

PARASITOLOGY-1

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Learning Objectives

At the end of lecture 3rd year students should be able to comprehend ,

- What are Parasites
- Classify parasites
- Concept of life cycle of a parasite & host parasite relationship
- Role of vectors in causing disease

What is Parasite and Parasitism

PARASITE

- Organism that lives & infects other living things (host) & obtain shelter & nourishment from it.

PARASITISM

- Relation in which one organism (called parasite) benefits at the expense of another organism usually of different species(called host).



Definitions

- **Host:** The organism in, or on, which the parasite lives & causes harm.
- **Definitive host:** Organism in which the adult or sexually mature stage of parasite lives.
- **Intermediate host:** Organism in which the parasite lives during a period of its development only. i.e. Asexual, immature form of parasite.
- **Zoonosis:** Parasitic disease in which an animal is normally the host.
- **Vector:** Living carrier (e.g. an arthropod) that transports a pathogenic organism from an infected to a non-infected host. (e.g. Female *Anopheles* mosquito transmitting malaria).

Types of Hosts

- **Definitive host:** In which sexual cycle of a parasite takes place.
- **Intermediate host:** In which asexual cycle of a parasite takes place.

HOST PARASITE RELATION

- Parasites utilize nutrition from host resulting in damage.
1. **Loss of nutrition** e.g.
 - **Iron deficiency** in hookworm infestation.
 - **Vit B₁₂ deficiency** in *Diphyllobothrium latum* infection.
 2. **Morbidity:** due to tissue injury e.g.
 - *E. histolytica* dysentery.
 - Severe itch due to *Enterobius vermicularis*.
 3. **Mortality:** Fulminant diarrhea due to *Cryptosporidium parvum* infection.



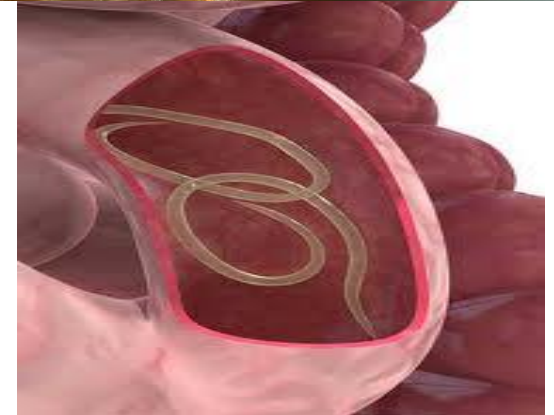
Strongyloides stercoralis
hyperinfection in HIV

ROLE OF VECTOR

- Vector: (Latin word meaning **carrier**).
- Important in transmission of parasite.
- No direct damage by vector.
- ***Anopheles* mosquito** transmits Malaria, Filaria.
- **Sandfly vector** for Leishmaniasis.
- **Domestic cats-vector** of *Toxoplasma gondii*, *Echinococcus granulosus*.

Endoparasites and Ectoparasites

- **Ectoparasites:**
 - Parasites that live on surface of host.
 - No penetration in to tissues. (e.g. lice, mite).
- **Endoparasites:**
 - Parasites that live inside the host.
 - All protozoa and helminths are endoparasites. (e.g. *Giardia lamblia*, *Ascaris lumbricoides* etc.)
- **Parasites requiring more than one host** for completion of life cycle.
 - e.g. *Plasmodium falciparum*.



INTRODUCTION TO BASIC PARASITOLOGY

- Parasites are Eukaryotes.
- **Two major groups:**
 - **Protozoa** (unicellular)
 - **Metozoa/Helminth** (Multicellular) or worms

Important Groups of Human Parasites

Protozoa

- Amoeba
- Flagellate
- Sporozoa
- Ciliate

Helminthes

- Platyhemintnes
 - Trematodes
 - Cestodes
- Nematodes

Arthropoda

- Mosquito
- Fly
- Tick
- Mite
- Bug
- Flea
- Lice

Terminologies

- **Sarcodina (Amoeba):** Move by pseudopodia e.g. Entamoeba.
- **Mastigophora (Flagellates):** Move with flagella e.g. Giardia, Trichomonas.
- **Apicomplexa (Sporozoa) :** Apical complex, no locomotor apparatus; sexual reproduction e.g. Plasmodium, Toxoplasma, Cryptosporidium.
- **Ciliophora (Ciliates):** Move with cilia e.g. Balantidium coli.

