

Parasitic helminths (worms)

There are two major groups of helminth: 1) nematodes, or roundworms, and 2) platyhelminths, or flatworms. Flatworms are, in their turn, represented by two classes: Trematoda (flukes) and cestoda.

I) Platyhelminthes (Flatworms)

1) Trematoda (Flukes)

- Most are hermaphrodite (ثنائية الجنس): both sex organs are in the same individual
- Body structures: oral, ventral suckers, mouth, pharynx, esophagus, branched intestine, ovary, uterus, 2 testes.
- Schistosoma (Bilharzia) are dioecious (احادية الجنس)
- **Species included: Liver Flukes (Fasciola hepatica and Opisthorchis), Heterophyes heterophyes, Echinostoma, 3 species of Schistosoma (Bilharzia).**

A) Liver Flukes (Fasciola hepatica and Opisthorchis)

➤ **Epidemiology:**

Fasciola hepatica, Opisthorchis (previously named Clonorchis) affect humans in various parts of the world.

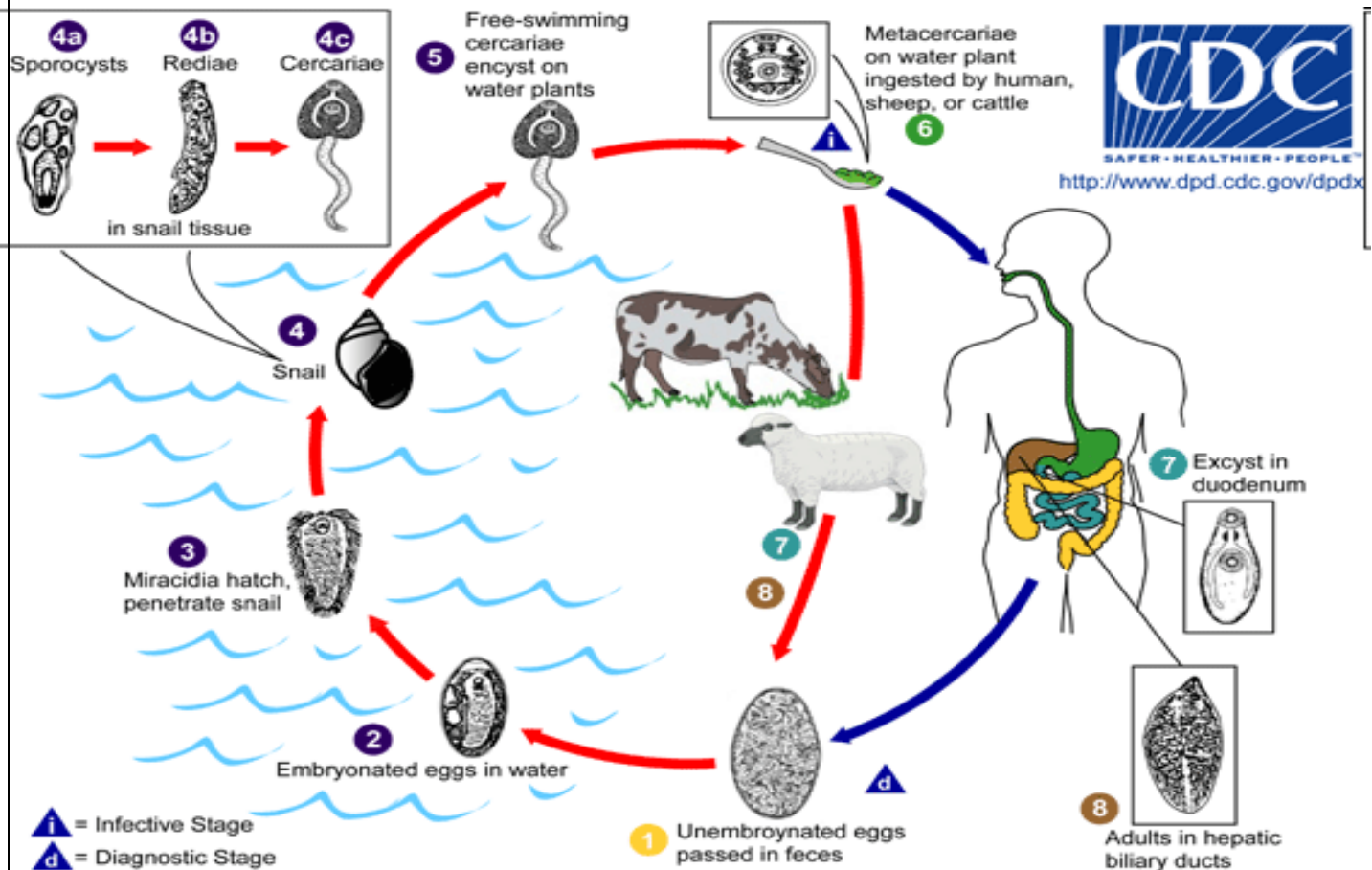
❖ **Fasciola hepatica**

➤ **Morphology:**

F. hepatica is leaf shaped and measures approximately 1 x 3 cm. The eggs measure 80 x 150 µm.

➤ **Life cycle:**

Humans are infected by the consumption of improperly cooked watercress that harbors encysted larval metacercariae. The larval fluke penetrates the duodenal wall and migrates to the peritoneal cavity, penetrates the liver capsule and migrates into the bile duct where it matures. The adult fluke passes its eggs in stool that hatch in water to produce miracidia. The miracidium must find an appropriate snail to continue the life cycle. In the snail, the miracidium divides and gives rise to cercariae which exit the snail and encyst as metacercariae attached to watercress leaves.



B) Heterophyes heterophyes:

The smallest trematode of human 1.7 mm
2nd intermediate host (IH): fresh water fish
Egg is small 15 x 30 micron

C) Echinostoma:

Body is spiny
1 cm
2nd IH is snail

D) Schistosoma (Bilharzia):

- Cause :Schistosomiasis(bilharziasis)
- Three species: *S. hematobium*, *S. mansoni*, *S. japonicum*.
- The three species of *Schistosoma* have different geographic distributions.
 - *S. hematobium* is prevalent in Africa,
 - *S. mansoni* is found in Africa and America
 - *S. japonicum* is common in the far east.

➤ Epidemiology:

Approximately 250 million people are infected with schistosomes and 600 million are at risk.

