## 1 FOCUS

### Objective

**21.2.1** ***Identify*** the characteristics of the four main groups of fungi.

### Guide for Reading

### Vocabulary Preview

Help students remember the meanings of the second and third Vocabulary words by explaining that *rhizoid* is derived from a Greek word meaning "root" and *stolon* is derived from a Latin word meaning "branch."

### Reading Strategy

Students' main topics should be the four groups of fungi. For each, students should note details about structure and function and list examples.

## 2 INSTRUCT

### The Common Molds

#### Build Science Skills

**Observing** Divide the class into small groups, and give each group a different food sample in an open plastic container with a dampened paper towel lining the bottom. Foods might include bread (without preservatives), fruit, vegetables, or potato chips. Have students dampen the food with water and expose it to the air for the rest of the day. Then, place all samples in a warm, dark place for two or three days. Have students observe and make drawings of any mold that grows on their samples. Ask students to compare their observations. L2 L3

Go Online NSTA SCILINKS

Download a worksheet on fungi for students to complete, and find additional support from NSTA SciLinks.

# 21–2 Classification of Fungi

7 2.a. Students know the differences between the life cycles and reproduction methods of sexual and asexual organisms.

### Guide for Reading

**Key Concept**
- What are the characteristics of the four main phyla of fungi?

**Vocabulary**
zygospore
rhizoid
stolon
gametangium
conidium
ascus
ascospore
budding
basidium
basidiospore

**Reading Strategy: Finding Main Ideas** Before you read, skim the section to identify the four main groups of fungi. Write the name of each group on a notecard. As you read, make note of the characteristics of each group.

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**For:** Links on fungi
**Visit:** www.SciLinks.org
**Web Code:** cbn-6211

The kingdom Fungi has over 100,000 species. Fungi are classified according to their structure and method of reproduction. The methods by which fungi reproduce are unlike those of any other kingdom. The four main groups of fungi are the common molds (Zygomycota), the sac fungi (Ascomycota), the club fungi (Basidiomycota), and the imperfect fungi (Deuteromycota).

## The Common Molds

The familiar molds that grow on meat, cheese, and bread are members of the phylum Zygomycota, also called zygomycetes.

**Zygomycetes have life cycles that include a zygospore.** A **zygospore** (ZY-goh-spawr) is a resting spore that contains zygotes formed during the sexual phase of the mold's life cycle. The hyphae of zygomycetes generally lack cross walls, although the cells of their reproductive structures do have cross walls.

**Structure and Function of Bread Mold** Black bread mold, *Rhizopus stolonifer,* is a familiar zygomycete. Expose preservative-free bread to dust, and you can grow the mold. Keep the bread warm and moist in a covered jar, and in a few days dark fuzz will appear. With a hand lens, you can see delicate hyphae on moldy bread. There are two different kinds of hyphae. The rootlike hyphae that penetrate the bread's surface are **rhizoids** (RY-zoydz). Rhizoids anchor the fungus to the bread, release digestive enzymes, and absorb digested organic material. The stemlike hyphae that run along the surface of the bread are **stolons.** The hyphae that push up into the air are the sporangiophores, which form sporangia at their tips. A single sporangium may contain up to 40,000 spores.

