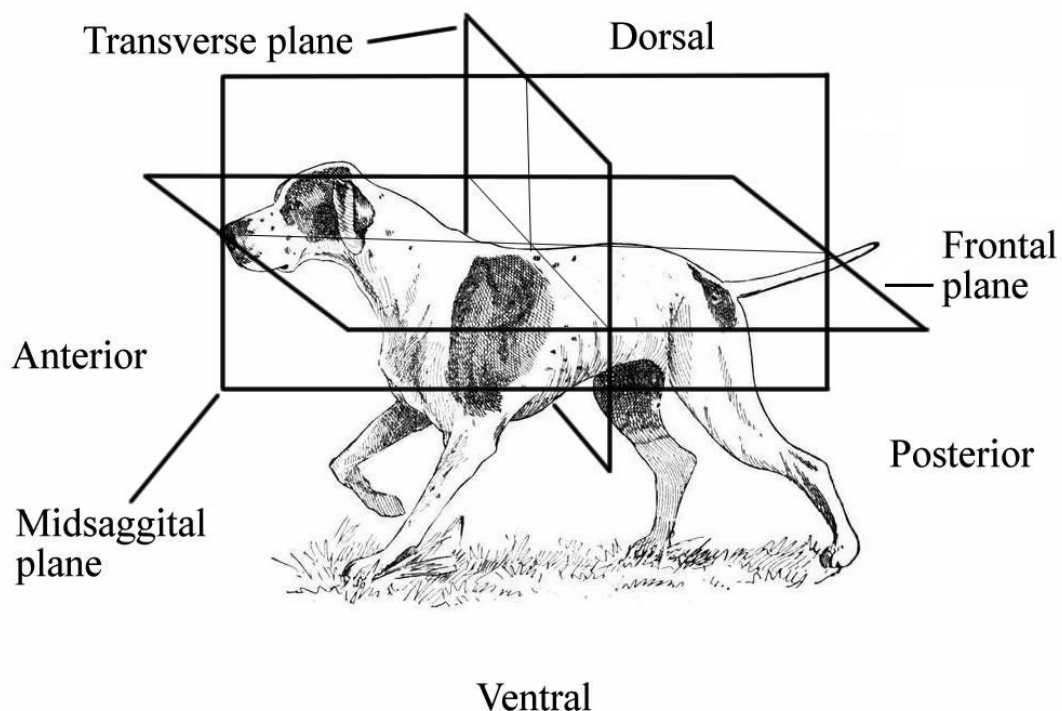


## Dissection Tips <sup>sm</sup>

Please read this document carefully before you begin dissection.

### Objectives:

1. To comprehend the value of and importance of good dissection techniques.
2. To appreciate the various systems represented as well as the preserved specimen.
3. Understand instrumentation.
4. Distinguish between the terms: posterior and anterior, dorsal and ventral, transverse plane and frontal plan and sagittal plane.



Please recognize the following equipment: scissors, forceps, scalpel, teasing needles, probe, ruler and dropping pipette. (These instruments must be kept clean and dry. Any student placing dirty instruments in the containers will be subject to penalty.)

**Scalpel:** used for making incisions. Hold it upright and almost perpendicular to the surface of the organism making a clean cut. Do not cut deeply and be aware of potential internal structural damage.

**Forceps and dissecting needles:** used for lifting, loosening and moving anatomical structures to expose those hidden from view by organs and structures.

**Drawings:** Should be clean and neat. Students are not expected to be artists but the drawing represents significant processing of information.

