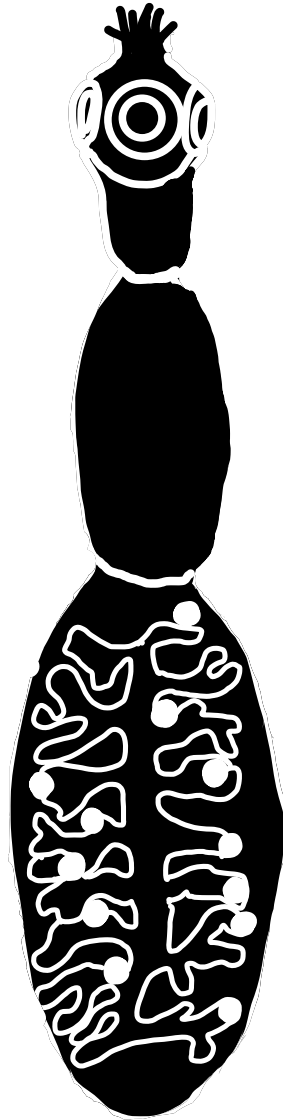


Medical Parasitology Flashcards



Faris Gari, Hamzeh Khirfan, Sana Saffarzadeh, Vandela Wihlner, Oto Melter
©2022

Department of Medical Microbiology, Second Faculty of Medicine, Charles University, Prague

INTRODUCTION

Dear fellow colleagues,

We would like to introduce to you the first edition of medical parasitology flashcards. These flashcards include clinically significant parasites which can be used for reviewing the basic taxonomy and basic principles of parasitic cycles. Fortunately, developed countries are nearly free of parasites, and parasitic infections are rarely seen in hospitals or at clinics. Therefore, attention on parasitology is usually not emphasized in the course of medical microbiology. Moreover, we acknowledge that some students find preparing for the parasitology section quite challenging. In order to counteract that, we have designed a supplementary educational material in the form of flashcards. Please note that this material shall not replace obligatory recommended literature for the medical microbiology exam. Thanks to their design and layout, the following flashcards could be used at any place and could be taken anywhere. Feel free to print them as couplets and even use them as a board game. Enjoy them as you wish!

ACKNOWLEDGEMENT

We would like to offer our special thanks to MUDr. Kamila Dundrová, Department of Medical Microbiology, University Hospital Motol, Prague, for reviewing the flashcards

The Flashcards were published with the cooperation of Mgr. Drahomíra Dvořáková, Department of Scientific Information, Second Faculty of Medicine, Charles University, Prague

Contents

1- Protozoa

1.1- Flagellates

- 1.1.1- *Giardia lamblia*
- 1.1.2- *Trichomona vaginalis*
- 1.1.3- *Naegleria fowleri*
- 1.1.4- *Leishmania* spp.
- 1.1.5- *Trypanosoma brucei*
- 1.1.6- *Trypanosoma cruzi*

1.2- Amebas

- 1.2.1- *Acanthamoeba* spp.
- 1.2.2- *Entamoeba histolytica*

1.3- Sporozoa

- 1.3.1- *Cryptosporidium parvum*
- 1.3.2- *Toxoplasma gondii*
- 1.3.3- *Plasmodium* spp.

2- Helminths

2.1- Nematodes

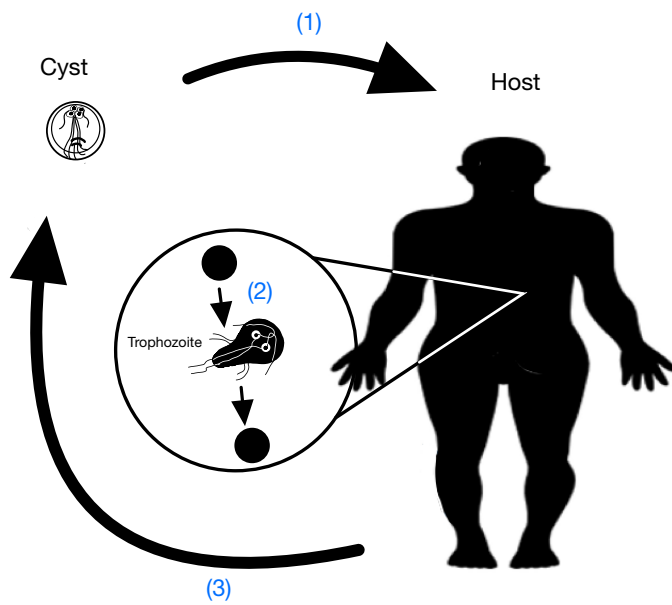
- 2.1.1- *Wuchereria bancrofti*, *Brugia malayi*
- 2.1.2- *Onchocerca volvulus*, *Loa loa*
- 2.1.3- *Ascaris lumbricoides*
- 2.1.4- *Toxocara* spp.
- 2.1.5- *Enterobius vermicularis*
- 2.1.6- *Ancylostoma duodenale*, *Necator americanus*, *Strongyloides stercoralis*
- 2.1.7- *Trichuris trichura*
- 2.1.8- *Trichinella spiralis*

2.2- Trematodes

- 2.2.1- *Schistosoma* spp.

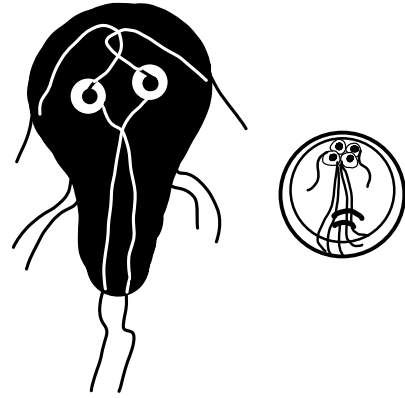
2.3- Cestodes

- 2.3.1- *Echinococcus multilocularis*
- 2.3.2- *Echinococcus granulosus*
- 2.3.3- *Diphyllobothrium latum*
- 2.3.4- *Taenia solium*
- 2.3.5- *Taenia saginata*
- 2.3.6- *Hymenolepis nana*
- 2.3.7- *Hymenolepis diminuta*

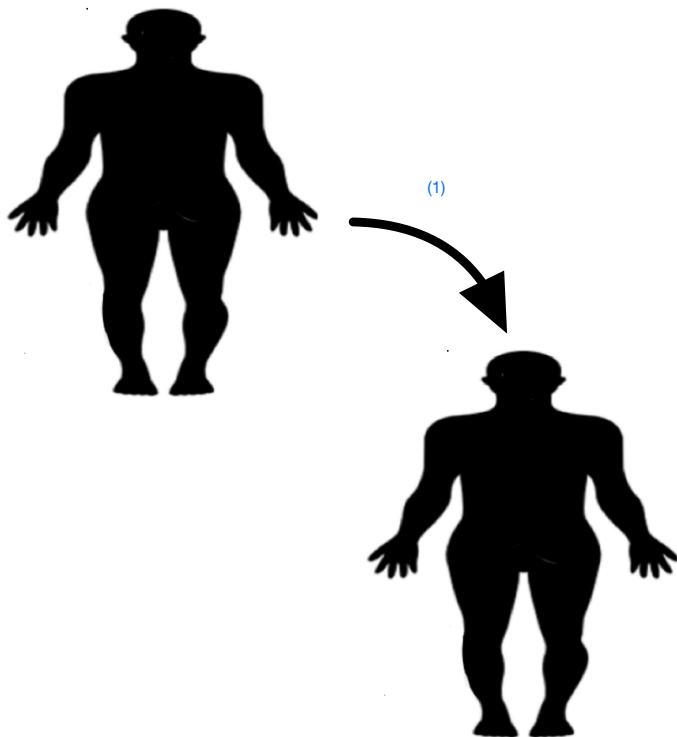


- (1) Cyst is ingested from contaminated food or water.
- (2) Excystation of the cyst in duodenum.
- (3) Cysts (and trophozoites) are released in stool to the environment.