➤ Morphology

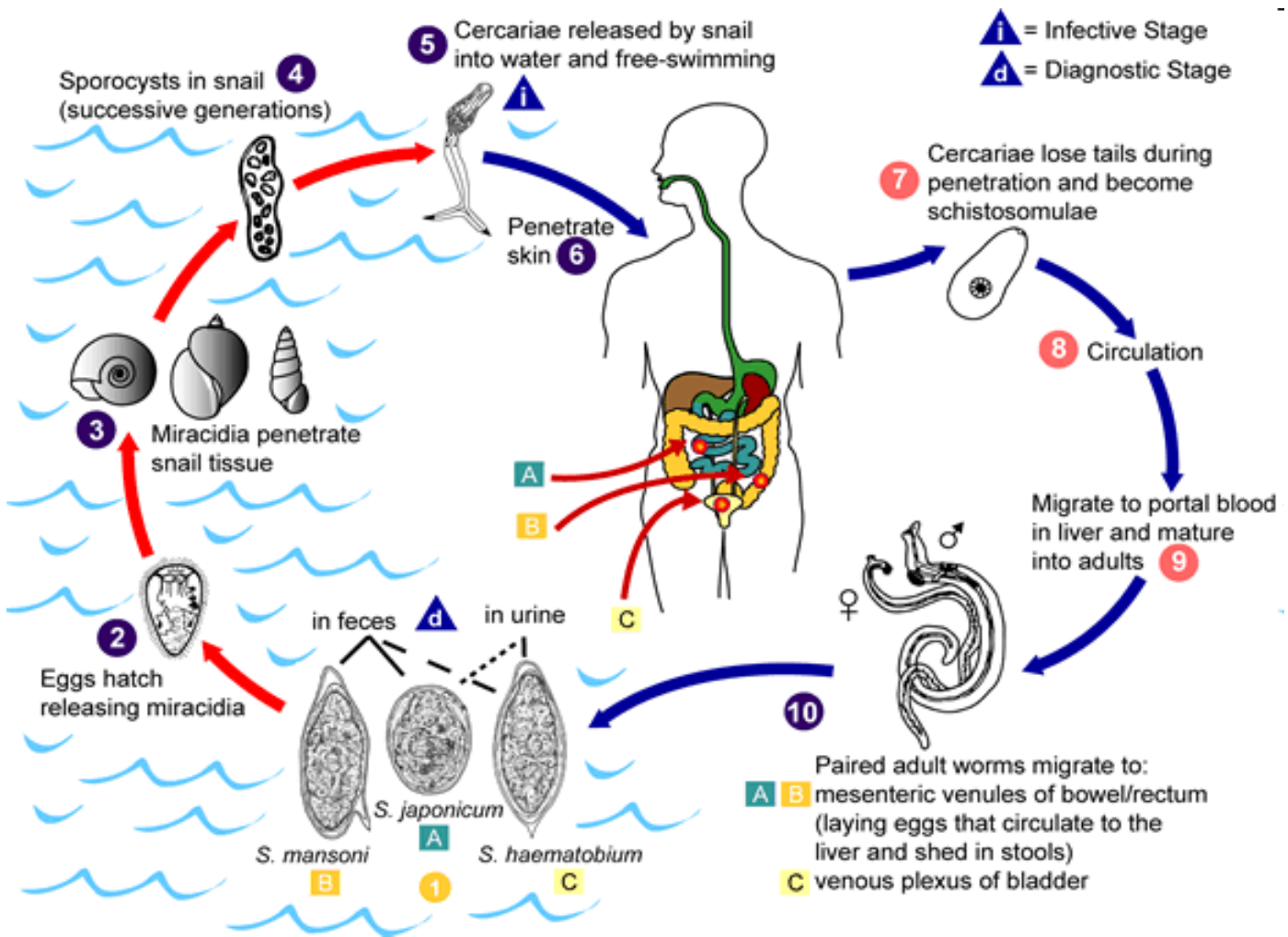
Adult worms are 10 to 20 mm long; the male has a canal in which the slender female worm resides. Unlike other trematodes, schistosomes have separate sexes (figure 1).

- Separate sexes(dioecious) is in contrast to hermaphrodite (male and female sex structures exist in the same individual)



➤ **Life cycle:**

Man is infected by cercaria in fresh water by skin penetration. The cercaria travel through the venous circulation to the heart, lungs and portal circulation. In about 3 weeks, they mature and reach the mesenteric (*S. japonicum* and *S. mansoni*) or the bladder (*S. hematobium*) vessels where they live and ovulate for the duration of the host's life. Eggs germinate as they pass through the vessel wall into the intestine or bladder and are excreted in feces (*S. japonicum* and *S. mansoni*) or urine (*S. hematobium*). In fresh water, the larval miracidium hatches out of the egg and swims about until it finds an appropriate snail. After two generations of multiplication in the snail, the fork-tailed cercariae emerge into the water and infect another human (figure 2).



2) Cestoda

- Species included:

- 1) Tenia (*T. solium* and *T. saginata*) :Cause teniasis
- 2) Echinococcus (*E. granulosus* and *E. multilocularis*):cause Echinococcosis(hydatidosis)

1) Tenia (*T. solium* and *T. saginata*)

➤ Epidemiology:

These cestodes have a worldwide distribution but incidence is higher in developing countries.

