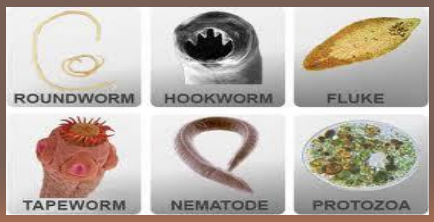
Introduction to Parasitology



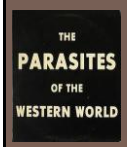
DR .FARWA IMRAN,
Assistant Professor
Microbiology

Human Parasitology

Science that deals with the study of parasites on humans.

These organism have adapted themselves to existence in or on another organism, the latter, which harbours the parasite, being termed as the HOST.

Recent estimates of the number of people infected with parasites in the world

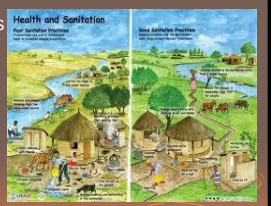


Ascaris	**1.3 billion**
Hookworms	**1.3 billion**
Whipworms	**1 billion**
Filarial worms	**657 million**
Malaria	**500 million**
Schistosomes	**270 million**
Amebiasis	**50 million**
Tapeworms	**50 million**
Clonorchis	**20 million**
Chagas' Disease	**15 million**

These parasites cause untold sufferings and deaths in the world today.

High incidence in developing/poor countries

- Inadequate sanitation
- Contaminated water supplies
- Poor health education
- Poverty & Malnutrition
- Failure to control vectors
- Climatic factors
- Population migrations



Branches of Human Parasitology:

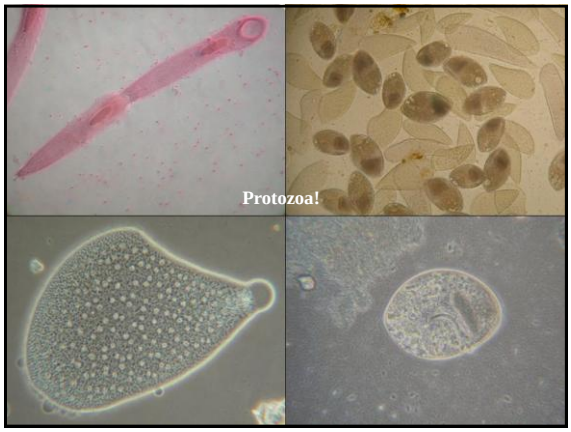
A) Protozoology - study of single-celled animals (protozoa)

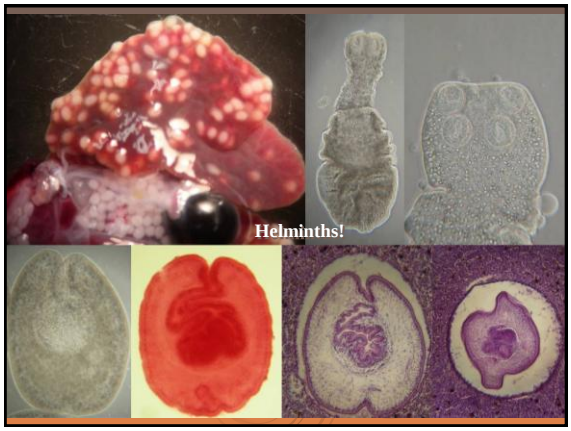
B) Helminthology- study of worms & wormlike organisms (roundworms, flukes, tapeworms)

C) Arthropodology - study of jointed - legged organisms like the arthropods (flea, mite, mosquito, etc.)

