Name _____ Class _____ Date _____

Comparing Invertebrate Body Plans

Pre-Lab Discussion

Invertebrates, like all other organisms, are divided into groups based on certain distinguishing characteristics. Two characteristics that are examined when grouping invertebrates are cell layers and body cavities.

The number of cell layers making up the body varies among invertebrates. Cnidarians—jellyfishes and sea anemones, for example—possess only two cell layers in their body wall: an inner gastroderm and an outer epidermis. More advanced invertebrates—worms, mollusks, arthropods, and echinoderms, to name a few—have three basic cell layers: an inner endoderm, a middle mesoderm, and an outer ectoderm.

The animals that possess three basic cell layers can be divided into groups based on the structure of their body cavity. The body cavity, if present, is a fluid-filled hollow in the body wall that is located between the endoderm and the ectoderm. Animals that lack a body cavity are called acoelomates. Animals that have a body cavity that is only partially lined with mesoderm are called pseudocoelomates. And animals that have a body cavity that is completely lined with mesoderm are called coelomates.

In this investigation, you will compare the body plans and structures of invertebrates from four different phyla.

Problem

What are the differences in body plans and structures of the cnidarians, flatworms, roundworms, and annelids?

Materials *(per group)*

Microscope
Prepared slides of cross sections of:
- Cnidarian *(Hydra)*
- Flatworm *(Dugesia)*
- Roundworm *(Ascaris lumbricoides)*
- Earthworm *(Lumbricus terrestris)*

Safety

Handle all glassware carefully. Always handle the microscope with extreme care. You are responsible for its proper care and use. Use caution when handling glass slides as they can break easily and cut you. 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. Examining the Body Plan and Structures of the Cnidarian