Giardia lamblia

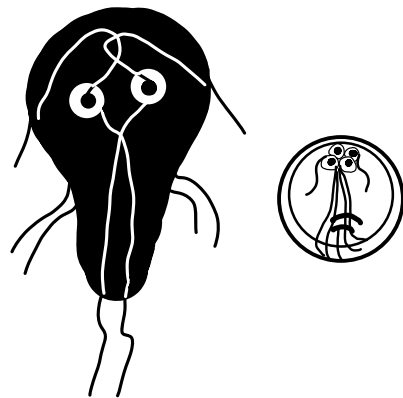


PROTOZOA
Flagellates

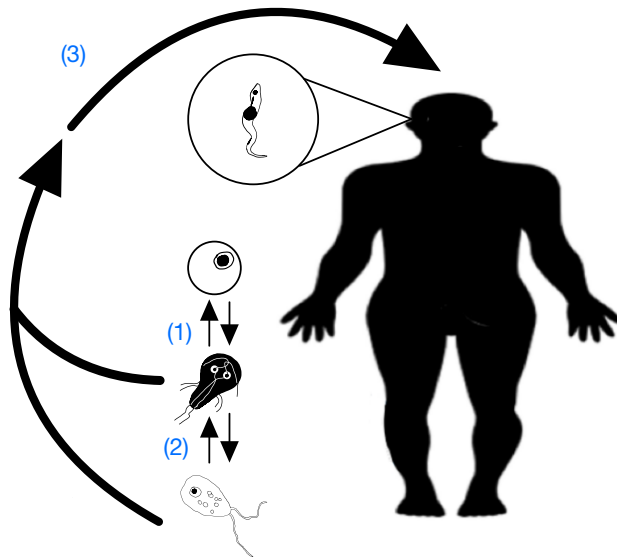


- (1) Trophozoite is transmitted from an infected person to a healthy person during sexual intercourse

Trichomonas vaginalis

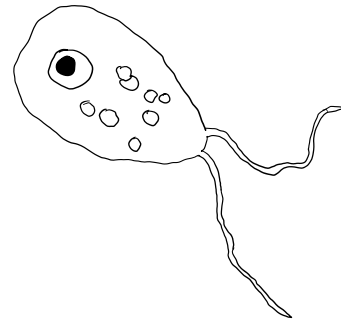


PROTOZOA
Flagellates



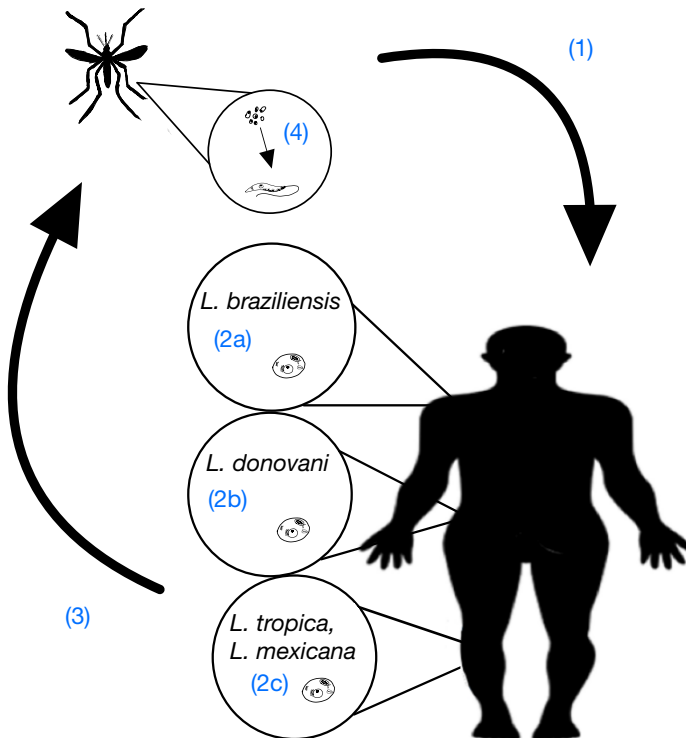
- (1) Cysts form trophozoites and vice versa.
- (2) Trophozoites interchange between flagellated and unflagellated forms.
- (3) Trophozoites infect humans during water related activities and enter the brain through the cribriform plate, causing primary amebic meningoencephalitis.

Naegleria fowleri



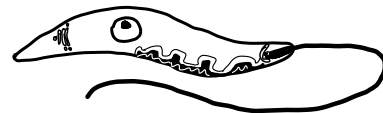
PROTOZOA
Flagellates

Promastigote in sandfly

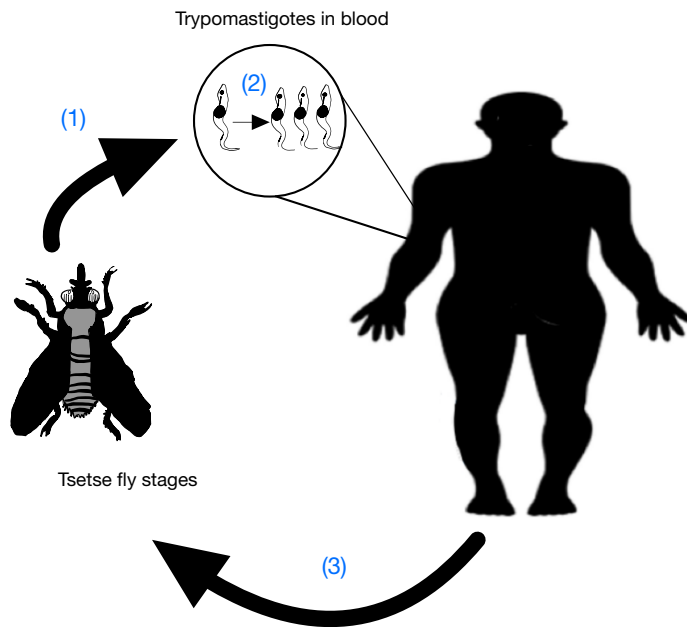


- (1) Promastigote injected into skin via bite, then phagocytosed by macrophages, then transformed into Amastigotes.
- (2a) Mucocutaneous form - amastigotes in skin lymphoid tissue.
- (2b) Visceral form - amastigotes in visceral tissue.
- (2c) Skin form - amastigotes in skin and mucous membranes.
- (3) Sandfly ingests macrophages infected with amastigotes.
- (4) Amastigotes transform into promastigotes.

Leishmania spp.

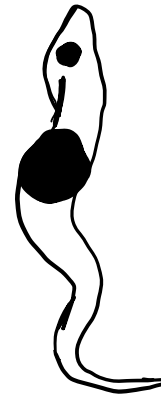


PROTOZOA
Flagellates

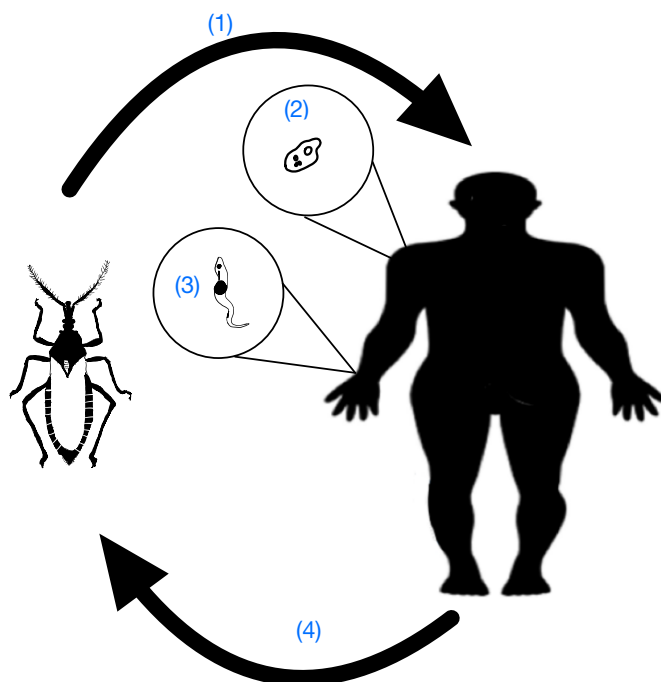


- (1) Tsetse fly injects trypomastigote into blood.
- (2) Trypomastigotes multiply by binary fission in blood, CSF and lymph.
- (3) When another fly feeds from an infected human, it gets infected.

