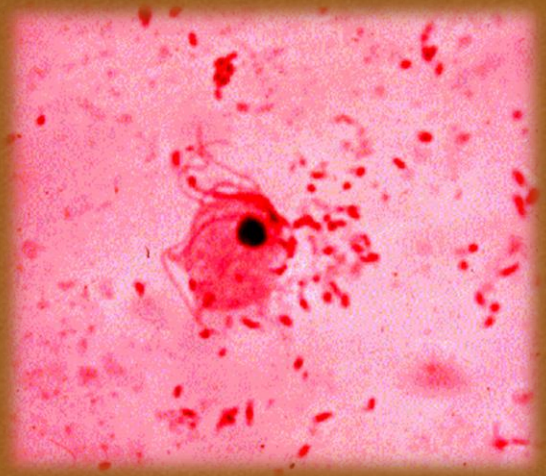

Human Parasitology

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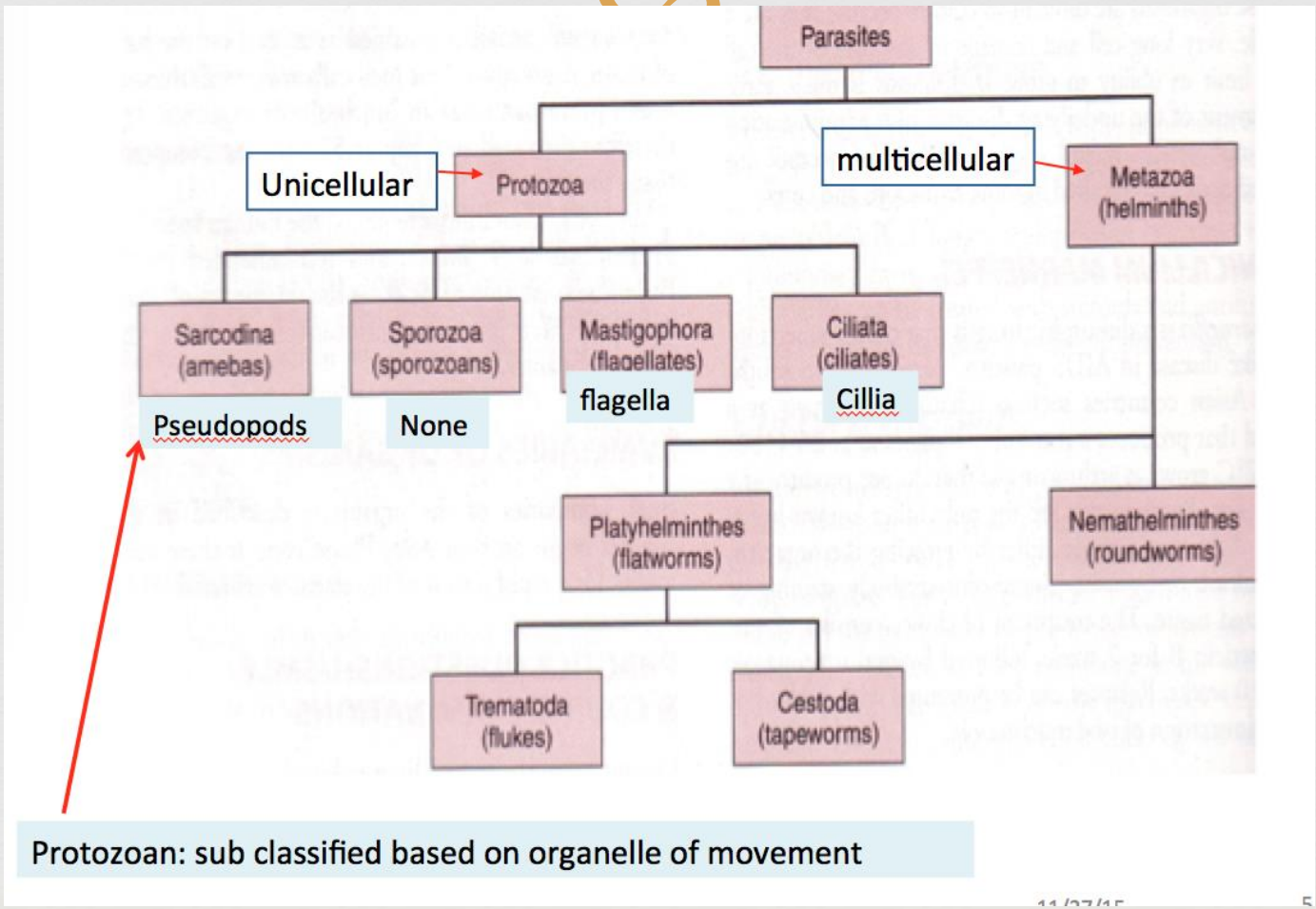
2017-2018

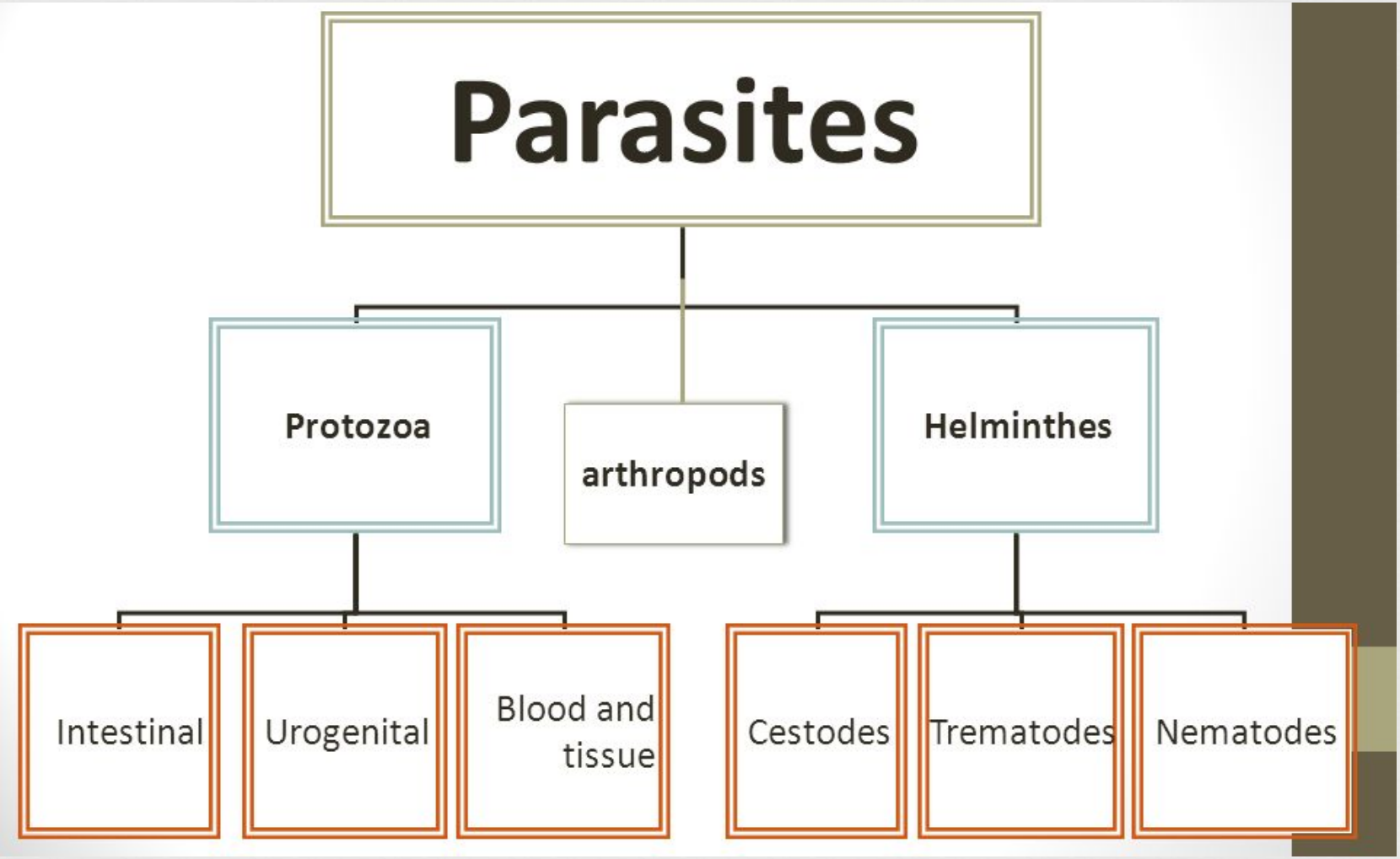
Parasites

- Parasitology: The science studying parasites .
- Parasite: Organisms or Microorganisms live in or on the human body and harm it.
- Endo and Ecto Parasite
- Eukaryotes
- Mode of transmission of parasite
- Host: Final (Definitive Host) and intermediate Host

Classification of Parasites



Classification of Parasites



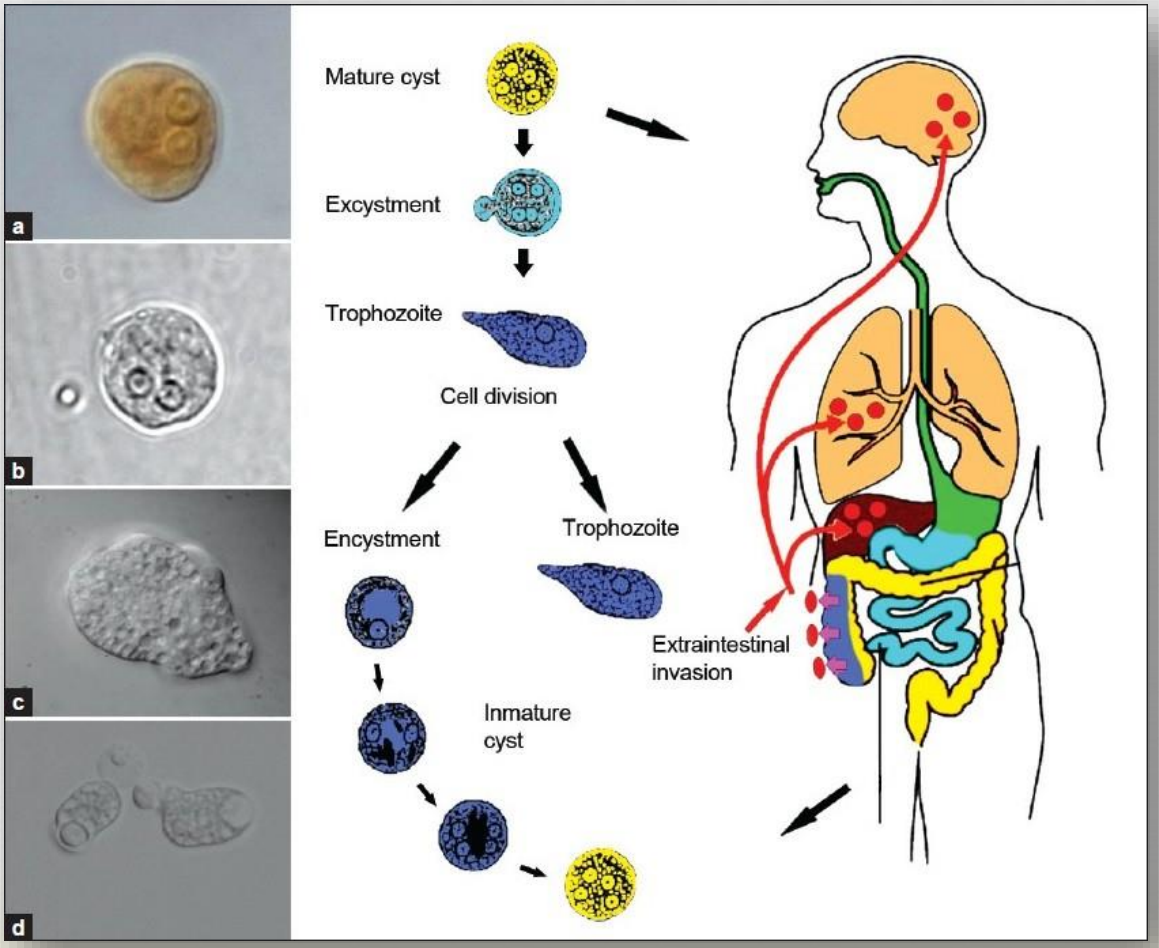
Taxonomic classification of protozoa

Sub kingdom	Phylum	Sub-phylum	Genus-examples	Species-examples
Protozoa	Sarcomastigphora further divided into	Sarcodina move by pseudopodia	Entamoeba	*E. histolytica*
		Mastigophora move by flagella	Giardia	*G. lamblia*
	Apicomplexa no organelle of locomotion		Plasmodium	*P. falciparum,* *P. vivax,* *P. malariae,* *P. ovale*
	Ciliophora move by cillia		Balantidium	*B. coli*
	Microspora Spore-forming		Enterocytozoa	*E. bienusi*

