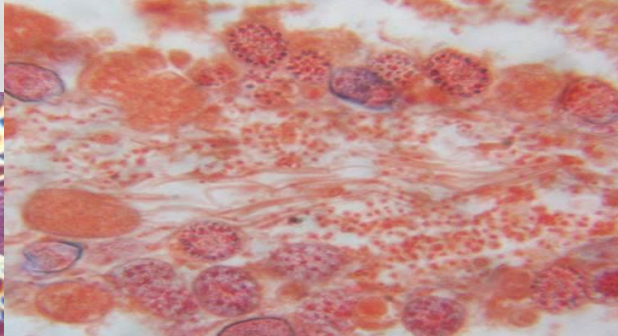
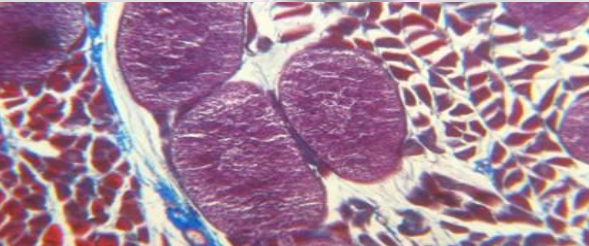
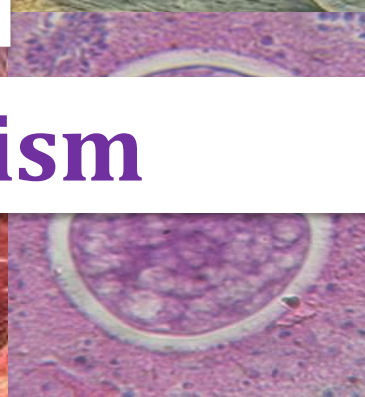
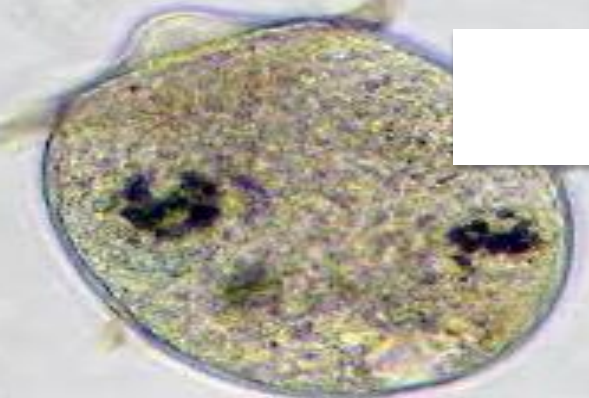


Lecture (3)

Parasitology and parasitism



Phylum Apicomplexa

...Apicomplexa Levine, 1970 constitute a large protozoan phylum of obligate eukaryotic intracellular parasites responsible for many serious diseases of humans and domestic animals. These diseases include:

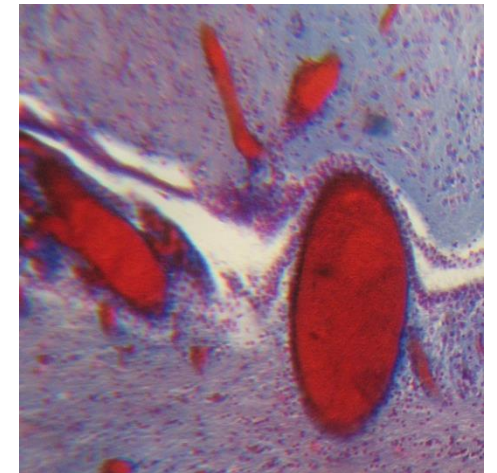
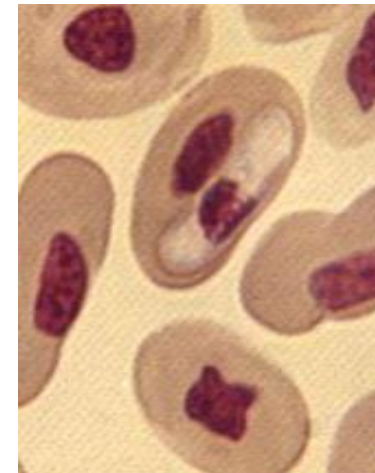
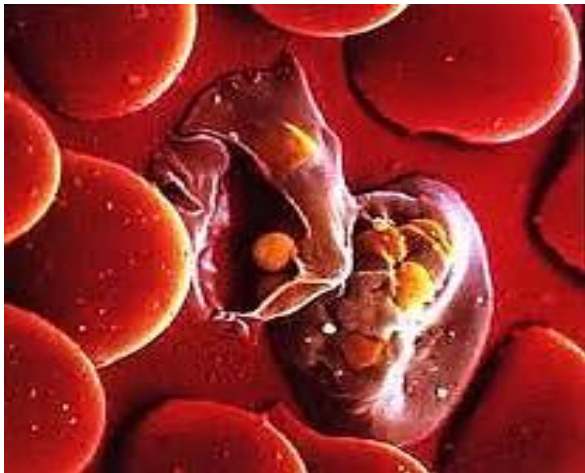
Human Malaria
Caused by
Plasmodium spp.

Coccidiosis (Eimeriosis)
caused by
Eimeria spp.

Sarcocystosis
caused by
Sarcocystis sp.

Hepatozoonosis
caused by
Hepatozoon

Toxoplasmosis
caused by
Toxoplasma sp.



