Lab 3: Diversity of Life II— Kingdoms Plantae and Animalia

Kingdom Plantae and Introduction to Kingdom Animalia

Domain: Eukaryotes.
Supergroup (unranked): Archaeplastida
Kingdom: Plantae are autotrophic (with a few exceptions), contain chlorophyll a, and have cell walls containing cellulose. Life cycles of all members of the plant kingdom are variations on alternation of generations (Fig. 1; both haploid and diploid sexual stages are represented by multicellular bodies). The plant kingdom is divided into different groups based on the presence or absence of *vascular tissue*, the production of *seeds*, and the presence of *flowers*. A distinguishing characteristic of most plants is the presence of specialized areas of growth and activity: apical meristems (localized regions of cell division), which increase resource acquisition - plants cannot move in order to acquire nutrients and water, but the elongation and branching of their shoots and roots maximizes their exposure to environmental resources.

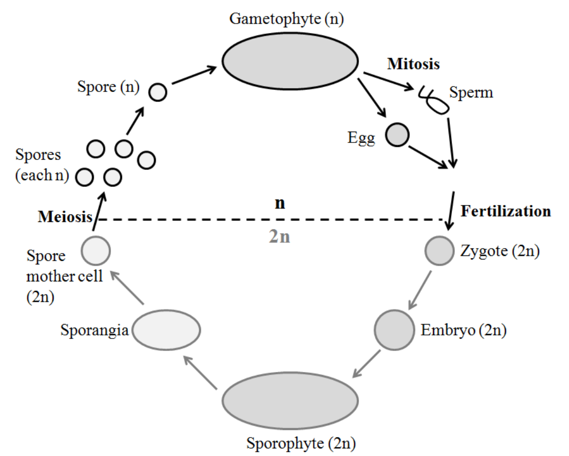


Figure 1: Generalized plant life cycle

Bryophytes include three divisions, the liverworts, mosses, and hornworts, and are the most primitive group of terrestrial plants. Bryophytes lack specialized vascular tissues, which limits their distribution to moist habitats, because their rhizoids (root-like structures) neither penetrate the soil very far nor absorb many nutrients, and thus all tissues need to be in contact with water. Because vascular tissues, along with supporting tissues (lignified tissues), are generally absent, bryophytes are relatively small and inconspicuous.

Seedless, vascular plants include two divisions with a vascular system of fluid-conducting xylem and phloem and rely on spores for reproduction: *Pterophyta* (true ferns, whisk ferns, and horsetails) and *Lycophyta* (e.g., club mosses; Fig. 2). These plants also have lignified tissues that enable larger bodies than bryophytes. True ferns inhabit almost all types of environments and possess characteristics of the more advanced seeded plants such as bristles on the rhizomes to provide protection from temperature, desiccation, predation, and physical abrasion. Many ferns depend on associations with mycorrhizal fungi. Club mosses possess true roots, aerial stems, and scale-like leaves.

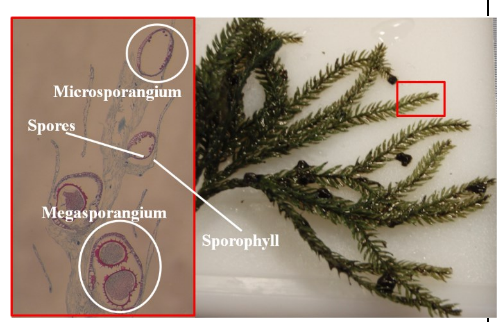


Figure 2: Club moss

Gymnosperms are plants with exposed seeds borne on scale-like structures called cones. Like ferns, gymnosperms have a well-developed alternation of generations, but unlike most ferns, gymnosperms are heterosporous - they produce two types of spores and actually produce an unenclosed seed (Fig. 3). In gymnosperms, pollen is transported by the wind from male cones (where pollen is produced) to female cones, which house eggs. They were the first plants to evolve that did not need water to transfer sperm to egg, and were therefore able to thrive in terrestrial habitats. In contrast to a spore (in seedless plants), which is single-celled, a seed is a resistant structure that is multicellular and more complex. A seed consists of a sporophyte embryo packaged along with a food supply within a protective coat derived from the outer covering of the ovule that can remain dormant until conditions are favorable for continued growth. Gymnosperms include four phyla of plants linked by the presence of vascular tissue and cones that produce seeds for reproduction. One type of gymnosperm is a conifer (*Coniferophyta*). Many conifers experience considerable temporal variability in temperature, and thus seasonally alter their biochemistry to make them more resistant to freezing (hardening process). Many conifers also have distinctly scented resin, secreted to protect the tree against insect infestation and fungal infection. The leaves of many conifers are long, thin and have a needle-like appearance and are often dark green in color which can help absorb energy from weak sunshine at high latitudes or under forest canopy shade.

