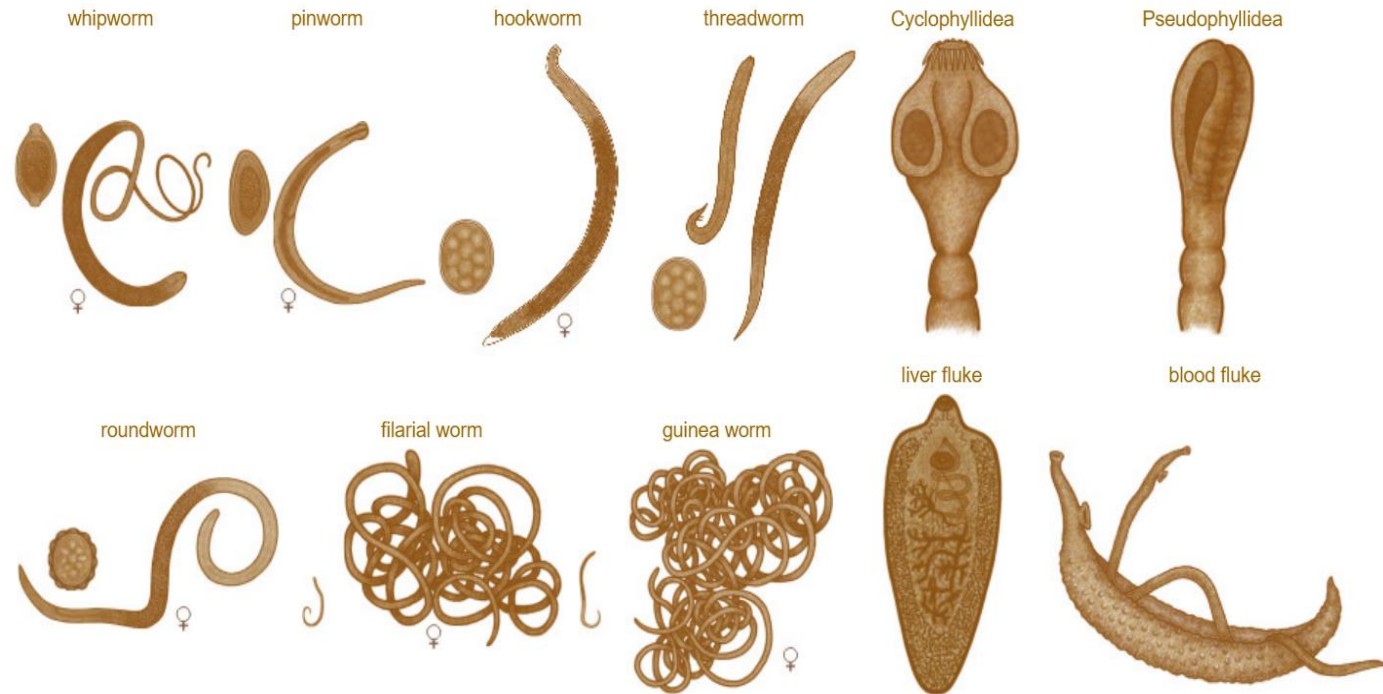




Universiti Islam Antarabangsa Sultan Abdul Halim Mu'adzam Shah

جَامِعَةُ السُّلْطَانِ عَبْدِ الْحَلِيمِ مُعَظَّمِ شَاهِ الْإِسْلَامِيَّةِ الْعَالَمِيَّةِ

Sultan Abdul Halim Mu'adzam Shah International Islamic University



Introduction to Helminthology

Topic Learning Outcomes

At the end of the lecture, students will be able to

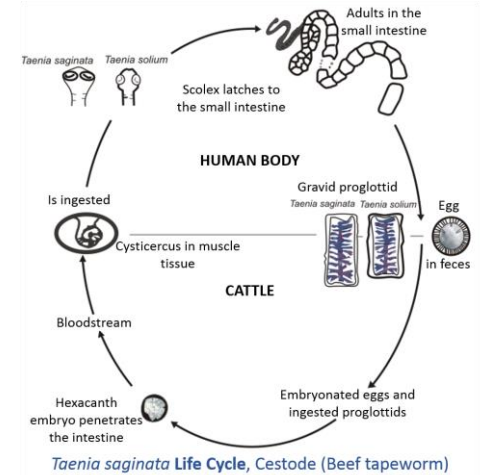
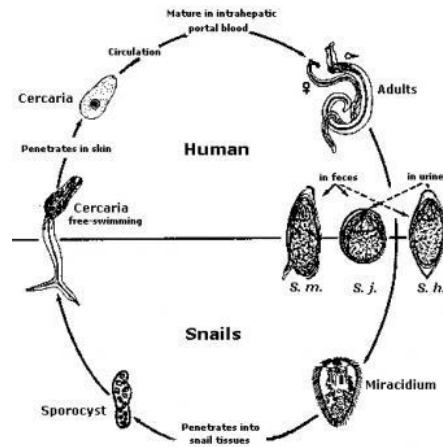
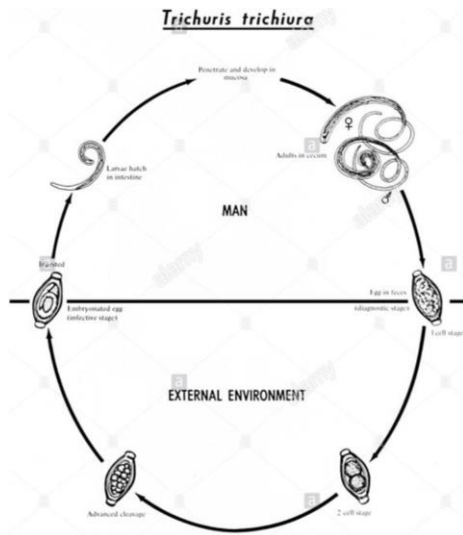
1. classify medically important helminth
2. discuss the general aspects of helminth, such as morphology, life cycle, epidemiology and mode of transmission
3. outline the types of helminth habitats

Introduction: Overview

- Helminth = worm
- Biodiversity



- Life cycle



1. Classification

Sarcodina

Mastigophora

Coccidia

Sarcomastigophora

Ciliophora

Apicomplexa

Microspora

4.1 Protozoa
(Protozoology)

Nematoda

4.2 Helminths
(Helminthology)

Platyhelminthes

Trematoda

Cestoda

4.3 Arthropods
(Entomology)

Insecta

Scorpions

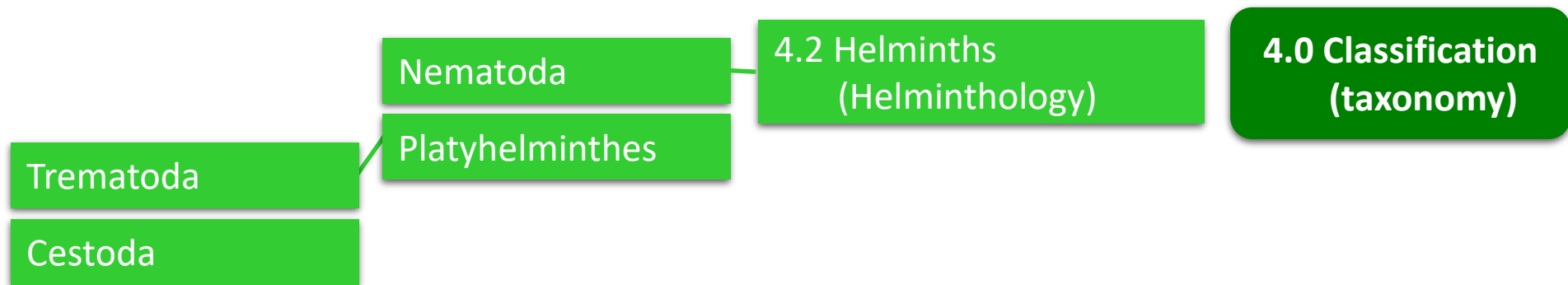
Arachnida

Spiders

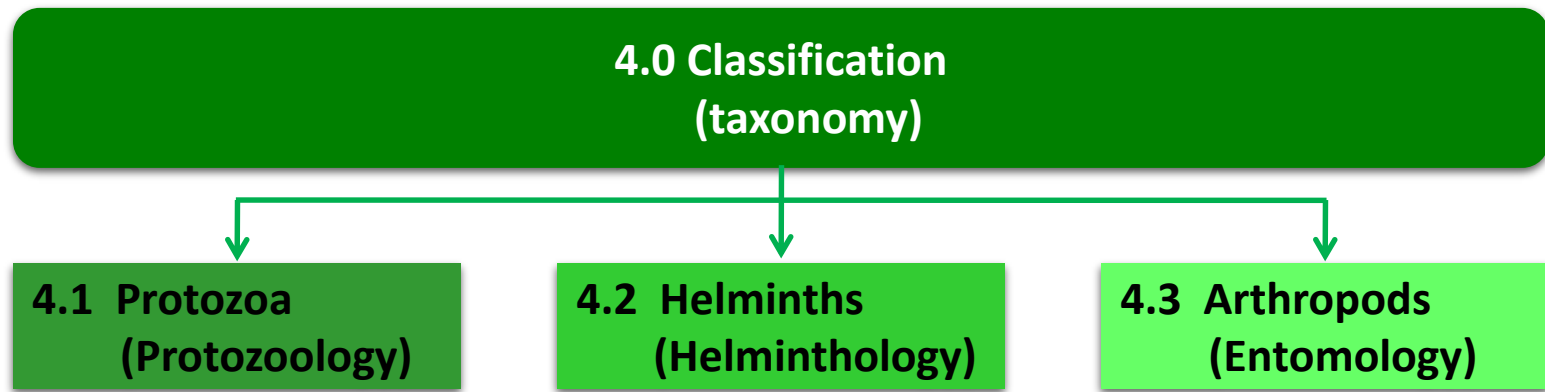
Acari (mites , ticks)

