



# Microbiology

Doctor 2018 | Medicine | JU

Sheet

Slides

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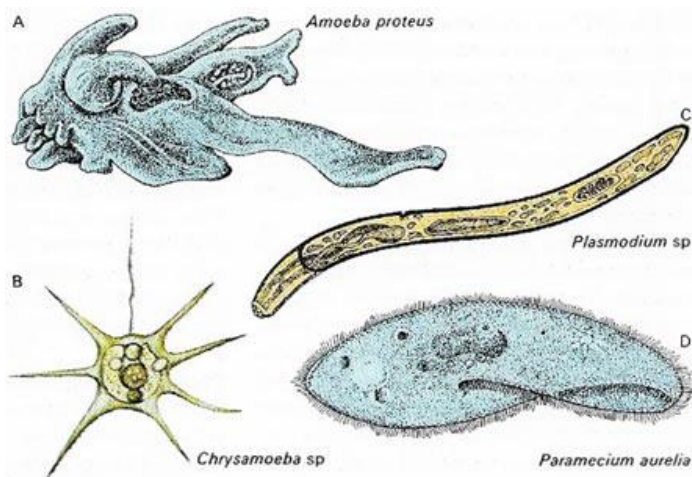
Nader Al Aridah

# Introduction

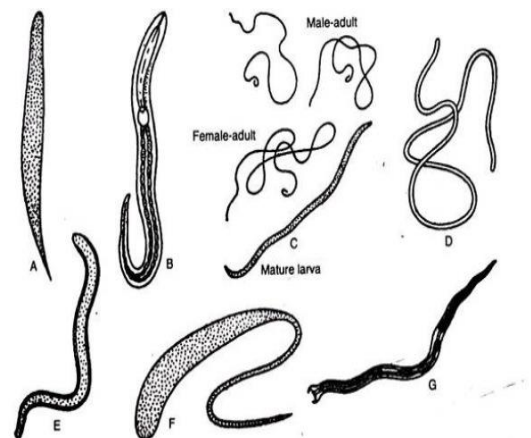
(a very important note before I start: this sheet and the upcoming one are very important and have a good chunk of marks in the final exam. they are very long and have a lot of info, but I'll make sure to tell what dr. Nader focused on and what he didn't. please please please don't leave these sheets to guarantee a good mark).

Parasitology is the study of parasites (طفيليات). Parasites have two major types:

- 1) Protozoa (الاوليات): This branch of parasitology studies organisms that are composed of one cell (unicellular), very basic in structure, small and cannot be seen in the bare eye. These will be discussed in this lecture.
- 2) Metazoa (Helminths): organisms that are mostly characterized by their bigger size (multicellular), like worms. These will be discussed in the upcoming lecture.



**Protozoa**



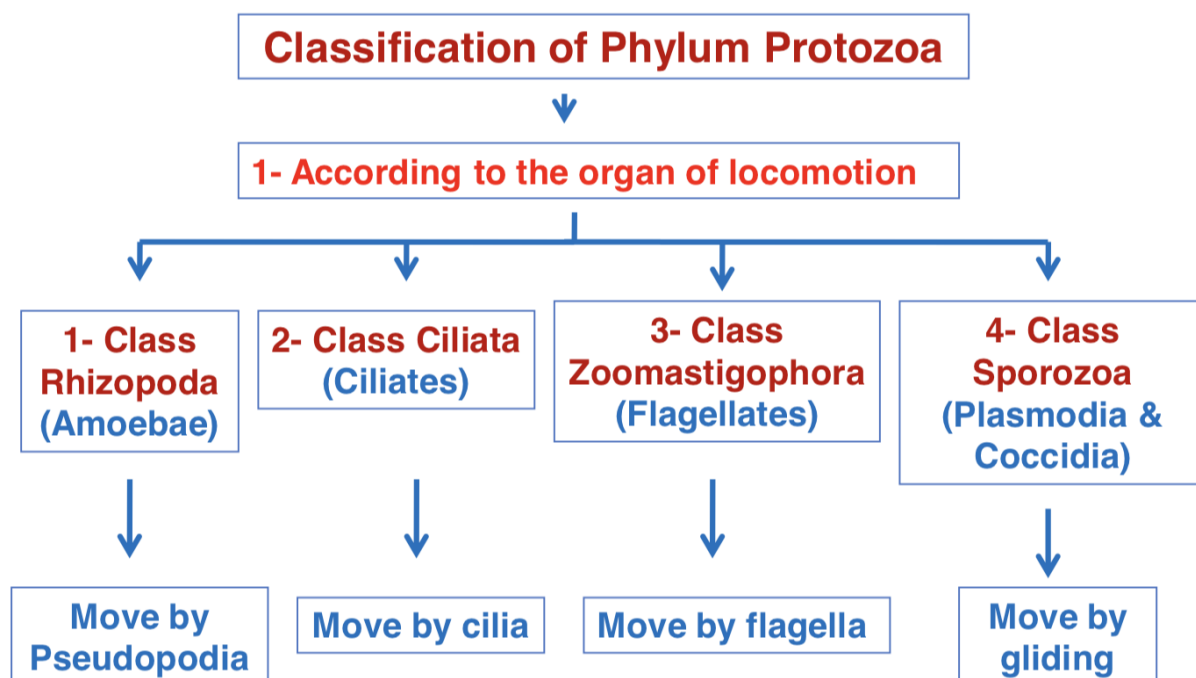
**Helminths**

# Protozoa

Protozoa are classified according to:

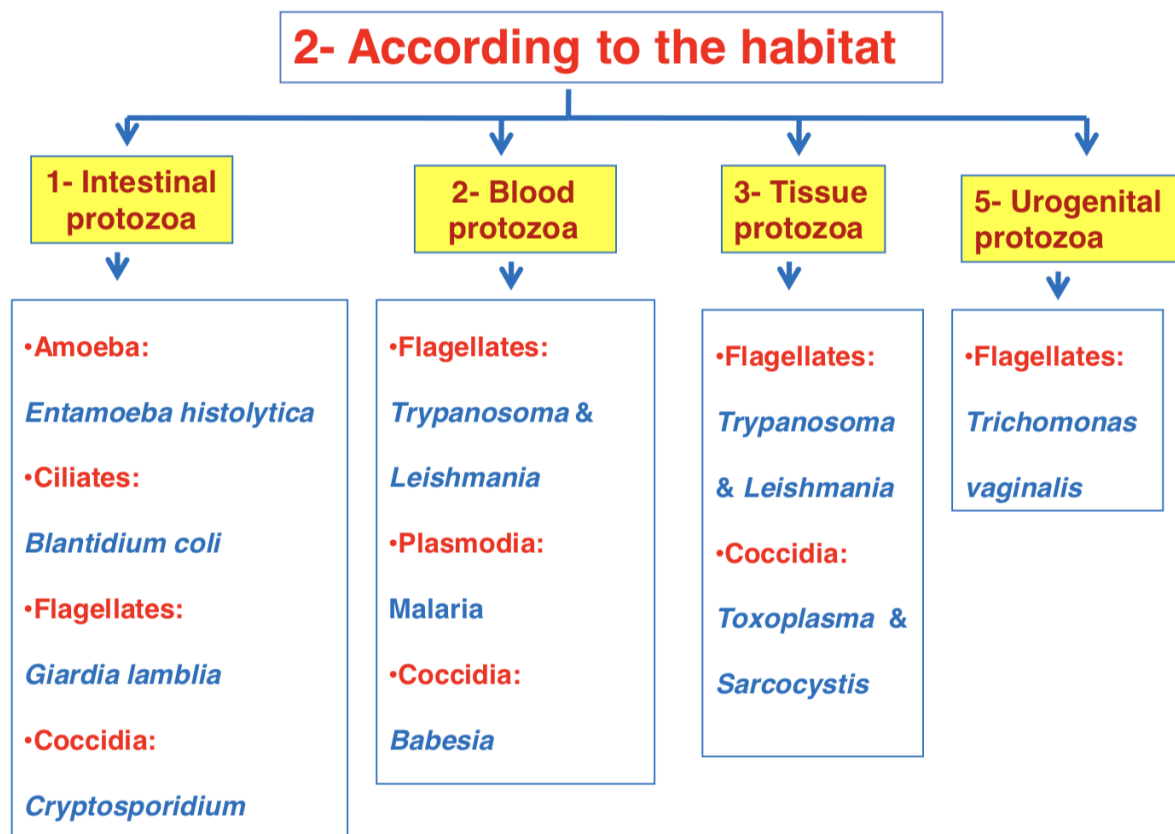
**1) Organ of locomotion:** this classification groups protozoa according to the organ they use to move:

- Class Rhizopoda (Pseudopods or Amoebae): protozoa which use pseudopods to move. An example on this group is *E. histolytica*.
- Class Ciliata (Ciliates): Protozoa which use cilia to move. An example is *Balantidium Coli*.
- Class Zoomastigophora (Flagellates): Protozoa which use Flagella to move. Examples include blood flagellates like *Trypanosoma* and *Leishmania*.
- Class Sporozoa (Plasmodia & Coccidia): These have no organ of locomotion; they only move by gliding. They are special because they can reproduce both sexually and asexually, unlike all the above protozoa, which only reproduce asexually.



**2) According to the habitat they live in:** This classification is the one we will be using in this sheet, as it is a more clinical/ medical classification.

- Intestinal Protozoa: which take the intestine as a place to grow and reproduce.
- Blood Protozoa: which live in the blood mainly.
- Tissue Protozoa: which live in multiple tissues of multiple organs.



\*\*\*\*Note: Don't worry about all the names in this table. We'll only be covering the ones that dr nader mentioned. Any extra protozoa mentioned here is only for extra knowledge.

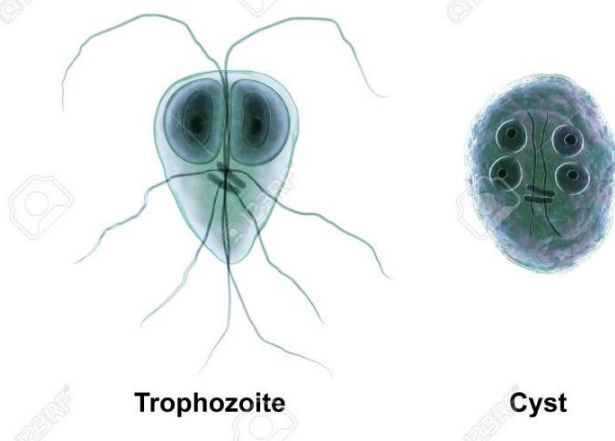
## Terms before we start

Protozoa have two morphological forms (stages of life) that we can see under the microscope:

- 1) **Trophozoite:** which is the general term for the active, feeding, multiplying stage of most protozoa. This is the living stage inside host bodies and is the stage we find living in tissues.
- 2) **Cysts:** the protective mechanism of protozoa, just like spores in bacteria. (cysts are the sporadic form of a trophozoite, and is found outside the body, for protection against environmental conditions).



### GIARDIA INTESTINALIS



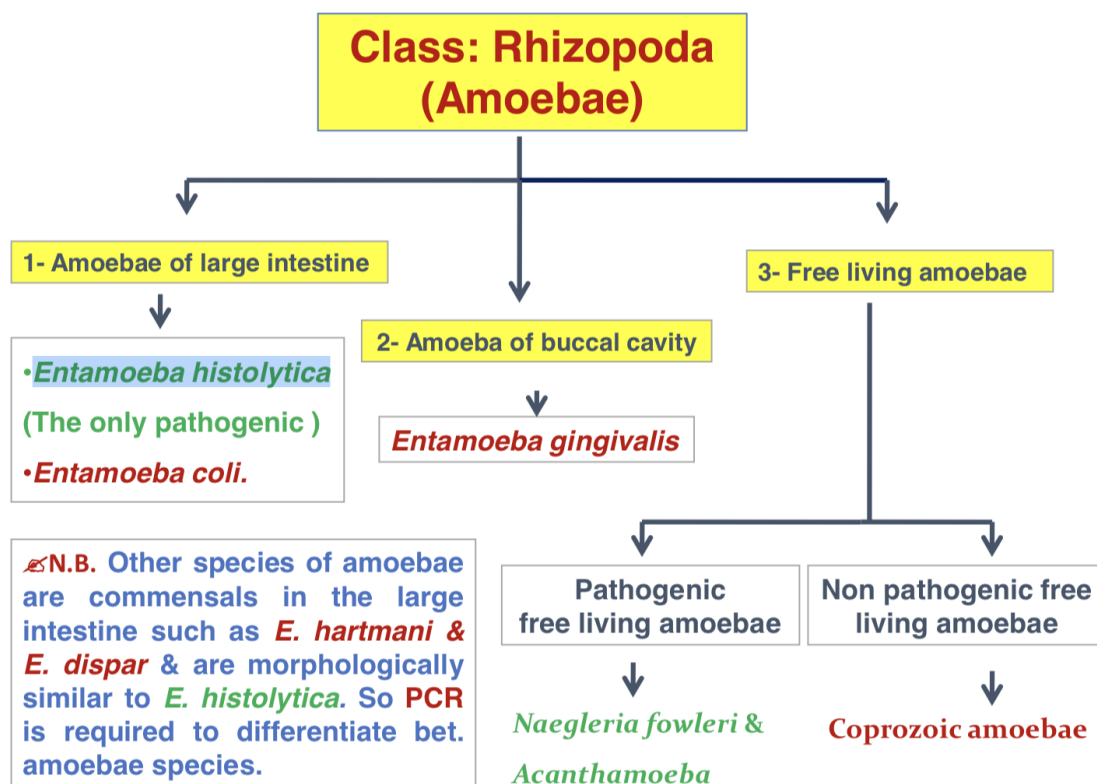
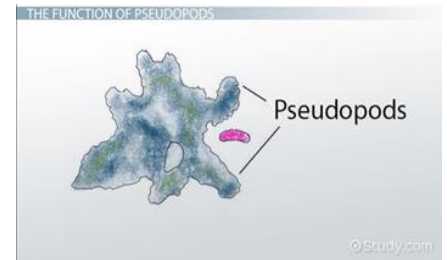
-Note that the protozoan shown here has two forms, one of them is the active form that has morphological structures which help it to move, evade and eat (Trophozoite, left).

-The other is a more protective form that only seeks to survive, and live for a longer period (cyst, right).