Human Parasitology

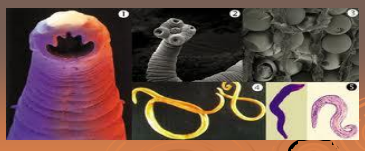
- **Medical Protozoology**
  - Class Sarcodina
  - Class Mastigophora
  - Class Sporozoa
  - Class Ciliata
- **Medical Helminthology**
  - Class Nematoda
  - Class Trematoda
  - Class Cestoda
- **Medical Arthropodology**
  - Class Insecta
  - Class Arachnida
  - Class Crustacea
  - Class Chilopoda





Parasite

Organism that lives on or within another organism for survival and usually cannot exist as free living



Types of Parasites

1) Obligate parasites

Organisms which are completely dependent on the host for existence and cannot exist without a host → die (nematodes *A. lumbricoides*)

2) Facultative / Opportunistic parasites

A parasite is capable of living even without a host and can exist as free – living or as parasite Ex. Nematodes (*S. stercoralis*)

3) Ectoparasite

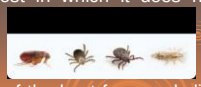
Organisms that live outside of the surface of the host and produce pathology on the external surface of the body. (lice)

4) Endoparasite

Live inside the body of the host e.g.in the blood, tissue, body cavities, digestive tract and other organs. (all protozoa and heminthic parasites)

5) Incidental or accidental parasite

Parasite that establishes itself in a host in which it does not ordinarily live



6) Permanent parasite

Parasite that remains on or in the body of the host from early life until maturity or for its entire life . (ascaris)

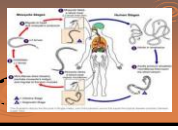
Host

Are organisms from whom the parasite derive or depends their sustenance or nourishment and are bigger than a parasite

Types:

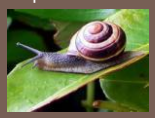
a) Definitive host

Where the parasites live & complete their life cycle and also harbor the mature adult/sexual stage of the parasite.
E.g: Man is a definitive host in Filarial, Round worm and Hook worm infection.



b) Intermediate host

Where the larval form/asexual stages of the parasite develop in another animal.
Eg: Snail – schistosoma
Man – malaria, hydatid disease



c) Reservoir host

Animal that harbors the same parasite and ensures continuity of the parasite's life cycle. Act as additional source of human infection.

Eg: Pig - *T. solium*
Cat - *T. gondii*

Vectors

Are biological systems that transmit parasites

Types:

1) Mechanical

Transmit a parasite without being a host. Parasite does not undergo development in it and is not essential to the life cycle of the parasite. Ex. Flies

2) Biological

Serves both as vector and a host for the developmental stages of the parasite
Eg: Anopheles mosq. (malaria)

Types of parasitic infections

1) Autoinfection

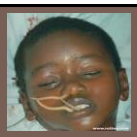
Infection acquired by an individual resulting from their own direct source of exposure.

2) Reinfection

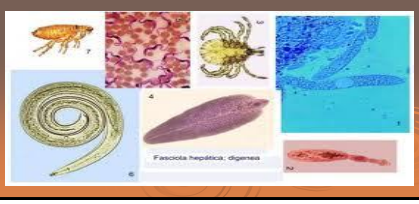
When a person is infected with a parasite, and after complete cure again gets infected with the same specie of parasite.

3) Superinfection

When a host is harboring more than one parasite at a time.



Classification of Human parasites



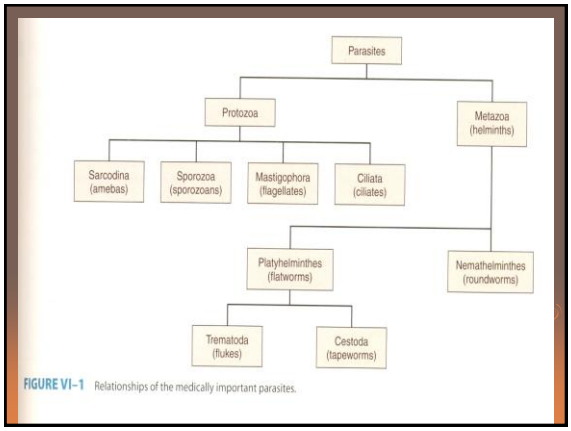


FIGURE VI–1 Relationships of the medically important parasites.

