Lab Topic 18

Animal Diversity II

This lab is a continuation of observations of organisms in the animal kingdom as discussed in Animal Diversity I. Return to Lab Topic 17 and review the objectives of the lab on page 453. Review the descriptions of the 13 characteristics you are investigating in the study and dissection of these animals (pp. 455–457).

For a 2-hour lab: Omit the sea star and pig. See Teaching Plan.

In this lab topic you will study examples of two protostome phyla included in the group or clade **Ecdysozoa,** Nematoda (Exercise 18.1) and Arthropoda (Exercise 18.2). Recall that these organisms have coverings on their body surfaces. In Exercises 18.4 and 18.5, you will study two deuterostome phyla, Echinodermata and Chordata.

As you continue your study of representative organisms, continue to record your observations in Table 18.1 at the end of this lab topic. Keep in mind the big themes you are investigating.

1. What clues do similarities and differences among organisms provide about phylogenetic relationships?
2. How is body form related to function?
3. How is body form related to environment and lifestyle?
4. What characteristics can be the criteria for major branching points in producing a phylogenetic tree (representing animal classification)?

EXERCISE 18.1

Phylum Nematoda—Roundworms (*Ascaris*)

Materials

dissecting instruments
dissecting pan
dissecting pins
compound microscope
disposable gloves
preserved *Ascaris*
prepared slide of cross section of *Ascaris*
hand lens (optional)

Remind students to refer to Appendix C if they need to check definitions of orientation terms.

Introduction

Ascaris is a **roundworm**, or nematode (clade Ecdysozoa), that lives as a parasite in the intestines of mammals such as horses, pigs, and humans (Color Plate 56). Its body is covered with a proteinaceous **cuticle** that sheds periodically. Most often these parasites are introduced into the mammalian body when food contaminated with nematode eggs is eaten. Keep in mind the problem of adaptation to a parasitic lifestyle as you study the structure of this animal.

Wear gloves while dissecting preserved animals.

Procedure

1. Wearing disposable gloves, obtain a preserved *Ascaris* and determine its sex. Females are generally larger than males. The posterior end of the male is sharply curved.
2. Use a hand lens or a stereoscopic microscope to look at the ends of the worm. A mouth is present at the anterior end. Three "lips" border this opening. A small slitlike **anus** is located ventrally near the posterior end of the animal.
3. Open the animal by making a middorsal incision along the length of the body with a sharp-pointed probe or sharp scissors. Remember that the anus is slightly to the ventral side (Figure 18.1). Be careful not to go too deep. Once the animal is open, pin the free edges of the body wall to the dissecting pan, spreading open the body. Pinning the animal near the edge of the pan will allow you to view it using the stereoscopic microscope. As you study the internal organs, you will note that there is a **body cavity.** This is not a true coelom, however, as you will see shortly when you study microscopic sections. From your observations, you should readily identify such characteristics as symmetry, tissue organization, and digestive tract openings.
   a. The most obvious organs you will see in the dissected worm are **reproductive organs,** which appear as masses of coiled tubules of varying diameters.
   b. Identify the flattened **digestive tract,** or intestine, extending from mouth to anus. This tract has been described as a "tube within a tube," the outer tube being the body wall.
   c. Locate two pale lines running laterally along the length of the body in the body wall. The excretory system consists of two longitudinal tubes lying in these two **lateral lines.**
   d. There are no organs for gas exchange or circulation. Most parasitic roundworms are essentially anaerobic (require no oxygen).
   e. How would nourishment be taken into the body and be circulated?

   Semidigested food is sucked into the mouth, is further digested and absorbed in the intestine, and passes into the pseudocoelom and to all tissues.

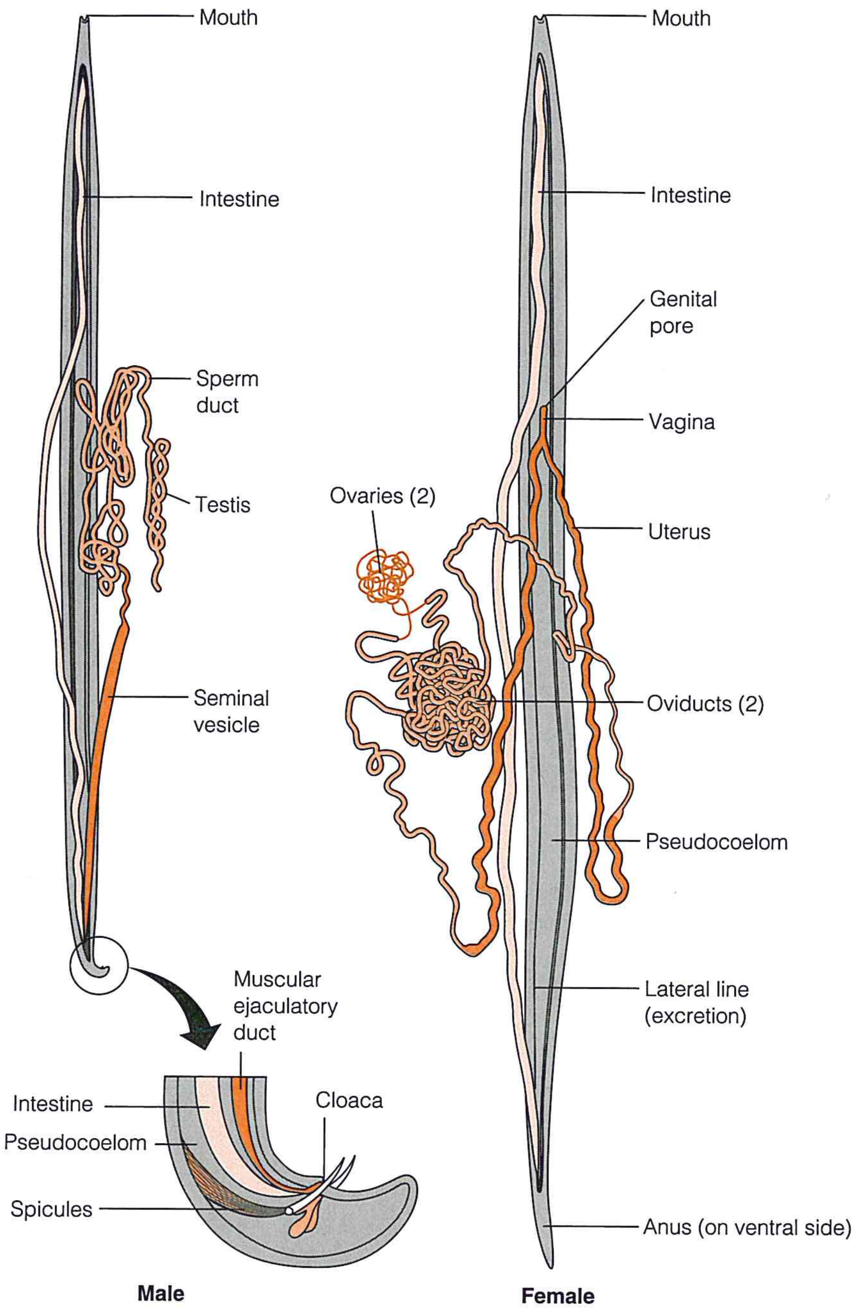


Figure 18.1.
Male and female *Ascaris*.
The digestive tract originates at the mouth and terminates in the anus. Reproductive structures fill the body cavity.

