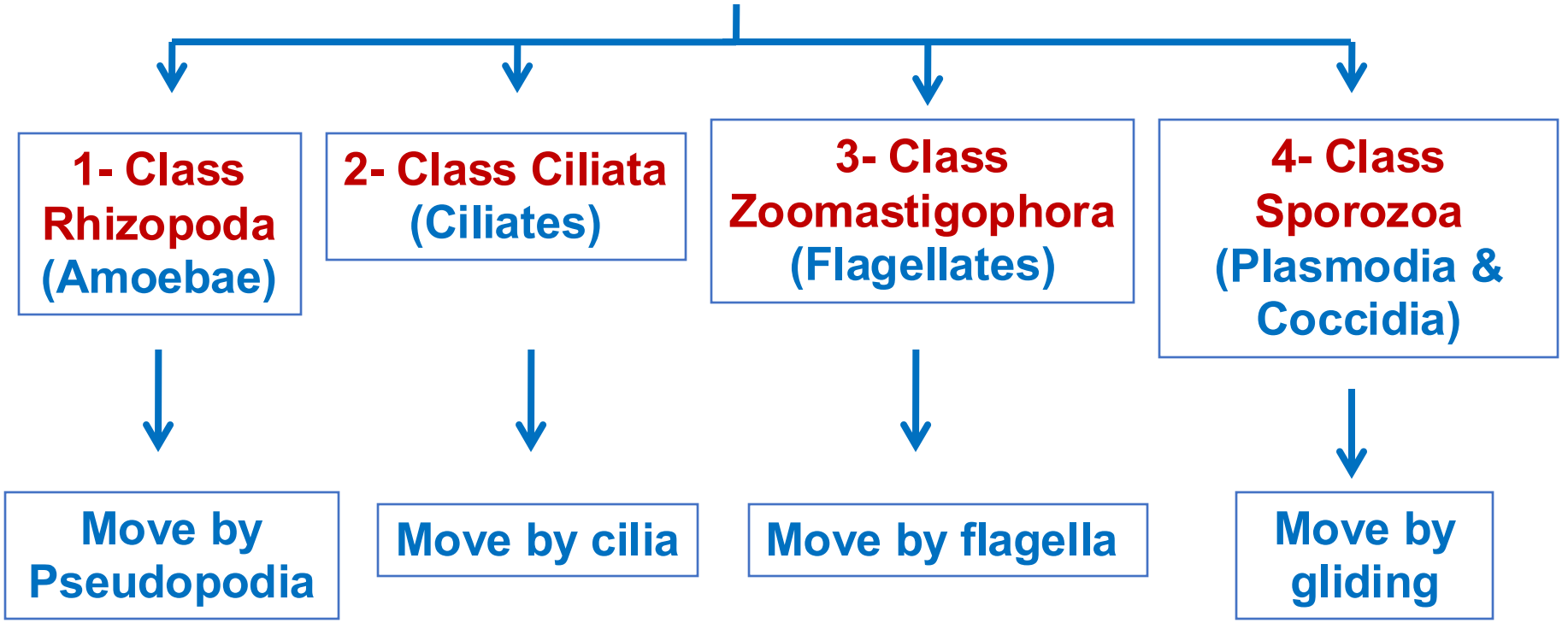
Protozoal Infections

By: Nader Alaridah MD, PhD

Classification of Phylum Protozoa

1- According to the organ of locomotion



2- According to the habitat

1- Intestinal protozoa

- **Amoeba:**
  - *Entamoeba histolytica*
- **Ciliates:**
  - *Blantidium coli*
- **Flagellates:**
  - *Giardia lamblia*
- **Coccidia:**
  - *Cryptosporidium*

2- Blood protozoa

- **Flagellates:**
  - *Trypanosoma & Leishmania*
- **Plasmodia:**
  - Malaria
- **Coccidia:**
  - *Babesia*

3- Tissue protozoa

- **Flagellates:**
  - *Trypanosoma & Leishmania*
- **Coccidia:**
  - *Toxoplasma & Sarcocystis*

5- Urogenital protozoa

- **Flagellates:**
  - *Trichomonas vaginalis*

INTESTINAL PROTOZOAN INFECTIONS

Class: Rhizopoda (Amoebae)

1- Amoebae of large intestine

- *Entamoeba histolytica* (The only pathogenic)
- *Entamoeba coli.*

2- Amoeba of buccal cavity

Entamoeba gingivalis

3- Free living amoebae

Pathogenic free living amoebae

Naegleria fowleri & *Acanthamoeba*

Non pathogenic free living amoebae

Coprozoic amoebae

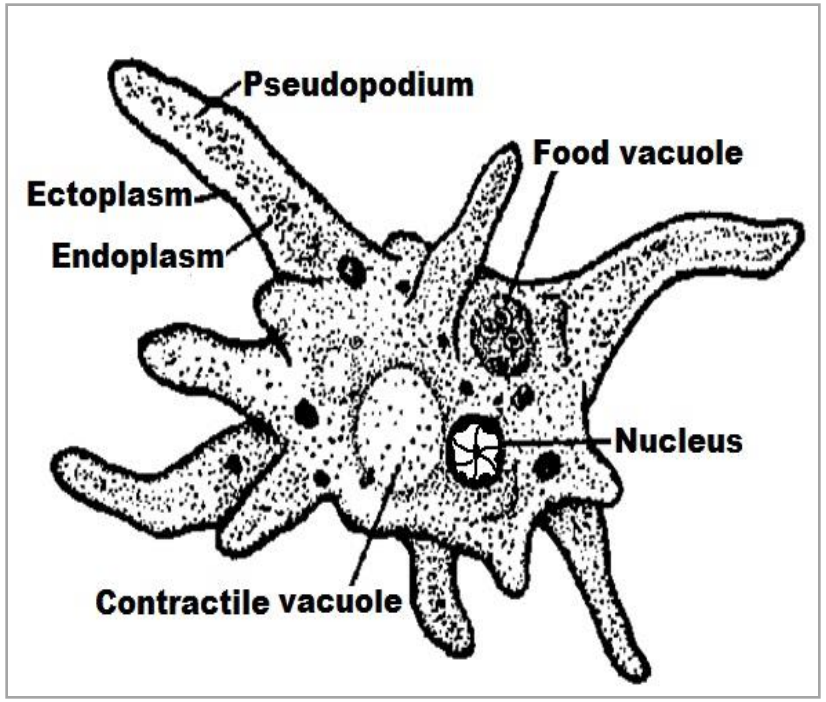
✍**N.B.** Other species of amoebae are commensals in the large intestine such as ***E. hartmani*** & ***E. dispar*** & are morphologically similar to ***E. histolytica.*** So **PCR** is required to differentiate bet. amoebae species.