➤ **Morphology:**

T. saginata can be up to 4 to 6 meters long and 12 mm broad

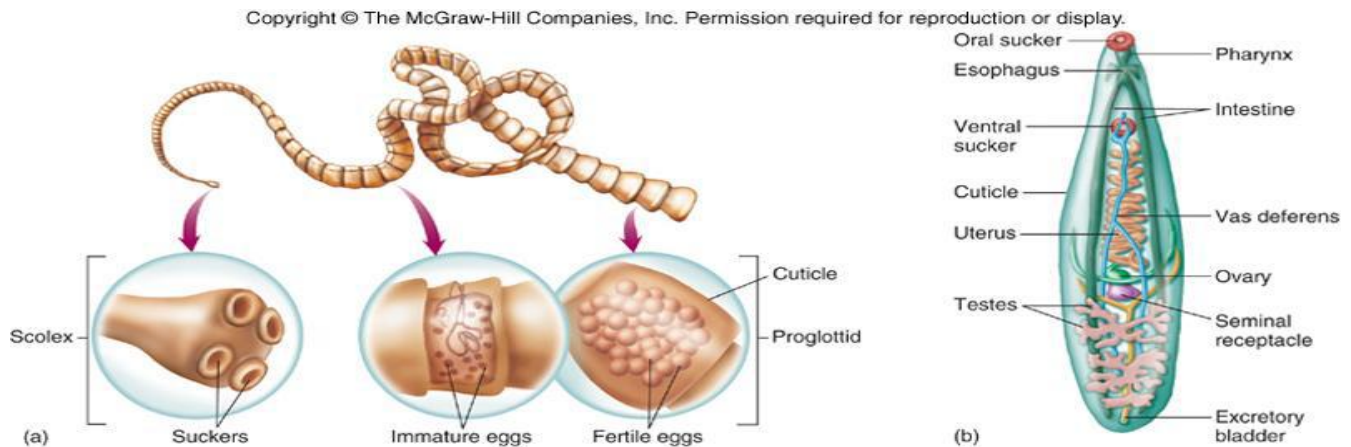
It has a scolex with four suckers without hooks