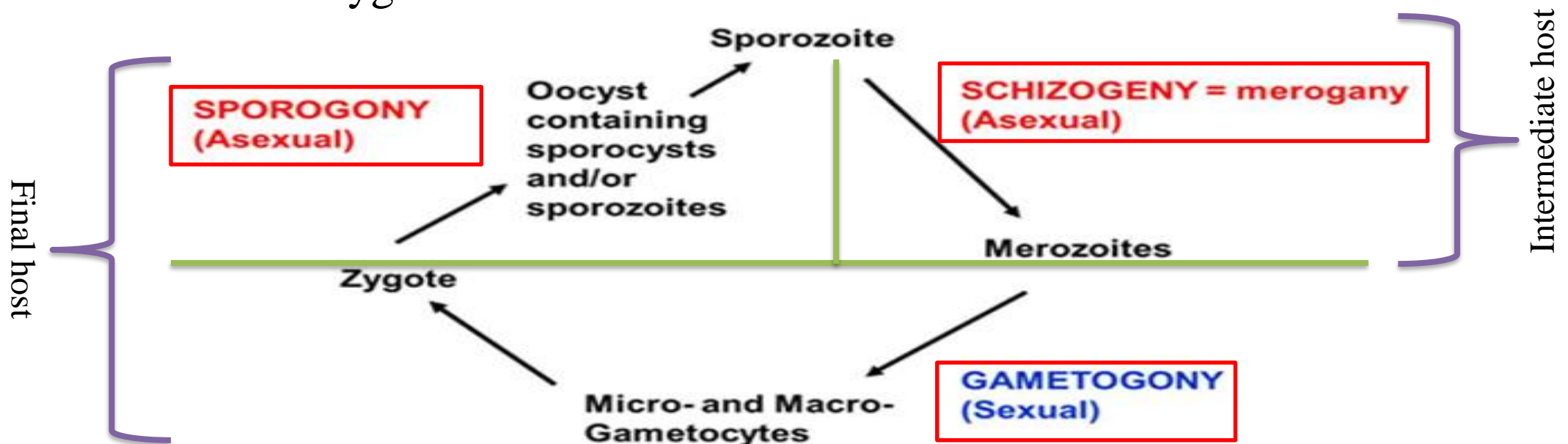
➤ **Life cycle of each organism in this phylum involves:**

1- Asexual cycles

- I. **Schizogony or Merogony (Multiple fission)**, means formation of merozoites which acts as the feeding stage.
- II. **Sporogony (Multiple fission)**, means formation of sporozoites which acts as the infecting stage.

2- Sexual cycle

- I. **Gametogony or gamogony**, where male and female gametes unite resulting in the formation of zygotes.



Habitat of parasites

Intercellular parasites

Lives between cells



Intracellular parasites

Lives inside cells

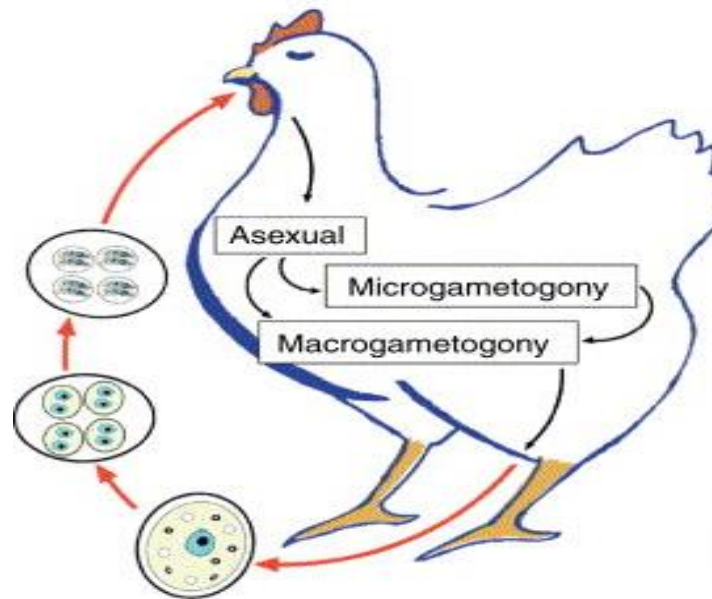


What is the difference?

Types of life cycle

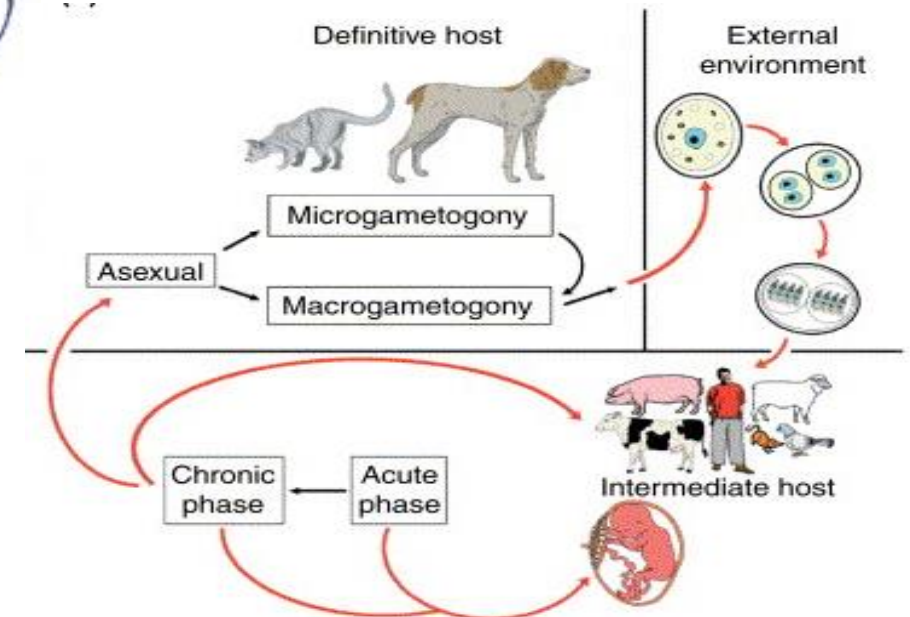
Homoxenous life cycle

Only one host in the life cycle



Heteroxenous life cycle

More than one host in the life cycle



II. Class Aconoidasida

...Sporozoan apicomplexa without conoid.