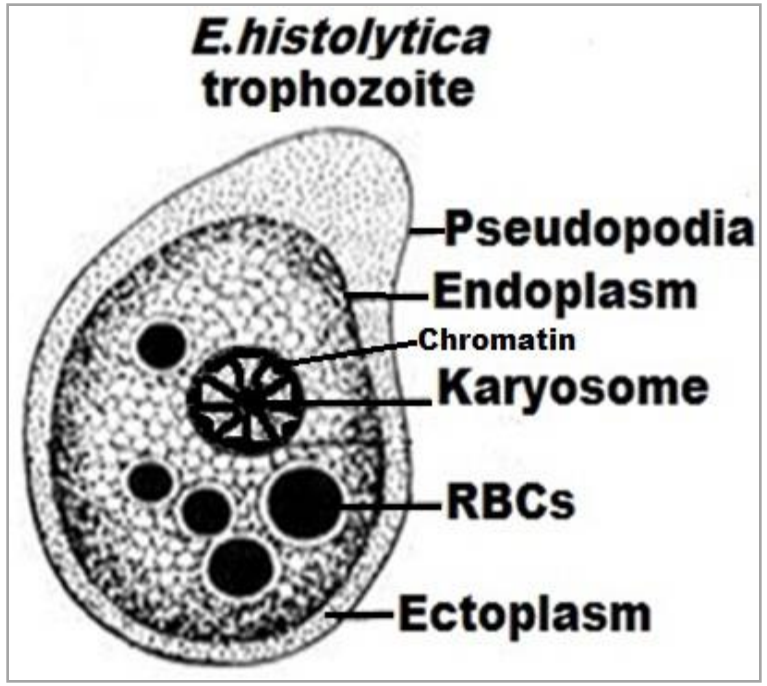
Entamoeba histolytica

- **Geographical distribution:** Worldwide especially in the temperate zone and more common in areas with poor sanitary conditions.
- **Habitat:** Large intestine (caecum, colonic flexures and sigmoidorectal region).
- **D.H:** Man
- **R.H:** Man, Dogs, pigs, rats and monkeys.
- **Disease:** Amoebiasis or amoebic dysentery

Morphological characters

1- Trophozoite stage (Vegetative form or tissue form):



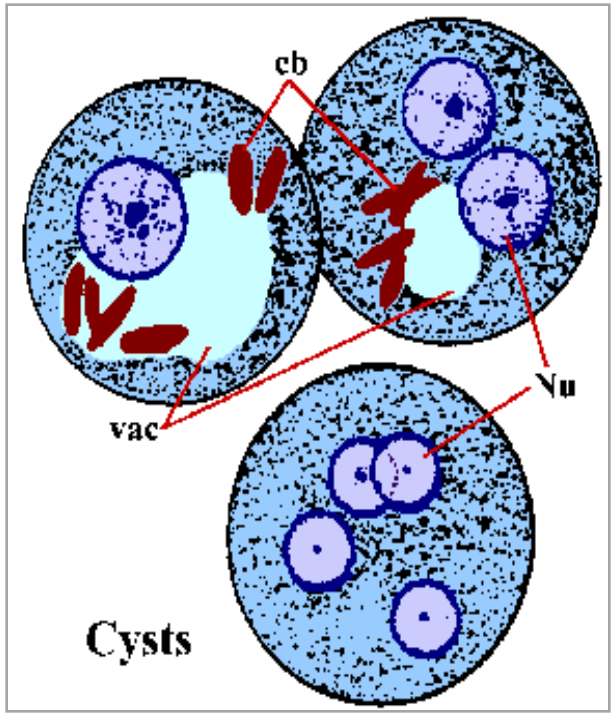


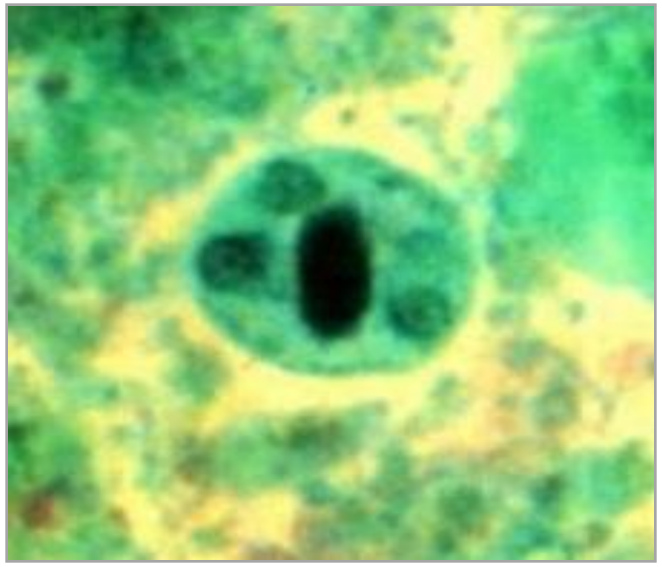
2- Cyst stage (Luminal form):

(a) Immature cyst (Uninucleate cyst and Binucleate cyst):

- ❖Uninucleate cyst (one nucleus)
- ❖Binucleate cyst (2 nucleus)

b) Mature cyst (Quadrinucleate cyst)





Mode of infection

1- Contaminated foods (ex. green vegetables) or drinks or hands with human stool containing mature cyst.

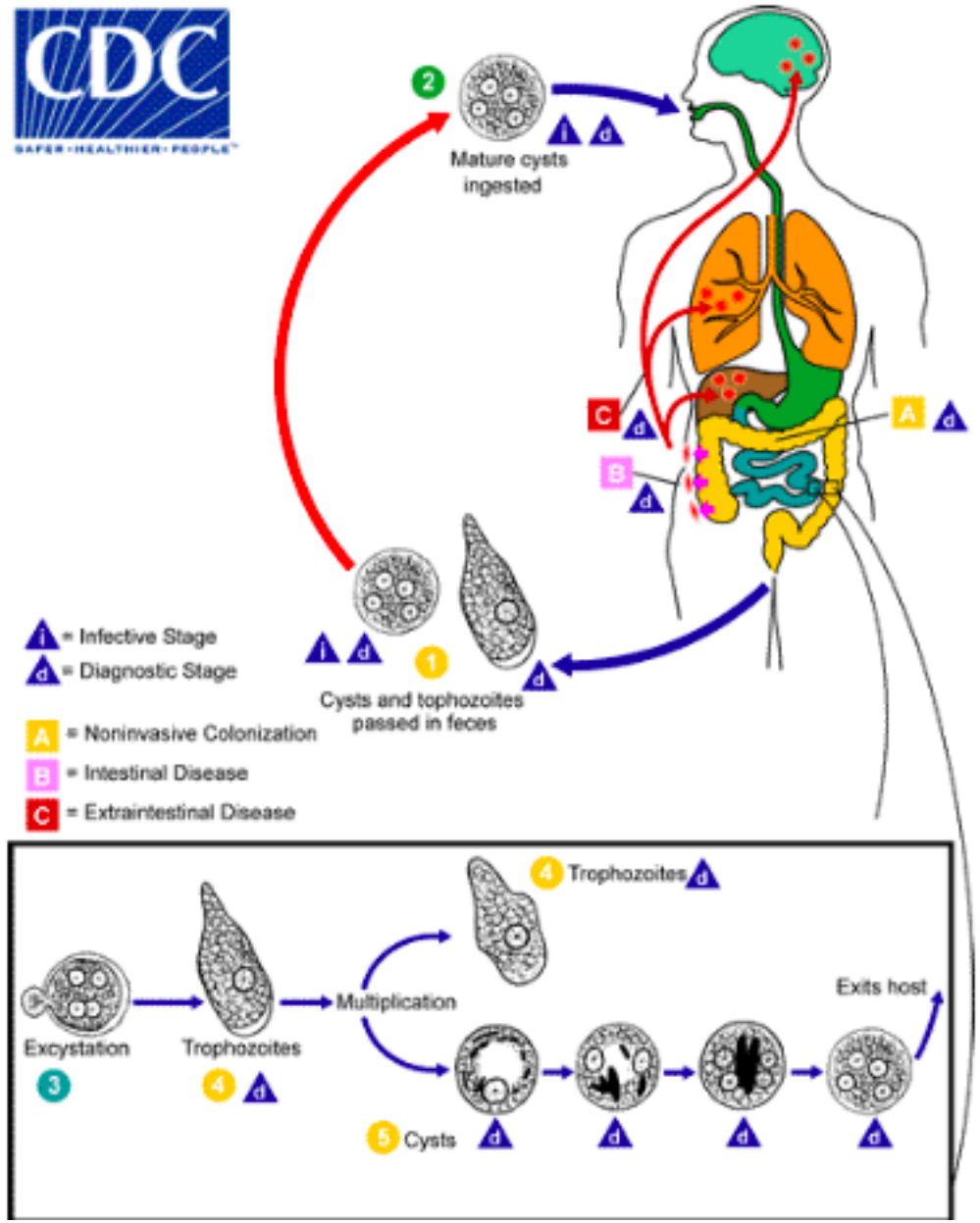
2- Handling food by infected food handlers as cookers and waiters.

