Parasites

CLS 212: Medical Microbiology

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Introduction

- **Parasite** is an organism baring food and shelter temporarily or permanent and living in or on another organism.

- The study of parasites is called **Parasitology.**

- **Parasites can be**

1. **Facultative parasite:** parasites able to live both free living and parasite living e.g. *Strongyloides species.*
2. **Obligate parasite:** parasite living permanently in a host and cannot live without a host e.g. *Trichomonos species.*
3. **Coprozoic (spurious) parasites:** foreign, pass through alimentally canal without affect.

- **Clinical Parasitology:** deals with animal parasites of man and their medical importance.

Host

- A host is an organism harboring the parasite species and it may be affected or not.

- **Types of Hosts:**

1. **Definitive host:**

   Harbors the adult/final stages or sexual stages (♂♀) in the development of parasite e.g. man.

2. **Intermediate host:**

   Harbors the larva/Intermediate stages or asexual stages in the development of parasite e.g. Taenia.

   Adult------ man

   Larva –---- cattle

3. **Reservoir host (carrier):**

   The carrier host is well adapted to the parasite and tolerates the infection but serve as source of the infection to other organisms.

Life Cycle

- **Life cycle :** The whole process of parasite growing and developing.

- **Types of Life Cycle:**

1. **The direct life-cycle: Only one host (no intermediate host).**
2. **The indirect life cycle: Life cycle with more than one host (intermediate host and final host).**

Types of Parasites

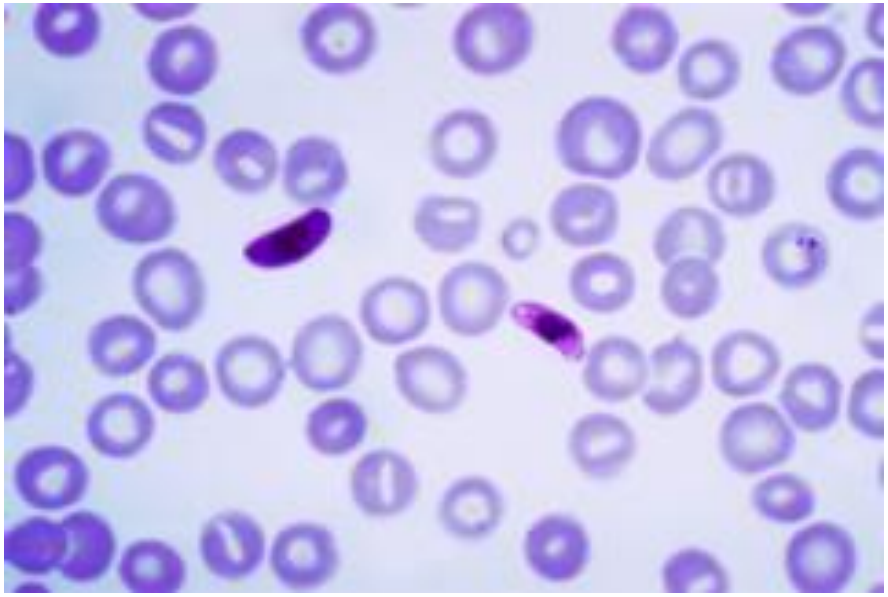
- **Ectoparasites**
  - Live on the outside or skin of the host.
  - Are Arthropods: Insects (mosquitoes, lice, and fleas) and Arachnids (ticks, mites, or spiders).

- **Endoparasites**
  - Parasites found inside the body of the host.
  - Can be in blood, tissue, or gastro-intestinal tract.
  - Are Protozoa and Helminthes.

Classification of Parasites

- **General Classification** animal parasites are classified according to international code taxonomy – Each parasite belong to a:

Domain	Eukarya
Kingdom	Chromalveolata
Phylum	Apicomplexa
Class	Aconoidasida
Order	Haemosporida
Family	Plasmodiidae
Genus	*Plasmodium*
Species	***P. falciparum***

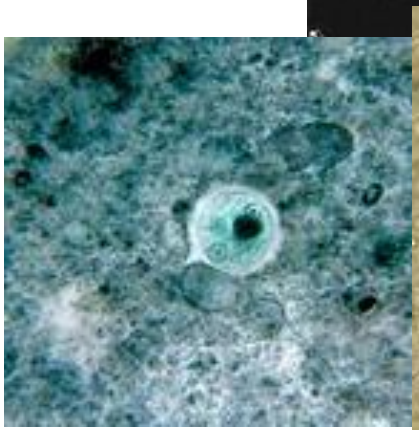


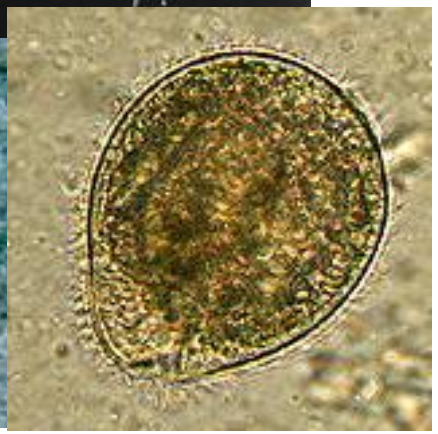
e.g. Plasmodium falciparum

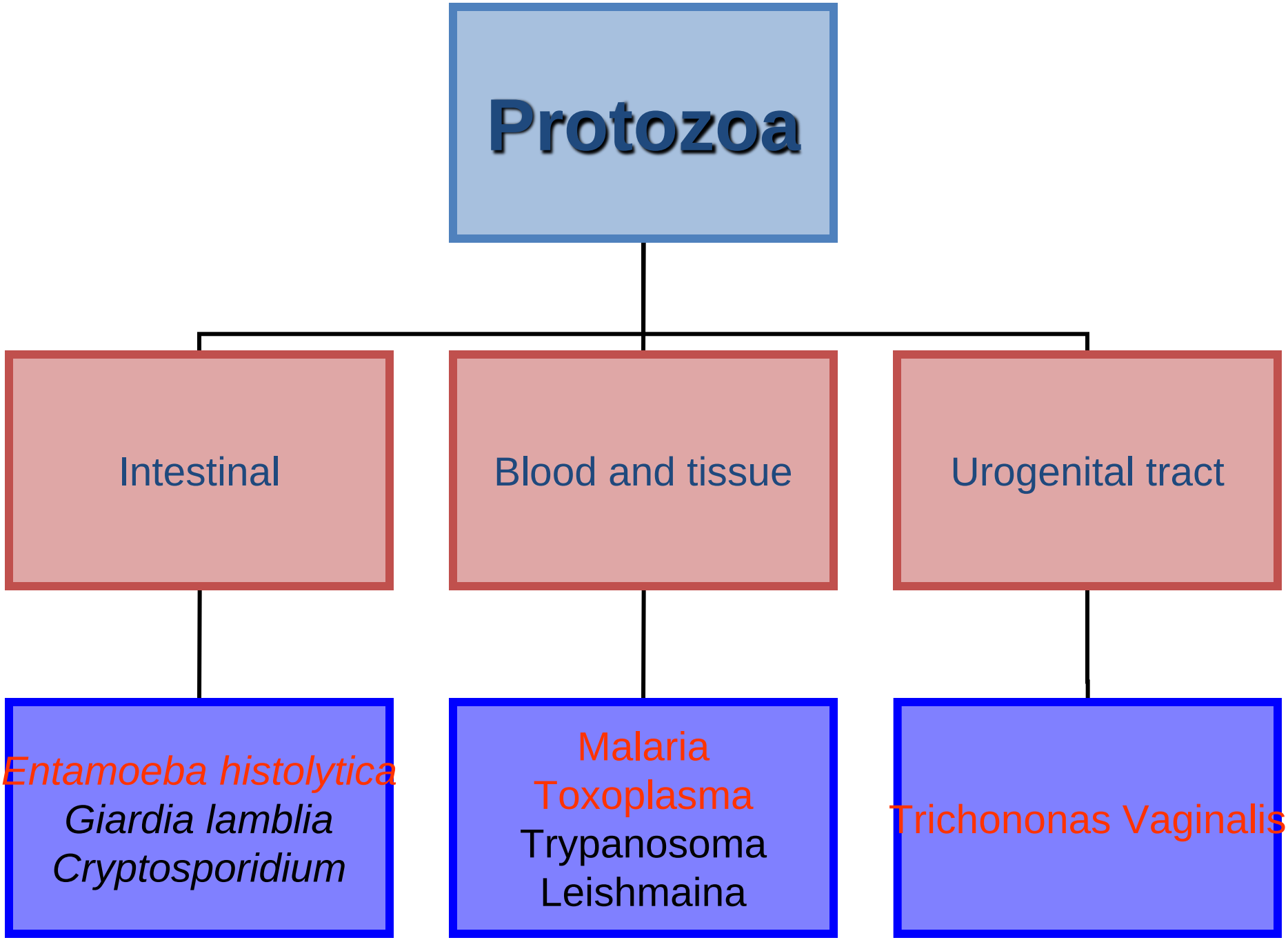
Classification of Protozoa

- Protozoa are classified into phyla, subphyla, or classes according to the method of locomotion (movement).