Order Haemospororida

Ex. *Plasmodium* sp.

...They are parasites of blood and liver cells of birds and mammals.

...They cause malaria disease.

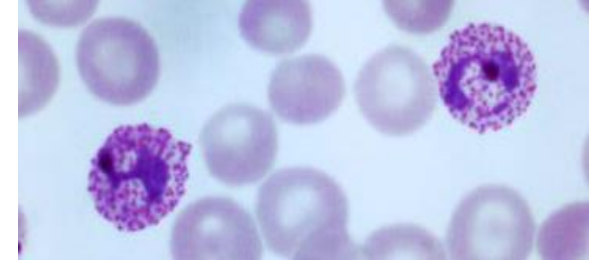
...There are four species of *Plasmodium* can cause malaria.

i- *P. vivax*

ii- *P. malaria*

iii- *P. ovale*

iv- *P. falciparum*



Life cycle of *Plasmodium* sp.

Female Anopheles, final host

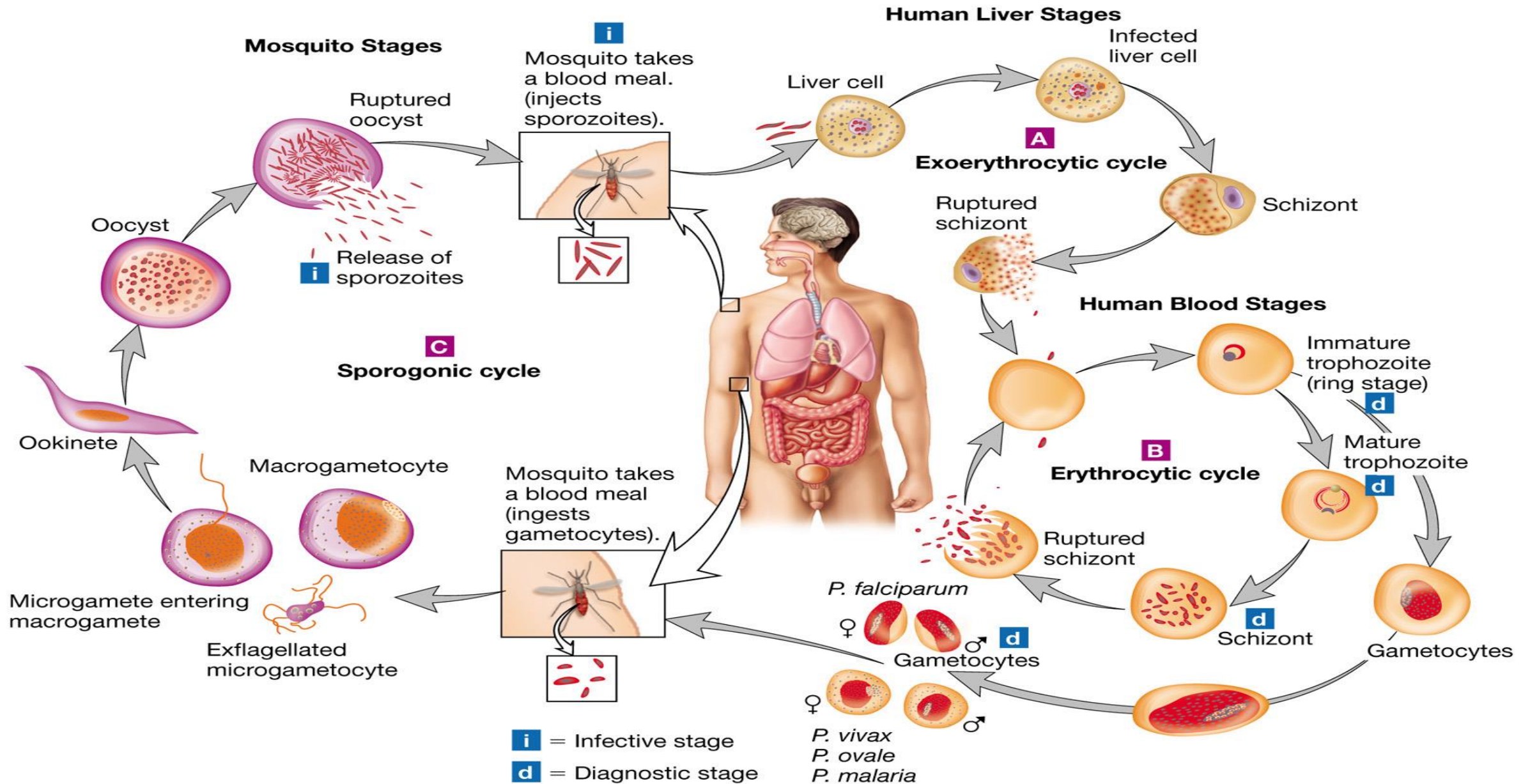
1...**Gamogony** (Sexual cycle inside the stomach of mosquitoes).

