Section 20–5

1 FOCUS

Objectives

20.5.1 ***Compare and Contrast*** funguslike protists and fungi.
20.5.2 ***Describe*** slime molds and water molds.
20.5.3 ***Summarize*** the ecological roles of funguslike protists.

Guide for Reading

Vocabulary Preview

Call on students at random to pronounce the Vocabulary words in the order in which they appear. Correct any mispronunciations.

Reading Strategy

Before students read, have them rewrite the blue headings in the section as *how, why,* or *what* questions about funguslike protists. Then, as they read, they can write down answers to the heading questions.

2 INSTRUCT

Slime Molds

Address Misconceptions

Because of the terminology involved in the two groups of slime molds, students may infer that cellular slime molds are the rule and acellular slime molds the exception. Explain that the majority of slime mold species are acellular and form plasmodia. L2

20–5 Funguslike Protists

Guide for Reading

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?

Vocabulary
cellular slime mold
acellular slime mold
fruiting body
plasmodium
hypha
zoosporangium
antheridium
oogonium

Reading Strategy: Predicting Before you read, preview the life cycles in **Figure 20–22** and **Figure 20–23.** Predict how these life cycles are similar and how they are different.

If you look closely at the debris-laden floor of a forest after several days of rain, you may see patches of what looks like brightly colored mold. Funguslike protists, such as in **Figure 20–20** and **Figure 20–21,** grow in damp, nutrient-rich environments and absorb food through their cell membranes, much like fungi. These organisms have sometimes been classified as fungi, even though their cellular structure more closely resembles that of the protists. **Like fungi, the funguslike protists are heterotrophs that absorb nutrients from dead or decaying organic matter. But unlike most true fungi, funguslike protists have centrioles. They also lack the chitin cell walls of true fungi.** The funguslike protists include the cellular slime molds, the acellular slime molds, and the water molds.

Slime Molds

Slime molds are found in places that are damp and rich in organic matter, such as the floor of a forest or a backyard compost pile. **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.

Two broad groups of slime molds are recognized. The individual cells of **cellular slime molds** remain distinct—separated by cell membranes—during every phase of the mold's life cycle. Slime molds that pass through a stage in which their cells fuse to form large cells with many nuclei are called **acellular slime molds.**

Cellular Slime Molds Cellular slime molds belong to the phylum Acrasiomycota (ak-ruh-see-oh-my-KOH-tuh). They spend most of their lives as free-living cells that are not easily distinguishable from soil amoebas. In nutrient-rich soils, these amoeboid cells reproduce rapidly. When their food supply is exhausted, they go through a reproductive process to produce spores that can survive adverse conditions. First, they send out chemical signals that attract other cells of the same species. Within a few days, thousands of cells aggregate into a large sluglike colony that begins to function like a single organism. The colony migrates for several centimeters, then stops and produces a **fruiting body,** a slender reproductive structure that produces spores. Eventually, the spores are scattered from the fruiting body. Each spore gives rise to a single amoeba-like cell that starts the cycle all over again, as shown in **Figure 20–22.**

▼ **Figure 20–20 Funguslike protists absorb nutrients from dead organic matter.** Slime molds like this red raspberry slime mold are often found in the damp, shaded environments preferred by many fungi.

SECTION RESOURCES

Print:
- ***Laboratory Manual A,*** Chapter 20 Lab
- ***Teaching Resources,*** Section Review 20–5
- ***Reading and Study Workbook A,*** Section 20–5
- ***Adapted Reading and Study Workbook B,*** Section 20–5
- ***Lesson Plans,*** Section 20–5