**Key Terms:**

**Aboral:** away from the mouth.

**Anterior:** toward the head.

**Bilateral symmetry:** A midsagittal plane divides the body into two mirror images.

**Caudal:** toward the tail.

**Cephalic:** reference to the head.

**Cranial:** reference to skull.

**Cross section:** Sections perpendicular to the sagittal and frontal planes.

**Distal:** at a point away from the reference point.

**Dorsal:** reference to the back or opposite of ventral.

**Frontal plane:** a plane which bisects a bilaterally symmetrical animal into upper and lower halves.

**Lateral:** toward the side.

**Longitudinal:** lengthwise.

**Medial:** Toward the center of the body.

**Oral:** reference to the mouth.

**Peripheral:** toward the surface.

**Posterior:** toward the rear of the body.

**Proximal:** close to a reference point

**Radial symmetry:** arrangement around a central point as a radius is to a circle.

**Sagittal plane:** any longitudinal plane passing from head to tail.

**Superficial:** toward the surface of the body.

**Transverse plane:** plane perpendicular to the sagittal or frontal plane.

**Ventral:** relating to the belly or opposite from dorsal.

## **Classification (Campbell, 10th Ed.) Taxa for Kingdom Animalia sm**

**Phylum= P Subphylum=SP Superclass=SC Class=C Order=O Suborder=SO  
Genera=G Species=S**

**Porifera=P sponges (ascon, sycon, leucon)**

**Cnidaria=P**

Anthozoans SP- coral, sea fans

MedusozoaSP

Hydrozoa=C- hydra

Scyphozoa=C – moon jellies

Cubozoa=C box jellies

**Ctenophora=P-comb jellies**

**Platyhelminthes=P-flat worms**

Catenulida=SP-fresh water

Rhabditophora=SP

Turbellaria/Planarians=C-non-parasitic

Trematoda=C-flukes

Cestoda=C-tapeworms

**Nematoda=P-round worms**

**Rotifera=P**

**Nemertea=P-ribbon worms**

**Ectoprocts and Brachiopods=P-lamp shells,moss animals**

**Mollusca=P**

Polyplocophora/Chiton=C-eight plates

Bivalvia=C-clams, mussels

Gastropoda=C-snails, slugs, nudibranchs

Cephalopoda=C-octopi, squid, cuttlefish

**Annelida=P**

Errantians=SP-parapodia

Sedentarians=SP

Oligochaeta=C-earth worms

Hirudinia=C-leeches

**Arthropoda=P**

Chelicerates=C-spiders, ticks, horseshoe crabs

Myriapoda=C

Diplopoda=SC-millipedes

Chilopoda=SC-centipedes

Insecta=C-six legs

Pancrustacea=C-crayfish, lobster

**Echinodermata=P**

Asteroidea=C-starfish

Ophiuroidea=C-brittle starfish

Echinoidea=C-sea urchins, sand dollars

**Crinoidea=C-sea lillies**  
**Holothuroidea=C-sea cucumber**  
**Chordata=P**  
**Urochordata=SP-sea squirt**  
**Cephalochorda=SP-lancelet**  
**Cyclostomes=SP**  
**Myxini=C-hagfish**  
**Petromyzonida=C-lamprey**  
**Vertebrata=SP**  
**Chondrichthyes=C-sharks, rays**  
**Actinopterygii=C-ray-finned fish**  
**Actinistia=C-lobe-finned fish**  
**Dipnoi=C-lung fish**  
**Amphibian=C**  
**Urodela=O-salamanders**  
**Anura=O-frogs/toads**  
**Apoda/Caecilians=O-no legs**  
**Reptilia=C**  
**Chelonia(Testudines)=O-turtles**  
**Lepdosauria=O-snakes, lizards**  
**Crocodylia=O-alligators, crocodiles**  
**Aves=O-birds**  
**Mammalia=C**  
**Monotremata=O-spiny echidna, platypus**  
**Marsupialia=O-kangaroos, wombats**  
**Cetartiodactyla=O-sheep, bison, whales, dolphins**  
**Carnivora=O-dogs, cats, wolves**  
**Chiroptera=O-bats**  
**Xenarthra=O-sloths**  
**Lagomorpha=O-rabbits**  
**Perissodactyla=O-horses, rhinos**  
**Proboscidea=O-elephants**  
**Rodentia=O-rats, mice**  
**Sirenia=O-manatees**  
**Primates=O**  
**Prosimii=SO**  
**Anthropoidea=SO**  
**New World Monkeys=G-spider monkeys, capuchins**  
**Old World Monkeys=G-macaques, baboons**  
**Hylobates=G-gibbons**  
**Pongo=G-orangutans**  
**Gorilla=G**  
**Pan=chimpanzee, bonobosG**  
**(Groups of hominins)**  
**Sahelanthropus tchadensis=GS**  
**Ardipithecus ramidusGS**

**Australopithecus=G**

**Homo=G**

**habilis=S**

**erectus=S**

**neanderthalensis=S**

**sapiens=S**

## Laboratory – Invertebrates, Part I sm

The kingdom, Animalia includes organisms that are multicellular, heterotrophic eukaryotes. The cells of animals lack cell walls but typically express a variety of junctions such as tight junctions, desmosomes and gap junctions. Many tissues in an organism reflect the personality of that particular tissue with specific biochemistry, structures etc. As we follow the suggested course of study of diverse organisms we must not fail to note the increasing complexity and specialization of all systems. Animals inhabit virtually all of the various types of habitats on this planet including aquatic as well as terrestrial. While most of us remain most intimately connected with other chordates, particularly the vertebrates, we comprise a small percentage of animal species.

### Objectives:

1. Differentiate between ascon, leucon and sycon body plans of sponges (Phylum Porifera.)
2. Recognize main structures in a sponge cross-section: osculum, spicule, porocyte, pinacocyte, choanocyte, amoebocyte, spongocoel and ostium.
3. Differentiate between siliceous and calcareous spicules as well as spongin fibers.
4. Recognize the main classes of the Phylum Cnidaria, general characteristics and examples of each class.
5. Differentiate between the polyp and medusa form of each cnidarian.
6. Explain the life cycle of the hydrozoan, Obelia.
7. List the main characteristics of important classes of Platyhelminthes as well as recognize examples of each class.
8. Recognize the main structures of the flatworms, Dugesia and Cestoidea.
9. Describe life cycles of fluke and tapeworm.
10. Recognize structures of nematoda.
11. Understand the body plan of the roundworm and dissect it.
12. List main classes of Phylum Mollusca, giving characteristics and examples of each.
13. Describe the main structures of the clam, having dissected one of them.
14. List the main classes of the Phylum Annelida.
15. Give main characteristics of each class and recognize examples.
16. Describe the general structure of the earthworm, Lumbricus terrestris, having dissected one of them.
17. Describe the economic and aesthetic significance of each phylum.

Consult your photographic atlas for diagrams and photos of representatives of Invertebrata.

## Invertebrata

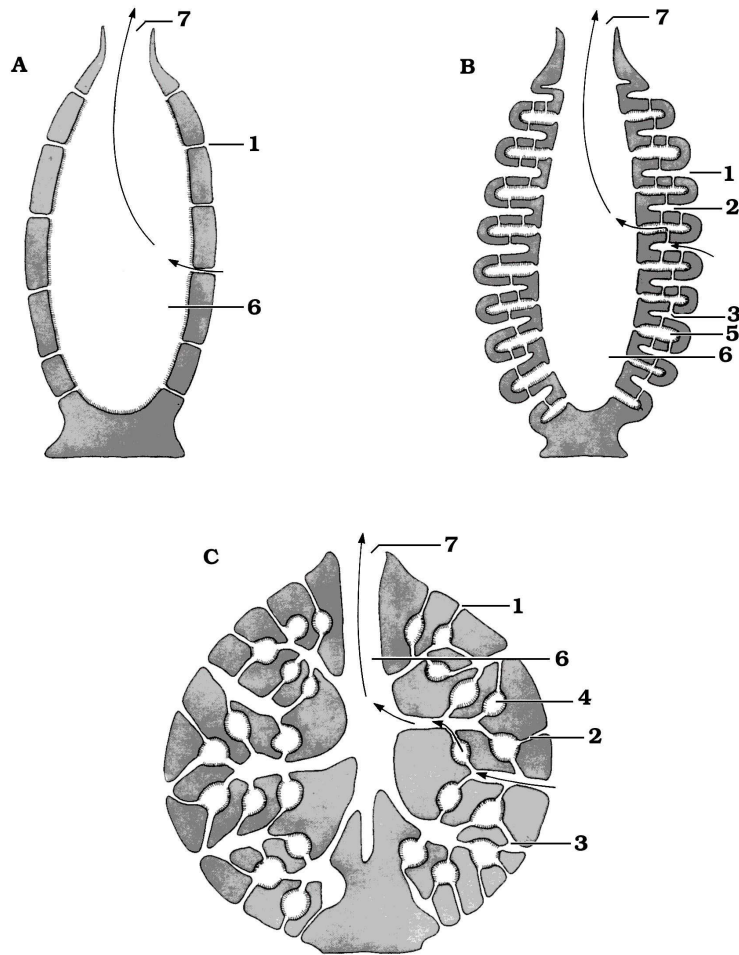
General characteristics of animals with no backbones are that they are eukaryote, multicellular, heterotrophic (ingestive), capable of glycogen storage and often possess intercellular junctions: tight, gap, desmosomes. Nervous and muscle tissue are present to some extent and most of the organisms reproduce sexually.

