

# Protozoan parasitology

Second class

Department of biology-College of Sciences-University of Baghdad

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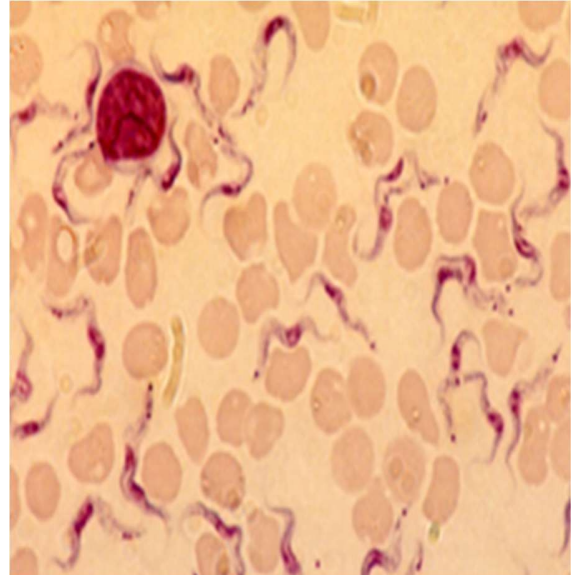
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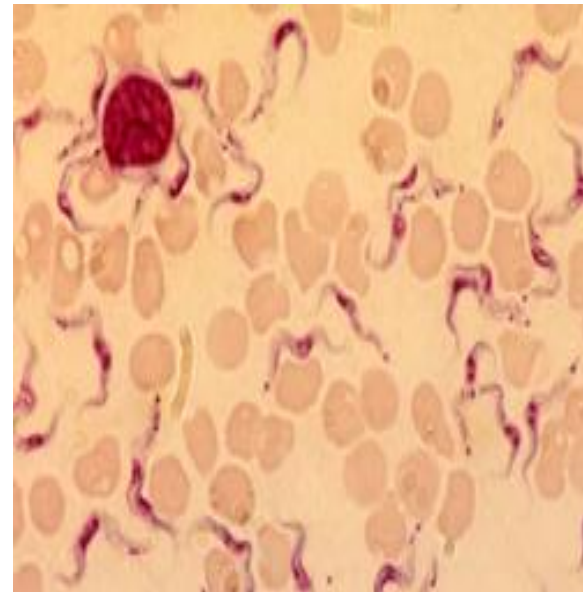
ام.د.حارث سعيد جعفر



**University Of Baghdad**  
**College of science**  
**Department of Biology**

# **Protozoa Parasitology Labs.**

## **Second Grade**



## Parasitic Protozoa

**1-Sarcodina (Amoebae):** *Entameba histolytica*, *Entameba coli*, *Endolimax nana*, *Iodameba butchlii*, *Entamoeba gingivalis*

**2- Ciliates:** *Balantidium coli*

**3-Mastigophora (Flagellates):** *Dientameba fragilis*, *Giardia lamblia*, *Trichomonas vaginalis*, *Trypanosoma brucei*, *T. cruzi*, *Leishmania donovani*, *L. tropica*

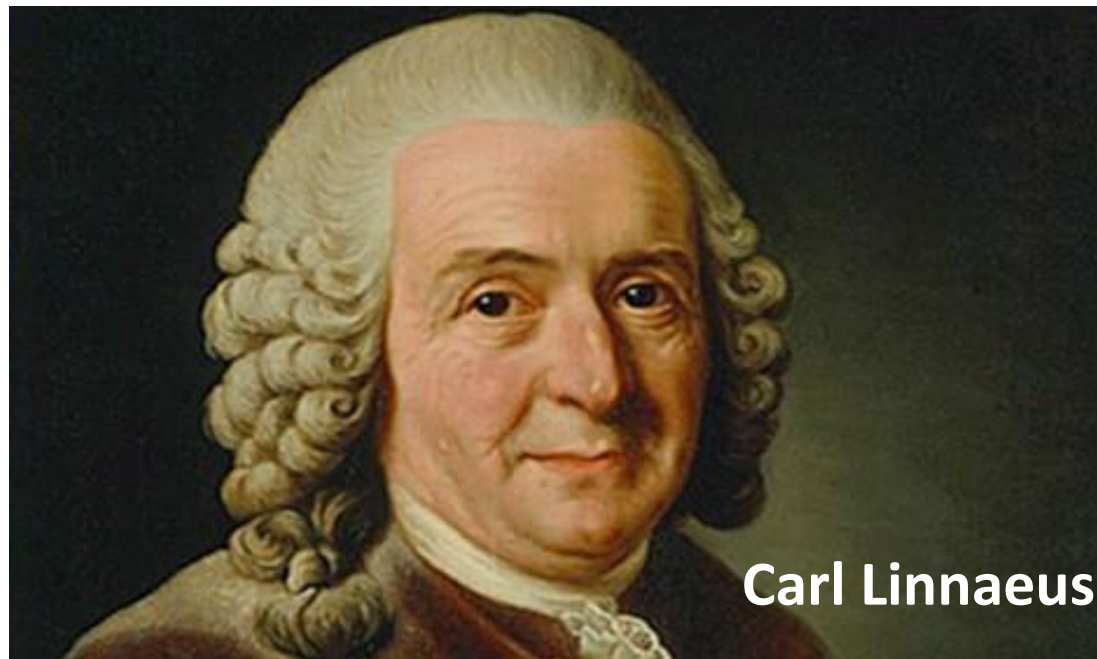
**4- Sporozoa:** *Plasmodium falciparum*, *Toxoplasma gondi*, *Cryptosporidium parvum*

# Lab 1

## General objectives of our Lab.

### 1- Scientific name and common name

- He is known as the father of modern taxonomy,  
Many of his writings were in Latin



Carl Linnaeus

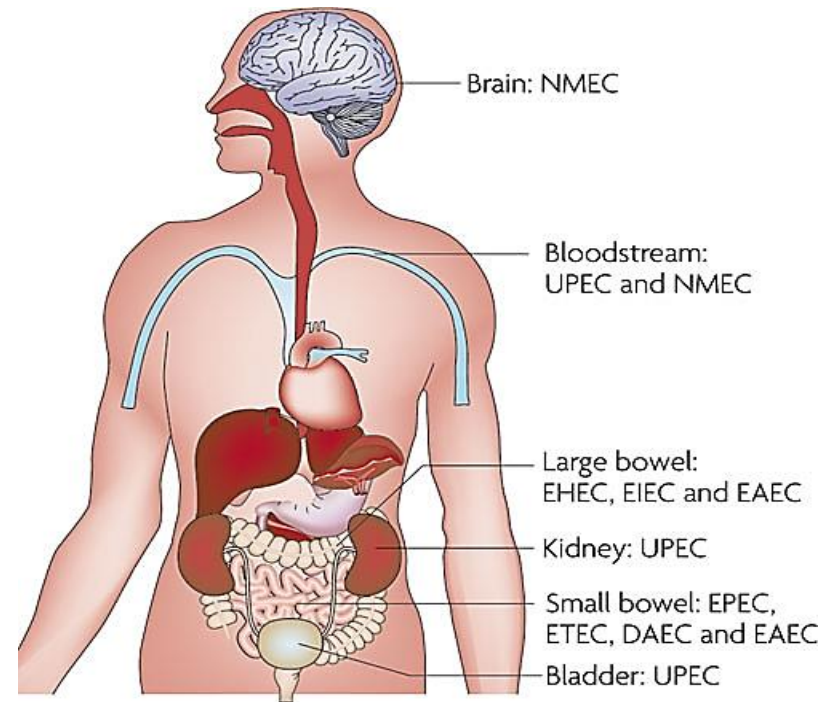
# General objectives of our Lab.

## 2- Identification:

Shape – Nucleus – Cyst and/or Trophozoite – locomotion- Vacuoles.

## 3- Pathogenicity:

- Location of parasite
- Name of Disease
- Symptoms



# Protozoa general characteristics:

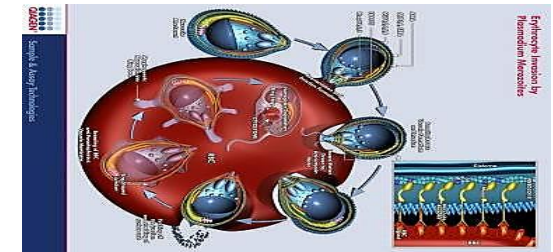
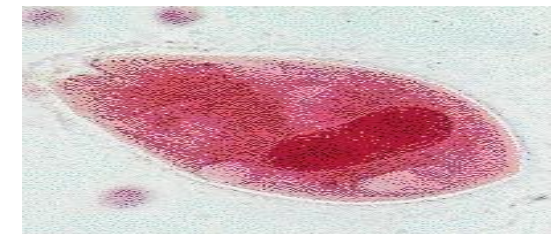
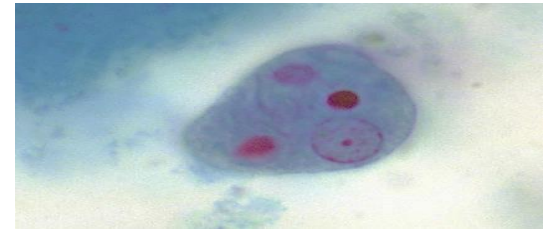
- 1- Unicellular eukaryotes.
- 2- Have organelles that often function similarly to organs and systems of multicellular organisms
- 3- locomotion: pseudopodia, flagella or cilia
- 4- Reproduction: Asexual (binary fission or multiple fission) Sexual (conjugation or syngamy).



# Taxonomy

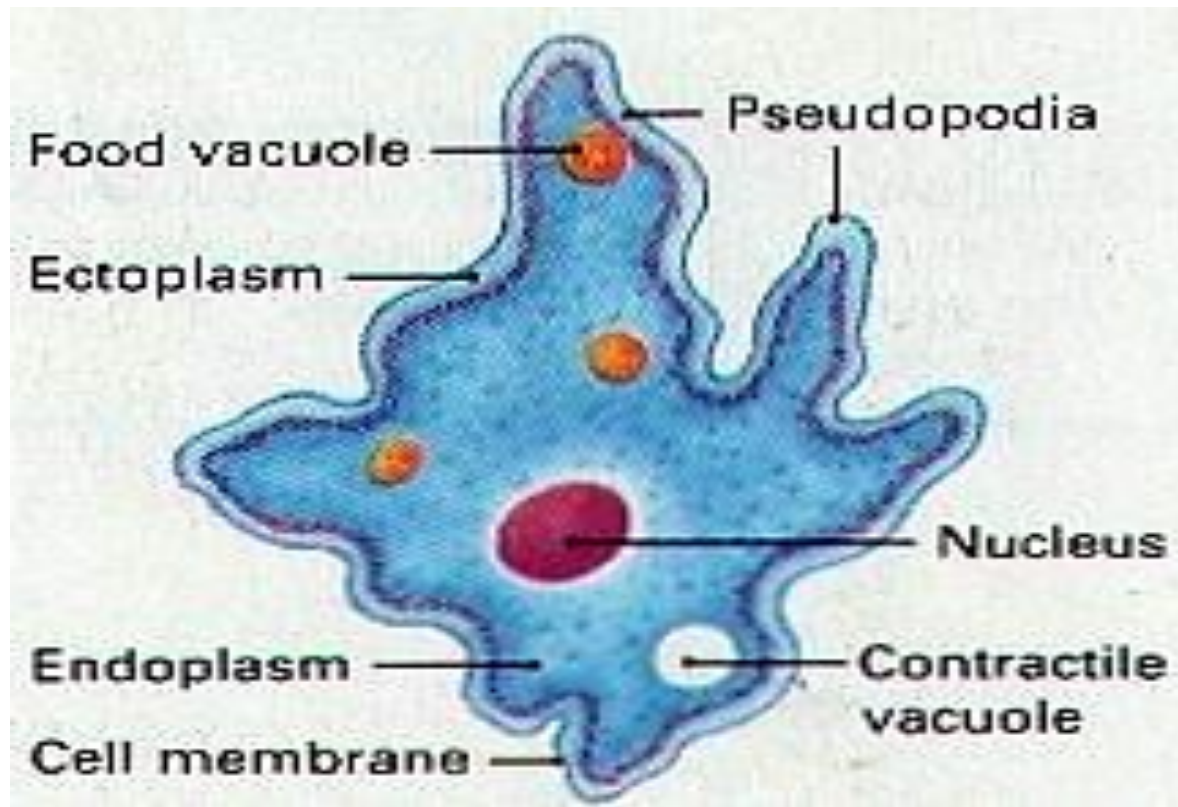
## Phylum: Protozoa

- Super class: Sarcodina
- Super class: Flagellata
- Super class: Ciliata
- Super class: Sporozoa