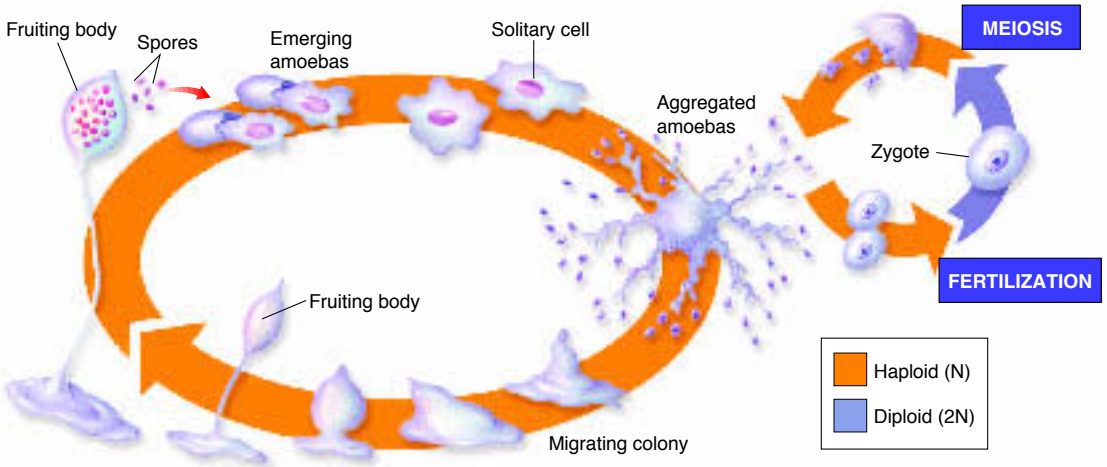
Technology:
- ***iText,*** Section 20–5
- ***Transparencies Plus,*** Section 20–5

Figure 20–21 **Slime molds help recycle organic matter.** The bright yellow acellular slime mold shown here, *Fuligo septica,* is often found growing in gardens on damp, rich soil.

In many ways, these remarkable organisms challenge our understanding of what it means to be multicellular. During much of their life cycle, cellular slime molds are unicellular organisms that look and behave like animallike protists. When they aggregate, however, they act very much like multicellular organisms. Slime molds have been especially interesting to biologists who study how cells send signals and regulate development. They have kept biologists busy for decades, but their secrets are still not fully understood.

CHECKPOINT ***Why is it difficult to classify cellular slime molds as unicellular or multicellular?***

Figure 20–22 Cellular slime molds reproduce asexually and sexually.
Interpreting Graphics
Is most of the cellular slime mold life cycle haploid or diploid?



Use Visuals

Figure 20–22 Have students study the life cycle of cellular slime molds, and ask: **What are slime molds?** *(Funguslike protists that play key roles in recycling organic material)* **How are cellular slime molds different from acellular slime molds?** *(The individual cells of cellular slime molds remain distinct, while the cells of acellular slime molds fuse to form large cells with many nuclei.)* **How do the individual cells of cellular slime molds reproduce?** *(They reproduce by cell division.)* Emphasize that most of the life cycle is haploid. L2

Demonstration

The spores of slime molds are abundant in airborne dusts. To demonstrate, place a dead leaf or piece of bark on a few dry oatmeal flakes in a petri dish. Sprinkle some water over the flakes, and cover the dish. If you put the dish aside for a few days, an acellular slime mold plasmodium will likely grow on the oatmeal flakes. Have students observe the funguslike protist and make drawings. L1 L2

Differentiated Instruction Solutions for All Learners

English Language Learners
Focus students' attention on the terms *cellular* and *acellular*. Point out that the prefix *a-* means "not." Thus, an acellular slime mold is a slime mold that is "not cellular." Point out that this organism does actually consist of cells. The distinction—and the derivation of the term—is that in acellular slime molds the amoeba-like cells fuse together to produce structures with many nuclei. Such a structure is not "cellular" in the common meaning of that term. L1 L2

Advanced Learners
Encourage students who need an extra challenge to research the Great Potato Famine in nineteenth-century Ireland. Have them find out how the potato blight was diagnosed at the time, whether there were any attempts to attack the pest, and what is done today to prevent or treat attacks by *P. infestans*. Also, have them investigate the ramifications of the human crisis that the potato blight caused. Ask students to report what they learned to the class. L3

Answers to . . .