**4.0 Classification
(taxonomy)**

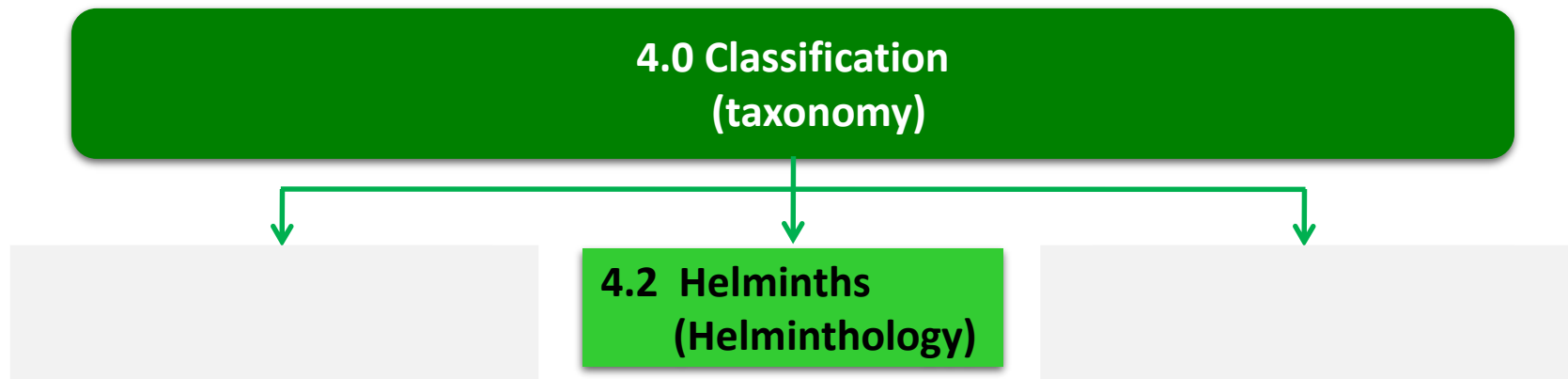
1. Classification



1. Classification



1. Classification



1.1 Classification of helminths found in human

PHYLUM	PARASITE	DISEASE
Nematoda		
Intestine	<i>Enterobius vermicularis</i> <i>Ascaris lumbricoides</i> <i>Trichuris trichiura</i> <i>Strongyloides stercoralis</i> Hookworm: <i>Necator americanus</i> / <i>Ancylostoma duodenale</i>	Enterobiasis Ascariasis Trichuriasis Strongyloidiasis Hookworm infection
Blood/ Tissue*/ Subcutaneous+	<i>Wuchereria bancrofti</i> <i>Brugia malayi</i> <i>Loa loa</i> + <i>Onchocerca volvulus</i> + <i>Mansonella ozzardi</i> <i>M. pertans</i> <i>M. streptocerca</i> <i>Dirofilaria immitis</i> <i>Trichenella spiralis</i> * <i>Dracunculus medinensis</i> *	Lymphatic filariasis Lymphatic filariasis <i>Loa loa</i> filariasis/ s.f. River blindness/ s.f. Serous cavity filariasis Serous cavity filariasis Subcutaneous filariasis (s.f.) Trichinosis

1.2 Taxonomy of pathogenic helminth (Nematode)

CLASSIFICATION	NAME	EXAMPLE (<i>Genus sp.</i>)
Kingdom	Animalia	
Phylum	Nematoda	
Class	Rhabditea	
Order	Ascaridida	
Family	Ascarididae	
Genus	<i>Ascaris</i>	
Species	<i>lumbricoides</i>	<i>Ascaris lumbricoides</i>

1.2 Classification of helminths found in human

PHYLUM	PARASITE	DISEASE
Platyhelminthes (flat worms)		
Class Trematoda (flatworms)		
Intestine	<i>Faciolopsis buski</i>	Faciolopsiasis
Blood	<i>Schistosoma mansoni</i> <i>S. japonicum</i> <i>S. haematobium</i>	Schistosomiasis
Liver/ Lung*	<i>Faciola hepatica</i> <i>Paragonimus westermani</i> *	Facioliasis Paragonimiasis
Class Cestoda (tapeworms)		
Intestine	<i>Taenia saginata</i> , <i>T. solium</i>	Taeniasis
Tissue	<i>Echinococcus granulosus</i>	Echinococcosis

1.2 Taxonomy of pathogenic helminth (Trematode)

CLASSIFICATION	NAME	EXAMPLE (<i>Genus sp.</i>)
Kingdom	Animalia	
Phylum	Platyhelminthes	
Class	Trematoda	
Order	Strigeiformes	
Family	Schistosomatidae	
Genus	<i>Schistosoma</i>	
Species	<i>mansoni</i>	<i>Schistosoma mansoni</i>

1.2 Taxonomy of pathogenic helminth (Cestode)

CLASSIFICATION	NAME	EXAMPLE (<i>Genus sp.</i>)
Kingdom	Animalia	
Phylum	Platyhelminthes	
Class	Cestoda	
Order	Cyclophyllidea	
Family	Taeniidae	
Genus	<i>Taenia</i>	
Species	<i>saginata</i>	<i>Taenia saginata</i>

2. General Concepts

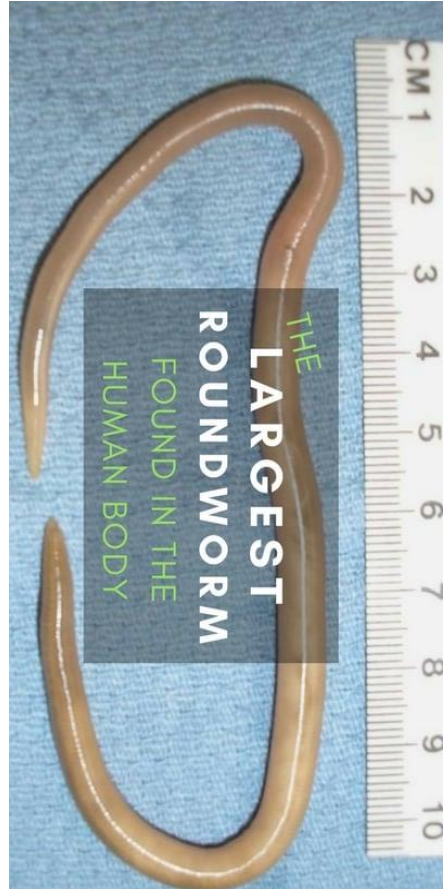
2. General Concepts

2. General characteristic: morphology

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
Shape	 <p>THE LARGEST ROUNDWORM FOUND IN THE HUMAN BODY</p>		

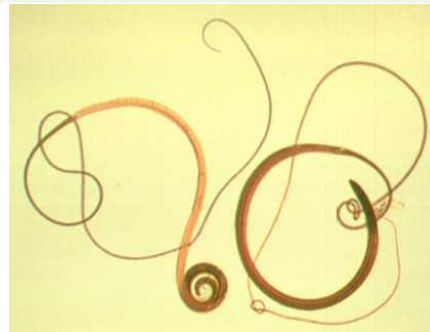
2. General characteristic: morphology

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
Shape	Round Elongated Cylindrical	Leaf-like, unsegmented	Tape-like, segmented



2. General characteristic: morphology

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
Sexes			



Trichuris trichiura

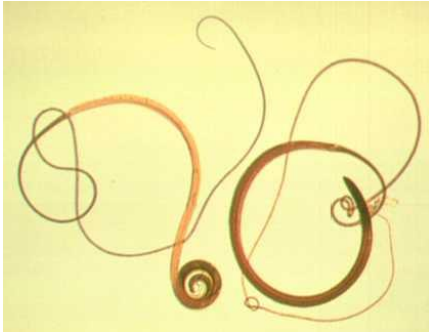




Fasciola hepatica

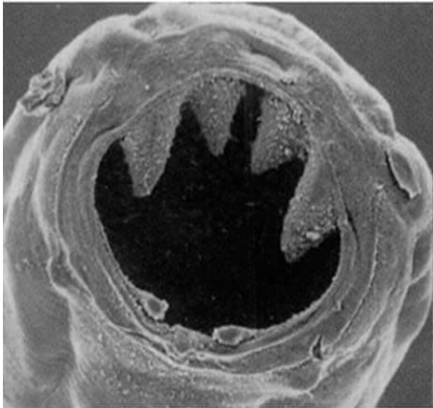

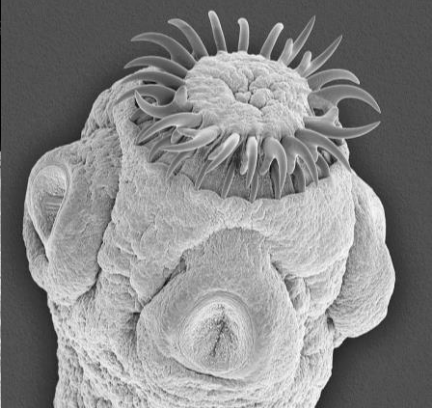


Echinococcus granulosus

2. General characteristic: morphology

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
Sexes	Separate (diecious)	Not separated (monoecious) <i>Except:</i> blood flukes (diecious)	Not separated (monoecious)
			
	<i>Trichuris trichiura</i>	<i>Faciola hepatica</i>	<i>Echinococcus granulosus</i>

2. General characteristic: morphology

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
“Head end”			
	<i>Ancylostoma duodenale</i>	<i>Faciola sp.</i>	<i>Taenia saginata</i>

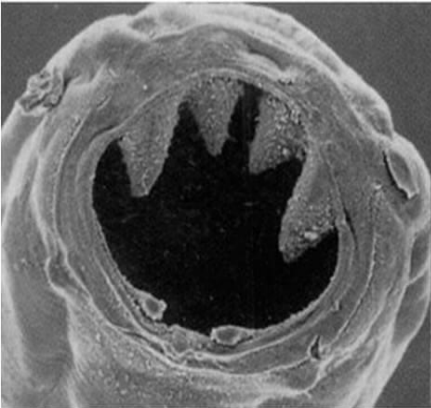
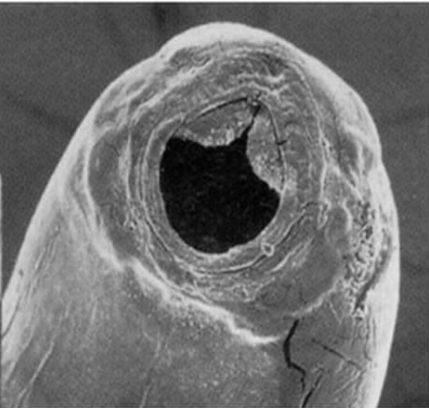