Trypanosoma brucei
 subspp. *gambiense* et
rhodesiense

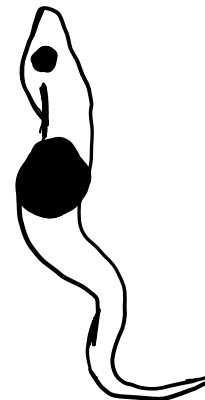


PROTOZOA
 Flagellates

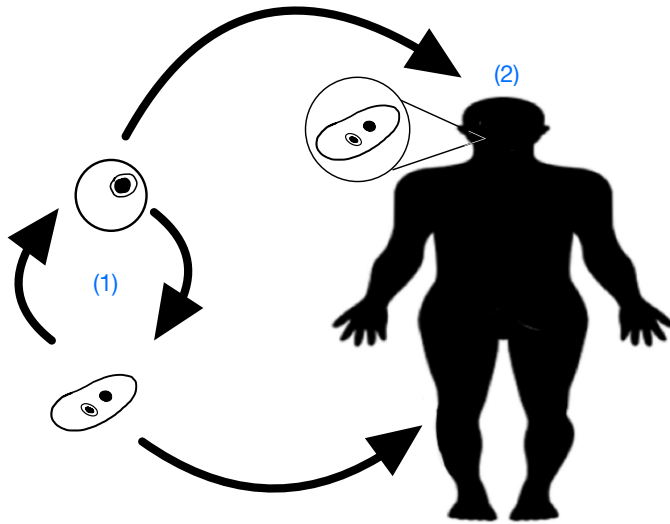


- (1) Reduviid bug transmits the organism by defecating at the site of bite wound.
- (2) From the blood, the organism enters various tissues and forms amastigotes, which divide by binary fission.
- (3) When cells rupture, amastigotes will be released and turn again into trypomastigotes in the blood.
- (4) Reduviid bug takes a blood meal containing trypomastigotes.

Trypanosoma cruzi

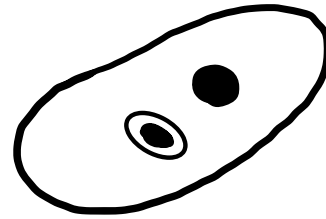


PROTOZOA
 Flagellates

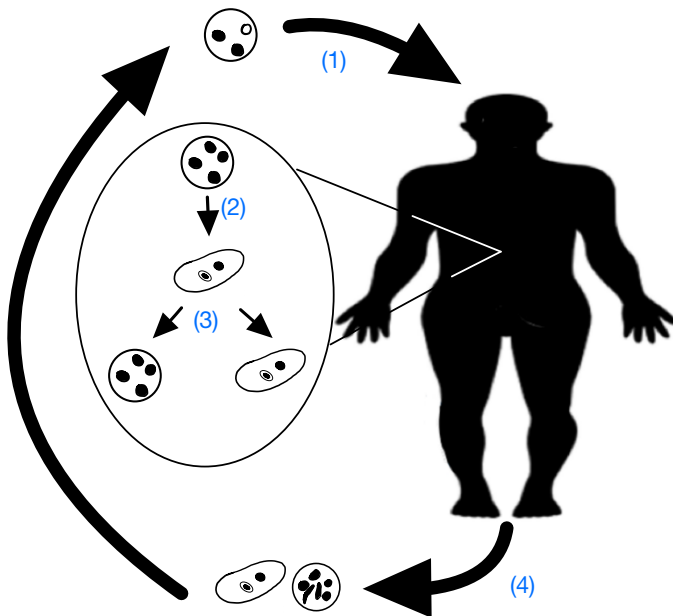


- (1) Both cysts and trophozoites can be commonly found in soil and water.
- (2) Trophozoites and cysts can enter the body through various ways:
 - (2a) Eyes: causing Severe keratitis in healthy humans
 - (2b) Nasal cavity to lower respiratory system: resulting in granulomatous encephalitis or disseminated disease in immunocompromised humans.
 - (2c) Skin breaks: causing granulomatous encephalitis, disseminated disease, or skin manifestations in immunocompromised humans.

Acanthamoeba keratitis

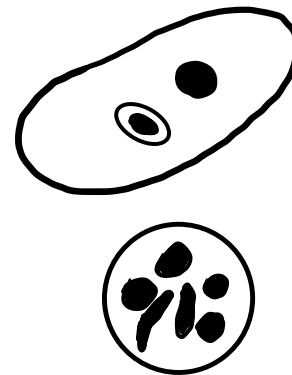


PROTOZOA
Amebae

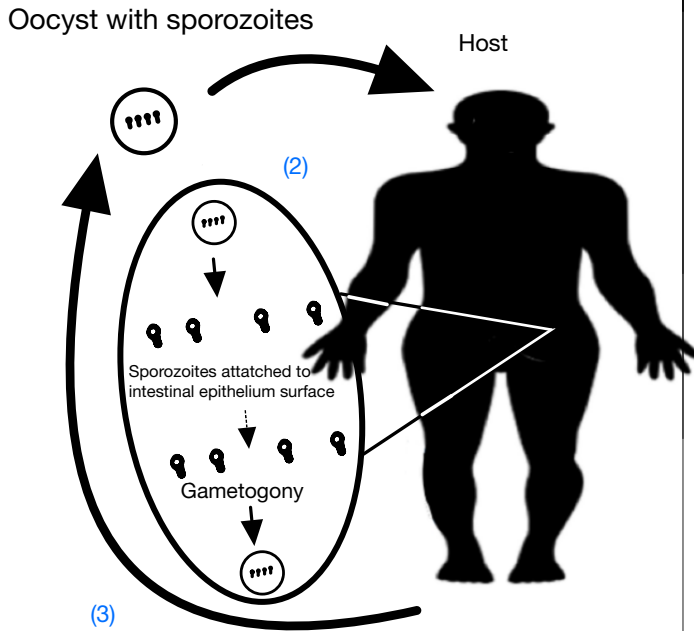


- (1) Host ingests matured cysts in contaminated food or water.
- (2) In the small intestine, excystation occurs, releasing trophozoites which migrate to the large intestine. The trophozoites can remain in the intestinal lumen, invade intestinal mucosa, or enter bloodstream invading extraintestinal sites (e.g. liver, lungs, or brain).
- (3) Trophozoites multiply and produce cysts, and both are released in feces.
- (4) Cysts and trophozoites are released in stools.

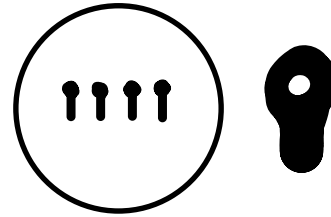
Entamoeba histolytica



PROTOZOA
Amebae

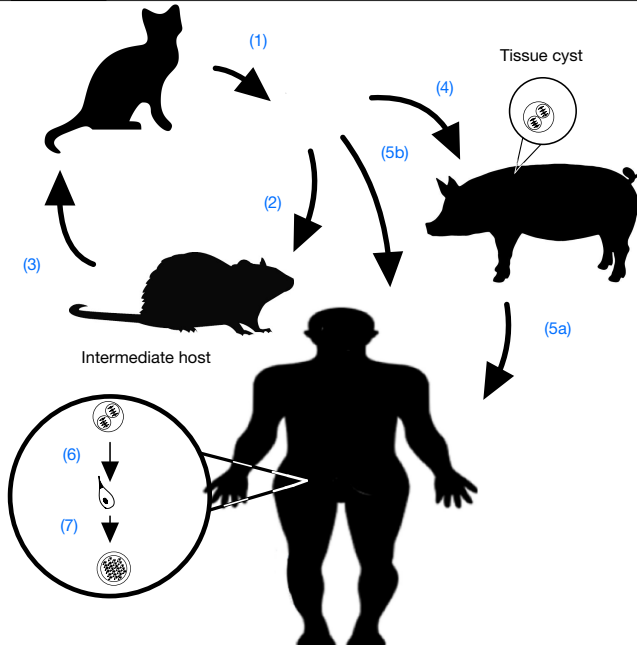


Cryptosporidium parvum

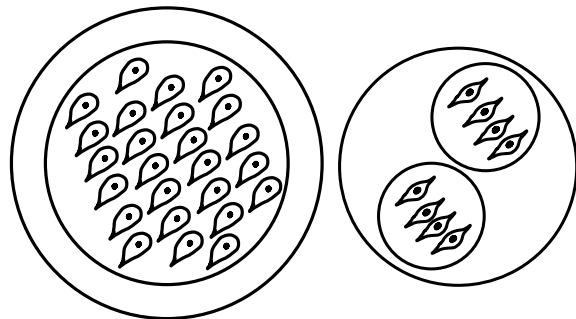


PROTOZOA
Sporozoans

- (1) Oocyst is ingested from contaminated water or food, and undergo excystation. The sporozoites parasitize the epithelial cells in small intestine
- (2) Sporozoites undergo the asexual cycle (into merozoites) or the sexual cycle, eventually producing oocysts
- (3) Oocysts are released by stool to the environment