General properties of Protozoa

- Single “cell like unit” morphologically & functionally complete.
- **Morphology:**
 - Cytoplasm
 - **Ectoplasm** – Hyaline, protective, locomotive & Sensory functions.
 - Ectoplasmic structures –
 - » Organelles of locomotion – Pseudopodia, Flagella, Cilia.
 - » Contractile vacuoles.
 - » Rudimentary digestive system.
 - » Cyst wall.

General properties of protozoa

- **Endoplasm** – Granular, nutritive & reproductive functions
 - Nucleus
 - Well defined nuclear membrane, chromatic granules, karyosomes.
- Encystment – Inactive, protective and resistant stage.
- **Reproduction**
 - Asexual
 - Binary fission
 - Multiple fissions or schizogony
 - Sexual
 - Conjugation – in ciliates.

Clinical Classification of Protozoa

- **Intestinal**

- *Entamoeba histolytica* (Amoebiasis)
- *Giardia lamblia* (Giardiasis)
- *Balantidium coli* (Opportunistic infections)
- *Isospora*
- *Cryptosporidium* (Fulminant diarrhea)

Free living amoeba

Acanthamoeba –

**Meningoencephalitis &
Keratitis**

- **Vaginal**

- *Trichomonas vaginalis* (Viginal infections)

Naeglaria –

- **Blood**

- *Plasmodium* (Malaria)
- *Leishmania* (Kala Azar)
- *Trypanosoma* (Sleeping sickness)

Primary

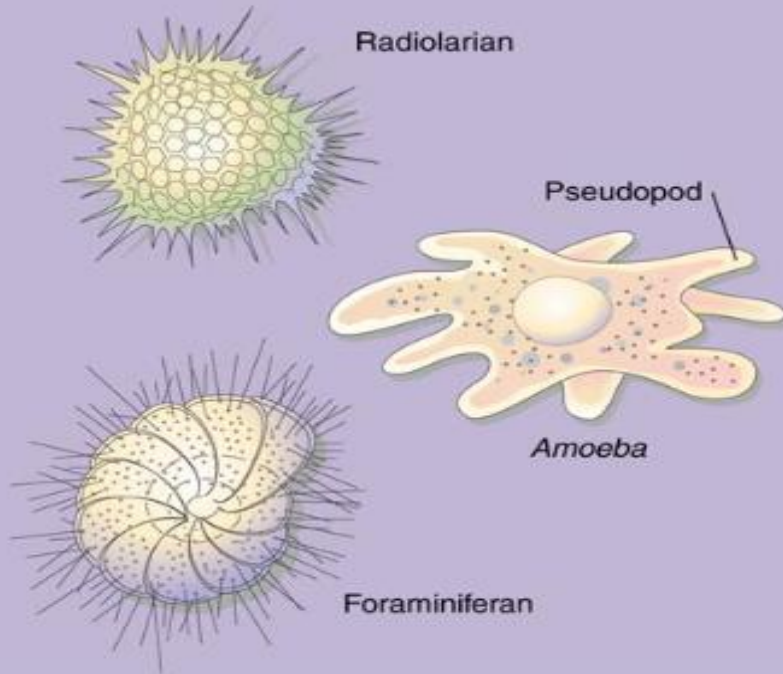
Meningoencephalitis

- **Tissue**

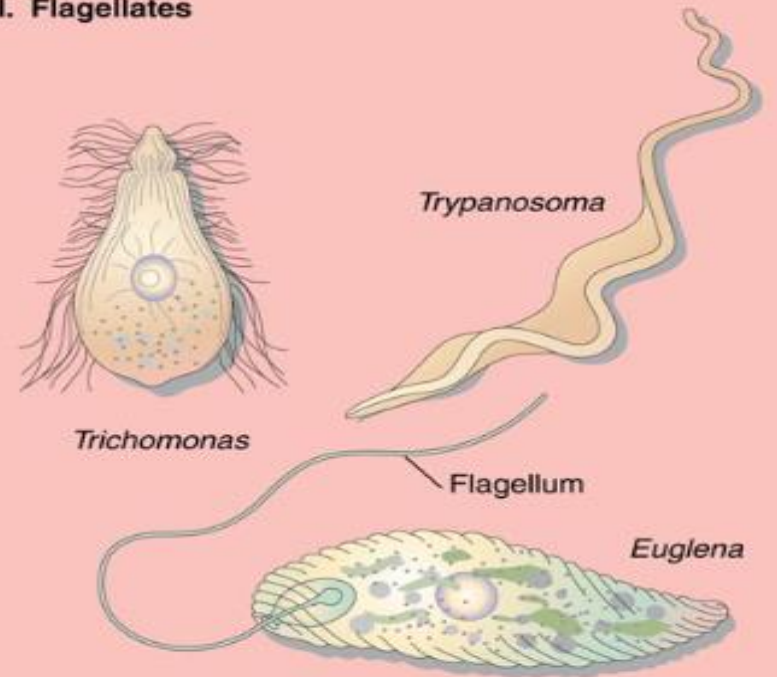
- *Toxoplasma gondii* (Toxoplasmosis)

