Lab 4: Diversity of Life III— Kingdoms Animalia

Kingdom Animalia

Domain: Eukaryotes.
Supergroup (unranked): Unikonta
Kingdom: Animalia
Phylum: Annelia include earthworms, leeches, and polychaetes. The most distinctive characteristic of this phylum is segmentation: the body of an annelid is divided into repetitive segments arranged on a longitudinal axis and divided by septa. Each segment contains parts of the circulatory, digestive, nervous, and excretory systems. The circulatory system of annelids is closed meaning that blood is always retained in vessels. Annelids also have setae: small, bristle-like appendages often occurring in pairs on lateral and ventral surfaces. The degree of setal development is distinctive for each of the three annelid classes. Interestingly, many species can use mechanisms similar to asexual reproduction to regenerate after injuries.
Class: Polychaetes live in marine sediments. *Nereis* (Fig. 1) is distinctly segmented and each segment bears a pair of fleshy parapodia that are highly vascularized with blood vessels and help the polychaete move and respire. In some species, brittle, tubular setae are filled with poison and used for defense, while in others, the setae help filter food from the water. In general, the mouth of polychaetes includes a pair of jaws and a pharynx that can be rapidly everted, allowing the worm to grab food and pull it into the mouth. The digestive tract is simple, usually with a stomach. There is usually a simple circulatory system, with two main blood vessels, and smaller vessels to supply the parapodia and the gut. The nervous system extends through the entire body, and consists of a single or double ventral nerve cord, with ganglia and nerves in each segment. Most polychaetes have separate sexes. Gametes mature inside of the body cavity and are generally expelled into the water column where fertilization takes place (copulation rarely occurs in polychaetes).

Procedure:

1. Examine a preserved specimen of *Nereis*, a polychete.

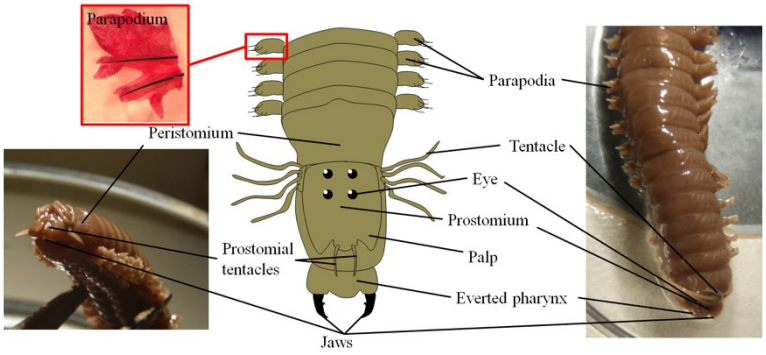


Figure 1. Anatomy of the anterior of *Nereis*

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

Class: Oligochaetes lack the distinct parapodia possessed by polychaetes, and thus their movement behavior differs. Oligochaetes move through a series of extensions, anchoring, and contractions. Clinging bristles (setae) along the body surface help prevent backsliding. Like nematodes, oligochaetes have complete digestive tracts, but their digestive tracts are considerably more advanced and specialized than nematodes (Fig. 2). Reproductive organs cluster around the anterior segments. The dorsal and ventral blood vessels (above and below the intestine) are the main vessels of the circulatory system and are connected by five lateral hearts. The digestive tract has an internal fold of tissue arising from the dorsal wall, which creates a U-shaped intestinal lumen and doubles the surface area for absorption. Copulating worms attach their clittela (specialized segments) and exchange sperm (earthworms are hermaphroditic, and each of the copulating worms produces egg and sperm cells). After the eggs are fertilized, the worm releases it as a cocoon.

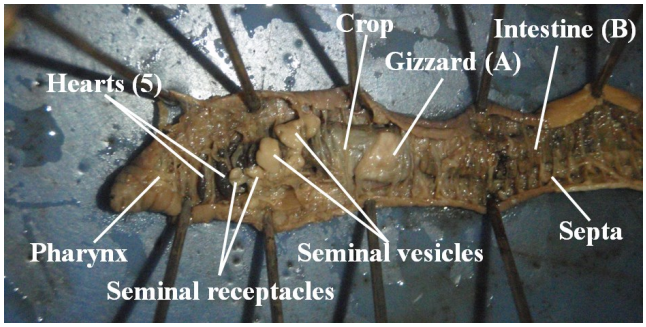
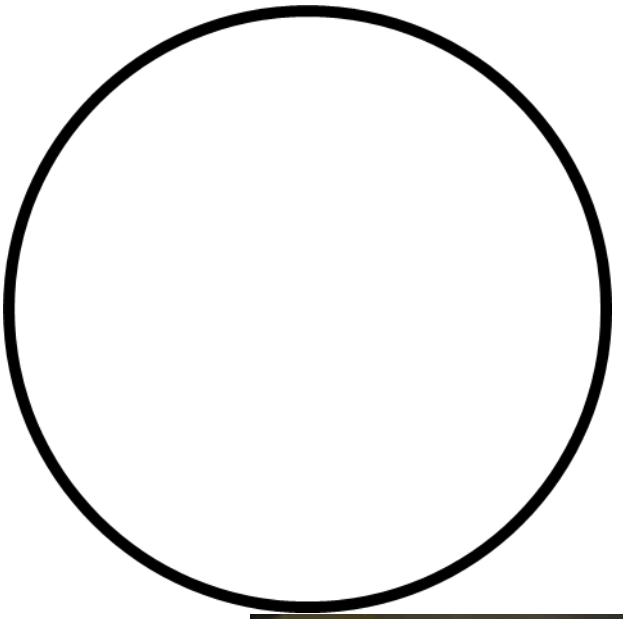


Figure 2. Internal anatomy of an earthworm

Procedure:

2. Examine a preserved earthworm, an oligochete, and note its external features, including the clitellum, mouth, anus, and setae.

Domain:
Supergroup:
Kingdom:
Phylum:
Class: Clitellata
Subclass: Oligiochaeta
Genus: ***Lumbricus***
Magnification:
Notes:



Class: Hirudineans include leeches, which lack true segmentation, have no setae, and have anterior and posterior suckers that hold prey (Fig. 3). Leeches reproduce sexually and individuals are hermaphroditic. Sperm is released into the coelomic cavity, and the cells move to the ovaries to fertilize the eggs. Days later, the leech secretes a nutrient-rich cocoon to protect the eggs, and the eggs are extruded into the cocoon, which is

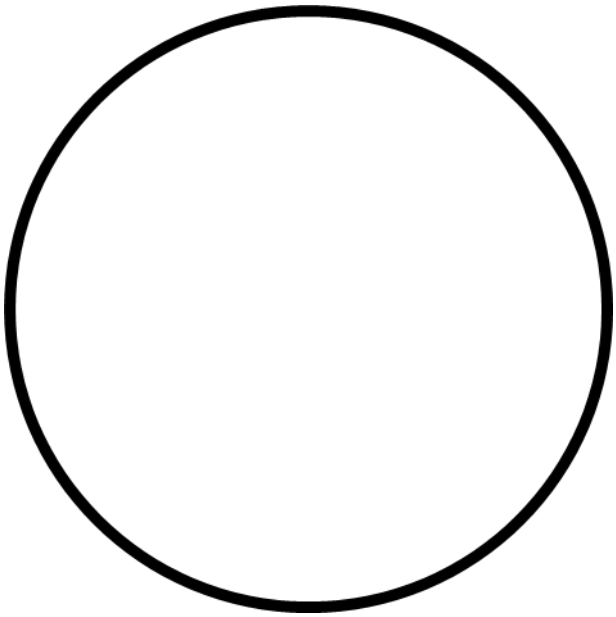

Figure 3. Anterior sucker of a leech

either brooded (remains with parent), or attached to submerged objects or vegetation. Leeches attach to their hosts, feed on bodily fluids (generally blood), and remain there until they become full, at which point they fall off to digest. They use mucus and suction (by concentric muscles in the suckers) to stay attached, and secrete anti-clotting enzymes into the host's blood stream.

