6. FUNGI

INTRODUCTION

The Kingdom Fungi includes a diversity of organisms that all have certain traits in common. They are **heterotrophic** (consumers) obtaining their nutrients by absorption. They digest their food outside of their bodies and then absorb the digested products into their cells. Some are **decomposers**, feeding on dead and decaying material. Some fungi are **predators**, capturing and killing their prey (nematodes for example). Other fungi are **parasites**, living off of another organism without killing the host (ringworm is really a fungus on your skin). Still others form mutualistic associations with plant roots; these fungal/root associations are called **mycorrhizas**. Through this relationship fungi contribute to plant growth and survival by obtaining nutrients and water through a vast array of hyphae.

Fungal bodies are made of thread-like structures called **hyphae** that grow through the growth media - dead wood, leaf mold, soil, skin, glass, etc. Each cell is surrounded by a cell wall made up of a carbohydrate called **chitin**. A mass of hyphae is called **mycelium.** When the fungus is ready to reproduce it will produce spores either **sexually** or **asexually**. We usually only notice the fungus when it reproduces because the individual hyphae are too small to see with the naked eye, but the structures that hold the spores are larger and more obvious. Those fungi that reproduce **asexually** have spore-producing structures called **sporangia**. In the fungi that reproduce **sexually** we call the spore-producing structure a **fruiting body** (like a mushroom), or in the case of the Zygote fungi it is also called a sporangium.

Here is a review of the basic classification system used for all living organisms:

Type of Cell	Domain	Kingdom	Example
Prokaryotic	Archaea	***Not Used***	Prokaryotic organisms found in extreme environments
Prokaryotic	Bacteria	***Not Used***	common bacteria, cyanobacteria
Eukaryotic	Eukarya	Protists	algae, *Paramecium*, *Amoeba*, *Euglena*
Eukaryotic	Eukarya	Fungi	mushrooms, mold, *Penicillium*
Eukaryotic	Eukarya	Animals	vertebrates, insects, nematodes, sponges
Eukaryotic	Eukarya	Plants	moss, ferns, redwoods, flowering plants

GOALS AND OBJECTIVES

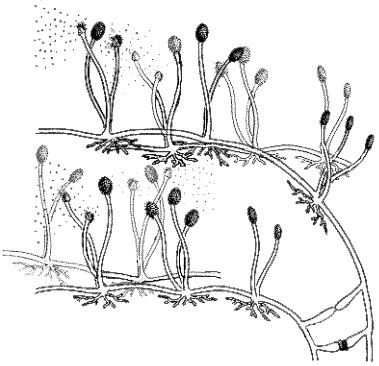
1. Know the distinguishing characteristics of the Fungi.
2. Understand the life history of fungi. Know the function of hyphae, sporangia, fruiting bodies, and spores.
3. Recognize and distinguish the Kingdom Fungi from organisms in other Kingdoms.
4. Understand the differences between sexual and asexual reproduction, and the advantages and disadvantages of each.
5. Be able to recognize the three phyla of the Kingdom Fungi.
6. Understand the ecology and structures of lichens.
7. Be able to identify the three different forms of lichens.

KINGDOM FUNGI CLASSIFICATION USED IN LAB

Fungi are divided into three phyla depending on their mode of reproduction.

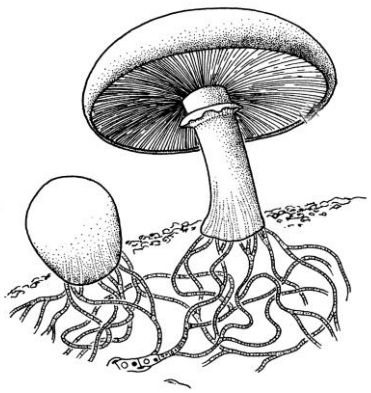
PHYLUM ZYGOTE FUNGI – bread molds and other terrestrial molds

Sexual reproduction begins with the fusion of two different types of hyphae and results in the formation of a resistant structure (a type of fruiting body) that produces a sporangium. This sporangium forms many spores with combined traits of each parent. Zygote Fungi also reproduce asexually by forming a sporangium that produces spores genetically identical to the original hyphae.