CHECKPOINT *During most of their life cycle, cellular slime molds are unicellular organisms that look and behave like animallike protists. When they aggregate, however, they act very much like a multicellular organism.*

Figure 20–22 *Haploid*

20–5 (continued)

Use Visuals

Figure 20–23 Ask students: **What forms when cells of acellular slime molds aggregate?** *(A plasmodium forms.)* **What contains the many nuclei within the plasmodium?** *(A single cell membrane)* Explain that when environmental conditions change, a plasmodium will break up and produce fruiting bodies, which are reproductive structures. Ask: **What are produced within the fruiting bodies?** *(Spores)* **Are the spores haploid or diploid?** *(Haploid)* L2

Water Molds

Demonstration

Several days before students read about water molds, ask a local pet store to provide you with a dead tropical fish. Put the dead fish in a jar of water, place a top on the jar, and set it aside for a few days. Have students observe the fuzzy water mold that grows on the dead fish. Explain that the "fuzziness" is actually a mass of hyphae, which students will learn more about when they study fungi. Ask students: **What is the food source for this water mold?** *(The decaying body of the dead fish)* Point out that the water mold is providing a necessary environmental service in recycling this dead organic matter. L1 L2

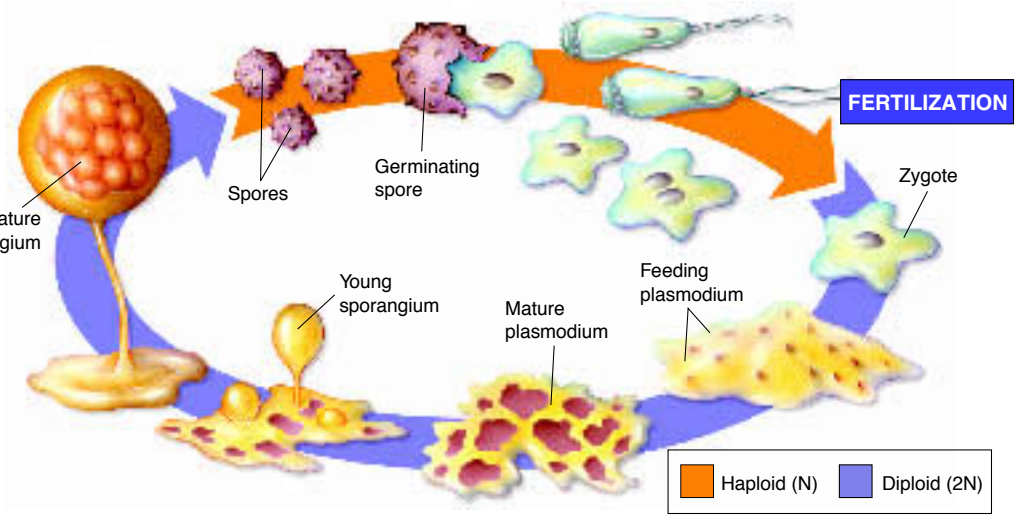


Figure 20–23 The plasmodium of an acellular slime mold is the collection of many amoeba-like organisms contained in a single cell membrane. The plasmodium will eventually produce sporangia, which in turn will undergo meiosis and produce haploid spores. Upon pairing up and fusing, these result in new diploid amoeba-like cells. **Interpreting Graphics** ***What stage of the life cycle is shown in the photograph?***

Acellular Slime Molds Acellular slime molds belong to the phylum Myxomycota (myk-suh-my-KOH-tuh). Like cellular slime molds, acellular slime molds begin their life cycles as amoeba-like cells. However, when they aggregate, their cells fuse to produce structures with many nuclei.

These structures are known as **plasmodia** (singular: plasmodium). The large plasmodium of an acellular slime mold, such as the one shown in **Figure 20–23,** is actually a single structure with many nuclei. A plasmodium may grow as large as several meters in diameter!

Eventually, small fruiting bodies, or sporangia, spring up from the plasmodium. The sporangia produce haploid spores by meiosis. These spores scatter to the ground where they germinate into amoeba-like or flagellated cells. The flagellated cells then fuse in a sexual union to produce diploid zygotes that repeat the cycle.