# Intestinal Protozoa

## A) *Entamoeba histolytica*:

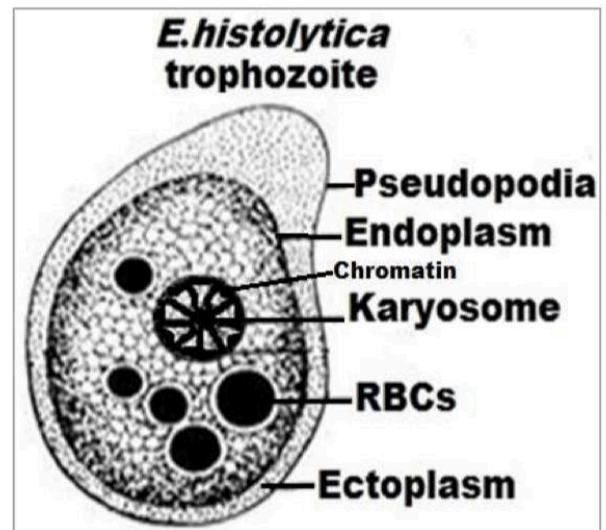
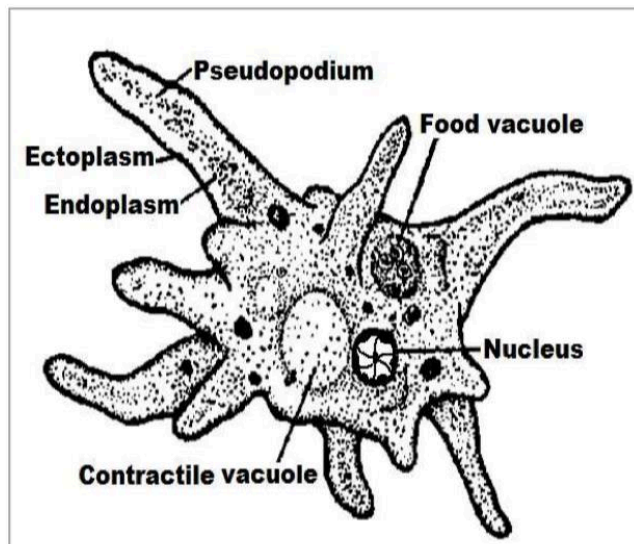
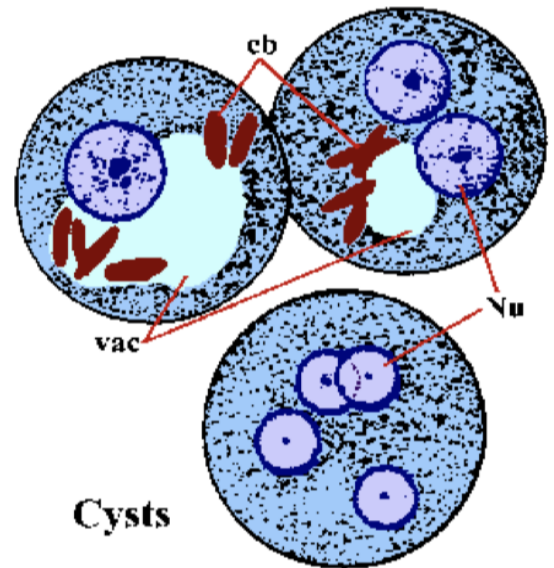
- *E. Histolytica* follows class Rhizopoda (Amoebae) in classification. This class involves other pseudopods, but *E. Histolytica* is the only pathogenic one of all Rhizopods.
- The disease caused by *E. Histolytica* is called **Amoebiasis** (الزحار الاميبي).
- It forms pseudopods and moves through them.
- Its habitat is the Large intestine (caecum, colonic flexures and sigmoidorectal region).
- It multiplies by binary fission (asexual reproduction).
- This protozoan causes dysentery (الزحار) (diarrhea containing blood and mucus).
- This pseudopod is mostly confused with other pseudopods of the same class as ***E. Hartmani*** and ***E. Dispar***. When taking a stool sample that we suspect could have entamoeba, we should immediately check if it has the pathogenic type which is *E. Histolytica*, or the non-pathogenic types *E. Hartmani* and *E. Dispar* to decide if we should treat or leave the patient (last two are not treated).
- The reservoir host are mostly animals, but the definite host are humans.





## Morphology of *E. Histolytica*

- Just like any other protozoa, *e. histolytica* has two morphological forms; a trophozoite and a cyst.
- Cysts have two forms; they can be **immature** (uni or binucleated) or **mature** (quadrinucleated).
- Trophozoites also have two forms and have a granulated endoplasm. They have ingested RBCs which differs them from other mentioned Rhizopods.



## Mode of infection

Humans can be infected by *E. Histolytica* in different ways, including:

- 1- Contaminated foods (ex. green vegetables) or drinks or hands with human stool containing mature cyst.
- 2- Handling food by infected food handlers as cooks 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 of *E. Histolytica*

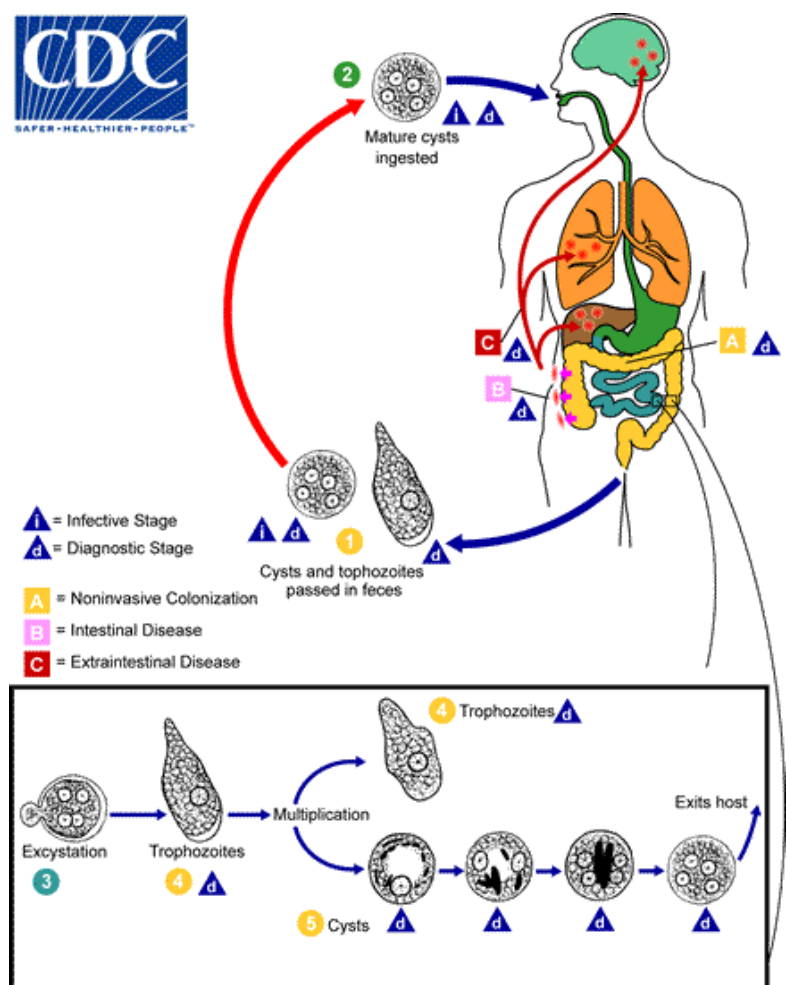
- 1) Infection by ***Entamoeba histolytica*** occurs by ingestion of mature cysts by the definitive host.
- 2) Then the excystation occurs, where each cyst gives 8 trophozoites.
- 3) The disease is established, and the patient suffers from Amoebiasis.
- 4) Large intestines secrete the cysts again, so they mature outside the body and enter again.

### Note:

i= infective stage, The stage in the life cycle of an endoparasite wherein it can initiate infection to its host

d=diagnostic stage, the stage where symptoms start to show, and the disease can be diagnosed.

It's very important to know the I and d stage for each protozoan.

