

Plasmodium Handout

Phylum Apicomplexa

- large and diverse group
- originally called sporozoa
- no free-living forms
- complex life cycles
 - spore-like stages
 - intracellular stages
- defined by apical organelles
 - rhoptries
 - micronemes
- gliding motility

Apicomplexans infecting humans

Plasmodium
Babesia
Toxoplasma
Sarcocystis
Isospora
Cryptosporidium
Cyclospora

Genus *Plasmodium*

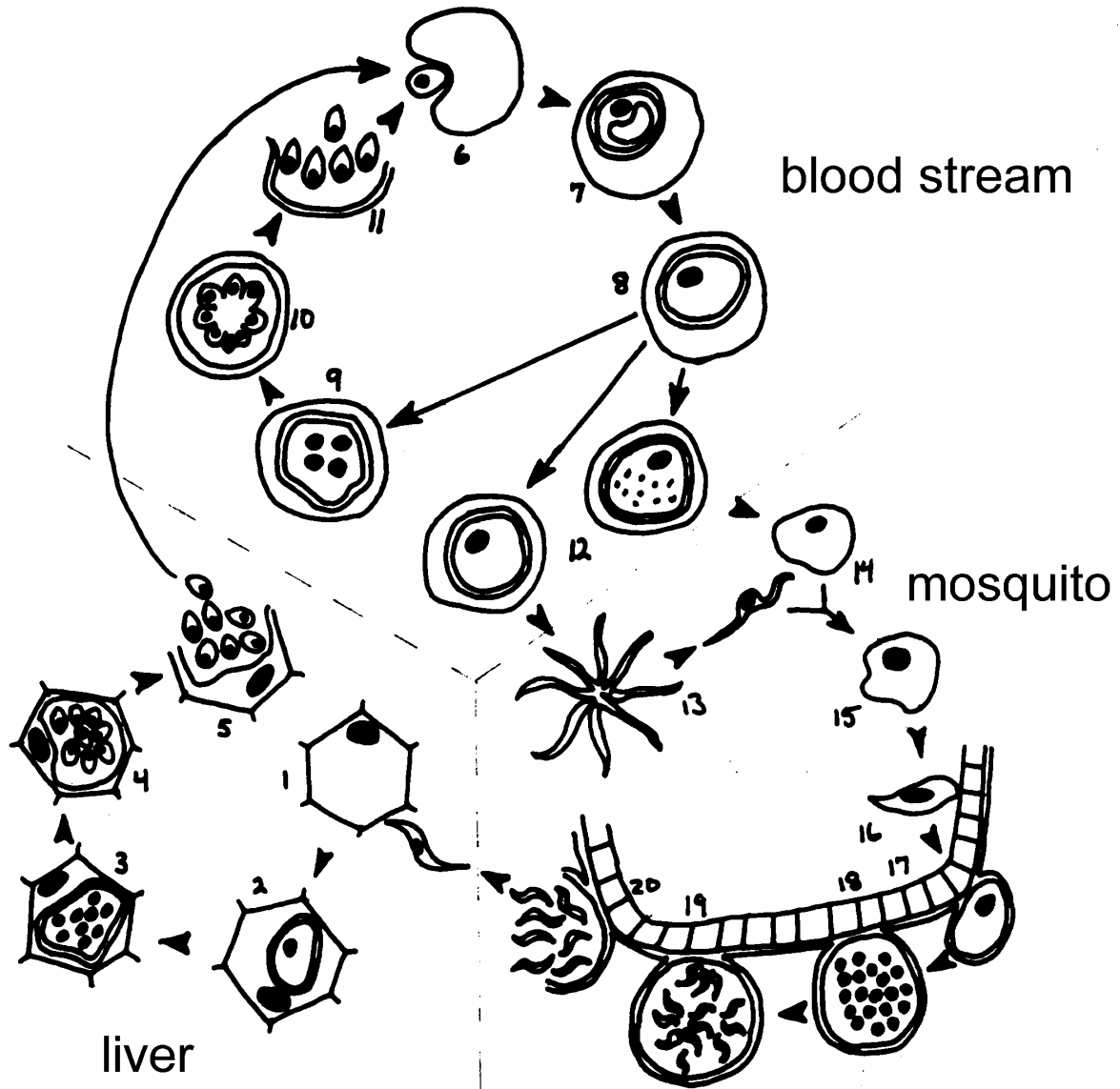
- ~155 named species
- vertebrate hosts include: reptiles, birds, rodents, monkeys, and humans
 - highly specific for host and vector
 - 4 human species: *P. falciparum*, *P. vivax*, *P. ovale*, *P. malariae*
 - no zoonoses or animal reservoirs
- transmitted by insect vector
 - *Anopheles* mosquito (mammalian)

Life Cycle

- transmitted by mosquitoes
- sporozoites invade liver cells
- exoerythrocytic schizogony
- merozoites invade RBCs
- repeated erythrocytic schizogony
- gametocytes infective for mosquito
- fusion of gametes in gut
- sporogony on gut wall in hemocoel
- sporozoites invade salivary glands

Plasmodium Life Cycle

The malaria parasite exhibits a complex life cycle involving an insect vector (mosquito) and a vertebrate host (human). Four *Plasmodium* species infect humans: *P. falciparum*, *P. vivax*, *P. ovale* and *P. malariae*. All four species exhibit a similar life cycle with only minor variations.



Exoerythrocytic Schizogony

- hepatocyte invasion
- asexual replication
- 6-15 days
- 1000-10,000 merozoites produced depending on species
- no overt pathology
- hypnozoite forms in *Pv* and *Po*
 - causes true relapses

Merozoite Invasion

- merozoite recognizes receptors on erythrocyte surface
- reorientation so apical end is juxtaposed to host membrane
- micronemes and rhoptries participate in cell invasion
- parasite lies within parasitophorous vacuole surrounded by parasitophorous vacuolar membrane (PVM)
- other invasive stages also use similar mechanism

Erythrocytic Schizogony

- intracellular parasite undergoes trophic phase (= trophozoites)
- young trophozoite called 'ring form'
- ingests host hemoglobin via cytostome
- hemoglobin digested within food vacuole
- heme converted into hemozoin (malarial pigment)
- multiple rounds of nuclear division without cytokinesis (= schizont)
- merozoites bud from the mature schizont (= segmenter)
- merozoites released following rupture of the infected erythrocyte

Gametocytogenesis

- alternative to asexual replication
- induction factors not known
- microgametocytes and macrogametocytes formed
- no pathology for human host
- infective stage for mosquito

Gametogenesis

- occurs in mosquito gut
- 'exflagellation' of microgametocyte
 - 3X rounds of nuclear replication
 - 8 microgametes formed
- exposure to air induces *in vitro*
 - temperature drops (2-3°C)
 - pH rises (8-8.3)
 - result of ↓ pCO₂
- gametocyte activating factor in mosquito (= xanthurenic acid)

Sporogony

- occurs in mosquito (9-21 d)
- fusion of micro- and macrogametes
- zygote → ookinete (~24 hr)
- ookinete transverse gut epithelium ('trans-invasion')
- ookinete → oocyst
- oocysts lies between epithelium and basal lamina
- asexual replication → sporozoites
- sporozoites released into hemocoel and 'invade' salivary glands