- Most are free living in water and soil
 - Classified by motility & life cycle
 - Subdivided by location in human host (GIT, blood, G)
1. Amoeba - move by pseudopods
 2. Ciliates - move by cilia
 3. Flagellates - move by flagella
 4. Sporozoa – complex life cycle

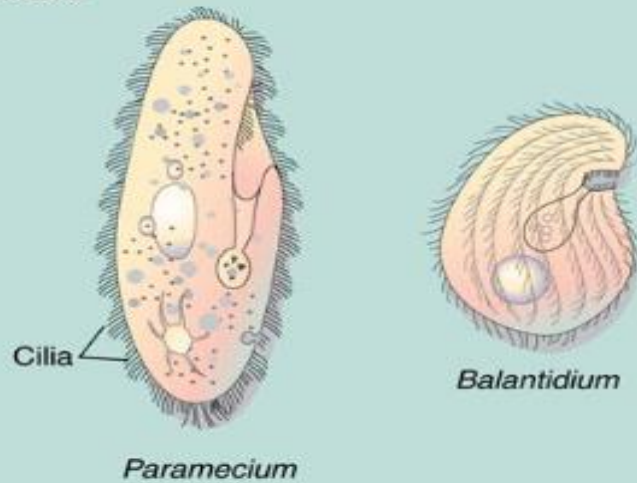
I. Amoebas



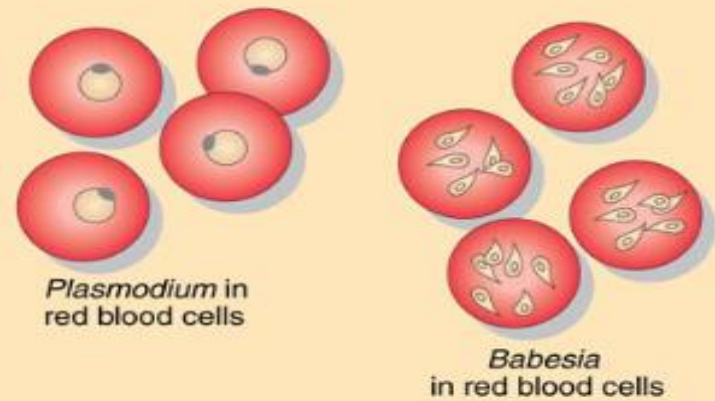
II. Flagellates



III. Ciliates

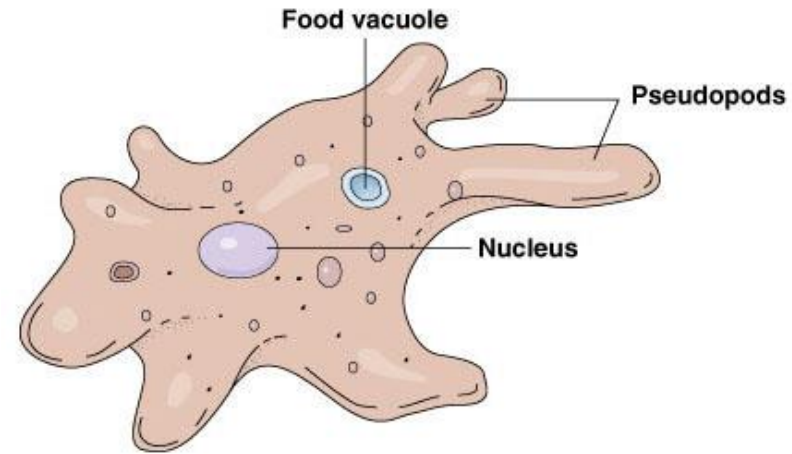


IV. Apicomplexans (Sporozoa)

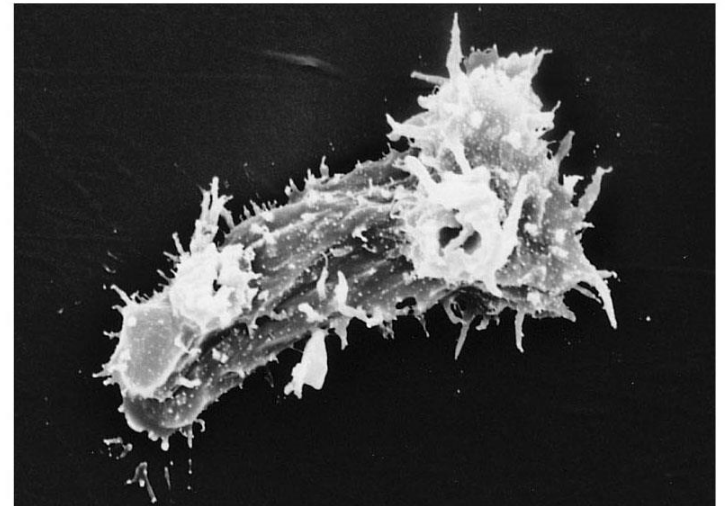


Amoeba

- *Entamoeba histolytica*
 - Amoebic dysentery
- *Naegleria*
 - primary amoebic meningoencephalitis
- *Acanthamoeba*
