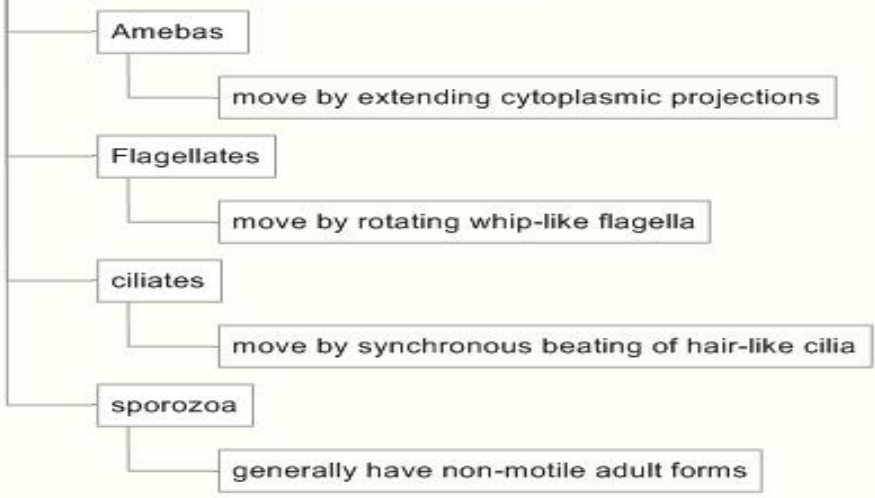


PARASITES I

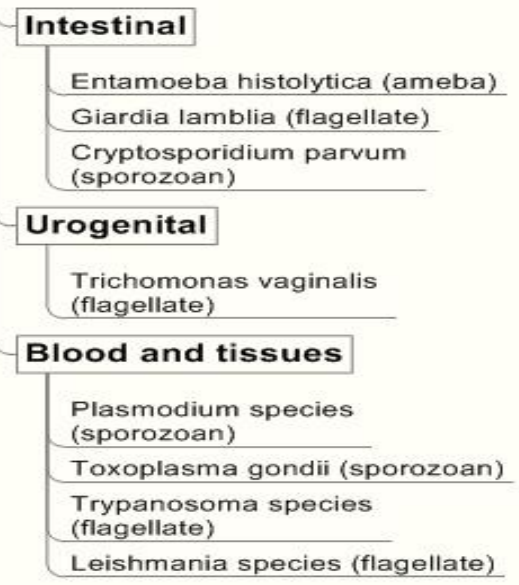
Parasitic Classification, Structure, and Replication

- intestinal and urogenital protozoa,
- blood and tissue protozoa,
- nematodes,
- trematodes,
- cestodes,
- arthropods

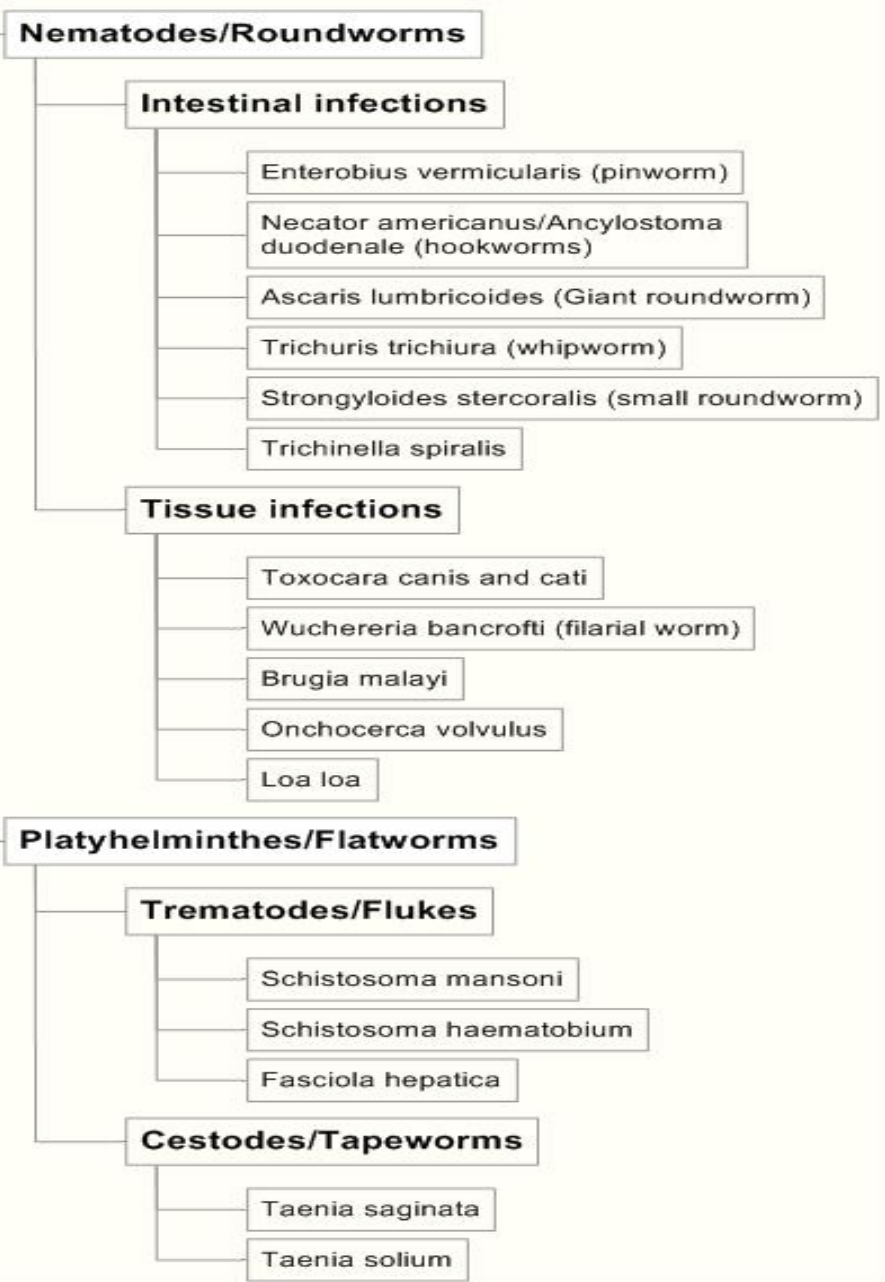
Protozoa (single-celled, eukaryotes)