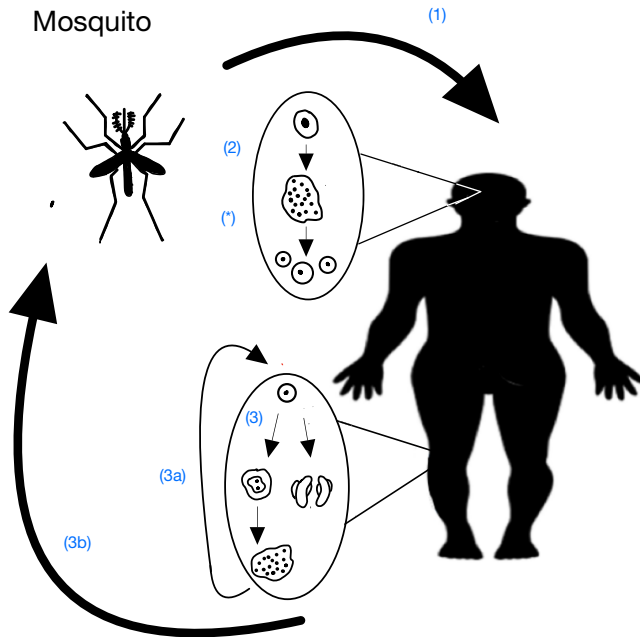


Toxoplasma gondii



PROTOZOA
Sporozoans

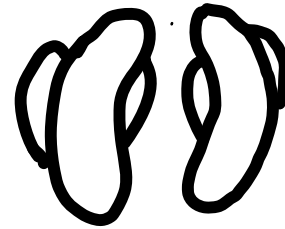
- (1) Oocysts are released in the cat's feces.
- (2) Intermediate host will be infected by ingesting contaminated soil, water, plant.
- (3) Cats become infected after consuming intermediate host.
- (4) Animals bred for human consumption, will become infected by ingesting sporulated oocysts in the environment.
- (5a) Human can be infected by eating undercooked meat of infected animals.
- (5b) Human can be infected by consuming contaminated water and food with cat feces.
- (6) Oocysts transform into tachyzoites shortly after ingestion by intermediate host. (*)
- (7) These tachyzoites localize in neural and muscle tissue and develop into tissue cyst bradyzoites.
- (*) Primary infection during pregnancy can lead to vertical transmission.



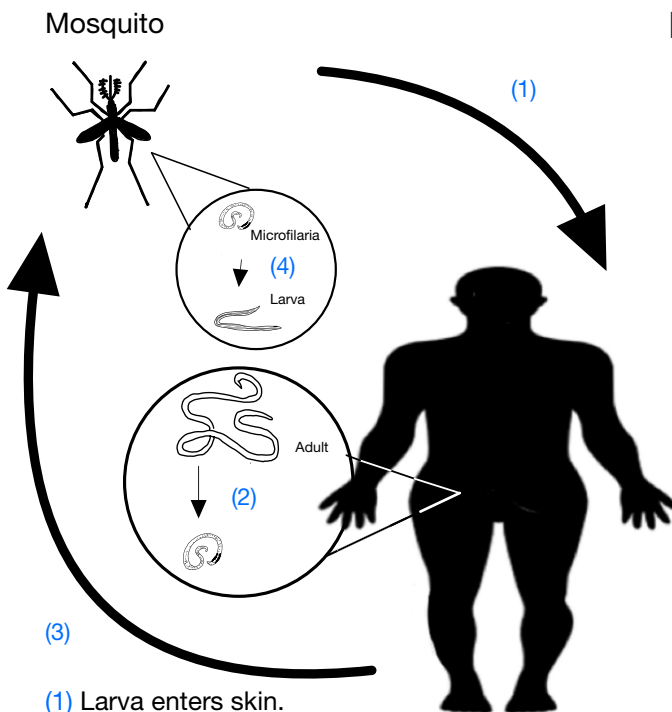
- (1) Sporozoites enter the blood stream with a mosquito bite.
- (2) Sporozoites reach the liver and develop into schizonts. Schizonts rupture and release merozoites into the blood stream.
- (*) *P. vivax* and *ovale* can remain dormant in the liver as hypnozoite.
- (3) Merozoites infect RBCs and can undergo :
 - (3a) Asexual reproduction to develop into trophozoites and then schizonts that can rupture and release merozoites to further infect more RBCs.
 - (3b) Sexual reproduction to form gametocytes, that another mosquito can become infected with to continue the cycle.

***Plasmodium* spp.**

Plasmodium vivax and *Plasmodium ovale*
Plasmodium malariae
Plasmodium falciparum
Plasmodium knowlesi

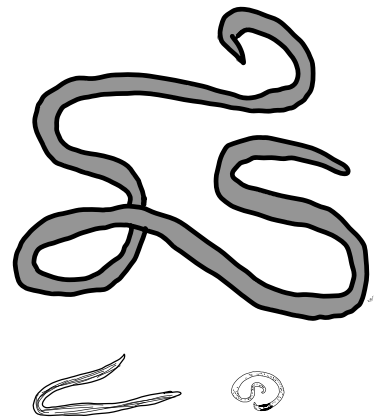


PROTOZOA
Sporozoans

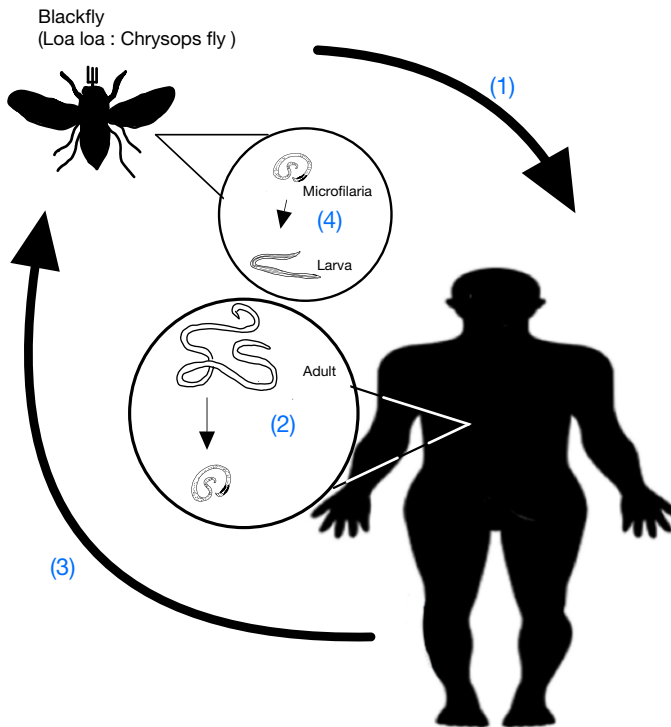


- (1) Larva enters skin.
- (2) Adult in lymphatics produce microfilaria that migrate into lymphatic and peripheral blood circulation.
- (3) Mosquitos ingest microfilariae.
- (4) Microfilaria form larvae in mosquito midgut.

