

# MS Protists and Fungi

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Printed: August 6, 2012

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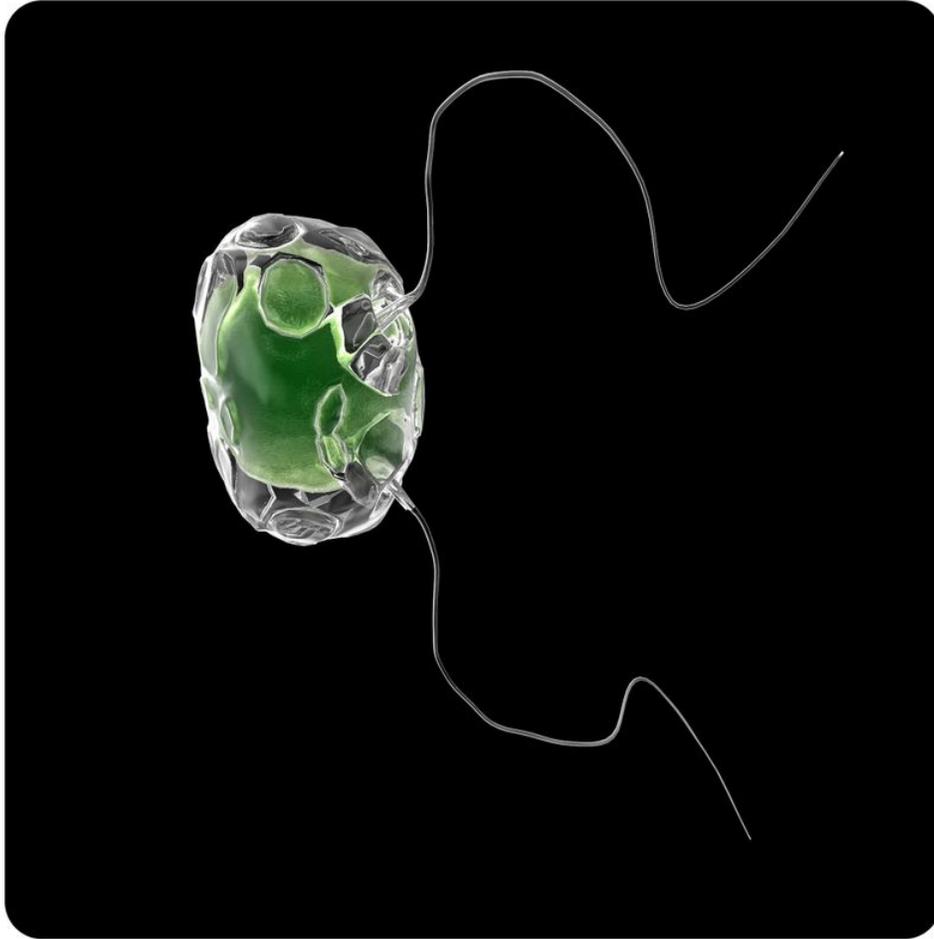
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# CHAPTER 1

# MS Protists and Fungi

## CHAPTER OUTLINE

- 1.1 Protists
- 1.2 Fungi
- 1.3 References



What does the above image look like to you? A bacteria? An animal? A plant? Actually, it is not found in any of those categories. The above organism is called a "protist."

Protists are a unique category of organisms because they are very different when compared to each other, but they can be very similar to plants, animals, and fungi.

What are fungi? They are another kingdom of organisms that are not related to protists, but are equally interesting. There are estimated to be 1.5 million species of fungi, although only 5% of them are classified.

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# 1.1 Protists

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## Lesson Objectives

- Explain why protists cannot be classified as plants, animals, or fungi.
- List the similarities that exist between most protists.
- Identify the three subdivisions of the organisms in the kingdom Protista.

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## Check Your Understanding

- What are some basic differences between a eukaryotic cell and a prokaryotic cell?
- List some characteristics that all cells have.

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## Vocabulary

**autotroph** Organism that produces complex organic compounds from simple inorganic molecules using a source of energy such as sunlight.

**cilia** Finger-like projects from the cells; can be found from the cells of mucous membranes.

**filter-feeder** An organism that feeds by filtering organic matter out of water.

**heterotroph** Organism which obtains carbon from outside sources.

**protist** Eukaryotic organism that belongs to the kingdom Protista; not a plant, animal or fung

**protozoa** Animal-like protists.

**pseudopodia** A moving fake foot; the cell surface extends out a membrane and the force of this membrane propels the cell forward.

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## What are Protists?

**Protists** are eukaryotes, and most are single-celled. You can think about protists as all eukaryotic organisms that are neither animals, nor plants, nor fungi.