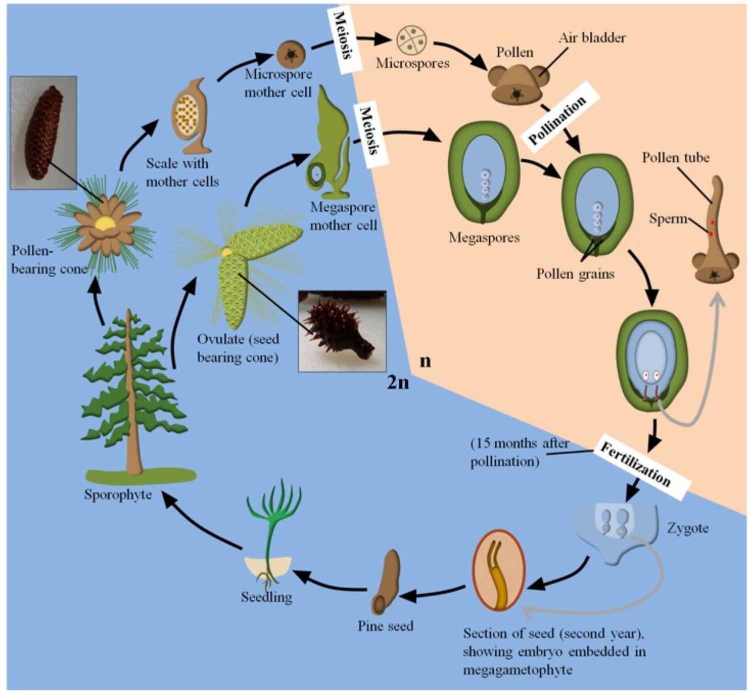


Figure 15: Pine life cycle.

Flowering plants, known as **angiosperms** (*Anthophyta*), are the most abundant, diverse, and widespread of all land plants. They owe their success to several factors, including their structural diversity, efficient vascular systems, and mutualisms with fungi and animals. Angiosperm (Fig. 4) reproduction depends on pollination not just wind transport. Many angiosperms produce fruits containing a ripened ovary that surround and/or carry seeds, and are appetizing meals for a variety of animals. The colors, shapes, aromas, and tastes of fruits are adaptations to attract certain animals that will eat the fruit and associated seeds, and transport them to areas away from the parent plant.

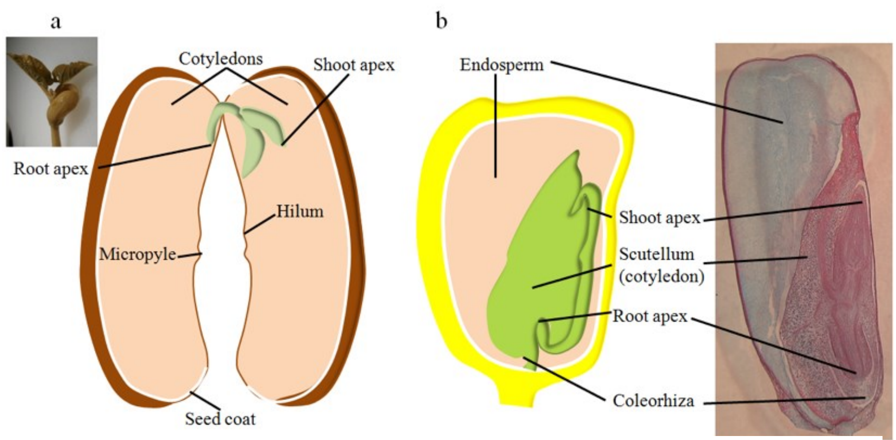


Figure 4: Seed structure of a bean (dicot) and corn (monocot).

Procedure:

1. As you examine prepared slides and live *Marchantia*, a Liverwort (Division: *Hepaticophyta*), one of the earliest land plants, take note of the pores on the upper side of the thallus (body) that lead to air chambers that house photosynthetic cells.

Domain:
Supergroup:
Kingdom:
Division (phylum): Bryophyta
Genus: ***Merchantia***
Magnification:
Notes:

Domain:
Supergroup:
Kingdom:
Division (phylum): **Hepaticophyta**
Magnification:
Notes:

2. Examine the live specimens of true ferns in the lab.

Domain:
Supergroup:
Kingdom:
Clade: Pterophyta
Subclass: **True ferns**
Magnification:
Notes:

3. Examine the specimen of *Selaginella* (club mosses).

Domain:
Supergroup:
Kingdom:
Clade: *Lycophyta*
Genus: ***Selaginellacea***
Magnification:
Notes:

4. Examine the available pine twigs with needles and a terminal bud and living or preserved ovulate cones.

Domain:
Supergroup:
Kingdom:
Unranked: Gymnosperms
Clade: Tracheophytes
Division: Pinophyta or Coniferophyta (Conifers)
Genus: ***Pinus* (Pine)**
Magnification:
Notes:

Domain:
Supergroup:
Kingdom:
Unranked: Gymnosperms
Clade: Tracheophytes
Division: Pinophyta or Coniferophyta (Conifers)
Genus: ***Pinus* (Pine)**
Magnification:
Notes:

5. Examine the flowers.

Domain:
Supergroup:
Kingdom:
Clade: Tracheophytes
Clade: Spermatophores
Clade: **Angiosperms**
Magnification:
Notes:

Domain: Eukaryotes
Supergroup (unranked): Unikonta
Clade 1: Opisthokonta
Kingdom: Animalia
Phylum: Porifera (sponges), like all animals, are eukaryotic, multicellular, and heterotrophs (derive their energy from organic molecules made by other organisms). Sponges are the simplest of the major animal phyla, with most species living in the oceans. Sponges lack tissues and organs and are typically asymmetrical assemblages of cells that perform a variety of functions (e.g. nutritive, reproductive…). While sponges are sessile, they are highly efficient filter-/suspension-feeders (feed by straining suspended matter and food particles from the water, typically by passing water over a specialized filtering structure). The structure of sponges is simple but effective for filtering gallons of seawater daily (Fig. 5). Sponges reproduce asexually and sexually. They can provide protection for a number of small marine plants, which live in and around their pore systems. Symbiotic relationships with bacteria and algae have also been reported - the sponge provides support and protection and the symbiont provides the sponge with food.

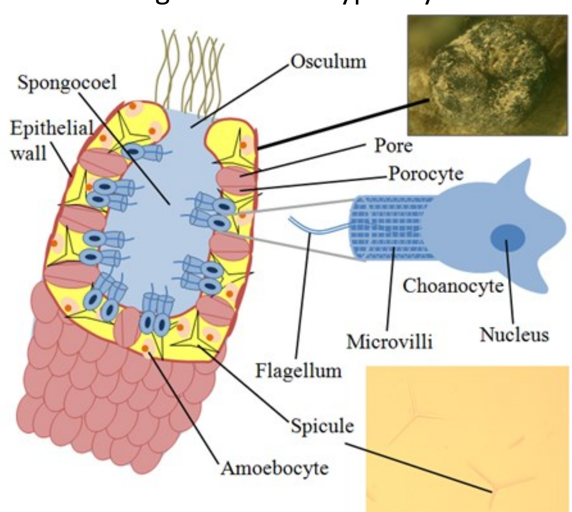


Figure 5. Morphology of a simple sponge.

Procedure:

1. Examine the available sponges using your dissecting and compound light microscope.

Domain:
Supergroup:
Kingdom:
Phylum: **Porifera**
Magnification:
Notes:

Phylum: Cnidaria

Cnidaria includes three classes that are mostly marine carnivores with radially symmetrical bodies. The body wall has two cellular layers, and unlike sponges, cnidarians have true tissues (Fig. 6). Muscles and nerves occur in their simplest forms in cnidarians, but cnidarians lack organs that centralize these tissues. Cnidarians have two basic body plans: polyps and medusa. Polyps are cylindrical animals with upward-facing mouths surrounded by tentacles. They are usually attached to the substrate, and must wait for prey to come to them. Polyps may be solitary or colonial. In contrast to polyps, medusa are usually free-floating or actively moving (swim by jet propulsion), and umbrella-shaped. Their mouths point downward and are surrounded by hanging tentacles. Cnidarian classes are distinguished primarily by the relative dominance of the polyp or medusa stage in the life cycle. Some cnidarians only occur as polyps or medusa, but many alternate between these two forms. Most cindarians are carnivores, but some absorb dissolved organic chemicals, filter food particles out of the water, or obtain nutrients from symbionts. Tentacles that surround the mouth are used to capture prey, and are armed with stinging cells containing small, barbed harpoon-like structures. Captured prey are pushed through the mouth into the gastrovascular cavity, where extracellular digestion occurs, followed by phagocytosis of small food particles and intracellular digestion. In cnidarians, there is only one external opening to the gastrovascular cavity (incomplete digestive tract), therefore food enters through the same opening waste is eliminated from. As a result, cnidarians are restricted in their consumptive and digestive processes.

