Spring 2003

Biology 204 Laboratory 4. Biodiversity: Fungi and the Lower Animals

Textbook Reading: Chapter 31; Chapt. 32 pp. 633-639; Chapt. 33 pp. 646-655. Pay particular attention to Fig. 32.8 in your book.

Objectives

1. Understand the distinctive characteristics shared by organisms in the kingdom Fungi
2. Become familiar with the morphology of 3 phyla of fungi.
3. Understand the basic fungal life cycle and how the three different phyla vary in this life cycle.
4. Examine fungi exhibiting various fungal life styles such as yeasts, molds, lichens and mycorrhizas and realize that these life styles are carried out by fungi in more than one phylum.
5. Understand the distinctive characteristics shared by organisms in the kingdom Animalia.
6. Understand the distinctive characteristics shared by organisms in the following phyla: Porifera, Cnidaria, Platyhelminthes, Nemertea. Be aware of the existence and distinctive characteristics of the following phyla: Ctenophora, Rotifera, Phoronida, Brachiopoda.
7. Understand the distinctive characteristics shared by organisms in the following classes: *Cnidaria*: Hydrozoa, Scyphozoa, Anthozoa; *Platyhelminthes*: Turbellaria.
8. Recognize how each taxon (phylum and class) feeds and deals with living in water or on land.
9. Be able to identify an organism on display into its proper phylum and, if appropriate, class.
10. Understand the evolutionary relationships between the lower animals and the key innovations that distinguish them.

Key Themes

1. The fungi are absorptive heterotrophs, a central commonality in all their diverse lifestyles.
2. All fungi have a zygotic life cycle, in which meiosis occurs soon after fertilization, so that most growth is in the haploid state.
3. The three most common fungal phyla are differentiated by the way in which they form spores.
4. Phylogeny of the animal phyla has changed considerably in the last few years. Classification used to be based on body plans, but molecular data have caused us to rearrange the protostomes.
5. Animals can still be differentiated by body tissues, body cavities, embryological development and larval type.

Key Terms

Kingdom Fungi

phylogeny	parasite	Stipe
hyphae	decomposer (saprobe)	veil
mycelium	mutualist	gill
sporangium	zygosporangium	mold
conidia	asci	thallus
spores	basidia	lichen
dikaryotic	ascocarp	crustose
heterotrophic	basidiocarp	fruticose
yeast	cap	foliose
		mycorrhizae

Kingdom Animalia

radial symmetry	tissues	oral end
bilateral symmetry	organs	aboral end
diploblastic embryos	larvae	polyp
triploblastic embryos	gastrovascular cavity	medusa
epidermis	complete digestive system	acoelomate
gastrodermis	filter feeders	pseudocoelomate

Samples (refer to the chalkboard for updates)

Kingdom Fungi

prepared slides: 76, 73, 77, 75	representative fungi from 3 phyla
slides and coverslips for fresh preparations	yeast culture
forceps	representative lichens

Kingdom Animalia

prepared slides: *Obelia* (88, 89), *Hydra* (87), *Planaria* (91)	acontia squash demo
representative sponges	representative flatworms
spicule demonstration	representative nemerteans
water flow demo	representative rotifers
representative cnidarians (three classes)	representative bryozoans

What to do

Kingdom Fungi

There are approximately 80,000 species of true fungi. Until recently, the kingdom Fungi contained many additional organisms (such as water molds and slime molds) that are now classified in Protista. You will start this lab by examining representatives from phyla of the true fungi. Then you will study examples of "fungal life styles" that apply to all three phyla.

The fungi are defined by having eukaryotic **hyphae**, non-motile (unflagellated, that is) **spores**, and **absorptive, heterotrophic** nutrition (enzymatic digestion of their food is external to their "bodies"). The hyphae of fungi are long "threads" of cells, many of which form an extensive and diffuse **mycelium**, the "body" of an individual fungus. It is this mycelium that is ecologically active, playing one of three roles in specific habitats: **decomposer**, **parasite** (mostly on plants), or **mutualist**. Although mycelia can be active throughout the year, the spore-producing structures they make (such as mushrooms) are usually formed during restricted times. The kingdom Fungi includes four phyla, three of which we will investigate in this lab: Zygomycota, Ascomycota and Basidiomycota. These phyla are distinguished by details of their sexual stages, specifically by the structures in which meiosis and spore formation occur. Some fungi in each phylum are microfungi (mycelium only; little or no macroscopic structures) and some are macrofungi (mycelium produces macroscopic **"fruit bodies"** for spore production).