Even among themselves, they have very little in common. Although these organisms were put in the category *Protista* by Ernst Haeckel in 1866, the Kingdom Protista was not an accepted classification in the scientific world until the 1960s. These unique organisms can be so different from each other that sometimes Protista is called the “junk drawer kingdom.” This kingdom contains the eukaryotes that cannot be put into any other kingdom.

## Unicellular or Multicellular?

Most protists, such as the ones shown in **Figure 1.1**, are so small that they can be seen only with a microscope. Protists are mostly unicellular (one-celled) eukaryotes that exist as independent cells. A few protists are multicellular (many-celled) and surprisingly large. These protists do not, however, show cellular specialization or differentiation into tissues. For example, kelp is a multicellular protist and can be over 100-meters long with cells that perform mostly the same jobs.

## Characteristics of Protists

A few characteristics are common between protists:

- a. They are eukaryotic, which means they have a nucleus.
- b. Most have mitochondria.
- c. They can be parasites.
- d. They all prefer aquatic or moist environments.

For classification, the protists are divided into three groups:

- a. Animal-like protists
- b. Plant-like protists
- c. Fungi-like protists.

But remember, protists are not animals, nor plants, nor fungi (**Figure 1.2**).

## Classification of Protists

As there are many different types of protists, the classification of protists can be difficult. Recently, scientists confirmed that the protists are related by analyzing their DNA. Protists with more common DNA sequences are more closely related to each other than those with fewer common DNA sequences.

Find information on different types of protists here: <http://www.ucmp.berkeley.edu/alllife/eukaryotasy.html>

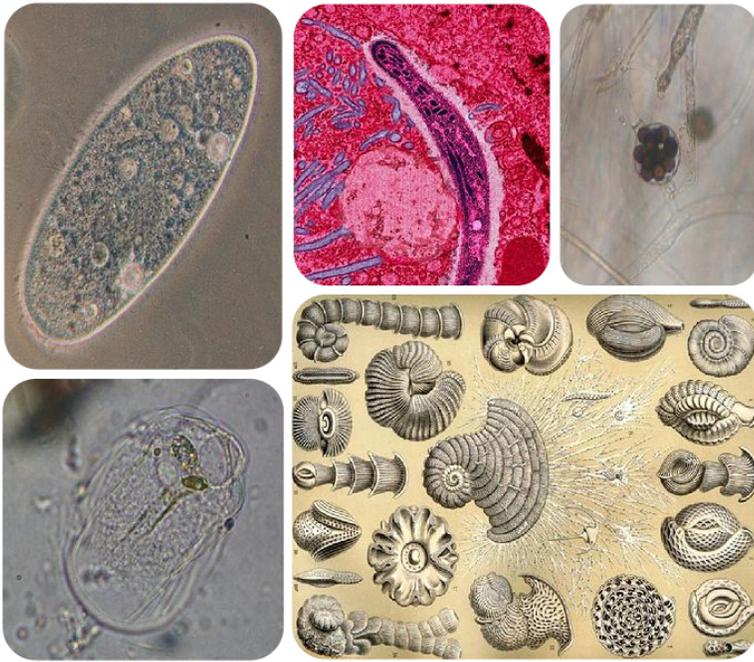
## How Protists Obtain Food

The cells of protists need to perform all of the functions that other cells do, such as grow and reproduce, maintain homeostasis, and obtain energy. They also need to obtain food to provide the energy to perform these functions.

For such simple organisms, protists get their food in a complicated process. Although there are many photosynthetic protists, such as algae, that get their energy from sunlight, many others must "swallow" their food through a process called endocytosis. Endocytosis happens when a cell takes in substances through its membrane. The process is described below:

- a. The protist wraps its cell wall and cell membrane around its prey, which is usually bacteria.
- b. It creates a food vacuole, a sort of "food storage compartment," around the bacteria.
- c. The protist produces toxins which paralyze its prey.
- d. Once paralyzed, the food material moves through the vacuole and into the cytoplasm of the protist.

Other protists are parasitic and absorb nutrients meant for their host, harming the host in the process.




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**FIGURE 1.1**

Protists come in many different shapes.

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**FIGURE 1.2**

This slime mold is a protist. Slime molds had previously been classified as fungi but are now placed in the Kingdom Protista. Slime molds live on decaying plant life and in the soil.

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## Animal-like Protists

Animal-like, plant-like, and fungi-like protists are different from each other mainly because they have different ways of getting carbon. Carbon is important in the formation of organic compounds like carbohydrates, lipids, proteins, and nucleic acids. You get it from eating, as do other animals.