1. Study Figure 1, which shows the basic body plans of the four invertebrates you will be examining.

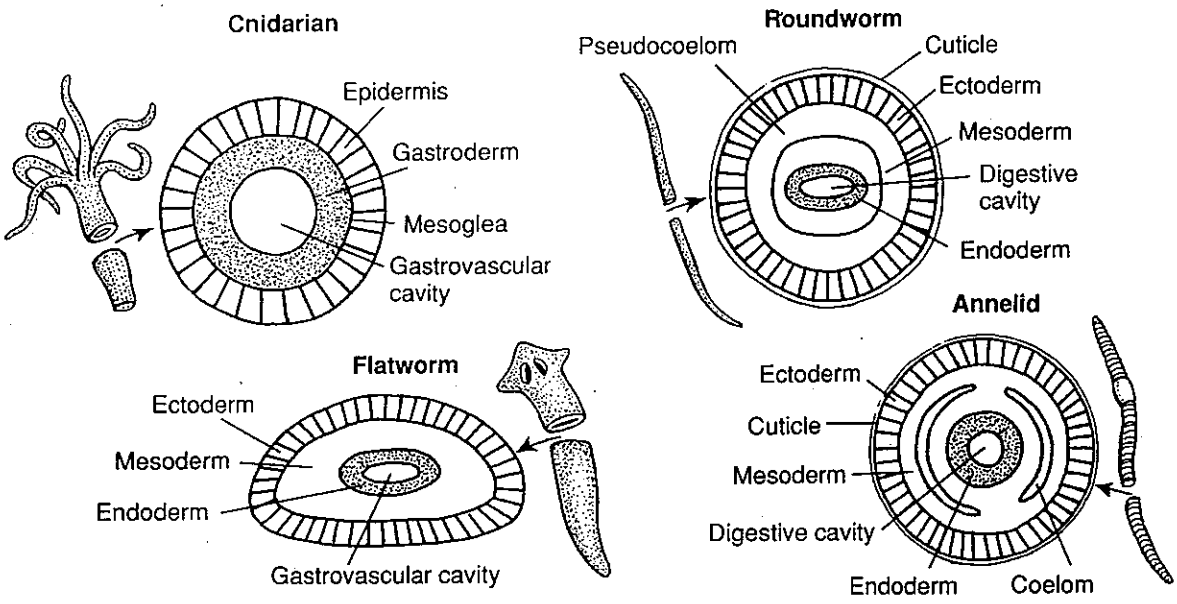

Figure 1

2. Examine a prepared slide of a cross section of a cnidarian under the low-power objective of a microscope. Look at the body layers. Switch to high power to see the specific structures in greater detail. **CAUTION**: *When switching to the high-power objective, always look at the objective from the side of the microscope so that the objective does not hit or damage the slide.*
3. Locate the epidermis, or outer layer of cells. Try to find some barbed cells called cnidocytes, each of which contains a stinging structure called a nematocyst.
4. Locate the gastroderm, or inner cell layer. Notice how some of the cells in the gastroderm have flagella. These flagellated cells help to circulate food and other materials within the gastrovascular cavity.
5. Locate the gastrovascular cavity in the center of the cross section of the cnidarian. Food digestion occurs within the gastrovascular cavity.
6. Locate the mesoglea, which is a noncellular jellylike material between the epidermis and the gastroderm.
7. In the appropriate place in Observations, label the following structures on the cross section of the cnidarian *(Hydra)*: epidermis, mesoglea, gastroderm, cnidocyte, nematocyst, and gastrovascular cavity.

Part B. Observing the Body Plan and Structures of the Flatworm

1. Examine a prepared slide of a cross section of a flatworm under low power. Locate the ectoderm, endoderm, and gastrovascular cavity.
2. Find the middle cell layer, or mesoderm, between the ectoderm and the endoderm. The mesoderm makes up most of the flatworm and consists of muscles, glands, organs, loose cells, and many other kinds of structures. Notice the absence of a body cavity.

Label - ectoderm, mesoderm, endoderm, gastrovascular cavity.

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Part C. Examining the Body Plan and Structures of the Roundworm

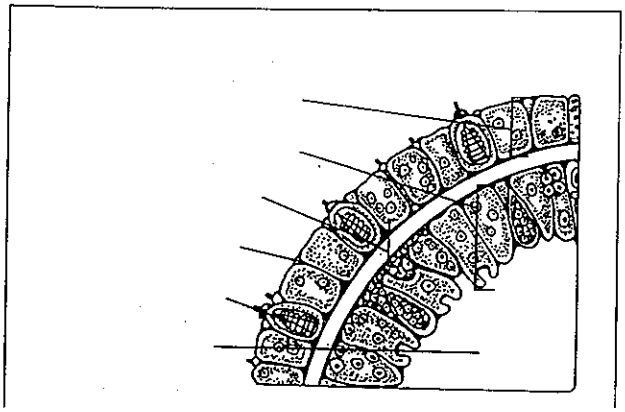
1. Examine a prepared slide of a cross section of a roundworm under low power. Locate the thick outer covering called the cuticle. This tough coating keeps a parasitic roundworm from being digested by its host. Just inside of the cuticle is the ectoderm, a thin layer of cells. Locate the mesoderm, the fiberlike layer just inside the epidermis.
2. Toward the center of the roundworm, look for the endoderm. The space inside the endoderm is the inside of the roundworm's digestive tract. The space between the endoderm and the mesoderm is called a pseudocoelom.
3. In the appropriate place in Observations, label the following structures on the cross section of the roundworm: cuticle, ectoderm, mesoderm, endoderm, and pseudocoelom.

Part D. Examining the Body Plan and Structures of the Earthworm

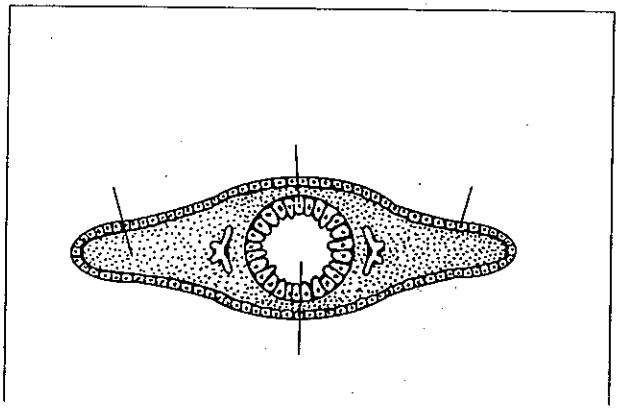
1. Examine a prepared slide of a cross section of an earthworm. Find the thin protective outer layer called the cuticle. Just below the cuticle, look for the layer of cells of the ectoderm.
2. Inside the ectoderm are two muscle layers. The outer layer contains the circular muscles, which run circularly around the earthworm. The thick inner layer contains the longitudinal muscles, which run the length of the worm. These two layers of muscle make up the mesoderm.
3. Study the center of the slide. You will see a round or horseshoe-shaped space that is the inside of the digestive tract. The layer of cells that surrounds the space is the endoderm. Surrounding the endoderm is another set of circular and longitudinal muscles.
4. Notice a relatively open space between the muscles surrounding the digestive tract and the muscles just inside the epidermis. This body cavity is called a coelom.
5. Locate a long, fiberlike structure inside the coelom. This structure, called a nephridium, is involved in excretion. There should be one nephridium on each side of the earthworm's body.
6. On the outer surface of the earthworm, find some bristly structures called setae. The earthworm uses the setae to help move its body through the soil.
7. In the appropriate place in Observations, label the following structures on the cross section of the earthworm: cuticle, ectoderm, circular and longitudinal muscles (both sets), endoderm, coelom, nephridium, and setae.