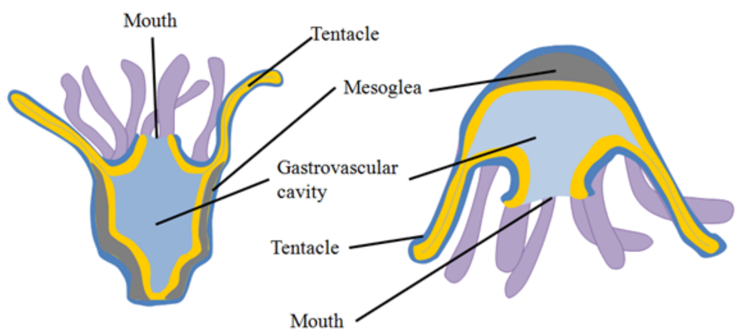


Figure 6. Basic morphology of a cnidarian polyp and medusa.

Class: Hydrozoan—The polyp stage dominates the **hydrozoan** life cycle, although both occur in most species. In colonial hydrozoans, the majority of polyps are specialized for feeding, and some polyps are specialized for reproduction. *Hydra* are small, common hydrozoans, that live in shallow, freshwater pools, and prey on small invertebrates. *Hydra* have no medusa stage - they are only found as polyps. They are solitary and occasionally hang from the water's surface. More often, however, they attach to a hard substrate with their basal disk. To move, *Hydra* can detach themselves and somersault along the substrate. *Physalia* is a floating colony of polymorphic polyps that can form a gas-filled sac with a sail that provides buoyancy and suspends other polyps that comprise long tentacles used to capture prey that are passed to feeding polyps.

Procedure:

1. Examine preserved specimens of hydrozoans (*Physalia*).

Domain:
Supergroup:
Kingdom:
Class:
Genus: ***Physalia***
Magnification:
Notes:

Class: Scyphozoans are commonly called jellyfish, because the gelatinous medusa dominates their life cycle, with the polyp reduced to a small larval stage. *Aurelia* is a typical scyphozoan, and its life cycle is typical to cnidarians, except that its gametes are the only haploid stage of its entire life cycle. *Aurelia* has four bright circular gonads that are under the stomach, and food travels through the muscular body cavity while radial canals help disperse the food.

Procedure:

1. Examine prepared slides of *Aurelia*, a scyphozoan, in its different life stages as well as any available preserved specimens.

Domain:
Supergroup:
Kingdom:
Class:
Genus: ***Aurelia***
Magnification:
Notes:

Class: Anthozoan polyps are sessile solitary or colonial, and there is no medusa phase. Anemones (Fig. 7) attach themselves to the substrate with their flat and sticky basal/pedal disk, however this attachment is not permanent, and anemones can slowly slide on a film of mucus. When pieces of the basal disk tear away from a moving anemone the pieces can form a new individual (asexual reproduction by fragmentation). Corals are structurally similar to anemones, but corals are usually colonial and much smaller and secrete a hard skeleton of calcium carbonate with many small cups surrounding the polyps.

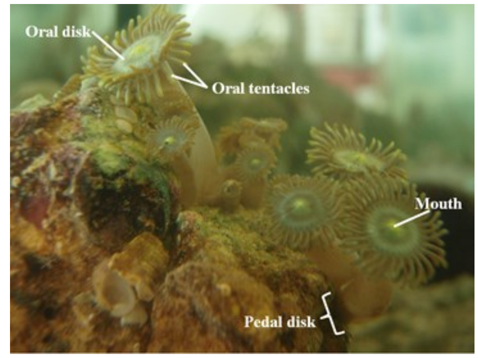


Figure 7. Sea anemone external body plan

Procedure:

1. Obtain a preserved anemone, an anthozoan, and identify the tentacles, mouth, pharynx, gastrovascular cavity, septum, and basal/pedal disc. Also, examine the available pieces of dried coral and look for the small depressions where the corals were located.

Domain:
Supergroup:
Kingdom:
Class:
Subclass:
Order: **Actiniaria (Sea anemone)**
Magnification:
Notes:

Kingdom: Animalia
Phylums: Platyhelminthes and Nematoda

Flatworms (**Platyhelminthes**) and roundworms (**Nematoda**) occur in marine, freshwater, terrestrial, and parasitic environments. Their morphologies are more complex than that of sponges and cnidarians. Flatworms are acoelomate - their mesoderm is a solid mass of tissue allowing for development of organs, but inhibiting true muscle tissue and more complex organs from forming (Fig. 8a). In contrast, roundworms are pseudocoelomates - they have a body cavity consisting of fluid-filled space between their body wall and digestive tract, where internal organs are suspended (Fig. 8b).

