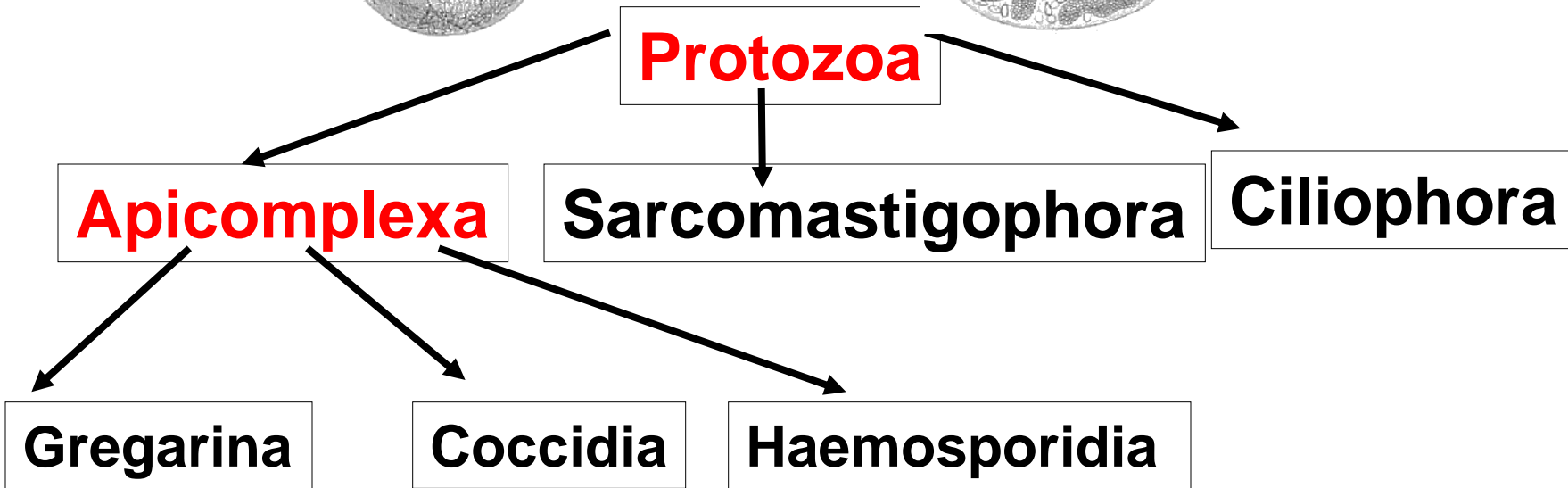
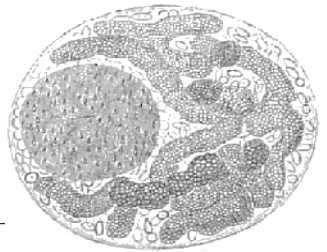


Apicomplexa

Kingdom II Euprotista

Phylum Apicomplexa



Classes (& Genus):

Gregarina (*Monocystis*), **Coccidia** (*Eimeria*, *Sarcocystis*, *Toxoplasma*, *Haemogregarina*), **Haemosporidia** (*Plasmodium*, *Haemoproteus*), **Piroplasma**, **Perkinsea**

Apicomplexa

Apical complex:

Polar rings (one or more)

Conoid

Rhoptries (cell penetration and nutrient transport)