CHECKPOINT *What is a zygospore?*

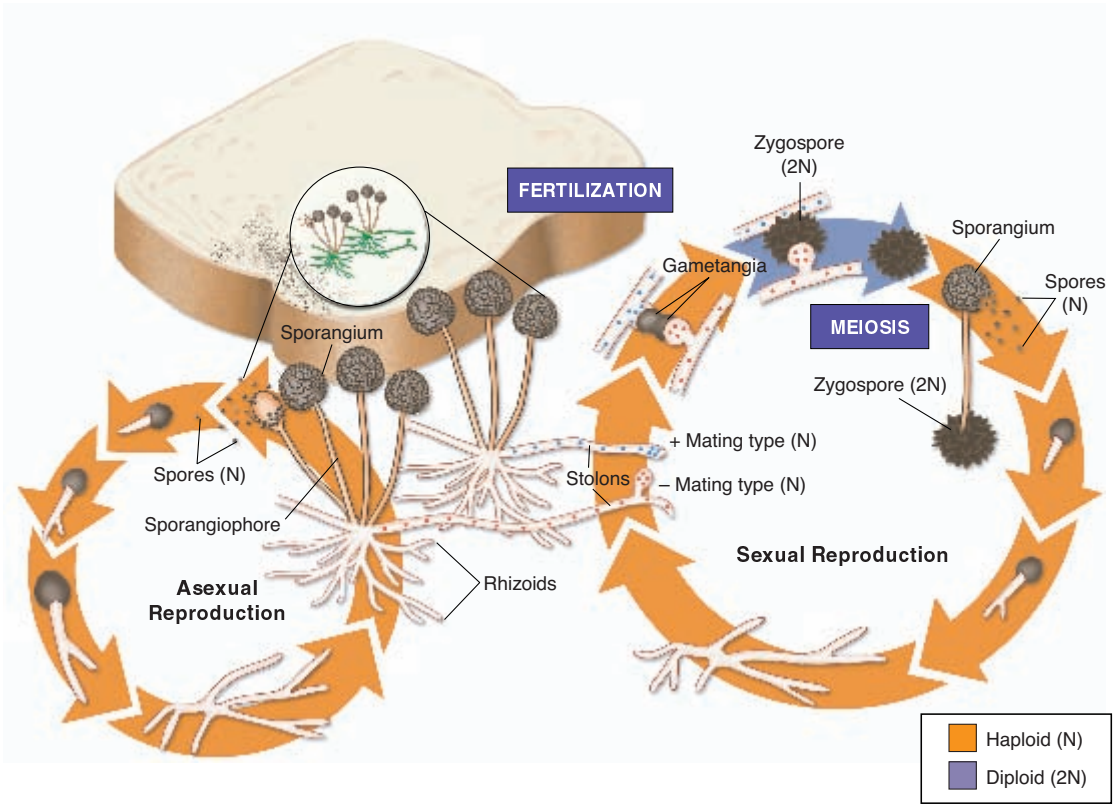
**Life Cycle of Molds** The life cycle of black bread mold is shown in **Figure 21–5.** Its sexual phase begins when hyphae from different mating types fuse to produce gamete-forming structures known as **gametangia** (gam-uh-TAN-jee-uh; singular: gametangium). Haploid (N) gametes produced in the gametangia fuse with gametes of the opposite mating type to form diploid (2N) zygotes. These zygotes develop into thick-walled zygospores, which may remain dormant for months. When conditions become favorable, the zygospore germinates, then undergoes meiosis, and new haploid spores are released. The significance of this sexual process—zygote formation followed by meiosis—is that it produces new combinations of genetic information that may help the organism meet changing environmental conditions.

TIME SAVER

### SECTION RESOURCES

**Print:**
- ***Laboratory Manual A,*** Chapter 21 Lab
- ***Laboratory Manual B,*** Chapter 21 Lab
- ***Teaching Resources,*** Lesson Plan 21–2, Adapted Section Summary 21–2, Adapted Worksheets 21–2, Section Summary 21–2, Worksheets 21–2, Section Review 21–2, Enrichment
- ***Reading and Study Workbook A,*** Section 21–2
- ***Adapted Reading and Study Workbook B,*** Section 21–2
- ***Issues and Decision Making,*** Issues and Decisions 20

**Technology:**
- ***iText,*** Section 21–2
- ***Transparencies Plus,*** Section 21–2




▲ **Figure 21–5** **Zygomycetes have life cycles that include a zygospore.** During sexual reproduction in the bread mold *Rhizopus stolonifer,* hyphae from two different mating types form gametangia. The gametangia fuse, and zygotes form within a zygospore. The zygospore develops a thick wall and can remain dormant for long periods. The zygospore eventually germinates, and a sporangium emerges. The sporangium reproduces asexually by releasing haploid spores produced by meiosis.

## Quick Lab

BIIE 1.d

### What is the structure of bread mold?

**Materials** transparent tape, moldy bread, microscope slide, microscope

**Procedure**

1. Touch the sticky side of a 2-cm piece of transparent tape to the black "fuzzy" area of a bread mold.
2. Gently stick the tape to a glass slide. Observe the slide under the compound microscope. Make a sketch of your observations.
3. Return all slides to your teacher for proper disposal. Wash your hands before leaving the laboratory.

**Analyze and Conclude**

1. **Observing** Describe the structures you observed in the bread mold.
2. **Formulating Hypotheses** What do you think the function of the round structures is? Why might it be advantageous for a single mass of bread mold to produce so many of the round structures?
3. **Inferring** How can your observations help explain the ability of molds to appear on foods even in very clean kitchens?

## UNIVERSAL ACCESS

***Less Proficient Readers***

Focus students' attention on Figure 21–8, and call on students at random to explain what is occurring at each step in the diagram. If a student has trouble with an explanation, read aloud the sentences from the text that would provide insight into that step. Then, ask the student again to explain what is occurring at that place on the diagram. Continue this questioning process around the diagram more than once, emphasizing its cyclic character. L1 L2

***Advanced Learners***

Encourage students who need a challenge to research and prepare a report on the discovery of the "wonder drug," penicillin. Direct students to books about famous scientists to read about Alexander Fleming, who won a Nobel Prize for his work. Make sure students focus on the initial experiment that showed how a culture of *Penicillium notatum* killed bacteria. L3

## Quick Lab

**Objective** Students will be able to observe the major structures of a mold and hypothesize why bread mold produces so many sporangia. L2 L3

**Skill Focus** **Formulating Hypotheses, Observing, Inferring**

**Materials** transparent tape, moldy bread, microscope slide, microscope

**Time** 15 minutes

**Advance Prep** Prepare moldy bread by moistening slices of bread and placing them in a warm, dark place several days in advance of the activity.

