



# Blood & tissue protozoa

*Plasmodium species*

*Toxoplasma gondii*

*Leishmania species*

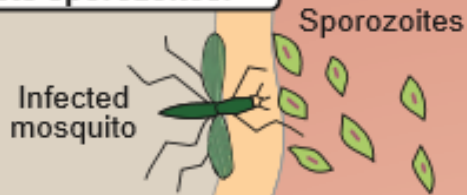
*Trypanosoma species*

# MALARIA

- Malaria is a febrile disease caused by 4 different protozoa: *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium ovale*, and *Plasmodium malariae*.
- They infect about 300-500 million persons worldwide each year, resulting in 20-40 million deaths.
- The female anopheles mosquito carries the organisms within its salivary glands and injects them into humans while it feeds.

# Life cycle

**1** Infected mosquito injects sporozoites.



**2** Sporozoites migrate to the liver, where they form merozoites.



Infection can also result from use of a blood-contaminated needle or transfusion of blood.

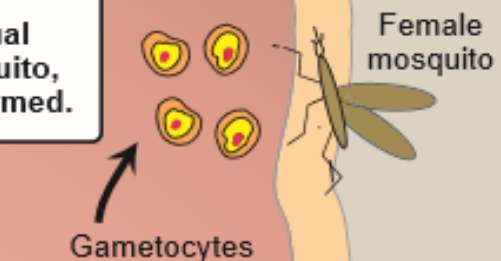
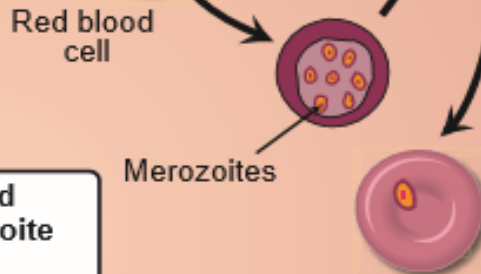
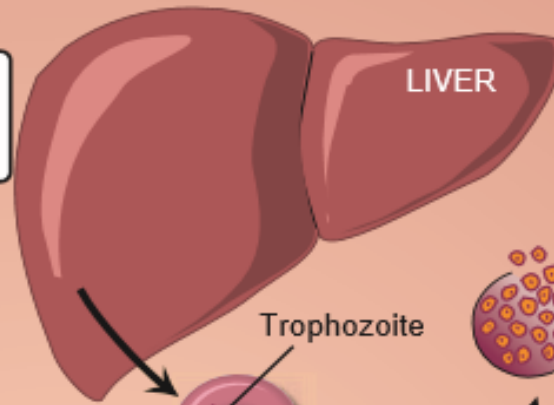
**3** Merozoites are released and invade red blood cells.

**4** In the red blood cell, the merozoite becomes a trophozoite.

**7** The female mosquito picks up gametocytes from an infected human. The sexual cycle occurs in the mosquito, where sporozoites are formed.

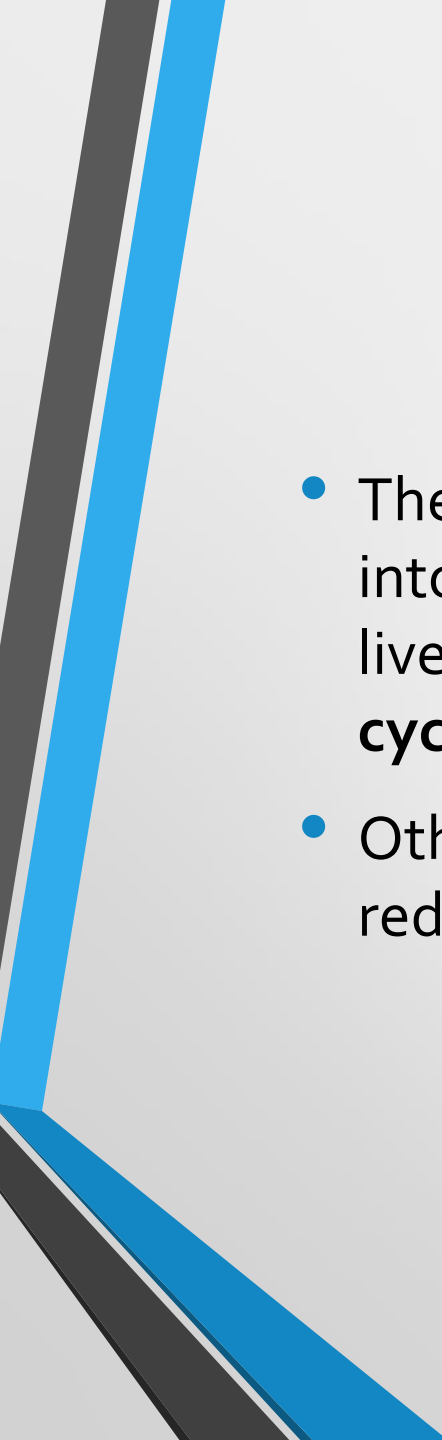
**6** Some merozoites become gametocytes.

