Introduction to Helminthology
HELMINTHES (WORMS) - Characteristics

- Eukaryotic, multicellular animals that usually have digestive, circulatory, nervous, excretory, and reproductive systems.
- Worms with bilateral symmetry, head and tail, and tissue differentiation (endoderm, mesoderm, and ectoderm).
Helminthes

Two main groups (phyla)
- Platyhelminths (Flatworms)
- Nematoda (Roundworms)

Life Cycle
- Extremely complex (egg → larva → adult)
- Intermediate hosts harbor larval (developmental) stage.
- Definitive host harbors adult stage.
Sexual reproduction strategies

1. Male and female reproductive organs are found in separate individuals.
2. One animal has both male and female sex organs (most hermaphrodites copulate with other animals, a few copulate with themselves).

**Female helminths:**

- **Oviparous** – lay eggs without embryonic development.
- **Oovoviviparous** – embryos develop inside eggs.
- **Viviparous** – the larva develops inside the body of the mother.

**Eggs:** unsegmented (no larva inside the egg) & segmented (larva inside the egg)
Way of transmission

- Fecal-oral
- Contaminated food, water
- Ingestion of meat (larvae)
- Through skin
- Through vector

Localization
- Intestinal helminthes
- Blood and tissue helminthes
Nematodes (Roundworms)

- Cylindrical body tapered at each end.
- Have a complete digestive system: mouth, intestine, and anus.
- Body is covered by tough cuticle that resists drying and crushing.
- Separate males and females (males are smaller than females and have one or two spicules on posterior end).
- Infections can be caused by eggs or larvae.
- Reproduction and development:
  
  egg → egg fertilization → embryo in egg → larva 4 molts → adult
Nematodes - classification

Intestinal nematodes - with adults in bowel
- *Ascaris lumbricoides*
- *Trichuris trichiura*
- *Enterobius vermicularis*
- *Ancylostoma duodenale and Necator americanus*
- *Strongyloides stercoralis*

Tissue nematodes - adults or larval stage in tissue
- *Trichinella spiralis, native etc*
- *Toxocara canis (visceral larva migrans)*
- *Filaria - Wuchereria bancrofti*
  - *Brugia malayi*
  - *Onchocerca volvulus*
  - *Loa loa, etc.*
Cestodes (Tapeworm) - structure

- Scolex - attachment organ, contains suckers and hooks used to attach to a host organism.
- Zone of proliferation - undifferentiated area behind the scolex (neck region)
- Strobilia - chain of segments (proglottids) - square body segments used for reproduction.
  - Immature proglottids - developing reproductive
  - Mature proglottids: mature reproductive organs.
  - Gravid proglottids: contain eggs in the uterus.
Immature Segment

- note that the reproductive organs are just beginning to differentiate.

Developing reproductive organs (Carmine stained)

(by P.W. Pappas and S.M. Wardrop)
Mature Segments (Proglottids)

- Tapeworms are Hermaphroditic
Cestodes (Tapeworm)

Intestinal cestodes
• *Taenia solium* (pork tapeworm)
• *Taenia saginata* (beef tapeworm)
• *Diphyllobothrium latum* (fish tapeworm)
• *Hymenolepis nana* (dwarf tapeworm)
• *Hymenolepis diminutia*
• *Dipylidium caninum*

Tissue cestodes
• *Taenia solium* - cysticercosis
• *Echinococcus granulosus* (unilocular hydatid)
• *Echinococcus multilocularis* (alveolar hydatid)
Principle of stool sampling collection, handling and processing for parasites examination

Collection and handling:
- Minimum 3 samples
- Clean, water-tight container with a screw-cap lid
- The smallest acceptable amount of stool is 2-5g
- Urine should not be allowed to contaminate the specimen
- The specimen container should be labeled correctly (patients’ name, date and time of sample collection, test/tests requested, suspected diagnosis, clinical findings, travel history)
The ideal specimen is a freshly collected stool sample
5-10% formalin
Macroscopic examination:
- consistency
- color
- gross abnormalities
- blood and mucus in feces
- worms in feces

Microscopic examination: standard procedures