PHYLUM CLUB FUNGI – mushrooms, shelf fungi, puff balls, earthstars, and coral fungi

Mushrooms are a familiar example of a fruiting body of the club fungi. Club Fungi sexually reproduce four spores on the surface of club-shaped structures called **basidia**.



PHYLUM SAC FUNGI – yeast, morels, truffles, *Penicillium*, and other blue-green molds

Sexual Reproduction results in eight spores that are formed in sac-like structures called an **ascus**.

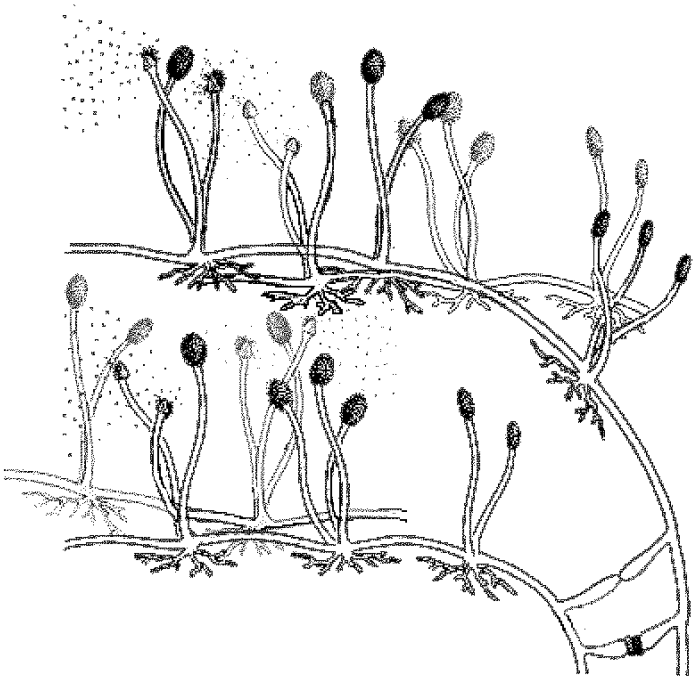
FUNGAL ANATOMY AND GROWTH

Phylum – Zygote Fungi

Observation 1 – Bread Mold: *Rhizopus stolonifer*

A. Look at the prepared slides of *Rhizopus* using the compound microscope.

B. Identify the **hyphae, sporangia**, **spores** and areas of **conjugation**. Label the diagram.

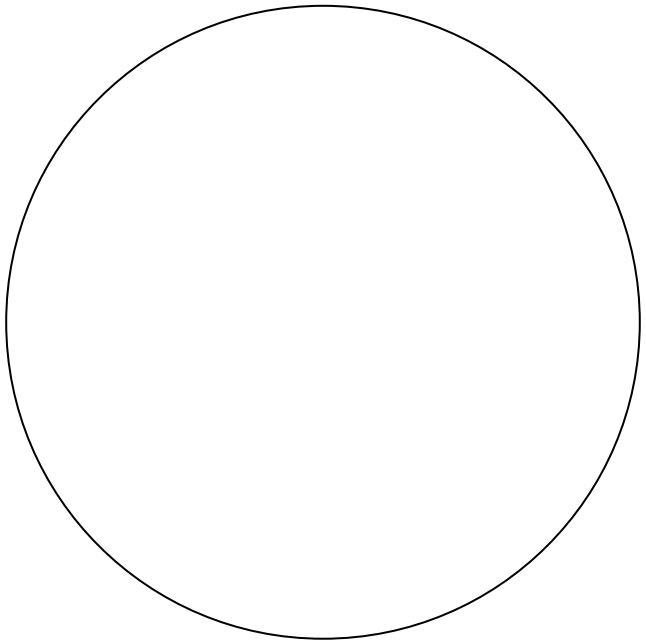


1. Describe the hyphae, their role in the life of the fungi, and major activities that occur around the hyphae

2. What is the function of the sporangia?

3. What is the function of the spores?

Rhizopus (compound microscope). Make illustrations of bread mold fungi as you see them.