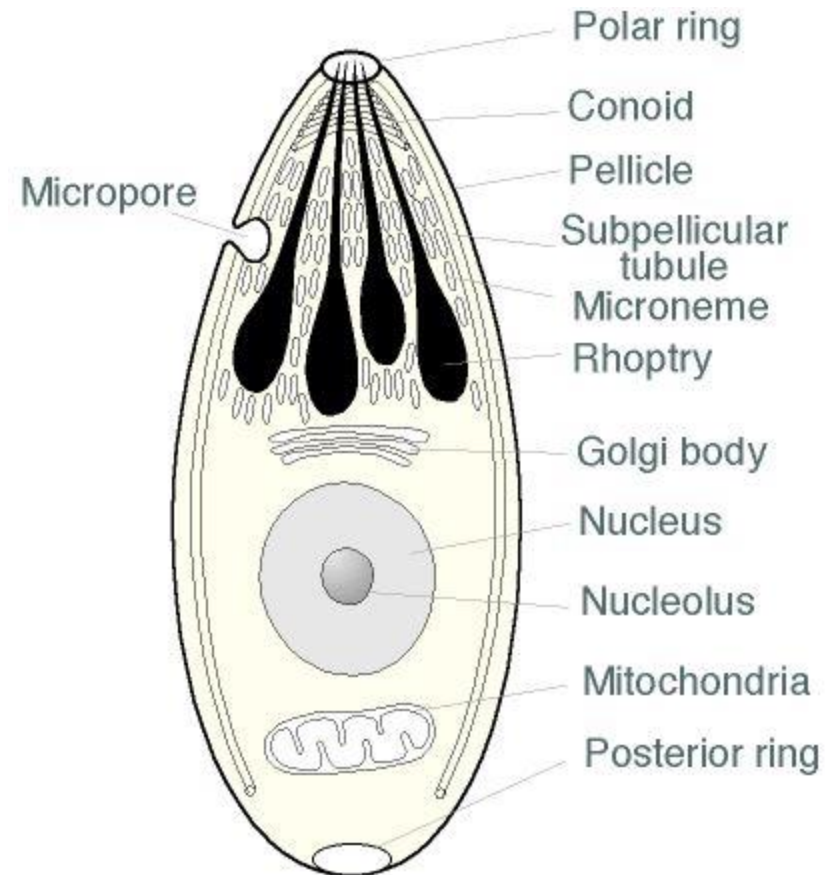
Micronemes (attachment of parasite to host cell)

Subpellicular microtubules

Dense granules

(containing proteins; released after invasion to function in calcium binding and formation of cysts)

- Diverse group
- **All are Parasitic** - endoparasitic
- **Most have complex life cycles**
- Many have a spore stage
- Exquisitely evolved interaction with their host
- Associations range from **avirulent to virulent** pathogens
- No obvious external organelles involved in locomotion
- No cilia or flagella, except for gametes
- Feeding: Osmotrophy, Phagotrophy (**Micropore/Cytostome**)
- Asexual (**Schizogony** or *Endopolyogony*) and sexual reproduction (**Syngamy**, *Conjugation*).
- Include parasites with huge impact on human and animal health.

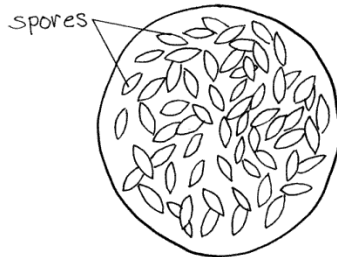
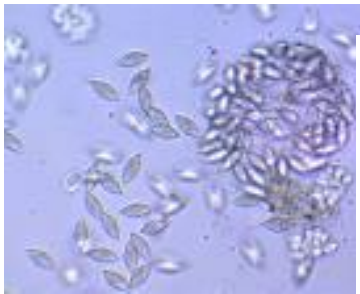


Class Gregarina: Genus *Monocystis*

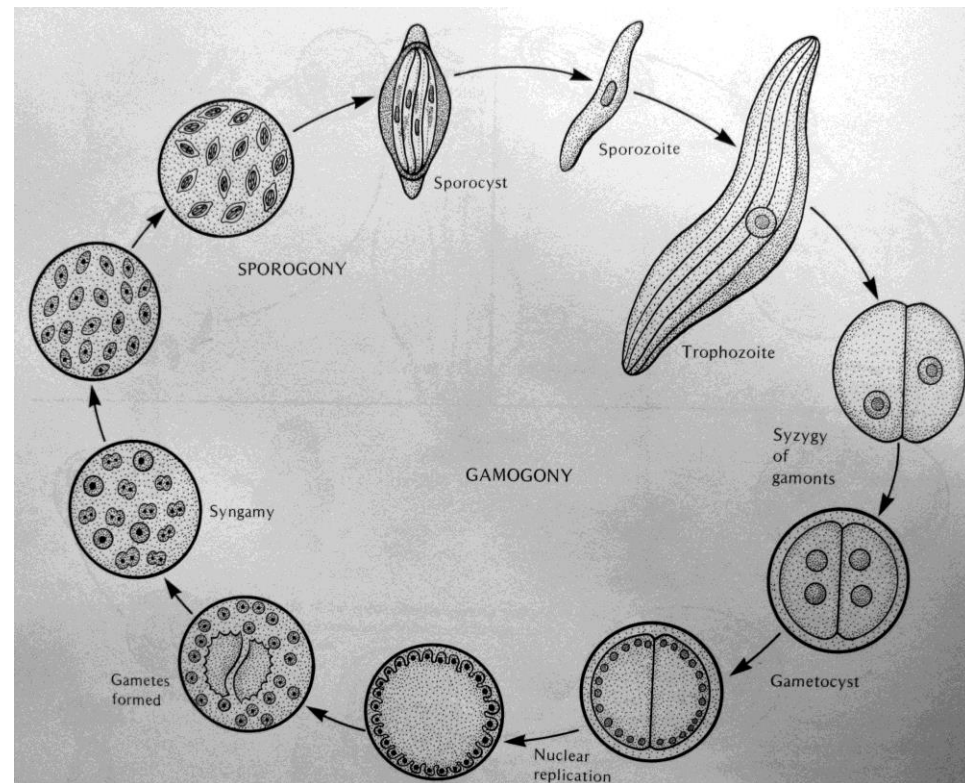
- some elements of AC converted into holdfast organelles (attachment to host cell)
- **Hosts:** invertebrates primarily annelids (earthworm) and arthropods
- no schizogonic phase (trophozoite instead merogony)
- sporozoites form trophozoites in sperm mother cell of earthworm

