

The Earthworm

Pre-Lab Discussion

The earthworm, *Limbricus terrestris*, is a member of the phylum Annelida. An earthworm is quite well-adapted to a life of burrowing through the soil. Its streamlined shape helps it move through the soil. A coating of mucus secreted by the skin lubricates the earthworm as it passes through the soil. The mucus coating also helps oxygen pass through the earthworm's skin while it is in the air or under the water. The earthworm moves through the soil by sucking the soil in its path into its mouth with the aid of its muscular pharynx. As material passes through the tubelike digestive system, sand grains in the gizzard help grind the food, which is then digested and absorbed in the intestine.

In this investigation, you will examine the external and internal structure of the earthworm.

Problem

How is the earthworm's body adapted to its environment?

Materials (per group)


Preserved earthworm
Dissecting tray
Scalpel
Scissors
Medicine dropper
Probe
Dissecting pins
Forceps
Hand lens
Resealable plastic bag
Paper towels

Safety


Put on a laboratory apron if one is available. Handle all glassware carefully. Be careful when handling sharp instruments. Note all safety alert symbols next to the steps in the Procedure and review the meanings of each symbol by referring to the symbol guide on page 10.

Procedure

Part A. The Technique of Animal Dissection

1. Dissection is the technique of exposing the internal structures of an organism for observation. Dissection is commonly used in the study of large and complex plants and animals. The opportunity to dissect an animal should be thought of as a unique opportunity to gain firsthand knowledge of an animal you know little about. As you dissect an animal, you should think in terms of structure related to function.
-  2. Obtain the following tools and instruments needed for dissection: dissecting tray, scalpel, scissors, probe, dissecting pins, and forceps. **CAUTION:** *The scalpel, scissors, and probe are sharp. Use extreme caution when handling these instruments to avoid cuts. Always cut in a direction away from your hands and body.* Become familiar with these tools and instruments used in dissection.
3. Most cutting in dissection is done with scissors rather than a scalpel. Most of the actual dissection involves the forceps, probe, and fingers. These instruments are used to tear, separate, and move or lift parts instead of cutting them.
4. Read the following rules for dissection.
 - Before beginning a dissection, identify all external parts.
 - Determine the proper order in which internal structures are to be exposed.
 - Identify which structures could be easily damaged if dissection is not done properly.
 - Do not completely remove any body part unless instructed to do so. If a body part is to be removed, leave a small portion of it attached as a reference point.
 - When making the first cut, insert the point of the scissors just below the skin. Cut with short, clipping motions. Keep the lower blade of the scissors pointing upward, away from the internal structure of the animal being dissected.

Part B. External Anatomy of the Earthworm

1. Rinse a preserved earthworm thoroughly with water to remove excess preservative. Place the earthworm in a dissecting tray lined with moist paper towels. Turn the earthworm over and observe the difference between the darker-colored dorsal side and the lighter-colored ventral side of the cuticle (outer layer). With your fingers, feel the shape of the dorsal and ventral surfaces. **CAUTION:** *The preservative used on the earthworm can irritate your skin. Avoid touching your eyes while working with the preserved earthworm.* Answer question 1 in Observations.
2. Locate the slightly pointed anterior end and the blunt posterior end of the earthworm's body. Notice the somites, or segments, of the body. Count the total number of segments in the earthworm. The segments of an earthworm are counted from anterior to posterior. In the anterior portion of the earthworm identify the clitellum, the light brown enlarged band around the body. The clitellum functions in reproduction by secreting the cocoon into which eggs are deposited. Answer question 2 in Observations.
3. Locate the mouth on the ventral side of the anterior end of the earthworm. The flap of skin overhanging the mouth is the prostomium. **Note:** *The prostomium is not counted as the first segment in the earthworm's body.* Locate the anus, the opening in the last segment of the posterior end. The mouth and anus are the two openings of the tubelike digestive system.
-  4. Slide your fingers along the ventral surface of the earthworm from anterior to posterior and feel the bristlelike setae. The setae anchor the earthworm to the ground and function in movement. Then slide your fingers along the dorsal surface of the worm from anterior to posterior. With a hand lens, observe the location and number of setae on each segment of the earthworm's body. Answer question 3 in Observations.