Wuchereria bancrofti,* *Brugia malayi

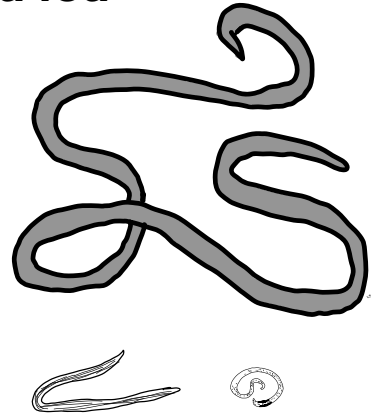


HELMINTHS (WORMS)
Nematodes (Roundworms)

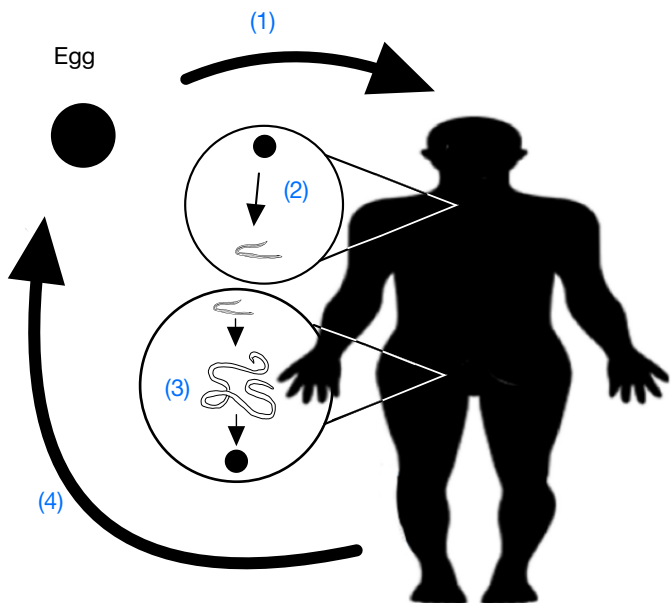


- (1) Larva enters skin, and develops into adult.
- (2) Adult in subcutaneous tissue produce microfilaria that are found typically in skin and lymphatics (Loa loa: in CSF, blood, lungs, urine).
- (3) Fly ingests microfilariae.
- (4) Microfilaria form larvae in fly midgut.

Onchocerca volvulus, *Loa loa*

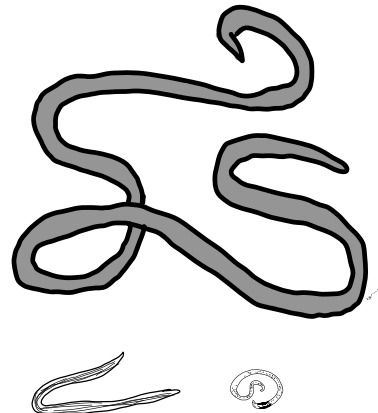


HELMINTHS (WORMS)
Nematodes (Roundworms)

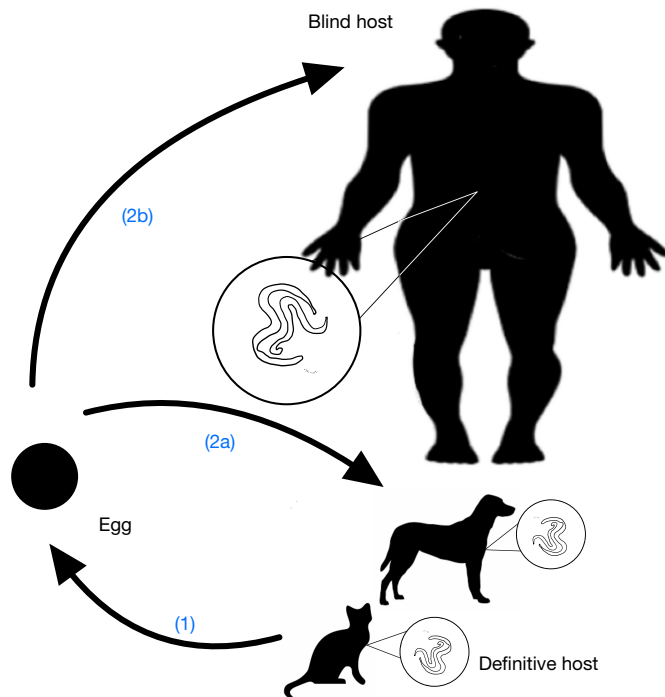


- (1) Egg is ingested from contaminated food or water.
- (2) Larvae hatch and enter the bloodstream, eventually reaching the pulmonary circulation and enter the alveoli. They reach the larynx through tracheal migration and are coughed up then swallowed to return to the small intestine.
- (3) Larvae develop into adult worms in the small intestines and produce eggs.
- (4) Eggs are released in stool to the environment.

Ascaris lumbricoides

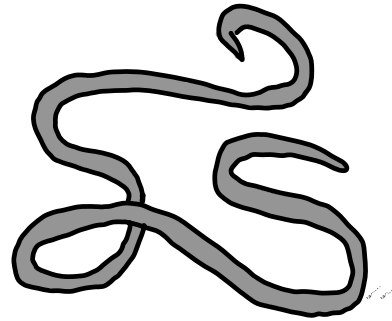


HELMINTHS (WORMS)
Nematodes (Roundworms)

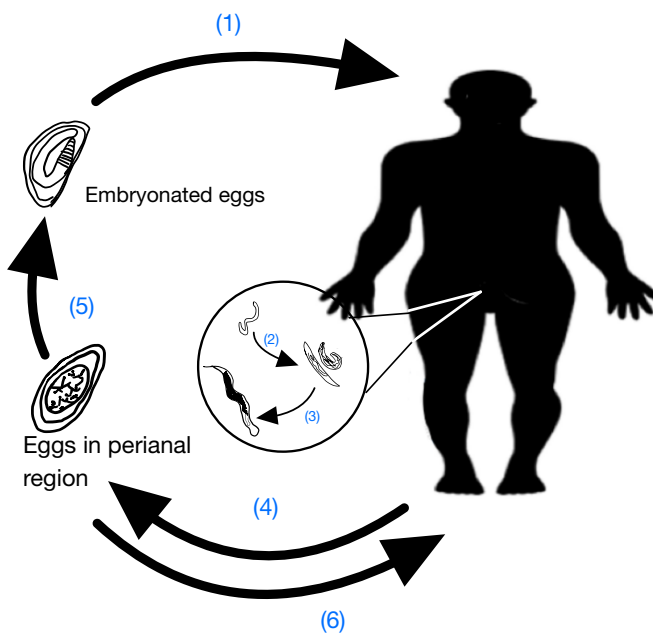


- (1) Eggs are released in feces of cats (*T. cati*) or dogs (*T. canis*).
- (2a) Eggs are ingested by definitive hosts, which develop adult helminths in small intestines.
- (2b) Matured eggs can also be ingested by blind host.
- (3) Larvae migrate in various tissues (liver, heart, lungs, brain, eyes).

Toxocara spp. cati, canis

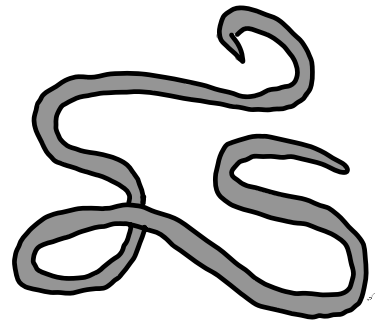


HELMINTHS (WORMS)
Nematodes (roundworms)

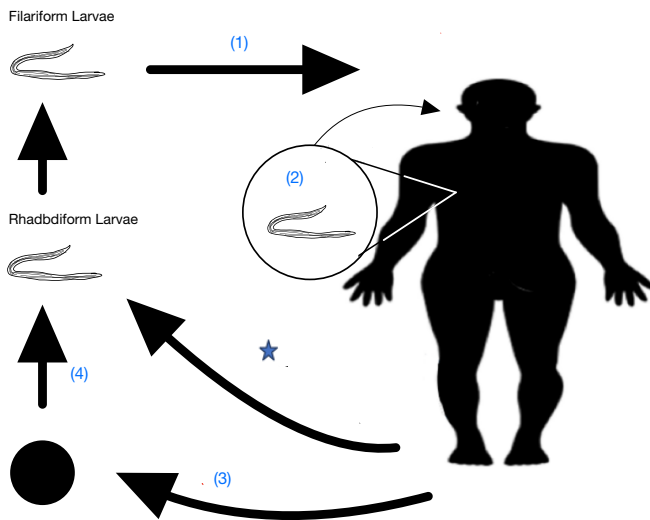


- (1) Matured eggs are ingested.
- (2) Larvae hatch in the small intestine.
- (3) Adults develop from larvae and mature in the caecum.
- (4) Gravid female migrates nocturnally to the perianal region to lay eggs.
- (5) Larvae mature with access to oxygen within eggs in 4-6 hours.
- (6) Autoinfection.