Phylum Porifera includes sponges, a group of organisms so simple in nature that for many years they were not considered as animal. They are simple and lack tissues while possessing different cell types with various functions. Most of the 5,000 species classified are marine although about 150 varieties are fresh water sponges such as *Spongilla*. The economic significance of the sponge has historically been centered around cleaning. Very little harvesting currently takes place due to overfishing and pollution.

There exist three basic body plans for sponges. They are ascon, the most simple, sycon and leucon, which is generally the most complex. Morphology consists of inner and outer layers which sandwich a mesohyl matrix. The gelatinous mesohyl layer is considered by some a type of connective tissue. The skeleton of the sponge consists of spicules of calcium carbonate, silica salts or spongin fibers which are often secreted by specialized cells, amoebocytes. The inner cell layer is characterized by specialized cells, choanocytes. These are flagellated cells with collars responsible for carrying out phagocytosis.

The ascon body-plan is represented by *Leucosolenia*. Obtain a slide and locate the following structures: osculum the opening into the central cavity, the spongocoel, as well as the spicules. *Scypha*, also referred to as *Grantia* and *Sycon*, is a sycon-type sponge. Obtain a stained cross-section and examine the morphology. Note the diagram and locate the structures indicated.

## SPONGE TYPES



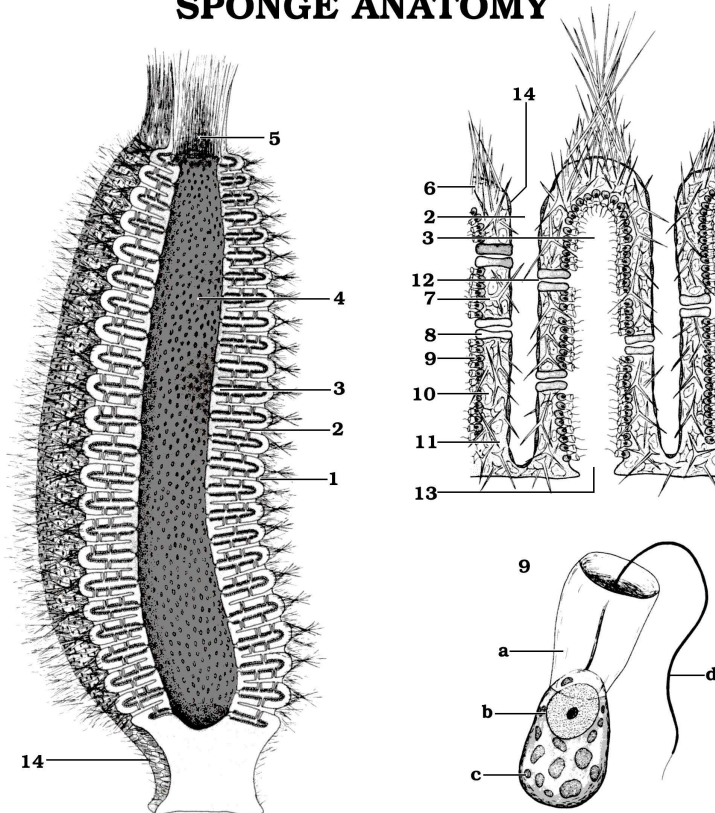
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|-----------------------------------|------------------------------------|
| <b>A. Asconoid</b>                | <b>3. Prosopyle</b>                |
| <b>B. Syconoid</b>                | <b>4. Flagellated chamber</b>      |
| <b>C. Leuconoid</b>               | <b>5. Radial canal</b>             |
| <b>1. Incurrent pore (ostium)</b> | <b>6. Spongocoel</b>               |
| <b>2. Incurrent canal</b>         | <b>7. Excurrent pore (osculum)</b> |

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The most complicated body plan is the leucon-type which represents higher degrees of folding of the sandwich structure of wall. Examine a bath sponge and observe the rubbery texture and the network of canals. Note other examples of Porifera in the laboratory.



## SPONGE ANATOMY



- 1. Ostium
- 2. Incurrent canal
- 3. Radial canal
- 4. Spongocoel
- 5. Osculum
- 6. Monaxon spicule
- 7. Triaxon spicule
- 8. Porocyte

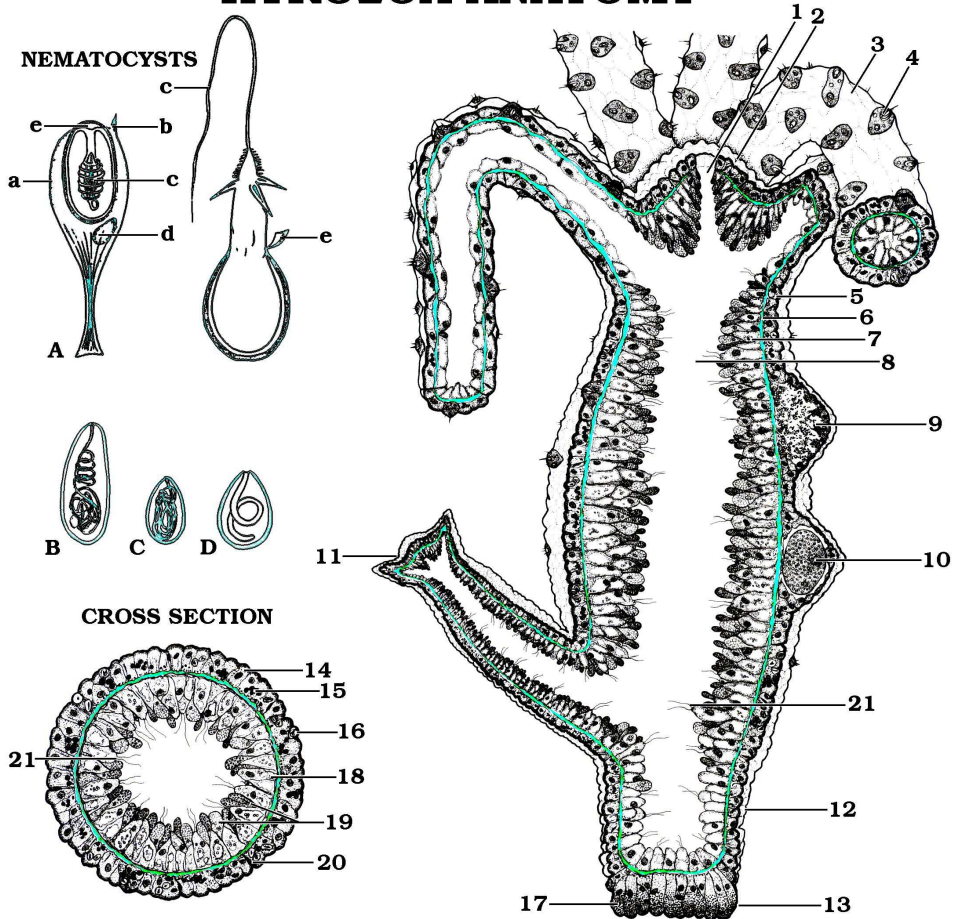
- 9. Choanocyte
  - a. Collar
  - b. Nucleus
  - c. Yolk body
  - d. Flagellum
- 10. Amoebocyte
- 11. Mesenchyme
- 12. Prosopyle
- 13. Apopyle
- 14. Pinacocytes

