Foundation Block

Introduction to Parasitology

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- The natural ecology of malaria involves malaria parasites infecting successively two types of hosts: humans and female Anopheles mosquitoes. In humans, the parasites grow and multiply first in the liver cells and then in the red cells of the blood. In the blood, successive broods of parasites grow inside the red cells and destroy them, releasing daughter parasites ("merozoites") that continue the cycle by invading other red cells.

- The blood stage parasites are those that cause the symptoms of malaria. When certain forms of blood stage parasites ("gametocytes") are picked up by a female Anopheles mosquito during a blood meal, they start another, different cycle of growth and multiplication in the mosquito.

- After 10-18 days, the parasites are found (as "sporozoites") in the mosquito's salivary glands. When the Anopheles mosquito takes a blood meal on another human, the sporozoites are injected with the mosquito's saliva and start another human infection when they parasitize the liver cells.

- Thus the mosquito carries the disease from one human to another (acting as a "vector"). Differently from the human host, the mosquito vector does not suffer from the presence of the parasites

DEFINITIONS

- ***Infection:***
  - **The entry , development and multiplication of an infectious agent in the body of humans or animals. The result may be:**
    - **inapparent (asymptomatic) infection, or**
    - **manifest (symptomatic) *infection..***

DEFINITIONS

- ***Host:***
  - A human or animal which harbors an infectious agent under natural conditions .

- ***Definitive host (primary host):***
  - A host in which the parasite passes its **sexual stage**.
- ***Intermediate host (secondary host):***
  - A host in which the parasite passes its **larval** or **asexual stages**.

DEFINITIONS

- ***carrier:***
  - A person or animal that harbors a specific infectious agent in the absence of symptoms and signs of a disease and serves as a ***potential source of infection***
- ***pathogenesis:***
  - Production and development of disease.
- ***pathogenicity:***
  - Capability of an infectious agent to cause disease in a ***susceptible*** host.

DEFINITIONS

- **Parasitism:**
  - A relationship in which an organism (the infectious agent, the parasite) **benefits** from the association with another organism *(the host)* whereas the host is **harmed** in some way.

- **commensalism:**
  - Kind of relationship in which one organism , the commensal , is **benefited** whereas t , the host , *is* **not** harmed but or even helped by this association.

DEFINITIONS

- ***Ectoparasite:*** parasite that lives on the outer surface of its host.
- ***Endoparasite:*** Parasite that lives inside its host.
- ***zoonosis:*** Disease of animals that is transmissible to humans .

Scientific names of parasites follow Zoological Classification

Kingdom

Division

Class

Order

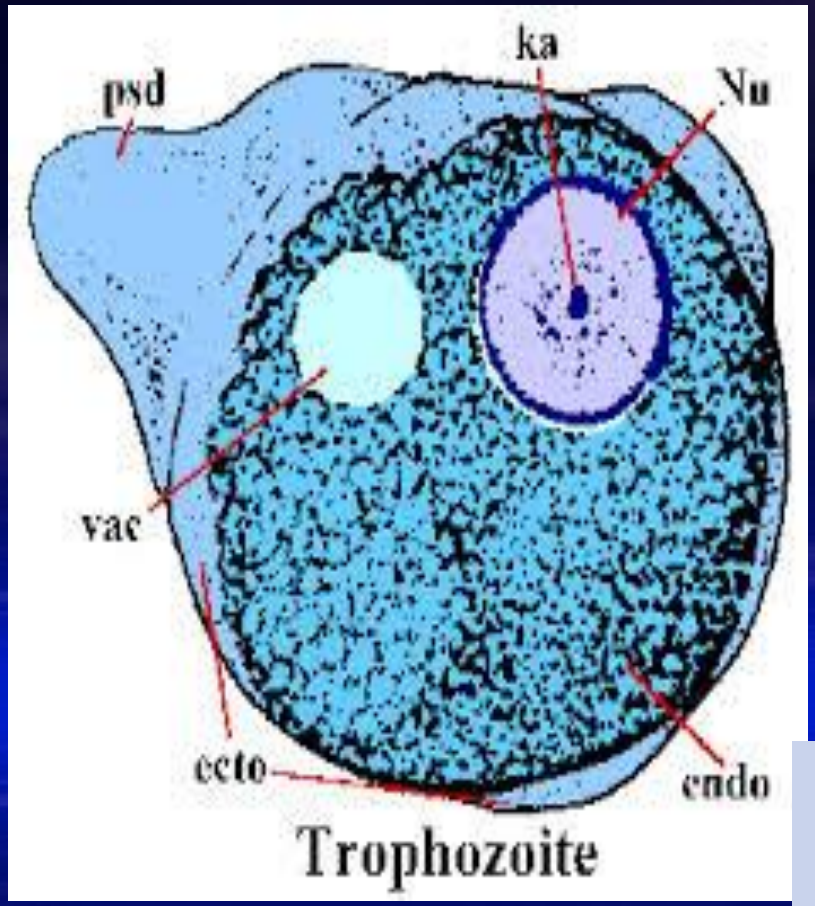
Family

Genus

Species

CLASSIFICATION OF PARASITES

PROTOZOA	HELMINTHS
Unicellular Single cell for all functions	Multicellular Specialized cells
1:Amoebae: move by pseudopodia. 2:Flagellates: move by flagella. 3:Ciliates: move by cilia 4:Apicomplexa(Sporozoa) tissue parasites	Round worms (Nematodes): - elongated, cylindrical, unsegmented. Flat worms : - Trematodes: leaf-like, unsegmented. - Cestodes: tape-like, segmented.


