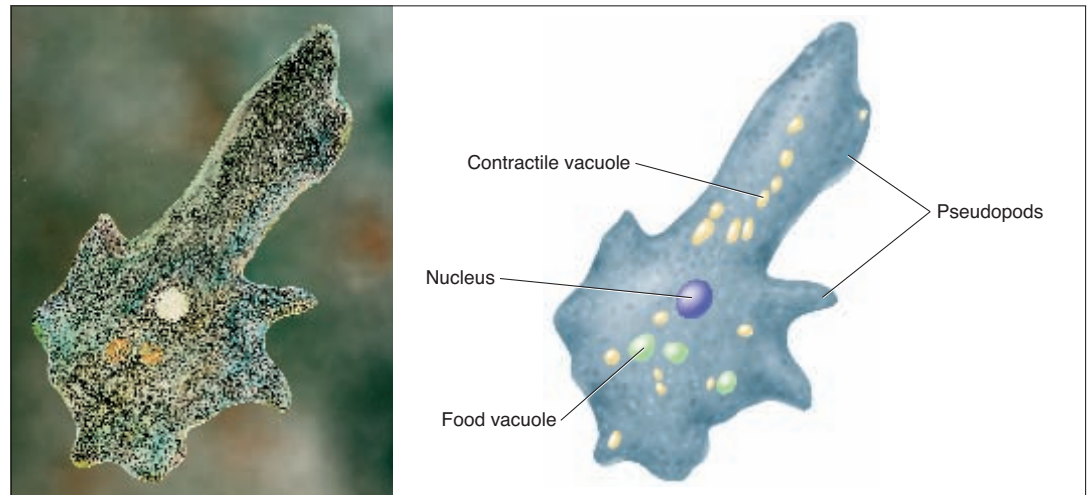
Observing Have each student gather a handful of grass from a field near the school. The grass should then be dried on a flat tray for at least one day. After the grass is dried, have students place the grass in a clean glass jar, add bottled water until the jar is about three-quarters full, and seal it tightly with a lid. After three days, students should open the jar in a well-ventilated area and gently stir the contents. Have students then use a dropper pipette to make slides from the water in the jar and observe the slides under a microscope. Typically, students will observe several different types of protists, such as paramecia and amoebas. Ask students to make drawings and try to identify the organisms they see. L2 L3

Word Origins

Pseudopod comes from the Greek words *pseudes*, meaning “false,” and *-pous*, meaning “foot.” So *pseudopod* means “false foot.” The suffix *-onym* comes from the Greek word *onoma*, meaning “name.” What do you think the word *pseudonym* means?

▼ **Figure 20-4** Sarcodines use pseudopods for feeding and movement. The amoeba, a common sarcodine, moves by first extending a pseudopod away from its body. The organism’s cytoplasm then streams into the pseudopod. Amoebas also use pseudopods to surround and ingest prey.

Amoeba proteus (magnification: 330×)



Sarcodines

Members of the phylum Sarcodina, or sarcodines, move via temporary cytoplasmic projections known as **pseudopods** (SOO-doh-pahdz). Sarcodines are animal-like protists that use pseudopods for feeding and movement. The best-known sarcodines are the amoebas, shown in **Figure 20-4**. Amoebas are flexible, active cells with thick pseudopods that extend out of the central mass of the cell. The cytoplasm of the cell streams into the pseudopod, and the rest of the cell follows. This type of locomotion is known as **amoeboid movement**.

Amoebas can capture and digest particles of food and even other cells. They do this by surrounding their meal, then taking it inside themselves to form a food vacuole. A **food vacuole** is a small cavity in the cytoplasm that temporarily stores food. Once inside the cell, the material is digested rapidly and the nutrients are passed along to the rest of the cell. Undigestible waste material remains inside the vacuole until its contents are eliminated by releasing them outside the cell. Amoebas reproduce by mitosis and cytokinesis.

Foraminiferans, another member of Sarcodina, are abundant in the warmer regions of the oceans. Foraminiferans secrete shells of calcium carbonate (CaCO_3). As they die, the calcium carbonate from their shells accumulates on the bottom of the ocean. In some regions, thick deposits of foraminiferan shells have formed on the ocean floor. The white chalk cliffs of Dover, England, are huge deposits of foraminiferan skeletons that were raised above sea level by geological processes.

Heliozoans comprise another group of sarcodines. The name *heliozoa* means “sun animal.” Thin spikes of cytoplasm, supported by microtubules, project from their silica (SiO_2) shells, making heliozoans look like the sun’s rays.



