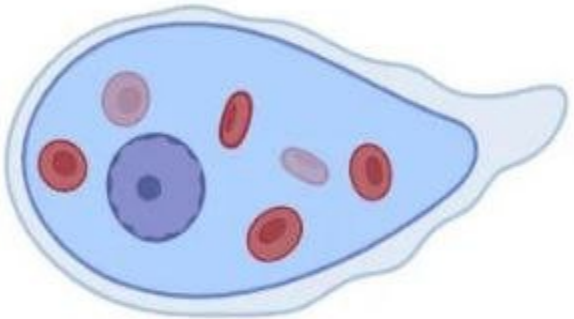
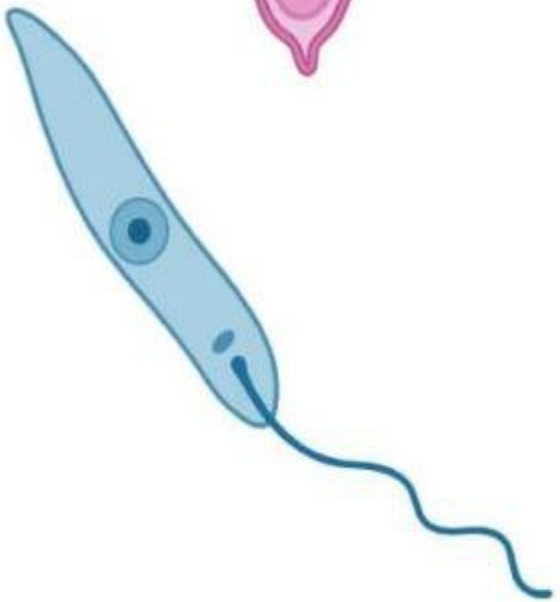
Parasitology



Introduction to Parasitology

Prepared & Presented by:

M.Sc. Ghadeer Mahmood

- Parasitology : is a branch of biology that includes the study of parasites in terms of their **classification**, **life cycles**, **host–parasite relationships**, as well as the **diseases they cause**, their **modes of transmission**, and **methods of control**.

- Parasites : are living organisms, which depend on a living host for their **feeding and living**. They multiply or undergo development in the host.

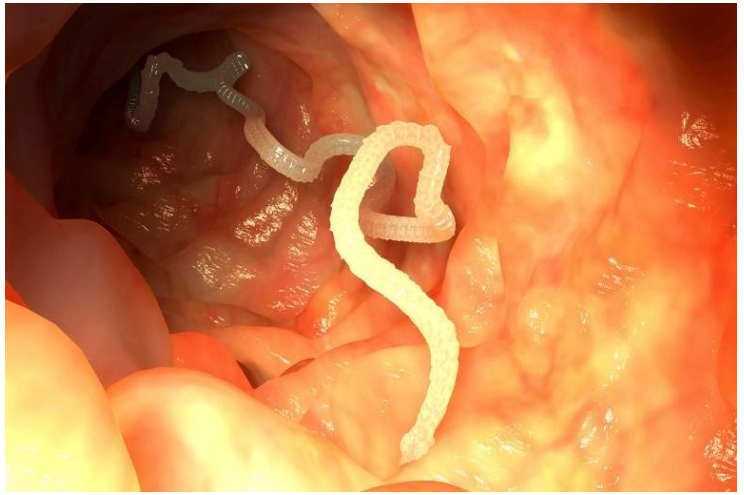
What is the host?

- **Host** : is the organism that is used by a parasite as a source of **feeding and living**.
- **Types of host**
- **final host :** The host, in which the **adult parasite** lives and undergoes **sexual reproduction**.
- The final host may be a human or any other living being.
- **Intermediate host :** The host, in which the **larval stage** of the parasite lives or undergoes **asexual reproduction**.
- In some parasites, 2 different intermediate hosts may be required to complete different larval stages. These are known as first and second intermediate hosts.

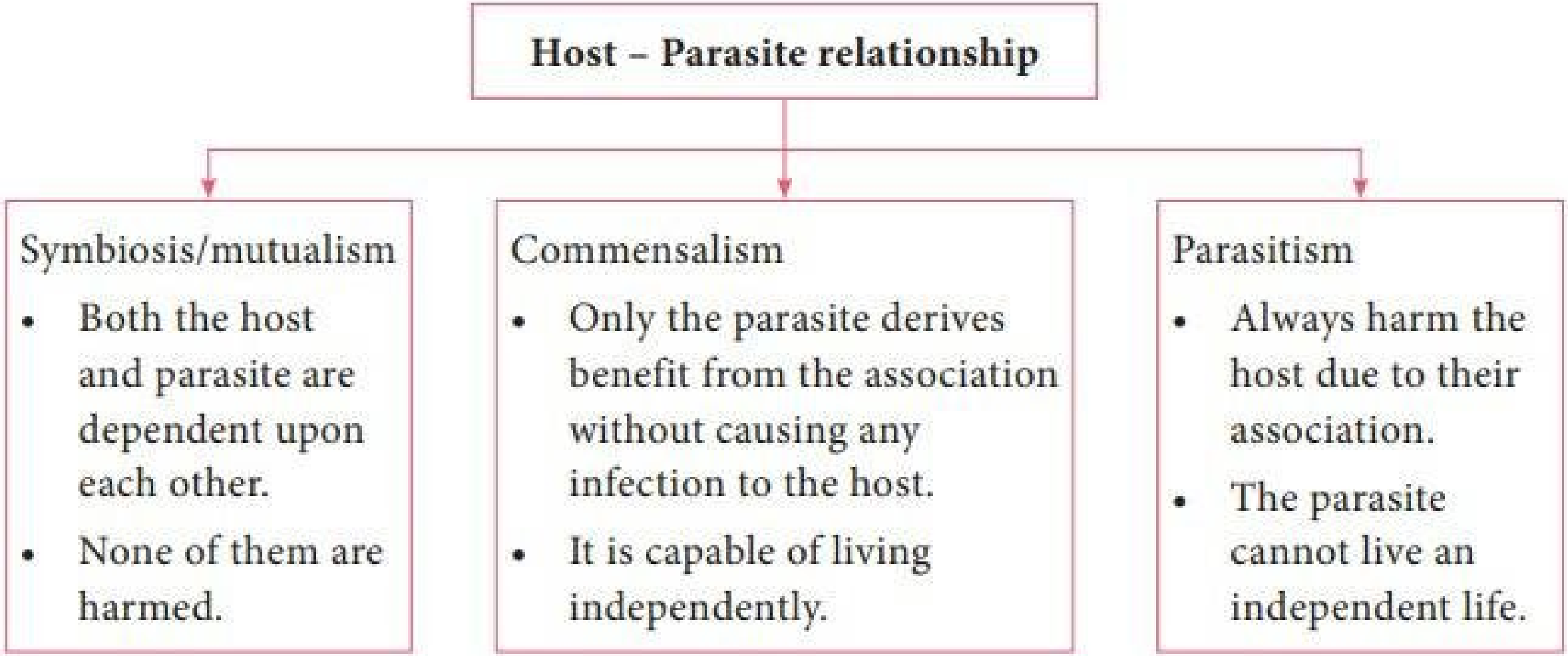
- Tyeps of parasites

- **Ectoparasite:** A parasite, which lives outside the body of the host . without penetrating the tissue.

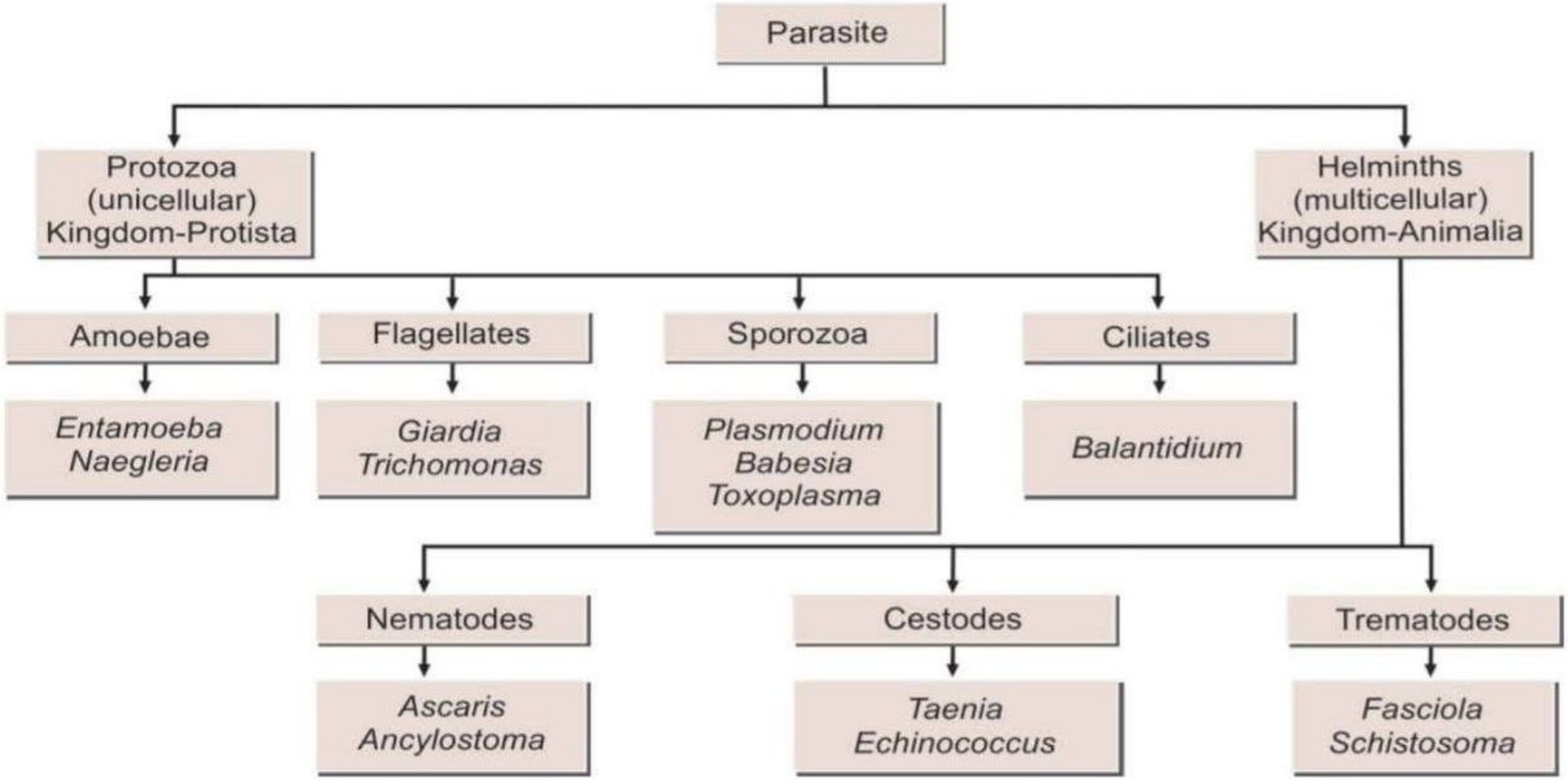
- Ä **Endoparasite:** A parasite, which lives within the body of the host and is cause diseases .



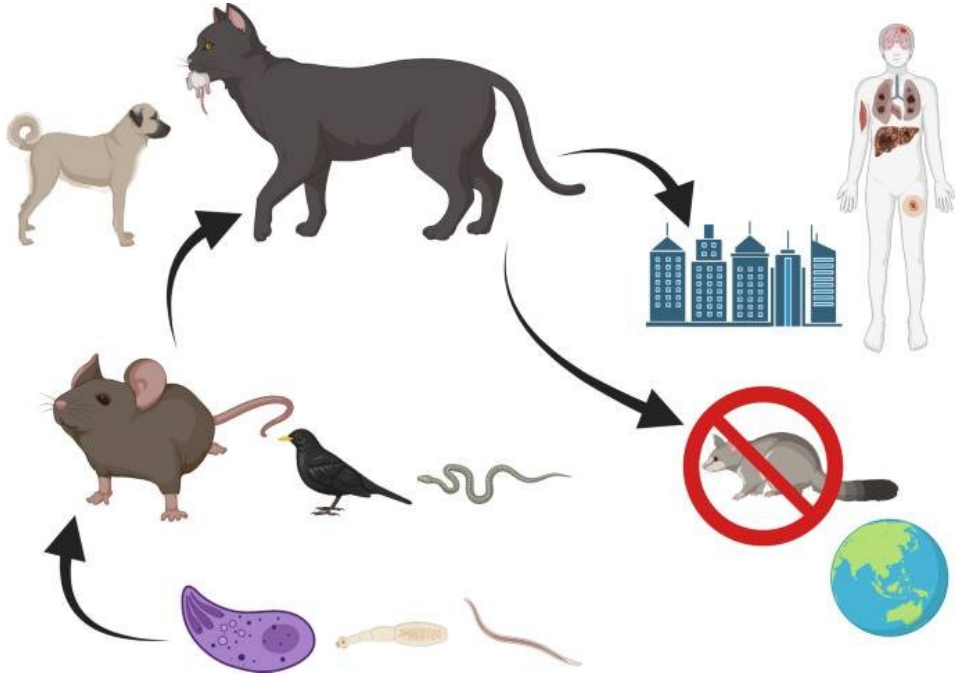
- Most of the protozoan and helminthic parasites causing human disease are endoparasites.

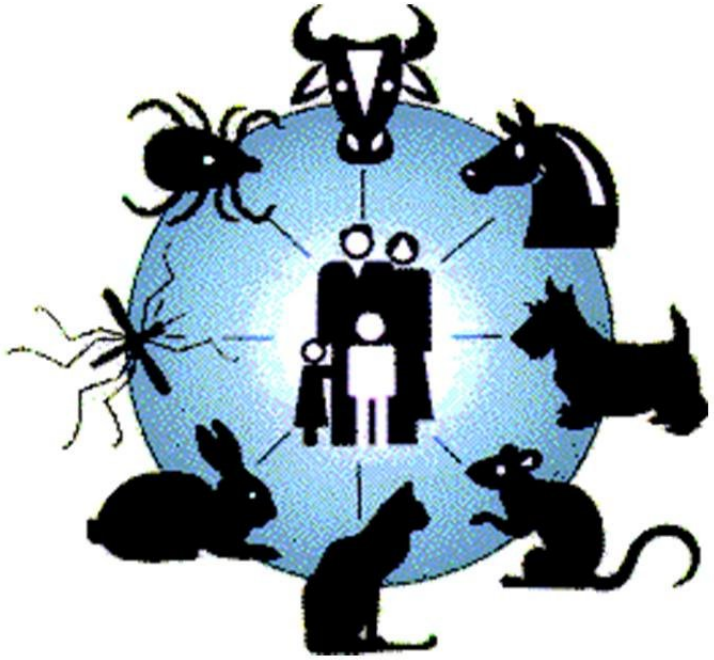

Host – Parasite relationship
Symbiosis/mutualism
• Both the host and parasite are dependent upon each other.
• None of them are harmed.
Commensalism
• Only the parasite derives benefit from the association without causing any infection to the host.
• It is capable of living independently.
Parasitism
• Always harm the host due to their association.
• The parasite cannot live an independent life.

Classification of parasites



- **Zoonosis**
- include the diseases shared in nature by man and animals Later, in 1959, the World Health Organization (WHO)
- defined zoonosis : as “**those diseases and infections, which are naturally transmitted between animals and man”.**

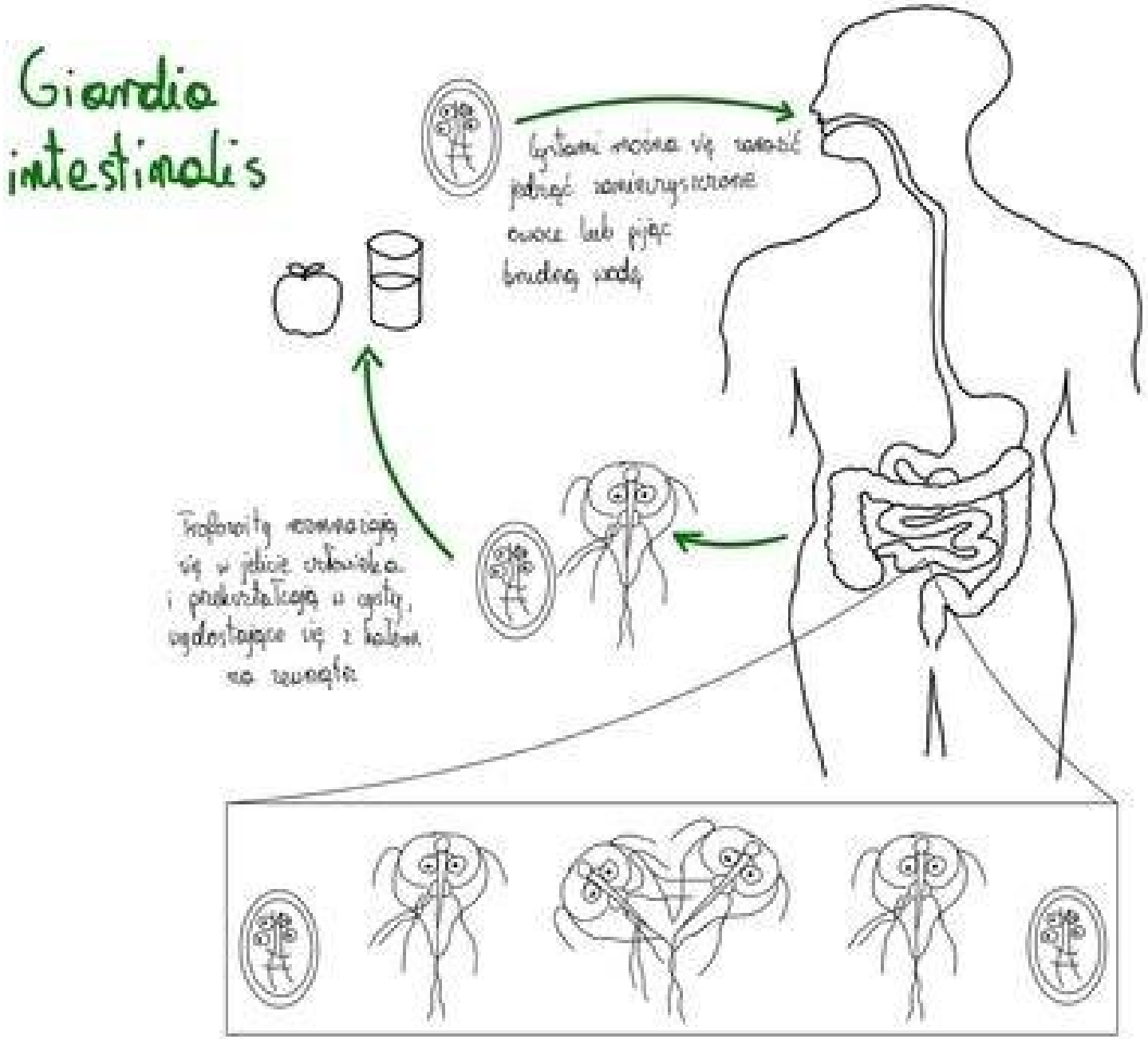




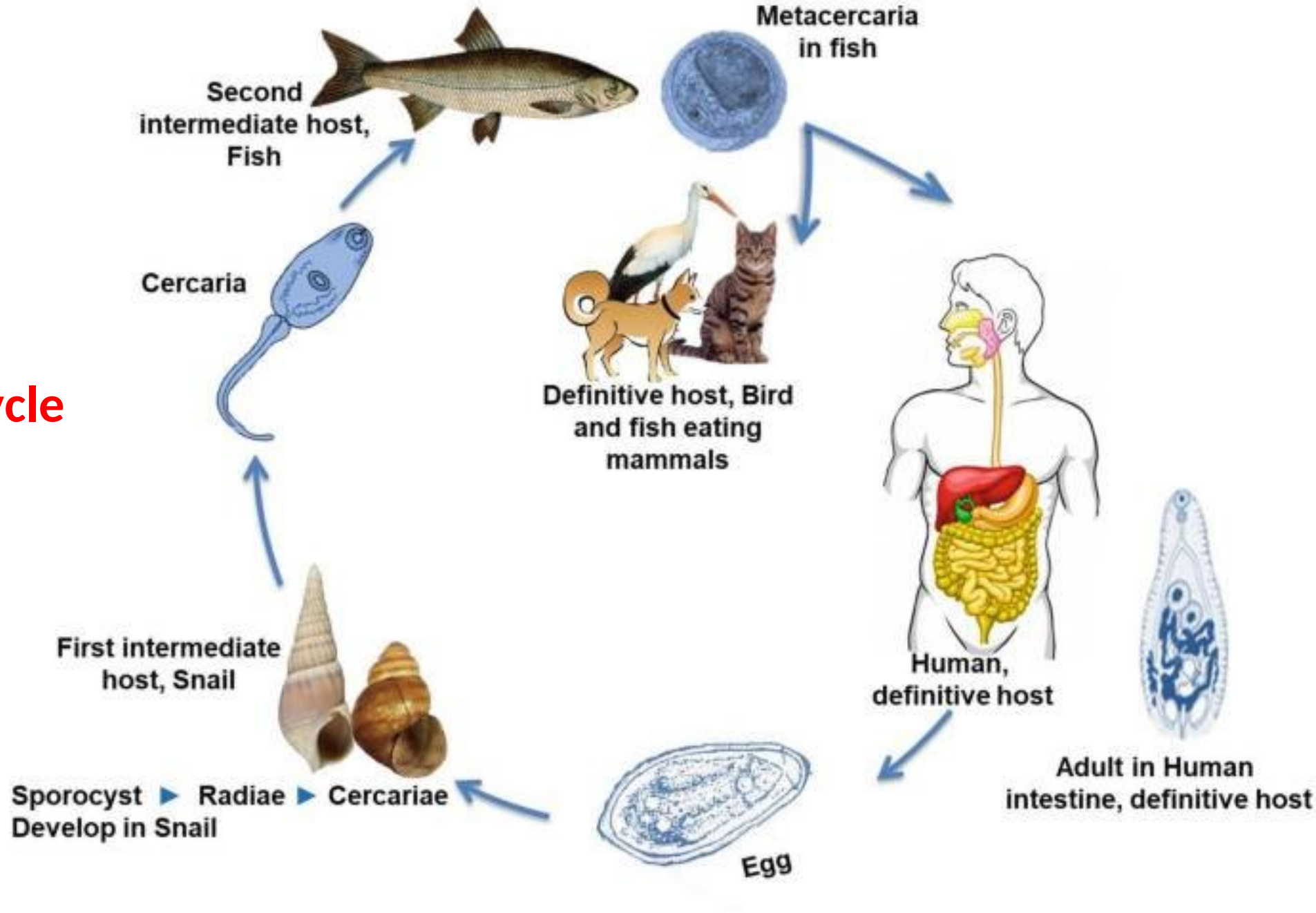
• Life Cycle of Parasites

- **Direct life cycle:** When a parasite requires **only single host** to complete its development, it is called as direct life cycle, e.g. *Giardia lamblia* requires only a human host to complete its life cycle.
- **Indirect life cycle:** When a parasite requires **2 or more species of host** to complete its development, the life cycle is called as indirect life cycle, e.g. malarial parasite requires both human host and mosquito (vector) to complete its life cycle.

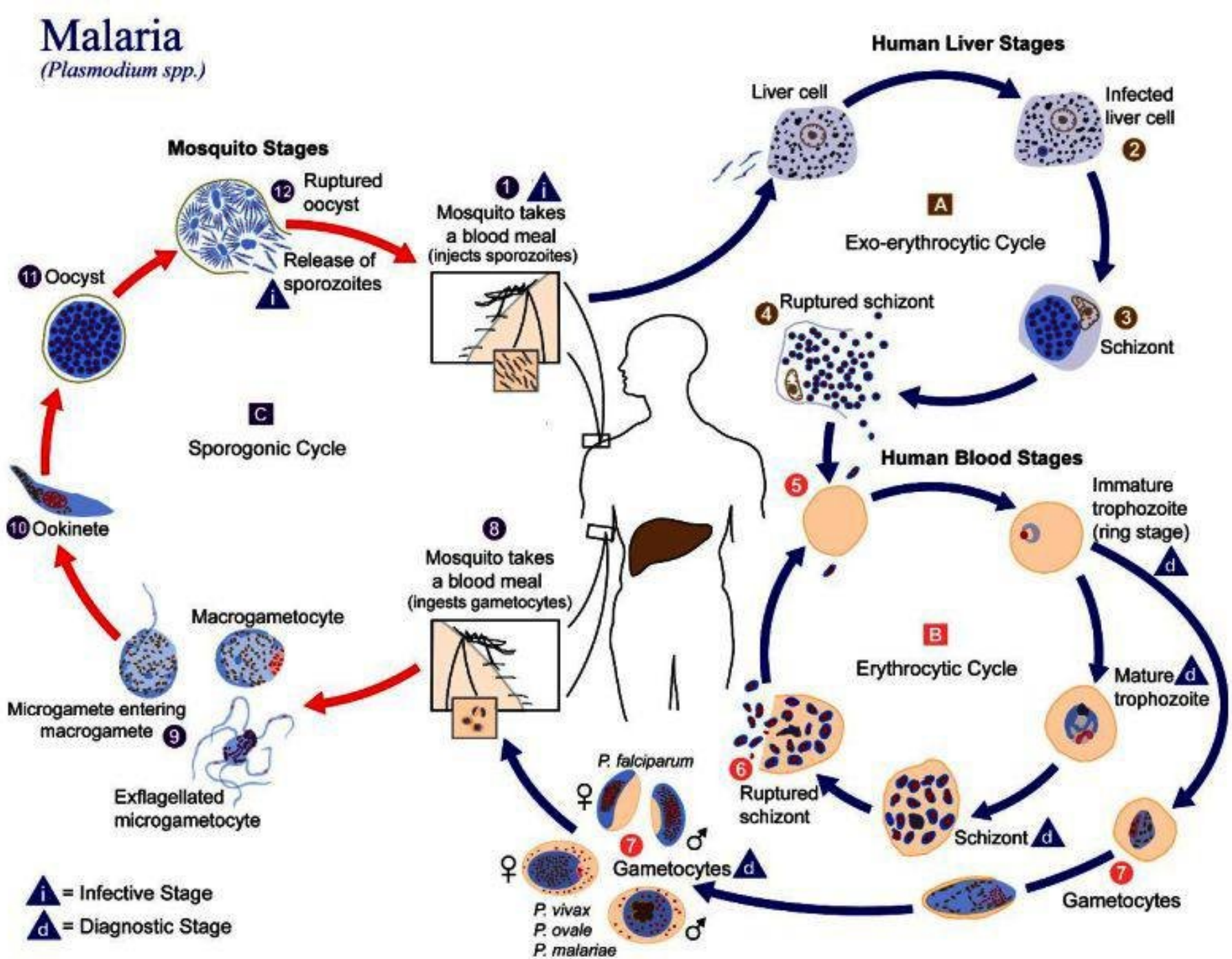
- **Direct life cycle**



Indirect life cycle



Indirect life cycle

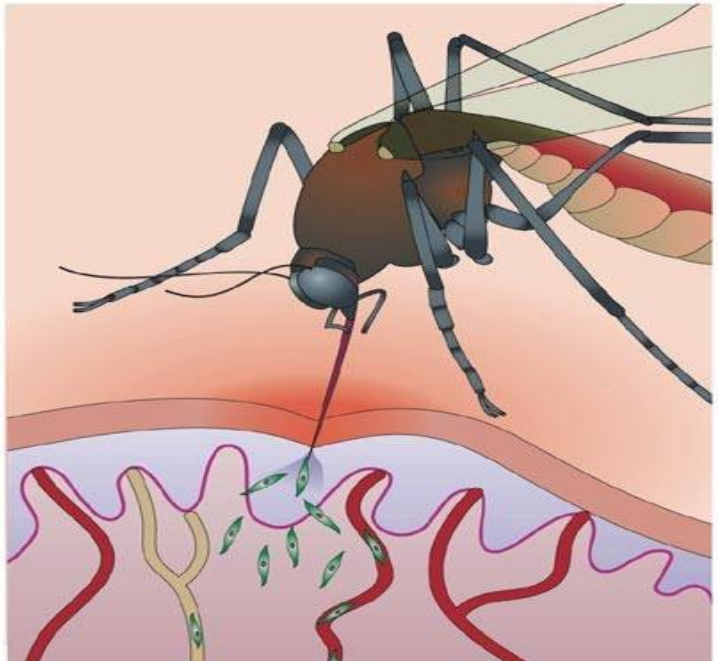


What is the vector and what are its types ?

- **Insect vectors**: usually an arthropod that transmits an infection from man to man or from other animals to man, e.g. female Anopheles is the vector of malarial parasite.
- Vectors can be:

- **Biological vectors:** refers to a vector, which not only assists in the transfer of parasites but **the parasites undergo development or multiplication** in their body as well.

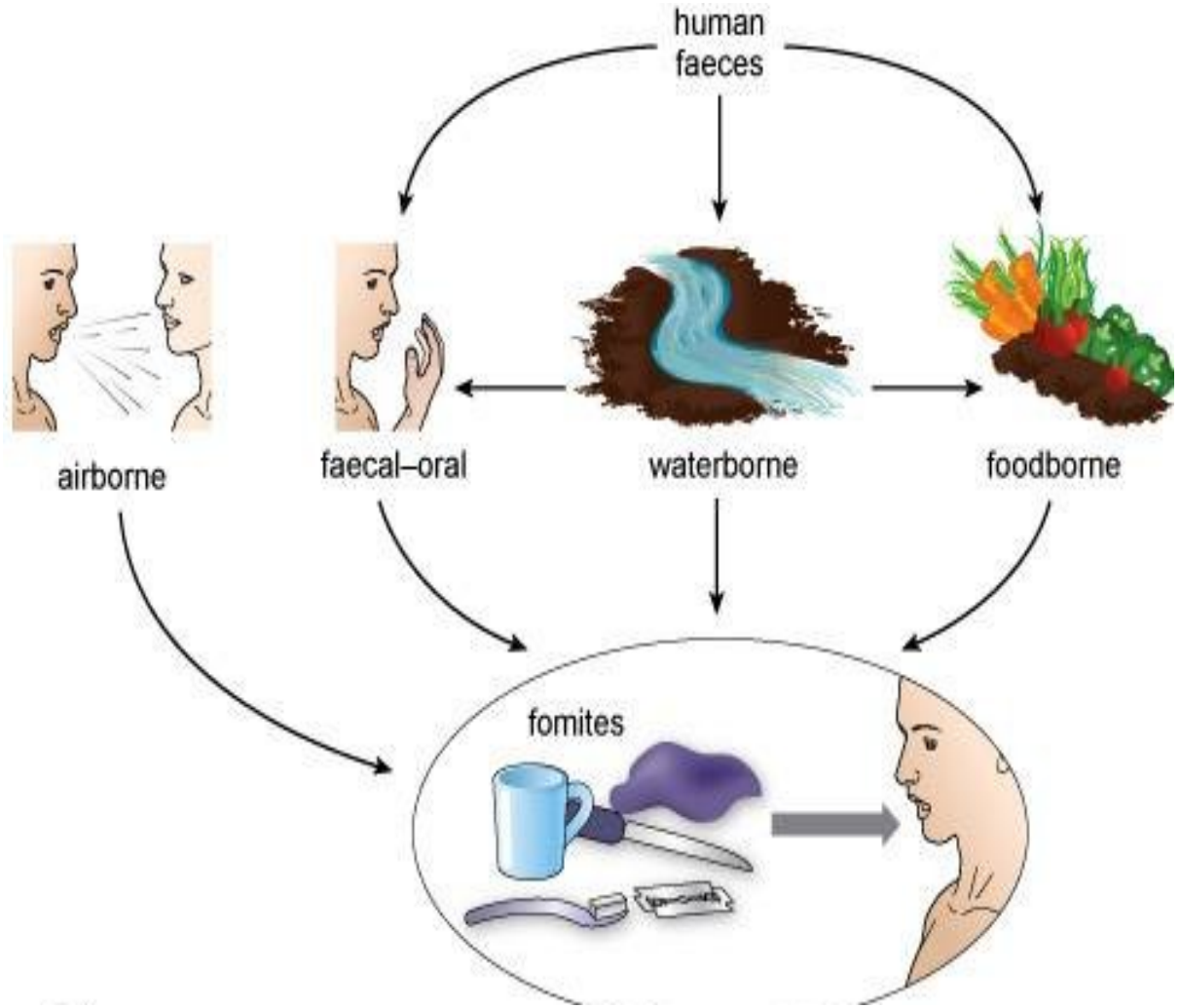
- **Example of Biological vectors are:**
- **Mosquito—Malaria, filariasis**
- **Sandflies—Kala-azar**
- **Tsetse flies—Sleeping sickness**
- **Reduviid bugs—Chagas' disease**
-



- **Mechanical vectors**: The term mechanical vector refers to a vector, which assists in the transfer of parasitic form between hosts but is not essential in the life cycle of the parasite. Example of Mechanical
- vectors is:
- Housefly—amoebiasis
- **Sources of infection**
- Eggs
- Cyct
- trophozoite
- Larvae

What are the methods of infection?

- **Oral transmission:** The most common method of transmission is through oral route by contaminated food, water, soiled fingers. Many intestinal parasites enter the body in this manner. the infective stages being **cysts**, **eggs**, or **larval forms**. Infection with E. histolytica and other intestinal protozoa occurs when the infective cysts are swallowed.
- **Skin transmission:** Entry through skin is another important mode of transmission. Hookworm infection is acquired, when the larvae enter the skin of persons walking barefooted on contaminated soil. Schistosomiasis is acquired when the cercarial larvae in water penetrate the skin.



Oral transmission

skin transmission

- **Vector transmission**: Many parasitic diseases are transmitted by insect bite, e.g., malaria is transmited by bite of female Anopheles mosquito,. A vector could be a biological vector or a mechanical vector.

- **Direct transmission**: Parasitic infection may be transmitted by person-to-person contact in some cases, e.g. by **kissing** in the case of *gingival amoebae* and by **sexual contact** in trichomoniasis.

What is a Scientific Name and How to Write it?

- **A scientific name:** is a universal system used to identify living organisms.
- • It consists of two parts:
- 1. Genus name: always starts with a capital letter.
- 2. Species name: written in lowercase letters.
- • If the species is unknown, we use **sp.**
- • If more than one species is unknown, we use **spp.**
- • Both genus and species should be written in ***italic*** **or** **underlined**.

- Examples:
- *Giardia lamblia*
- *Hymenolips nana*
- *Plasmodium* sp.
- *Plasmodium* spp.