- Use a hand lens to find the openings of the seminal receptacles, which are located on the ventral surface in the grooves between segments 9 and 10 and segments 10 and 11. The seminal receptacles receive sperm from another earthworm during reproduction. On the sides of segment 14, locate the openings of the oviducts. These openings are pores through which eggs are released. On the side of segment 15, locate the openings of the sperm ducts. These openings are pores through which sperm are released and are surrounded by swollen "lips." You may be able to observe slight ridges that run posteriorly from the sperm duct openings to the clitellum. These ridges direct sperm into the clitellum.
- In the appropriate place in Observations, label the following structures of the earthworm's external anatomy: anterior end, posterior end, mouth, prostomium, setae, segments, seminal receptacles, oviduct openings, sperm duct openings, clitellum, and anus. Give the number(s) of the segment(s) in which each structure appears.

Part C. Internal Anatomy of the Earthworm

- Place the preserved earthworm in the dissecting tray with the dorsal surface up. Slightly stretch out the earthworm's body. With dissecting pins, pin the first and last segments of the earthworm to the bottom of the dissecting tray. Locate the dorsal blood vessel, a dark line that runs along the midline of the dorsal surface. The vessel runs from the anterior end to the posterior end. Insert the tip of a pair of scissors just to the right of the dorsal blood vessel and about 10 segments from the posterior end. Cut along the blood vessel to the anterior end as shown in Figure 1. Keep the scissors parallel to the bottom of the dissecting tray. **CAUTION:** When using scissors, cut in a direction away from your hand and body to avoid cutting yourself. Keep the cut as shallow as possible. The body wall of the earthworm is very thin, and the internal organs lie just inside. **Note:** The major internal organs of the earthworm are anterior to the clitellum. Be very careful when cutting in this area.

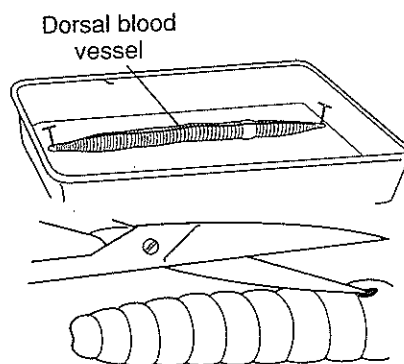


Figure 1

- When the cut is complete, carefully open the body wall. Notice that the coelom is not one large cavity but is separated into segments by septa (singular, septum), or thin partitions of tissue. The septa are continuations of the external segments. Beginning at the anterior end, use a probe or dissecting pin to carefully tear the septa from the anterior to the posterior end. Place dissecting pins in segments 5, 15, 25, 35, and 45 to hold open the body wall. Place the pins at an angle as shown in Figure 2. Placing pins in every tenth segment will help you locate the major internal organs that are located in specific segments. Use a medicine dropper to place several drops of water on the exposed organs of the earthworm. **Note:** Throughout the dissection, add water to the earthworm to keep it from drying out.
- Trace the digestive system of the earthworm from the mouth to the anus. The mouth is located in the first three segments. Locate a slight swelling, the muscular-walled pharynx, posterior to the mouth in segments 3 to 6. The slender esophagus, located in segments 6 to 14, empties into the thin-walled crop, located in segments 15 and 16. The crop temporarily stores food. Examine the gizzard, a grinding organ located in segments 17 and 18. The gizzard mixes food with sand from the soil and physically breaks the food into smaller pieces. Use a probe to feel the difference in the walls of the crop and gizzard. Locate the intestine, or straight tube

