References (Textbook - pages 530-532, Lab Manual pages 173-176)

Characteristics

1. Their body plan is a tube within a tube. This the first time we have encountered this condition in our tour of the animal kingdom.

2. Roundworms are often called nematodes and our textbook calls the phylum Nematoda.

3. Roundworms are pseudocoelomate. They possess a pseudocoel in that the interior gut and muscular outer wall is separated by a fluid filled cavity.

4. Like flatworms, roundworms have bilateral symmetry.

5. They are triploblastic.

6. Members of the phylum are non-metameric. Another way to say this is that there is no segmentation of body parts. Their bodies are cylindrical and tapered at both ends.

7. They are usually dioecious. There are both male and female individuals. The sexes are separate. However, a few are hermaphroditic.


9. There are many parasitic forms and they are universally present in fresh and salt water and the soil.

10. Virtually all of plants and animals are parasitized by one or more kinds of nematodes.

   - They cause millions of dollars in crop damage annually.
   - At least 45 species are parasites of man.

Anatomy and Physiology (Ascaris as representative example)

We will briefly overview the anatomy and physiology of the nematodes using Ascaris lumbricoides as an example. Please refer to the handout from page 175 of our lab manual
• **Structure**

1. Nematodes are "threadlike" and range in size from microscopic to about 4 inches long.

2. The body wall is composed of longitudinal muscle fibers, epidermis, and cuticle (B-2).

3. The non-living cuticle is secreted by the underlying epidermis and provides protection from the host's digestive enzymes.

• **Digestion**

1. Roundworms have a complete digestive tract.

2. It is a straight digestive tract that includes the mouth (A-1), pharynx (A-2), esophagus (not shown on diagram), intestine (A-3) and anus (A-6).

3. Between the intestine and body wall is the fluid filled cavity called the pseudocoel ((B-7)).

• **Excretion**

1. Situated near the anterior (head) end is a single excretory pore (A-7).

2. The excretory pore connects to two excretory canals (A-8) that run longitudinally along each side of the body.

• **Reproduction**

1. The Male (Figure C)

   • Has a single, coiled threadlike testis (C-3).

   • The testis are connected to two tubes, the vas deferens (C-2) which lead to a wider tube called the seminal vesicle (C-5).

   • The seminal vesicle empties into a short muscular ejaculatory duct called the sheath (C-4).

   • The male copulatory organ is the penial setae (C-6).
2. The **Female** (Figure A).
   - Has a *Y-shaped* reproductive system.
   - Each branch consists of a coiled, threadlike *ovary* (A-5).
   - The *ovary* is continuous with the *oviduct* (A-4) through which the *egg* is carried.
   - The *oviduct* leads to the *uterus* (A-11).
   - The *uteri* of the two branches *unite* into a short muscular *tube* called the *vagina* (A-10).
   - The *vagina* opens to the outside through the *vulva* (A-9).

- **Life Cycle and Pathology**
  
  1. Review page 176 of our lab manual for an overview of the life cycle of *Ascaris*.

  2. *Ascaris* worms live in the *intestinal cavities* of *men* and *pigs* where they do *little harm* because they do not injure the intestine. They only "*share*" the digested *food* of their *host*.

  3. However, occasionally these *adult worms* wander up the *bile duct* and into the *liver* where they *clog* up the bile duct or *damage* liver tissue. This can result in serious injury or death.

  4. Other *organs* that can be harmed by *adult* roundworms are the *appendix*, *stomach*, and *esophagus*.

  5. The *greatest damage* is done by the *larvae* that *migrate* through the host's *tissues* from the *intestines* to the *lungs* and back to the *intestine*. This causes internal bleeding, muscle spasms, fever, and anemia.
Other Important Roundworm Parasites

1. See the handout on Some Roundworms that live in Man. These include:

   - The Eye Worm
   - Pinworm
   - Hookworm
   - Whipworm
   - Guinea worm
Some roundworms that live in man.

- **Hookworm, Necator americanus, from intestine**
- **Larva of Wuchereria bancrofti, from blood (causes Elephantiasis)**
- **Adult eye worm, Loa loa, from eye**
- **Pinworm, Enterobius vermicularis, from cecum**
- **Pinworm embryo**
- **Whipworm, Trichuris trichiura, from cecum**
- **Guinea worm, Dracunculus medinensis, being wound on a stick**

Figure 82. Some roundworms that live in man.
TRICHINOSIS

A routine government meat inspection will protect them from trichinosis. Nothing could be farther from the truth, for there could be several hundred thousand of the parasites hiding under the purple United States Government meat inspector's stamp in the carcass of an inspected animal. Thus, it is up to the consumer to beware of this dreaded disease and cook pork thoroughly to avoid infection. Salami, pork sausage, head cheese, and other pork products are also likely to prove dangerous unless they, too, are thoroughly cooked.