Pathogenic protozoa



Metazoa (Helminths/worms/multicellular, eukaryotes)



Protozoa – life cycle

- active (trophozoite)
- inactive stage-cyst - resistant stage of the parasite - infective to its human host.
- to reach a new host - transferred mechanically (carrier or by some intermediaries (insect-house-flies
- asexual method - sexual method or encystment
- sexual method - often in a different host (*Plasmodia*)

Protozoa - Flagellates:

- one or more flagella - locomotion
- In some cases - undulating membrane (Trypanosoma)
- intestinal and genitourinary flagellates :
 - Giardia,**
 - Trichomonas,**
 - Dientamoeba,
 - Chilomastix,
- blood and tissue flagellates :
 - Trypanosoma,**
 - Leishmania,**
- They reproduce asexually by binary fission.

Giardia

- intestinal flagellates
- *Giardia intestinalis*

cysts - can survive several months in cold water.

- ingestion of cysts - contaminated water, food, or by the fecal-oral route (hands or fomites)
- small intestine - excystation releases trophozoites
- Trophozoites –multiply - in the lumen of the proximal small bowel (free or attached to the mucosa by a ventral sucking disk .
- Encystation occurs as the parasites transit toward the colon.
- cyst - found in nondiarrheal feces
- cysts - infectious
- person-to-person transmission is possible

Trichomonas

- genitourinary flagellates
- Incubation Period : 5 to 28 days
- No known cystic form
- May survive in a host for 2+ years

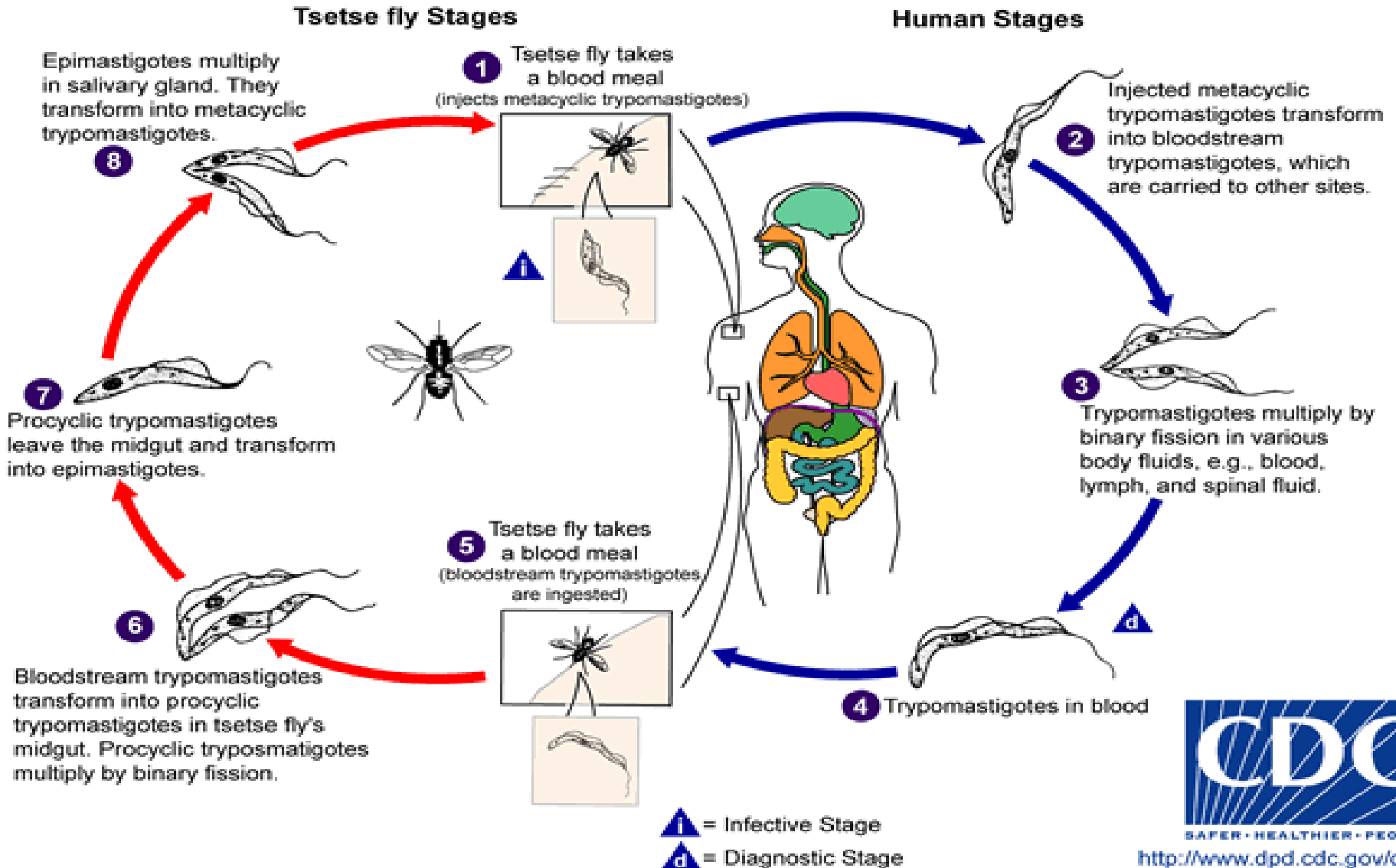
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Morphology

- *T. vaginalis* : pear-shaped protozoan
- Four flagella – movement, fifth - help with direction
- High motility - pathogenicity
- Reproduces through binary fission

Mastigophora- Trypanosoma

- blood and tissue flagellates



Trypanosoma

T. gambiense

- massive stimulation of immune system and complement-mediated lysis of host cells (gives characteristic anemia)
- Generalized pain, weakness, cramps and swelling of neck lymph nodes (Winterbottom sign)
- invade all organs
- latter leads to apathy, mental dullness, tremors, convulsions and sleepiness, coma
- rapid weight loss
- Malnutrition
- heart failure,
- pneumonia