 - contact lens contaminant



(a) *Amoeba proteus*



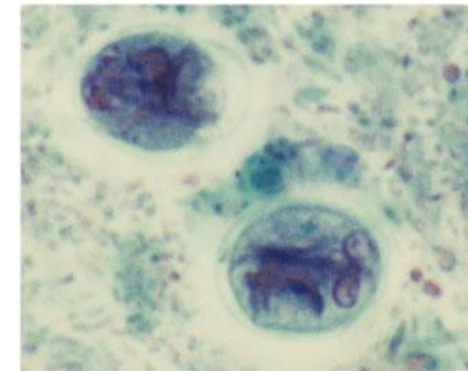
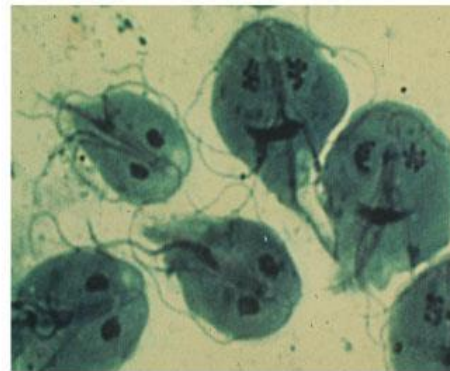
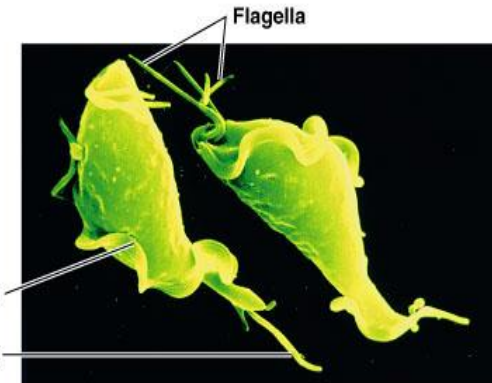
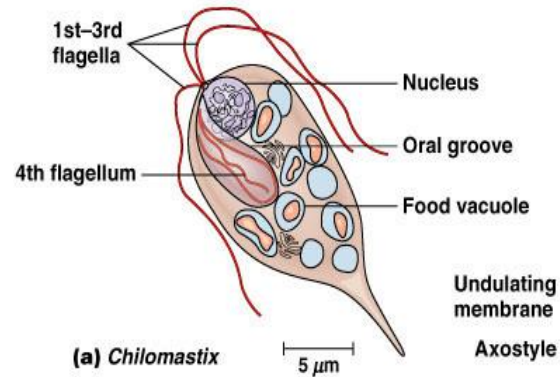
Flagellates

- *Trichomonas vaginalis*

- no cyst stage
- Trichomoniasis – STD

- *Giardia lamblia*

- Intestinal malabsorption
- Traveler's diarrhea, day care centers, hikers.



Hemoflagellates

– *Trypanosoma*

- African sleeping sickness or Chagas disease.
- Transmitted by tsetse flies or reduvid bugs.

– *Leishmania*

- leishmaniasis – “Baghdad Boil”- Desert Storm.
- Transmitted by sand fly vector.