Phylum Zygomycota: "Zygote Fungi"

Members of the Zygomycota are characterized by producing coarse haploid hyphae that usually lack cross walls, by the production of asexual spores inside asexual **sporangia** (spore sacks), and by the production of **zygosporangia** as the distinctive sexual stage. (See figure 31.7 in your text.)

This phylum includes the black bread mold, *Rhizopus* and other common molds that decompose a variety of substrates in soil. *Rhizopus* grows well on any medium rich in starch. It reproduces rapidly by forming asexual spores. Later, if the proper mating type is present, it will produce special sexual zygosporangia.

Obtain a Petri plate with potato dextrose agar medium that has been inoculated with two mating types of *Rhizopus* separated by several centimeters. Examine the cultures under the dissecting microscope. Identify the hyphae, asexual sporangia, and asexual spores. Look for the sexual zygosporangia. Prepared slide (# 76) includes *Rhizopus* (along with two unrelated molds - see below, p. 4). How can you visually differentiate between the asexual sporangia and the zygosporangia? Is there any difference between the spores produced by each in terms of ploidy?

Phylum Ascomycota: "Sack fungi"

All members of this phylum produce sack-shaped sexual sporangia called **asci** (singular, ascus) at some point in their life cycles. They often also reproduce asexually early in their life (we'll discuss this further on in the section on molds). Ascomycota range from unicellular forms with no hyphae (yeasts) to complex forms with asci contained in fruiting bodies (**ascocarps)** both above and below ground - the latter, the true truffles. (See figure 31.10 in your text).

Examine the living "cup fungus" material if available (perhaps the genus *Peziza*, *Aleuria*, or *Morchella*). Identify the cups (ascocarps that are in the shape of open cups are also called apothecia). The cups are produced on the surface of the substrate in which the mycelium is living (this mycelium may be saprobic, parasitic or mutualistic). Examine the prepared slide of a cross section of *Peziza* (# 73) and look for the hyphae that make up the structure of the cup, the asci, and the spores within them. How many spores are in each ascus?

Phylum Basidiomycota: "Club fungi"

All members of this phylum produce club-shaped cells called **basidia** during sexual reproduction. Four spores are produced outside each basidium on small spines. Some of the primitive members of the phylum, the rusts and smuts, are nasty plant parasites. In the more advanced members, the basidia are contained in a fruiting body called a **basidiocarp**, such as mushrooms, puffballs and the "brackets" of the shelf fungi. In contrast to Ascomycota and Zygomycota, Basidiomycotes have a long-lived **dikaryotic** mycelial phase. (See figure 31.12 in your text).

Agaricus. This genus includes the species of the common commercial mushroom (*Agaricus brunescens*) and a number of wild relatives, some of which are edible (and some, not). Examine a button and note the **cap, stipe** ("stem"), and the **veil** (a thin membrane between the margin of the cap and the stipe). The underside of the cap is formed into numerous, flap-like "**gills**" (lamellae) to increase the spore-bearing surface. Examine a slightly older mushroom: the gills become darker as the dark spores mature. Spore color is one of the most important features used to identify mushrooms. In many mushrooms, including *Agaricus*, the veil forms a ring on the stipe, another of features identifying mushroom genera. Examine the prepared slide (# 77) of a cross section of *Coprinus* (inkcap mushroom) gills, looking for the basidia and spores. How many spores are associated with each basidium?

Examine the examples of Basidiomycota, making note of the great diversity in fruiting body structure. Especially, look closely at the shelf fungi, or "polypores," in which the basidia line the interior of cylindrical "pores."

Fungal life styles

The fungi in the above phyla can live their lives along specialized "life styles" adapted to specific conditions. We give these fungi common names, that aren't necessarily taxonomic, for example truffles (below-ground fruit bodies) and mycorrhizas (fungus roots - see text and lecture). In this part of the lab you will investigate three others: yeasts, molds, lichens. Keep in mind that each life style is shared by fungi from several phyla.

Yeasts

Some members of all three of the fungal phyla live as unicells. The unicellular life style is an adaptation to living in plant sap. *Saccharomyces cerevisiae* is the common brewer's or baker's yeast that is able to ferment sugar solutions into ethanol and carbon dioxide. Examine a drop of yeast culture and note the size and shape of the cells. Look for and observe cells undergoing **budding**, the asexual reproduction of this yeast (see fig. 31.15). Although asci are rarely produced by this yeast, it is known to be an Ascomycote. There are also yeast-forming fungi that form basidia and zygosporangia. Where would you expect yeasts to be found in nature? Why is *Saccharomyces* valuable in brewing and baking?