Animal-like protists are called protozoa. **Protozoa** are single-celled eukaryotes that share certain traits with organisms in the animal kingdom. Like animals, they can move, and they get their carbon from outside sources. They are **heterotrophs**, which means they eat things outside of themselves instead of producing their own food.

Animal-like protists are very small, measuring only about 0.01–0.5mm. Animal-like protists include the zooflagel-

lates, ciliates, and the sporozoans (**Figure 1.3**).



**FIGURE 1.3**

Euglena are animal-like protists. Over 1000 species of Euglena exist. They are used in industry in the treatment of sewage.

Some animal-like protists literally “eat with their tails.” The tail of a protist is a flagellum. These protists are called flagellates. Flagellates are **filter-feeders**. They acquire oxygen and nitrogen by constantly whipping the flagellum back and forth, a process called filter-feeding. The whipping of the flagellum creates a current that brings food into the protist. Recall that prokaryotes can also have flagella (the plural of flagellum).

### Different Kinds of Animal-like Protists

Are there different types of animal-like protists? Yes. They are different because they move in different ways.

- Flagellates have long flagella, or tails. Flagella rotate in a propeller-like fashion. An example of a flagellate is the *Trypanosoma*, which causes African sleeping sickness.
- Other protists have what are called transient **pseudopodia**, which are like temporary feet. The cell surface extends out a membrane, and the force of this membrane moves the cell forward. An example of a protist with a pseudopod is the amoeba.
- Another way protists move is by the movement of cilia. **Cilia** are thin, very small tail-like projections that extend outward from the cell body. Cilia beat back and forth, moving the protist along. The *paramecium* has cilia that propel it.
- A few protists are do not move at all, such as the *toxoplasma*. These protists form spores that become new protists, and are known as sporozoa.

### Plant-like Protists

Plant-like protists are **autotrophs**. This means that they produce their own food. They perform photosynthesis to produce sugar by using carbon dioxide and the energy from sunlight, just like plants. Plant-like protists live in soil, in seawater, on the outer covering of plants, and in ponds and lakes (**Figure 1.4**). Protists like these can be unicellular or multicellular. Some protists, such as kelp, live in huge colonies in the ocean.

Plant-like protists are essential to the environment because they produce oxygen through photosynthesis, which helps other organisms, like animals, survive.

Plant-like protists are classified into a number of basic groups (**Table 1.1**).

**TABLE 1.1: Plantlike Protists**

Phylum	Description	Number (approximate)	Example
Chlorophyta	green algae - related to higher plants	7,500	<i>Chlamydomonas</i> , <i>Ulva</i> , <i>Volvox</i>
Rhodophyta	red algae	5,000	<i>Porphyra</i>
Phaeophyta	brown algae	1,500	<i>Macrocystis</i>
Chrysophyta	diatoms, golden-brown algae, yellow-green algae	12,000	<i>Cyclotella</i>
Pyrrophyta	dinoflagellates	4,000	<i>Gonyaulax</i>
Euglenophyta	euglenoids	1,000	<i>Euglena</i>



**FIGURE 1.4**

Red algae are a very large group of protists making up about 5,000–6,000 species. They are mostly multicellular, live in the ocean. Many red algae are seaweeds and help create coral reefs.

## Fungus-like Protists

Fungus-like protists are heterotrophs that have cell walls and reproduce by forming spores (see Lesson 9.2 for more information about spores). Fungus-like protists usually do not move, but some develop movement at some point in their lives.

There are essentially three types of fungus-like protists (see **Table 1.2**):

- Water molds.
- Downy mildews.
- Slime molds.

Slime molds represent the characteristics of the fungus-like protists. Most slime molds measure about one or two centimeters, but a few slime molds are as big as several meters. They often have bright colors, such as a vibrant yellow. Others are brown or white.

*Stemonitis* is a kind of slime mold which forms small brown bunches on the outside of rotting logs. *Physarum polycephalum* lives inside rotting logs and is a gooey mesh of yellow "threads" that are a several centimeters long. *Fuligo*, sometimes called "vomit mold," is a yellow slime mold found in decaying wood.

**TABLE 1.2: Fungus-like Protists**

Protist	Source of Carbon	Environment	Characteristics
omycetes: water molds (Figure 1.5)	decomposed remains, parasites of plants and animals	most live in water	Causes a range of diseases in plants; common problem in greenhouses where the organism kills new seedlings (plants from seeds); includes the downy mildews, which are easily identifiable by the appearance of white "mildew" on leaves.
Mycetozoa: slime molds (Figure 1.6)	dispose of dead plant material, feed on bacteria	common in soil, on lawns, and in the forest commonly on deciduous logs	Includes the cellular slime mold, which involves numerous individual cells attached to each other, forming one large "super-cell," essentially a bag of cytoplasm containing thousands of individual nuclei. The plasmodial slime molds spend most of their lives as individual cells, but when a chemical signal is released, they form a cluster that acts as one organism.