Procedure:

3. Observe the movement of living leeches and examine the external anatomy of a preserved leech, and locate the two suckers.

Domain:
Supergroup:
Kingdom:
Phylum:
Class: Clitellata
Subclass: Hirudinea
Genus: ***Hirudo***
Magnification:
Notes:



Phylum: Arthropod is the most diverse and abundant phylum of animals, and its tremendous success in all major habitats is due mainly to their segmentation, rigid external skeleton, and jointed appendages. Their appendages are extensions of the main body, and are highly adapted for locomotion, feeding, reproduction, defense, and sensing the environment. Bodies of arthropods are segmented, allowing for specialization of body regions and appendages (i.e. allows for an efficient body plan by the division of labor among regions). The arrangement of these segments and the structure of appendages are often used to classify arthropods. The exoskeleton of arthropods is made of chitin, which may be soft, or, if filled with calcium carbonate, extremely hard. This provides protection from potential predators and the environment, serves as a moisture barrier that prevents desiccation in terrestrial environments, and is a place for muscle attachment. This outer covering limits growth, however, thus arthropods periodically shed their exoskeleton and quickly enlarge before the new exoskeleton hardens. Jointed appendages of arthropods are attached to body segments, and provide arthropods with both strength and flexibility. Arthropods are coelomates, their circulatory system is open, and all organ systems are well developed. Arthropods detect stimuli with an array of well-developed sensory organs, including eyes, olfactory receptors for smell, and antennae for touch and smell.

Subphylum: Chelicerates, such as spiders, scorpions, and horseshoe crabs, are arthropods with the appendages of their most anterior segment modified into feeding structures called chelicerae. The second pair of appendages are pedipalps, and are modified for capturing prey, sensing the environment, or copulating (Fig. 4). Body segments of chelicerates are fused into two body regions; 1) a cephalothorax

consisting of a fused head and thoracic segments, and 2) an abdomen as the most posterior body region. Chelicerates lack antennae and most have simple eyes, however some have sensory hairs for touch and slit sense organs for primitive hearing or motion detection.

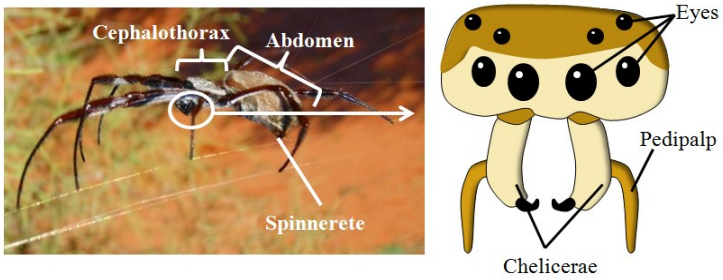
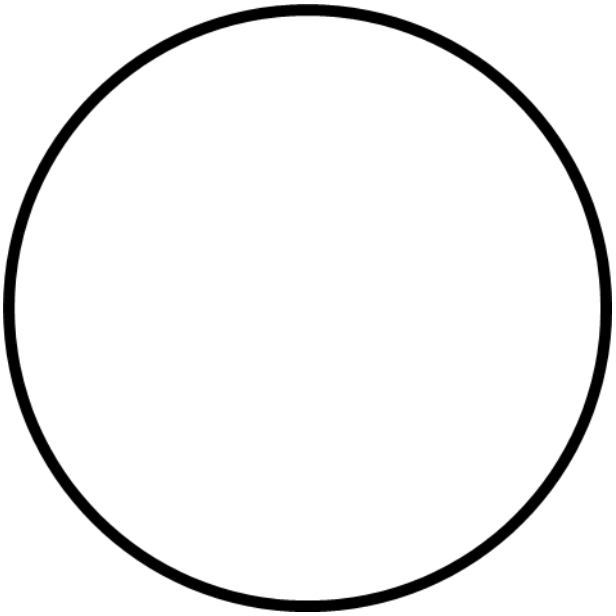


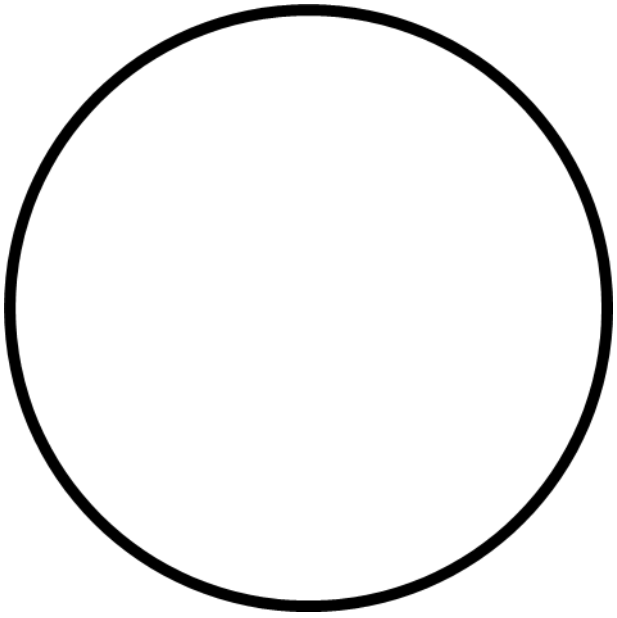
Figure 4. Spider body plan.

Procedure:

1. Examine chelicerates in a preserved spider and scorpion and note the external structures, especially the carapace, chelicerae, pedipalps, walking legs, and book gills.

Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum:
Class: Arachnida
Order: **Araneae**
Magnification:
Notes:





Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum:
Class: Arachnida
Order: **Scorpiones**
Magnification:
Notes:

Subphylum: Crustaceans live in aquatic environments (most), and are fundamentally different from other arthropods because they have specialized biramous (double-branched) appendages. The five anterior pairs of crustacean appendages are modified into first antennae, second antennae, mandibles, maxillae, and maxillipeds (Fig. 5). In addition to antennae, crustaceans usually have compound eyes with multiple lenses used to sense their environment. In the open circulatory system of a crustacean, blood flows from a diamond-shaped heart through large arteries to the gills and to sinuses surrounding and bathing the internal organs. During reproduction, males and females copulate, and sperm cells are passed to the genital openings of the female. Fertilization is internal, and fertilized eggs are extruded and retained for maturation on swimmerets of the female.