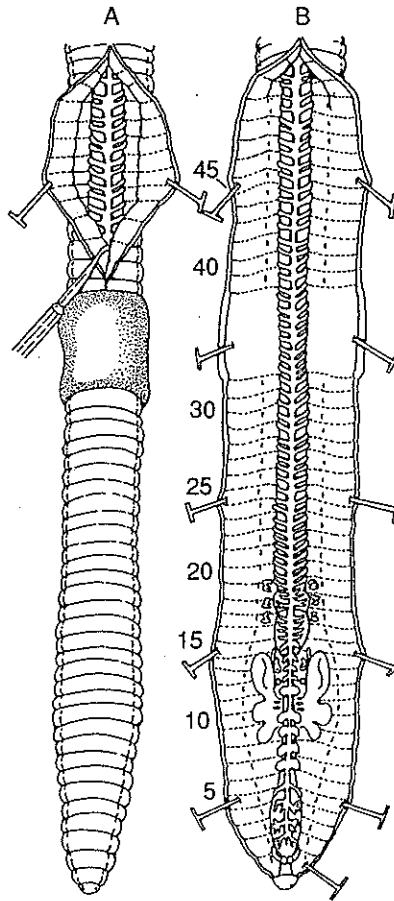


Figure 2

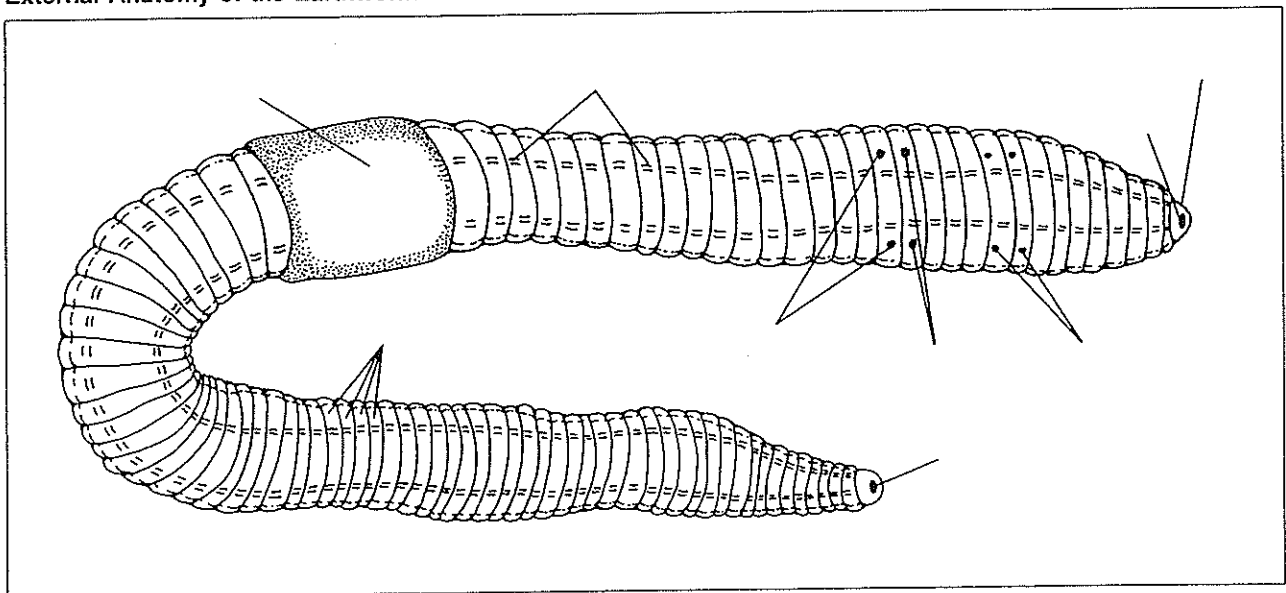
leading from the gizzard to the anus. Near the posterior end of the earthworm, cut out a 1-cm section of the intestine and observe it with a hand lens. Locate the dorsal fold of tissue in the inside of the intestine. This tissue fold is the typhlosole. Answer question 4 in Observations.