Reports have shown that freezing pork for a period of a week or two will usually kill the larvae, but cooking is safer and usually is more practical for the average consumer.

Orthodox Jews will not eat pork because of Ancient Jewish laws which declared it unclean. (This practice could hardly have developed from the fear of trichinosis, however, because the presence of the worms was not detected until many years after the invention of the microscope.) No doubt it would prove rather embarrassing for an Orthodox Jew to come down with a proven case of trichinosis!

When infected meat is eaten, the tiny larvae are released from their protective cysts in the muscle tissue by the action of the digestive juices. They now start developing in their newly found host. Growth is rapid and they become sexually mature in the brief interval of two or three days. After mating, the females, which by now are about ¼ inch long, burrow into the walls of the intestine, where they remain for some time while they give birth to about fifteen-hundred microscopic larvae. These enter the circulatory system whence they are carried to the skeletal muscles. They are usually about ⅛ of an inch long at this time. Here they burrow into the muscles and encyst there until the flesh of this new host is eaten by some other animal.

The greatest damage done to the host is during the migrations of the larvae. Their numbers are sometimes unbelievable, as many as half a billion boring through the tissues of a single host at the same time.

Symptoms of trichinosis vary considerably, but usually there are excruciating muscular pains, weakness, fever, anemia, and swelling in various regions of the body. Attacks have been known to cause epileptic (ek'lep'tik) seizures and heart failure when worms invade the vital areas of the brain and the heart.

There is approximately 5 per cent fatality in known cases of trichinosis, but diagnosis is very difficult and there is no known treatment for the disease.

Elephantiasis (el'fan-tis'is) is a bizarre tropical or subtropical disease brought about by another parasitic roundworm, known as Wuchereria bancrofti (wook'er er'ta ban'krofti). Adults of these worms are about 2 to 4 inches long. They cause the disease known as elephantiasis when they congregate in sufficient numbers to block the lymph (limf) glands in which they live. The lymph, which cannot get back into the circulatory system, accumulates in the arms, legs, or scrotum (skrö'tum, sack that holds male testes) and causes them to swell to fantastic proportions. In severe cases abnormal connective tissue forms in the affected areas to further complicate the condition. People become infected when bitten by a tropical mosquito (usually the Culex (kū'leks) or Aedes (a'ë'dez) which is incubating the larvae. Mosquitoes become

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FIG. 7-7. Elephantiasis -- and the microfilaria worm that causes it. The small size of this worm can be approximated by comparing it with the red blood cells in the black circle. (Drawn from a photograph)

FIGURE 84. Elephantiasis due to Wuchereria bancrofti. This woman lives on a South Pacific Island. The infection started in the left arm when she was 33 years of age, and at 38 both arms and legs were affected. This photograph was taken at the age of 43. The filaria worms block the lymph vessels, which results in the diversion of lymph into the tissues and the enormous growth of connective tissue. (Courtesy of W.A. Robinson.)
Ascaris lumbricoides (As'ka ris lum bri ko'id es) — A Typical Roundworm

Nematode worms are so similar in form and structure that the description of an ascaris worm fits practically every other roundworm in the phylum — that is, if size is no criterion. This large parasite of man and pig is invariably chosen as a laboratory "type animal" because of its large size and availability.

Habitat. Ascaris worms customarily live in the intestinal cavities of men and pigs, where they do relatively little harm because they do not injure the intestines and only "share" the digested food of their host by ingesting small amounts of his predigested foodstuffs. Occasionally, however, the worms become restless and wander up the bile duct into the liver, where they do a great deal of damage by clogging up the bile duct or doing mechanical damage to the liver. This damage usually results in serious illness or death. They may also wander into the appendix and set up an inflammation there, or go anteriorly through the pyloric valve into the stomach from which a few adventurous ones sometimes migrate up the esophagus. They have occasionally been known to emerge through the nostrils of the horrified host! Several thousand ascaris worms have been found in a single individual, but this is a rare phenomenon in humans. When large concentrations such as this are present, death is likely to occur from blockage of the intestine, since even 100 worms have been known to plug up this vital digestive tube completely.

The greatest damage by ascaris worms is caused by the larvae, which migrate through the tissues from the intestines to the lungs and back to the intestine again via the alimentary canal, causing internal bleeding, muscular spasms, fever, and anaemia.

External Anatomy. Externally, the elon-
Pork Tapeworm

Figure 76. Life cycle and structure of the pork tapeworm, Taenia.