Introduction for phylum protozoa

Prepared & Presented by:

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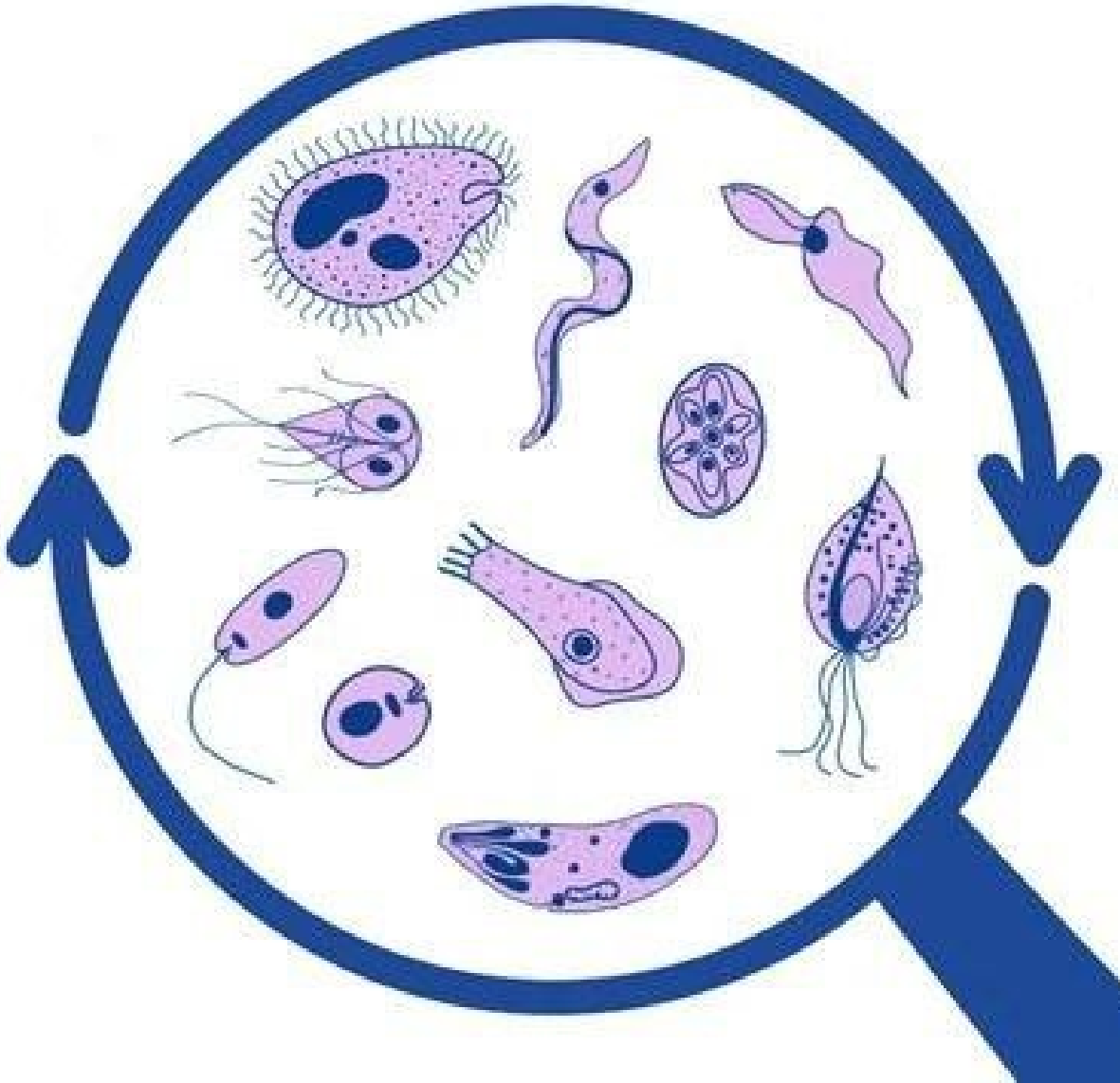


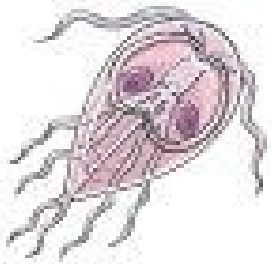
What is the definition of protozoa?

- **Protozoa:** They are very small organisms are unicellular, microscopic eukaryotic organisms that can exist freely in nature or as parasites within host organisms . Several protozoan species are of medical importance **because they cause diseases in humans and animals**.
- Protozoa were first discovered in 1674 by the Dutch scientist Antonie van Leeuwenhoek. He used a simple microscope that he made himself to look at pond water and saw tiny moving organisms.

- Later, in 1681, he also described protozoa (such as *Giardia*) in his own diarrheal stool samples.

Protozoa

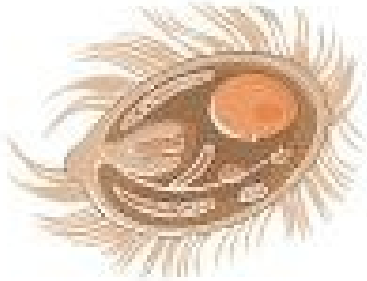
a. Flagellates
（*Giardia intestinalis*）



b. Amebae
（*Entamoeba*）

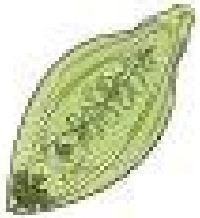
c. Sporozoa
（*Plasmodium*）

d. Ciliates
（ *Balantidium coli*）

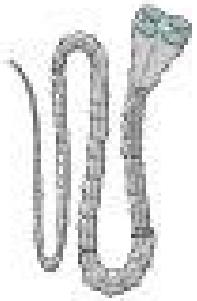


Helminths

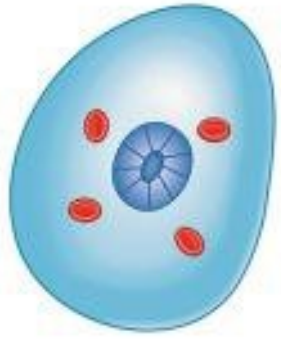
e. Nematodes
（*Ascaris lumbricoides*）



f. Trematoda
（*Fasciola hepatica*）



g. Cestoda
（*Taenia*）

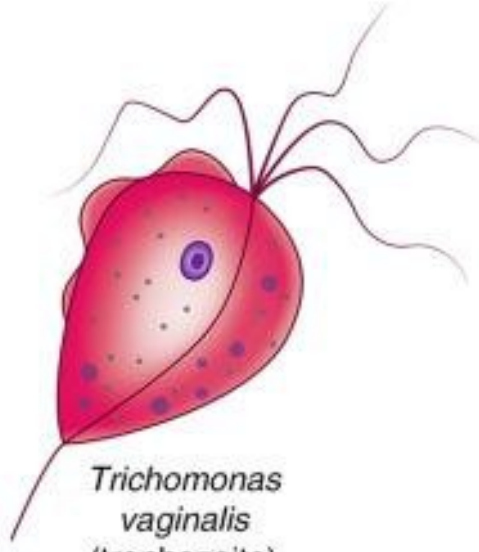


Entamoeba histolytica (cyst) 14 µm

Trypanosoma brucei gambiense (trypomastigote) 22 µm

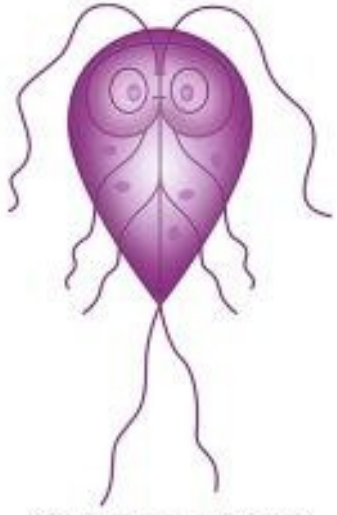
12 µm

Leishmania tropica (amastigote) 2.5 µm



Trichomonas vaginalis (trophozoite) 25 µm

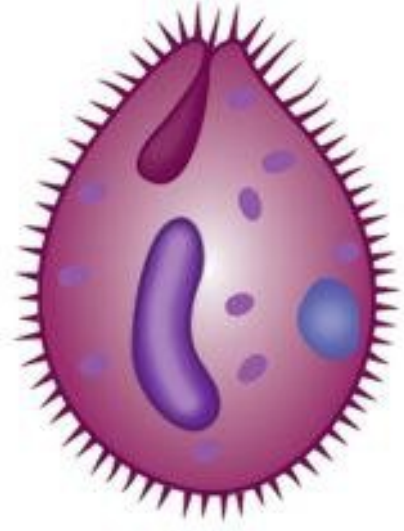
Amoebozoa **Kinetoplastida** **Metamonada**



Giardia duodenalis (trophozoite) 15 µm

Plasmodium falciparum (sporozoites) 12.5 µm

Toxoplasma gondii (trophozoite) 8 µm



Balantidium coli (trophozoite) 40-200 µm

Metamonada **Apicomplexa** **Ciliophora**

What are the general characteristics of protozoa?

Some of the characteristics are:

- There are about 50,000 known species of Phylum Protozoa.
- They are small, usually microscopic, not can see without a microscope.
- Single cell performs all vital functions: nutrition, digestion, respiration, excretion, reproduction.

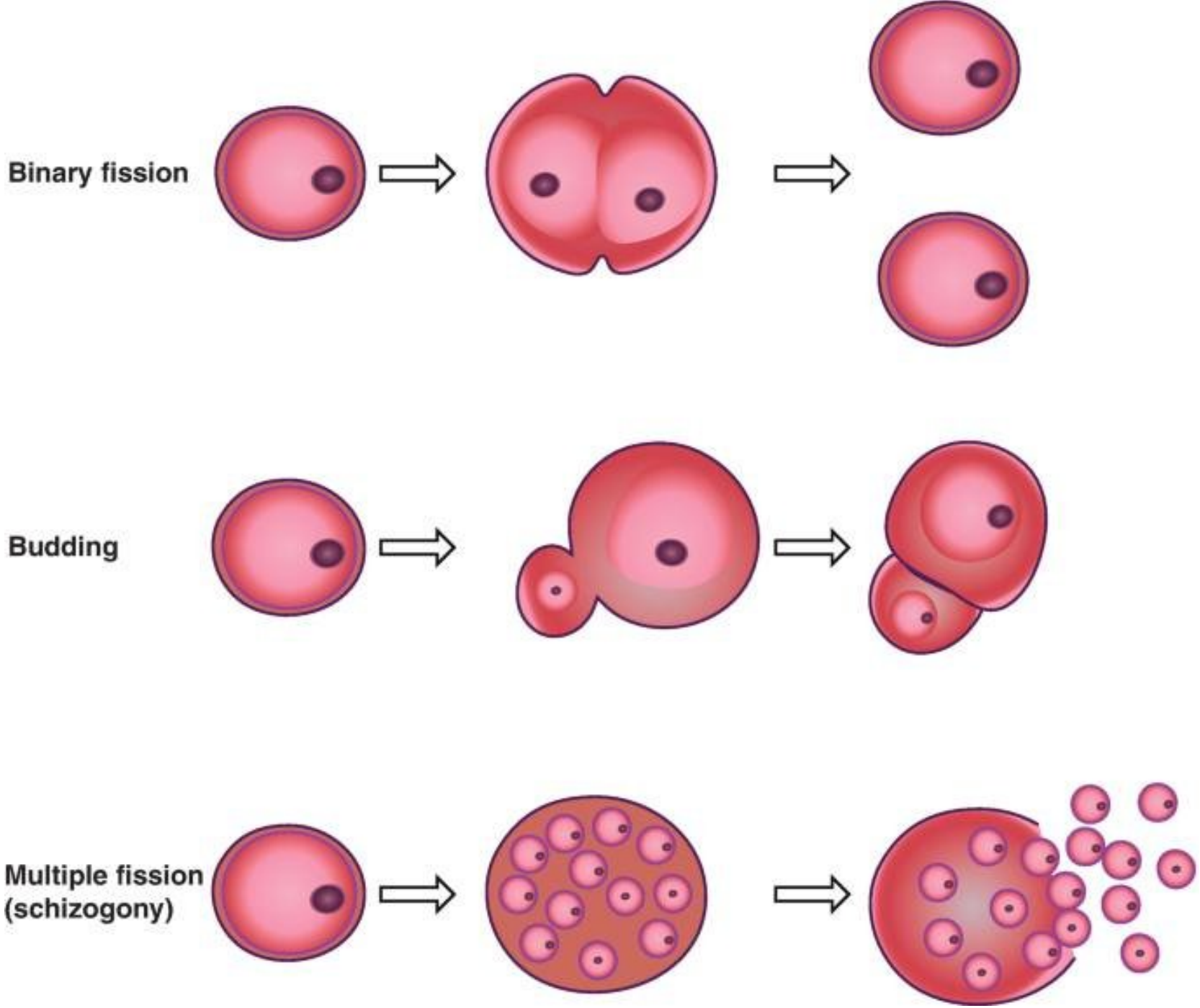
- Protozoans exhibit mainly two forms of life; free-living (freshwater, seawater) and parasitic (ectoparasites or endoparasites).
- The body is unicellular (without tissue and organs).
- They can live **single** (solitary) or in **groups** (colonial).
- Simple body organization with one or more nuclei; protoplasm differentiated into ectoplasm and endoplasm.

What are the reproductive methods of protozoa?

A- Asexual reproduction

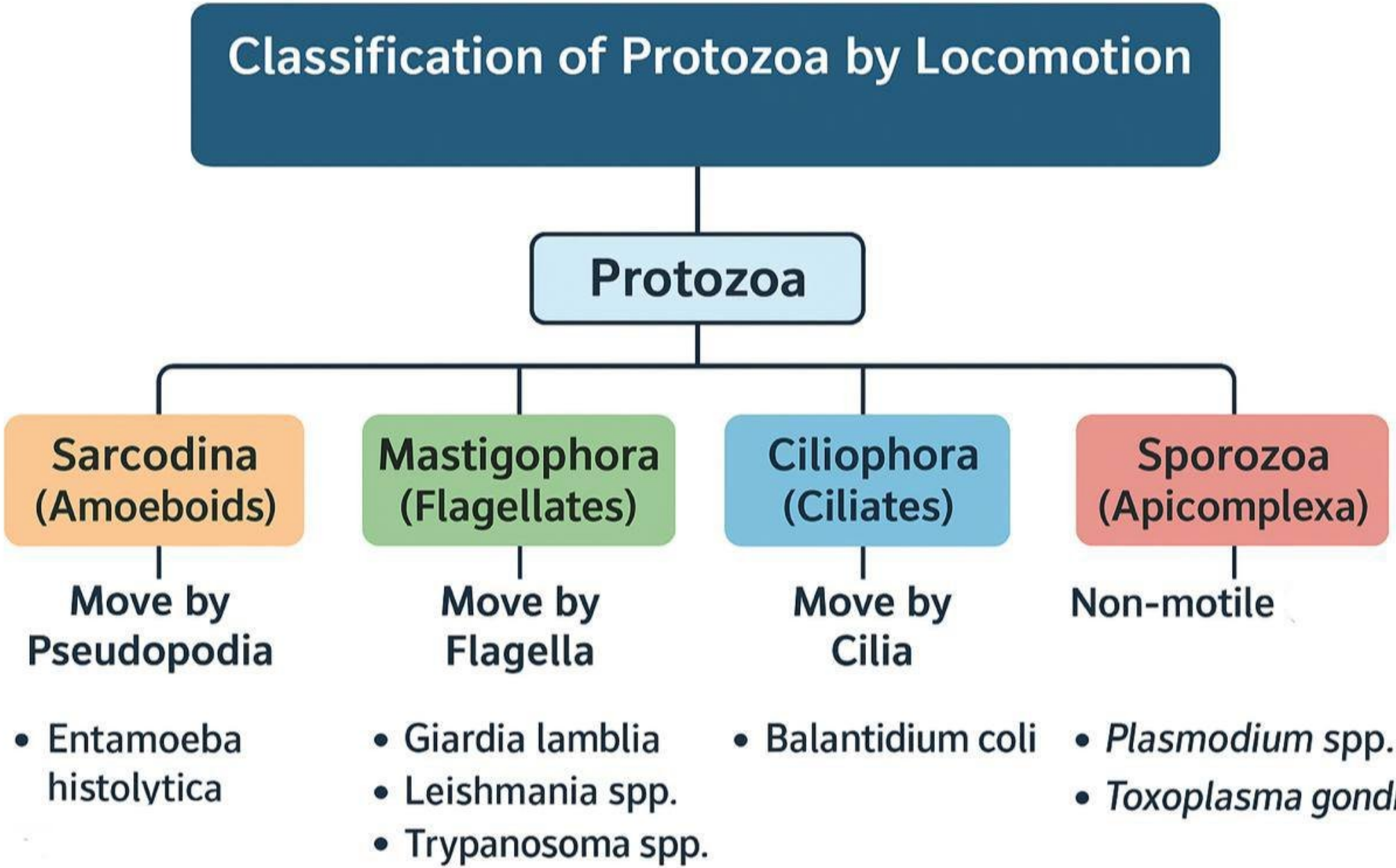
- 1. **Simple binary fission**: The nucleus and cytoplasm divide into two equal parts, producing two identical cells.
- 2. **Multiple fission**: The nucleus divides into many nuclei, and each nucleus is surrounded by cytoplasm to form new cells.
- This process is called **schizogony**.
- 3. **Budding**: A small bud appears on the mother cell, grows and develops, then separates to form a new independent cell.

- **B- Sexual reproduction**
- 1. Syngamy:
- Two sex cells (gametes) unite together:
- ● **Microgamete**: small, active, and motile (male gamete).
- ● **Macrogamete**: large, non-motile (female gamete).
- Their fusion results in the formation of a **zygote**, which is the first stage of a new cell.


Binary fission
Budding
Multiple fission
(schizogony)

Locomotion in Protozoa

- **Pseudopodia (false feet):** extensions of the cytoplasm used for **movement and feeding**.
- Example: Amoeba (**causes amoebiasis**).
- **Flagella (whip-like structures):** long, whip-like tails for **swimming.**
- Example: *Giardia lamblia* (causes **giardiasis**).
- **Cilia (hair-like structures):** short hair-like projections that beat rhythmically.
- Example: *Balantidium coli* (causes **balantidiasis**).


Classification of Protozoa by Locomotion
Protozoa
Sarcodina (Amoeboids)
Mastigophora (Flagellates)
Ciliophora (Ciliates)
Sporozoa (Apicomplexa)
Move by Pseudopodia
Move by Flagella
Move by Cilia
Non-motile
• Entamoeba histolytica
• Giardia lamblia
• Leishmania spp.
• Trypanosoma spp.
• Balantidium coli
• Plasmodium spp.
• Toxoplasma gondii

1-Sarcodina (Amoeboids)

- **Amoebae: are structurally simple protozoans which have no fixed shape.**

- The cytoplasm of amoeba is bounded by a membrane and can be differentiated into an outer ectoplasm and inner endoplasm.

- Pseudopodia are formed by the amoeba by thrusting out ectoplasm, followed by endoplasm. These are used for locomotion of food by **phagocytosis.**

- Reproduction occurs by Simple binary fission and budding.
- Cyst is formed in unfavorable conditions and is usually the infective form for host (e.g. Entamoeba histolytica).

Amoeba Classification based on habitat in host

Atrial parasites → ***Entamoeba gingivalis***

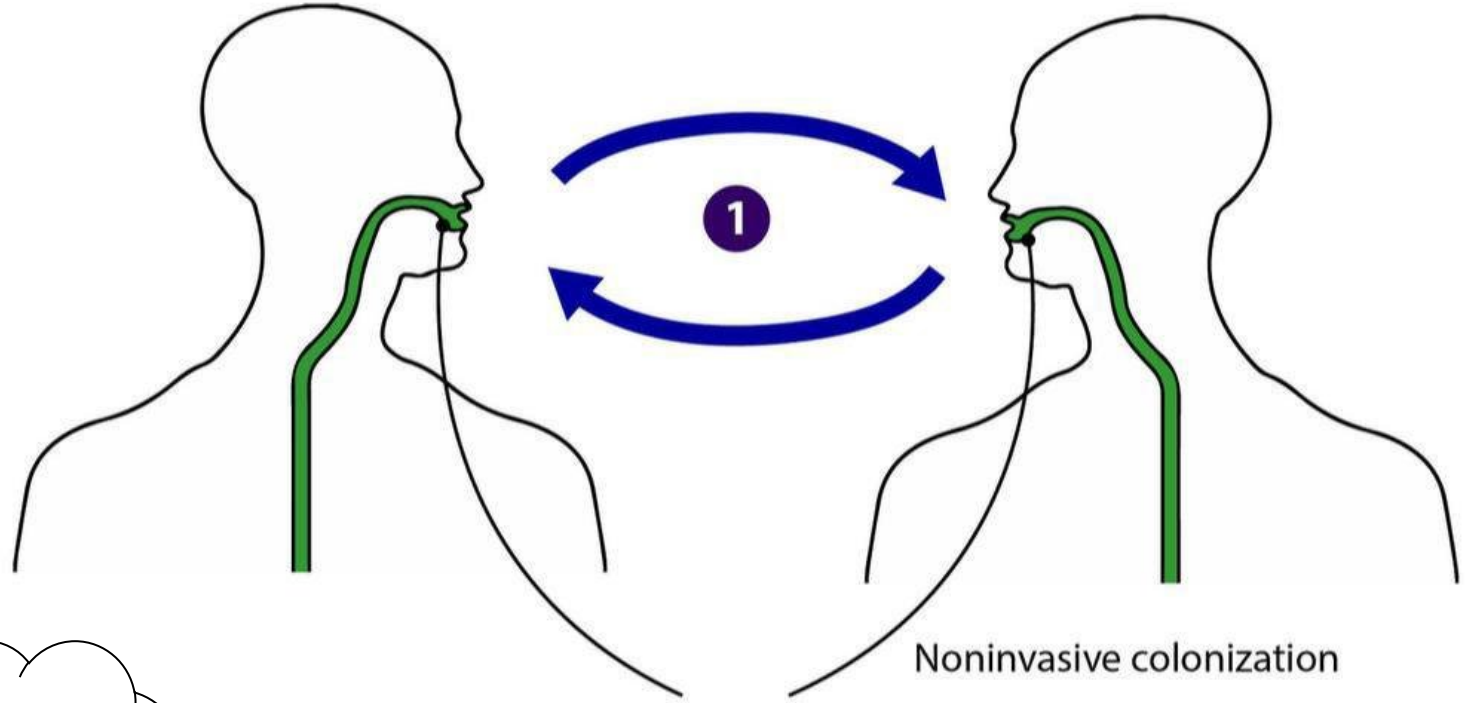
Intestinal parasites →

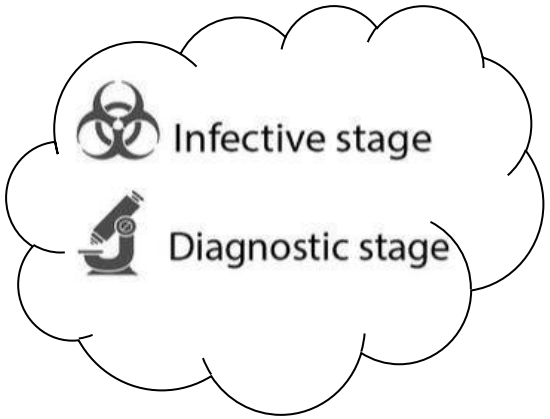
Entamoeba histolytica
Entamoeba coli
Endolimax nana
Iodamoeba bütschlii

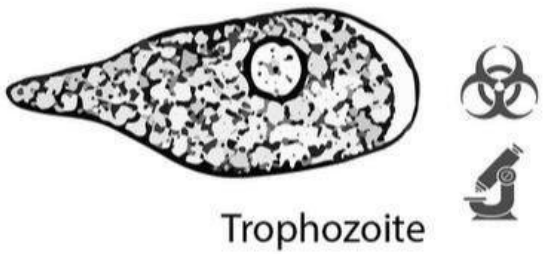
Entamoeba gingivalis

- *E. gingivalis* was the first amoeba of humans, discovered by Gros in 1849.
- It is global in distribution.
- **Only the trophozoite is found**
- The amoeba lives in gingival tissues and They are abundant in unhealthy mouths
- It **is transmitted by direct oral contact.**

Entamoeba gingivalis







Amoebida

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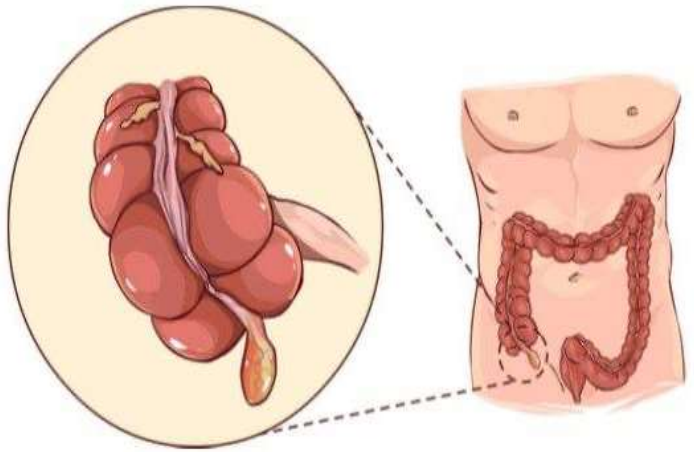
Intestinal amoeba

- 1- Entamoeba histolytica: is a protozoan parasite that infects humans, monkeys, dogs, cats, birds, and rats. It mainly lives in the large intestine, especially the **cecum**, and causes **amoebic dysentery**, which is characterized by **diarrhea with blood** .
- *Entamoeba histolytica* was first discovered in 1875 by. Losch in Russia, when he found it in the dysenteric stool of a patient.
- In 1890, William Osler described the case of a young man with dysentery who later died due to a *liver abscess.*



- **Geographic Distribution**

- Worldwide, with higher incidence of amebiasis in developing countries.

- **Amebiasis** is the third leading parasitic cause of death, surpassed only by malaria and schistosomiasis.

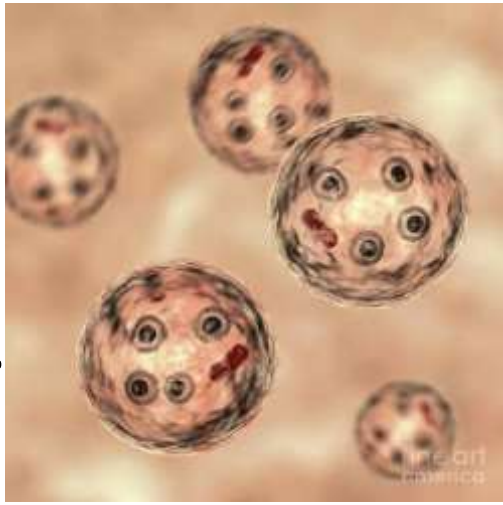
- On a global basis, amebiasis affects approximately 50 million persons each year and causes 50,000 deaths annually.

Mode of infection

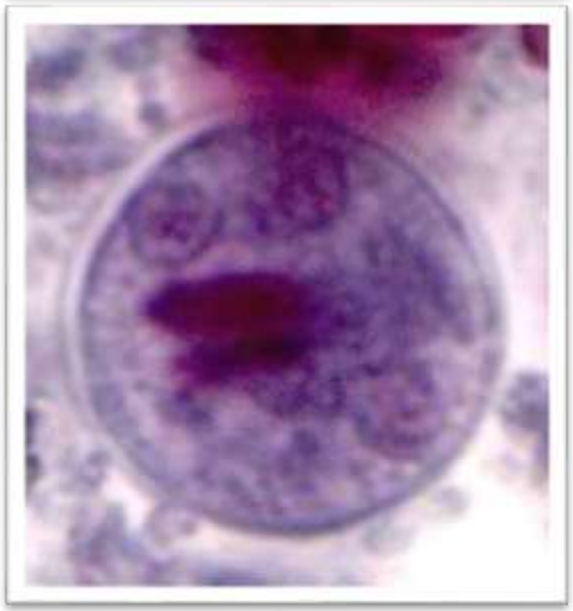
- Oral – fecal type.
- By ingesting food and water containing mature cyst.
- House fly may act as vector sometimes.

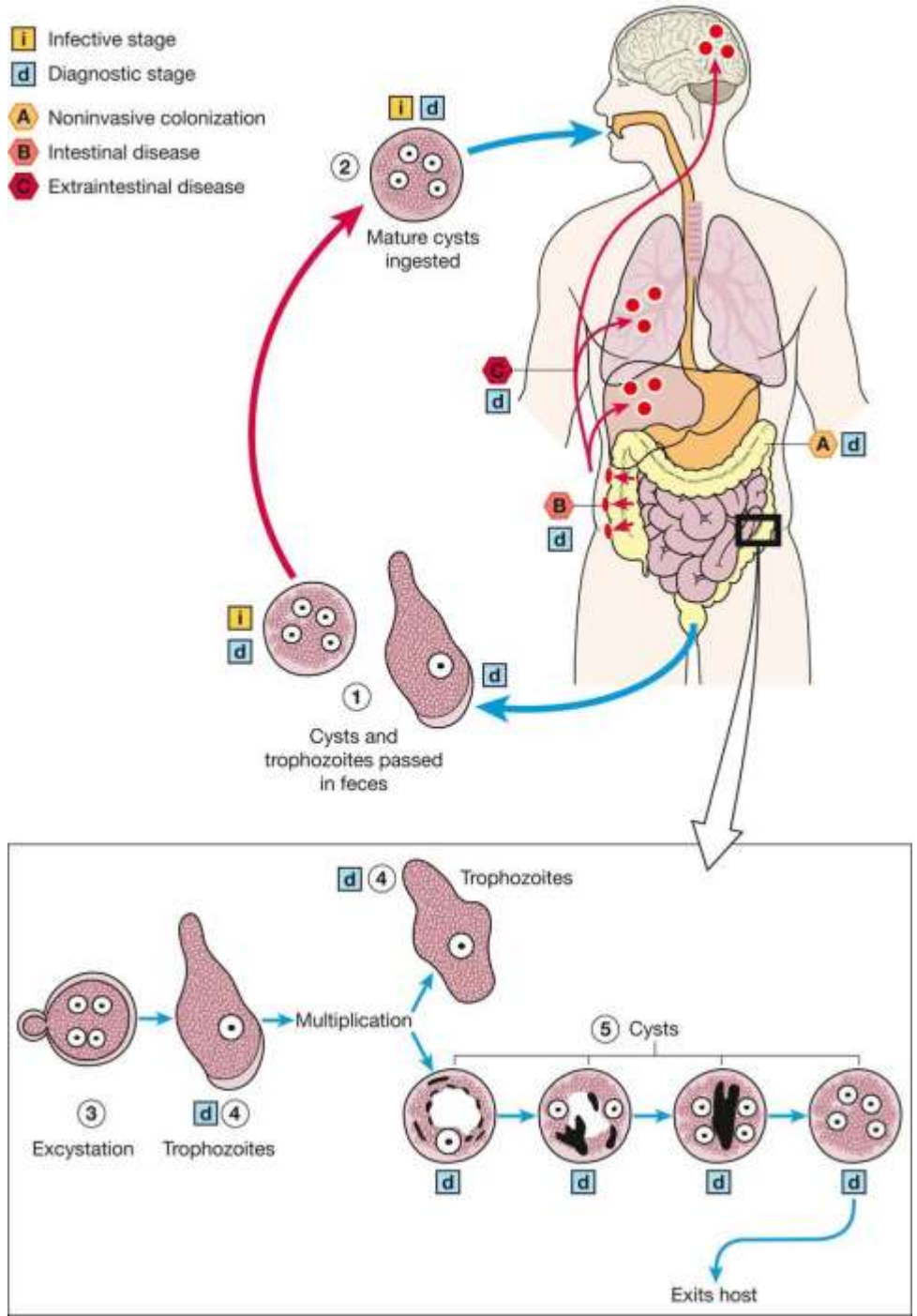
- ***E. histolytica* occurs in 4 forms for life cycle**
- Morphological Characteristics of *Entamoeba histolytica*
- (in vivo)
- **1. Trophozoite**
- Size: about 20–40 µm.
- Movement: active motility through the formation of pseudopodia.
- nucleus: a **single nucleus** with a **small central karyosome**. karyosome (0.5 µm) and evenly distributed **peripheral chromatin.**
- The cytoplasm contains food vacuoles, which may include ingested red and white blood cells or bacteria.
- Chromatoid bodies **appear rod-like with rounded ends**.
- The trophozoites divide by binary fi ssion in every 8 hours

- **2. Precyst**: Shape: Oval.
- Contains a single nucleus.
- Transitional stage between trophozoite and cyst.
- Pseudopodia and food vacuoles disappear.



- **3. Cyst**:
- Shape: Spherical, 10–16 µm.
- Mature cyst: Has 4 nuclei and small **central karyosome** location .
- **4. Metacyst**:
- Found in the intestine.
- Divides into 4 trophozoites (each with one nucleus).
- This process is called **Excystation**.
- Occurs when the parasite emerges from a mature cyst (with 4 nuclei) inside the small intestine.




i Infective stage
d Diagnostic stage
A Noninvasive colonization
B Intestinal disease
C Extraintestinal disease
2
Mature cysts ingested
1
Cysts and trophozoites passed in feces
d 4 Trophozoites
3 Excystation
d 4 Trophozoites
Multiplication
5 Cysts
Exits host

Pathology and symptomaiogy

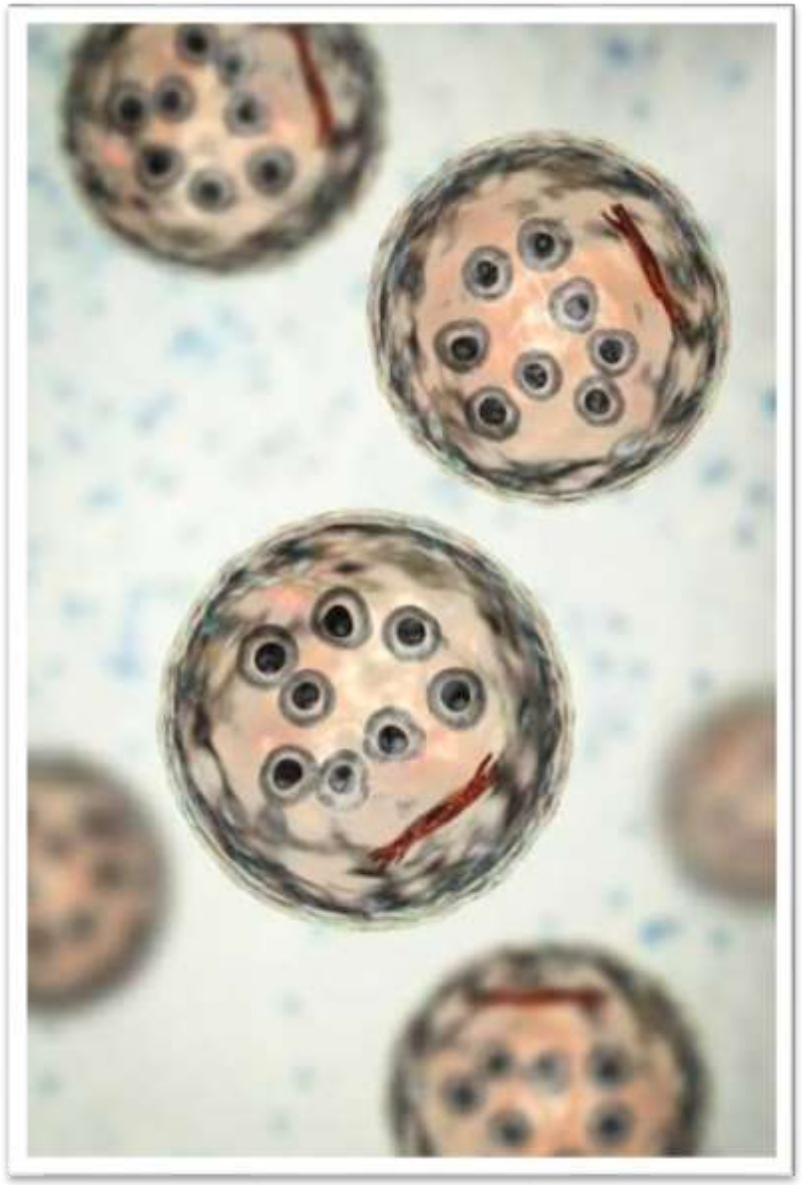
- **Intestinal:** Bloody diarrhea, abdominal pain, cramps.
- **Extraintestinal:** The parasite can invade the bloodstream and reach the **liver**, **lungs**, or **brain**, causing fever, liver pain (**liver abscesses**) , and organ-specific complications.
- The right lobe of the liver is involved in up to 85% of cases, with **Leukocytosis.**

- **What are the infective and diagnostic stages of *Entamoeba histolytica*?**
- Infective stage: Mature cyst ingested via contaminated food or water.
- Diagnostic stage: cyst in stool sometime trophozoite.

- **What are the methods for clinical and laboratory examination?**
- Clinical: Abdominal pain, diarrhea (sometimes bloody), fever, fatigue.
- Laboratory: Trophozoites/cysts in stool, leukocytosis, elevated liver enzymes (if abscess).
- **Question:** Why does Entamoeba histolytica attack the mucosal layers of the intestine?
- **Answer:** Because of the slow movement of the colon, which is its main site.

- 2- **Entamoeba coli** (**amoeba colon**).