psd
ka
Nu
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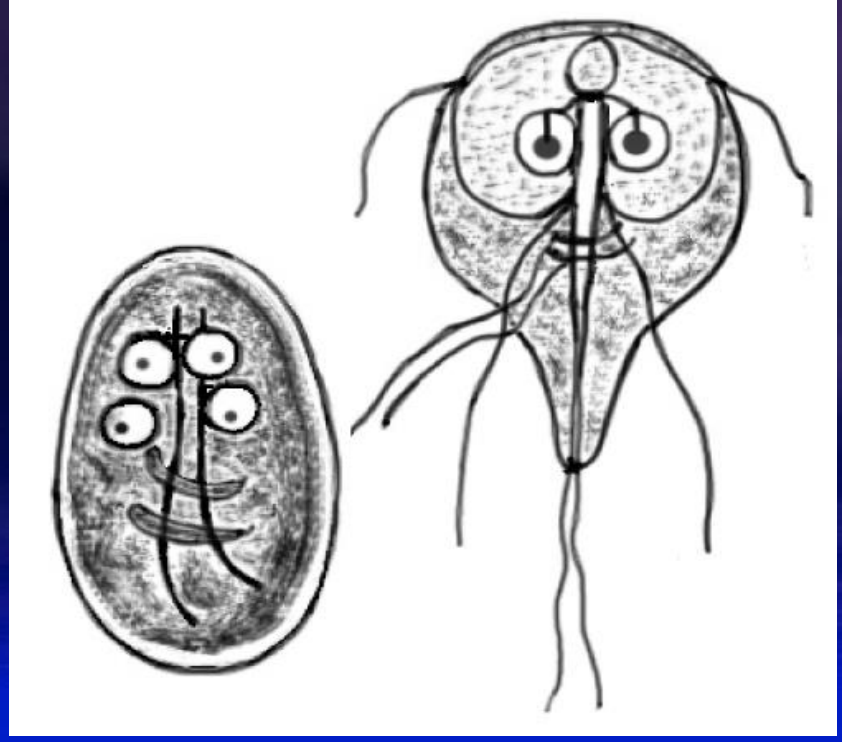
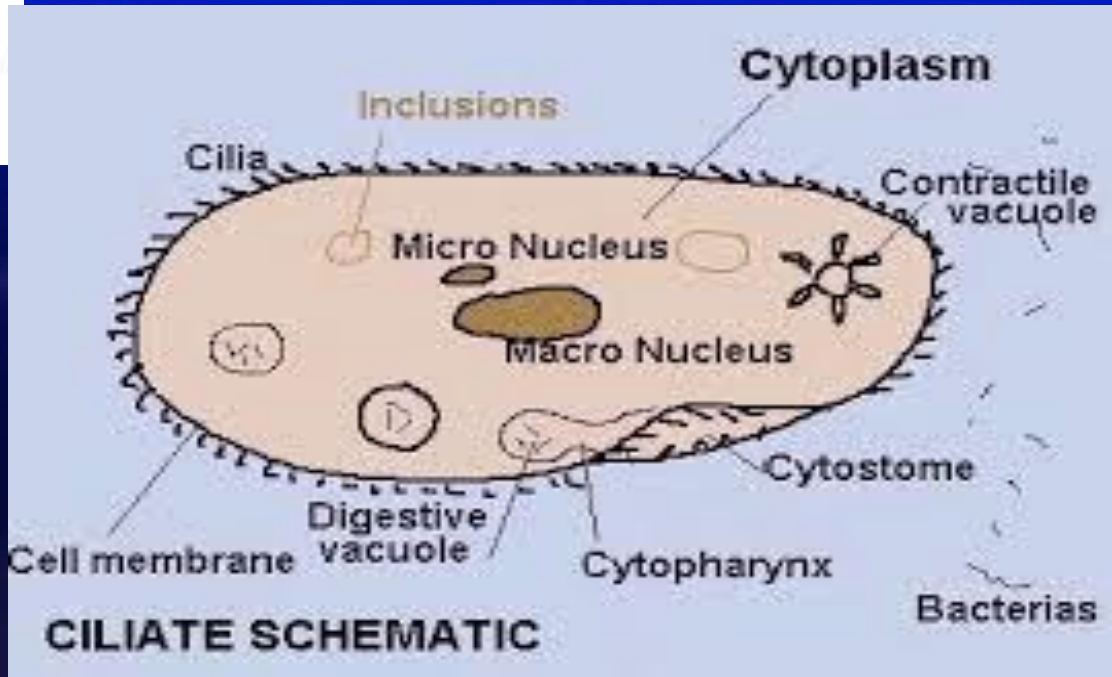
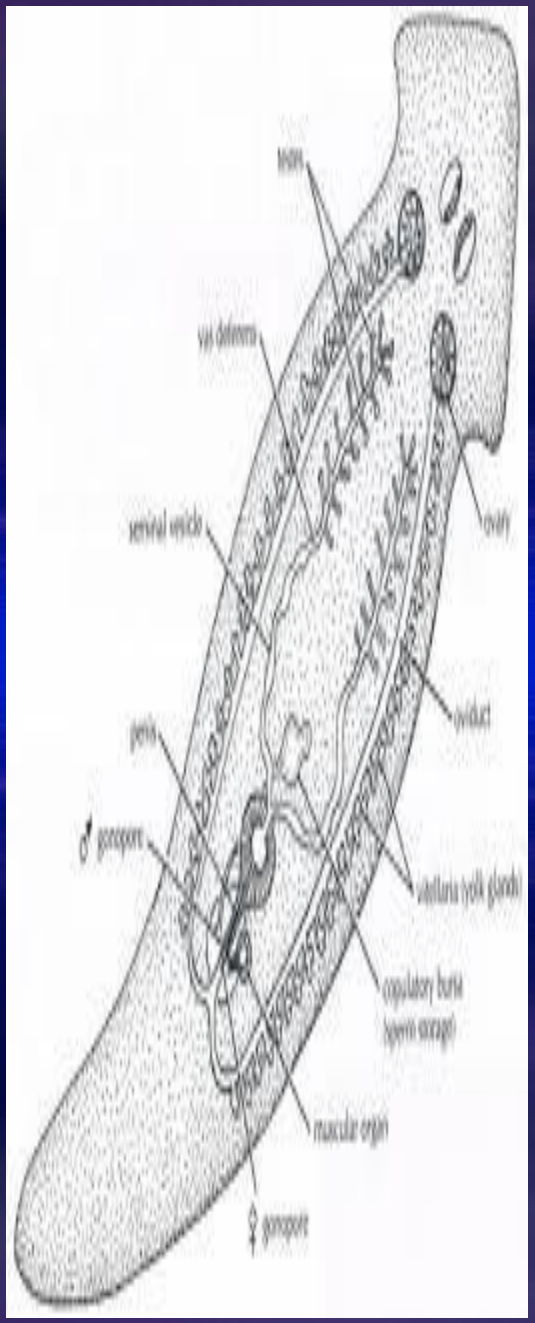
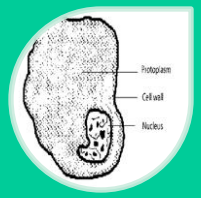
Trophozoite