**Safety** Students who have allergies to molds should avoid any exposure to the bread mold. Make sure students wash their hands with soap and warm water before leaving the lab.

**Strategies**

- Suggest that students look at the slide near the edge of the tape, where it may be easier for them to see the hyphae and spores.
- If students are unable to identify the sporangia, encourage them to review the subsection Structure and Function of Bread Molds and Figure 21–5.

**Expected Outcomes** Students should observe hyphae and reproductive structures in bread mold.

**Analyze and Conclude**

**1.** The tangled filaments are hyphae, including rhizoids, stolons, and sporangiophores. The round structures are sporangia.

**2.** Sporangia produce and release spores. The production of such a large number of sporangia increases the number of spores released, thus increasing the chances of the mold's reproduction.

**3.** Molds produce large numbers of very tiny spores that are easily spread by wind and animals. Keeping all spores out of a kitchen is impossible.

### *Answer to . . .*

CHECKPOINT *A zygospore is a resting spore that contains zygotes formed during the sexual phase of the mold's life cycle.*

## The Sac Fungi

### Word Origins

A mycologist studies fungi. L2

### Address Misconceptions

Make sure students understand that ascomycetes produce two different kinds of spores. Which kind they produce depends on the environmental conditions. Ask: **Which kind of spores do sac fungi produce in asexual reproduction?** *(Conidia)* **Which kind of spores do they produce in sexual reproduction?** *(Ascospores)* Point out that bread yeasts, which are ascomycetes, reproduce asexually by budding, not by the production of conidia. Yet, when yeasts reproduce sexually, they produce ascospores. L2

### Use Visuals

**Figure 21–7** Have students study the life cycle. Then, ask: **Are the conidia produced in asexual reproduction haploid or diploid?** *(Haploid)* **Which type of reproduction involves development of a fruiting body?** *(Sexual reproduction)* **What cellular process results in haploid ascospores?** *(Meiosis)* **After mitosis occurs, how many ascospores are there per ascus?** *(Eight)* L2

### Word Origins

The name of each phylum of fungi ends in *-mycota.* This suffix is derived from *mukes,* the Greek word for "fungi." The term *mycelium* is also derived from this root. **What organisms do you think a mycologist studies?**

## The Sac Fungi

Sac fungi, also known as ascomycetes, belong to the phylum Ascomycota. **The phylum Ascomycota is named for the ascus, a reproductive structure that contains spores.** There are more than 30,000 species of ascomycetes, making it the largest phylum of the kingdom Fungi. Some ascomycetes, such as the cup fungi shown in **Figure 21–6,** are large enough to be visible when they grow above the ground. Others, such as yeasts, are microscopic.

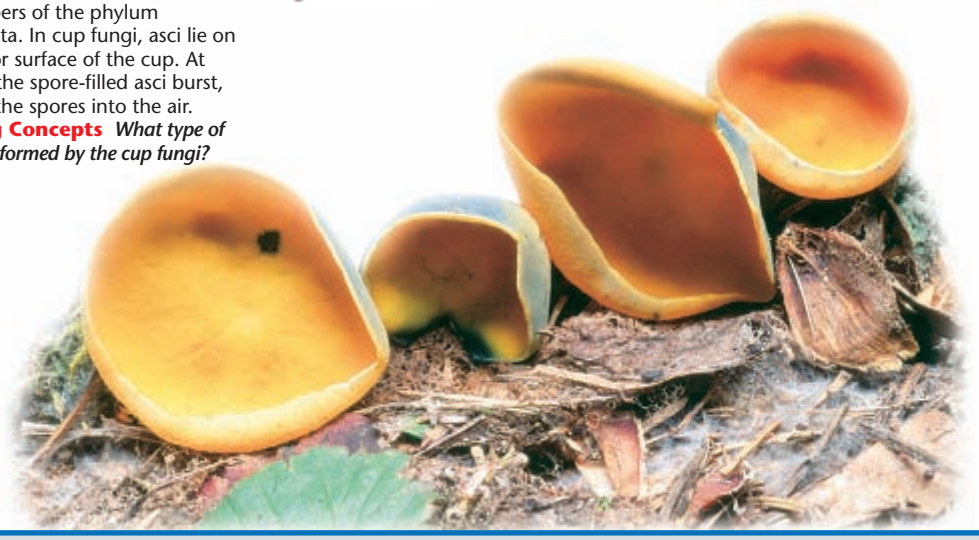
**Life Cycle of Sac Fungi** The life cycle of an ascomycete usually includes both asexual and sexual reproduction. The life cycle of a cup fungus is shown in **Figure 21–7.**

In asexual reproduction, tiny spores called **conidia** (koh-NID-ee-uh; singular: conidium) are formed at the tips of specialized hyphae called conidiophores. These spores get their name from the Greek word *konis,* which means "dust." If a conidium lands in a suitable environment, it grows into a haploid mycelium.

