

Investigating Platyhelminthes, Nematoda, and Annelida

Lab XI-2

EQUIPMENT AND MATERIALS

You'll need the following items to complete this lab session. (The standard kit for this book, available from www.thehomescientist.com, includes the items listed in the first group.)

MATERIALS FROM KIT

- Magnifier

MATERIALS YOU PROVIDE

- Microscope
- Slides, prepared, Nematoda
- Slides, prepared, Platyhelminthes
- Slides, prepared, Annelida

BACKGROUND

The word *worm* was applied by early taxonomists to any *invertebrate* (spineless) animal that was not an *arthropod* (insect, spider, crustacean, etc.). In common usage, worm is sometimes used to refer to any legless creature with a tubular body, including caterpillars, grubs, maggots, centipedes and millipedes, legless amphibians, and even snakes, none of which are true worms in the original sense of that word. Although taxonomists no longer consider worms a valid grouping, not least because the various species formerly classified as worms do not make up a monophyletic group, the word is still used by biologists as a term of convenience. Worms range in size from microscopic to many meters in length, and can be found in diverse terrestrial and aquatic environments. Some species are free-living predators, while others are parasites that occupy the bodies of various animal hosts.

Like other invertebrates, worms are classified according to the number of structural cell layers they contain and the type of body cavity, if any. The *Porifera* and *Cnidaria* we examined in the preceding lab session contain only two structural cell layers, the outer ectoderm and the inner endoderm. As more complex animals, the worms we'll examine in this lab session contain an additional structural cell layer called the mesoderm, which is located between the ectoderm and endoderm.

In worms, a fluid-filled body cavity may or may not be present in the mesoderm. Worms without a body cavity are called *acoelomates*. Those with a body cavity that is partially lined with mesoderm are called *pseudocoelomates*. Those with a body cavity that is fully lined with mesoderm are called *coelomates*.

In this lab session, we'll examine some characteristics of representatives of three major worm phyla: *Platyhelminthes*, or *flatworms*; *Nematoda*, or *round worms*; and *Annelida*, or *segmented worms*. These three phyla provide examples of acoelomates, pseudocoelomates, and coelomates, respectively.

PROCEDURE XI-2-1: OBSERVING PLATYHELMINTHES (FLATWORMS)

As you perform this procedure, record your observations in your lab notebook. Sketch or shoot images of any significant features you observe.

1. Examine a whole-mount prepared slide of a representative Planarian, such as *Dugesia* sp., shown in Figure XI-2-1, with the magnifier and at low magnification with your microscope. Identify any external features visible, such as the *pharynx*, *ocelli* (eye spots), *auricles* (small flaps near the anterior end, used for detecting water currents), and so on.
2. Examine a cross-section of the Planarian at low magnification. Locate and identify the exterior cell layer, the *ectoderm*, which surrounds and contains the middle cell layer, the *mesoderm*. The mesoderm is the cellular connective tissue that makes up the bulk of the body, and contains all of the organs. Examine the structures visible within the mesoderm, including the collagen fibers that provide structural support for the body and the muscles that attach to those fibers. Identify the interior cell layer, called the *endoderm*, a single layer of cells that surrounds the *gastrovascular cavity*. Figures XI-2-2 through XI-2-4 show Planarian cross-sections of the anterior, pharynx, and posterior regions, respectively.

Figure XI-2-1: *Planaria* (*Dugesia* sp.) anterior and pharynx regions wm, 40X

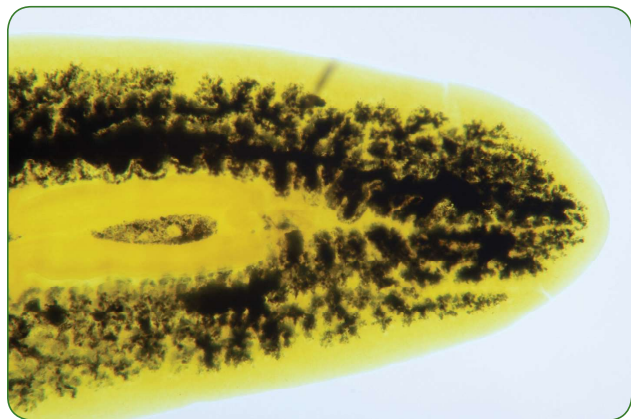


Figure XI-2-2: *Planaria* anterior region cs, 100X



Figure XI-2-3: *Planaria pharynx region cs, 100X*



Figure XI-2-4: *Planaria posterior region cs, 100X*



Although *Platyhelminthes* in the paraphyletic sub-phylum *Turbellaria* (like the *Planaria*) are generally free-living and predatory, many flatworm species are parasites that colonize animal hosts and cause serious diseases in humans and animals. These parasites are members of the monophyletic *Neodermata* sub-phylum, which contains three classes: *Cestoda* (tapeworms, such as *Taenia* sp.), *Trematoda* (flukes, such as *Schistosoma* sp.), and *Monogenea* (fish parasites).