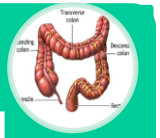

Cytoplasm
Inclusions
Cilia
Contractile vacuole
Micro Nucleus
Macro Nucleus
Cytostome
Digestive vacuole
Cell membrane
Cytopharynx
Bacterias
CILIATE SCHEMATIC


brain
ventral vessels
ovary
oviduct
pharynx
seminal vesicle
♂ gonopore
♀ gonopore

Parasitic Protozoa



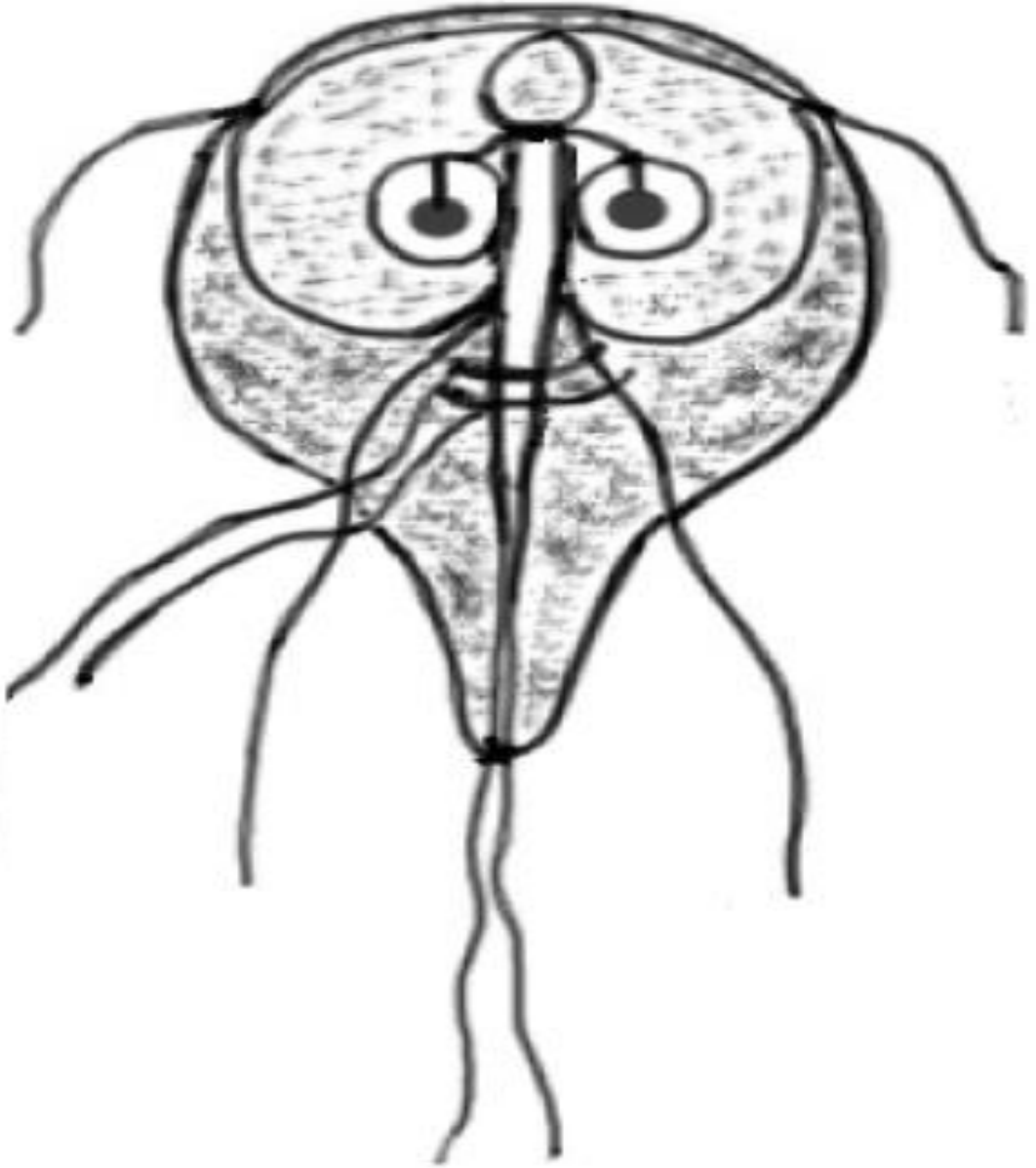
Intestinal



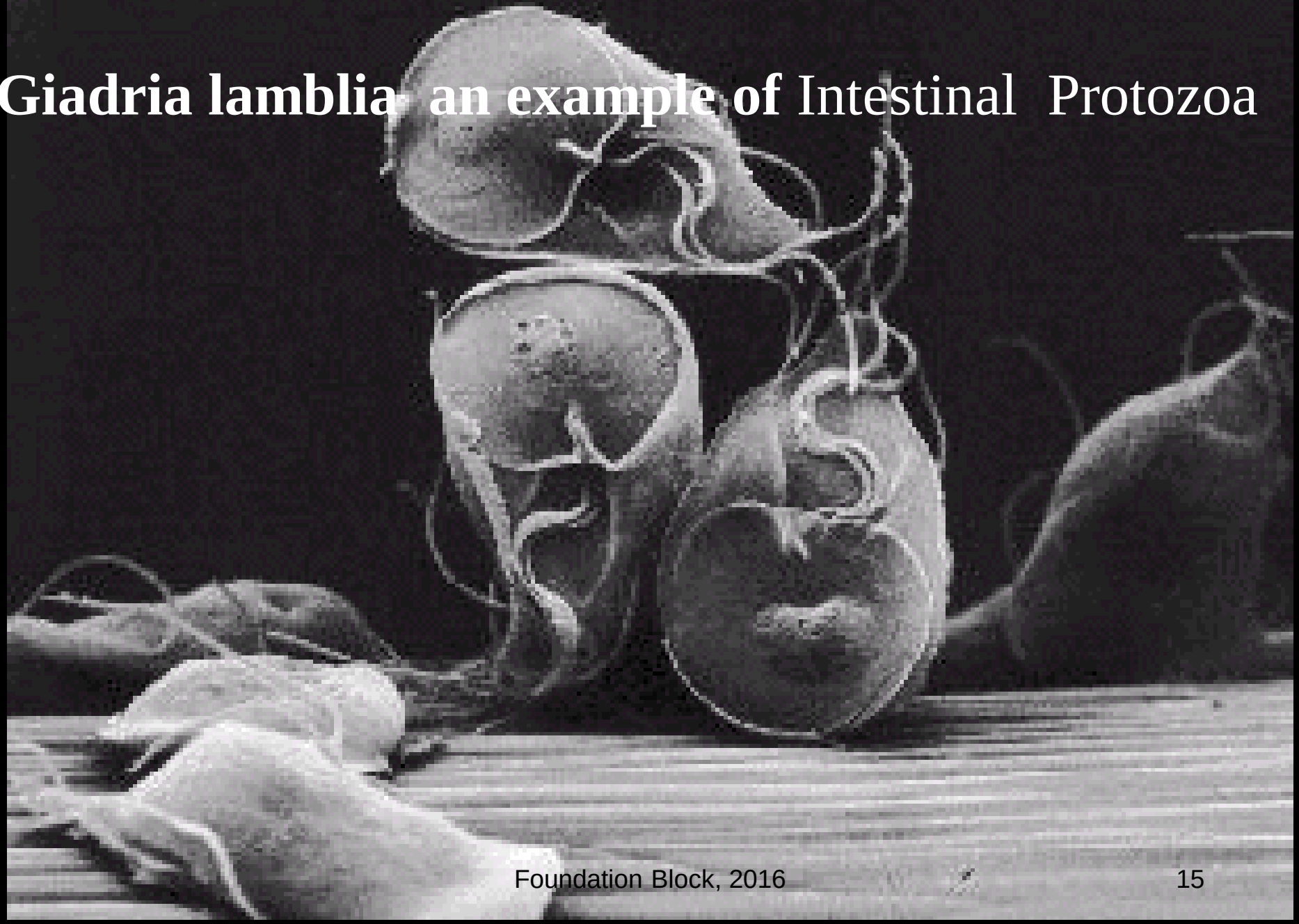
Blood and tissues

Examples of Diseases caused by Intestinal Protozoa

Parasite	Disease
Giardia lamblia	giardiasis
Entamoeba histolytica	amoebiasis



Giadria lamblia- an example of Intestinal Protozoa



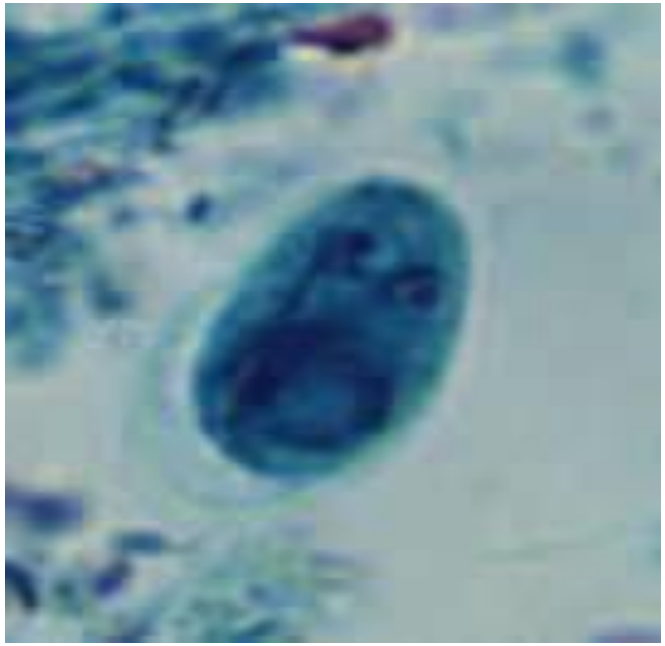
Life

In the life cycle of Plasmodium, a female Anopheles mosquito (the definitive host) transmits a motile infective form (called the sporozoite) to a vertebrate host such as a human (the secondary host), thus acting as a transmission vector. A sporozoite travels through the blood vessels to liver cells (hepatocytes), where it reproduces asexually (tissue schizogony), producing thousands of merozoites. These infect new red blood cells and initiate a series of asexual multiplication cycles (blood schizogony) that produce 8 to 24 new infective merozoites, at which point the cells burst and the infective cycle begins anew.

Other merozoites develop into immature gametocytes, which are the precursors of male and female gametes. When a fertilised mosquito bites an infected person, gametocytes are taken up with the blood and mature in the mosquito gut. The male and female gametocytes fuse and form a fertilized, motile zygote which develop into new sporozoites that migrate to the insect's salivary glands, ready to infect a new vertebrate host. The sporozoites are injected into the skin, in the saliva, when the mosquito takes a subsequent blood meal.

Only female mosquitoes feed on blood; male mosquitoes do not transmit the disease. The females of the Anopheles mosquito prefer to feed at night.

Giardia **cyst**
(infective stage)