3- Flies and cockroaches that carry the cysts from faeces to exposed food.

4- Autoinfection (faeco-oral or hand to mouth infection).

5- Homosexual transmission.

Life Cycle


CDC
SAFER·HEALTHIER·PEOPLE
2
Mature cysts ingested
i d
C d
A d
B d
i d
1
d
Cysts and tophozoites passed in feces
i = Infective Stage
d = Diagnostic Stage
A = Noninvasive Colonization
B = Intestinal Disease
C = Extraintestinal Disease
4 Trophozoites d
Multiplication
Exits host
Excystation
3
Trophozoites
4 d
5 Cysts
d
d
d
d

Clinical pictures

I) Intestinal amoebiasis

1-Asymptomatic infection

Most common and trophozoites remain in the intestinal lumen feeding on nutrients as a commensal without tissue invasion (Asymptomatic patient known as a healthy carrier and cyst passers)

2-Symptomatic infection

a) Acute amoebic dysentery

Presented with fever, abdominal pain, tenderness, tenesmus (difficult defecation) and frequent motions of loose stool containing mucus, blood and trophozoites.

b) Chronic infection

-Occurs if acute dysentery is not properly treated.
-With low grade fever, recurrent episodes of diarrhea alternates with constipation.
- Only cysts are found in stool.

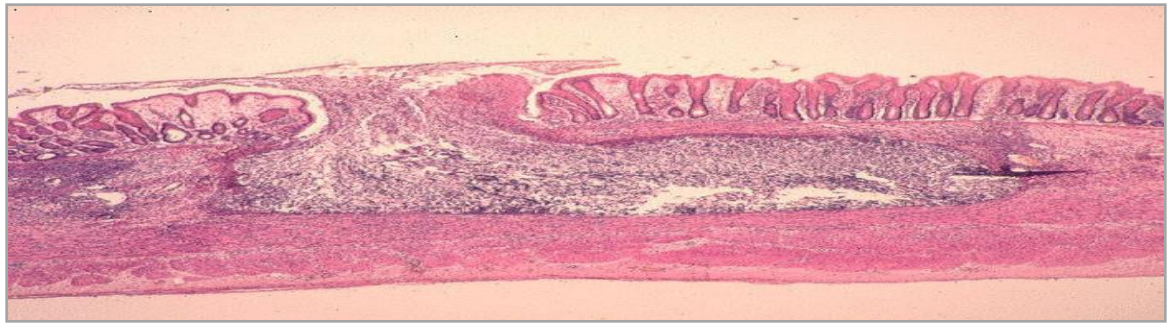
3-Complications

- Haemorrhage due to erosion of large blood vessels.
- Intestinal perforation ➲ peritonitis.
- Appendicitis.
- Amoeboma (Amoebic granuloma) around the ulcer ➲ stricture of affected area.

With heavy infection and lowering of host immunity

The trophozoites of *E. histolytica* invade the mucosa and submucosa of the large intestine by secreting lytic enzymes ➲ amoebic ulcers

The ulcer is flask- shaped with deeply undermined edges containing cytolyzed cells, mucus and trophozoites.



The most common sites of amoebic ulcers are caecum, colonic flexures and sigmoidorectal regions due to decrease peristalsis & slow colonic flow at these sites that help invasion.

II) Extra-intestinal amoebiasis

Due to invasion of the blood vessels by the trophozoites in the intestinal ulcer ➲ reach the blood ➲to spread to different organs as:

→ **Liver** →

-Amoebic liver abscess or diffuse amoebic hepatitis.
-Affect commonly right lobe either due to spread via portal vein or extension from perforating ulcer in right colonic flexure.
-CP: include fever, hepatomegaly and pain in right hypochondrium.

→ **Lung** →

•Lung abscess ➲ pneumonitis with chest pain, cough, fever.
•Amoebic lung abscess usually occur in the lower part of the right lung due to direct spread from the liver lesions through the diaphragm or very rarely trophozoites may reach the lung via blood.

→ **Brain** → Brain abscess ➲ encephalitis (fatal).

→ **Skin** → **Cutaneous amoebiasis (Amoebiasis cutis) due to either extension of acute amoebic colitis to the perianal region or through rupture on the abdominal wall from hepatic, colonic or appendicular lesions.**

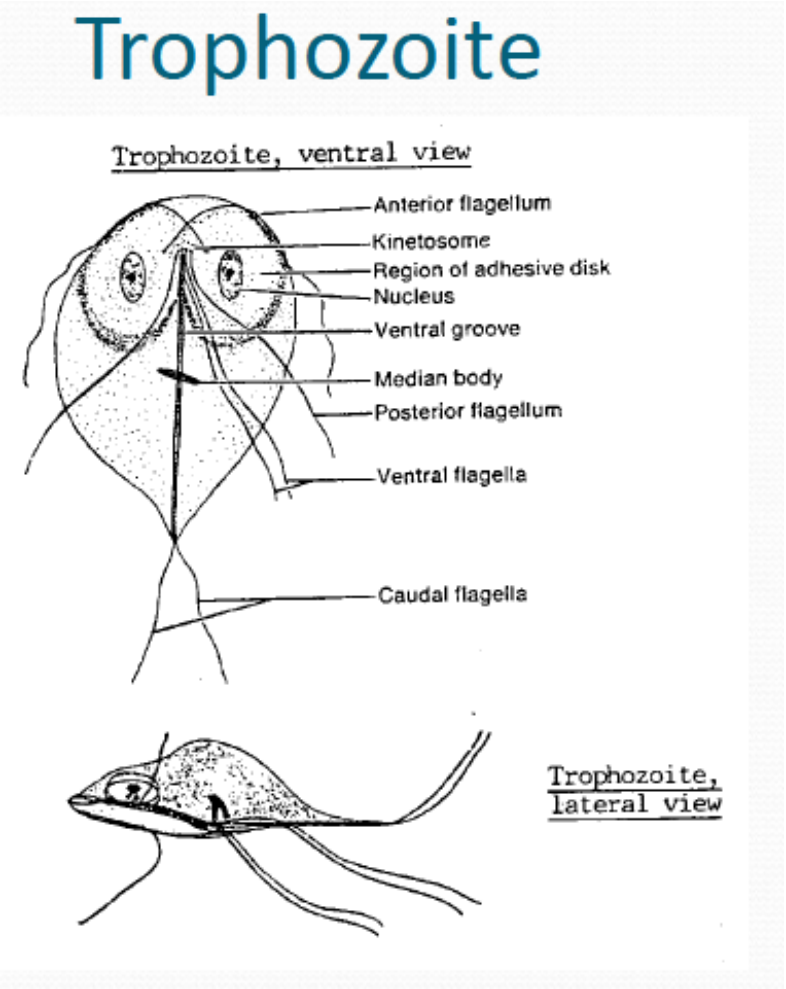
GIARDIA LAMBLIA (INTESTINAL FLAGELLATE)

- Giardia lamblia (also referred to as Giardia duodenalis or Giardia intestinalis) is the causative agent of giardiasis and is the only common pathogenic protozoan found in the duodenum and jejunum of humans.

- Giardia exists in two forms: the trophozoite and the cyst forms.