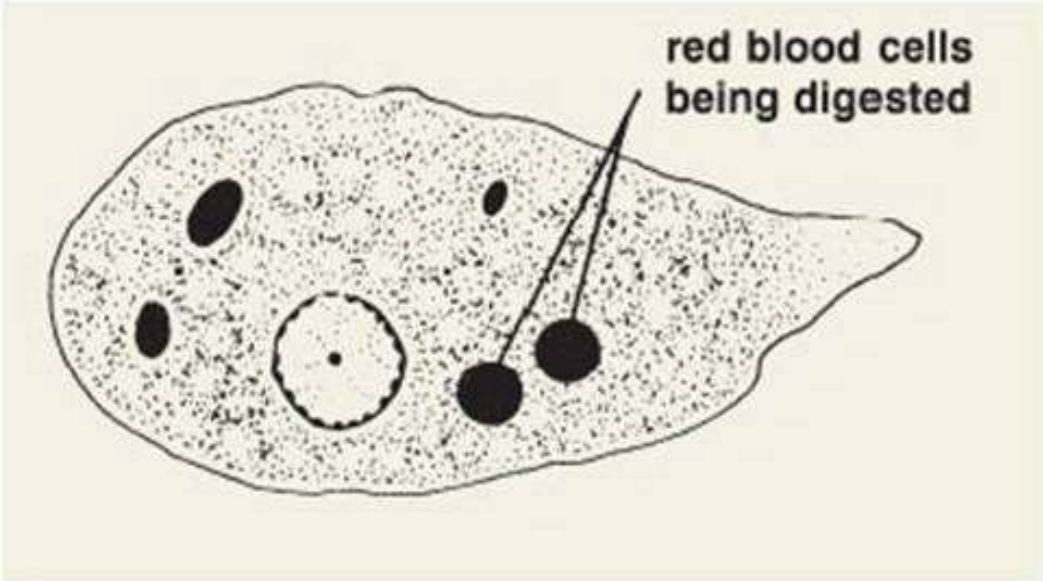
- *E. coli* was first described by Lewis (1870).
- It is worldwide in distribution and a **nonpathogenic**.
- It is larger than *E. histolytica* about 20–50 µm.
- It is one of the largest amoeba occuring in the human **colon** .
- In the life cycle of parasite there are two stages: form (**trophozoite**) and a (**cyst**).
- The cysts contain **eight nuclei** and not central karyosome .
- The nucleus contains a nucleolus that is eccentrically located.
- Chromatin bodies are absent or very thin.
- It does not invade tissues.

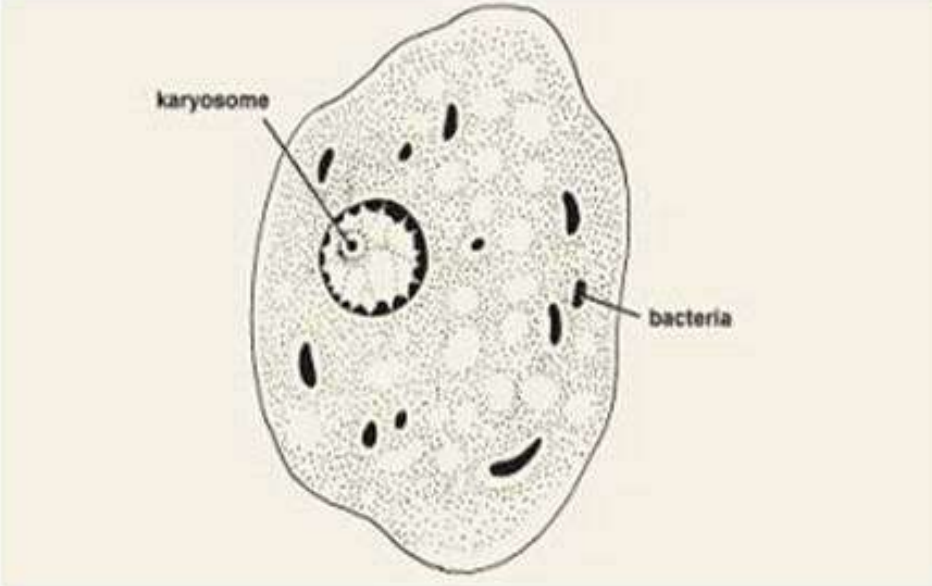


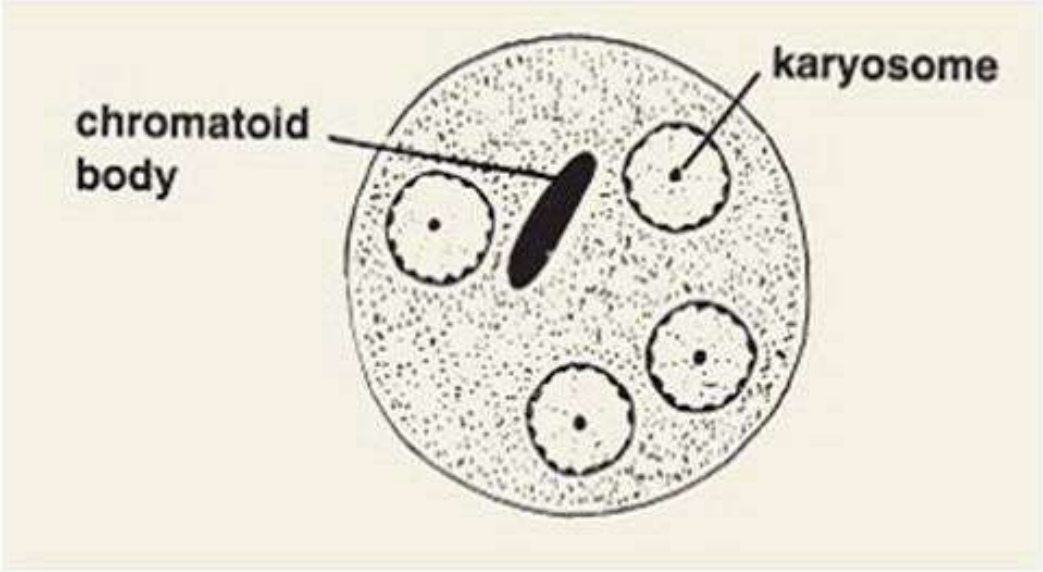
Infective stage: Cyst

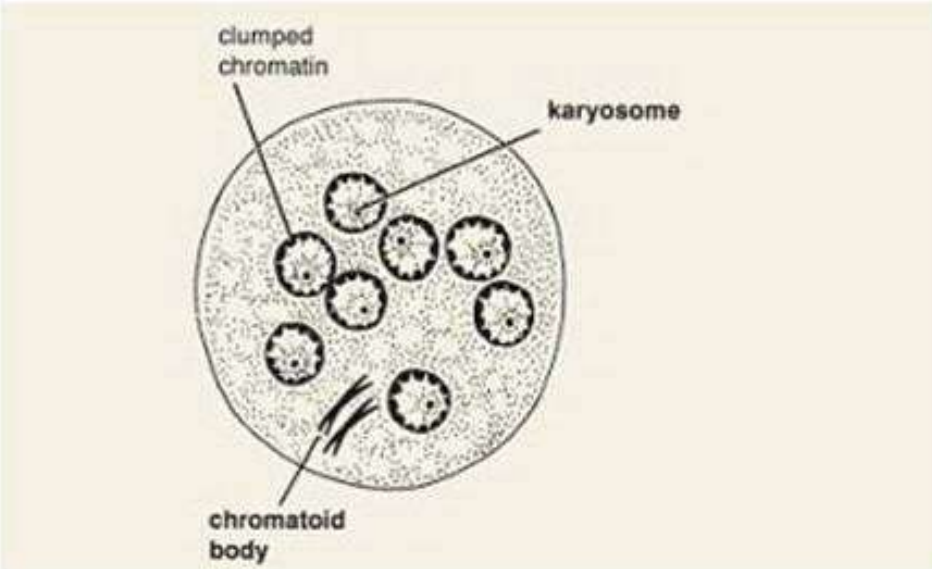
Diagnostic stage: Cyst

Entamoeba histolytica and Entamoeba coli









- 3- **Endolimax nana**

Endolimax nana is a small intestinal amoeba that lives in the **human colon**. It is considered **nonpathogenic**.

Life cycle & stages:

- **Infective stage**: mature cyst **(4 nuclei and large not central karyosome).**
- Excystation in small intestine → release of trophozoites.
- Trophozoites multiply by binary fission in large intestine.
- Encystation in colon → cysts passed in feces.

diagnostic stages: cysts.

Site of infection:

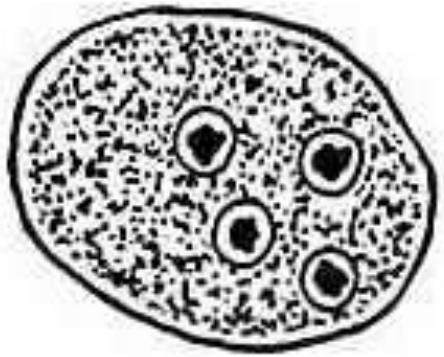
- Lumen of the **large intestine** (colon).

Mode of transmission:

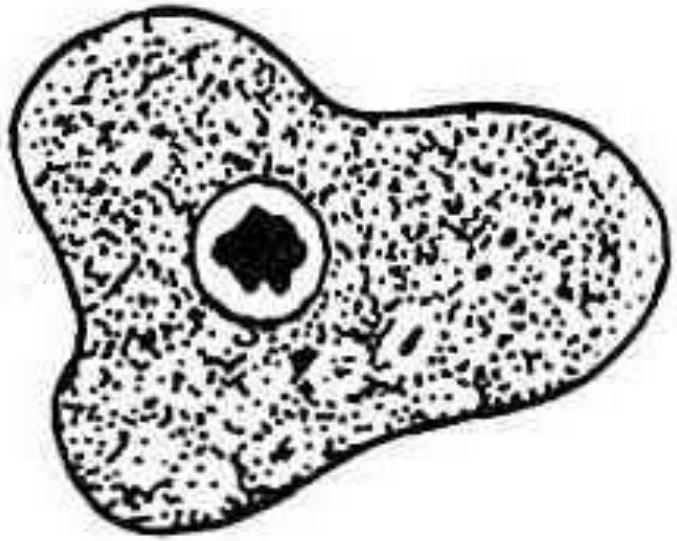
- mature cysts in contaminated food, water, or hands.

Endolimax nana

Infective stage: Cyst
Diagnostic stage: Cyst



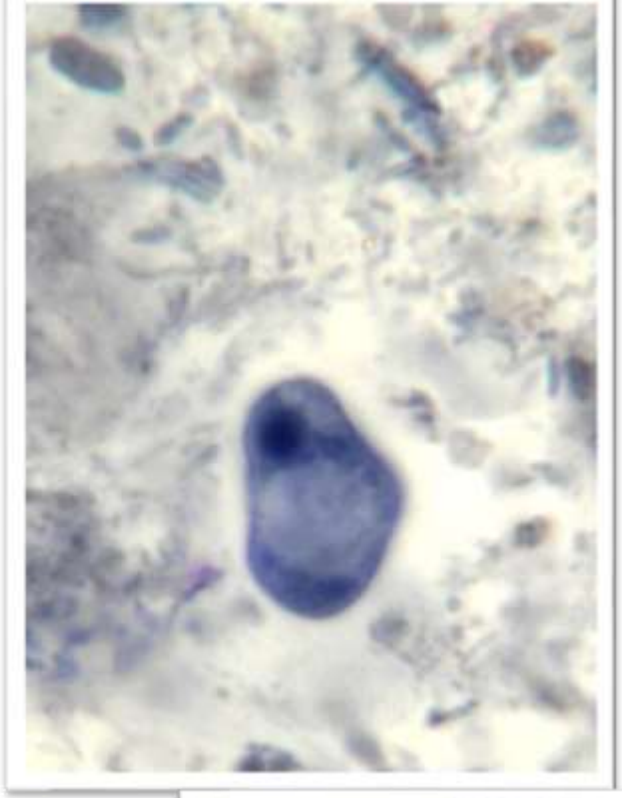
6 to 8 µm (range 5 to 10 µm)



8 to 10 µm (range 6 to 12 µm)

•4- Iodamoeba butschlii

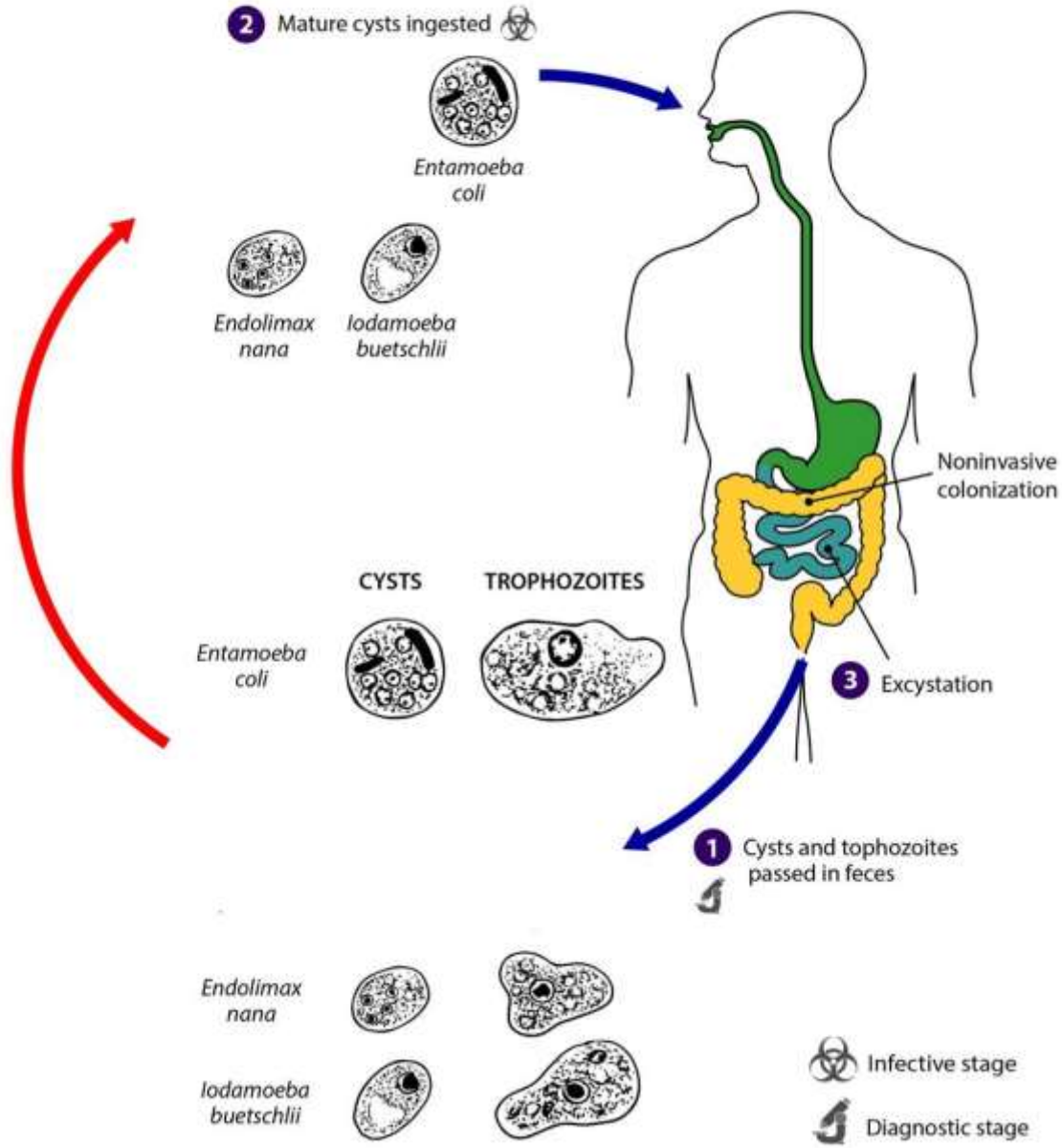
- is a commensal intestinal amoeba that inhabits the **human colon**. It is generally considered **nonpathogenic**, and its detection is mainly an indicator of fecal contamination
- Life Cycle & Stages
- • **Infective stage**: Mature cyst (with a single nucleus with **large not central karyosome** and a **large glycogen vacuole**).
- • Excystation: Occurs in the small intestine → release of trophozoites.
- • Multiplication: Trophozoites divide by binary fission in the large intestine.
- • Encystation: In colon → cysts passed out with feces.
- **diagnostic stages**: cysts
- Site of Infection
- • Lumen of the large intestine (colon).



Infective stage: Cyst

Diagnostic stage: Cyst

Intestinal Amebae
(Nonpathogenic)

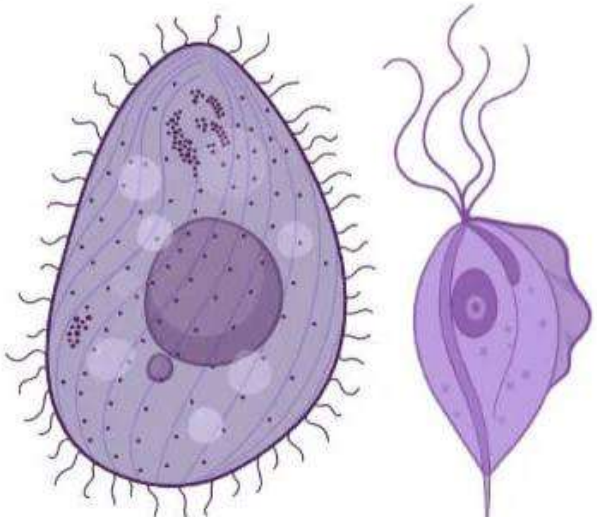


- **Diagnostic Methods for Intestinal Amoebae**
- 1. Stool Microscopy: Direct smear: Detects trophozoites.
- 2. Molecular Methods: PCR: Confirms diagnosis and differentiates pathogenic from nonpathogenic species.

- **Prevention of Intestinal Amoebae**
- 1. Wash fruits and vegetables thoroughly with clean water.
- 2. Wash hands well before eating and after using the toilet.
- 3. Eat and drink from safe, clean sources.
- 4. Control insects that can transmit infection.

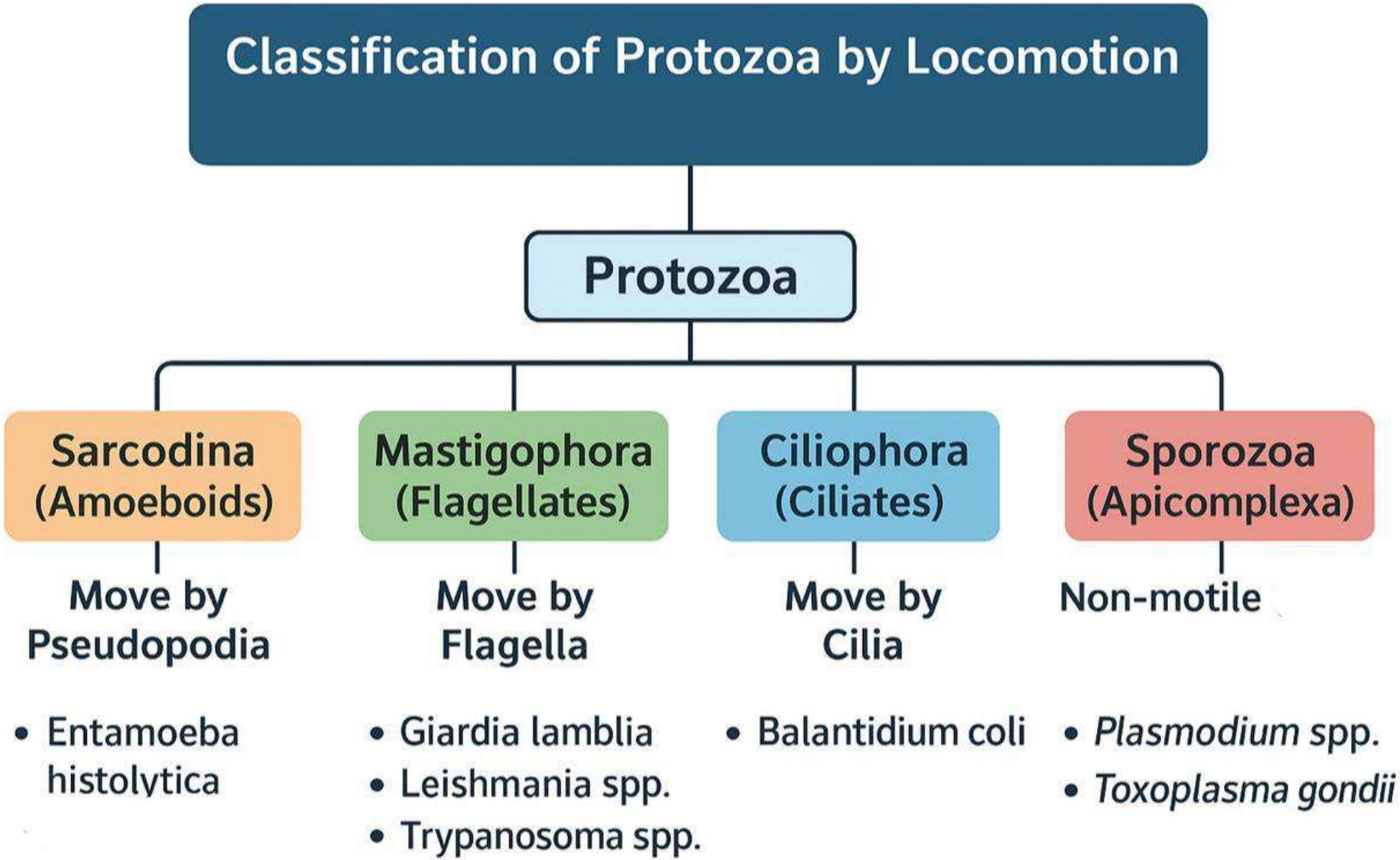
Protozoa

Ciliophora and Mastigophora



Prepared & Presented by:

M.Sc. Ghadeer Mahmood


Classification of Protozoa by Locomotion
Protozoa
Sarcodina (Amoeboids)
Mastigophora (Flagellates)
Ciliophora (Ciliates)
Sporozoa (Apicomplexa)
Move by Pseudopodia
Move by Flagella
Move by Cilia
Non-motile
• Entamoeba histolytica
• Giardia lamblia
• Leishmania spp.
• Trypanosoma spp.
• Balantidium coli
• Plasmodium spp.
• Toxoplasma gondii

2-Ciliophora

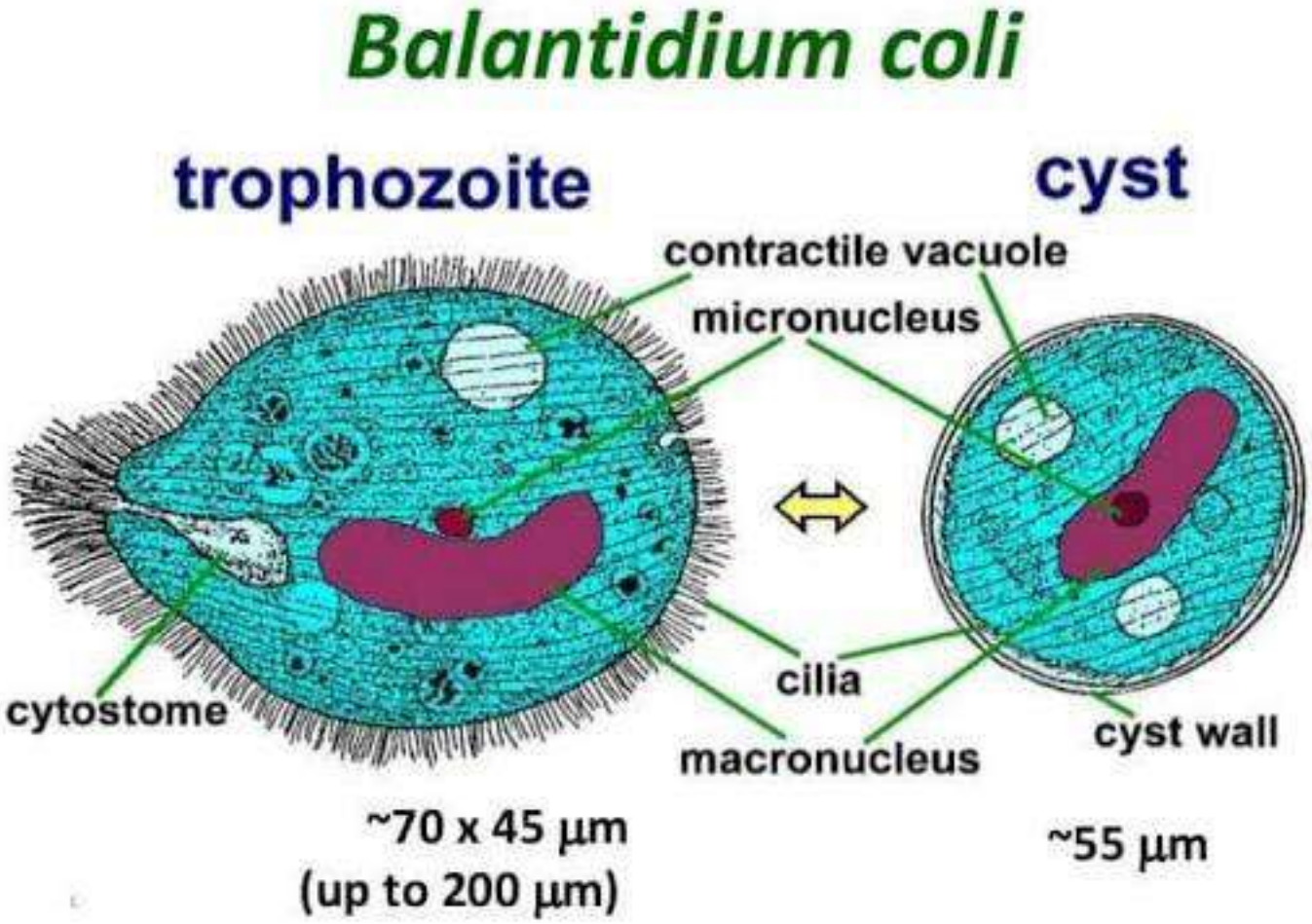
- Balantidium coli : belongs to the Phylum Ciliophora , Family Balantididae.
- It is the only ciliate protozoan parasite of humans
- It is the **largest protozoan parasite of humans**.
- It was first described by Malmsten in 1857, in the feces of dysenteric patients.
- It is present worldwide, but the prevalence of the infection is very low.

Habitat

- *B. coli* resides in the large intestine of man, pigs, and monkeys.

Morphology

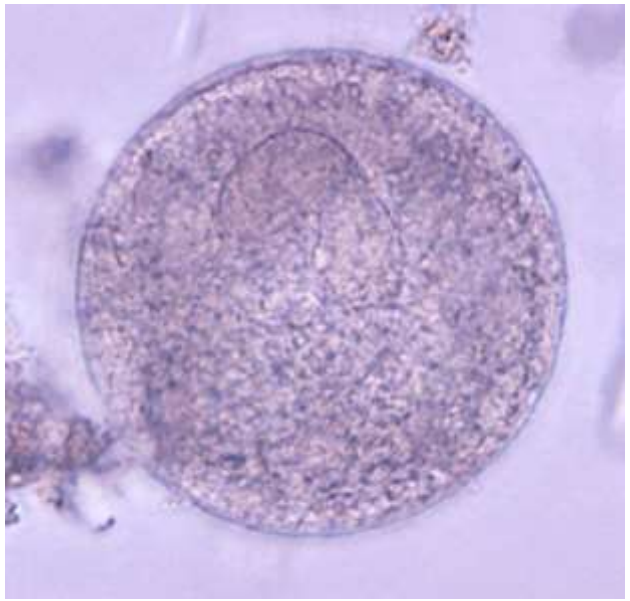
- B. Coli occurs in 2 stages – trophozoite and cyst

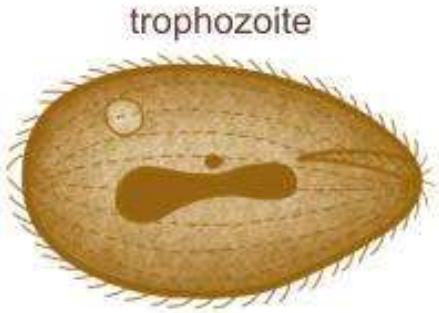


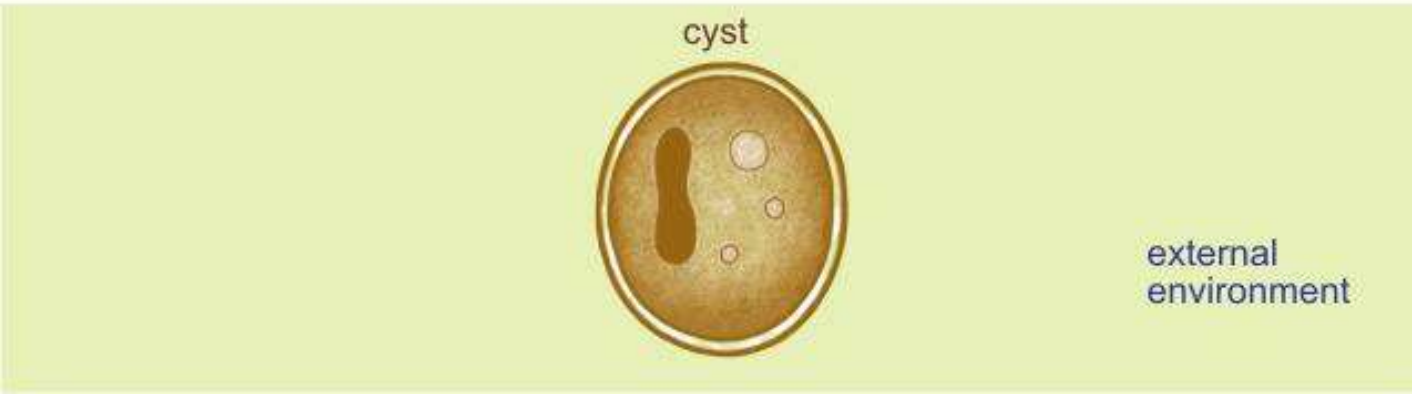
- **Trophozoite**
- The trophozoite lives in the **large intestine.**
- The trophozoite is **actively motile** .
- The motility of trophozoite is due to the presence of short delicate cilia over the entire surface of the body.
- **Cyst**
- The cyst is **spherical in shape** and measures 40–60 µm in diameter.
- It is surrounded by a thick and transparent double-layered wall.
- The cytoplasm is granular. **Macronucleus, micronucleus**, and vacuoles are also present in the cyst.
- **The cyst is the infective stage of *B. coli*.**

- **Life Cycle**
- *B. coli* passes its life cycle in **one host only** (Man,Pig, monkey, and rat).
- **Mode of transmission**:
- Balantidiasis **is a zoonosis**. Human beings acquire infection by ingestion of food and water contaminated with feces containing the cysts of *B. coli*.
- Once the cyst is ingested, **excystation occurs in the small intestine.**
- From each cyst, a single trophozoite is produced which migrates to **large intestine.**
- trophozoites multiply in the **large intestine** by transverse **binary fission**. **Sexual union by conjugation.**

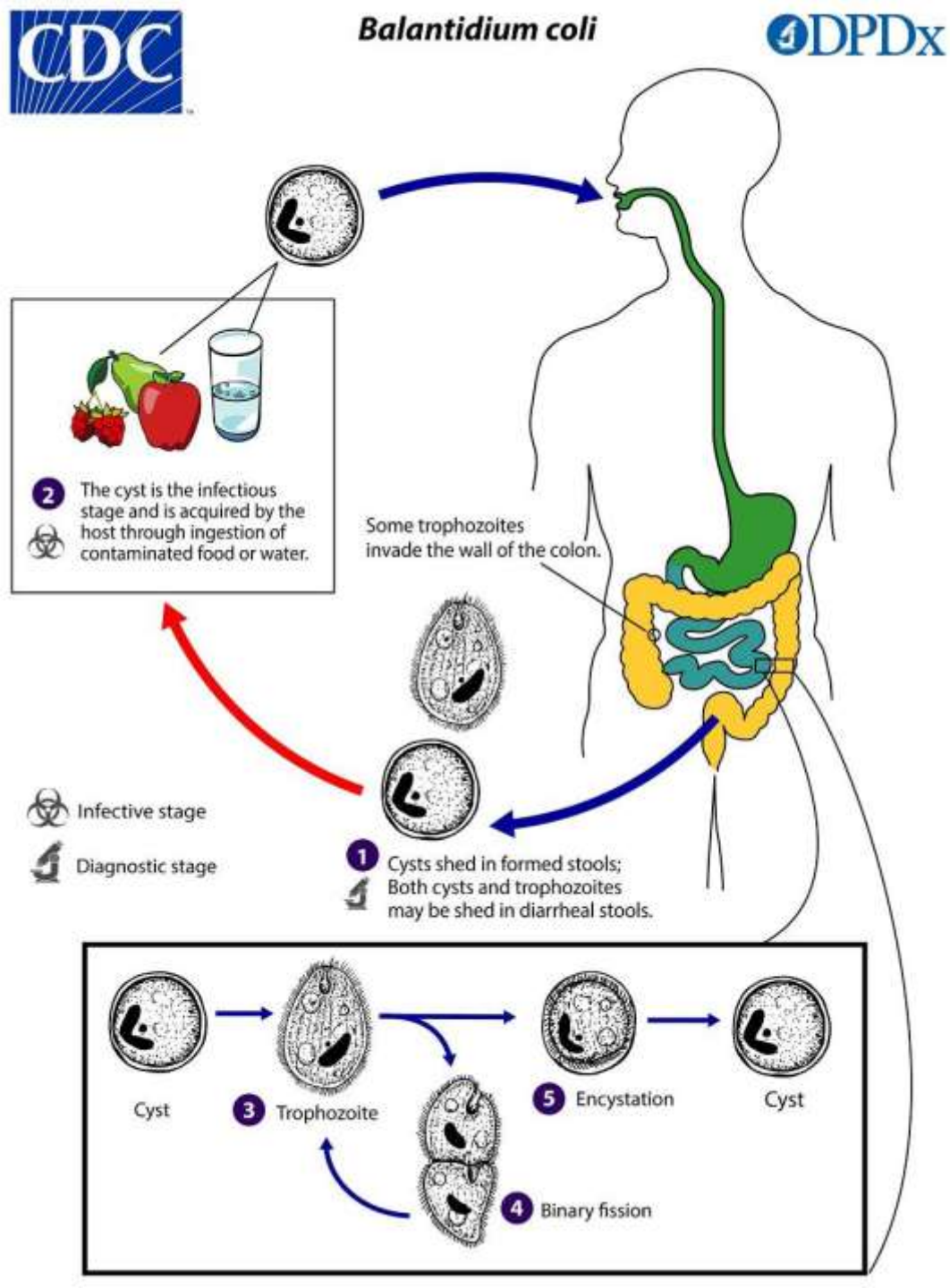
cysts







trophozoite


CDC
Balantidium coli
DPDx
2 The cyst is the infectious stage and is acquired by the host through ingestion of contaminated food or water.
Some trophozoites invade the wall of the colon.
Infective stage
Diagnostic stage
1 Cysts shed in formed stools; Both cysts and trophozoites may be shed in diarrheal stools.
Cyst
3 Trophozoite
4 Binary fission
5 Encystation
Cyst

Parasitic flagellates

A-Atrial flagellates

Urogenital flagellates

Trichomonas vagi-

Oral flagellates

Trichomonas tenax

B-Intestinal flagellates

Trichomonas hominis

Giardia lamblia

Chilomastix mesnili

C-Blood and tissue flagellates

Leishmania spp.

Trypanosoma spp.

3-Mastigophora

- **1- Trichomonas vaginalis** (Pathogenic flagellate)
- History and Distribution
- *T. vaginalis* was first observed by Donne (1836) in **vaginal secretion**.
- Prevalence of trichomoniasis varies from 5% patients at hospitals to 75% in sexual workers.
- Have **only trophozite stage**.