Entamoeba histolytica

- **Anaerobic intestinal parasitic , lives in intestine as trophozoite , produce resistant cysts, which are passed in feces .**
- ***Entamoeba histolytica*: may invade the colon and cause bloody diarrhoea**
- **amoebic dysentery. Also causes ameobic liver abscess.**
- **estimated to infect about 50 million people worldwide**
- **Transmitted by fecal-oral , swallowing cysts in contaminated water or food.**
- **Cysts survive outside the host in moist conditions**

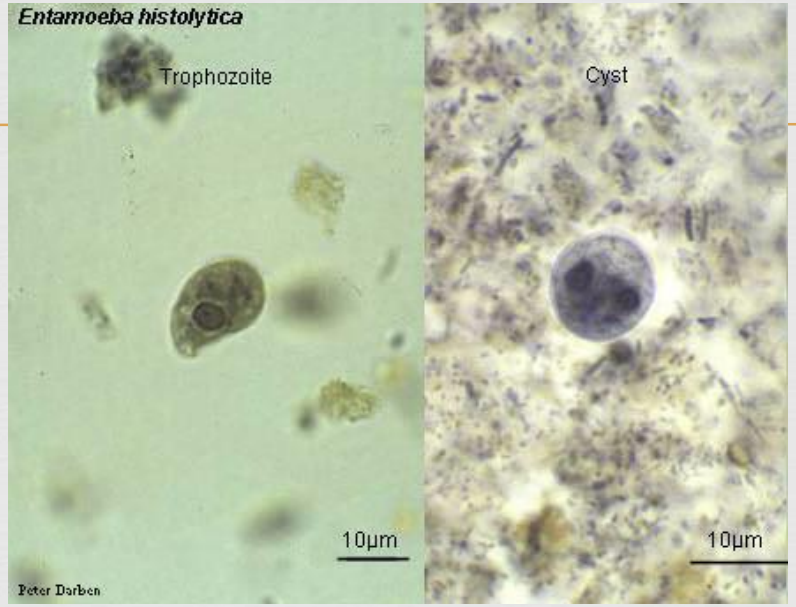
Life cycle of E. histolytica

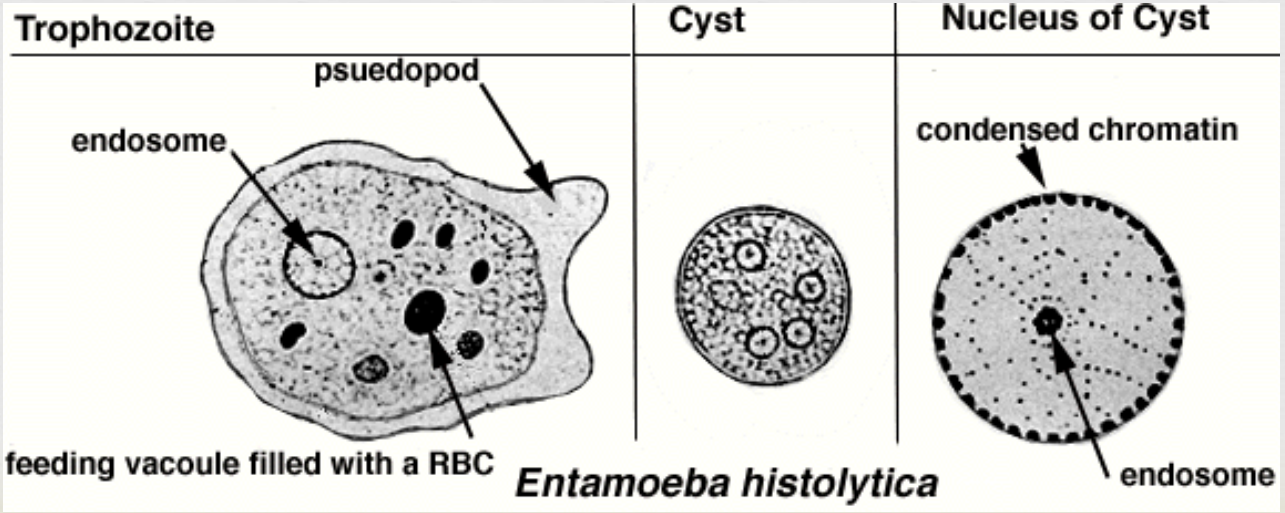


Diagnosis

- It can be diagnosed by stool samples, but it is important to note that certain other species are impossible to distinguish by microscopy alone. Trophozoites may be seen in a fresh fecal smear and cysts in an ordinary stool sample. ELISA (**enzyme-linked immunosorbent assay**)or RIA (**Radioimmunoassay**)can also be used.

Entameoba histolytica





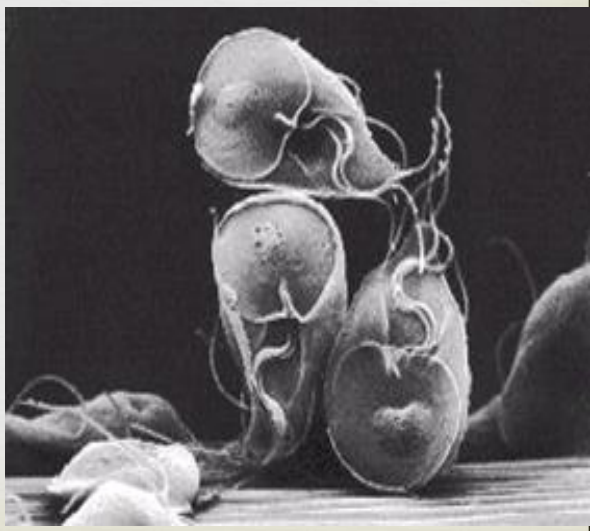
Giardia lamblia

Giardiasis

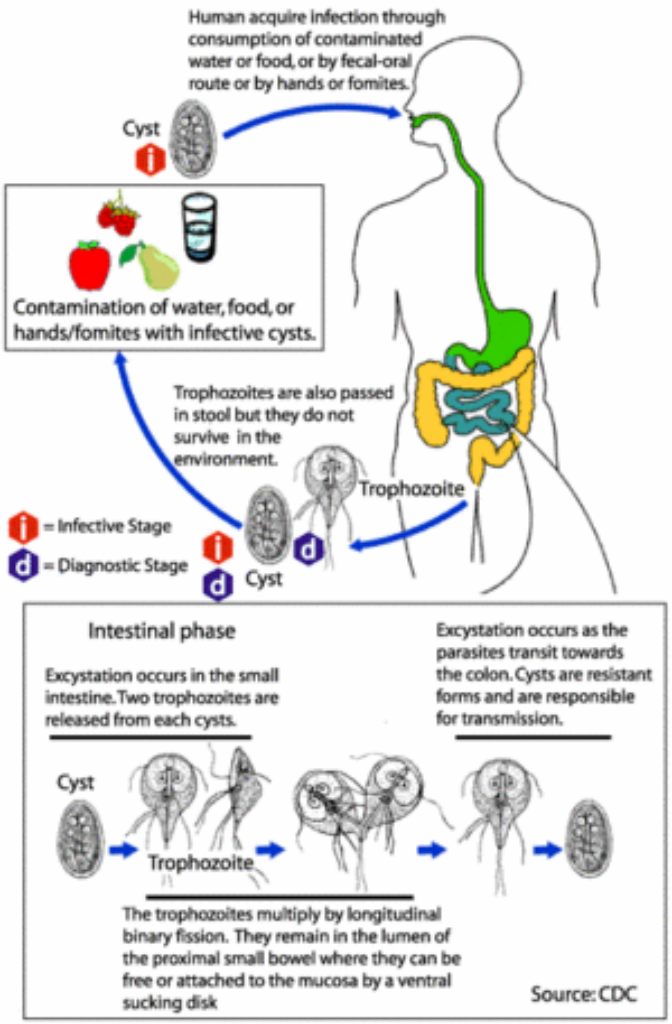
- Intestinal flagellate , live on mucosa of mall bowel. Produces cysts which are passed in feces .
- world-wide distribution,
- lives in the small intestine and

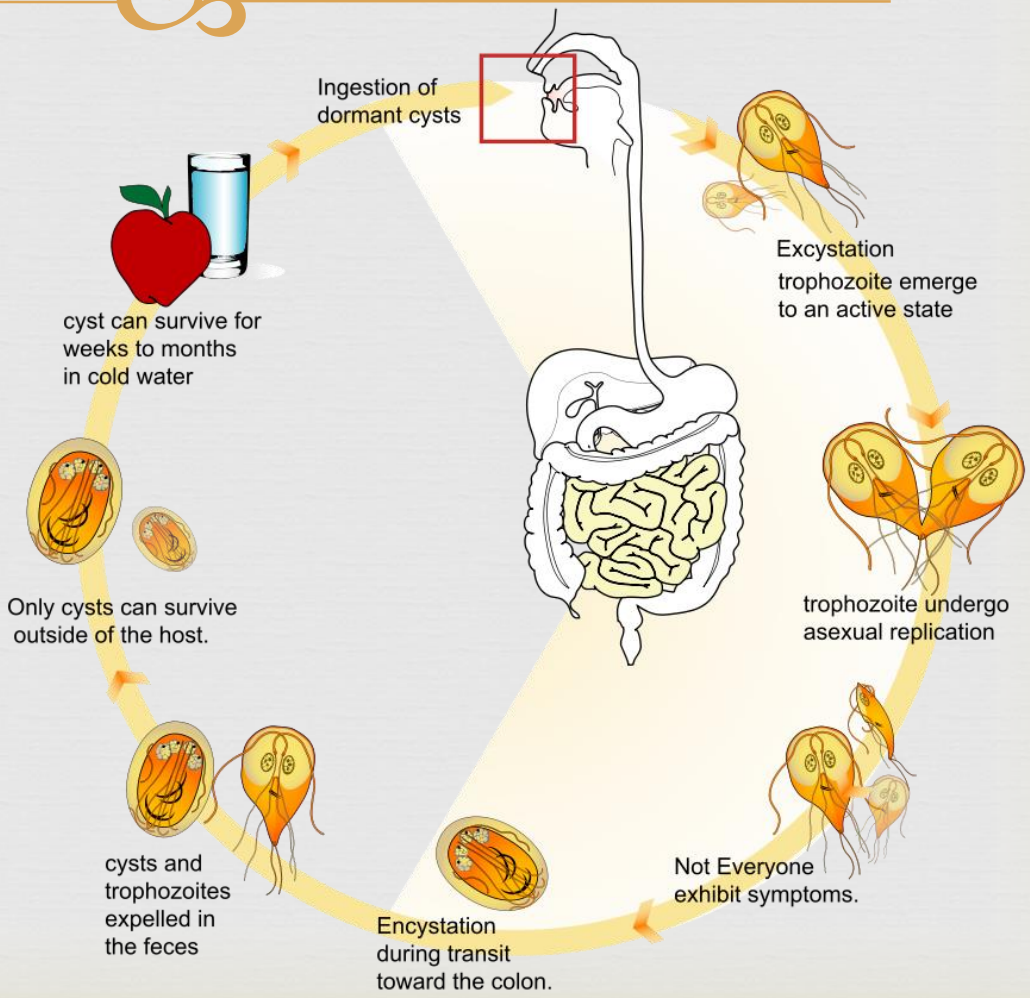
results in malabsorption

- most common protozoan in children



Life cycle


Human acquire infection through consumption of contaminated water or food, or by fecal-oral route or by hands or fomites.
Cyst
Contamination of water, food, or hands/fomites with infective cysts.
Trophozoites are also passed in stool but they do not survive in the environment.
Trophozoite
= Infective Stage
= Diagnostic Stage
Cyst
Intestinal phase
Excystation occurs in the small intestine. Two trophozoites are released from each cysts.
Excystation occurs as the parasites transit towards the colon. Cysts are resistant forms and are responsible for transmission.
Cyst
Trophozoite
The trophozoites multiply by longitudinal binary fission. They remain in the lumen of the proximal small bowel where they can be free or attached to the mucosa by a ventral sucking disk
Source: CDC


Ingestion of dormant cysts
Excystation trophozoite emerge to an active state
cyst can survive for weeks to months in cold water
trophozoite undergo asexual replication
Only cysts can survive outside of the host.
Not Everyone exhibit symptoms.
cysts and trophozoites expelled in the feces
Encystation during transit toward the colon.