1. **Flagellates** (e.g. *Giardia lamblia*).
2. **Amoeboids** (e.g. *Entamoeba histolytica*).
3. **Sporozoans** (e.g. *Plasmodium knowlesi*).
4. **Ciliates** (e.g. *Balantidium coli*).






Protozoa
Intestinal
Blood and tissue
Urogenital tract
Entamoeba histolytica
Giardia lamblia
Cryptosporidium
Malaria
Toxoplasma
Trypanosoma
Leishmaina
Trichononas Vaginalis

Entamoeba histolytica

- **Name of Disease: Amoebiasis.**

- **Mode of movement:** Pseudopodia (false feet).
- **Geographical Distribution: cosmopolitan**, but more common in tropical and subtropical countries and in countries with poor sanitation.
- **Habitat:** in the lumen of the large intestine.
- **Reservoir:**

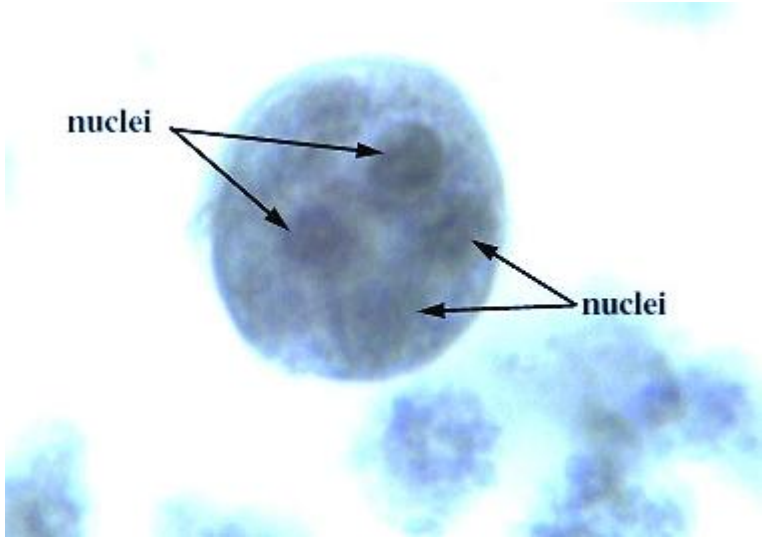
  Major: humans

  Minor: dogs, pigs, monkeys

Morphology: *Entamoeba histolytica*

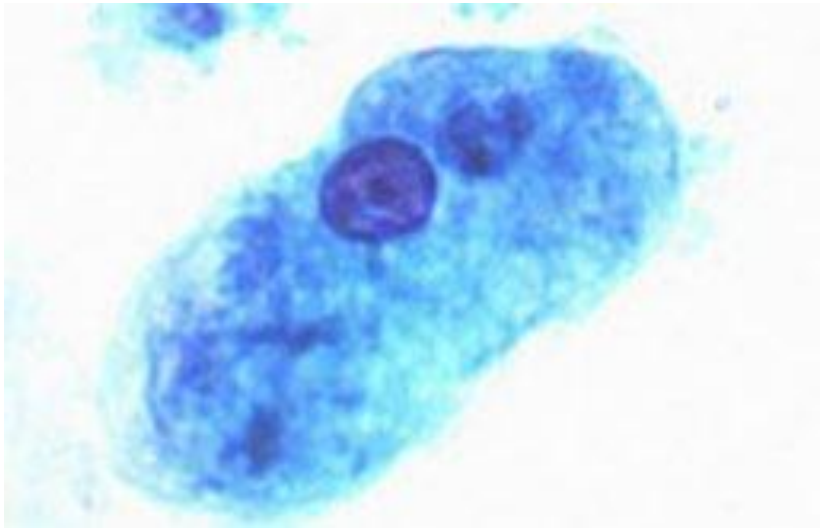
Two Forms

Cyst



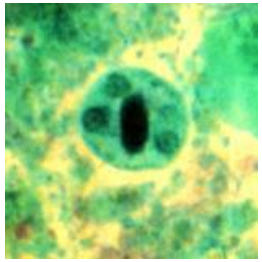
Infective stage: in polluted water and in infected food

Trophozoite

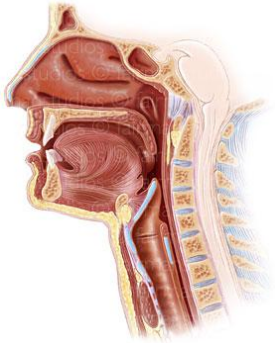


Pathogenic stage: give pathology as a result of infection

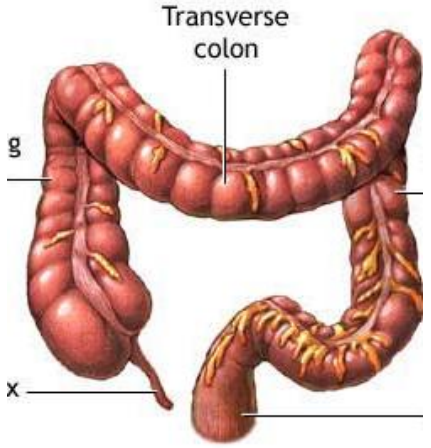
Life Cycle: *Entamoeba histolytica*



Cyst: infective stage



Inters mouth through contaminated food, drink, fly, or through using human stool as fertilizer

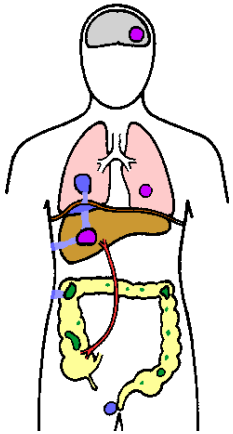


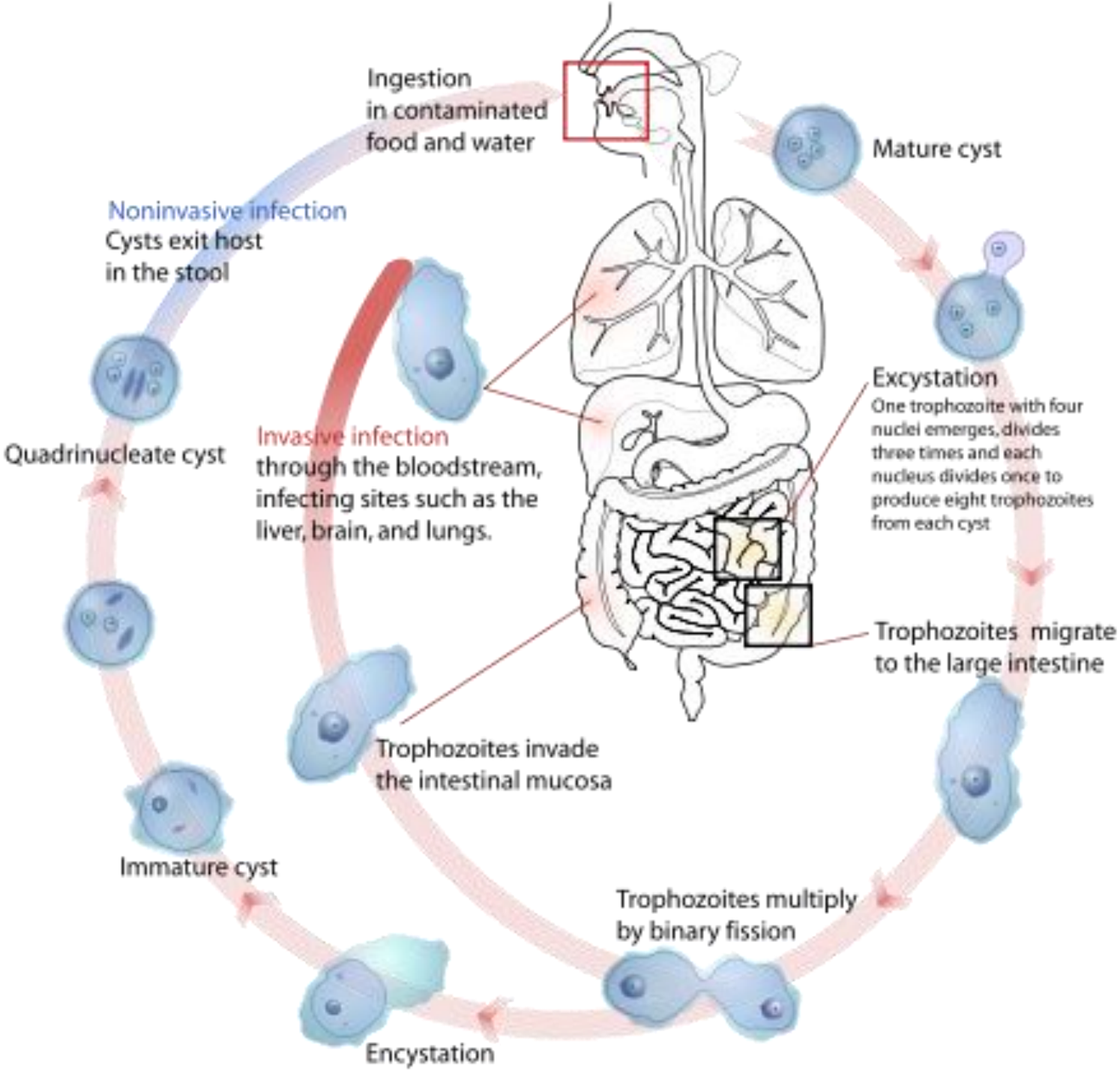
To L.I. lumen and change into trophozoite (pathogenic stage)