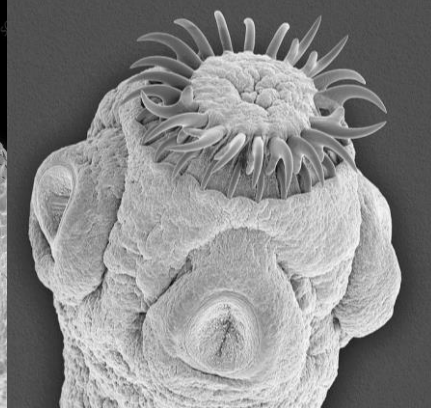
Ancylostoma duodenale

Necater americanus

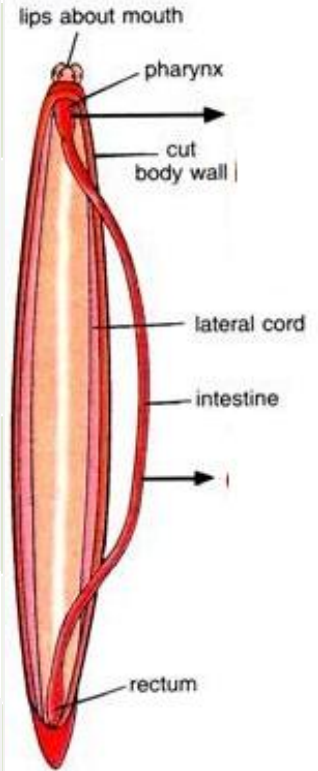
Faciola sp.

Taenia saginata

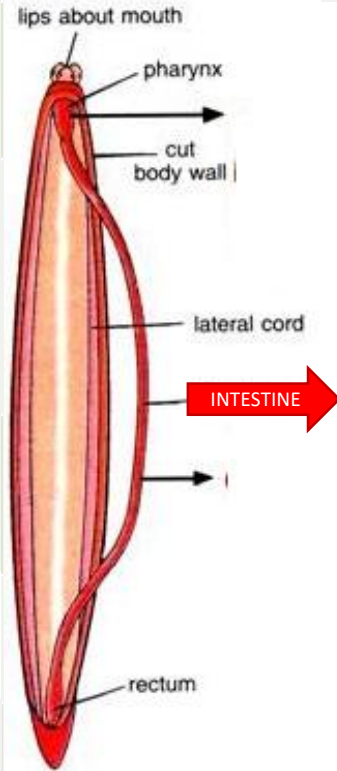
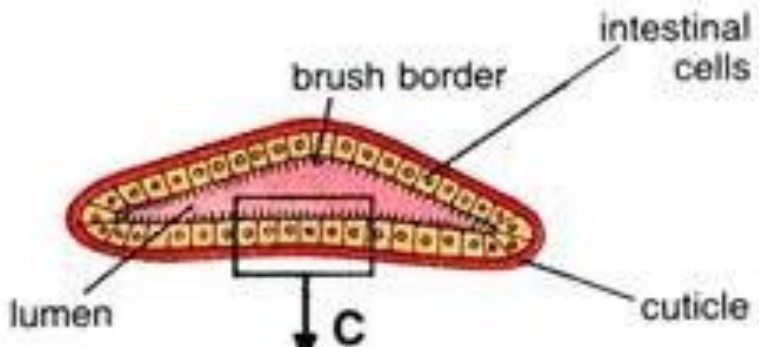
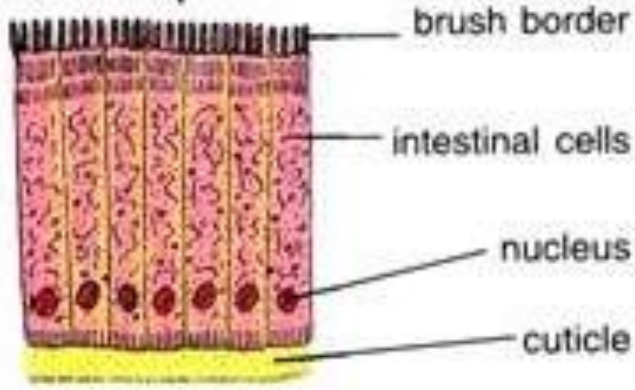
2. General characteristic: morphology

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
“Head end”	Without suckers, without hooks	Suckers, without hooks	Suckers, with hooks
			
<i>Ancylostoma duodenale</i>	<i>Necator americanus</i>	<i>Faciola</i> sp.	<i>Taenia saginata</i>

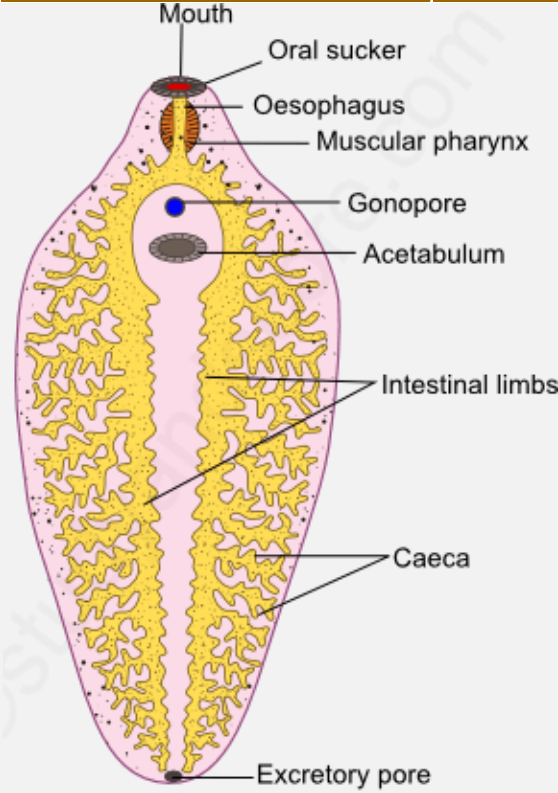
2. General characteristic: medically important helminths

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
Alimentary canal	 <p>lips about mouth pharynx cut body wall lateral cord intestine rectum</p> <p>A</p>		

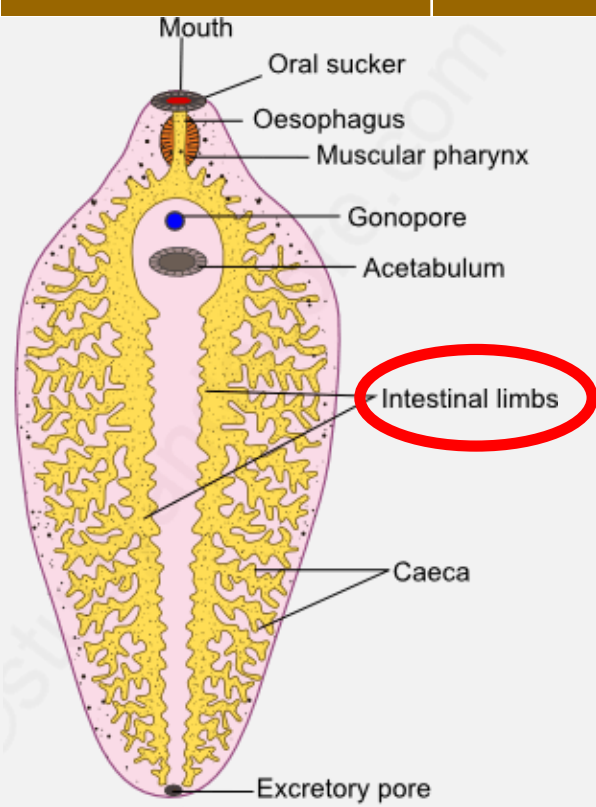
2. General characteristic: morphology

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
Alimentary canal	 <p>Diagram A illustrates the anatomy of a nematode, showing the alimentary canal. Key structures labeled include the lips about mouth, pharynx, cut body wall, lateral cord, and rectum. A red arrow labeled "INTESTINE" points to the central gut tube.</p>	 <p>Diagram C shows a cross-section of a Trematode's alimentary canal. The lumen is the central cavity, lined by intestinal cells with a brush border. The outer layer is the cuticle.</p>	 <p>Diagram D shows a cross-section of a Cestode's alimentary canal. The intestinal cells have a brush border and contain a nucleus. The outer layer is the cuticle.</p>