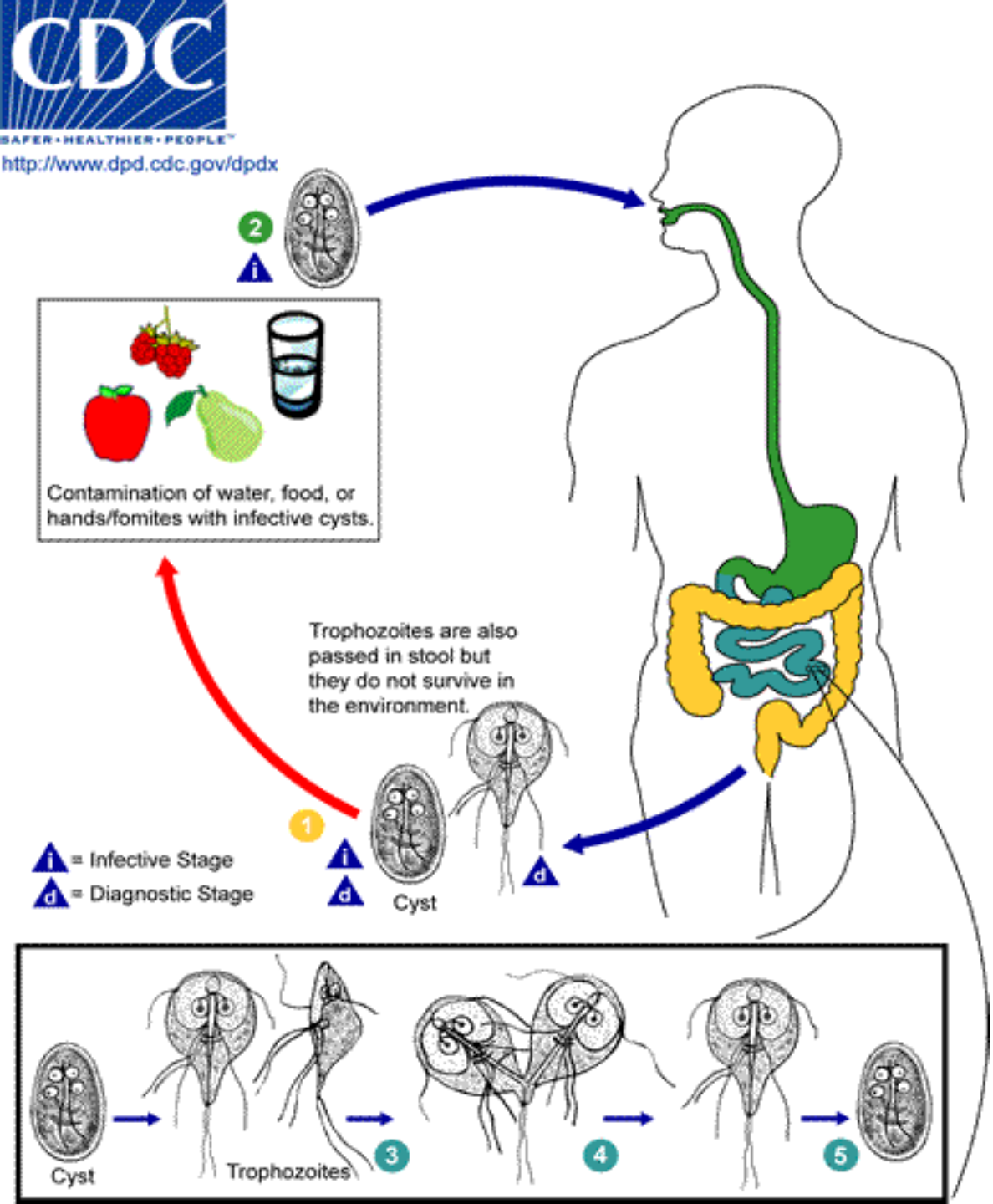


Giardia **trophozoite**

Giardia lamblia

Can cause diarrhea with poor absorption of the nutrient,loss of appetite,stomach cramp,vomiting.

Giardia infect the cells of the duodenum and jejunum.



1-. Giardia **cysts** are the infective stage of *G. intestinalis*. As few as 10 cysts can cause infection , These cysts are ingested by consuming contaminated food or water, or fecal-orally. They can survive outside the body for several months, and are also relatively resistant to chlorination, UV exposure and freezing.

2_. When cysts are ingested, the low pH of the ***stomach*** ,the acidity produces excystation , ***Excystation*** means the releases of **trophozoites** .

3. Within the small intestine(duodenum,jejunum), the trophozoites reproduce asexually (binary fission) and either float free or are attached to the mucosa of the lumen.

4. Some trophozoites then ***encyst*** in the **small intestine** (become cyst), Both cysts and trophozoites are then passed in the feces, but only the **cyst** is infectious ,

Person-to-person transmission is possible, Animals can also be infected with Giardia .