# Protozoa

## Super Class: Sarcodina

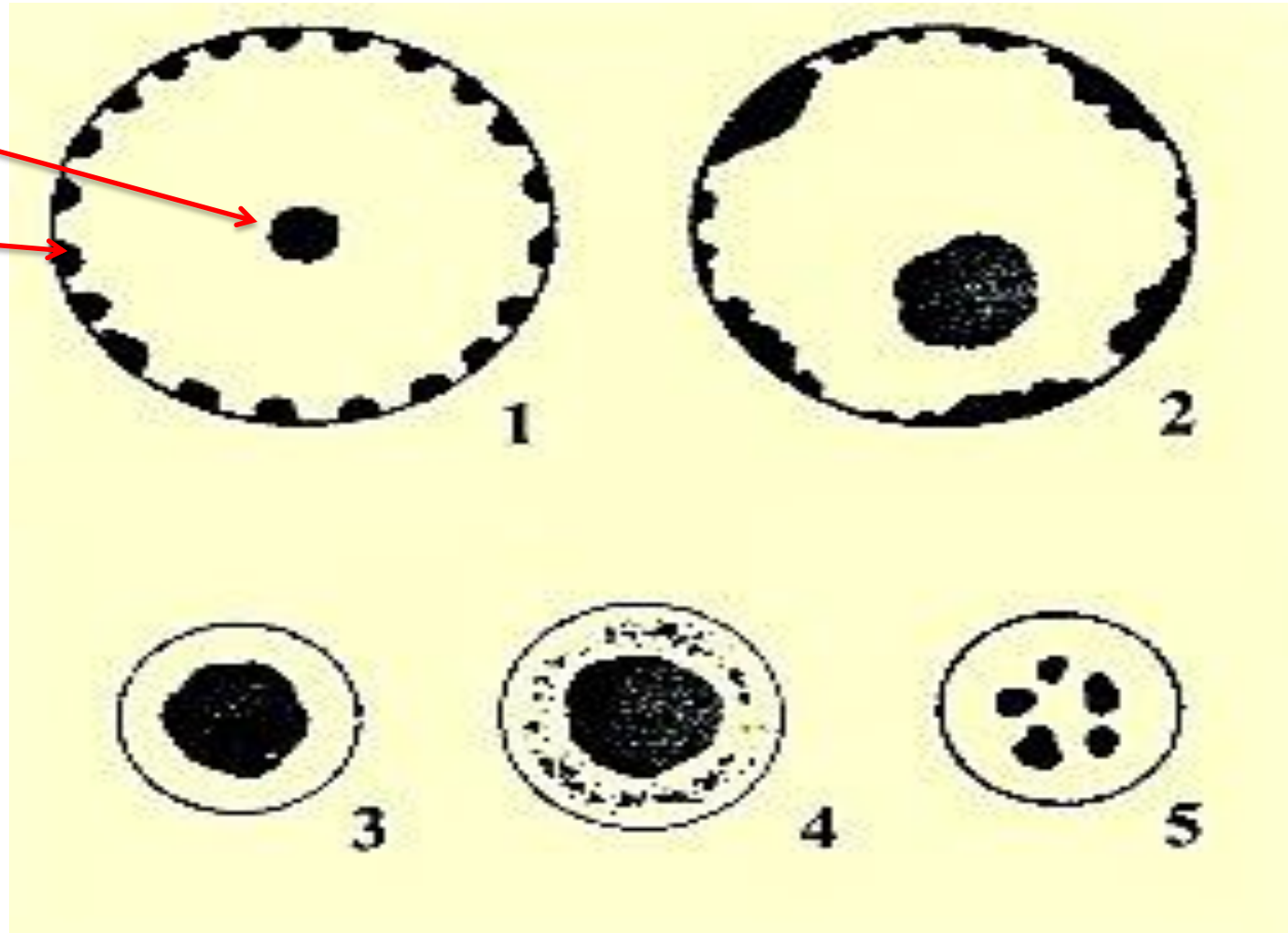




# Types of **nuclei** in Protozoa

Karyosome or endosome

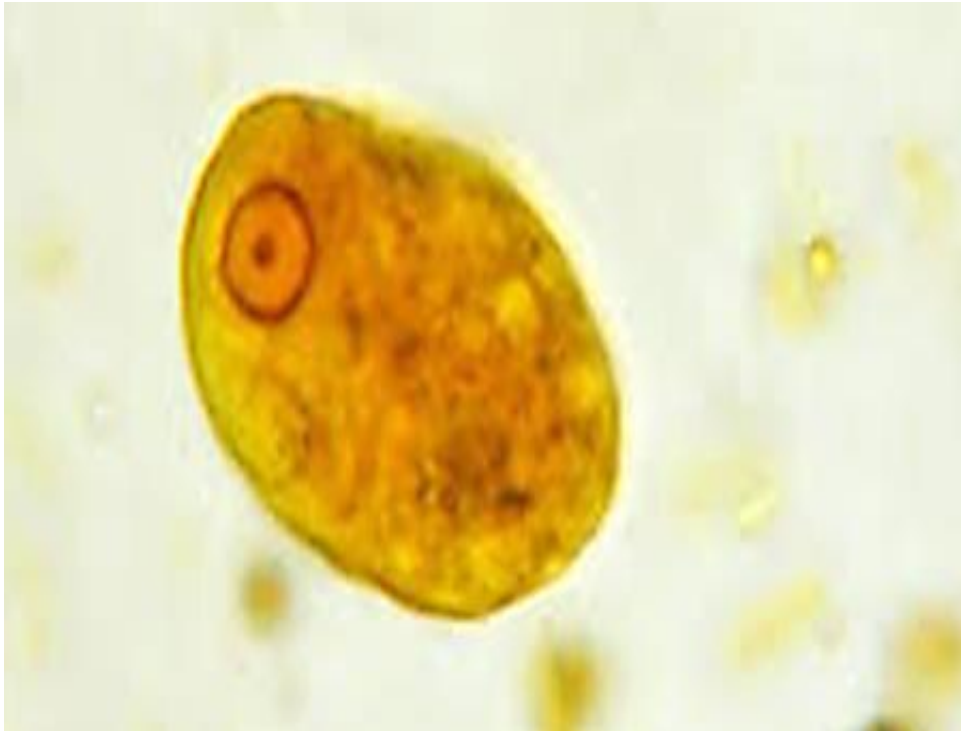
Chromatin granules



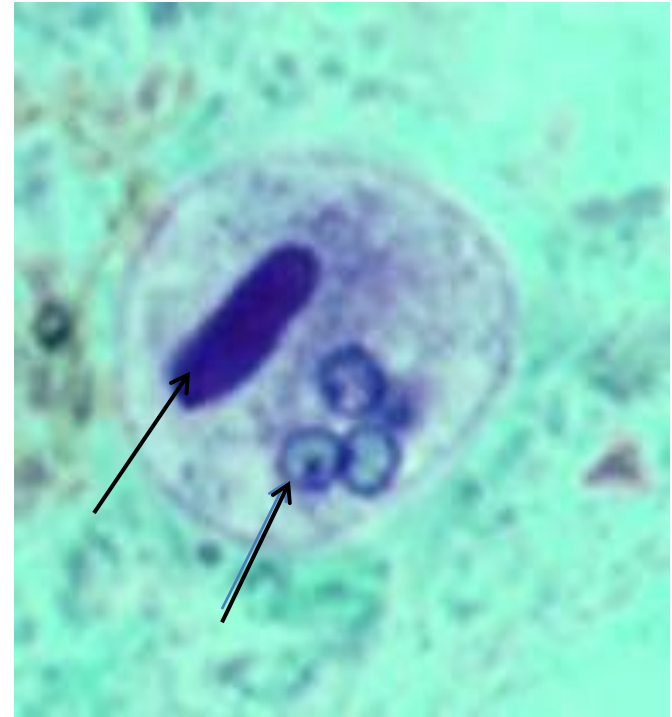
# Class Sarcodina- *Entamoeba histolytica*

- Trophozoite 10-60  $\mu\text{M}$  Cyst 10-30  $\mu\text{M}$  diameter.
- Found in the large intestine, cecum and terminal ileum.
- Endoplasm / ectoplasm.
- **Endosome of nucleus is small and centric, peripheral chromatin is identical.**
- Pseudopodia are thin.
- Food vacuoles usually contain RBC.
- Cysts is the infective stage and has **4 nuclei, chromatoid bodies are thick.**
- Pathogenic, causes amebic ulcer/ amoebiasis/ amoebic dysentery -blood in stool, complications- liver abscess.

# *Entamoeba histolytica*



Trophozoite of *E. histolytica*



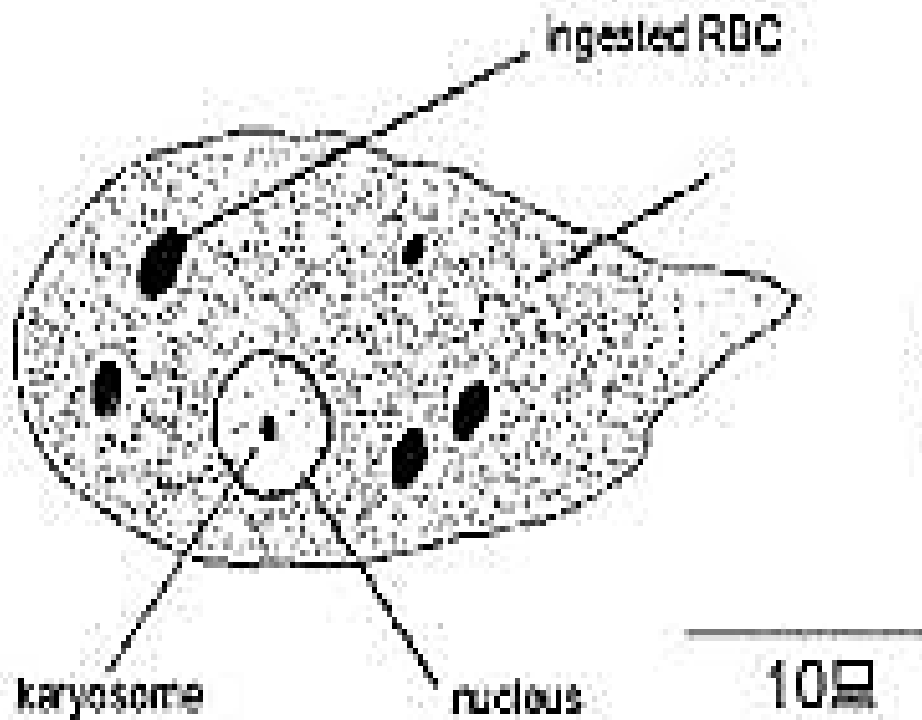
Cyst of *E. histolytica*

A:Nuclei

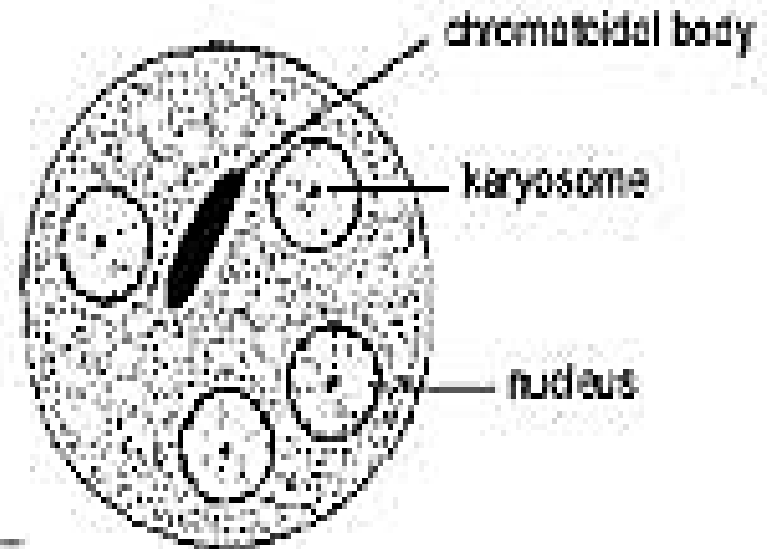
B:Chromatoid bar

# *Entamoeba histolytica*

Trophozoite

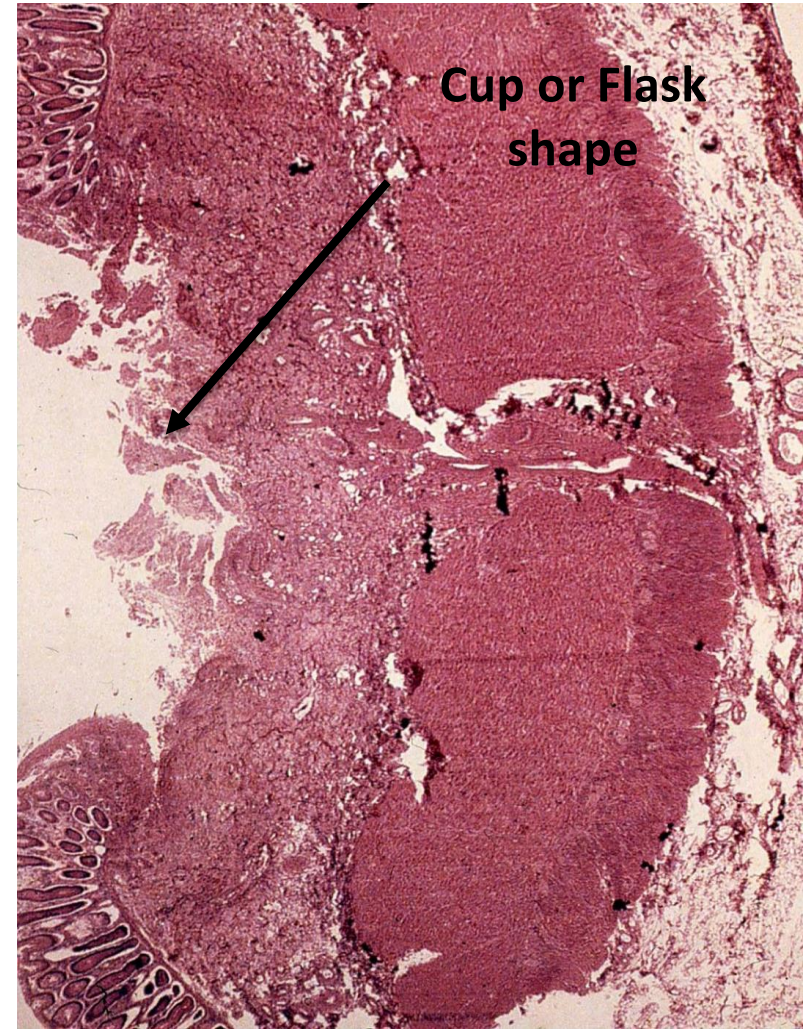
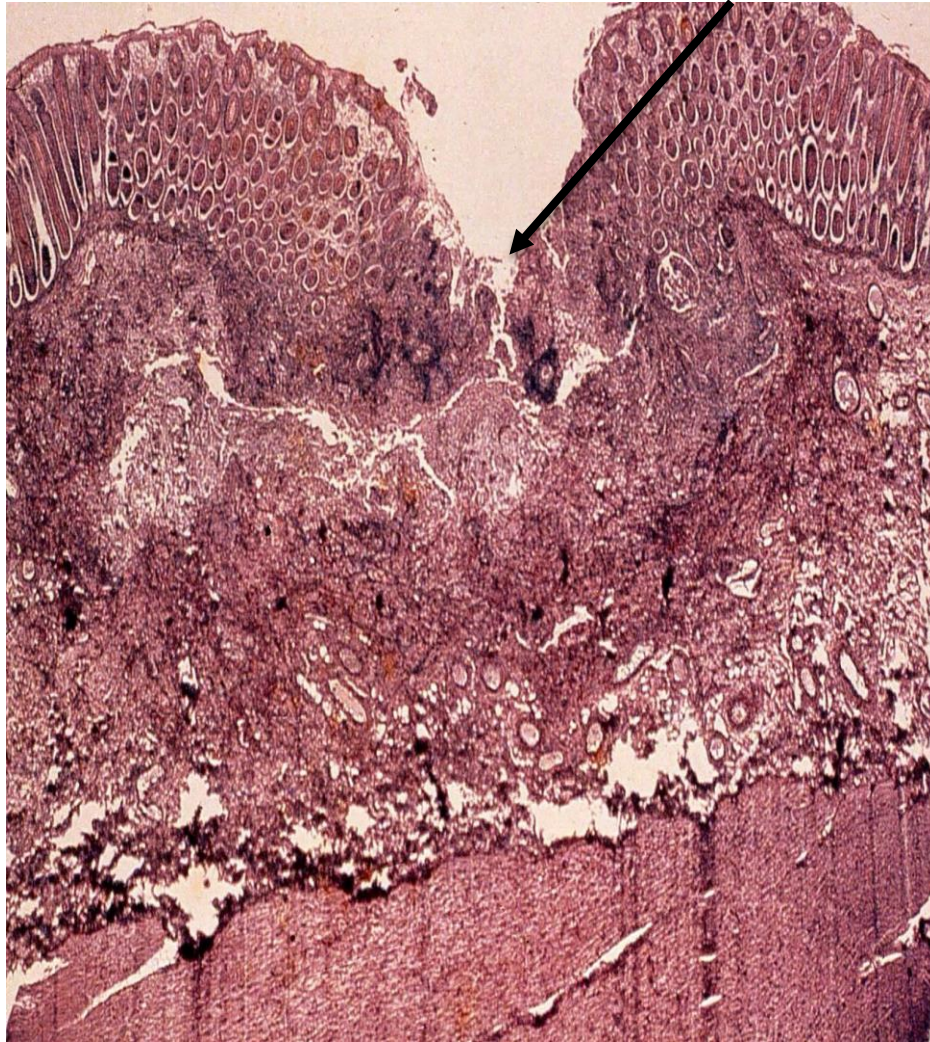


Cyst





# Amoebic ulcer caused by *E. histolytica*



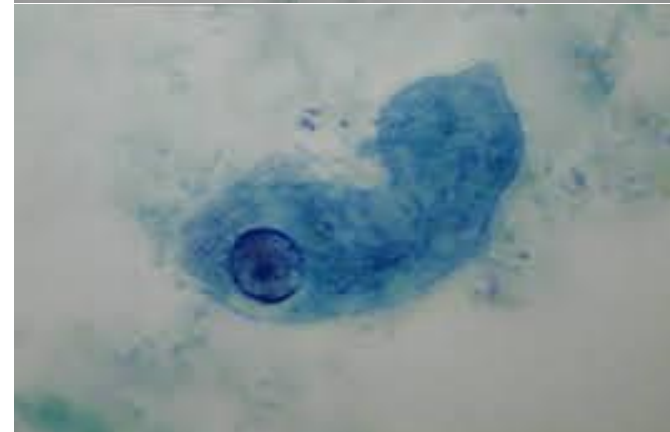
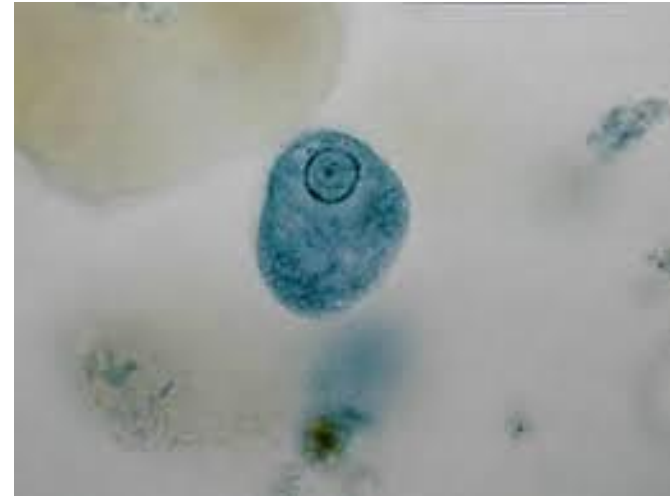
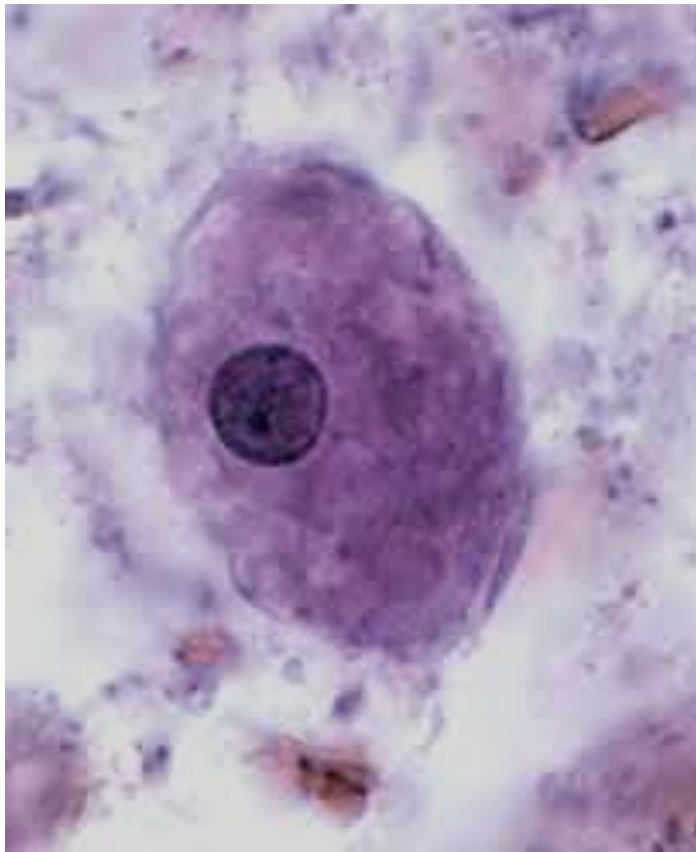
# Class Sarcodina- *Entamoeba coli*

- Trophozoite (15-50  $\mu$ M diameter) and Cyst.
- Found in the large intestine, colon.
- Endoplasm = ectoplasm.
- **Endosome of nucleus is acentric, peripheral chromatin is non-identical.**
- Pseudopodia usually thick.
- Food vacuoles **do not contain RBC.**
- Cysts has **8 nuclei, chromatoid bodies are thin.**
- Non-pathogenic, commensal.