Ciliates

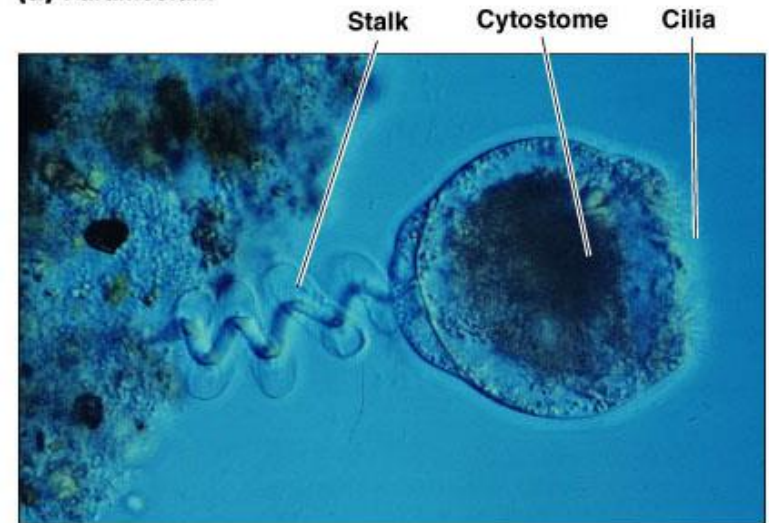
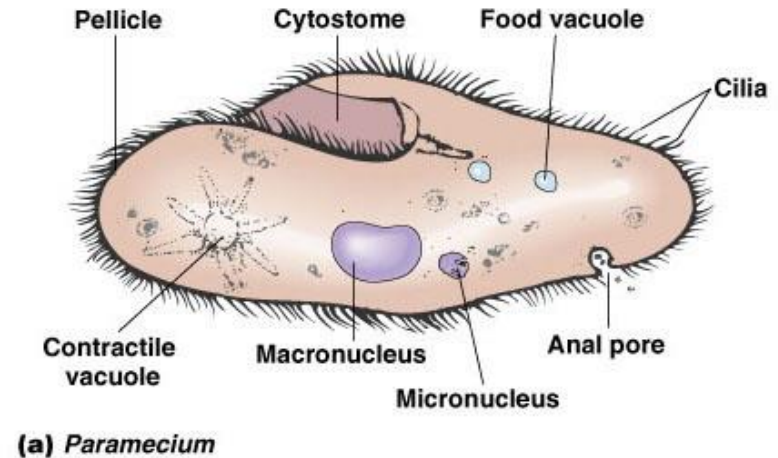
- Complex cells with rudimentary mouth (cytostome)

1. *Balantidium coli*: only human parasite

- intestinal disease
- associated with pork

2. *Paramecium*

3. *Vorticella*



Apicomplexa (Sporozoa)

- **Characteristics:**
 - Non-motile, Intracellular parasites
 - Complex life cycles having Asexual/sexual reproduction
- *Plasmodium* – malaria
 - transmitted by *Anopheles* mosquito
- *Cryptosporidium* – diarrhea (AIDS related)
- *Toxoplasma* – toxoplasmosis (AIDS related)

Helminths/Worms

- **Definitive host:** which harbor sexual phase of parasite.
- **Intermediate host:** which harbor asexual phase of parasite.



CLASSIFICATION of HELMINTHS

- **HELMINTHS**

- a. **Nematoda (roundworms)**

- Elongated , round & un-segmented.
- Complete digestive system.
- Highly developed separate-sexes.
- Eggs & larva- suited for external environment.
- Most human infections by ingestion of egg or larva.
- **Examples:** *Ascaris lumbricoides*, *Ankylostoma duodenale*, *Enterobius vermicularis* etc



CLASSIFICATION of HELMINTHS

b. **Platyhelminthes/ Flatworms:**

flattened, hermaphroditic, with a few exceptions.

- **Subdivided in to Two classes:**

- **Trematoda** (flukes).

- **Cestoda** (tapeworms).

I. Trematoda (flukes)

Fasciola hepatica, *Clonorchis sinensis*,
Schistosoma species.

II. Cestodes, or tapeworms

Taenia solium, *Echinococcus granulosus*.