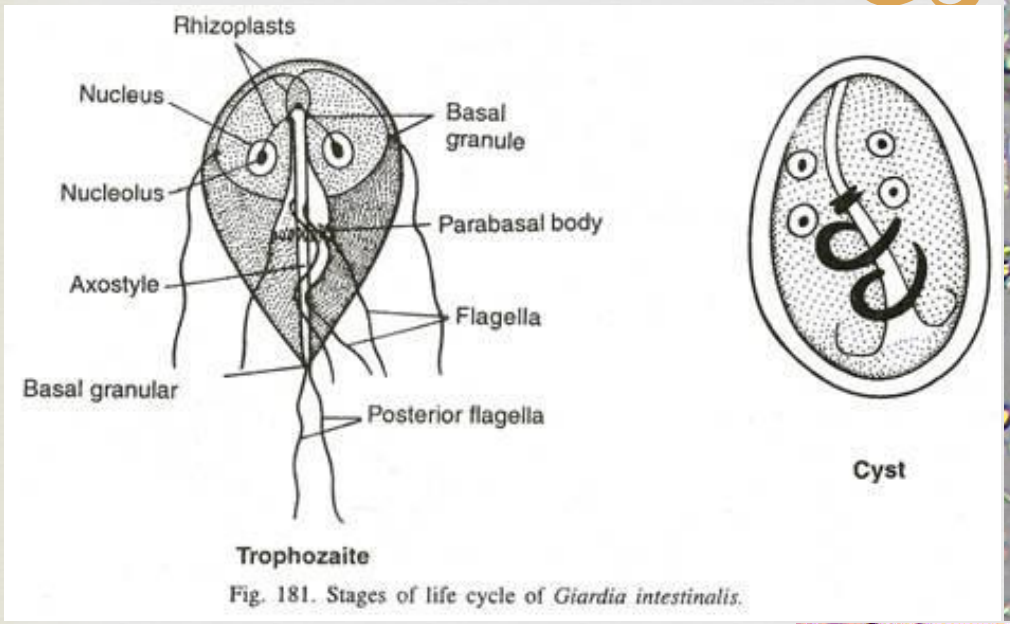
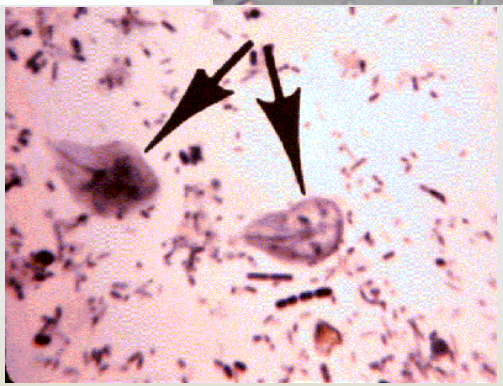
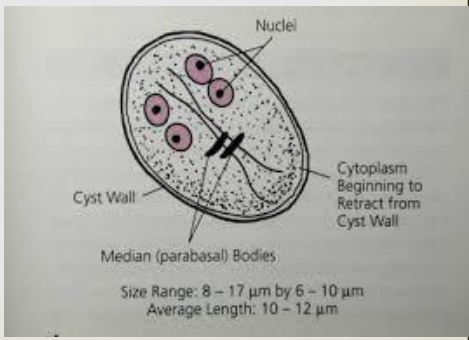


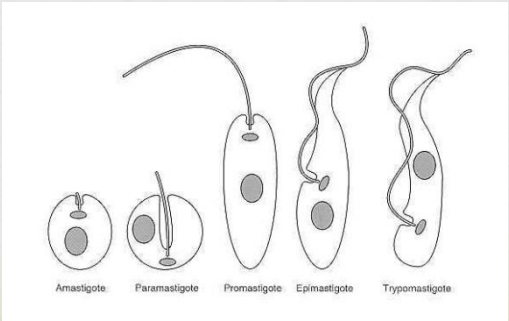
Fig. 181. Stages of life cycle of *Giardia intestinalis*.

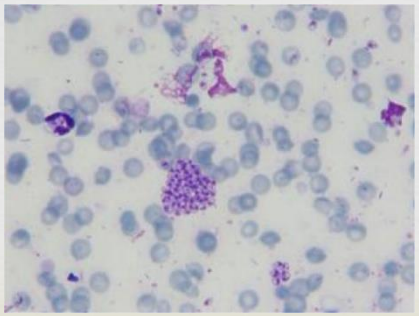




Leshmaniasis

- Genus contain several species .
- *L. donovani* : causes **visceral** leishmaniasis **(kala azar).**
- *L. tropica*: causes **cautaneous** leishmaniasis **(oriental sore).**
- *L. brasiliensis*: causes **mucocutaneous** leishmaniasis.
- Sporozoa living intracellulary in macrophages
- Transmitted by sandflies .

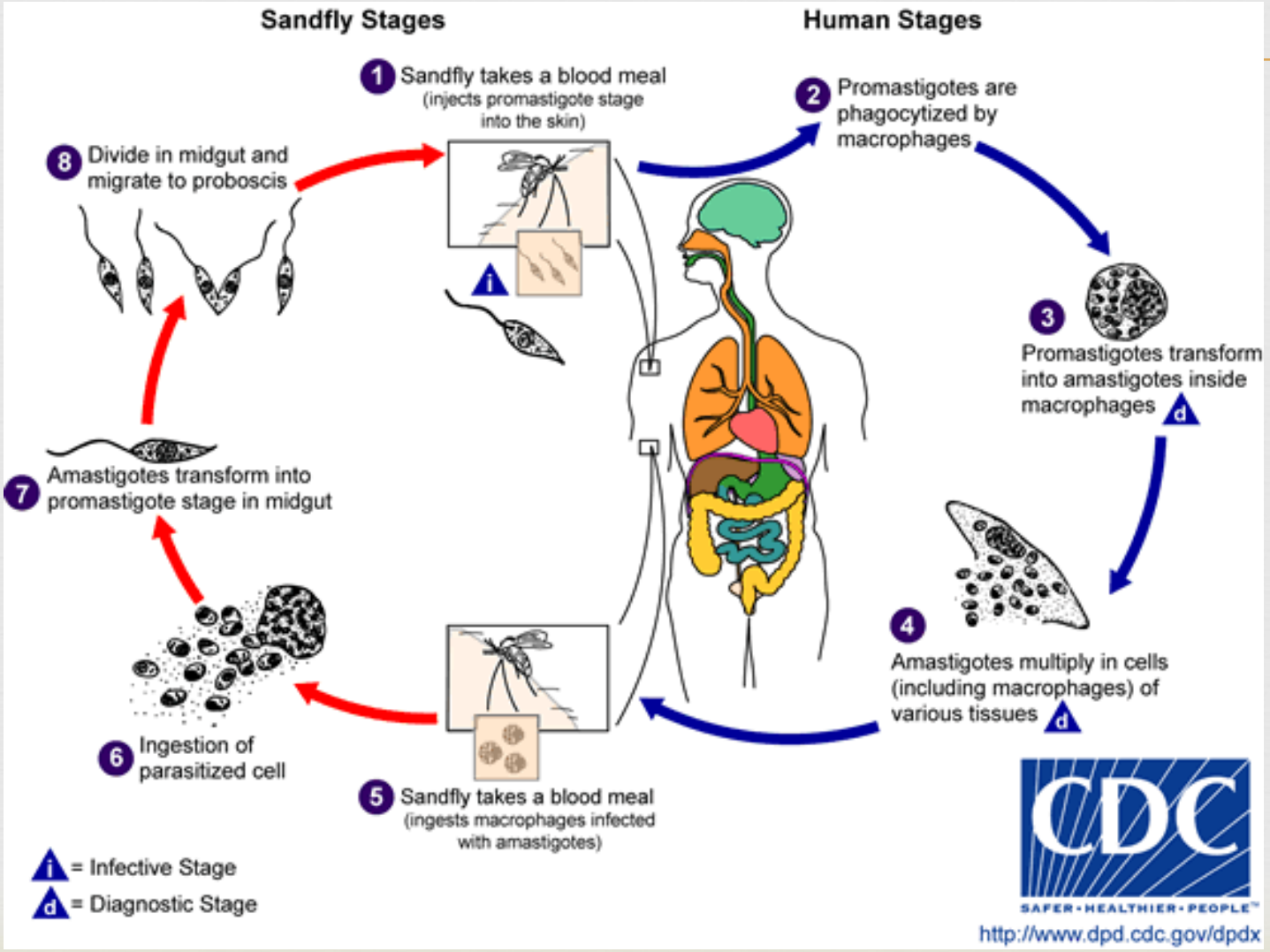




Coutaneous leishmaniasis (Baghdad boil)

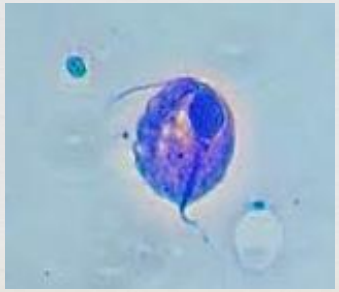
- Most cases spontaneously heal. But the ulcers leave unsightly scars.

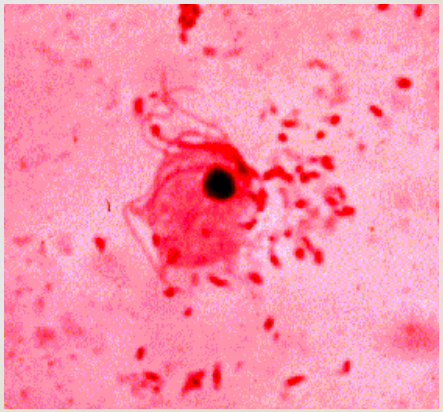
Leishmania life cycle



Trichomonas vaginalis

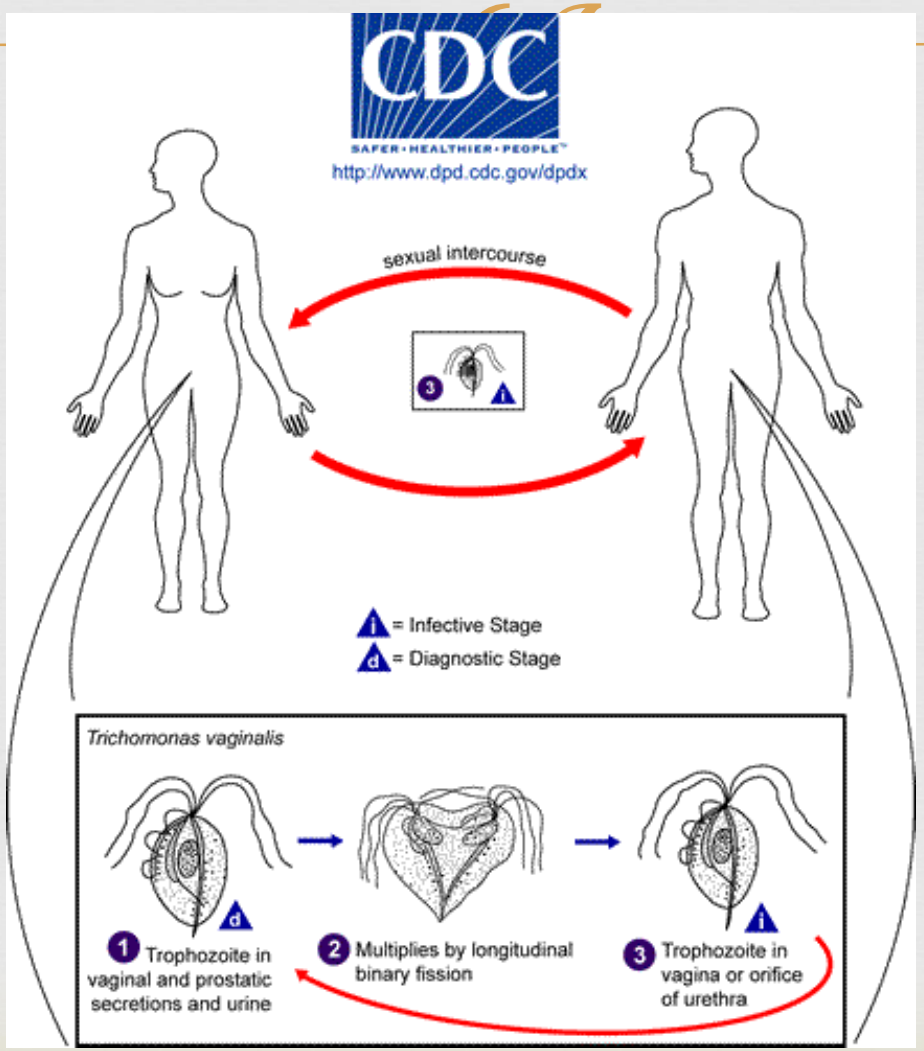
- *Trichomonas vaginalis* **is an anaerobic , flagellated protozoan. trichomoniasis. world wide distribution**
- **Flagellate living in urogental system of females and , occasionally, males .**
- **Trophozoite form only. No cyst**
- **Transmission : Venereol** (STD)
- **Treatment : Metronidazole**





Signs and symptoms

- Most people infected with *trichomonas vaginalis* do not have any symptoms. Symptoms experienced include pain, burning or itching in the penis, urethra (urethritis), prostate infections in males, or vagina (vaginitis) vulva, and cervix infections in females. Discomfort for both sexes may increase during intercourse and urination. For women there may also be a yellow-green, itchy, frothy, foul-smelling ("fishy" smell) vaginal discharge. In rare cases, lower abdominal pain can occur. Symptoms usually appear within 5 to 28 days of exposure.