Enterobius vermicularis

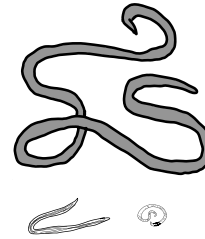


HELMINTHS (worms)
Nematode (roundworm)



- (1) Filariform larvae penetrates skin.
- (2) Larva goes via blood to lungs, and is then coughed up and swallowed.
- (3) Adults in the small intestine lay eggs which are released into feces.
- (4) Eggs release the noninfectious rhabdiform larvae which develops into infectious form (filariform larvae).

Ancylostoma duodenale,
Necator americanus,
Strongyloides stercoralis



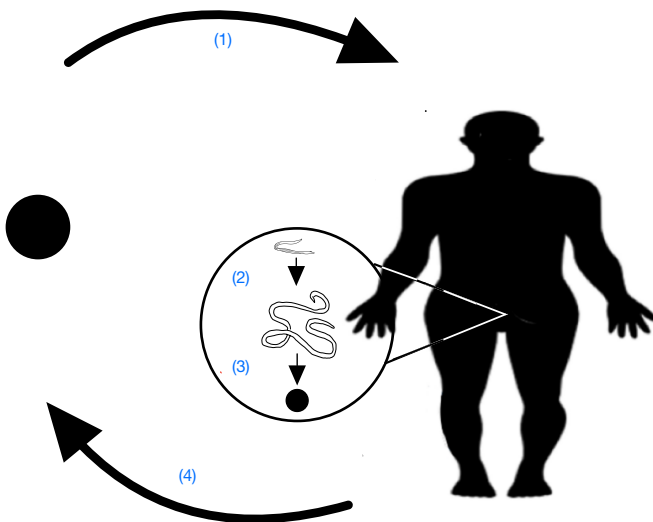
Necator americanus
Ancylostoma duodenale

Have the same life cycle, differing only in geographical distribution, size and shape of mouth parts

Strongyloides stercoralis

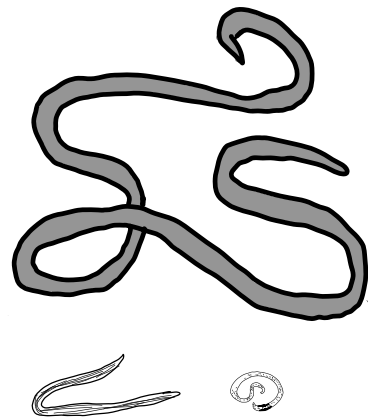
Have one step different in its life: Larvae hatch in the intestine before being released into feces, releasing the Rhabdiform larvae instead of egg

HELMINTHS (WORMS)
 Nematodes (Roundworms)

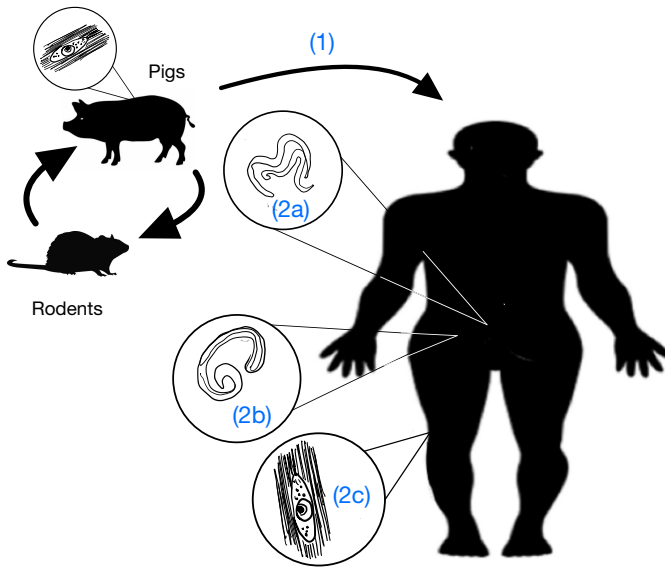


- (1) Host ingest eggs.
- (2) Larvae hatch in the small intestine and mature into adult worm in colon.
- (3) Adult worm lay eggs.
- (4) Eggs are shed in feces and become infectious after 3 weeks in soil.

Trichuris trichura

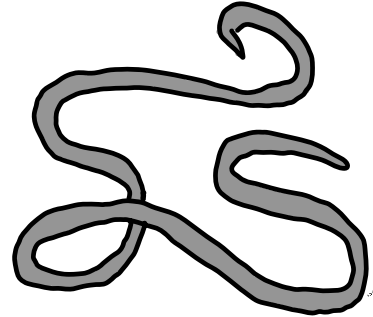


HELMINTHS (WORMS)
 Nematodes (Roundworms)

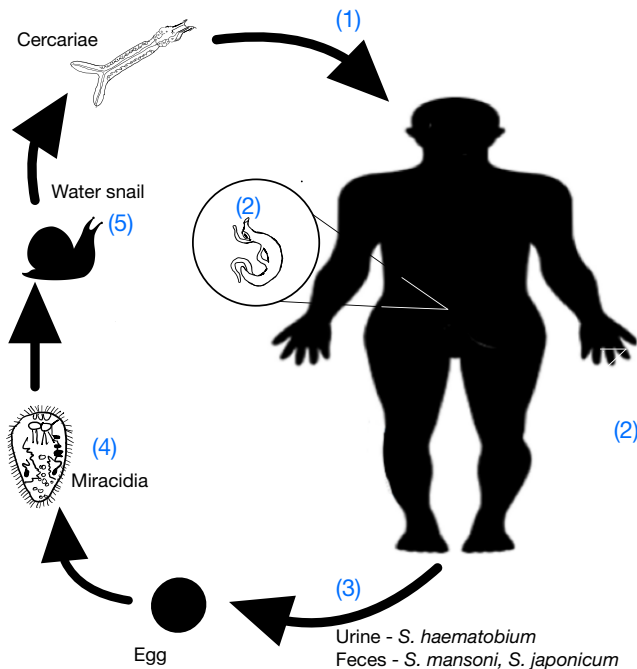


- (1) Host ingests undercooked meat containing larvae.
- (2a) Larvae will be released into the small intestines, which will develop into adults.
- (2b) Larvae will invade into and deposit in small intestine mucosa.
- (2c) Larvae will migrate into striated muscles, where they encyst.