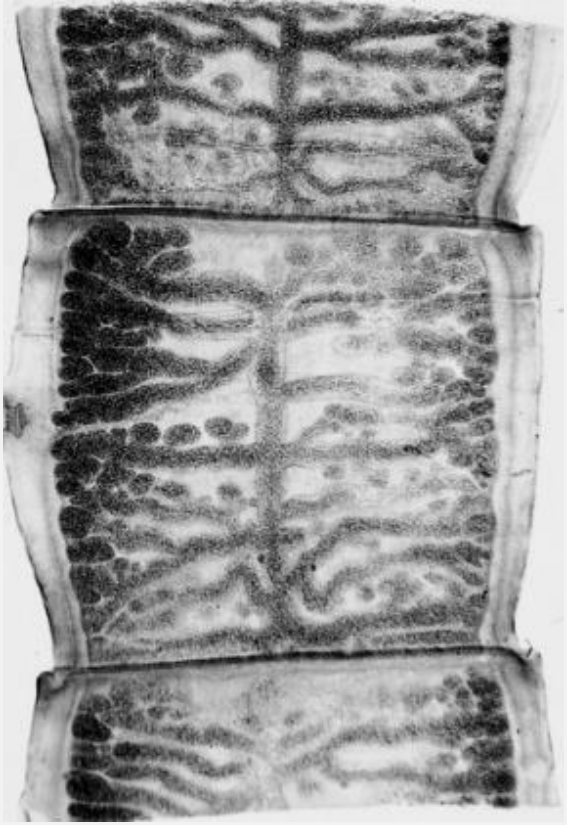
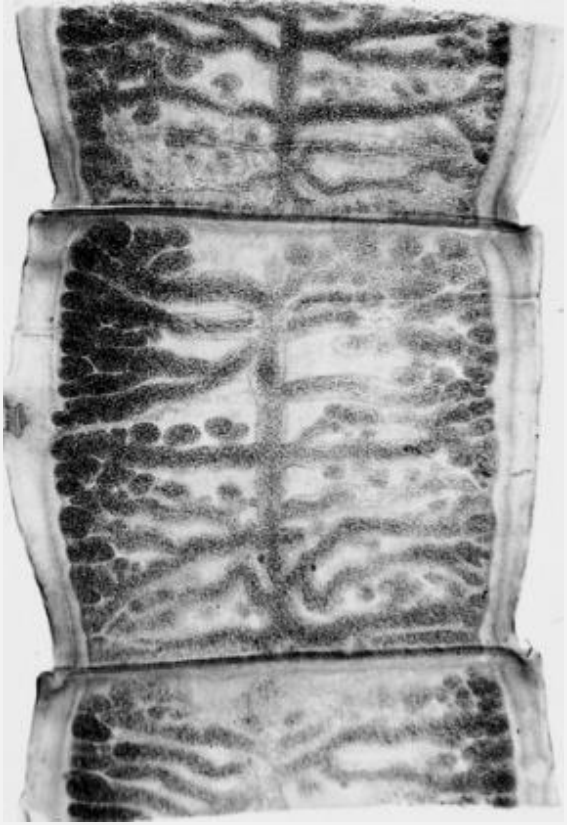
2. General characteristic: morphology

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
Alimentary canal		 <p>The diagram illustrates the Fasciola-Digestive System of a trematode. It shows a cross-section of the body with various internal structures labeled. At the anterior end, there is a mouth leading to an oral sucker, followed by the oesophagus and a muscular pharynx. A gonopore is located in the middle of the body. Below it is the acetabulum. The digestive system consists of a central caeca with numerous branching intestinal limbs. An excretory pore is located at the posterior end.</p>	

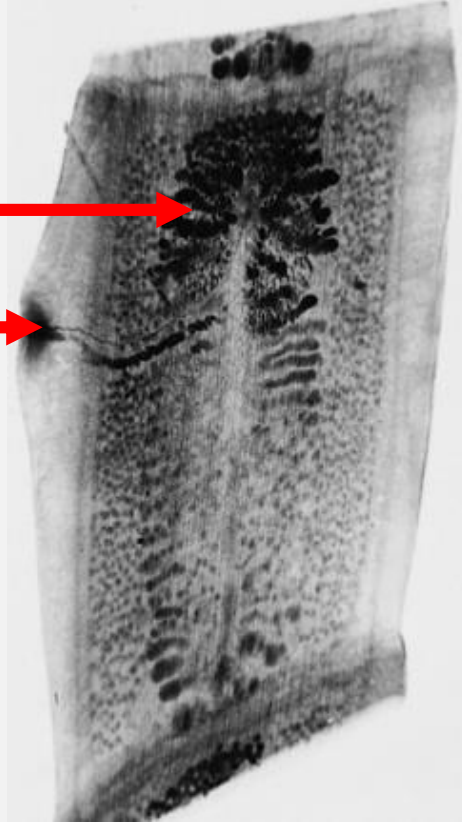
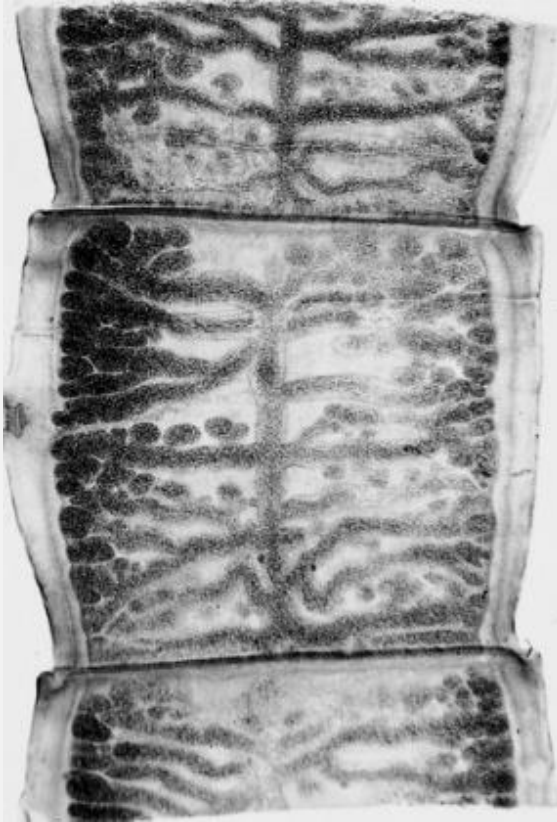
2. General characteristic: morphology

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
Alimentary canal		 <p>The diagram illustrates the Fasciola-Digestive System of a trematode. It shows a cross-section of the body with various internal structures labeled. At the anterior end, there is a mouth leading to an oral sucker, followed by the oesophagus and muscular pharynx. A gonopore is located in the middle of the body. Below it is the acetabulum. The central part of the body is filled with a complex network of yellow-colored intestinal limbs, which are circled in red. At the bottom, there are caeca and an excretory pore. The entire system is labeled as the Fasciola-Digestive System.</p>	

2. General characteristic: morphology

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
Alimentary canal			

2. General characteristic: morphology

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
	<p>Gravid proglottids: Branching uterus Genital pore</p> 		
Alimentary canal			

2. General characteristic: morphology

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
Alimentary canal	Present , complete	Present, incomplete	Absent

2. General characteristic: morphology

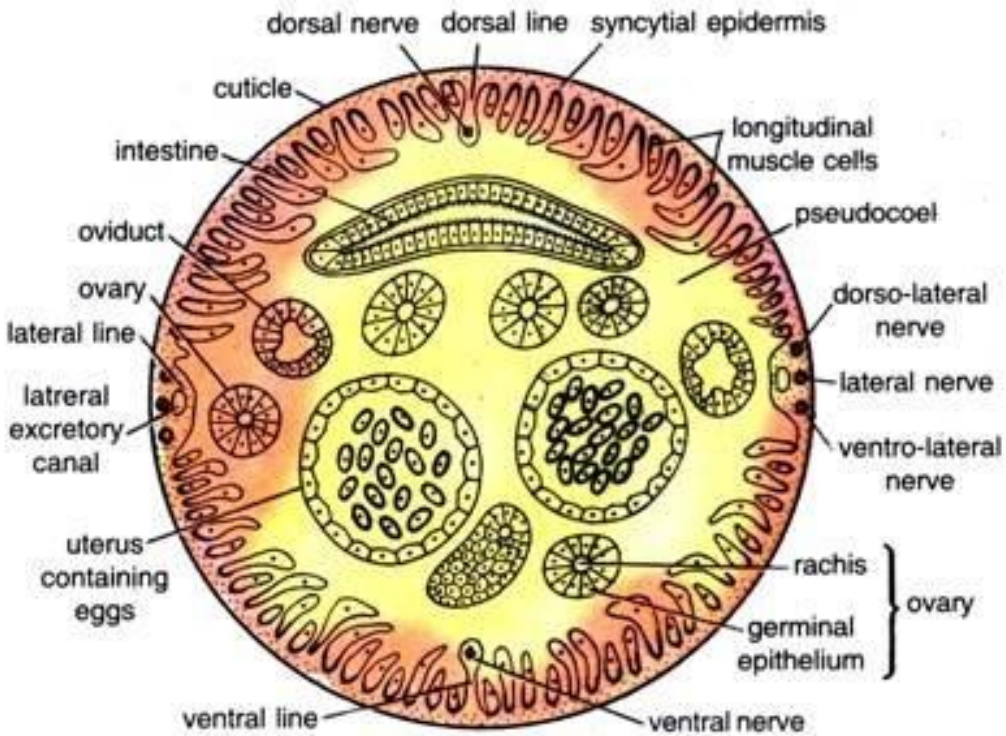
Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
Body cavity		 <p>The diagram shows a transverse section of a mature female <i>Ascaris lumbricoides</i>. The body is cylindrical and shows a clear body wall with a cuticle, syncytial epidermis, and longitudinal muscle cells. The internal cavity is filled with a pseudocoel. Key structures include the dorsal nerve, dorsal line, and ventral nerve, ventral line. The nervous system also includes dorso-lateral, lateral, and ventro-lateral nerves. The digestive system consists of an intestine. The reproductive system includes an oviduct, ovary (with rachis and germinal epithelium), and a uterus containing eggs. Other structures shown are the lateral line, lateral excretory canal, and intestines.</p>	

Fig. 46.14. *Ascaris lumbricoides*. T.S. of a mature female.