**5** In the red blood cell, the trophozoite multiplies, producing new merozoites. These are released when the red blood cell ruptures, and can infect other red blood cells.

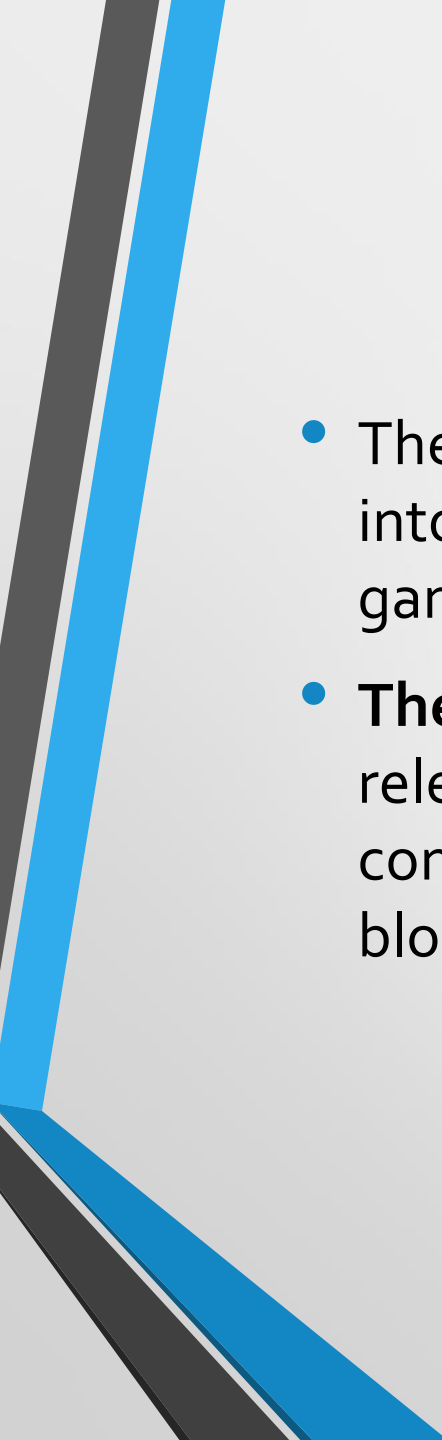


# Life cycle

- Thin, motile, spindle-shaped forms of the *Plasmodium*, called **sporozoites**, swim out of the mosquito's sucker and into the human bloodstream, where they rapidly migrate to the liver.
- There they form cyst-like structures containing thousands of **merozoites**.
- *P. vivax* and *P. ovale*, produce *dormant* forms in the liver (**hypnozoites**) which can grow years later, causing relapsing malaria.

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- The overloaded liver cell bursts, releasing the merozoites into the liver and bloodstream. Some will re-infect other liver cells, which is now called the **exo-erythrocytic cycle**.
  - Other merozoites will enter the bloodstream and enter red blood cells, starting the **erythrocytic cycle**.

- The merozoite rounds up to form a trophozoite. In the red cells the trophozoite is shaped like a ring.
- Nuclear division then occurs with formation of a large multinucleated **schizont**.
- Red cell lysis occurs with release of merozoites. The released merozoites stimulate an immune response, manifested as fevers, chills, and sweats.
- Some merozoites re-infect the RBCs and some become **gametocytes**.