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The subkingdom Eumetazoa (true animals) includes radiata, those with radial symmetry. The first Phylum that will be examined is Cnidaria. These are the simplest animals with definite tissues. Two well-defined germ layers, epidermis (outer layer) and gastrodermis (inner layer) are present, sandwiching a mesoglea, gelatinous material that differs in fine structure from class to class. A specialized cell is present, a cnidocyte, which houses a stinging capsule. There are two basic body plans in this phylum, a sessile polyp as well as a free-swimming medusa. The nerve net is diffuse and not focused and tentacles surround the mouth.

The class Hydrozoa includes *Hydra* and *Obelia*. Note the following diagrams and locate the structures indicated.

# HYROZOA ANATOMY

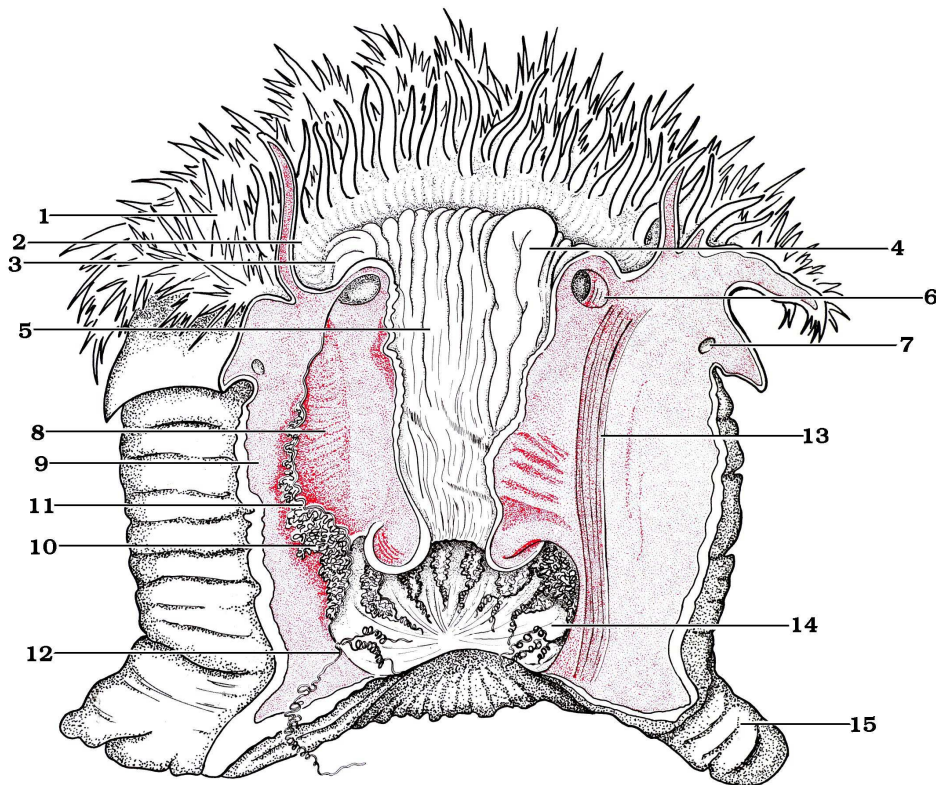


- |                          |                            |   |
|--------------------------|----------------------------|---|
| 1. Mouth                 | 11. Bud                    | A. Penetrant (before and after discharge) |
| 2. Hypostome             | 12. Stalk                  | a. Cnidoblast                             |
| 3. Tentacle              | 13. Foot                   | b. Cnidocil                               |
| 4. Nematocyst battery    | 14. Epitheliomuscular cell | c. Thread tube                            |
| 5. Epidermis             | 15. Interstitial cell      | d. Nucleus                                |
| 6. Mesoglea              | 16. Cnidoblast             | e. Cap                                    |
| 7. Gastrodermis          | 17. Glandulomuscular cell  | B. Streptoline glutinant                  |
| 8. Gastrovascular cavity | 18. Nutritive cell         | C. Steroline glutinant                    |
| 9. Testis                | 19. Gland cell             | D. Volvent                                |
| 10. Ovary                | 20. Sensory cell           |   |
|                          | 21. Cilia                  |   |

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The class Anthozoa includes anemones (the flower-like marine structure) and corals as well as sea-fans. This class is characterized by the polyp form of the cnidarian. Note the examples that your instructors have placed in the lab.