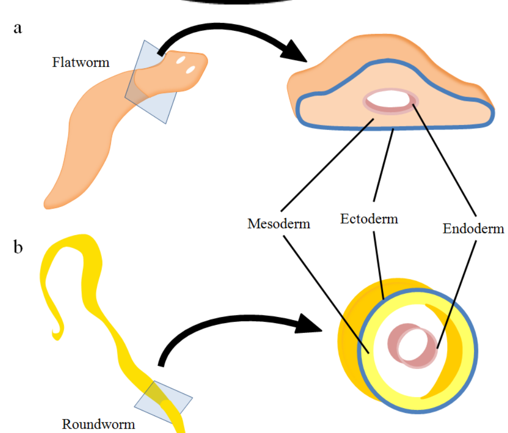


Figure 8. Two body plans for bilaterally symmetrical animals. (a) Acoelomates have no body cavity. (b) Psuedocoelomates develop a body cavity between the mesoderm and endoderm.

Phylum: Platyhelminthes (Flatworms) are dorsoventrally compressed animals with primitive sense organs. Like cnidarians, flatworms have incomplete digestive tracts - their gastrovascular cavity has one opening that is both mouth and anus. Their nervous system is more advanced than that of cnidarians and consists of a ladder-like arrangement of nerve cords extending the length of the body, which allows them to learn and modify their response to stimuli.

Class: Tubellarians are free-living flatworms inhabiting freshwater, saltwater, and moist terrestrial environments. They scavenge and prey on small animals, and are hermaphroditic - individuals have both male and female sex organs. *Dugesia* (i.e. planaria; Fig. 9) has a head that has lateral lobes and sensory organs called eyespots that detect light, as well as lateral flaps that function mainly for smell. *Dugesia* feeds by spilling digestive juices out of its mouth from the gastrovascular cavity onto prey, and sucking food through its mouth into a tubular pharynx leading to the gastrovascular cavity.

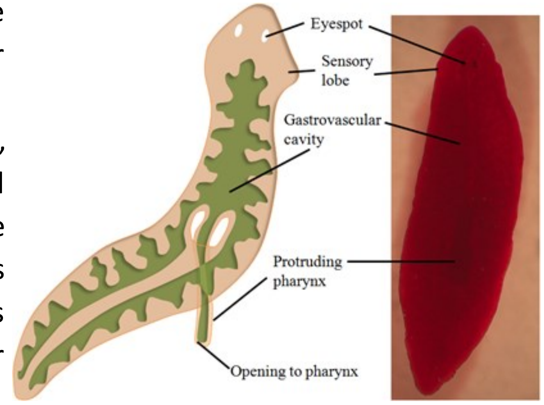


Figure 9. General anatomy of *Dugesia*.

Procedure:

1. Obtain a *Dugesia*, a tubellarian, and examine its morphology with your dissecting microscope.

Domain:
Supergroup:
Kingdom:
Phylum:
Class:
Genus: ***Dugesia***
Magnification:
Notes:

Class: Trematodes, commonly called flukes, are parasitic flatworms, and their oval bodies are usually only a few millimeters long. Flukes infect vertebrates and include both endoparasites (parasites inside their host) and ectoparasites (parasites on the surface of their host). Trematodes are covered by an acellular, metabolically active epicuticle made of proteins and lipids secreted by mesodermal cells and resists digestive

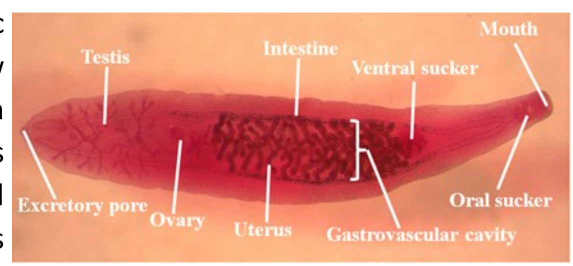


Figure 10. *Clonorchis sinensis*, liver fluke.

enzymes. It also aids in respiration and absorbing nutrients. The ventral surface of a fluke usually has two adhesive organs (suckers) that surround the mouth. Reproductive organs fill the majority of the interior of these worms. *Clonorchis sinensis*, the Chinese liver fluke (Fig. 10), often parasitizes humans in Asia by attaching to the bile duct and releasing eggs that move through the digestive system of the host and exit with feces. Larvae of the flukes typically develop in snails and fish, and humans are infected when they eat raw or poorly cooked fish.

Procedure:

1. Use your dissecting and compound light microscopes to examine prepared slides of the trematode, *Clonorchis*, and identify the oral and ventral suckers, gastrovascular cavity, gonads (reproductive structures), and epicuticle.

Domain:
Supergroup:
Kingdom:
Phylum:
Class:
Genus: ***Clonorchis***
Magnification:
Notes:

Class: Cestodes (e.g. tapeworms) are the most specialized platyhelminthes. They are endoparasites of the gut of vertebrates and are covered by a cuticle similar to that of trematodes. However, tapeworms lack a mouth or digestive tract and have a unique body plan: 1) their cuticle efficiently absorbs nutrients from their host; 2) their anterior end (scolex) adheres to the host's intestinal wall with hooks or suckers; and 3) behind the scolex is the neck followed by a series of segments called proglottids, which may reach 10-15 meters long (Fig. 11). Self-fertilization occasionally occurs in proglottids, but cross-fertilization by copulating proglottids of adjacent worms is more common. Gravid (egg carrying) proglottids eventually break from the end of the worm and pass from the host with the feces. Although each proglottid has a complete reproductive system, the excretory ducts and longitudinal nerves are continuous between proglottids.