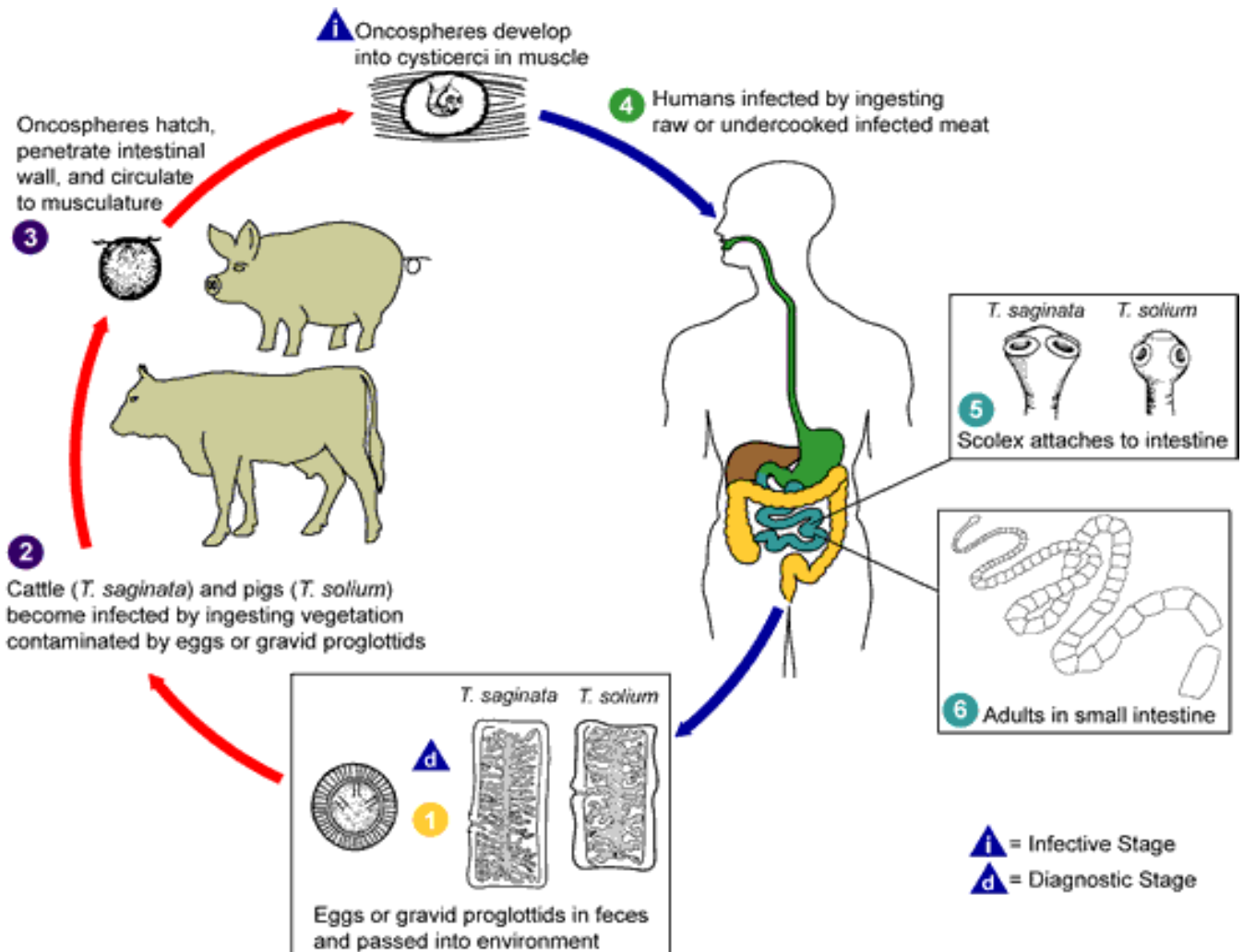
It has several hundred segments (proglottids). Each segment is about 18 x 6 mm with a branched uterus (15-30 branches).

The egg is 35 x 45 micrometers, roundish and yellow-brown. It contains an embryo with 3 pairs of hooklets.

➤ **Life cycle:**

A tapeworm larval cyst (cysticercus) is ingested with poorly cooked infected meat; the larva escapes the cyst and passes to the small intestine where it attaches to the mucosa by the scolex suckers. The proglottids develop as the worm matures in 3 to 4 months. The adult may live in the small intestine as long as 25 years and pass gravid proglottids with the feces. Eggs extruded from the proglottid contaminate and persist on vegetation for several days and are consumed by cattle or pigs in which they hatch and form cysticerci (Figure 1).





2) Echinococcus (*E. granulosus* and *E. multilocularis*)

- *Echinococcus granulosus* and *E. multilocularis* are causative agents of hydatid cysts.