## Importance of Protists

Humans could not live on Earth if it were not for protists. Why? Protists produce almost one-half of the oxygen on the planet, decompose and recycle nutrients that humans need to live, and make up a huge part of the food chain.

Humans use protists for many other reasons:

- Many protists are also commonly used in medical research. For example, medicines made from protists are used in treatment of high blood pressure, digestion problems, ulcers, and arthritis.
- Other protists are used in scientific studies. For example, slime molds are used to analyze the chemical signals used in cells.
- Protists are also valuable in industry. Look on the back of a milk carton. You will most likely see carrageenan, which is extracted from red algae. This is used to make puddings and ice cream solid. Chemicals from other

**FIGURE 1.5**

An example of a slime mold.

**FIGURE 1.6**

An aquatic insect nymph attacked by water mold.

kinds of algae are used to produce many kinds of plastics.

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## Lesson Summary

- Protists are highly diverse organisms that belong to the Kingdom Protista.
- Protists are divided into three subgroups: animal-like protists, plant-like protists and fungus-like protists.
- Animal-like protists are unicellular eukaryotes that share certain traits with animals, such as mobility and heterotrophy.

- Plant-like protists are unicellular or multicellular autotrophs that live in soil, in seawater, on the outer covering of plants, and in ponds and lakes.
- Fungus-like protists, such as water molds, downy mildews, and slime molds, are heterotrophs that reproduce by forming spores.

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## Review Questions

### Recall

1. List the characteristics that all protists share.
2. List two ways that protists obtain food.
3. Describe the characteristics of an animal-like protist.
4. Describe the characteristics of a plant-like protist.
5. Describe the characteristics of a fungi-like protist.
6. Name three kinds of fungi-like protists.

### Apply Concepts

7. Explain why protists are important to life on Earth.
8. You find a protist that is a heterotroph and lives in the ocean. Is this protist most similar to a plant, animal, or fungus? Why or why not?

### Critical Thinking

9. Imagine that you are a scientist delivering a paper called *Protists: the Junk-Drawer Kingdom*. Explain your reasoning for this title?

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## Further Reading / Supplemental Links

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## Points to Consider

- Fungi comprise one of the eukaryotic kingdoms. Think about what might distinguish a fungi-like protist from a true fungus?
- Given the vast differences between the protists discussed in this lesson, think about the possibilities of dividing this kingdom into additional kingdoms. How might that division be accomplished? Is that a good idea or would it just lead to confusion?

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## 1.2 Fungi

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### Lesson Objectives

- Describe the characteristics of fungi.
- Identify structures that distinguish fungi from plants and animals.
- Explain how fungi can be used in industry.

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### Check Your Understanding

- What is a significant difference between a protist and other eukaryotic organisms?
- What are some of the distinguishing characteristics of fungus-like protists?

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### Vocabulary

**budding** Asexual reproduction in which part of the body of a fungus, for example, grows and breaks off, eventually becoming a new organism.

**chitin** A nitrogen-containing material found in the cell wall of fungi; also found in the shells of animals such as beetles and lobsters.

**fruiting body** Specialized structure used in sexual reproduction; part of the fungus that produces the spores.

**hyphae** Thread-like structures which interconnect and bunch up into mycelium; helps bring food, such as a worm, inside the fungus.

**mycelial fragmentation** Asexual reproduction involving splitting off of the mycelia; a fragmented piece of mycelia can eventually produce a new colony of fungi.

**mycelium** Help the fungi absorb nutrients from living hosts; composed of hyphae.

**mycorrhizal symbiosis** A relationship between fungi and the roots of plants where both benefit; the plant provides sugar to the fungus; the fungi provides minerals and water to the roots of the plant.

**parasite** The organism that benefits in a relationship between two organisms in which one is harmed.

**spore** The basic reproductive unit of fungi.

## What are Fungi?

Ever notice blue-green mold growing on a loaf of bread? Do you like your pizza with mushrooms? Has a physician ever prescribed an antibiotic for you?

If so, then you have encountered fungi. Fungi are organisms that belong to the Kingdom Fungi (**Figure 1.7**). Our environment needs fungi. Fungi help decompose matter and make nutritious food for other organisms. Fungi are all around us and are useful in many ways.



**FIGURE 1.7**

These many different kinds of organisms that demonstrate the huge diversity within the Kingdom Fungi.