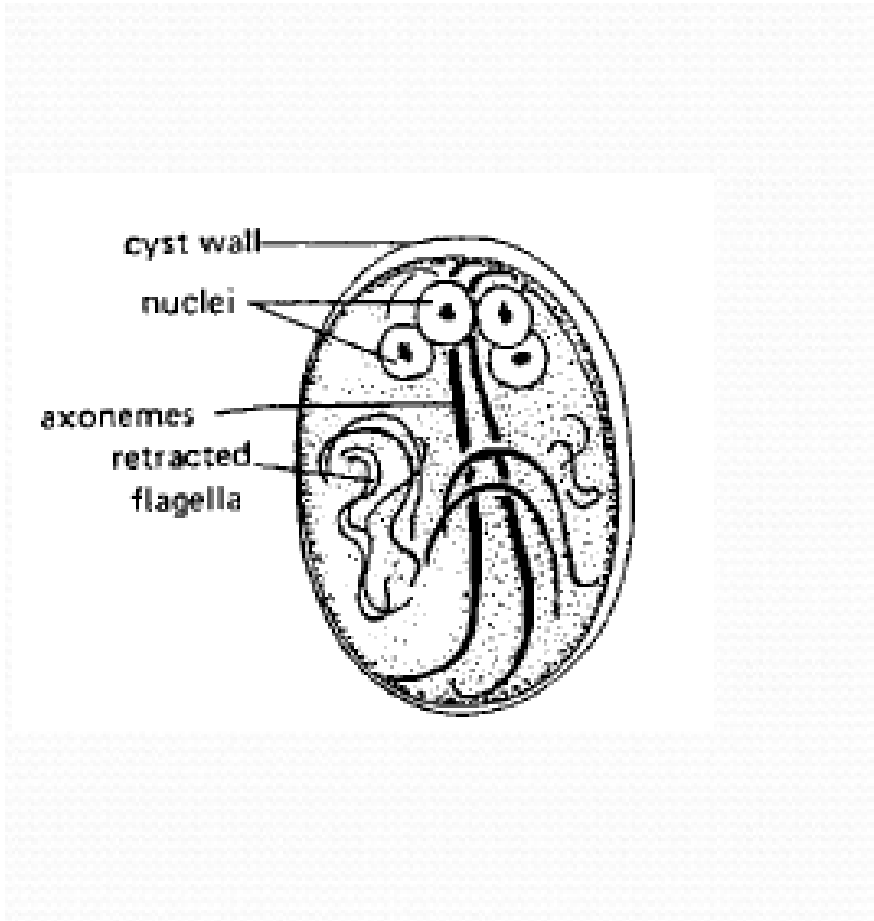
Giardia lamblia : Morphology

- The trophozoite of G lamblia is a heart-shaped organism, has four pairs of flagella, 2 nuclei with prominent central karyosome, 2 axostyles and is approximately 15 µ m in length.
- A large concave sucking disk on the ventral surface helps the organism to adhere to intestinal villi. As the parasites pass into the colon, they typically encyst, and the cysts are passed in the stool.
- The swaying or dancing motion of the trophozoits in fresh preparations is unmistakable .



- Cysts are found in the stool –often in enormous numbers. As the parasites pass into colon they typically encyst.

- They are ellipsoid, thick-walled, highly resistant, and 8–14 µ m in length; they contain two nuclei as immature forms and four as mature cysts.



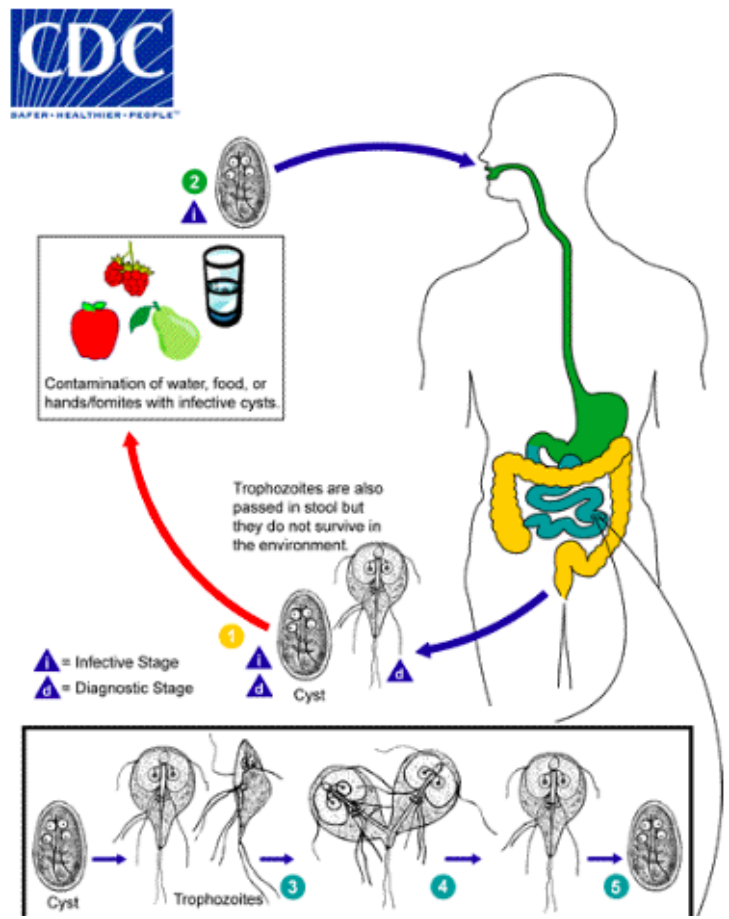
Pathology and Pathogenesis

- Giardia lamblia is usually only weakly pathogenic for humans.
- Cysts may be found in large numbers in the stools of entirely asymptomatic persons.
- In some persons, however, large numbers of parasites attached to the bowel wall may cause irritation and low-grade inflammation of the duodenal or jejunal mucosa, with consequent acute or chronic diarrhea associated with crypt hypertrophy, villous atrophy or flattening, and epithelial cell damage.

Transmission

- Humans are infected by ingestion of fecally contaminated water or food containing giardia cysts or by direct fecal contamination, as may occur in day care centers, refugee camps, and institutions, or during oral–anal sex.
- Epidemic outbreaks have been reported at resorts, where overloading of sewage facilities or contamination of the water supply has resulted in sudden outbreaks of giardiasis.
- Cysts can survive in water for up to 3 months

Life Cycle:


CDC
SAFER·HEALTHIER·PEOPLE™
Contamination of water, food, or hands/fomites with infective cysts.
Trophozoites are also passed in stool but they do not survive in the environment.
= Infective Stage
= Diagnostic Stage
Cyst
Cyst
Trophozoites

GIARDIASIS: CLINICAL ASPECTS

- The spectrum varies from asymptomatic carriage to severe diarrhea and malabsorption. Subclinical infections common in endemic areas.

- In acute outbreaks , Stools may be watery, semisolid, greasy, bulky, and foul smelling at various times during the course of the infection.

- The diagnosis of giardiasis is made by finding the cyst in formed stool or the trophozoite in diarrheal stools, duodenal secretions, or jejunal biopsy specimens.

- Commercially available, enzyme immunoassays(EIAs) detect Giardia antigen in stool

CRYPTOSPORIDIUM (INTESTINAL SPOROZOA)

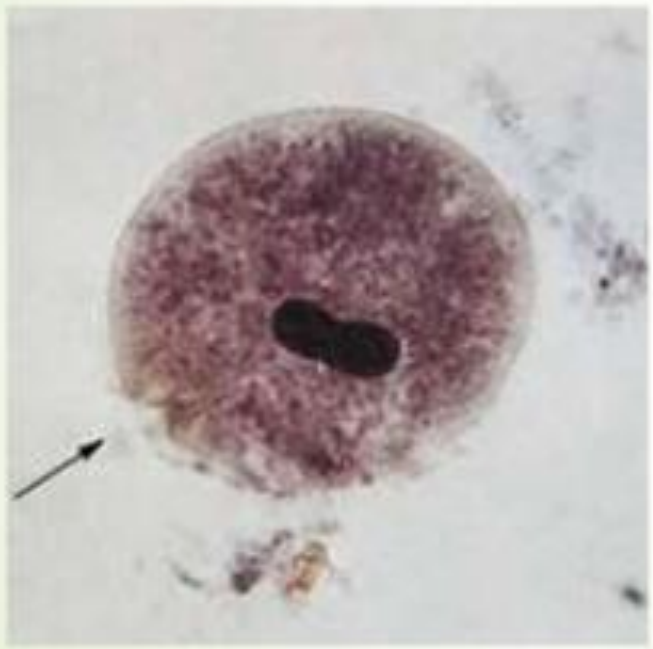
- Cryptosporidium species, typically C hominis, C parvum can infect the intestine in immunocompromised persons (eg, those with AIDS) and cause severe, intractable diarrhea.
- They have long been known as parasites of rodents, fowl, rhesus monkeys, cattle, and other herbivores and have probably been an unrecognized cause of self-limited, mild gastroenteritis and diarrhea in humans.
- Cryptosporidium inhabits the brush border of mucosal epithelial cells of the gastrointestinal tract, especially the surface of villi of the lower small bowel