f. The nervous system consists of a ring of nervous tissue around the anterior end of the worm, with one dorsal and one ventral nerve cord. These structures will be more easily observed in the prepared slide.

g. Do you see signs of segmentation in the body wall or in the digestive, reproductive, or excretory systems?

No. The body wall is smooth and continuous, and the systems show no signs of segmentation.

h. Do you see signs of a support system? What do you think supports the body?

The body is supported by a hydrostatic skeleton.

4. Using the compound microscope, observe a prepared slide of a cross section through the body of a female worm. Note that the body wall is made up of (from outside inward) **cuticle** (noncellular), **epidermis** (cellular), and **muscle fibers.** The muscle (derived from mesoderm) lies at the outer boundary of the body cavity. Locate the **intestine** (derived from endoderm). Can you detect muscle tissue adjacent to the endodermal layer?

   There is no muscle here, which is characteristic of pseudocoelomates.

   What do we call a coelom that is lined by mesoderm (outside) and endoderm (inside) (see Figure 17.2b)?

   a pseudocoelom

5. Most of the body cavity is filled with reproductive organs. You should see cross sections of the two large **uteri,** sections of the coiled **oviducts** with small lumens, and many sections of the **ovaries** with no lumen. What do you see inside the uteri?

   eggs

6. By carefully observing the cross section, you should be able to locate the **lateral lines** for excretion and the dorsal and ventral **nerve cords.**

Results

1. Sketch the cross section of a female *Ascaris*. Label the **cuticle, epidermis, muscle fibers, intestine, body cavity** (give specific name), **reproductive organs, (uterus, oviduct, ovary), lateral lines,** and **dorsal** and **ventral nerve cords.**

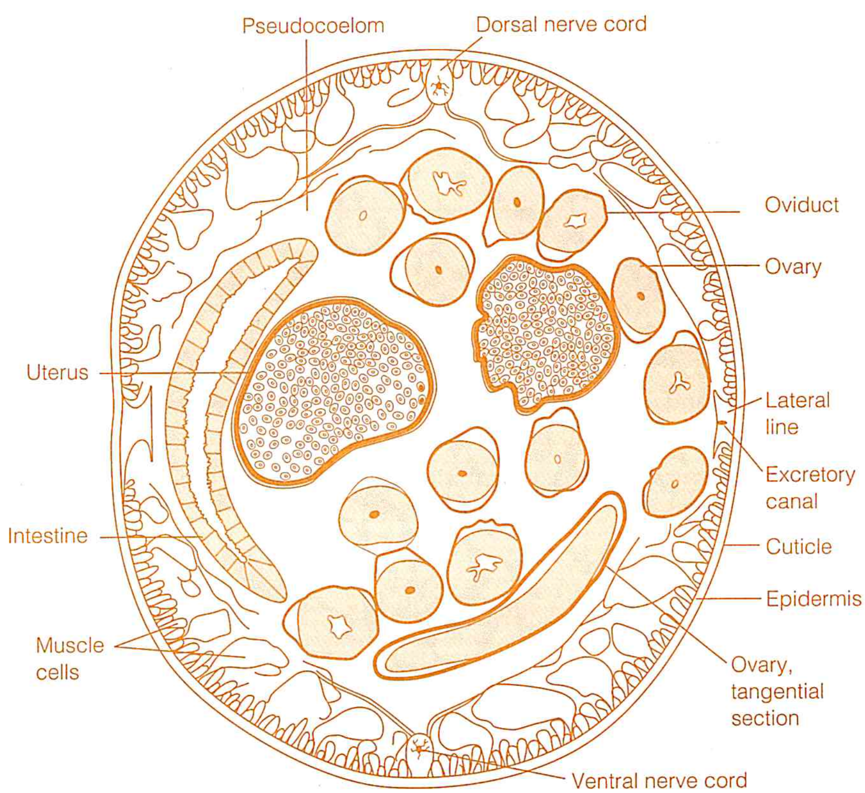


Illustration from Charles F. Lytle and J. E. Wodsedalek, General Zoology Laboratory Guide, *Complete version 9e (Dubuque, IA: Wm C. Brown, 1987) © 1987 Wm C. Brown Communications, Inc. Reproduced by permission of the McGraw-Hill Companies.*

2. List some features of *Ascaris* that are possible adaptations to parasitic life.

   cuticle to protect it from the host's digestive enzymes; sucking lips at mouth to suck up digested food from the host; extensive reproductive system to increase the chances that the offspring will be passed on to another host.

3. Complete the summary table, Table 18.1, recording all information for roundworm characteristics in the appropriate row. You will use this information to answer questions in the Applying Your Knowledge section at the end of this lab topic.

Discussion

1. Discuss the significance of an animal's having two separate openings to the digestive tract, as seen in *Ascaris*.

   Students will probably suggest the obvious advantage that food and waste do not mix in the digestive tract. However, point out that from the functional viewpoint, this design allows specialized regions to develop along the length of the gut.

2. What are the advantages of a body cavity being present in an animal?

   A cavity provides space where organs and organ systems can develop. Fluid in the cavity can be used to collect waste and circulate nutrients and may give hydrostatic support.

EXERCISE 18.2
Phylum Arthropoda

Organisms in the phylum Arthropoda (clade Ecdysozoa) have been very successful species. Evidence indicates that arthropods may have lived on Earth half a billion years ago. They can be found in almost every imaginable habitat: marine waters, fresh water, and almost every terrestrial niche. Many species are directly beneficial to humans, serving as a source of food. Others make humans miserable by eating their homes, infesting their domestic animals, eating their food, and biting their bodies. These organisms have an exoskeleton that periodically sheds as they grow. In this exercise, you will observe the morphology of two arthropods: the crayfish (an aquatic arthropod) and the grasshopper (a terrestrial arthropod).