Phylum: _____

Objective Lens: _____

Total Magnification: _____

1. Describe the shape of a hyphal filament.

2. How does this shape allow for maximum nutrient acquisition?

3. Hyphae elongate from the tip. How does this help them obtain nutrients from their environment?

Humidity and Fungal Growth

Consider the conditions under which fungi will grow. Do they require light, darkness, moisture?

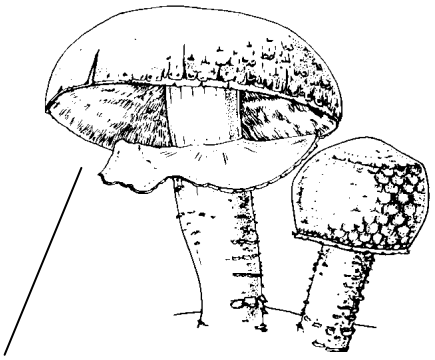
1. What are the requirements for fungal growth?

2. What rooms of your home are most likely to promote fungal growth?

3. There are fungi that infect human skin. What parts of the body are most likely to promote fungal growth?

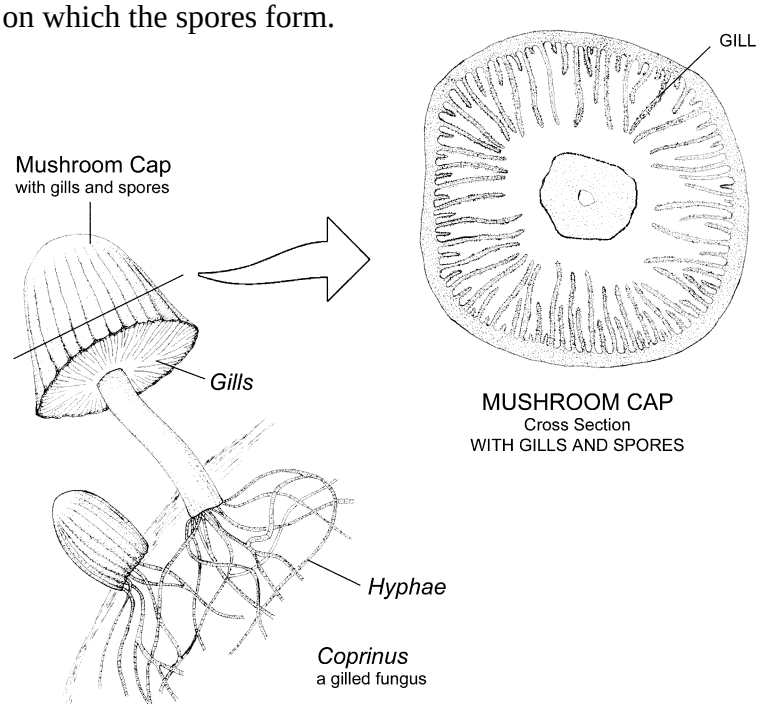
Phylum – Club Fungi

Club fungi are the typical types of fungi that we think of as a mushroom. The fruiting bodies of the club fungi vary widely and are grouped by general characteristics such as the area or structure on which their spores are formed. For instance gill fungi are club fungi that reproduce on structures called gills. On these gills are minute club-like structures called basidia that produce spores.



Gill Fungi
(A type of Club Fungi)

♣ Notice the gills on which the spores form.



***Coprinus* cross-section** (prepared slide)

Observe a prepared slide of the mushroom *Coprinus* under the compound microscope.