Taxonomic classification of protozoa

Sub kingdom	Phylum	Sub-phylum (class)	Genus-examples	Species-examples
Protozoa	Sarcomastig-ophora (further divided into)	Sarcodina-- - move by pseudopodia (amebas)	Entamoeba	*E. coli* *E. Histolytica*
		Mastigophora move by flagella (flagellates)	Giardia	*G. lamblia*
	Apicomplexa no organelle of locomotion	Sporozoa (sporozoans)	Plasmodium	*P. falciparum,* *P. vivax,* *P. malariae,* *P. ovale*
	Ciliophora move by cilia	Ciliata (ciliates)	Balantidium	*B. coli*

Protozoa

Type and Location	Species	Disease
Major protozoa		
Intestinal tract	*Entamoeba histolytica*	Amebiasis
	Giardia lamblia	Giardiasis
	Cryptosporidium parvum	Cryptosporidiosis
Urogenital tract	*Trichomonas vaginalis*	Trichomoniasis
Blood and tissue	*Plasmodium* species	Malaria
	Toxoplasma gondii	Toxoplasmosis
	Pneumocystis jiroveci	Pneumonia
	Trypanosoma species	Trypanosomiasis
	T. cruzi	Chagas' disease
	T. gambiense[1]	Sleeping sickness
	T. rhodesiense[1]	Sleeping sickness
	Leishmania species	Leishmaniasis
	L. donovani	Kala-azar
	L. tropica	Cutaneous leishmaniasis[2]
	L. mexicana	Cutaneous leishmaniasis[2]
	L. braziliensis	Mucocutaneous leishmaniasis
Minor protozoa		
Intestinal tract	*Balantidium coli*	Dysentery
	Isospora belli	Isosporiasis
	Enterocytozoon bieneusi	Microsporidiosis
	Septata intestinalis	Microsporidiosis
	Cyclospora cayetanensis	Cyclosporiasis
Blood and tissue	*Naegleria* species	Meningitis
	Acanthamoeba species	Meningitis
	Babesia microti	Babesiosis

[1]Also known as *T. brucei gambiense* and *T. brucei rhodesiense*, respectively.
[2]*L. tropica* and *L. mexicana* cause Old World and New World cutaneous leishmaniasis, respectively.
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Taxonomic classification of Helminths

Sub kingdom	Phylum	Class	Genus – examples
Metazoa	**Nemathehelminthes** Round worms; appear round in cross section, they have body cavities, a straight alimentary canal and an anus	Nematodes	Ascaris (roundworm) Trichuris (whipworm) Ancylostoma (hookworm) Necator (hookworm) Enterobius (pinworm or threadworm) Strongyloides
	Platyhelminthes Flat worms; dorsoventrally flattened, no body cavity and, if present, the alimentary canal is blind ending	Cestodes Adult tapeworms are found in the intestine of their host. They have a head (scolex) with sucking organs, a segmented body but no alimentary canal. Each body segment is hermaphrodite	Taenia (tapeworm)
		Trematodes Non-segmented, usually leaf-shaped, with two suckers but no distinct head. They have an alimentary canal and are usually hermaphrodite and leaf shaped. Schistosomes are the exception. They are thread-like, and have separate sexes	Fasciolopsis (liver fluke) Schistosoma (not leaf shaped)

Protozoa Glossary

Cyst: In parasitology, the term cyst may have two meanings. Firstly, a cyst may be the resistant dormant stage of a single-celled organism which is passed out and encourages the propagation of the species. Alternatively, cyst may refer to the intermediate stage of some tapeworms (e.g., hydatid cysts). This cyst must be eaten by the definitive host for it to be infected.

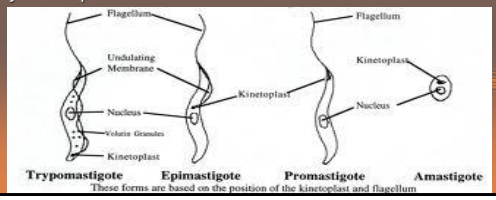
Trophozoite: The active or feeding stage of a single-celled organism.

Amastigote: An early stage in the life cycle of trypanosomes and leishmania. The body is rounded and the flagellum and undulating membrane is absent .The kinetoplast lies near the nucleus .

Promastigote: The body is elongated, the kinetoplast is anterior, consequently there is no undulating memb. A free flagellum is present.

