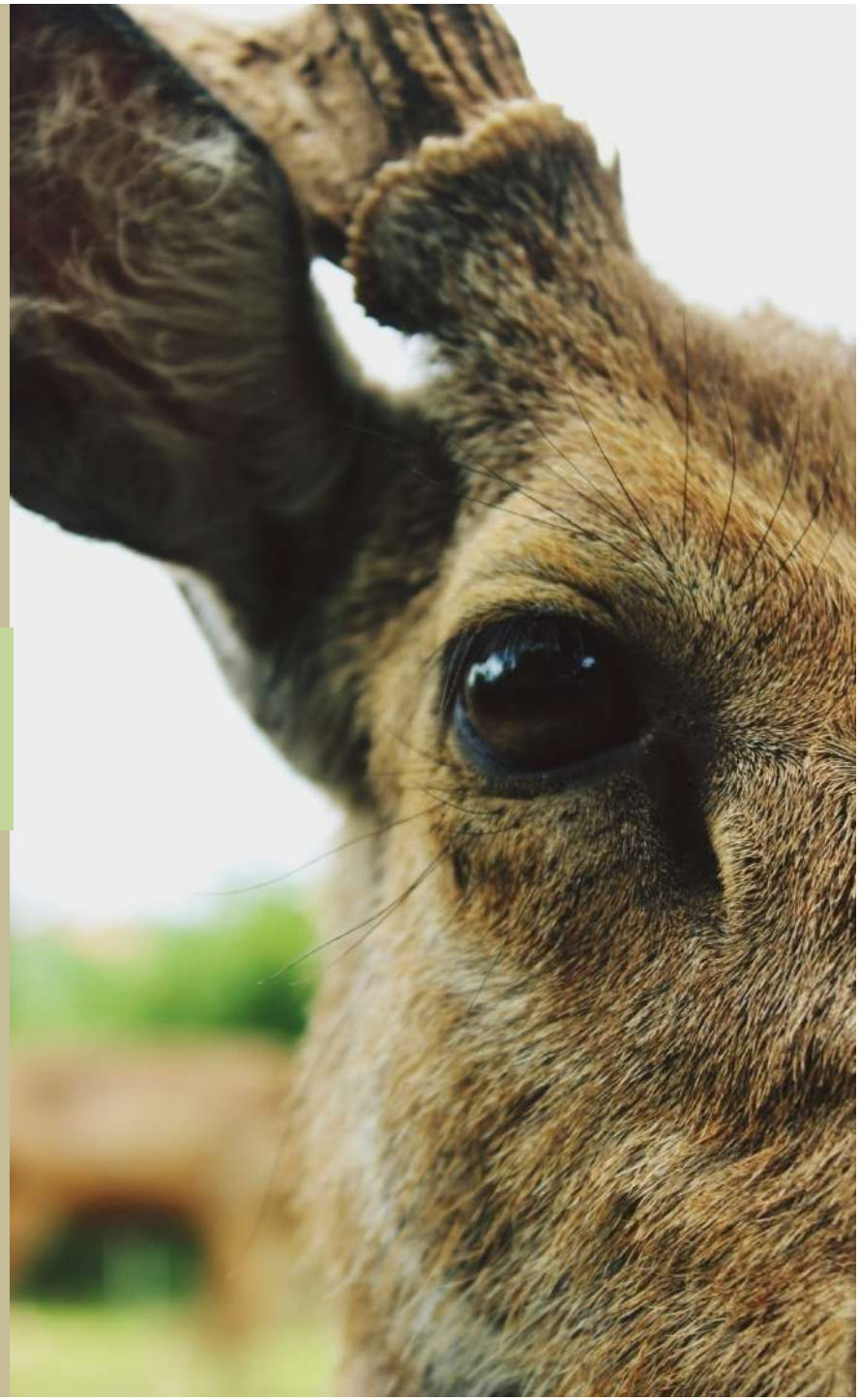
TAKSONOMI HEWAN

CHAPTER 5: PLATYHELMINTHES



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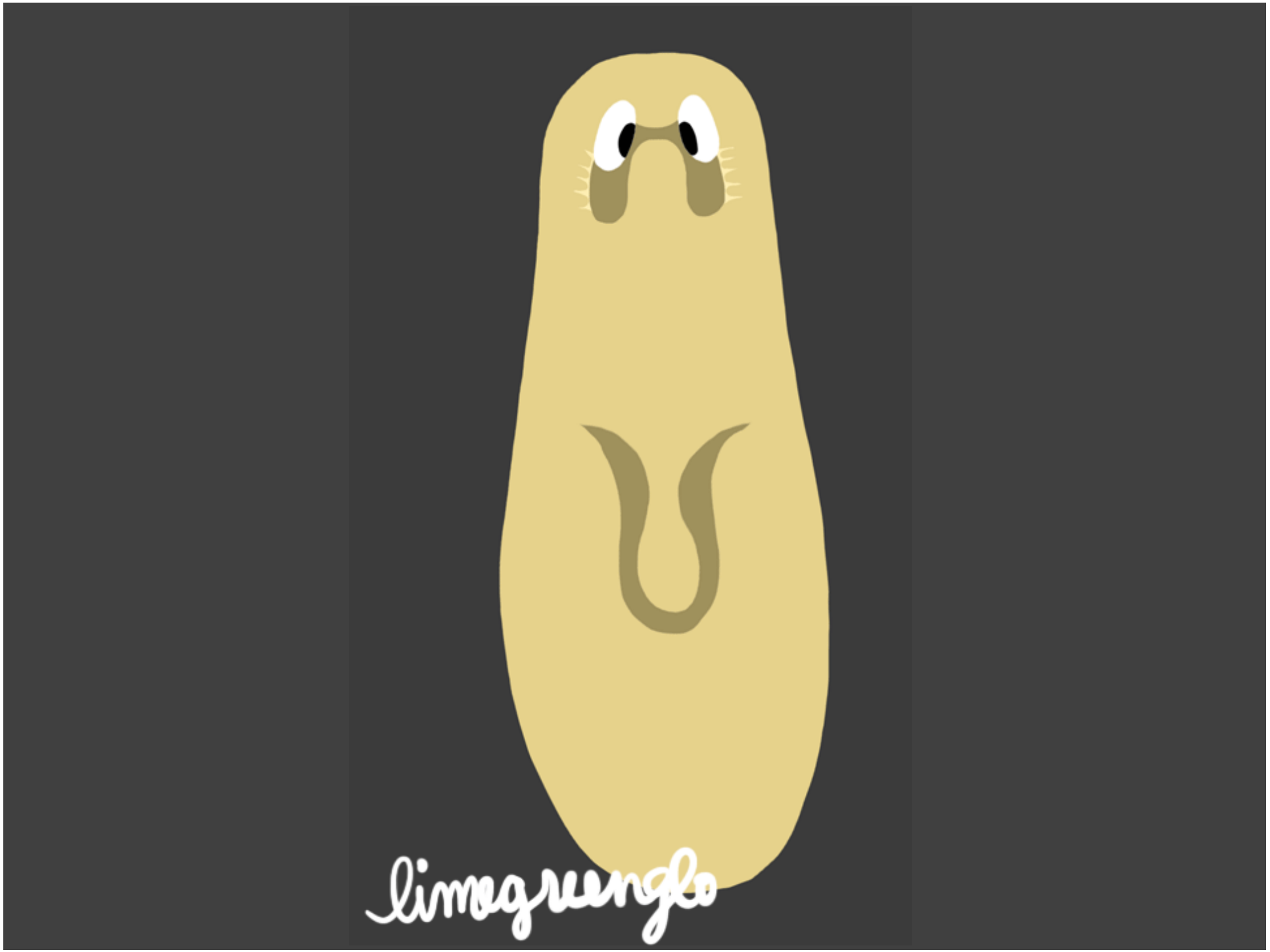
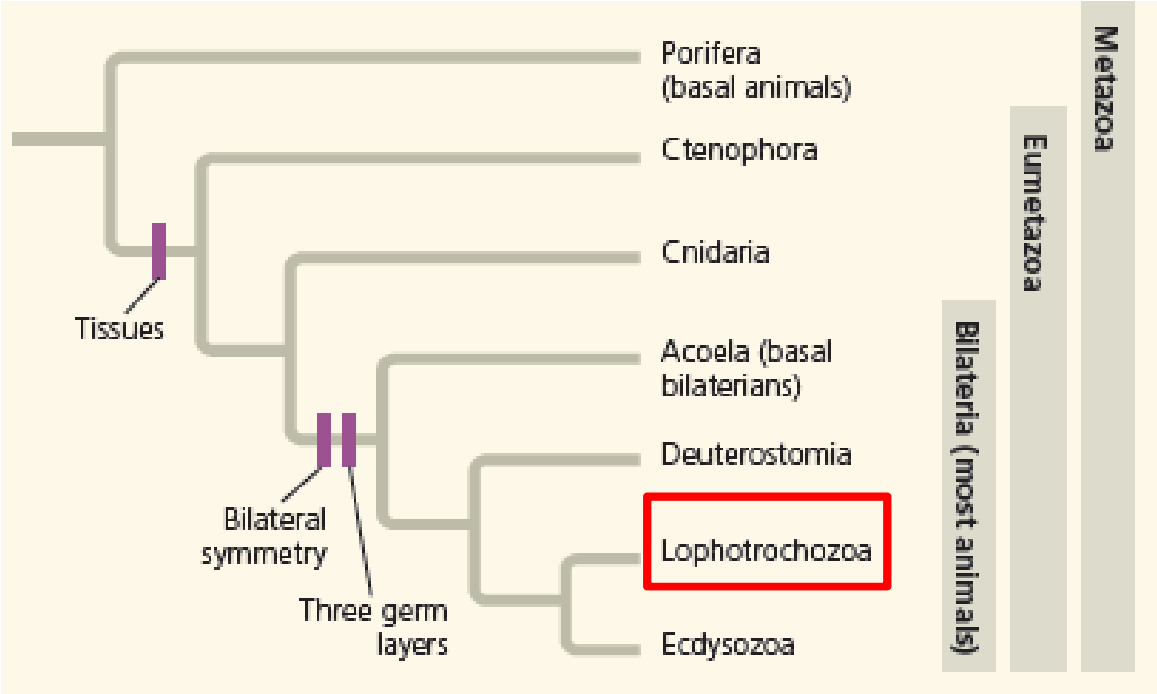

limegruenglo

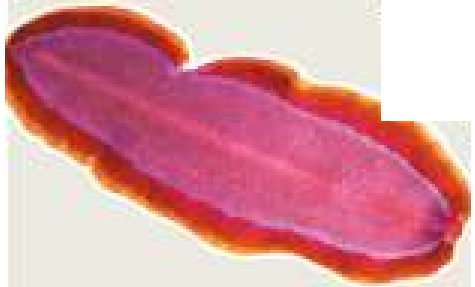
Lophotrochozoa



Some lophotrochozoans develop a structure called a ***lophophore***, **a crown of ciliated tentacles that functions in feeding**