2...**Sporogony** (Asexual cycle inside the stomach wall of mosquitoes)

Man, intermediate host (Asexual)

3...**Schizogony** in liver cells (Exo-erythrocytic cycle)

4...**Schizogony** in RBCS (Erythrocytic cycle)



Life cycle of *Plasmodium* sp.

Taxonomic summary

- ❑ **Pathogenicity:** Malaria
- ❑ **Definitive host “vector”:** Female anopheles mosquito
- ❑ **Habitat:** Blood (invades only **young immature erythrocytes**)
- ❑ **Intermediate host:** Human “in which asexual reproduction takes place”
- ❑ **Mode of transmission:** Bite from an infected female anopheles mosquito
- ❑ **Infective stage:** Sporozoites

Symptoms

- Flu-like symptoms, such as headache, muscle pains, photophobia, anorexia, nausea and vomiting.
- **As infection progresses:** mild to severe paroxysms with hours of sweating, chills, high temperatures & exhaustion

Diagnosis

- Microscopic examination of thick and thin blood films
- **Three developmental stages seen in blood films:**
Trophozoite, Schizont and Gametocyte

Treatment

Classes of antimalarial drugs

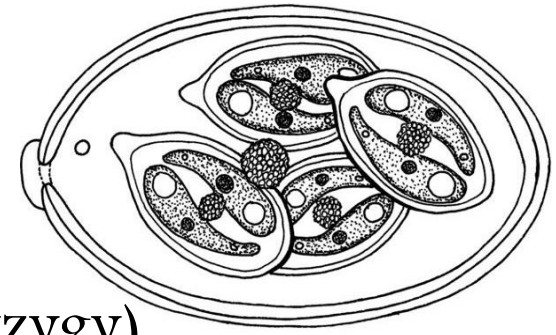
- 1) **Blood schizonticides** (quinine; chloroquine; artemisinin; mefloquine; sulfadoxin-pyrimethamine): effect on erythrocytic stage
- 2) **Tissue schizonticides** (Primaquine): effect on the stages in liver
- 3) **Chemoprophylaxis** taking suppressive drugs, beginning one week before travel to endemic area and continuing until 6 weeks after return.
- 4) **Malaria vaccines**

Prevention

breaking the human-mosquito-human cycle

Control of transmission route: by residual insecticides, avoidance of infected mosquitoes.

Order Eucoccidiorida
Suborder Eimeriorina



...Life cycle may be homoxenous or heteroxenous.

...Macrogamonts and microgamonts develop independently (without syzygy).

Family Eimeriidae

...The common name "coccidian" is applied to any member of this family.

...Most genera distinguished by numbers of sporocysts and sporozoites within oocyst as:

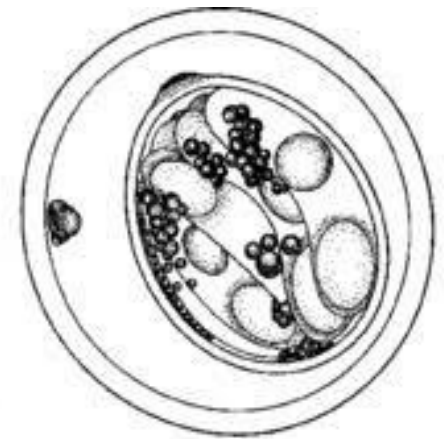
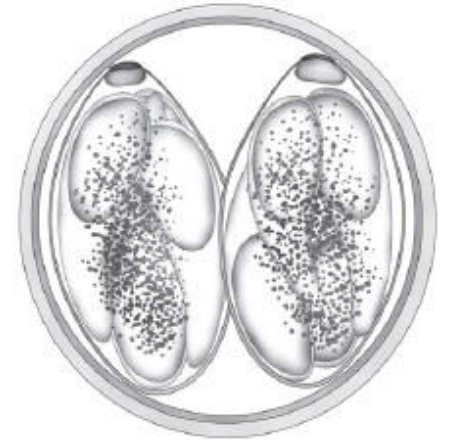
1- **Eimeria** (4 sporocysts in oocyst, each sporocyst with 2 sporozoites)

2- **Isospora** (2 sporocysts in oocyst, each sporocyst with 4 sporozoites).

3- **Cyclospora** (2 sporocysts in oocyst, each sporocyst with 2 sporozoites).

4- **Caryospora** (1 sporocyst in oocyst, with 8 sporozoites).

5- **Wenyonella** (4 sporocysts in oocyst, each sporocyst with 4 sporozoites).