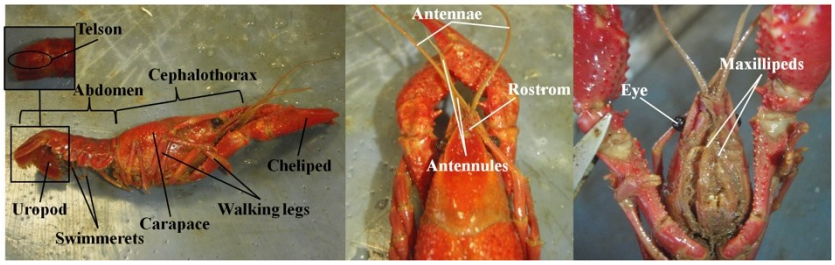
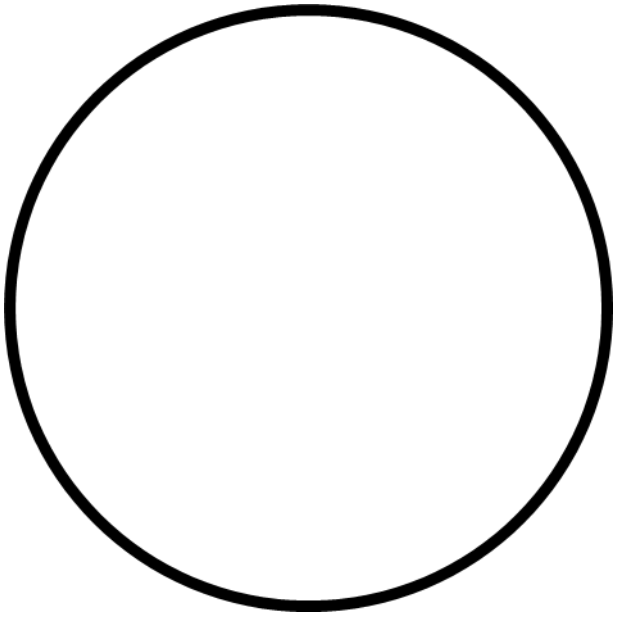


Figure 5. External anatomy of a crayfish.

Procedure:

1. Obtain a preserved crayfish, a crustacean, and locate the antennae, eyes, walking legs, maxilliped, mouth, carapace, swimmerets, abdomen, and anus.

Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum:
Order: Decapoda
Superfamily: **Astacoidea** & **Parastacoidea**
Magnification:
Notes:



Clade (unranked): Tracheata is a very large clade, or group, of arthropods that can breathe via channels in their bodies (tracheal systems), as distinguished from crustaceans, which breathe via gills. Tracheata includes subphylums such as Myriapoda and Hexipoda.

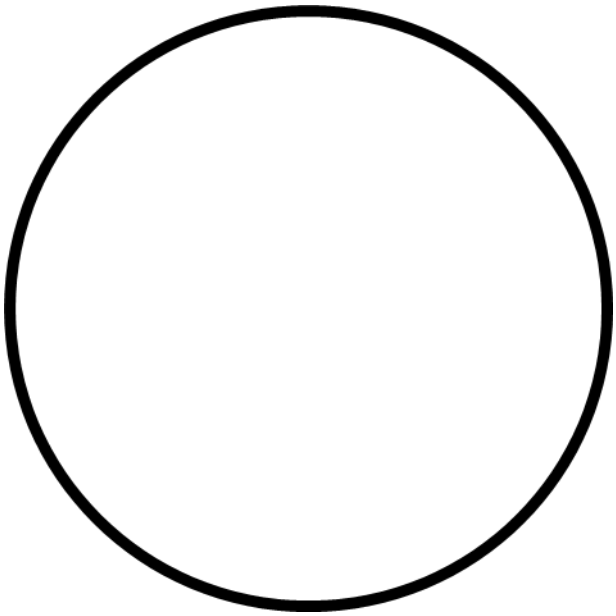
Subphylum: Myriapoda includes centipedes and millipedes. Centipedes live in soil under logs and stones where they prey on small arthropods. Centipedes move rapidly and are dorsoventrally flattened. Each body segment of a centipede bears a pair of legs. The large fangs on the head are not mandibles, but are maxillipeds (appendages modified for feeding). The mandibles are smaller and lie between the maxillipeds.

Centipedes have poison claws on the anterior-most trunk segment that paralyze prey and aid in defense. Centipedes may possess a variable number of ocelli, which may be grouped to form true compound eyes, but many lack eyes altogether. In some species the final pair of legs act as sense organs similar to antennae, but facing backwards, in addition to antennae at the anterior of the body on the head. Millipedes live in the same environments as centipedes, but feed mainly on decaying plant material by moisturizing food with secretions and then scraping it in with their jaws. Millipedes are also considerably slower moving than centipedes, and the number of legs on each segment distinguishes millipedes (two pairs of legs per segment) from centipedes.

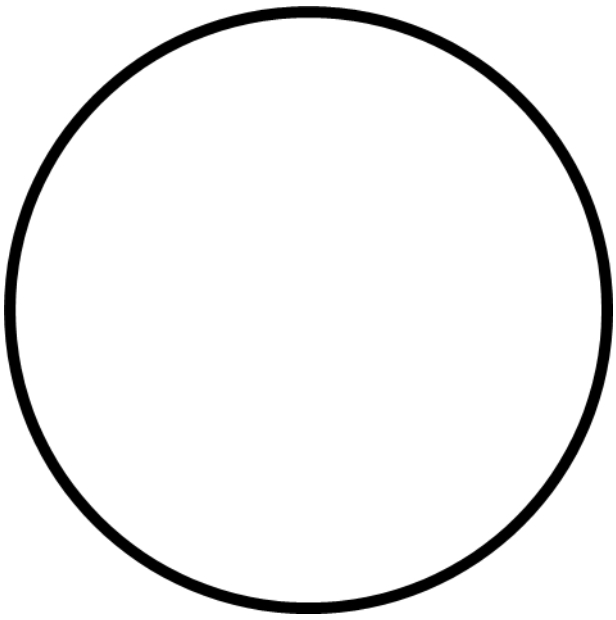
Procedure:

1. Examine the preserved centipedes and millipedes, noting the differences between them.

Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum:
Class: **Chilopoda (centipedes)**
Magnification:
Notes:



Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum:
Class: **Diplopoda (millipedes)**
Magnification:
Notes:



Subphylum: Hexapoda (Insects) are the largest group of organisms on Earth (1+ million species), and dominate virtually all terrestrial habitats. Three separate body regions (head, thorax, and abdomen) and six thoracic legs are the major diagnostic features of insects. Most insects have two pairs of wings (Fig. 6), which are outgrowths of the thoracic exoskeleton and enable some species to fly. Insects also have highly modified mouth parts based on their life history (e.g. mouth parts of grasshoppers are designed to grind coarse plant material, whereas mosquitoes have mouth parts that puncture and suck fluid from animals). The complete digestive system of insects is regionally specialized, with discrete organs functioning in the breakdown of food and the absorption of nutrients. Metabolic wastes are removed from an insect's hemolymph by excretory organs called Malpighian tubules. The insect nervous system consists of a pair of ventral nerve cords with several segmental ganglia and some converge at the head forming a cerebral ganglion (brain). Many insects undergo metamorphosis in their development and can have complex reproductive systems.