Produce lytic enzymes (capable of doing lysis and produce ulcer)

Flask shape ulcer

Can do erosion through B.V. to liver and other organs




Ingestion
in contaminated
food and water
Mature cyst
Noninvasive infection
Cysts exit host
in the stool
Excystation
One trophozoite with four nuclei emerges, divides three times and each nucleus divides once to produce eight trophozoites from each cyst
Quadrinucleate cyst
Invasive infection
through the bloodstream, infecting sites such as the liver, brain, and lungs.
Trophozoites migrate
to the large intestine
Trophozoites invade
the intestinal mucosa
Immature cyst
Trophozoites multiply
by binary fission
Encystation

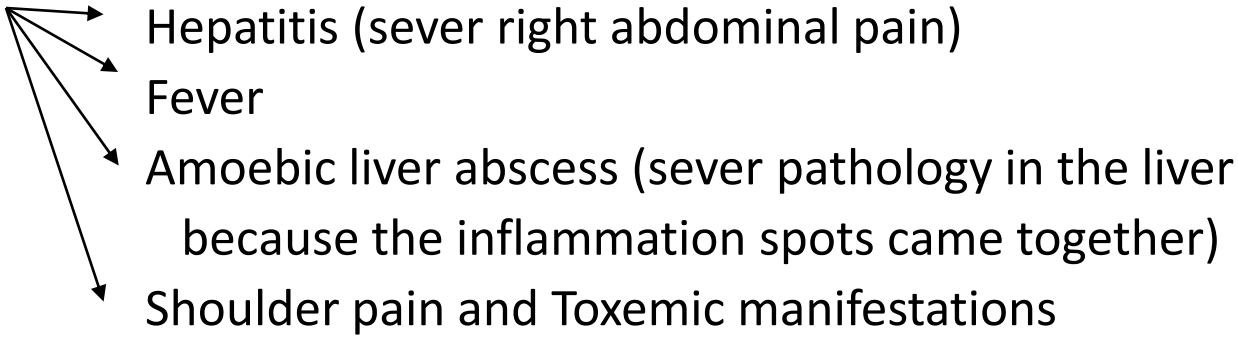
Clinical Picture:

- **Dysentery:** diarrhea with blood+mucus.
- **Sever abdominal pain.**
- **Tenesmus:** sense of incomplete evacuation.
  (the patient at this point should be seeking medical advice)

Complication:

A. **intestinal:** peritonitis, appendicitis, haemorrhage.

B. **Extra intestinal:** **Most commonly in liver**



Also in lung, skin, and brain..

Plasmodium sp. (Malaria)

- Approximately 300 million people worldwide are affected by malaria and between 1 and 1.5 million people die from it every year.

- **Geographical Distribution:** Previously extremely widespread, the malaria is now mainly confined to Africa, Asia and Latin America.
- The problems of controlling malaria in these countries are aggravated by **inadequate health structures** and **poor socioeconomic conditions**. The situation has become even more complex over the last few years with the increase in **resistance to the drugs** normally used to combat the parasite that causes the disease.
- **Causative Agent:** Malaria is caused by protozoan parasites of the genus ***Plasmodium.***

- **Species of *Plasmodium* are:**

✓ ***Plasmodium falciparum*** the most widespread and dangerous of the four, if untreated it can lead to fatal cerebral malaria.

✓ ***Plasmodium vivax.***

✓ ***Plasmodium ovale.***

✓ ***Plasmodium malaria.***

Plasmodium sp. (Malaria)

- **Transmission:**

  Malaria parasites are transmitted from one person to another by **female Anopheles Mosquito**. The males do not transmit the disease as they feed only on plant juices.

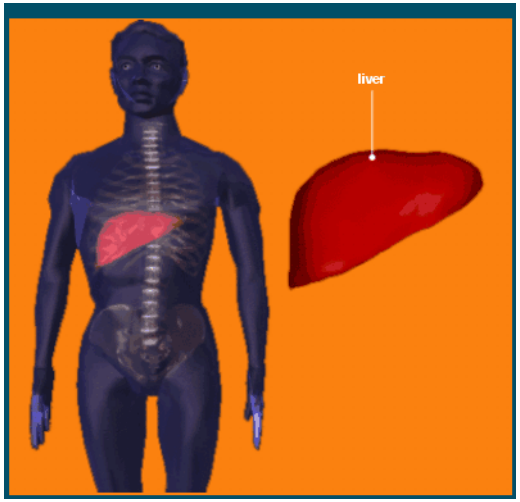
- **Reproduction:**

1. Sexually reproduction: in anopheles mosquito.
2. Asexual reproduction: in human (called ***sporozoans***) in which sporozones multiply to produce **merozoites**, these, in turn, become **trophozoits.**

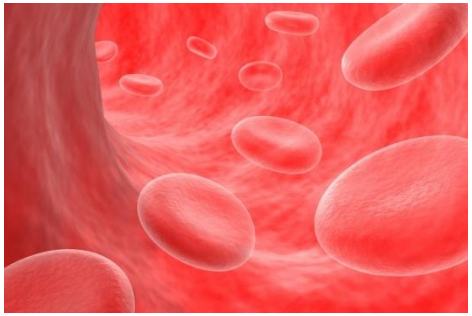
Life Cycle: *Plasmodium sp.*

Plasmodium develops in the gut of mosquito and is passed on in the saliva of an infected insect