If you had to guess, would you say a fungus is a plant or animal? Scientists used to debate about which kingdom to place fungi in. Finally they decided that fungi were plants. But they were wrong. Now, scientists know that fungi are not plants at all. Fungi are very different from plants.

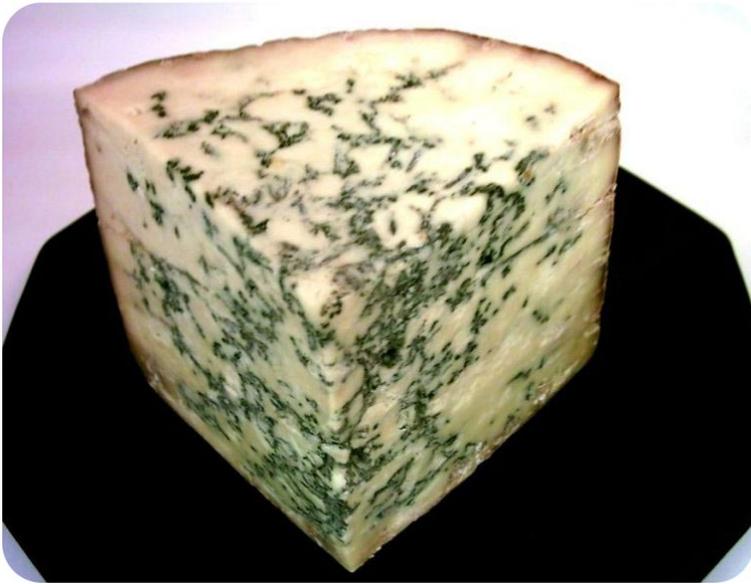
The main difference between plants and fungi is how they obtain energy. Plants are autotrophs, meaning that they make their own "food" using the energy from sunlight. Fungi are heterotrophs, which means that they obtain their "food" from outside of themselves. In other words, they must "eat" their food like animals and many bacteria do.

Yeasts, molds, and mushrooms are all different kinds of fungi (**Figure 1.8**). There may be as many as 1.5 million species of fungi. You can easily see bread mold and mushrooms without a microscope, but most fungi you cannot see. Fungi are either too small to be seen without a microscope, or they live where you cannot see them easily - deep in the soil, under decaying logs, or inside plants or animals. Some fungi even live in or on top of other fungi.

## Fungi and Symbiotic Relationships

If it were not for fungi, many plants would go hungry. In the soil, fungi grow closely around the roots of plants, and they begin to help each other. This form of helping each other out is called **mycorrhizal symbiosis**. Mycorrhizal means "roots" and symbiosis means "relationship" between organisms (**Figure 1.9**).

As the plants and fungi form the close relationship, the plant and the fungus "feed" one another. The plant provides glucose and sucrose to the fungus that the plant makes through photosynthesis, which the fungus cannot do. The

**FIGURE 1.8**

The blue in this blue cheese is actually mold.

fungi then provides minerals and water to the roots of the plant.

**FIGURE 1.9**

This mushroom and tree live in symbiosis with each other.

## Lichens

Have you ever seen an organism called a lichen? Lichens are crusty, hard growths that you might find on trees, logs, walls, and rocks. Although lichens may not be the prettiest organisms in nature, they are unique. A lichen is really two organisms that live very closely together: a fungus and a bacteria or algae. The cells from the algae or bacteria live inside the fungus. Each organism provides nutrients for the other.

What is it called when two organisms live close together and form a relationship? Symbiosis. A lichen is the result of symbiosis between a fungus and another organism. Because this relationship helps both organisms, it is called a mutualistic relationship.

## Fungi and Insects

Many insects have a symbiotic relationship with certain types of fungi:

- Ants and termites grow fungi in underground “fungus gardens” that they create. When the ants or termites have eaten a big meal of wood or leaves, they also eat some fungi from their gardens. The fungi help them digest the wood or leaves.
- Ambrosia beetles live in the bark of trees. Like ants and termites, they grow fungi inside the bark of trees and use it to help digest their food.

## Fungi as Parasites

Although lots of symbiotic relationships help both organisms, sometimes one of the organisms is harmed. When that happens, the organism that benefits and is not harmed is called a **parasite**.

Examples of parasitic fungi include the following:

- Beginning in 1950, Dutch Elm trees in the United States began to die. Since then much of the species has been eliminated. The disease was caused by a fungus that acted as a parasite. The fungus that killed the trees was carried by beetles to the trees. The tree tried to stop the growth of the fungus by blocking its own ability to gain water. However, without water the tree soon died.
- Some parasitic fungi cause human diseases such as athlete’s foot and ringworm. These fungi feed on the outer layer of warm, moist skin.