❖ *Echinococcus granulosus*

➤ **Epidemiology:**

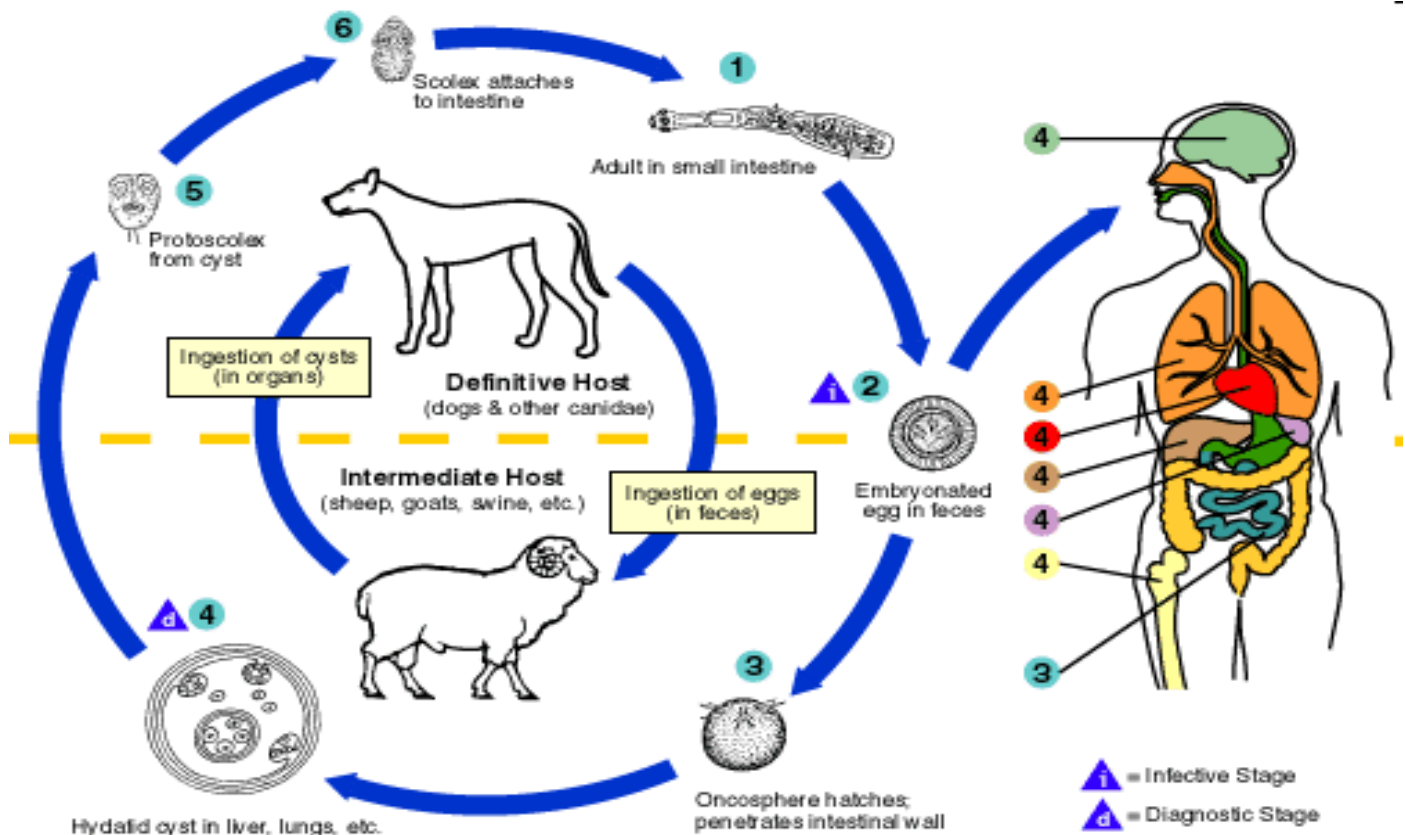
The organism is common in Asia, Australia, Eastern Africa, southern Spain, southern parts of South America and northern parts of North America.

➤ Morphology

This is the smallest of all tapeworms (3 to 9 mm long) with only 3 proglottids.

➤ Life cycle:

The adult worm lives in domestic and wild carnivorous animals. Eggs, passed by infected animals, are ingested by the grazing farm animals or man, localize in different organs and develop into hydatid cysts containing many larvae (proto-scolices or hydatid sand) (Figure 8). When other animals consume infected organs of these animals, proto-scolices escape the cyst, enter the small intestine and develop into adult worms (Figure 7). Echinococcus eggs, when swallowed by man, produce embryos that penetrate the small intestine, enter the circulation and form cysts in liver, lung, bones, and sometimes, brain. The cyst is round and measures 1 to 7 cm in diameter, although it may grow to be 30 cm. The cyst consists of an outer anuclear hyaline cuticula and an inner nucleated germinal layer containing clear yellow fluid. Daughter cysts attach to the germinal layer, although some cysts, known as brood cysts, may have only larvae (hydatid sand). Man is a dead end host.