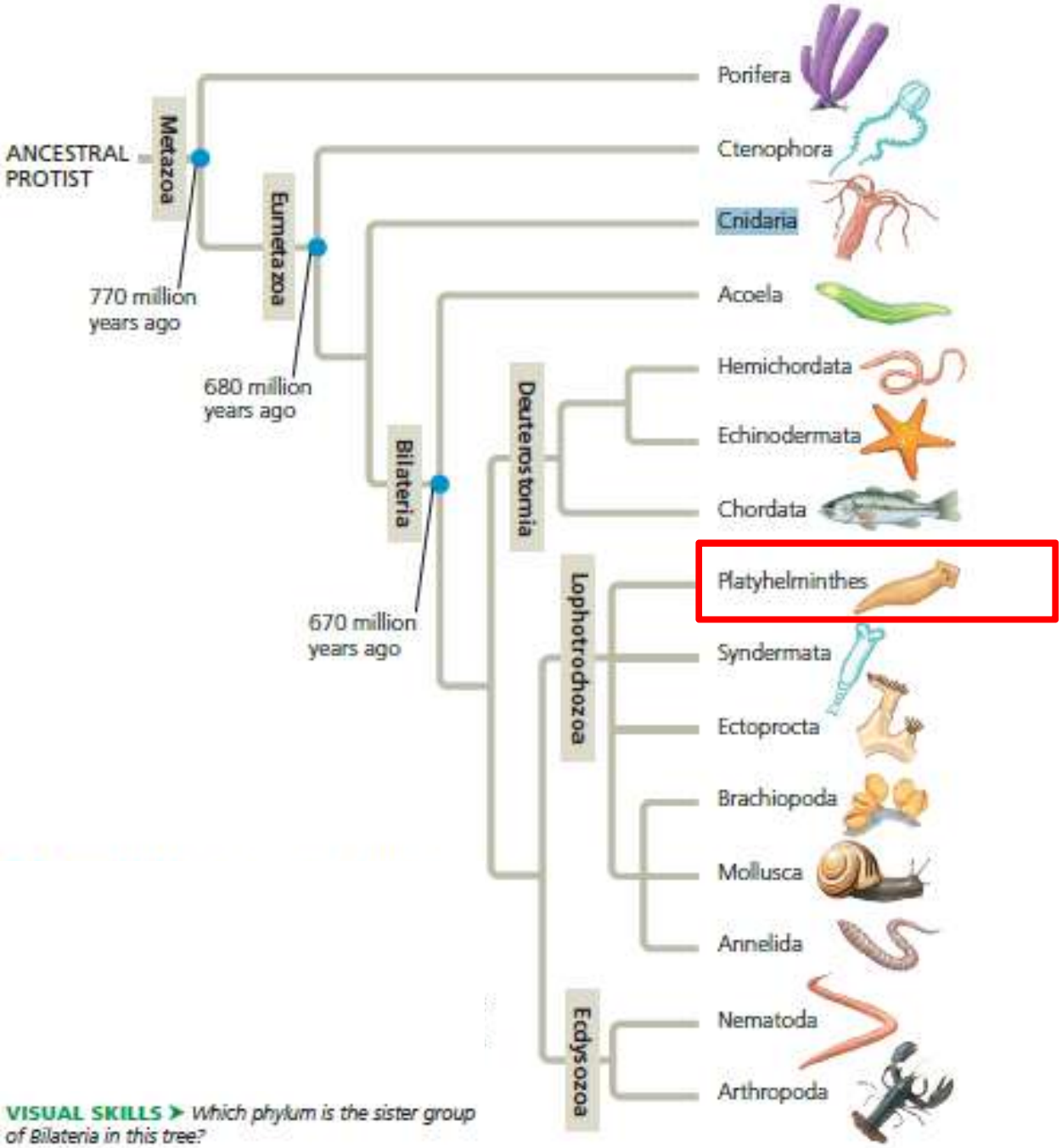
While others go through a distinctive stage called the ***trochophore larva***
Other members of the group have neither of these features. Few other unique morphological features are widely shared within the group

Platyhelminthes (20,000 species)

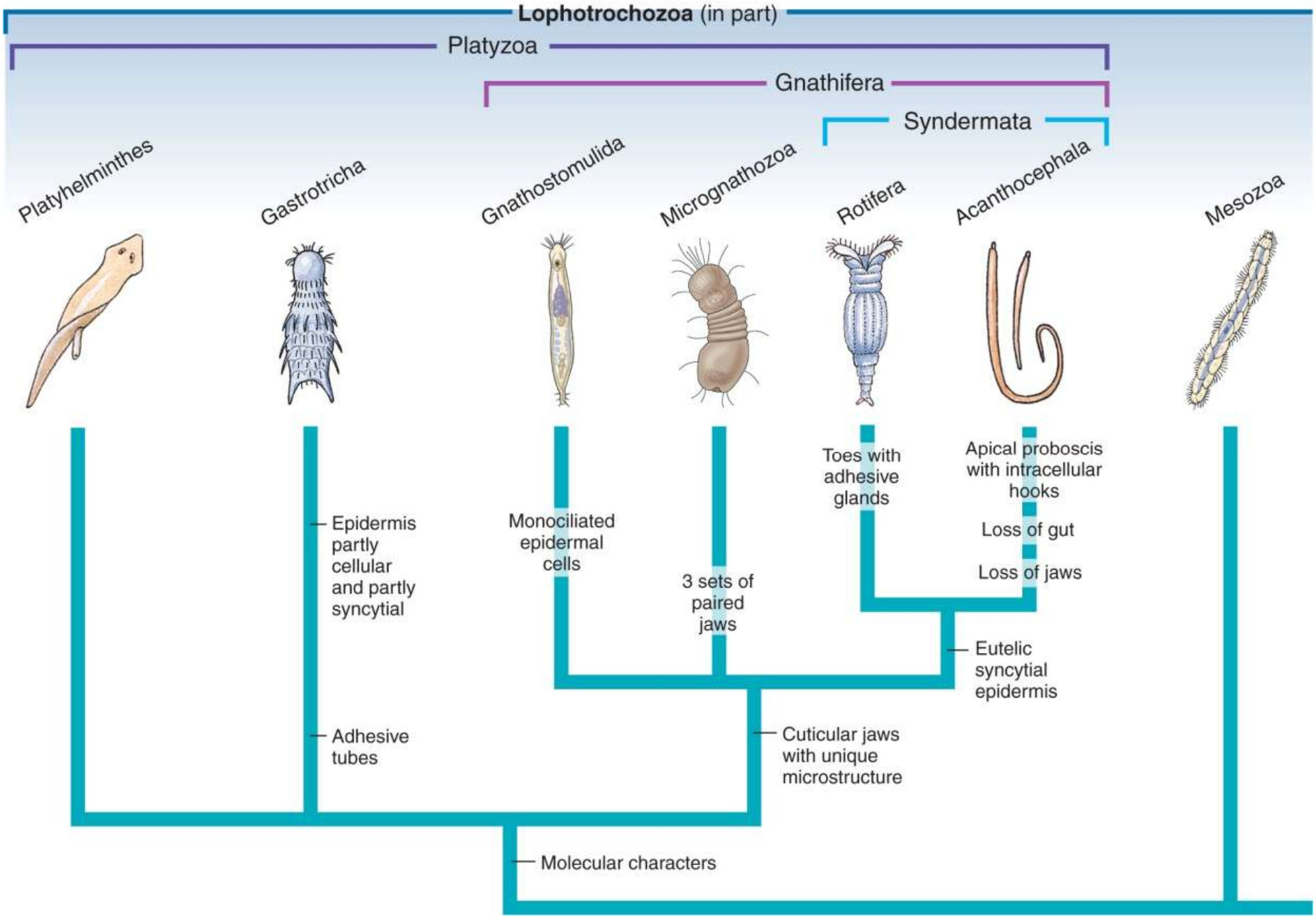


A marine flatworm

Cacing pipih (flatworms) termasuk **cacing pita (tapeworms)** , **Planaria** dan Flukes memiliki **simetri bilateral** dan **pusat sistem saraf** yg memproses informasi dr struktur sensori. Tidak memiliki rongga tubuh (**Acoelomata**) atau organ yg terspesialisasi utk transportasi



VISUAL SKILLS ➤ *Which phylum is the sister group of Bilateria in this tree?*


Lophotrochozoa (in part)
Platyzoa
Gnathifera
Syndermata
Platyhelminthes
Gastrotricha
Gnathostomulida
Micrognathozoa
Rotifera
Acanthocephala
Mesozoa
Epidermis partly cellular and partly syncytial
Adhesive tubes
Monociliated epidermal cells
3 sets of paired jaws
Toes with adhesive glands
Apical proboscis with intracellular hooks
Loss of gut
Loss of jaws
Eutelic syncytial epidermis
Cuticular jaws with unique microstructure
Molecular characters

PLOS ONE

CORRECTION

Correction: A Higher Level Classification of All Living Organisms

Michael A. Ruggiero, Dennis P. Gordon, Thomas M. Orrell, Nicolas Bailly, Thierry Bourgoin, Richard C. Brusca, Thomas Cavalier-Smith, Michael D. Guiry, Paul M. Kirk

OPEN ACCESS

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Published: June 11, 2015

Rank
Superkingdom
Kingdom
Subkingdom
Infrakingdom
Superphylum
Phylum
Subphylum
Infraphylum
Superclass
Class
Subclass
Infraclass
Superorder
Order

Main ranks are in bold type; unnamed taxa are not counted.