Life cycle: **direct**

Slide



1. Troph attached to cell
2. Syzygy (2 Trophs associate in cyst)
3. Gamogony
4. Syngamy
5. Sporogony
6. Gametocyst with Oocysts each with 8 Sporozoites



Class Coccidia

Intestinal Coccidia

Eimeria, *Isospora*, *Cyclospora*, *Cryptosporidium*

Order Eimeriidae

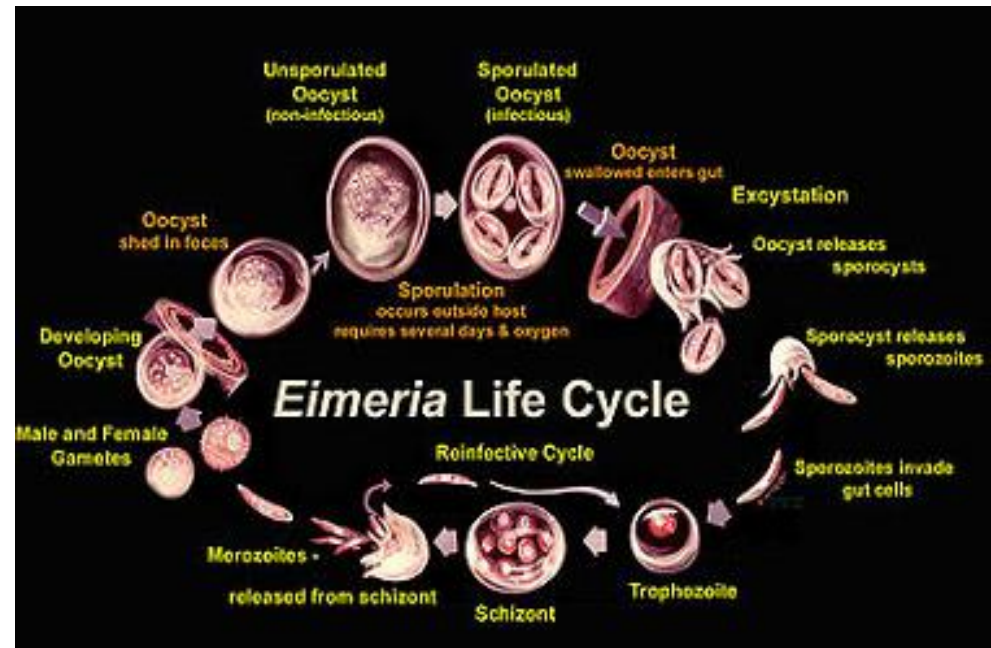
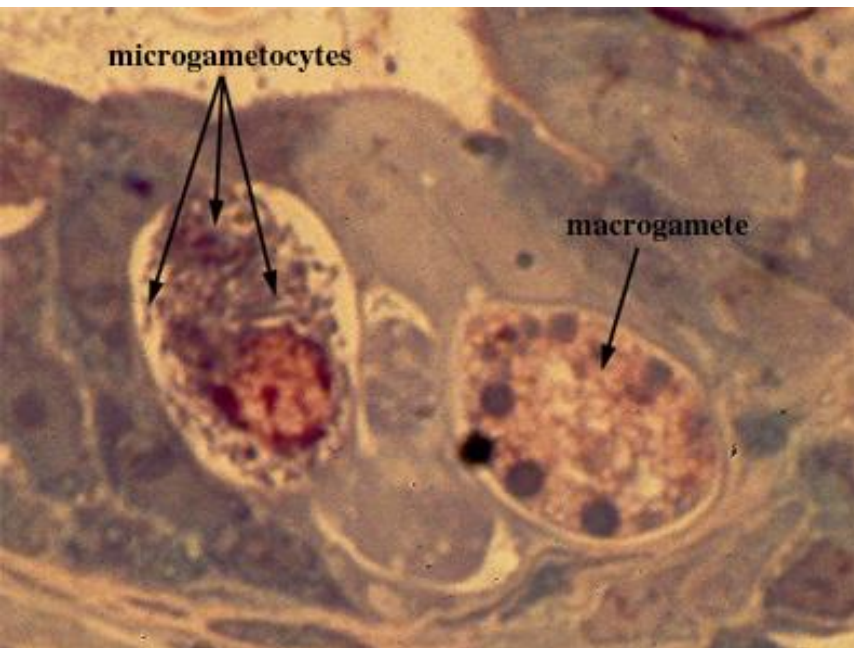
Slide: Liver tissue section infected with *Eimeria stiedae*.