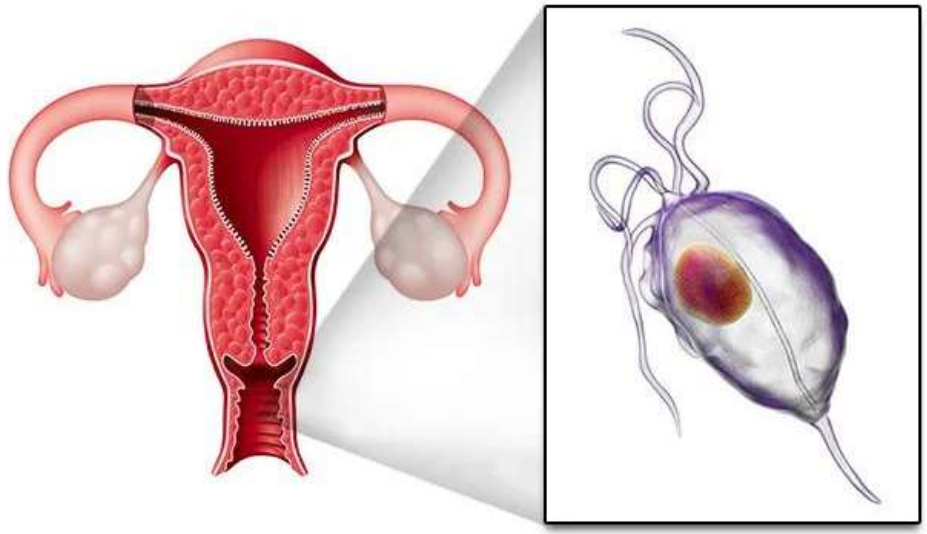
• Trophozoite stage:

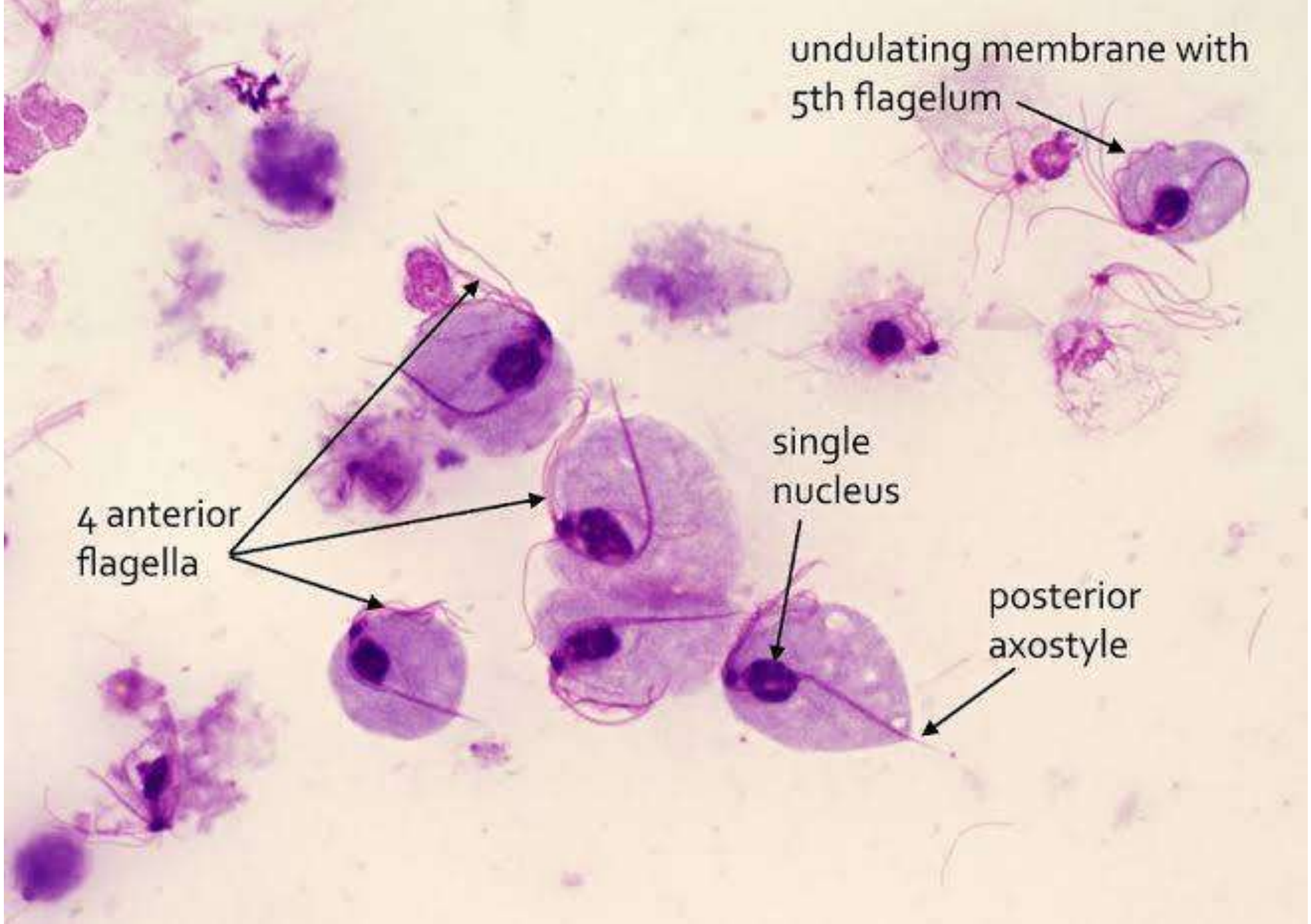
- Ovoid, round, or pear like in shape, rapid , jerky motility.
- **Have 5 flagella, 4 originate from the anterior while the fifth flagellum extends posteriorly to form undulating membrane extending only one half of the body.**
- Trophozoites divide by **binary fission.**
- As cysts are not formed, the **trophozite** itself is the **infective stage.**

• Mode of infection

- By **sexual contact** with infected person.

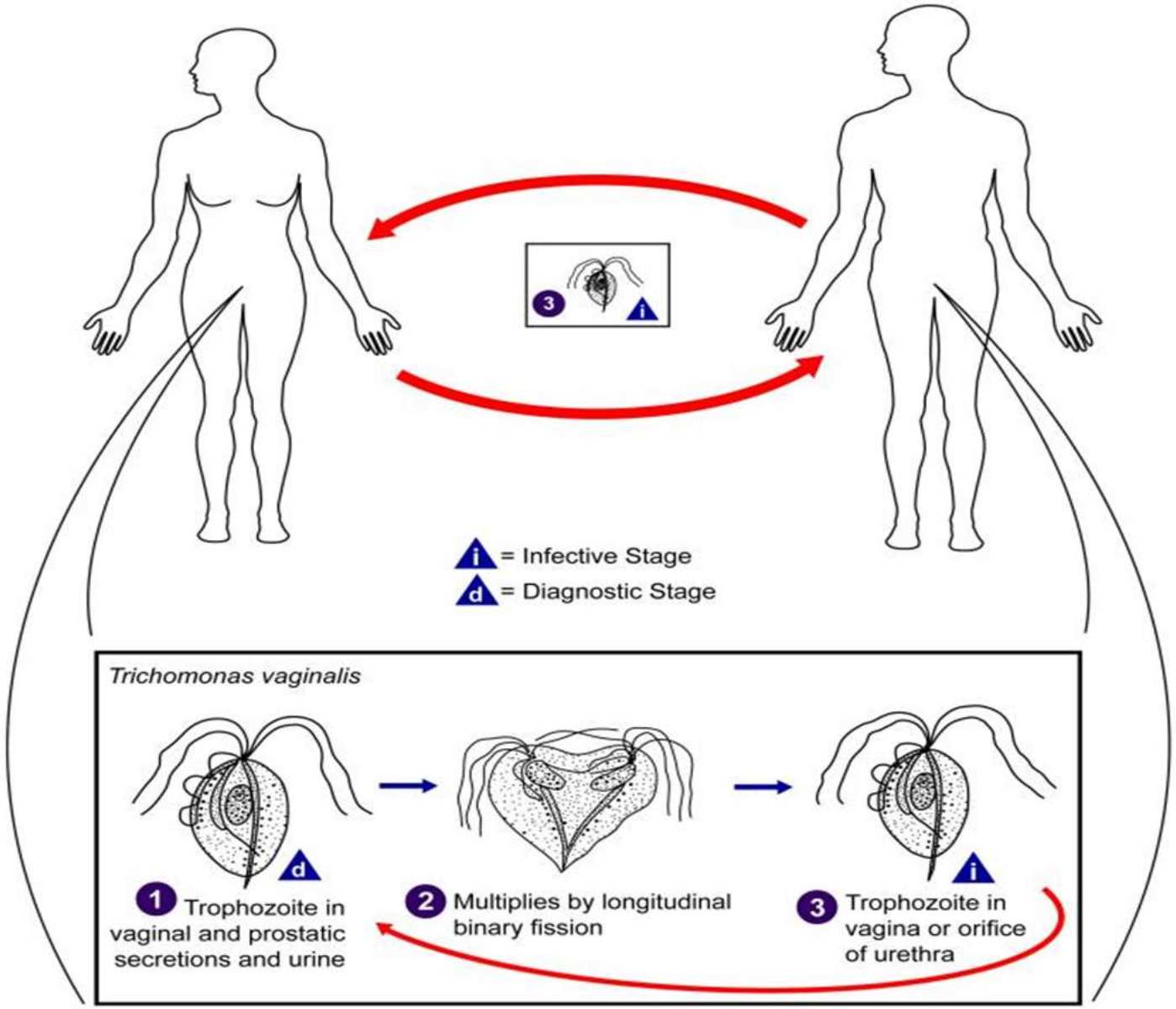
- Laboratory diagnosis
- Examination of wet drop of the contents of the vaginal direct or staining preparation for female .
- Examination of secretions of urethra and prostate glands, or urine for male.
- Symptoms
- About 70% of infected people do not have any signs or symptoms.
- In males: it causes inflammation of the urethra or prostate gland.
- In females: it causes intense itching, profuse yellow discharge, and an unpleasant odor.




undulating membrane with
5th flagelum
4 anterior
flagella
single
nucleus
posterior
axostyle

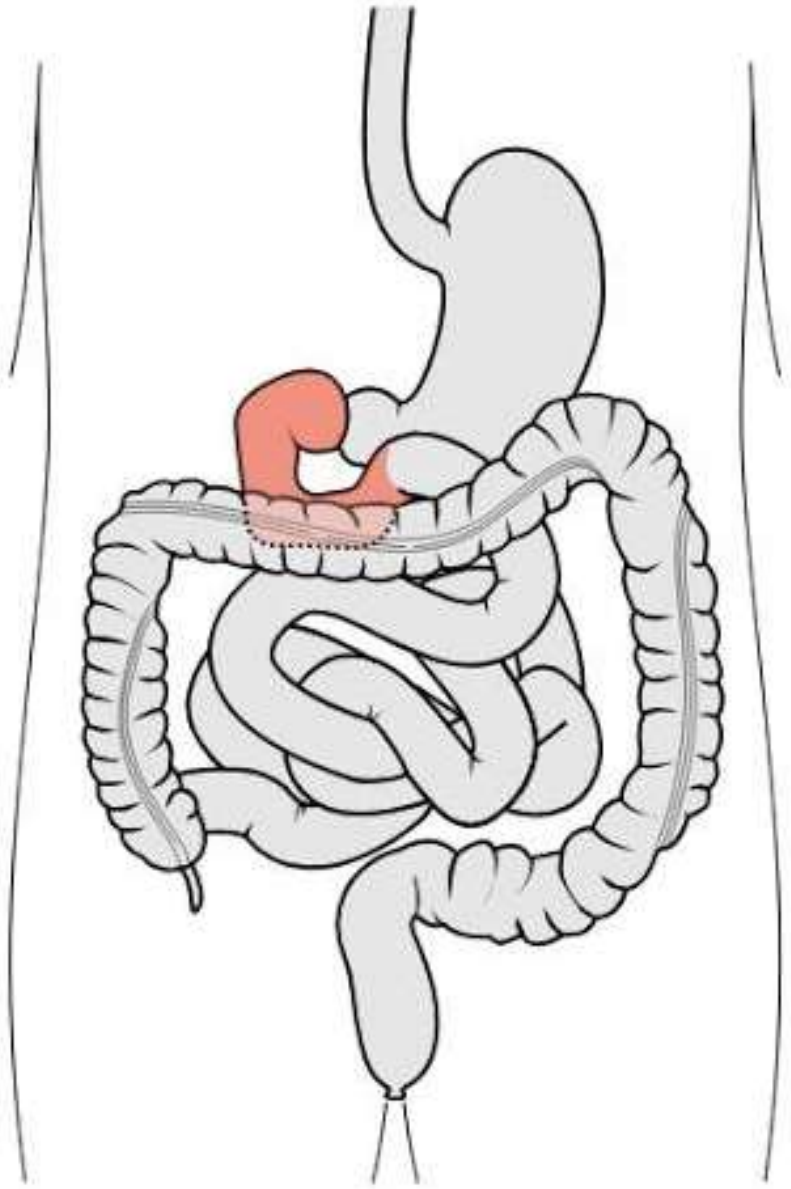
Trichomoniasis

(Trichomonas vaginalis)

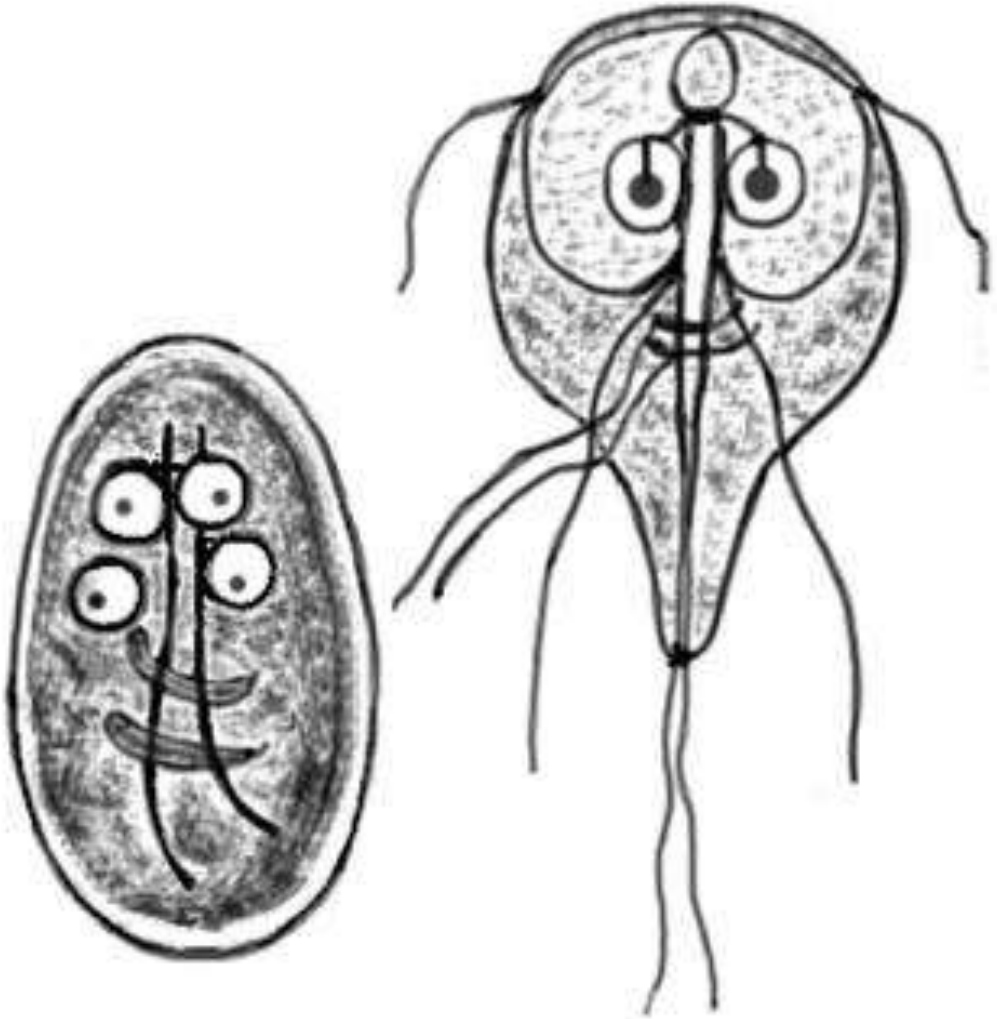


2-Giardia lamblia (Pathogenic)

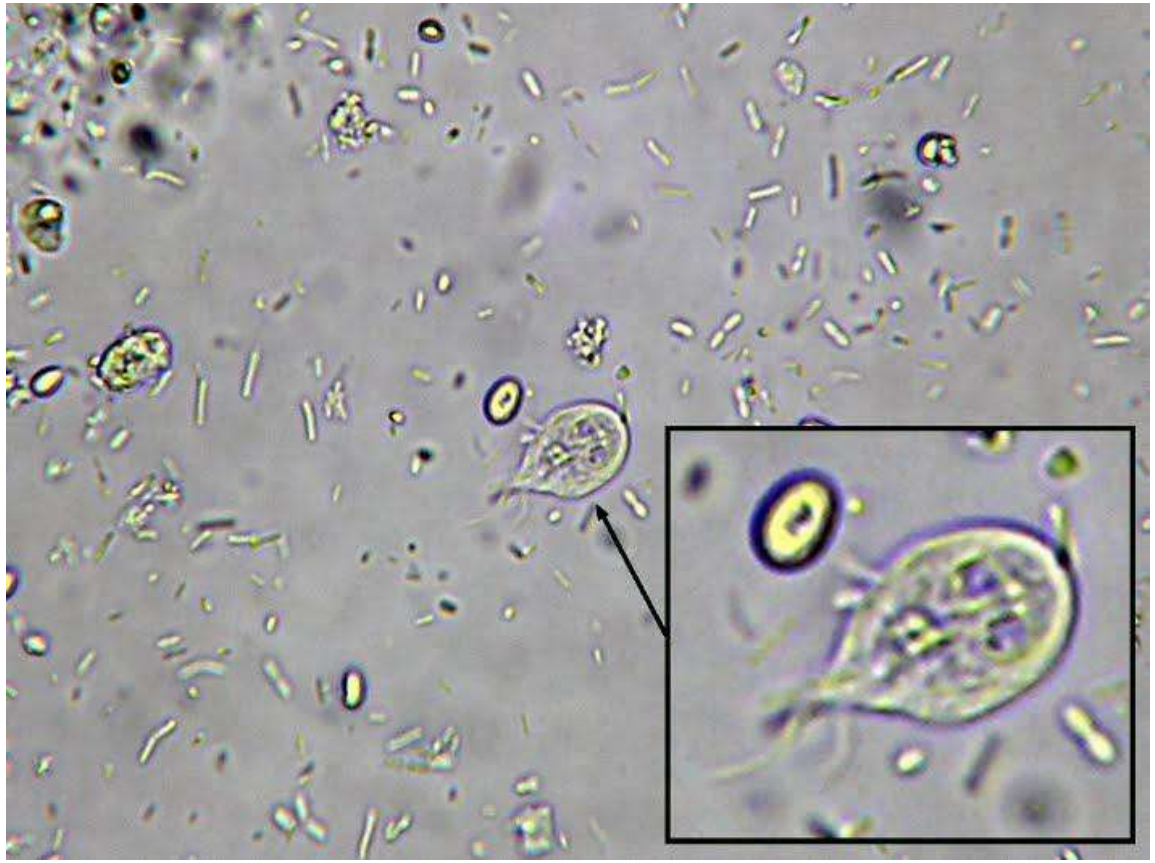
- The fl agellate was first observed by Dutch scientist Antonie von Leeuwenhoek (1681) in his own stools.
- It is the most common protozoan pathogen and is worldwide in distribution.
- Trophozoite: Pear-shaped, 12–15 µm long, two nuclei, eight flagella, two axostyles.
- Cyst: Oval, 8–12 µm, four nuclei. **Infective stage**.
- Location: **Duodenum** (small intestine) and is the only protozoan parasite found in the human small intestine..



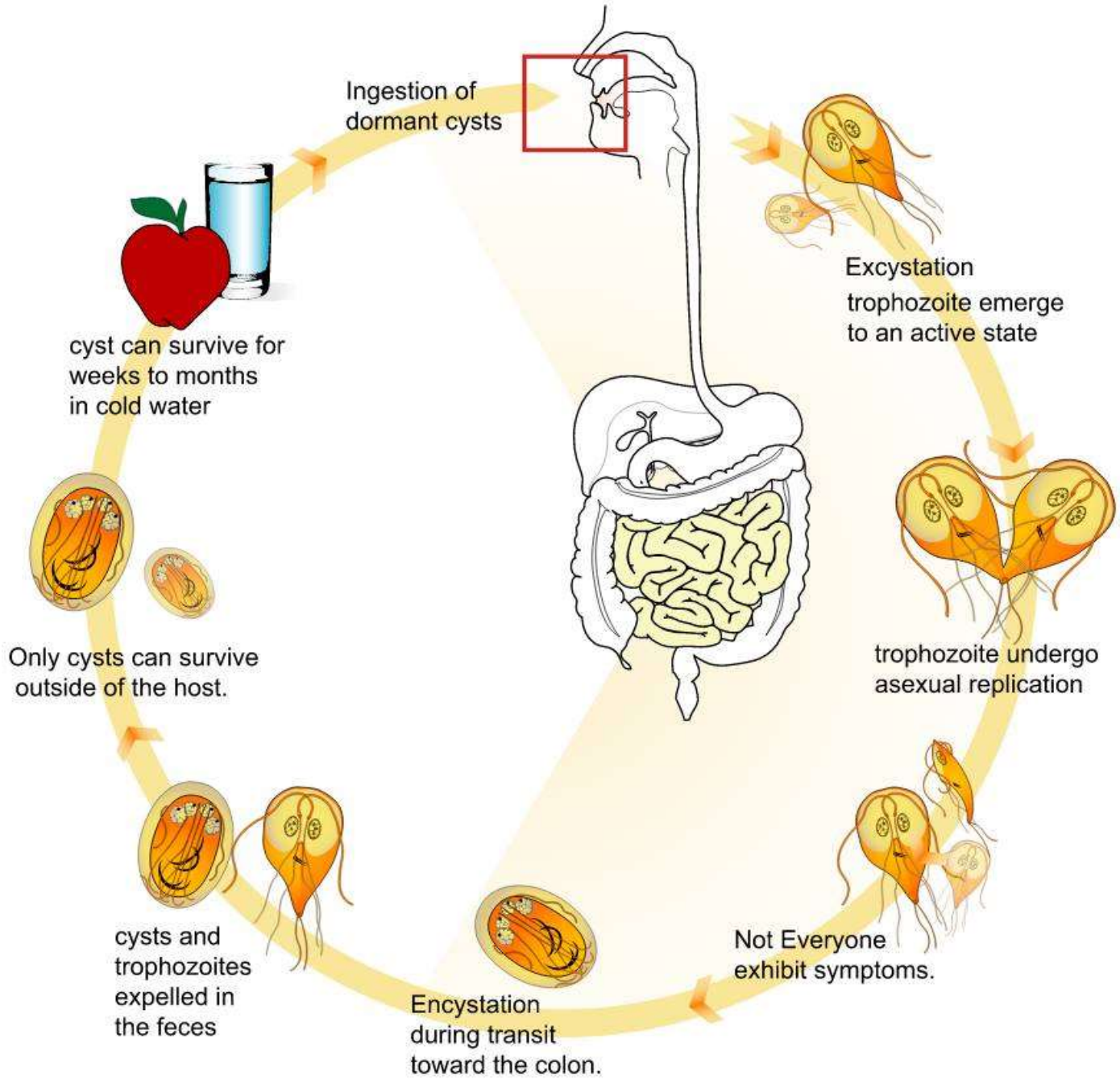
- The trophozoite is motile, Similar to movement **falling leaf**.
- it has a concave sucking disc, which helps in its attachment to the intestinal mucosa.



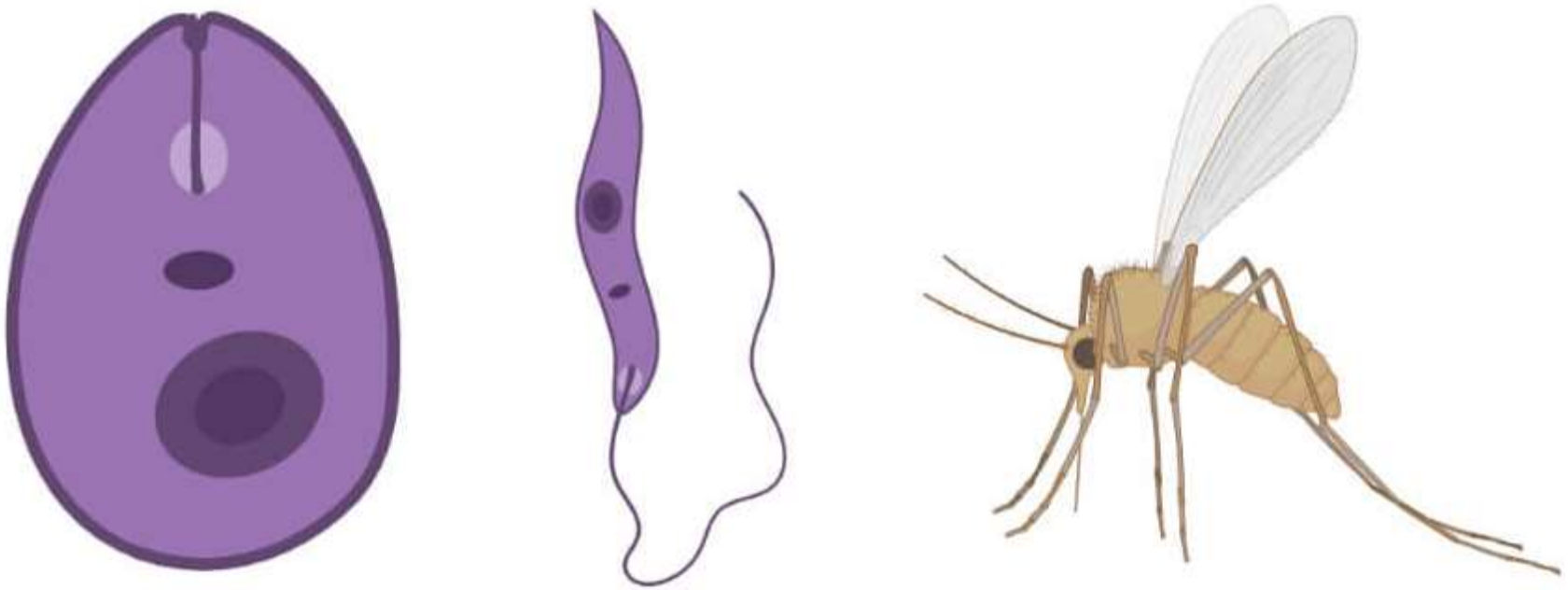
- **Life Cycle**
- Giardia passes its life cycle in **1 host**.
- Infective form: Mature **cyst**.
- Mode of transmission: Man acquires infection by ingestion of cysts in contaminated water and food.
- Direct person to person
- Within half an hour of ingestion, the cyst product two trophozoites, which multiply successively by **binary fission** and **colonize** in the duodenum.
- During unfavorable conditions, encystation occurs usually in **colon.**
- Infective dose is 10–100 cysts.



cyst


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

Mastigophora (Leishmania)



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Parasitic flagellates

A-Atrial flagellates

B-Intestinal flagellates

Trichomonas hominis

Giardia lamblia

Chilomastix mesnili

C-Blood and tissue flagellates

Leishmania spp.

Trypanosoma spp.

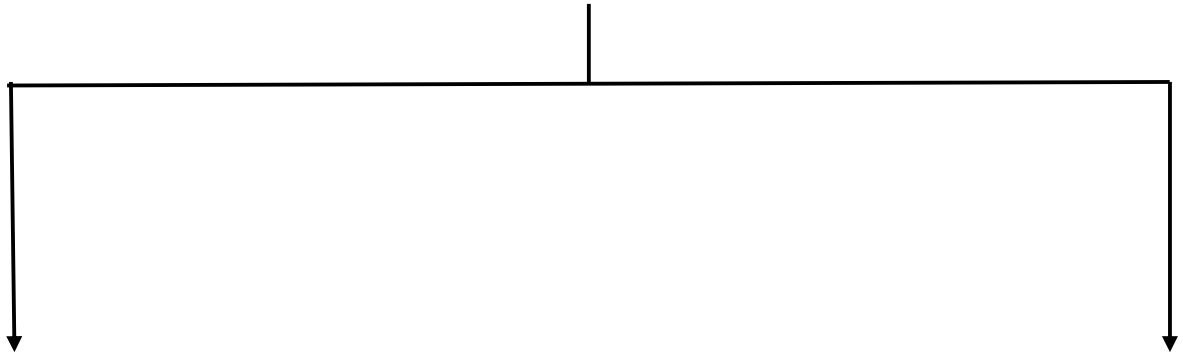
Urogenital flagellates

Oral flagellates

Trichomonas tenax

Trichomonas Vaginalis

Blood and tissue flagellates

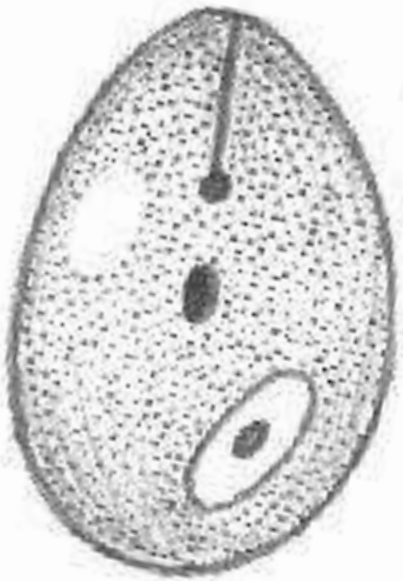


Leishmania donovani
Leishmania tropica
Leishmania braziliensis

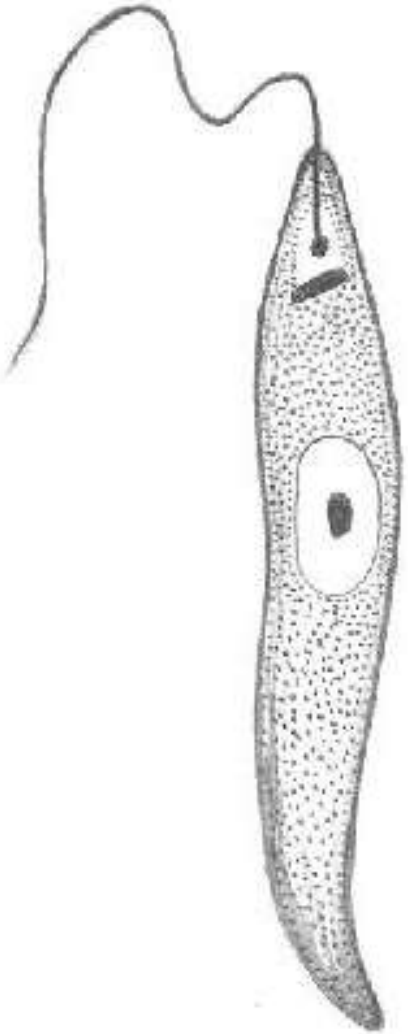
tissue

Trypanosoma brucei gambiense
Trypanosoma brucei rhodesiense
Trypanosoma cruzi

Blood

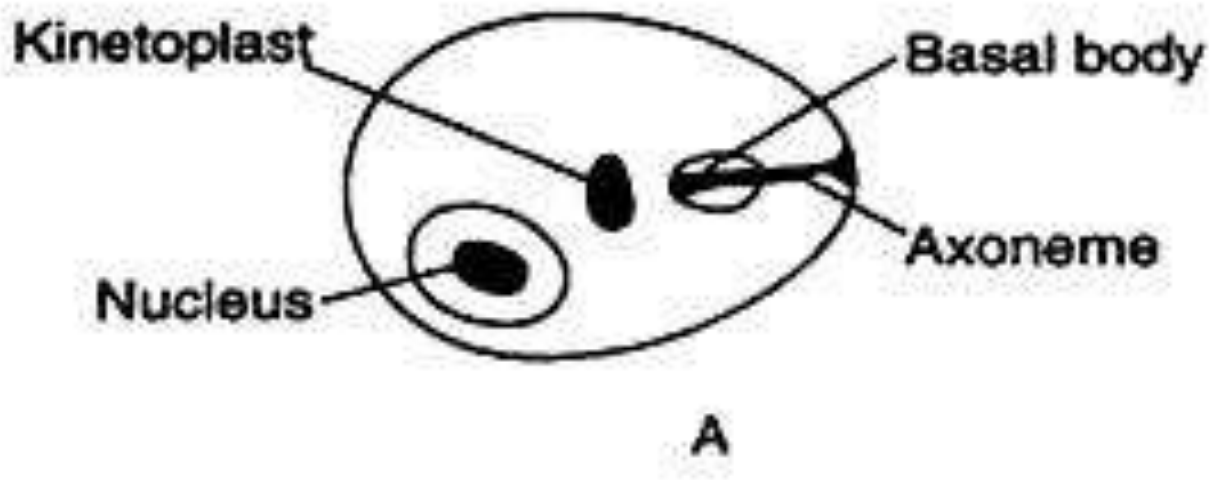


Amastigotes



Promastigotes

- **Leishmanoid Form (Amastigotes)**
- Oval or circular in shape (2–5 µm).
- Contains structures called kinetoplast and nucleus.
- Found in macrophages of the **reticuloendothelial system** in humans (liver, spleen, bone marrow, lymph nodes, lungs).
- **This form is the infective stage for the insect (sand fly) and the diagnostic stage for humans.**



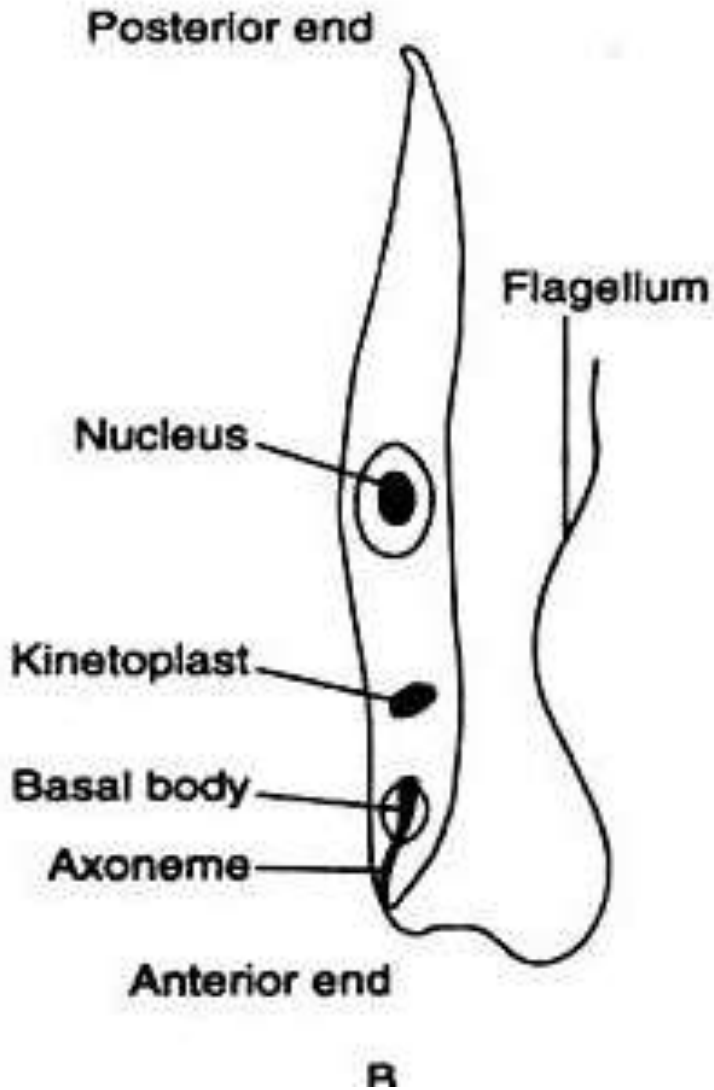
Leptomonad Form (Promastigotes)

Fusiform in shape (10–20 µm).

Has one central nucleus and a kinetoplast at the front of the body.

Found in the gut of infected sand flies.

This form is the infective stage for humans and the diagnostic stage for the insect.



- **Genus Leishmania**
- The genus Leishmania was first discovered by William Leishman.
- It represents a group **of zoonotic protozoan parasites**, meaning the infection can be transmitted between humans and animals.
- This genus includes three morphologically similar species, which differ in their clinical manifestations, geographic distribution, vector species, and type of disease caused.