Mosquito bite

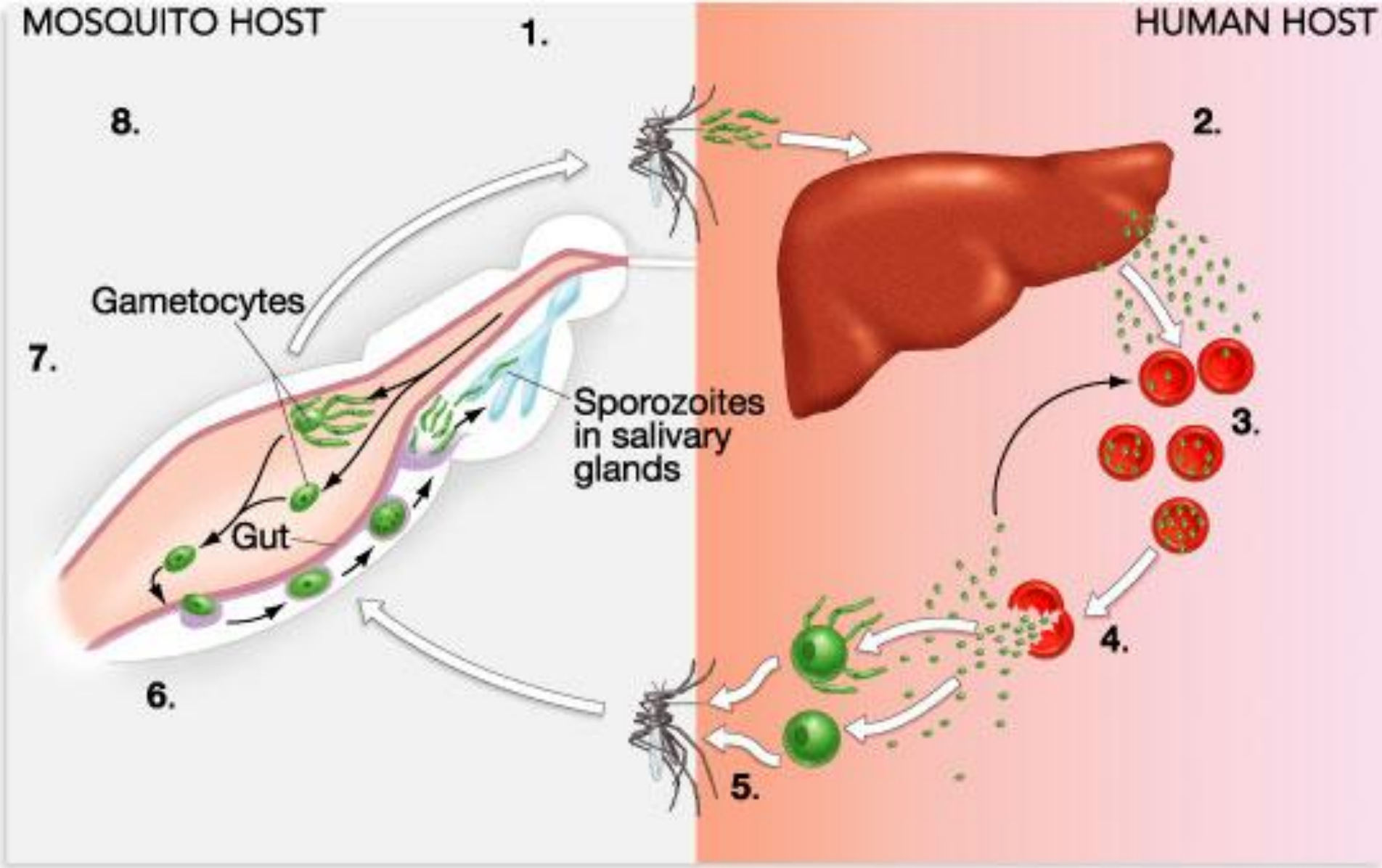


Sporozoites are carried by blood to the victim's liver where they form cyst-like structure containing thousands of merozoits



After 9-16 days they return to the blood and penetrate the red cells, where they multiply again, progressively breaking down the red cells

This induces bouts of fever and anemia in the infected individual. **In Cerebral Malaria**, the infected red cells obstruct the blood vessels in the brain. Other vital organs can also be damaged often leading to the death of the patient.


MOSQUITO HOST
HUMAN HOST
1.
2.
3.
4.
5.
6.
7.
8.
Gametocytes
Sporozoites in salivary glands
Gut

Plasmodium sp. (Malaria)

Pathology and Clinical Significance:

- When merozoits invade the blood cells, using hemoglobin as a nutrient, eventually, the infected red cells rupture, releasing merozoits that can invade other erythrocytes. If a large numbers of red cells rupture at roughly the same time, a paroxysm (sudden onset) of fever can result from the massive release of toxic substance.

- *Plasmodium falciparum* is the most dangerous species. *P. malriae, P. vivax,* and *P. ovale* cause milder form of the disease, probably because they invade either young or old red cells, but not both. *P. falciparum* invades cells of all ages.

- Infection with *Plasmodium falciparum* can lead to capillary obstruction and death if treatment is not introduced.

Toxoplama gondii

- **Disease is called: Toxoplasmosis**

- **Geographical Distribution:** world wide.
- **Reproduction:**

  1. Sexually reproduction: in Cats.

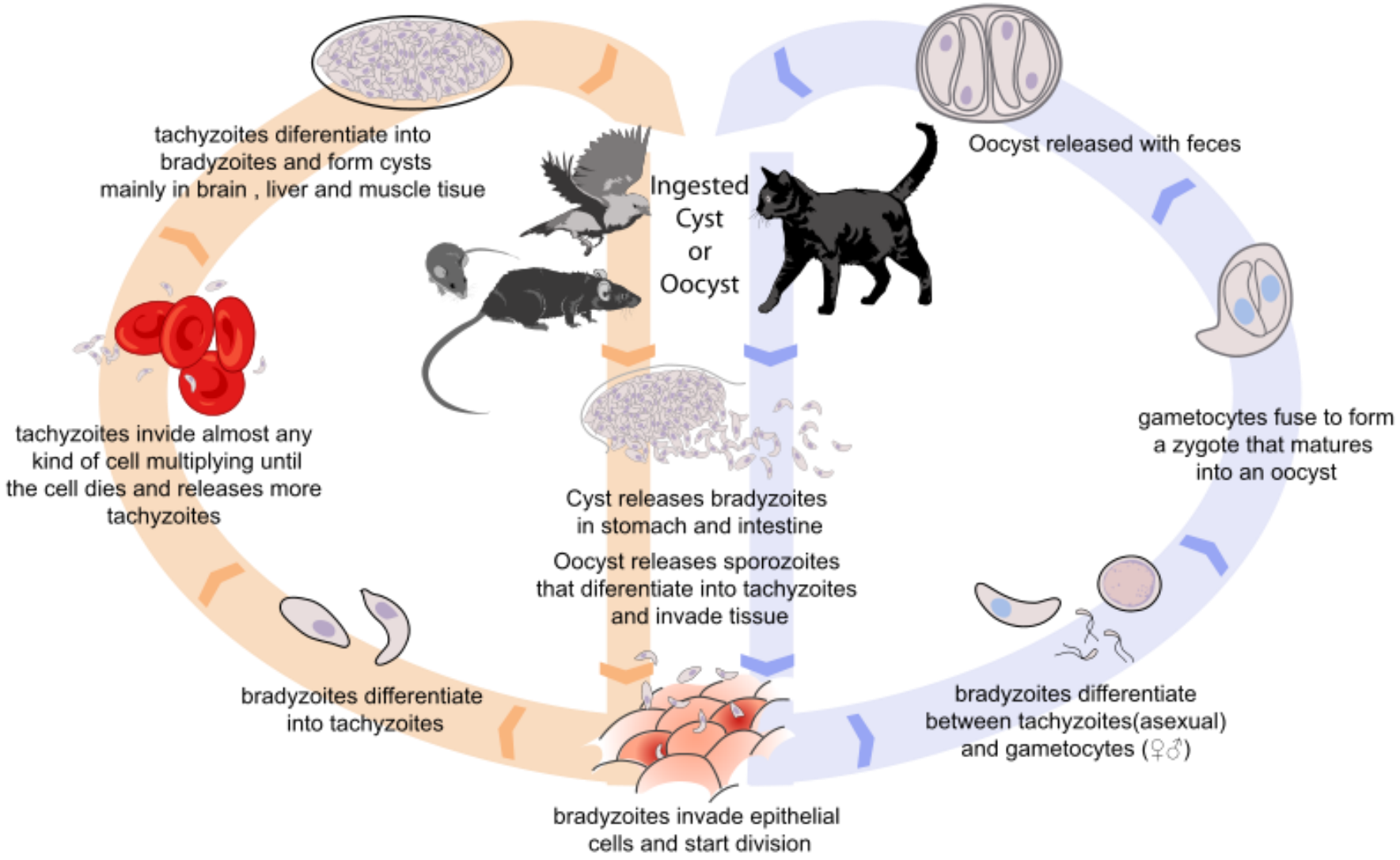
  2. Asexual reproduction: in worm blooded animals (cats, mice, humans, and birds).
- **Transmission:**