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- The gametocytes are sucked up by the mosquito, then into the stomach where the male and female gametocytes fuse to form **oocyst**.
  - **The oocyst divides** into many sporozoites which are released and migrate to the salivary glands, ready to complete the cycle when the mosquito takes her next blood meal.

- *P. falciparum*, *P. vivax* and *P. ovale* produce chills and fever followed by drenching sweats every 48 hours, which is called **tertian malaria**, while *P. malariae* bursts loose every 72 hours, causing a regular 3-day cycle. This is called **quartan malaria**.
- *P. falciparum*, **the most deadly** of the *Plasmodia*.



# Disease

- Mild :

Periodic episodes of severe chills and high fevers along with profuse sweating at 48-72 hour intervals.

- Severe:

Renal failure, lung edema, hepatosplenomegaly and may result in **cerebral malaria** characterized by seizures and impaired consciousness, leading to coma.

# Diagnosis

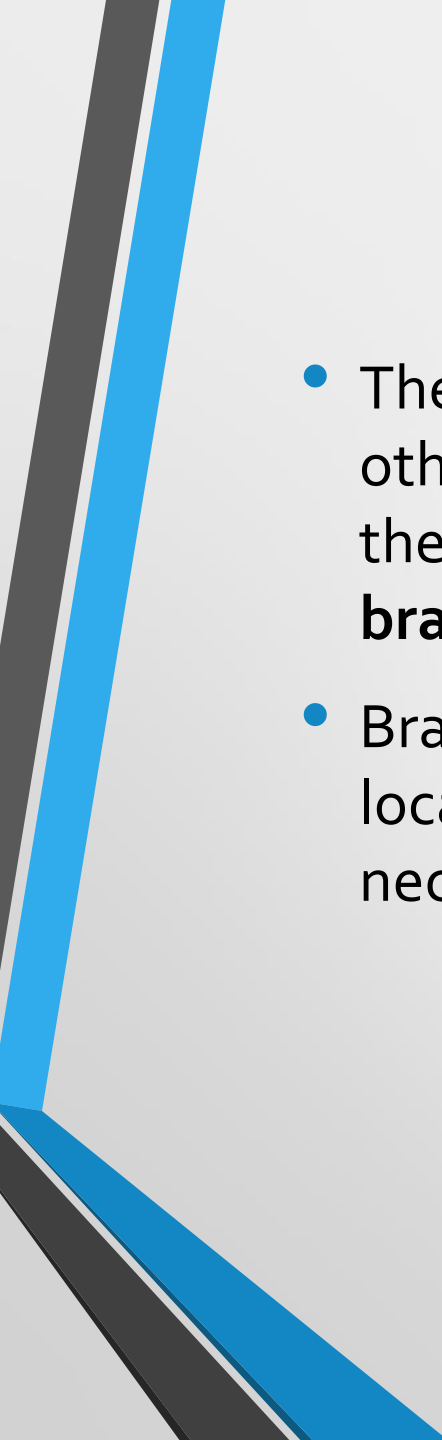
Examination of the of blood reveals the trophozoites (ring stage) within the erythrocytes.

# *TOXOPLASMA GONDII*

- *Toxoplasma gondii*, the cause of **toxoplasmosis**, is an obligate intracellular sporozoa.
- The disease is transmitted to other host species by the ingestion of oocysts passed in the feces of infected felines.

