

The Fabulous Fungi



MATERIALS

- ▶ Samples and photos of fungi (see Preparation)
- ▶ Textbooks, field guides and/or Web text that discusses fungi and their life cycles
- ▶ 400x microscope (optional)
- ▶ Viewing Guides, one per student

PREPARATION

You will need to set up two sets of exploration stations at which students can examine fungi and photos of fungi. The first set will allow simple exploration and the second will invite more in-depth study.

For Set 1: Samples, photos and questions to be provided by teacher.

Set up a few stations around the room with fungi and/or pictures of fungi. Prepare cards containing thought-provoking questions for each station. For example, beside a sample of bread mold, a question might be: "How do you think this fungus reproduces?"

For Set 2: Questions and set-up resources attached.

Prepare seven stations at which students can explore in more depth the characteristics and functions of fungi.

Sources of fungi:

- ▶ Check for expired food in refrigerators.
- ▶ Visit the grocery store produce aisle to find a variety of mushrooms. You might also look for Roquefort, blue or brie cheeses, which contain the mold *Penicillium*.
- ▶ Ask students a week before the lesson to look for mushrooms and molds to bring to class.
- ▶ Grow bread molds and yeast cells on your own or in the classroom.
For bread mold: Moisten a piece of bread (without preservatives), place between two pie tins and secure with a rubber band. Within a week, a nice array of molds should sprout.
For yeast cells: Mix a little powdered yeast in warm water and add a pinch of sugar. Yeast cells will grow in a few days. You must view the cells with a microscope (400x).

STANDARD COURSE OF STUDY CORRELATIONS:

Biology, Goal 4: The learner will develop an understanding of the unity and diversity of life.

4.01 Analyze the classification of organisms according to their evolutionary relationships.

- Similarities and differences among the eukaryotic kingdoms: Protists, Fungi, Plants, and Animals.

Biology, Goal 5: The learner will develop an understanding of the ecological relationships among organisms.

5.01 Investigate and analyze the interrelationships among organisms, populations, communities, and ecosystems

- Techniques of field ecology.
- Abiotic and biotic factors.
- Carrying capacity.

INTRODUCTION TO LESSON: Students will do a two-part activity in which they visit classroom exploration stations to examine fungi and answer questions about the characteristics of fungi and their function in the environment. Students will later research a fungal phylum and do a report or Webquest. They will also watch the video and answer Viewing Guide questions.

BACKGROUND FOR TEACHER: Although fungi may seem to be closely related to plants, they are actually more closely related to animals. Fungi can be found in most environments—in air, in water, in soil and on other organisms. Fungi are so important in an ecosystem that the type of fungi in a given environment will determine the types of plants and animals that can live there. Scientists think that they may have identified only about 5 percent of the different types of fungi on the planet.

Fungi are *heterotrophic* (they need to feed off other organisms) and *saprophytic* (they excrete enzymes externally, digest whatever they are living on, and then absorb the digested nutrients into the fungal cells). Some fungi are *parasitic*. The cell walls of fungi are composed of chitin, which is the material found in the exoskeletons of some animals, whereas the cell walls of plants are composed of cellulose. Plants store their sugar as starch, while animals and fungi store their sugar as glycogen.

Fungi can reproduce sexually and asexually. During sexual reproduction, the only diploid stage is the zygote. After fertilization to form the zygote, meiosis occurs, and the spores that produce the thread-like hyphae are all haploid.

There are four main groups of fungi: Basidiomycetes, Ascomycetes, Zygomycetes and Chytridiomycetes. The distinctions are based on the reproductive structures of the fungus.

- The Basidiomycetes are the mushrooms that we commonly see.
- The Ascomycetes are the morels and truffles and reproduce using sac-like structures.
- The Zygomycetes are the molds that reproduce with small structures that produce spores.
- The Chytridiomycetes are microscopic and were once classified with Protista. These fungi can be found in the digestive tract of cows and help digest the cellulose that cows eat.

engage > Set 1: Have students visit the stations to examine various fungi. Give students several minutes at each station and allow them to discuss their answers to the questions with each other. Emphasize that they are expected to do their best thinking and will not be graded on “right or wrong.” In addition, have students identify any questions that they have. What do they want to know more about?

explore > Show the video and have students answer Viewing Guide questions. Discuss answers.