## Fungi as Predators

Fungi growing on a tree trunk does not seem very dangerous. But some fungi are actually hunters. For example, some fungi trap nematodes. A nematode is a worm that some fungi like to eat. These hungry fungi live deep in the soil where they set traps for unsuspecting nematodes by making a circle with their hyphae. **Hyphae** are like arms and legs. They look like cobwebs and can be sticky. Fungi set out circular rings of hyphae with a lure inside, which brings the nematode inside the fungus (**Figure 1.10**).

## Fungi are Good Eaters

Fungi can grow fast because they are such good eaters. Fungi have lots of surface area and this large surface area “eats.” Surface area is how much exposed area an organism has compared to their overall volume. Most of a mushroom’s surface area is actually underground.

These are the steps involved in fungi eating:

- a. Fungi squirt special enzymes into their environment.
- b. The enzymes help digest large organic molecules, similar to cutting up your food before you eat.
- c. Cells of the fungi then absorb the broken-down nutrients.

Why do you think a large surface area allows fungi to obtain more nutrients?

## Fungi Body Parts

The most important body parts of a fungi include:

- a. Cell wall: A layer around the cell membrane of fungi cells, similar to that found in plant cells.

**FIGURE 1.10**

Hyphae are the cobweb-like arms and legs of fungi.

- b. Hyphae: These are thread-like structures which interconnect and bunch up into a **mycelium**. Ever see mold on a damp wall or on old bread? The things that you are seeing are really mycelia. The hyphae and mycelia help the fungi absorb nutrients from other organisms.
- c. Specialized structures for reproduction: One example is a fruiting body. A mushroom is a **fruiting body**, which is the part of the fungus that produces spores (**Figure 1.11**). Those spores, discussed in the next section, are the basic reproductive units of fungi.

**FIGURE 1.11**

A mushroom is a fruiting body.

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## Fungi Reproduction

Reproduction of fungi is different for different fungi. Many fungi reproduce both sexually or asexually, while some reproduce only sexually and some only asexually. Asexual reproduction takes only one parent and sexual reproduction takes two parents.

### Asexual Reproduction

Fungi reproduce asexually through three methods:

- Spores:** Spores are formed by the fungi and released to create new fungi. Have you ever seen a puffball? A puffball is a kind of fungus that has thousands of spores in a giant ball. Eventually the puffball bursts and releases the spores in a huge “puff.”
- Budding:** The fungus grows part of its body, which eventually breaks off. The broken-off piece becomes a “new” organism.
- Mycelial fragmentation:** In this method, a piece of the mycelium splits off of the fungi. A fragmented piece of the mycelium can eventually produce a new colony of fungi.

Asexual reproduction is faster and produces more fungi than sexual reproduction. Some species of fungi can only perform asexual reproduction. This form of reproduction is controlled by many different factors, including environmental conditions such as the amount of sunlight and carbon dioxide the fungus receives, as well as the availability of food.

### Sexual Reproduction

Almost all fungi can reproduce through the process of meiosis. Meiosis is a type of cell division where haploid cells are produced (discussed in chapter titled *Cell Division, Reproduction and DNA*). But meiosis in fungi is really different from sexual reproduction in plants or animals.

In plants and animals, meiosis occurs in diploid cells and is a process that produces haploid cells. Remember, a diploid cell is a cell with two sets of chromosomes, one from each parent. A haploid cell has one set of chromosomes. In meiosis, four haploid cells are produced. Each haploid cell has half the chromosome number of the parent cell.