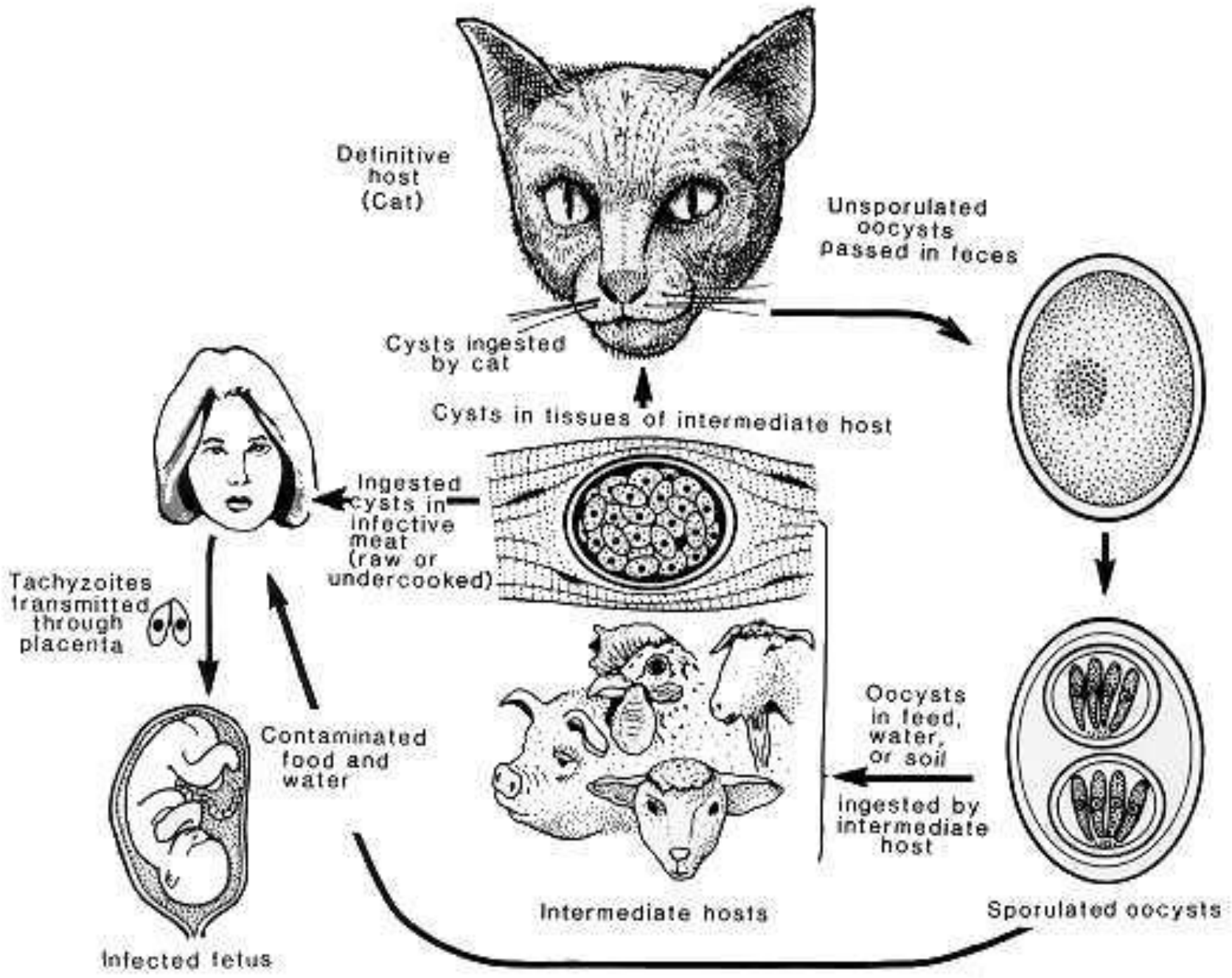
# Intermediate Hosts

- **Ingestion of cysts** by humans and other mammals in undercooked meat or from contact with cat feces.
- In the small intestine, the cysts rupture and release forms that invade the gut wall, where they are ingested by macrophages and differentiate into rapidly multiplying trophozoites (**tachyzoites**), which kill the cells and infect other cells.

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- The parasites enter host cells in the brain, muscle, and other tissues, where they develop into cysts in which the parasites multiply slowly. These forms are called **bradyzoites**.
  - Bradyzoites released from ruptured tissue cysts cause local inflammation with blockage of blood vessels and necrosis

# Definitive Host

- The cycle within the cat begins with the ingestion of cysts in raw meat, e.g.: mice.
- **Bradyzoites** are released from the cysts in the small intestine, infect the mucosal cells, and differentiate into male and female gametocytes, whose gametes fuse to form **oocysts** that are excreted in cat feces.



# TOXOPLASMOSIS

- In the vast majority of patients, infection with *T. gondii* is *completely asymptomatic*.
- However, they can be very severe in immunocompromised individuals.



# Congenital Toxoplasmosis

- **Congenital infection** of the fetus occurs *only* when the mother is infected during pregnancy.
- Congenital infections can also be severe, resulting in stillbirths, brain lesions, and hydrocephaly, and they are a major cause of blindness in newborns.