doi:10.1371/journal.pone.0130114.t001

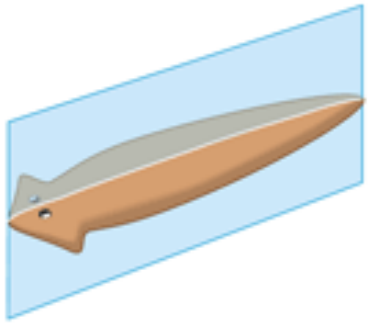
KLASIFIKASI PLATYHELMINTHES

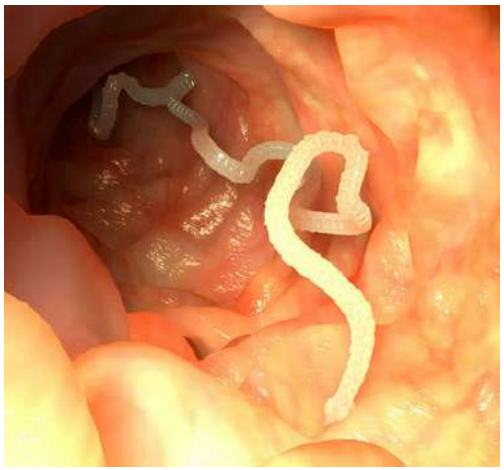
Phylum Platyhelminthes		
Subphylum Catenulidea		
		Order Catenulida
Subphylum Rhabditophora		
	Class Macrostomorpha	
		Order Haplopharyngida
		Order Macrostomida
	Class Neoophora	
		Subclass Eulecithophora
		Infraclass Adiaphanida
		Order Fecampiida
		Order Prolecithophora
		Order Tricladida
		Infraclass Rhabdocoela
		Order Dalytyphloplanida
		Order Endoaxonemata
		Order Kalyptorhynchia
		Subclass Neodermata
		Infraclass Cestoda
		Order Amphilinidea
		Order Bothriocephalidea
		Order Caryophyllidea
		Order Cyclophyllidea
		Order Diphyllidea
		Order Diphyllobothriidea
		Order Gyrocotylidea
		Order Lecanicephalidea
		Order Litobothridea

		Order Proteocephalidea
		Order Pseudophyllidea
		Order Rhinebothriidea
		Order Spathebothriidea
		Order Tetrabothriidea
		Order Tetraphyllidea
		Order Trypanorhyncha
		Infraclass Monogenea
		Order Capsalidea
		Order Chimaericolidea
		Order Dactylogyridea
		Order Diclybothriidea
		Order Gyrodactylidea
		Order Mazocraeidea
		Order Monocotylidea
		Order Montchadskyellidea
		Order Polystomatidea
		Infraclass Trematoda
		Order Aspidogastrida
		Order Diplostomida
		Order Plagiorchiida
		Order Stichocotylida
	Class Polycladidea	
		Order Lecithoepitheliata
		Order Polycladida
	Subclass Proseriatia	
		Order Proseriata

BODY FORM

- **Bilateral symmetry;** definite polarity of anterior and posterior ends
- **Body flattened dorsoventrally**
- Adult body three-layered **(triploblastic)**
- Body acoelomate
- In marine, freshwater, and moist terrestrial habitats
- **Turbellarian flatworms / Planarian** are mostly free living; **Infraclasses Monogenea, Trematoda**, and **Cestoda** entirely **parasitic**
- No Respiratory, circulatory, and skeletal systems





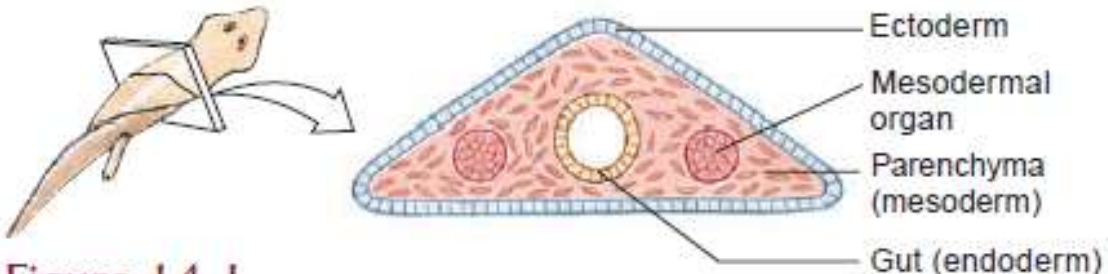


Figure 14.1
Diagram of acoelomate body plan (cross section).

EPIDERMIS AND MUSCLE

- Epidermis may be cellular or syncytial (ciliated in some)
  Rhabdites in of most **Planarians** → swell and form a **protective mucous sheath** around the body when discharged with water
  Syncytial Tegument ("skin") in **Monogenea, Trematoda, Cestoda** → **syncytial** : many nuclei are enclosed within a single cell membrane , tanpa cilia (in Adult)

- Most turbellarians/ Planarian have **dual-gland adhesive organs** in the epidermis → consist of three cell types: **viscid (sticky glutinous)** and **releasing gland cells** and **anchor cells**
- Tegument is sometimes called the **neodermis,** resistant to the immune system of the host in endoparasites & resists digestive juices in tapeworms
- **Muscular system**: primarily of a sheath form and of mesodermal origin; layers of circular, longitudinal, and sometimes oblique fibers beneath the epidermis
- **Parenchyma cells** →developed from mesoderm, fills the spaces between muscles and visceral organs.

EPIDERMIS AND MUSCLE

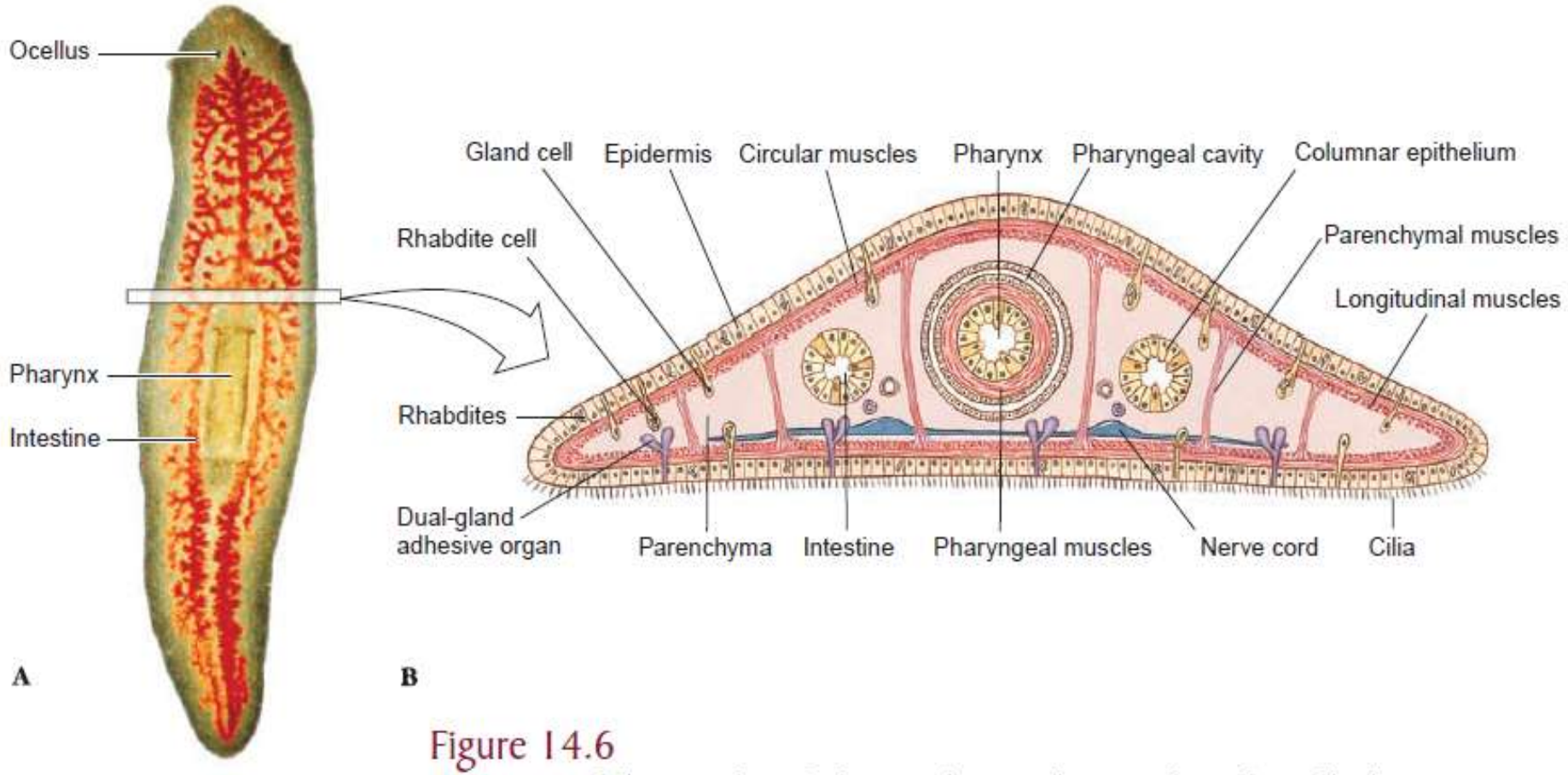


Figure 14.6
Cross section of planarian through pharyngeal region, showing relationships of body structures.

EPIDERMIS AND MUSCLE

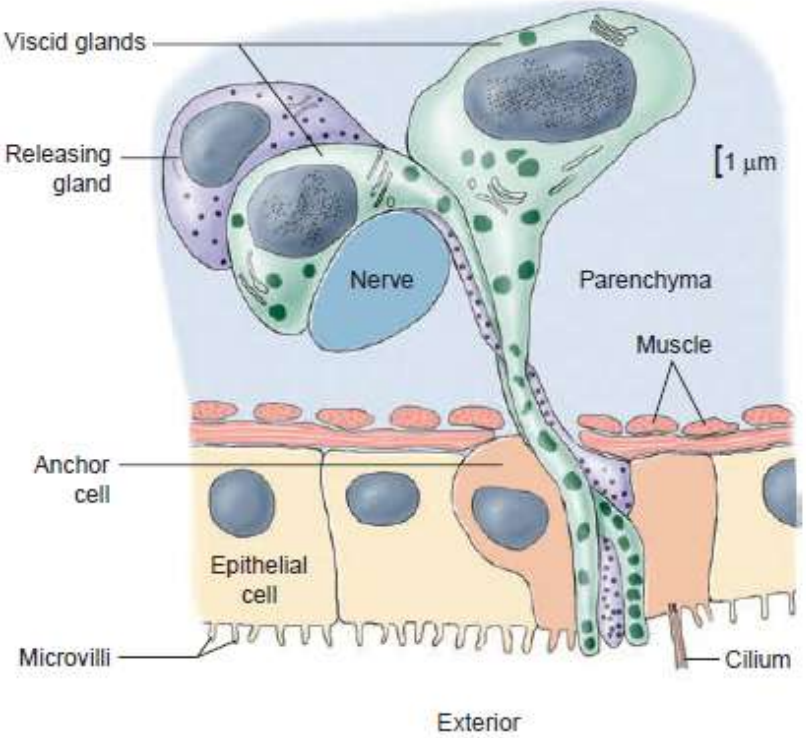


Figure 14.7
Reconstruction of dual-gland adhesive organ of the turbellarian *Haplopharynx* sp. There are two viscid glands and one releasing gland, which lie beneath the body wall. The anchor cell lies within the epidermis, and one of the viscid glands and the releasing gland are in contact with a nerve.