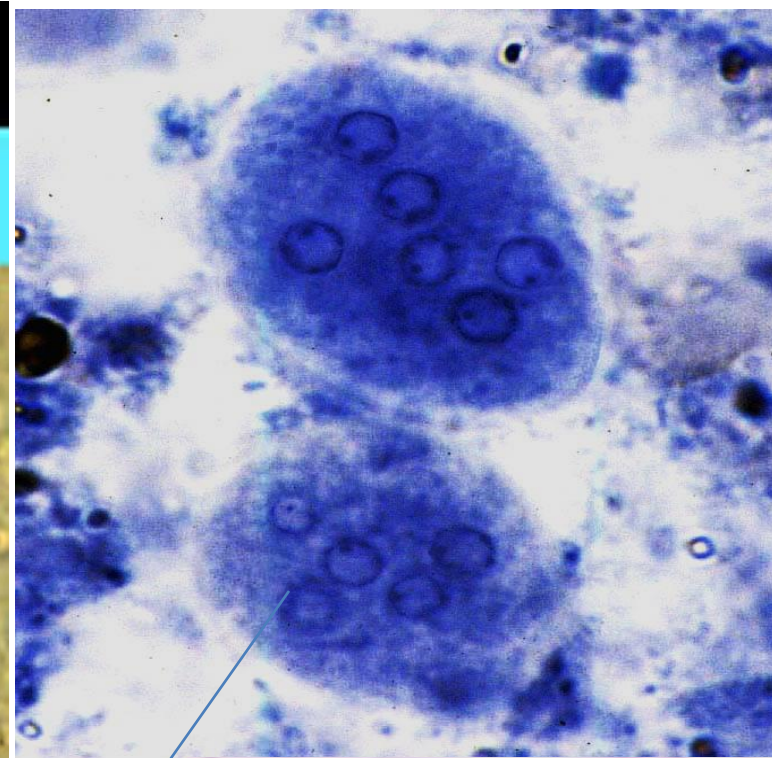
# Class Sarcodina- *Entamoeba coli*

**Endosome of nucleus is acentric, peripheral  
chromatin is non-identical**



# Entamoeba Coli

## Cyst Morphology



nuclei

Chromatoid bar

*Entameoba coli cyst*



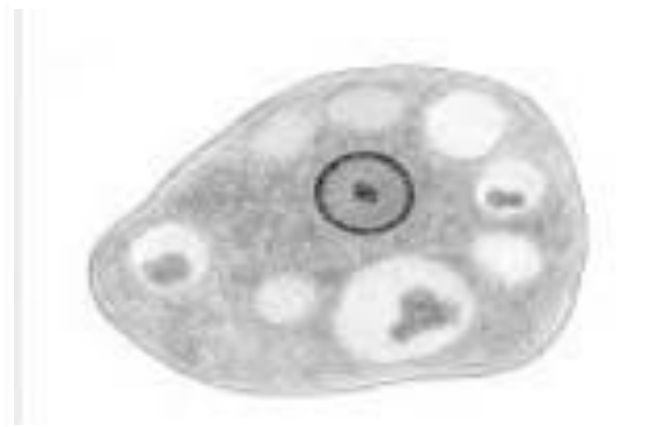
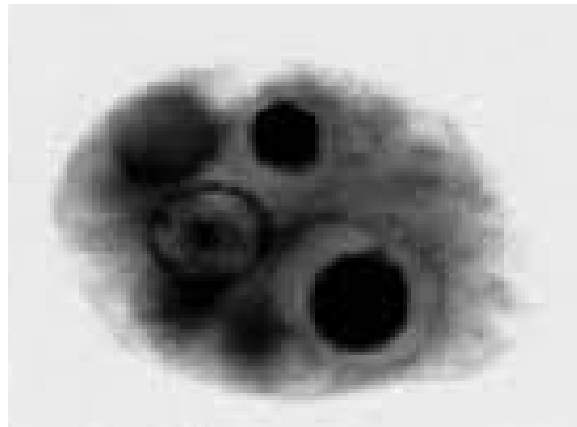
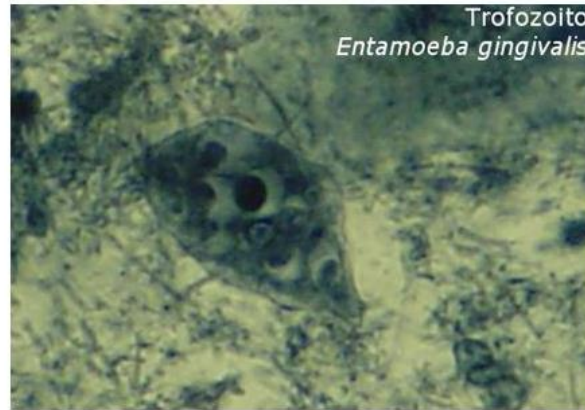
# Lab 2

## Class Sarcodina- *Entamoeba gingivalis*

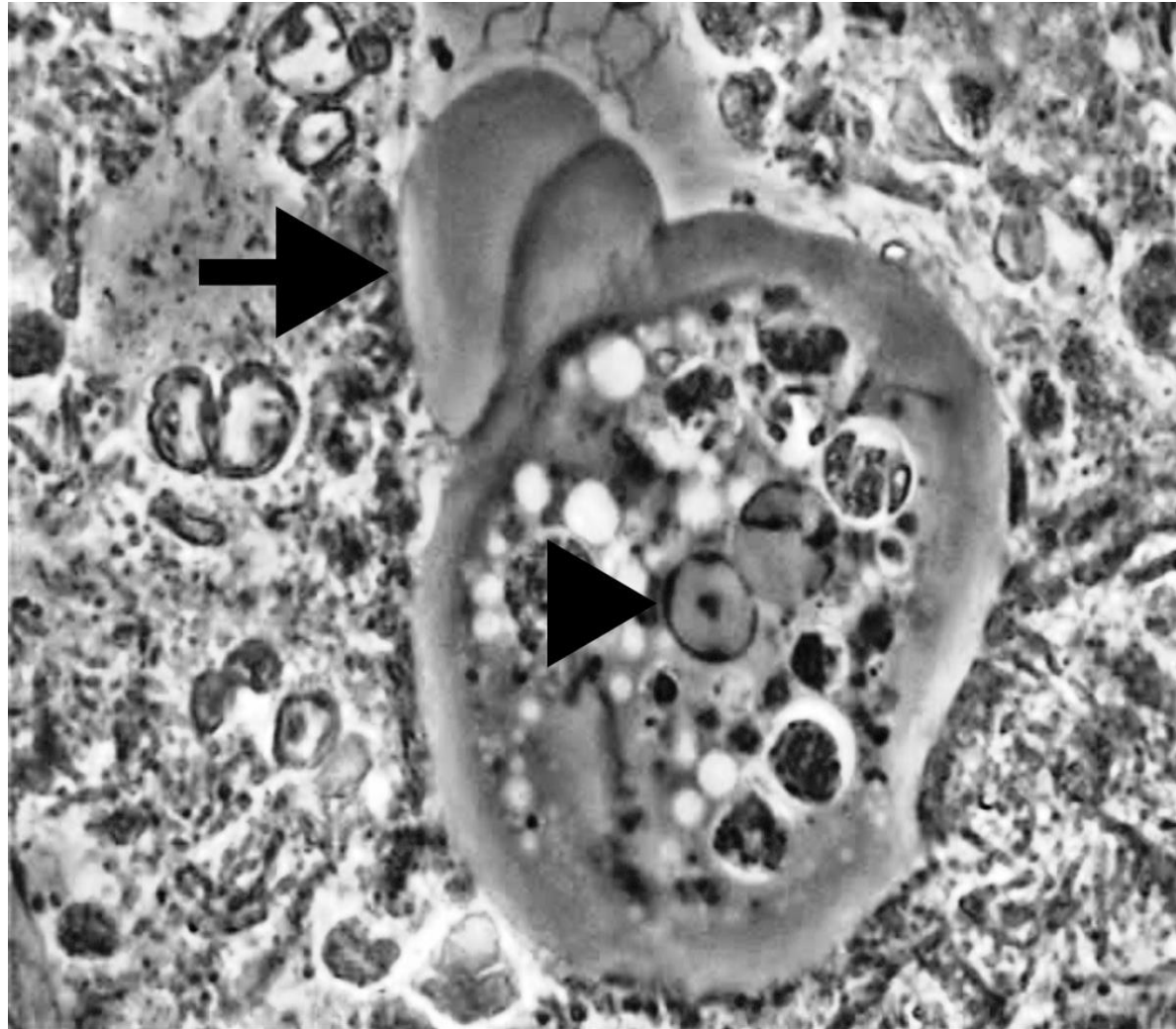
- **Only** trophozoite, 10-20  $\mu\text{M}$  diameter.
- Found in mouth, in teeth roots and gum, it is found with 95% of gum diseases.
- **Endosome is large, centric or acentric, peripheral chromatin is non-identical.**
- Highly vacuolated.
- Non-pathogenic.

# Class Sarcodina- *Entamoeba gingivalis*

**Endosome is large, centric or acentric,  
peripheral chromatin is non-identical**







*Entamoeba gingivalis*

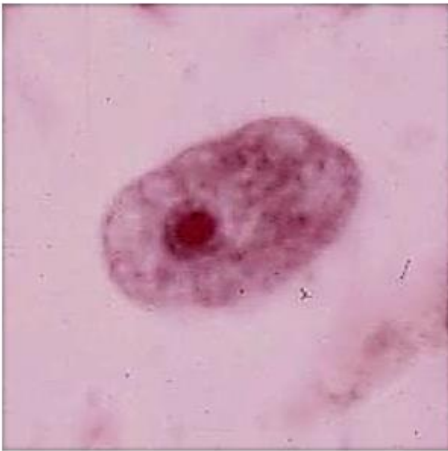
# Class Sarcodina- *Iodamoeba butschlii*

- Trophozoite 8-20  $\mu\text{M}$ , cyst 5-20  $\mu\text{M}$  diameter.
- Found in large intestine.
- Endoplasm = ectoplasm.
- **Large endosome surrounded by chromatic globules.**
- Non-pathogenic (commensal)
- Cyst has only one nucleus.

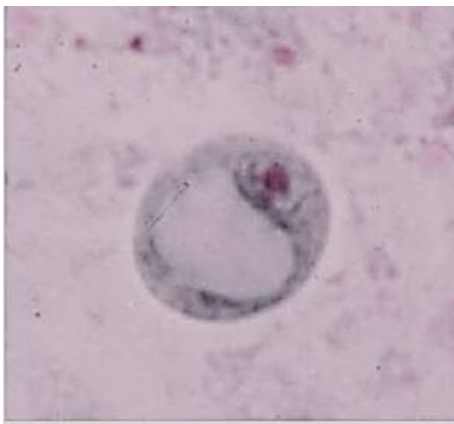


# Class Sarcodina- *Iodamoeba butschlii*

Large endosome surrounded by chromatic globules, Cyst has only one nucleus



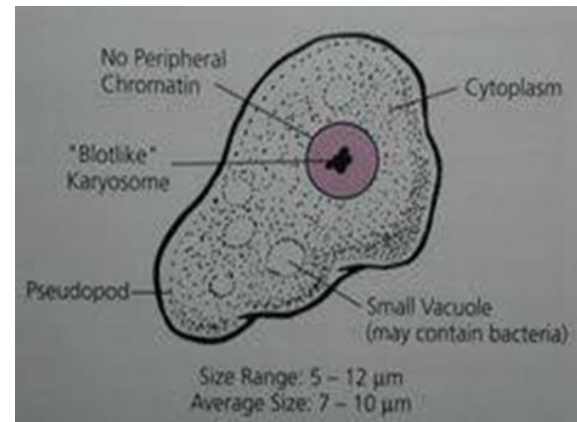
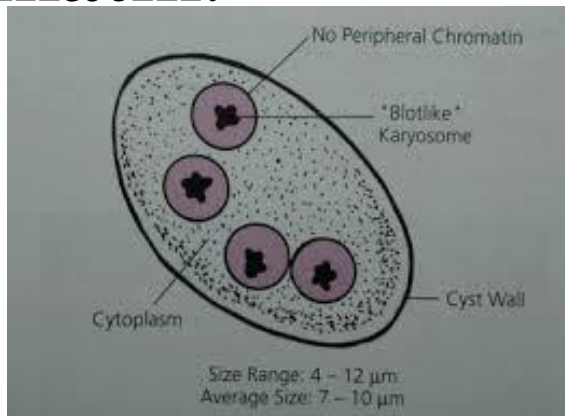
- **trophozoites**
  - 12-15  $\mu\text{m}$
- **nuclear structure**
  - no peripheral chromatin
  - large karyosome



- **cysts**
  - 10-12  $\mu\text{m}$
  - 1 nucleus
  - glycogen vacuole

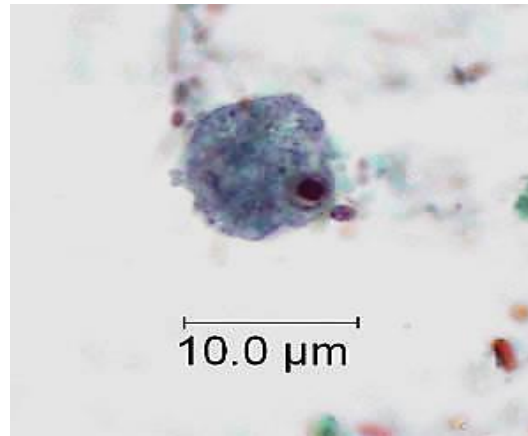
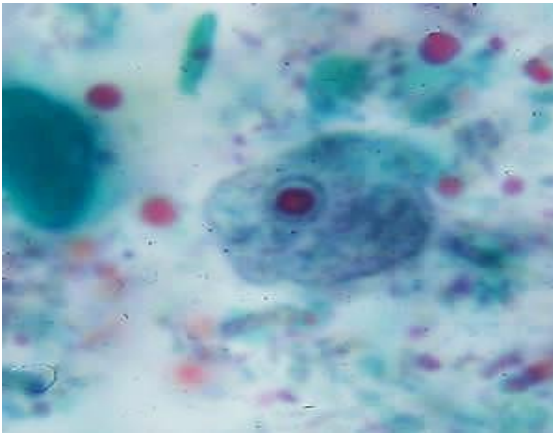
# Class Sarcodina- *Endoilemax nana*

- Very small – Trophozoite 6-12  $\mu\text{M}$
- Cyst 5-8  $\mu\text{M}$
- Live in large intestine, non-pathogenic
- Ectoplasm / Endoplasm
- **Large endosome with no peripheral chromatin.**

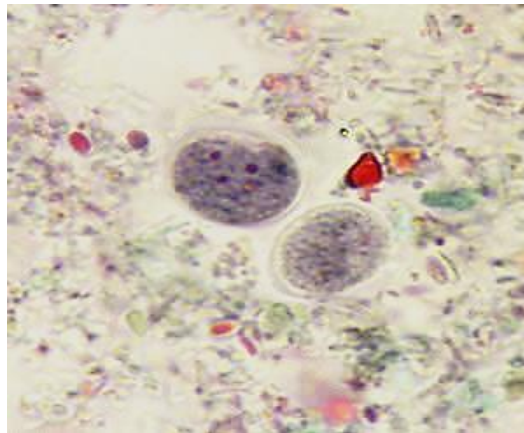


# Class Sarcodina- *Endolemax nana*

Large endosome with no peripheral chromatin



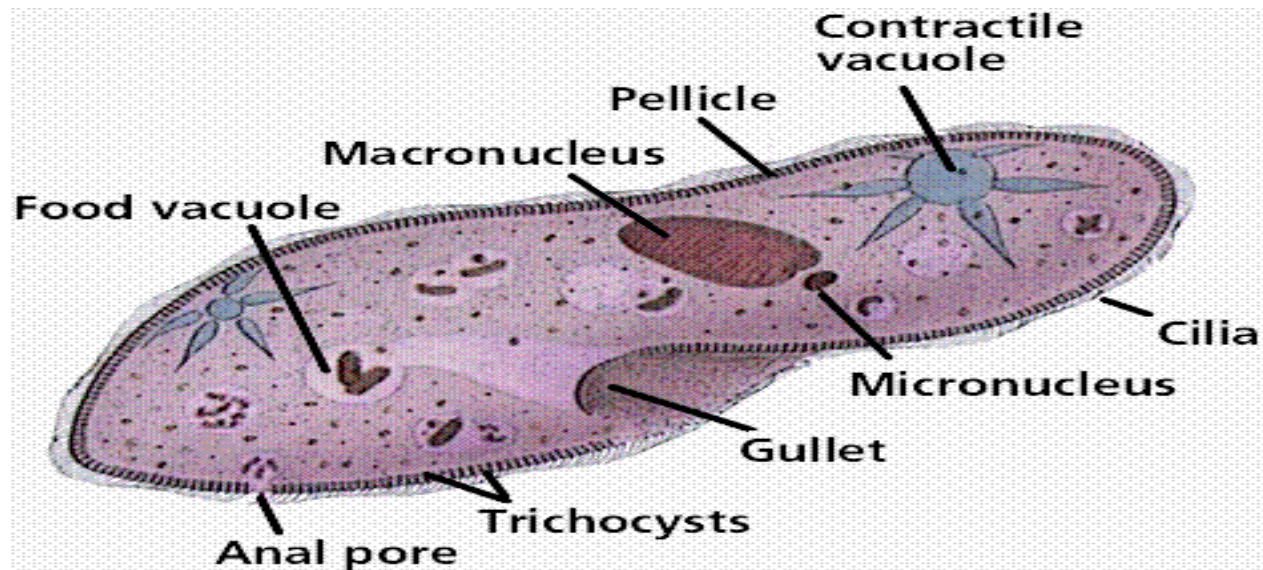
← Trophozoite



← Cyst – 4 nuclei

(الكروماتين غير  
موجود)