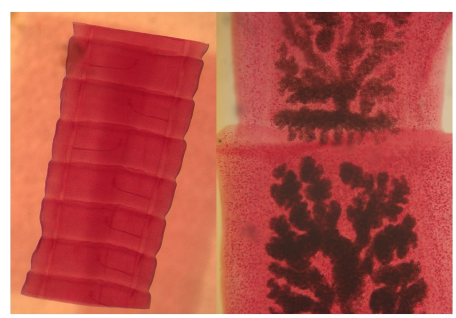


Figure 11. Immature (left) and mature (right) proglottids of a tapeworm

Procedure:

3. Examine a prepared slide of a cestode, tapeworm, and of the scolex and note the adaptations it has for a parasitic lifestyle.

Domain:
Supergroup:
Kingdom:
Phylum:
Class:
Genus: ***Clonorchis***
Magnification:
Notes:

Phylum: Nematodes (roundworms) are slender, long predators and parasites, with a relatively featureless exterior. They lack flagella and cilia, and are covered with a flexible and chemically complex cuticle that resists digestive enzymes and is permeable only to water, dissolved gases, and some ions. Roundworms have two morphological advances absent in flatworms: 1) their pseudocoelom permits space for internal organs, and 2) they have a complete digestive tract with mouth and anus. Roundworms lack a circulatory system, but nutrients are transported throughout the body via a fluid in the pseudocoelom. Nematode reproduction is usually sexual, and the zygotes of most species are resistant cells capable of surviving harsh conditions. *Ascaris* (Fig. 12) is a large nematode that infects the intestinal tract of humans and other vertebrates. Its eggs (up to 200,000 per day) are passed in the feces of infected persons.

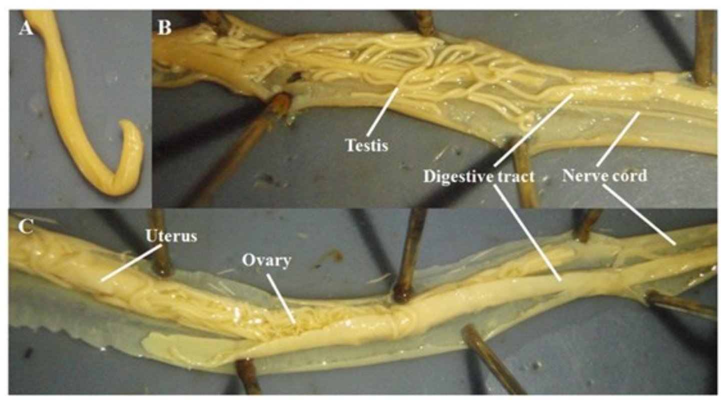


Figure 12. Dissected male (A & B) and female (C) *Ascaris*.

Procedure:

1. Obtain a preserved *Ascaris* and examine its external features using a dissecting microscope.

Domain:
Supergroup:
Kingdom:
Phylum:
Genus: ***Ascaris***
Magnification:
Notes:

Domain: Eukaryotes
Kingdom: Animal

Phylum: Mollusca have a coelomic body cavity (fluid-filled cavity completely lined by tissue derived from the mesoderm) containing complex systems of organs and compartments. Coelomates are further divided into protostomes and deuterostomes - protostomes include phyla Mollusca, Annelida, and Arthropoda, and have well-developed nervous, circulatory, excretory, reproductive, and digestive systems. **Mollusks** are soft-bodied animals with a specialized layer of epidermal cells called a mantle that secretes a shell. The basic body plan of a mollusk (Fig. 13) includes 1) a visceral mass of organ systems and sensory structures, 2) a ventral, muscular, and often highly modified foot used for locomotion, 3) a calcium-based shell (though occasionally absent), and 4) a mantle that secretes the shell and may aid in respiration and locomotion. Some mollusks also have a differentiated head. Extant species have a diversity of forms built on this basic body plan. For example, the foot of some mollusks has become elongated and used to capture food. Mollusks produce many kinds of external shells, with some having only a remnant internal shell or no shell at all. While mollusks are coelomates, their coelom is often reduced to a small chamber surrounding the heart. Mollusks have an open circulatory system (except cephalopods) - blood pools in sinuses and bathes organs directly. A few large vessels and a heart transports blood throughout the body, but there are no smaller vessels or capillaries.