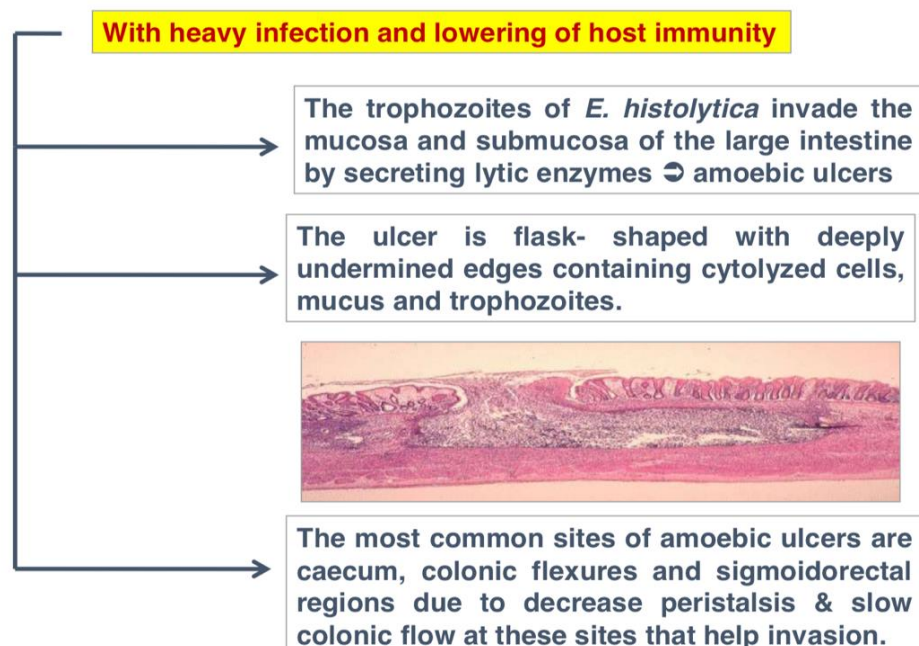
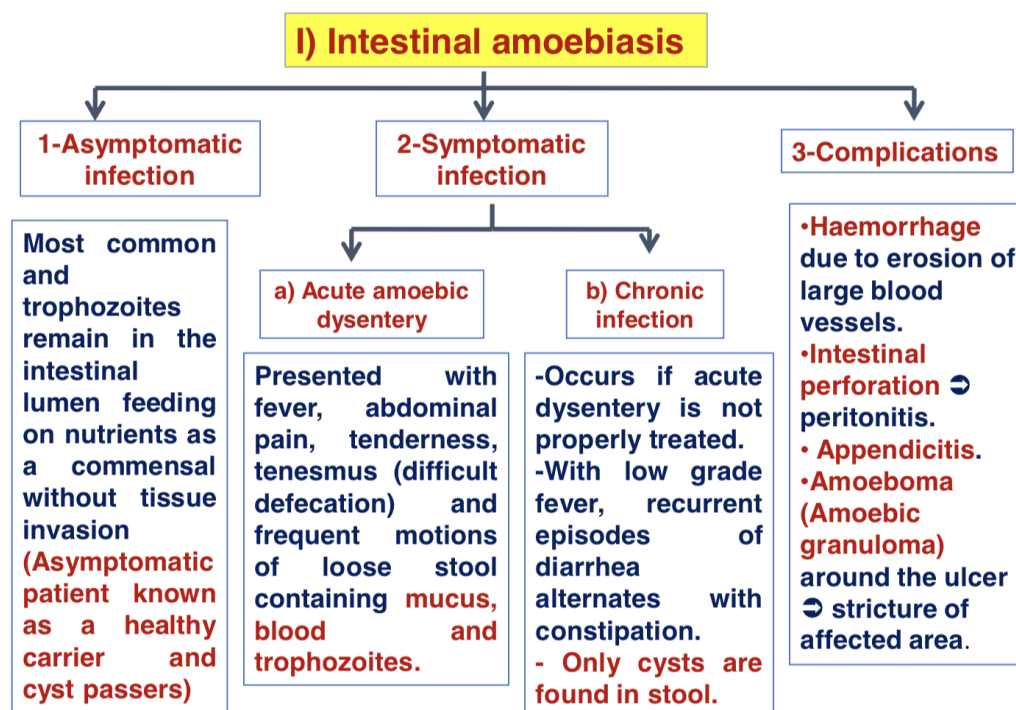




## Clinical manifestations of *E. Histolytica*

There are 4 results of *E. Histolytica* entering the human body:

- 1) **No infection**; in this case the person is a carrier/ cyst passer of the disease.
- 2) Infection; in this case we have an **acute infection (acute dysentery)** caused by a cyst or a trophozoite as mentioned above, or a **chronic inflammation** cause by cysts only.
- 3) **Complications** like hemorrhage.
- 4) **Extra intestinal Amoebiasis**. (Amoebiasis outside the large intestines. In this case, *E. Histolytica* travels outside and goes to other organs like the Liver or the Lungs).



## 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).

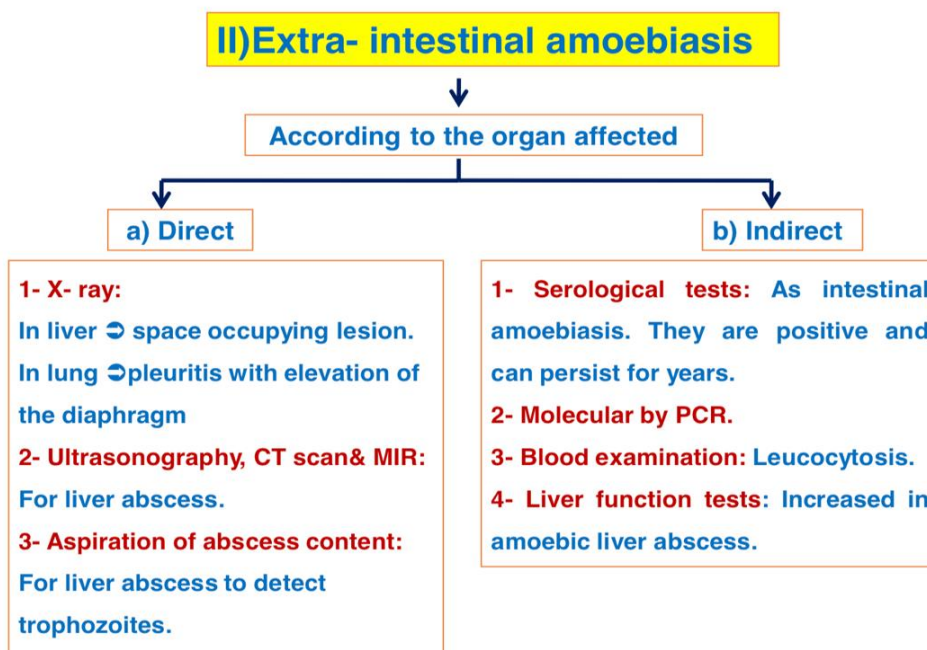
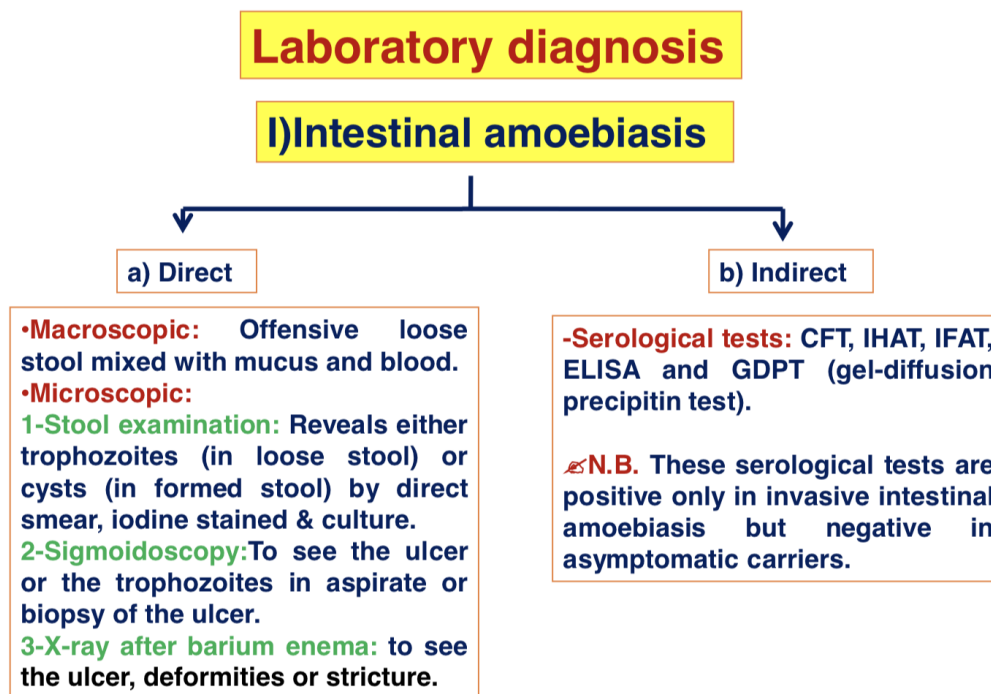
→ Skin →

**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.

## Laboratory diagnosis of E. Histolytica

As mentioned above, Amoebiasis has two forms; either intestinal or extra intestinal. According to that, each one of them has different laboratory ways to be diagnosed:

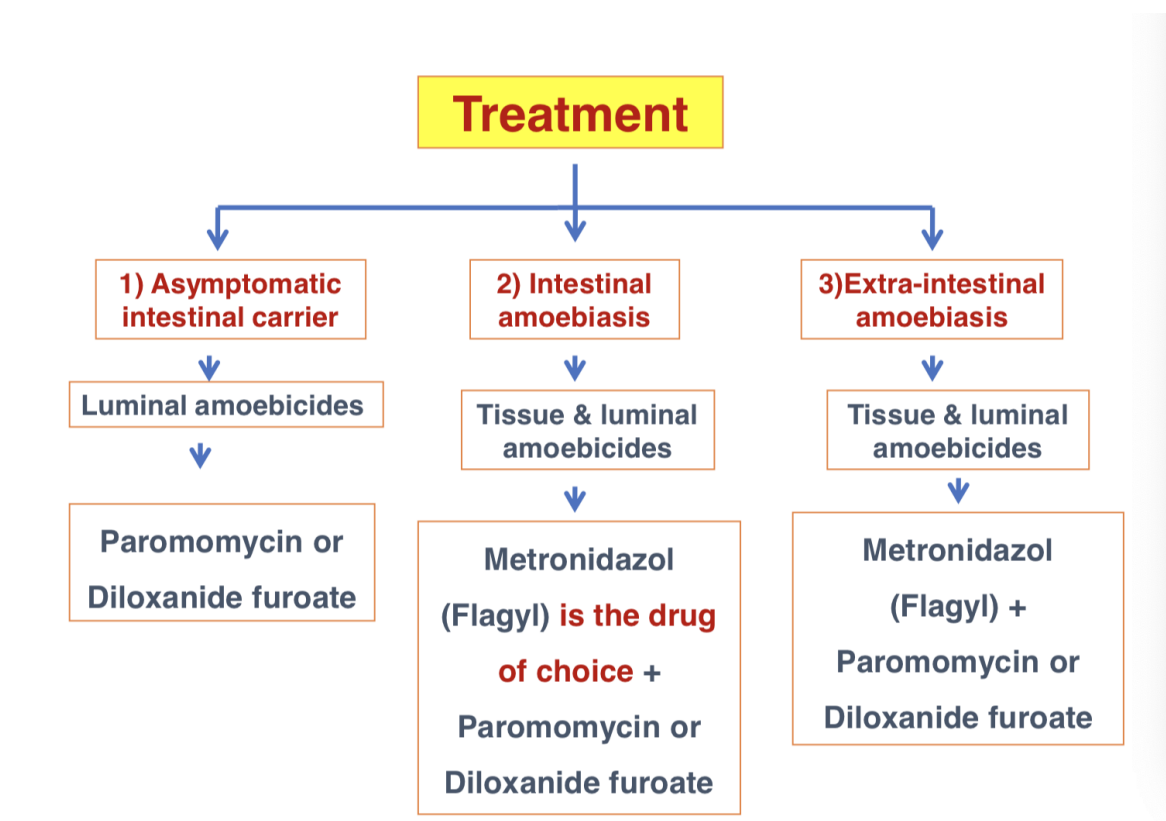
(Note: Dr Nader focused mainly on intestinal Amoebiasis and how it's diagnosed. That doesn't mean that extra intestinal Amoebiasis isn't important, just read it and understand the idea).



## Treatment of E. Histolytica

There are many treatments for E. Histolytica. The most famously used one is **Metronidazole (commercial name: Flagyl)**, which is a broad-spectrum drug that works mainly on anaerobic bacteria and protozoa. Although it's a first line drug, it has side effects that limit its usage, including being teratogenic (causes fetal abnormalities) and disulfiram like reactions, that cause a metal-like taste in the mouth.

(dr. Nader focused mainly on Metronidazole and said he would be very straight forward asking about treatment)



## B) Giardia Lamblia:

- Also called ***G. Intestinalis*** or ***G. Duodenales***, is the causative agent of **giardiasis** and is the only common pathogenic protozoan found in the duodenum and jejunum of humans.
- flagellated parasitic microorganism, that colonizes and reproduces in the small intestine. The parasite attaches to the epithelium by a ventral adhesive disc or sucker.
- reproduces via binary fission.
- Does NOT cause Dysentery (Diarrhea with blood and mucus). this differentiates it from *E. Histolytica*.
- Does not invade, only attaches by ventral discs.
- Causes **Steatorrhea**( a diarrhea that is greasy, bulky and has a foul/unpleasant smell).

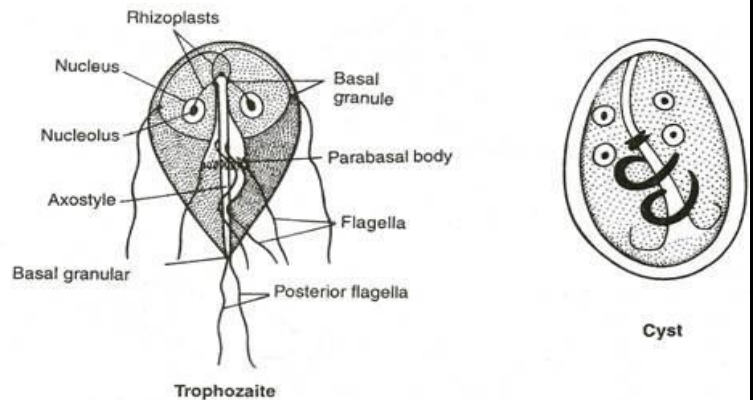
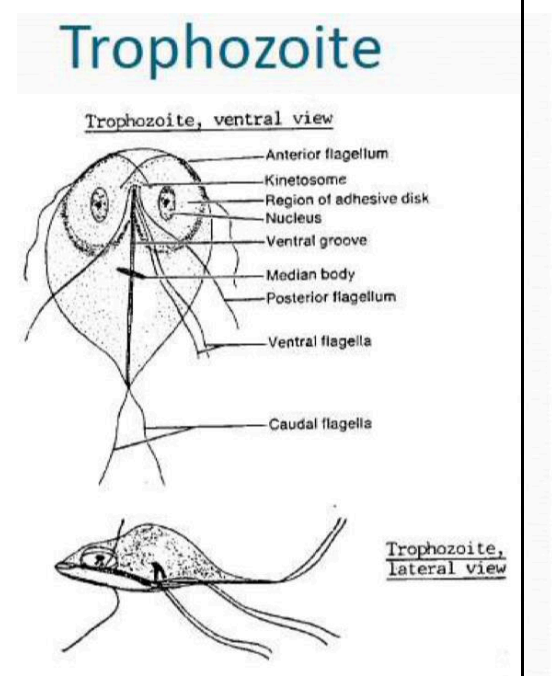


Fig. 181. Stages of life cycle of *Giardia intestinalis*.

## Morphology of G. Lamblia

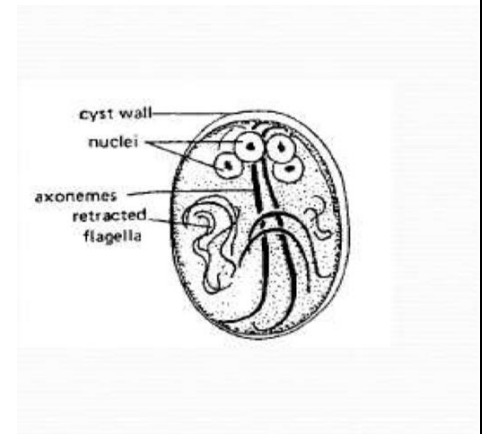
(it's very important that you recognize its trophozoite shape. It looks like a man whom wears glasses and has whiskers)

- Just like any protozoa, it has a trophozoite and a cyst form.
- The trophozoite of *G. lamblia* is heart-shaped, has four pairs of flagella, 2 nuclei with a prominent central karyosome and 2 axostyles.
- The trophozoite has a large concave sucking disk on the ventral surface helps the organism to adhere to intestinal villi.





- Cysts are found in the stool –often in enormous numbers. As the parasites pass into colon they typically encyst.
- Cysts are ellipsoid, thick-walled and highly resistant; they contain two nuclei as immature forms and four as mature cysts.