CDC
SAFER · HEALTHIER · PEOPLE™
http://www.dpd.cdc.gov/dpdx
sexual intercourse
= Infective Stage
= Diagnostic Stage
Trichomonas vaginalis
1 Trophozoite in vaginal and prostatic secretions and urine
2 Multiplies by longitudinal binary fission
3 Trophozoite in vagina or orifice of urethra

Malaria

- Malaria kills 1,000,000 children/ year

The face of malaria. Most deaths occur among children under 5 years old, many of whom succumb to anemia or coma following infection by parasites carried by the *Anopheles* mosquito.

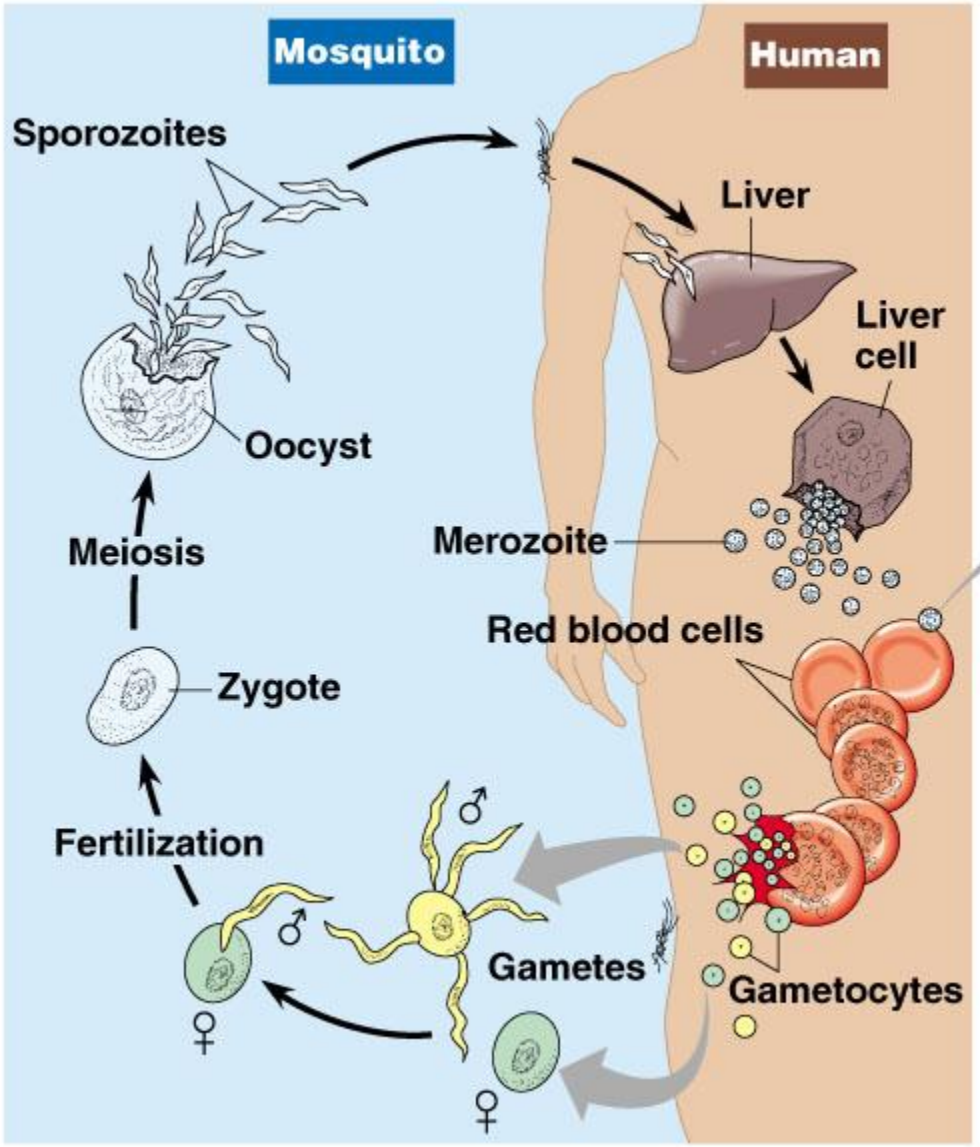
Plasmodium

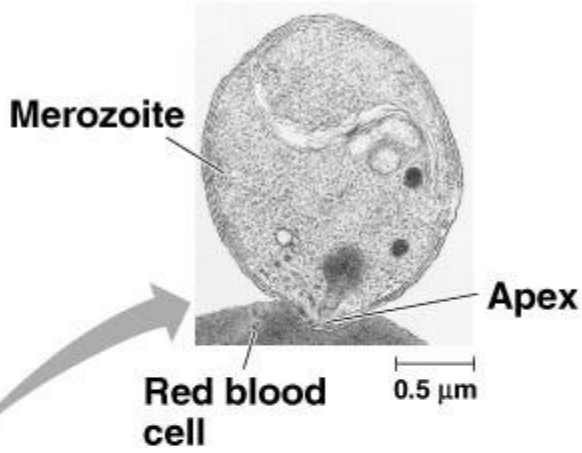
the cause of Malaria

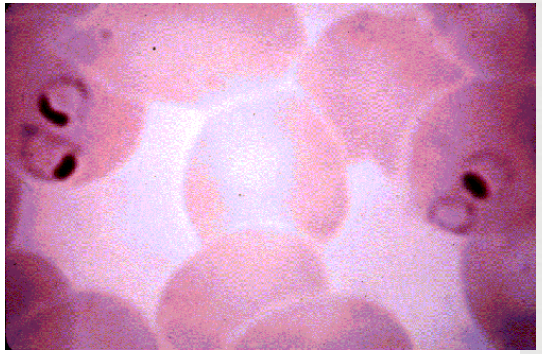
There are 4 species that infect man: *P. falciparum, P. vivax, P. ovale and P. Malariae*

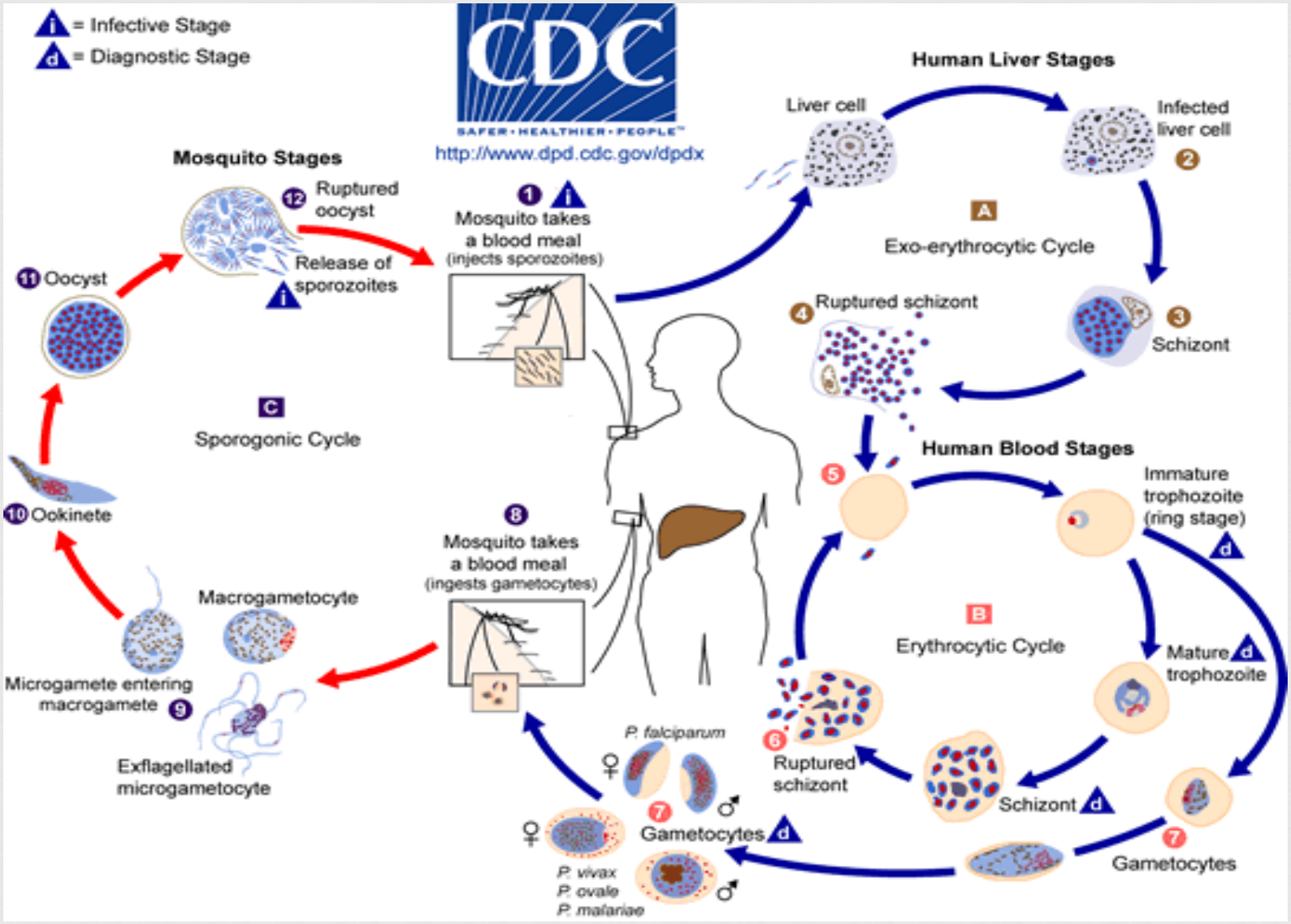
- sporozoa living intracellularly in liver and primarily in red blood cells.
- Transmission: by bite of infected female *anopheline mosquito* .
- Pathogenesis : Bursting of infected red cells causes periodic fever.
- **The majority of sporozoites migrate to the liver and invade hepatocytes**
- **Gametocyte carriage is associated with anaemia**

- **Life cycle**
  - **Infected human blood (gametocytes) Sucked by Anopheline mosquito ,In its stomach wall (many stages)**
    - **In the uninfected person Merozoites disappear within half an ahour from the circulation and infect the hepatocytes**
- **Hepatic phase**








i = Infective Stage
d = Diagnostic Stage
CDC
SAFER·HEALTHIER·PEOPLE™
http://www.dpd.cdc.gov/dpdx
Human Liver Stages
Liver cell
Infected liver cell
2
A
Exo-erythrocytic Cycle
3
Schizont
4
Ruptured schizont
Human Blood Stages
5
Immature trophozoite (ring stage)
d
Mature trophozoite
B
Erythrocytic Cycle
6
Ruptured schizont
Schizont
d
7
Gametocytes
P. falciparum
♀
♂
7
Gametocytes
d
P. vivax
P. ovale
P. malariae
8
Mosquito takes a blood meal
(ingests gametocytes)
Macrogametocyte
Microgamete entering macrogamete
9
Exflagellated microgametocyte
10
Ookinete
11
Oocyst
12
Ruptured oocyst
Release of sporozoites
Mosquito Stages
1
Mosquito takes a blood meal
(injects sporozoites)
C
Sporogonic Cycle