# 2- SUPERCLASS: Ciliata (CILIOPHORA)



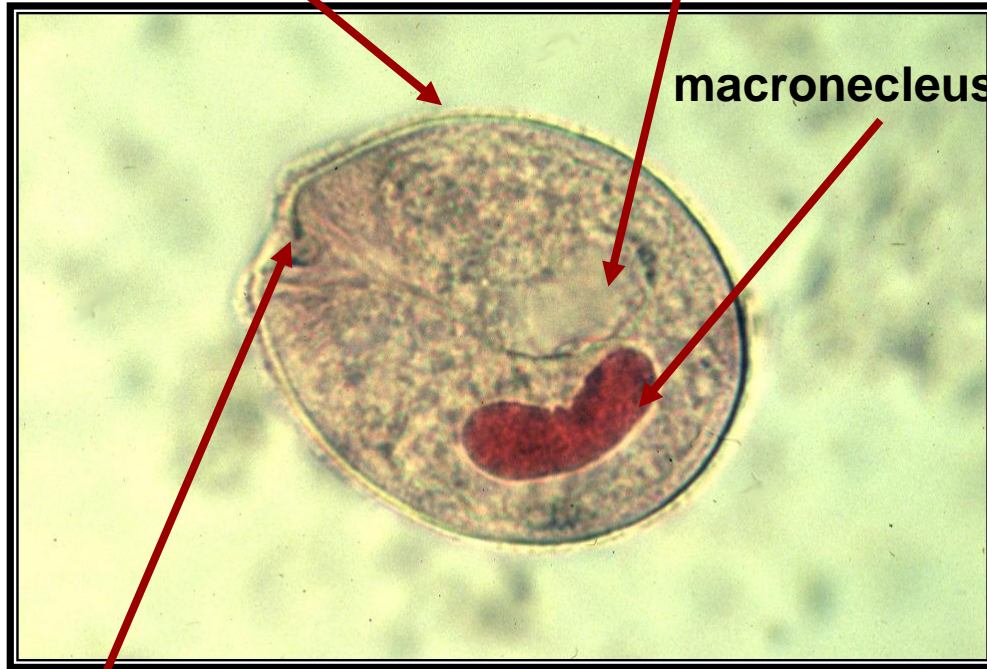
# *Balantidium coli*

- **Location:** Ileum, colon and rectum
- **Pathogenic:** Balantidiasis
- **Two forms:** Trophozoite + Cyst

**Cilia**

**Contractile vacuole**

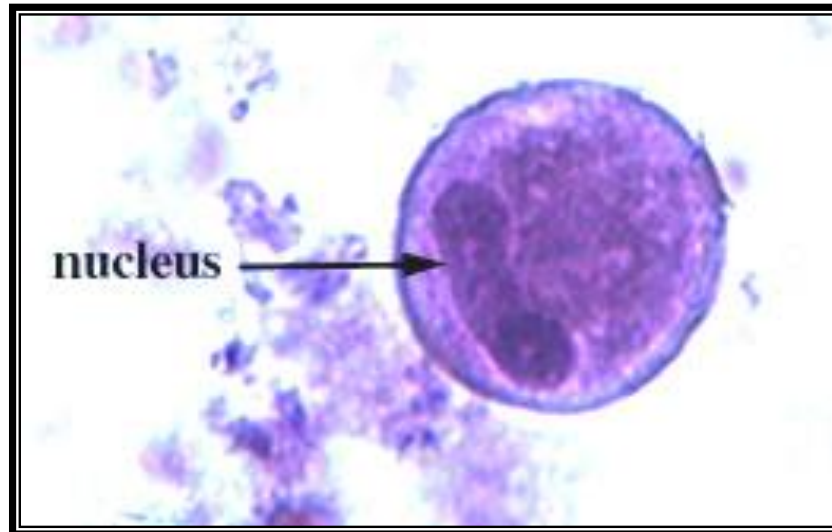
**macronucleus**



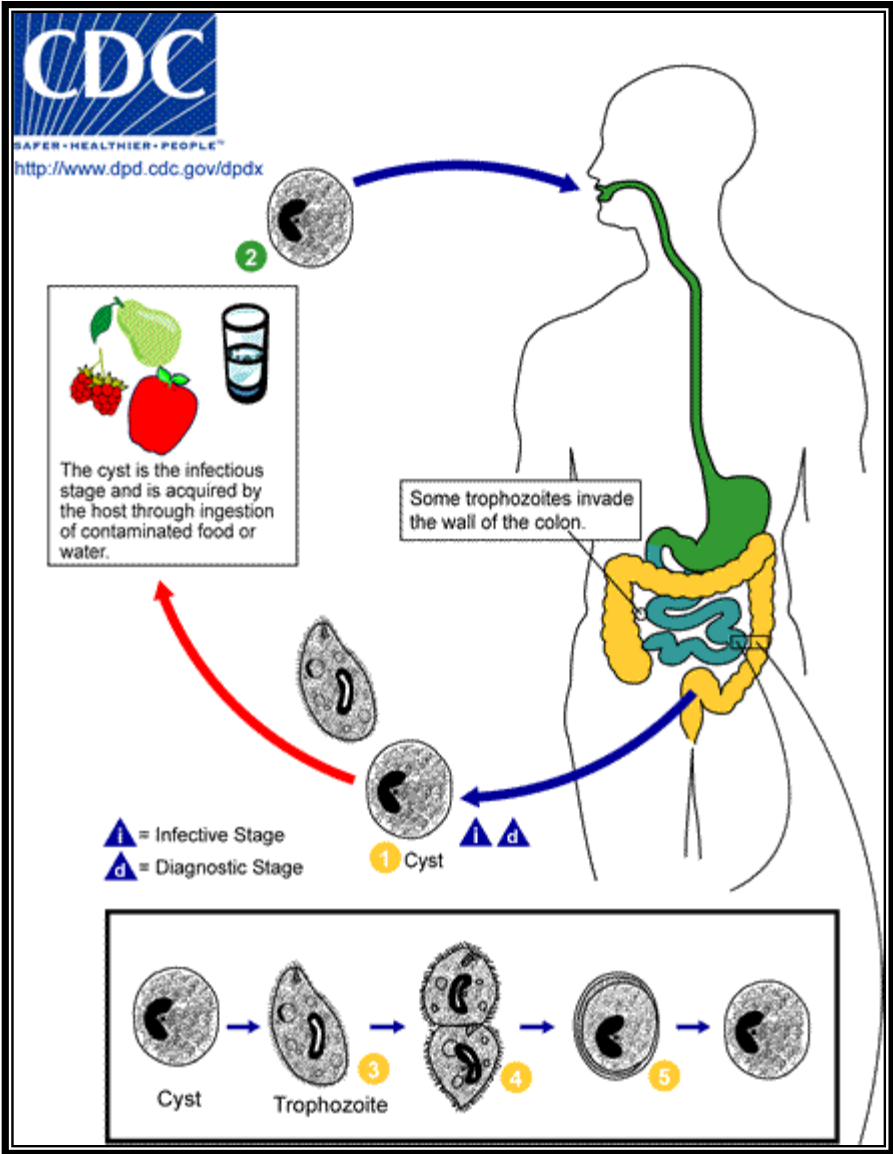
## Trophozoite

- Oval shape
- Course cilia
- Contractile vacuoles
- Kidney shape macronucleous

**Cytostome**







Life cycle of *Balantidium coli*

# Lab 3

## 3- SUPERCLASS: (Flagellata)

### MASTIGOPHORA

Include all protozoa that have one flagellum or more in trophozoite stage

```
graph TD; A[Flagellata] --> B[HAEMOFLAGELATES  
BLOOD & TISSUE FLAGELLATES]; A --> C[INTESTINAL FLAGELATES  
& Genital tract flagellates]
```

## Flagellata

HAEMOFLAGELATES

BLOOD & TISSUE FLAGELLATES

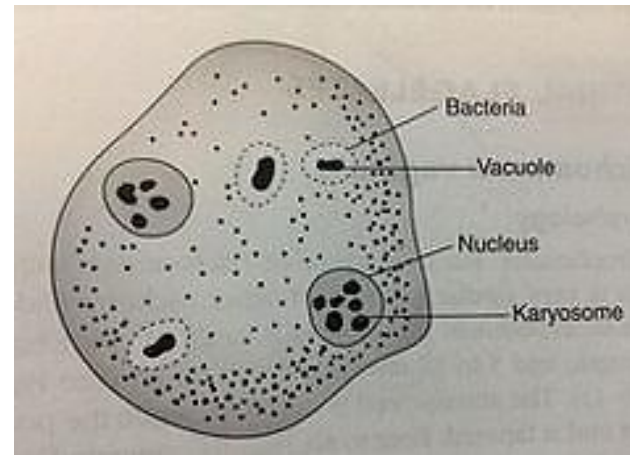
INTESTINAL FLAGELATES

& Genital tract flagellates

# INTESTINAL FLAGELATES

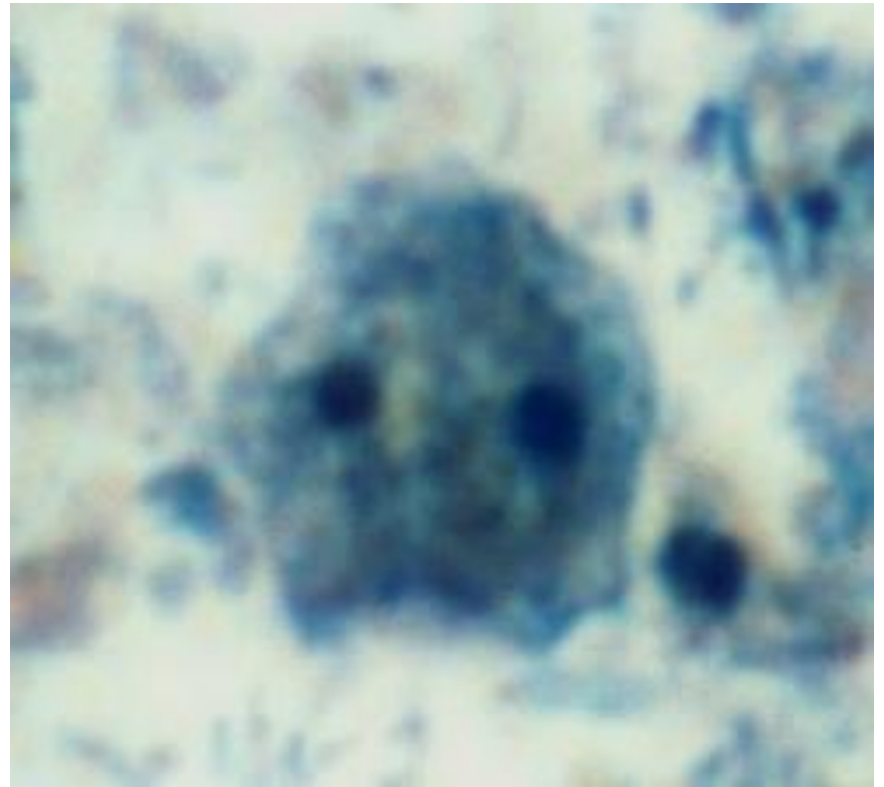
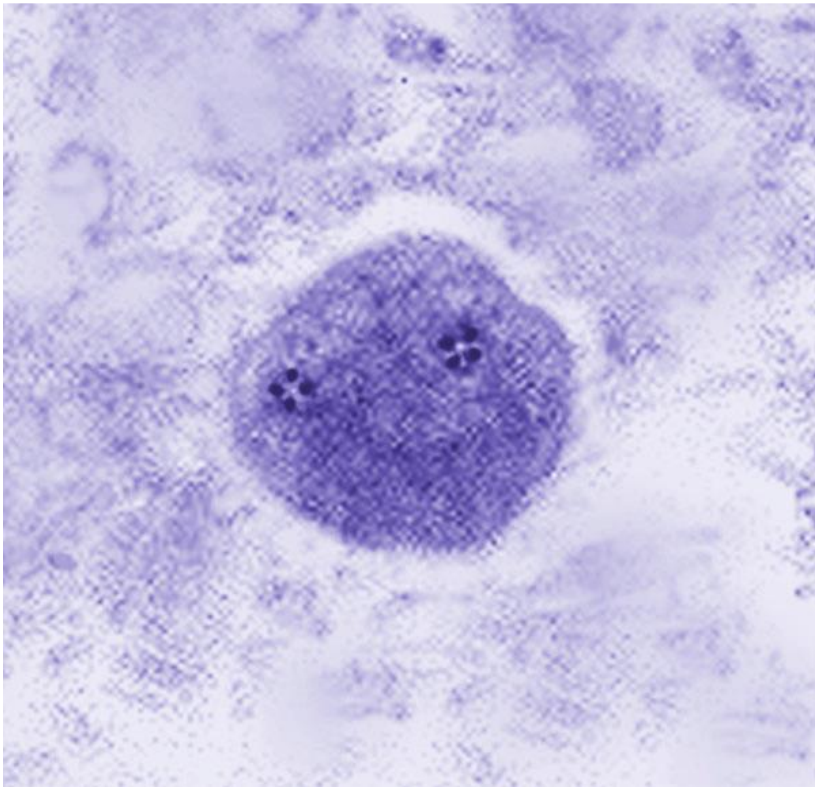
## *Dientamoeba fragilis*

- Trophozoite 5-12  $\mu\text{M}$
- Found in large intestine
- Ectoplasm / endoplasm.
- **Endosome consist of aggregated chromatin granules.**
- **60% has 2 nuclei.**



# *Dientamoeba fragilis*

**Endosome consist of aggregated chromatin granules.  
60% has 2 nuclei.**

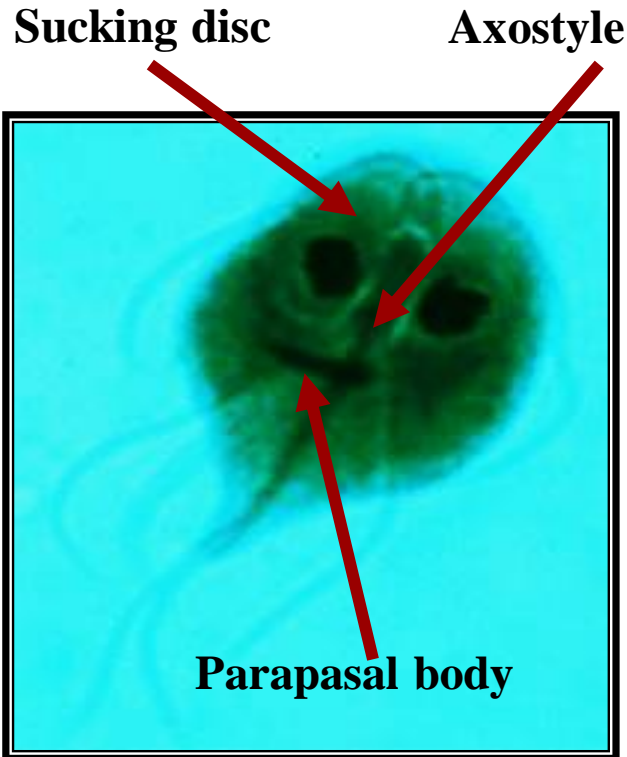


# INTESTINAL FLAGELATES

## *Giardia lamblia*

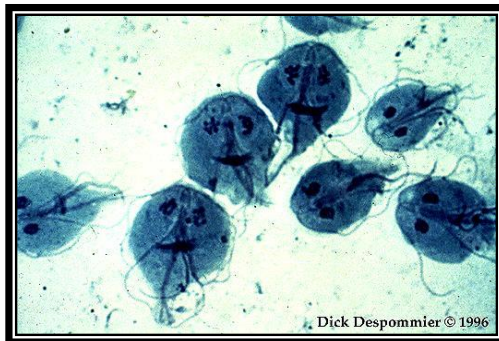
- **Location:** Small intestine (Duodenum)
- **Pathogenic:** Giardiasis or lambiasis
- **Two forms:** Trophozoite + Cyst

# Trophozoite of *Giardia lamblia*



## Trophozoite

- Bilaterally symmetrical
- Pear shape
- Broad round anterior and tapering posterior. Convex dorsal surface and concave sucking disc. Flat ventral surface
- Two nuclei with large central karyosomes
- Two axostyles, two parabasal bodies
- Four pairs of flagella





# Cyst of *Giardia lamblia*

## Cyst

- Oval in shape
- They have smooth well defined wall
- Contains four nuclei
- Contain parabasal bodies and flagellates