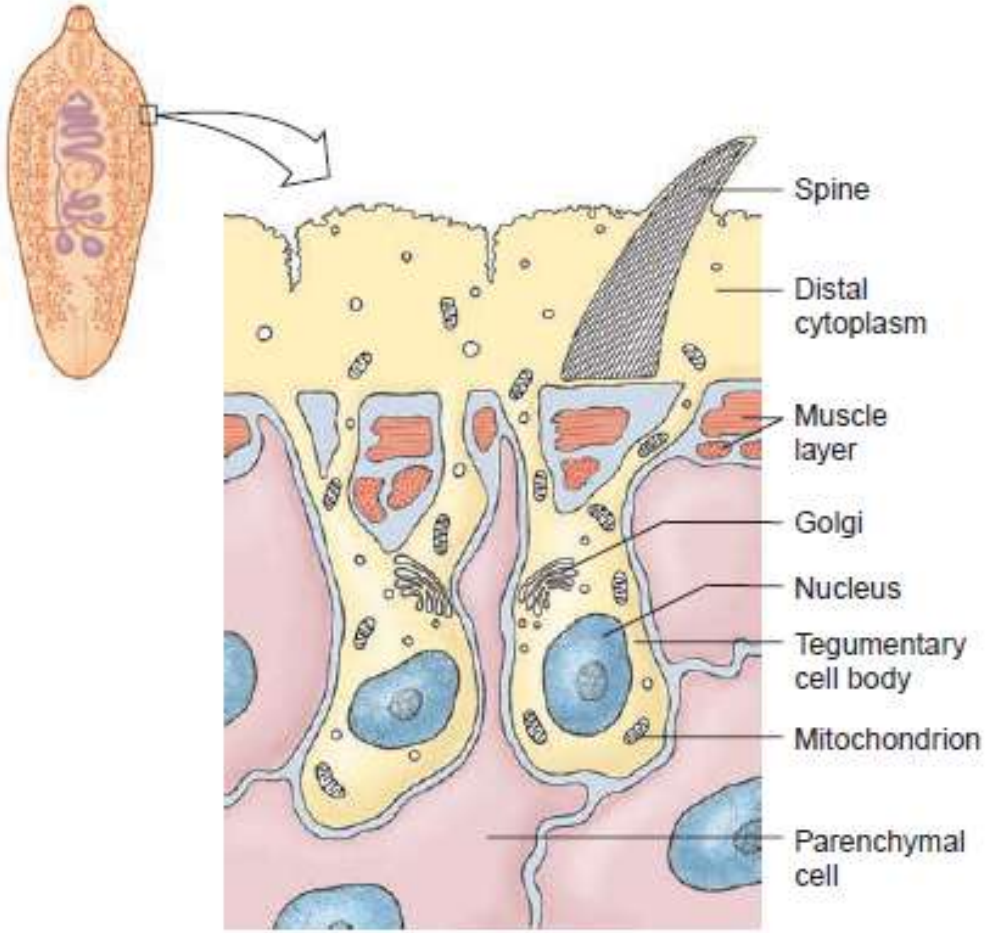
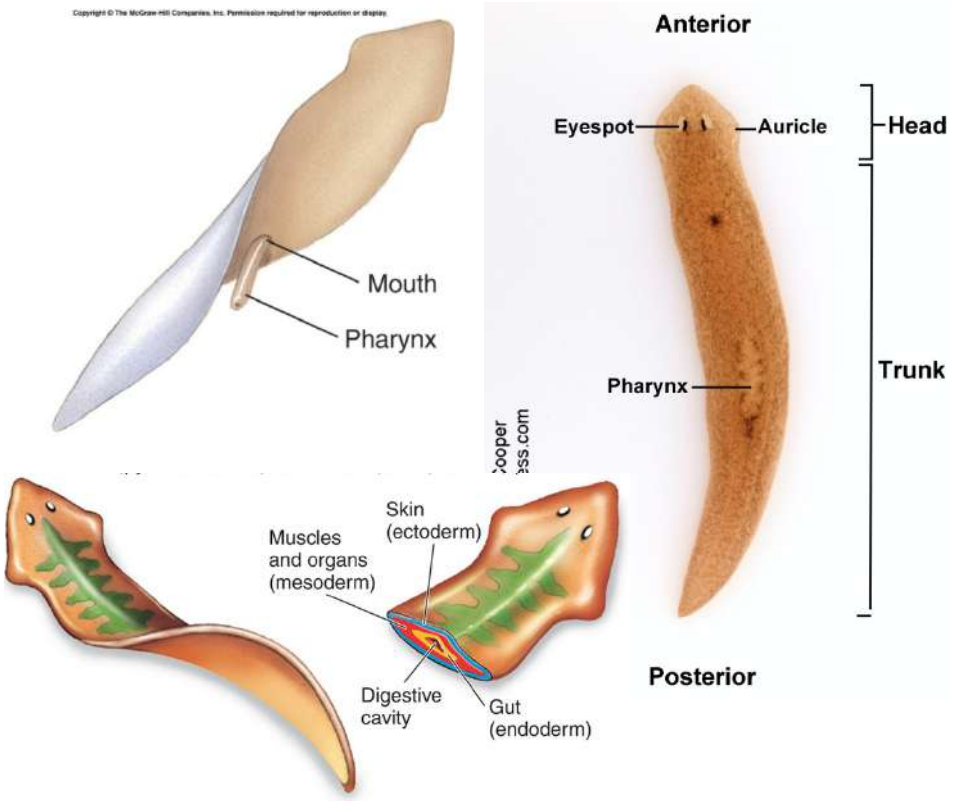
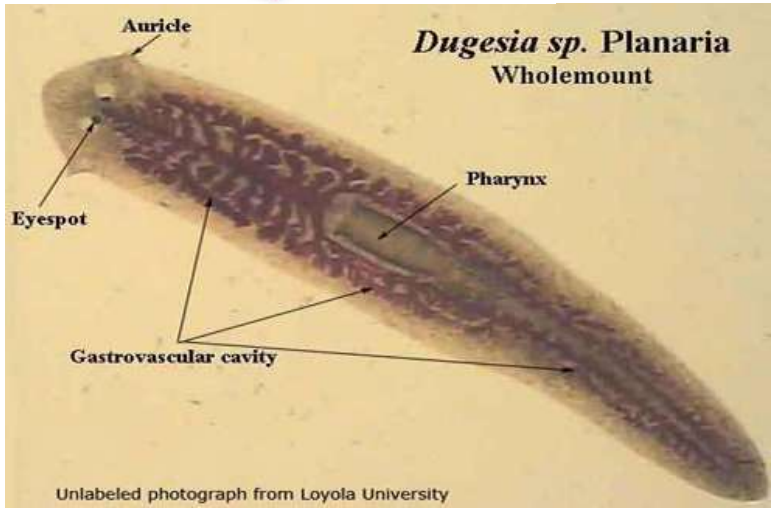


Figure 14.8
Diagrammatic drawing of the structure of the tegument of a trematode *Fasciola hepatica*.

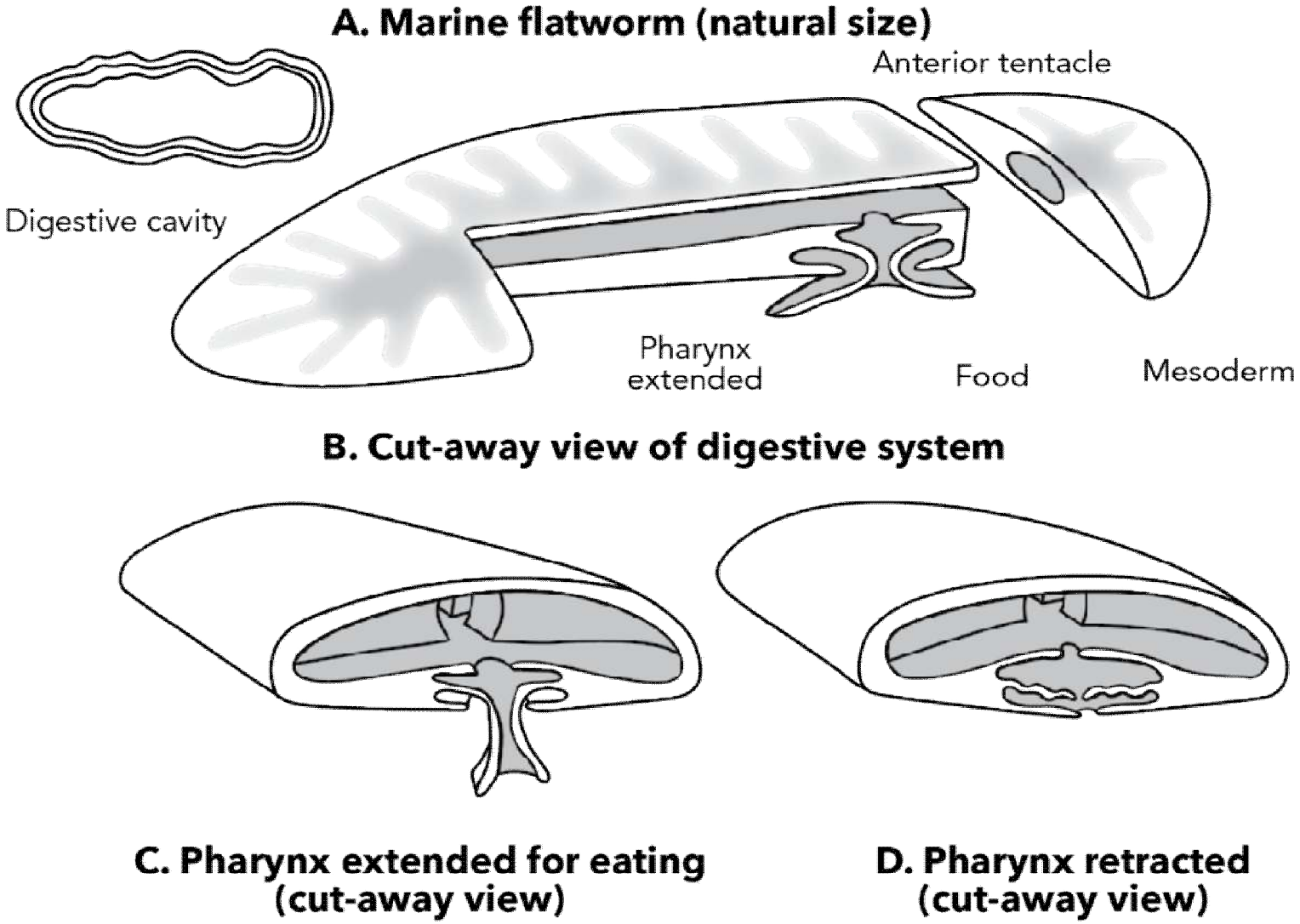
DIGESTY AND EXCRETORY

- Gut incomplete, **absent in Cestoda** (depend on host digestion, and absorption is confined to small molecules from the host's digestive tract).
- Platyhelminth digestive systems include a **mouth**, a **pharynx**, and an **intestine**
- The intestine has **three many-branched trunks**, one anterior and two posterior.
- The whole forms a **gastrovascular cavity** lined with columnar epithelium
- Extracellular digestion (proteolytic enzymes).
- Undigested food is egested through the **pharynx**.