## ANTHOZOA ANATOMY

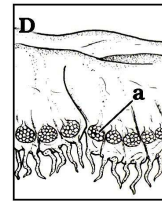
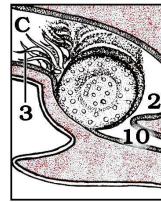
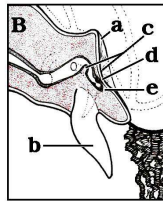
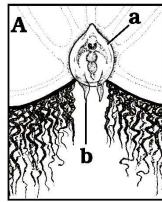
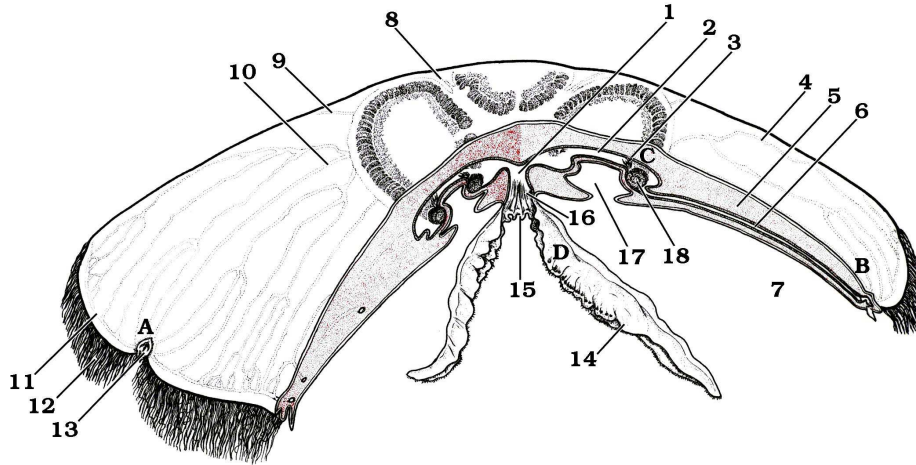


- |  |   |
|--|---|
| <p>1. Tentacles<br/>                 2. Oral disk<br/>                 3. Lip<br/>                 4. Siphonoglyph<br/>                 5. Gullet or pharynx<br/>                 6. Oral ostium<br/>                 7. Marginal ostium<br/>                 8. Primary mesentery</p> | <p>9. Secondary mesentery<br/>                 10. Gonads<br/>                 11. Mesenterial filament<br/>                 12. Acontia<br/>                 13. Retractor muscle of septum<br/>                 14. Gastrovascular cavity<br/>                 15. Basal disk</p> |
|--|---|

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The class Scyphozoa is characterized by *Gonionemius*, a jelly. Note structures in the diagram and locate preserved examples on the laboratory table.

# SCYPHOZOA ANATOMY



- |                         |                               |                       |
|-------------------------|-------------------------------|-----------------------|
| 1. Central stomach      | } Gastrovascular cavity       | 13. Rhopalium (A-B)   |
| 2. Gastric pouch        |                               | a. Rhopalial hood     |
| 3. Gastric filaments    |                               | b. Rhopalial lappet   |
| 4. Exumbrella           | } Gastrovascular canal system | c. Sensory pits       |
| 5. Mesoglea             |                               | d. Eye spot (ocellus) |
| 6. Gastrodermis         |                               | e. Statolith          |
| 7. Subumbrella          |                               | 14. Oral arm (D)      |
| 8. Per-radial canal     |                               | a. Brood pouches      |
| 9. Ad-radial canal      |                               | 15. Manubrium         |
| 10. Inter-radial canals | 16. Mouth                     |                       |
| 11. Ring canal          | 17. Subgenital pit            |                       |
| 12. Tentacles           | 18. Gonad (C)                 |                       |

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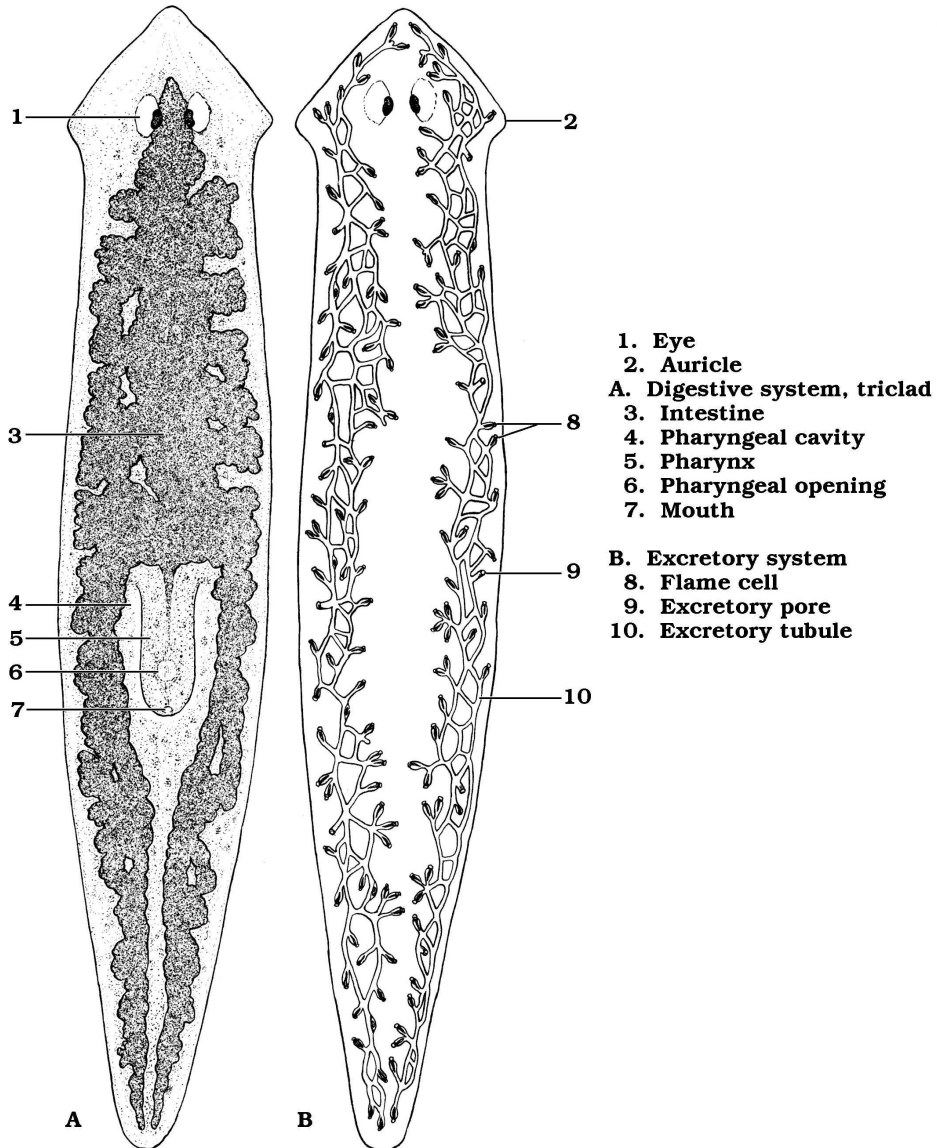
Bilateria includes those animals with two-sided symmetry (dorsal and ventral sides) as well as anterior-posterior polarity with cephalization. Cephalization allows the organism to concentrate nervous tissue in one area, the anterior, and allows it to be highly directional in terms of locomotion. There are some significant advantages to this basic structure. The first group of bilateria that we will examine is the Platyhelminthes, the acoelomates, those with no body cavity (flatworms, planarians, tapeworms, flukes.)