Symptoms

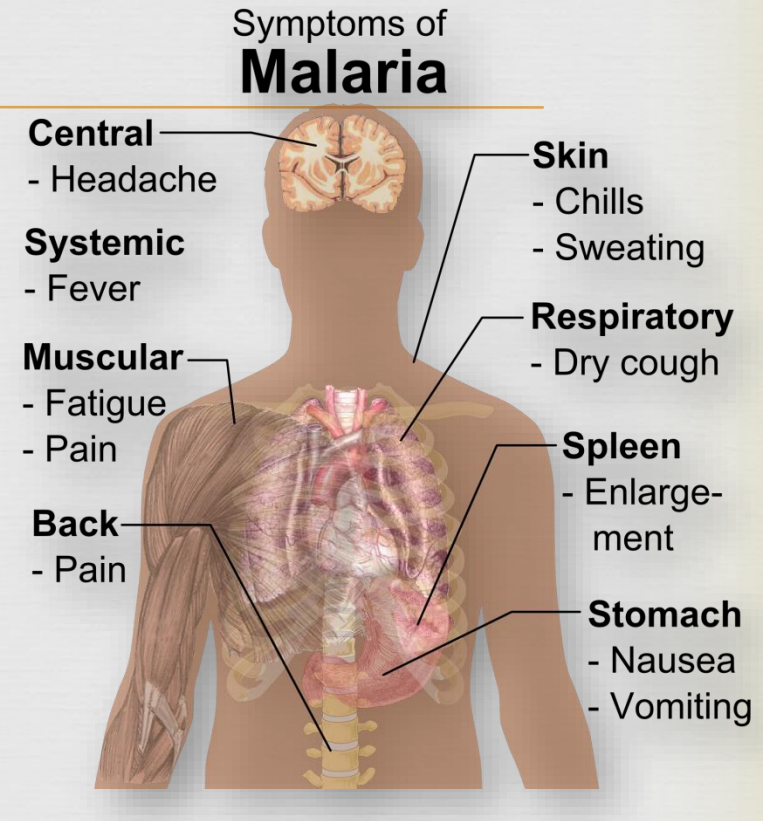
Cold stage

- **After half and hour hot stage**
- **After 1-6 hours sweating**

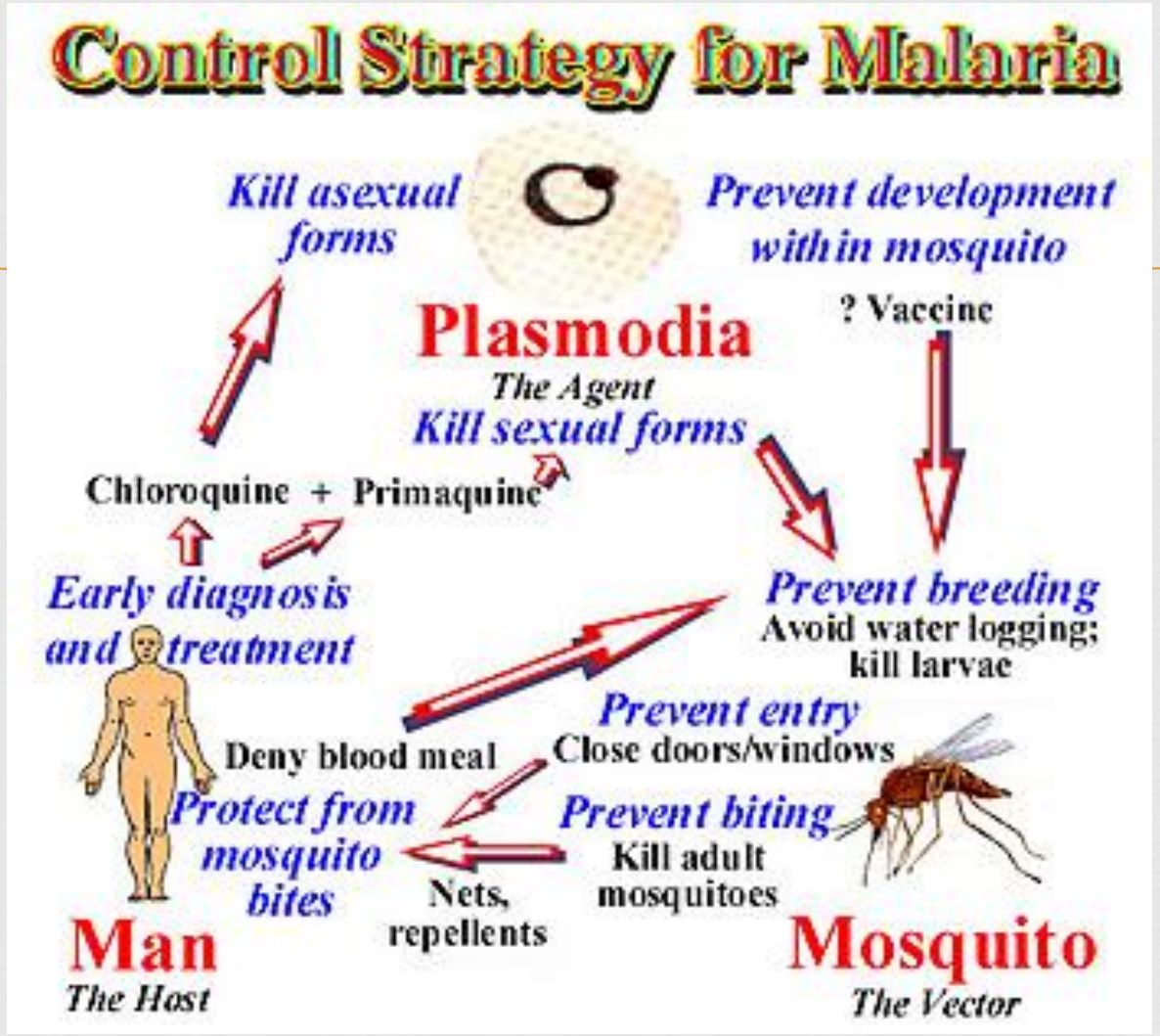
- **Residence in or travel to an epidemic area**
- **High fever, chills, headache**
- **Jaundice, vomiting, diarrhea**
- **Anemia**
- **coma**

***Older children**

headache, backache, fatigue



Control Strategy for Malaria



TREATMENT

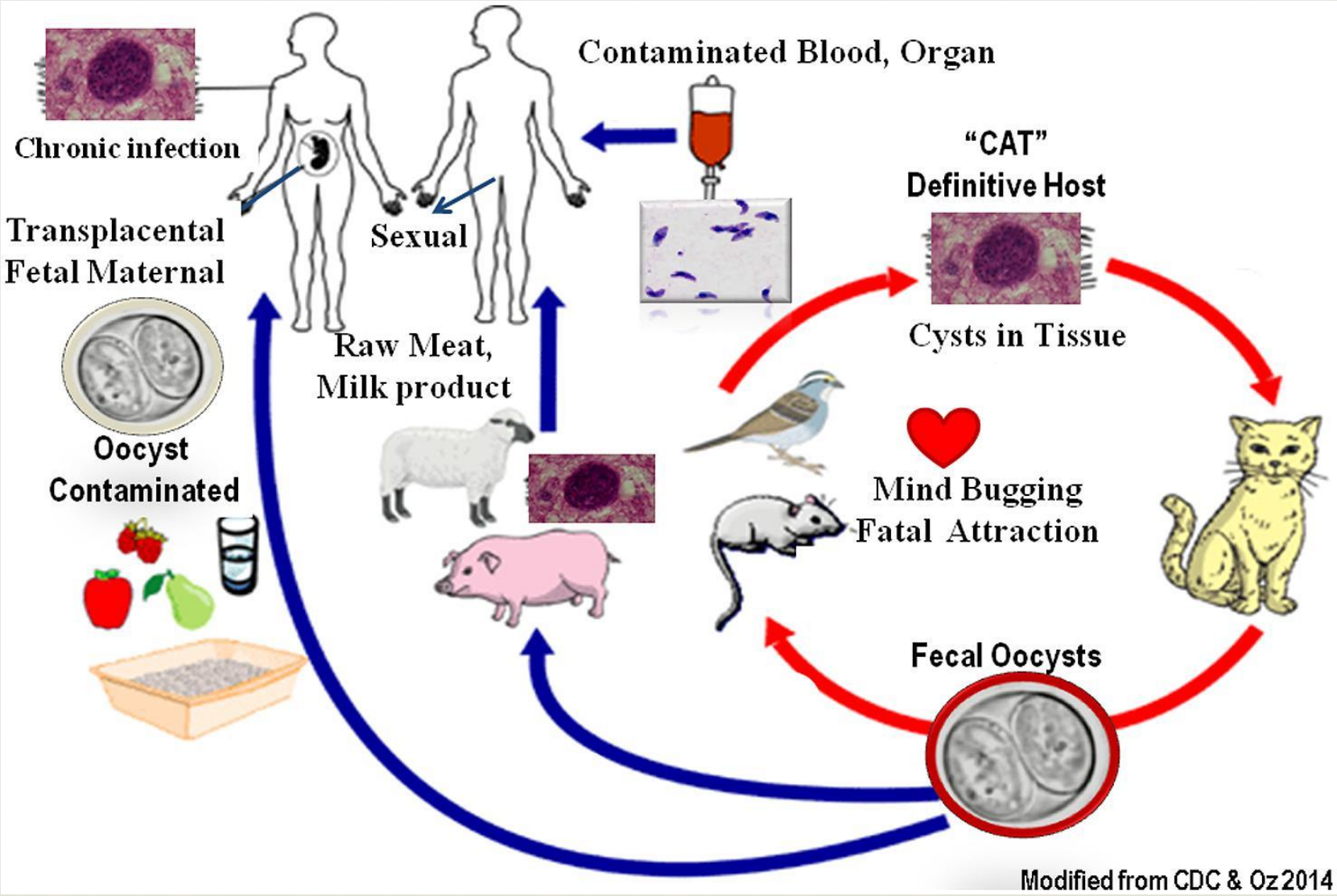
- Sprozoites are resistant to drugs
- Casual prophylaxis = drugs with act on hepatic phase
- Suppression = drugs which act on erythrocytic phase
- **Chloroquine phosphate** = safe in pregnancy

Toxoplasmosis

- ***Toxoplasma gondii:*** Intracellular parasite. Zoonotic; an **opportunistic** pathogen. Infects animals, cattle, birds, rodents, pigs, sheep and humans.
- Toxoplasmosis is leading cause of abortion in sheep and goats.
- Final host (cat)
- Intermediate host (mammals)
- **All parasite stages are infectious**
- **Risking group:** Pregnant women, meat handlers (food preparation) or anyone who eats the raw meat
- **Humans can catch this disease from:**
  - coming into contact with infected cat feces
  - eating raw or undercooked meat that's infected
  - eating contaminated vegetables or fruits being born with it

  Note: Once a person is infected, the infection remains in the body for life, usually in an inactive form. It can reactivate when that person's immune system is weak.

Life cycle of *Toxoplasma gondii*



Signs and Symptoms

1. Toxoplasmosis in an otherwise healthy person may have no symptoms or only a few swollen glands usually in the patient's neck.

2. Toxoplasmosis in a person with a weakened immune system may only have symptoms of swollen glands, or in the case of an infection that attacks the brain and nervous system, the symptoms may include fever, headache, psychosis, and problems with vision, speech, movement, or thinking.

3. Children born with Toxoplasmosis, which accounts for about 98% of cases, may show symptoms including:

- Fever
- Swollen glands
- Jaundice
- An unusually large or small head
- Rash
- Bruises or bleeding under the skin
- Anemia
- Enlarged liver or spleen
- Limp muscle tone
- Mental retardation
- Hearing loss
- Vision problems (toxoplasmosis of the eye)

Signs and symptoms

Infection has three stages:

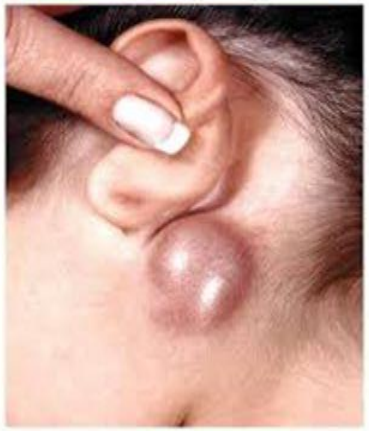
- **Acute toxoplasmosis**

During acute toxoplasmosis, symptoms are often influenza-like:

- swollen lymph nodes
- muscle aches and pains that last for a month or more.

Young children and immunocompromised people, such as those with HIV/AIDS, those taking certain types of chemotherapy, or those who have recently received an organ transplant, may develop severe toxoplasmosis.

The toxoplasmic trophozoites causing acute toxoplasmosis are referred to as Tachyzoites, and are typically found in bodily fluids.



Congenital toxoplasmosis is a problem in 1-5/1000 pregnancies

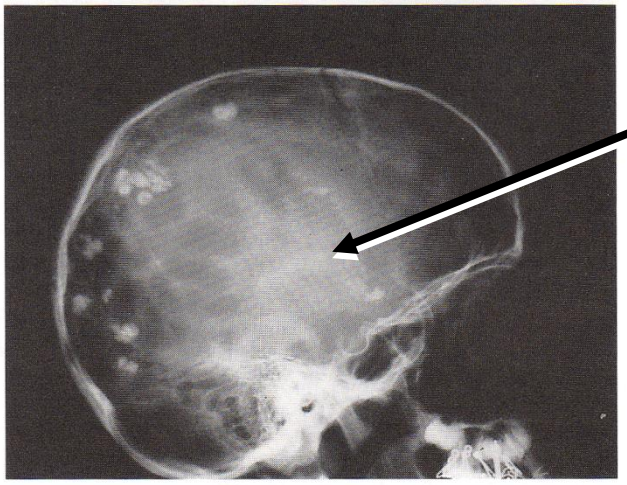


Fig. 16.10 Intracerebral calcification discovered fortuitously in a 10 year old girl, on a dental panoramic radiograph asked for by a dentist. The girl had unilateral retinochoroiditis and an IQ of 80. (Courtesy of Dr J. Couvreur).

* Intracerebral calcification.

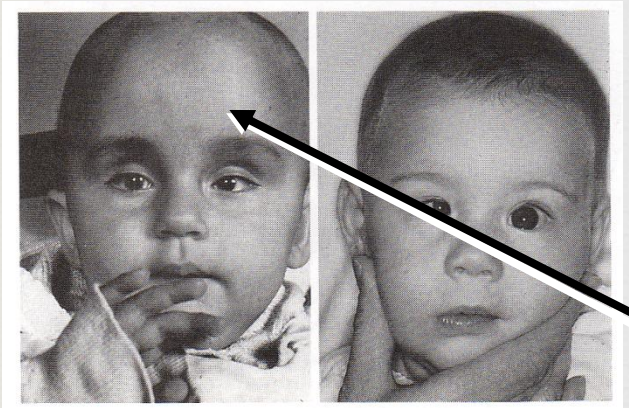


Fig. 16.9 Congenital toxoplasmosis in children. Hydrocephalus with bulging forehead (left) and microophthalmia of the left eye (right). (Courtesy of Dr J. Couvreur).