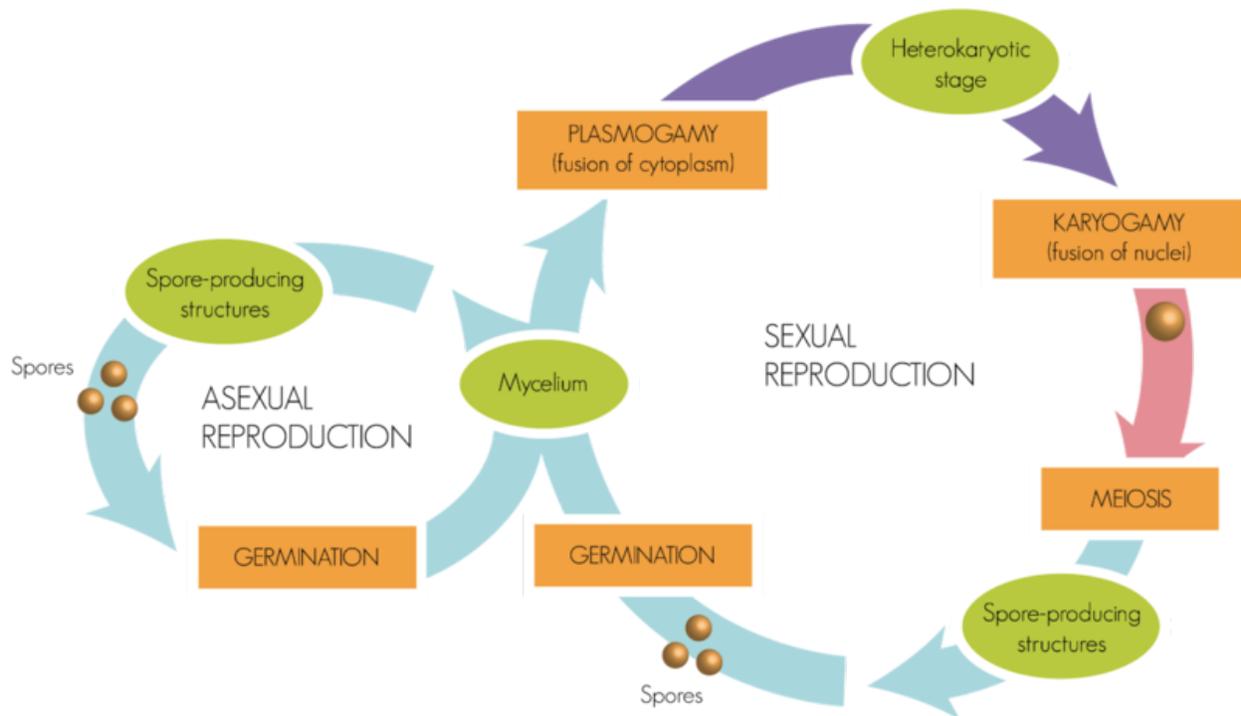
However, in fungi, meiosis occurs right after two haploid cells fuse, producing four haploid cells. Mitosis then produces a haploid multicellular "adult" organism or haploid unicellular organisms. Mitosis is cell division that creates two genetically identical offspring cells (**Figure 1.12**).

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## Classification of Fungi

Scientists used to think that fungi were members of the plant kingdom. They thought this because fungi had several similarities to plants. For example, fungi and plants usually have a leaf or flower that is attached to a stem. Also:

- Fungi and plants have similar structures.
- Plants and fungi live in the same kinds of habitats, such as growing in soil.
- Plants and fungi both have a cell wall, which animals do not have.

**FIGURE 1.12**

A diagram of how asexual and sexual reproduction work in fungi.

## Structure of Fungi

There are a number of characteristics that make fungi different from other eukaryotic organisms:

- Fungi cannot make their own food like plants can, since they do not have chloroplasts and cannot carry out photosynthesis. Fungi are more like animals because they have to obtain their food from outside sources.
- The cell walls in many species of fungi contain chitin. **Chitin** is a nitrogen-containing material found in the shells of animals such as beetles and lobsters. The cell wall of a plant is made of cellulose, not chitin.
- Unlike many plants, most fungi do not have structures that transfer water and nutrients.
- One characteristic that is unique to fungi is the presence of hyphae, which combine in groups called mycelia, as described above.

## The Evolution of Fungi

Fungi appeared during the Paleozoic Era, a geologic time period lasting from about 570 million to 248 million years ago. This is also the time when fish, insects, amphibians, reptiles, and land plants appeared. The first fungi most likely lived in water and had flagella that released spores. The first land fungi probably appeared in the Silurian period (443 million years ago to about 416 million years ago), the same time period that land plants also first appeared. See different types of fungi here: <http://www.tolweb.org/Fungi>.

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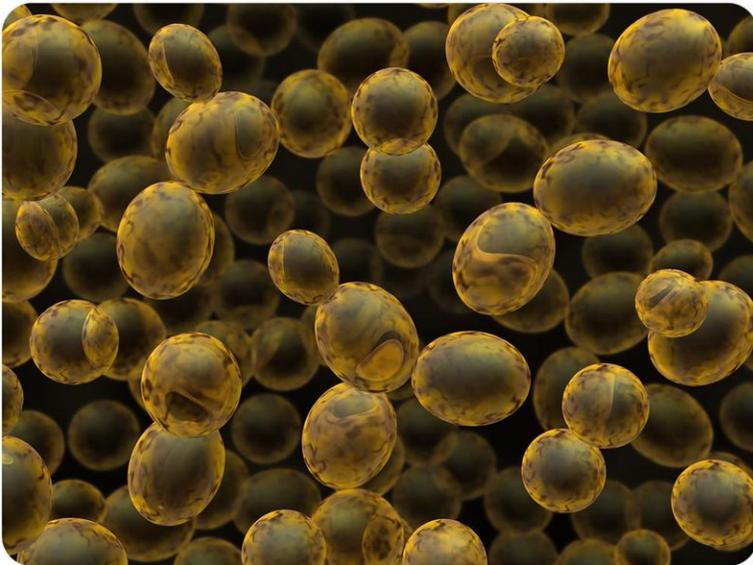
## Roles of Fungi