T. brucei rhodesiense

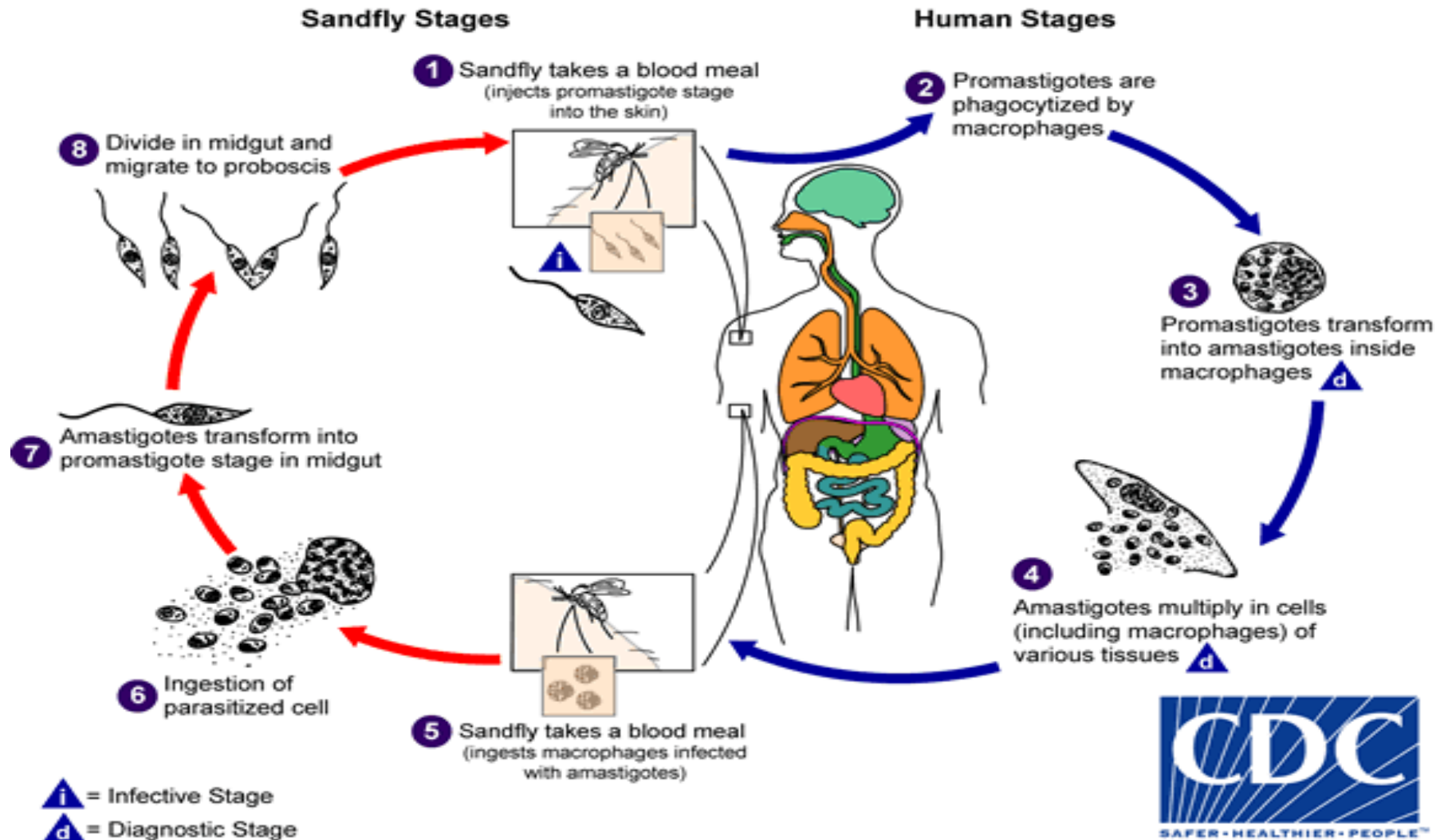
- no coma or nervous system symptoms (patient dies before these can develop)

***T. cruzi* - *Rhodnius prolixus*"kissing bugs"**

- Chagas Disease
- chronic symptoms : various digestive problems, weakening the heart muscle, cell lysis

Mastigophora- Leishmania

- blood and tissue flagellates



Leishmania

- Human infection is caused by about 21 of 30 species that infect mammals:

- ***L. donovani* complex :**

- (*L. donovani*, *L. infantum*, and *L. chagasi*);

- ***L. mexicana* complex**

- (*L. mexicana*, *L. amazonensis*, and *L. venezuelensis*);

- morphologically indistinguishable

- 2 forms

- **cutaneous leishmaniasis**

- one or more sores on their skin (volcano)

- painless or painful

- **visceral leishmaniasis (kala-azar)**

- fever, weight loss, and an enlarged spleen and liver

- (spleen is bigger than the liver).

- anemia, low white blood cell count, and low platelet count

- important opportunistic infection - HIV.

Amoeba

- typically amoeboid

Entamoeba,

Endolimax,

Iodamoeba,

Naegleria,

Acanthamoeba, etc.

shapeless mass of moving cytoplasm - divided in to granular
endoplasm and clear ectoplasm.

- They move by pushing out the ectoplasm to form pseudopodia (false feet) into which the endoplasm then flow.
- Amoebae reproduce asexually by simply dividing into two (binary fission)

Entamoeba

- *Entamoeba histolytica* -intestinal and extraintestinal infections
- Cysts and trophozoites are passed in feces

Sarcodina- Naegleria

- lakes, swimming pools, tap water, and heating and air conditioning units
- acute, usually lethal, central nervous system (CNS) disease - primary amebic meningoencephalitis (PAM).

Sporozoa

- super-class
- complex life cycle with alternating
- sexual and
- asexual reproductive phases (two different hosts)
- Coccidia -intracellular parasites,
asexually = schizogony (merogony)
sexually = sporogony.
- Class Coccidia
 - Isospora and Toxoplasma
- class Haematozoa
 - malarial parasites- Plasmodium species.