Cestoda are fascinating structurally. Their bodies are made up of a series of segmented plate-like structures called *proglottids*, which may overlap each other or simply be butted edge-to-edge. The *Cestode* continues to produce proglottids throughout its life cycle. As proglottids mature, they are expelled from the posterior of the *Cestode*, mixed with feces. Interestingly, because proglottids contain both male and female reproductive structures, an individual proglottid can reproduce independently. That leads some biologists to consider individual *Cestodes* to be proglottid colonies rather than single organisms.

3. If you have prepared slides available, examine whole-mounts and cross-sections of a representative *Cestode*, such as *Taenia* sp. or another tapeworm. Compare and contrast the structures with those of the *Turbellaria*. Identify the proglottids and examine proglottids in all three states: immature, mature, and gravid (filled with fertile eggs). Figure XI-2-5 is a 40X wm of gravid proglottids from *Taenia pisiformis*, a tapeworm commonly found in dogs, cats, and other carnivores.

Figure XI-2-5: *Tapeworm (Taenia pisiformis) proglottids wm, 40X*



4. If you have prepared slides available, examine whole-mounts and cross-sections of a representative *Trematoda*, such as *Schistosoma* sp., shown in Figure XI-2-6, or another fluke. Compare and contrast the structures with those of *Turbellaria* and *Cestoda*.

Figure XI-2-6: Blood fluke (*Schistosoma mansoni*) male wm, 40X



PROCEDURE XI-2-2: OBSERVING NEMATODA (ROUNDWORMS)

As you perform this procedure, record your observations in your lab notebook. Sketch or shoot images of any significant features you observe.

Using low magnification, examine a prepared slide of a cross-section of a representative *Nematode*, such as *Ascaris lumbricoides*, shown in Figures XI-2-7 and XI-2-8. Working from the outer layers toward the inner layers, identify the following structural features:

Cuticle

The *cuticle* is the outermost layer. Depending on the species, the cuticle may be quite thick and have a complex structure, or it may be relatively thinner and simpler. In parasitic species, the impervious cuticle protects the worm against attack by the digestive system or other active defenses of the host.

Ectoderm

The *ectoderm* (or *epidermis*) lies just inside the cuticle, and is a thin single layer of cells.

Mesoderm

The *mesoderm* layer lies just inside of the ectoderm, and has a filamentary or fiber-like appearance.

Pseudocoelom

The *pseudocoelom* occupies most of the body, from the inner edge of the mesoderm to the outer edge of the *endoderm*, and is cluttered with other structures scattered throughout it like raisins in a pudding.

Endoderm

The endoderm is a single layer of cells, bounded on the outside by the pseudocoelom, and surrounding the *gastric cavity*, which is the digestive tract of the worm and runs its length from the mouth to the anus.

Figure XI-2-7: Roundworm (*Ascaris lumbricoides*) cs, 40X



Figure XI-2-8: Roundworm (*Ascaris lumbricoides*) cs, 40X



PROCEDURE XI-2-3: OBSERVING ANNELIDA (SEGMENTED WORMS)

As you perform this procedure, record your observations in your lab notebook. Sketch or shoot images of any significant features you observe.

Using low magnification, examine a prepared slide of a cross-section of a representative *Annelida*, such as *Lumbricus terrestris*, (the common earthworm) shown in Figure XI-2-9. Working from the outer layers toward the inner layers, identify the following structural features:

Chaetae

Chaetae (singular *chaeta*), also called *chetae* or *setae*, are thin, stiff bristle-like structures on the exterior surface of Annelids, which provide a grip that allows the worm to move across surfaces, through soil, and so on. The chaetae in Figure XI-2-9 surround the worm but are barely visible as tiny bumps at 40X. Depending on your specimen, you may have to boost magnification to see any detail in the chaetae.

Cuticle

The *cuticle* is the thin, outermost layer, which encloses and protects the inner structures of the worm.

Ectoderm

The *ectoderm* lies just inside the cuticle, and is a thin single layer of cells.

Muscle layers

Lying just inside the ectoderm are two layers of muscles that form the outer boundary of the mesoderm. The thinner outer layer is the lateral muscles, which run around the diameter of the worm; the thicker inner layer is the longitudinal muscles, which run the length of the worm.

Mesoderm, coelum, nephridia, endoderm, and digestive cavity

The *mesoderm* layer is bounded on the outer side by the muscle layers, and on the inner side by the muscles that surround the central circular, oval, or horseshoe-shaped *digestive cavity*. The body cavity between the longitudinal muscles and the digestive cavity is called the *coelum*. (The true coelum body cavity present in *Annelida* differs from the pseudocoelum cavity present in *Nematoda* in that the true coelum is fully lined with mesoderm.) The two filamentary structures, one per side, inside the coelum are called *nephridia* (singular *nephridium*).

Figure XI-2-9: Earthworm (*Lumbricus terrestris*) cs, 40X



REVIEW QUESTIONS

Q1: If you are given a cross-section slide of an unidentified worm to classify, what single internal feature would allow you to identify unambiguously the worm as Platyhelminthes, Nematoda, or Annelida?

Q2: What characteristic do members of the three phyla we examined in this lab session have in common with each other that they do not share with members of Porifera or Cnidaria?

Q3: Given your knowledge of Annelida structures, propose an explanation for how an earthworm moves forward.