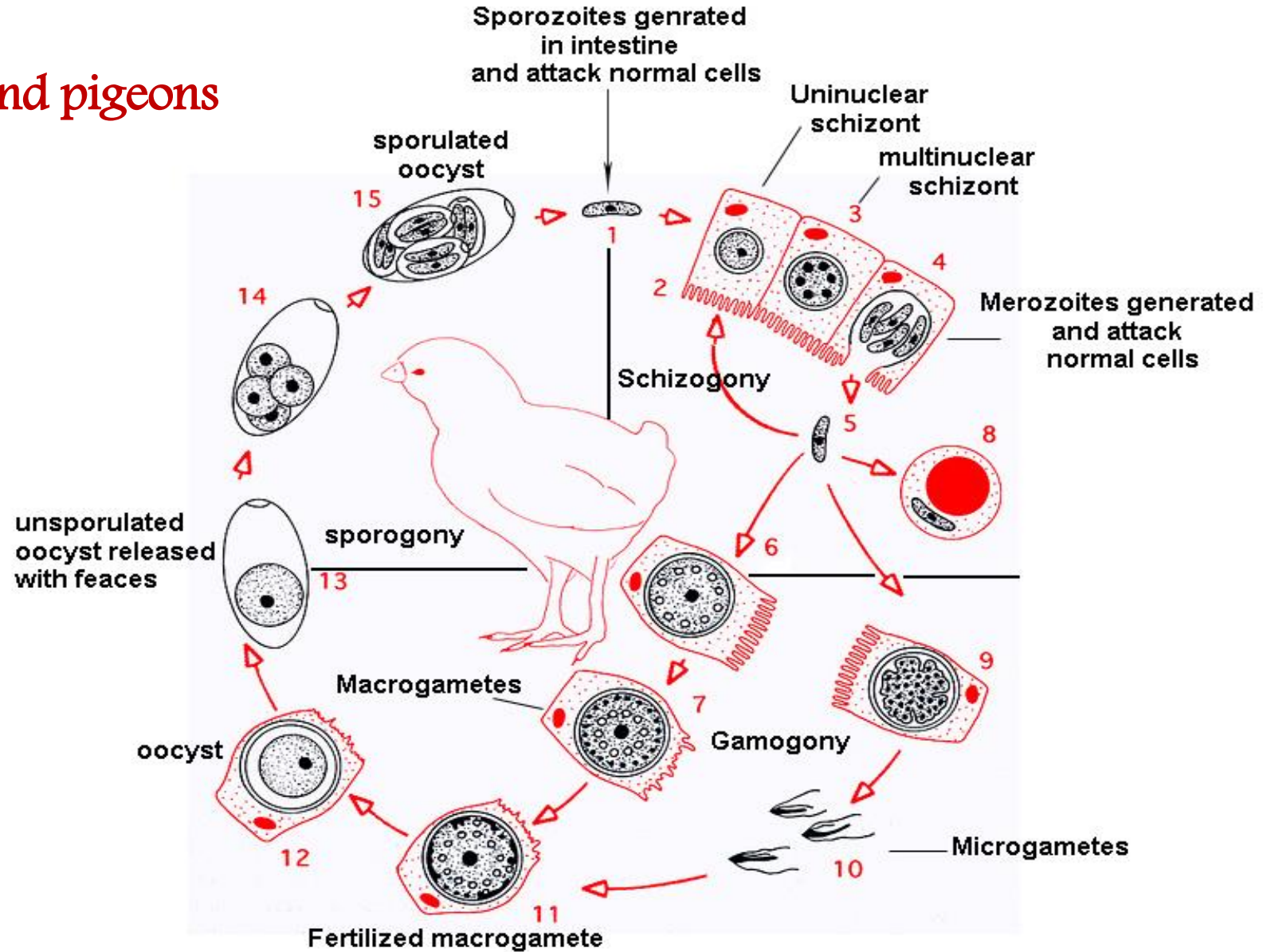


...*Eimeria* sp. infecting chickens and pigeons

...Is a parasite that infects the **intestinal cells of chickens and pigeons** causing **weakness and also death** of infected animals.

...Healthy chickens can be infected by ingestion of **food contaminated by sporulated oocysts**. After ingestion oocysts rupture and sporozoites generated and attack normal intestinal cells.

...It requires monoxenous life cycle with only one host.



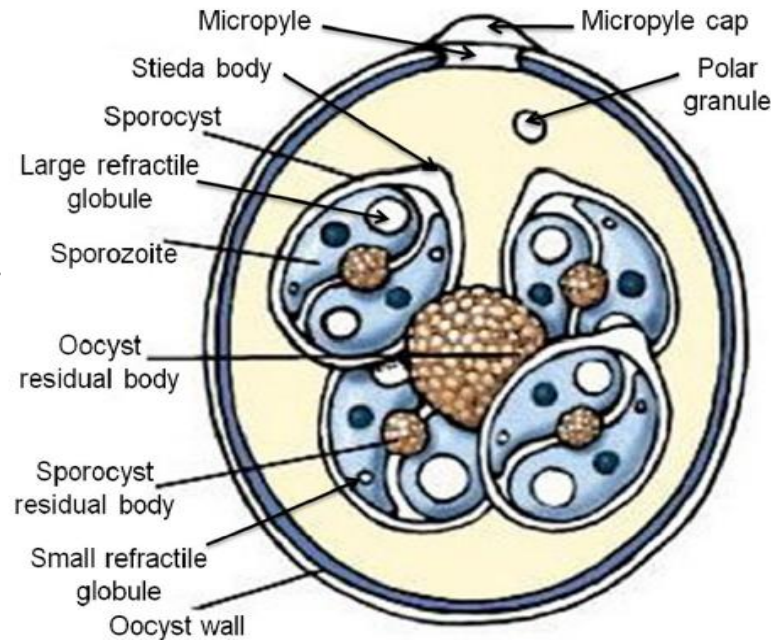
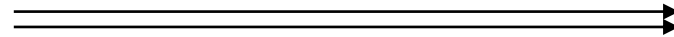
If we want to diagnose the infection with *Eimeria* sp. we can examine the feces of chickens we will see:

By light microscopy:



Unsporulated oocyst of *Eimeria* sp. released with feces of infected chickens.

Sporogony outside host



Sporulated oocyst of *Eimeria* sp. that can be eaten by a healthy chicken.

Sporulated oocyst (*Eimeria* type) 4 sporocysts each with 2 sporozoites with a total of 8 sporozoites.

Sarcocystis sp.

....A large number of *Sarcocystis* spp. infect birds as intermediate hosts and man as a final host.