A. Focus using the 4X lens and locate the edge of a gill. Observe with the 10X and 40X lenses.

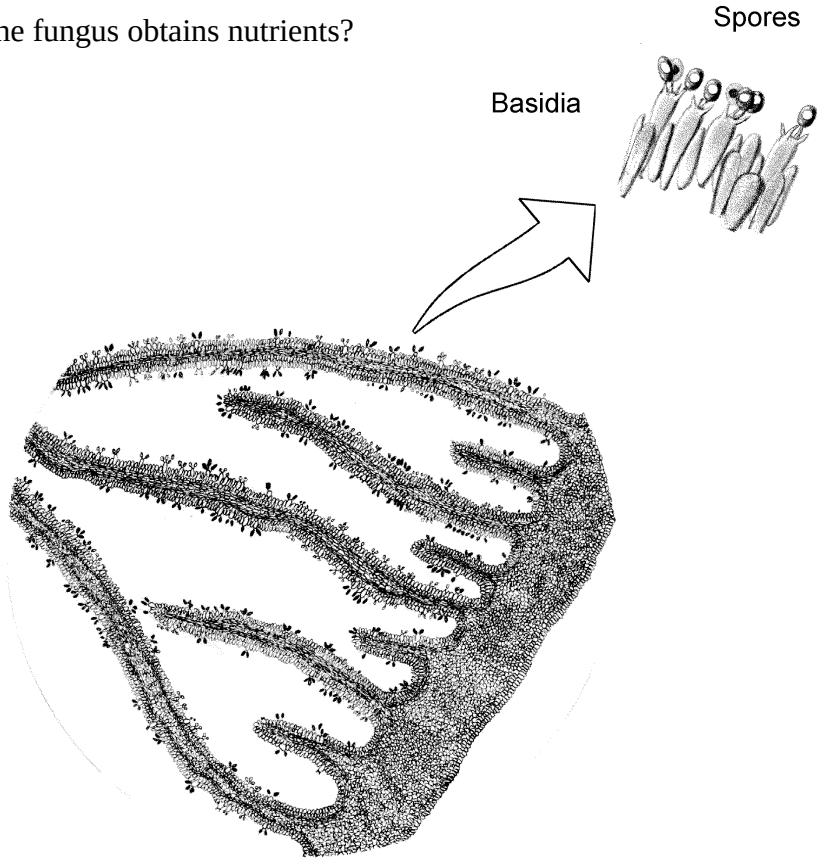
B. Observe the club-shaped structures (called basidia) on which spores are produced. The club fungi derive their name from these club-shaped structures.

C. Observe the many red-stained reproductive structures called spores. Note the mature spores are stained red. This should illustrate just how numerous the spores are in a single mushroom.

D. The slide shows a section through the type of mushroom pictured on the previous page. On that drawing, circle the portion of the fruiting body seen on this slide.