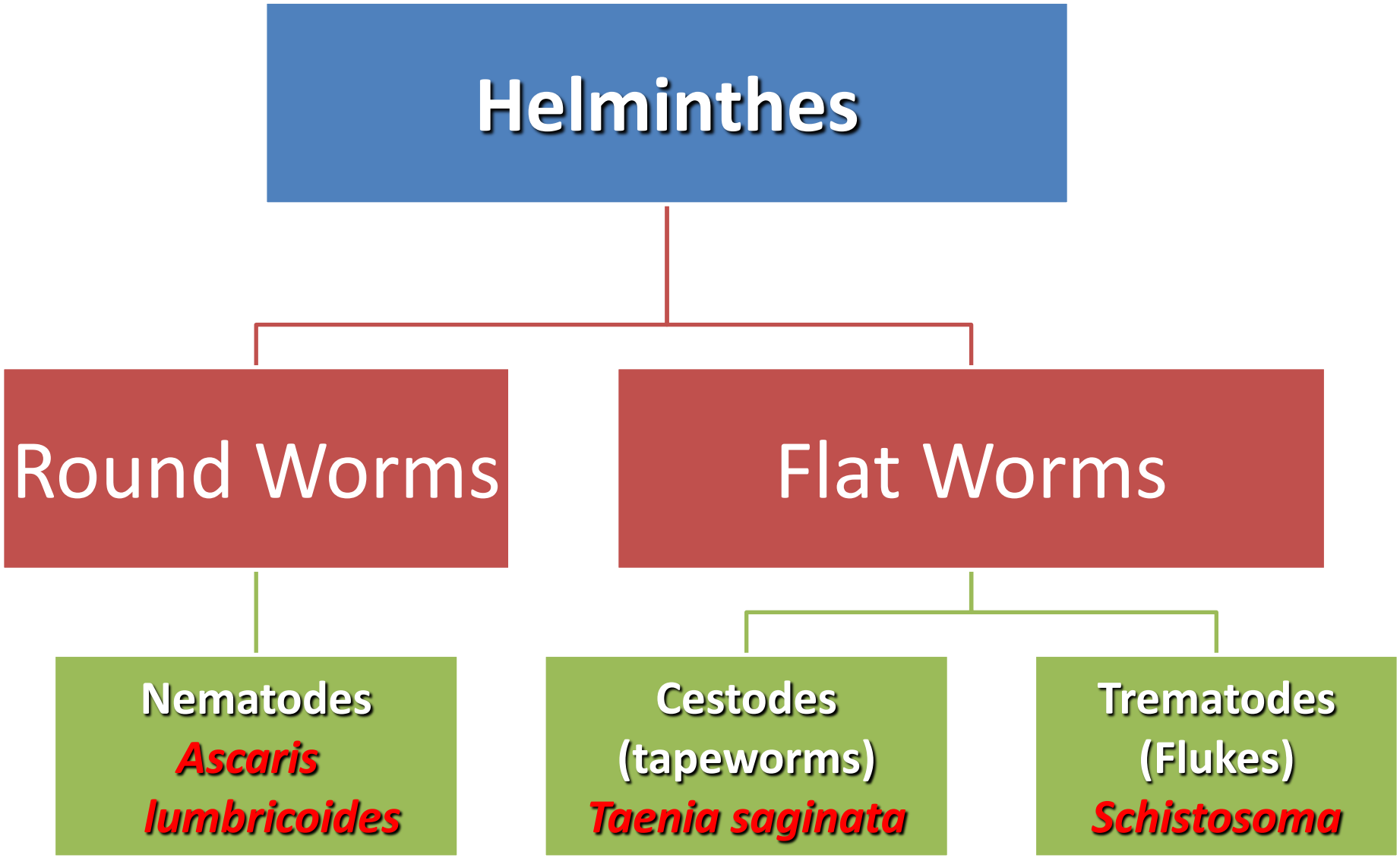
1. **Foodborne:** Eating row, undercooked meat containing viable trophozoits.
2. **Animal-to-Human:** Swallowing food and water contaminated with infected cat feces.
3. **Congenital:** through placenta (fatal) especially when infection occurs during pregnancy.
4. **Person to person:** blood transfusion or organ transmission.

- **Clinical Symptom:**

- Infection of normal human hosts are common and usually asymptomatic.
- The infection can be very sever in immunocompromised individuals, who may also suffer relapse of the infection.
- Congenital infections can also be sever, and they are the major cause of blindness, brain damage in newborns, miscarriage or stillborn baby.

Life Cycle: *Toxoplasma gondii*




Helminthes
Round Worms
Flat Worms
Nematodes
Ascaris
lumbricoides
Cestodes
(tapeworms)
Taenia saginata
Trematodes
(Flukes)
Schistosoma

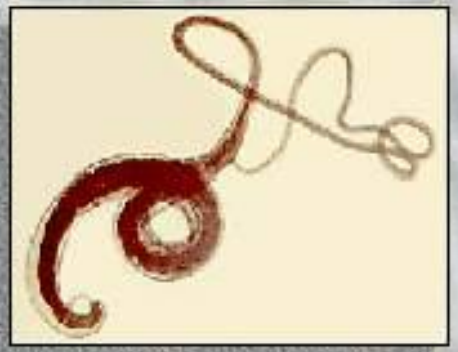
Nematodes

Round Worms

Are slender, worm-like animals, typically less than 2.5 millimeters long. The smallest nematodes are microscopic, while free-living species can reach as much as 5 centimeters and some parasitic species are larger still.

线虫
Nematode

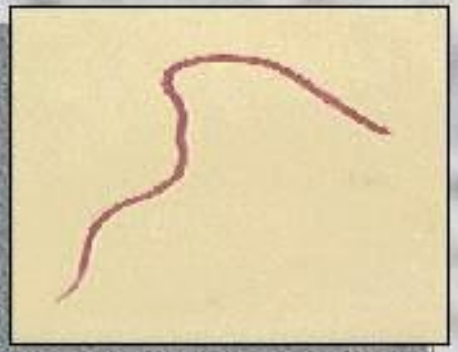
似蚓蛔线虫（蛔虫）
Ascaris lumbricoides



毛首鞭形线虫（鞭虫）
Trichuris trichiura

蠕形住肠线虫（蛲虫）
Enterobius vermicularis

钩 虫
Hookworm



旋毛形线虫（旋毛虫）
Trichinella spiralis

丝 虫
Filaria

Ascaris lumbricoides

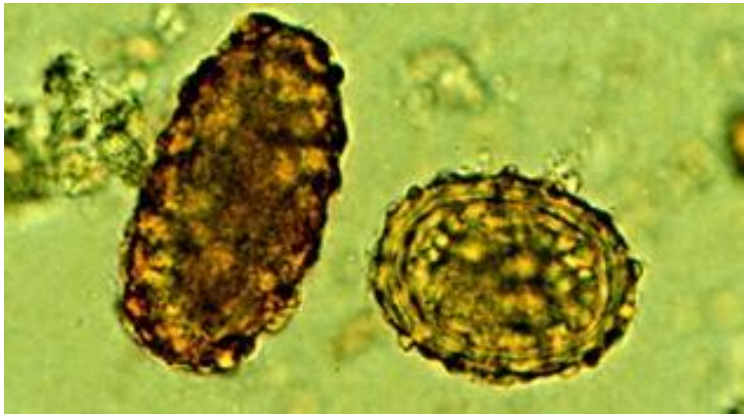
- *Ascaris lumbricoides* is the largest nematode parasitizing the human intestine.
- 1/3 the world population is infected with this worm.

- **Geographical distribution:** world wide, common among people with low standard of living and among children.