Trichinella spiralis



HELMINTHS (WORMS)
Nematodes (Roundworms)

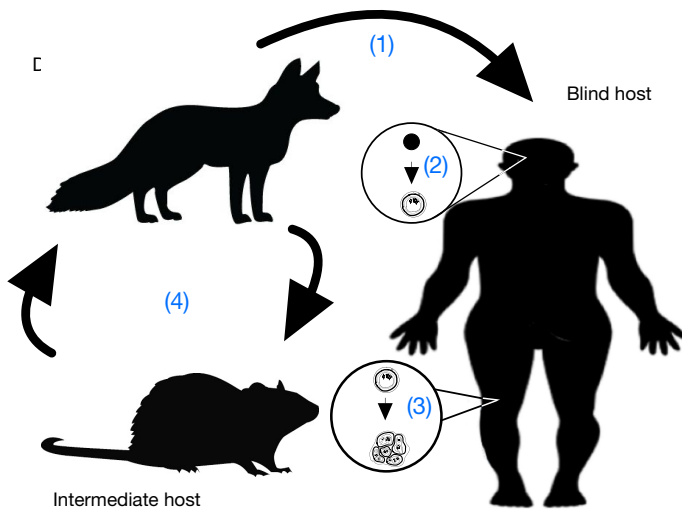


- (1) Cercariae in water penetrate skin, migrate to portal circulation and mature into adults.
- (2a) *S. japonicum* and *S. mansoni* are found in the mesenteric veins and cause intestinal schistosomiasis.
- (2b) *S. haematobium* is found in veins around the bladder and cause Vesicular schistosomiasis.
- (3) Eggs enter the bladder or intestine, where they may be excreted via urine or feces into water.
- (4) Eggs hatch into larvae (miracidia), which are ingested by water snails.
- (5) Miracidia mature in water snails, and it will be released into water as cercariae.

Schistosoma spp. *S. haematobium*, *S. mansoni*, *S. japonicum*

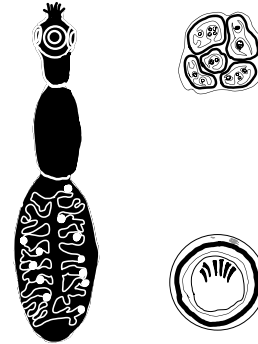


HELMINTHS (WORMS)
Trematodes (Flukes)

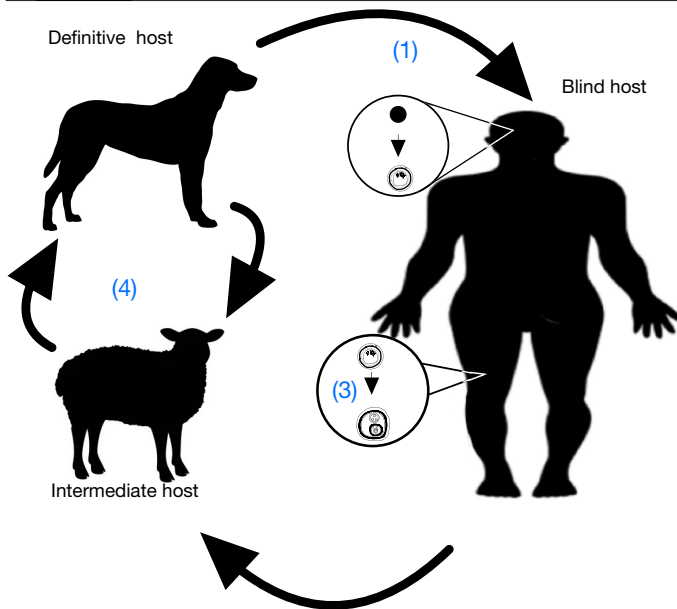


- (1) Egg released by canine stool is ingested by blind host.
- (2) Egg hatches, releasing oncosphere that enters bloodstream and reaches various organs (mainly liver).
- (3) The oncosphere develops into a thin-walled hydatid cyst.
- (4) The definitive host becomes infected by ingesting the cyst-containing organs of the infected intermediate host.

Echinococcus multilocularis

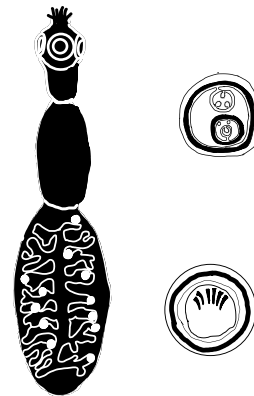


HELMINTHS (WORMS)
Cestodes (Roundworms)

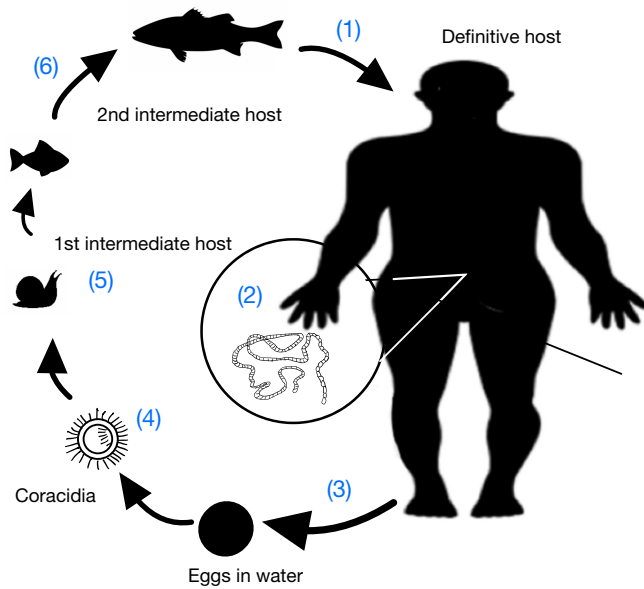


- (1) Egg released by canine stool is ingested by blind host.
- (2) Egg hatches in small intestine, releasing oncosphere that enters bloodstream and reaches various organs (mainly liver and lungs).
- (3) The oncosphere develops into a thick-walled hydatid cyst that enlarges gradually, producing protoscolices and daughter cysts that fill the cyst interior.
- (4) The definitive host becomes infected by ingesting the cyst-containing organs of the infected intermediate host.

Echinococcus granulosus

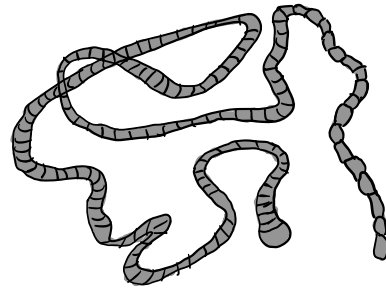


HELMINTHS (WORMS)
Cestodes (Roundworms)

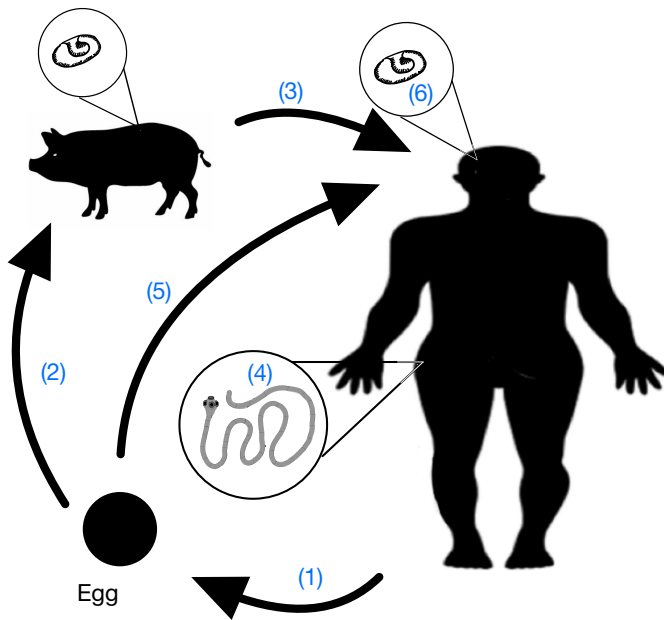


- (1) Human ingests raw or undercooked infected fish.
- (2) Adult tapeworm form in small intestine.
- (3) Immature eggs embryonate are released through feces into water, where they hatch into corracidia.
- (4) Corracidia are ingested by crustaceans.
- (5) Infected crustacean is ingested by small fish.
- (6) Predator fish eat small fish.