Molds

“Mold” is a general term for any rapidly-growing, asexually reproducing (occasionally sterile) fungi. Such fungi are extremely common, functioning as saprobes and parasites in many habitats. Molds often do not reproduce sexually, or do so only after an extended period of time.

How are molds classified? If the mold eventually reproduces sexually, it can be classified in one of three fungal phyla by reference to its sexual structures. If this is not possible, the mold is placed in the “holding tank” phylum **Deuteromycota** ("fungi imperfecti") and classified by features of its asexual spores (**conidia**). This is really for the convenience of those who work with these fungi, since their true sexual names can’t be easily (or perhaps at all) determined.

Observe the provided cultures of molds under the dissecting scope (remove the lids only to quickly wipe the water droplets off the inside with a paper towel). These plates were left out last week in areas where there were lots of mold spores. A prepared slide (# 76) compares asexual structures of three common molds: *Aspergillus*, *Penicillium* (which are known to be Ascomycota) and *Rhizopus* (which you have already seen is a Zygomycote). <u>How do the structures of the conidia or asexual sporangia differ among these species?</u>

<u>Lichens</u>

Lichens are mutualistic (both partners benefit) symbioses (“living together” in close association) in which a fungus is associated with a green alga and/or a cyanobacterium. The alga or cyanobacterium benefits from the fungus by the protection the fungus provides from the environment. The fungus benefits from the fixed carbon provided by the algae or cyanobacteria. Lichens are classified by the fungal partner (usually Ascomycotes, but some Basidiomycotes also form lichens). The fungi found in lichens rarely live apart from their photosynthetic partners, though the opposite is not necessarily true. Each species forms a distinctive **thallus** combining the two or three partners. Thalli are categorized among three growth forms: **foliose** (leaf-like, flattened, usually with a distinctly different upper surface), **fruticose** (shrub-like, often round in cross section), or **crustose** (paint-smear like, firmly attached, without a lower surface).

<u>Examine the examples on display and categorize the growth form of each</u>. <u>Can you find any evidence that the lichens on display are Ascomycota</u>? <u>Describe the structures you used to make your decision</u>. Asexual reproduction is common among lichens and usually takes the form of specialized structures (soredia or isidia) that include all partners in the mutualism (see figure 31.17 in your text). <u>What is the adaptive significance of this type of reproduction</u>?

Examine the prepared slide (# 75) of the cross section of a lichen, and look for the following structures: upper surface, algal layer, medulla (inner hyphal tissue), lower surface. <u>Where in the lichen are the photosynthetic cells? How can you tell?</u>

Kingdom Animalia

Study, draw and describe the specimens. Relate what you see to what you have read in the background information. For each specimen, try to identify most of the structures <u>underlined</u> in the background information; also describe how the animals move their body and body parts. Our survey will be taxonomic and the phyla displayed are arranged in order of evolutionary development. Make sure to study at least one organism of each phyla and class plus the four prepared slides. Most importantly, enjoy the animals; try to learn as much as possible and develop questions as you observe and describe. Throughout the animal part of this lab, you will want to refer to Fig. 32.8 in your book.

Animals are eukaryotes, **multicellular** (containing several different types of cells) and **heterotrophic** (must take in preformed organic molecules). Animals take in food by **ingestion**, that is eating organisms or **detritus** (dead organic matter) whole or in pieces. Animals have **tissues** (integrated groups of cells with a common structure and function) responsible for impulse conduction (**nervous tissue**) and movement (**muscle tissue**). Animals probably evolved from a colonial, flagellated protist. There are about 35 phyla of animals, most of them marine, totaling over one million species.

Subkingdom Parazoa- Animals without true tissues

Phylum Porifera ("pore bearer"): sponges.

» Observe the prepared sponge specimens and the live sponges, and relate what you observe to the information below. Observe how water flows through a sponge by watching the dye demonstration. Observe spicules in the sponge squash demonstration.

General information about Porifera

Sessile (permanently attached), without true tissues since cells are relatively unspecialized. About 9,000 species, most of them marine, in four classes. Height: <1 cm to 2 m.