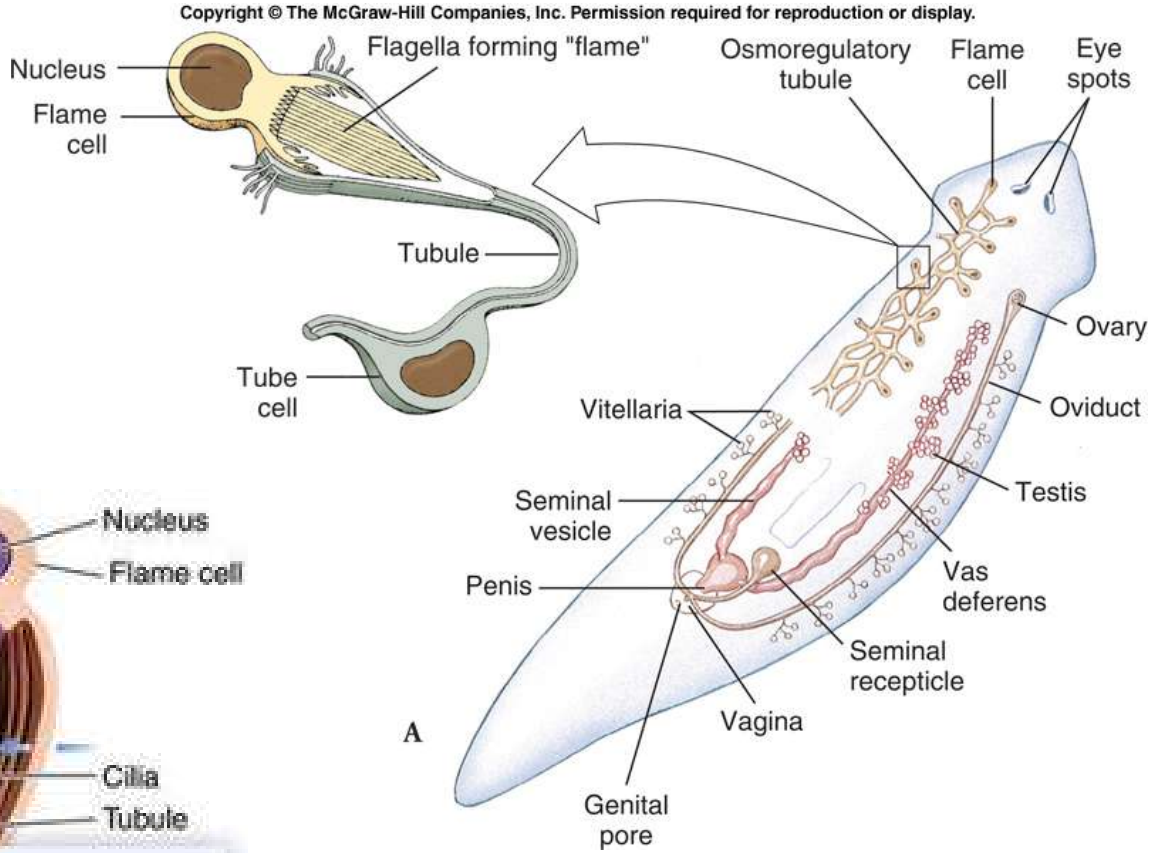
DIGESTY AND EXCRETORY

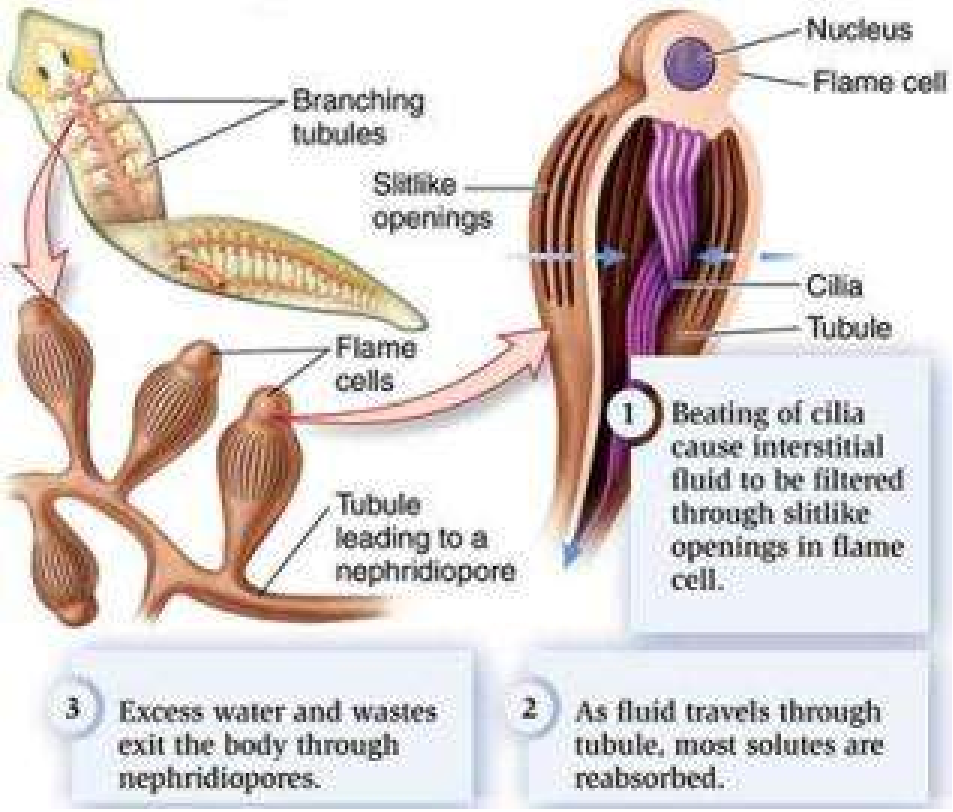


Marine flatworm showing (**A**) dorsal view (**B**) cut away view of digestive system (**C**) Pharynx extended for eating in a cut away view (**D**) Pharynx retracted in a cut away view

DIGESTY AND EXCRETORY

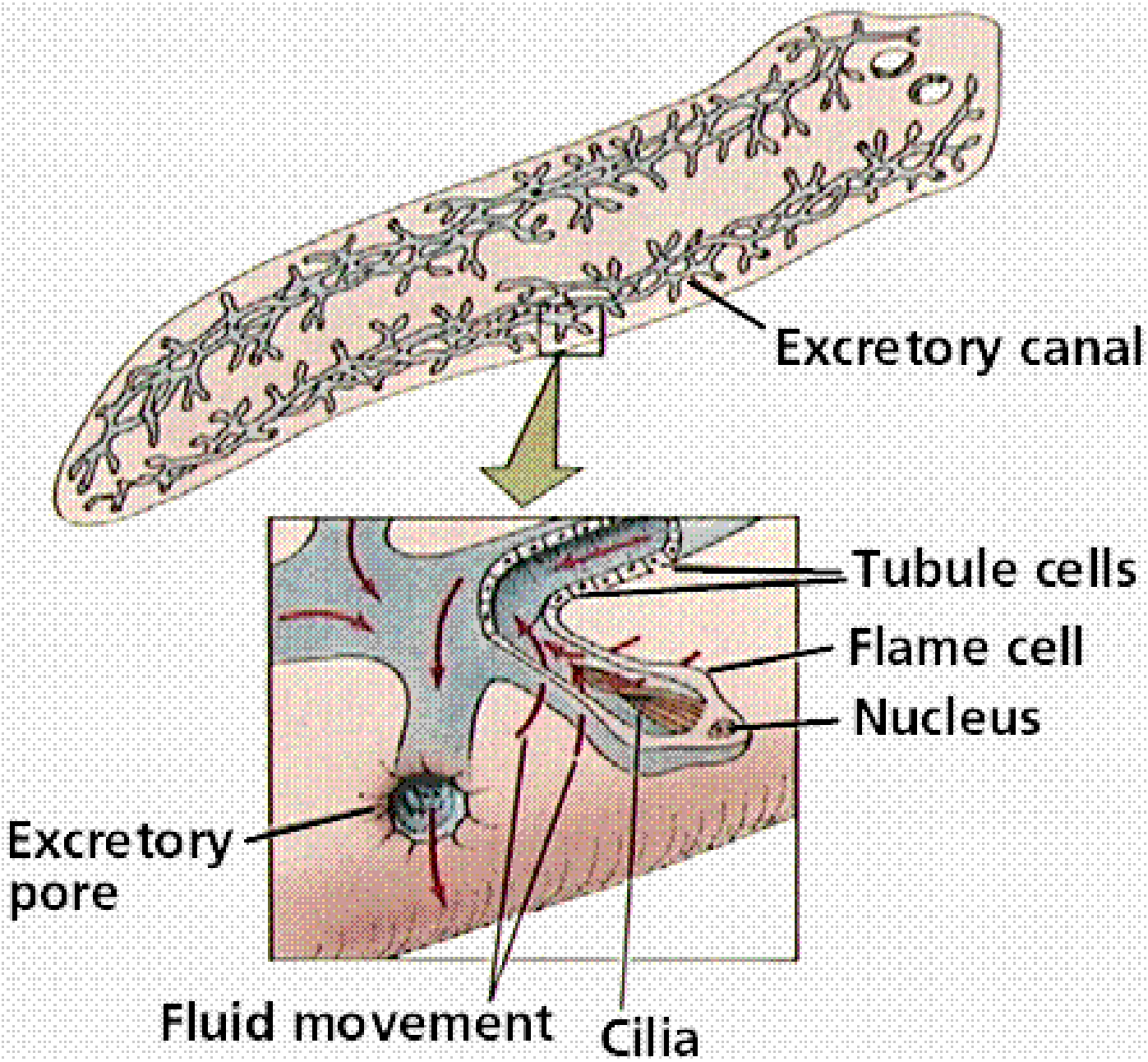
- The osmoregulatory system consists of **PROTONEPHRIDIA** (excretory or osmoregulatory organs closed at the inner end) with **FLAME CELLS**.