Hydrocephaly.

Taxonomic classification of helminths

Sub kingdom	Phylum	Class	Genus – examples
Metazoa	**Nematodes** Round worms; appear round in cross section, they have body cavities, a straight alimentary canal and an anus		Ascaris (roundworm) Trichuris (whipworm) Ancylostoma (hookworm) Necator (hookworm) Enterobius (pinworm or threadworm) Strongyloides
	Platyhelminthes Flat worms; dorsoventrally flattened, no body cavity and, if present, the alimentary canal is blind ending	Cestodes Adult tapeworms are found in the intestine of their host They have a head (scolex) with sucking organs, a segmented body but no alimentary canal Each body segment is hermaphrodite	Taenia (tapeworm)
		Trematodes Non-segmented, usually leaf-shaped, with two suckers but no distinct head They have an alimentary canal and are usually hermaphrodite and leaf shaped Schistosomes are the exception. They are thread-like, and have separate sexes	Fasciolopsis (liver fluke) Schistosoma (not leaf shaped!)

Tapeworm (Cestode)

Taenia solium

Taenia saginata

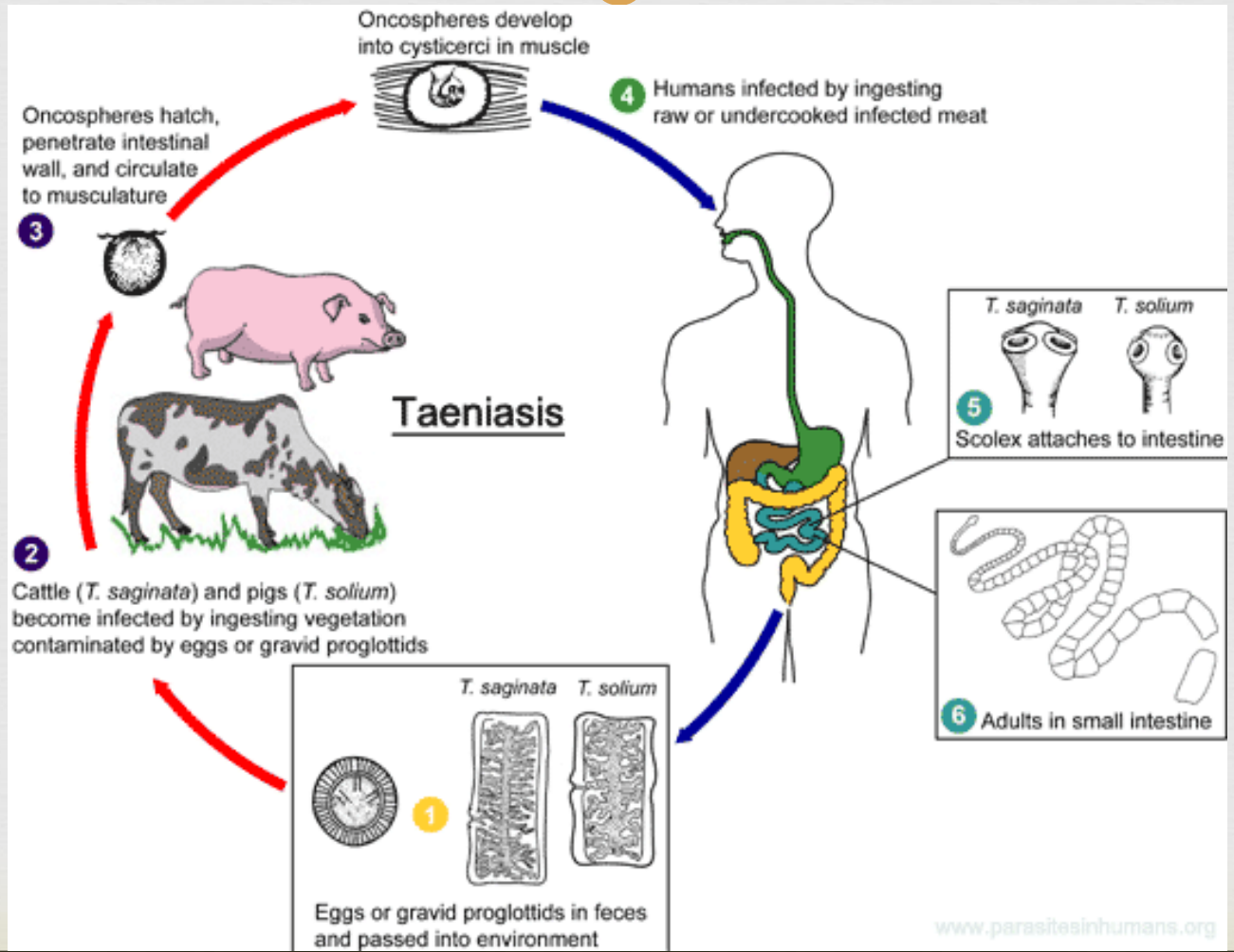
Echinococcus granulosus

Taenia

Intestinal - ("tapeworms")

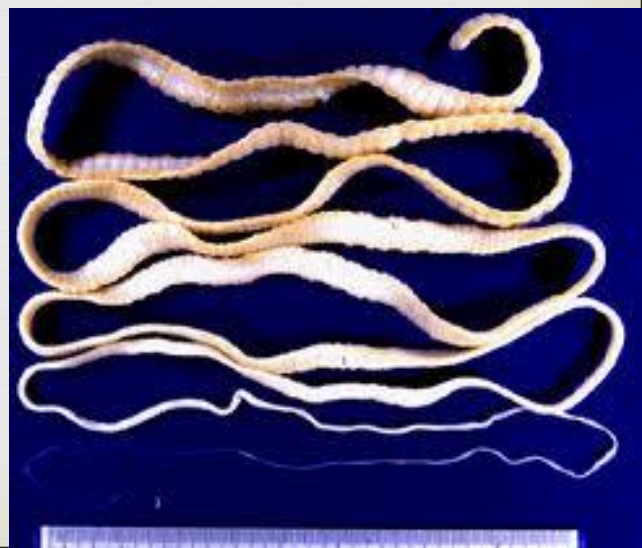
- *Taenia solium*
- *Taenia saginata* :
  - worldwide
  - acquired by ingestion of contaminated, uncooked beef
  - a common infection but causes minimal symptoms

Life Cycle


Oncospheres develop into cysticerci in muscle
4 Humans infected by ingesting raw or undercooked infected meat
Oncospheres hatch, penetrate intestinal wall, and circulate to musculature
3
Taeniasis
T. saginata
T. solium
5 Scolex attaches to intestine
6 Adults in small intestine
2
Cattle (T. saginata) and pigs (T. solium) become infected by ingesting vegetation contaminated by eggs or gravid proglottids
T. saginata
T. solium
1
Eggs or gravid proglottids in feces and passed into environment
www.parasitesinhumans.org

Taenia saginata

- Characteristics: Large (meters) adult tapworms in intestine
- Scolices with suckers???? .



Signs and symptoms

- *T. saginata* infection is usually asymptomatic, but heavy infection often results in weight loss, dizziness, abdominal pain, diarrhea, headaches, nausea, constipation, chronic indigestion, and loss of appetite. It is an also rare cause of ileus, pancreatitis, cholecystitis, and cholangitis

Echinococcus granulosus

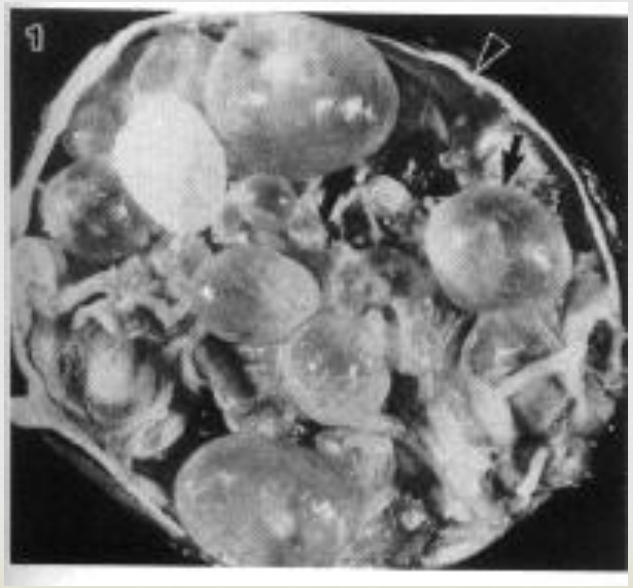
Hydatid worm or **Hyper Tape-worm** or **Dog Tapeworm**

- **Human echinococcosis (hydatidosis, or hydatid disease) is caused by the larval stages of cestodes of the *Echinococcus granulosus*.**
- ***Echinococcus granulosus* causes cystic echinococcosis (CE), the form most frequently encountered**
  - Worldwide distribution
  - Extra-intestinal tapeworm
  - Small tapeworm
  - Laval infection of *E. granulosus* may cause serious clinical disease ---hydatidosis/ hydatid disease

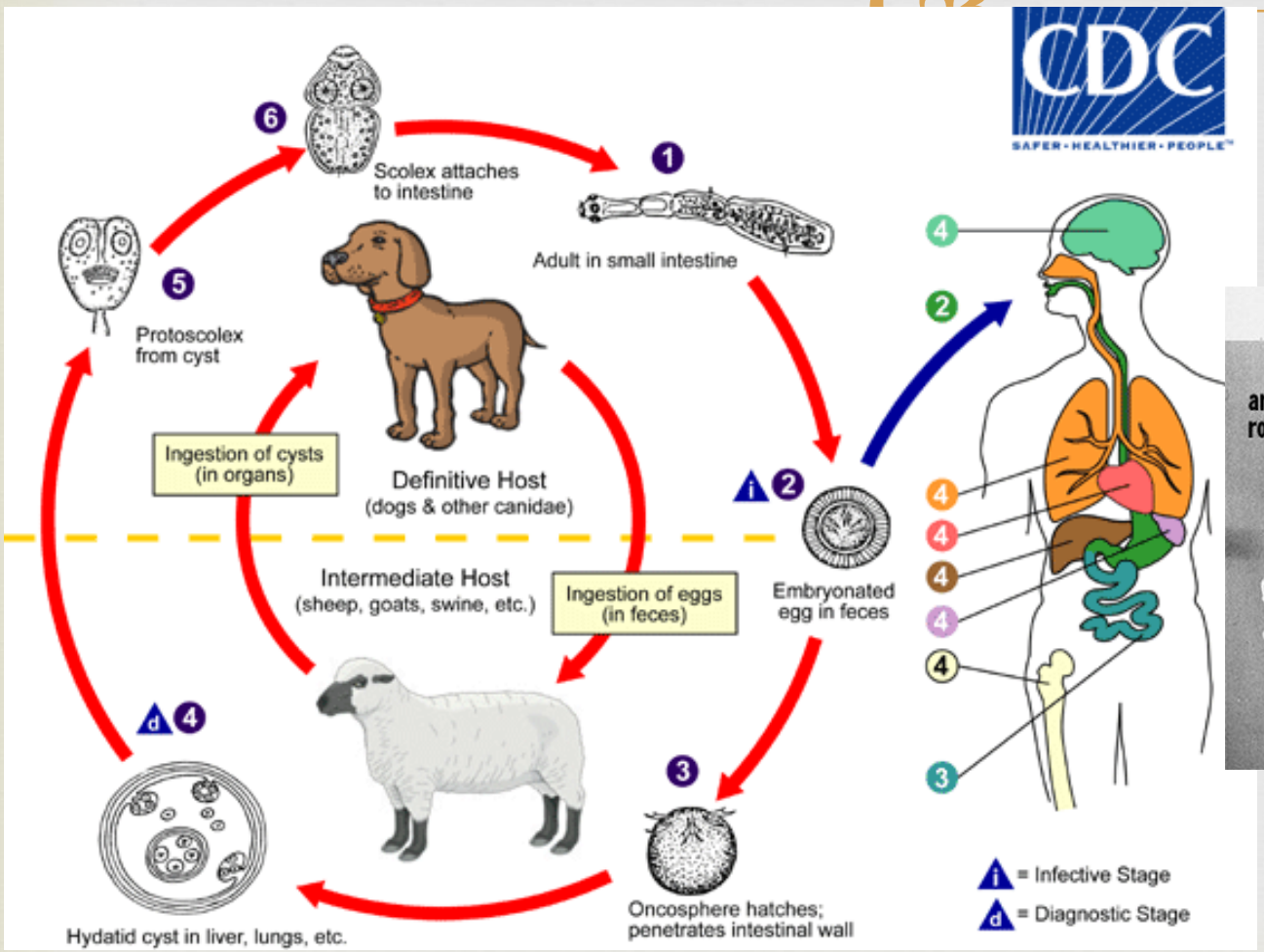
- Definitive host: dog
- Intermediate host: sheep, cattle, camel & human
- Infective stage: egg
- Sites of hydatid: liver, lungs, abdominal cavity, spleen, kidneys, heart, bones, central nervous system etc
- Man is a dead end host