Clinical aspects

- Clinically , range from self-limited watery diarrhea (immunocompetent) to chronic, severe, non-bloody diarrhea with nausea, vomiting, abdominal pain, and anorexia resulting in weight loss and death (immunocompromised).
- Diagnosis depends on detection of oocysts in fresh stool samples.
- Stool concentration techniques using a modified acid fast stain are usually necessary. stool antigen detection by direct fluorescent antibody or EIA tests are now commercially available.
- Nitozoxanide, a synthetic drug, has been approved for use in all patients over 1 year of age in the United States and is reported to have a cure rate of 72% to 88% by the CDC .

Balantidium coli (Intestinal Cilliated protozoa)

- It causes balantidiasis or balantidial dysentery, is the largest intestinal protozoa of humans.
- The trophozoite is ciliated oval organism 60 X 45 µ m or larger. It has a steady progression and rotation around the long axis motion.
- Most infections are apparently harmless. However, rarely, the trophozoites invade the large bowel and terminal ileum causing erosions and ulceration.
- Treatment : Oxytetracycline , may be followed by Iodoquinol or Metronidazole.



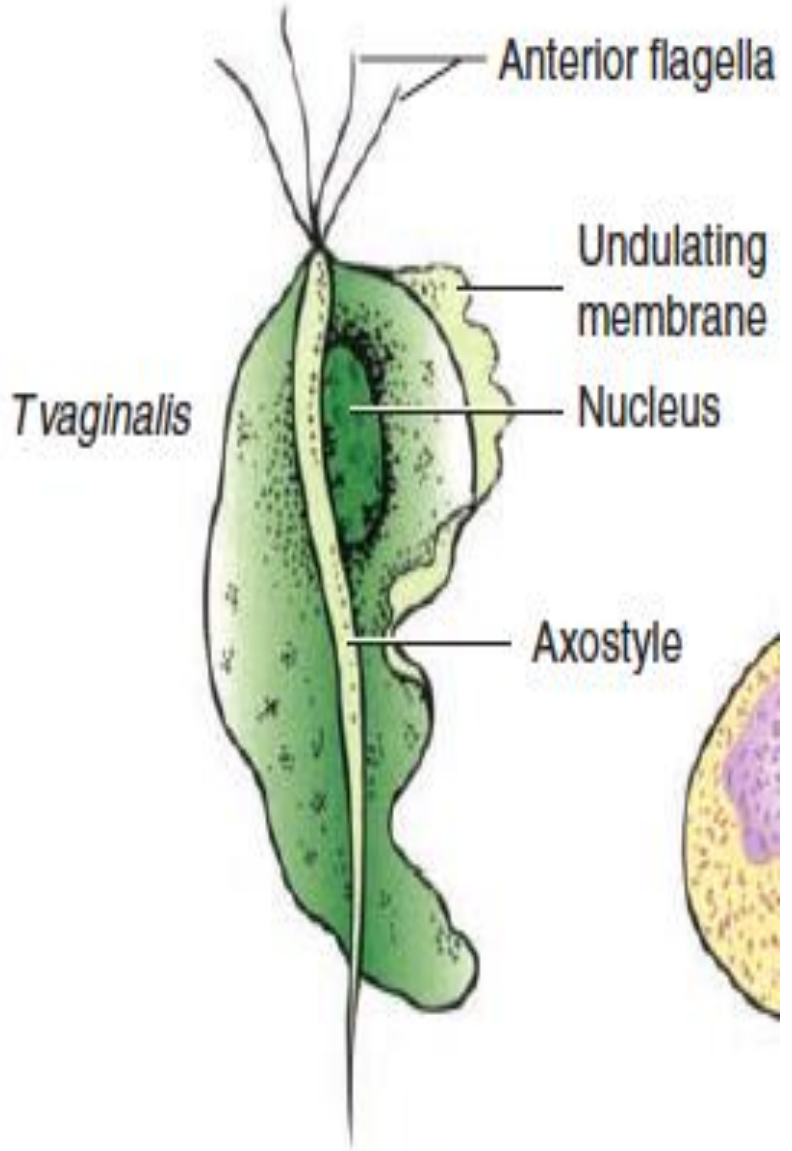
Trophozoite

Cyst

Sexually transmitted protozoan infection

TRICHOMONAS (Urogenital flagellated protozoa)

- Trichomonads are flagellated protozoa.
- Three members of the genus Trichomonas parasitize humans (Trichomonas hominis, Trichomonas tenax, Trichomonas vaginalis) but only T vaginalis is an established pathogen.
- Trichomonas vaginalis cause trichomoniasis in human .
- It is peard- shaped with undulating membrane lined with flaellum and 4 anterior flagella . It is about 5-30 X 2-14 µm. it moves with wobbling or rotating motion.



- Direct contact of T vaginalis with the squamous epithelium of the genitourinary tract results in destruction of the involved epithelial cells and the development of a neutrophilic inflammatory reaction and petechial hemorrhages.
- In females, It causes low-grad inflammation limited to vulva vagina and cervix causing frothy yellow or creamy discharge.
- In males, it may infect the prostate, seminal vesicles and urethra.

- Wet mount examination for motile trophozoites sufficient in most symptomatic cases

- Treatment: Topical and systemic Metronidazole.