# Genital tract flagellates

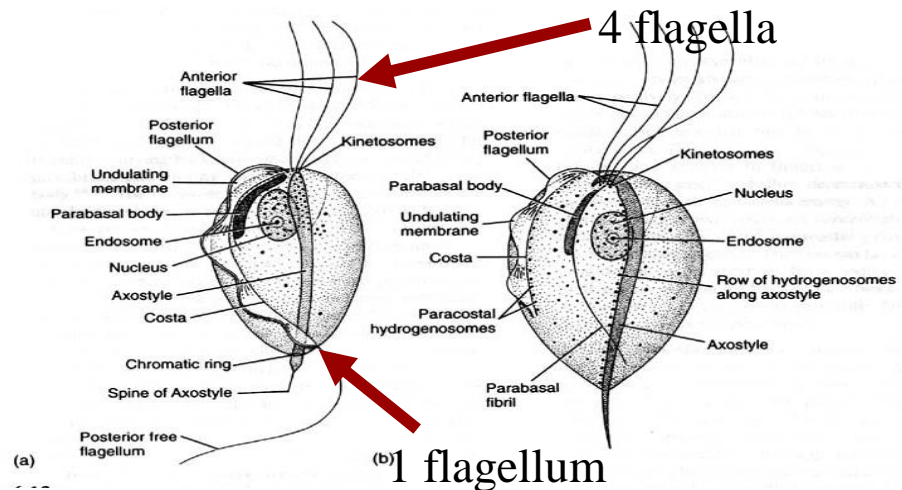
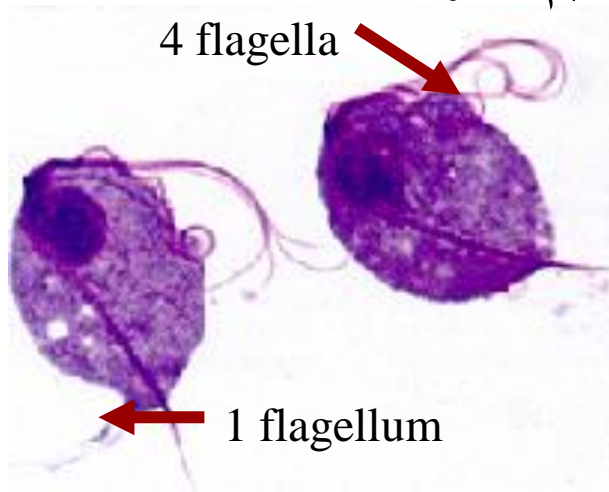
## Trophozoit of *Trichomonas*

**Location:** Vagina, Urethra

**Pathogenic:** Vaginitis, Urithritis

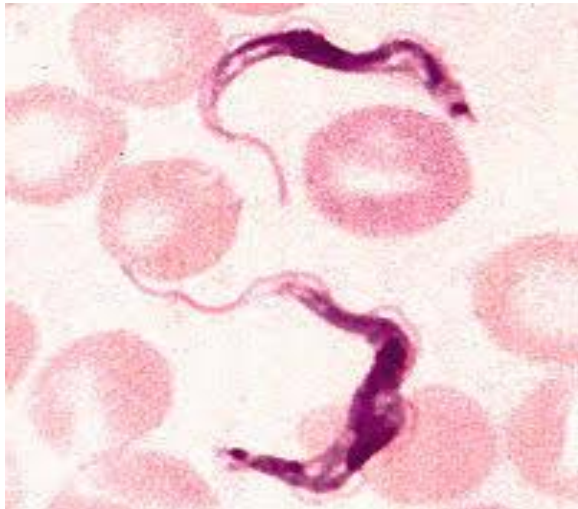
**One form:** Trophozoite

\* يتم انتقال العدوى بواسطة **الدور المغتذي** في دور السكون quiescent form الذي يتكون بتكور الدور المغتذي الذي يصبح عديم الحركة

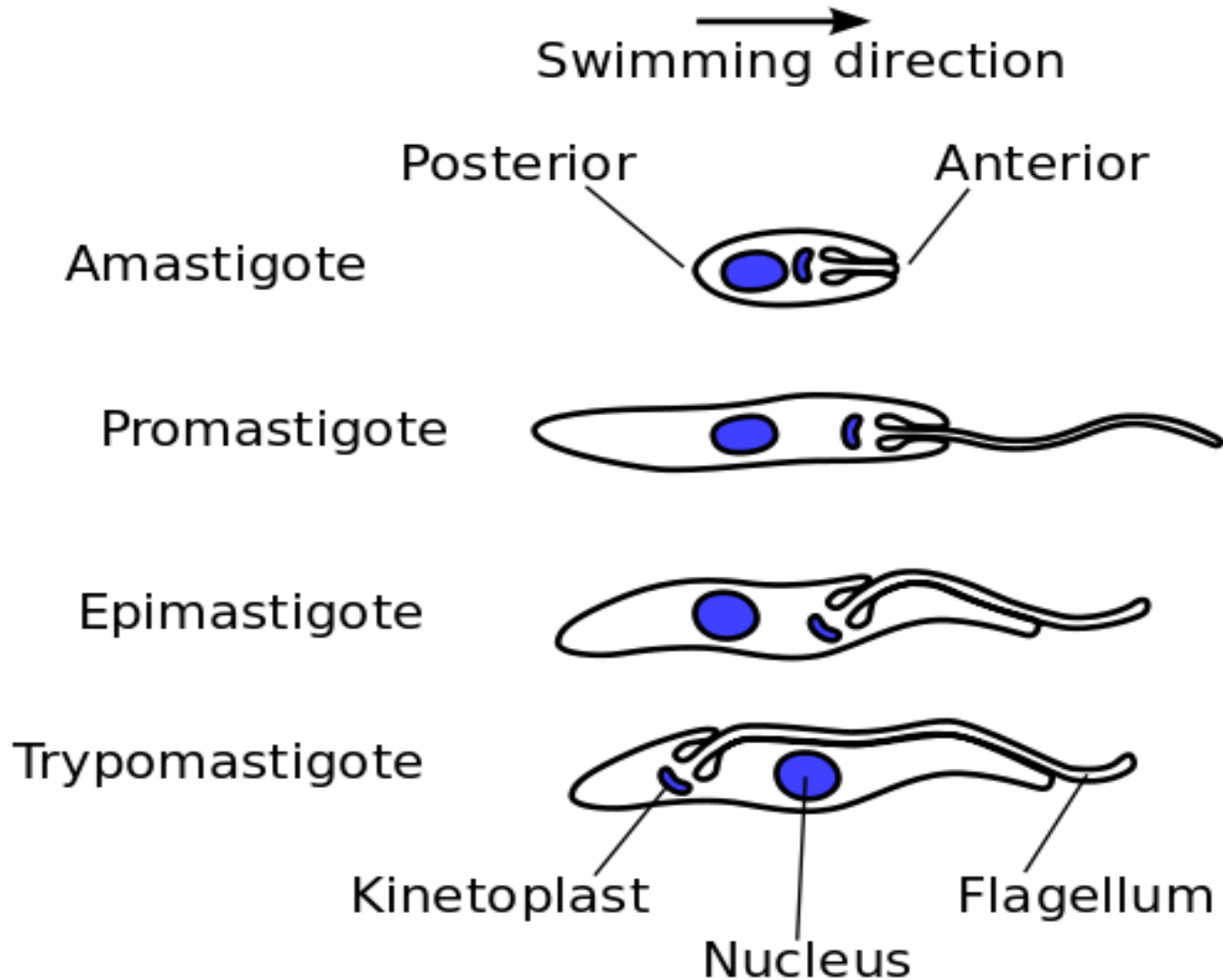


# Lab 4

## Blood and tissue flagellates or Haemoflagellates



# Haemoflagellates Forms



# ***Leishmania tropica***

**Location:-** Cutaneous



**Pathogenic:-** Baghdad boil or oriental sore

**Form:-** Amastigote + Promastigote

**Vector:-** *Phlebotomus* (Sand fly)

# ***Leishmania donovani***

**Location:-** visceral

**Pathogenic:-** Dum – Dum fever or kalazar

**Form:-** Amastigote + Promastigote

**Vector:-** *Phlebotomus*



# *Leishmania braziliensis*

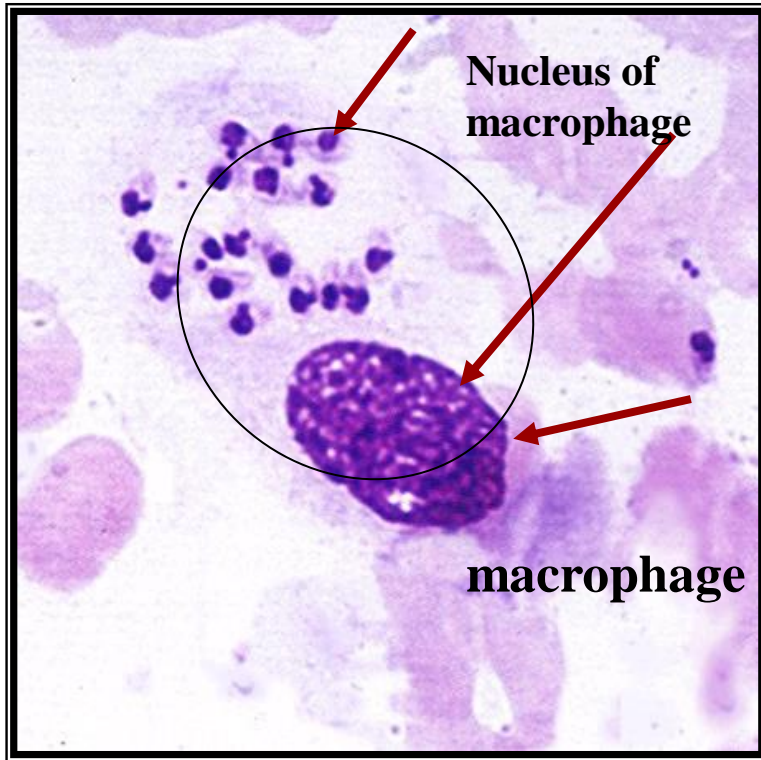
**Location:-** mucocutaneous

**Pathogenic:-** Uta, Chiclero ulcer, Espundia

**Forms:-** Amastigote + Promastigote

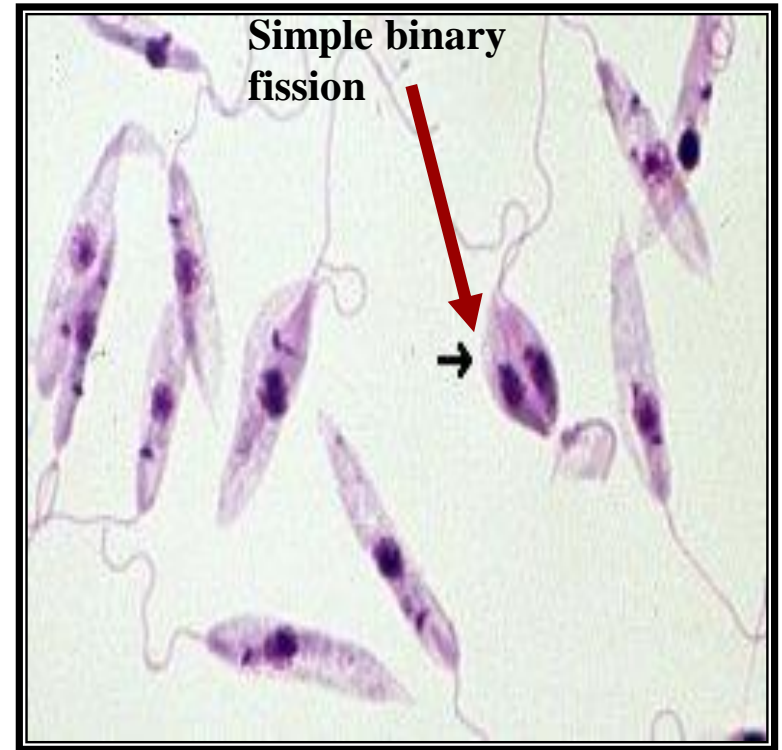
**Vector:-** *Lutzomyia*

## ***Amastigote of Leishmania***



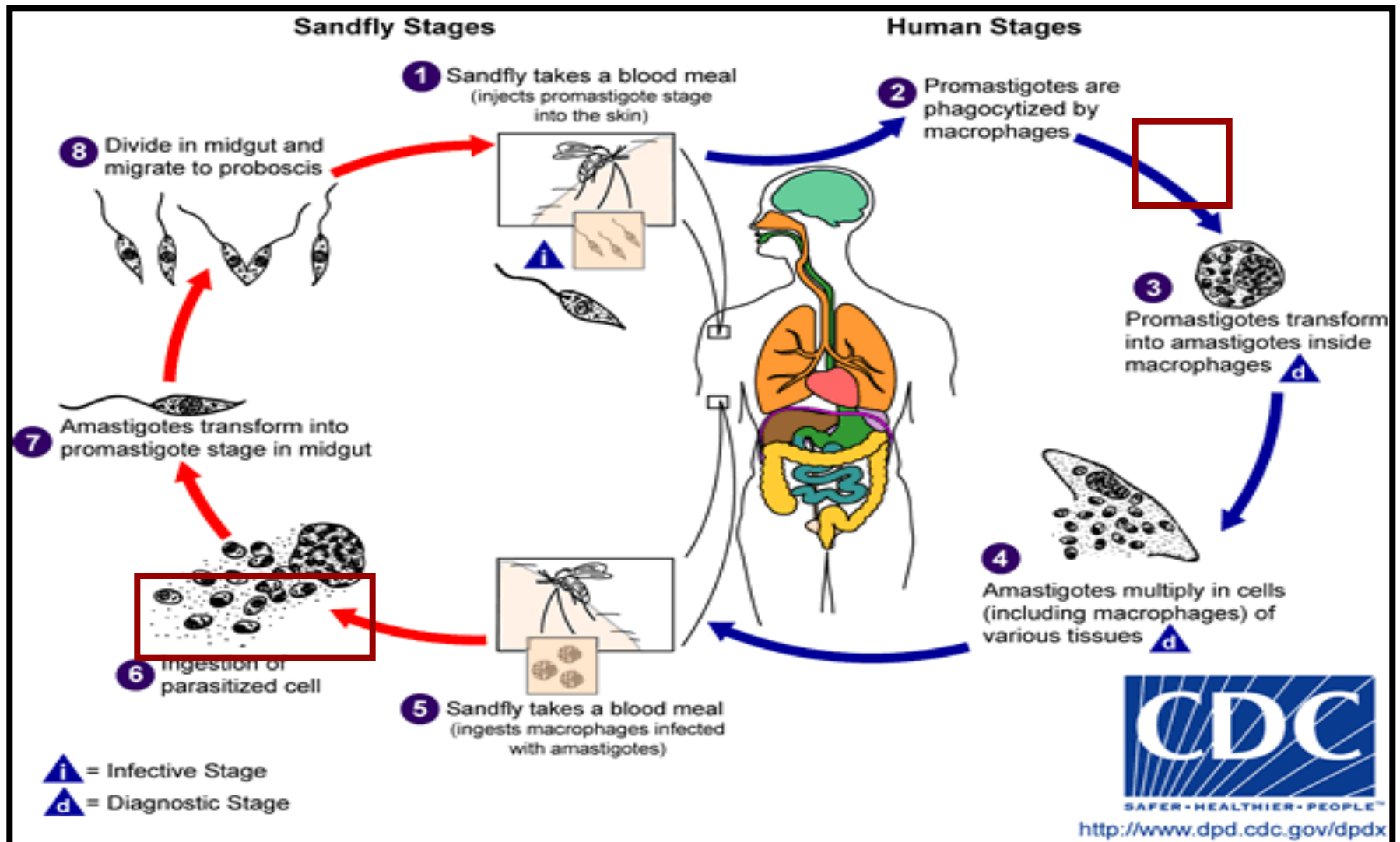
**In monocyte or phagocytic cells**

## ***Leishmania* promastigote**

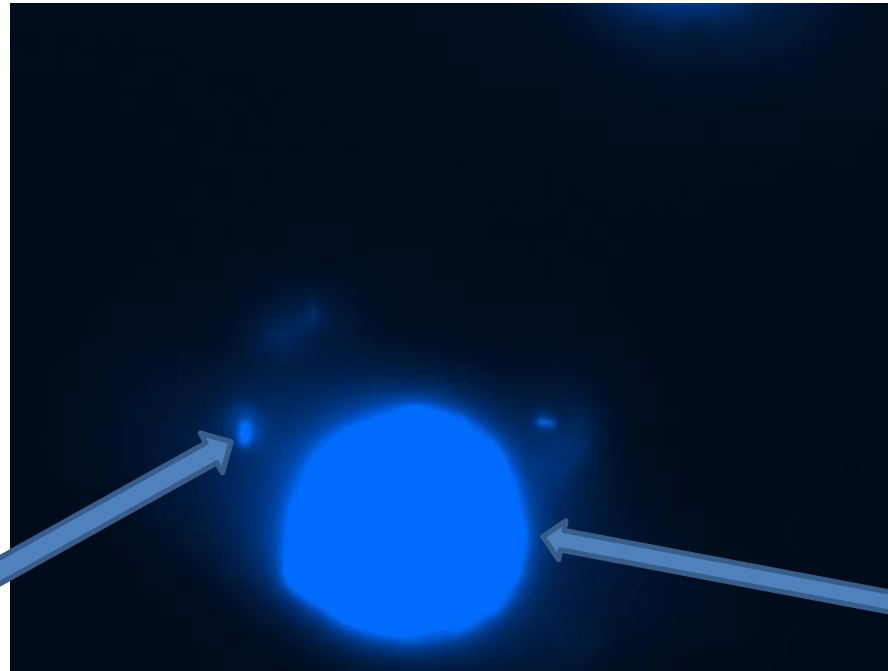


**In the invertebrate vector or  
the culture**

# Life cycle of *Leishmania spp.*



# Amastigotes phagocytized by macrophage



Amastigotes  
Nucleus

Macrophage  
nucleus

*In vitro* infection of macrophage with *Leishmania* amastigotes, DAPI stain (Hayder Z. Ali *et al.* 2012)



## **Oriental sore or Baghdad boil**



## Case infected with kalazar





# Chiclero ulcer or Uta



Mucocutaneous Leishmaniasis. W.Peters, H.M. Gilles. Color Atlas of Tropical Medicine and Parasitology. 1st Edition, 1977.