Sporozoa- Toxoplasma

- eating undercooked meat of animals harboring tissue cysts
- consuming food or water contaminated with cat feces or by contaminated environmental samples (such as fecal-contaminated soil or changing the litter box of a pet cat)
- blood transfusion or organ transplantation
- transplacentally from mother to fetus

Pathogenesis

- Swallowing of the cyst (bradysoit) or oocyst (sporosoit)
- Releasing of microorganism
- Invasion to the small intestine epithelium
- Dissemination and multiplication intracelularly
- Death of infected cells, releasing od tachysoits that invade other cells
- Reaction of immunity system, change of tachy to bradysoits, formation of tissue cysts (in muscles, heart, brain)
- Reactivation during IDS – rupture of cysts, releasing of parasits

Infection in men

- 1) food borne with inappropriately boiled food containing tissue cysts
- 2) transplantacently
- 3) accidentally by inoculation of tachysoits
- 4) swallowing of oocysts (sandy playgrounds, contaminated hands)
- 5) contaminated trasfusion or transplantation

Toxoplasmosis

- Usually asymptomatic
- 10% - 20% ***cervical lymphadenopathy*** + flue like symptoms
- Clinically selflimiting – reactivation in IDS, in gravidity

Toxoplasmosis in IDS

- Primary infection or reactivation of anamnestic infection
- CNS , myocarditis, pneumonia
- AIDS patients – encephalitis, intracerebral lesions

Congenital toxoplasmosis

- In acute primoinfection of mother during pregnancy
- Symptoms depends on the length of gravidity during primary infection
- Therapy can decrease the symptomatology
- Acute diagnosis is important

- New borne can have
 - subclinical symptoms – without therapy usually getting worse
 - sy i.u. toxoplasmosis – hydrocephalus, calcifications in brain and liver, cataracta, microcephalus

Eye toxoplasmosis

- Often asymptomatic until the 2nd-3rd decenium
- Symptoms – rupture of the cyst in eye, tachysoits and bradysoits are released
- Chorioretinitis
 - unilateral – after gained infection
 - bilateral – after i.u. infection

Toxoplasma gondii - i.c. parasite

- Infects different warm-blood animals
- Cat is host for sexual stages of *Toxoplasma gondii* (schizonts) – main source
- 3 stages
 - tachysoit (trophozoit) – quick multiplication and destruction of the invaded tissue – bradysoit – slowly multiplying in tissue cysts – sporozoit (male and female gamonts) in oocysts – in cat excrements

Sporozoa- Toxoplasma - Dg

- **Observation of parasites** - bronchoalveolar lavage material from immunocompromised patients, **lymph node biopsy**.
- **Isolation** - from **blood** or other body fluids, by intraperitoneal inoculation into mice or tissue culture. The mice should be tested for the presence of *Toxoplasma* organisms in the peritoneal fluid 6 to 10 days post inoculation; if no organisms are found, serology can be performed on the animals 4 to 6 weeks post inoculation.
- **Detection** - **PCR**, - detecting congenital infections in utero.
- **Serologic testing is the routine method of diagnosis.**

Serology of *Toxoplasma gondii* in pregnancy

- I. trimester
 - **test for IgM antibodies** – detection of i.u. infection – positivity – indicate recent infection
 - current IgA positivity – acute infection – therapy of mother and screening of the baby
- IgG antibodies positive (seldom with IgM positivity) – not indicating acute infection, can result in reactivation of possible tissue cyst, than has no relation to pregnancy and cannot be eliminated by therapy
- Increase of IgG antibodies – reactivation of past infection without threat of fetus health

Antenatal diagnosis of inborne toxoplasmosis

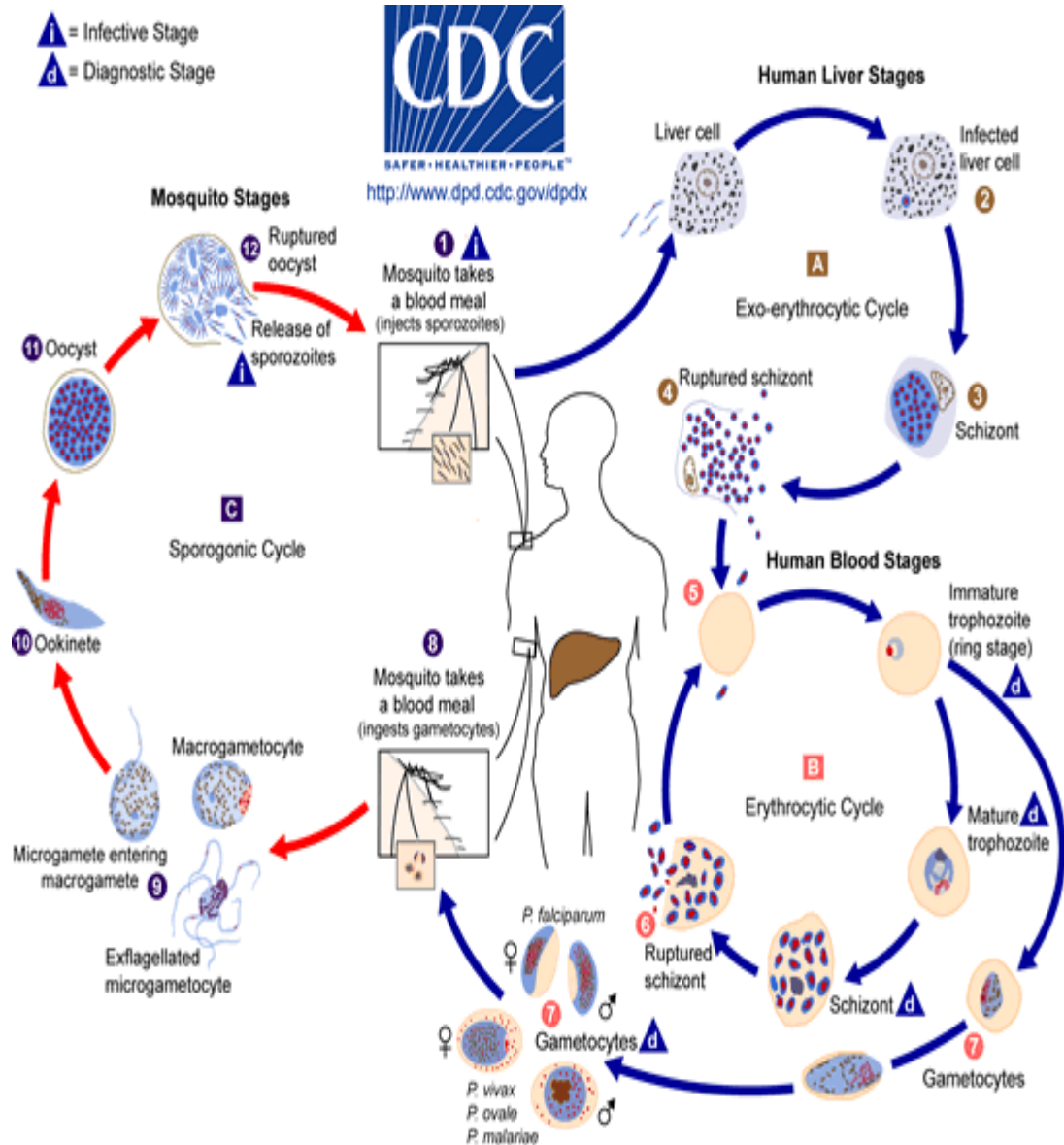
- Acute infection in pregnant mother
- Therapy
- Ultra sonography
- Amnionic fluid + fetal blood: PCR innoculation do mouse and tissue cultures
- Fetal blood: Toxo IgM and IgA,