2. General characteristic: morphology

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode

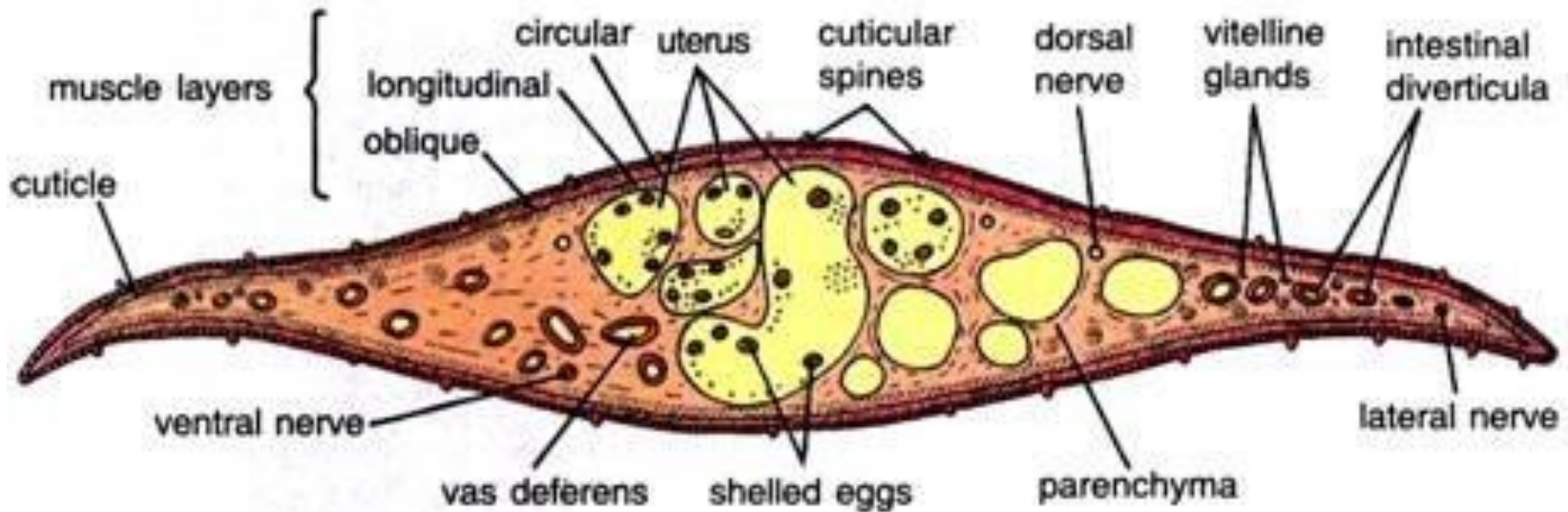
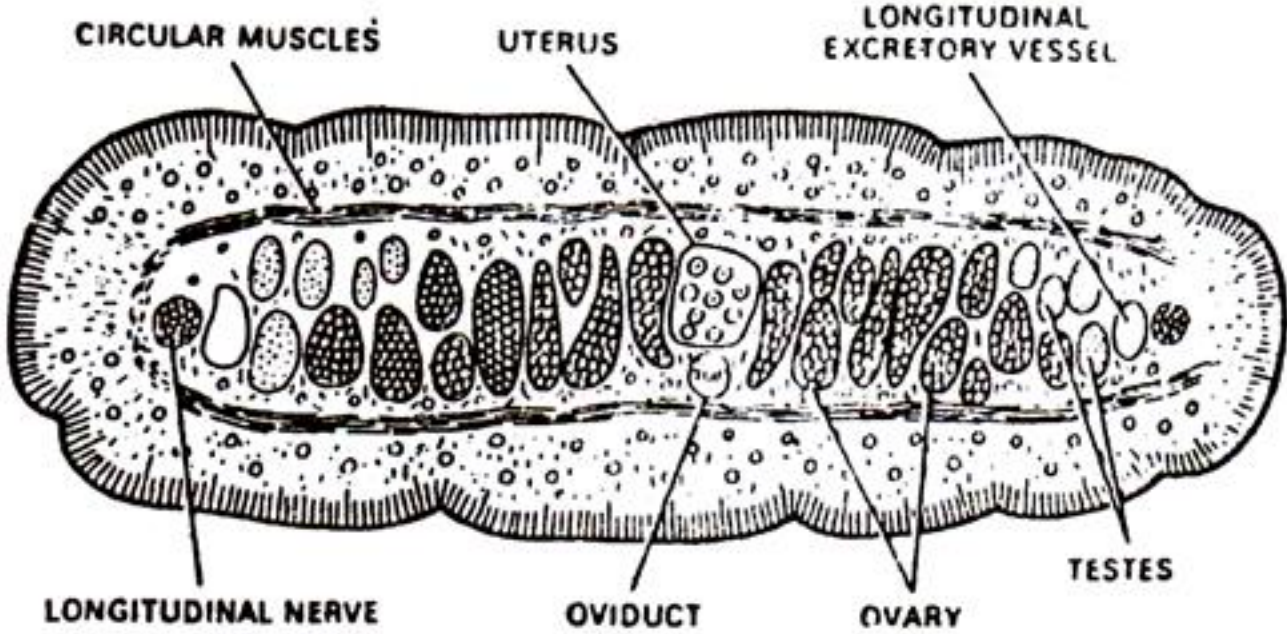


Fig. 41.12. *Fasciola hepatica*. T.S. of body through uterus.

Body cavity

2. General characteristic: morphology

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
Body cavity		 <p>Fig. 116 T.S. TAENIA MATURE PROGLOTTID</p>	

2. General characteristic: morphology

Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
Body cavity	Present	Absent	Absent

2. General characteristic: morphology

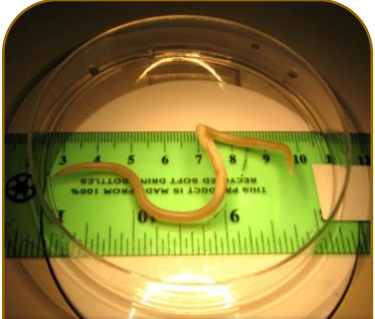
Characteristic	Nematode	Platyhelminthes	
		Trematode	Cestode
Shape	Elongated, cylindrical	Leaf-like, unsegmented	Tape-like, segmented
Sexes	Separate (diecious)	Not separated (monoecious) <i>Except:</i> blood flukes (diecious)	Not separated (monoecious)
“Head end”	Without suckers, without hooks	Suckers, without hooks	Suckers, with hooks
Alimentary canal	Present , complete	Present, incomplete	Absent
Body cavity	Present	Absent	Absent

Note:

1. Multicellular
2. Bilaterally symmetrical animals
3. Have 3 germ layers

Characteristic of Nematoda

- 1. **.round**worms
- 2. having elongated cylindrical unsegmented bodies
- 3. Internally the cuticle is formed from an underlying hypodermis
- 4. has four longitudinal thickenings



Ascaris lumbricoides



Trichuris trichiura



Strongyloides stercolis



Wuchereria bancrofti



Brugia malayi



Loa loa

microfilaria

Characteristic of Platyhelminthes

1. dorso-ventrally **flattened** worms
2. with solid acoelomate bodies, (i.e. no body cavities),
3. the organs and muscle fibres being embedded in parenchymal tissue
4. no respiratory or circulatory systems present