Lab Study A. Crayfish (*Cambarus*)

Materials

dissecting instruments
dissecting pan
preserved crayfish
disposable gloves

Consider using freshly killed crayfish available in some farmers' markets.

Introduction

Crayfish live in streams, ponds, and swamps, usually protected under rocks and vegetation. They may walk slowly over the substrate of their habitat, but they can also swim rapidly using their tails. The segmentation seen in annelids is seen also in crayfish and all arthropods; however, you will see that the segments are grouped into functional units (Color Plate 57).

Procedure

1. Obtain a preserved crayfish, study its external anatomy, and compare your observations with Figure 18.2. Describe the body symmetry, supportive structures, appendages, and segmentation, and state the adaptive advantages of each characteristic.

   a. body symmetry

   bilaterally symmetrical—promotes cephalization, directed locomotion

   b. supportive structures

   exoskeleton—protects soft body parts

   c. appendages

   Appendages are segmented, allowing more complex limb movements, and specialized, promoting greater diversity of function.

   d. segmentation

   The segmented body promotes greater flexibility and more complex body movements.

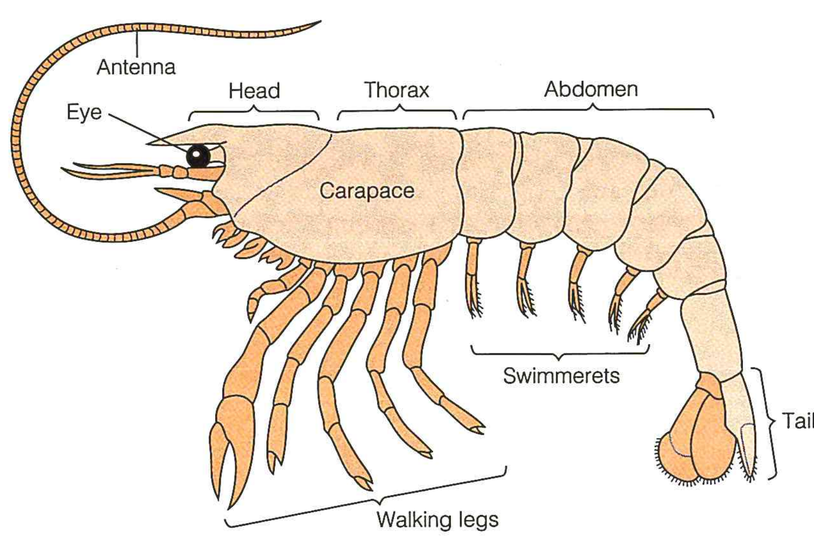


Figure 18.2.
External anatomy of a crayfish.
The body is divided into head, thorax, and abdominal regions. Appendages grouped in a region perform specific functions.

2. Identify the three regions of the crayfish body: the **head, thorax** (fused with the head), and **abdomen.** Note the appendages associated with each region. Speculate about the functions of each of these groups of appendages.
   a. head appendages

   moving food into the mouth, sensory

   b. thoracic appendages

   walking, defense, obtaining food

   c. abdominal appendages

   swimming, reproduction

3. Feathery **gills** lie under the lateral extensions of a large, expanded exoskeletal plate called the **carapace** (see Figure 18.2). To expose the gills, use scissors to cut away a portion of the plate on the left side of the animal. What is the function of the gills? Speculate about how this function is performed.

   Gas exchange. Water flowing under the carapace flows through the gills; oxygen leaves the water and enters the gills, while carbon dioxide passes into the water and out of the body.

4. Remove the dorsal portion of the carapace to observe other organs in the head and thorax. Compare your observations with Figure 18.3.
   a. Start on each side of the body at the posterior lateral edge of the carapace and make two lateral cuts extending along each side of the thorax and forward over the head, meeting just behind the eyes. This should create a dorsal flap in the carapace.

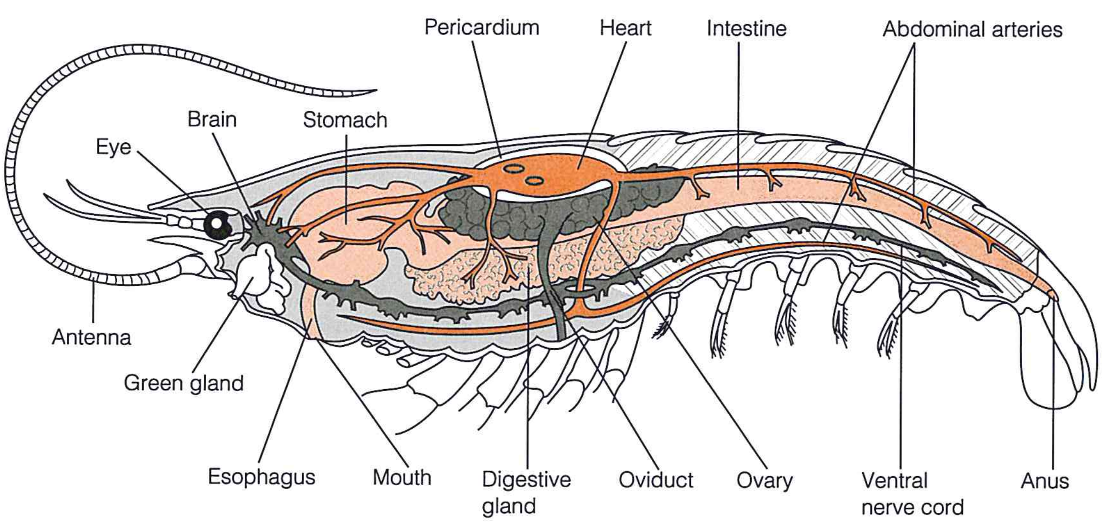


Figure 18.3.
Internal anatomy of the crayfish. Large digestive glands fill much of the body cavity. The intestine extends from the stomach through the tail to the anus. The green glands lie near the brain in the head.