  Tinidazole, Ornidazole are equally effective with fewer side effects

Blood and tissue protozoan infections

Haemflagellate

Trypanosoma

leishmania

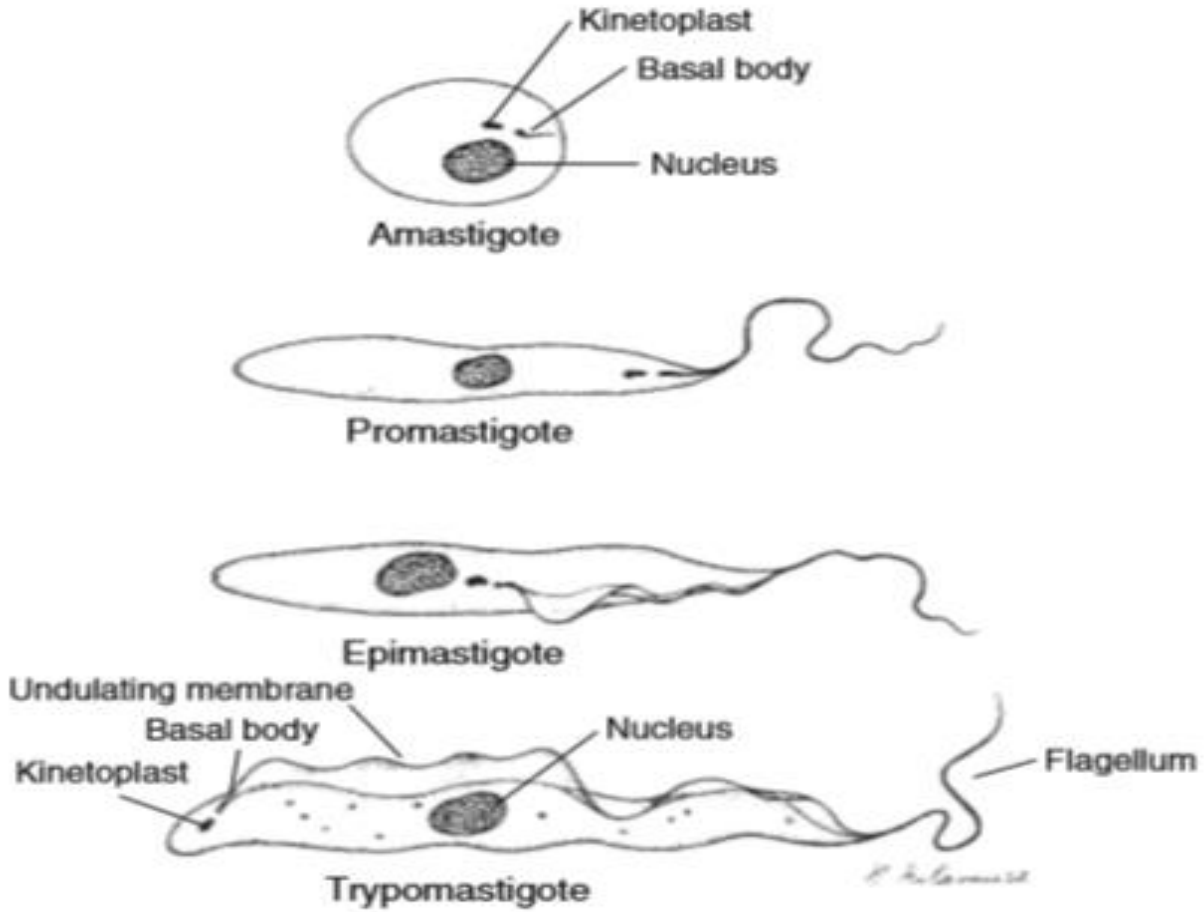
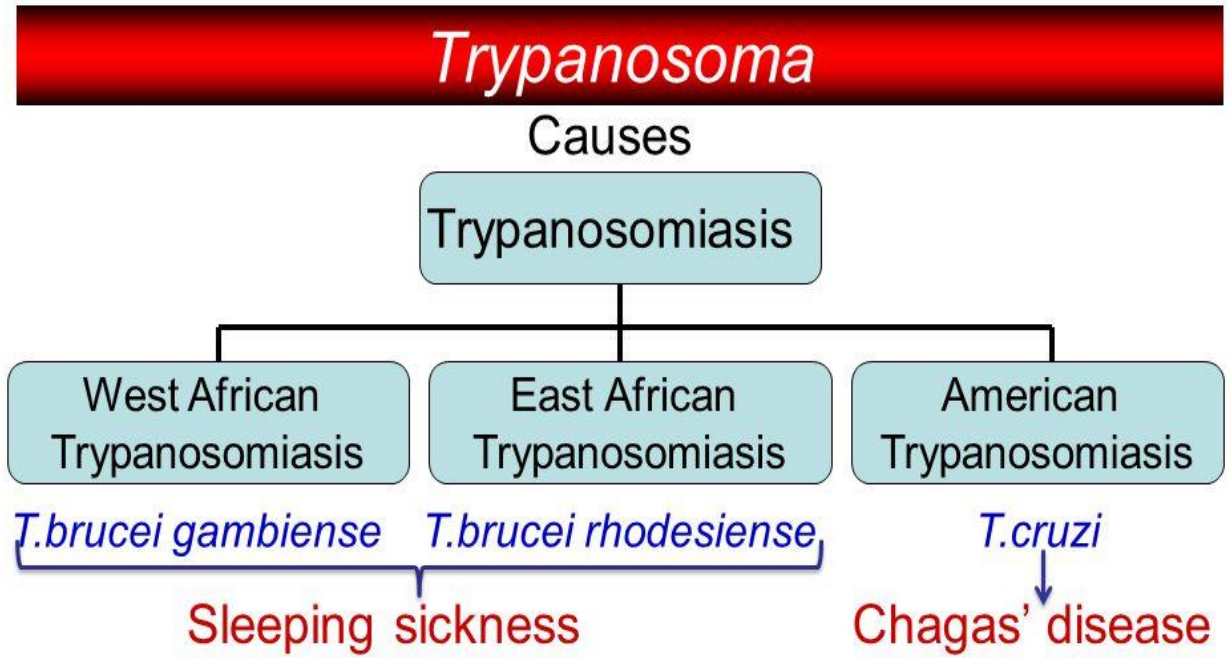


Figure 49-8 Characteristic stages of species of *Leishmania* and *Trypanosoma* in human and insect hosts. (Illustration by Nobuko Kitamura.)

TRYPANOSOMA

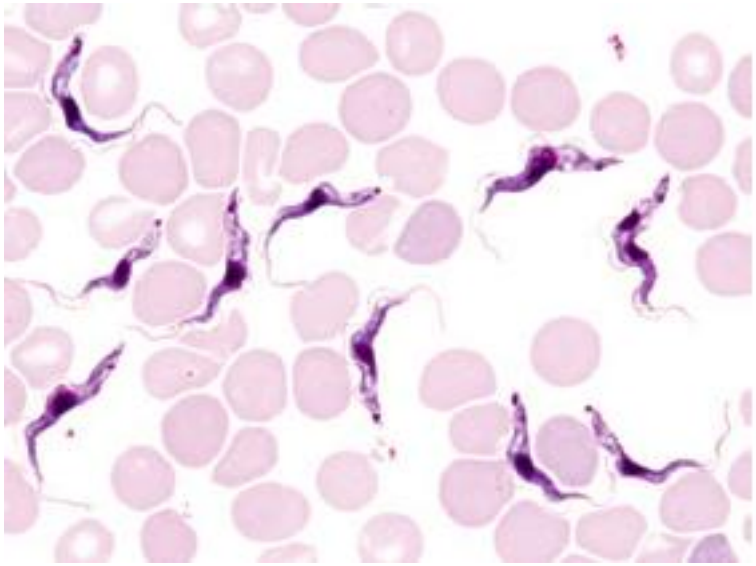
African trypanosomiasis : African sleeping sickness

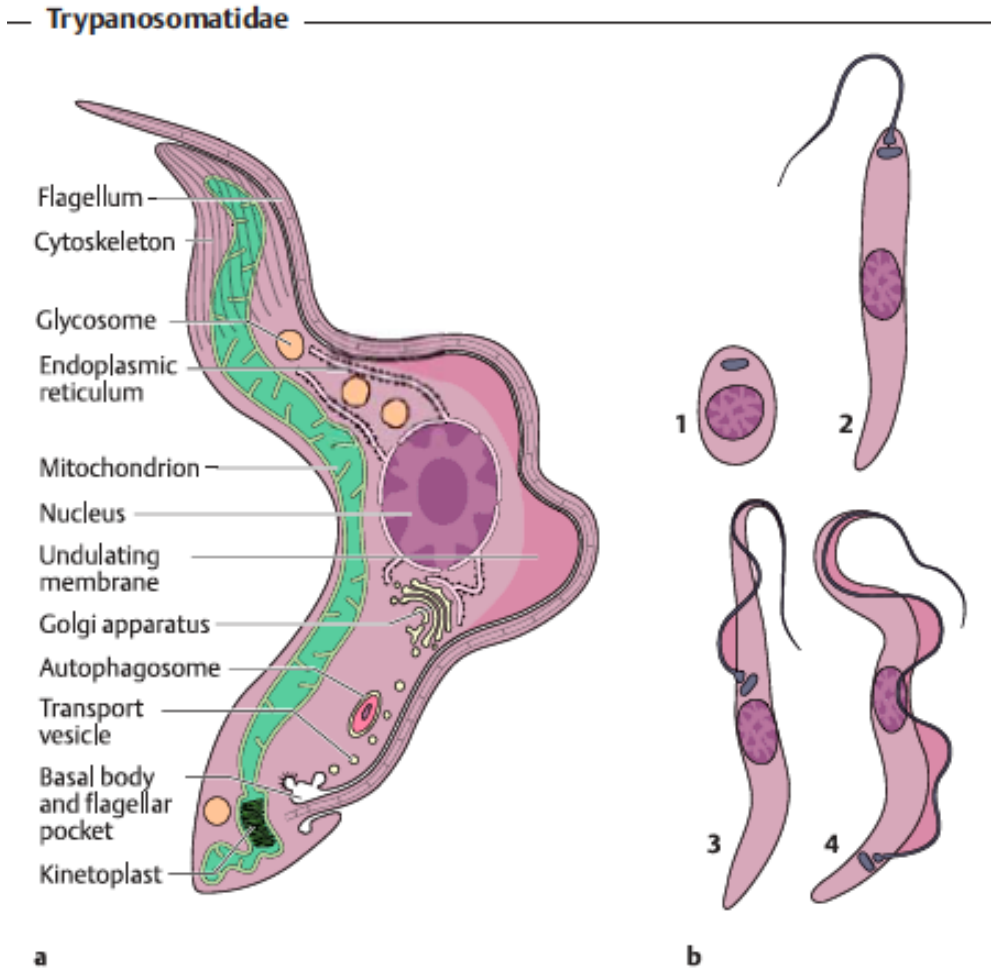
American trypanosomiasis (Chagas' disease)