Diphylllobothrium latum

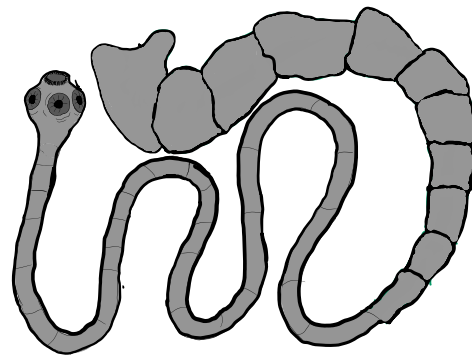


HELMINTHS (WORMS)
Cestodes (tapeworms)

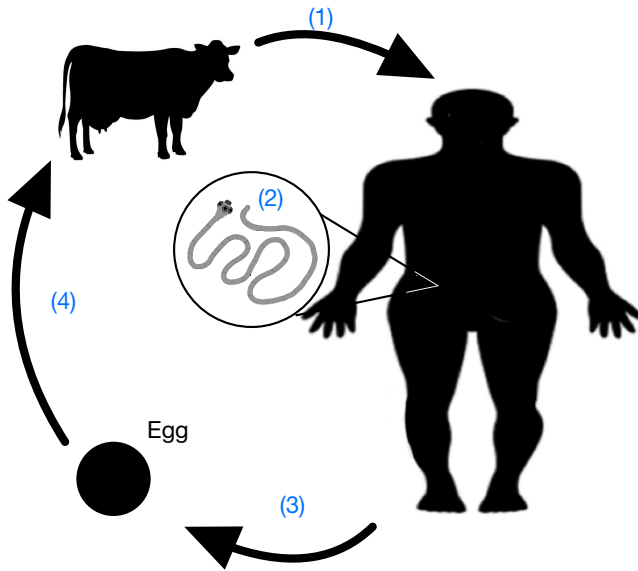


- (1) Humans are infected once they ingest undercooked pork meat.
- (2) Scolex attached and adult tapeworms develop in small intestines.
- (3) Eggs are released in stools into the environment.
- (4) Pigs are infected once they ingest eggs from the environment. Eggs will hatch into oncospheres, which travel to muscles and develop into cysticerci there.
- (5) Eggs can also be ingested directly from the environment, hatch into oncospheres and travel into muscles.
- (6) Cysticerci develop in multiple tissues, especially in muscles, subcutaneous tissues, brain and eyes (Cysticercosis).

Taenia solium

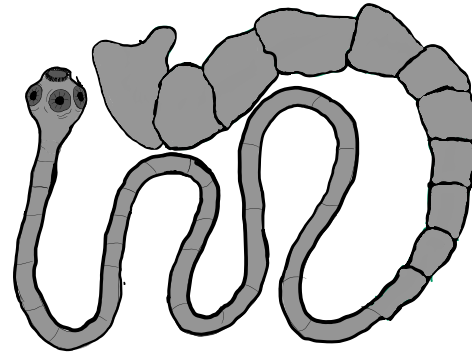


HELMINTHS (WORMS)
Cestodes (tapeworms)

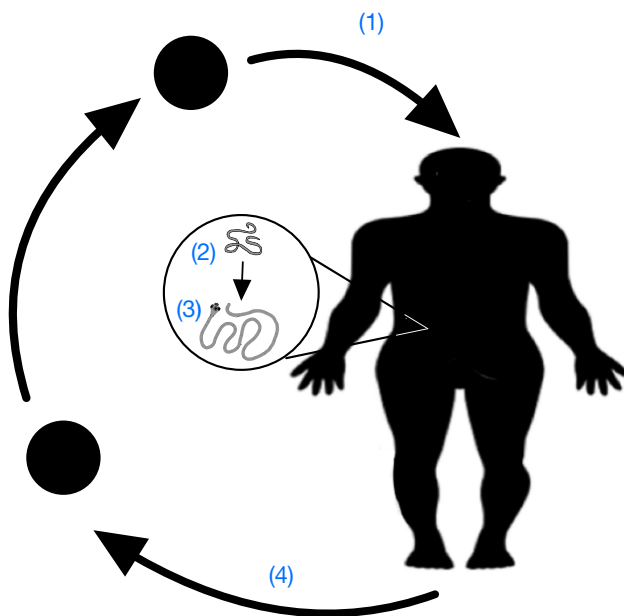


- (1) Humans are infected once they ingest undercooked meat including cysticercus.
- (2) Scolex attaches to intestinal mucosa and adult tapeworm develops in the small intestine.
- (3) Eggs or gravid proglottids are released by stools into the environment.
- (4) Cattle are infected once they ingest eggs from the environment. Eggs will hatch into oncospheres, which travel to muscles and develop into cysticerci there.

Taenia saginata

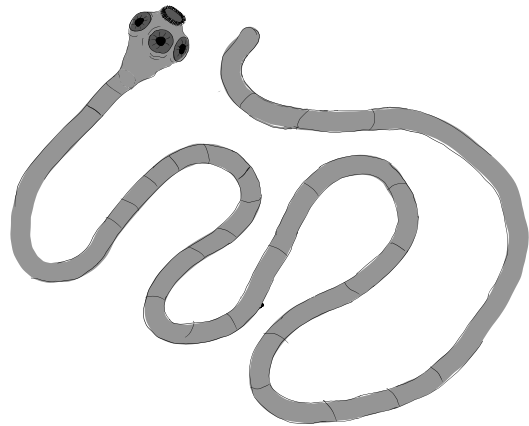


HELMINTHS (WORMS)
Cestodes (tapeworms)

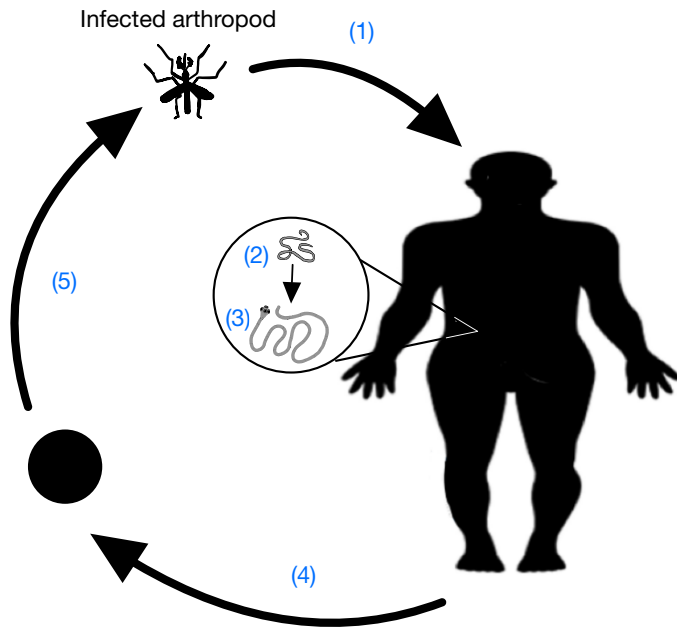


- (1) Eggs are ingested by human host.
- (2) Cysticercoid larvae hatch and attaches to the small intestine with their sucker.
- (3) Adults in the small intestine.
- (4) Adult worms produce eggs which are passed in feces, eggs are immediately infectious and can initiate a new cycle.

Hymenolepis nana

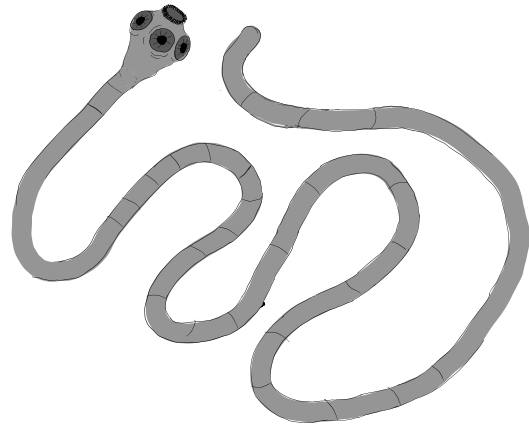


HELMINTHS (WORMS)
Cestodes (tapeworms)



- (1) Cysticeroid infected arthropods are ingested by human (typically found in grains).
- (2) Ingested arthropod is digested and release cysticeroid larvae into small intestine.
- (3) Adults in the small intestine.
- (4) Adult worms produce eggs which are passed in feces.
- (5) Eggs are ingested by intermediate host (insects), in which the cysticeroid larvae develops.

Hymenolepis diminuta



HELMINTHS (WORMS)
Cestodes (tapeworms)