Examples of Diseases caused by Blood and Tissue Protozoa

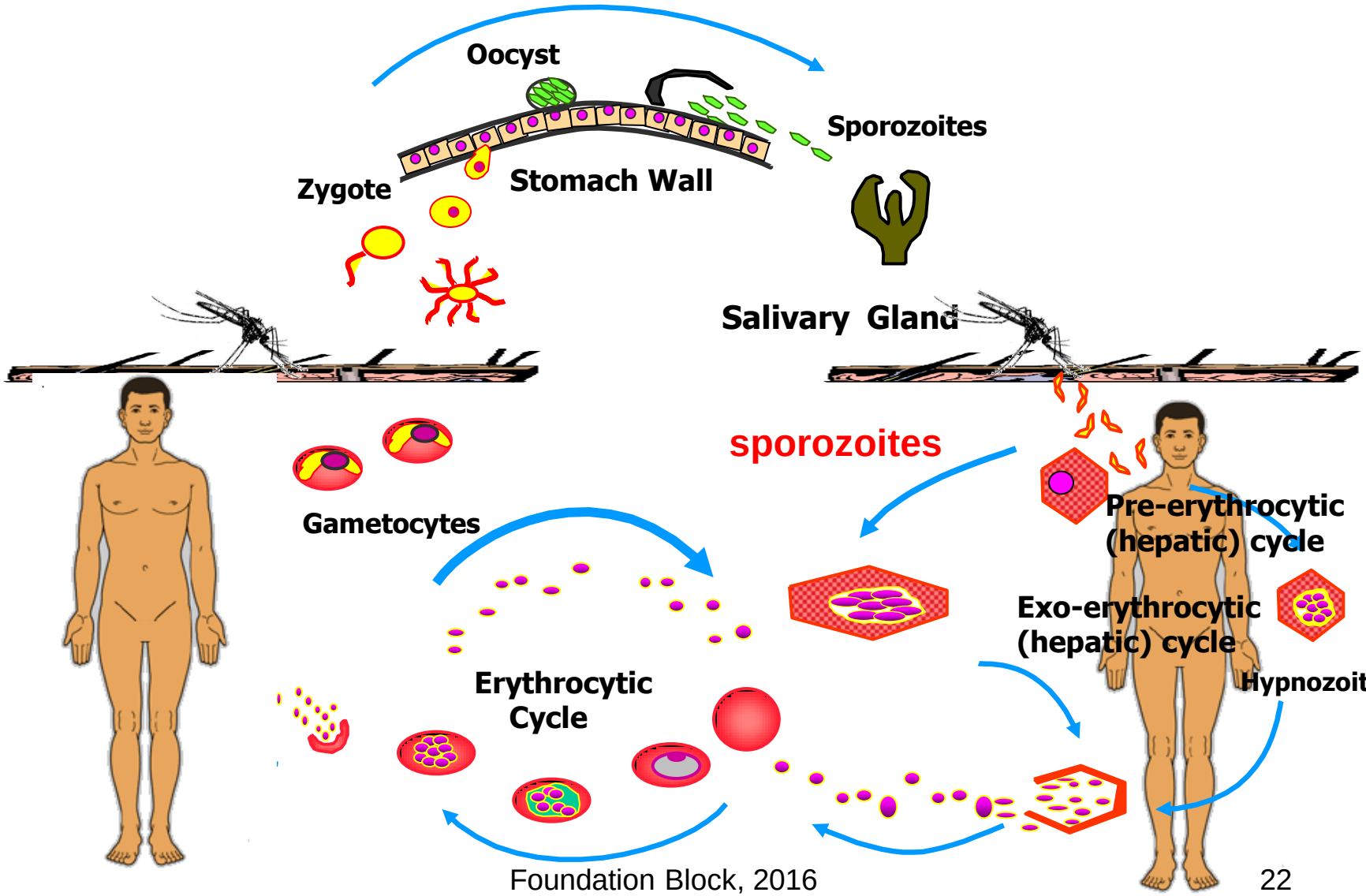
Parasite	Disease
Plasmodium spp	malaria

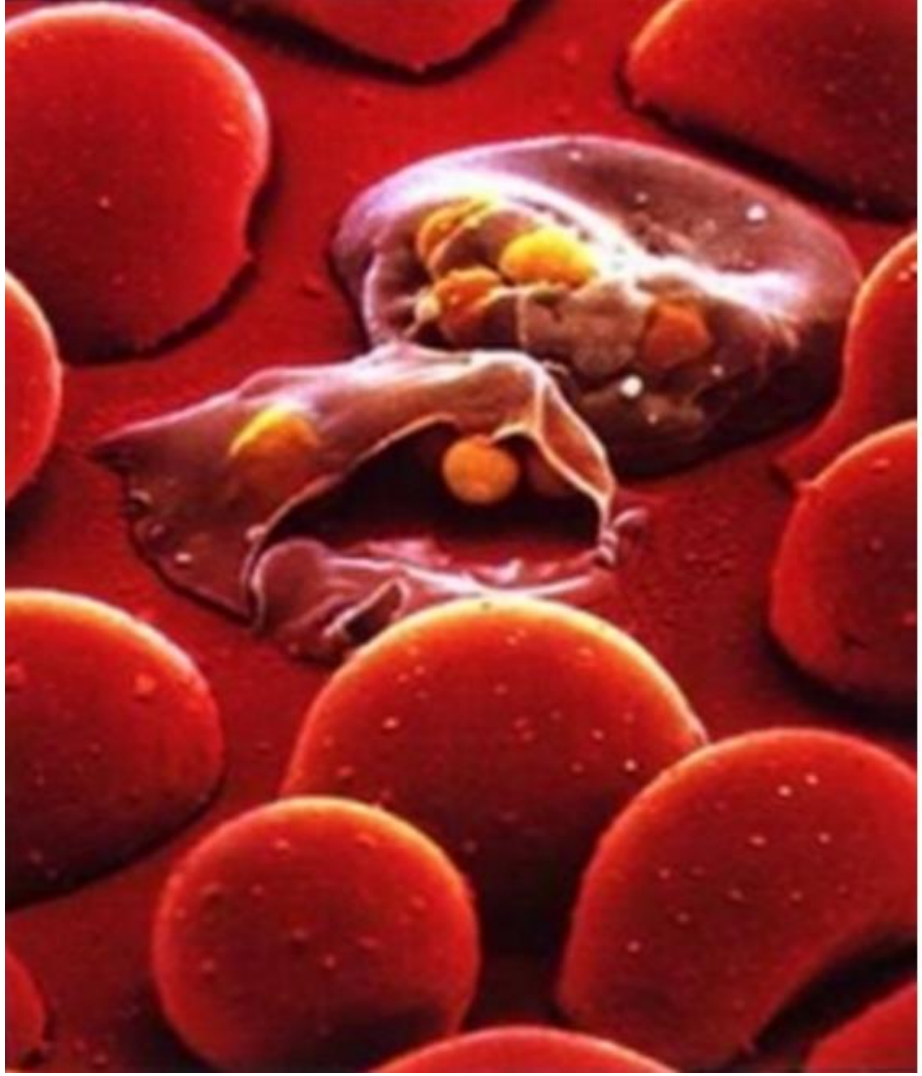
Malaria Species