Sequelae of toxoplasma infection in women

- primary infection – possibility of fetal death
– lethal infection of the fetus
- intrauterine infection - ill newborn
- Previous infection with cysts in tissue of genital tract – problems with conception and successful pregnancy (habitual abortions)

Sporozoa- Plasmodium

- *P. falciparum*,
- *P. vivax*,
- *P. ovale*
- *P. malariae*



Plasmodium-malariae, falciparum

- Definitive host: Anopheles Transient host: human, monkey
- disease: malaria acc.to the rate of schizogonia- clinically as fever attacks - tercianna, quartana,
- **ovale malaria** a mild form due to *Plasmodium ovale*, with recurring tertian febrile paroxysms and a tendency to end in spontaneous recovery.
- **quartan malaria** that in which the febrile paroxysms occur every 72 hours, or every fourth day counting the day of occurrence as the first day of each cycle; due to *Plasmodium malariae*.
- **quotidian malaria** vivax malaria in which the febrile paroxysms occur daily
- **tertian malaria** vivax malaria in which the febrile paroxysms occur every 42 to 47 hours, or every third day counting the day of occurrence as the first day of the cycle.
- **vivax malaria** that due to *Plasmodium vivax*, in which the febrile paroxysms commonly occur every other day (*tertian m.*), but may occur daily (*quotidian m.*), if there are two broods of parasites segmenting on alternate days.

Malaria symptoms

- non-specific
- untreated malaria -may be rapidly (<24 hours) fatal,
- history of exposure (mostly: past travel or residence in disease-endemic areas).
- fever and chills, headache, myalgias, arthralgias, weakness, vomiting, and diarrhea.
- splenomegaly, anemia, thrombocytopenia, hypoglycemia, pulmonary or renal dysfunction, and neurologic changes.
- *P. falciparum* -to severe, potentially fatal forms with central nervous system involvement (cerebral malaria), acute renal failure, severe anemia, or adult respiratory distress syndrome.
- *P. vivax* -splenomegaly (with, rarely, splenic rupture),
- *P. malariae* - nephrotic syndrome.

Classification of Parasitic Helminths

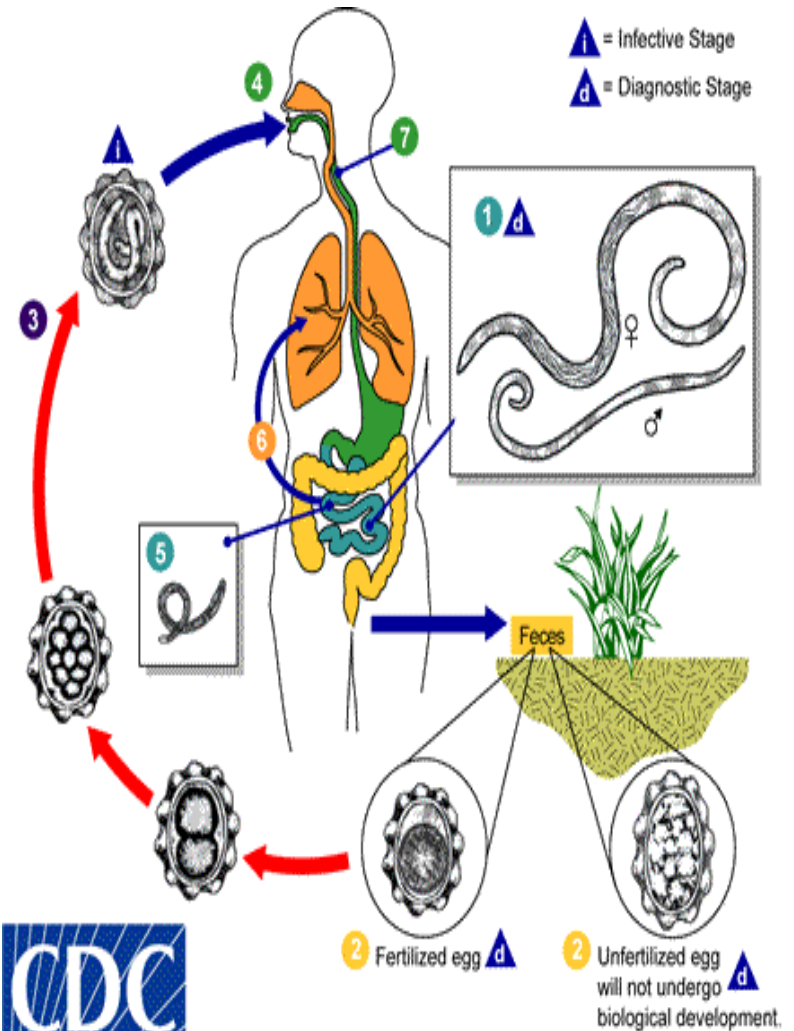
- Helminths
- *A) Nematelminthes*
- Nematoda(Round Worms)
-
- *B) Platyhelminthes*
- 1)Cestoda(Tapeworms)
- 2)Trematoda(Flukes)