- **Morphology:**

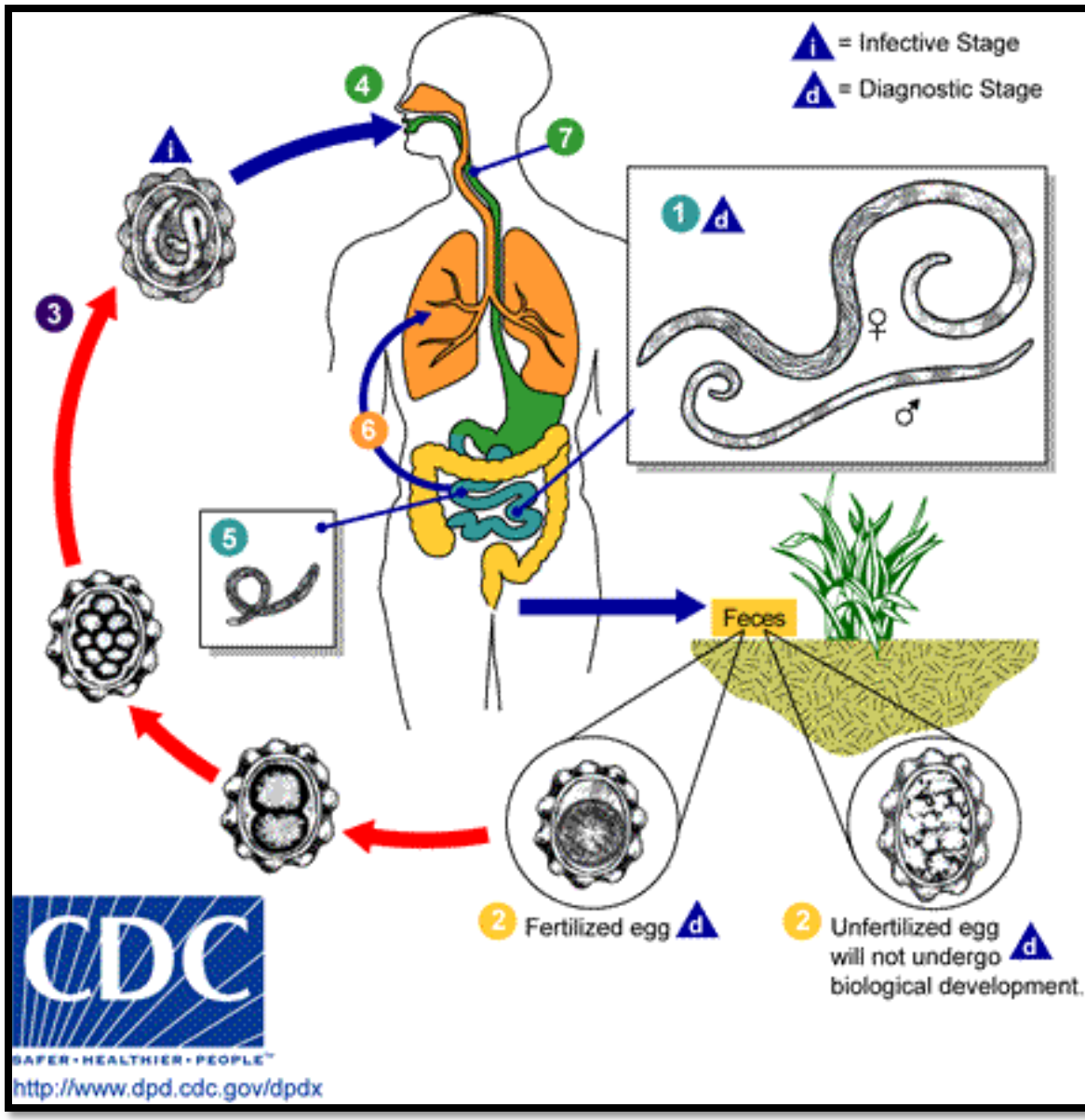
Adult: in small intestine

Egg: infective stage



Life Cycle: *Ascaris lumbricoides*

- **Disease is called: Ascariasis.**
- 2 phases: lung and intestinal.
- Egg ingested, hatches in duodenum; larvae penetrate intestine wall, enter blood vessels and goes through liver to lungs.
- They then migrate into airspaces, up trachea and are swallowed, taking up permanent adult residence in the small intestine; ~ 2 months from egg to mature adult.
- Each female produce 200,000 eggs per day.
- **Adult worms can live 1 to 2 years.**

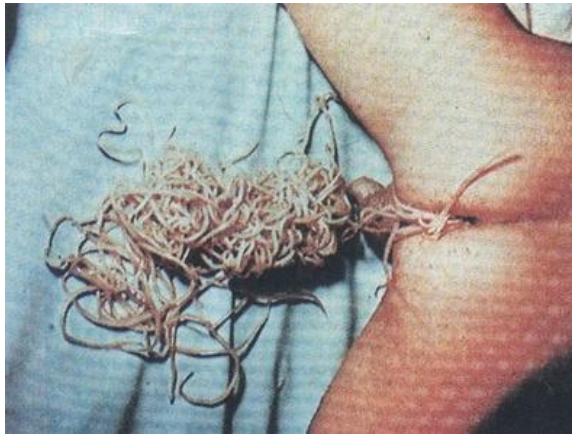


Clinical Symptoms: *Ascaris lumbricoides*

Lung phase

- *A.lumbricoides* is known as **Ascaris pneumonitis.**
- It causes hemorrhage, inflammation, bacterial infection.
- **Symptoms:** Bloody sputum, cough , wheezing, and fever.

Intestinal phase



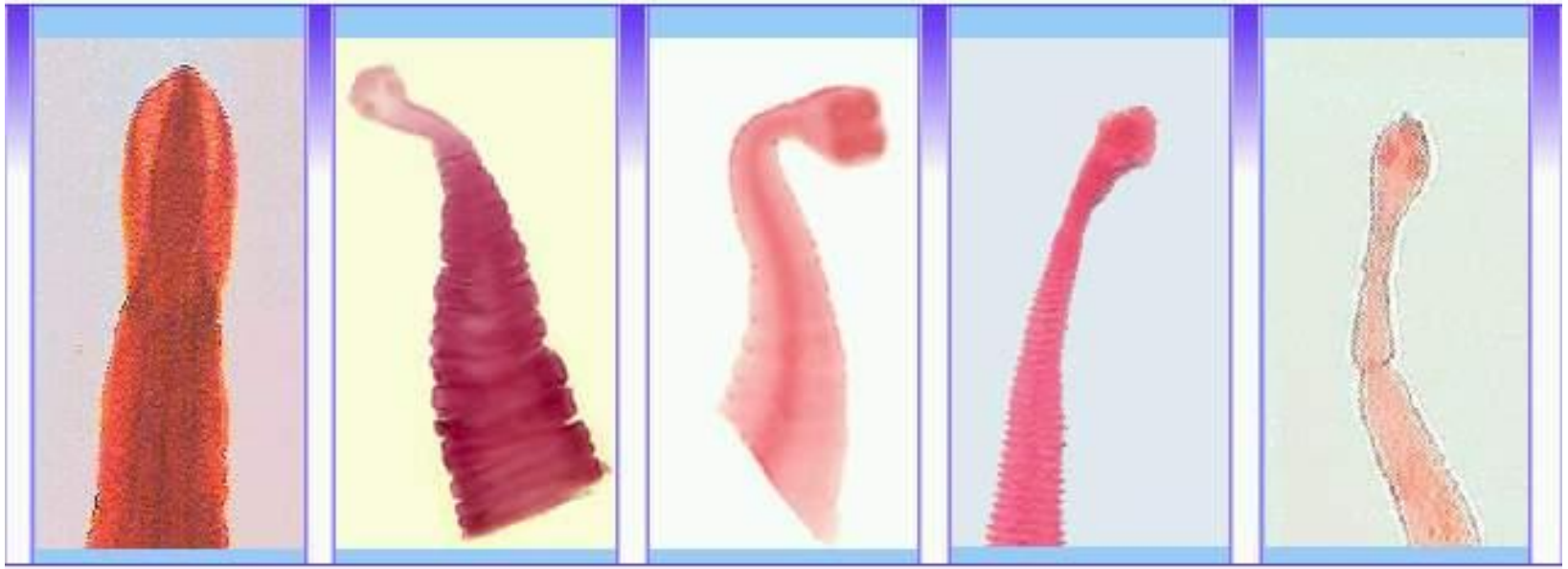
- **Symptoms:** Related to number of worms;
  Small numbers: asymptomatic.
  large numbers: Passing of worm in stool and vomit, nausea, and abdominal pain
- **Complications:** If untreated, can cause intestinal obstruction (blockage) and malnutrition.

Cestodes

Tapeworms

Are ribbon-shaped multi-segmented flatworms that dwell as adults entirely in the human small intestine. The larval forms lodge in skin, liver, muscles, the central nervous system, or any of various other organs

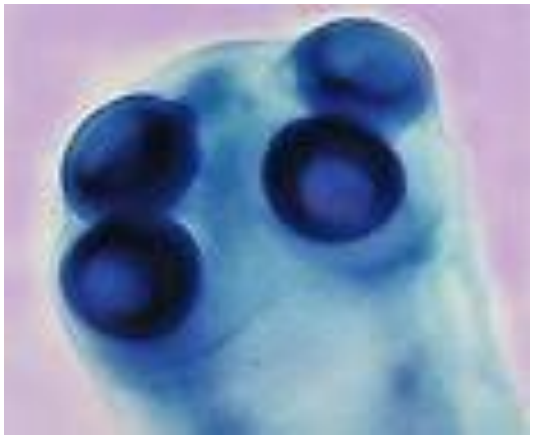
绦 虫
Tapeworm (cestode)



曼氏迭宫绦虫	链状带绦虫（猪带绦虫）	肥胖带绦虫（牛带绦虫）	微小膜壳绦虫	细粒棘球绦虫（包生绦虫）
Spirometra mansoni	Taenia solium	Taenia saginata	Hymenolpis nana	Echinococcus granulosus

Taenia saginata (Beef Tapeworms)

- **Habitat:** in the small intestine (the ileum).
- **Transmission:** acquired in humans through the ingestion of raw or poorly cooked meat of infected cows. These cows have been infected via the ingestion of human feces containing the eggs of the parasite.



- **Morphology:**

➢ **Adult** is divided into three parts,

1- Head: round and small. It has four suction disks.

2- Neck: A small, slender neck, about an inch long.

3- Number of Segments.

- Adult tapeworms can grow up to 25 meters in the lumen of the intestine, but are usually closer to 5 meters in length.