Four main species of malaria :

Plasmodium falciparum
Plasmodium vivax
Plasmodium ovale
Plasmodium malariae

LIFE CYCLE OF MALARIA





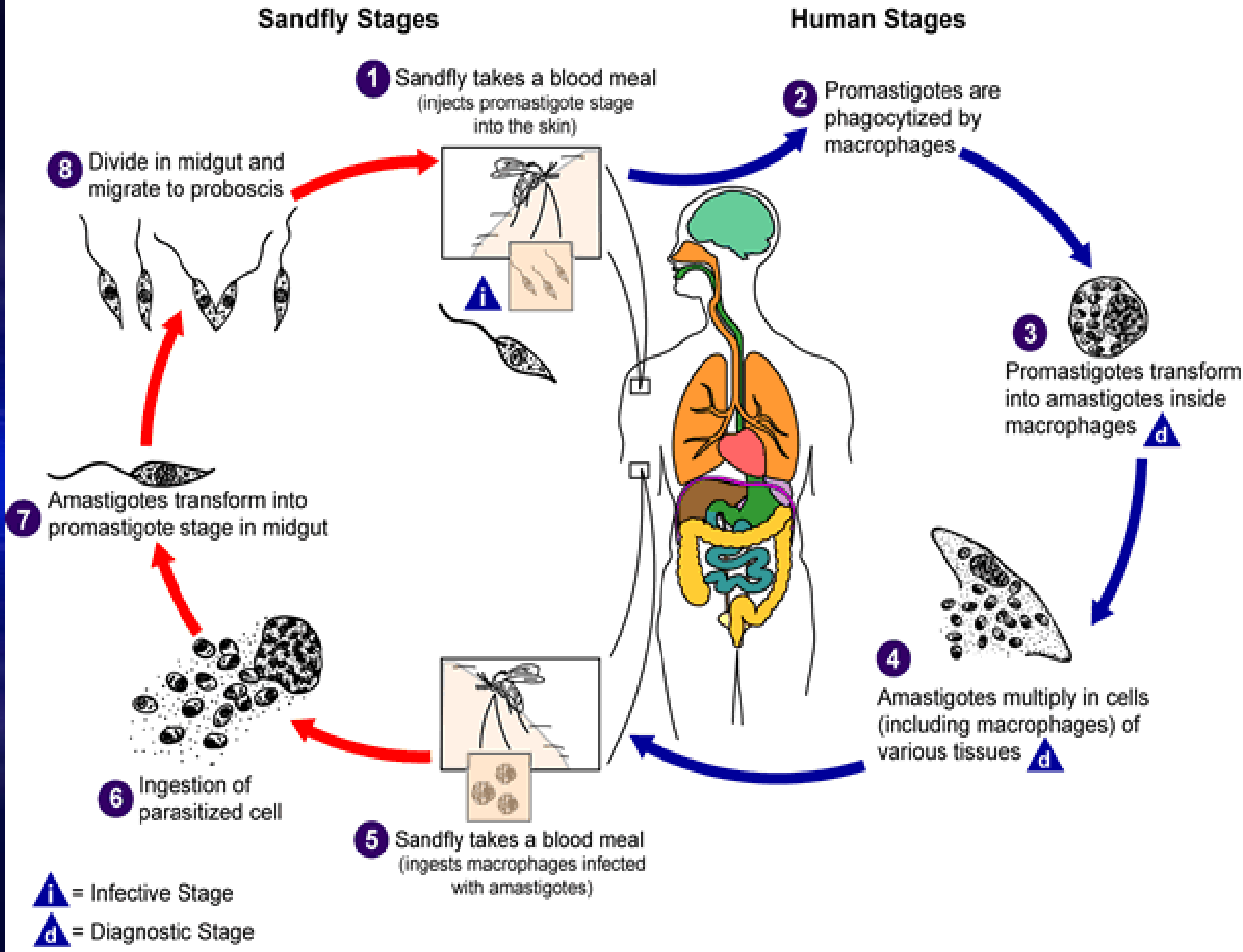
Malaria parasites inside red blood cells