Nematodes

- Their body is elongated, cylindrical and unsegmented. Sexes are separate (diecious). They also lack hooks and suckers.
- They possess the complete alimentary canal and body cavity. Examples are:
- **1. Intestinal**
- i. **Small intestine only:** *Ascaris lumbricoides* (Common round worm), *Ancylostoma duodenale* (The old world hook worm), *Necator americanus* (American hookworm)
- ii. **Caecum and vermiform appendix:** *Enterobius vermicularis* (Threadworm or pin worm), *Trichuris trichuria* (Whipworm).
-
- **2. Somatic (inside the tissues and organs)**
- i. **Lymphatic system:** *Wuchereria bancrofti*, *Brugia malayi*
- ii. **Subcutaneous tissue:** *Onchocerca volvulus*, *Dracunculus medinensis*
- iii. **Lungs:** *Strongyloides stercoralis*
- iv. **Conjunctiva:** *Loa loa*

Nematodes- *Ascaris lumbricoides*

- Adult females: 20 to 35 cm;
- adult male: 15 to 30 cm



Ascaris lumbricoides

- **Laboratory Diagnosis:**

Microscopic identification of eggs in the stool is the most common method for diagnosing intestinal ascariasis. The recommended procedure is as follows:

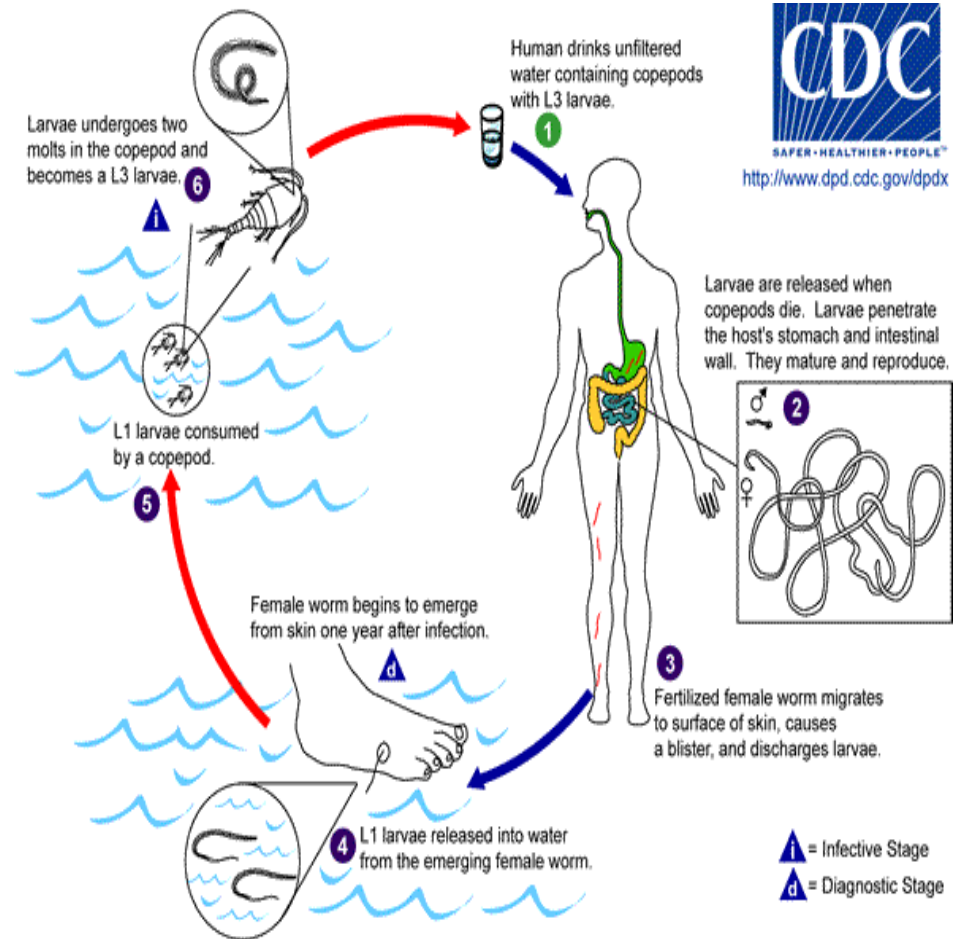
- Collect a stool specimen.
- Fix the specimen in 10% formalin.
- Concentrate using the formalin–ethyl acetate sedimentation technique.
- Examine a wet mount of the sediment.
- **Diagnostic findings**
- Microscopy
- Macroscopy
- Morphologic comparison with other intestinal parasites

Nematodes- *Enterobius vermicularis*

- Enterobiasis
- asymptomatic.
- perianal pruritus, especially at night, which may lead to excoriations and bacterial superinfection.
- Occasionally, invasion of the female genital tract with vulvovaginitis and pelvic or peritoneal granulomas can occur.
- Other symptoms include anorexia, irritability, and abdominal pain.
- ("**Scotch test**", **cellulose-tape slide test**)