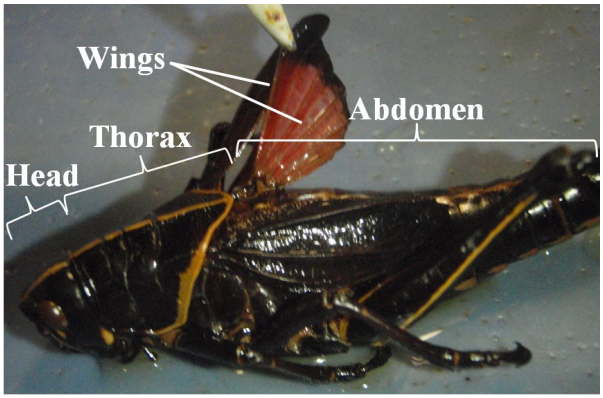
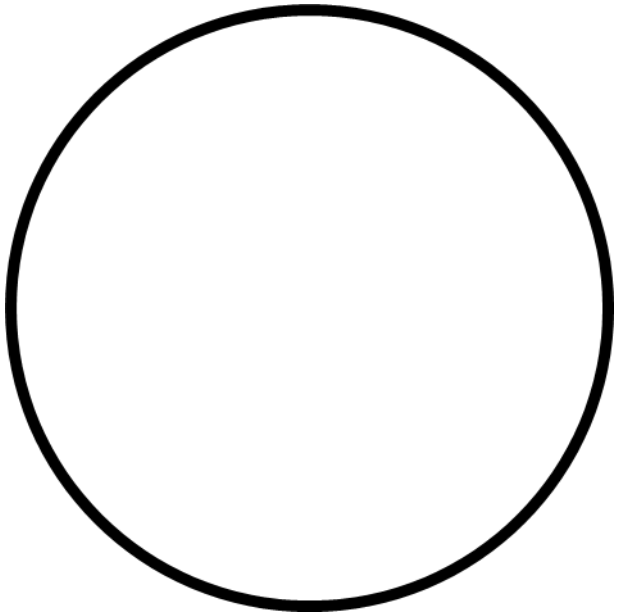


Figure 6. External anatomy of a grasshopper

Procedure:

1. Examine the preserved grasshopper.

Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum:
Class: **Diplopoda (millipedes)**
Magnification:
Notes:



Phylum: Echinoderms are deuterostomes which represent a departure from the other animals we have discussed. Deuterostomes differ significantly in their embryonic development for instance the blastopores give rise to an anus rather than a mouth. Echinoderms are an exclusively marine phylum of bottom dwellers that exhibit pentaradial symmetry, have a calcareous endoskeleton, and possess the ability to regenerate after losing significant portions of their body. Sometimes their epidermis may have cells filled with toxins or pigment cells giving them intense color. Echinoderms have a unique water vascular system consisting of a series of coelomic water-filled canals with hollow projections called tube feet (Fig. 7). These tube feet can be controlled by hydrostatic pressure and muscles leading to relatively slow movement speeds, but intense power to rip open a clam's shell, a common prey item for some species.

The water vascular system also is used in gas exchange and nutrient circulation. There are five **classes** of echinoderms. (1) **Asteroidea** (sea stars) are continuous with the central disk and have very pronounced tube feet. A sea star has two stomachs and one stomach can be everted through the mouth to secrete digestive enzymes in order to start the digestion process externally. (2) **Ophiuroidea** (brittle stars) have slender branched arms clearly demarcated from the central disk. **Echinoidea** (sea urchins and sand dollars) lack distinct arms and have ossicles fused into a solid shell. (3) **Crinoidea** (sea lilies or feather stars) have a mouth on the top surface surrounded by, often more, than 5 feeding arms. (4) **Holothuroidea** (sea cucumbers) have soft bodies, reduced ossicles, and few, if any, spines.

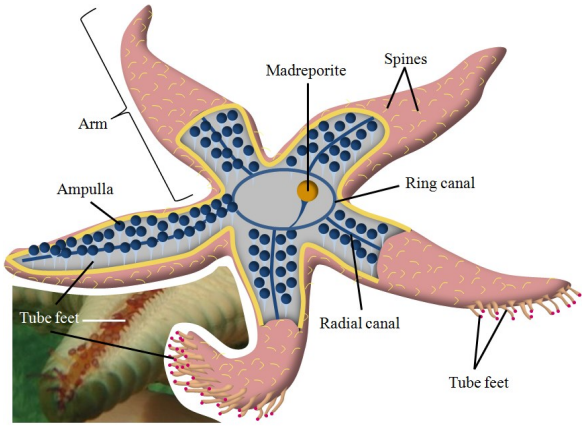
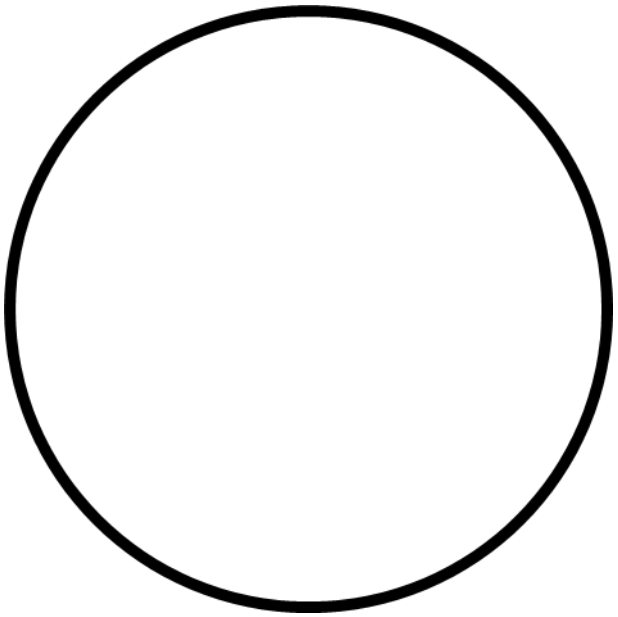