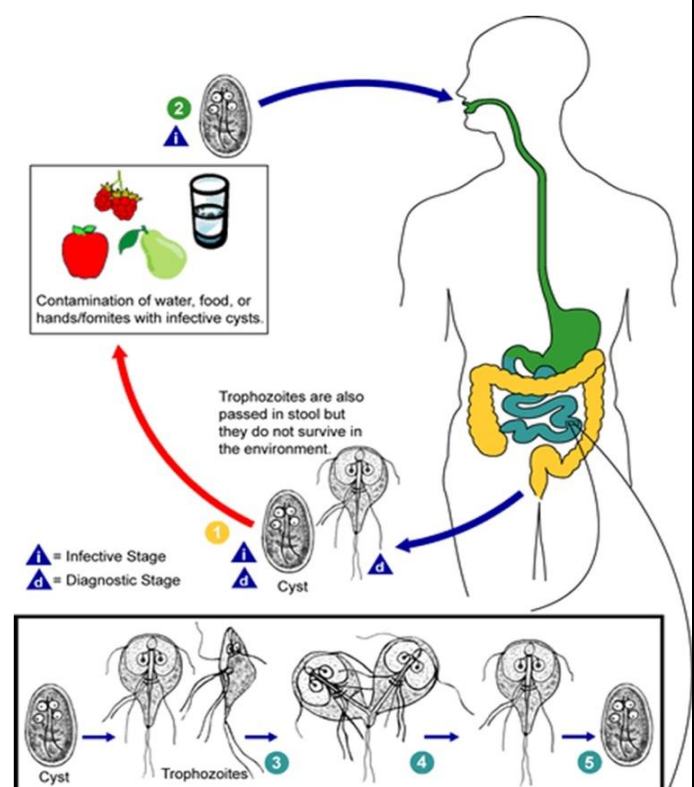
## Transmission of G. Lamblia

G. Lamblia is transmitted in different ways, including:

- 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 from ingestion, and are chlorine resistant.

## Life Cycle of G. Lamblia

- infection occurs by the ingestion of quadrinucleated cysts in contaminated water, food, or by the fecal-oral route.
- In the small intestine, excystation releases trophozoites (each cyst produces two trophozoites).
- The infective stage is both the mature cyst and the trophozoite.





## Clinical manifestations of G. Lamblia

- The spectrum varies from **asymptomatic carriage** to **severe diarrhea, fever** and malabsorption.
- 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.

## Treatment of G. Lamblia

(note: again, dr. Nader focused on metronidazole only, the rest are for general knowledge).

- Quinacrine and metronidazole are effective and are preferred for patients capable of ingesting tablets.
- Tinidazole.
- Furazolidone is used by pediatricians.
- Close contacts should be examined



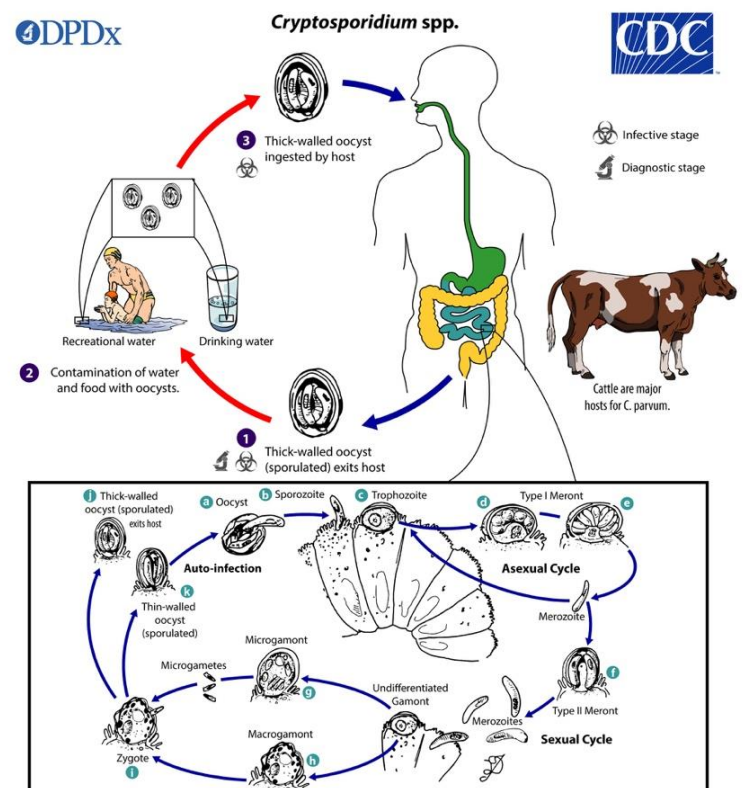
## C) Cryptosporidium:

- Cryptosporidium is an intestinal sporozoan, and it's an obligate intracellular parasite.
- Since it's a sporozoan, it multiplies mainly sexually.
- C. Hominis and C. Parvum are the most common cause of the disease Cryptosporosis.
- If this protozoan enters an immunocompetent patient (normal immunity), it causes no disease. The problem is with those whom are immune compromised (low immunity, especially in AIDS).
- It causes intractable diarrhea (a non-stop diarrhea).
- Acid fastness is used to diagnose Cryptosporidium and Cyclospora, which will be mentioned later on.

### Life cycle of Cryptosporidium

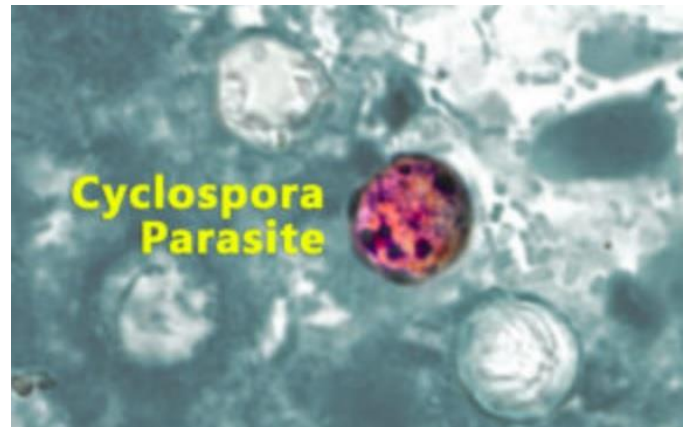
- 1) Ingestion of a sporulated cyst is the infective stage (i) and where the cycle begins. since it reproduces sexually, the cyst is called an Oocyst.
- 2) For the cycle to continue, the cyst has to be sporulated (a sporulated cyst is a cyst capable of going through excystation).

\*\*This drawing is not for memorization\*\*



#### D) Cyclospora:

- Obligate intracellular, intestinal sporozoan that is similar to Cryptosporidium.
- Needs acid fast staining to diagnose.
- Just like cryptosporidium, it only causes problems for immunocompromised people.
- The Oocyst is not immediately infectious here, instead, it needs a week to be sporulated so it can enter the cycle. This is an important difference between Cryptosporidium and Cyclospora.



#### E) Balantidium Coli:

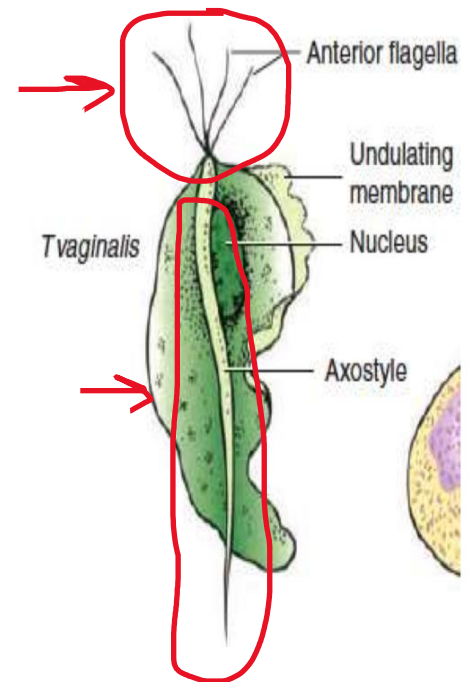
- a ciliated intestinal protozoan, and the largest of all intestinal protozoa.
- Causes a disease caused Balantidiasis.
- Causes dysentery.
- Its habitat is the large intestine.
- Evades the large intestine, and that's why it causes bloody diarrhea.
- Has two nuclei: macro and micro nuclei.
- Treatment is mostly Metronidazole.