Fungi are found all over the globe in many different kinds of habitats. Fungi even thrive in deserts. Most fungi are found on land rather than in the ocean, though some species live only in ocean habitats. Fungi are extremely important to these ecosystems because they are one of the major decomposers of organic material. Scientists have estimated that there are nearly 1.5 million species of fungi.

### Importance of Fungi for Human Use

Humans use fungi for food preparation or preservation and other purposes.

- Yeasts help ferment beer, wine and bread (**Figure 1.13**).
- Some fungi are used in the production of soy sauce and tempeh, a source of protein used in Southeast Asia.
- Mushrooms are used in the diet of people all over the globe.
- Fungi can produce antibiotics, such as penicillin.
- The chitin in the cell walls of fungi has been said to have healing properties.



**FIGURE 1.13**

*Saccharomyces cerevisiae*, a single-celled fungus called Brewer's or Baker's yeast, is used in the baking of bread and in making wine and beer through fermentation. There are several other species of yeast used in brewing beer. Each can impart a distinctive taste.

### Edible and Poisonous Fungi

Some of the best known types of fungi are mushrooms, which can be edible or poisonous (**Figure 1.14**).

Many species are grown commercially, but others are harvested from the wild. When you order a pizza with mushrooms or add them to your salad, you are most likely eating *Agaricus bisporus*, the most commonly eaten species. Other mushroom species are gathered from the wild for people to eat or for commercial sale. Many mushroom species are poisonous to humans. Some mushrooms will simply give you a stomach ache, while others may kill you. Some mushrooms you can eat when they are cooked but are poisonous when raw.

Have you ever eaten blue cheese? Do you know what makes it blue? You guessed it. Fungus. For certain types of cheeses, producers add fungus spores to milk curds to promote the growth of mold, which makes the cheese blue. Molds used in cheese production are safe for humans to eat.

**FIGURE 1.14**

Some of the best known types of fungi are the edible and the poisonous mushrooms.

### Fungi Control of Pests

Some fungi work as natural pesticides. For example, some fungi may be used to limit or kill harmful organisms like mites, pest insects, certain weeds, worms, and other fungi that harm or kill crops.

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## Lesson Summary

- Fungi are classified in their own kingdom based on their structures, ways of obtaining food, and on they reproduce.
- Fungi live with other organisms in symbiotic relationships.
- Fungi reproduce asexually and sexually.
- Fungi appeared during the Paleozoic Era.
- Fungi are widely used in foods, industry, and medicine.

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## Review Questions

### Recall

1. What are two characteristics distinguishes fungi from plants?
2. How many species of fungi exist?
3. Name two human diseases caused by fungus.
4. What is a lichen?

### Apply Concepts

5. Explain how mycorrhizal symbiosis works.
6. Describe the relationship between the ambrosia beetle and fungi.
7. If you see mold on your bread, what part of the fungus are you observing?

8. Describe the three methods of asexual reproduction in fungi.

### Critical Thinking

9. "Sexual reproduction in fungi is similar to sexual reproduction in animals." Explain why this statement is true or false.

10. You go back in time to talk with scientists who believe that fungi are a type of plant. What will you tell them?

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### Further Reading / Supplemental Links

- Money, Nicholas, *The Triumph of Fungi: A Rotten History*. Oxford University Press, 2006.
- Webster, Robert and Weber, Roland, *Introduction to Fungi*. Cambridge University Press, 2007.
- Moore-Landecker, Elizabeth, *Fundamentals of Fungi*. Benjamin Cummings, 1996.
  
- <http://www.ucmp.berkeley.edu/fungi/fungi.html>
- <http://www.perspective.com/nature/fungi>
- <http://en.wikipedia.org/wiki/Image:DecayingPeachSmall.gif>
- <http://waynesword.palomar.edu/trfeb98.htm>

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### Points to Consider

- Plants are fascinating, diverse organisms. Although scientists used to think that fungi were plants, we now know that plants and fungi are separate. In this lesson we have discussed fungi. Next we start discussing plants. What do you think sets plants apart from fungi?

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## 1.3 References

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