Have both plain and injected crayfish available. The heart will be destroyed in the injected animals, but arteries are more obvious. Have students view the heart in the plain crayfish.

b. Carefully insert a needle under this flap and separate the underlying tissues as you lift the flap.

c. Observe the **heart,** a small, angular structure located just under the carapace near the posterior portion of the thorax. (If you were not successful in leaving the tissues behind as you removed the carapace, you may have removed the heart with the carapace.) Thin threads leading out from the heart are **arteries.** Look for holes in the heart wall. When blood collects in **sinuses** around the heart, the heart relaxes, and these holes open to allow the heart to fill with blood. The holes then close, and the blood is pumped through the arteries, which distribute it around the body. Blood seeps back to the heart, since no veins are present. What is the name given to this kind of circulation?

open circulation

d. Locate the **stomach** in the head region. It is a large, saclike structure. It may be obscured by the large, white **digestive glands** that fill the body cavity inside the body wall. Leading posteriorly from the stomach is the **intestine.** Make longitudinal cuts through the exoskeleton on either side of the dorsal midline of the abdomen. Lift the exoskeleton and trace the intestine to the anus. (When shrimp are "deveined" in preparation for eating, the intestine is removed.) Given all of the organs and tissues around the digestive tract and inside the body wall in the body cavity, what kind of coelom do you think this animal has?

a true coelom, or eucoelom

e. Turn your attention to the anterior end of the specimen again. Pull the stomach posteriorly (this will tear the esophagus) and look inside the most anterior portion of the head. Two **green glands** (they do not look green), the animal's excretory organs, are located in this region. These are actually long tubular structures that resemble nephridia but are compacted into a glandular mass. Waste and excess water pass from these glands to the outside of the body through pores at the base of the antennae on the head.

f. Observe the **brain** just anterior to the green glands. It lies in the midline with nerves extending posteriorly, fusing to form a **ventral nerve cord.**

Results

Complete Table 18.1, recording all information for crayfish characteristics in the appropriate row. Use this information to answer questions in the Applying Your Knowledge section at the end of this lab topic.

Discussion

How does the pattern of segmentation differ in the crayfish and the earthworm?

In the earthworm, the segments are uniform, but in the crayfish, segments are grouped into regions that have different functions.

Lab Study B. Grasshoppers *(Romalea)*

Materials

dissecting instruments
dissecting pan
preserved grasshopper
disposable gloves

Consider using freshly killed grasshoppers or crickets. These can be dissected under water for a better view of the trachea.

Introduction

The grasshopper, an insect, is an example of a terrestrial arthropod (Color Plate 58). Insects are the most successful and abundant of all land animals. They are the principal invertebrates in dry environments, and they can survive extreme temperatures. They are the only invertebrates that can fly. As you study the grasshopper, compare the anatomy of this terrestrial animal with that of the aquatic crayfish, just studied. This comparison should suggest ways that terrestrial animals have solved the problems of life out of water.

Procedure

1. Observe the external anatomy of the grasshopper. Compare your observations with Figure 18.4.
   a. Note the symmetry, supportive structures, appendages, and segmentation of the grasshopper.
   b. Observe the body parts. The body is divided into three regions: the **head,** the **thorax** (to which the legs and wings are attached), and the **abdomen.** Examine the appendages on the head, speculate about their functions, and locate the mouth opening into the digestive tract.
   c. Turning your attention to the abdomen, locate small dots along each side. These dots are **spiracles,** small openings into elastic air tubes, or **tracheae,** that branch to all parts of the body and constitute the respiratory system of the grasshopper. This system of tubes brings oxygen directly to the cells of the body.

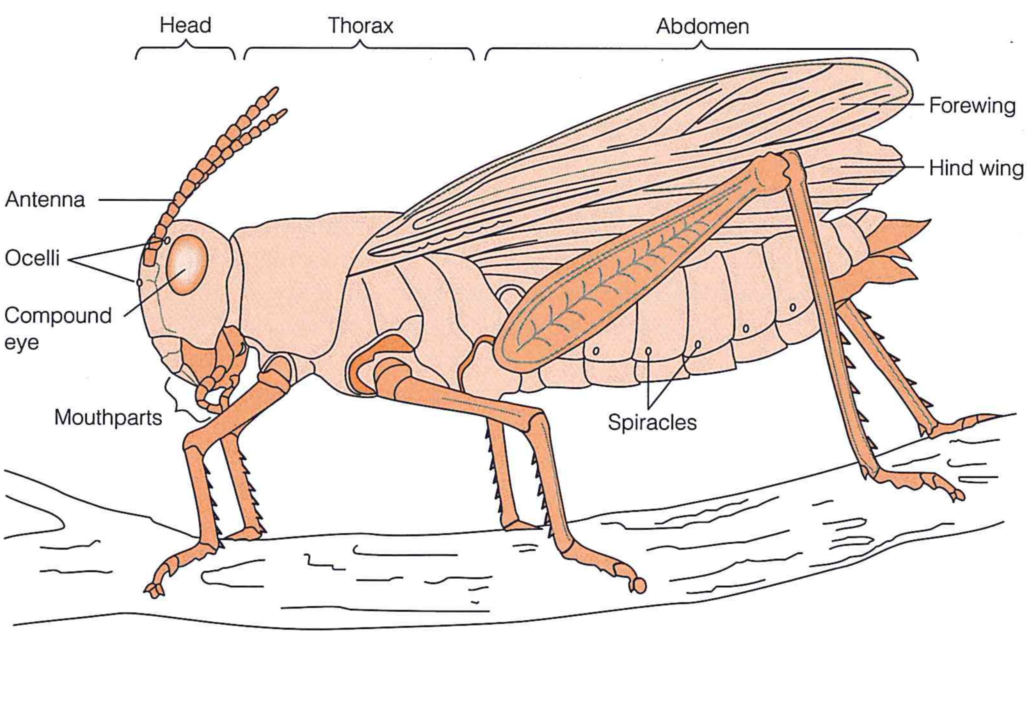


Figure 18.4. External anatomy of the grasshopper. The body is divided into head, thorax, and abdominal regions. Wings and large legs are present. Small openings, called *spiracles,* lead to internal tracheae, allowing air to pass into the body.