## 2) Sexually transmitted protozoa:

### A) Trichomonas:

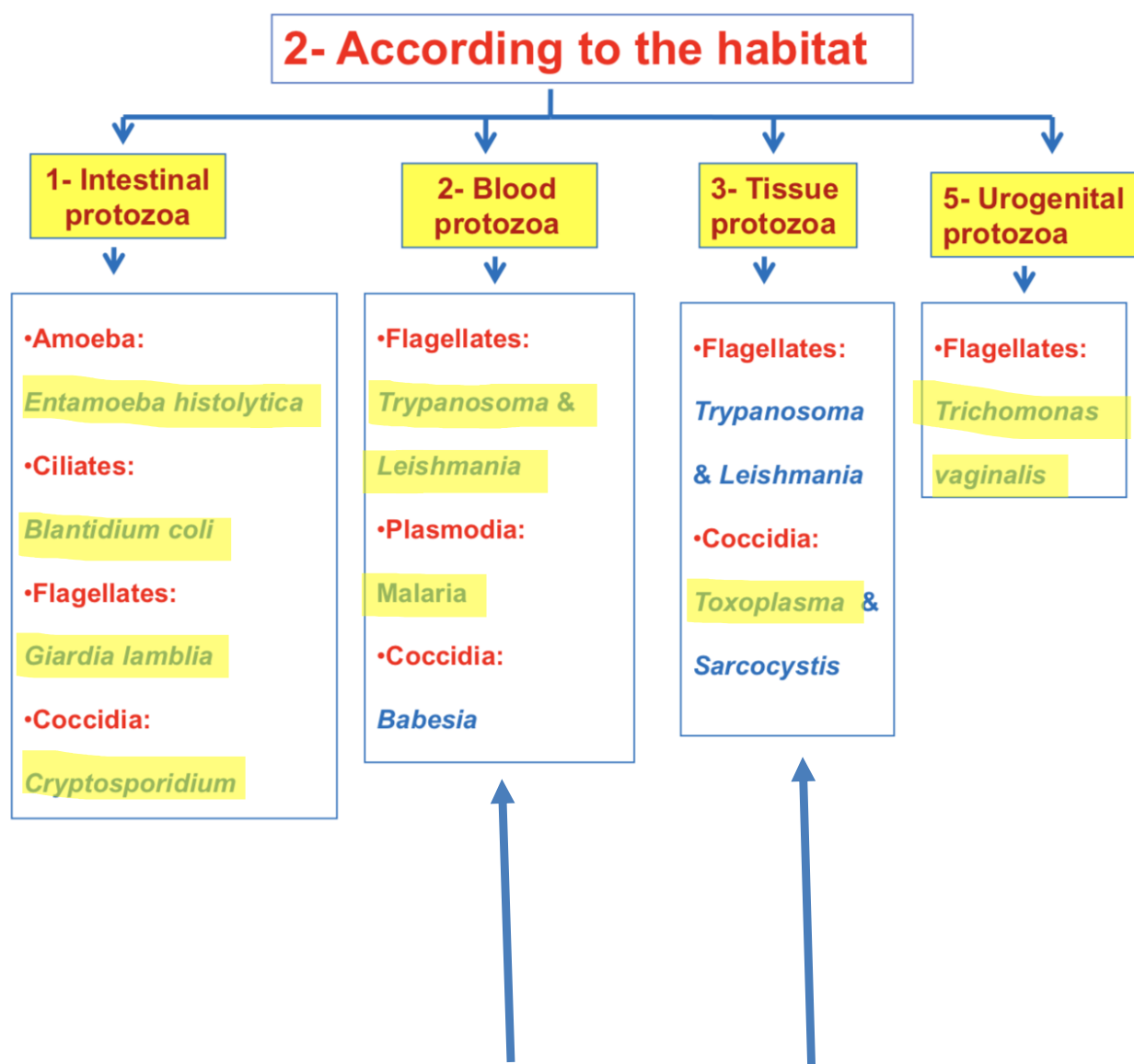
- *T. Vaginalis* is the cause of a disease called Trichomoniasis vaginitis.
- It has only one form, a trophozoite, and doesn't have a cyst form.
- It was named trichomonas because at first, it was thought to have 3 anterior flagella. Instead, it actually has 4 anterior and one flagellum that forms an axostyle.
- Causes vaginitis and vulvovaginitis.
- in females but is asymptomatic in males who get the disease.
- When a female has the disease, you should immediately check the partner.
- Symptoms include a yellow, frothy and fishy smelly discharge in females, but no symptoms in males.
- Treatment is metronidazole.



To be followed...

## Followed...

In the previous sheet, we discussed intestinal and urogenital protozoan infections. This sheet will have the second two parts, which are blood and tissue protozoan infections.



# Blood Protozoan Infections

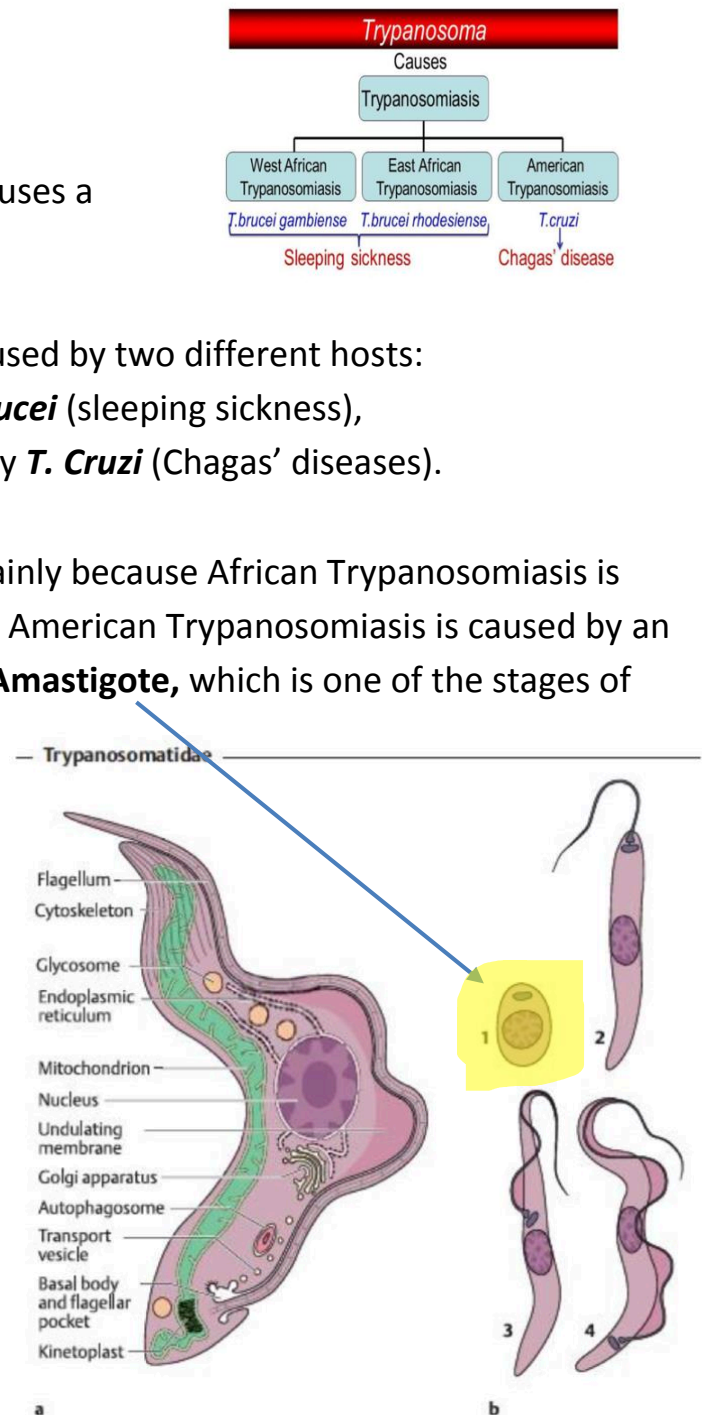
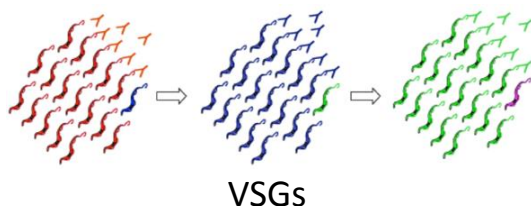
Blood protozoa that we will be discussing are three: two flagellates (Trypanosoma and Leishmania) and one plasmodium (Malaria which is caused by Plasmodium).