....Oocysts with two sporocysts, each with four sporozoites (**Isospora type**).

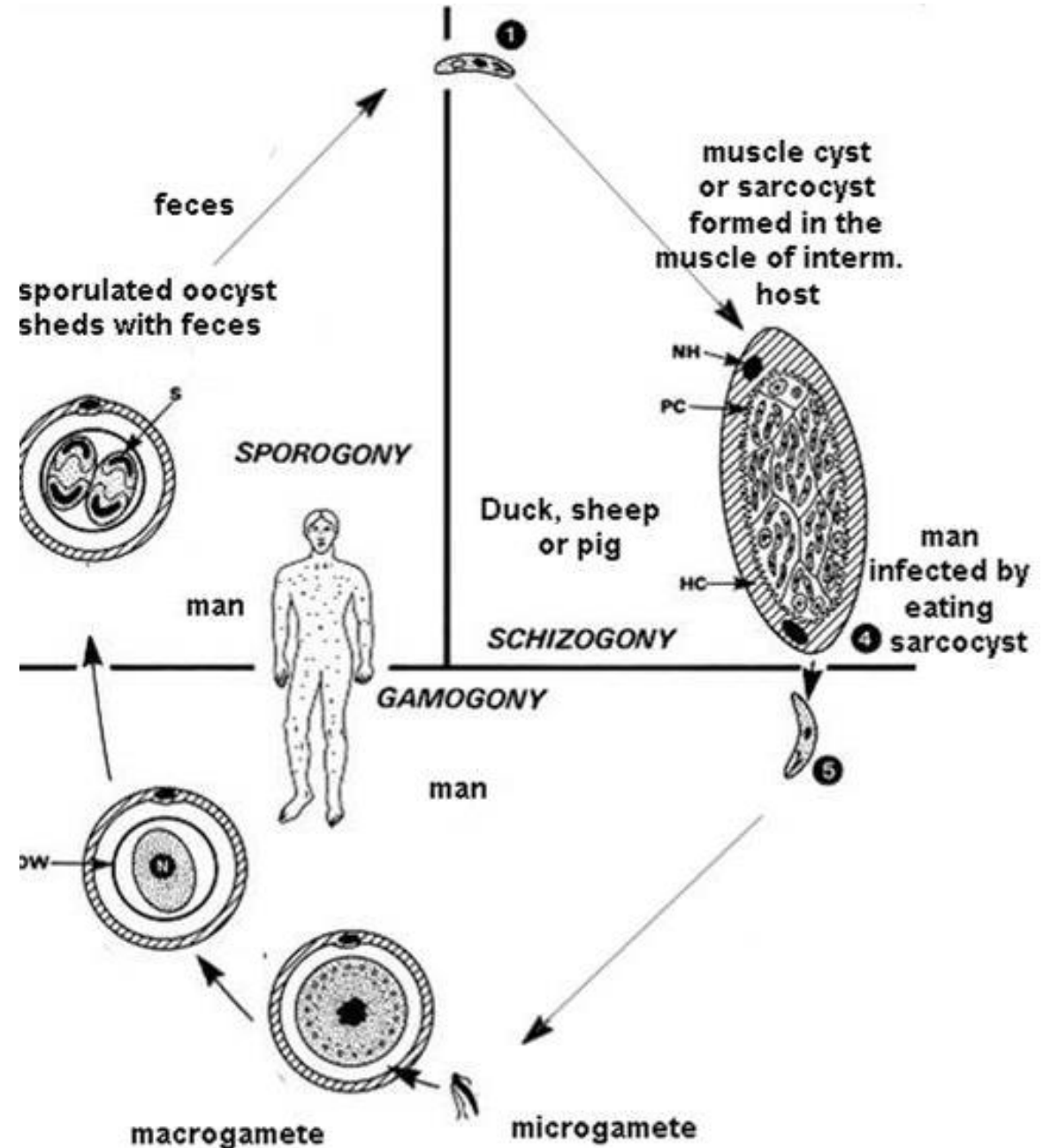
....Obligatory **heteroxenous** life cycle including two hosts as:

1- Schizogony (Asexual stages)

in intermediate host with polyzoic cysts containing septa and merozoites in striated muscle.

2- Gamogony and sporogony (Sexual stages)

in definitive host in intestinal wall; sporulation endogenous.



We can diagnose infection with *Sarcocystis* in either final or intermediate hosts as follow:

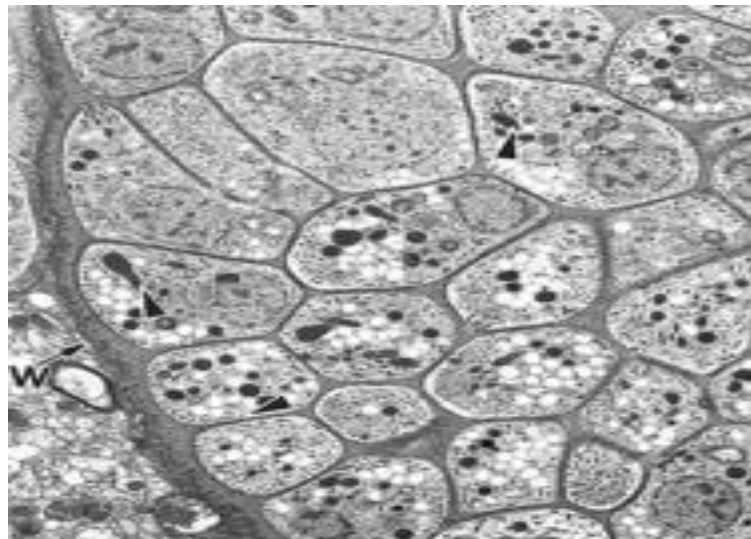
In man (final host):

....If we examine the feces of infected man we will observe a sporulated oocyst with the *Isospora* type (2 sporocysts each with 4 sporozoites).