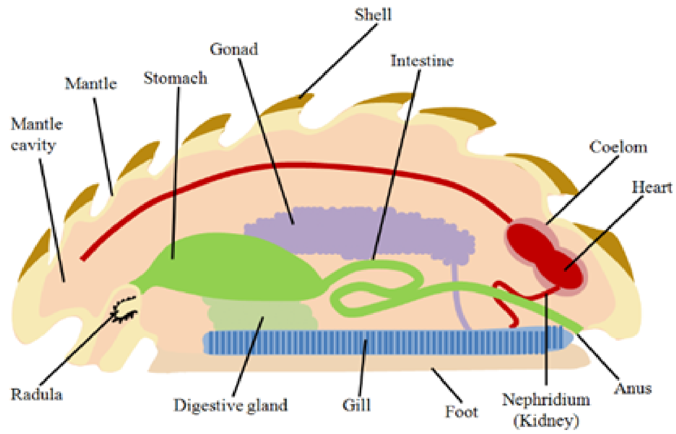


Figure 13. Generalized molluscan body plan.

Class: Chitons (Fig. 14) are exclusively marine and have a primitive structure. The dorsal shell is divided into eight plates embedded in the mantle, which provide protection for impact, but permit the chiton to flex upward for locomotion. The ventral foot is a broad oval muscle used to propel chitons slowly over the surface of rocks. The mouth contains a tongue-like radula that scrapes food from rocks with rows of chitinous teeth. They also have light-sensitive cells used to stay in the photic zone (upper part of the water column).

Figure 14: Chiton body plan

Procedure:

1. Observe the preserved chitons with your dissecting microscope, noting all identifiable body parts, including the shell, foot, gills, and mouth.

Domain:
Supergroup:
Kingdom:
Phylum:
Class: Polyplacophora (Chitons)
Genus: ***Chiton***
Magnification:
Notes:

Class: Gastropods (Fig. 14) are among the few invertebrate groups to have successfully populated terrestrial habitats. Terrestrial snails lack the gills typical of most aquatic gastropods, and instead the lining of the mantle cavity functions as a lung, exchanging respiratory gases with the air. Most gastropods are protected by a single, spiraled shell into which animals can retreat when threatened (some lack shells, e.g. nudibranchs, slugs). Many gastropods feed on algae and plants with a radula like a chiton, but some are predatory, and use their radula to bore holes in the shells of other mollusks, or for tearing apart tough animal tissue. Many gastropods have distinct heads with eyes at the tip of tentacles. Snails move by a rippling motion of the elongated foot. The most distinctive characteristic of gastropods is a process known as torsion that results in the anus and mantle cavity being placed above the head in the adult.

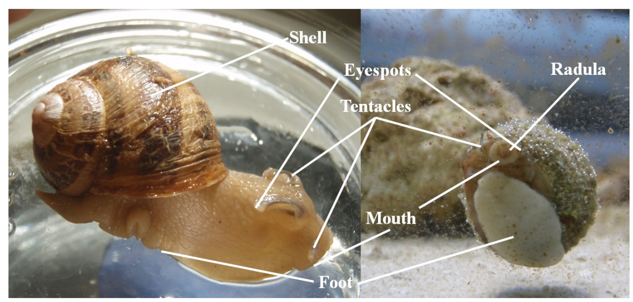


Figure 14: Gastropod body plan

Procedure:

1. Observe the preserved and live gastropods with your dissecting microscope. Note all observed body parts, including the shell, foot, and mouth.

Domain:
Supergroup:
Kingdom:
Phylum:
Class: **Gastropoda**
Magnification:
Notes:

Class: Bivalves have a dorsally-hinged two-part shell (Fig. 15). The mantles of the left and right valves join to form siphons that directs water through the bivalve. Bivalves have no distinct head, and the radula has been lost. Bivalves are typically suspension-feeders (filter particles from the water column) that lead sedentary lives. Sessile mussels secrete strong threads that tether them to rocks, docks, boats, and the shells of other animals. Clams can pull themselves into the sand or mud, using their muscular foot as an anchor. And, in addition to digging, scallops can move along the sea floor by flapping their shells.