1. On which part of the mushroom *Coprinus* are the spores formed?

2. Which part of the fungus obtains nutrients?

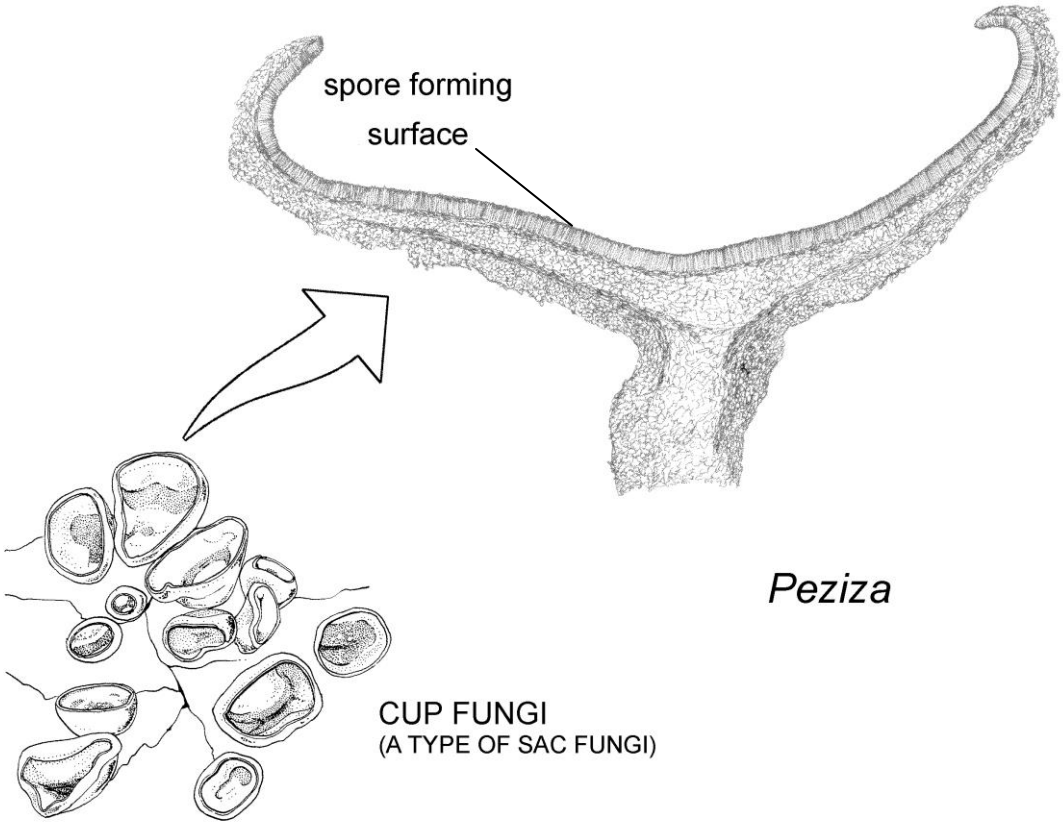


Gills with Club-Shaped Basidia and Spores

♣ Phylum – Sac Fungi.

Although the Sac Fungi are less familiar to most people this phylum is very important economically. Yeast is a sac fungus used to make bread, beer, and wine. *Pencillium* is a sac fungus that was the source of the first antibiotic and its close relatives are responsible for the flavor of cheeses such as Brie and Roquefort. Truffles and morels are sac fungi prized for flavor. Still others cause extensive economic damage as they cause crop diseases or food spoilage.

All sac fungi reproduce 8 spores in sac-like structures called asci.

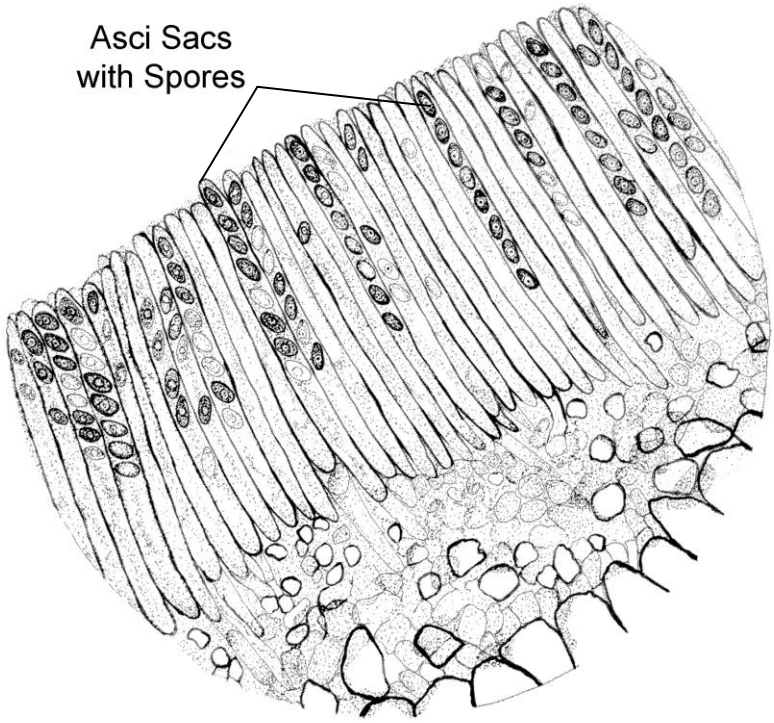


***Peziza* cross-section** (prepared slide).

Obtain a prepared slide of the cup fungus *Peziza* (cross section).

A. Focus your microscope on the slide and locate the asci sacs along the upper layer. Notice that each mature asci sac contains 8 spores.

B. Identify the asci sac and spores.



Fungal Diversity Review

1. What are the unique/distinctive characteristics of the Fungi?

2. How are the other fungi on display similar to *Rhizopus*? How are they different?

3. Which is the dominant or more common structure in a fungus' life cycle, the fruiting body or the hyphae below the surface? What is the function of each?

4. Imagine an ecosystem without fungi. How would it be different?

5. What do you think the advantages and disadvantages are for asexual reproduction? And for sexual reproduction?

6. List four **economically** important **uses** of fungi.

1.

2.

3.

4.

7. List three **ecologically** important **roles** of fungi.

1.

2.

3.

Lichens

Lichens are a **mutualistic** relationship between a fungus and an alga. The fungus provides a protective environment for its photosynthetic algal partner. The fungus benefits by having a source of nutrients, which leak, from the algal cells.