Observations

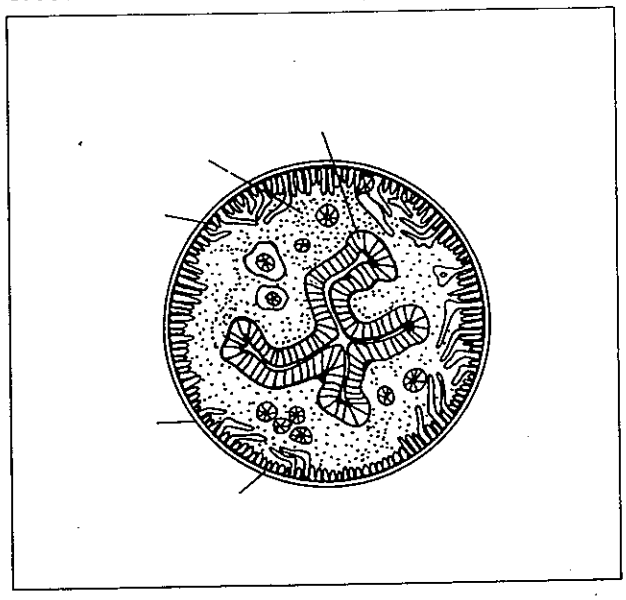
Cross Section of Cnidarian *(Hydra)*



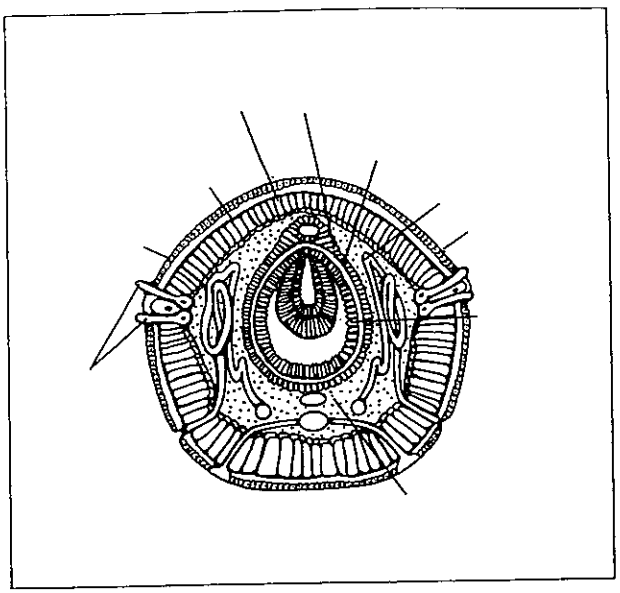
Cross Section of Flatworm *(Dugesia)*



Cross Section of Roundworm *(Ascaris)*



Cross Section of Earthworm *(Lumbricus)*



Analysis and Conclusions

1. What structures in the cnidarian correspond to the digestive cavity, ectoderm, and endoderm in the earthworm? _____

2. How is the body plan of the cnidarian different from the body plan of the flatworm?

3. How is the body plan of the flatworm similar to the body plan of the roundworm?

4. How is the body plan of the flatworm different from the body plan of the roundworm?

5. How is the body plan of the earthworm different from the body plans of the other three organisms you examined? _____

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Critical Thinking and Application

1. Suppose a newly discovered organism is found to have three body layers. Scientists think that it is a worm but disagree as to the group in which it should be placed. How could they assign it to the proper group based on body structure? _____

2. What are two advantages of the presence of a coelom in an organism?

3. Suppose a new phylum of invertebrates is discovered. These invertebrates have a gastrovascular cavity and a very thin layer of mesodermal cells but show no organ development. Where would you place this new phylum with respect to the ones studied in this investigation? Explain your placement. _____

Going Further

Construct or draw a new form of invertebrate having characteristics of one existing phylum or intermediate characteristics of two related phyla. From your completed model or drawing, your classmates should be able to identify the animal's symmetry, locomotion, nervous system, method of circulation, excretory system, and type of digestive system and, based upon its gas-exchange structure, whether your new "species" is terrestrial or aquatic.