Trophozoites are round inclusions in the biliary epithelium.

Macrogametocytes are large oval bodies with peripheral red-staining granules.

Microgametocytes are few in number and more diffusely stained than macrogametocytes.

Schizonts (contain 6-20 banana-shaped merozoites).



Class Coccidia

Extraintestinal Coccidia (tissue Coccidia)

Toxoplasma, Sarcocystis, Neospora

- ***Toxoplasma gondii***

- **Toxoplasmosis**

- **Hosts (low host specificity)**

Definitive: **Felines** (intestinal tissue)

Intermediate: almost any mammal, bird (most nucleated cell types)

- **Transmission**

Definitive: prey-predator (ingestion of flesh)

Intermediate: Ingestion of oocyst (cat feces)

Ingestion of bradyzoites (raw meat)

Congenital

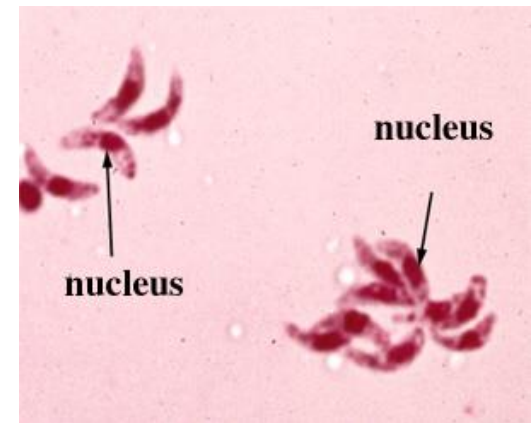
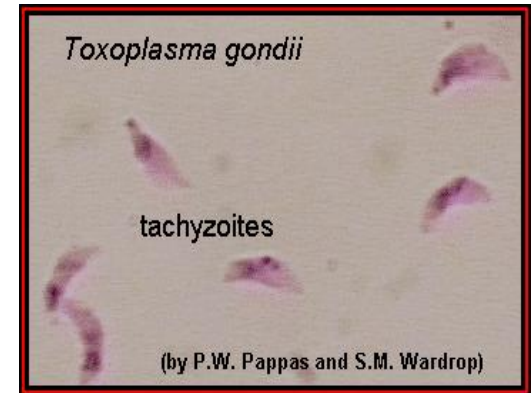
- **Two host indirect life cycle; intermediate host not mandatory!**

- **Pathology**

In most humans infected with *Toxoplasma*, the disease is asymptomatic.

However, under some conditions, toxoplasmosis can cause serious pathology, including hepatitis, pneumonia, blindness, and severe neurological disorders.

→ immuno-compromised individuals (AIDS)