There are three types of lichens: crustose, foliose, and fruticose. **Crustose** lichens form a crust-like layer on the surface of rocks or branches. It is almost impossible to separate a crustose lichen from its substratum. **Foliose** lichens appear as a leaf-like layer on the substratum. If it is possible to get a pin beneath the lichen it is foliose (not crustose). The third type is the fruticose lichen. **Fruticose** lichens hang from branches or are shrub-like. Since lichens absorb both water and minerals from the air they are sensitive to air pollution. An area with an abundance of lichens probably has good air quality.

Observation 10 – Lichen

Examine the lichen specimens with your naked eye and then the dissecting microscope.

1. What two organisms make up a lichen? What are their modes of nutrition (autotrophic or heterotrophic)?

Organism	Mode of Nutrition
1.	
2.	

2. Which organism in a lichen produces a source of energy-rich nutrients that feeds the other?

3. When two organisms live in close association, what term is applied to the relationship?

4. What term applies when both benefit from the relationship?

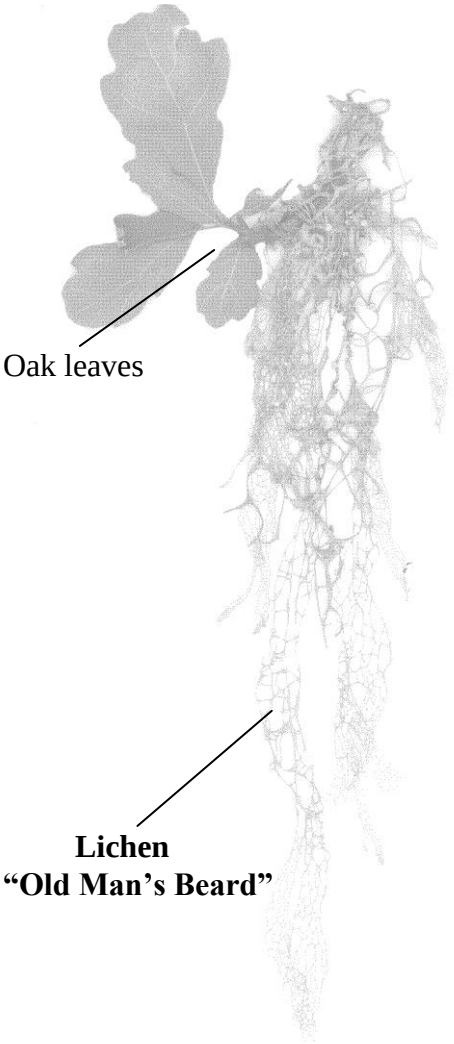
5. Name at least one ecological role of lichen in the environment.

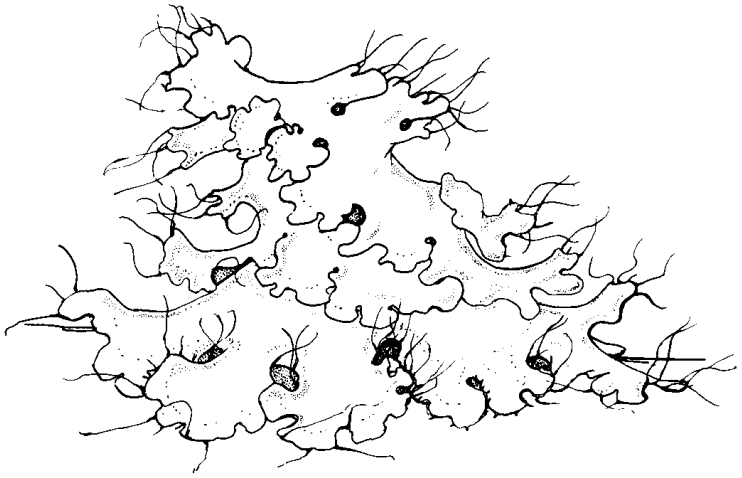
♣ **Observation 12 – Types of Lichens**.

Name three types of lichens and be able to identify each.

1. 2. 3.

Fruticose Lichen





Foliose Lichen

Crustose Lichen