# *Trypanosoma gambiense*

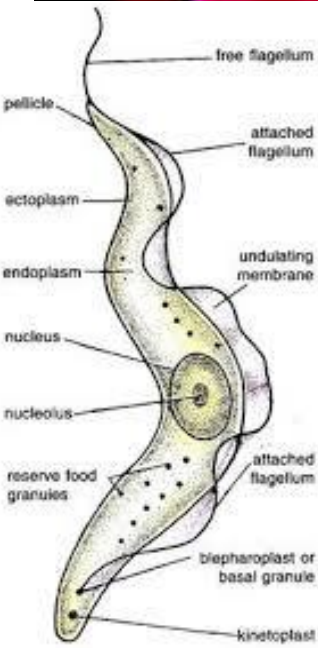
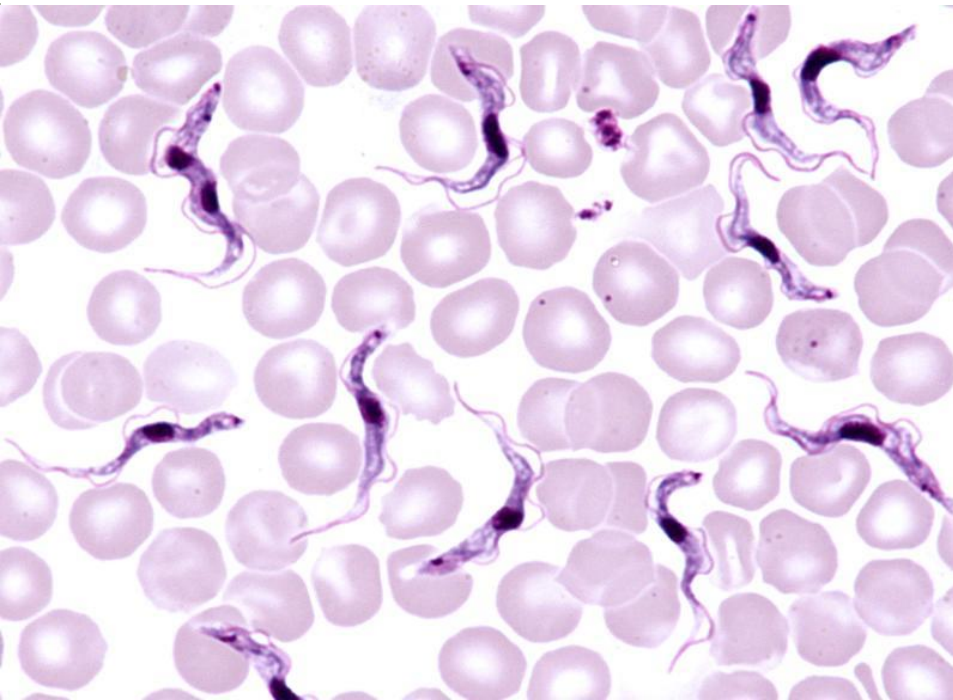
## Anterior station development

**Location:-** In plasma of blood

**Pathogenic:-** Mid and west African sleeping sickness

**Forms:-** Epimastigote and trypomastigote

**Vector:-** Tse-tse or *Glossina palpalis*



*Trypanosoma gambiense*  
 elongated spindle shape  
 trypomastigote

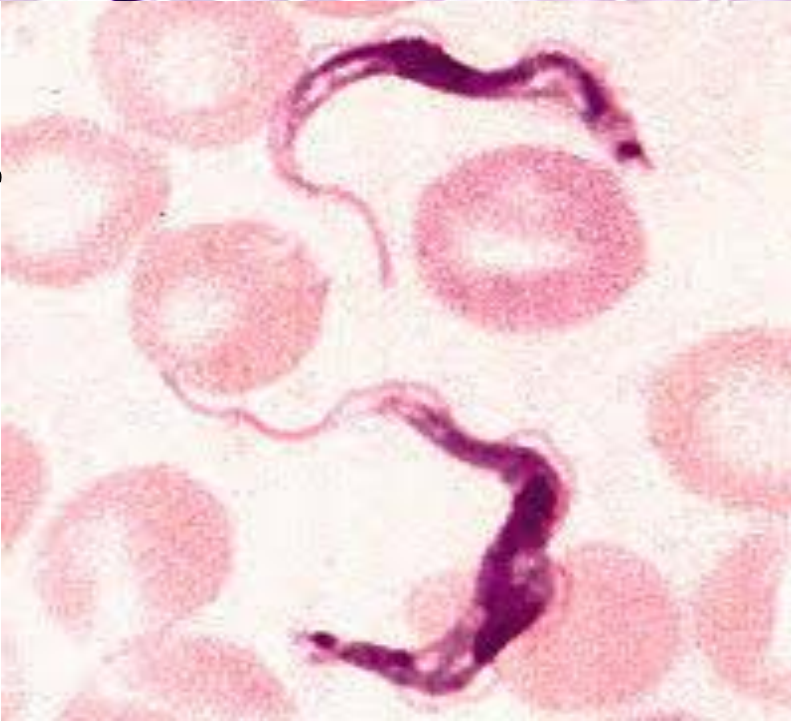


Fig. 13.3. Trypanosoma gambiense.



# *Trypanosoma cruzi*

## Posterior station development

**Location:-** Muscles of heart and nervous system muscles

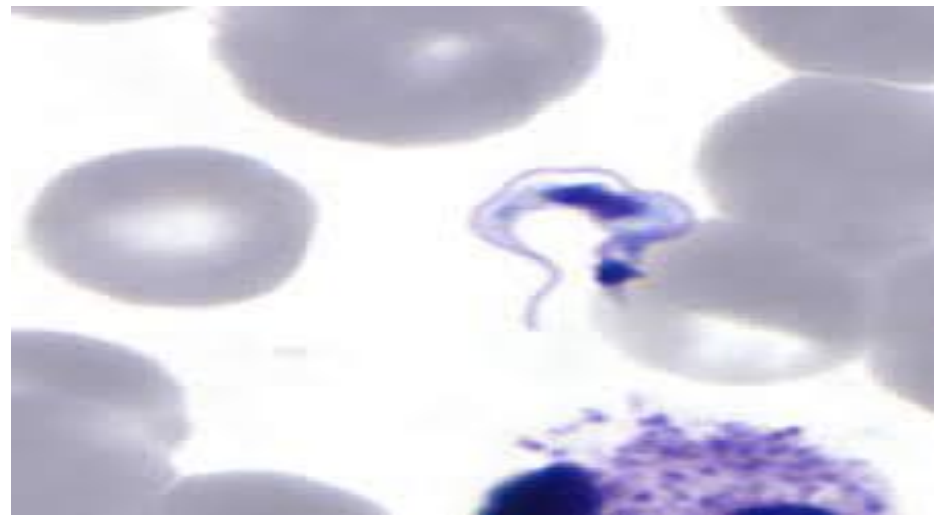
**Pathogenic:-** South America trypanosomiasis (Chaga's disease)

**Forms:-** Amastigote + promastigote +  
epimastigote + trypomastigote

**Vector:-** Triatomidae (Kissing bug)



**Kinetoplast (big)**



***Trypanosoma cruzi***

Lab 5

**U or C shape Trypomastigote**





# Lab 6

## 4- SUPERCLASS: Sporozoa

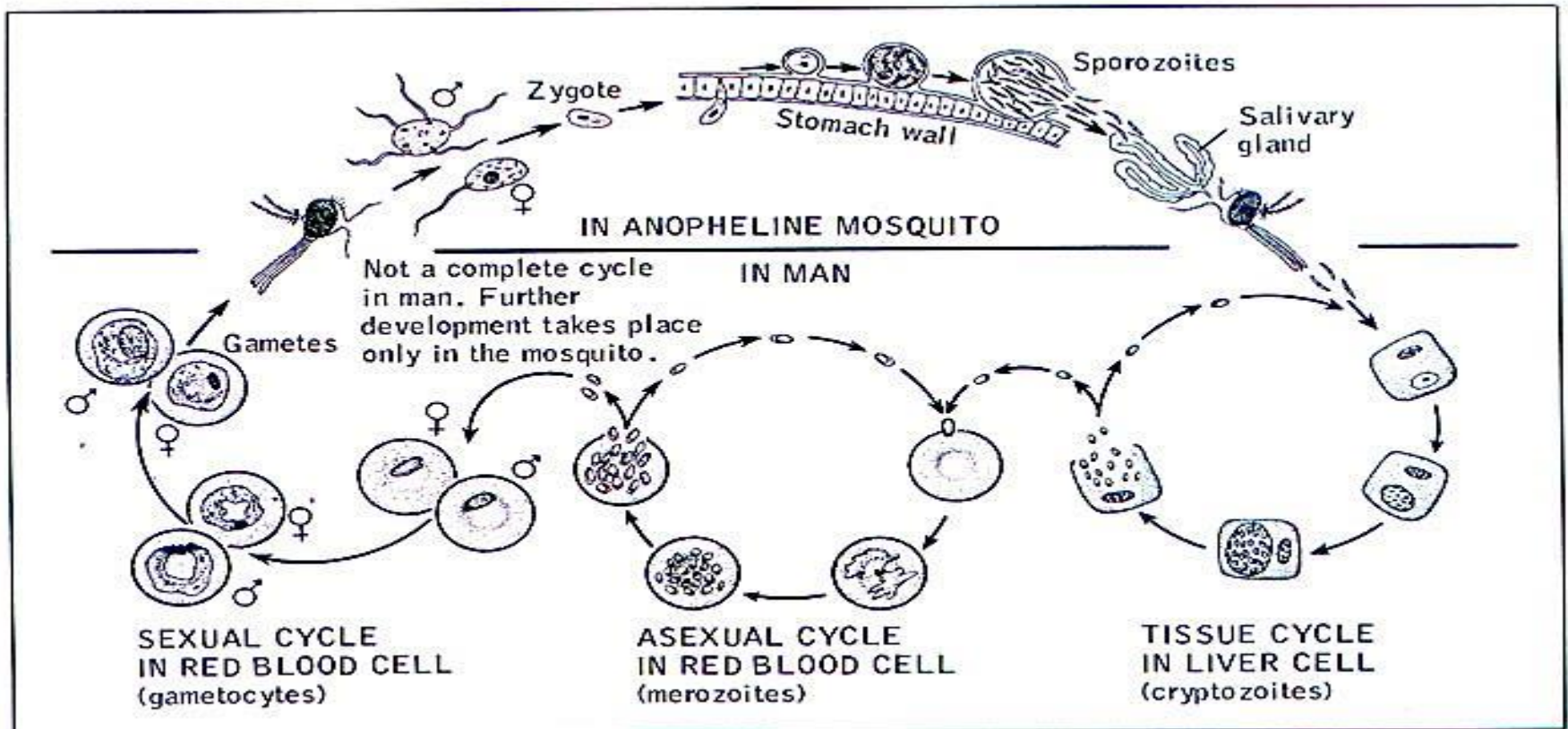


Figure 2-31 The life cycles of *Plasmodium* in a mosquito and in man. (Redrawn and modified from Blacklock and Southwell.)  
 From R. D. Barnes

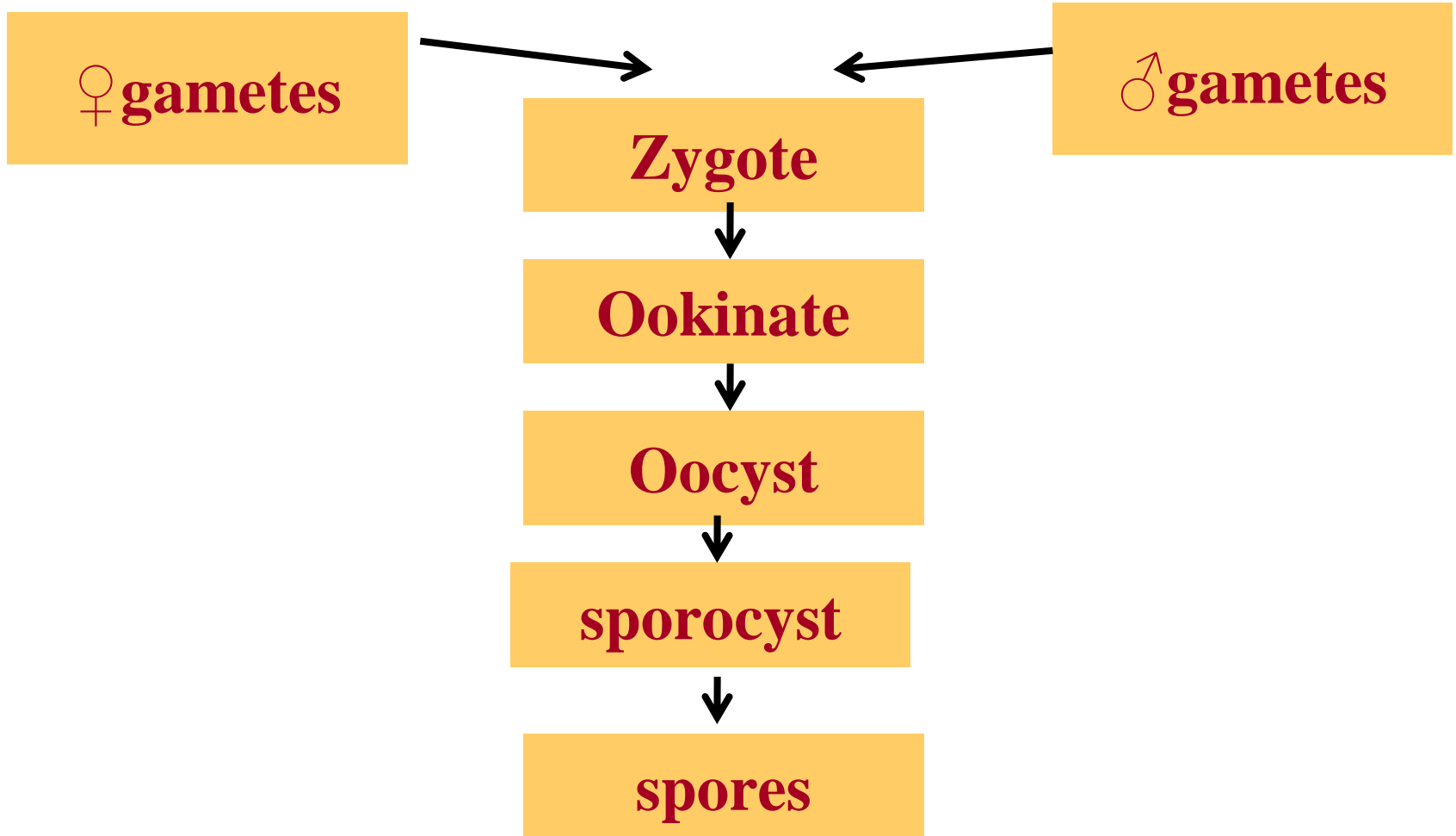
# Sporozoa

- All of the species belong to this group are parasitic
- Produce spores, oocyst
- No clear organs for movement or locomotion
- Reproduction:

**Asexual:** Binary fission, Multiple fission, Endodyogeny

**Sexual:** Anisogametes, Isogametes

# Sexual Reproduction



# Malaria

**Malaria** is a mosquito-borne infectious disease of humans caused by eukaryotic protists of the genus *Plasmodium*

It is widespread in tropical and subtropical regions, including much of Africa, Asia and the Americas

The disease results from multiplication of malaria parasites within red blood cells, causing symptoms typically include fever and headache, in severe cases progressing to coma, and death

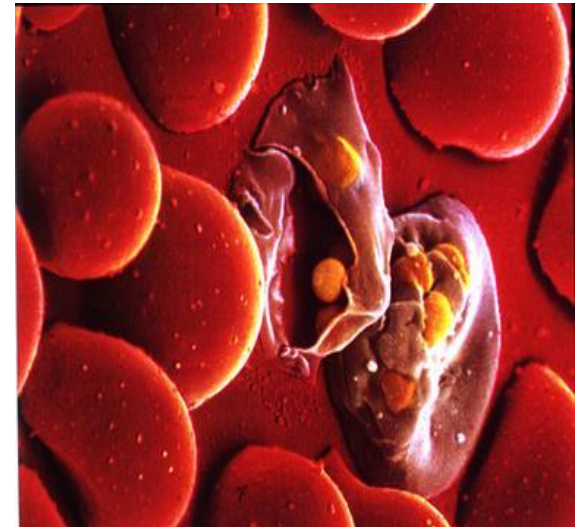
Four species of *Plasmodium* can infect humans:

*Plasmodium falciparum*

*Plasmodium vivax*

*Plasmodium ovale*

*Plasmodium malariae*



# *Plasmodium*

Parasite	Diseases	No. people infected	Deaths/yr
<i>Plasmodium</i>	malaria	273 million	1.12 million

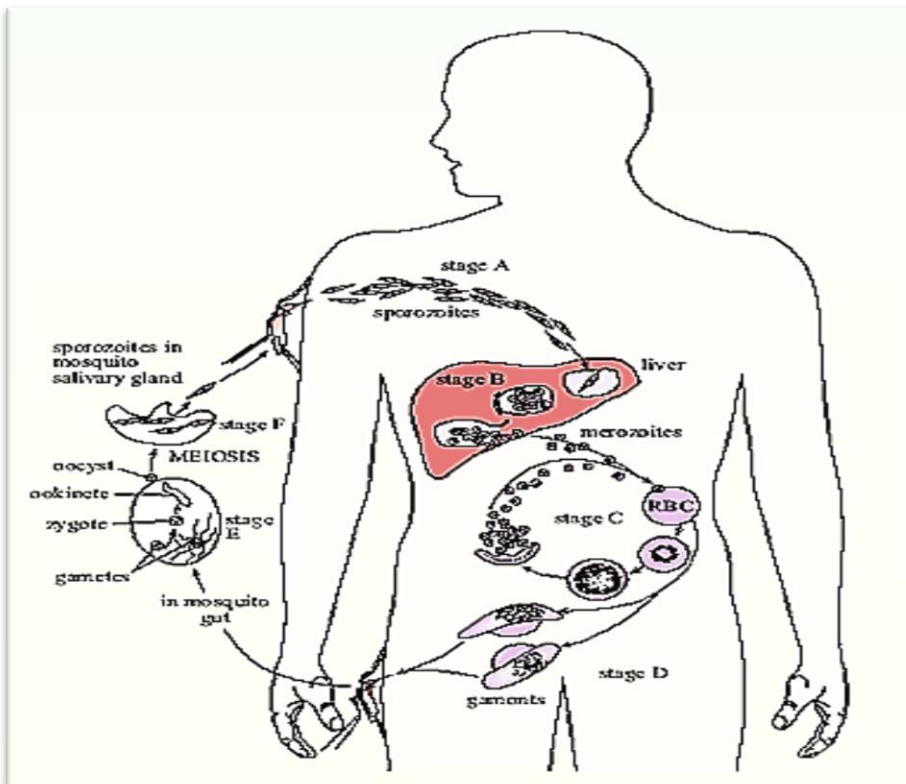
- Include the sporozoa that have two replication cycle:

**Schizogony (asexual)**

**Sporogony (sexual)**

- In the vertebrate host

- In the invertebrate host



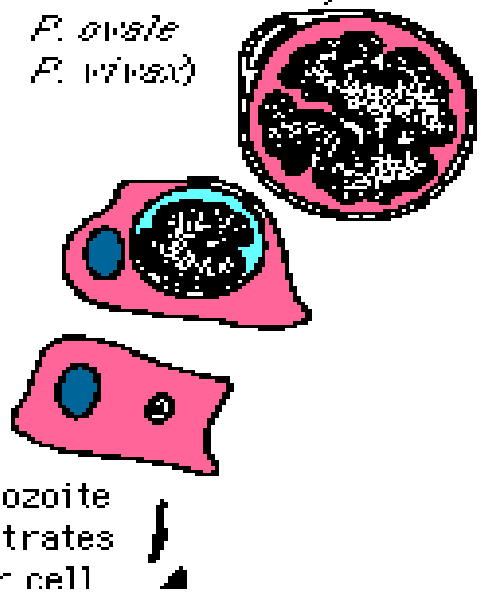


# Life cycle of *Plasmodium* in mammals (asexual)

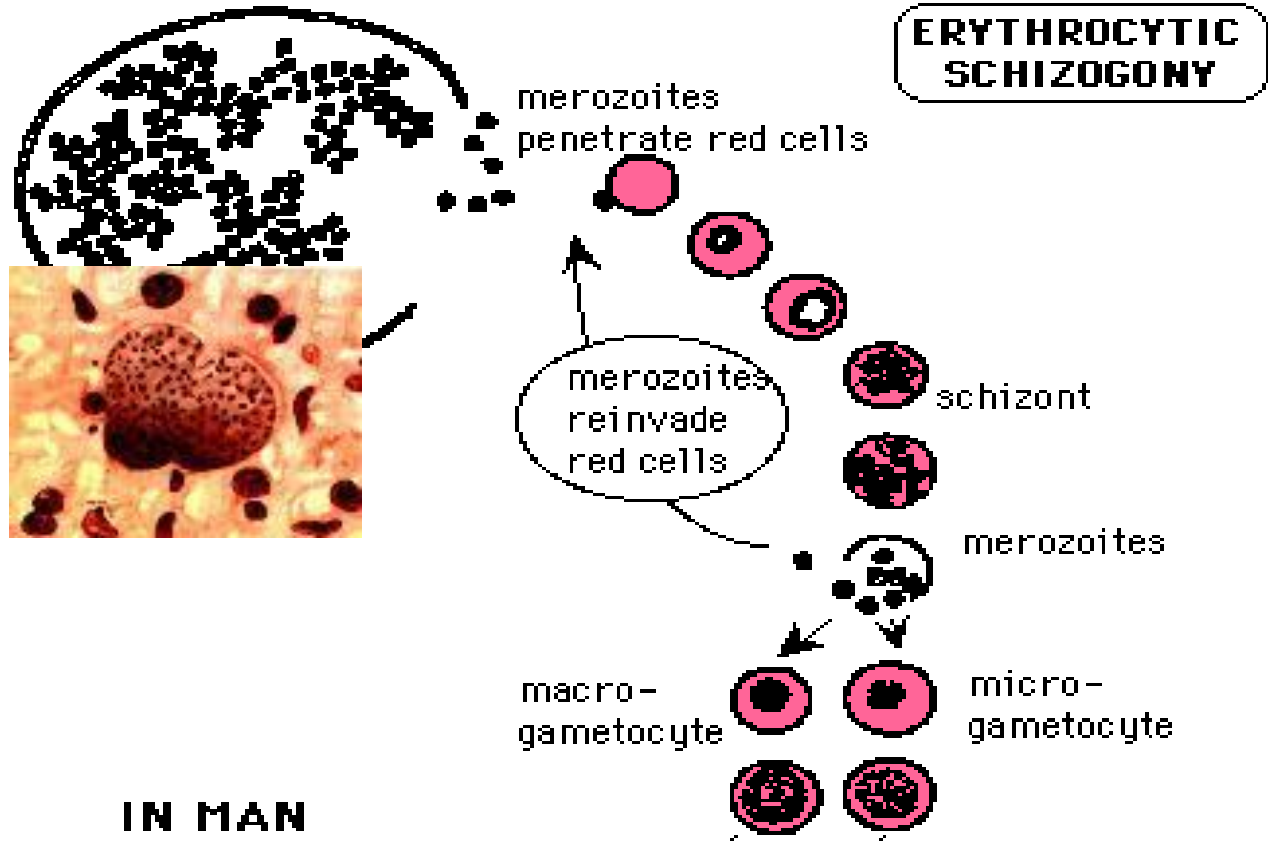
<i>P.vivax</i>	<i>P.malariae</i>	<i>P.ovale</i>	<i>P.falciparum</i>
Tertian malaria	Quatrain malaria	Ovale tertian malaria	Malignant malaria
48 h	72 h	48 h	36-48 h

## EXOERYTHROCYTIC SCHIZOGONY

(hypnozoites remain in liver, *P. ovale*, *P. vivax*)



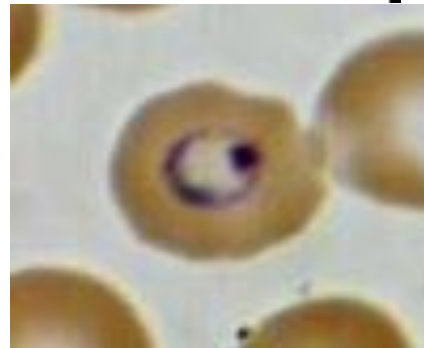
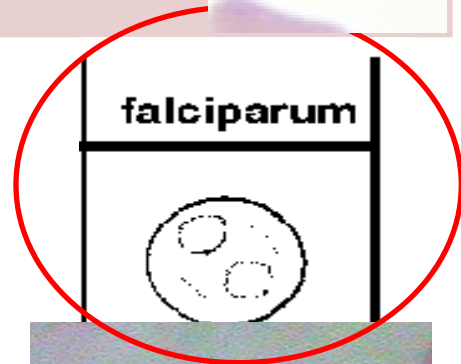
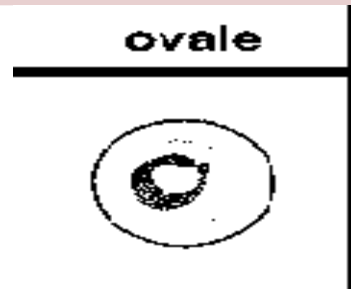
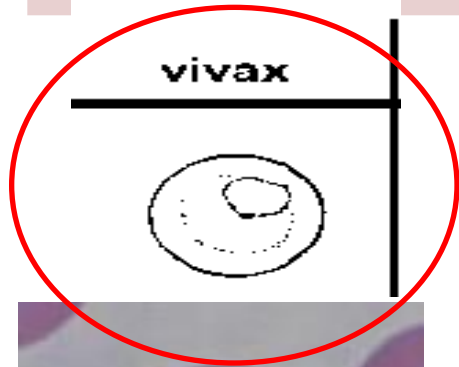
## ERYTHROCYTIC SCHIZOGONY



IN MAN

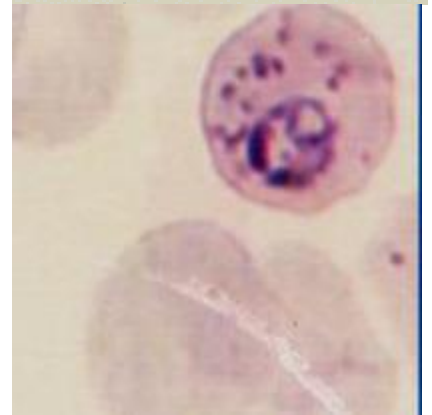
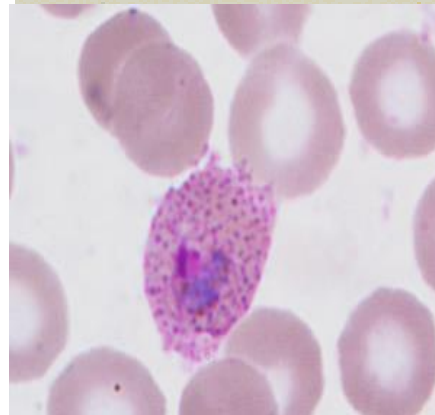
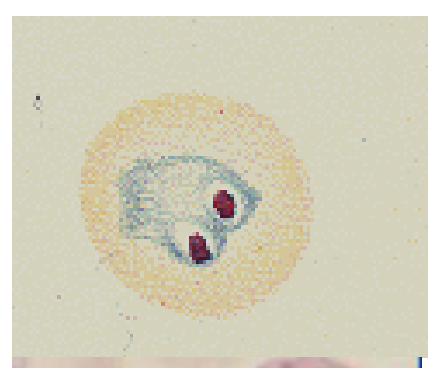
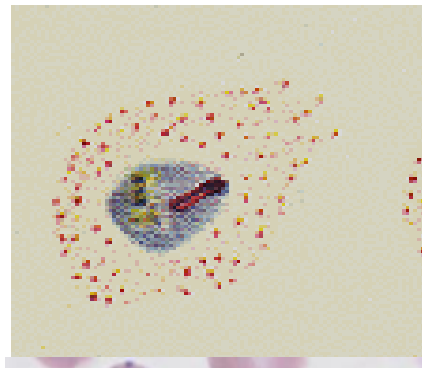
# Ring form (early trophozoites)

<i>P. vivax</i>	<i>P. malariae</i>	<i>P. ovale</i>	<i>P. falciparum</i>
Delicate cytoplasmic ring measuring 1/3 RBC diameter, single chromatin dot, ring surround a vacuole	smaller in size than <i>P. vivax</i> , occupied 1/6 of the RBC, heavy chromatin dot, vacuole may appeared filled in pigment	Resembles that of <i>P. vivax</i> , ring larger in size and thicker.	Scanty cytoplasm and small vacuoles, multiple rings common



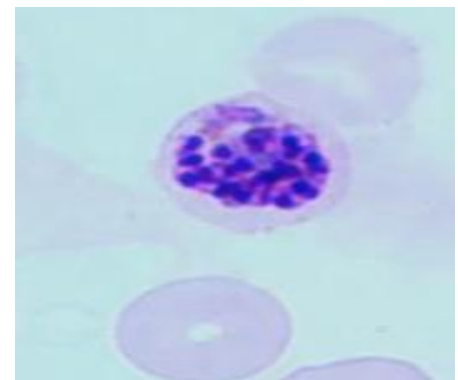
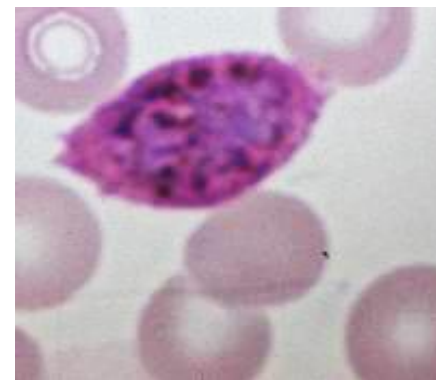
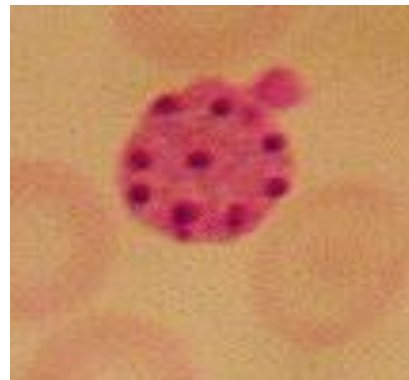
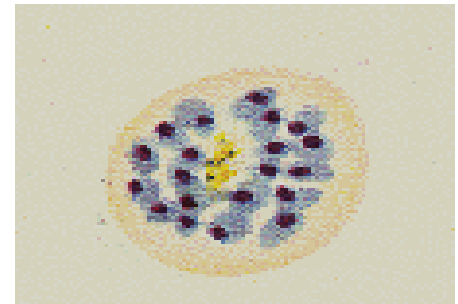
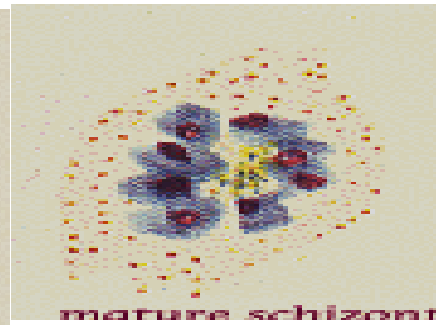
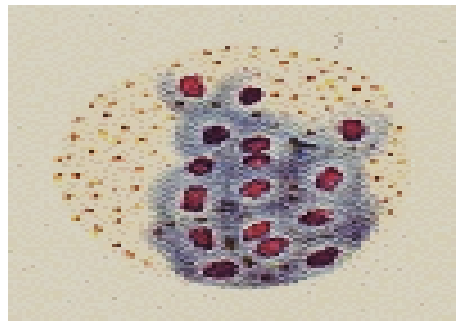
# Amoeboid stage (developing trophozoite)

<i>P. vivax</i>	<i>P. malariae</i>	<i>P. ovale</i>	<i>P. falciparum</i>
Irregular amoeboid appearance. ring remnant is common,	Solid cytoplasm, band form	Amoeboid tendencies not as evident as in <i>P. vivax</i>	Fine pigment granules are common, only detected in severe infection



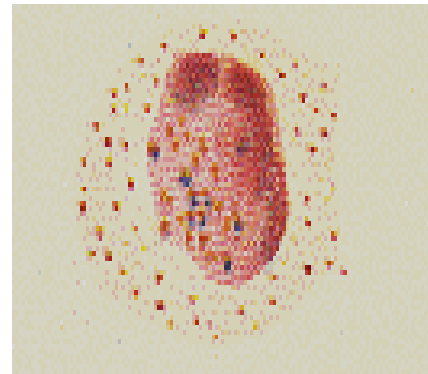
# Mature Schizont

<i>P. vivax</i>	<i>P. malariae</i>	<i>P. ovale</i>	<i>P. falciparum</i>
Parasites occupy $\frac{3}{4}$ of RBCs, rossete of an average of 12-24 merozoites	Schizont smaller but merozoites larger an average of 6-12 merozoites	Meriozoite larger than <i>P. malariae</i> , irregular rosset, usually 8	Smaller merozoites single pigment mass, an average of 8-26 merozoites



# Microgametocyte

<i>P.vivax</i>	<i>P.malariae</i>	<i>P.ovale</i>	<i>P.falciparum</i>
Spherical, compact, no vacuole, large nucleus, cytoplasm stains light blue	Similar to <i>P. vivax</i> but smaller, less numerous	Similar to <i>P.vivax</i> but smaller, never abundant	Usually sausage shape, chromatin diffused