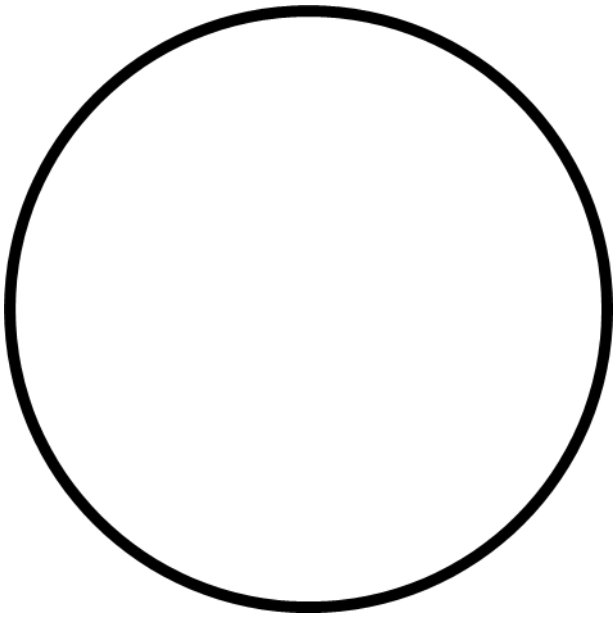
Figure 7. Echinoderm body plan of a sea star, emphasizing the water vascular system

Procedure:

1. Obtain preserved specimens of a sea star, sea urchin, sand dollar, and sea cucumber. Compare and contrast the structures in these specimen. Identify and locate: tube feet, radial canal, spines, madreporite, mouth, and anus.

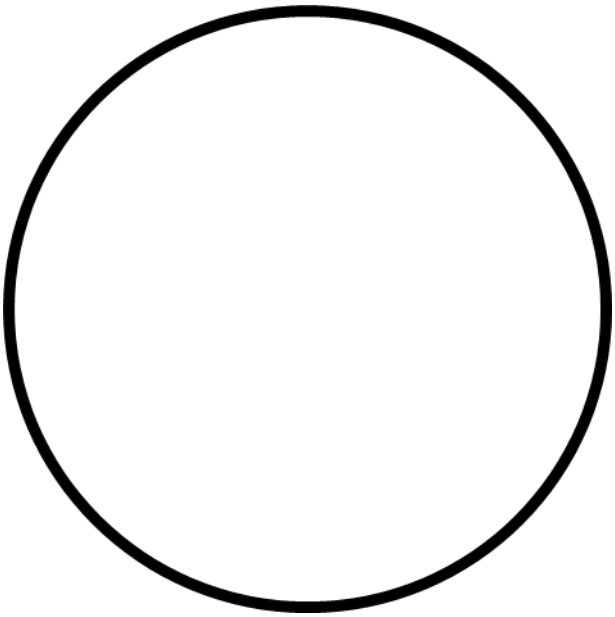
Domain:
Supergroup:
Kingdom:
Phylum:
Class: **Asteroidea**
Magnification:
Notes:

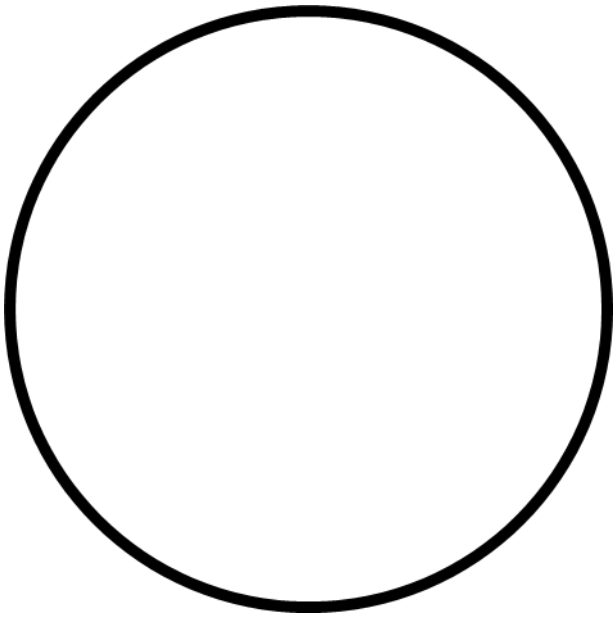




Domain:
Supergroup:
Kingdom:
Phylum:
Class: **Echinoidea** (sea urchin)
Magnification:
Notes:

Domain:
Supergroup:
Kingdom:
Phylum:
Class: **Echinoidea** (sand dollar)
Magnification:
Notes:





Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum: Echinozoa
Class: **Holothuroidea** (sea cucumber)
Magnification:
Notes:

Phylum: Chordata members share four key features: **1)** a dorsal hollow nerve cord (develops into the spinal cord in vertebrates), **2)** a notochord (cartilaginous rod that forms on the dorsal side of the gut in the embryo; develops into the spine in vertebrates), **3)** pharyngeal slits (may develop into gills along the pharynx), and **4)** a postanal tail (Fig. 8). Note that some groups only have these present in embryonic development. There are 2 **subphylums** of invertebrate chordates: **Tunicata** (Tunicates) and **Cephalochordata** (lancelets). Tunicates are also known as sea squirts and have a thick, carbohydrate material with covers their outer body like a tunic. They live a sessile life in shallow ocean waters as suspension feeders on plankton and detritus. Lancelets are also suspension feeders. They are small (few centimeters long) with a blade-like shape and burrow into sand at the bottom of warm ocean waters.

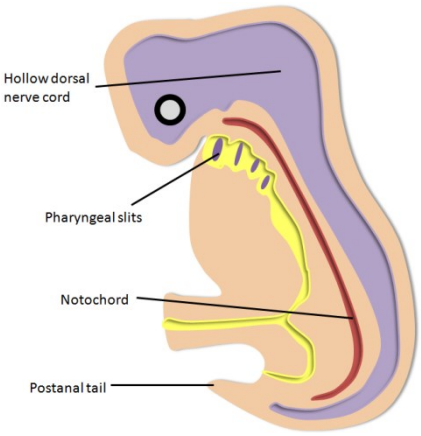


Figure 8: The four principle features of chordates shown in a generalized embryo.

Procedure:

1. Examine the preserved tunicates and lancelets with your dissecting microscope.

Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum: **Tunicata**
Magnification:
Notes:

Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum: **Cephalochordata**
Magnification:
Notes:

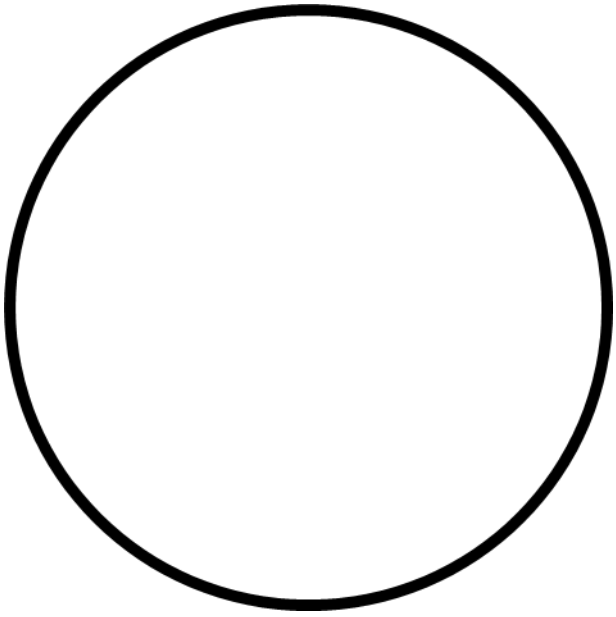
Subphylum: Vertebrates have a distinct head and a vertebral column (series of stiff elements (vertebrae) separated by mobile joints (intervertebral discs)) that replaces the notochord in adults and surrounds the dorsal nerve cord (i.e. spinal column).