Sexual reproduction occurs when the haploid hyphae of two different mating types (+ and –) grow close together. The N + N hyphae then produce a fruiting body in which sexual reproduction continues. Gametangia from the two mating types fuse, but the haploid (N) nuclei do not fuse. Instead, this fusion produces hyphae that contain haploid nuclei from each of the mating types (N + N).

The **ascus** (plural: asci) forms within the fruiting body. Within the ascus, two nuclei of different mating types fuse to form a diploid zygote (2N). The zygote soon divides by meiosis, producing four haploid cells. In most ascomycetes, meiosis is followed by a cycle of mitosis, so that eight cells known as **ascospores** are produced. In a favorable environment, an ascospore can germinate and grow into a haploid mycelium.

CHECKPOINT *Where are ascospores formed? Are they haploid or diploid?*



▼ **Figure 21–6** These cup fungi are members of the phylum Ascomycota. In cup fungi, asci lie on the interior surface of the cup. At maturity, the spore-filled asci burst, releasing the spores into the air. **Applying Concepts** *What type of spores are formed by the cup fungi?*

BIO INSIGHTS

### FACTS AND FIGURES

***The sport of mushroom hunting***

In springtime across the northern United States, scores of intrepid souls tramp over fields and through woods hunting for a highly prized "mushroom." Actually, they are searching for morels, which are ascomycetes, rather than basidiomycetes, the true mushrooms. Morels, most commonly *Morchella esculenta,* are small and tan and have a wrinkled, conelike top, as shown in this chapter's opening photograph. Each of the cup-shaped depressions on the morel's surface contains thousands of asci. Some morels produce mycorrhizae. Mushroom hunters find morels growing in a wide range of habitats, though they are often found in orchards. Another ascomycete found in southern Europe is even more prized—the delicious black truffle, *Tuber melanosporum.*

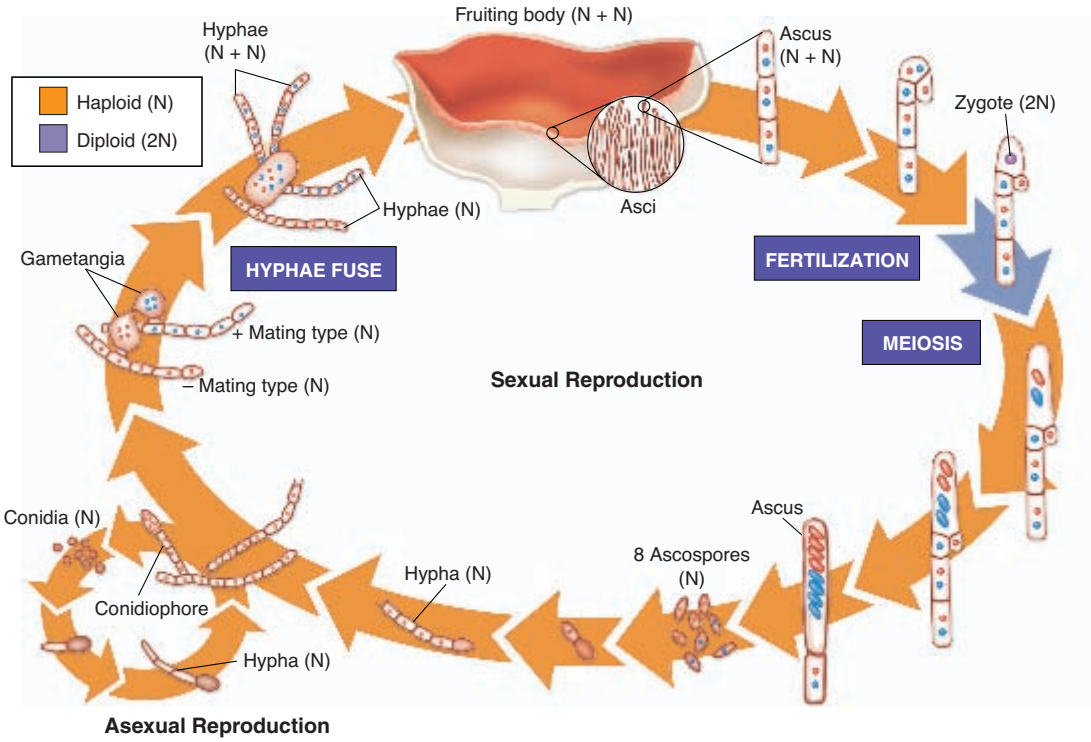



**Figure 21–7** The life cycle of ascomycetes includes both asexual and sexual reproduction. During asexual reproduction, spores called conidia are formed at the tips of specialized hyphae called conidiophores. During sexual reproduction, hyphae of two mating types fuse to form hyphae with two haploid nuclei (N + N). The N + N hyphae then form a fruiting body, which eventually releases ascospores. **Ascomycetes are named for the ascus, the reproductive structure that contains ascospores.**

**Yeasts** Yeasts are unicellular fungi. The yeasts used by humans for baking and brewing are classified as ascomycetes because they form asci with ascospores during the sexual phase of their life cycle.