Water Molds

If you have seen white fuzz growing on the surface of a dead fish in the water, you have seen a water mold in action. Water molds, or oomycetes, are members of the phylum Oomycota (oh-oh-my-KOH-tuh). **Oomycetes thrive on dead or decaying organic matter in water and some are plant parasites on land.** Oomycetes are commonly known as water molds, but they are not true fungi. Water molds produce thin filaments known as **hyphae** (singular: hypha). These hyphae do not have walls between their cells; as a result, water mold hyphae are multinucleate. Also, water molds have cell walls made of cellulose and produce motile spores, two traits that fungi do not have.

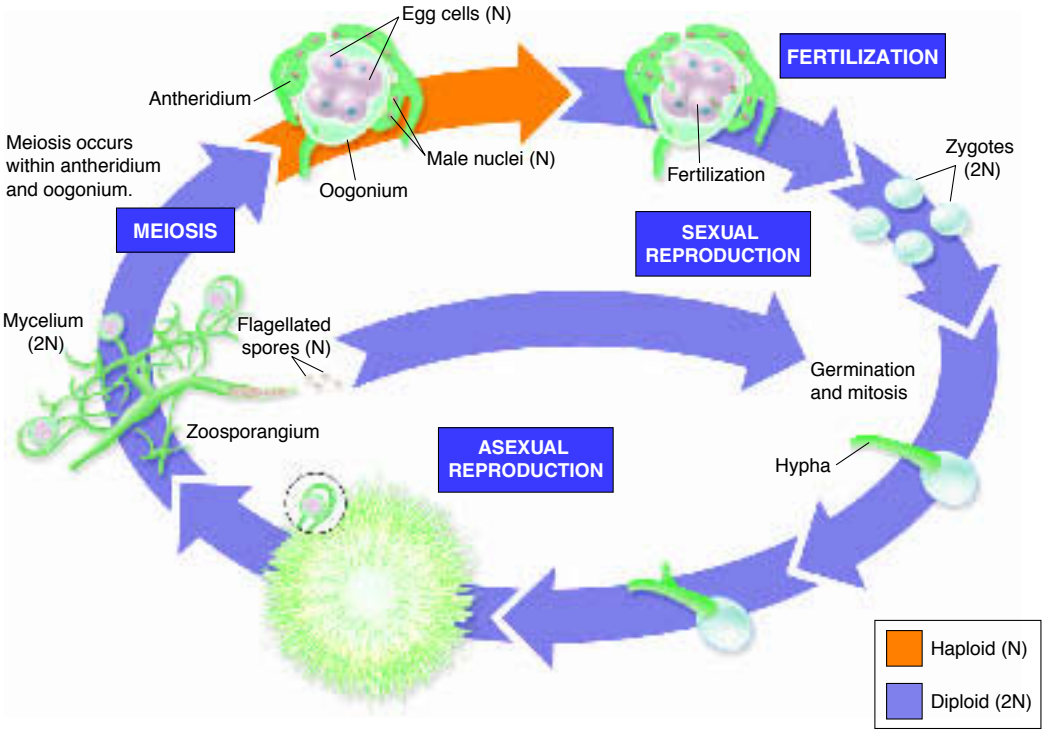
Water molds display both sexual reproduction and asexual reproduction in their life cycle, as shown in **Figure 20–24.** In asexual reproduction, portions of the hyphae develop into **zoosporangia** (singular: zoosporangium), which are spore cases.

BIO INSIGHTS

FACTS AND FIGURES

The attack of the giant amoeba

An acellular slime mold begins its life as an amoeba-like cell. When the cells aggregate to form a plasmodium, it becomes more like a giant amoeba. Plasmodia are usually white, but they may also be colorless, orange, yellow, violet, blue, or black. In a favorable environment, a plasmodium may increase to 25 times its original size in just one week, and it can grow to become 45 centimeters in length. A plasmodium tends to creep in one direction at a rate of 2.5 centimeters per hour. If the environment suddenly becomes unfavorable—if, for example, the food supply suddenly diminishes—a plasmodium will usually change into many separate, small sporangia, each of which contains thousands of spores. In some species, the plasmodium forms a single spore-bearing body.