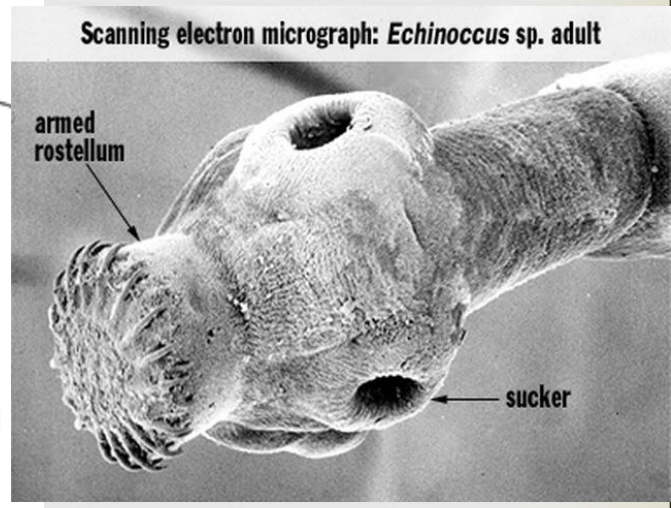
Hydatid Cyst:

- Round & cystic
- Wall – cuticle layer, germinal layer
- Contents
  - cystic fluid, brood capsules, protoscolex, daughter & grand daughter cysts (hydatid sands)



Life cycle


CDC
SAFER·HEALTHIER·PEOPLE™
Scolex attaches to intestine
Adult in small intestine
Protoscolex from cyst
Ingestion of cysts (in organs)
Definitive Host (dogs & other canidae)
Intermediate Host (sheep, goats, swine, etc.)
Ingestion of eggs (in feces)
Embryonated egg in feces
Oncosphere hatches; penetrates intestinal wall
Hydatid cyst in liver, lungs, etc.
= Infective Stage
= Diagnostic Stage


Scanning electron micrograph: *Echinoccus* sp. adult
armed rostellum
sucker

Pathogenesis

- **Depends on the size, the location and the number of cyst.**
  - **Pressure** –by tremendous size of the cyst. results in disfunction of liver, lung or nervous system
  - **Allergy** -due to rupture of cyst, may cause severe allergic reaction
  - **Regeneration** – due to rupture of cyst, intracystic protoscolex or germinal layer may be transplanted and result in multiple secondary infection

    Secondary regeneration 5.3%
  - **Toxicosis** by secretion of worm

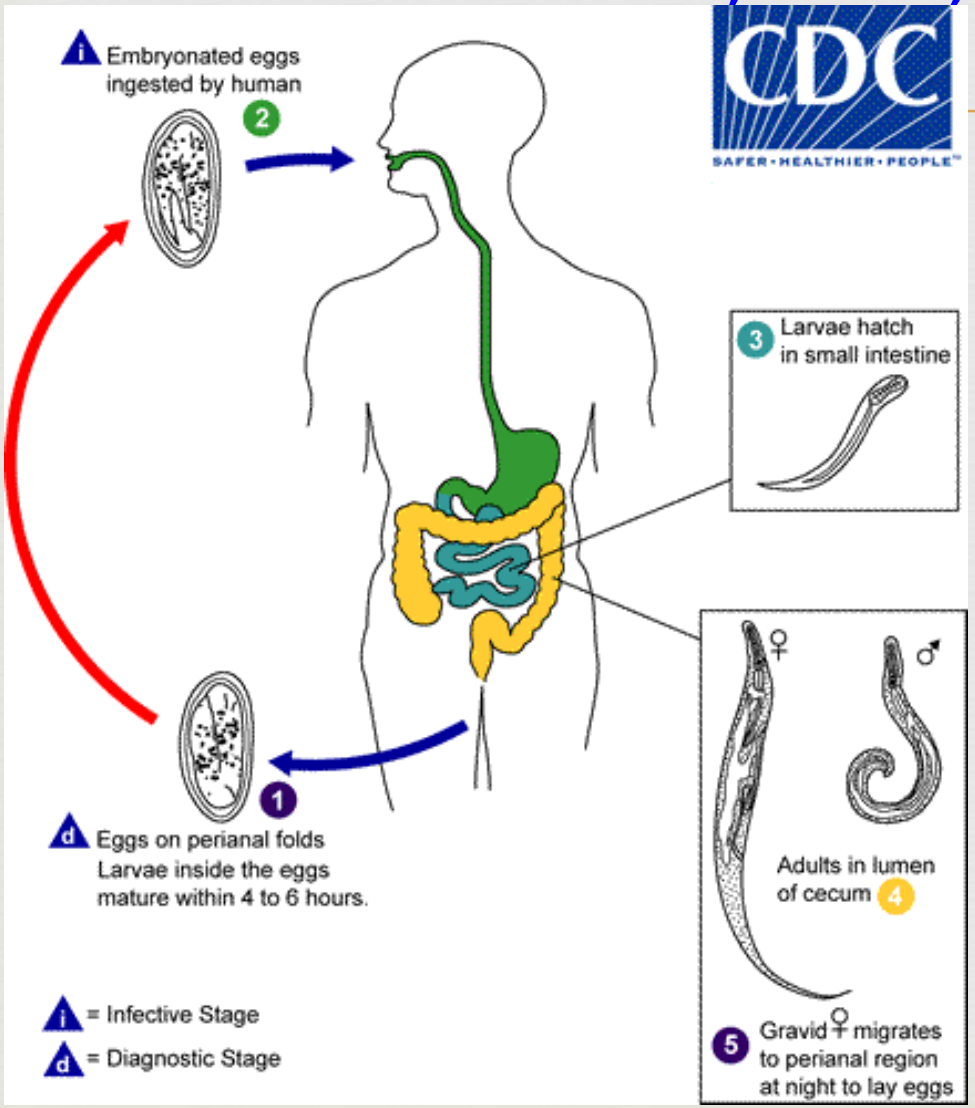
Control and treatment

- Regular treatment of infected dogs to reduce worm load.
- Prevention of dogs from eating infected offals of domestic animals(sheep,etc) in the endemic areas.
- Health education and strict personal hygiene.
- Avoidance of unnecessary contact with infected dogs.
- Surgery is still remains the mainstay of the treatment of hydatid disease.
- Albendazole have proved to be effective against hydatid cyst(for median or small size cysts).

Enterobius vermicularis

- (pinworm) small (1cm) round worm in large bowel. worms emerge from anus at night to lay egges.
- Enterobiasis .
  - prevalent in cold and temperate climates but rare in the tropics
  - found mainly in children
  - swallowing egges which can be carried on fingers and dust, eggs infective when laid , so direct reinfection is common.
  - Mebendazole, piperazine.
  - hygiene .

Life cycle

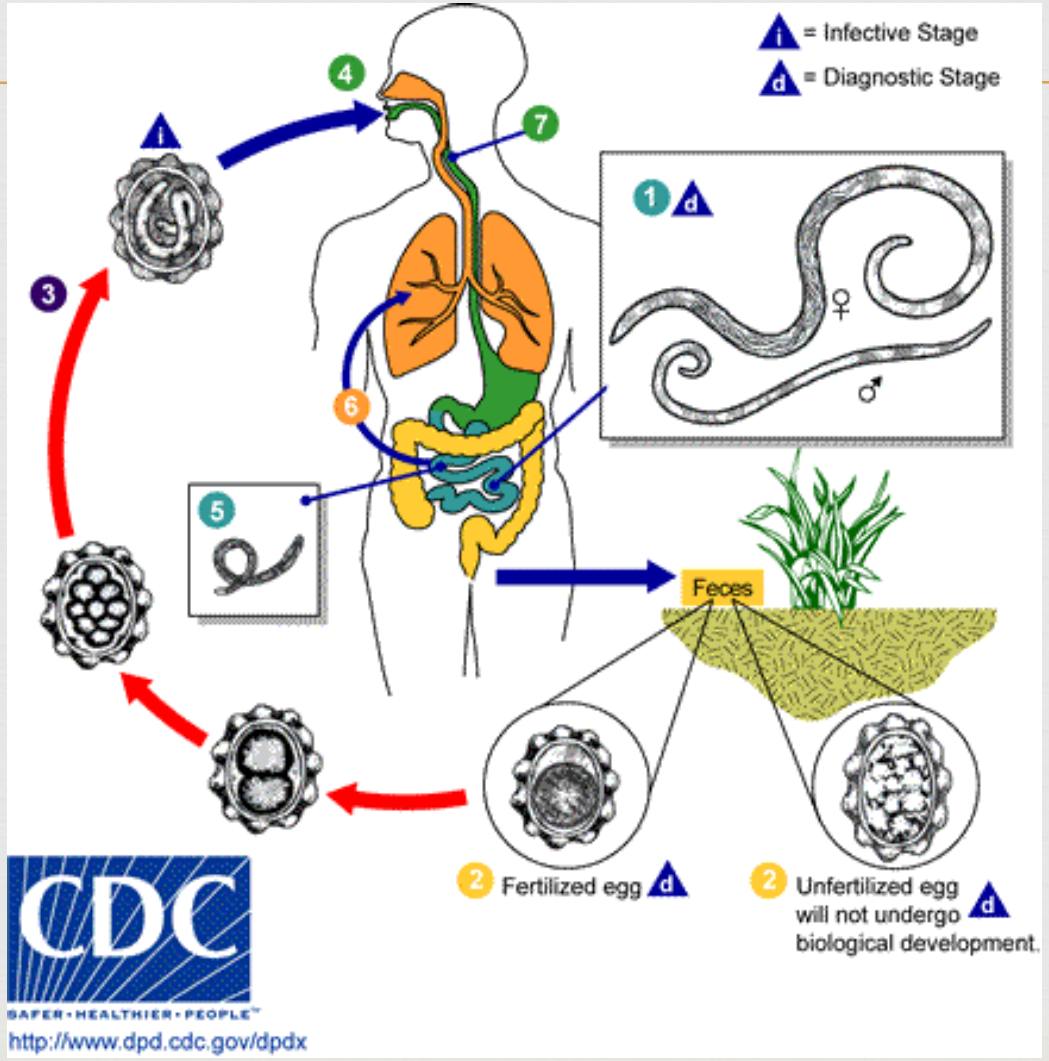


- 3 mm to 10 mm long
- it causes an intense itching in the area of an infected person's anus, especially at night

Ascaris lumbricoides

- (roundworm)
- Large (up to 30 cm) intestinal parasite. Migratory stages pass through liver and lungs.
- causes Ascariasis .
  - Found world-wide in conditions of poor hygiene, transmitted by the faecal- oral route
  - Adult worms lives in the small intestine
  - Causes eosinophilia
  - Transmission: swallowing infective eggs in contaminated soil, food or water.
  - Pathogenesis : Migrating larvae cause pneumonia-like symptoms. Adults can obstruct intestine , interfere with digestion and absorption of food ,migrate in bile duct. Allergic symptoms common.
  - Treatment : Mebendazole, Piperazine ,
  - Prevention: Hygiene

Ascariasis Life Cycle

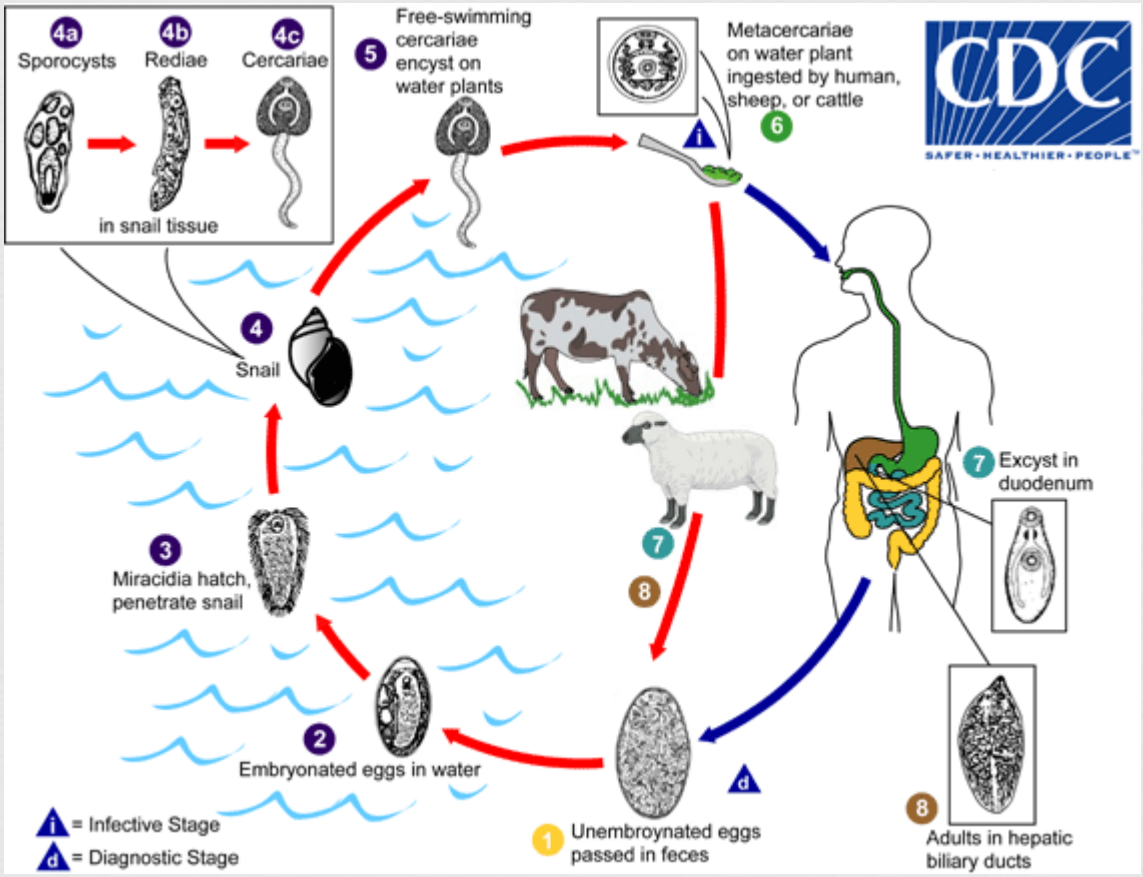


Heavy intestinal infections may occur with *Ascaris*. Adult worms can be several cms long.