Morphology

- The morphologically differentiated forms include spindly, uniflagellate stages (trypomastigote, epimastigote, promastigote) and a rounded, amastigote form.





AFRICAN TRYPANOSOMIASIS

- Is caused by 2 sub spp. :
- T. brucei gambiense :West African trypanosomiasis
- T. brucei rhodesiense: East African trypanosomiasis

- Vector: **tsetse fly** (Glossina spp.)
- Which is found only in rural Africa
- Glossina palpalis transmits T. b. gambiense
- Glossina morsitans transmits T. b. rhodesiense

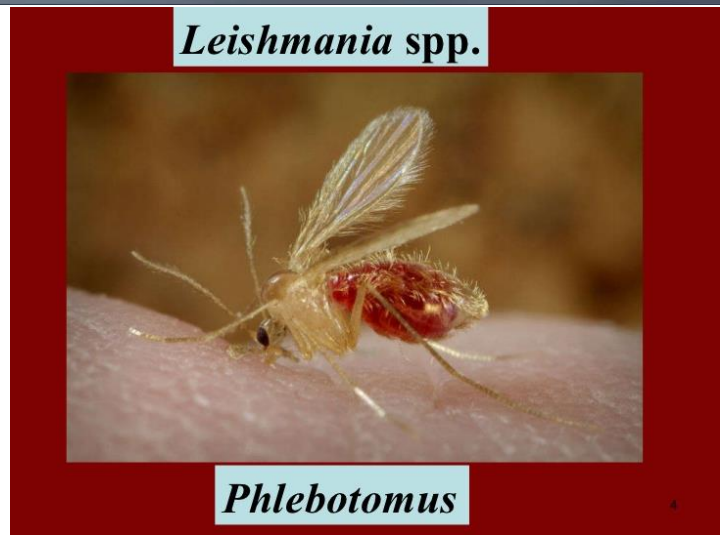
AMERICAN TRYPANOSOMIASIS

- Trypanosoma cruzi **(Chagas' disease)**
- Zoonosis
- Transmitted by vector : reduviid bugs.
- Reduviid bug defecates while taking a blood meal

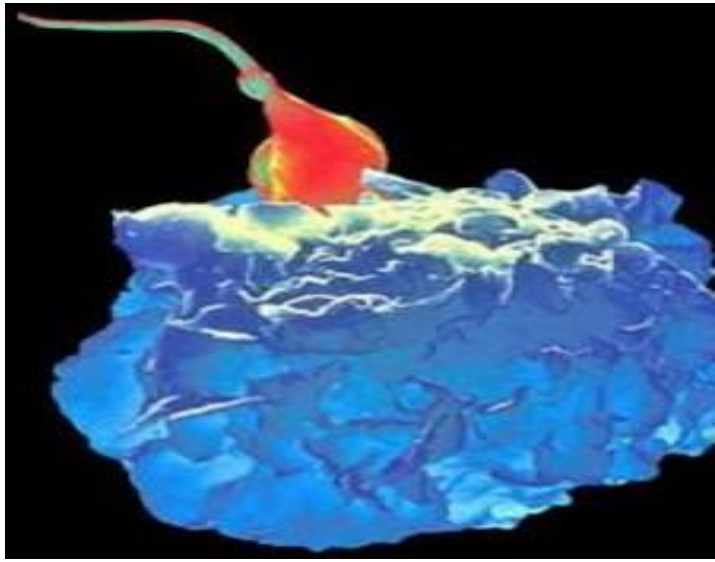
- **Definitive host:**
- Human, dog, cat, rats…etc.
- **Habitat** in the Definitive host:
- Trypomastigote in blood
- Amstigote in tissue

LEISHMANIA

- It is a flagellated protozoan
- Life cycle requires two hosts :
  a) **vertebrate** ; mammalian host
  b) **Invertbrate vector** ; female sand fly



- Obligate intracellular organism
- Infects primarily phagocytic cells and macrophages
- The incubation period ranges from 10 days to 2 years,



Transmission

1. Bite of sand fly
2. Transfusion blood and transplantation
3. Mother to baby
4. Direct contact; from man to man through nasal secretion.

LEISHMANIA SPP.

- Leishmaniasis is divided into clinical syndromes according to what part of the body is affected most.

1. **Cutaneous Leishmaniasis(L.tropica,Leishmania major)**
2. **Mucocutaneous leishmaniasis(L. braziliensis)**
3. **Visceral Leishmaniasis(L.donovani).**

Plasmodium (Blood sporozoa)

- ***Plasmodium*** is a genus of parasitic alveolates, many of which cause malaria in their hosts.
- The parasite always has two hosts in its life cycle: Dipteran insect host and a vertebrate host.

- **Species**:

1. *P. falciparum*
2. *P. malariae*
3. *P. vivax*
4. *P. ovale*
5. *Plasmodium knowlesi*

- ***Plasmodium falciparum*** *is the major species associated with* deadly infections throughout the world.

Mechanism of Infection

- The **vector** for malaria is the female anopheline mosquito.
- When the vector takes a blood meal, **sporozoites** contained in the salivary glands of the mosquito are discharged into the puncture wound.
- Within an hour, these infective **sporozoites** are carried via the blood to the liver, where they penetrate hepatocytes and begin to grow, initiating the **pre-erythrocytic** or **primary exoerythrocytic cycle.**
- **The sporozoites** become round or oval and begin dividing repeatedly.
- **Schizogony results in** large numbers of exoerythrocytic merozoites.
- Once these **merozoites** leave the liver, they invade the red blood cells (RBCs), initiating the **erythrocytic cycle.**

- **A dormant schizogony** may occur in *P. vivax and P. ovale organisms,* which remain quiescent in the liver.

- These resting stages have been termed **hypnozoites** and lead to a true relapse, often within 1 year or up to more than 5 years later.

- Once the RBCs and reticulocytes have been invaded, the parasites grow and feed on hemoglobin.