Each zoosporangium produces flagellated spores that swim away in search of food. When they find food, the spores develop into hyphae, which then grow into new organisms.

Sexual reproduction takes place in specialized structures that are formed by the hyphae. One structure, the **antheridium** (an-thur-ID-ee-um), produces male nuclei. The other structure, the **oogonium** (oh-oh-GOH-nee-um), produces female nuclei. Fertilization, or sexual fusion, occurs within the oogonium, and the spores that form develop into new organisms.

CHECKPOINT *Where does sexual reproduction in water molds take place?*

▲ Figure 20–24 **Water molds live on decaying organic matter in water.** Water molds reproduce both asexually and sexually. During asexual reproduction, flagellated spores are produced by the diploid (2N) mycelium. These spores grow into new mycelia. During sexual reproduction, a male nucleus fuses with a female nucleus.

Ecology of Funguslike Protists

Slime molds and water molds are important as recyclers of organic material. In other words, they help things rot. A walk through woods or grassland shows that the ground is not littered with the bodies of dead animals and plants. After these organisms die, their tissues are broken down by slime molds, water molds, and other decomposers. The dark, rich topsoil that provides plants with nutrients results from this decomposition.

Some funguslike protists can harm living things. In addition to their beneficial function as decomposers, land-dwelling water molds cause a number of important plant diseases. These diseases include mildews and blights of grapes and tomatoes.

Go Online PHSchool.com
For: Links on funguslike protists
Visit: PHSchool.com
Web Code: cbe-6205

TEACHER TO TEACHER

As a review of the many different organisms included in the kingdom Protista, I use a game with a format like Bingo. The game uses a card or grid with either the written name or a picture of each organism being reviewed. I develop several different cards and copy them onto card stock. Plastic pieces cut from colored transparencies can be used as game pieces. In this game, the teacher draws a description of an organism from a container and reads it to the class. The students match the description with the name or picture of the organism, and in doing so, try to get Bingo. The degree of difficulty depends on the descriptions you write for the protists.

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Use Visuals

Figure 20–24 Ask students: **What is the cellular process that produces male and female nuclei in water molds?** *(Meiosis)* **Where are these nuclei produced?** *(The male nuclei are produced in the antheridium, and the female nuclei are produced in the oogonium.)* **Are the spores produced by the mycelia haploid or diploid?** *(Diploid)* Explain that a mycelium is a mass of hyphae, as shown in the bottom left of the figure. Ask: **How are oomycetes different from true fungi?** *(Oomycetes have cell walls made of cellulose and produce motile spores, whereas fungi have chitin cell walls and do not have motile stages.)* L2

Ecology of Funguslike Protists

Make Connections

Environmental Science Focus students' attention on the role that funguslike protists play in the environment. Ask: **What do funguslike protists feed on?** *(Dead or decaying organic matter)* **What are organisms called that feed on dead material?** *(Decomposers)* **How is the role played by decomposers like that of the recyclers who collect the glass and paper you put in recycle bins?** *(Like the recyclers of glass and paper, the decomposers use the material accumulated in dead organisms for new purposes instead of letting that material go to waste.)* L1 L2

Go Online PHSchool.com
Your students can extend their knowledge of funguslike protists through this online experience.

Answers to . . .

CHECKPOINT *Sexual reproduction takes place within the oogonium.*

Figure 20–23 *The photograph shows a mature sporangium.*

Water Molds and the Potato Famine

Use Visuals

Figure 20–25 Ask students: **In some history books, the Great Potato Famine is blamed on a fungus. Is that true?** *(No, it was not caused by a fungus, but by an oomycete, or water mold.)* **When spores of *P. infestans* reached a potato during that period in Ireland, how did the spore change, and what caused that change?** *(The spores developed into hyphae, which grew into new organisms, because that's what occurs when spores find food.)* L2

3 ASSESS

Evaluate Understanding

Call on students at random to compare and contrast cellular slime molds with acellular slime molds. Students should mention that both types are funguslike heterotrophs, and they should distinguish between the "slug" of the cellular slime mold and the plasmodium of the acellular slime mold.