What diseases are caused by Leishmania?

Leishmania donovani Visceral leishmaniasis Kala-azar

Leishmania tropica Cutaneous leishmaniasis Baghdad boil,

Leishmania braziliensis Mucocutaneous leishmaniasis ,

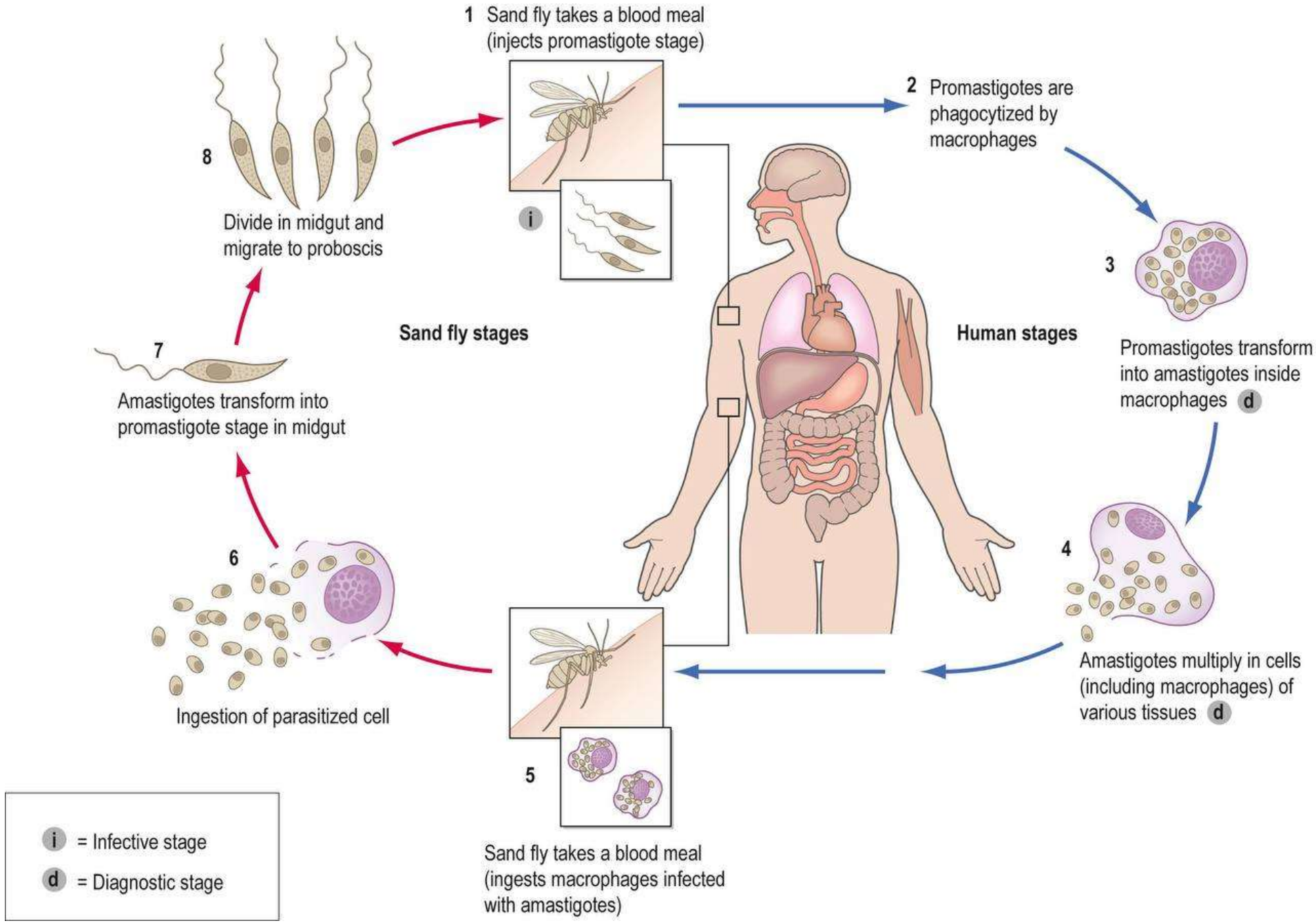
American leishmaniasis,

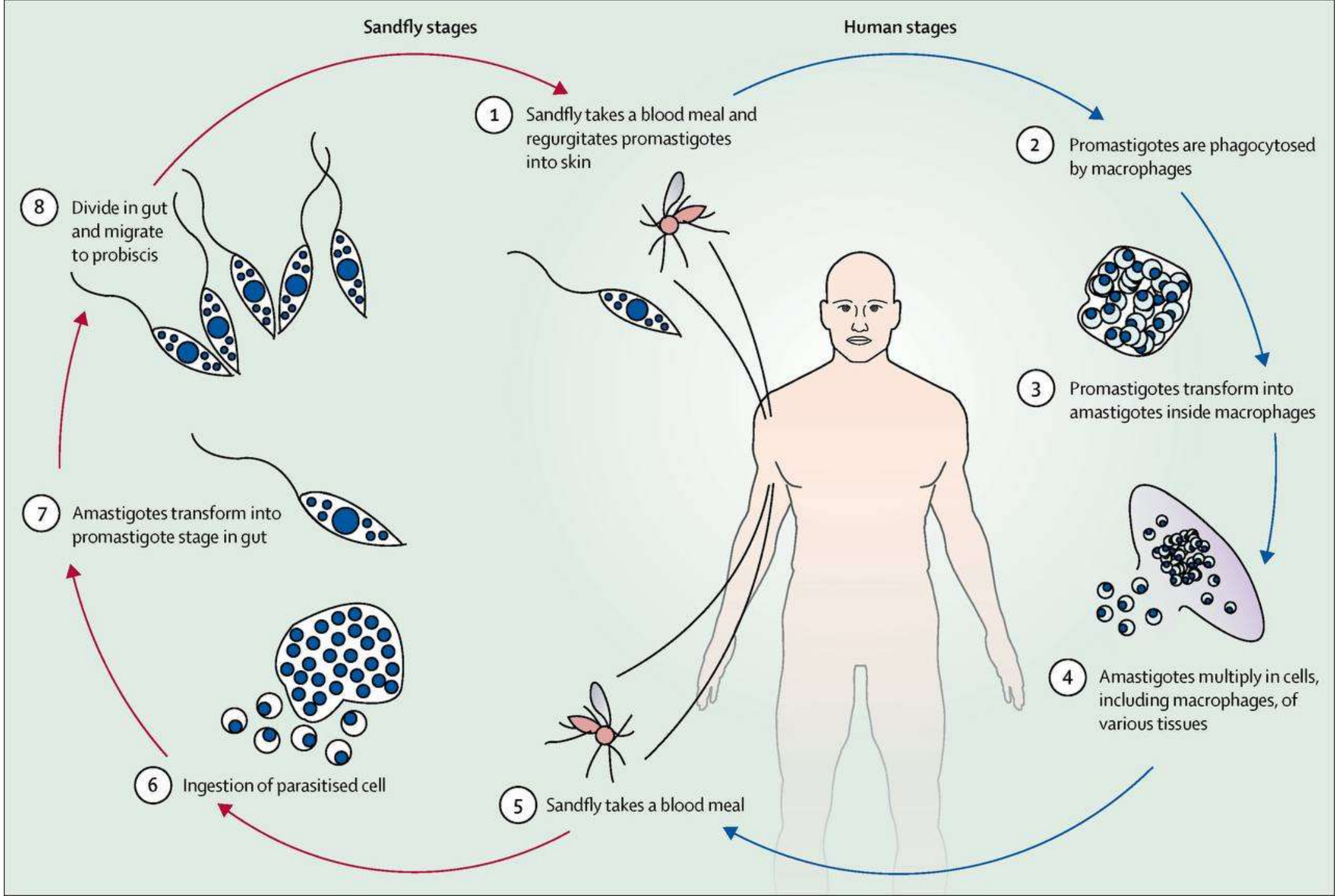
1-*Leishmania donovani*

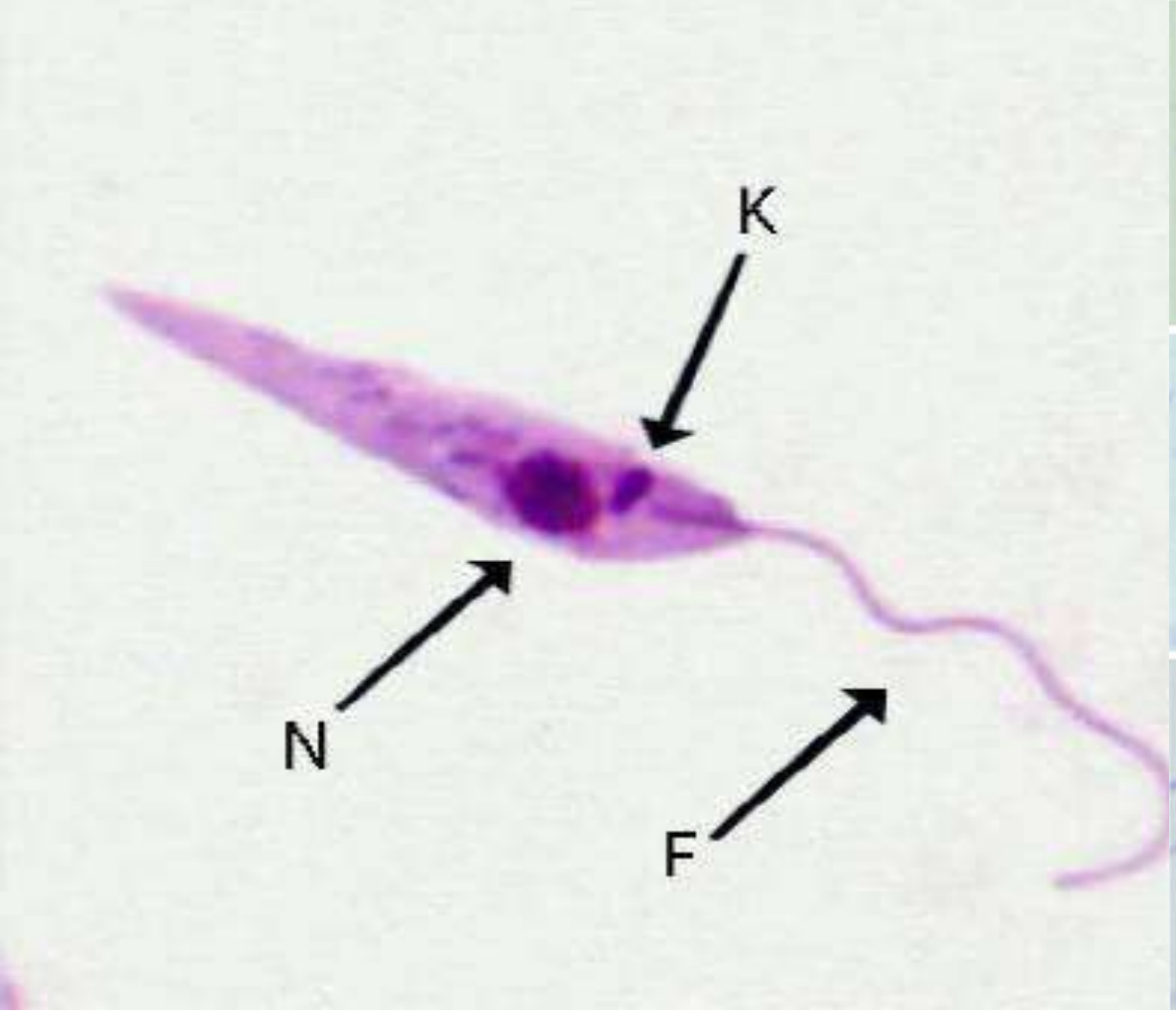
- Visceral leishmaniasis, also known as kala-azar, is a severe parasitic disease that primarily affects the **internal organs**, including the **spleen, liver, heart, and intestines**. The skin of infected individuals may take on a grayish discoloration, hence the name "**black fever**." If left untreated, the disease is often fatal.
- This infection is endemic in many regions, including Iraq.

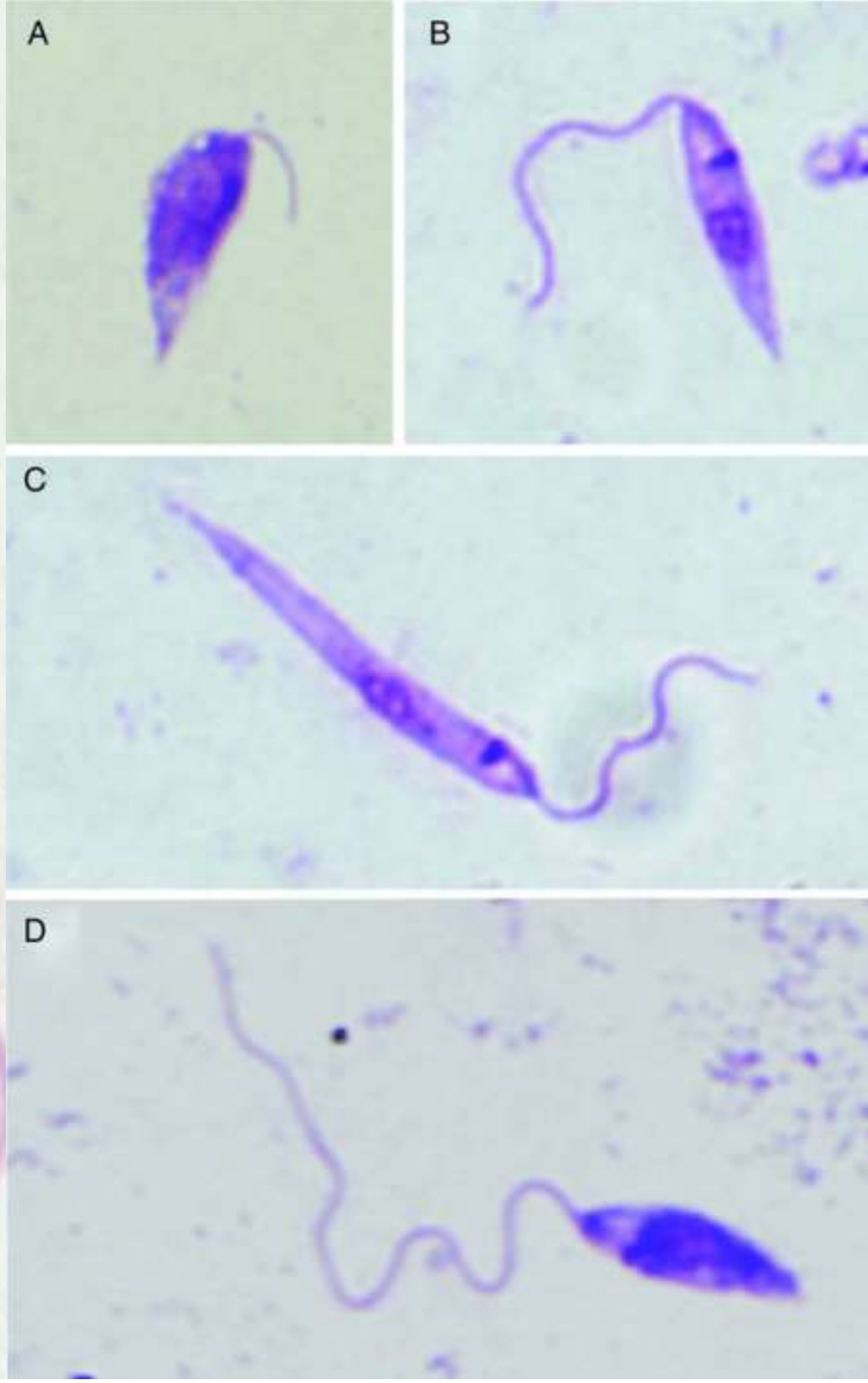
Life Cycle

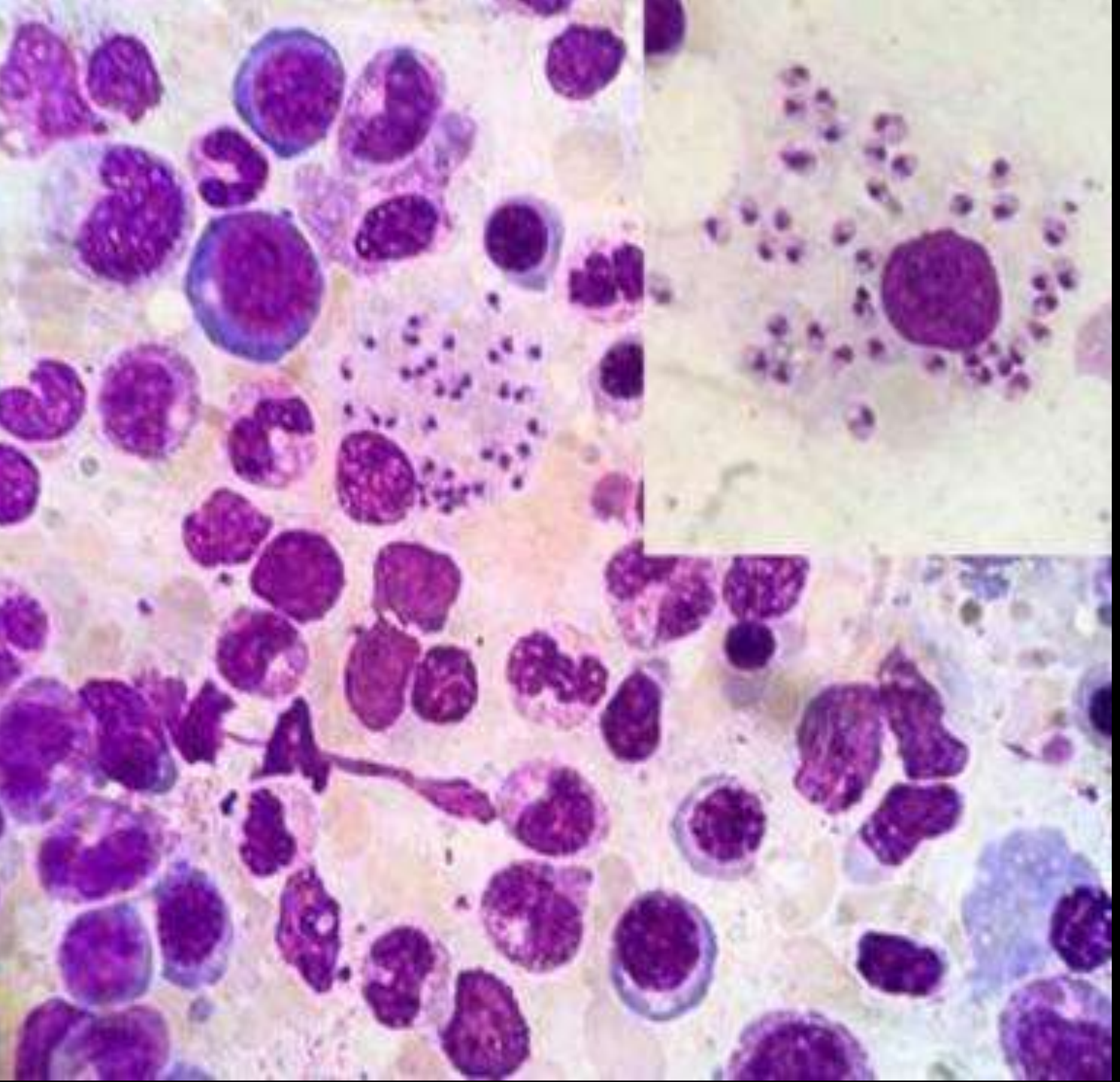
- The vector responsible for transmission is the **sand fly** (Phlebotomus species).
- During feeding, the infective promastigote stage of the parasite is injected into the human skin through the bite of the sand fly.
- Once inside the host, the promastigotes are phagocytosed by macrophages, where they lose their flagella and transform into the amastigote (Leishman-Donovan) form.
- Inside the macrophages, the amastigotes multiply by binary fission until the cell ruptures, releasing the parasites into the bloodstream and infecting new macrophages.
- When another sand fly feeds on the blood of an infected individual, it ingests the amastigote forms, which then transform into promastigotes within the insect's midgut.
- These promastigotes multiply and migrate to the proboscis of the sand fly, becoming infective to another host, thus completing the life cycle.

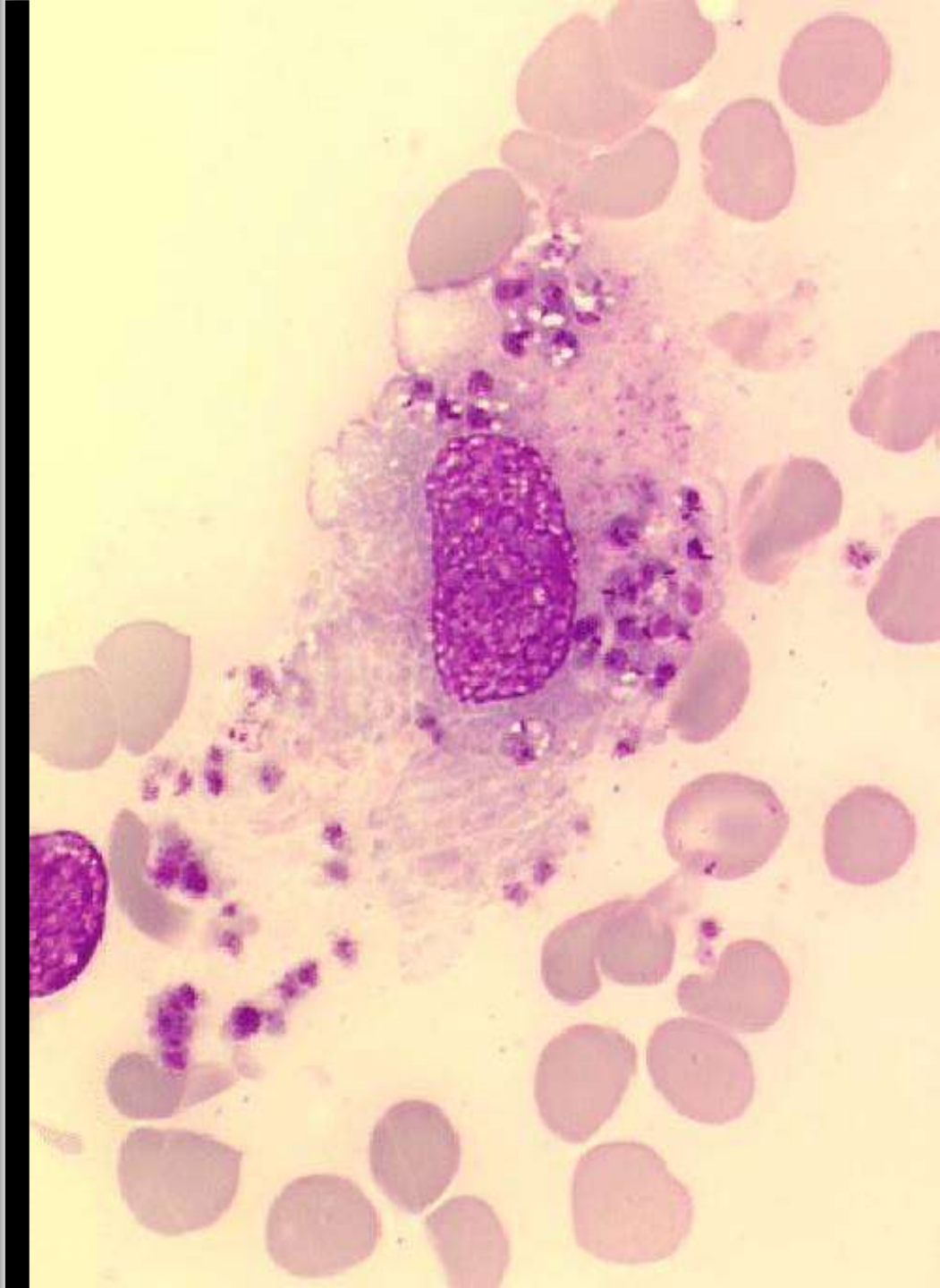

1 Sand fly takes a blood meal (injects promastigote stage)
i
2 Promastigotes are phagocytized by macrophages
3
Promastigotes transform into amastigotes inside macrophages d
4
Amastigotes multiply in cells (including macrophages) of various tissues d
5
Sand fly takes a blood meal (ingests macrophages infected with amastigotes)
6
Ingestion of parasitized cell
7
Amastigotes transform into promastigote stage in midgut
8
Divide in midgut and migrate to proboscis
Sand fly stages
Human stages
i = Infective stage
d = Diagnostic stage

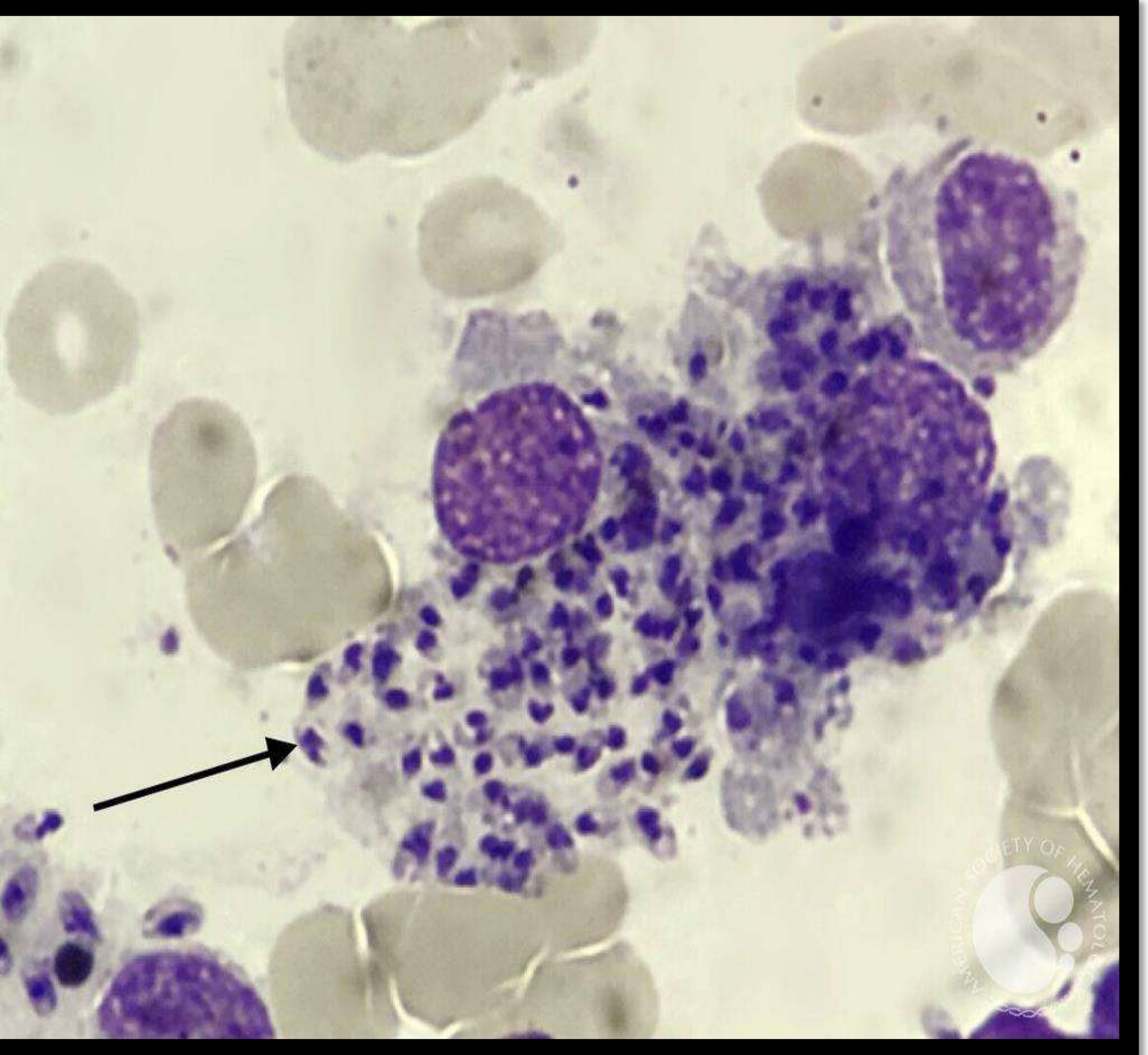

Sandfly stages
Human stages
1 Sandfly takes a blood meal and regurgitates promastigotes into skin
2 Promastigotes are phagocytosed by macrophages
3 Promastigotes transform into amastigotes inside macrophages
4 Amastigotes multiply in cells, including macrophages, of various tissues
5 Sandfly takes a blood meal
6 Ingestion of parasitised cell
7 Amastigotes transform into promastigote stage in gut
8 Divide in gut and migrate to probiscis

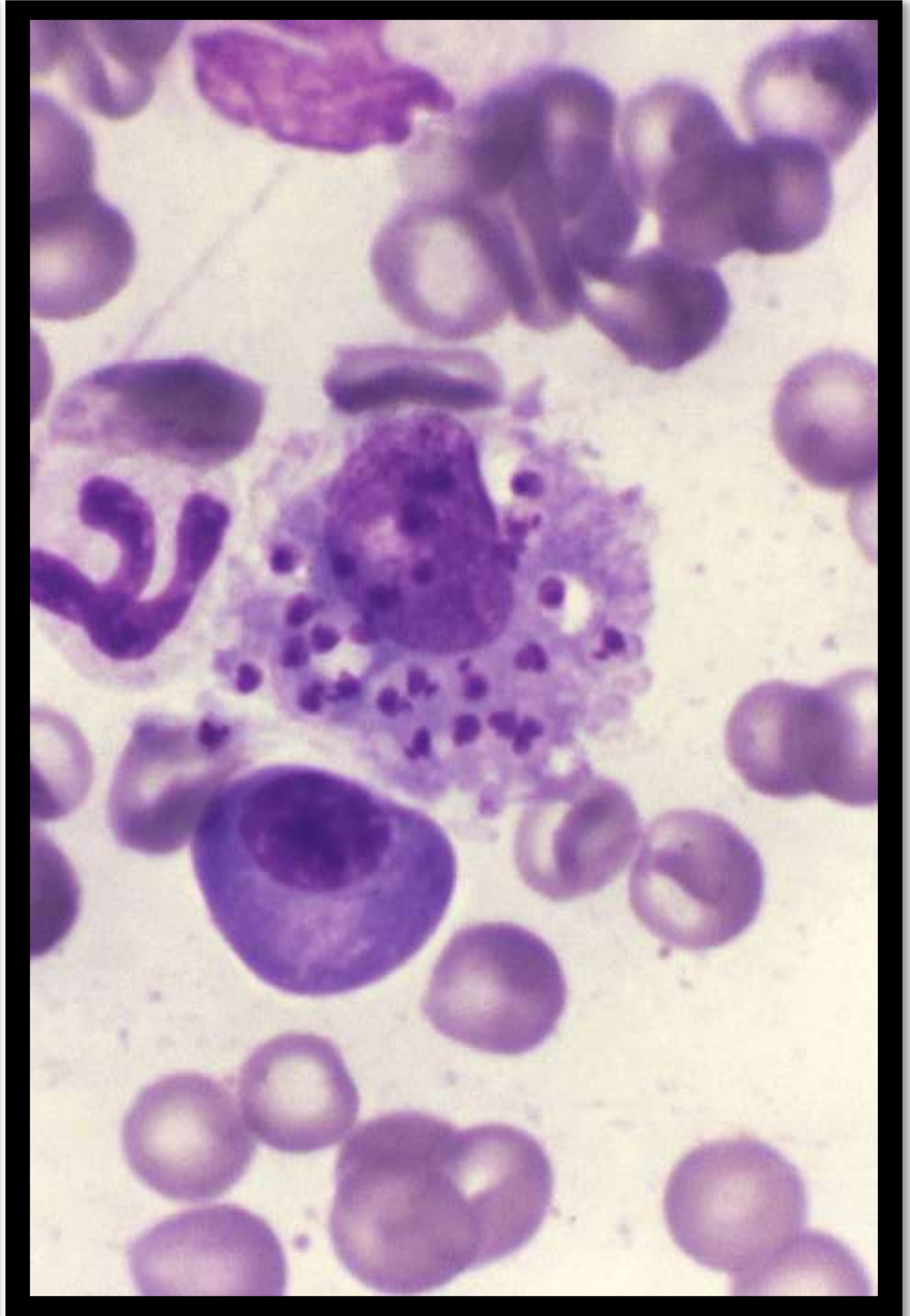

K
N
F


A
B
C
D



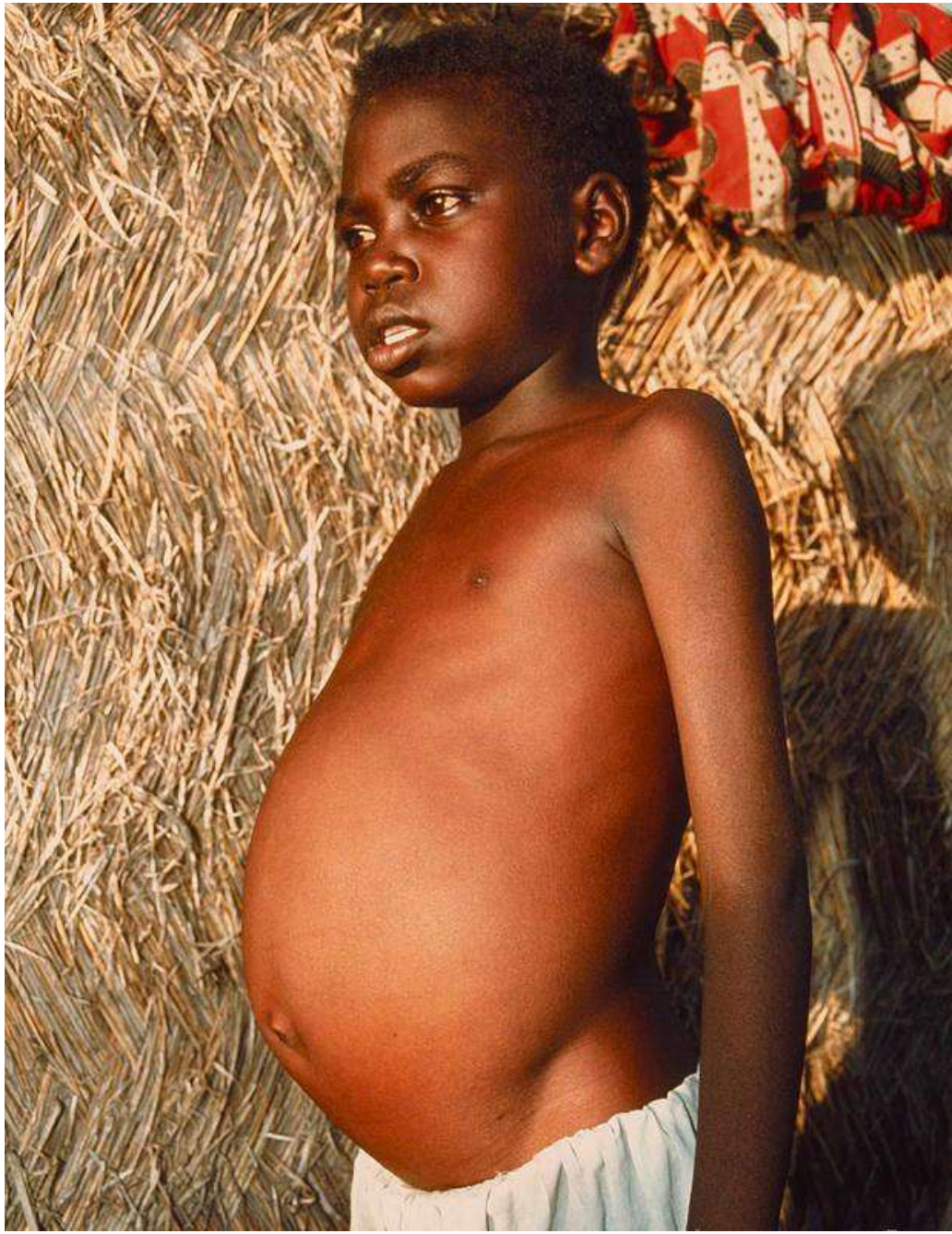






symptoms

- The infection is characterized by systemic manifestations including **high fever** (up to 40°C), **chills**, **diarrhea**, and **hepatosplenomegaly** (enlargement of the liver and spleen).
- A distinct feature of the disease is skin **hyperpigmentation**, which gives rise to the term “black fever” or “kala-azar”.