Class Coccidia

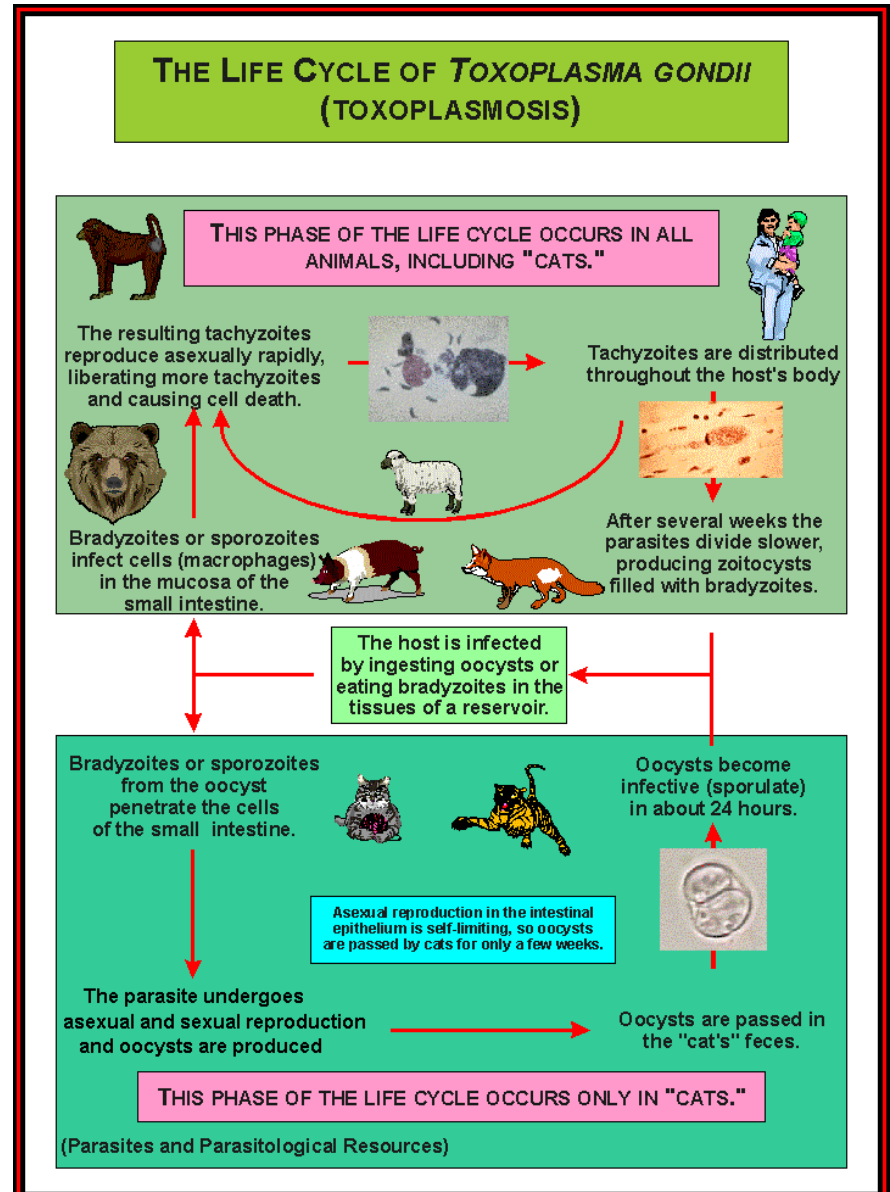
Extraintestinal Coccidia (tissue Coccidia)

Toxoplasma, *Sarcocystis*, *Neospora*

- Two host indirect life cycle; intermediate host not mandatory!

→ Extraintestinal phase (intermediate host)

→ Intestinal phase (definitive host)



Intestinal coccidia:

Eimeria, Isospora, Cryptosporidium

Genetically programmed number of asexual cycles-
sexual reproduction-oocysts- exit with feces

Extra Intestinal coccidia:

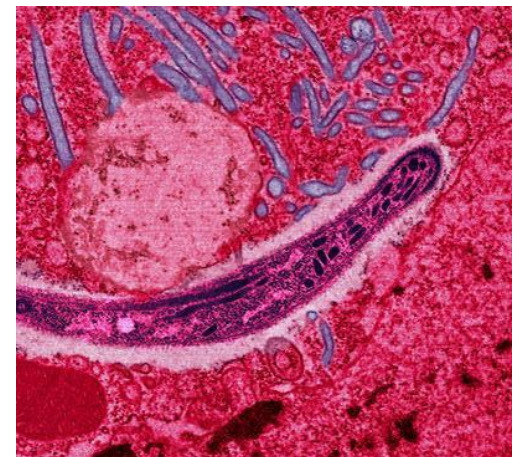
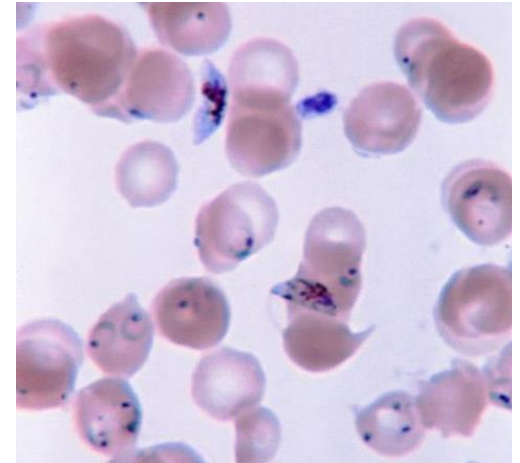
Toxoplasma, Sarcocystis