Superclass: Agnathans are jawless fishes with cartilaginous endoskeletons and notochords, and lack paired fins. Seven pharyngeal gill slits are located near the head and their gill arches are reinforced with cartilage. The mouth is at the center and is armed with horny teeth and a rasping tongue. Agnatha do not have an identifiable stomach, but have a long gut, more or less homogenous, throughout its length. Most lampreys are parasites and attach to the side of a fish, rasp a hole in the body with their tongue, and feed on the body fluids of the fish. Fertilization and development are both external. Agnathans have a two-chambered heart and are ectotherms - they do not regulate their own body temperature, and external changes in temperature affect their internal temperature.

Procedure:

1. Observe the external features of the preserved lamprey.

Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum:
Superclass: **Agnathans**
Order: Petromyzontiformes (lampreys)
Magnification:
Notes:

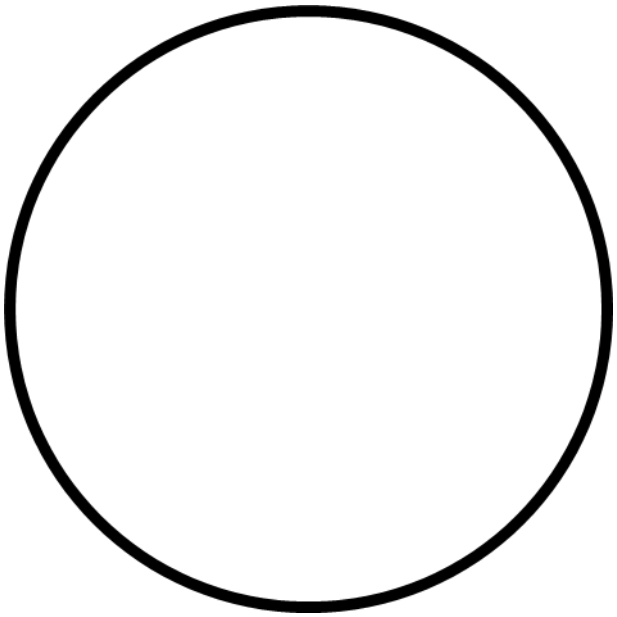


Class: Chondrichthyes includes sharks and their relatives, which are abundant in oceans as predators and scavengers. Their endoskeleton is cartilaginous and the anterior gill arches are modified into jaws. Their external anatomy illustrates some advanced features appropriate for a predator: **1)** fin structure allows for stabilization and maneuvering, **2)** jaws are large and powerful in most species, **3)** receptors in the nostrils and epidermis are sensitive to smells and electrical currents (Ampullae of Lorenzini), and **4)** a lateral line runs along each side of the body and contains sensory cells to detect slight vibrations. Chondrichthyans have two-chambered hearts. The notochord is gradually replaced by cartilage as these animals grow. Their tough skin is covered with dermal denticles similar to the scales of bony fishes, but much smaller. Chondrichthyans breathe through 5-7 gills. Fertilization is internal, but development can be external or internal. Most chondrichthyans are ectotherms. Unlike bony fish, sharks do not have swim bladders. Instead, sharks have extremely large livers full of oils that help them with their buoyancy.

Procedure:

1. Examine a preserved dogfish. Determine the sex of your shark. Locate the Ampullae of Lorenzini, lateral line, liver, stomach, and spiral intestines.

Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum:
Class: Chondrichthyes
Genus: ***Squalus***
Species: **acanthias** (spiny dogfish)
Magnification:
Notes:

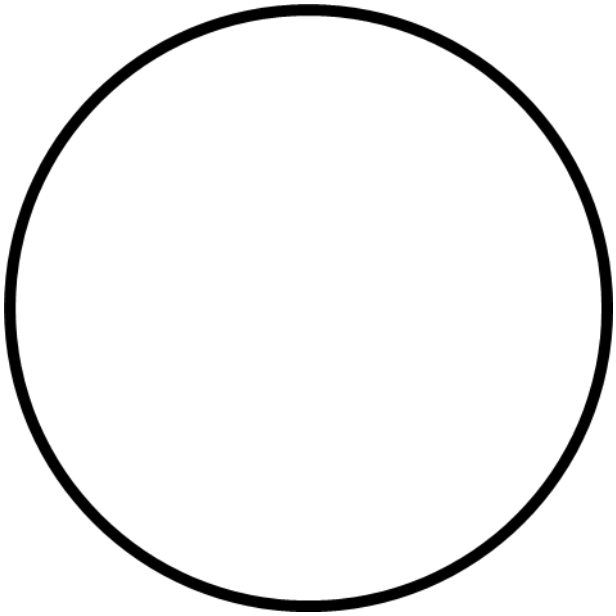


Infraclass: Teleosts, or bony fish, are the most diverse group of vertebrates. Advanced features of teleosts include a bony endoskeleton, modified gill arches, and internal air bladders for balance and buoyancy. Gills are protected by a moveable gill cover (operculum). Along each side and branching over the head of most fishes is the lateral-line system consisting of sensory pits in the skin (like Chondrichthyans). These pits detect water currents and predators or prey that may be moving near the fish. Most teleosts are ectothermic - their body temperatures vary as ambient temperatures change. Most species have streamlined bodies for rapid swimming. Fishes extract oxygen from water using gills, or use accessory breathing organs to breathe atmospheric oxygen. Fish have a closed-loop circulatory system - the two-chambered heart pumps the blood in a single loop throughout the body. Teleosts typically have two sets of paired fins, usually one or two dorsal fins, an anal fin, and a tail fin. They have jaws, skin that is usually covered with scales, and lay eggs. Fertilization and development is typically external with no parental care; yet, there are common exceptions. Most fish possess highly developed sense organs with all daylight fish having color vision, and many fish have chemoreceptors that provide information about taste and smell.

Procedure:

1. Obtain a preserved bony fish and examine its external features: gills, lateral line, fins. Locate internal features: liver, stomach, air bladder, intestines.

Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum:
Infraclass: **Teleost**
Genus: ***Perca*** (Perch)
Magnification:
Notes:

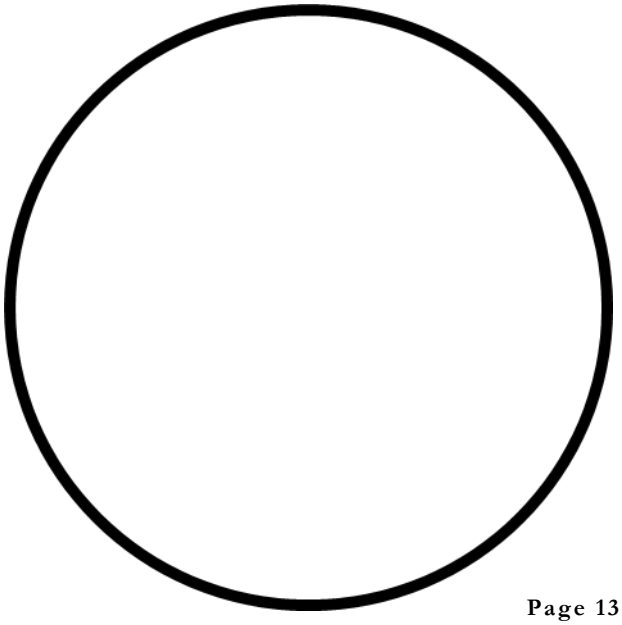


Class: Amphibians were the first land vertebrates. Most amphibian adults are terrestrial, but they lay eggs in water. The eggs are fertilized externally and each hatches into an aquatic larval stage called a tadpole, which extracts oxygen from the water. Tadpoles undergo a dramatic metamorphosis of body shape as they become air-breathing adults. The development of legs and lungs in amphibians were major evolutionary events enabling a terrestrial existence. The lungs in amphibians are primitive, however, compared to other terrestrial vertebrates - they possess few internal septa, large alveoli, and therefore have a slow diffusion rate of oxygen into the blood. Yet, in addition to lungs, the soft, moist skin of some amphibians is highly vascularized and accounts for as much oxygen diffusion as the lungs. To enable sufficient cutaneous respiration, the surface of their highly vascularized skin must remain moist in order for the oxygen to diffuse at a sufficient rate. Amphibians are ectothermic.

Procedure:

1. As a class, obtain a preserved amphibian and examine its external and internal anatomy (heart, lungs, stomach, kidney, intestines).

Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum:
Class: **Amphibia**
Specimen of choice: _____
Magnification:
Notes:

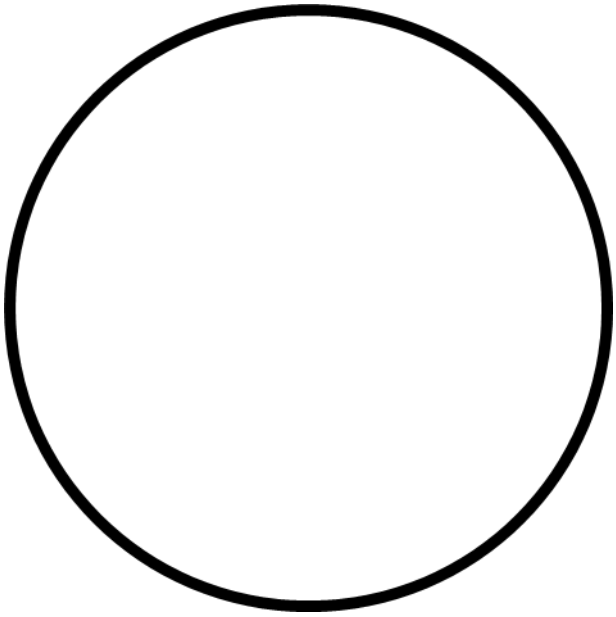


Class: Reptiles are independent of aquatic habitats, and therefore air exchange occurs in the lungs. Reptiles have developed structures for internal fertilization, and most species lay watertight eggs that contain a food source and a series of membranes. The outermost membrane (chorion) allows oxygen to enter the porous shell but retains water within the egg. The amnion encases the developing embryo within a fluid-filled cavity. The yolk sac provides food from the yolk for the embryo via blood vessels connecting to the embryo's gut. The allantois surrounds a cavity into which waste products from the embryo are excreted. Reptiles have a dry skin covered with scales or scutes that retard water loss. Most reptiles have a three-chambered heart consisting of two atria, one ventricle, and two aortas that lead to the systemic circulation. Reptiles are poikilothermic - their body temperature depends on the environment. If the external temperature reaches a threshold (either too low or too high), internal metabolic activity will be disrupted. Due to a less stable core temperature than birds and mammals and the increased variability terrestrial ambient temperatures experience compared to aquatic vertebrates, reptilian biochemistry requires enzymes capable of maintaining metabolic efficiency over a relatively wide range of temperatures. Most reptiles are carnivorous and have rather simple and comparatively short digestive tracts. The vision of reptiles is typically adapted to daylight conditions, with color vision and more advanced visual depth perception than most amphibians and mammals.

Procedure:

1. As a class, obtain a preserved reptile and examine its external and internal anatomy (heart, lungs, stomach, kidney, intestines). .

Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum:
Class: **Reptilia**
Specimen of choice: _____
Magnification:
Notes:



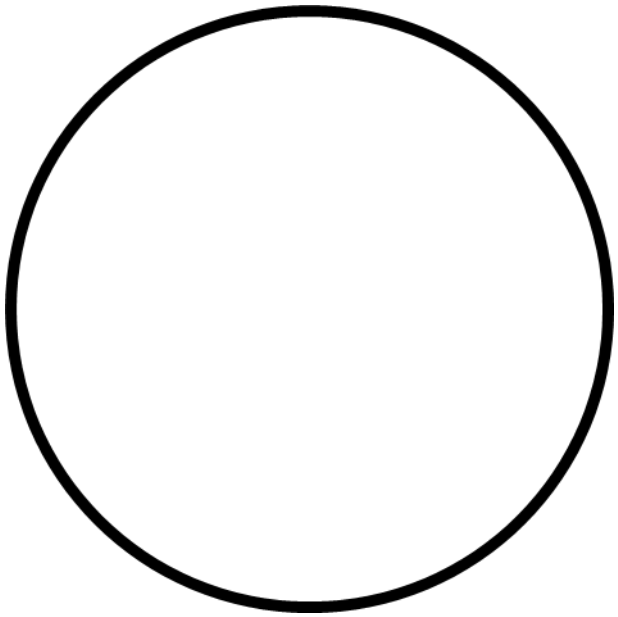
Class: Aves (Birds) are considered reptiles under cladistic analysis (based on most recent common ancestor), but are excluded in traditional taxonomy. Birds are the only animals with feathers, and they share the ability to fly with only a few groups. Each feather has a hollow shaft that supports many barbs, which in turn support barbules that interlock with hooks to give the feather its form. Birds are

homeothermic (they maintain a constant body temperature), which enables a consistent energy supply, and is important during flight. Other adaptations for flight include a high metabolism, a lightweight skeleton, an efficient respiratory system, and heavy musculature at the breast to move the wings. The wing is supported by an elongated and modified forelimb with extended fingers, and most bird species can fly. The bones of birds have large, air-filled cavities (pneumatic cavities), which, in addition to decreasing their density and overall mass, connect with the respiratory system. Upon inhalation, 75% of the fresh air bypasses the lungs and flows directly into a posterior air sac which extends from the lungs and connects with air spaces in the bones and fills them with air. The other 25% of the air goes directly into the lungs. When the bird exhales, the used air flows out of the lungs and the stored fresh air from the posterior air sac is simultaneously forced into the lungs. Thus, a bird's lungs receive a constant supply of fresh air during both inhalation and exhalation. Birds have beaks with no teeth, and may be predatory, scavengers, or herbivores. The digestive system of birds is unique, with a crop for storage and a gizzard that contains swallowed stones for grinding food to compensate for the lack of teeth. Most birds are highly adapted for rapid digestion to aid in flight. Birds have four-chambered hearts. Birds lay hard eggs and the development of the embryo is external. Many birds provide some form of parental care, and the duration of this care can last for days to years. The eyes of birds are prominent, and vision is one of their most highly developed senses.