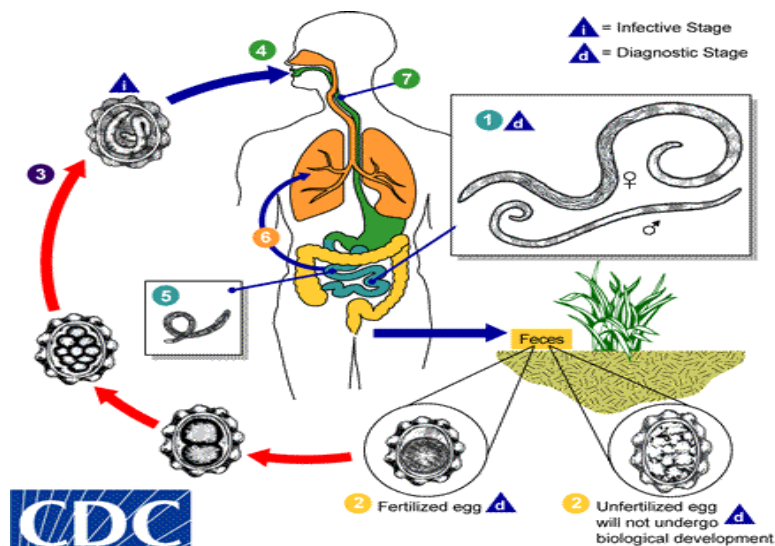
II) Nematodes(Roundworms)

- Either adults or larvae (or both) can cause disease/pathology
- The principal nematods parasites are conveniently considered under two headings: intestinal nematodes and tissue nematodes.

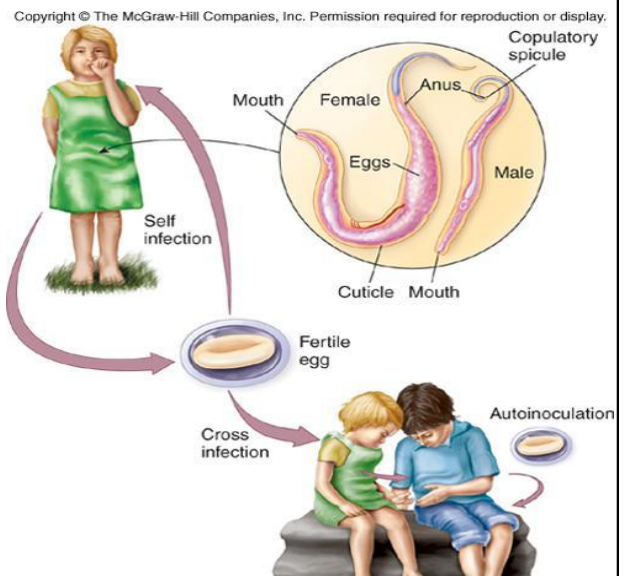
1) intestinal nematodes

- includes:
 - Ascaris lumbricoides,
 - Ancylostoma(hookworm),
 - Enterobius vermicularis(pinworm),
 - trichuris(whipworm)
 - toxocara
 - strongyloides