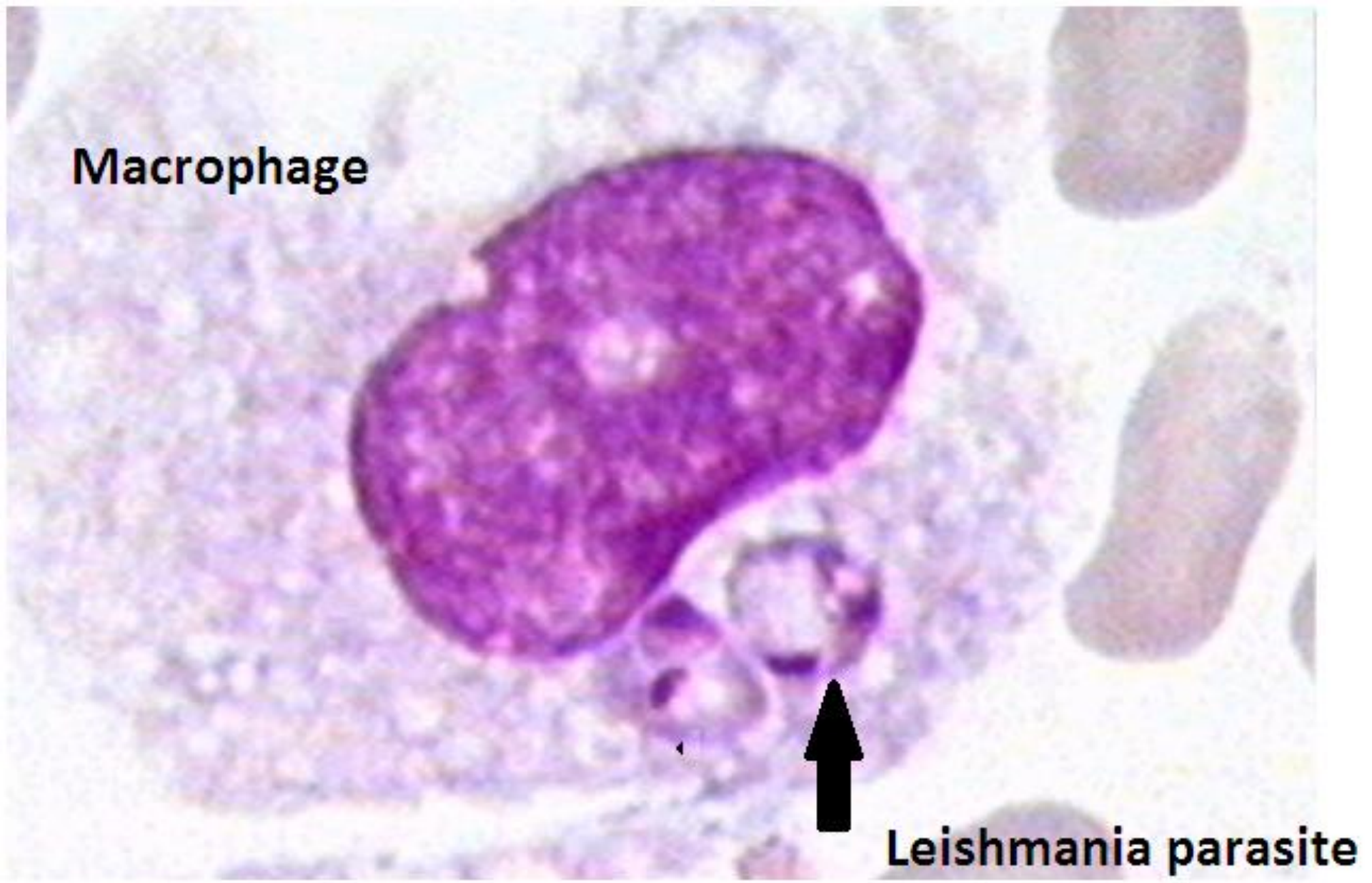
Main pathology of malaria is due to invasion of the RBCs