A
B
C

- **Laboratory diagnosis of visceral leishmaniasis**:

- Sample collection from bone marrow, liver, spleen, or lymph nodes.
- Microscopy with Giemsa or Leishman stain to detect **amastigotes.**
- Culture on NNN medium to observe **promastigotes**.
- Serological tests for antibody detection...

Indirect Fluorescent Antibody Test **(IFAT**) .

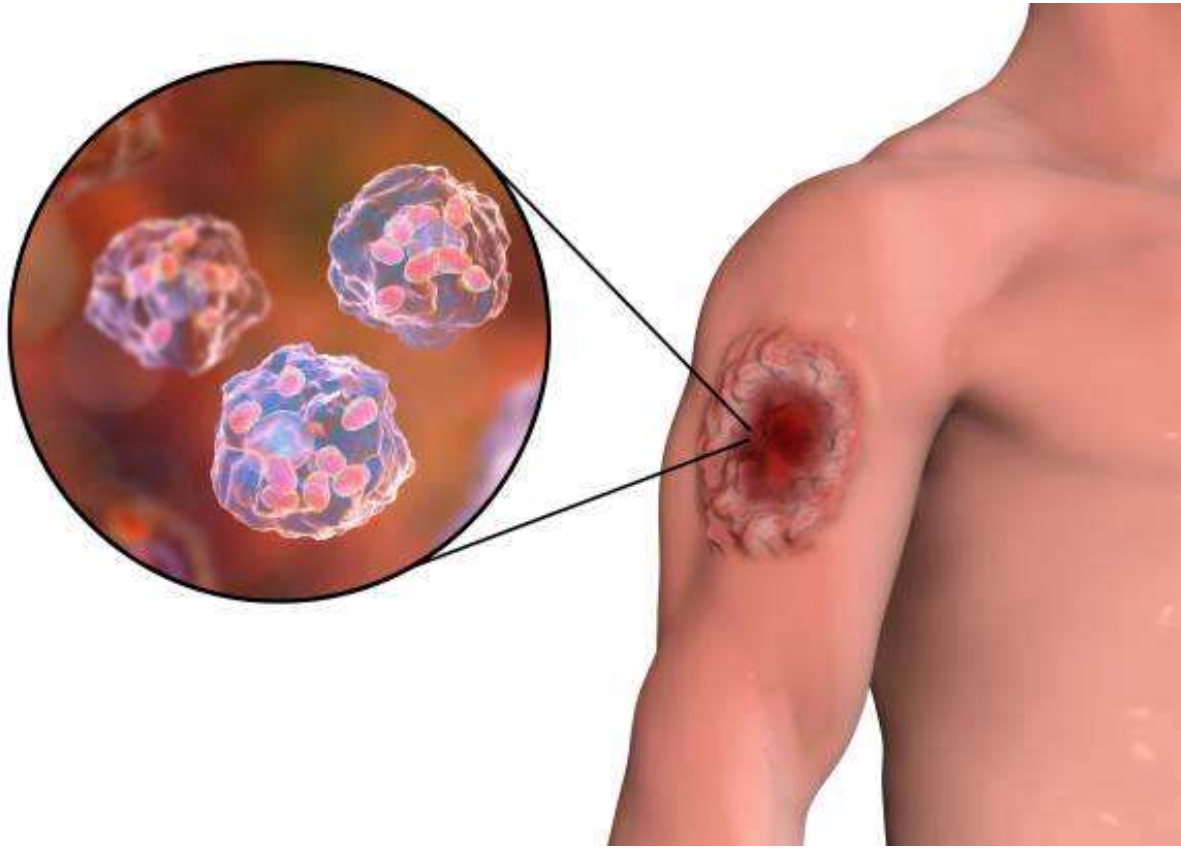
Direct Agglutination Test (**DAT**).

Enzyme Linked Immunosorbent Assay **(ELISA**) .

Formol gel test.

2-*Leishmania tropica*

- is a common **skin disease**, transmitted by **sand fly bites**.
- It causes skin **ulcers or nodules** and stays only in the skin without affecting internal organs.
- The parasite’s life cycle is similar to visceral leishmaniasis: it enters the skin from the sand fly and transforms into amastigotes inside skin cells.



- **Pathological Effects and Diagnosis of Cutaneous Leishmaniasis**
- Development of nodules at the site of sand fly bite.
- The ulcers typically exhibits a dry, raised periphery with a moist central area.
- May be associated with a **foul odor**.
- Noduls can be painful, depending on secondary infection or location.
- **Laboratory diagnosis**:
- A tissue sample should be collected from the firm edge of the noduls .
- Microscopic examination of stained smears (e.g., Giemsa or Leishman stain) is used to identify amastigote forms of Leishmania within host.


30 01 2008

3-*Leishmania braziliensis*

- Mucocutaneous leishmaniasis affects the **nose**, **mouth**, and **throat**. It is less common than other forms of leishmaniasis. At first, a small bump appears at the site of the sand fly bite, similar to cutaneous leishmaniasis. Later, the infection spreads to the mucous membranes, causing swelling or ulcers inside the nose and mouth, which may enlarge the nose and lips. The voice may change if the throat is affected. The ulcers can leave scars and facial deformities.

moth infection

nose infection

ear infection

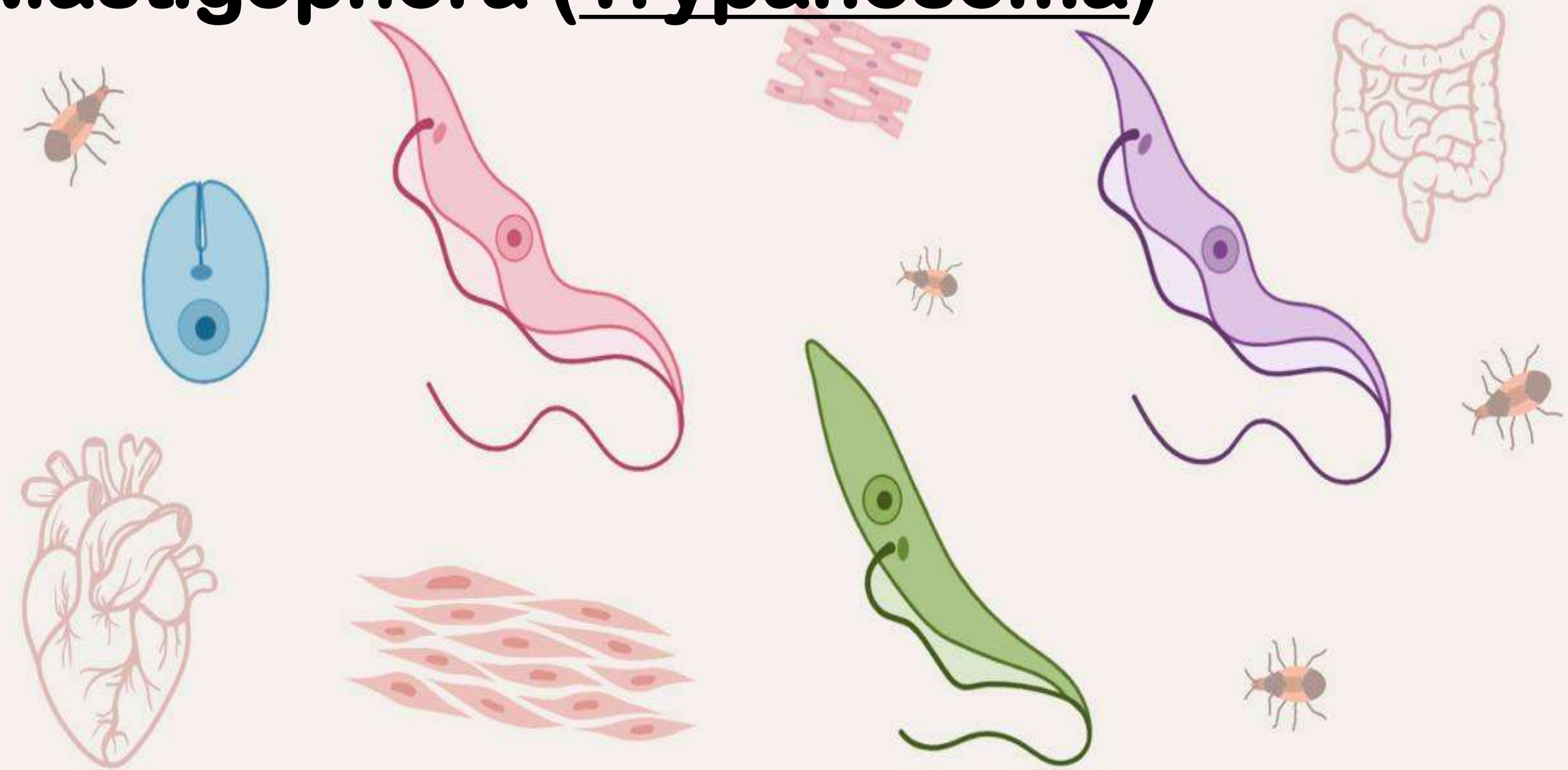
Laboratory diagnosis

- Diagnosis is made by microscopic examination or culture of material taken from the edge of a firm ulcer or from infected lymph nodes to detect the presence of the parasite in its amastigote form.

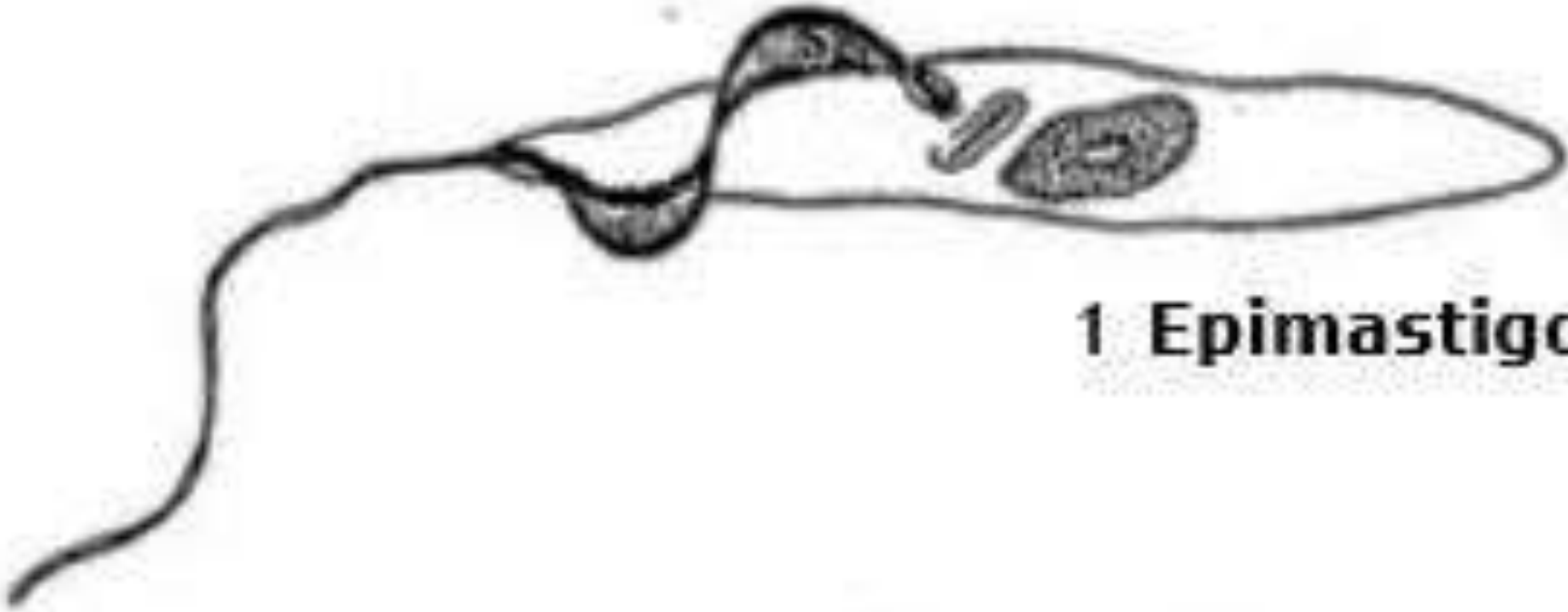
Prevention and Control

- The control of transmission is complicated because it is difficult to limit exposure of humans with sand flies because they are very small insects.
- Personal protection from sand-fly bites.
- avoiding endemic areas especially when sandflies are active.
- Avoid auto-infection /self-infection,
- Treating infected person and health education.

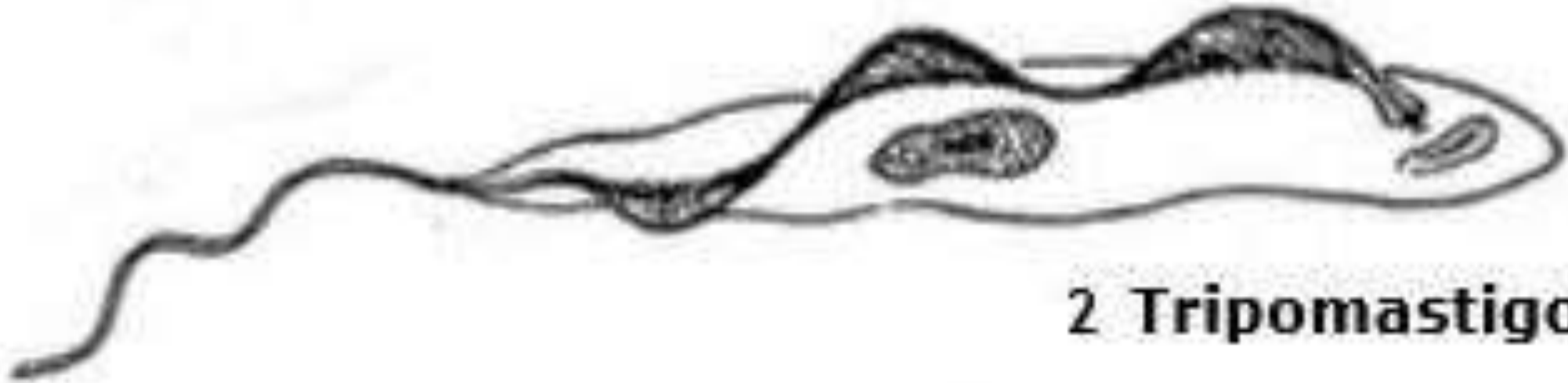
Mastigophora (Trypanosoma)



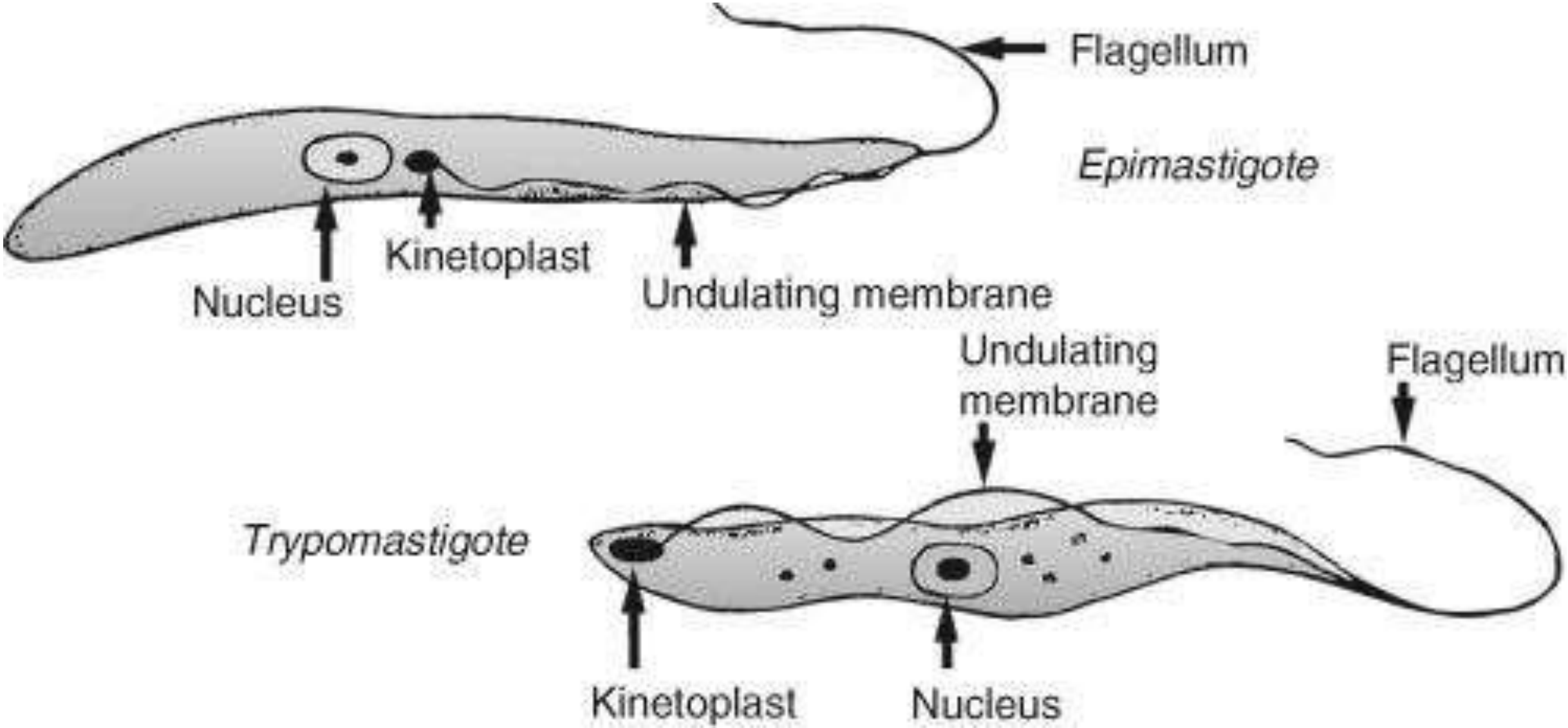

Trypanosoma gambiense
Trypanosoma rhodesiense
Trypanosoma cruzi

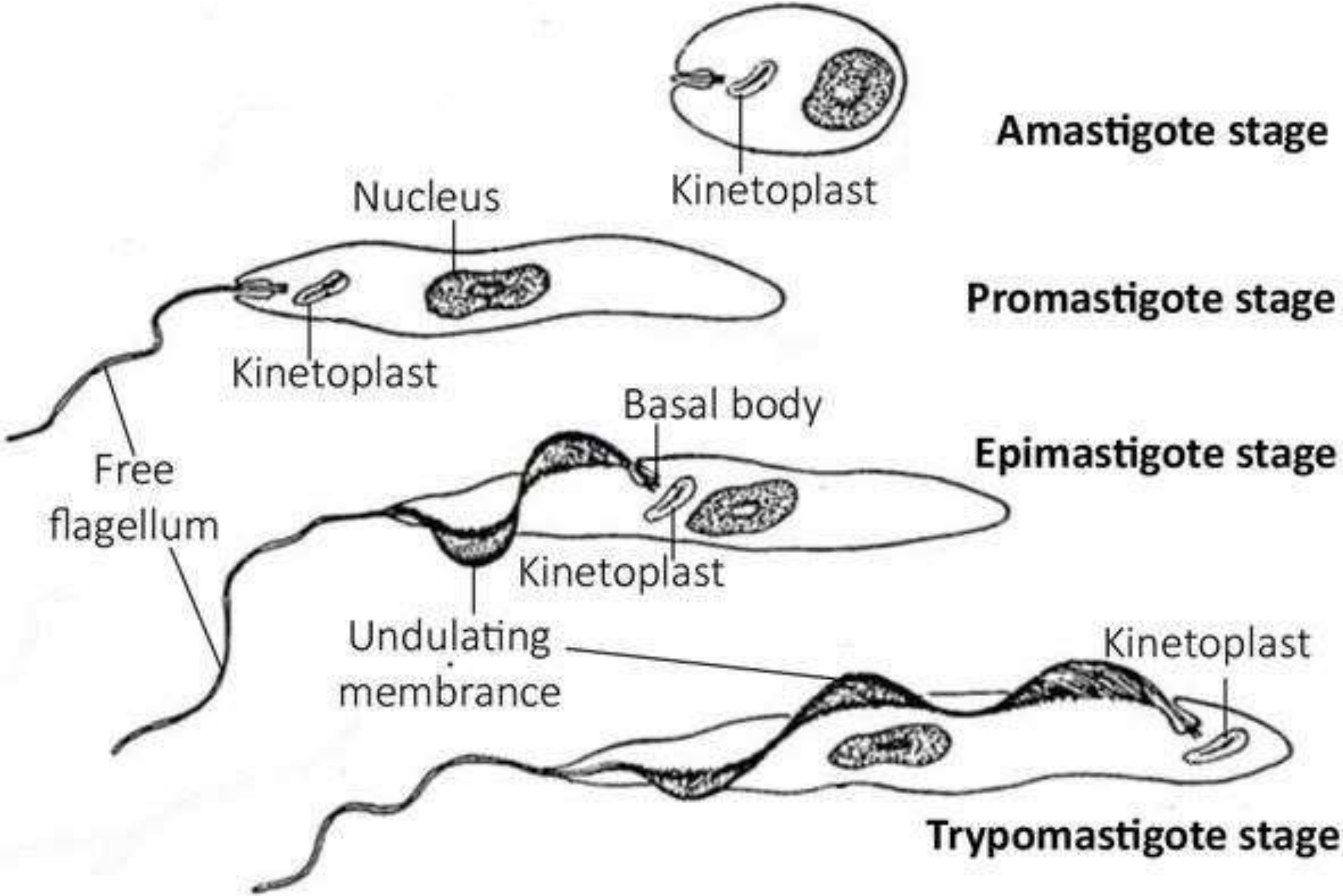


1 Epimastigote



2 Tripomastigote


Flagellum
Epimastigote
Nucleus
Kinetoplast
Undulating membrane
Undulating membrane
Flagellum
Trypomastigote
Kinetoplast
Nucleus


Amastigote stage
Kinetoplast
Nucleus
Promastigote stage
Kinetoplast
Basal body
Epimastigote stage
Free
flagellum
Kinetoplast
Undulating
membrance
Kinetoplast
Trypomastigote stage

QUESTIONS

1. What are the morphological forms found in blood flagellates?
2. What are the morphological forms found in tissue flagellates?
3. What are the morphological forms found in both blood and tissue flagellates?

1-*Trypanosoma gambiense*

- It was first discovered in **Gambia** and named by **Dutton**.
- Trypanosoma gambiense is a **blood parasite** that causes **Gambian trypanosomiasis**, also known as **wast African sleeping sickness**, in infected individuals.
- The parasite is transmitted by the tsetse fly (**Glossina species**).
- Inside the human host, the parasite multiplies by **binary fission.**
- Large numbers of parasites invade the **lymph nodes**, and later affect the **central nervous system (CNS)** and **cerebrospinal fluid** leading to the characteristic symptoms of **African sleeping sickness.**

- **Clinical Features and Diagnosis**
- Fever and headache.
- Enlarged lymph nodes, especially in the neck and behind the ear (**Winterbottom's sign**).
- Pain in the palms of the hands (**Kerandel's sign**).
- Encephalitis (**inflammation of the brain**) may occur in advanced infection.
- **Laboratory Diagnosis:**
- Detection of **trypomastigote forms** in blood, lymph node fluid, or cerebrospinal fluid (CSF) by microscopy.
- **leukocytosis**
- Serological tests can be used to confirm infection

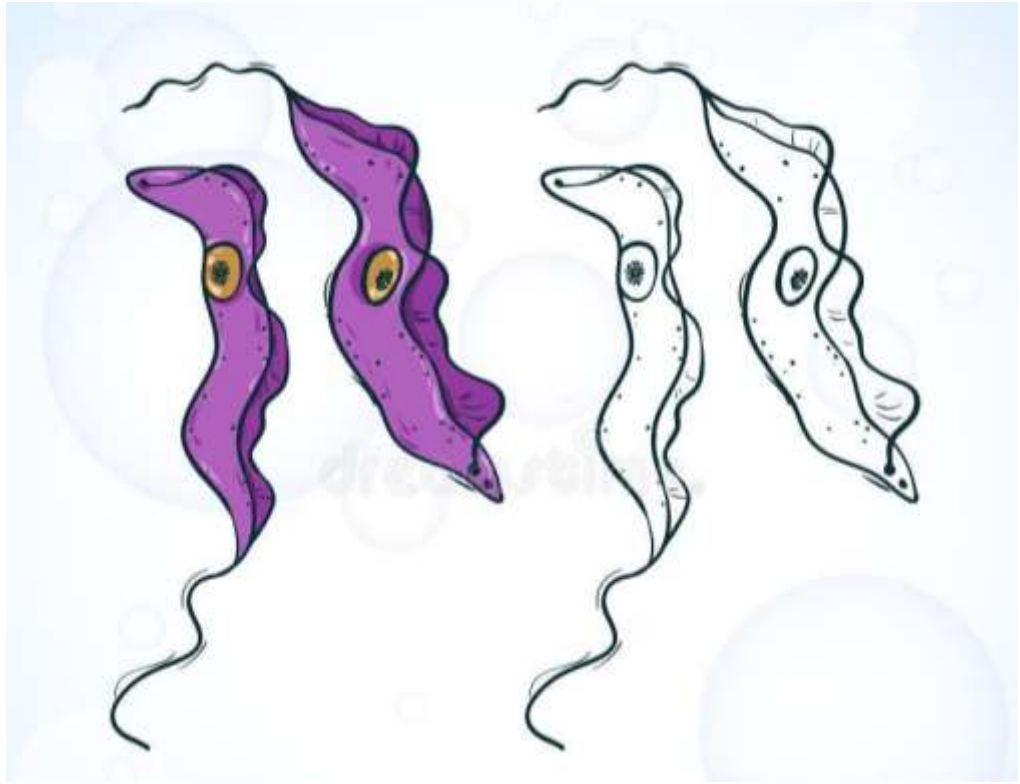
Winterbottom’s sign

2-Trypanosoma rhodesiense

- Trypanosoma rhodesiense causes **Rhodesian trypanosomiasis**, also known as **East African sleeping sickness.**

- The disease occurs mainly in **East Africa.**

- The **tsetse fly** (Glossina species) acts as the vector that transmits the parasite to humans.



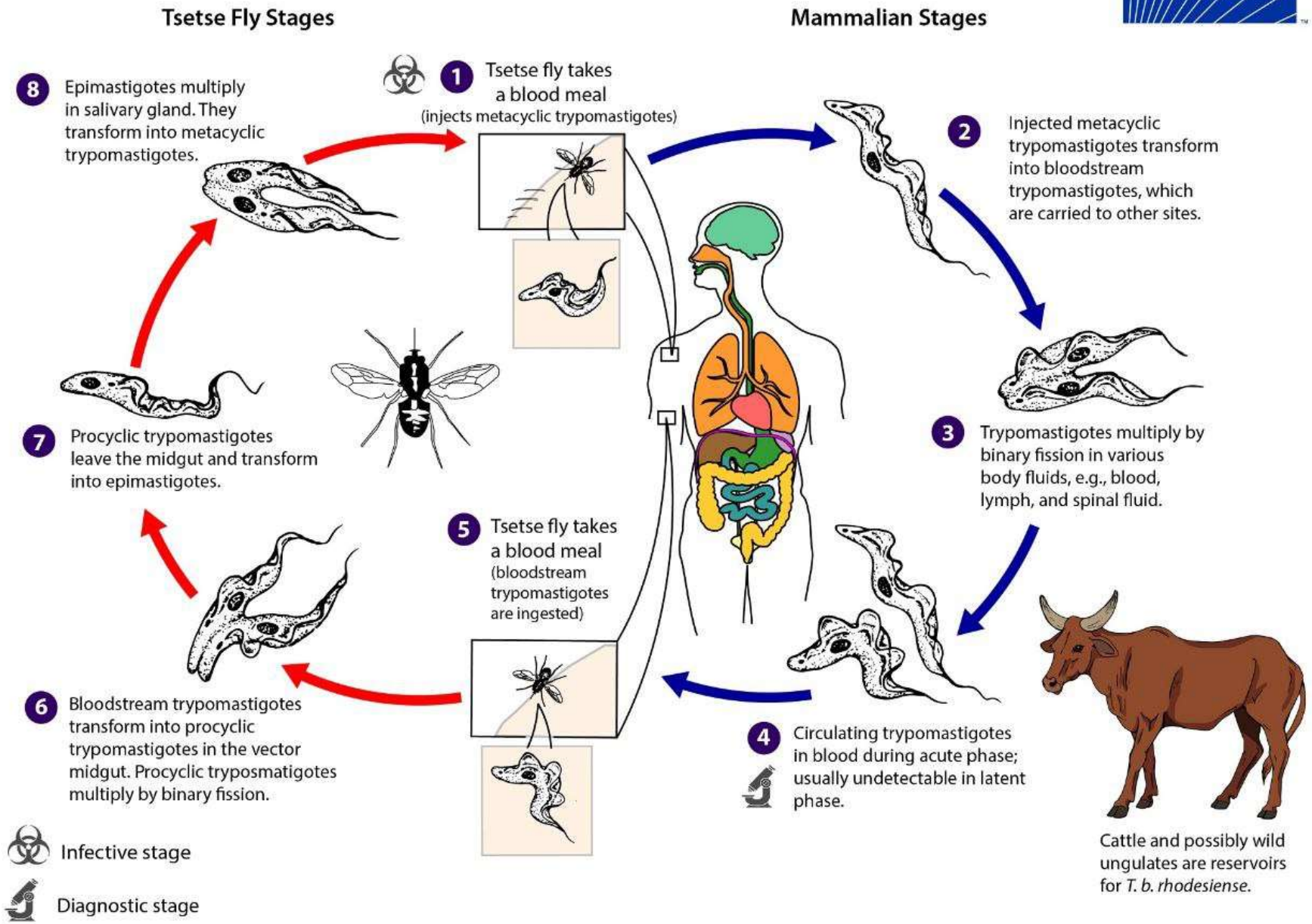
- **Clinical Features**
- **Lymphadenopathy**
- **endothelial hyperplasia**
- high fever and headache
- Muscle and joint pain
- Swelling of the face and hands
- **Laboratory Diagnosis**
- Detection of trypomastigotes in blood or cerebrospinal fluid (CSF) by microscopy
- White blood cell infiltration (**leukocyte infiltration**) may be observed
- Serological tests can help confirm infection

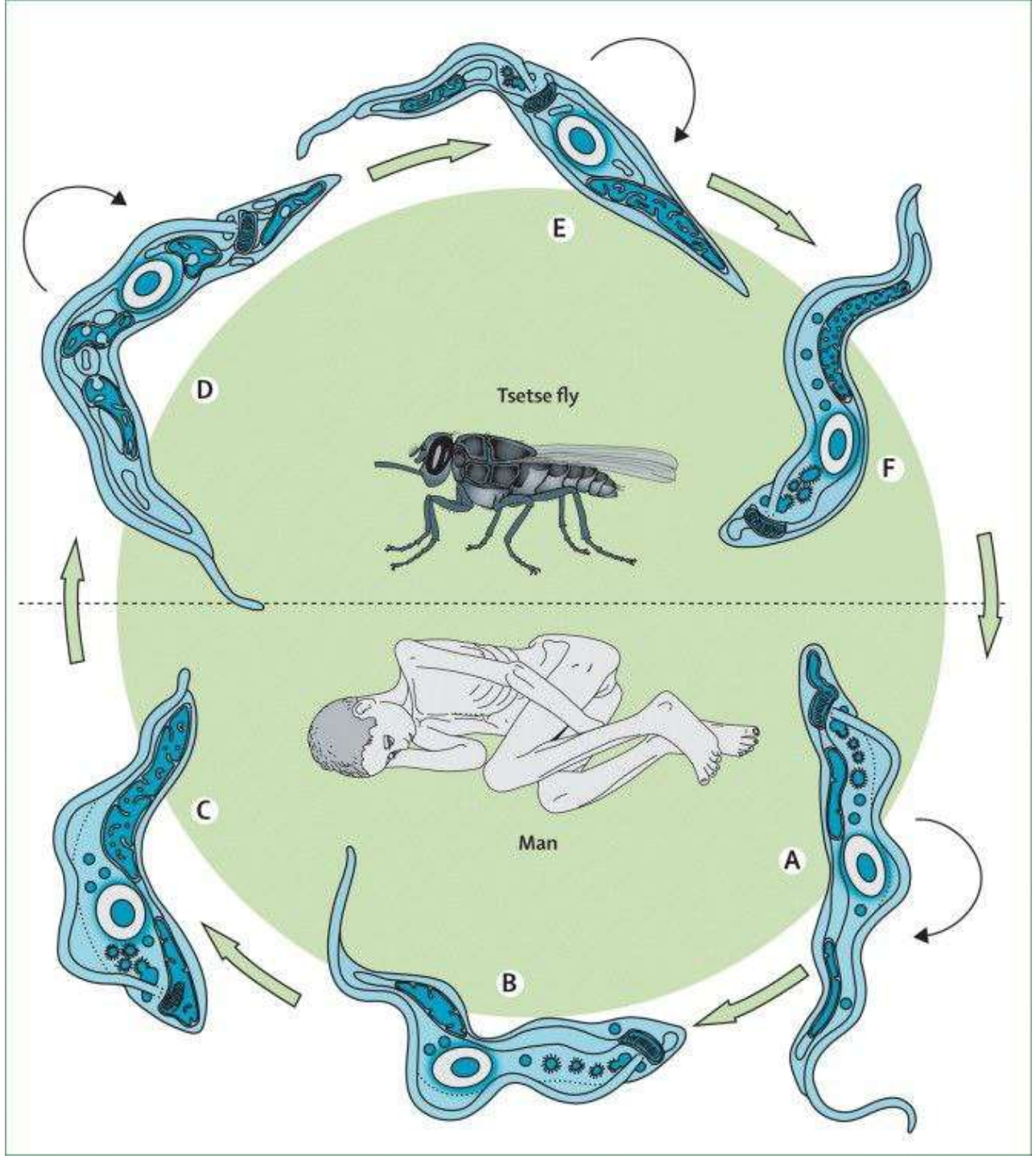
African Trypanosomiasis

Trypanosoma brucei gambiense & Trypanosoma brucei rhodesiense

DPDx

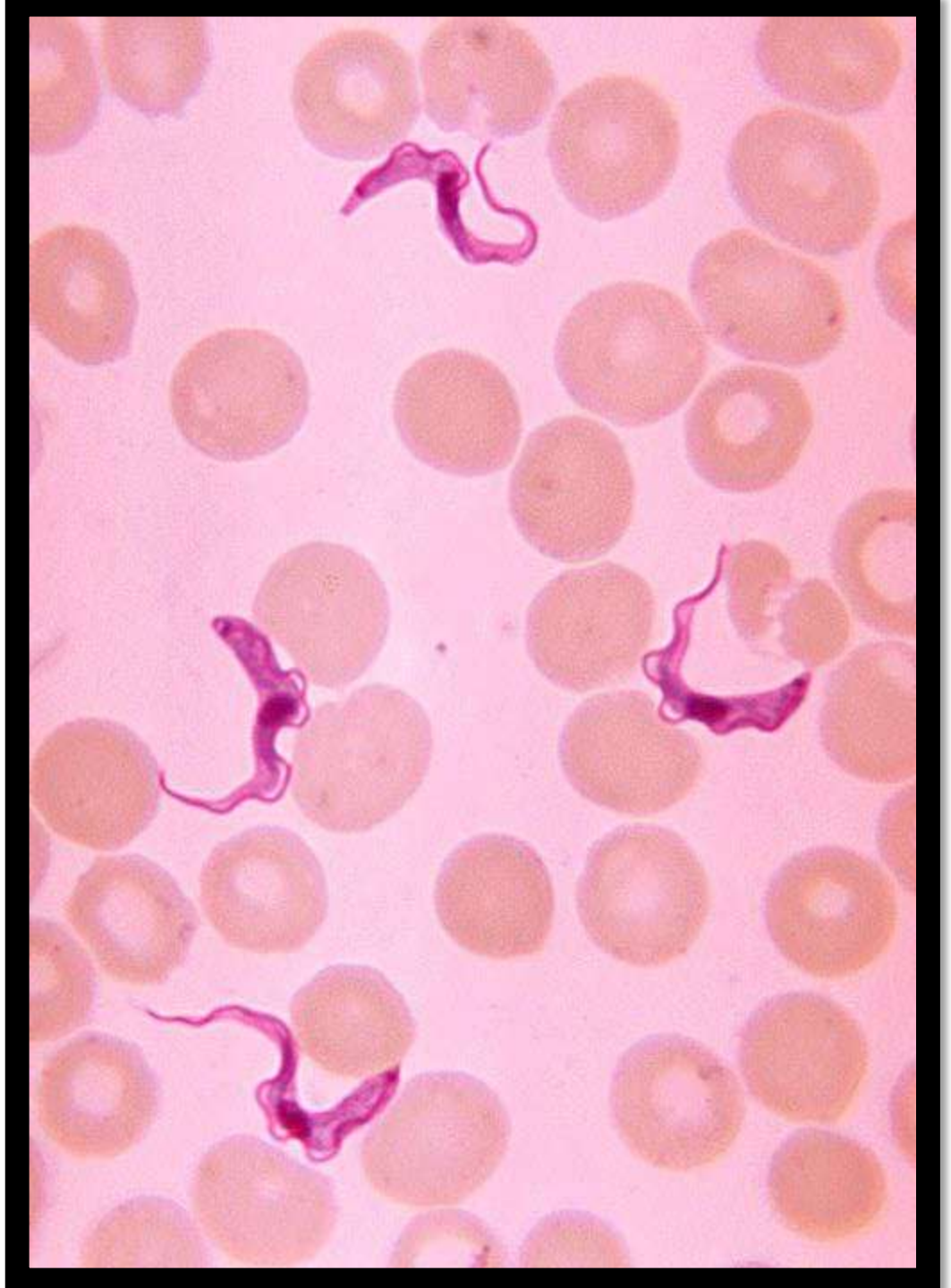
CDC





Question:

What is the diagnostic stage and the infective stage of these parasites?