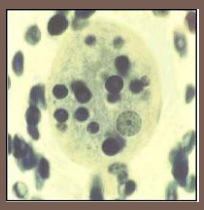
Epimastigote: The body is elongated; the kinetoplast is situated just infront of nucleus; a short undulating memb. And free flagellum is usually present.

Trypomastigote: The body is elongated; kinetoplast is near the post. end, there is an undulating memb. a free flagellum may or may not be present.



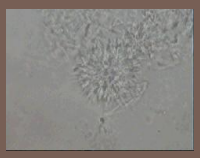
These forms are based on the position of the kinetoplast and flagellum

Class Sarcodina (amebas)

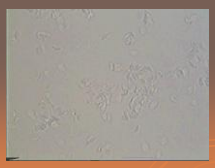



Entamoeba histolytica
Non-pathogenic amoeba

Class Mastigophora (flagellates)

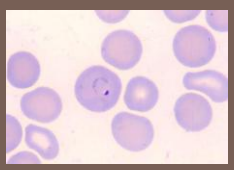


Leishmania sp




Giardia *Trichomonas vaginalis*

Class Sporozoa



- Plasmodium spp

Toxopasma gondii
Cryptosporidium
Pneumocycstis carinii

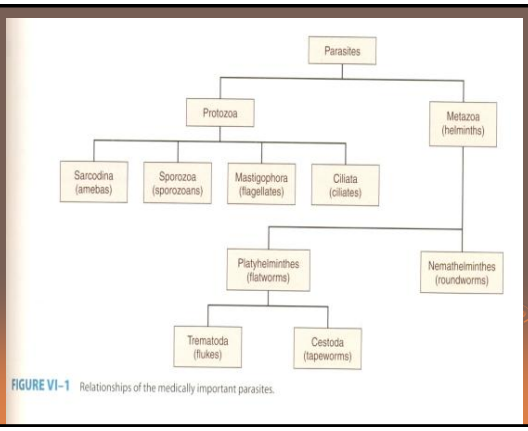
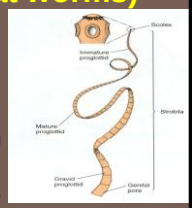


FIGURE VI–1 Relationships of the medically important parasites.

Cestodes (Tape or Flat worms)

- Tape worm have head (scolex), neck (region of growth) and trunk (strobila or proglotides or segments)
- Segmented bodies
- No alimentary system or nervous system
- Head carries suckers and hooks
- They are monoecious or hermophrodites (with functional male and female sex organs in the same individual)
- Main Larval forms- (i) Bladder larvae (sp.of Cyclophllidea), (ii) Solid larvae (sp. of Pseudophyllidea)
- The main type of bladder larvae are: a) Cysticercus, b) Cysticercoid, c) Coenurus, d) Echinococcus.



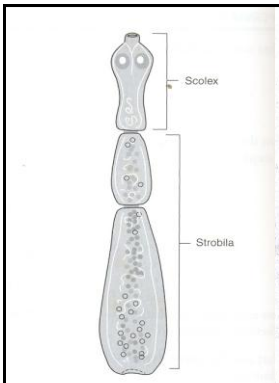


Figure 32-1. Example of a cestode

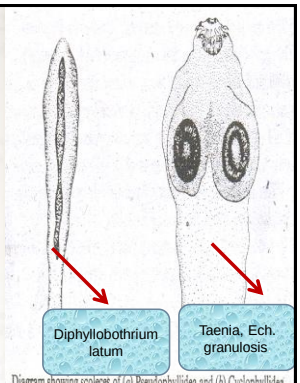


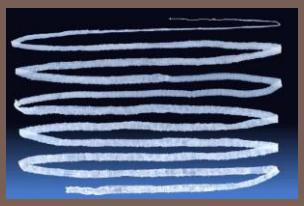
Diagram showing scoleces of (a) Pseudophyllidea and (b) Cyclophyllidea.