➢ **Egg**

Taenia saginata

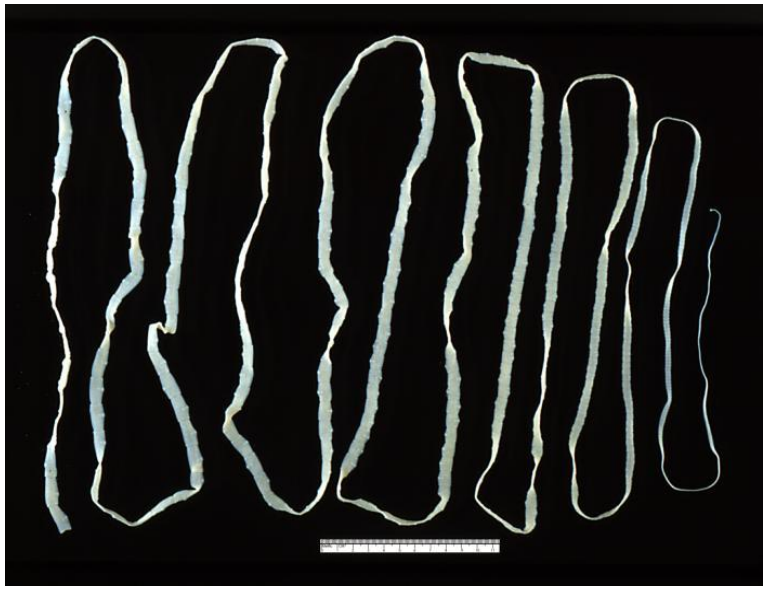
Hosts:

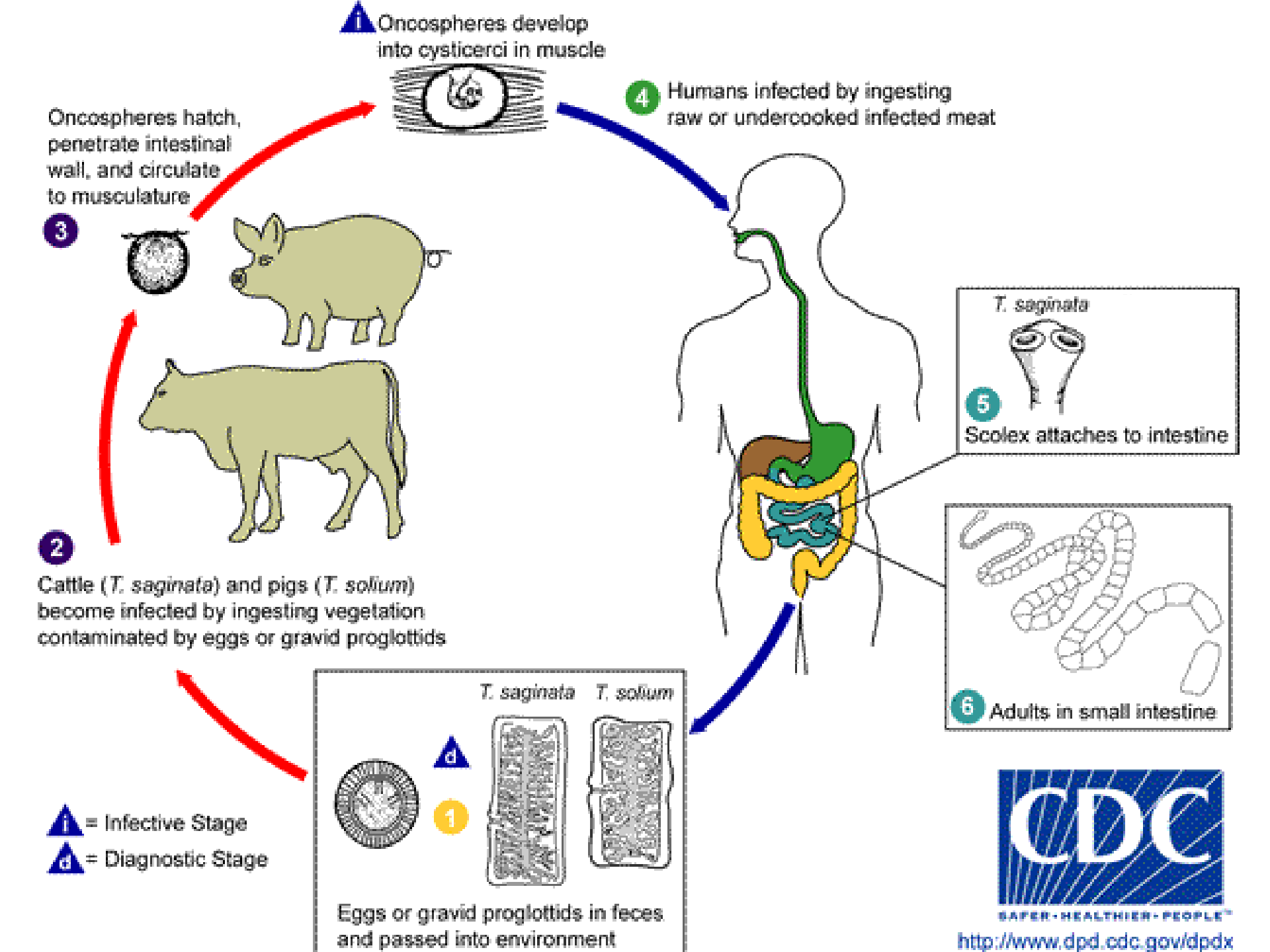
- **Adult** in small intestine of human only.
- **Egg** in feces of human.
- **Larva stage** in muscle of thigh, shoulder, neck and heart of cattle. (intermediate host)

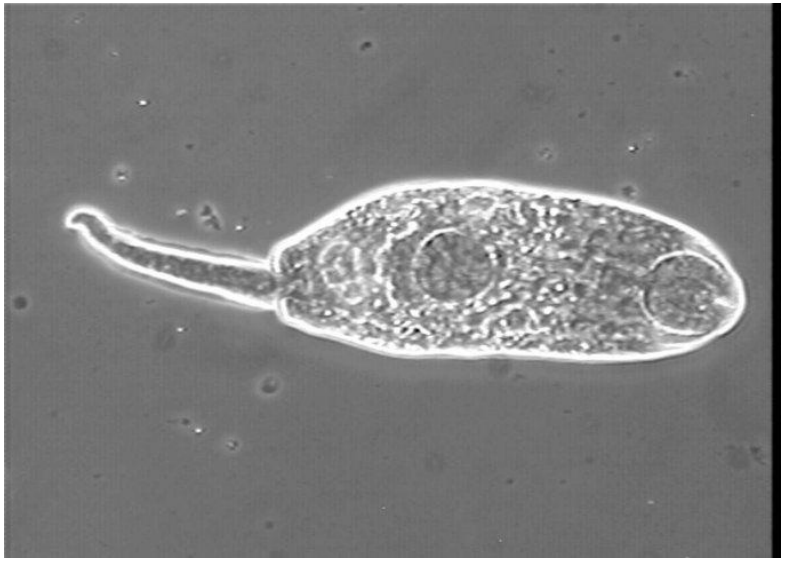
Clinical symptoms:

- Usually asymptomatic.
- Heavy infection causes: diarrhea, vomiting, loss of appetite, nausea, headache, and constipation.

Disease is called: Teniasis.




i 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
T. saginata
5 Scolex attaches to intestine
2 Cattle (T. saginata) and pigs (T. solium) become infected by ingesting vegetation contaminated by eggs or gravid proglottids
6 Adults in small intestine
T. saginata
T. solium
d
1
Eggs or gravid proglottids in feces and passed into environment
i = Infective Stage
d = Diagnostic Stage
CDC
SAFER·HEALTHIER·PEOPLE™
http://www.dpd.cdc.gov/dpdx



Trematodes

Flukes

Are flattened oval or worm-like animals, usually no more than a few centimeters in length, although species as small as 1 millimeter and as large as 7 meters are known. Their most distinctive external feature is the presence of two suckers, one close to the mouth, and the other on the underside of the animal.

吸 虫
Trematode

华枝睾吸虫（肝吸虫）	布氏姜片虫（肠吸虫）	卫氏并殖吸虫（肺吸虫）	斯氏狸殖吸虫	日本血吸虫（血吸虫）
Clonorchis sinensis	Fasciolopsis buski	Paragonimus westermani	Pagumogonimus skrjabini	Schistosoma japonicum

Schistosoma spp.