3-Trypanosoma cruzi

- Trypanosoma cruzi is a **blood and tissue parasite** that causes **Chagas disease** in humans.
- It is mainly found in Latin America.
- The disease is transmitted by (**kissing bugs**), which are the vector of the parasite.

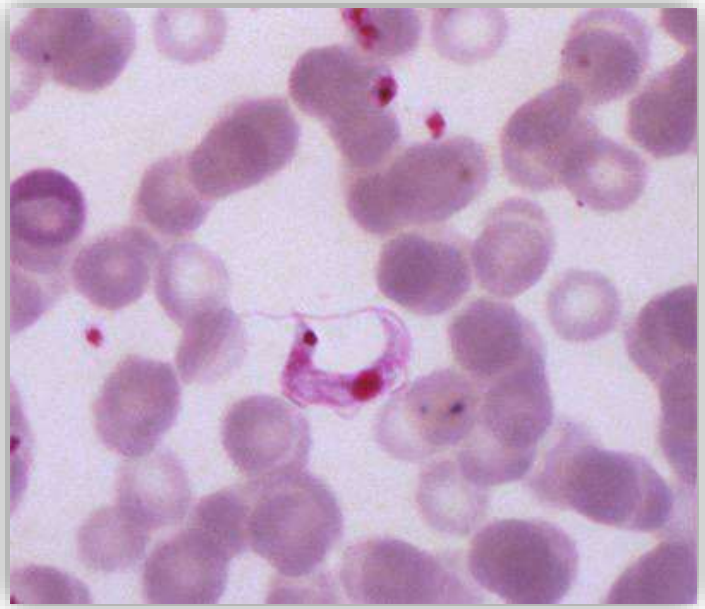
In Trypanosoma cruzi, all three main forms of the parasite are

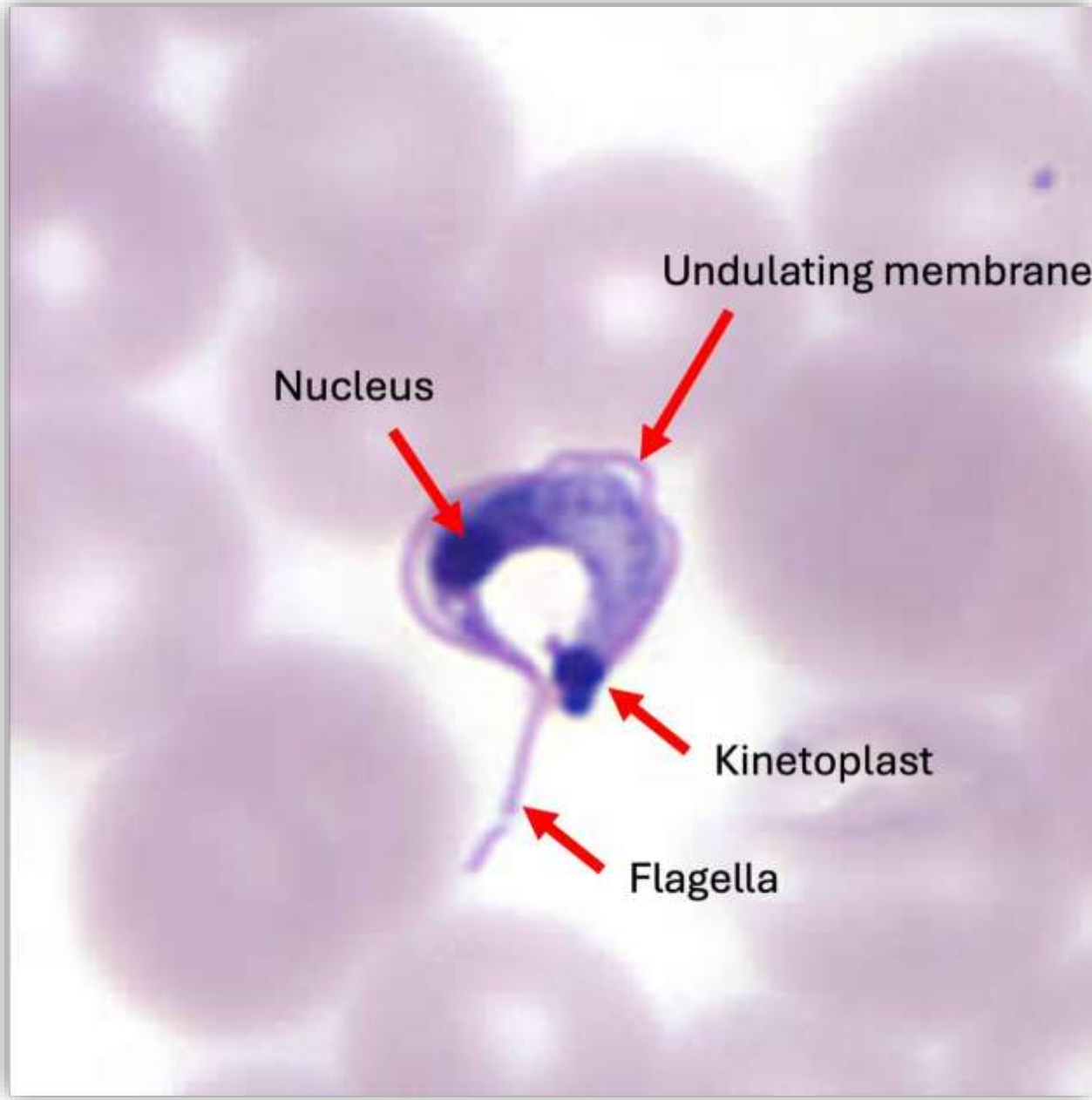
Epimastigote

Trypomastigote

Amastigote

- **Clinical Features**
- Fever Swelling of the eyelids (**Romana's sign**)
- Enlargement of lymph nodes, liver, and spleen
- Heart complications (**arrhythmias**, **cardiomyopathy**) in chronic cases
- Gastrointestinal complications (**megacolon**, **megaesophagus**) in chronic cases
- **Laboratory Diagnosis**
- Detection of **trypomastigotes in blood**
- Detection of **amastigotes in tissue samples** (muscle, heart) .
- Serological tests can confirm infection
- Increased white blood cell count (**leukocyte infiltration**) may be observed
- **Diagnostic and Infective Stages**
- **Diagnostic stage: Trypomastigote in blood or amastigote in tissues.**
- **Infective stage: trypomastigote present in the feces of the kissing bug.**




Undulating membrane
Nucleus
Kinetoplast
Flagella


The Romana's Sign

Trypanosoma cruzi

DPDx

Triatomine Bug Stages

1 Triatomine bug takes a blood meal
(passes metacyclic trypomastigotes in feces, trypomastigotes enter bite wound or mucosal membranes, such as the conjunctiva)

8 Metacyclic trypomastigotes in hindgut

7 Multiply in midgut

6 Epimastigotes in midgut

5 Triatomine bug takes a blood meal
(trypomastigotes ingested)

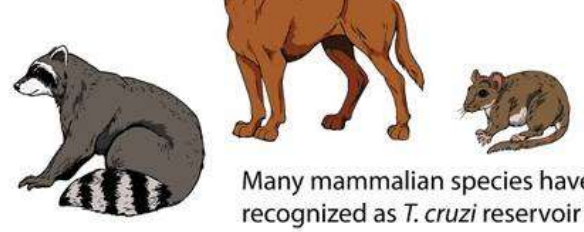
Mammalian Stages

2 Metacyclic trypomastigotes penetrate various cells at bite wound site. Inside cells they transform into amastigotes.

3 Amastigotes multiply by binary fission in cells of infected tissues.

4 Intracellular amastigotes transform into trypomastigotes, then burst out of the cell and enter the bloodstream.

Trypomastigotes can infect other cells and transform into intracellular amastigotes in new infection sites.

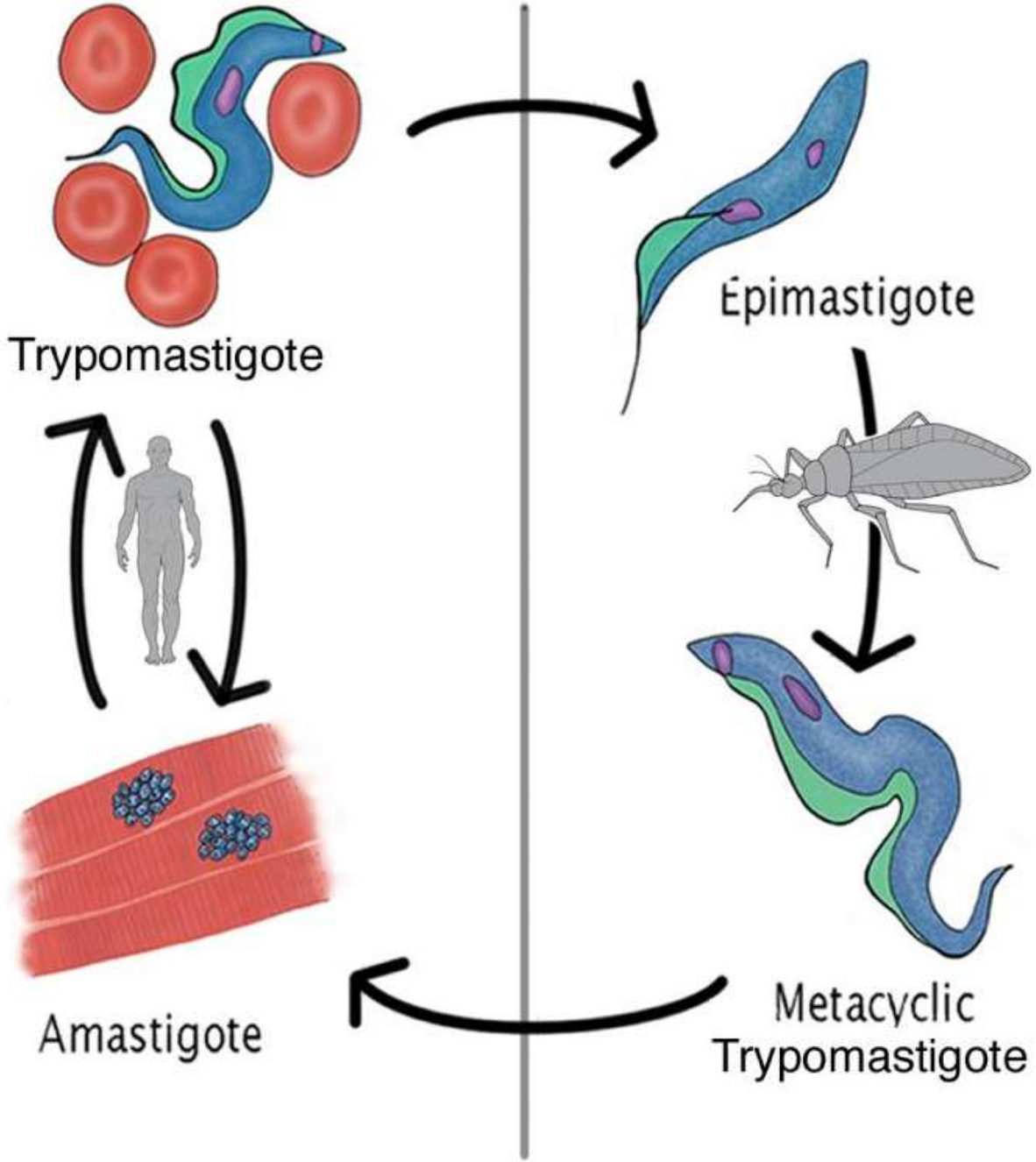


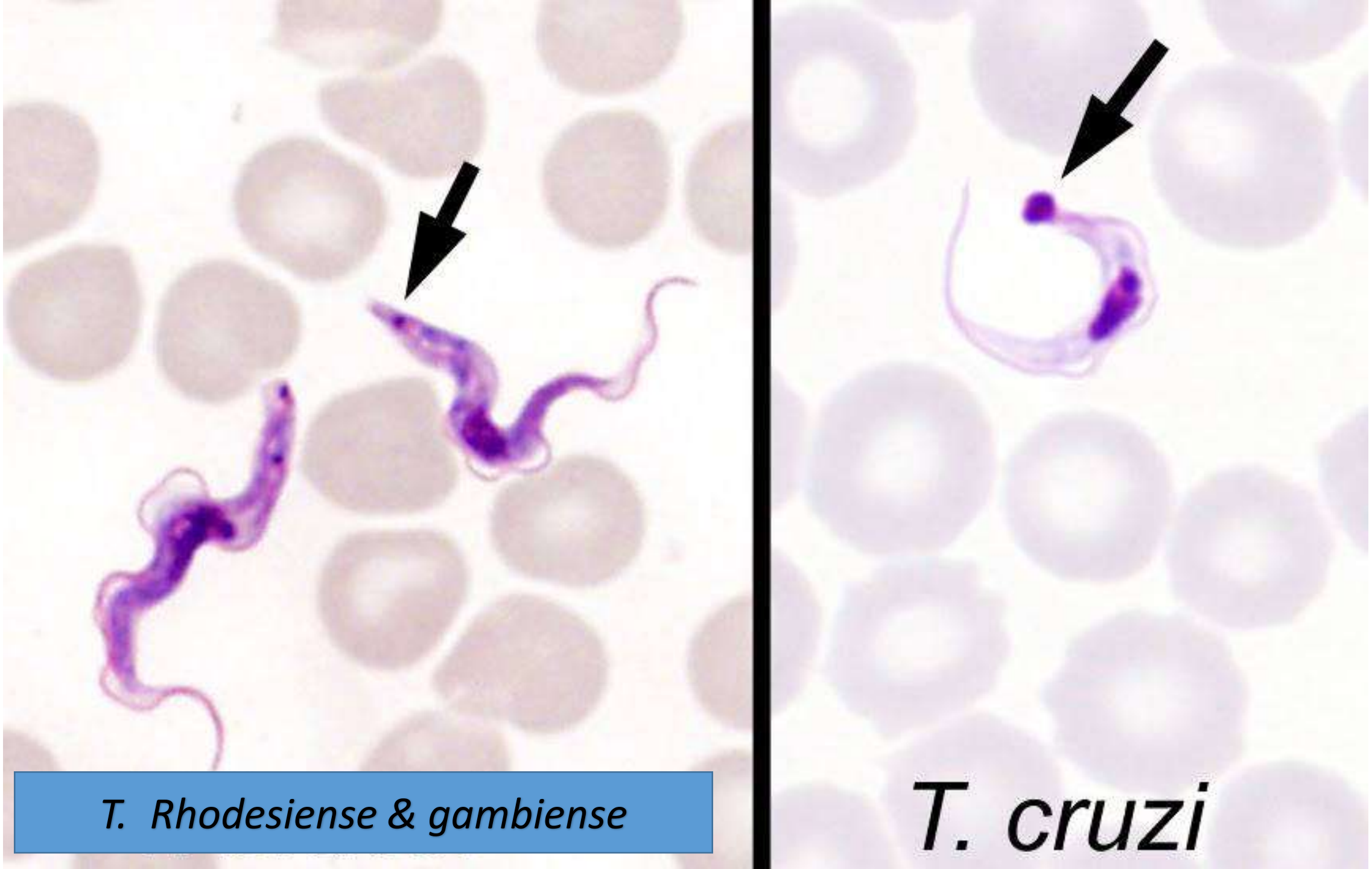
Many mammalian species have been recognized as *T. cruzi* reservoir hosts.

CDC

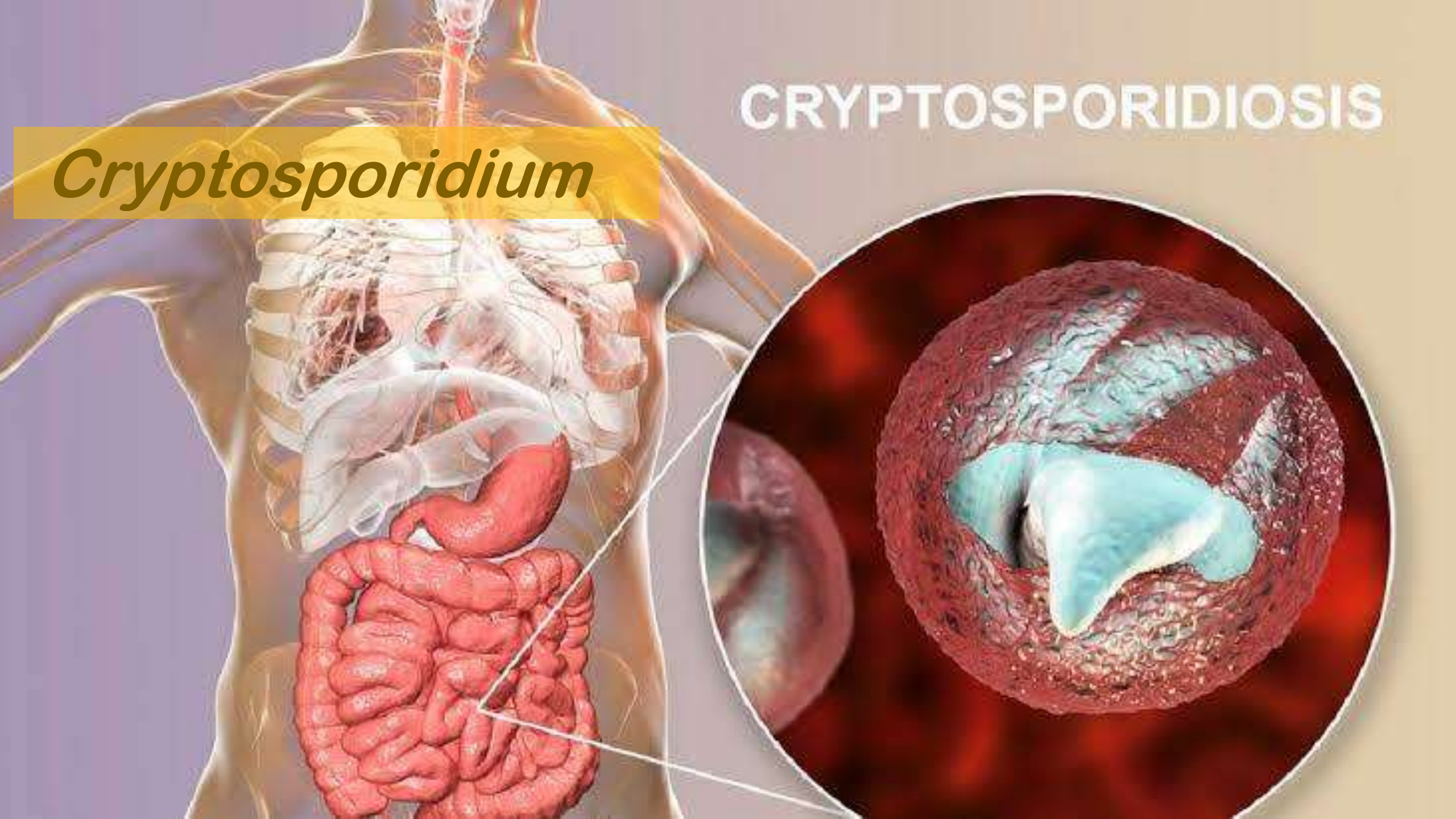
Infective stage

Diagnostic stage


Trypomastigote
Epimastigote
Amastigote
Metacyclic
Trypomastigote


T. Rhodesiense & gambiense
T. cruzi

Cryptosporidium



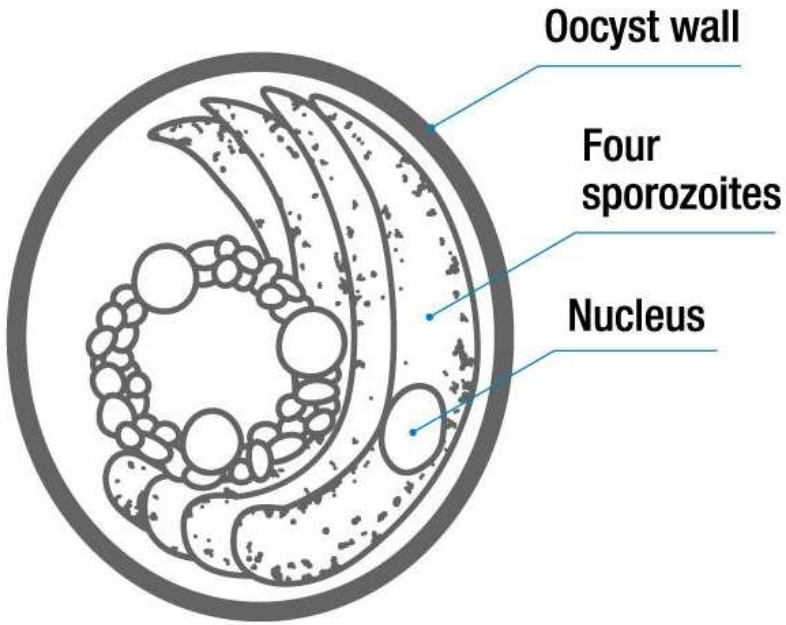
- **History and Distribution**
- Cryptosporidia were first observed in the gastric mucosal crypts of laboratory mice in 1907.
- Its importance as a pathogen causing diarrohea in animals was recognized in 1971 and the first case of human infection was reported in 1976.
- Cryptosporidium has great importance as a frequent cause of intractable diarrohea, in AIDS patients, and immunocompromised subjects.
- It is worldwide in distribution.
- Two species of cryptosporidium, C. hominis and C. parvum cause human infections.
- **Habitat**
- C. parvum inhabits the **small intestine** (especially ileum).
- It may also be found in stomach, colon.

Cryptosporidium parvum

Disease Name

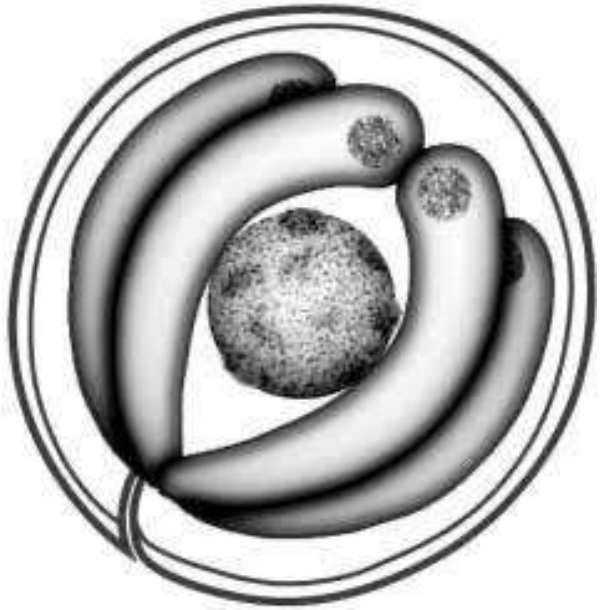
- **Cryptosporidiosis**

Morphology



- The infective stage of the parasite is **oocyst.**
- The oocyst is spherical or oval and
- measures about 5 µm in diameter.
- The wall of the oocysts is **thick**, but in 20% cases, wall
- may be **thin**. These thin walled oocysts are responsible for **autoinfection.**
- Both thin walled and thick walled oocyst contain **4 sporozoites.**

- Clinical Manifestations
- **Immunocompromised individuals** : Develop chronic, severe diarrhea with large stool volumes, leading to dehydration and wasting.
- **Immunocompetent individuals**: develop self-limited watery diarrhea with **abdominal pain**.
- Laboratory Diagnosis
- 1) Stool Examination Detect oocysts in stool
- Concentrated stool + Acid-Fast Staining
- Oocysts stain red/pink; 4–6 µm
- ELISA (detect antigen)
- PCR
- Direct fluorescent antibody (DFA)

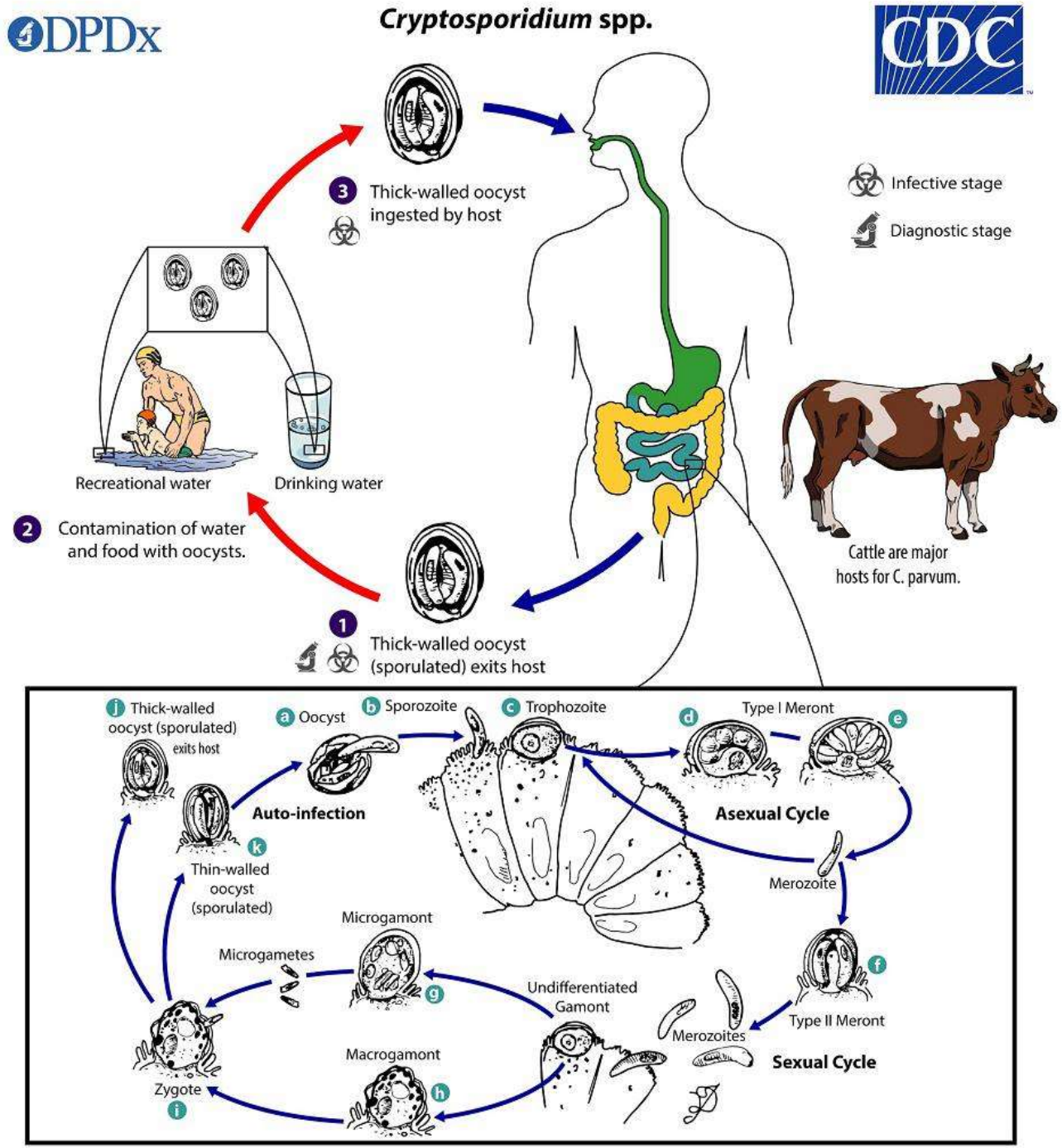


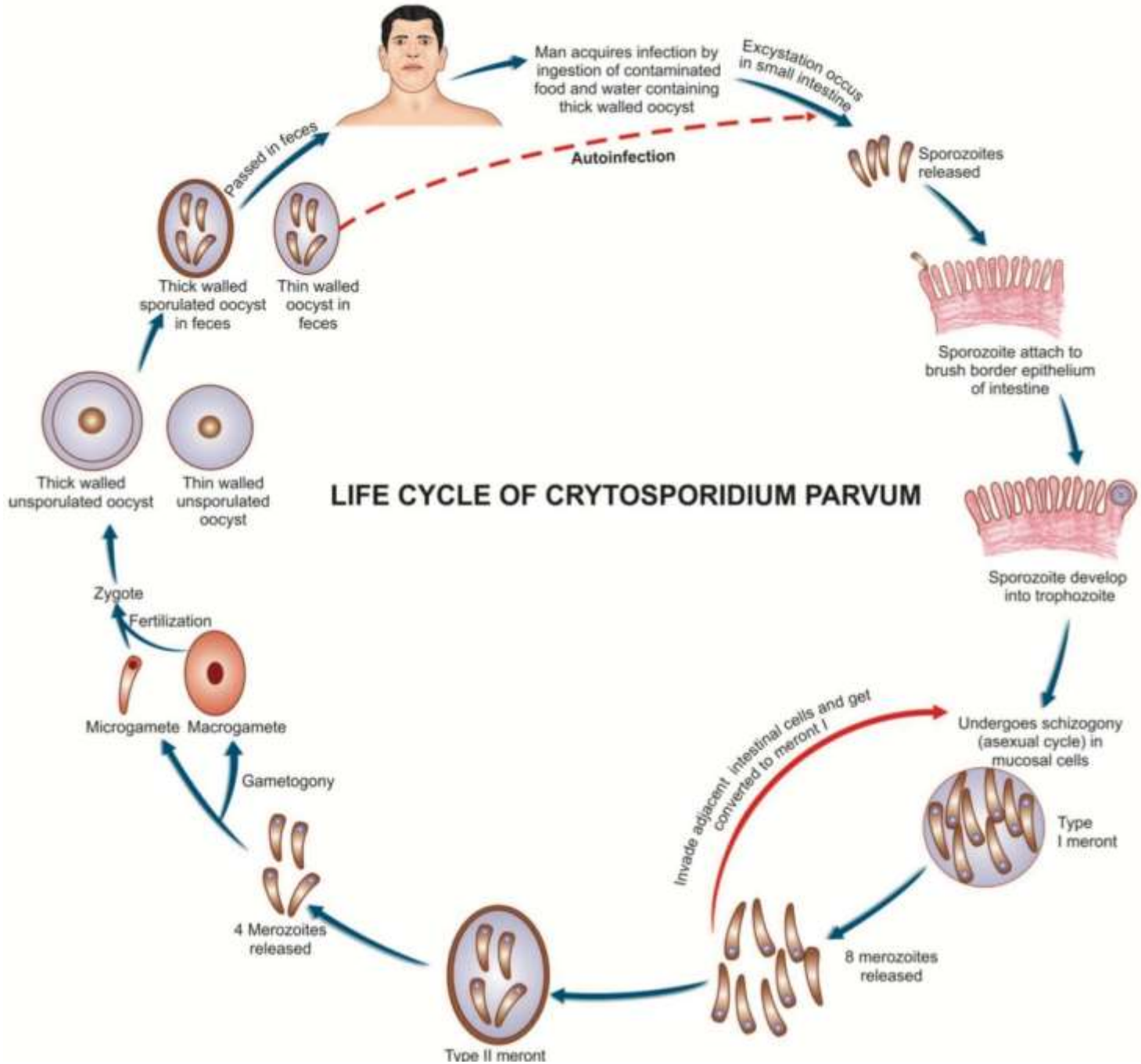
Mode of transmission:

- Man infection by: swallowing of food and water contaminated with feces containing **oocysts**.
- Life Cycle
- The parasite complete its life cycle, sexual and asexual reproduction in a **single host**.
- Infective stage: **oocyst containing 4 sporozoites.**
- In the intestine, sporozoites are **released** and develop into **trophozoites.**
- Trophozoites undergo **asexual multiplication (schizogony)** to form Type I meronts, which release **8 merozoites**.
- Merozoites reinvade cells to repeat schizogony or develop into Type II meronts, which **release 4 merozoites**.
- These undergo gametogony to form **microgamete** and **macrogamete**.
- Fertilization produces a **zygote,** which develops into an oocyst.

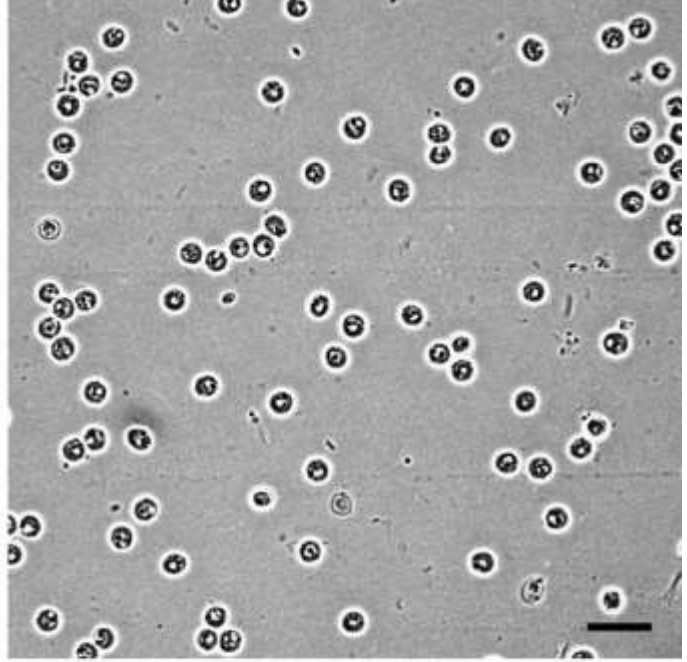
Consists of oocysts is **thick** and **thin** walled oocyste

- oocysts are shed in feces (thick walled) and are **immediately infective**.
- Thin walled oocysts can cause **autoinfection**.

