

## Helminths (Worms)

Did you know that helminths cause the following threats to public health?

- **Trichinosis (*Trichinella spiralis*)**
- **Pinworms (*Enterobius vermicularis*)**
- **Ascaris (*Ascaris lumbricoides*)**

## Objectives of This Lesson

After completing this lesson, you will be able to:

- Describe the general characteristics of helminths
- Differentiate helminths from other eukaryotes
- Gain familiarity with trichinella and ascaris and how they may differ from Protozoans and other eukaryotes
- State at least one pathogenic disease associated with Helminths

## Helminths: The Basics

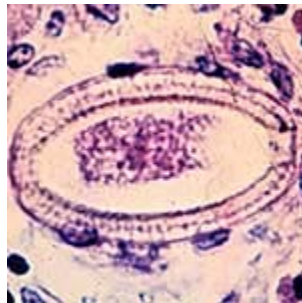
### Characteristics of a Helminth

The helminths are worm-like parasites. They are conveniently referred to as worms. Helminth is Greek for "worms". Helminths are separated according to their general external shape and the host organ they inhabit. The definitive classification is based on the external and internal morphology of egg, larval, and adult stages. Helminths are multicellular eukaryotes. There are three classes:

- **Trematodes** – "flukes"
  - Adult flukes are leaf-shaped flatworms. Prominent oral and ventral suckers help maintain position. Flukes are hermaphroditic except for blood flukes, which are bisexual. The life cycle includes a snail intermediate host. An example is the organism that causes schistosomiasis.
- **Cestodes** – pig and cattle "tapeworms"
  - Adult tapeworms are elongated, segmented, hermaphroditic flatworms that inhabit the intestinal lumen. Larval forms, which are cystic or solid, inhabit extraintestinal tissues.
- **Nematodes** – "roundworms"
  - Adult and larval roundworms are bisexual, cylindrical worms. They inhabit intestinal and extraintestinal sites. In this course, we will explore nematodes for examples of infections and life cycles. The nematodes include *Trichinella*, *Ascaris*, and *Enterobius*.



Trematodes



Nematodes



Cestodes

## Nematodes

Intestinal nematodes all mature into adults within the human intestinal tract. The larval forms of many of these roundworms may be distributed widely throughout the body.

Three of the intestinal nematodes are acquired by the ingestion of nematode eggs:

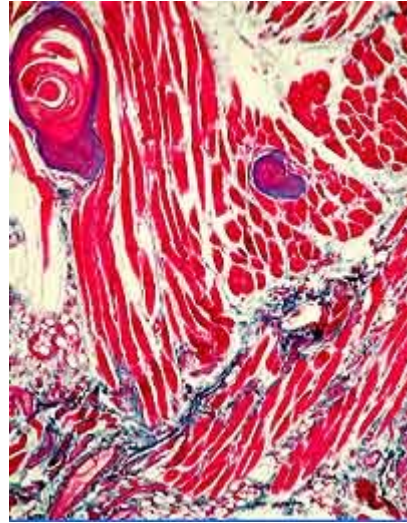
- *Trichuris trichiura* ("whipworm")
- *Ascaris lumbricoides*
- *Enterobius vermicularis* ("pinworm")

Two worms are acquired when their larvae penetrate through the skin, usually of the foot:

- *Necator americanus* ("hookworm")
- *Strongyloides stercoralis*

One is acquired by the ingestion of the encysted larvae in muscle (pork meat):

- *Trichinella spiralis*

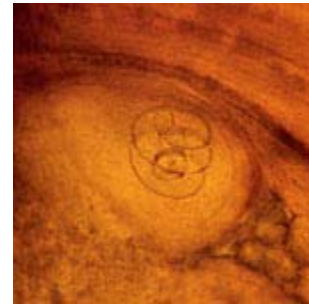


Trichinella is the most well known nematode in the U.S.