Cestodes (Tape or Flat worms)

TABLE 54–1 Features of Medically Important Cestodes (Tapeworms)

Cestode	Mode of Transmission	Intermediate Host(s)	Main Sites Affected in Human Body	Diagnosis	Treatment
Taenia solium	(A) Ingest larvae in undercooked stool	Pigs	Intestine	Proglottids in stool	Praziquantel
	(B) Ingest eggs in food or water contaminated surgical removal of with human feces		Brain and eyes (cysticerci)	Biopsy, CT scan	Praziquantel, albendazole, or surgical removal of cysticerci
Taenia saginata	Ingest larvae in undercooked beef	Cattle	Intestine	Proglottids in stool	Praziquantel
Diphyllobothrium latum	Ingest larvae in undercooked fish	Copepods and fish	Intestine	Operculated eggs in stool	Praziquantel
Echinococcus granulosus	Ingest eggs in food contaminated with dog feces	Sheep	Liver, lungs, and brain (hydatid cysts)	Biopsy, CT scan, serology	Albendazole or surgical removal of cyst

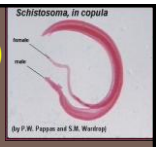
Class Cestoda



- *Taenia solium*

Taenia saginata
Echinococcus granulosus
Diphyllobothrium latum

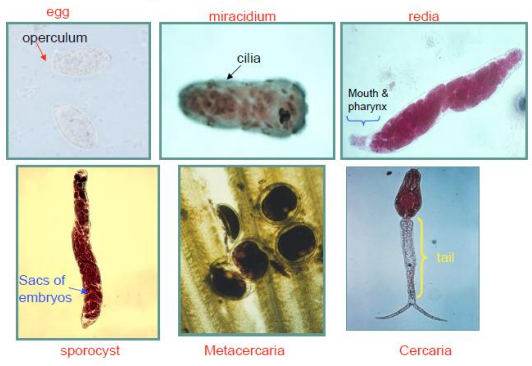
TREMATODES (Flukes)



- Flat or fleshy leaf like.
- Unsegmented body,
- Imcomplete alimentary canal (y-shaped) with out anus.
- Posses suckers but no hooks.
- Sexes are separate (diecious) in schistosomes while
- other are hermphrodites (both male and female in same worm self fertilize as well as cross fertilize)
- Larval stages- Miracidium, Sporocyst, Redia, Cercaria, Metacercaria

Schistosomas are known as blood flukes,
Paragonimus--- lung fluke,
Clonrchis --- liver fluke,
Fasciola hepatica --- Sheep liver fluke

Life Cycle Stages of Trematodes



Trematodes

TABLE 55–1 Features of Medically Important Trematodes (Flukes)

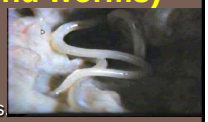
Trematode	Mode of Transmission	Main Sites Affected	Intermediate Host(s)	Diagnostic Features of Eggs	Endemic Area(s)	Treatment
Schistosoma mansoni	Penetrate skin	Veins of colon	Snail	Large lateral spine	Africa, Latin America (Caribbean)	Praziquantel
Schistosoma japonicum	Penetrate skin	Veins of smal intestine, liver	Snail	Small lateral spine	Asia	Praziquantel
Schistosoma haematobium	Penetrate skin	Veins of urinary bladder	Snail	Large terminal spine	Africa, Middle East	Praziquantel
Clonorchis sinensis	Ingested with raw fish	Liver	Snail and fish	Operculated	Asia	Praziquantel
Paragonimus westermani	Ingested with raw crab	Lung	Snail and crab	Operculated	Asia, India	Praziquantel

Class Trematoda

- ✓ *Clonorchis sinensis*

Fasciolopsis buski
Paragonimus westermani
Schistosoma japonicum

Nematodes (Round worms)



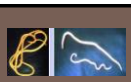
- Elongated cylindrical worm,
- Unsegmented body,
- Well define alimentary cannal uptil anus
- Head does not have sucker and hook
- Have a buccal capsule with teeth or cutting plates.
- Sexes are separate.
- Some produce egg (oviparous) or larvae (viviparous) and Some lays eggs contaning larvae which immediately hatch out (ovoviviparous)
- Two imp. Larval nematodes are (Rhabditiform - noninfectious, feeding form) and (Filariform - infectious, nonfeeding form)