Body: resembles a sac perforated with holes. Pores in the body go into a central cavity, the **spongocoel**, that opens into a large opening called the **osculum**. Complex sponges have branched water canals and several oscula. The body consists of two layers of cells, the outer epidermal cells and the internal **choanocytes** ("collar cells", for the membranous collar around the base of the flagellum), which line the spongocoel or internal water chambers. These two layers are separated by a gelatinous region called the **mesohyl**. Wandering through the mesohyl are cells called **amoebocytes**, named for their use of pseudopodia. These cells transport nutrients, digest food and produce material for skeletal fibers, either sharp **spicules** made of calcium carbonate or silica, or more flexible fibers of a protein called **spongin**.

Feeding: nearly all are **suspension-feeders** (also known as **filter-feeders**), that is they collect food particles from water passed through a food-trapping mechanism. The flagella of choanocytes produces a water current through the porous body and the collars trap food particles, which are digested within the cell (**intracellular digestion**) by choanocytes or amoebocytes.

Muscle/nerves: no true tissues, however cells sense and react to changes in the environment.

Reproduction: asexual and sexual. In the second case, most are **hermaphroditic** (each individual functions as both male and female). Larvae are flagellated, swim freely and turn into adults after settling on a suitable **substratu**m (an underlying surface of certain characteristics).

Evolutionary notes: multicellularity, even if loosely coordinated, allows sponges to draw food from their surroundings into the body. Key in this task are choanocytes, which are unique in the animal kingdom. However, sponges lack true tissues and body symmetry.

Subkingdom Eumetazoa- Animals with true tissues. These members of this main subkingdom of the animal kingdom (but also all plants and many fungi) have really figured out what being multicellular can do for an organism. The first animals that you study will be relatively simple examples, but their tissues already show a great deal of specialization.

Branch Radiata- Oldest eumetazoans, **radial symmetry** (top and bottom, but no head or tail end or left and right), and **diploblastic** embryos (with ectoderm and endoderm, but no mesoderm).

Phylum Cnidaria ("nettle"): cnidarians.

Class Hydrozoa ("water animal"). Most marine. Alternate polyp and medusa forms; the polyp is often colonial and is more conspicuous than the medusa. Hydra are unusual because they live in freshwater and exist only as polyps. Portuguese man-of-war, hydras, *Obelia*, some corals.

» *Obelia* is a colonial hydrozoan (the polyps live together in a colony). Observe the prepared slide of *Obelia* polyps (slide #88). Do the polyps look different? What might be their different functions? Observe the prepared slide of *Obelia* medusa (slide #89). What is the advantage of having a medusa state for this organism? Observe the prepared slide of *Hydra* (slide #87). Identify the oral and aboral ends. Find the outline of the gastrovascular cavity. Relate what you observe to the general information below.

Class Scyphozoa ("cup animal"). All marine and free-swimming since the medusa stage is prevalent and the polyp stage is reduced. Jellies, sea wasp, sea nettle.

Class Anthozoa ('flower animal"). All marine and sessile because they occur only as polyps. The medusa stage is absent. Sea anemones, most corals, sea fans. Coral animals live as solitary or colonial forms and secrete hard skeletons of calcium carbonate. Each polyp generation builds on the skeletal remains of earlier generations constructing reefs unique to each species.

» Observe the prepared Anthazoa specimens and the live anemones. Observe how anemones feed by placing a small piece of mussel on the tentacle of an anemone. What is an advantage of a gastrovascular cavity compared to no cavity at all (as in the sponges)? What is a disadvantage? Observe nematocysts in the acontia squash demonstration.

General information about Cnidarians
True tissues, **radial symmetry** (equal parts radiating from center; have top and bottom, but no front and back, and no left and right) and **diploblastic embryos** (two germ layers: ectoderm and endoderm). Over 10,000 species, most marine, in four classes. Diameter: up to 2 m.

Body: a sac with a **gastrovascular cavity**, that is a central digestive compartment with a single opening that functions both as mouth and anus. There are two variations to this body plan: the sessile **polyp** and the floating **medusa**. Polyps are cylindrical forms that adhere to the substratum by the **aboral end** of the body (end opposite to the mouth end). Examples are hydras ands sea anemones. A medusa is a flattened, mouth-down version of the polyp. It moves freely in the water and the **oral end** (mouth end) points downward. Both forms have two layers of cells: an **epidermis** (outer layer for protection) and a **gastrodermis** (an inner layer for digestion). Sandwiched between them is a gelatinous layer of **mesoglea**.