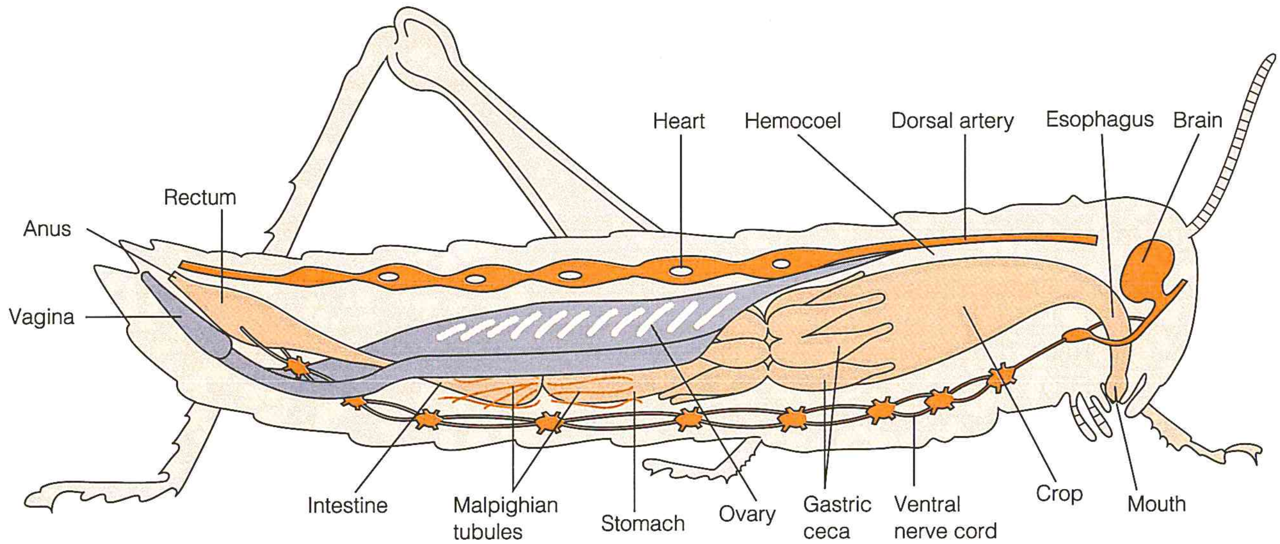


Figure 18.5.
Internal anatomy of the grasshopper. The digestive tract, extending from mouth to anus, is divided into specialized regions: the esophagus, crop, stomach, intestine, and rectum. Gastric ceca attach at the junction of the crop and the stomach. Malpighian tubules empty excretory waste into the anterior end of the intestine.

2. Remove the exoskeleton. First take off the wings and, starting at the posterior end, use scissors to make two lateral cuts toward the head. Remove the dorsal wall of the exoskeleton and note the segmented pattern in the muscles inside the body wall. Compare your observations with Figure 18.5 as you work.

   a. A space between the body wall and the digestive tract, the **hemocoel** (a true coelom), in life is filled with colorless blood. What type of circulation does the grasshopper have?

      open

      The heart of a grasshopper is an elongate, tubular structure lying just inside the middorsal body wall. This probably will not be visible.

   b. Locate the digestive tract and again note the mouth. Along the length of the tract are regions specialized for specific functions. A narrow **esophagus** leading from the mouth expands into a large **crop** used for food storage. The crop empties into the **stomach,** where digestion takes place. Six pairs of fingerlike extensions called **gastric pouches** or **ceca** connect to the digestive tract where the crop and the stomach meet. These pouches secrete digestive enzymes and aid in food absorption. Food passes from the stomach into the **intestine,** then into the **rectum,** and out the **anus.** Distinguish these regions by observing constrictions and swellings along the tube. There is usually a constriction between the stomach and the intestine where the Malpighian tubules (discussed below) attach. The intestine is shorter and usually smaller in diameter than the stomach. *The intestine expands into an enlarged rectum that absorbs excess water from any undigested food, and relatively dry excrement passes out the anus.*

c. The excretory system is made up of numerous tiny tubules, the **Malpighian tubules,** which empty their products into the anterior end of the intestine. These tubules remove wastes and salts from the blood. Locate these tubules.

d. Push aside the digestive tract and locate the **ventral nerve cord** lying medially inside the ventral body wall. Ganglia are expanded regions of the ventral nerve cord found in each body segment. Following the nerve cord anteriorly, note that branches from the nerve cord pass around the digestive tract and meet, forming a brain in the head.

Results

Complete Table 18.1, recording all information for grasshopper characteristics in the appropriate row. Use this information to answer questions in the Applying Your Knowledge section at the end of this lab topic.

Discussion

1. Describe how each of the following external structures helps the grasshopper live successfully in terrestrial environments.

   a. Exoskeleton

   prevents desiccation and provides protection to soft tissues.

   b. Wings

   allow the insect to extend its range to find favorable habitats and food, and suitable mates.

   c. Large, jointed legs

   allow the insect to make rapid, precise movements.

   d. Spiracles

   allow air into the body, facilitating internal gas exchange.

2. Describe how each of the following internal structures helps the grasshopper live successfully in terrestrial environments.

   a. Tracheae

   connected to spiracles, these carry oxygen to all body cells. This system provides an efficient means of respiration with minimum water loss.

   b. Malpighian tubules

   carry waste and water from the coelom into the digestive tract.

   c. Rectum

   reabsorbs into the coelom most water in the digestive tract before it exits the body.

EXERCISE 18.3

Deuterostome—Phylum Echinodermata—Sea Star

Because of time constraints, we have added the study of the sea star as a demonstration only. If your laboratory schedule allows it, have each student dissect a sea star. Provide more details on external and internal anatomy. Check a zoology text.

Echinodermata is one of three phyla in the group of animals called deuterostomes. You will study another deuterostome phylum in Exercise 18.4, phylum Chordata. Examples of echinoderms include the sea star, sea urchin, sea cucumber, and sea lily. Some of the most familiar animals in the animal kingdom are in the phylum Chordata—fish, reptiles, amphibians, and mammals. Take a look at a sea star (starfish) in the salt-water aquarium in your lab or in a tidal pool on a rocky shore. What are the most obvious characteristics of this animal? Then imagine a chordate—a fish, dog, or even yourself. You might question why these two phyla are considered closely related phylogenetically. The most obvious difference is a very basic characteristic—the sea star has radial symmetry and most chordates that you imagine have bilateral symmetry. The sea star has no head or other obvious chordate features and it crawls around using hundreds of small suction cups called tube feet. Most chordates show strong cephalization and move using appendages. Your conclusion from the superficial observations might be that these two phyla are not closely related. Your observations are a good example of the difficulty faced by taxonomists when comparing animals based only on the morphology of adults. Taxonomists must collect data from studies of developmental and—as we discovered with the protostomes—molecular similarities before coming to final conclusions.