Genetically programmed number of asexual cycles-
sexual reproduction-oocysts- exit with feces **some
stages enter muscle or other tissues- transmitted
via predation**

Class Heamosporidia

Genus *Plasmodium*

- This group includes the **most pathogenic parasites of man**.
- Cosmopolitan disease in tropical and sub tropical regions of the world
- Most important vector-borne disease
- Romans called it “mala aria” - disease emanating from the swamps
- The causal agent only identified in 1897
- 40% of the world population is at risk for contracting malaria.
- It occurs in over 90 countries.
- 500 million new cases and 2-3 million deaths annually.
- Problems with vector resistance to insecticides, *Plasmodium* resistance to drugs, no vaccine have made malaria an excellent example of a re-emerging infectious disease.



Class Heamosporidia

Genus *Plasmodium*

Human malaria parasites belong to one of four species

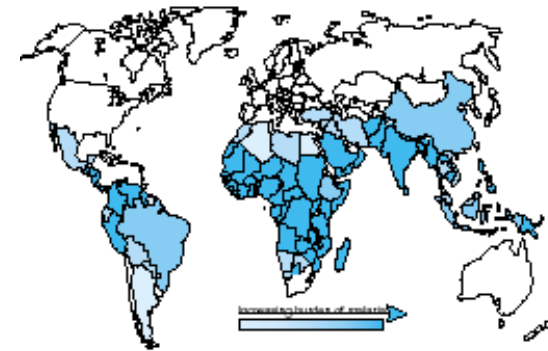
Plasmodium vivax benign tertian malaria, vivax malaria

Plasmodium falciparum malignant tertian malaria, falciparum malaria

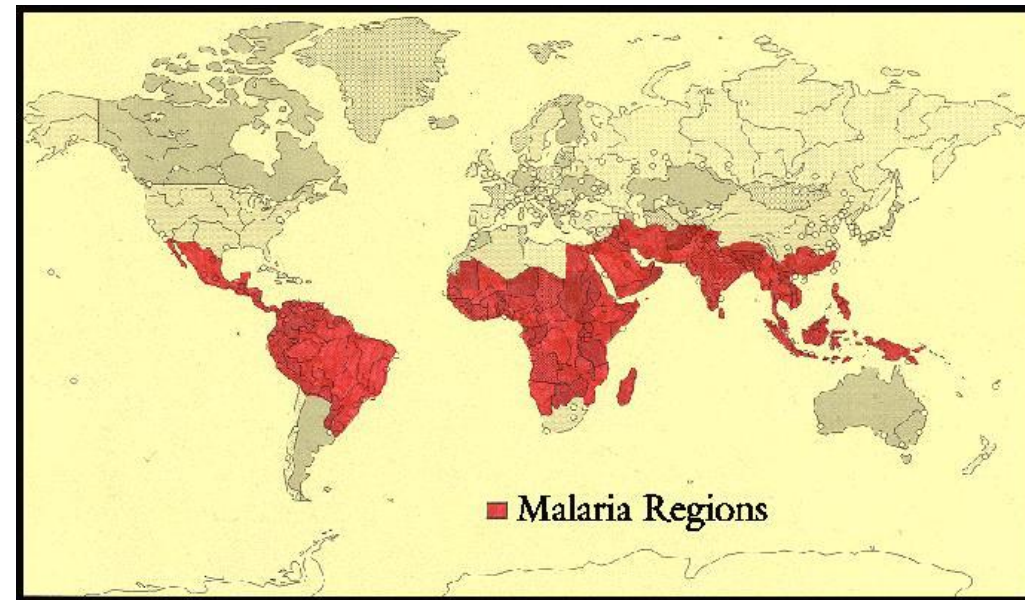
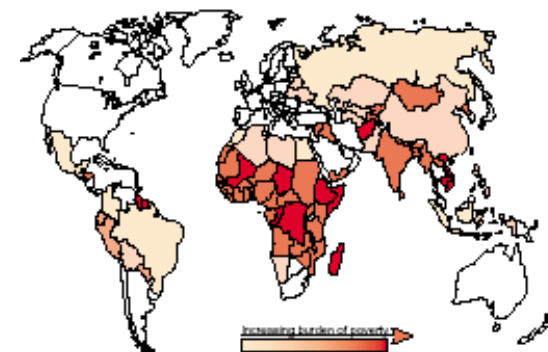
Plasmodium ovale tertian malaria, ovale malaria