In Duck, Sheep or Pig (intermediate hosts):

....Intermediate hosts are infected following ingestion of water or food contaminated with sporocysts from the feces of a final host. After ingestion, sporocysts penetrate the host's intestinal wall and migrate to skeletal or cardiac muscles forming sarcocysts as shown.



← This is the ultrastructure of sarcocysts...observe the large number of merozoites which are the end products of schizogony phase characteristic for intermediate hosts.

Subfamily Toxoplasmatinae

Sarcocystid coccidia, with two hosts, asexual stages can be transmitted from one host to another; merozoites and septa are not formed in polyzoic tissue cysts; oocysts sporulate exogenously.

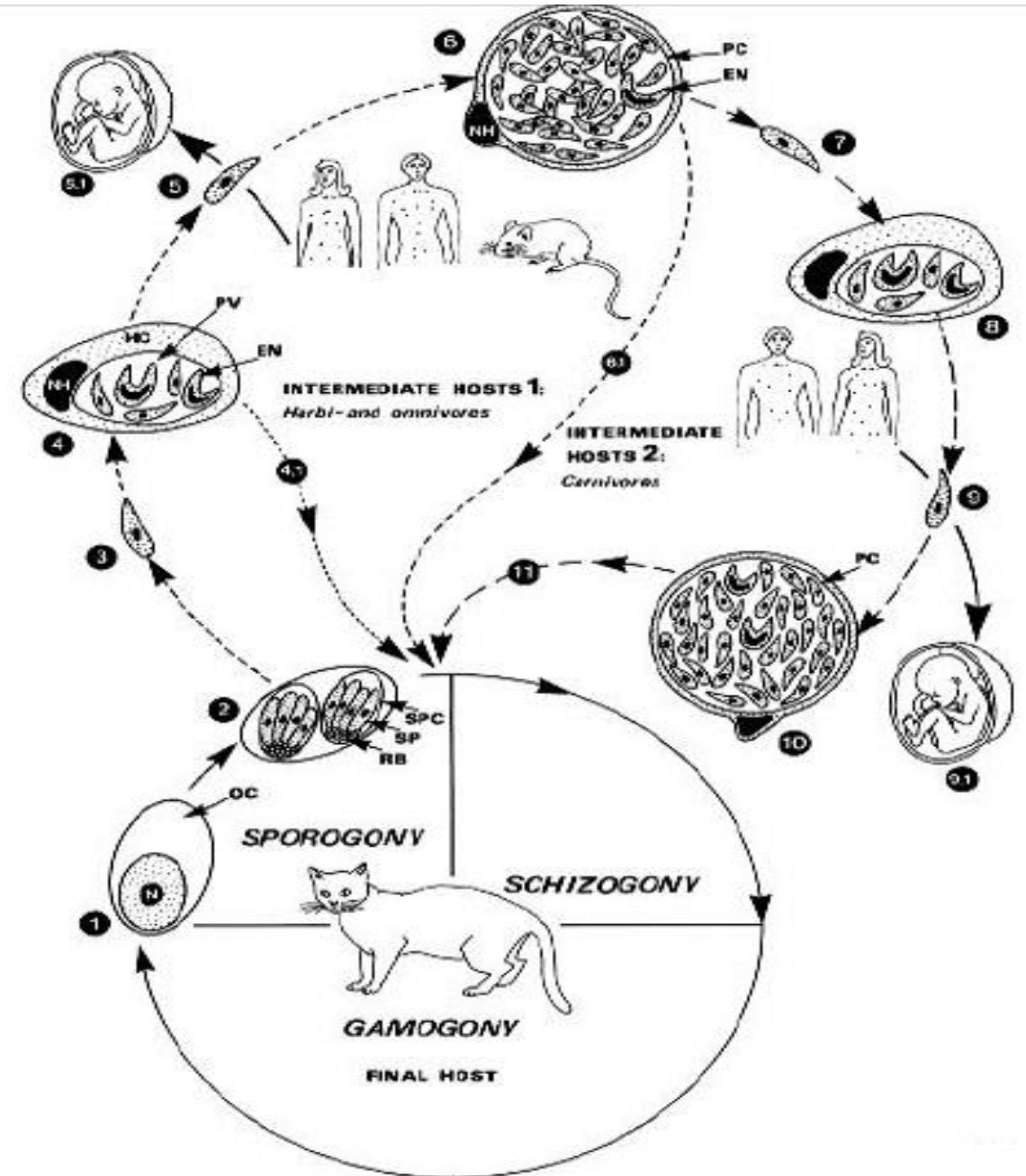
Toxoplasma gondii

....It is a coccidian parasite that infects most species of warm blooded animals, including humans, causing the disease toxoplasmosis.

....*Toxoplasma gondii* is an obligatory intracellular, but extracytoplasmic coccidian parasite.

Transmission of Toxoplasmosis:

- 1- Foodborne transmission.
- 2- Animal-to-human (zoonotic) transmission.
- 3- Mother-to-child (congenital) transmission.



Endodyogeny

Some life cycle stages of *Toxoplasma* exhibit a unique form of binary fission called **endodyogeny**.