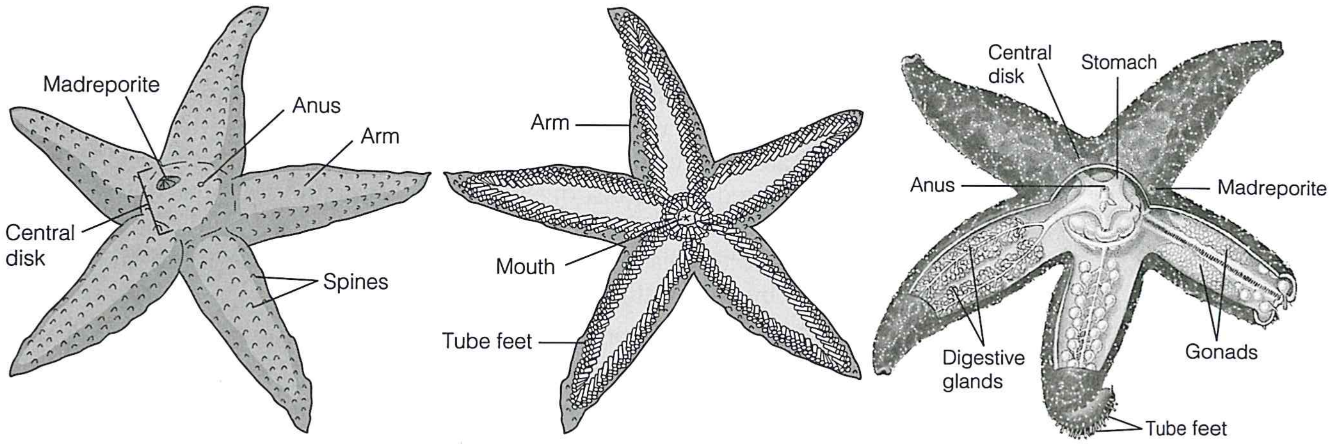
In this and the following exercise, you will examine an echinoderm, the adult sea star (demonstration only), and two chordates, asking questions about their morphology and adaptation to their habitats. You may not be convinced of their phylogentic relationships, however, until you complete Lab Topic 24, Animal Development, when you will study early development in sea urchins and sea stars. In that lab topic, you will see that chordates and echinoderms have similar early embryonic developmental patterns, including the formation of the mouth and anus and the type of cleavage.

Materials

whole preserved sea stars on demonstration
several dissected sea stars on demonstration showing the internal contents of the body and the inside surface of oral and aboral halves of the body

Introduction

The sea star is classified in the phylum Echinodermata. They are marine animals with an endoskeleton of small, spiny calcareous plates bound together by connective tissue. Their symmetry is radial pentamerous (five-parted). They have no head or brain and few sensory structures. All animals in this phylum have a unique **water-vascular system** that develops from mesoderm and consists of a series of canals carrying water that enters the body through an outer opening, the **madreporite.** The canals are located inside the body and include a ring around the central disk of the body and tubes or canals that extend out into each arm. The canals then terminate in many small structures called **tube feet** along the groove on the oral side of each arm. Tube



a. Aboral surface **b.** Oral surface **c.** Dissected, portions of aboral wall removed

Figure 18.6.
(a) Aboral surface of a sea star. (b) Oral surface of a sea star. (c) Dissected sea star with portions of the aboral wall removed.

feet extend to the outside of the body and end in a small suction cup in most species. By contracting muscles and forcing fluid into its tube feet, the sea star can extend and attach the feet to hard surfaces such as the surface of a clamshell, or rocks on the ocean shore.

Procedure

1. Observe the preserved sea star on demonstration. Locate the **aboral** surface—the "upper" surface away from the mouth (Figure 18.6a). The downside is the **oral** surface where the mouth is located (Figure 18.6b).
2. Count the number of arms that extend out from the **central disk.** Echinoderms are usually pentamerous, meaning that their arms are in multiples of five. Occasionally a sea star with six arms will be found. Arms that are damaged or lost can be regenerated, and an extra arm may regenerate.
3. Observe the animal's aboral surface (Figure 18.6a). Locate the **madreporite,** a small porous plate displaced to one side of the central disk that serves to take water into the water vascular system.

   Notice that the surface of the animal's body is spiny. The spines project from calcareous plates of the **endoskeleton.** The endoskeleton is derived from the embryonic germ layer mesoderm. In life, the entire surface of the body is covered with an **epidermis** derived from ectoderm that may not be visible with the naked eye.
4. Observe the dissected sea star on demonstration (Figure 18.6c). In this dissection the entire aboral surface has been lifted off the body and placed to the side, inside up. This exposes the internal organs. The endoskeleton and its calcareous plates are obvious as viewed from the inside of the body.
5. Inside the body the organs are located in a **true body cavity.** Small delicate projections of the body cavity protrude between the plates of the endoskeleton to the outside of the body. These projections, covered with epidermis, are called **skin gills** or dermal branchiae, and function in the exchange of oxygen and carbon dioxide with the water bathing the animal's body. In addition, nitrogenous waste passes through these

skin gills into the surrounding water; these structures thus having both respiratory and excretory functions.

6. The central disk contains the stomach, a portion of which can be everted through the mouth on the oral side of the animal. A small anus is located on the aboral body surface, although very little fecal material is ejected here. Most digestion takes place in the stomach, which may be everted into the body of a clam. The digested broth is then sucked up into the sea star body. After feeding, the sea star draws in its stomach by contracting its stomach muscles.
7. Conspicuous organs in the arms of the animal are gonads and digestive glands. Other systems cannot be easily observed in this preparation. A reduced circulatory system (hemal system) exists, but its function is not well defined. It consists of tissue strands and unlined sinuses. The nervous system includes a nerve ring around the mouth and radial nerves with epidermal nerve networks. There is no central nervous system.

Results

Complete Table 18.1, recording in the appropriate row as much information as you have been able to observe.

Discussion

1. Imagine that you are a zoologist studying sea stars for the first time. What characteristics would you note from the dissection of an adult animal that might give a clue to its phylogenetic relationships—that it belongs with deuterostomes rather than protostomes?

   There is very little evidence in the adult sea star. One clue is the endoskeleton, similar to chordates. Most protostomes have either no skeleton or an exoskeleton.

2. What structures have you observed that appear to be unique to echinoderms?

   The water vascular system is unique.

3. How would you continue your study to obtain more information that might help in classifying these animals?

   A study of early development would reveal that these animals show a primitive deuterostome pattern of development. Gastrulation is by invagination. Cleavage, coelom formation, and the formation of the mouth and anus are similar to other deuterostomes. The bipinnaria larva is bilaterally symmetrical and radial symmetry develops secondarily. Point out to students that they will learn more about early development in echinoderms in Lab Topic 24. Students may also suggest molecular studies.