Reteach

Use Figure 20–23 to reteach the basics of funguslike protists. Make sure students understand the formation of fruiting bodies and the production of haploid spores. This knowledge will set the stage for the next chapter, which focuses on fungi.

Thinking Visually

The steps in the students' flowcharts should reflect an understanding of the life cycles illustrated in Figure 20–22 for cellular slime molds and Figure 20–23 for acellular slime molds.

Interactive Textbook

If your class subscribes to the iText, use it to review the Key Concepts in Section 20–5.

Answer to . . .

Figure 20–25 *Many Irish people migrated to the United States, where they changed the ethnic and social character of many American cities.*

Figure 20–25 *Phytophthora infestans* is an oomycete that attacks potatoes (bottom right). In the summer of 1846, *P. infestans* destroyed nearly the entire potato crop of Ireland within weeks, leading to the Great Potato Famine. **Applying Concepts** ***How did the famine affect the United States?***

Water Molds and the Potato Famine

One water mold helped to permanently change the character of the United States. Roughly 40 million Americans can trace at least some part of their ancestry to Ireland. If you are one of those people, the chances are very good that your life and the lives of your ancestors were changed by the combination of a plant and a protist.

The plant was the potato. Potatoes are native to South America, where they were cultivated by the Incas. Spanish explorers were so impressed with this plant that they introduced it to Europe. By the 1840s, potatoes had become the major food crop of Ireland.

The protist was *Phytophthora infestans*, an oomycete that produces airborne spores that destroy all parts of the potato plant. The oomycete can disrupt an ecosystem and cause disease in a potato crop. Potatoes that are infected with *P. infestans* may appear normal at harvest time. Within a few weeks, however, the protist makes its way into the potato, reducing it to a spongy sac of spores and dust. The summer of 1845 was unusually wet and cool, ideal conditions for the growth of *P. infestans*. By the end of the growing season, the potato blight caused by this pathogen had destroyed as much as 60 percent of the Irish potato crop. The photographs in **Figure 20–25** show the effects of *P. infestans* on a potato. The art shows a woman digging for potatoes in a field.

Because the poorest farmers depended upon potatoes for their food, the effects were tragic. In 1846, nearly the entire potato crop was lost, leading to mass starvation. Between 1845 and 1851, at least 1 million Irish people died of starvation or disease. During this same period, more than 1 million people emigrated from Ireland to the United States and other countries. The Great Potato Famine, as this tragic event was known, changed the ethnic and social character of many American cities, the new home of so many Irish immigrants.

20–5 Section Assessment

1. **Key Concept** How are funguslike protists and fungi similar? How are they different?
2. **Key Concept** Compare acellular slime molds, cellular slime molds, and water molds.
3. What is the role of slime molds in the environment?
4. How can water molds affect other living things?
5. **Critical Thinking** **Comparing and Contrasting** How is the sluglike mass of cellular slime molds similar to the plasmodium of acellular slime molds? How do they differ?

Thinking Visually

Constructing a Flowchart
Draw two flowcharts—one showing the steps from unicellular existence through multicellular existence and reproduction in cellular slime molds and one showing those steps in acellular slime molds.

20–5 Section Assessment

1. Like fungi, funguslike protists are heterotrophs that absorb nutrients from dead or decaying organic matter. Unlike most true fungi, funguslike protists have centrioles and lack the chitin cell walls of true fungi.
2. The individual cells of cellular slime molds remain distinct throughout the life cycle. Acellular slime molds pass through a stage in which their cells fuse to form large cells with many nuclei. Water molds have a diploid life cycle. The only haploid stage is the gamete.
3. They recycle organic material.
4. Water molds can cause plant diseases, such as potato blight.
5. Both the cellular slime mold mass and the plasmodium function like a single organism, and both produce a fruiting body. They differ in that the cells of a plasmodium fuse, while cells in a slime mold mass preserve their separate cellular identities.