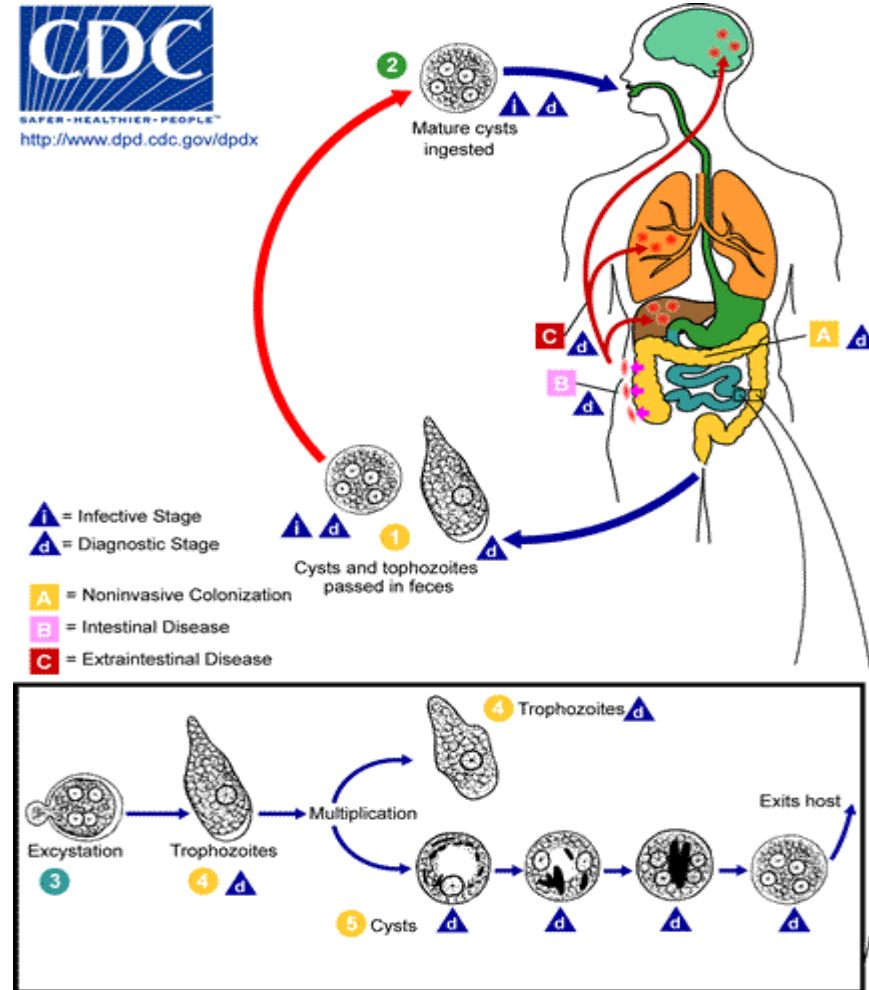
Fasciola hepatica



Taenia saginata

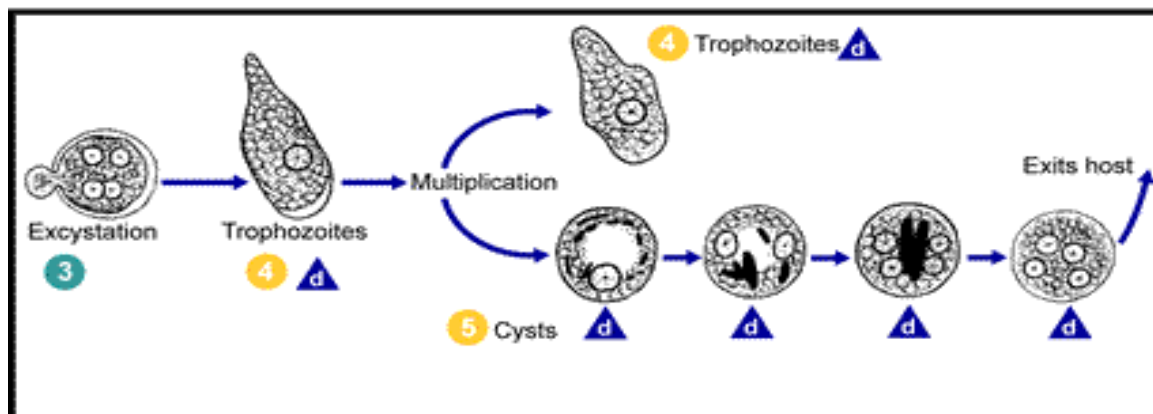
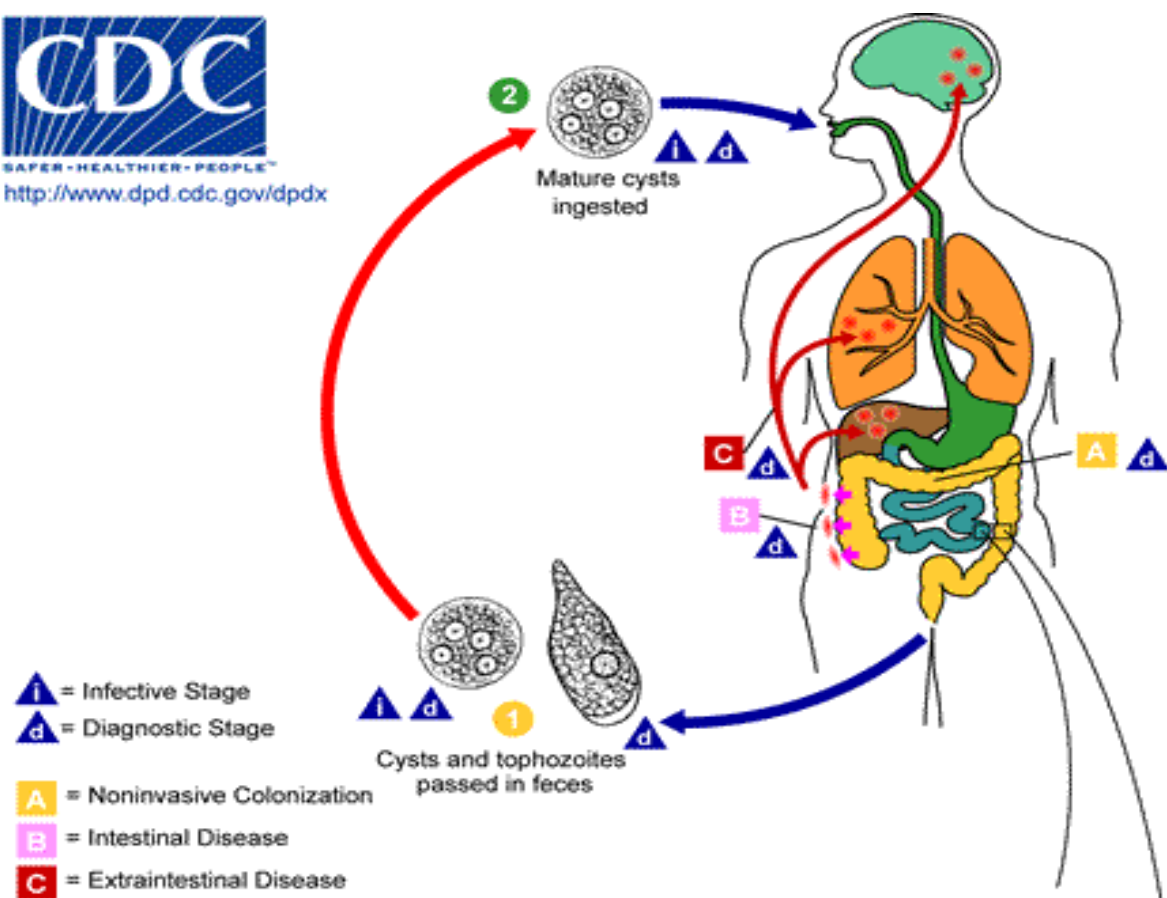
Direct Life Cycle

- **Direct Life cycle**
- Only humans are host
- Infective form like ovum, cyst, larva passed out of body that infect healthy person.
- **Example:**
- *E.histolytica*, *Giardia*, *Ascaris lumbricoides*.