Feeding: carnivores that use tentacles arranged in a ring around the mouth to capture prey. The tentacles are armed with batteries of **cnidocytes**, unique cells that function in defense and the capture of prey. Cnidocytes contain **cnidae**, capsule-like organelles capable of everting, which stinging components are called nematocysts. Food is partially digested inside the body, in the gastrovascular cavity, but outside the cells (**extracellular digestion**), then fragments are ingested by the cells for intracellular digestion. Undigested wastes are ejected through the mouth/anus.

Muscle/nerves: most simple. Nets of nerve cells coordinate contraction of contractile fibers in the cells of the epidermis and gastrodermis, with little central control.

Reproduction: asexual and sexual. Medusas reproduce sexually; polyps may reproduce asexually.

Larvae are known as **planulae**, which are ciliated and swim freely, settling on a substratum to form a polyp; in some species the planulae develop directly into medusae.

Evolutionary notes: true tissues allow for different cells to take different roles. Thus, the cnidocytes, unique in the animal kingdom, and the extracellular digestion of food by gastrodermis cells allow cnidarians to capture and digest food larger than individual cells. Radial body symmetry allows them to detect and respond to stimuli equally from all directions.

Phylum Ctenophora ("comb-bearer"): comb jellies. NO SPECIMENS TO EXAMINE but watch the Jelly video to observe how ctenophores swim compared to Cnidarians.
True tissues, radial symmetry and diploblastic embryos. Named for their eight rows of comblike plates composed of fused cilia and used for locomotion. Diameter: 1 to 10 cm.

Branch Bilateria- animals with **bilateral symmetry** (top, bottom, head, and tail) and varying degress of **cephalization** (concentration of nervous tissue at the anterior end). These animals also have a third germ layer, the **mesoderm**, during embryonic development and are thus **triploblastic**.

Branch Protostomia - animals with **spiral, determinate cleavage** during embryonic development. The coelom forms by **schizocoely** and the **blastopore** becomes the mouth of the adult.

Branch Lophothrochozoa - animals that have **trochophore larvae** and some have **lophophores** (crown of rentacles used for feeding).

Phylum Platyhelminthes ("flat worm"): flatworms.

Class Turbellaria ('turmoil"). Most marine, some freshwater or terrestrial. Named for the cilia-created turmoil when moving. Predators and scavengers. *Planaria*, free-living flatworms.

» Observe living specimens of *Planaria* and marine Turbellarians, and the prepared slide of *Planaria* (slide #91). Identify the anterior and posterior ends, the pharynx, and the gastrovascular cavity. What is an advantage of bilateral symmetry? Relate what you observe to the general information below.

General information about Platyhelminthes

True tissues, **bilateral symmetry** (two-sided symmetry: have **dorsal** or top and **ventral** or bottom sides and an **anterior** or head and **posterior** or tail ends) and **triploblastic embryos** (three germ layers: ectoderm, endoderm, and mesoderm). They are **acoelomates** (no body cavity between digestive tract and outer body wall). Over 20,000 species living in marine, freshwater, and damp terrestrial habitats, and divided into four classes. Length: <1 mm to over 20 m.

Body: with a thin body between the dorsal and ventral surfaces.

Feeding (Class Turbellaria): carnivores and **scavengers** (eat dead animals) that spill digestive juices onto their food. The **pharynx** (muscular chamber that ends in the mouth) sucks small pieces of food into the gastrovascular cavity, where digestion continues. Undigested wastes are ejected through the mouth, which is found on the ventral side.

Muscle/nerves (Class Turbellaria): move by using cilia on the ventral epidermis. They have a pair of dense cluster of nerve cells (ganglia) near the head and longitudinal nerve cords that constitute a simple central nervous system. They have a head with a pair of eyespots that detect light and lateral flaps that function mainly for smell.

Reproduction: asexual and sexual. They are hermaphroditic. In some species fertilized eggs hatch into miniature adults, in other species there is a succession of larval forms.

Evolutionary notes: bilateral symmetry allows for high levels of specialization within parts of the body in the form of **organs** (specialized centers of body function composed of several different types of tissues), such as the eyespots.

Phylum Rotifera ("wheel--bearer"): rotifers.

» Observe living specimens of rotifers and relate what you observe to the general information below. What are some advantages of a fluid filled body cavity?

True tissues, bilateral symmetry, triploblastic embryos and **pseudocoelom** (fluid-filled body cavity separating digestive tract from outer body wall, but not completely lined by tissue derived from mesoderm). Named for the crown of cilia that draws a vortex of water into the mouth. More anatomically complex than flatworms. Have a complete digestive tract. Size: 0.5 to 2 mm.