African trypanosomiasis : African sleeping sickness

American trypanosomiasis (Chagas' disease)

## A) Trypanosoma:

- Trypanosoma is a blood flagellate that causes a disease called **Trypanosomiasis**.
- Trypanosomiasis has two major types caused by two different hosts:  
**African Trypanosomiasis** caused by *T. Brucei* (sleeping sickness),  
and **American Trypanosomiasis** caused by *T. Cruzi* (Chagas' diseases).
- Morphology is different in both types, mainly because African Trypanosomiasis is caused by an extracellular parasite, while American Trypanosomiasis is caused by an intracellular rounded parasite, called an **Amastigote**, which is one of the stages of life in *T. Cruzi*.
- T. Brucei* makes VSGs (Variant Surface Glycoproteins). each time the antigenic coat changes, the host does not recognize the organism and must mount a new immunologic response, so this is basically a way it uses to survive.





## African Trypanosomiasis

African Trypanosomiasis (sleeping sickness) has two types caused by two different parasites:

- 1) T. Brucei Gambiense: **West African** trypanosomiasis.
- 2) T. Brucei Rhodesiense: **East African** trypanosomiasis.

Both are caused by T. Brucei, and the vector for the parasite is the **Tsetse fly**.

(that's as far as you need to know about African Trypanosomiasis).



## American Trypanosomiasis

Also has two types, north and south American Trypanosomiasis (Chagas' disease), (no details about both).

- The vector for transmission is the Reduviid bug (kissing bug).
- The bug puts its feces on the face of the host. The disease starts by rubbing the eye, causing a unilateral eyelid swelling. (this is an important sign, be aware of it).



## B) Leishmania:

- Leishmania is a blood flagellate.
- It's an intracellular parasite.
- Leishmania targets macrophages or mono nuclear phagocytes.
- It's vector for transmission is the **female sand fly**. it can also be transmitted by blood transfusion, nasal secretions, organ transplantations and from pregnant mother to baby.
- It causes a disease called **Leishmaniasis**, and it has three types:

- **Cutaneous Leishmaniasis**, caused by *L. Tropica* and *L. Major*, and this is the most abundant type of Leishmaniasis. This type of Leishmaniasis is mostly shown on the face.



- **Mucocutaneous Leishmaniasis**, Caused by *L. Braziliensis*. It's also called Nasopharyngeal Leishmaniasis because it shows on the nose and mouth areas mostly.



- **Visceral Leishmaniasis**, caused by *L. Donovanii*.



### C) Plasmodium:

- Plasmodium is a genus of parasitic alveolates, many of which cause malaria in their hosts. The parasite is transmitted by the female anopheline mosquito.


- It has five species:

1) *P. falciparum*: causes malignant tertian malaria الحمى الثلاثية الخبيثة

2) *P. malariae*: causes the classical malaria, and a quaternary fever حمى رباعية

3) *P. vivax*:

4) *P. ovale* :



These are the most common types,  
and cause benign tertian malaria

5) *Plasmodium knowlesi*

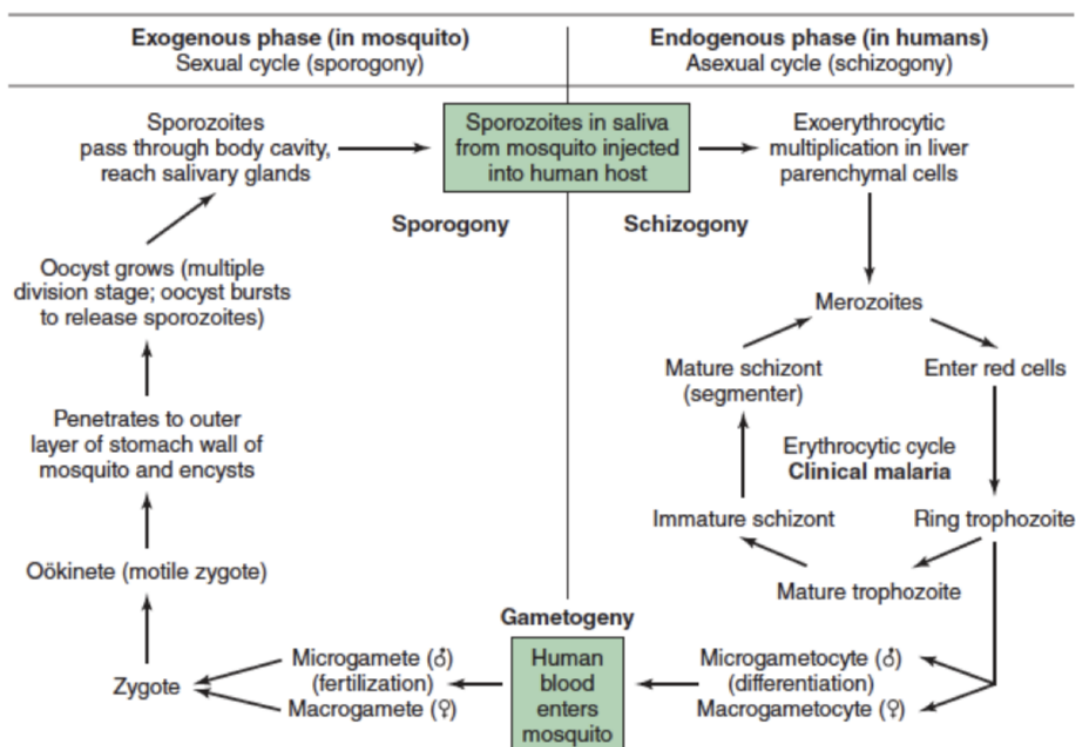
### Life Cycle of Plasmodium

(Only understand the concept. This is by far the most important cycle.)

- 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.

## Malaria life cycle



## Laboratory diagnosis of Malaria

All you need to know is that we use thick and thin blood films, no more detail.

## Therapy for Malaria

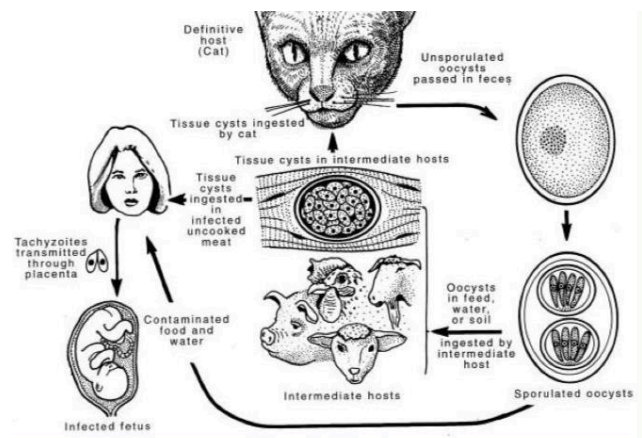
***Tetracycline***, ***doxycycline***, and ***clindamycin*** are used increasingly in combination with other antimalarials to improve their efficacy

## Tissue Protozoan infections

We only have one tissue protozoa to discuss in this sheet:

### A) *Toxoplasma gondii*:

- It's a coccidian protozoon.
- Cats are the vector host.
- Risky in pregnant women.



The end, thank you so much for bearing!