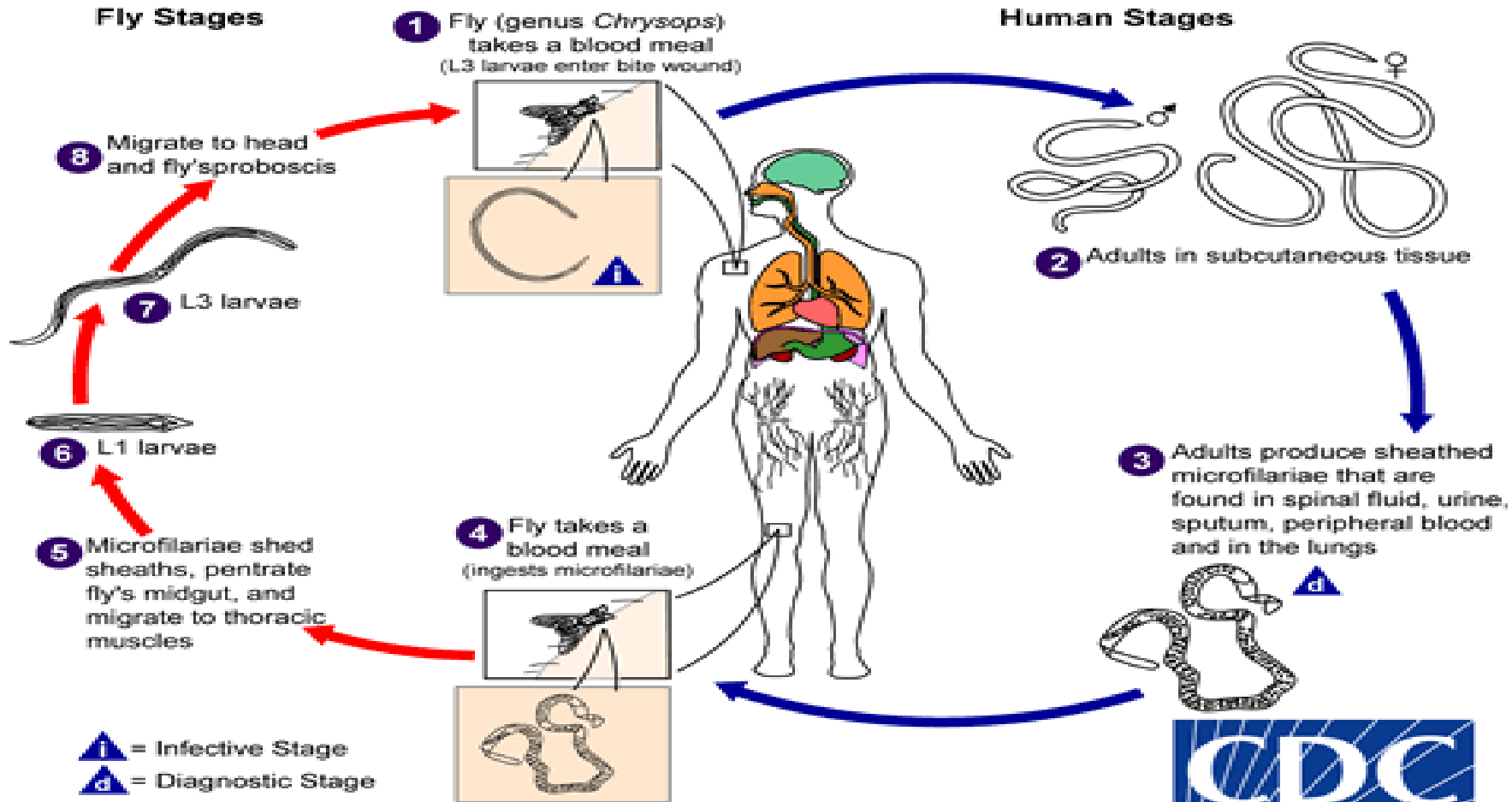
Nematodes- *Dracunculus medinensis*

- guinea worm disease
- female guinea worm induces a painful blister
- after rupture of the blister, the worm emerges as a whitish filament
- in the center of a painful ulcer which is often secondarily infected.