4. In the appropriate place in Observations, label the following parts of the earthworm's digestive system: mouth, pharynx, esophagus, crop, gizzard, and intestine.
5. Trace the earthworm's closed circulatory system by following the dorsal blood vessel anteriorly along the midline to the five aortic arches, located in segments 7 to 11. In the posterior section use a probe to carefully move aside the intestine. Locate the ventral blood vessel. The aortic arches connect the dorsal blood vessel with the ventral blood vessel.
6. In the appropriate place in Observations, label the following parts of the earthworm's circulatory system: aortic arches, dorsal blood vessel, and ventral blood vessel.
7. In the appropriate place in Observations, sketch the plan of the earthworm's circulatory system as seen from the side. Label the aortic arches, dorsal blood vessel, and ventral blood vessel. Include arrows that indicate the flow of blood in each vessel.
8. Locate the brain, which is a white mass of tissue found in the third segment anterior and dorsal to the pharynx. With a probe, gently push aside the pharynx and esophagus to expose the white ventral nerve cord. The ventral nerve cord runs along the inner ventral surface from segment 3 to the last segment. With a hand lens, you may be able to see the two branched nerves that run from the brain around the esophagus to the ventral nerve cord. In each segment, locate a mass of nerve cells, or ganglia, attached to the ventral nerve cord.
9. In the appropriate place in Observations, label the following parts of the earthworm's nervous system: brain, ventral nerve cord, and ganglion.

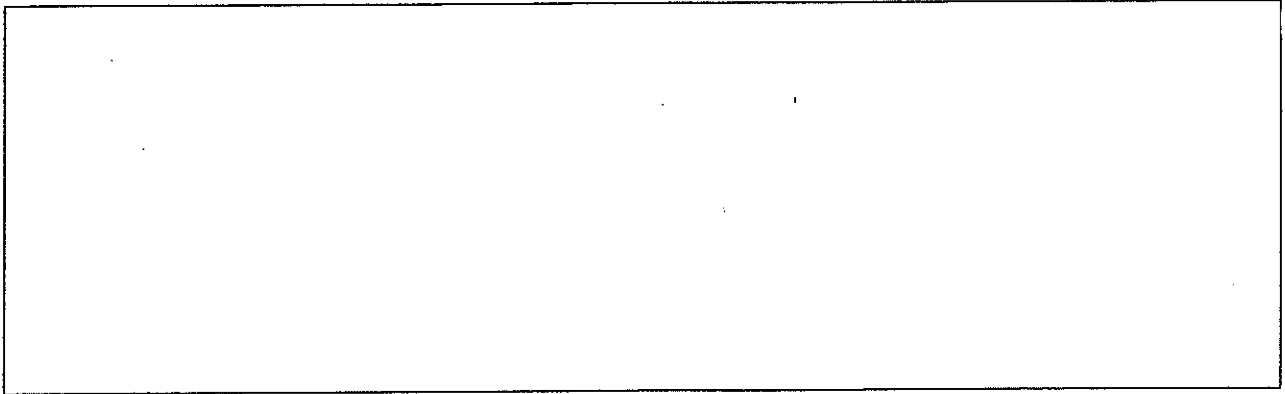
10. With a probe, push aside the intestine in a region just posterior to the clitellum. With a hand lens, look for the white, coiled nephridia (singular, nephridium). A pair of nephridia occur in every segment except the first three segments and the last segment. Each nephridium collects wastes from the coelom and carries them to the outside of the body through pores, or openings, in the body wall of each segment.
11. In the appropriate place in Observations, label the nephridia, or structures of the earthworm's excretory system.
12. An earthworm has both male and female reproductive organs and can produce both eggs and sperm. Use a hand lens during the remainder of the dissection. First locate the male reproductive organs. Find the two seminal vesicles in segments 9 to 13. The seminal vesicles are three-lobed, light-colored organs along the sides of the esophagus. Two small pairs of testes are located in segments 10 and 11. The female reproductive organs include a pair of small, spherical seminal receptacles, located in segments 9 and 10, and a pair of ovaries, located in the septum between segments 12 and 13. With the exception of the seminal vesicles, most of the reproductive organs are small and difficult to see in preserved specimens.
13. In the appropriate place in Observations, label the following parts of the earthworm's reproductive system: seminal vesicles, testes, seminal receptacles, and ovary.
14. Follow your teacher's instructions for storing the earthworm for further use or properly disposing of the earthworm and its parts. Thoroughly wash and dry your dissecting tray, scissors, pins, probe, and any other equipment you may have used. Wash your hands with soap and water.