Members of the phylum Platyhelminthes are acoelomates and lack body cavities. Flatworms (20,000 species) are found in water or damp habitats. Many are parasites capable of unidirectional movement. We observe increased cephalization, presence of a mesoderm, more complex organs, true muscle and gastrovascular cavity. Classes: 1. Class Turbellaria: marine, planarians, diffusion for excretion, flame cells for osmoregulation, eyespots, auricles (smell), 2. Class Trematoda: flukes, parasites, suckers, large reproductive organs. 3. Class Cestoidea: tapeworms, parasitic flatworms, scolex with hooks, proglottids (sacs of sex organs), no digestive system. Phylum Nematoda: cylindrical pseudocoelomate, worms w/ tapered ends. Roundworms, many parasites, 1mm-1m, complete digestive tract, longitudinal muscles, sex, internal fertilization, *Trichinella spiralis* (trichinosis), some agricultural pests.

The first class that we will examine is Turbellaria. The planarian, *Dugesia*, will be provided in the laboratory for you to examine. If live planarians are present you may wish to place one in a watch glass under the dissecting scope and observe its behavior. Whole mounts of *Dugesia* will also be provided. Flame cells function in osmoregulation, diffusion allows for gas exchange and they do have eyespots for light detection and auricles for smell.

# PLANARIAN ANATOMY

## Digestive and Excretory Systems



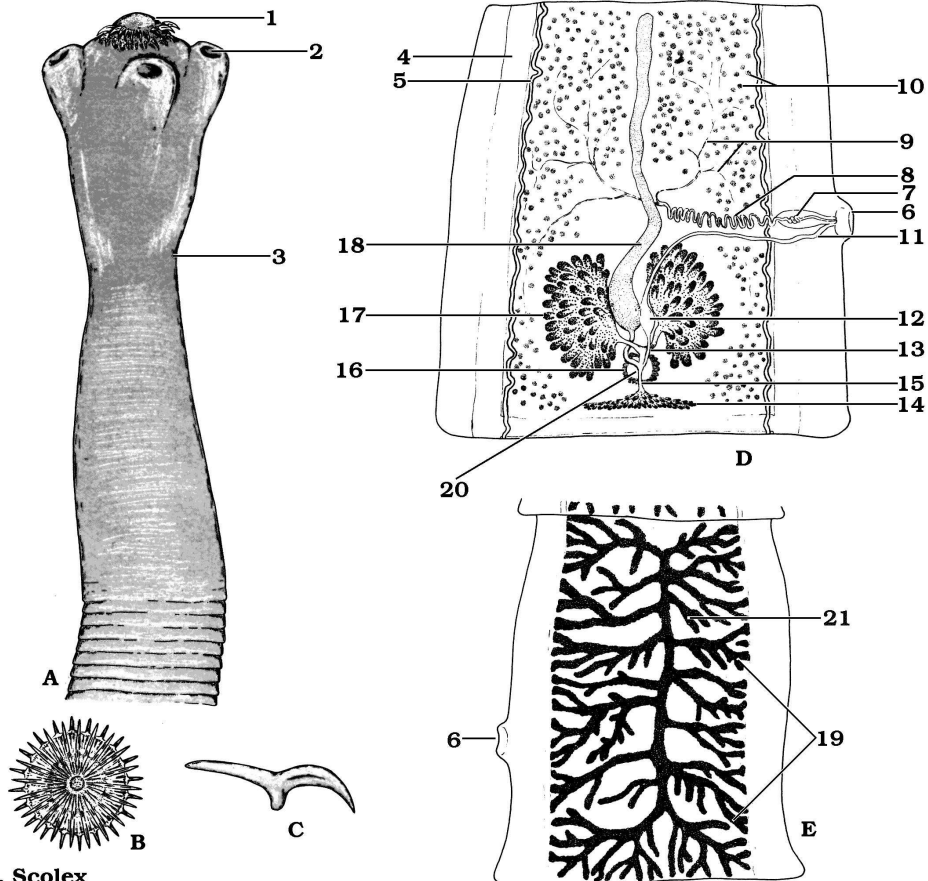
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The class Trematoda is represented by many parasites such as the human liver fluke (*Clonorchis sinensis*) and the sheep liver fluke (*Fasciola hepatica*). Note the whole mounts in the laboratory and locate structures indicated in the diagram. Much of the body of the organism is focused on reproduction.

The class Cestoidea includes the tapeworm that inhabits the gut of many vertebrates. Note the structures indicated. Examine the preserved slides and tapeworms provided in the laboratory. There is no digestive system as nutrition is absorbed.