Procedure:

1. Observe the available bird specimen.

Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum:
Class: **Aves**
Specimen of choice: _____
Magnification:
Notes:



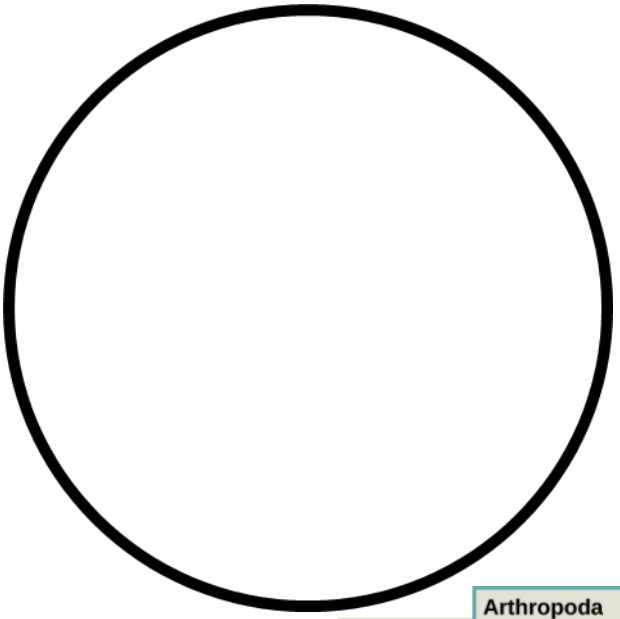
Class: Mammals are covered with insulating body fat and hair, and maintain a constant body temperature as birds do. Since small mammals have a high ratio of heat-losing surface area to heat-generating volume, they tend to have high-energy requirements and a higher metabolic rate than larger mammals. Most mammals possess sweat glands and specialized teeth based on their feeding behavior(s). Mammals have a well-developed circulatory system with a four-chambered heart. The circulatory system distributes oxygen,

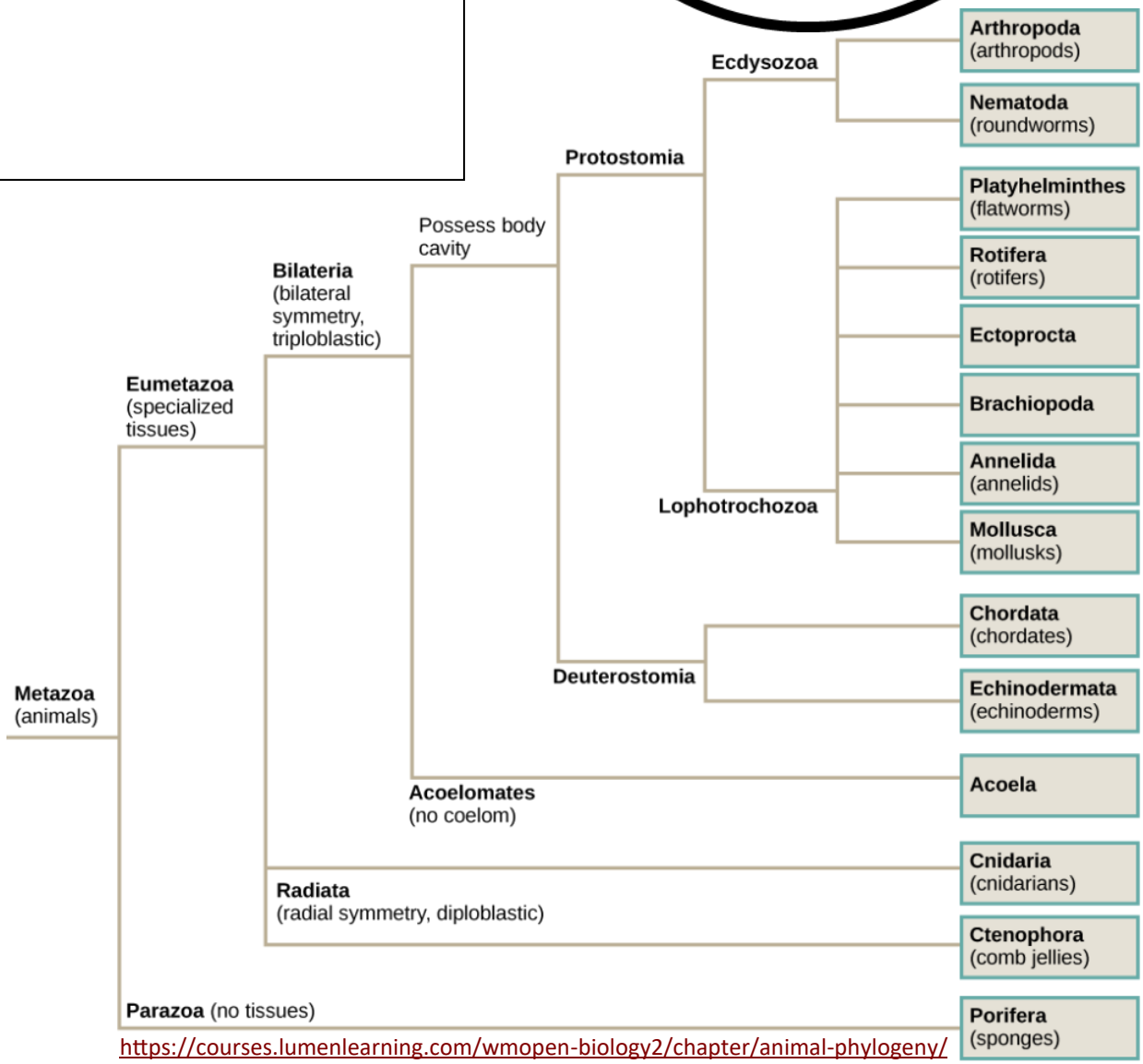
nutrients, and heat. Mammals give birth to live young, and nourish their young with milk produced by the mother's mammary glands. The lungs of mammals have a spongy texture and are honeycombed with epithelium having a much larger surface area in total than the outer surface area of the lung itself.

Procedure:

1. Obtain a preserved fetal pig and examine its external and internal anatomy.

Domain:
Supergroup:
Kingdom:
Phylum:
Subphylum:
Class: **Mammalia**
Genus: ***Sus***
Magnification:
Notes:





https://courses.lumenlearning.com/wmopen-biology2/chapter/animal-phylogeny/

REVIEW #4— Lab 4 (DOL 3)
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 concluded 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)