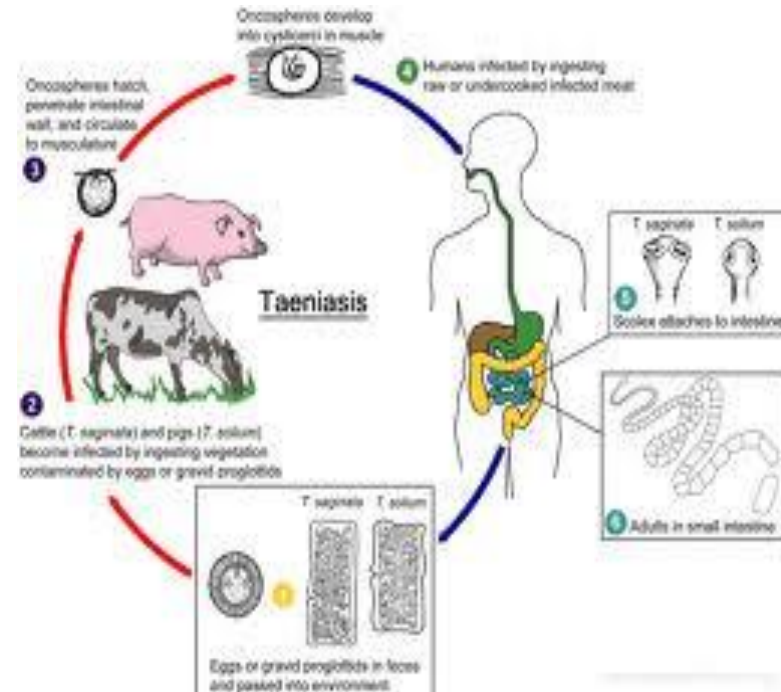


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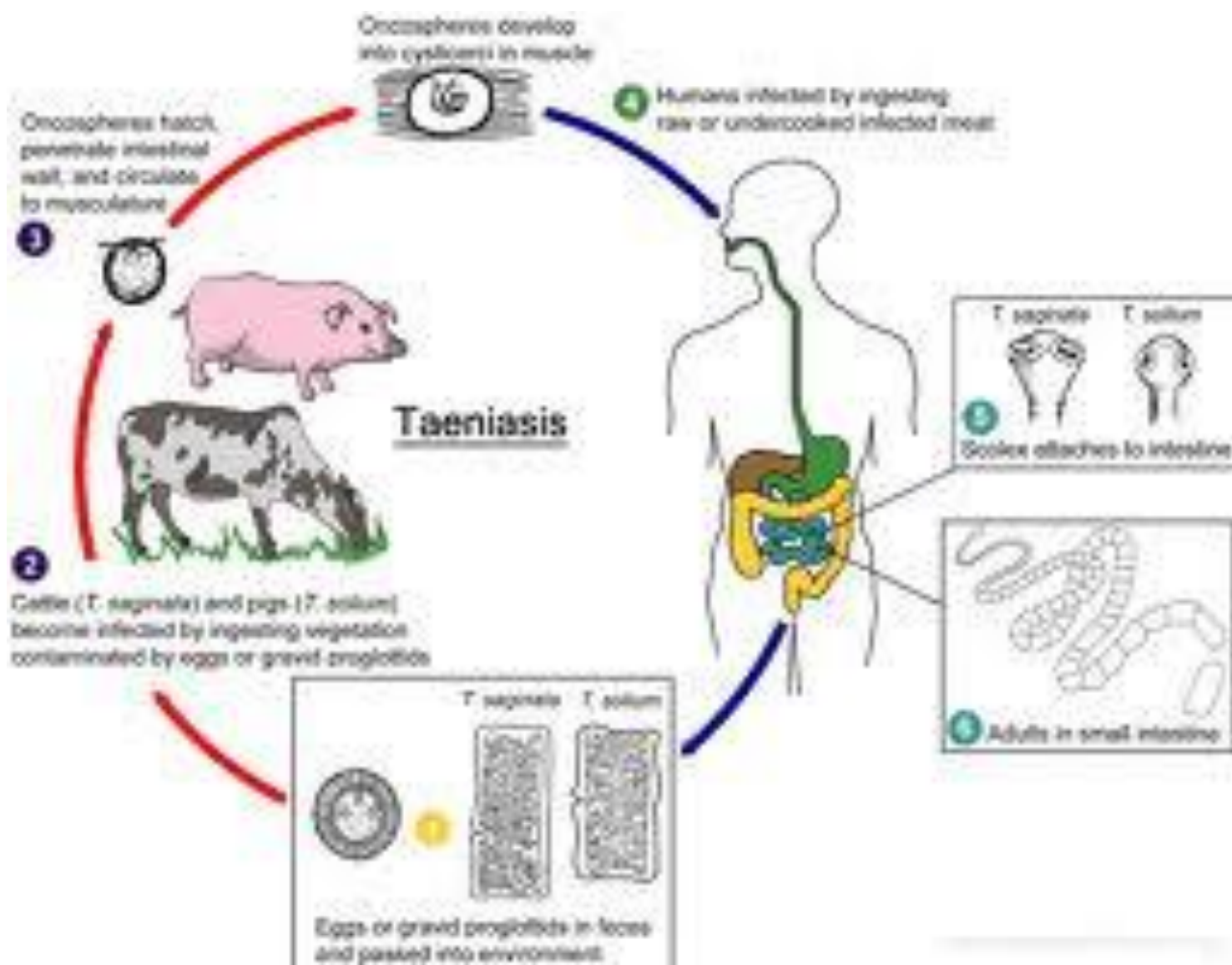


Indirect Life Cycle

- **Indirect Life cycle**
- Multiple hosts or involvement of vector.
- Definitive host, Intermediate host.
- Example *Taenia saginata* species, *Schistosoma* species. etc



Life cycle of *Taenia saginata*



Infective and Diagnostic stage

- **Forms or stages of a parasite:**
- **Diagnostic Stage:**
- Trophozoite: (active, feeding, vegetative stage of a protozoal parasite).
- **Infective Stage:**
- Cyst/ oocyst: (inactive, dormant with protective thick wall, infective form).