explain > Set 2: Divide class into seven groups and have them circulate among the seven stations. Ideally, each group of students will visit each of the stations, and its members will work together to answer the questions. Alternatively, you could assign each group of students to a separate station and have the groups report their work to the entire class.

elaborate > Have each group of students research one of the following fungal phyla:

- Zygomycota (bread molds)
- Ascomycota (mildews and molds)
- Basidiomycota (mushrooms, puffballs, rusts, smuts)
- Glomeromycota (mycorrhizae)
- Chytridiomycota (microscopic, aquatic)
- Blastocladiomycota (microscopic, parasitic)
- Neocallimastigomycota (microscopic, lives in the guts of herbivorous mammals)
- Mycophycophyta (lichens)

Students should gather information on fungi structures, functions, methods of reproduction, role in the environment and unique features that differentiate the phylum from other organisms. They may assemble the information into a group report or do a Webquest (<http://webquest.org/>).

evaluate > Students are to keep a notebook with their initial questions and answers from the *Engage* activity, their Viewing Guide answers and their fungi exploration report. Have them write a summary of what they have learned.

Teacher's Notes:

BEYOND THE CLASSROOM

Go on a mushroom hunt in a nearby forest. Take field guides and materials for collection, including small trowels, boxes and baggies.

Additional Resources:

Photographs and fun activities related to fungi •

http://botit.botany.wisc.edu/toms_fungi/

Excellent photographs of the various types of fungi •

<http://tolweb.org/fungi>

Fungi information that could be used for a Webquest •

<http://www.ucmp.berkeley.edu/fungi/fungi.html>

Photos and information on mushrooms and fungi of North Carolina •

<http://www.biology.duke.edu/fungi/>

• <http://www.duke.edu/~jspippen/fungi/mushrooms.htm>

A Field Guide to Mushrooms: North America (Peterson Field Guide Series). McKnight, Kent H. and Vera B. 1987. New York: Houghton Mifflin Co.

National Audubon Society Field Guide to North American Mushrooms. Lincoff, Gary H. 1981. New York: Knopf.

North American Mushrooms: A Field Guide to Edible and Inedible Fungi (FalconGuide). Miller, Dr. Orson K. Jr. and Hope H. Miller. 2006. Guilford, Conn.: The Globe Pequot Press.

Teacher's Set-up Guide for Set 2 Stations

In addition to placing textbooks or field guides at each station, you will need to gather a collection of fungi and photos of fungi for students to examine, including examples of a fairy ring, lichens, hyphae, bread mold, *Penicillium* mold, edible mushrooms and yeast cells.

Collect the following items or pictures of items, label them and place them at corresponding stations. Web sites are included here for acquiring the necessary illustrations/photographs. You might choose to find your own images.

Station 1: Adaptations

- Lichen sample (Look for these grayish-green, fungus-like organisms on tree bark or rock surfaces.)
- Picture of fairy ring (<http://web.utk.edu/extepp/profiles/OT/turfgrass/diseases/fairyring-1.jpg>)

Station 2: Nutrition

- Example of decomposition by fungi (Leaf being decomposed by fungus; note mycelia of the fungal organism. <http://www.ipm.iastate.edu/ipm/hortnews/files/images/mycelium-on-leaf-litter.tif.jpg>)
- Diagram of energy pyramid with decomposers (<http://www.rbnc.org/schoolunits/schlphoto/natpyra/food-pyramid.jpg>)

Station 3: Transport, Excretion and Respiration

- Hyphae (You might dig up rich soil in the woods, display hyphae from a bread mold and/or use images showing the relationship between the larger mycelia and the smaller hyphae at <http://upload.wikimedia.org/wikipedia/commons/thumb/f/f1/Hyphae.JPG/800px-Hyphae.JPG> and <http://mycorrhizas.info/ecm/ecmhyphae2.gif>)

Station 4: Reproduction

- Mushrooms
- Bread mold
- Bread mold life cycle image (<http://universe-review.ca/I10-21-fungi1.jpg>)
- Mushroom life cycle image (<http://www.fungi.com/info/infopics/lifecycle/lifecycle.gif>)
- Ascomycetes life cycle image (<http://www.palaeos.com/Fungi/Ascomycota/Images/AscoReproCycle.gif>)

Station 5: Comparison to Plants

- Samples of fungus and plant, side by side
- Illustration of plant life cycle (<http://www.butler.edu/herbarium/treeid/lifecycleflower.jpg>)
- Illustration of fungus life cycle (<http://cas.bellarmine.edu/tietjen/Laboratories/Bio%20Pix%204%20U/Image49.gif>)