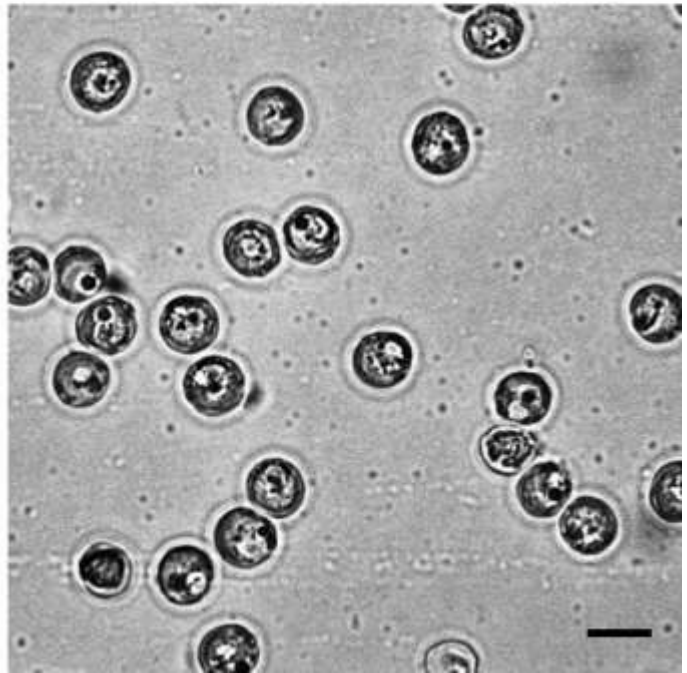

DPDx
Cryptosporidium spp.
CDC
Infective stage
Diagnostic stage
3 Thick-walled oocyst ingested by host
Recreational water
Drinking water
2 Contamination of water and food with oocysts.
1 Thick-walled oocyst (sporulated) exits host
Cattle are major hosts for C. parvum.
j Thick-walled oocyst (sporulated) exits host
a Oocyst
b Sporozoite
c Trophozoite
d Type I Meront
e
Auto-infection
Asexual Cycle
k Thin-walled oocyst (sporulated)
Merozoite
Microgamont
Microgametes
g
f
Type II Meront
Undifferentiated Gamont
Merozoites
Sexual Cycle
Macrogamont
h
Zygote
i

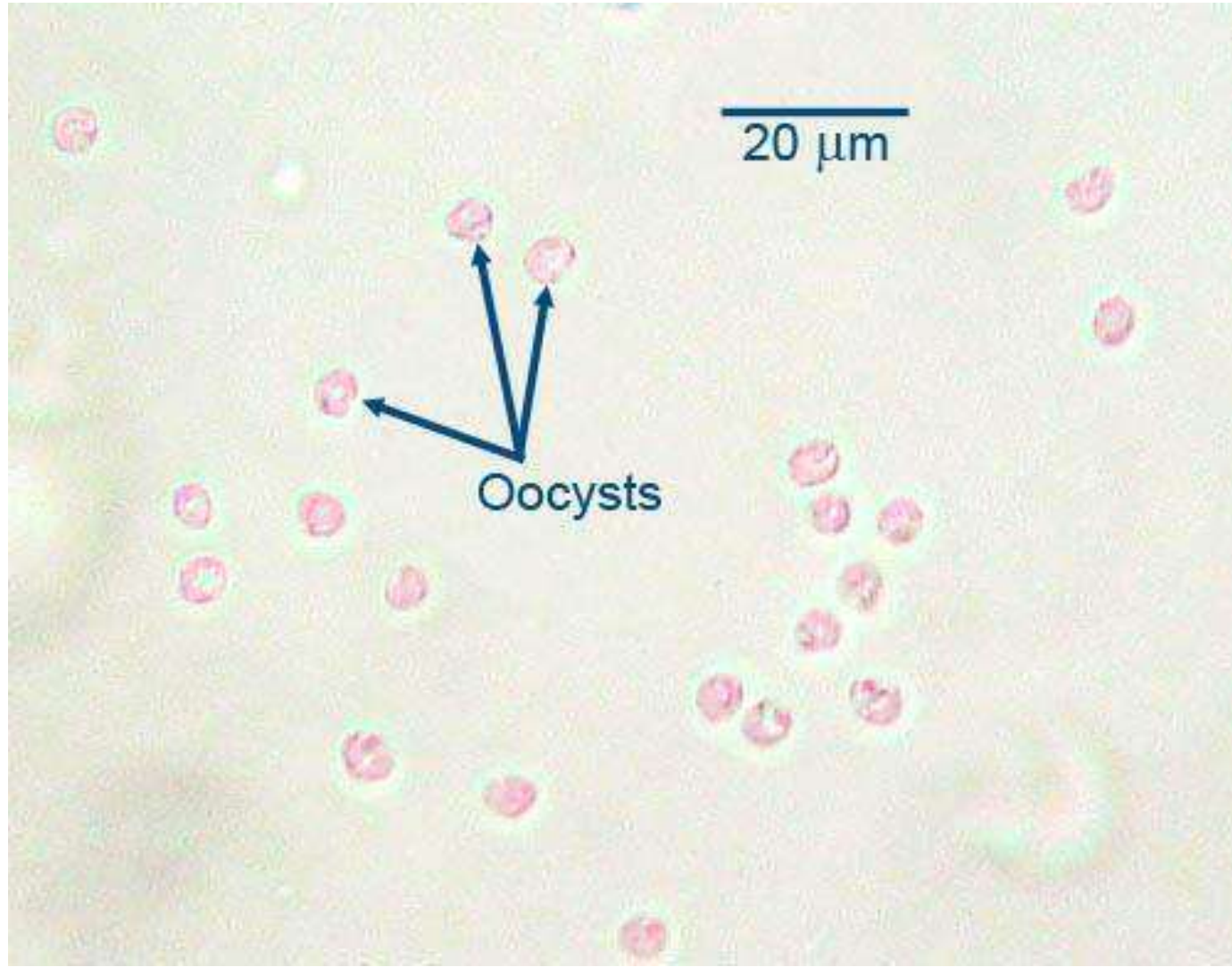

LIFE CYCLE OF CRYTOSPORIDIUM PARVUM
Man acquires infection by ingestion of contaminated food and water containing thick walled oocyst
Excystation occus in small intestine
Sporozoites released
Sporozoite attach to brush border epithelium of intestine
Sporozoite develop into trophozoite
Undergoes schizogony (asexual cycle) in mucosal cells
Type I meront
8 merozoites released
Type II meront
Invade adjacent intestinal cells and get converted to meront I
4 Merozoites released
Gametogony
Microgamete
Macrogamete
Fertilization
Zygote
Thick walled unsporulated oocyst
Thin walled unsporulated oocyst
Thick walled sporulated oocyst in feces
Thin walled oocyst in feces
Passed in feces
Autoinfection

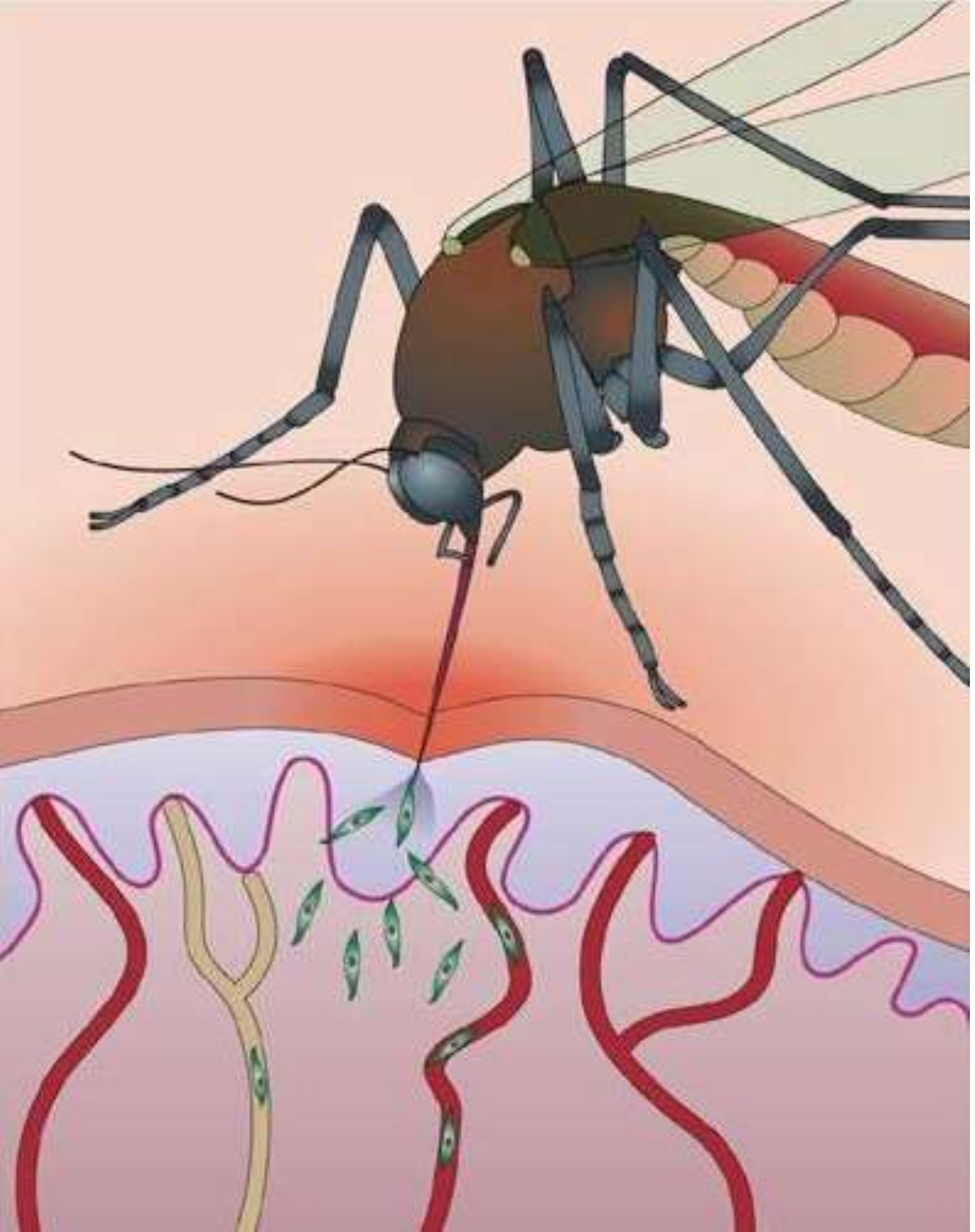
A



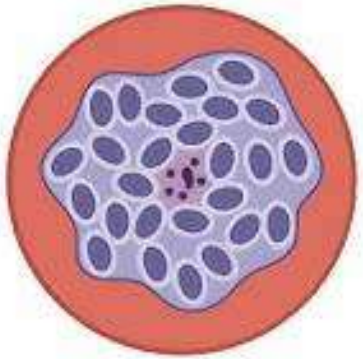
B



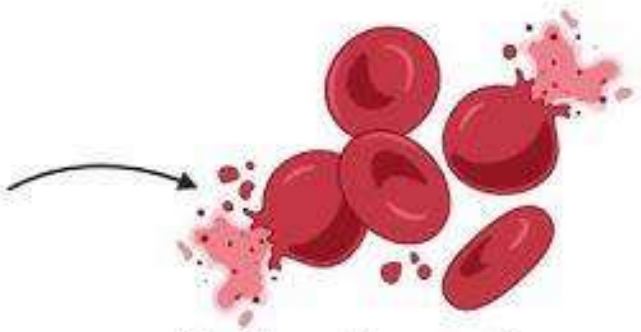




Plasmodium



Schizont



Malaria

Prepared & Presented by:

M.Sc. Ghadeer Mahmood

- Malaria parasites belong to the genus *Plasmodium*.
- Approximately **one million people die** evry yaer from malaria.
- The disease is prevalent in Africa, the Americas, India, and the Middle East.
- *Plasmodium* species lack locomotory organelles.
- Historically, malaria was also present in Iraq.
- The parasite have two hosts in its life cycle: a **final host**, which is the female Anopheles mosquito, and an **intermediate host**, which is the human.
- What is the difference between the intermediate host and the final host?

Symptoms : Chills → Fever → Sweating

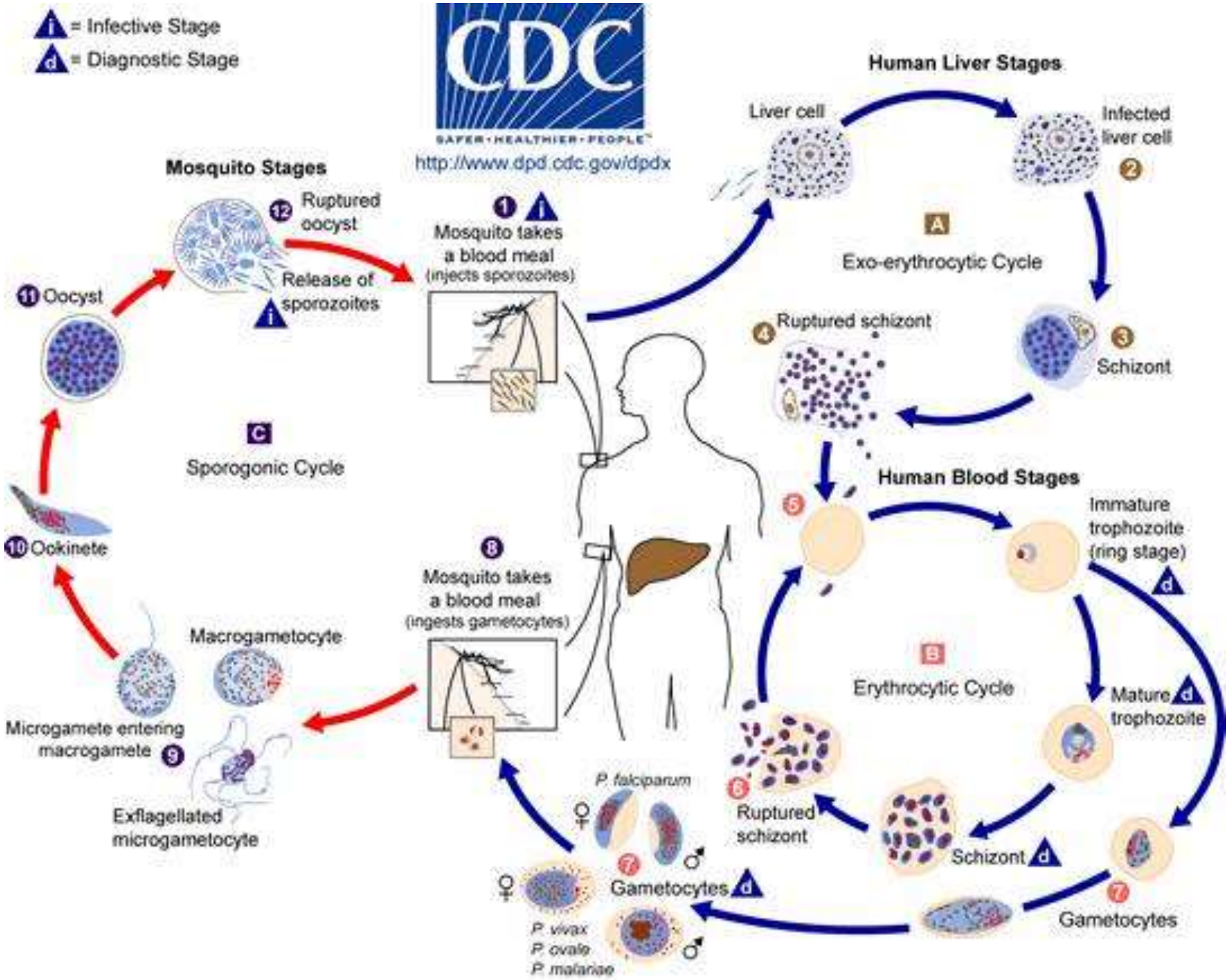
Plasmodium

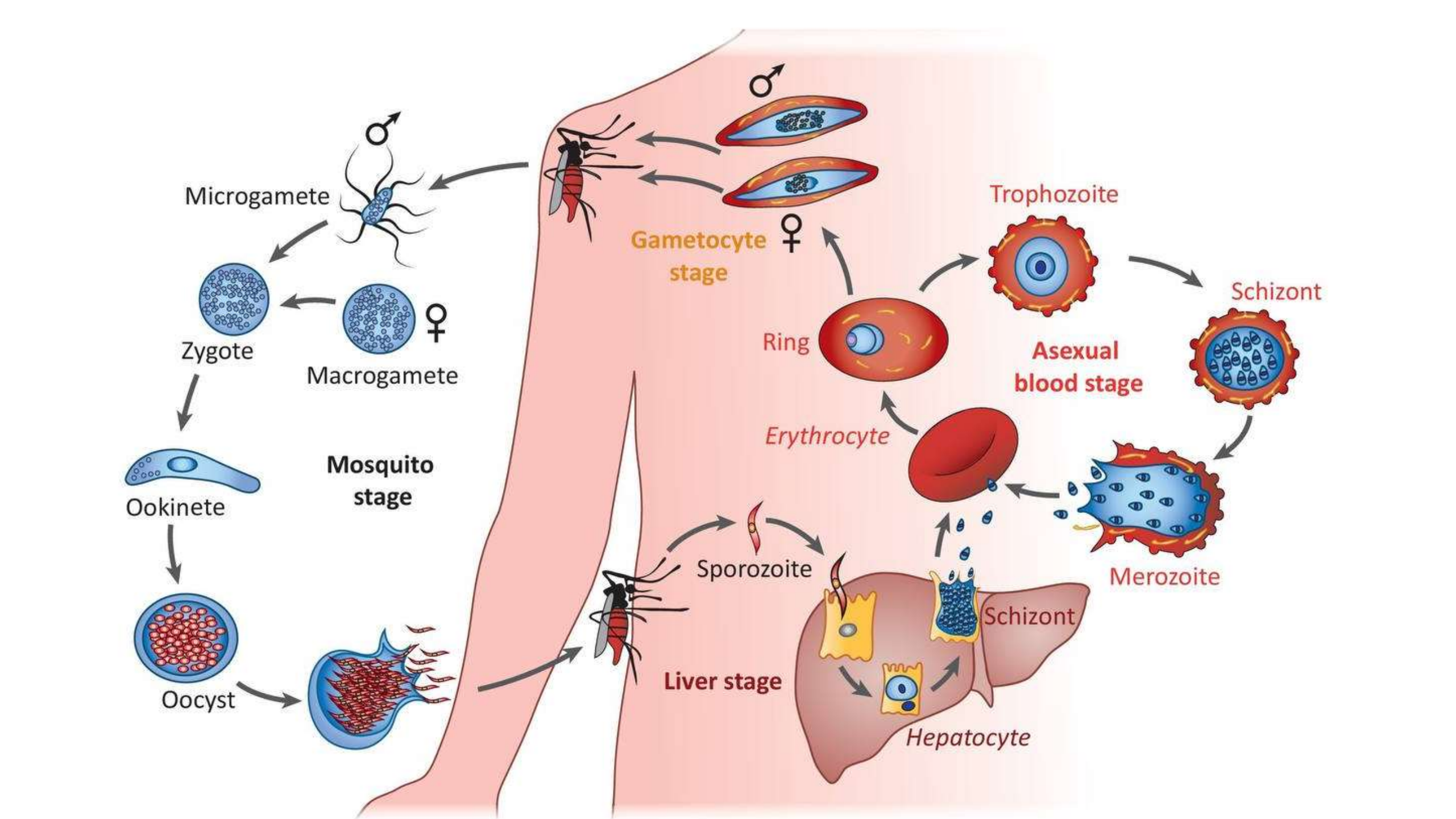
- 1. Plasmodium falciparum → **Malignant Malaria**
- 2. Plasmodium vivax → **Tertian Malaria**
- 3. Plasmodium ovale → **Tertian Malaria**
- 4. Plasmodium malariae → **Quartan Malaria**

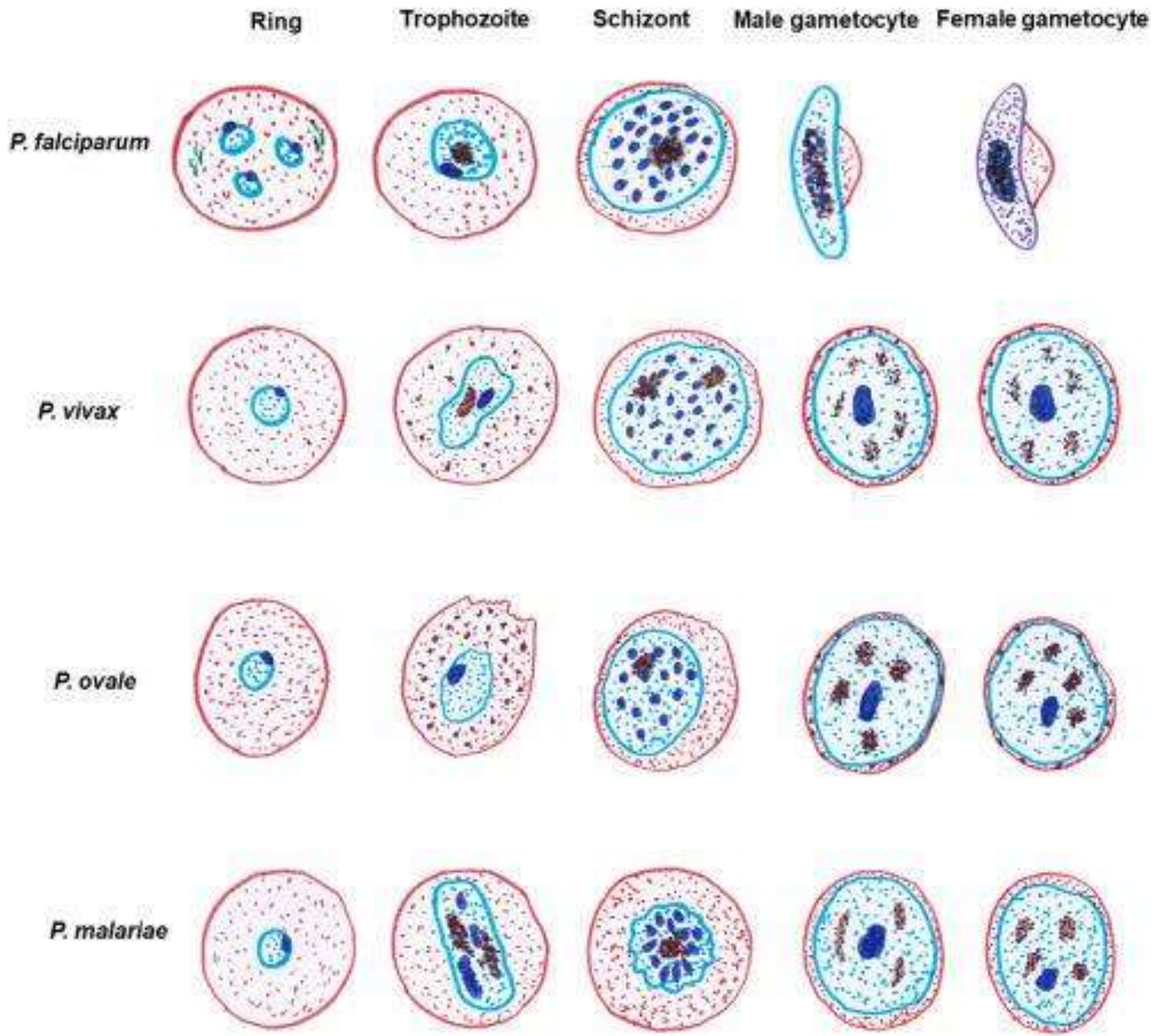
Life Cycle

- Malaria parasite passes its life cycle in 2 hosts.
- **final host: Female Anopheles mosquito.**
- **Intermediate host: Man.**
- The life cycle of malarial parasite comprises of 2 stages an **asexual phase** occurring in humans, which act as the intermediate host and a **sexual phase** occurring in mosquito, which serves as a final host for the parasite.

Mode of transmission through the insect bite.


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
Ruptured schizont
4
3
Schizont
Human Blood Stages
5
Immature trophozoite (ring stage)
d
B
Erythrocytic Cycle
Mature trophozoite
d
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
C
Sporogonic Cycle
Mosquito Stages
12
Ruptured oocyst
Release of sporozoites
i
1
i
Mosquito takes a blood meal
(injects sporozoites)


Microgamete
Zygote
Macrogamete
Ookinete
Mosquito stage
Oocyst
Sporozoite
Liver stage
Schizont
Hepatocyte
Merozoite
Erythrocyte
Ring
Trophozoite
Schizont
Asexual blood stage
Gametocyte stage


Ring
Trophozoite
Schizont
Male gametocyte
Female gametocyte
P. falciparum
P. vivax
P. ovale
P. malariae

- **Q/ What forms of the malaria parasite appear in infected hosts?**

- **In the mosquito (Anopheles)**

• Gametes • Zygote • Ookinete • Oocyst • Sporozoites.

- **In the human liver**

• Sporozoites • Trophozoite • Liver schizont (hepatic schizont) • Merozoites.

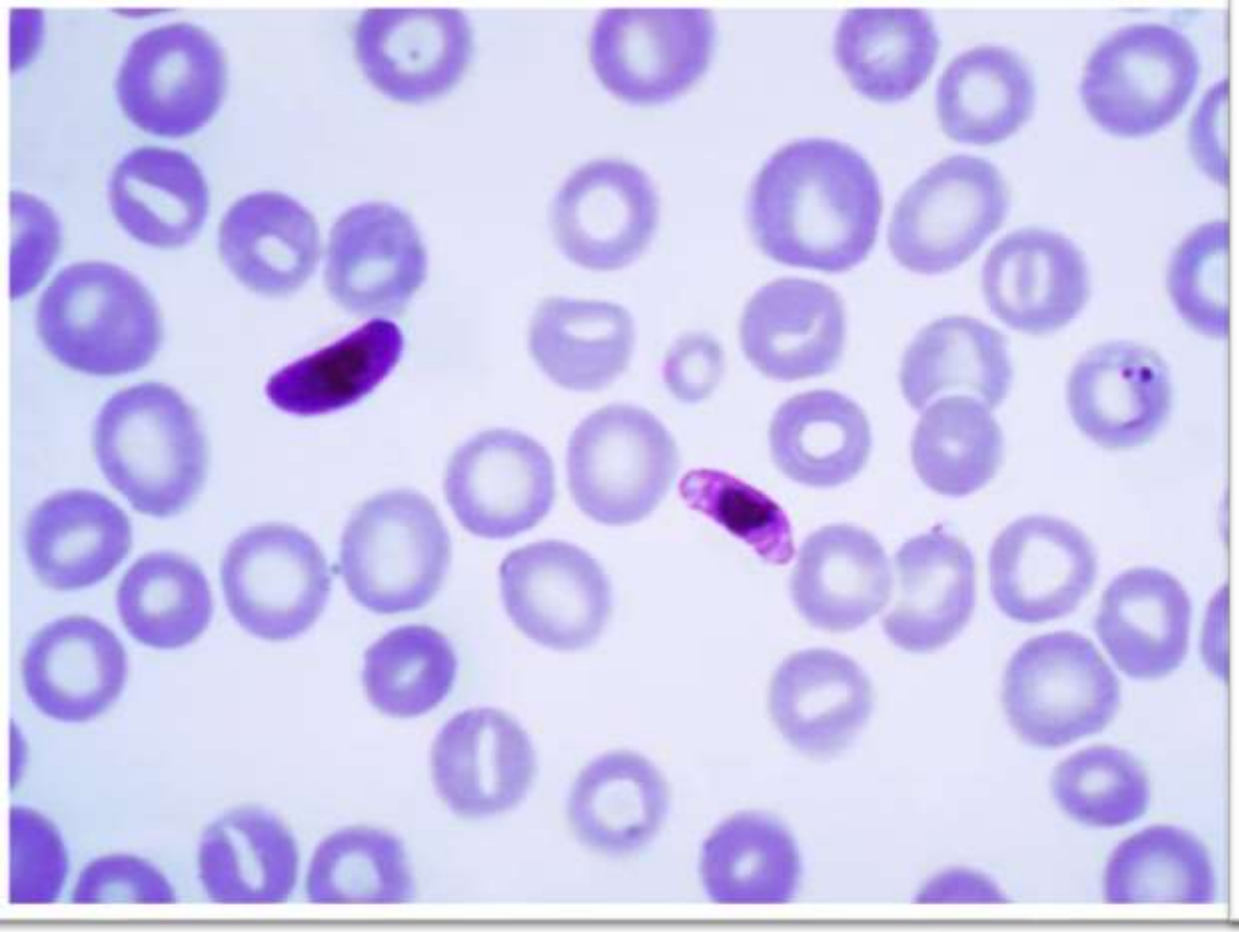
- **In the human blood**

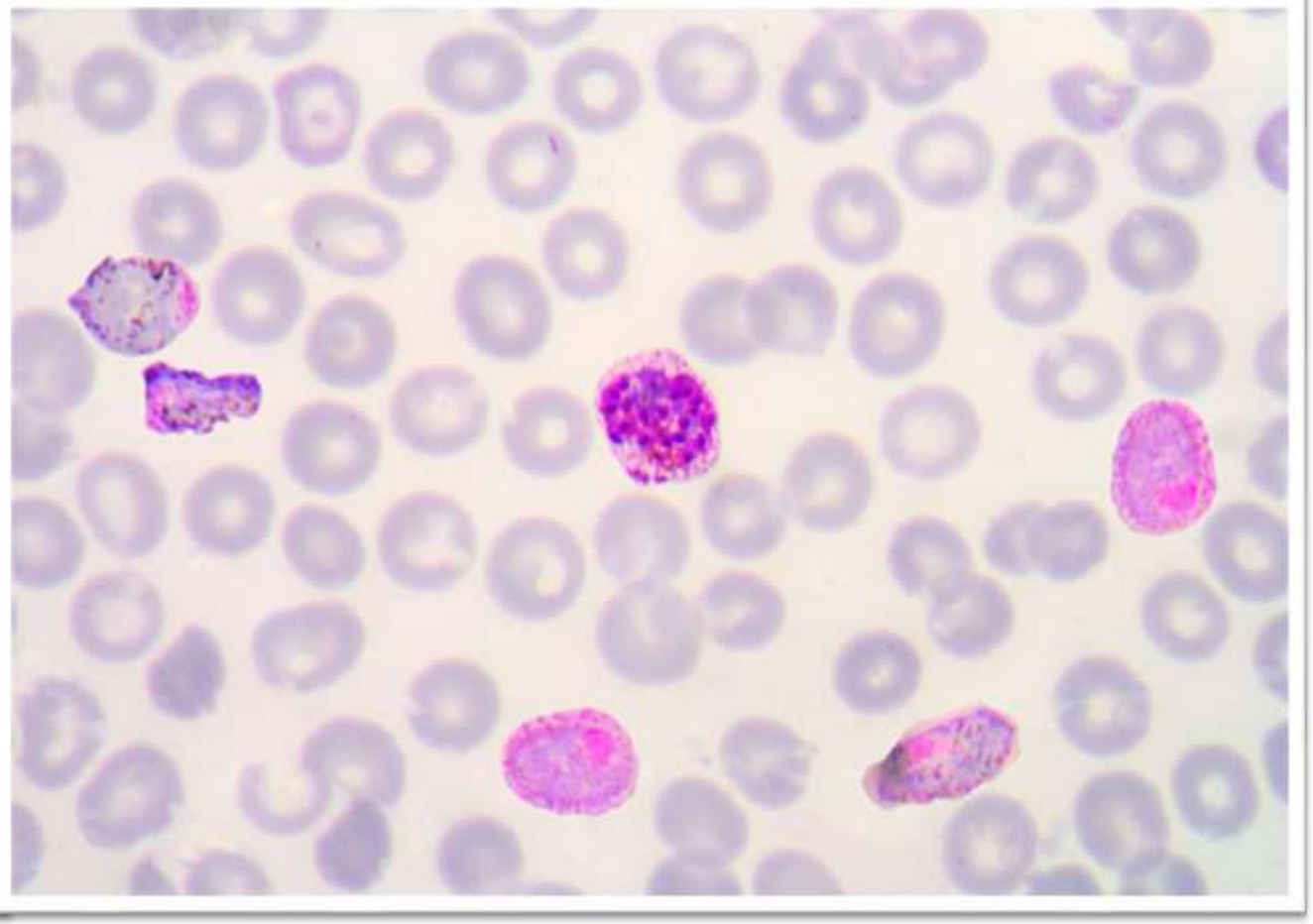
• Merozoites • Ring stage (early trophozoite) • Trophozoite • Schizont • Gametocytes (male & female).

- Q: What is the difference between liver schizonts and blood schizonts?
- A: The number of merozoites.

- Q: What is an ookinete?
- A: A motile Zygote .

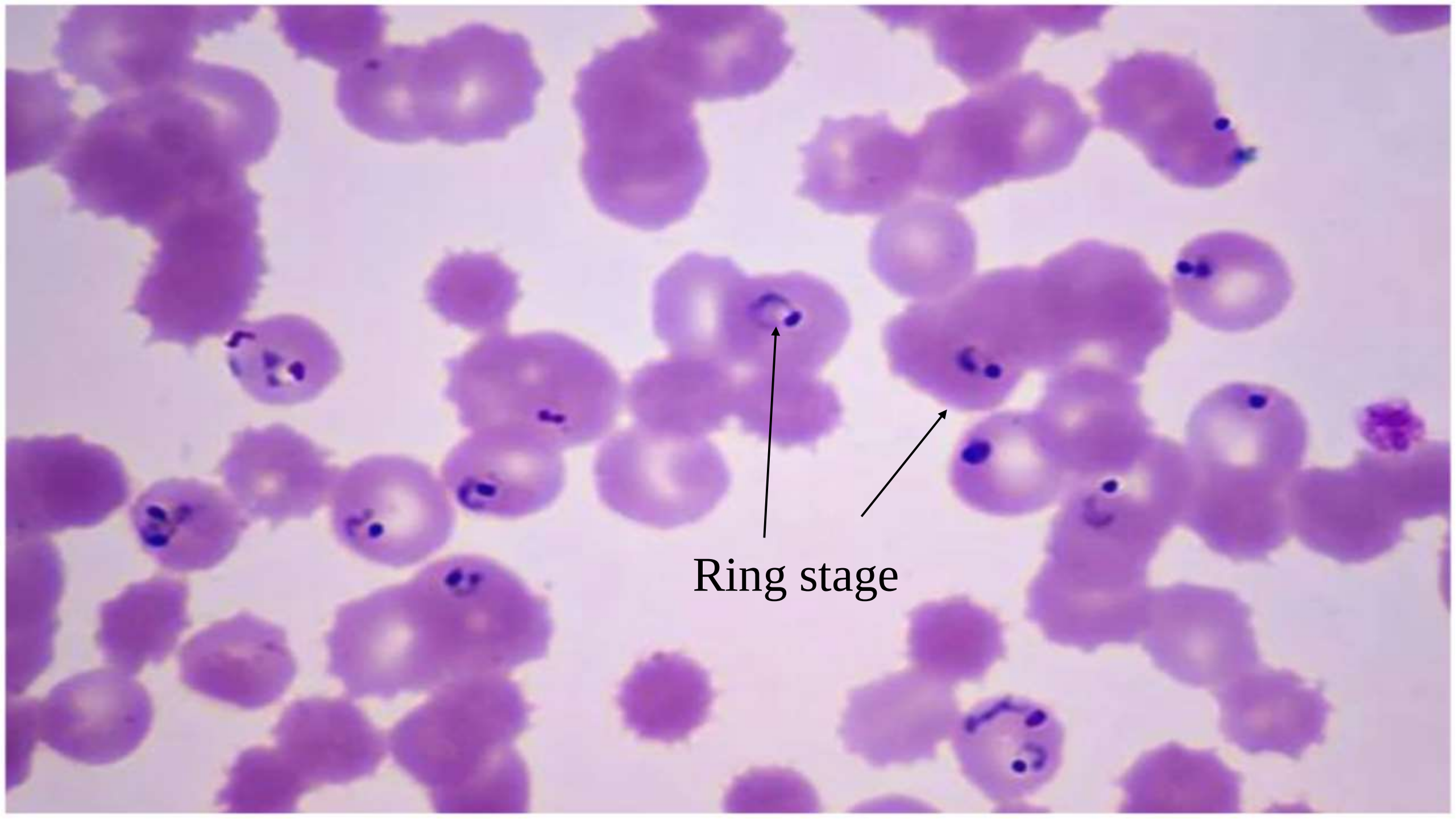
- Q: What is an oocyst?
- A: A Zygote enclosed in a protective wall.





Gametocytes (male & female)

schizont


Ring stage

Method of diagnosis

1. Take a blood sample and prepare a thin blood smear on a glass slide.
2. Allow the smear to dry and stain it (usually with Giemsa stain).
3. Examine the slide under a microscope.
4. Identify the shapes and stages of *Plasmodium* parasites in red blood cells.