You might think of yeast as a lifeless, dry powder that is used to make bread. Actually, the dry granules contain ascospores, which become active in a moist environment. To see this for yourself, add a spoonful of dry yeast to half a cup of warm water that contains some sugar. In about 20 minutes, when you examine a drop of this mixture under a microscope, you will be able to see cell division in the rapidly growing yeast cells. The process of asexual reproduction you are observing is called **budding.**

The common yeasts used for baking and brewing are members of the genus *Saccharomyces,* which means "sugar fungi." These yeasts are grown in a rich nutrient mixture containing very little oxygen. Prior to baking, the nutrient mixture is a mound of thick dough. Lacking oxygen, the yeasts within the mixture use the process of alcoholic fermentation to obtain energy. The byproducts of alcoholic fermentation are carbon dioxide and alcohol. The carbon dioxide gas makes beverages bubble and bread rise (by producing bubbles within the dough). The alcohol in bread dough evaporates during baking. In brewing, alcohol remains in the resulting alcoholic beverages.

## Build Science Skills

**Observing** Allow students to carry out the activity described in paragraph 2. Divide the class into small groups, and provide each group with a package of dry yeast, beaker, molasses, aluminum foil, dropper pipette, microscope, microscope slide, coverslip, and methylene blue. Have students mix 5 mL of molasses and 500 mL of warm water in the beaker and then stir in half the package of dry yeast. They should cover the top of the beaker and place it in a warm spot for 20–30 minutes. Then, students should make slides of the yeast cells that have grown in the beaker and observe them under a microscope at low and high power. Adding a drop of methylene blue under the coverslip will ensure that the cells can be clearly observed. Have students make drawings of the yeast cells and share their observations in a class discussion. L2 L3

## Build Science Skills

**Designing Experiments** Explain to students that bromthymol blue solution turns green then yellow in the presence of carbon dioxide, which is one of the byproducts of alcoholic fermentation. Then, divide the class into small groups, and ask each group to design an experiment that investigates at what temperature yeast is most active. A typical experiment will involve adding bromthymol blue solution to a yeast-molasses mixture at various temperatures and observing how fast the color changes. L2

## BIO INSIGHTS FACTS AND FIGURES

***Yeast on the shower curtain!***

Yeasts are unicellular ascomycetes that reproduce both asexually and sexually. When yeasts reproduce asexually, it is mostly by budding. A parent cell forms a bud on its outer surface that eventually breaks off. Yeasts also reproduce by fission. Sexual reproduction occurs when two haploid yeasts fuse to form a diploid zygote. The zygote then undergoes meiosis, which results in haploid spores. These haploid spores remain for some period within the diploid cell wall—the ascospores and ascus of these ascomycetes. Yeasts are found widely in nature, mostly in liquid or moist environments. Yeasts are often seen as a white powder on leaves and fruits. One yeast, *Rhodotorula,* is seen in the home as a pink coating on shower curtains. *Saccharomyces* is used not only in baking and brewing but also often in research, because it is so easily cultured.

### Answers to . . .

CHECKPOINT *Ascospores are formed in the asci. They are haploid.*

**Figure 21–6** *Cup fungi form conidia (asexually) and ascospores (sexually).*

Go Online NSTA SCILINKS
Download a worksheet on asexual reproduction for students to complete, and find additional support from NSTA SciLinks.

## The Club Fungi

### Use Visuals

**Figure 21–8** After students have studied the figure, ask: **What occurs that produces a secondary mycelium?** *(Mycelia of different mating types fuse.)* Explain that each cell of the secondary mycelium has both plus (+) and minus (-) nuclei. **What is a button?** *(A thick bulge of growing hyphae at the soil's surface)* The common mushrooms found in the produce section at the grocery are buttons of the basidiomycete *Agaricus bisporus.* Ask: **What happens in the basidia?** *(The plus and minus nuclei fuse in fertilization, forming diploid zygotes.)* **What cellular process results in haploid basidiospores?** *(Meiosis)* Point out that the basidiospores are forcibly discharged from the gills, as shown in one of the bottom illustrations. **What force distributes these basidiospores far from the mushroom cap?** *(The wind)* L1 L2

### Address Misconceptions

Show students a photo of a mushroom growing in the wild, and ask: **Is there a difference between this mushroom and a toadstool?** *(Some students may suggest that a toadstool is a kind of poisonous mushroom.)* Explain that folklore in some places makes distinctions between mushrooms and toadstools; however, mycologists make no such distinctions. A toadstool is a folk term—not a scientific term—for some kinds of mushrooms. L2