Observations

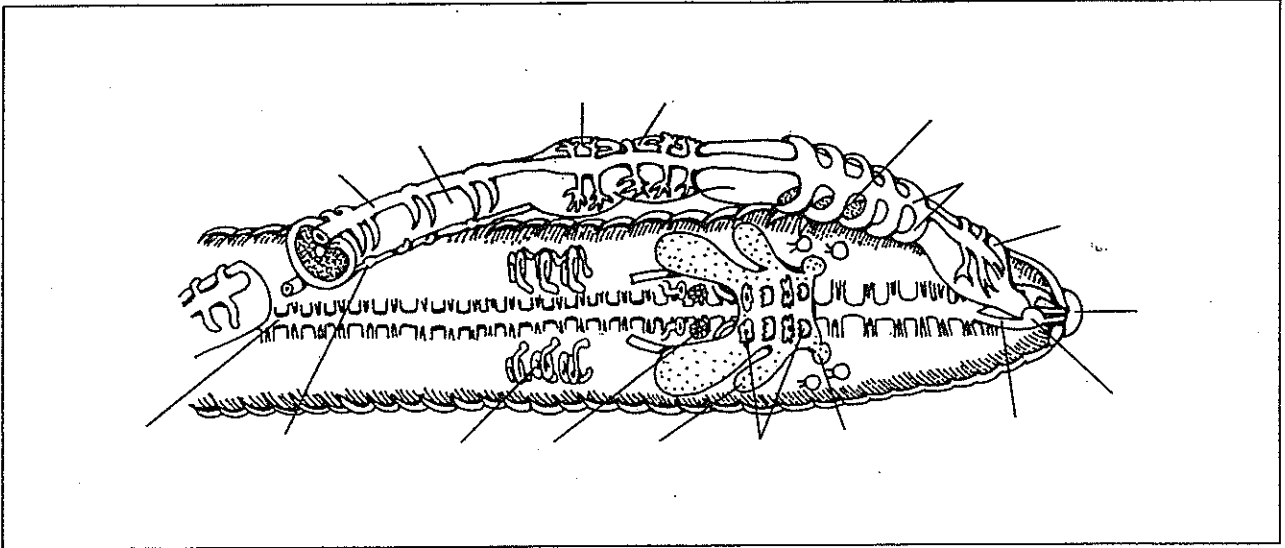
External Anatomy of the Earthworm



Circulatory System of the Earthworm



Internal Anatomy of the Earthworm



1. Describe the shape of the dorsal and ventral surfaces of the earthworm's body.

2. a. How many segments are in your earthworm? _____

b. In which segments is the clitellum located? _____

3. a. Where are setae located on the earthworm? _____

b. How many setae are on each segment? _____

4. Compare the walls of the crop and the gizzard. _____

Analysis and Conclusions

1. Why is it important not to make a deep cut with the scissors when dissecting your earthworm specimen? _____

2. What do you think is the function of the typhlosole? _____

3. How does the earthworm's digestive system adapt it to filtering food out of the soil?

4. Describe two ways in which an earthworm's body is adapted to life in the soil.

Critical Thinking and Application

1. Imagine an assembly line for disassembling things instead of putting them together. Compare the earthworm's tubelike digestive system to such a "disassembly line." What is the advantage of a tubelike digestive system over a saclike digestive system?

2. Describe one way in which an earthworm is poorly adapted to life on land.

3. How might an earthworm's lack of appendages be an adaptation to burrowing?

4. Explain how an earthworm enriches and aerates the soil, thus improving it for plant growth.

Going Further

1. With a probe, carefully tear open each organ of the digestive system and observe its contents.
2. Observe a prepared transverse section of an earthworm through a dissecting microscope. Make a sketch of the section and label the following parts: dorsal blood vessel, ventral blood vessel, ventral nerve cord, intestine, typhlosole, nephridia, setae, circular muscle fibers, longitudinal muscle fibers, and cuticle.
3. Set up a terrarium with live earthworms and observe their burrowing, feeding, and mating behavior.
4. Obtain earthworm cocoons from a biological supply house or collect them outdoors. Place the cocoons on moist paper towels in a covered petri dish. Watch for 12 to 20 earthworms to hatch in 1 to 30 days. Describe what you observe.