Plasmodium malariae quartan malaria, malariae malaria

Estimate of world malaria burden



Estimate of world poverty



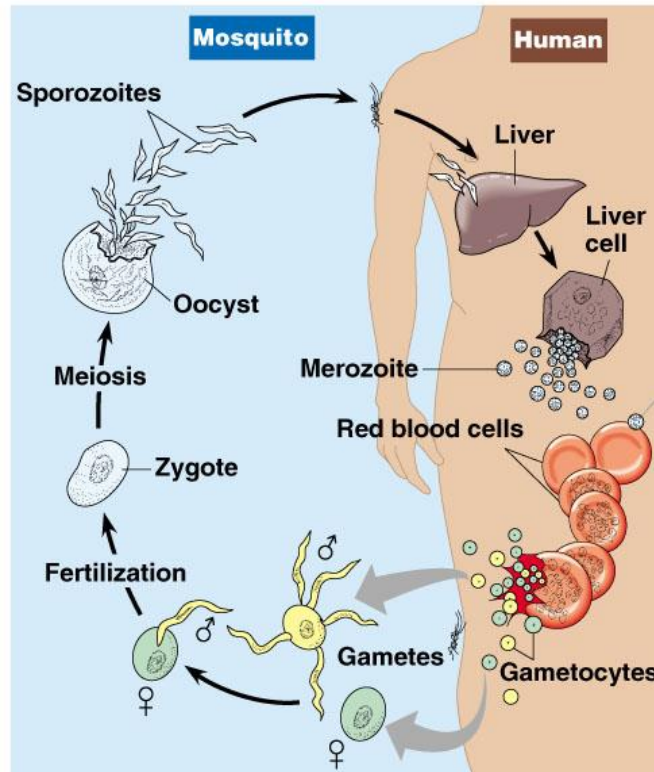
- Cosmopolitan disease in tropical and sub tropical regions of the world
- It occurs in over 90 countries.
- 500 million new cases and 2-3 million deaths annually.
- Most deaths occur among young children in tropical Africa who are infected with *P. falciparum*.

Class *Heamosporidia* Genus *Plasmodium* Life cycle

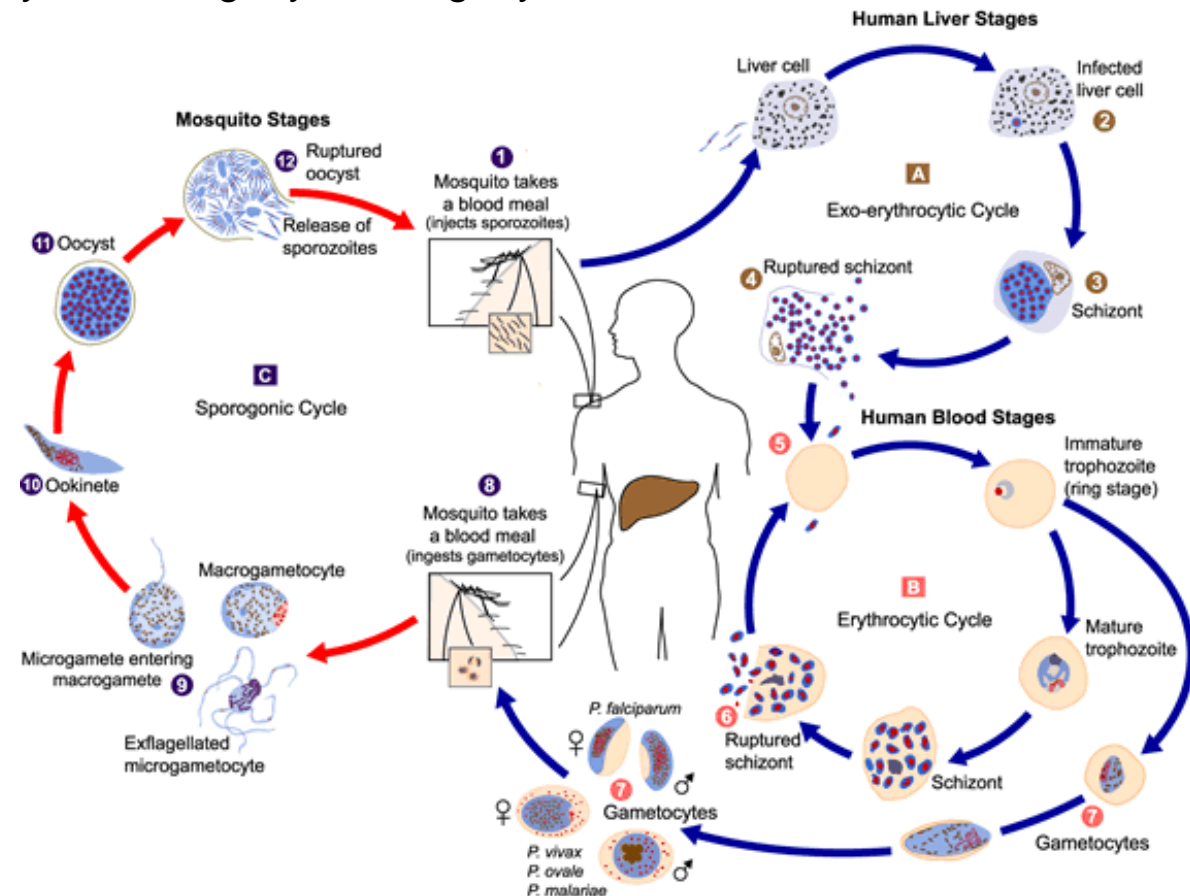
Two host indirect life cycle (Vector required for completion)