Go Online NSTA SCILINKS
**For:** Links on asexual reproduction
**Visit:** www.SciLinks.org
**Web Code:** cbn-6212

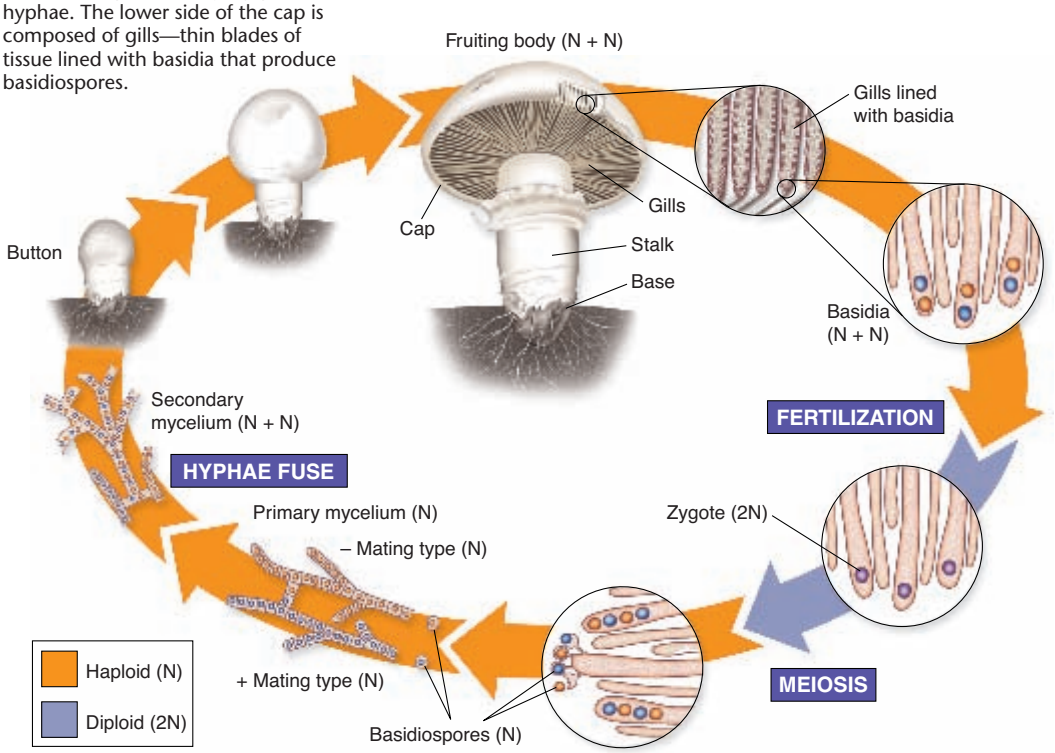
## The Club Fungi

**The phylum Basidiomycota, or club fungi, gets its name from a specialized reproductive structure that resembles a club.** The spore-bearing structure is called the **basidium** (buh-SID-ee-um; plural: basidia). Basidia are found on the gills that grow on the underside of mushroom caps.

**Life Cycle of Club Fungi** Basidiomycetes undergo what is probably the most elaborate life cycle of all the fungi. As shown in **Figure 21–8,** a basidiospore germinates to produce a haploid primary mycelium, which begins to grow. Before long, the mycelia of different mating types fuse to produce a secondary mycelium. The cells of the secondary mycelium contain haploid nuclei of each mating type. Secondary mycelia may grow in the soil for years, reaching an enormous size. A few mycelia have been found to be hundreds of meters across, making them perhaps the largest organisms in the world.

When the right combination of moisture and nutrients occurs, spore-producing fruiting bodies push above the ground. You would recognize these fruiting bodies as mushrooms. Each mushroom begins as a mass of growing hyphae that forms a button, or thick bulge, at the soil's surface.

**Figure 21–8** **The club fungi are named after the club shape of their reproductive structure, the basidium.** The cap of a basidiomycete such as a mushroom is composed of tightly packed hyphae. The lower side of the cap is composed of gills—thin blades of tissue lined with basidia that produce basidiospores.




BIO INSIGHTS

### FACTS AND FIGURES

***Cultivated mushrooms***

The common "white button" mushrooms sold in grocery stores are the buttons of *Agaricus bisporus.* This mushroom was probably first cultivated in and around Paris, France, in the mid-1600s. In the United States, one of the main centers for commercial cultivation of white buttons is Kennett Square, a small town in southeastern Pennsylvania. Large-scale mushroom growing is generally done in long, windowless warehouses, or "mushroom houses." The mushrooms are cultivated on compost made from straw and manure, first pasteurized to destroy harmful microorganisms. The compost is seeded with compact mycelium and watered regularly. The temperature is kept cool (9–13°C) to cut down on disease and insect attacks. For taste reasons, mushrooms are harvested as immature buttons, before spores are produced in great numbers.