Faciolopsis buski



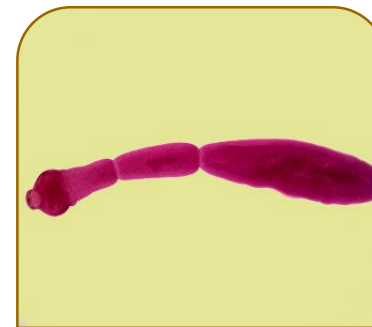
*Schistosoma
mansoni*



Faciola hepatica



Taenia saginata



*Echinococcus
granulosus*

2. General characteristic: life cycle

nematode cycle
egg - larvae (L1-L4) - adult



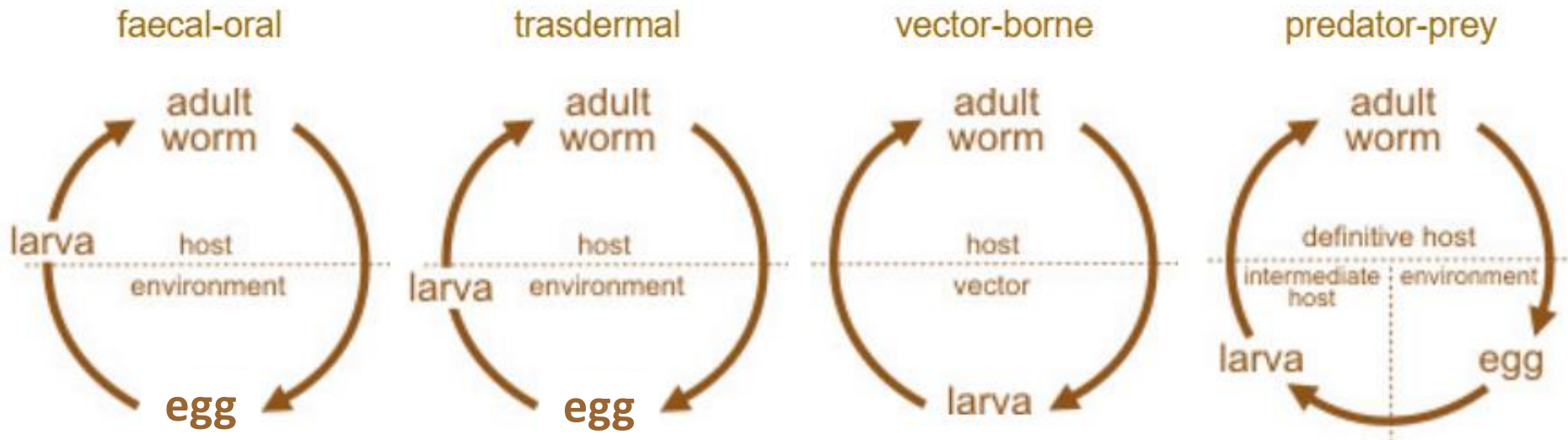
cestode cycle
egg - metacestode - adult



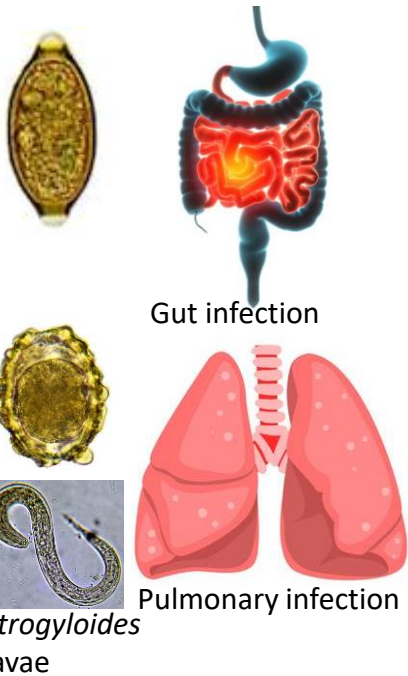
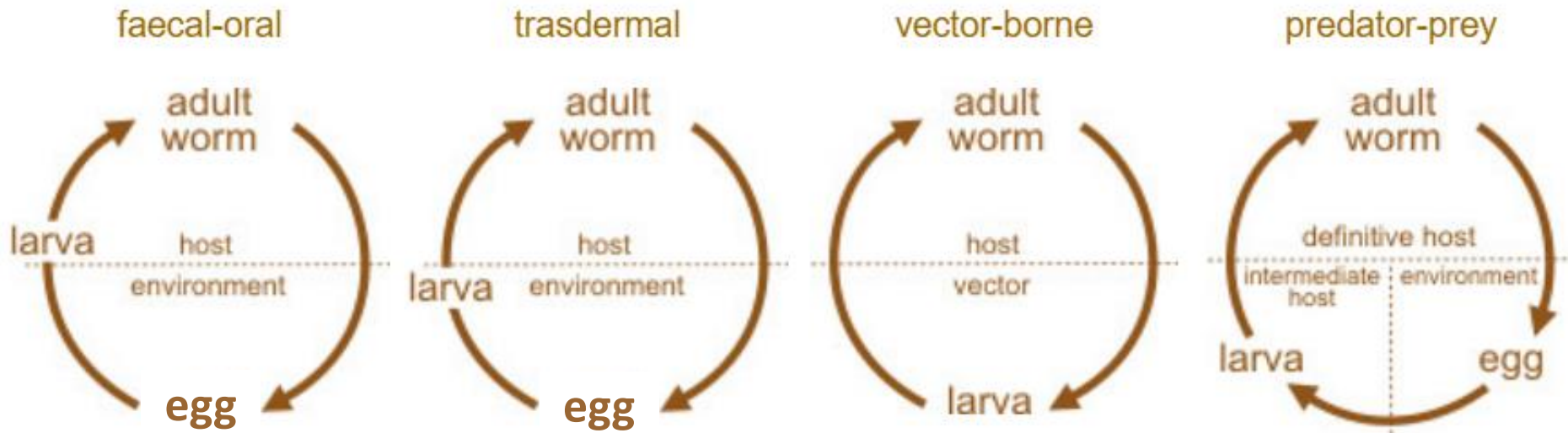
trematode cycle
egg-miracidium-sporocyst-redia-cercaria-(metacercaria)-
adult



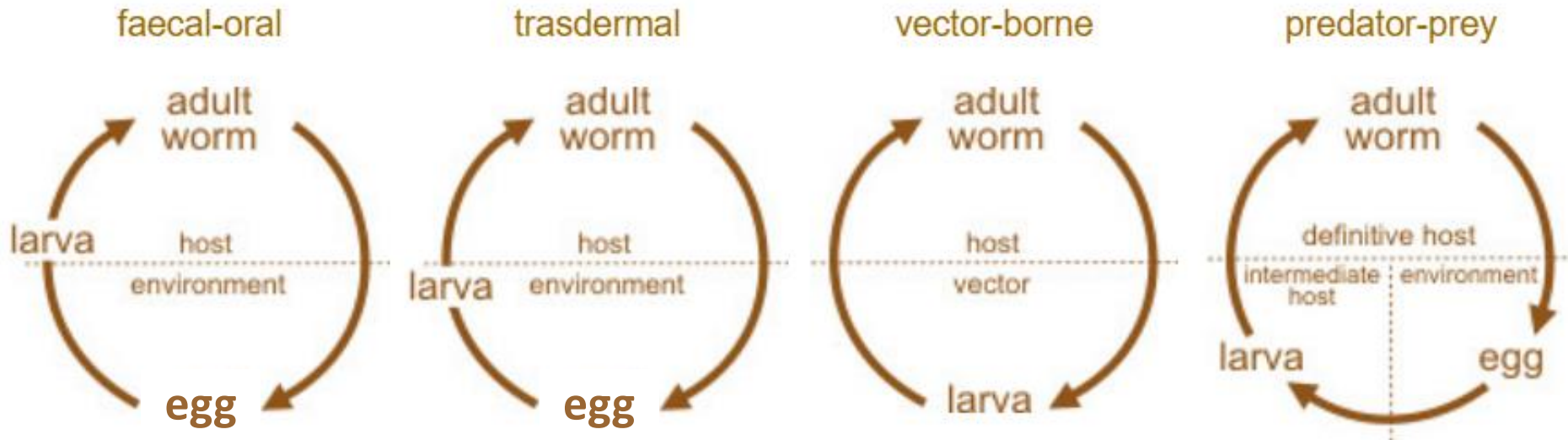
2. General characteristic: modes of transmission



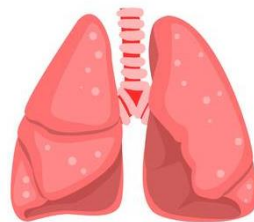
2. General characteristic: modes of transmission



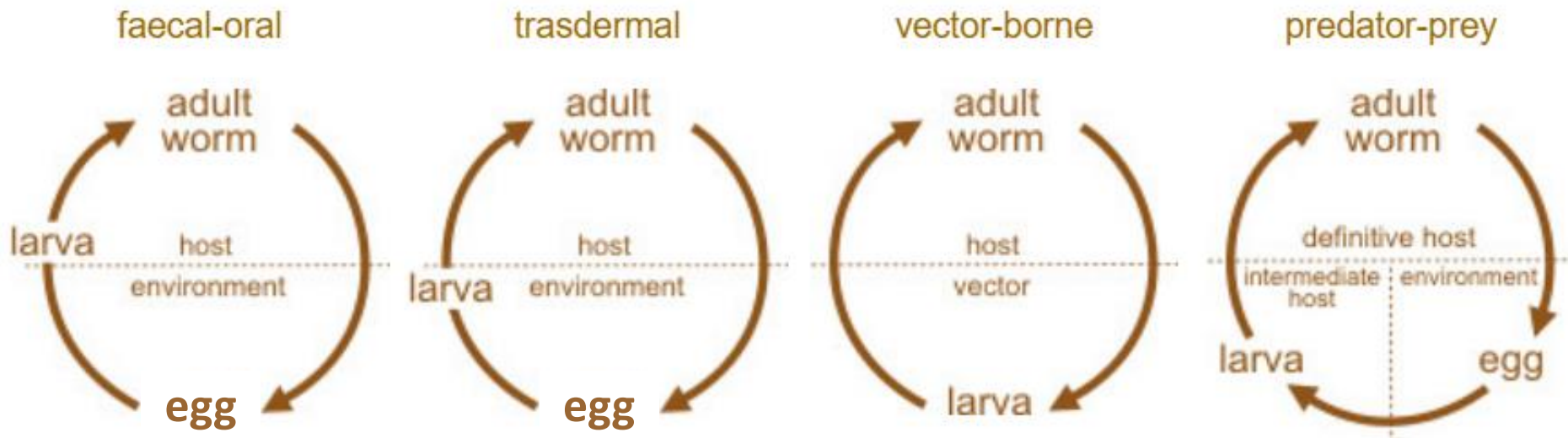
2. General characteristic: modes of transmission



Larval
hookworm



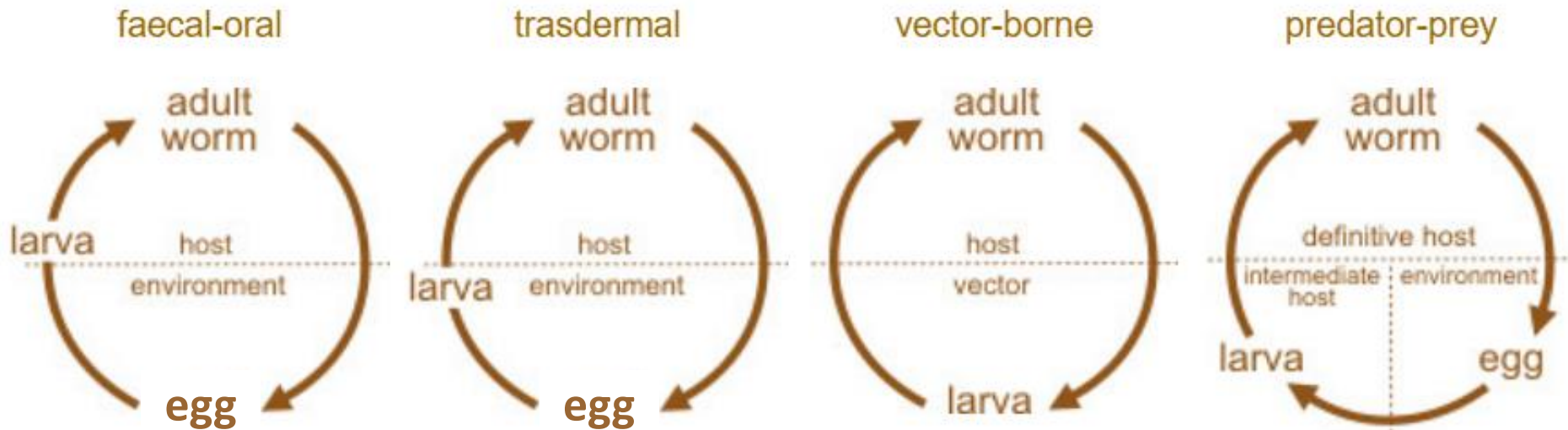
2. General characteristic: modes of transmission