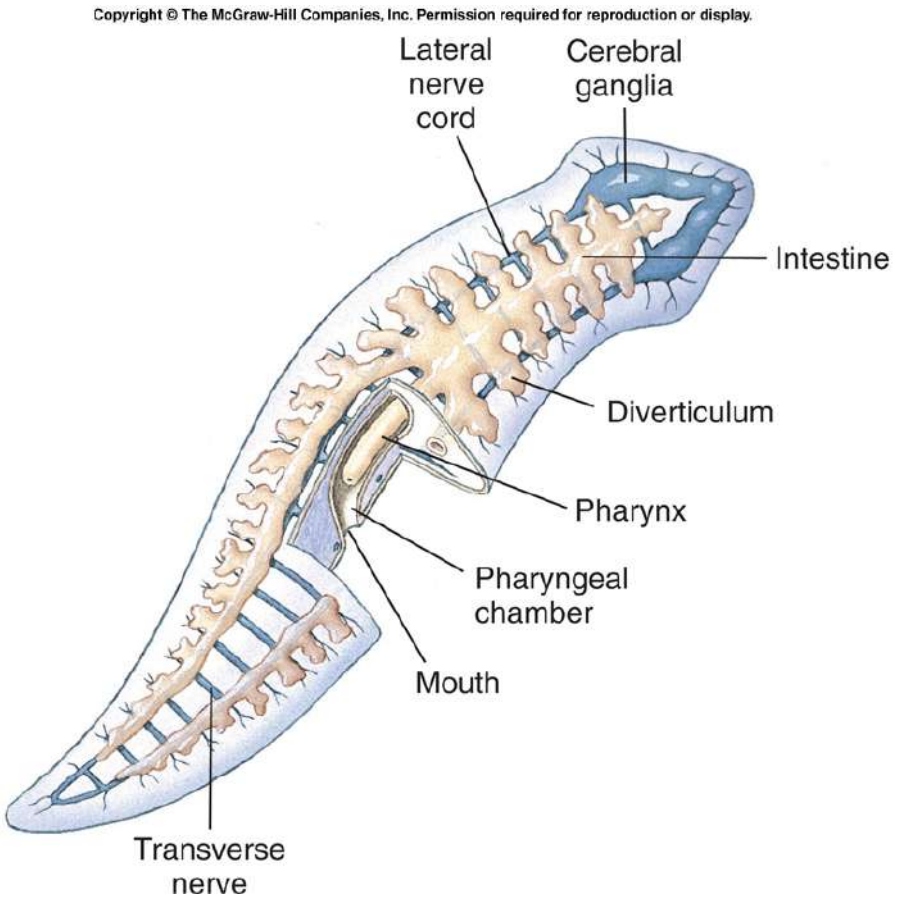
Most metabolic wastes removed by **diffusion** across the body wall.

DIGESTY AND EXCRETORY



NERVOUS SYSTEM

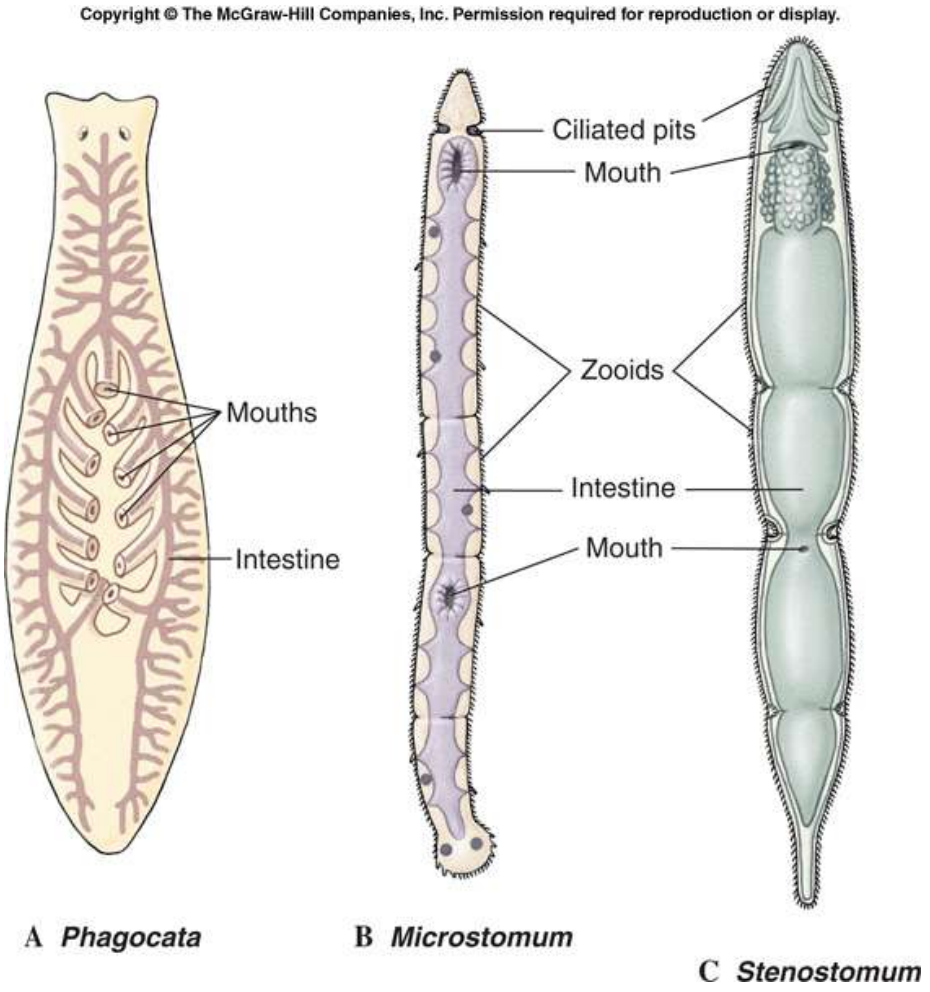
- The nervous system consists of a ladder-like network of nerves
- Nervous system consisting of a **pair of anterior ganglia** with **longitudinal nerve cords connected by transverse** nerves and located in the mesenchyme in most forms
- Sense organs include **STATOCYSTS** (organs of balance) and ocelli
- Large **OCELLI** – light sensing organs.
- **The auricles** contain chemoreceptors that are used to find food.



REPRODUCTION

- **ASEXUAL REPRODUCTION**: **fragmentation (fission)** and other methods as part of complex parasite life cycles
- **SEXUAL REPRODUCTION**: reproductive system complex, usually with **well-developed gonads**, **ducts**, and **accessory organs; internal fertilization**

- Most forms **Monoecious (hermaphroditic)**
- Development direct in free swimming forms and those with single hosts
- Complicated life cycle often involving several hosts in many internal parasites



In some fissioning forms individuals may remain temporarily attached, forming chains of **ZOOIDS**