Station 6: Value to Humans

- *Penicillium* mold (<http://media-2.web.britannica.com/eb-media/25/59225-004-FDOE7C1B.jpg>)
- Edible mushrooms (http://www.jesperlaunders.com/img/client/18_edible_mushrooms_and_long_shadows.jpg)
- Yeast cells under microscope (actual cells and 400x microscope or image at <http://bugs.bio.usyd.edu.au/learning/resources/CAL/Microconcepts/images/Topics/Diversity/buddingYeastCells.jpg>)

Station 7: Fungal Diseases

- Ringworm image (<http://z.about.com/d/pediatrics/1/0/a/2/ringworm.jpg>)
- Athlete's foot image (http://www.consumerreports.org/health/resources/images/conditions/athletes-foot_default.jpg)
- Crop fungus image, e.g. tomato (<http://www.garden.ie/img/troubles/215.jpg>)

Fungi Exploration

Station 1: Adaptations



1. After it rains, mushrooms often pop up all over a forest. Why is this? What is the value of this adaptation?
2. The kingdom Fungi contains some of the largest organisms on Earth. What is the reason for this?
3. How do fungal spores ensure the survival of the species?
4. Why do “fairy rings” become larger each season?
5. Fungi often form relationships with other organisms. Sometimes a fungus will form a symbiotic relationship with an alga; sometimes a fungus will form a symbiotic relationship with a plant. What is the name of each of these relationships? How do these relationships benefit the fungus and the alga or plant?
6. How can being toxic benefit a fungal organism?

Fungi Exploration

Station 2: Nutrition



1. Generally, how do fungi get food for their energy needs?
2. Fungi are called *eukaryotic*, *heterotrophic* and *multicellular*. What do each of these terms mean?
 - a. Eukaryotic
 - b. Heterotrophic
 - c. Multicellular
3. Most fungi are *saprophytic*. What does this term mean?
4. Some fungi are *parasitic*. How do these fungi get their food?
5. Some fungi are *mycorrhizal*. What does this term mean?
6. How is fungi nutrition related to the ecological process of decomposition?

Fungi Exploration

Station 3: Transport, Excretion and Respiration



1. How do fungi get rid of waste?
2. What structures do fungi use to get water?
3. How do fungi get oxygen for cellular respiration?
4. A fungus digests food outside of its “body.” How does the digested food get into the fungal cells so it can be used?
5. What processes do fungi use to get energy out of their food?

Fungi Exploration

Station 4: Reproduction



1. Each phylum of Kingdom Fungi has a unique structure for producing spores (except for the Imperfect Fungi). What are these structures? List them for each of these groups: Zygomycota, Ascomycota, Basidiomycota.
2. Most fungi reproduce sexually and asexually. Describe asexual reproduction in fungi.
3. Describe sexual reproduction in fungi.
4. What are some ways in which spores are dispersed far away?
5. What is meant by “haploid” mating types and “diploid” zygotes?
6. How are Imperfect Fungi different from the other three groups of fungi?

Fungi Exploration

Station 5: Comparison to Plants



1. Fungi were once thought of as unusual types of plants. In what ways are fungi different from plants?
2. Which probably appeared on land first—fungi or plants?
3. What role did fungi probably have in helping to support early plant life?
4. What is the evidence that plants and fungi may be co-evolving?
5. What part of a plant is largest and most visible—vegetative or reproductive? What part of a fungus is most visible?
6. Where is most of the vegetative part of the fungus located?

Fungi Exploration

Station 6: Value to Humans



1. Fungi are considered a delicacy in the human diet. Name at least three different types of edible fungi.
2. Which phylum of fungi contains most of the fungi we eat?
3. Morels and truffles belong to what phylum of fungi?
4. What are the conditions in the warehouses in which edible mushrooms are cultivated?
5. What important drugs to treat bacterial infections come from fungi?
6. Why are fungi important in a compost bin?

Fungi Exploration

Station 7: Fungal Diseases



1. Describe two fungal diseases in humans.
2. Describe where fungi like to grow on the human body.
3. What are some fungal diseases than can affect plants?
4. What conditions are necessary for fungi to grow on the scalp, feet, plants, etc.?
5. Why is it common in North Carolina for molds to grow in areas inside a house, such as bathrooms?