Schistosoma mansoni
miracidium



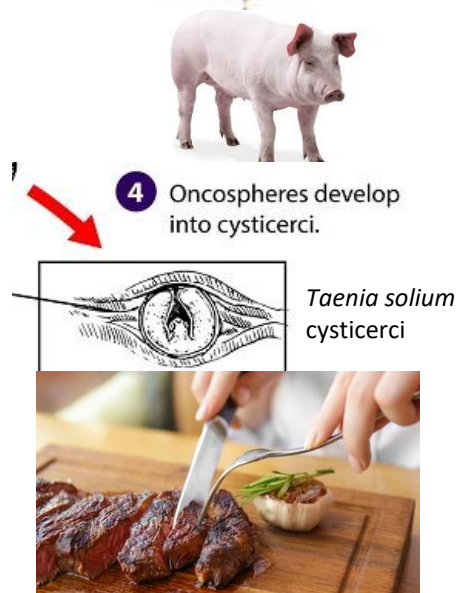
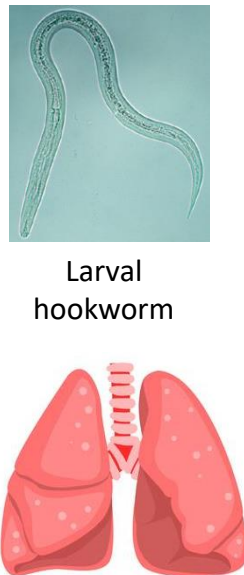
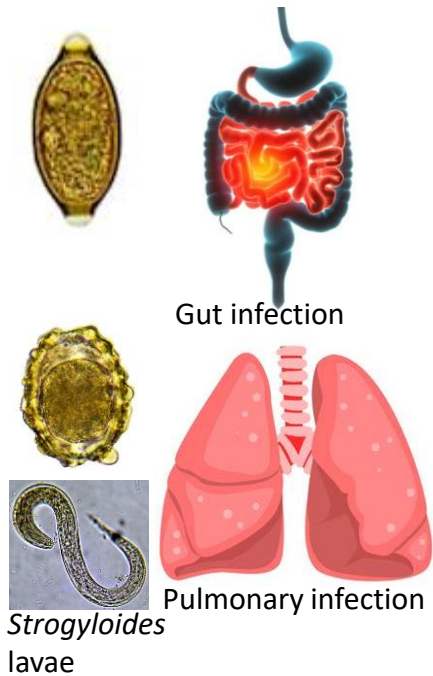
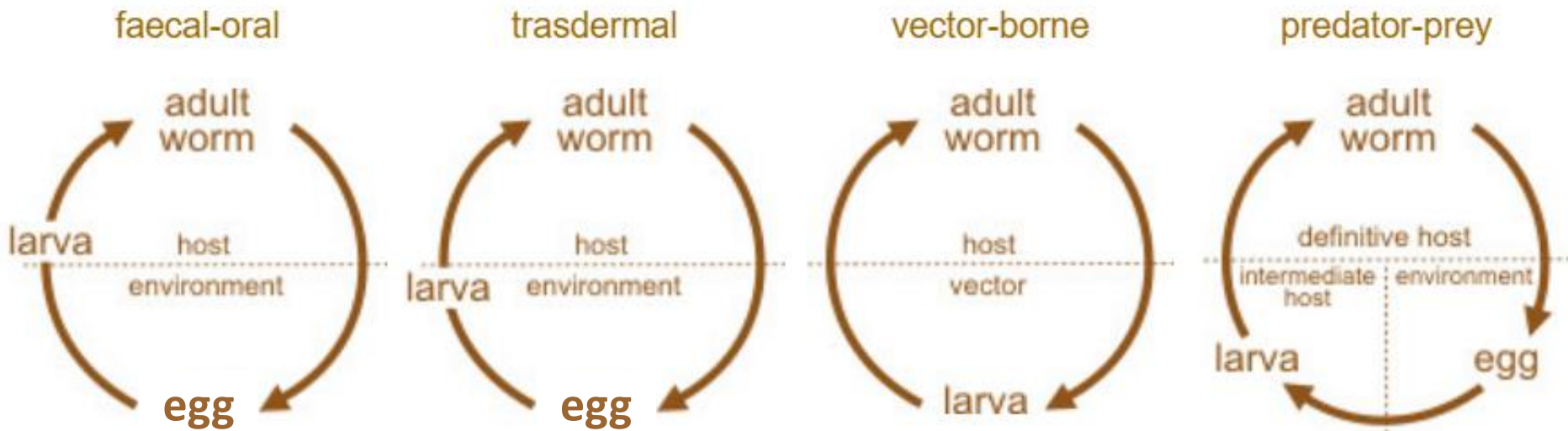
2. General characteristic: modes of transmission



4 Oncospheres develop into cysticerci.



2. General characteristic: modes of transmission



3. Habitats

Blood/ Body fluid

Nematode:

Wuchereria bancrofti,
Brugia malayi/ *B. timori*/
B. Pahangi
Mansonella ozzardi/
M. pertans/
M. streptocerca

Blood Fluke:

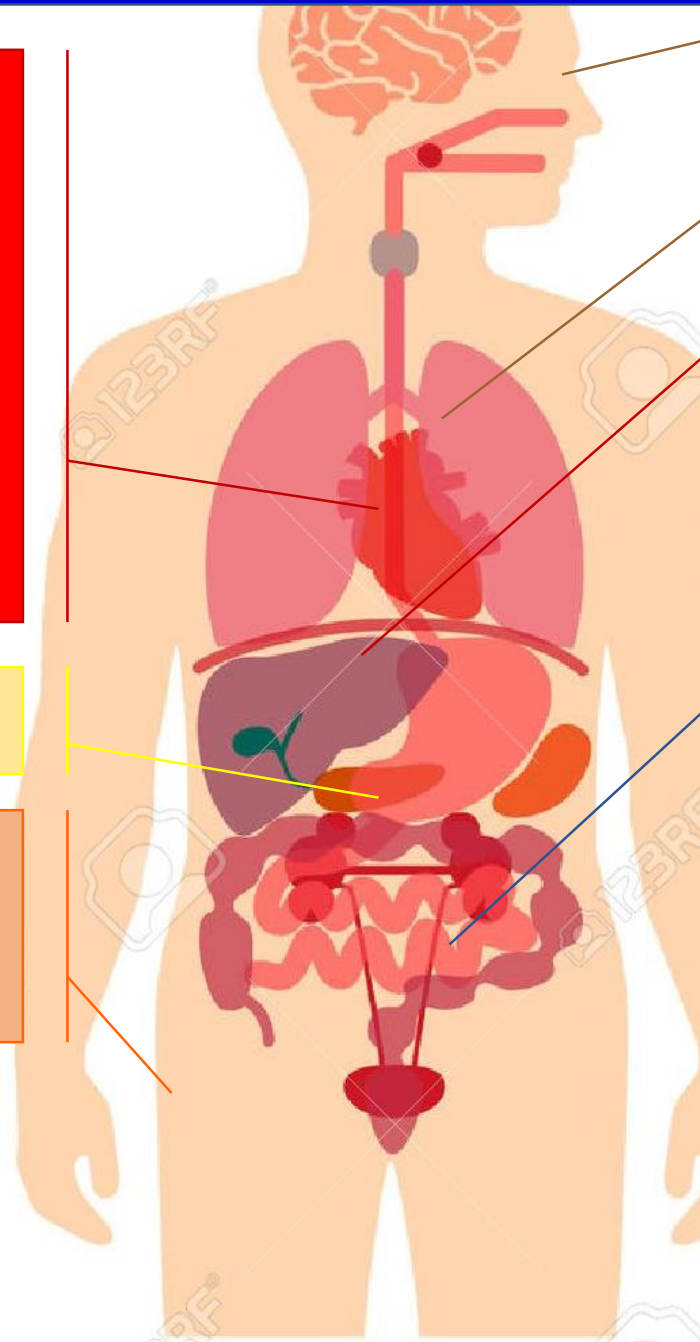
Schistosoma mansoni
S. japonicum
S. haematium

Pancreas

Eurytrema spp.

Tissue

Trichinella spiralis
Dracunculus medinensis
Echinococcus granulosa
Multiceps spp.



Eye (tissue)

Nematode: *Loa loa*

Onchocerca volvulus (river blindness)

Lung

Fluke: *Paragonimus westermani*

Liver

Fluke: *Faciola hepatica*,
Clonorchis sinensis,
Opisthorchis spp.,
Dicrocoelium spp.

Intestinal

Nematodes:

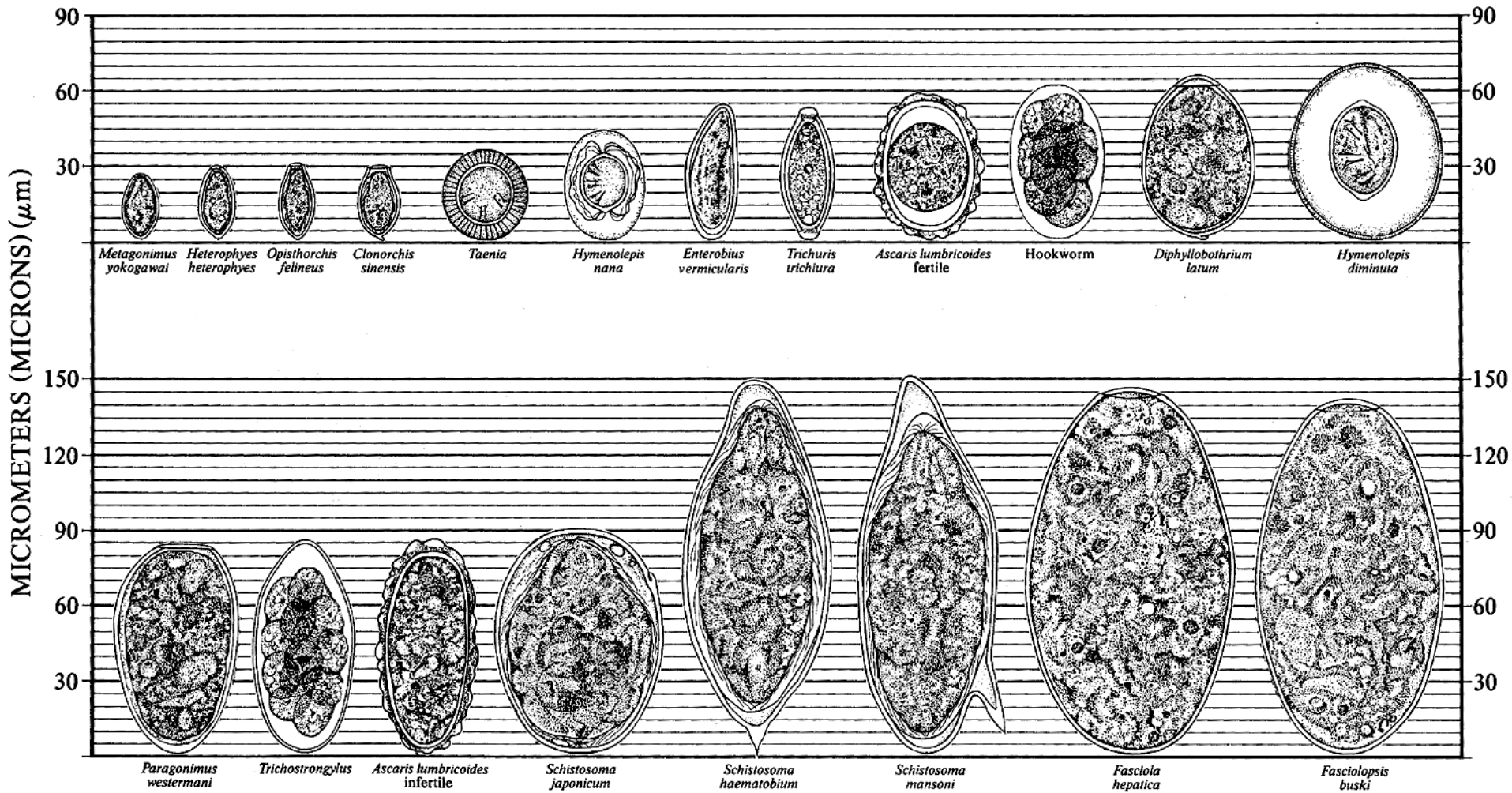
Enterobius vermicularis
Ascaris lumbricoides
Trichuris trichiura
Necator americanus/
Ancylostoma duodenale
Stroglyoides stercoralis

Flukes: *Faciolopsis buski*,
Heterophyes heterophyes,
Metagonimus yokogawai

Cestode:

Diphyllobothrium latum
Taenia saginata/ *T. solium*
Hymenolepis nana/
Hymenolepis diminuta
Dipylidium caninum

4. Summary



- Classification of trematodes according to their habitat
- Blood flukes include *Schistosoma haematobium*, *Schistosoma mansoni*, *Schistosoma japonicum*, *Schistosoma mekongi*, and *Schistosoma intercalatum* (clade B – mammalian freshwater schistosomes).
- Liver flukes include *F hepatica*, *Fasciola gigantica*, *C sinensis*, *Opisthorchis felinus*, *O viverrini*, *Dicrocoelium dendriticum*, *Dicrocoelium hospes*, and *Metorchis conjunctus*.
- Pancreatic flukes include *Eurytrema pancreaticum*, *Eurytrema coelomaticum*, and *Eurytrema ovis*.
- Lung flukes include *Pwestermani*, *Paragonimusheterotremus*, *Paragonimus kellicoti*, *Paragonimus mexicana*, *Paragonimus skrjabin*, *Paragonimus miyazakii*, *Paragonimus compactus*, and *Paragonimushueit'ungensis*.
- Intestinal flukes include *F buski*, *M yokogawai*, *Echinostoma ilocanum*, *Watsonius watsoni*, *H heterophyes*, and *Gastrodiscoides hominis*.
- Eye flukes include *Philophthalmus lacrimosus*, *Philophthalmus palpebrarum*, and *Philophthalmus gralli* (*Philophthalmus lucipetus*).
- Other flukes include *Alaria americana* and *Clinostomum complanatum*.

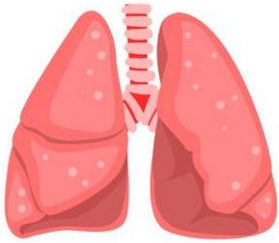
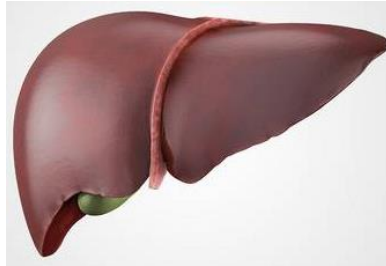
https://www.123rf.com/photo_128230000_Stock-vector-ascaris-life-cycle-vector-illustration-of-the-most-common-human-nematode-infection-worms-grow-and-reproduce.html

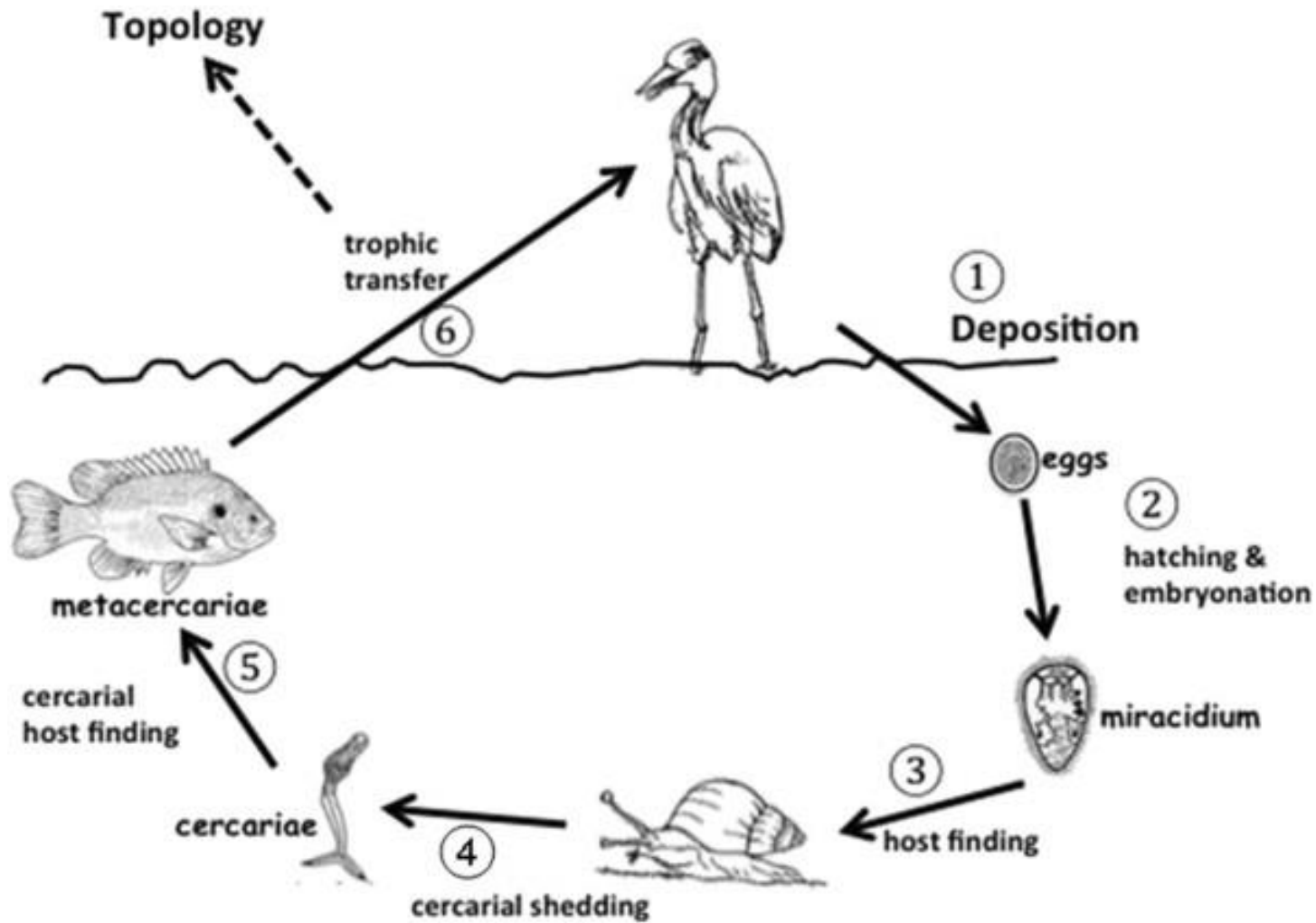
Trichuris trichiura (Eggs)

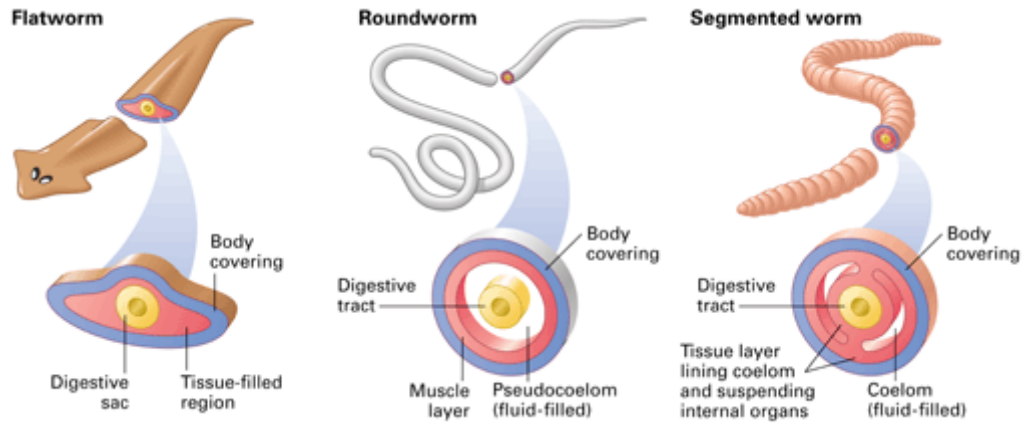


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3. Habitats







Measurements in micrometers (μm)