REPRODUCTION

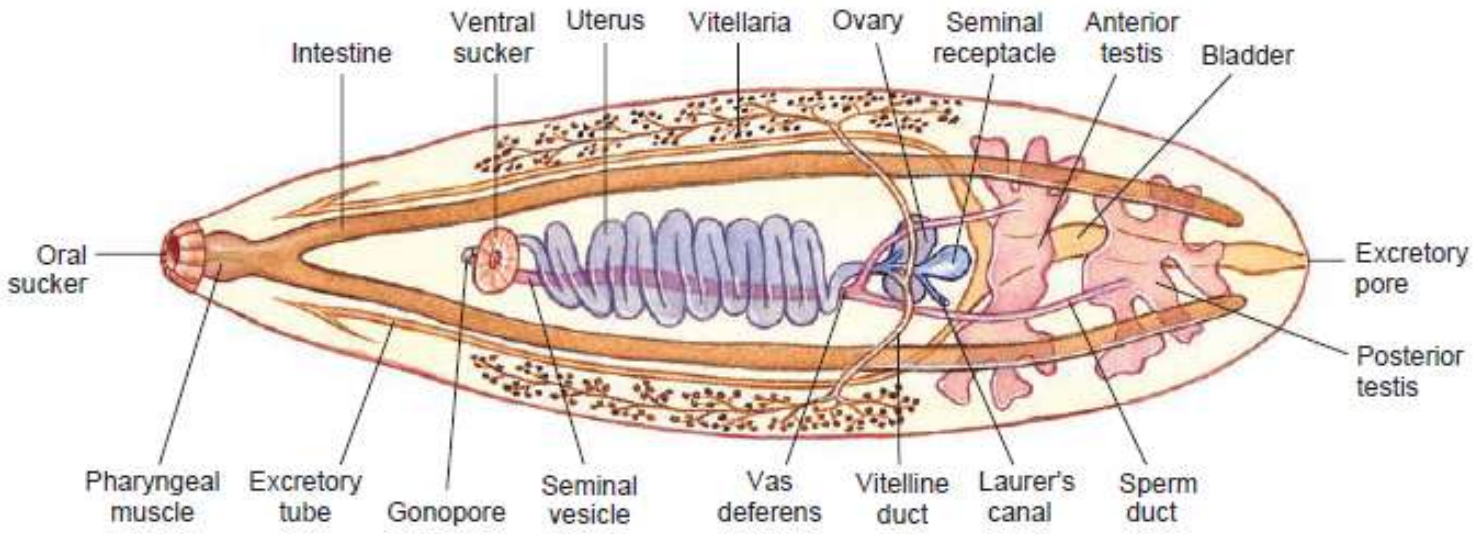
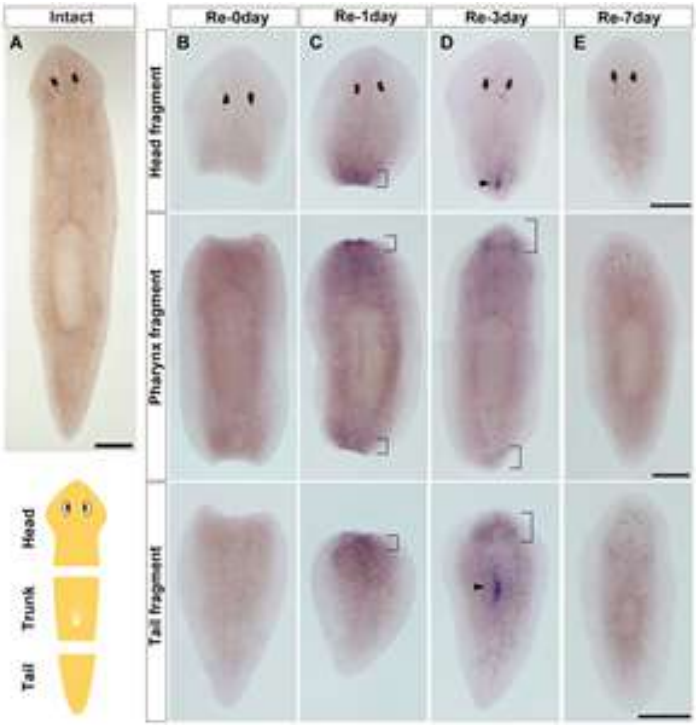
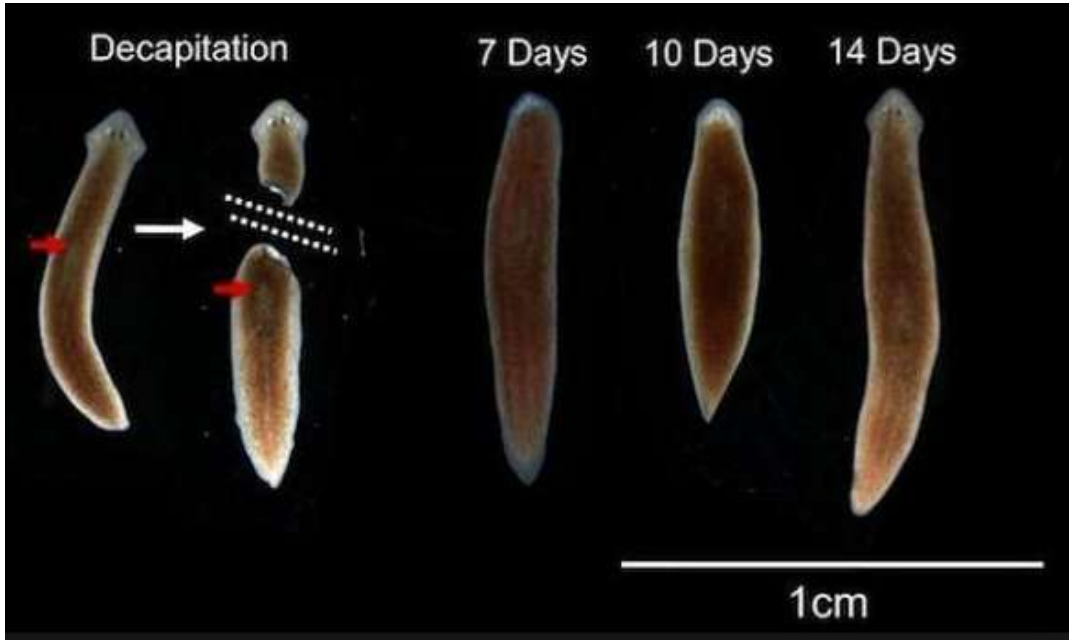
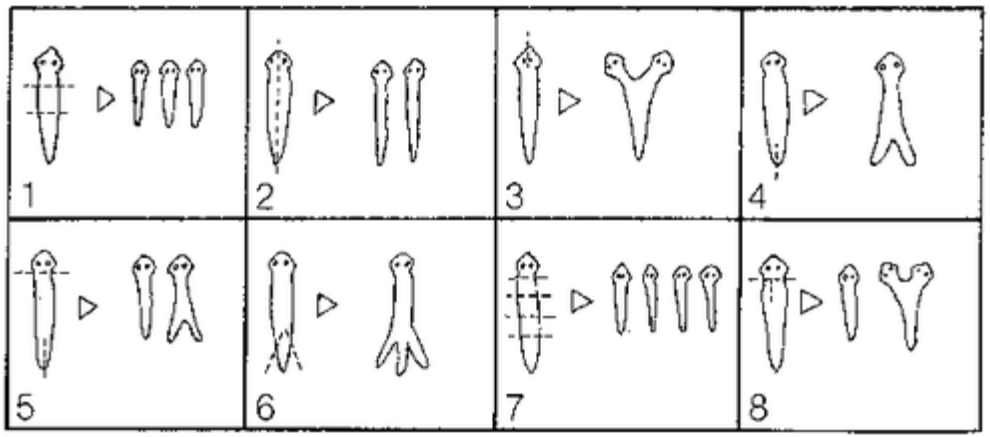


Figure 14.10
Structure of human liver fluke *Clonorchis sinenesis.*

REPRODUCTION







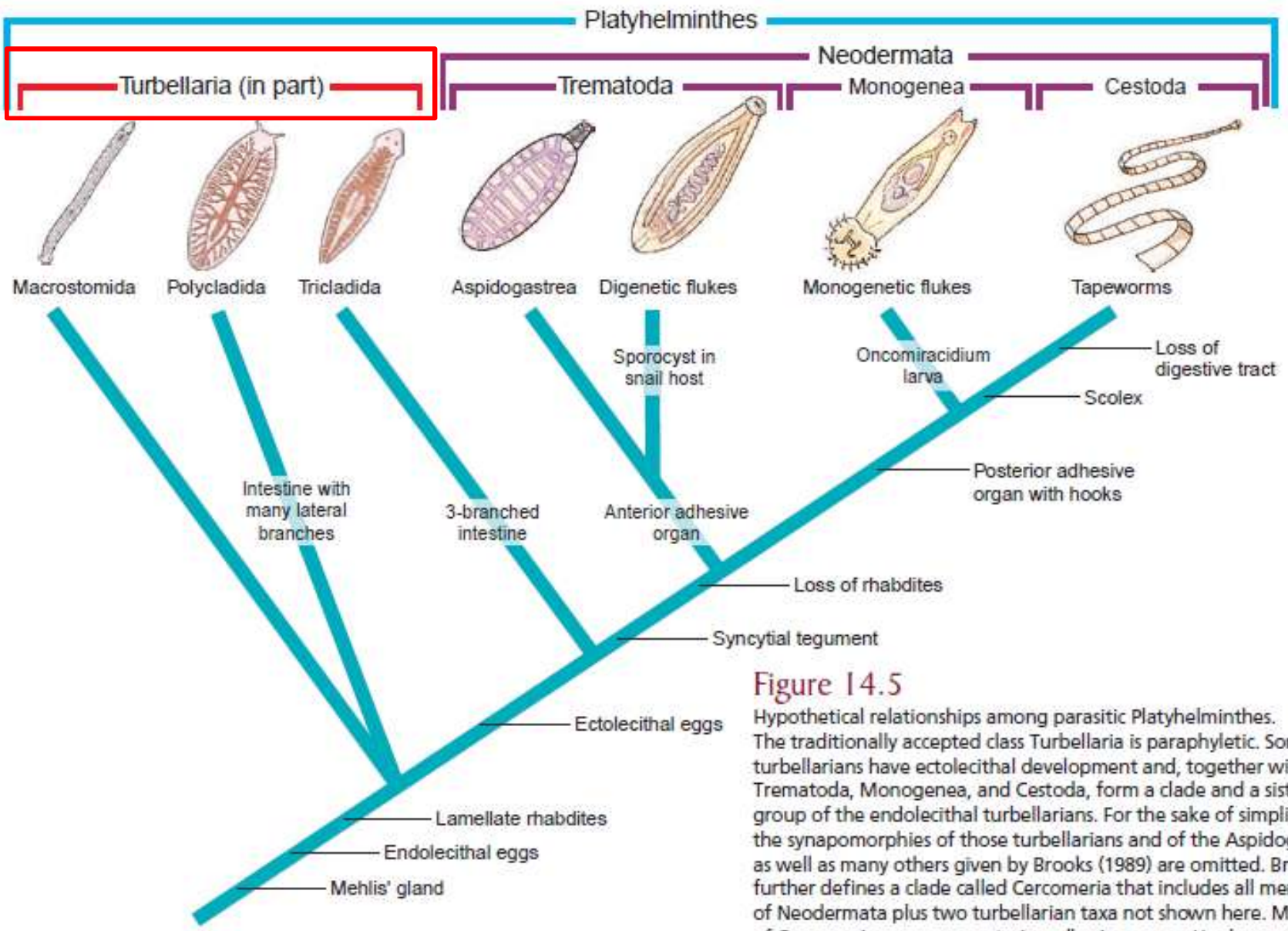
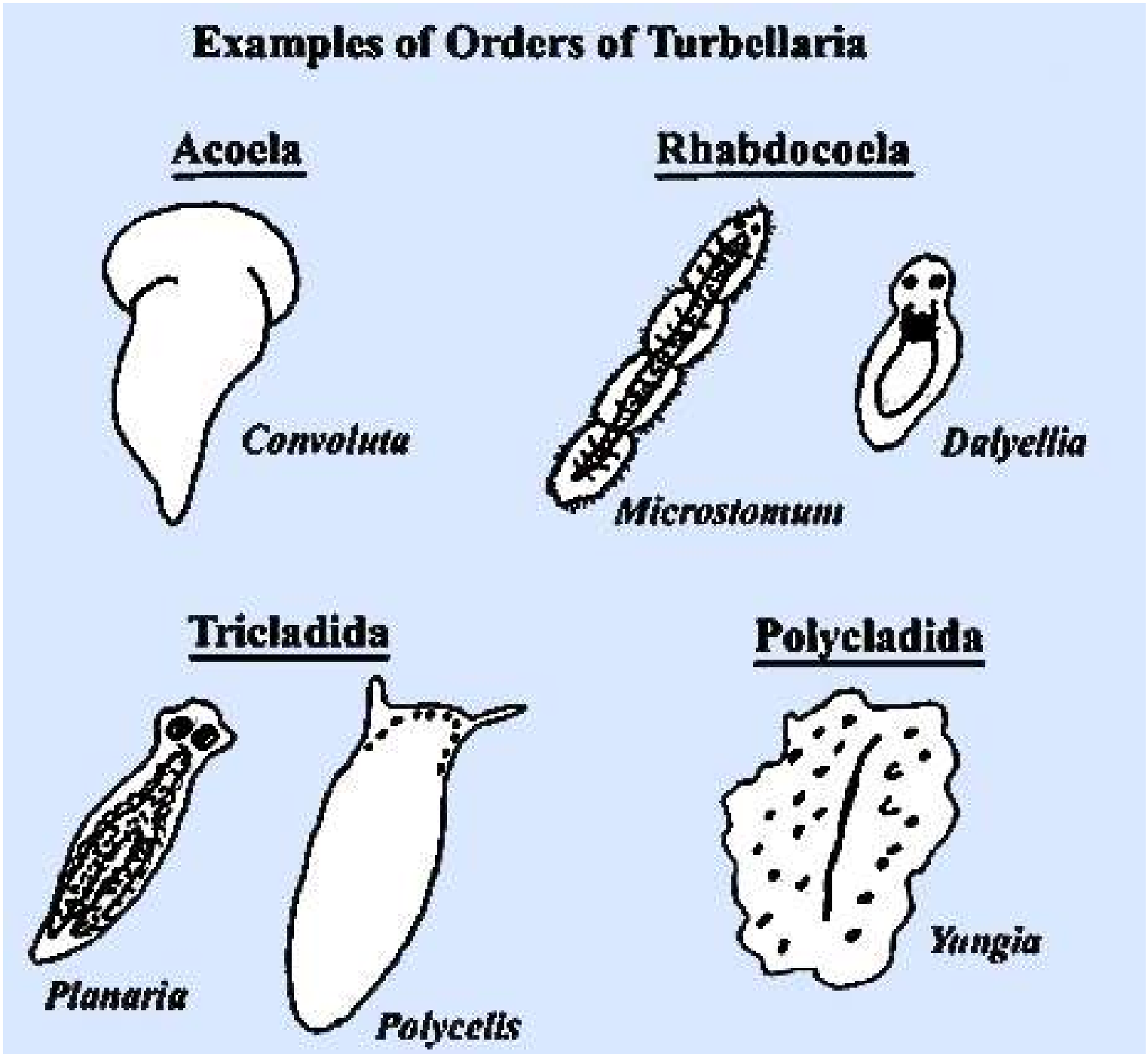