## TAPEWORM ANATOMY

### *Taenia*



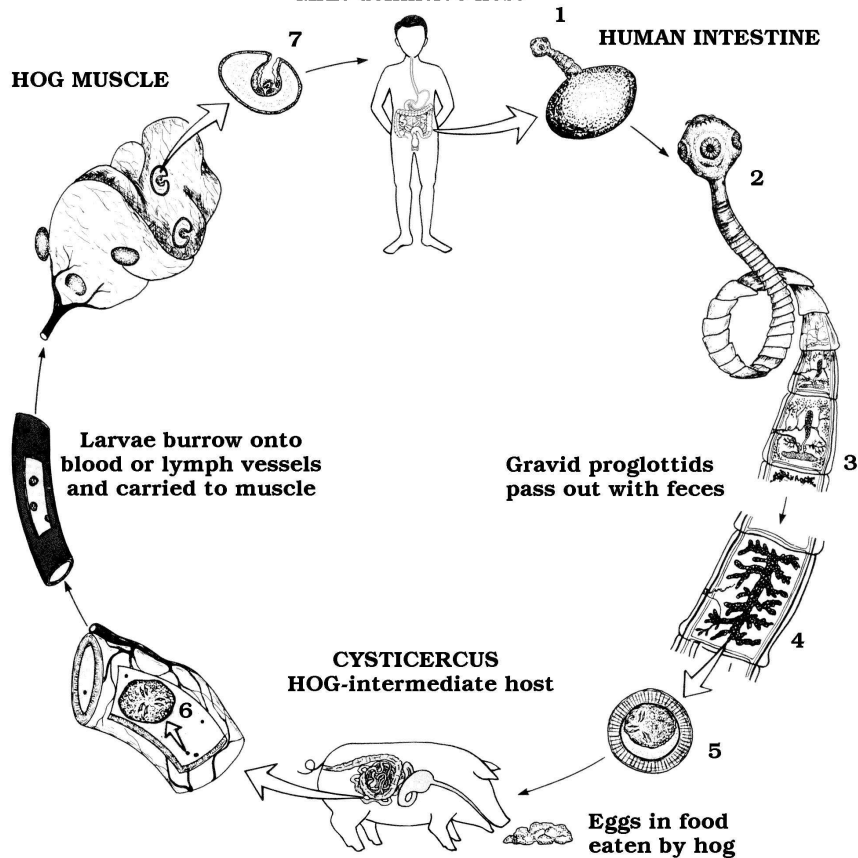
- |   |                               |                             |
|---|-------------------------------|-----------------------------|
| <b>A. Scolex</b>                              | <b>6. Genital pore</b>        | <b>14. Vitelline gland</b>  |
| <b>B. Rostellum (showing rostellar hooks)</b> | <b>7. Cirrus sac</b>          | <b>15. Vitelline duct</b>   |
| <b>C. Hook</b>                                | <b>8. Vas deferens</b>        | <b>16. Shell gland</b>      |
| <b>D. Mature proglottid</b>                   | <b>9. Vasa efferentia</b>     | <b>17. Ovary</b>            |
| <b>E. Gravid proglottid</b>                   | <b>10. Testes</b>             | <b>18. Uterus</b>           |
| <b>1. Rostellum</b>                           | <b>11. Vagina</b>             | <b>19. Branched uterus</b>  |
| <b>2. Sucker</b>                              | <b>12. Seminal receptacle</b> | <b>20. Ootype</b>           |
| <b>3. Neck</b>                                | <b>13. Sperm duct</b>         | <b>21. Uterus with eggs</b> |
| <b>4. Ventral excretory canal</b>             |                               |                             |
| <b>5. Dorsal excretory canal</b>              |                               |                             |

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# TAPEWORM LIFE CYCLE

## *Taenia solium*

ADULT WORM  
MAN-definitive host



- |                                 |                                 |
|---------------------------------|---------------------------------|
| 1. Cysticercus (everted scolex) | 5. Egg                          |
| 2. Adult tapeworm               | 6. Oncosphere (6-hooked embryo) |
| 3. Mature proglottid            | 7. Cysticercus (bladder worm)   |
| 4. Gravid proglottid            |                                 |

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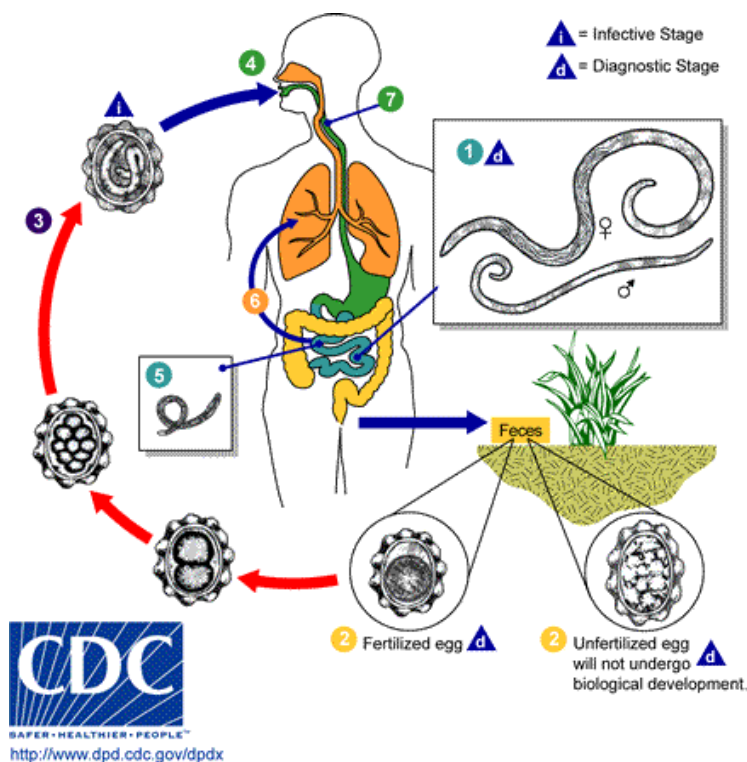
Pseudocoelomates are those organisms whose body cavity is partially lined by mesoderm. The phylum Nematoda will be examined. This phylum includes a number of animal parasites including *Ascaris*, which is found in the pig intestine.

Obtain a specimen of *Ascaris* and place it in a dissecting pan. Refer to the pictures in Van de Graaff and Crawley and note the external structures and determine the sex of the



roundworm. Females do tend to be larger and males exhibit a curl at the posterior end. Pin the anterior and posterior ends. Cut the animal longitudinally along the mid-dorsal line. Pin the body wall against the pan to expose organs. Note the tube within a tube body plan. What are some of the advantages to separate mouth and anus???

The picture below illustrates the complex life cycle of this human parasite.



Adult worms **1** live in the lumen of the small intestine. A female may produce approximately 200,000 eggs per day, which are passed with the feces **2**. Unfertilized eggs may be ingested but are not infective. Fertile eggs embryonate and become infective after 18 days to several weeks **3**, depending on the environmental conditions (optimum: moist, warm, shaded soil). After infective eggs are swallowed **4**, the larvae hatch **5**, invade the intestinal mucosa, and are carried via the portal, then systemic circulation to the lungs **6**. The larvae mature further in the lungs (10 to 14 days), penetrate the alveolar walls, ascend the bronchial tree to the throat, and are swallowed **7**. Upon reaching the small intestine, they develop into adult worms **1**. Between 2 and 3 months are required from ingestion of the infective eggs to oviposition by the adult female. Adult worms can live 1 to 2 years.