Fecal/oral transmission



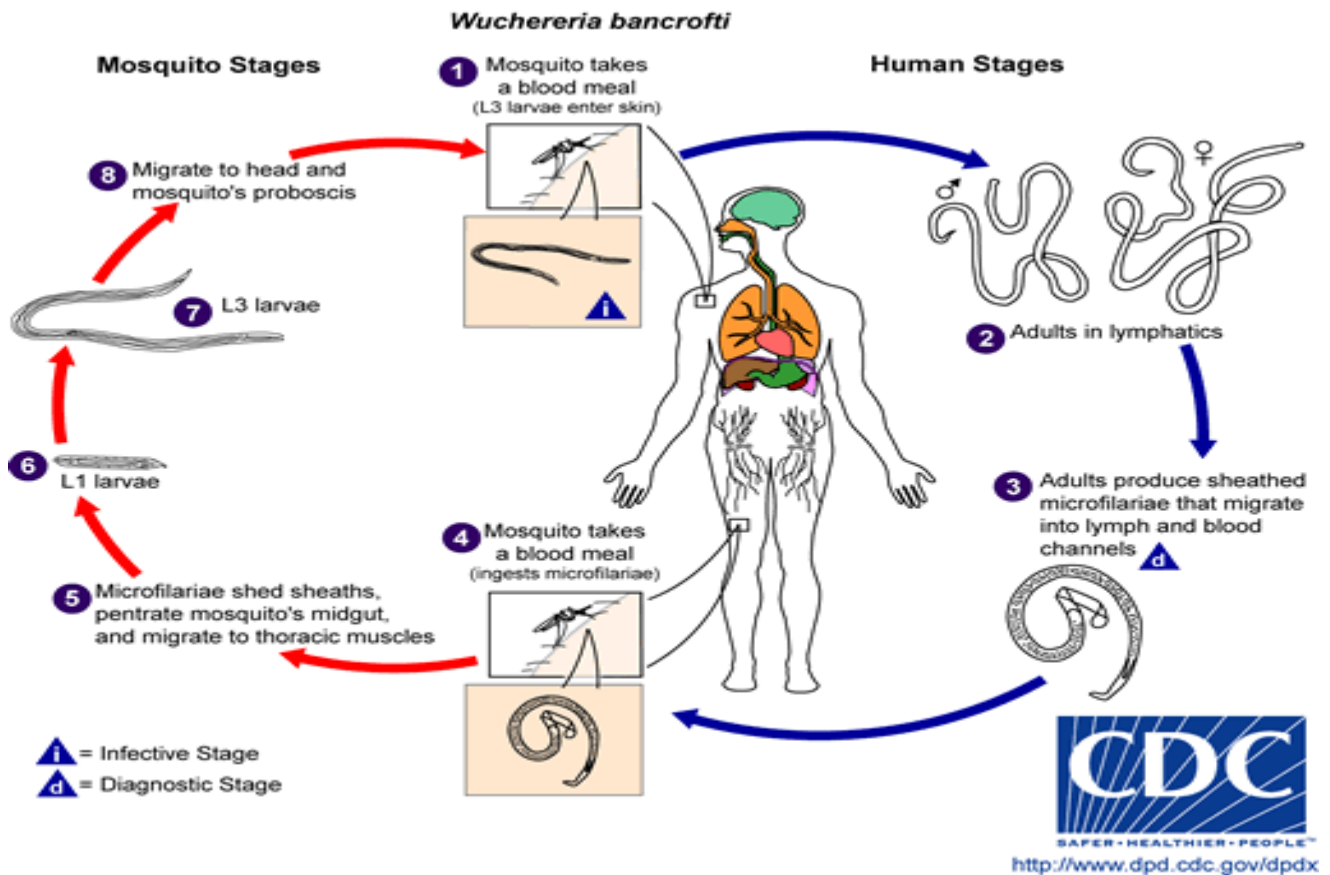
Ascaris lumbricoides life



Pinworm life cycle-*Enterobius*

2) intestinal nematodes (Filarial nematodes):

- The infective stage is L3 larva
- Example : *Wuchereria bancrofti* which cause elephantiasis



Note

Hosts are classified as **definitive hosts** if they harbor a parasite while it reproduces sexually; they are said to be **intermediate hosts** if they harbor the parasite during some other developmental stages. The mosquito is the definitive host for the malaria parasite because that parasite reproduces sexually in the mosquito; the human is an intermediate host, even though humans suffer greater damage from.