Definitive Host: Mosquito; sexual cycle; Maturation of gametes, fertilization, Sporogony

Intermediate Host: Human; asexual cycle; Merogony, Gamogony



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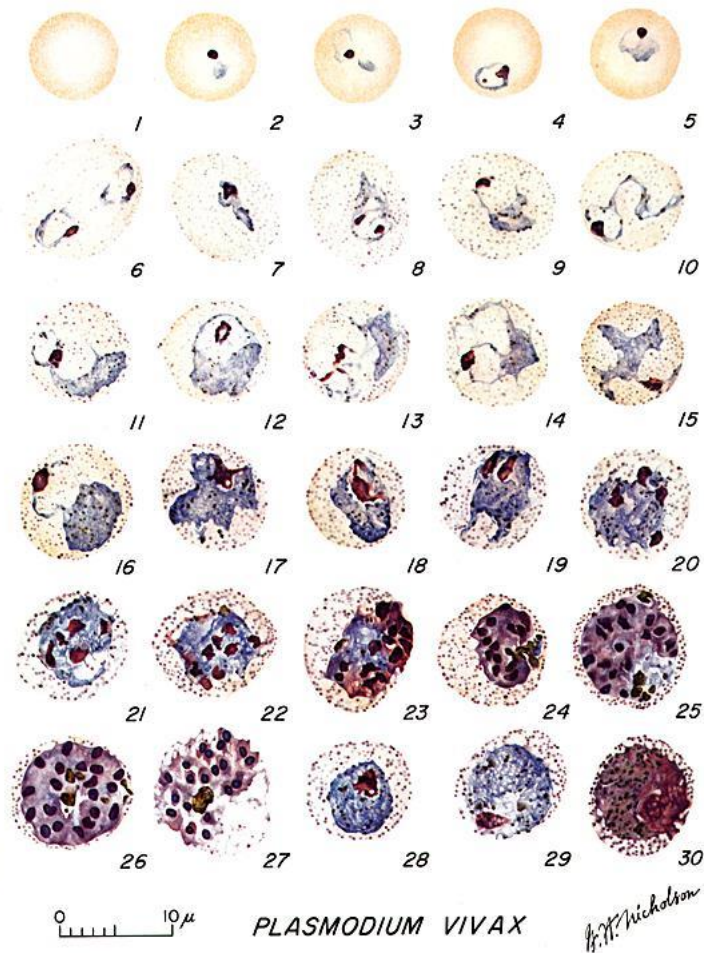


3 Cycles: Sporogonic cycle, Exo-erythrocytic cycle (liver cells), Erythrocytic cycle (RBC)

Class Heamosporidia

Genus *Plasmodium*

Slide: Blood smear of *Plasmodium vivax*. *Plasmodium vivax* can be recognized by its variable ring stage. Schizonts contain **about 16 merozoites** and the infected cell is enlarged and contains **Schuffner's dots**. The disease caused by this *Plasmodium* is mild and known as **benign tertian malaria** (fever paroxysms typically every 48 hours)



Class Heamosporidia

Genus *Plasmodium*

Slide: Blood smear of *Plasmodium falciparum*: has a very neat ring stage trophozoite. Multiply infected cells are common. Schizonts are rare in the peripheral blood. Gametocytes are crescent shaped. The disease caused by this organism is severe and known as **malignant tertian malaria** (fever paroxysms every 48 hours). It is this species that kills the vast majority of humans that die of malaria.