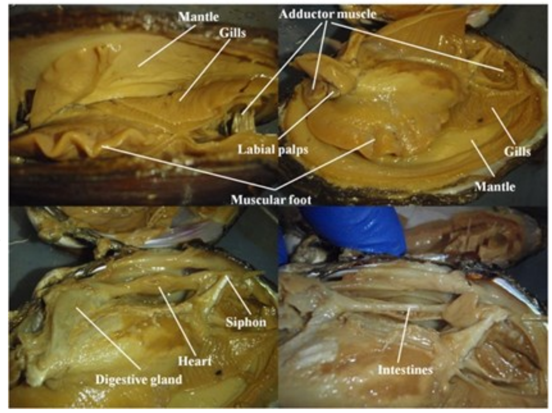
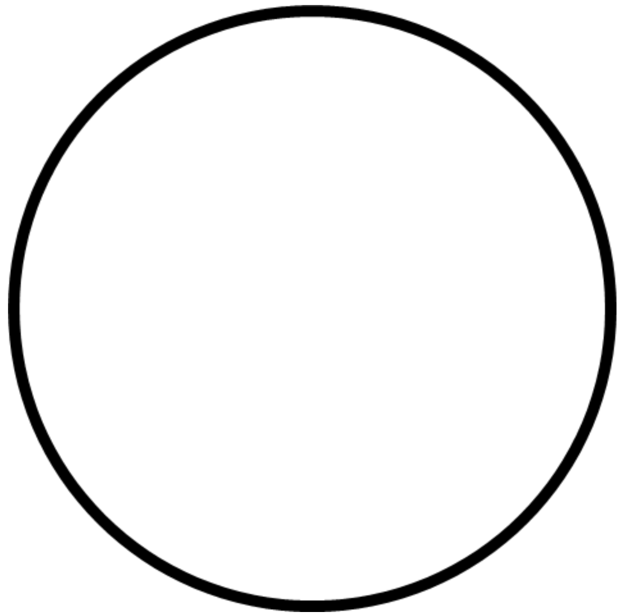


Figure 15. Bivalve body plan.

Procedure:

1. Obtain a preserved bivalve and study its structure.

Domain:
Supergroup:
Kingdom:
Phylum:
Class: **Bivalvia**
Magnification:
Notes:



Class: Cephalopods do not resemble their molluskan relatives. Cephalopod shells may be absent or reduced to an internal remnant. The foot of a cephalopod is modified into tentacles. And, unlike most other mollusks, cephalopods are predatory and their anatomies are appropriately adapted: cephalopods have muscular tentacles, highly developed sensory structures and a complex brain (the nervous system of cephalopods is the most complex of invertebrates), and a jet propulsion system for quick and elaborate movement. A squid (Fig. 16) darts about by drawing water into its mantle cavity and then firing a jet stream of water through the excurrent siphon. Also unlike other mollusks, cephalopods have a closed circulatory system - they have two gill hearts that move blood through the capillaries of the gills. A single systemic heart then pumps the oxygenated blood through the rest of the body. Most cephalopods possess chromatophores (special colored pigments), which are used

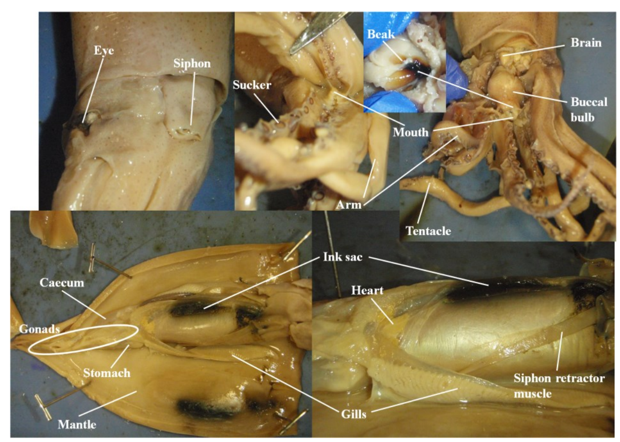


Figure 16: Squid body plan

to provide camouflage. They have a two-part beak, and most have a radula. Cephalopods capture prey with their tentacles and draw it in to their mouth as they eject a mixture of toxic digestive juices to initiate digestion.

Procedure:

1. Examine the external and internal features of the available squid.

Domain:
Supergroup:
Kingdom:
Phylum:
Class:
Superorder: **Decapodiformes (Squid)**
Magnification:
Notes:

REVIEW #3— Lab 3 (DOL 2)
BSC2011L B5__
Spring 2020

Name: ______________________
Panther ID:____________________

Directions: In paragraph form, address (at minimum) the below questions/topics.

- In a few sentences, what was done in today's lab?
- What was your main take-away?
- What are some key concepts from today's lab that you think might be on your quiz next week?
- Applying knowledge: Look at the map of BBC below. Today we continued our plunge into "*The Diversity of Life*". For each phyla group we discussed today, discuss their identifying characteristics and list an example specimen from each phyla that we could find in or around BBC. In a few sentences, discuss where on campus you would expect to find the example specimen and why. What are some characteristics of these specimen that would allow them to thrive in those locations?
- Choose one of your listed specimen and create a testable, ecological question that we could investigate on campus. Create a null and alternative hypothesis for this question**.**

Writing should take about a page (more is ok)
Font: Calibri, 11pt font
Single spaced
1" Margins (except for headers)