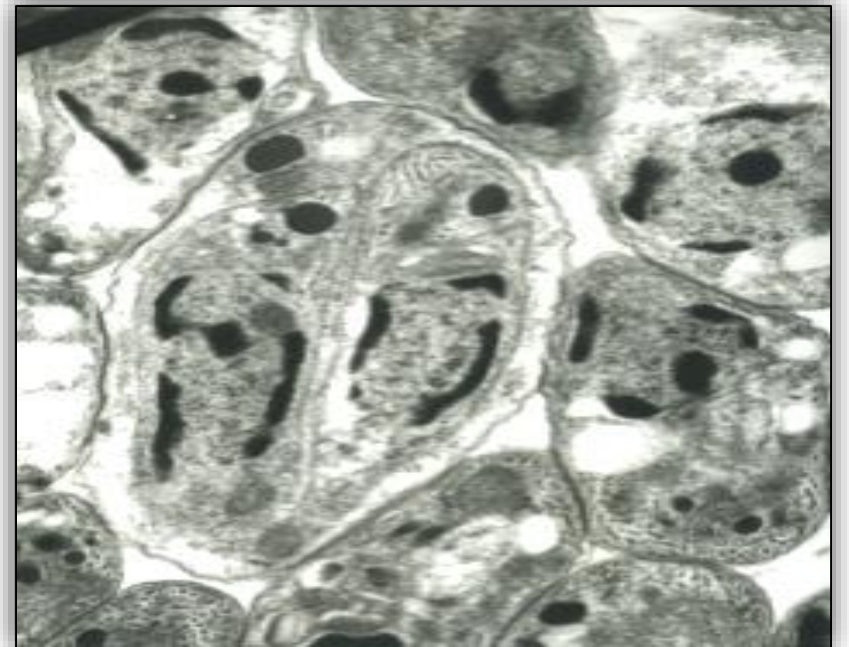
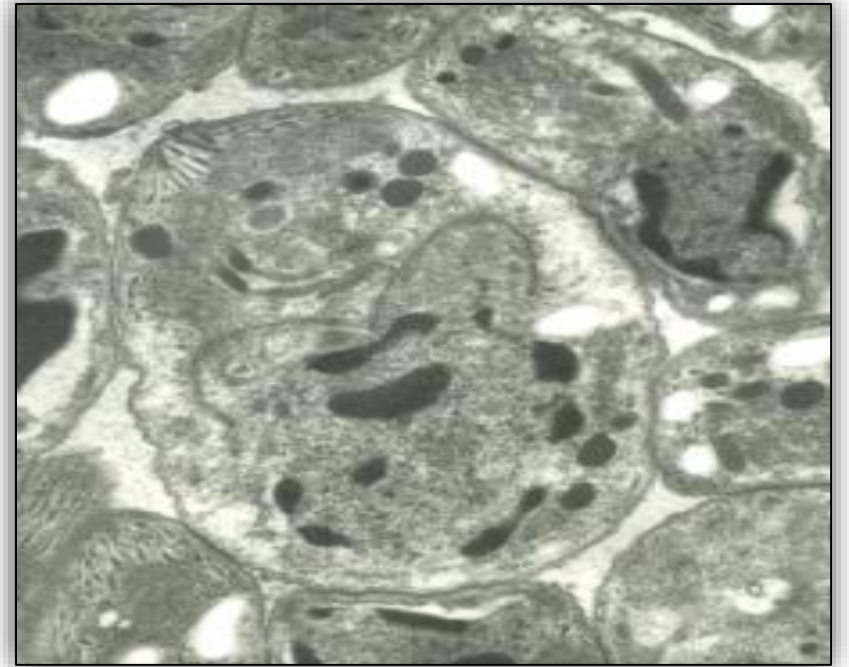
During endodyogeny:

1- Apical organelles and inner pellicular membranes of the daughter cells start to form within the cytoplasm of the cell instead of at the plasma membrane.

2- Other organelles (i.e., nuclei, mitochondria, and apicoplasts) divide and also associate with the newly forming daughter cells within the mother cell termed as **metrocystes**.

3- Inner pellicular membranes of the mother cell disappear and are replaced by the inner pellicular membranes of the daughter cells.

4- Outer plasma membrane of the mother cell is reused to form the outer plasma membrane of the daughter cells.



Diagnosis

Many serologic tests have been used to detect antibodies to T. gondii:

1. **Detection of *Toxoplasma gondii* antigen** in blood or body fluids by enzyme-linked immunosorbent assay (ELISA) technique.
2. **Sabin-Feldman dye test:** is a sensitive and specific neutralization test. It measures IgG antibody and is the standard reference test for toxoplasmosis. High titers suggest acute disease.
3. **IgM fluorescent antibody test:** detects IgM antibodies within the first week of infection, but titers fall within a few months.
4. **Polymerase Chain Reaction** on body fluids, including CSF, amniotic fluid, and blood.

Prevention

Certain precautions can help prevent toxoplasmosis:

1. Wear gloves when you garden or handle soil.
2. Don't eat raw or undercooked meat.
3. Wash kitchen utensils thoroughly.
4. Wash all fruits and vegetables.
5. Don't drink unpasteurized milk.
6. Cover children's sandboxes.

For cat lovers

If you're pregnant or otherwise at risk of toxoplasmosis or its complications, take these steps to protect yourself:

1. Help your cat stay healthy.
2. Avoid stray cats or kittens.
3. Have someone else clean your cat's litter box.

Prevention of congenital transmission is possible through early diagnosis of acute infection in mothers and administration of a prophylactic regimen of spiramycin

Thank You