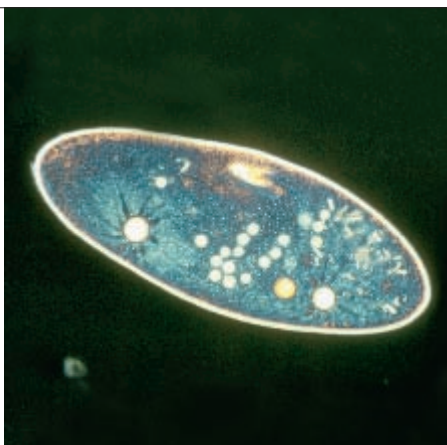
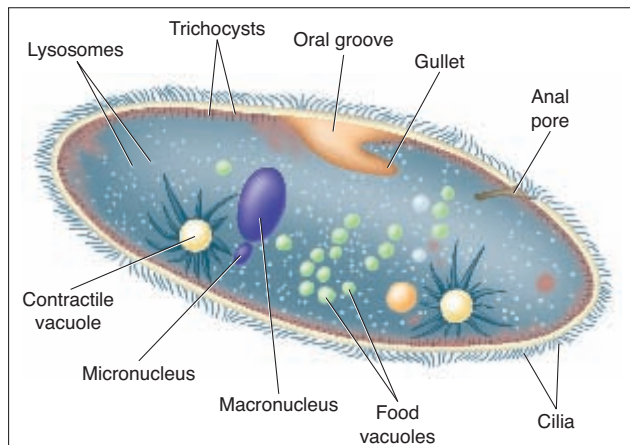
UNIVERSAL ACCESS

Less Proficient Readers

To reinforce the anatomies of two important animal-like protists, have students make their own labeled drawings of *Amoeba proteus* and a paramecium, using Figures 20-4 and 20-5 for reference. Then, call on students at random to describe the function of each of the labeled structures in both drawings. L1 L2

English Language Learners

Help English language learners pronounce the term *sporozoite*, which is introduced on page 502. Explain that the word is derived from a Greek word meaning “seed.” Point out that knowledge of derivation can aid in understanding, but derivation can sometimes be misleading. For instance, a *sporozoite* is a unicellular stage of the sporozoan life cycle. A seed, by contrast, is a multicellular structure with clearly organized and specialized tissues. L1 L2



Paramecium caudatum (magnification: 2500×)

Ciliates

The phylum Ciliophora is named for **cilia** (singular: cilium), short hairlike projections similar to flagella. **Members of the phylum Ciliophora, known as ciliates, use cilia for feeding and movement.** The internal structure of cilia and flagella are identical. The beating of cilia, like the pull of hundreds of oars in an ancient ship, propels a cell rapidly through water.

Ciliates are found in both fresh and salt water. In fact, a lake or stream near your home might contain many different ciliates. Most ciliates are free living, which means that they do not exist as parasites or symbionts.

CHECKPOINT What are cilia, and how do ciliates use them?

Internal Anatomy Some of the best-known ciliates belong to the genus *Paramecium*. A paramecium can be as long as 350 micrometers. Its cilia, which are organized into evenly spaced rows and bundles, beat in a regular, efficient pattern. The cell membrane of a paramecium is highly structured and has trichocysts just below its surface. **Trichocysts** (TRY-koh-sists) are very small, bottle-shaped structures used for defense. When a paramecium is confronted by danger, such as a predator, the trichocysts release stiff projections that protect the cell.

A paramecium's internal anatomy is shown in **Figure 20-5**. Like most ciliates, a paramecium possesses two types of nuclei: a macronucleus and one or more smaller micronuclei. Why does a ciliate need two types of nuclei? The **macronucleus** is a “working library” of genetic information—a site for keeping multiple copies of most of the genes that the cell needs in its day-to-day existence. The **micronucleus**, by contrast, contains a “reserve copy” of all of the cell's genes.

Figure 20-5 Ciliates use hairlike projections called cilia for feeding and movement. Ciliates, including this paramecium, are covered with cilia that propel them through the water. Cilia also line the organism's gullet and move its food—usually bacteria—to the organism's interior. There, the food particles are engulfed, forming food vacuoles. The contractile vacuoles collect and remove excess water, thereby helping to achieve homeostasis, a stable internal environment.

Go Online active art
 For: Amoeba and Paramecium activity
 Visit: PHSchool.com
 Web Code: cbp-6202

Ciliates

Use Visuals

Figure 20-5 Ask students: Which animal-like protist phylum includes paramecia? (*Ciliophora*) What structures do paramecia use for movement? (*Cilia*) What are some other structures in a paramecium cell? (An oral groove, a gullet, an anal pore, a contractile vacuole, a micronucleus, a macronucleus, and food vacuoles) **L1 L2**

Build Science Skills

Observing Provide students with a prepared slide of a paramecium. Have them use a microscope to observe the slide and make a labeled drawing of what they see. **L2**

Go Online active art

For: Amoeba and Paramecium activity

Visit: PHSchool.com

Web Code: cbe-6209

Students learn about two types of protozoans—the amoeba and the paramecium.



FACTS AND FIGURES

No difference

Students may wonder what the real difference is between a cilium and a flagellum. Some might suspect that there must be a subtle difference in internal structure about which their textbook or teacher is not telling them. The truth is that there is no difference—a cilium and a flagellum are the same organelle. The difference in terminology is derived from the days of the light microscope,

when biologists thought that the many fine hairs surrounding some cells might well turn out to be different from the few long whips that move other cells. With the advent of the electron microscope, however, it became clear that the structure and biochemistry of both organelles are identical, at least in protists. There is a real difference, however, between the flagella of prokaryotes and those of protists.

Answer to . . .

CHECKPOINT Cilia are short hairlike projections that ciliates use for feeding and movement.