Nematodes (Round worms)

TABLE 56–1 Features of Medically Important Nematodes

Primary Location	Species	Common Name or Disease	Mode of Transmission	Endemic Areas	Diagnosis	Treatment
Intestines	*Enterobius*	Pinworm	Ingestion of eggs	Worldwide	Eggs on skin	Mebendazole or pyrantel pamoate
	Trichuris	Whipworm	Ingestion of eggs	Worldwide, especially tropics	Eggs in stools	Mebendazole
	Ascaris	Ascariasis	Ingestion of eggs	Worldwide, especially tropics	Eggs in stools	Mebendazole or pyrantel pamoate
	Ancylostoma and *Necator*	Hookworm	Larval penetration of skin	Worldwide, especially tropics (*Ancylostoma*), United States (*Necator*)	Eggs in stools	Mebendazole or pyrantel pamoate
	Strongyloides	Strongyloidiasis	Larval penetration of skin, also autoinfection	Tropics primarily	Larvae in stools	Ivermectin
	Trichinella	Trichinosis	Larvae in undercooked meat	Worldwide	Larvae encysted in muscle; serology	Thiabendazole against adult worm
	Anisakis	Anisakiasis	Larvae in undercooked seafood	Japan, United States, Netherlands	Clinical	No drug available
Tissue	*Wuchereria*	Filariasis	Mosquito bite	Tropics primarily	Blood smear	Diethylcarbamazine
	Onchocerca	Onchocerciasis (river blindness)	Blackfly bite	Africa, Central America	Skin biopsy	Ivermectin
	Loa	Loiasis	Deer fly bite	Tropical Africa	Blood smear	Diethylcarbamazine
	Dracunculus	Guinea worm	Ingestion of copepods in water	Tropical Africa and Asia	Clinical	Thiabendazole prior to extracting worm
	Toxocara larvae	Visceral larva migrans	Ingestion of eggs	Worldwide	Clinical and serologic	Albendazole or mebendazole
	Ancylostoma larvae	Cutaneous larva migrans	Penetration of skin	Worldwide	Clinical	Thiabendazole

Class Nematoda

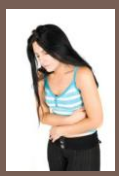


✓ *Hookworm*

Trichuris trichiura
Ascaris lumbricoides
Enterobius vermicularis
Filaria
Trichinella spiralis

Diagnosis of Parasitic Infections

1. Clinical diagnosis
2. Laboratory diagnosis



LAB DIAGNOSIS OF PARASITES

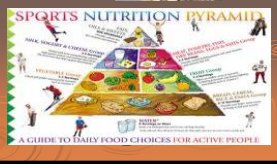
- Stool examination
  - Direct wet film
  - Concentration techniques
  - Permanent stained slides
- Culture methods
- Blood films (thick & thin)
- CSF examination
- Tissues impressions (l.Nodes, spleen, liver, bone marrow)
- Sputum examination
- Urine and vaginal secretion
- Animal inoculation
- Xenodiagnosis

Diagnostic Stages

HELMINTHS		
Adult worms	Segments	Larvae
Ascaris lumbricoides	*Taenia siginata*	Hook worms
Entrobius vermicularis	*Taenia solium*	
OVA		
Nematodes	Trematodes	Cestodes
A. lumbricoides	*Schistosoma mansoni*	*Taenia spp* *H. nana*
PROTOZOA (Trophozoites)		
Amoeba	Flagellates	Ciliates
E. histolytica	*Giardia lamblia*	*Balantidium coli*
PROTOZOA (Cysts)		
E. Histolytica	*Giardia lamblia*	*Balantidium coli*

Treatment of Parasitic Infections

1. Medical and surgical
2. Antiparasitic drugs
3. Adequate nutrition



Prevention and Control

1. Reduction in sources
2. Education
3. Destruction and/or control of reservoir hosts and vector

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

THANK YOU