Phylum Nemertea ("Nemertes"): proboscis worms or ribbon worms.

» Observe living specimens of Nemerteans and relate what you observe to the general information below. What is an advantage of a complete digestive system?

True tissues, bilateral symmetry and triploblastic embryos. Acoelomates (see below). About 900 species in two classes, most marine, few in freshwater and damp soil. Length: <1 mm to 30 m.

Body: similar to that of a flatworms, except that they have a small fluid-filled sac that might be a primitive coelom and is shaped like a thread or a ribbon. Head, tail, dorsal, ventral.

Feeding: carnivores with an extensible **proboscis**, a long, muscular tube operated by the fluid-filled sac and used to capture prey. They are the simplest animals possessing a **complete digestive tract** (one-way digestive system, a digestive tube with a separate mouth and anus).

Muscle/nerves: move similarly to flatworms. They have several ganglia and small eyes in the head end and two lateral nerve cords and a mid-dorsal nerve cord that run down the body.

Reproduction: some asexual, most sexual. Sexes separate in most species. Fertilization is external in the vast majority of species.

Evolutionary notes: many evolutionary trends that become fully developed in more derived animals make their first appearance in ribbon worms, such as **closed circulatory system** (blood circulates inside vessels rather than freely in the body) and complete digestive tract.

Phylum Bryozoa ("moss animals"): moss animals.

» Observe living specimens of Bryozoans and relate what you observe to the general information below.

General information about Bryozoans
This phylum is also known as Ectoprocta. True tissues, bilateral symmetry, triploblastic embryos and **coelom** (fluid-filled body cavity separating digestive tract from outer body wall and completely lined by tissue derived from mesoderm). About 5,000 species in three classes, most live in marine environments where they are among the most widespread and numerous animals. Colonial animals that superficially resemble mosses. Length: usually <0.5 mm.

Body: In most species, the colony is encased in a hard exoskeleton with pores, one lophophore extends out through each pore. The **lophophore** is a horseshoe-shaped or circular fold of the body wall bearing ciliated tentacles that surround the mouth.

Feeding: suspension-feeders that trap food particles drawn by the cilia of the tentacles. U-shaped digestive tract, with the anus lying outside the whorl of tentacles.

Muscle/nerves: lack a distinct head but possess ganglia near the mouth. A retractor muscle allows the animal to retract the lophophore inside the pore of the hard exoskeleton.

Reproduction: asexual and sexual. Most hermaphroditic. Larvae are ciliated and free-living.

Evolutionary notes: the U-shaped digestive tract and the absence of a distinct head are adaptations to a sessile existence; however, bryozoans are relatively complex animals with various organs. They share a common ancestor with phoronids and lamp shells.

Phylum Phoronida ("Phoronis"): phoronids. NO SPECIMENS TO EXAMINE

True tissues, bilateral symmetry, triploblastic embryos, coelom and a lophophore. Only about 15 species of these tube-dwelling marine worms. Length: 1 mm to 50 cm.

Phylum Brachiopoda ("arm foot"): lamp shells. NO SPECIMENS TO EXAMINE

True tissues, bilateral symmetry, triploblastic embryos, coelom and a lophophore. About 330 species, most marine. Length: 1 mm to 9 cm. Lamp shells are attached to the substratum by a stalk. They superficially resemble clams, but the halves of the shell are dorsal and ventral.

Instructor and TA Preparation

FUNGI:

1. Collect fungal specimens:
   Ascos: Peziza, Aleuria or Morchella
   Basidios: Agaricus from store, bracket fungi, others (what's available now?)
2. Start Rhizopus cultures
   Petri dishes
   Potato dextrose agar
   Rhizopus spores of two different mating types
3. Yeast cultures
4. Have students start their own fungal plates the week prior?
   - Get enough agar plates – 1 per pair
5. Put out plates to start mold cultures
6. Lichen examples from three morphotypes: thallose, crustose, and fruticose

ANIMALS

1. order Planaria, Rotifers, Hydra
2. collect at Marine Park (Saturday at 1 pm): flatworms, nemerteans, anemones, sponges
3. get from SPMC: *Metriidium*
4. Demos during class:
   - feeding anemone
   - acontia squash
   - spicule demo
   - sponge water flow - use food coloring as dye?
5. preserved organisms for phyla in lab