4. Given the fact that other deuterostomes are bilaterally symmetrical, what is one explanation for the radial symmetry of most adult echinoderms?

   Radial symmetry probably evolved secondarily in response to their relatively sessile adult lifestyle.

EXERCISE 18.4

Deuterostome—Phylum Chordata

Up to this point, all the animals you have studied in Lab Topics 17 and 18 are commonly called **invertebrates,** a somewhat artificial designation based on the absence of a backbone. Those animals with a backbone are called **vertebrates.** The phylum Chordata studied in this exercise includes two subphyla of invertebrates and a third subphylum of vertebrates, animals that have a bony or cartilaginous endoskeleton with a vertebral column. Chordates inhabit terrestrial and aquatic (freshwater and marine) environments. One group has developed the ability to fly. The body plan of chordates is unique in that these animals demonstrate a complex of four important characteristics at some stage in their development. In this exercise, you will discover these characteristics.

You will study two chordate species: the lancelet, an invertebrate in the subphylum Cephalochordata, and the pig, a vertebrate in the subphylum Vertebrata. The third subphylum, Urochordata, will not be studied.

Lab Study A. Lancelets (*Branchiostoma*, formerly *Amphioxus*)

Materials

compound microscope
stereoscopic microscope
preserved lancelet in watch glass
prepared slide of whole mount of lancelet
prepared slide of cross section of lancelet

Introduction

Lancelets are marine animals that burrow in sand in tidal flats. They feed with their head end extended from their burrow. They resemble fish superficially, but their head is poorly developed, and they have unique features not found in fish or other vertebrates. They retain the four unique characteristics of chordates throughout their life cycle and are excellent animals to use to demonstrate these features. In this lab study, you will observe preserved lancelets, prepared slides of whole mounts, and cross sections through the body of a lancelet (Color Plate 59).

Procedure

1. Place a preserved lancelet in water in a watch glass and observe it using the stereoscopic microscope. Handle the specimen with care and *do not dissect it.* Note the fishlike shape of the slender, elongate body. Locate the anterior end by the presence at that end of a noselike **rostrum** extending over the mouth region, surrounded by small tentacles. Notice the lack of a well-defined head. Look for the segmented muscles that surround much of the animal's body. Can you see signs of a tail? If the animal you are studying is mature, you will be able to see two rows of 20 to 25 white gonads on the ventral surface of the body.
2. Return the specimen to the correct container.

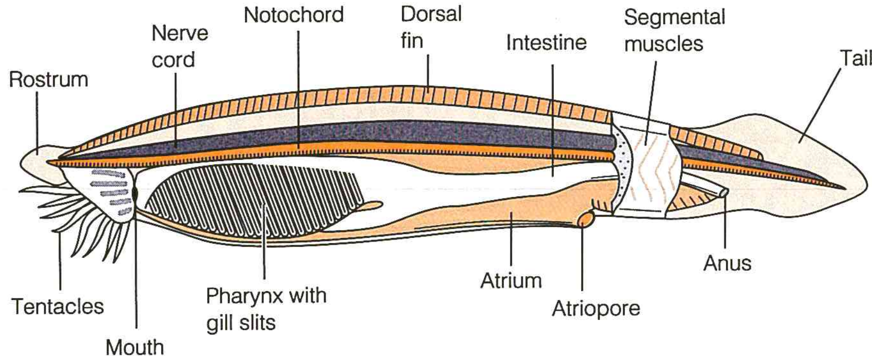


Figure 18.7.
The lancelet, whole mount. The rostrum extends over the mouth region. The pharynx, including the pharyngeal gill slits, leads to the intestine, which exits the body at the anus. Note that a tail extends beyond the anus. Structures positioned from the dorsal surface of the body inward include a dorsal fin, the nerve cord, and the notochord.

3. Observe the whole mount slide of the lancelet and compare your observations with Figure 18.7.

Use only the lowest power on the compound microscope to study this slide.

a. Scan the entire length of the body wall. Do you see evidence of segmentation in the muscles?

Students should notice the muscle segmentations.

b. Look at the anterior end of the animal. Do you see evidence of a sensory system? Describe what you see.

Students may notice the single dark "eyespot" (sensory function not established), and may note the absence of large sensory structures. Sensory cells are concentrated in the rostrum and mouth region, but these are not visible with the microscope. Students may conclude that the tentacles are sensory, and, indeed, more sensory cells may be located on these structures. However, their main function is to prevent large food particles from entering the mouth. Students may ask about the apparent absence of a brain.

c. Locate the mouth of the animal at the anterior end. See if you can follow a tube from just under the rostrum into a large sac with numerous gill slits. This sac is the **pharynx with gill slits,** a uniquely chordate structure. Water and food pass into the pharynx from the mouth. Food passes posteriorly from the pharynx into the intestine, which ends at the anus on the ventral side of the animal, several millimeters before the end. The extension of the body beyond the anus is called a **post-anal tail.** Think of the worms you studied in Lab Topic 17, Animal Diversity I. Where was the anus located in these animals? Was a post-anal region present? Explain.

The anus in worms is at the end of the body. The small overextension in Ascaris is not a post-anal tail.

d. Water entering the mouth passes through the gill slits and collects in a chamber, the **atrium,** just inside the body wall. The water ultimately passes out of the body at a ventral pore, the **atripore.** Surprisingly, the gill slits are not the major gas exchange surface in the lancelet body. Because of the great activity of ciliated cells in this region, it is even possible that blood leaving the gill region has less oxygen than that entering the region. The function of gill slits is simply to strain food from the water. The major site for gas exchange is the body surface.

e. Now turn your attention to the dorsal side of the animal. Beginning at the surface of the body and moving inward, identify the listed structures and speculate about the function of each one.

dorsal fin:

locomotion, important in swimming

nerve cord:

nerve impulse transmission

notochord:

support; an endoskeleton

The nerve cord is in a dorsal position. Have you seen only a dorsal nerve cord in any of the animals previously studied?

no

The notochord is a cartilage-like rod that lies ventral to the nerve cord and extends the length of the body. Have you seen a notochord in any of the previous animals?

no

The lancelet circulatory system is not visible in these preparations, but the animal has **closed circulation** with dorsal and ventral aortae, capillaries, and veins. Excretory organs, or nephridia (not visible here), are located near the true coelom, which surrounds the pharynx.

4. Observe the slide of cross sections taken through the lancelet body. There may be several sections on this slide, taken at several positions along the length of the body. Find the section through the pharynx and compare it with Figure 18.8.

Study this slide on the lowest power.