Fasciola hepatica

- ***Fasciola hepatica***, also known as the **common liver fluke** or **sheep liver fluke**, is a parasitic trematode (fluke or flatworm, a type of helminth) that infects the livers of various mammals, including humans. The disease caused by the fluke is called fascioliasis or fasciolosis, and has been classified as a neglected tropical disease. *F. hepatica* is distributed worldwide, has been known as an important parasite of sheep and cattle for hundreds of years and causes great economic losses in sheep and cattle.

Fasciola hepatica life cycle



Pathogenesis

- **Acute fascioliasis**
- Large numbers of migrating larvae invade the liver and cause a traumatic hepatitis that is frequently fatal. Sometimes the liver capsule may rupture into the peritoneal cavity, causing death from peritonitis.
- More usually the invasive phase lasts many weeks, with the most common symptoms being intermittent fever, hepatomegaly, and abdominal pain
- **Chronic fascioliasis**
- After reaching the liver, there is then a latent phase lasting months or even years, when infection is asymptomatic.
- However, with maturation there may be an obstructive phase causing hepatitis, cholangitis, or pancreatitis.

Prevention

- Water-grown vegetables should be washed with 6% vinegar or potassium permanganate for 5-10 minutes, which kills the encysted metacercariae..
- Cook water-grown vegetables thoroughly before eating.
- Avoid sewage contamination of growing areas.

Schistosomiasis

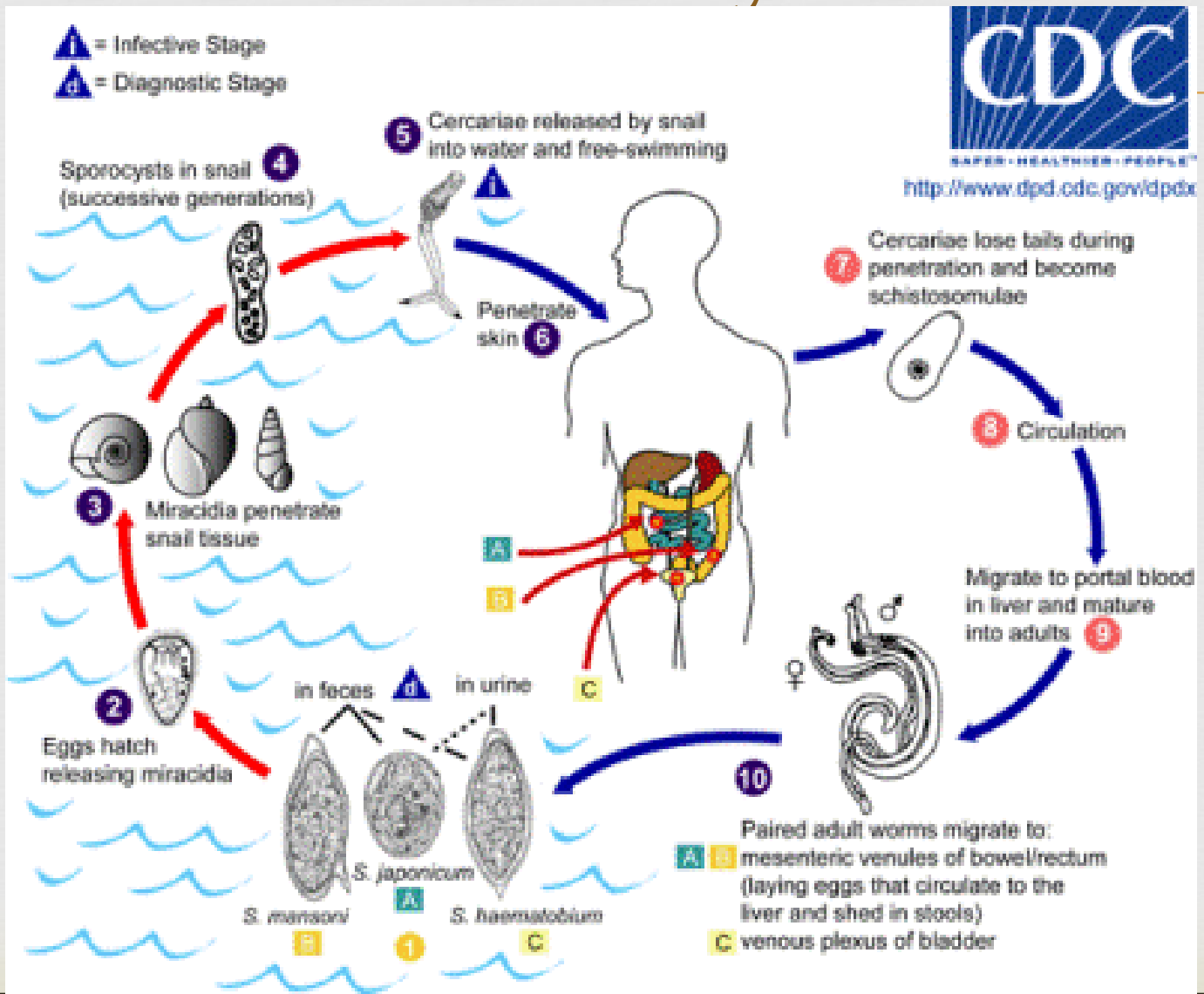
Trematodes (flukes)

- *Schistosoma haematobium*, S. *mansoni* and *S. japonicum* –
- Schistosomiasis (bilharzia)

Life cycle

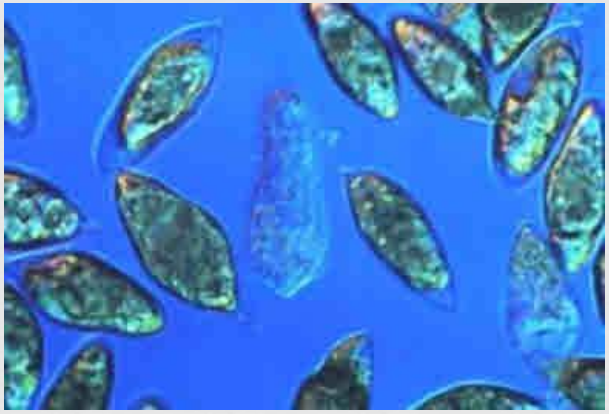
- Transmission occurs in fresh water
- Infective cercariae released from snails
- Cercariae penetrate the skin of people who drink, swim or bathe in infected water
- Adult worm live in the veins that drain the urinary system and release eggs into water in urine or faeces
- Eggs develop into miracidia which then infect snails

Life Cycle


= Infective Stage
= Diagnostic Stage
CDC
SAFER·HEALTHIER·PEOPLE™
http://www.dpd.cdc.gov/dpdx
5 Cercariae released by snail into water and free-swimming
Sporocysts in snail 4 (successive generations)
Penetrate skin 6
7 Cercariae lose tails during penetration and become schistosomulae
8 Circulation
Migrate to portal blood in liver and mature into adults 9
3 Miracidia penetrate snail tissue
2 Eggs hatch releasing miracidia
in feces
in urine
10
Paired adult worms migrate to:
A B mesenteric venules of bowel/rectum (laying eggs that circulate to the liver and shed in stools)
C venous plexus of bladder
S. japonicum
S. mansoni
S. haematobium
A
B
C

Schistosomiasis

Adult worms of *S. haematobium* are 1-2 cm long



S. haematobium eggs measure 140 x 50 µm

S. haematobium cercaria

Pathology

- Shistosoma eggs become trapped in the tissues of the urinary tract (*S. haematobium*) and intestines (*S. mansoni, S. japonicum*)
- This results in inflammatory response and tissue damage

Symptoms and signs

- Urinary Schistosomiasis:
  - *S. hamatobium*
  - Gross haematuria
  - Dysuria
  - Bladder, ureters and kidneys damaged Cancer of the bladder is common

- Intestinal schistosomiasis
  - *S. mansoni, S. japonicum*
  - Gradual enlargement of liver and spleen intestines
  - hypertension of the abdominal blood vessels which begin to bleed
  - Blood in the stools

Treatment

- Praziquantel: effective against all species

Prevention and control

- Educate people to not urinate or defecate in fresh water supplies
- Eliminate snail vectors by making the water habitat unsuitable (increase water flow, remove vegetation)
- Provide piped water to avoid direct contact with cercariae

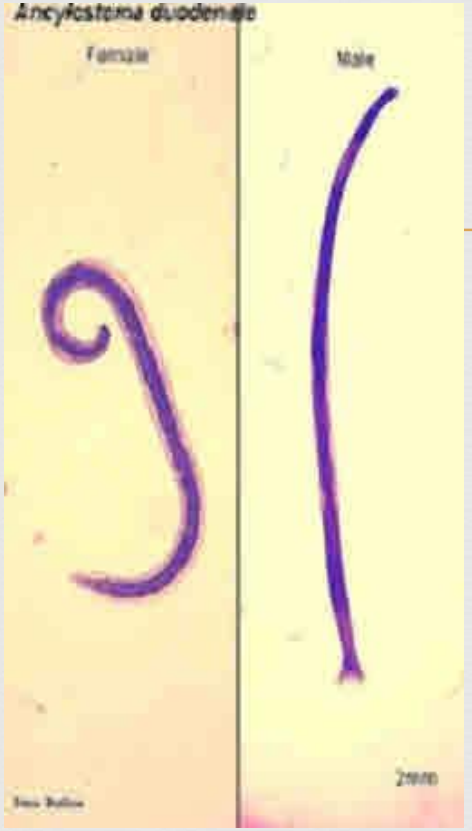
Ancylostoma

- *Ancylostoma* and *Necator* (hookworms)
  - A major cause of anaemia in the tropics

Hookworm
Ancylostoma duodenale

Life cycle

- Adult worms live in the intestine and excrete eggs in the faeces
- eggs contaminate soil and develop in warm.
- eggs hatch and infective filariform larvae develop in about one week and remain infective in soil for many weeks
- filariform larvae penetrate the skin when a person walks barefoot in the soil .
- larva migrate from the skin to the lungs via the lymphatic and blood systems
- larvae penetrate the capillary wall to enter the alveolus
- Develops to adult stage in upper intestine; adult worms are fully mature after about 5 weeks



Adult male and female worms of *A. duodenale*

Egg of *A. duodenale* in faecal smear

Filariform larvae

Pathology

- Heavy hookworm infection results in chronic haemorrhage
- *A. duodenale* ingests 4-5 times more blood each day than *N. americanus*
- In a child, the continued daily loss of 10ml of blood can lead to severe anaemia

Symptoms and signs

- Hookworm anaemia
  - Tiredness, aches and pains
  - Pallor
  - Breathlessness
  - Oedema

Treatment and Prevention

- Mebendazole

- Health education
- Encourage use of protective footwear

Trichuris trichiura

- (whipworm) medium size (0.75 cm) roundworm in large bowel.
- trichuriasis. Worldwide distribution .
  - A soil transmitted helminth.
  - swallowing infective eggs in contaminated soil, food or water.
  - prevalent in warm, humid conditions
  - Can cause diarrhoea, rectal prolapse and anaemia in heavily-infected people
  - Mebendazole
  - hygiene.

III. **Pathogenesis:**

1. **Light infection: Asymptomatic**
2. **Middle infection: Clinical manifestations are usually abdominal pain, anorexia, diarrhea, constipation .**
3. **Heavy infection: Bloody diarrhea, emaciation, prolapse of the anus may occur.**

IV. Diagnosis:

Discover the eggs in feces by saturated brine flotation method or direct fecal smear.

V. Treatment and prevention: Same as those of ascariasis

Take Mebendazole 3 days for a treatment course and repeat next week

Any Questions????