## Nematodes: Trichinella

Trichinosis is acquired following the ingestion of the encysted larvae of *Trichinella spiralis*, which are often present in raw pork. After ingestion, the cysts travel to the small intestine, where the larvae leave the cysts and mature into mating adults. Following mating, the adult males are passed in the feces. The females penetrate into the intestinal wall, producing thousands of larvae. The larvae then enter the bloodstream and spread to organs and skeletal muscle. Finally, the larvae become encysted in skeletal muscle, where they may last for decades.

Most patients are asymptomatic with the initial infection. Some patients will complain of abdominal pain, diarrhea, and fever as the worms mature in the small intestine and penetrate through the intestinal wall. In severe (sometimes fatal) cases, larvae may invade heart muscle and brain tissue.



Larvae of *Trichinella* in pressed muscle tissue



Larvae of *Trichinella*, freed from their cysts, typically coiled

## Nematodes: *Ascaris*

Infection occurs when individuals consume food that is contaminated with *Ascaris* eggs. Larvae emerge when the eggs reach the small intestine. The larvae penetrate through the intestinal wall and travel in the bloodstream to the lungs. The larvae grow in lung alveoli until they are coughed up and swallowed. These larvae again reach the small intestine and mature into adults. Adult worms produce over 200,000 eggs per day, which are excreted in feces. *Ascaris* can grow as large as 20 cm or more.

*Ascaris* infection may be mild or asymptomatic. With heavy infections the patient may develop abdominal cramping. Severe infections involve adult worm invasion into the bile ducts, gall bladder, appendix, and liver. Children with heavy worm loads may suffer from malnutrition because the worms compete for the same food and sometimes a mass of worms can actually block the intestine. When the larvae migrate into the lung, the patient may develop a cough, pulmonary infiltrate on chest x-ray, and a high eosinophil count in the blood and sputum.



*Ascaris* egg containing a larvae, which will be infective if ingested



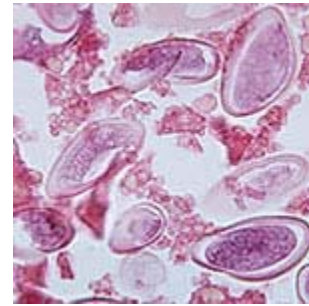
Adult *Ascaris*

## Nematodes: *Enterobius vermicularis* - "Pinworms"

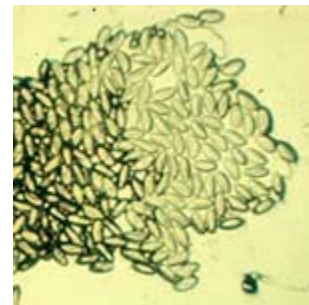
Pinworms are a more common, but less exotic, helminth infestation. It is something that physicians and public health officials deal with regularly.

The enterobius' life cycle is very simple. The eggs are ingested and the pinworms mature in the cecum and ascending large intestine. The female migrates to the perianal area (usually at night) to lay her eggs, which become infectious 4-6 hours later. This infection causes severe perianal itching. An infected individual will scratch the perianal area and then re-infect himself or others (hand-to-mouth) because his hands are now covered with the microscopic pinworm eggs.

Pinworms are diagnosed by placing scotch tape firmly on the perianal area. The scotch tape will pick up eggs, which can be viewed under a microscope. At night, the larger adult females can sometimes be seen with the unaided eye, crawling across the perianal area. There is no eosinophilia, since there is no tissue invasion.



*Enterobius* eggs seen from a cross-section of human appendix containing *Enterobius vermicularis*



*Enterobius* eggs on cellulose tape prep

## Question 1 of 4

**All worm life cycles require that fertilization and reproduction occur in the host.**

- A. True
- B. False

Submit Answer

## Question 2 of 4

**Enterobius does not invade local tissue although it is very irritating.**

- A. True
- B. False

Submit Answer

### Question 3 of 4

**Most parasitic worms are nematodes.**

- A. True
- B. False

Submit Answer

## Question 4 of 4

**All helminths enter the human body during their larval stage.**

- A. True
- B. False

Submit Answer