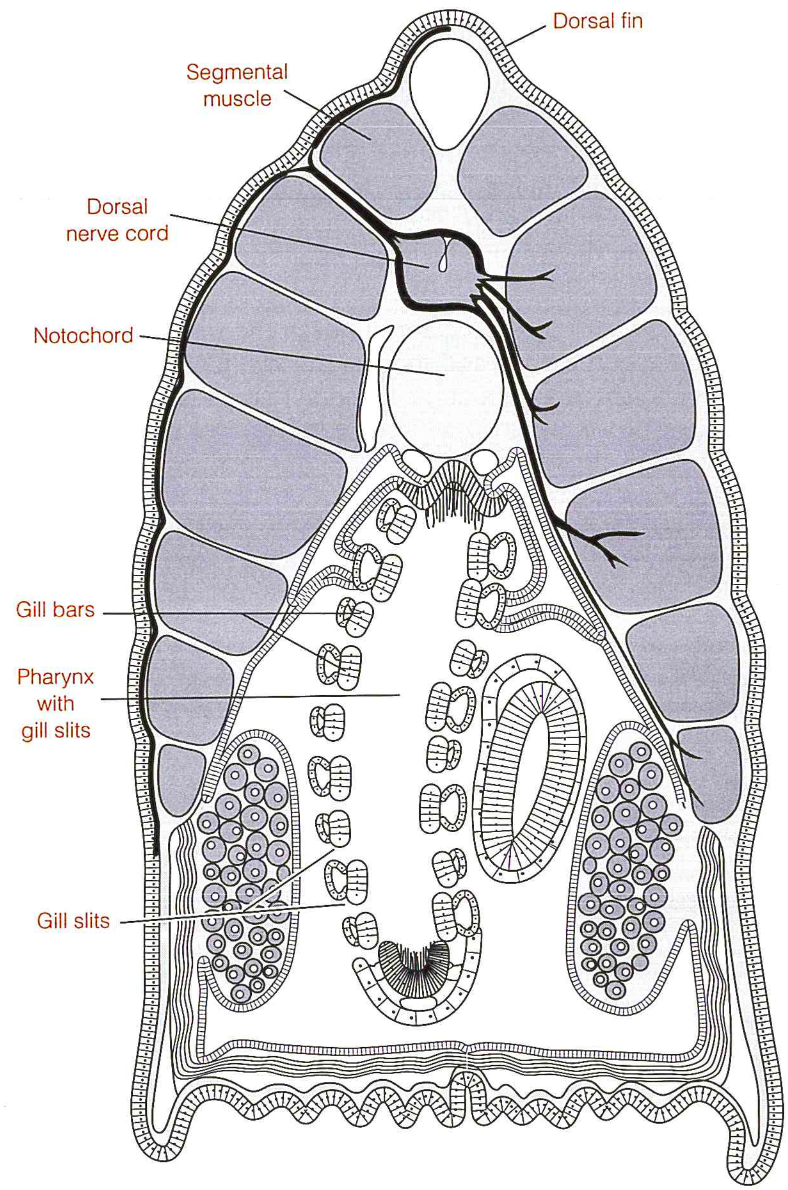


Figure 18.8.
Cross section through the pharyngeal region of the lancelet.

In cross section, it is much easier to see the structural relationships among the various organs of the lancelet. Identify the following structures and label them on Figure 18.8.

a. **Segmental muscles.** They are located on each side of the body, under the skin.

b. **Dorsal fin.** This projects upward from the most dorsal surface of the body.

c. **Nerve cord.** You may be able to see that the nerve cord contains a small central canal, thus making it hollow. The nerve cord is located in the dorsal region of the body, ventral to the dorsal fin between the lateral bundles of muscle.

d. **Notochord.** This is a large oval structure located just ventral to the nerve cord.

e. **Pharynx with gill slits.** This structure appears as a series of dark triangles arranged in an oval. The triangles are cross sections of **gill bars.** The spaces between the triangles are **gill slits,** through which water passes into the surrounding chamber.

Results

1. Complete the diagram of the lancelet cross section in Figure 18.8. Label all the structures listed in step 4 of the Procedure section.
2. Complete Table 18.1, recording all information for lancelet characteristics in the appropriate row. Use this information to answer questions in the Applying Your Knowledge section at the end of this lab topic.

Discussion

Describe the uniquely chordate features that you have detected in the lancelet that were not present in the animals previously studied.

(1) a dorsal hollow or tubular nerve cord; (2) a notochord, an endoskeletal rod that supports the body; (3) pharyngeal gill slits, which function in filter feeding or gas exchange in aquatic organisms and develop into other structures in land animals; (4) a post-anal tail containing a posterior extension of the notochord and nerve cord

Lab Study B. Fetal Pigs *(Sus scrofa)*

Materials

preserved fetal pig
dissecting pan
disposable gloves

Introduction

The pig is a terrestrial vertebrate. You will study its anatomy in detail in Lab Topics 21, 22, and 23. In this lab study, working with your lab partner, you will observe external features only, observing those characteristics studied in other animals in previous exercises. Compare the organization of the vertebrate body with the animals previously studied. As you dissect the pig in subsequent labs, come back to these questions and answer the ones that cannot be answered in today's lab study.

Procedure

1. Obtain a preserved fetal pig from the class supply and carry it to your desk in a dissecting pan.

Use disposable gloves to handle preserved animals.

2. With your lab partner, read each of the following questions. Drawing on observations you have made of other animals in the animal diversity lab studies, predict the answer to each question about the fetal pig. Then examine the fetal pig and determine the answer, if possible. Give evidence for your answer based on your observations of the pig, your knowledge of vertebrate anatomy, or your understanding of animal phylogeny.

a. What type of symmetry does the pig body have?
Prediction:

bilaterally symmetrical (based on phylogenetic trends)

Evidence:

right and left halves are mirror images

b. How many layers of embryonic tissue are present?
Prediction:

three (based on phylogenetic trends)

Evidence:

Skin, gut, muscles, and many organs are present; organs are not possible without three tissue layers.

c. Are cells organized into distinct tissues?
Prediction:

yes (based on phylogenetic trends)

Evidence:

Organs are composed of tissues; this answer is obvious.

d. How many digestive tract openings are present? Would you describe this as a "tube within a tube"?
Prediction:

two (based on phylogenetic trends); yes

Evidence:

mouth and anus present

e. Is the circulatory system open or closed?
Prediction:

closed (based on phylogenetic trends)

Evidence:

arteries, veins, heart present

f. What is the habitat of the animal?
Prediction:

terrestrial