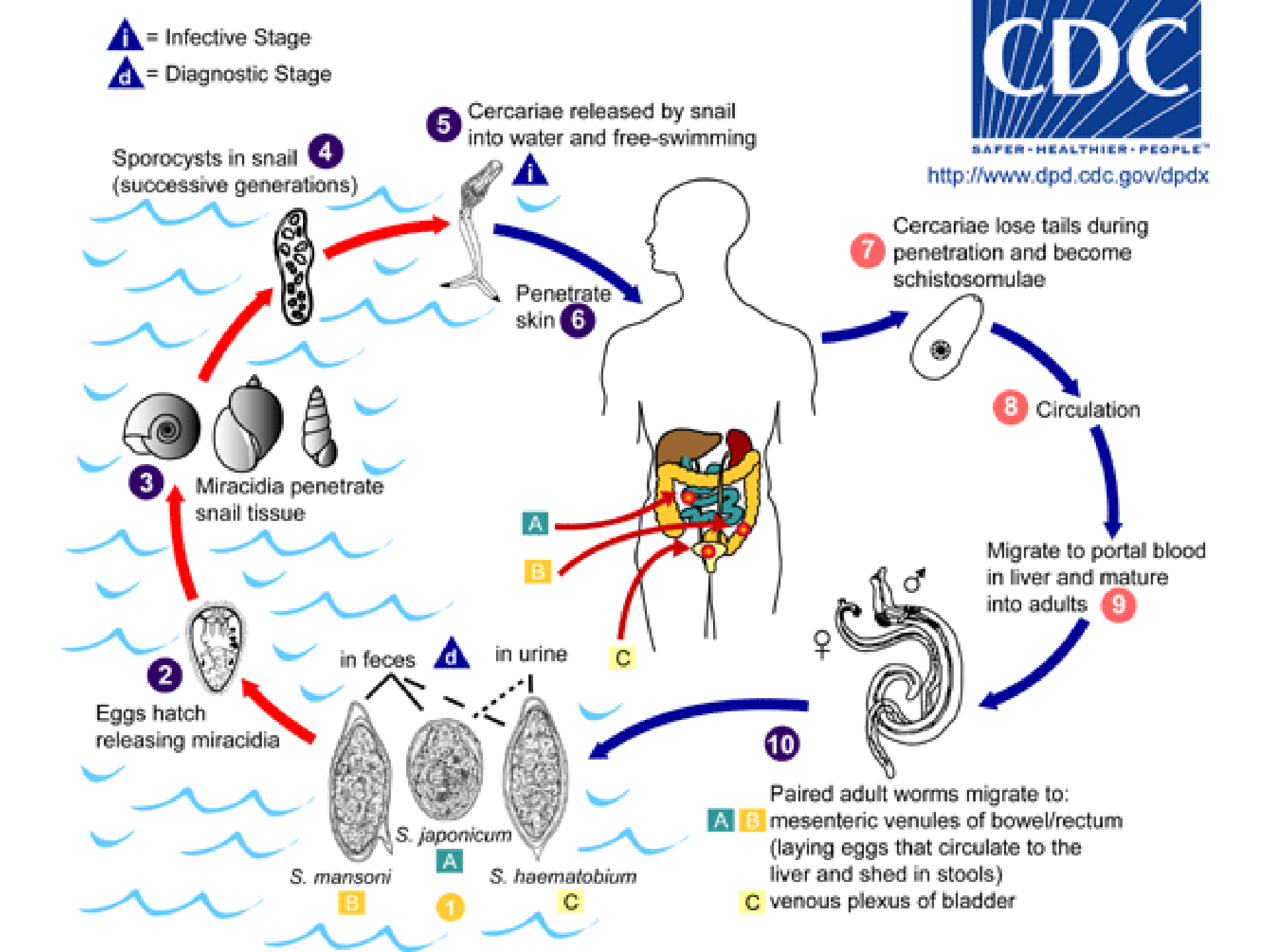
- **The disease is called: Bilharzia or schistosomiasis.**

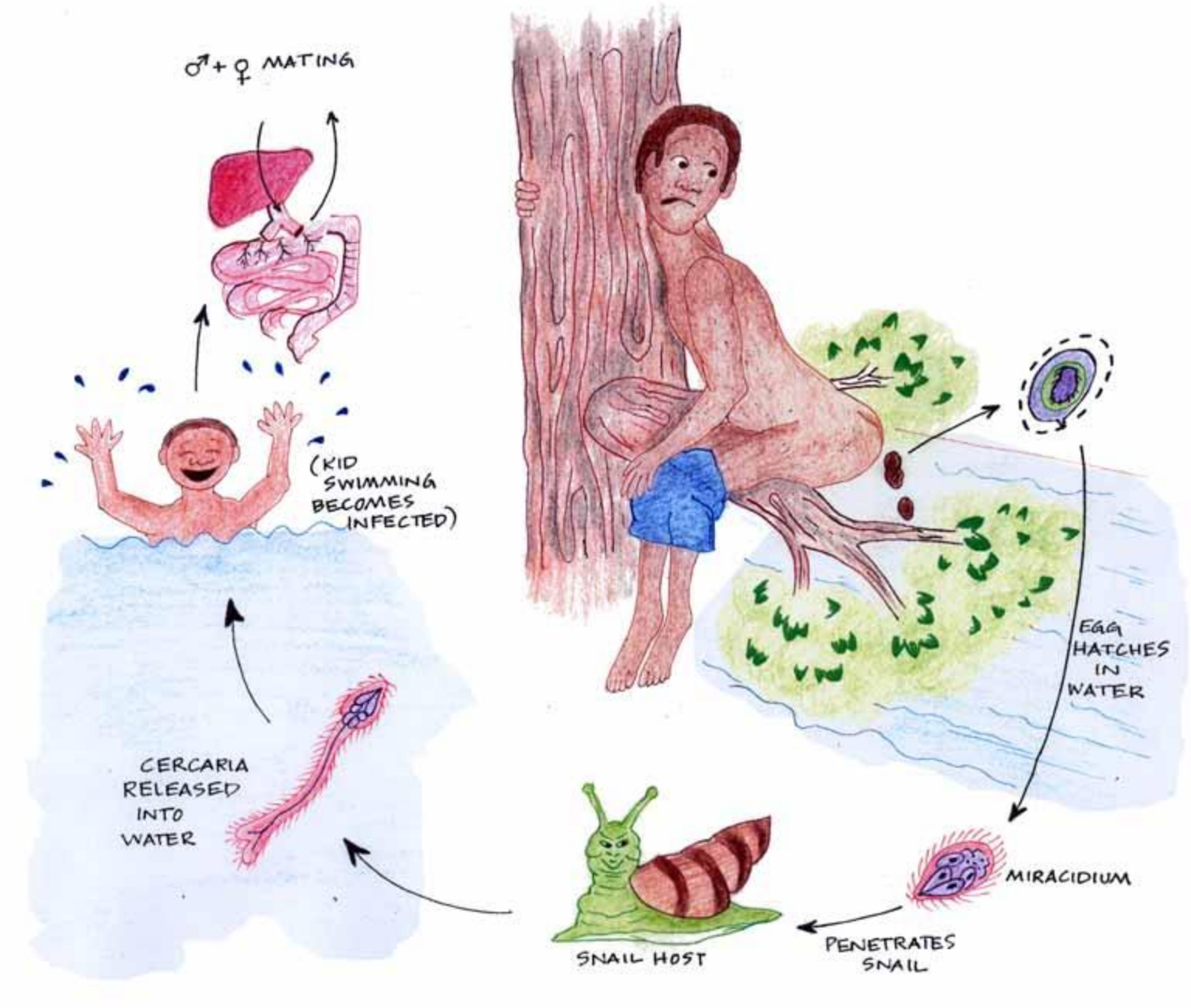
- Disease of the **venous system**, acquired by people when they come in contact with contaminated water.
- **Habitat:** Adult Schistosomes are present in the abdominal veins; they are, therefore called **(Blood Flukes).**
- Very common among children
- **Geographical Distribution:** developing countries, affects up to 200 million people.

- **Transmission:** ***"Direct skin penetration"***

  Fresh water becomes contaminated by Schistosoma eggs when infected people urinate or defecate in the water. The eggs hatch and the parasites grow and develop inside snails.

➢ Schistosoma is **NOT acquired by ingestion of contaminated food**, it directly penetrates the skin of swimmers in contaminated rivers and lakes.


i = Infective Stage
d = 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
3 Miracidia penetrate snail tissue
A
B
C
Migrate to portal blood in liver and mature into adults 9
in feces
d
in urine
2 Eggs hatch releasing miracidia
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
A
S. mansoni
B
S. haematobium
C
1


♂+♀ MATING
(KID SWIMMING BECOMES INFECTED)
EGG HATCHES IN WATER
MIRACIDIUM
PENETRATES SNAIL
SNAIL HOST
CERCARIA RELEASED INTO WATER

Bilharzia (*Schistosomiasis*)

Common Symptoms:

- Most people have no symptoms when they are first infected.
- After few days, rash or itchy skin.
- Within 1-2 months, symptoms may develop including fever, chills, cough, and muscle aches.

Chronic Schistosomiasis:

- Without treatment, schistosomiasis can persist for years.
- **Symptoms:**

  - Intestinal: GI bleeding, diarrhea, pain, and enlarged liver.

  - Urinary Tract: Heamaturia (blood in urine) and dysuria (painful urination).