Nematodes- *Loa loa*

Loa loa

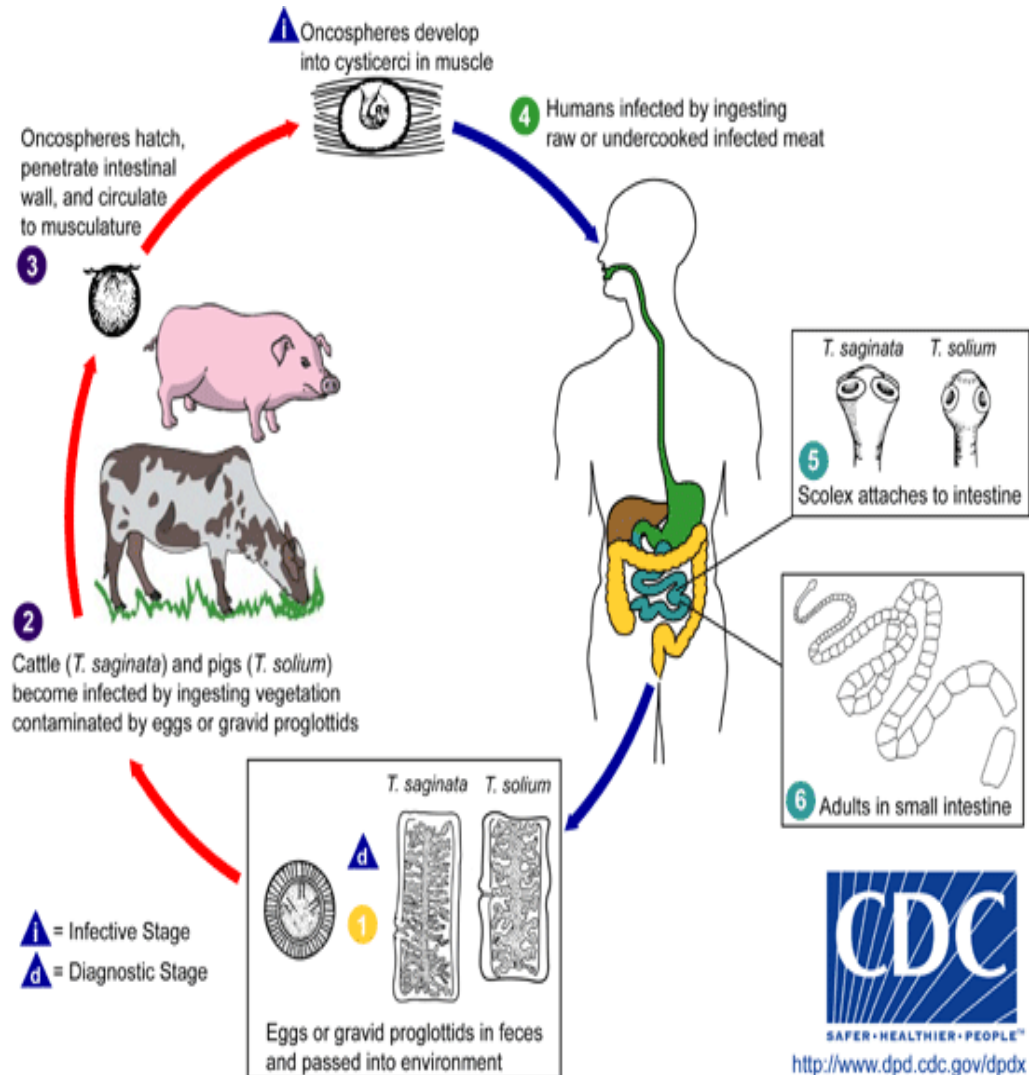


Cestodes

- tape-like,
- segmented
- hermaphrodite organism
- suckers in their head and in some species also hooks that attach the tapeworm to its host
- consists of a head (scolex) and many proglottids.
- Alimentary canal and body cavity are absent.
- *Diphyllobothrium, Taenia, Echinococcus, Hymenolepsis, etc*

Cestodes – Taenia

- *Taenia saginata* (beef tapeworm),
- *T. solium* (pork tapeworm)
- *T. asiatica* (Asian tapeworm)



Trematodes

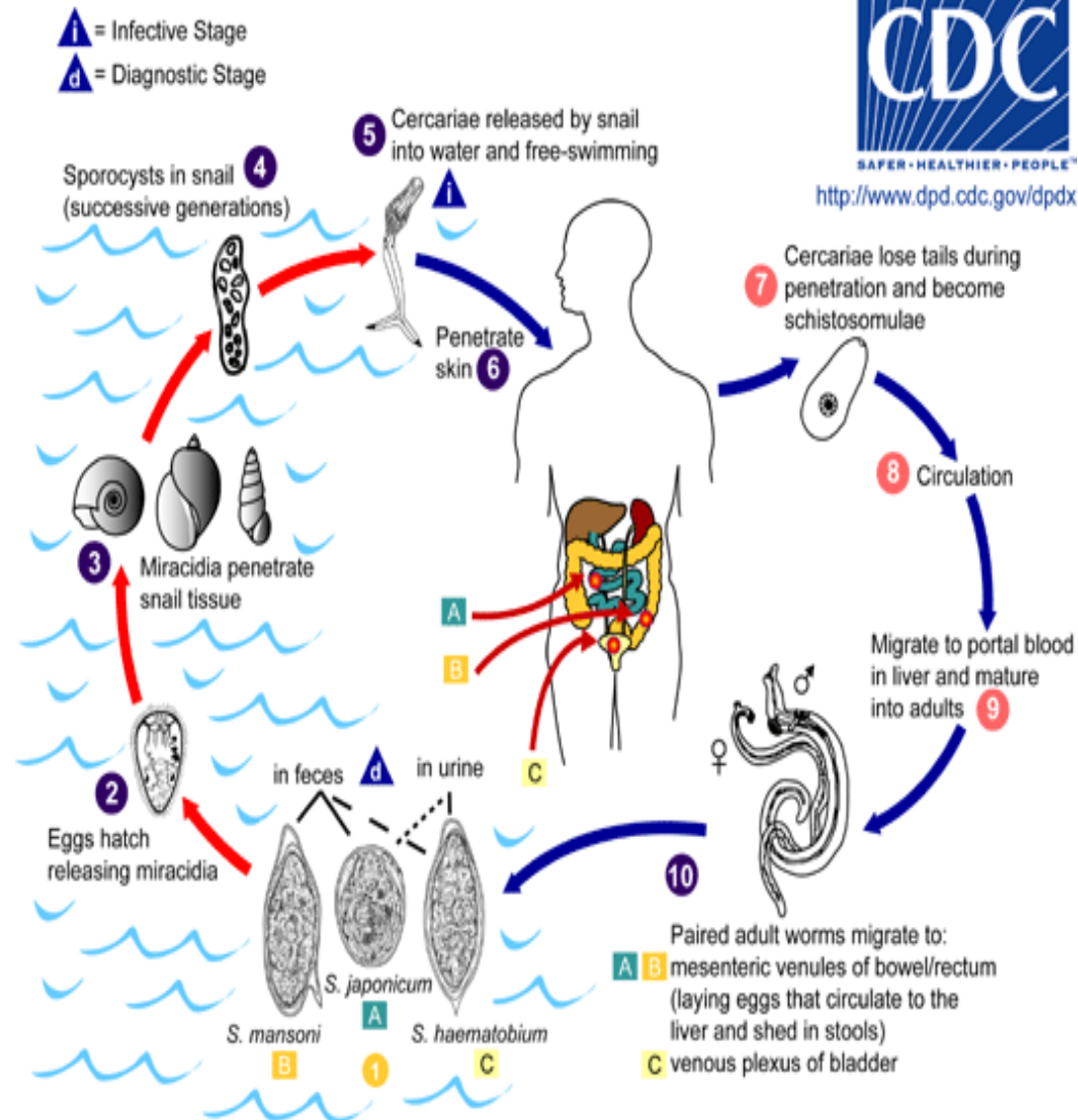
- leaf-like
- unsegmented
- Sexes are not separate (except Schistosomes-dieocious).
- don't have hooks and suckers
- Alimentary canal -present but is not complete (anus absent).
- The body cavity is absent.
- ***Schistosoma***, *Gastrodiscoides*, *Fasciolopsis*, *Fasciola*, *Clonorchis*, *Heterophyes*, etc.

Trematodes- *Schistosoma*



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



Stool specimens

Concentration procedure separate parasites from fecal debris and increase the chances of detecting parasitic organisms when these are in small numbers.

- **Flotation techniques** - solutions have higher specific gravity than the organisms -the organisms rise to the top and the debris sinks to the bottom.
- **Sedimentation techniques** - solutions of lower specific gravity than the parasitic organisms, thus concentrating in the sediment.

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