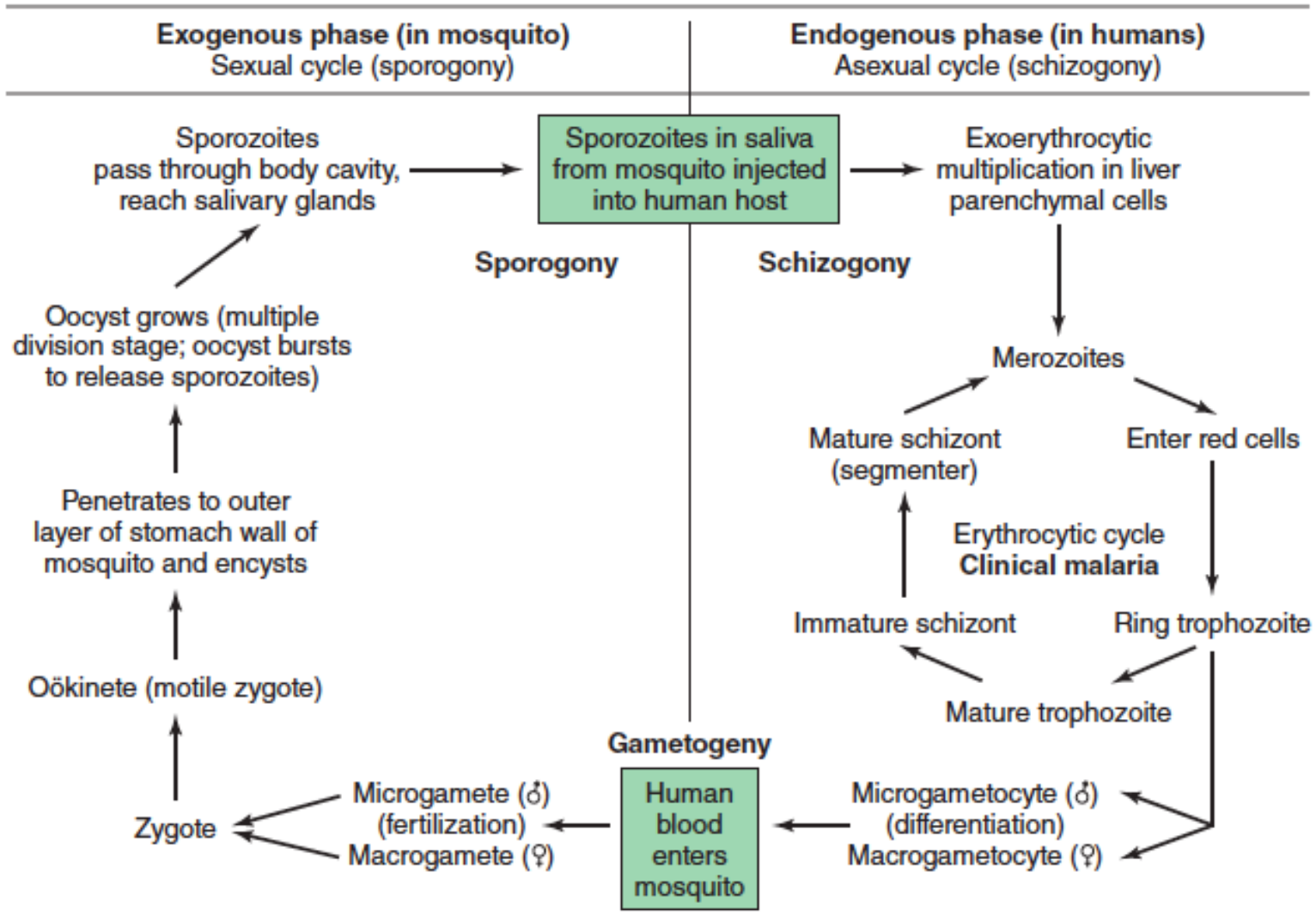
- Within the RBC, the merozoite (or young trophozoite) is vacuolated, ring shaped, more or less ameboid, and uninucleate.

- The excess protein and hematin present from the metabolism of hemoglobin combine to form malarial pigment.

- Once the nucleus begins to divide, the trophozoite is called a **developing schizont.**

- The mature schizont contains merozoites (whose number depends on the species), which are released into the bloodstream.

Malaria life cycle

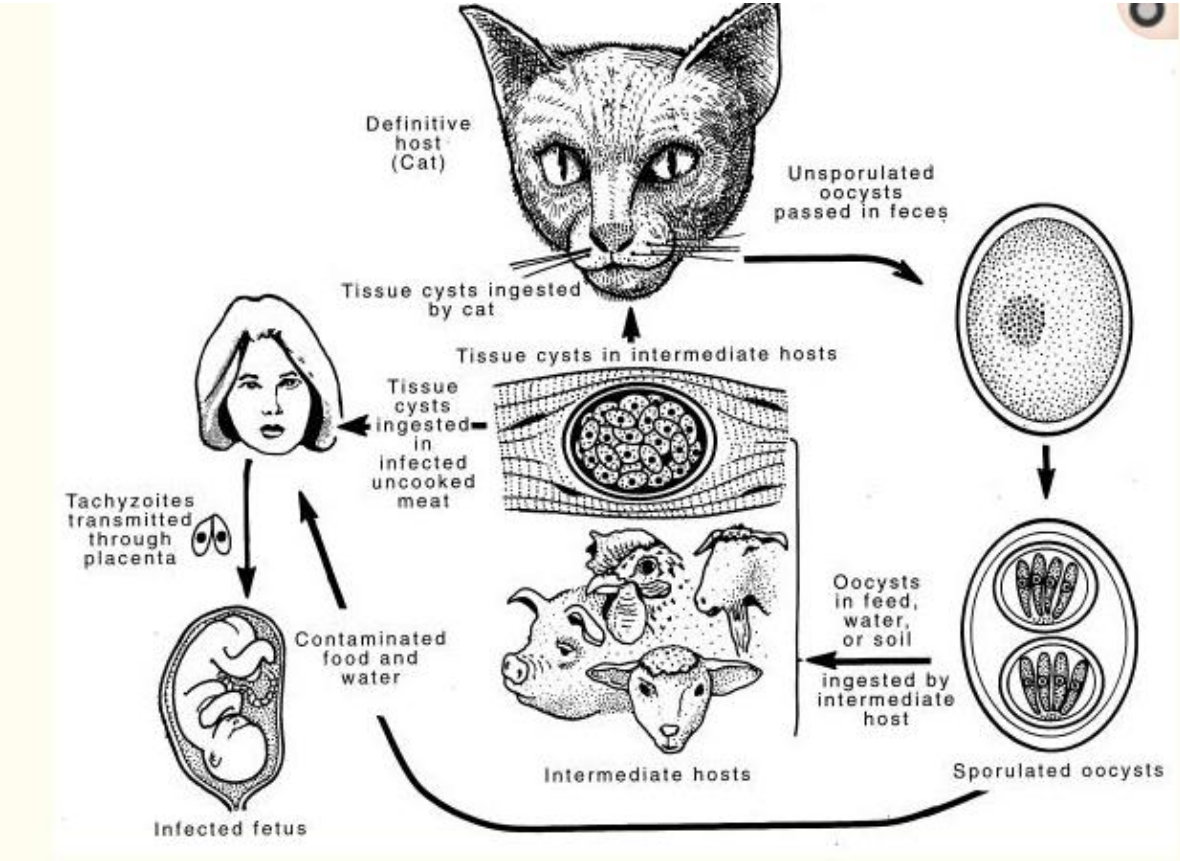


Tissue protozoa

Toxoplasma gondii (Tissue sporozoa)

- It is a coccidian protozoa with worldwide distribution that infects wide range of animals and birds but does not appear to cause disease in them.
- The normal final hosts are strictly the cats and its relatives, the only host of which the oocyst-producing sexual stage of toxoplasma can develop.
- When oocysts are ingested can either repeat its sexual life cycle in a cat, or- if ingested by a human- can establish an infection in which it can reproduce asexually .Where it open and release sporozoits to duodenum then invade various cells especially macrophages where they form tachyzoits which spread infection to lymph nodes and other organs.
- Latent infections occur with Toxoplasma (parasites in tissue cysts are called bradyzoites).

- It produce either congenital or postnatal toxoplasmosis.
- Congenital infections occur in non-immune mothers during pregnancy.



The End