Examples of Diseases caused by Blood and Tissue Protozoa

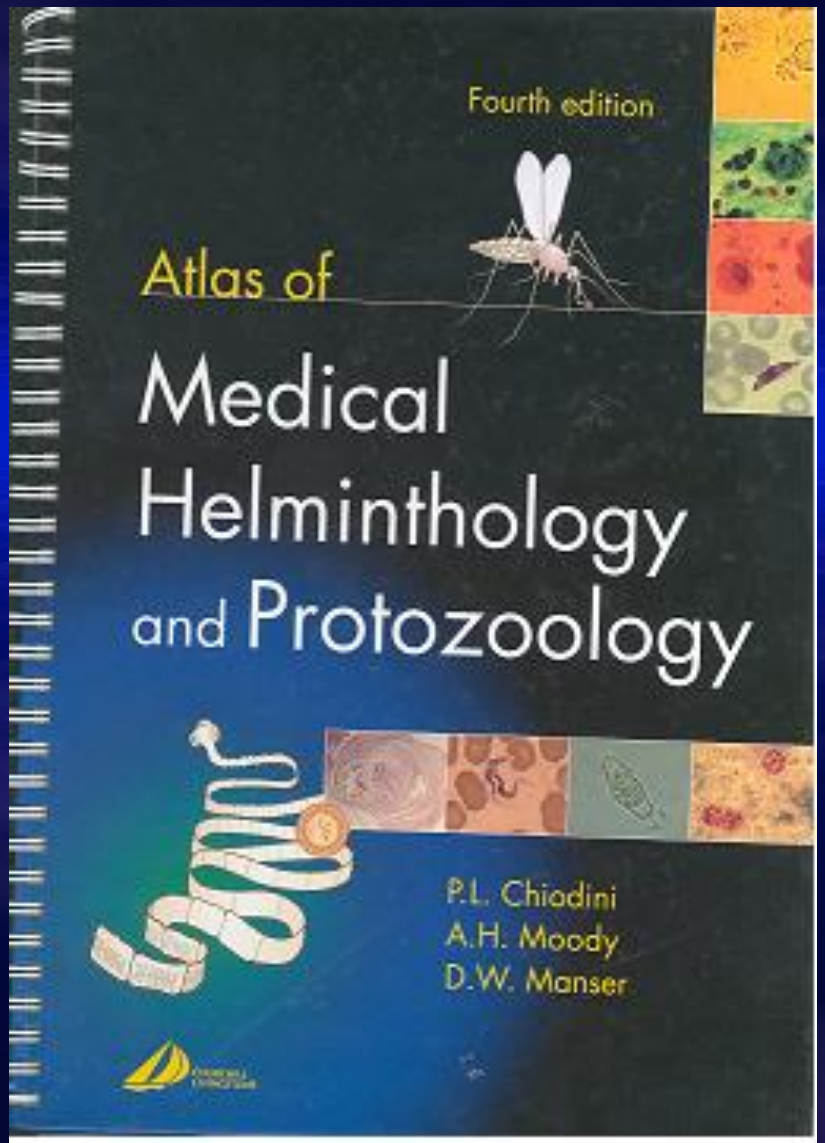
Parasite	Disease
Leishmania major	Cutaneous leishmaniasis

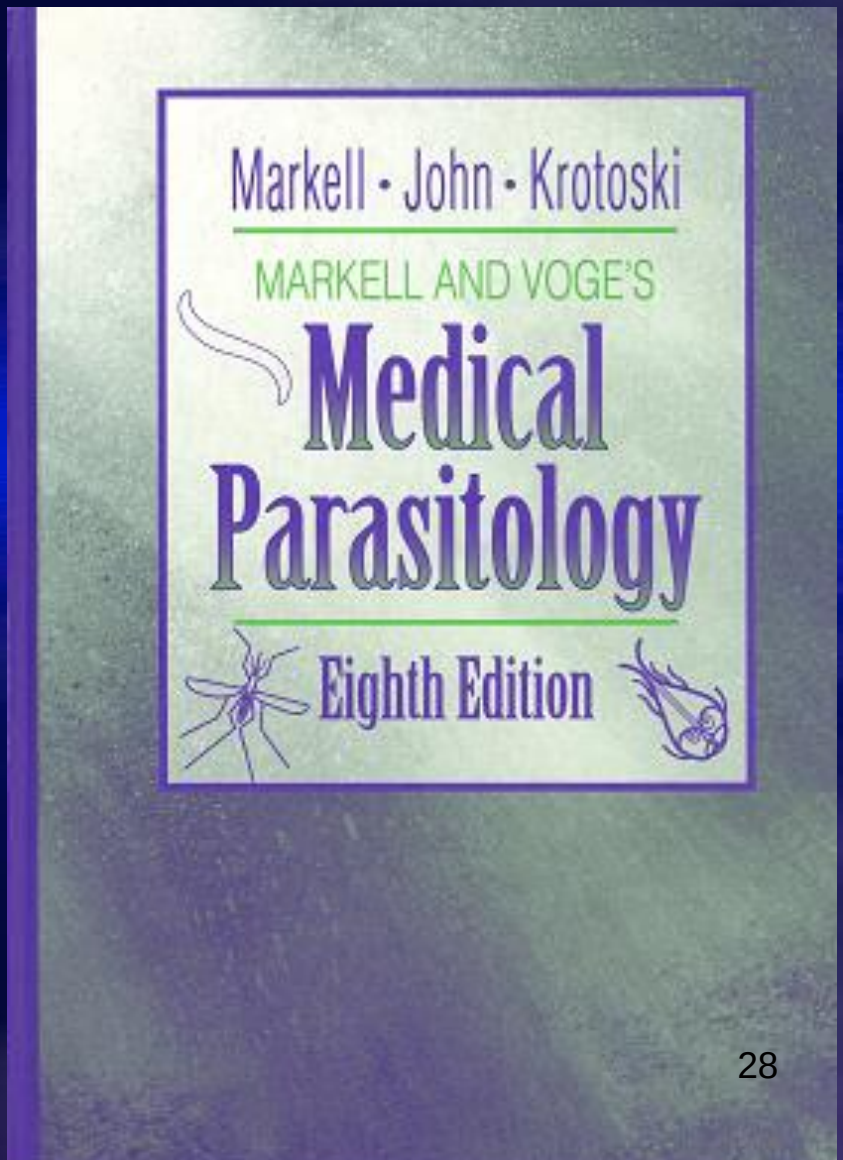
Cutaneous leishmaniasis caused by *Leishmania major*


Sandfly Stages
Human Stages
1 Sandfly takes a blood meal
(injects promastigote stage
into the skin)
2 Promastigotes are
phagocytized by
macrophages
3 Promastigotes transform
into amastigotes inside
macrophages
d
4 Amastigotes multiply in cells
(including macrophages) of
various tissues
d
5 Sandfly takes a blood meal
(ingests macrophages infected
with amastigotes)
6 Ingestion of
parasitized cell
7 Amastigotes transform into
promastigote stage in midgut
8 Divide in midgut and
migrate to proboscis
i
i = Infective Stage
d = Diagnostic Stage


Macrophage
Leishmania parasite

Resources on Parasitology





Resources on Parasitology

Centre for Disease Control and Prevention (CDC) :

http://www.dpd.cdc.gov/DPDx/HTML/Para_Health.htm

OBJECTIVES

By the end of this lecture the student should be able to:

1. Define common terms describing host-parasite relationship.

2. Outline the broad classification of parasites.

3. Name examples of protozoan parasites.

4. Describe the life-cycle of *Giadia lamblia* as an example of intestinal protozoa.

5. Describe the main stages of the life-cycle of *Plasmodium* as an example of blood and tissue protozoa.