# Macrogametocyte

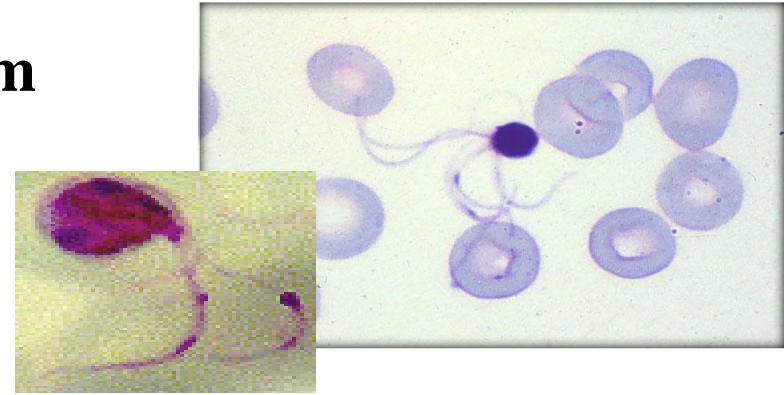
<i>P. vivax</i>	<i>P. malariae</i>	<i>P. ovale</i>	<i>P. falciparum</i>
spherical , compact ,acentric chromatin mass	Similar to <i>P. vivax</i> but smaller and less numerous	Similar to <i>P. vivax</i> but smaller	Crescent often longer and more slender , chromatin central , cytoplasm stain darker blue





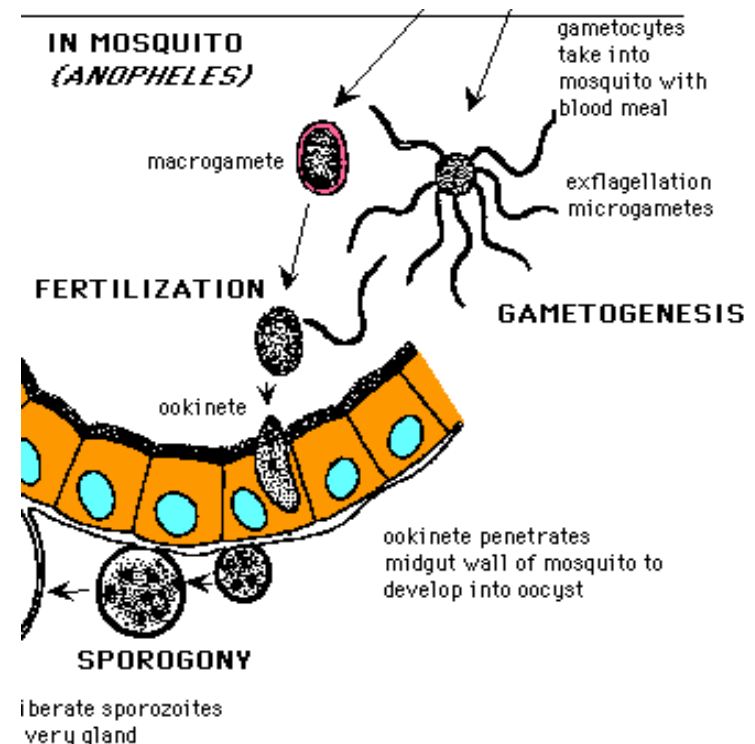
# Life cycle of *Plasmodium* in Mosquito (Sexual)

**Exflagellation:** formation of flagelliform microgametes from a microgametocyte in some sporozoa



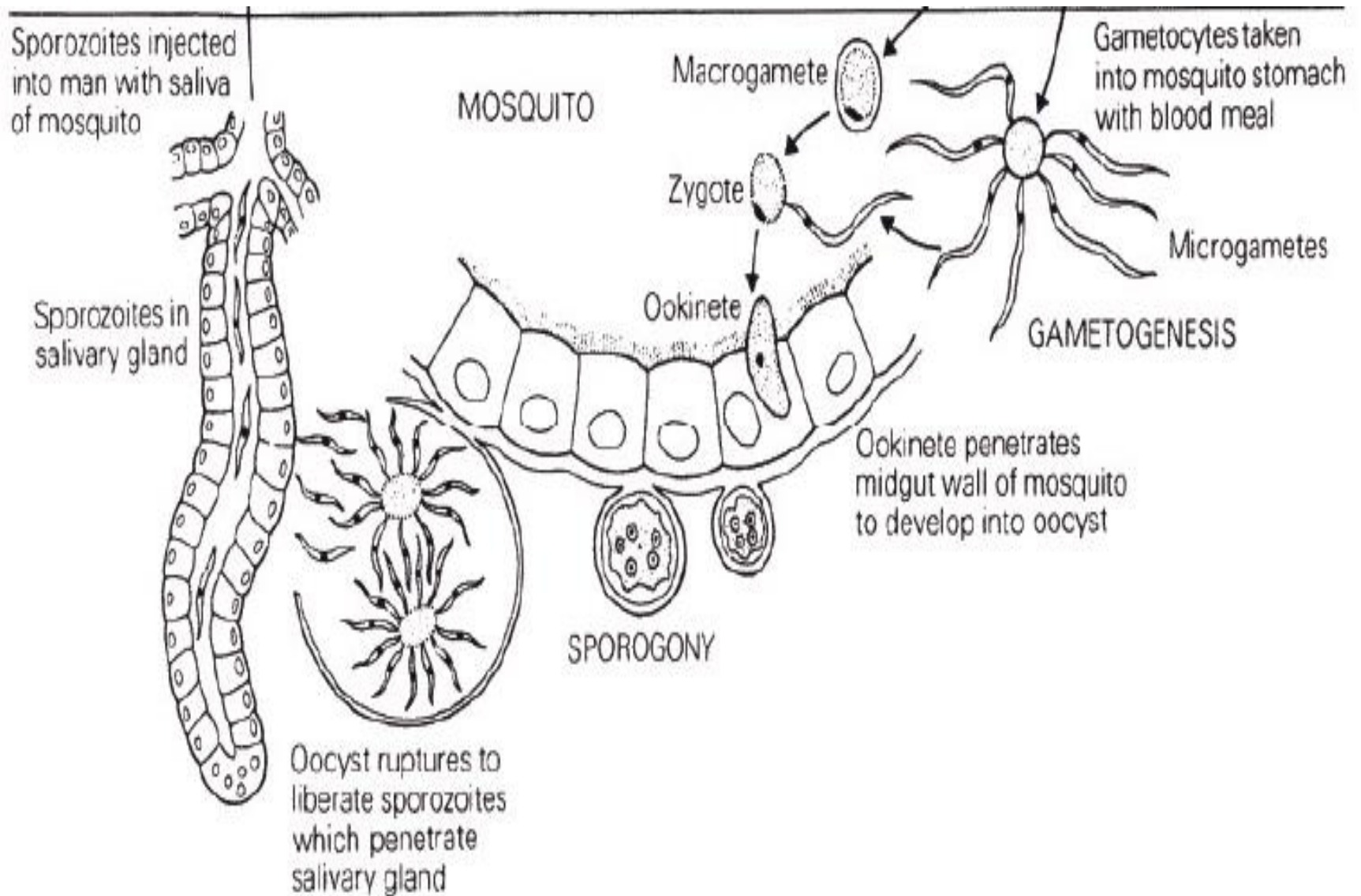
**Zygote:** the diploid cell that results from the fusion of two gametes

**Ookinete:** The motile stage of the zygote preceding the oocyst stage





# Life cycle of *Plasmodium* in Mosquito



# *Toxoplasma gondii*

**Final host:-** members of family Felidae (domestic cats and their relatives).

**Intermediate host:-** many warm-blooded animals, including humans.

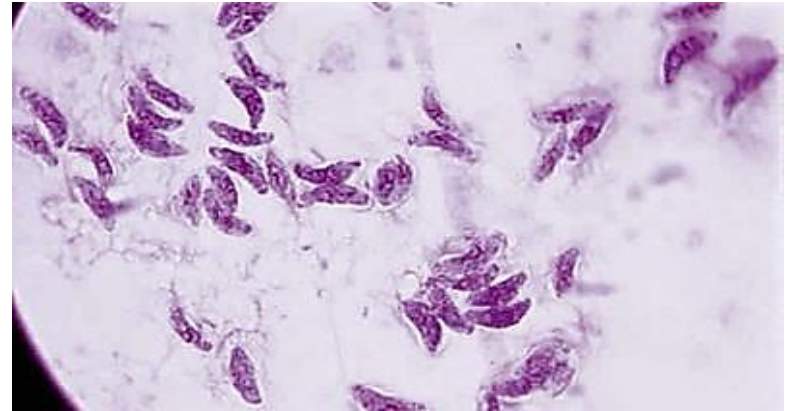
**Forms:-** Oocyst (contains two sporocysts, each one contain four sporozoites  
Tachyzoite, Bradizoite

**Diagnosis:-** is based on serology(IgM and IgG ELISA Test) and on histologic examination of tissue.

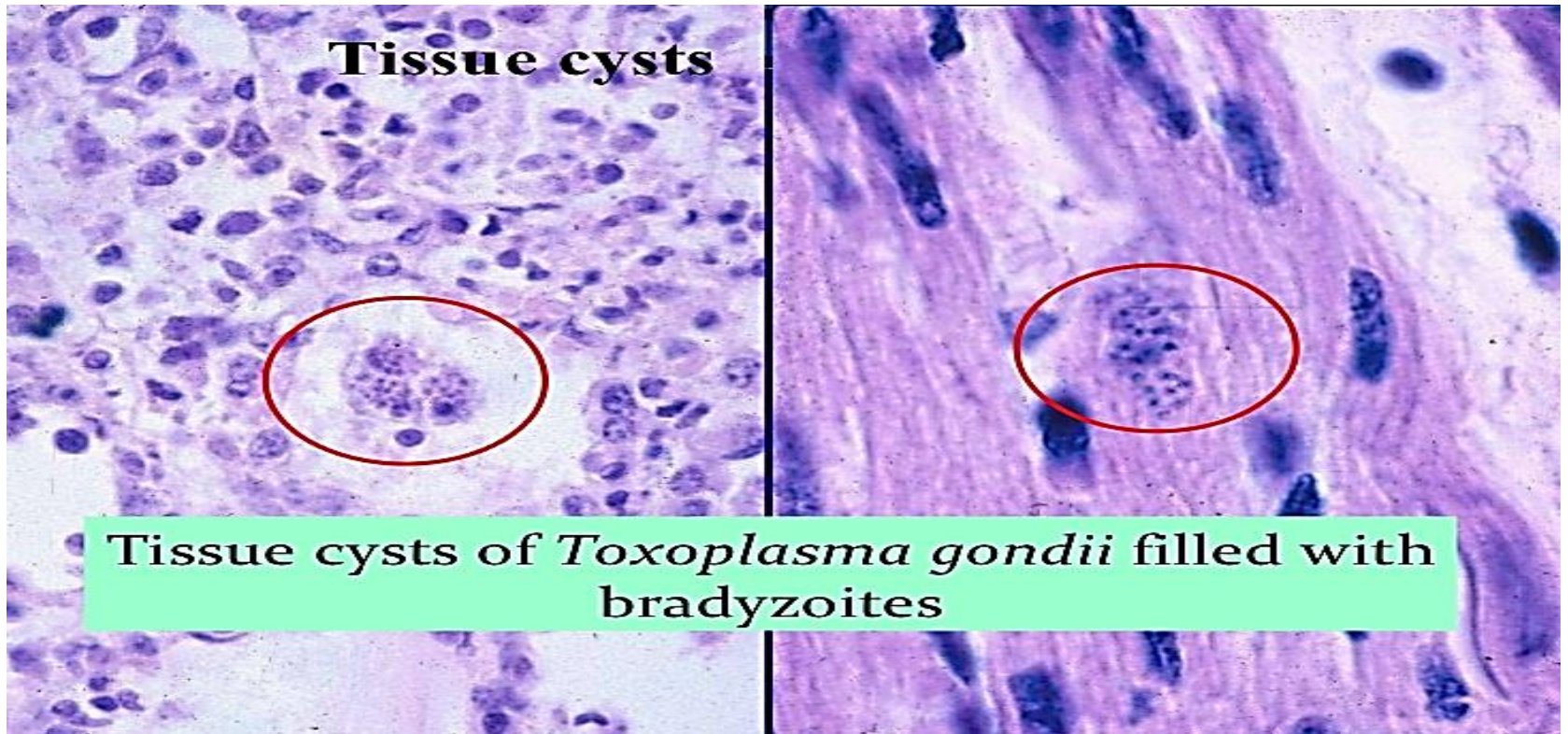




**Oocyst**



**Tachyzoite**



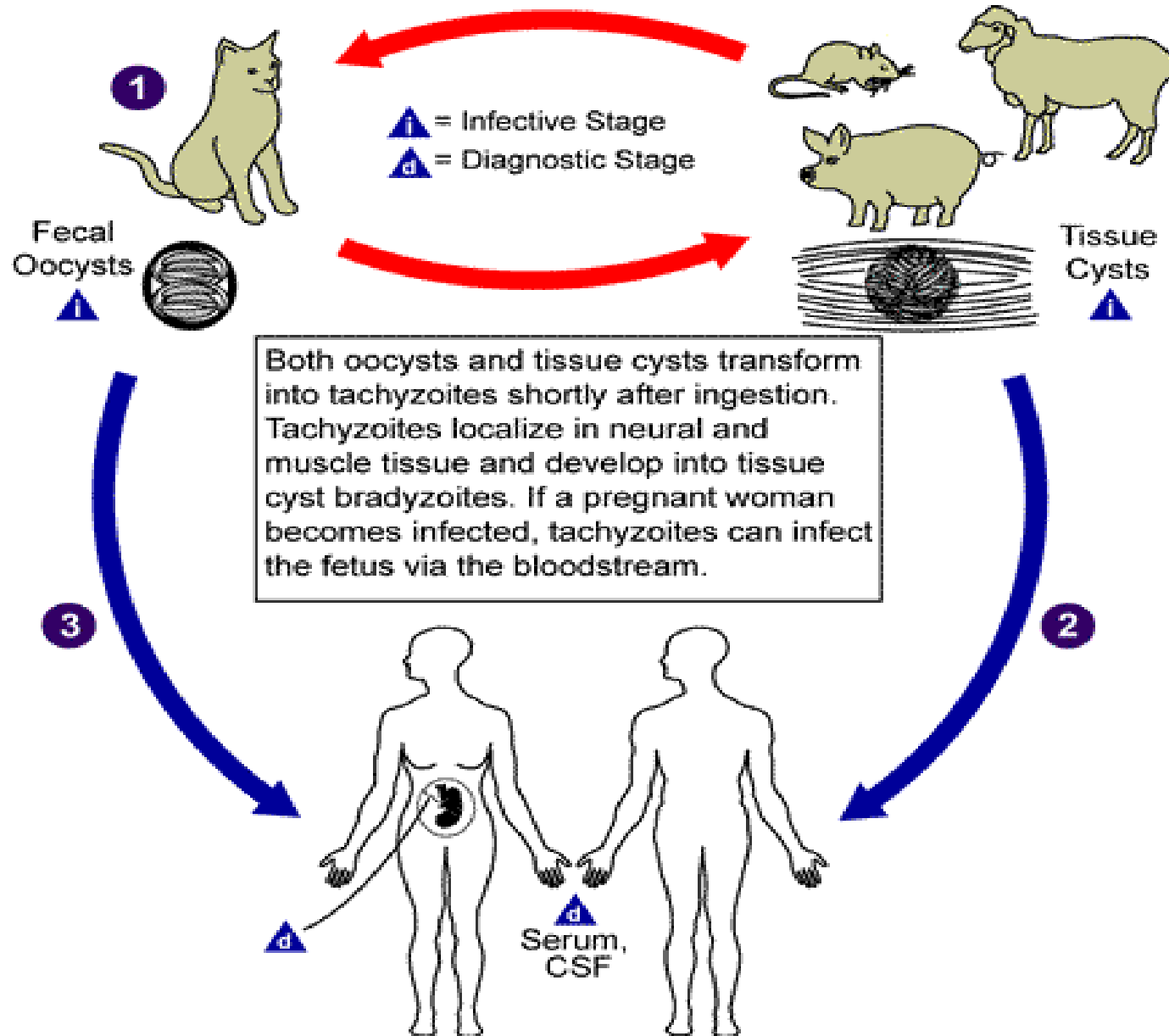
**Tissue cysts**

Tissue cysts of *Toxoplasma gondii* filled with bradyzoites

# *Toxoplasma gondii* Life Cycle

*T. gondii* primarily exists in three forms: **oocysts, tachyzoites, and bradyzoites**. Oocysts are only produced in the definitive host, members of the family Felidae. When passed in feces and then ingested, the oocysts can infect humans and other intermediate hosts. They develop into tachyzoites, which are the rapidly multiplying trophozoite form of *T. gondii*. They divide rapidly in cells, causing tissue destruction and spreading the infection. Tachyzoites in pregnant women are capable of infecting the fetus. Eventually tachyzoites localize to muscle tissues and the CNS where they convert to tissue cysts, or bradyzoites. This is thought to be a response to the host immune reaction. Ingestion of cysts in contaminated meat is also a source of infection, as bradyzoites transform back into tachyzoites upon entering a new host





# *Toxoplasma* life cycle