## Figure 21–9 Diversity of Club Fungi

Orange Jelly

Pigskin Poison Puffball

Fly Agaric

Star Stinkhorn Fungi

Shelf Fungus

Bird's Nest Fungus

Fruiting bodies expand with astonishing speed, sometimes producing fully developed mushrooms overnight. This remarkable growth rate is caused by cell enlargement, not cell division. The cells of the hyphae enlarge by rapidly taking in water.

When the mushroom cap opens, it exposes hundreds of tiny gills on its underside. Each gill is lined with basidia. The two nuclei in each basidium fuse to form a diploid (2N) zygote cell, which then undergoes meiosis, forming clusters of haploid **basidiospores.** The basidiospores form at the edge of each basidium and, within a few hours, are ready to be scattered. Mushrooms are truly amazing reproductive structures—a single mushroom can produce billions of spores, and giant puffballs can produce trillions.

**Diversity of Club Fungi** In addition to mushrooms, basidiomycetes include shelf fungi, which grow near the surfaces of dead or decaying trees. The visible bracketlike structure that forms is a reproductive structure, and it, too, is a prolific producer of spores. Puffballs, earthstars, jelly fungi, and plant parasites known as rusts are other examples of basidiomycetes. **Figure 21–9** shows some examples of basidiomycetes.

CHECKPOINT *On which part of a mushroom would you find basidia?*

▲ The club fungi are a very diverse group. These fungi are all decomposers, but other kinds of club fungi are parasites of plants and animals. At least two of these fungi, the pigskin poison puffball and the fly agaric, are poisonous. **Inferring** ***Can you tell by looking at a fungus whether or not it is poisonous?***

### Demonstration

Collect samples of basidiomycetes from local wild areas and bring them to class. (To collect a sample, use a self-sealing plastic sandwich bag. Turn it inside out, place it over a hand like a glove, pick the fungus, and invert the bag over the sample. You can use a plastic fork or similar tool to pry up the sample. If collecting proves impractical, obtain samples from a biological supply house or use photographs.) Display your collection for students to examine. Challenge students to identify the fruiting body, the hyphae, and the mycelium of each sample. Provide field guides, and encourage students to identify the different samples displayed. L2 L3

### Build Science Skills

**Using Models** Provide modeling compound, and challenge students to make a simple model of a basidiomycete. For an example of what to make, students can use illustrations in their textbook, photos in other books, or samples collected by teacher or students. Have students also make labels for the parts they include in their model. When the modeling compound dries, encourage students to use paints to simulate the colors of real basidiomycetes. L2

### TEACHER TO TEACHER

To help students understand how fungal spores spread, I have them make "mushroom prints." Give each student a mature mushroom and have them remove the stalk from the cap with a knife. Place the cap on a piece of white paper, with the gills down. Place a glass, cup, or bowl over the cap to make sure it is undisturbed, and leave it overnight. When the cover and mushroom are removed, there will be a radiating pattern on the paper, caused by basidiospores falling to the paper from the gills. Students can transfer some of the basidiospores onto a slide and examine them with a microscope. They can preserve their print by lightly spraying it with an artist's fixative or varnish.

*—Audra Williams*
*Biology Teacher*
*Sprayberry High School*
*Marietta, GA*

### Answers to . . .

CHECKPOINT *Basidia are found on the gills in the caps of mushrooms.*

**Figure 21–9** *You cannot tell by looking, because many species of poisonous mushrooms look very similar to edible mushrooms.*

# The Imperfect Fungi

## Use Visuals

**Figure 21–10** Ask students: **What is this blue-green deuteromycete growing on?** *(An orange)* Have students relate experiences with this same phenomenon at home, and point out that they may have observed an important and famous fungus in their own homes without realizing it. Ask: **What is the antibiotic penicillin used to kill?** *(Harmful bacteria)* Review with students what they learned in Chapter 19 about bacteria and antibiotics. L1 L2

## 3 ASSESS

## Evaluate Understanding

Have students write a paragraph that compares and contrasts the life cycles of a sac fungus and a club fungus.

## Reteach

Ask students to make a compare/contrast table entitled The Four Main Groups of Fungi. Column heads could include *Name, Phylum Name, Characteristic Structures, Life Cycle,* and *Examples*. Students should include as many important details about each of the four main groups as possible.