Phylum Mollusca includes approximately 50,000 species. Members are generally marine. Most have shells composed of calcium carbonate although some are shell-less. The body plan includes a muscular foot, visceral mass which contains internal organs, a mantle which drapes over the visceral mass and radula. Mollusks are generally monoecious. The larval form is the trochophore. The class Polyplacophora is composed of chitons which are ovoid marine forms with eight dorsal plates. They eat algae and are great aquarium cleaners. The class Gastropoda has 40,000 species of snails or slugs which undergo torsion yielding a single spiral shell. A head is present with eyes at tips of tentacles. Class Bivalvia or Pelecypoda contains clams, oysters, mussels and scallops. Two shells are held together with adductor muscles. Gills function for feeding and gas exchange as water passes through siphon to gills and exits through excurrent siphon.



back the mantle to expose the visceral mass and foot. Gently using the probe, locate the structures indicated.

Clams have an open circulatory system and the fluid involved is hemolymph. Using your photographic atlas, as well as the model provided, locate the main structures.

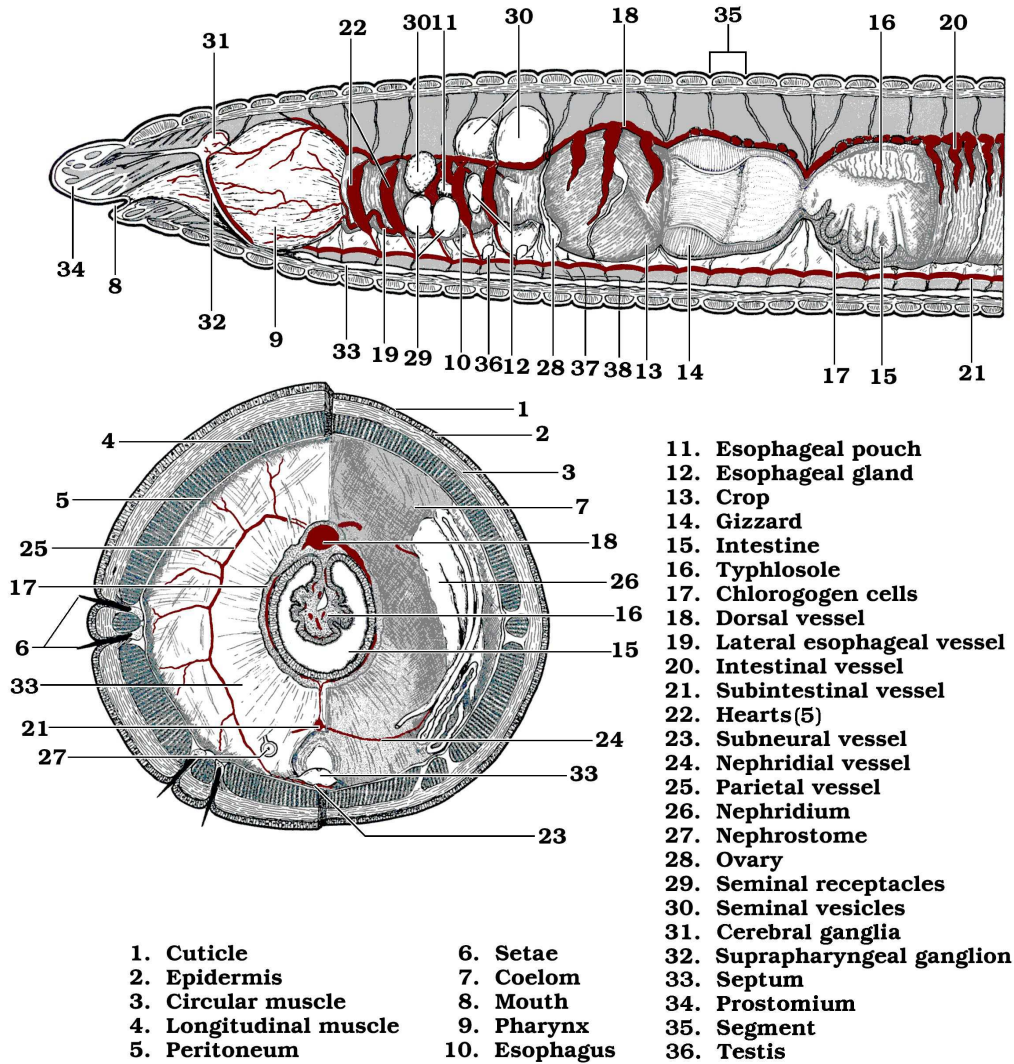
The class Cephalopoda includes squids, octopi and cuttle fish. They possess beak-like jaws and can sometimes inject poison. The mouth is centered in tentacles. The organism may be up to 17 m long. Octopuses creep and squids dart via expulsion of water. They possess closed circulatory systems (blood is in vessels) and well-developed nervous systems with complex brains. Locate the structures indicated.

The next phylum that we will be examining is Annelida. A successful adaptation is that of segmentation. Why is segmentation important? Approximately 15,000 species have been classified. They tend to be 1 mm-3m in length, terrestrial as well as aquatic. Nerve cords are present, as well as specialized digestive systems (pharynx, esophagus, crop, gizzard, intestine). Blood with hemoglobin is cleansed via metanephridia. Cerebral ganglion are present allowing for increasing success in terms of directional locomotion. Hermaphrodites undergo cross fertilization at the clitellum which secretes a mucous cocoon enclosing fertilized eggs.)

The class Oligochaeta is represented by the earthworm, *Lumbricus terrestris*. Obtain an earthworm and examine the exterior structures as you did with the roundworm. Compare the two organisms. What is similar??? Which characteristics are different? The segmentation is certainly one of the features that is quite different from roundworms. How would you compare the complexities of the two? Note the structures present in the diagram.

# EARTHWORM ANATOMY

## Dissection



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Pin both anterior and posterior ends of the earthworm. Cut longitudinally down the mid-dorsal line, pinning back the sides to expose the organs. Note the increasingly complex interior. Locate the structures indicated in the diagram.

**Questions:**

1. Describe the differences between the ascon, leucon and sycon body plans.

2. List the represented classes of Cnidaria and characteristics of each.

3. List the classes of Platyhelminthes and give characteristics of each.

4. How do roundworms appear to be more sophisticated than flat worms?

5. List the main classes of Mollusca and give main characteristics of each.

6. List the represented classes of Annelida and give characteristics of each.

In the following chart compare the various systems of the Phyla represented in this lab.

<u>Phylum</u>	<u>Alimentary System</u>	<u>Circulatory System</u>	<u>Uro-genital System</u>
1.			
2.			
3.			
4.			
5.			