**You & Your Community**

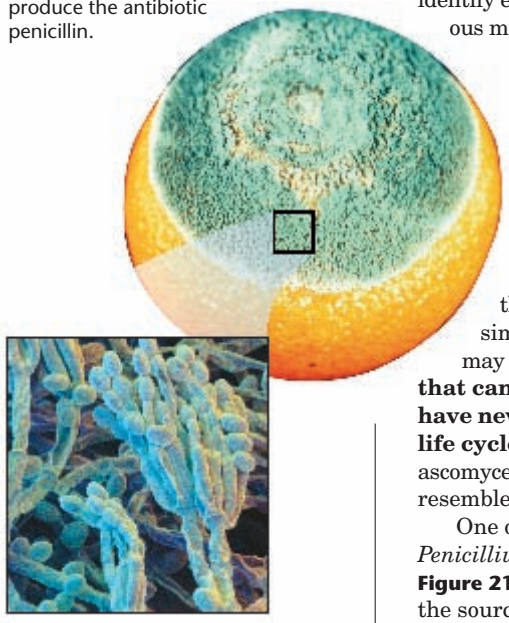
Encourage students to talk to the produce manager at a local supermarket. Students might also talk with the chefs of local restaurants, including Asian restaurants. Suggest that they investigate foods using portobello mushrooms (*Agaricus bisporus*), oyster mushrooms (*Pleurotus ostratus*), shiitake mushrooms (*Lentinus edodes*), or enoki mushrooms (*Flammulina velutipes*). Blue cheese is made using a *Penicillium* mold. *Aspergillus* fungi are used to produce soy sauce, as well as the Japanese food called *miso*.

Interactive Textbook

If your class subscribes to the iText, use it to review the Key Concepts in Section 21–2.



**Figure 21–10** **The phylum Deuteromycota is made up of fungi that cannot be classified in any other phylum.** Under the microscope, the brushlike clusters of many small, spherical conidia characterize *Penicillium notatum.* This organism was the first of the *Penicillium* fungi used to produce the antibiotic penicillin.



(magnification: 930×)

**Edible and Inedible Mushrooms** Many types of fungi have long been considered delicacies, and several different species of mushrooms are cultivated for food. You may have already tasted sliced mushrooms on pizza, feasted on delicious sautéed portobello mushrooms, or eaten shiitake mushrooms. When properly cooked and prepared, domestic mushrooms are tasty and nutritious.

Wild mushrooms are a different story: Although some are edible, many are poisonous. Because many species of poisonous mushrooms look almost identical to edible mushrooms, you should never pick or eat any mushrooms found in the wild. Instead, mushroom gathering should be left to experts who can positively identify each mushroom they collect. The result of eating a poisonous mushroom can be severe illness, or even death.

## The Imperfect Fungi

Fungi are usually classified by the sexual phase of their life cycle. So, what do biologists do when they discover a fungus that does not seem to have a sexual phase? Until a sexual phase is discovered, scientists place it in the phylum called Deuteromycota, or imperfect fungi. The term *imperfect*, by the way, doesn't mean that there's anything wrong with these organisms. It simply means that *our* understanding of their life cycles may not be perfect. **The Deuteromycota are fungi that cannot be placed in other phyla because researchers have never been able to observe a sexual phase in their life cycles.** A majority of the imperfect fungi closely resemble ascomycetes. Others are similar to basidiomycetes, and a few resemble the zygomycetes.

One of the best-known genera of the imperfect fungi is *Penicillium*. The species *Penicillium notatum,* shown in **Figure 21–10**, is a mold that frequently grows on fruit and is the source of the antibiotic penicillin. Like the ascomycetes, *Penicillium* reproduces asexually by means of conidia, leading many biologists to conclude that *Penicillium* evolved from an ascomycete that lost the sexual phase of its life cycle.

## 21–2 Section Assessment

1. **Key Concept** List the four phyla of fungi, and identify the main characteristics of the members of each phylum.
2. How do conidia form? What is their function?
3. Which fungal phylum contains the largest number of species?
4. **Critical Thinking Comparing and Contrasting** Compare the structure and function of an ascus and a basidium.
5. **Critical Thinking Comparing and Contrasting** Compare asexual and sexual reproduction in bread mold. At what stage does meiosis occur?

**You & Your Community**

**Exploring Your Community**
Visit a local supermarket to find out how fungi are used in the cuisines of different cultures. Select a particular fungus, research recipes in which it is used, and try one of the recipes. You may also want to find the scientific name of the fungus you have selected.

## 21–2 Section Assessment

1. Zygomycota have life cycles that include a zygospore. Ascomycota have asci that contain spores. Basidiomycota have a reproductive structure that resembles a club. Deuteromycota do not have an observed sexual phase.
2. In asexual reproduction of some ascomycetes, tiny spores called conidia are formed at the tip of specialized hyphae.
3. Phylum Ascomycota
4. The ascus, a sac that contains spores, forms within the fruiting body of an ascomycete. Within the ascus, two nuclei fuse to form a diploid zygote. The spore-bearing structure of a basidiomycete, called the basidium, is found on the gills of mushrooms. A basidiospore germinates to produce a haploid primary mycelium.
5. Students should describe both sexual and asexual reproduction, as discussed on page 530 and in Figure 21–5. Meiosis occurs when conditions become favorable and the zygospore germinates.