Figure 14.5

Hypothetical relationships among parasitic Platyhelminthes. The traditionally accepted class Turbellaria is paraphyletic. Some turbellarians have ectolecithal development and, together with the Trematoda, Monogenea, and Cestoda, form a clade and a sister group of the endolecithal turbellarians. For the sake of simplicity, the synapomorphies of those turbellarians and of the Aspidogastrea, as well as many others given by Brooks (1989) are omitted. Brooks further defines a clade called Cercomeria that includes all members of Neodermata plus two turbellarian taxa not shown here. Members of Cercomeria possess a posterior adhesive organ. Hooks are present on this organ in monogeneans and cestodes.

Source: Modified from D. R. Brooks. The phylogeny of the Cercomeria (Platyhelminthes: Rhabdocoela) and general evolutionary principles. Journal of Parasitology **75**:*606–616, 1989.*

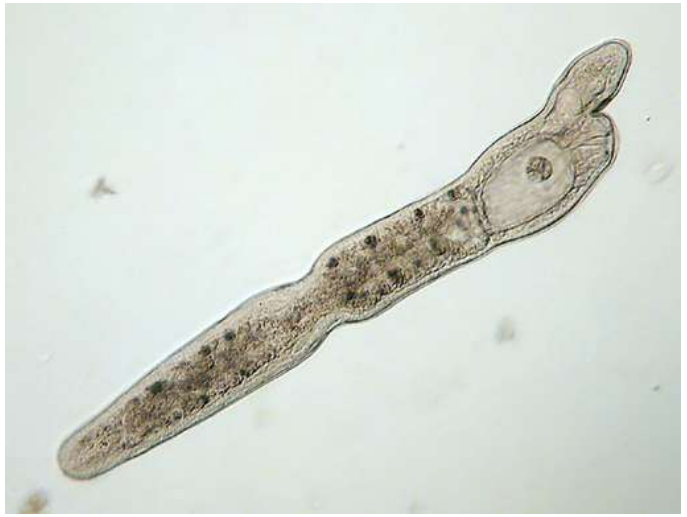
Examples of Orders of Turbellaria



Subphylum Catenulidae

ORDER CATENULIDA Meixner, 1924

- Pharynx simplex, simple gut and poorly differentiated parenchyma
- Vegetative reproduction via **paratomy**
- Specimens are often found with **many zooids forming chains**
- Usually lacking statocyst
- Unpaired protonephridial system arising caudally and running dorsally forward and then ventrally backwards to discharge posteriorly.
- Eggs **entolecithal** (yolk is stored within the oocytes), testes dorsal with penis antero-dorsal, male organs often lacking.
- Free-living, freshwater (marine groups have been described)
- **Single Order : Catenulida**



FAMILIES

Catenulidae Graff, 1905
Chordariidae Marcus, 1945
Stenostomidae Vejdovsky, 1880
Retronectidae Sterrer and Rieger, 1974
Tyrrheniellidae Riedl, 1959

Identification key to the genera of Catenulida (Larsson, 2008)

1.1. With eyes, with statocyst, with large epidermal inclusions, without ciliated furrows ..... *Tyrrheniella* fig. 3M

1.2. Without eyes..... 2.

2.1. Almost exclusively marine worms. Statocyst with one or more statoliths, sometimes no statocyst. Sexually mature specimens common, paratomy only in freshwater species..... 9.

2.2. Freshwater species. Statocyst with one statolith present or absent. Paratomy common, sexually mature specimens rare..... 3.

3.1. With ciliated pits in anterior end, paired anterior and posterior brain lobes. Pharynx often large and muscular..... 4.

3.2. Without ciliated pits, brain undivided..... 5.

4.1. With muscular gut surrounding proximal part of intestine, without refractile bodies..... *Myostenostomum*, fig. 3I

4.2. Without muscular gut, with or without refractile bodies, with or without excretophores..... *Stenostomum*, fig. 3C

5.1. Mouth placed far from anterior end, brain placed at the anterior tip, with or without statocyst. With male duct consisting of a penis and a seminal vesicle..... *Chordarium*, fig. 3F

5.2. Mouth placed close to brain, without male duct, statocyst absent or present..... 6.

Identification key to the genera of Catenulida (Larsson, 2008)

6.1. Long and slender body, often curled up, with proboscidiform anterior appendage, with or without statocyst, no paratomy..... ..... ***Rhynchoscolex***, fig 3B

6.2. With pre-oral ciliated furrow and paratomy, body long and slender or not evenly shaped .....7.

7.1. Large number of small zooids generating a long chain (10–40 mm), granules present.....***Africatenula***, fig. 3A

7.2. Body slender or not slender, with 1–8 zooids sometimes more.....8.

8.1. Body slender, intestine pronounced, with or without statocyst.....***Dasyhormus***, fig. 3L

8.2. Body slender, intestine not pronounced, with statocyst, protonephridium often sinous or body not slender with pre-oral swelling with ciliated furrows and conspicuous epidermal inclusions .....***Catenula***, fig. 3E

9.1. With rostrum, with or without statocyst. Without mouth, pharynx and gut-lumen.....***Paracatenula***, fig 3K

9.2. Without rostrum, with mouth and pharynx.....10.

10.1 With strong muscle ring surrounding mouth opening, statocyst with one statolith present, without brain lobes..... .....***Myoretronectes***, fig. 3H

10.2. With brain lobes, usually with statocyst with one or several statoliths... .....***Retronectes***, fig. 3G

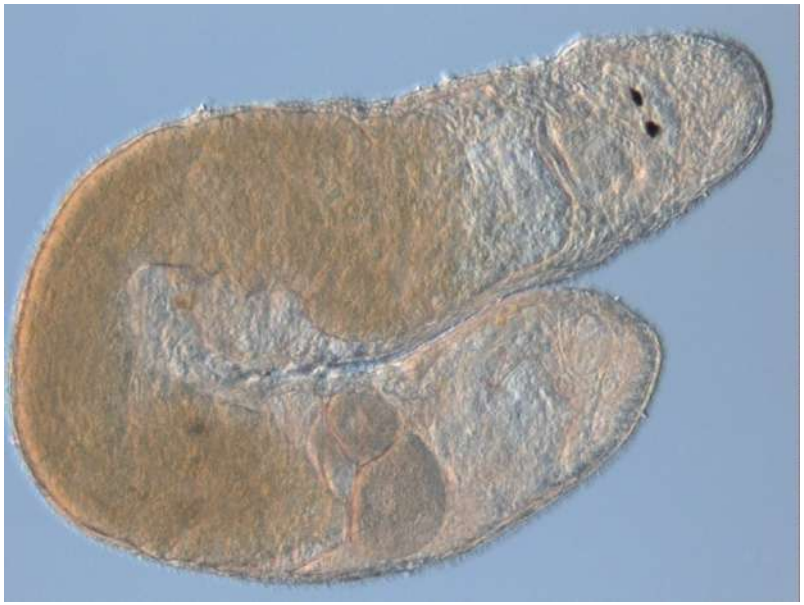
Subphylum Rhabditophora

- Characterized by the **presence of lamellated rhabdites**, rodlike granules secreted in the cells of the epidermis and consisted of concentric lamellae.
- They are absent in the clade Neodermata (epidermis → **syncytium in adult**)
- Duo-glandular adhesive system. It is a structure of the epidermis containing three different cell types: **anchor cells**, **adhesive glands** and **releasing glands**.
- The adhesive glands secrete an adhesive substance that attaches the anchor cells to a surface, while the releasing glands secrete a substance able to release the anchor cells from surfaces.
- That systems allows rhabditophorans to adhere and release quickly from the substrate, even several times in a second
- The secretory organs of rhabditophorans, the **protonephridia**, also have a unique anatomy in which the **flame cells**

Class Macrostomorpha

Order Haplopharyngida

- **Order Macrostomida**
- With pharynx simplex and simple gut
- Brain not encapsulated, without statocyst. Paired protonephridia
- Eggs entolecithal, female gonopore anterior to male (separate or into a common atrium); testes compact, male canal passes directly posterior to gonopore, usually with a hard stylet
- Free-living, marine and freshwater.



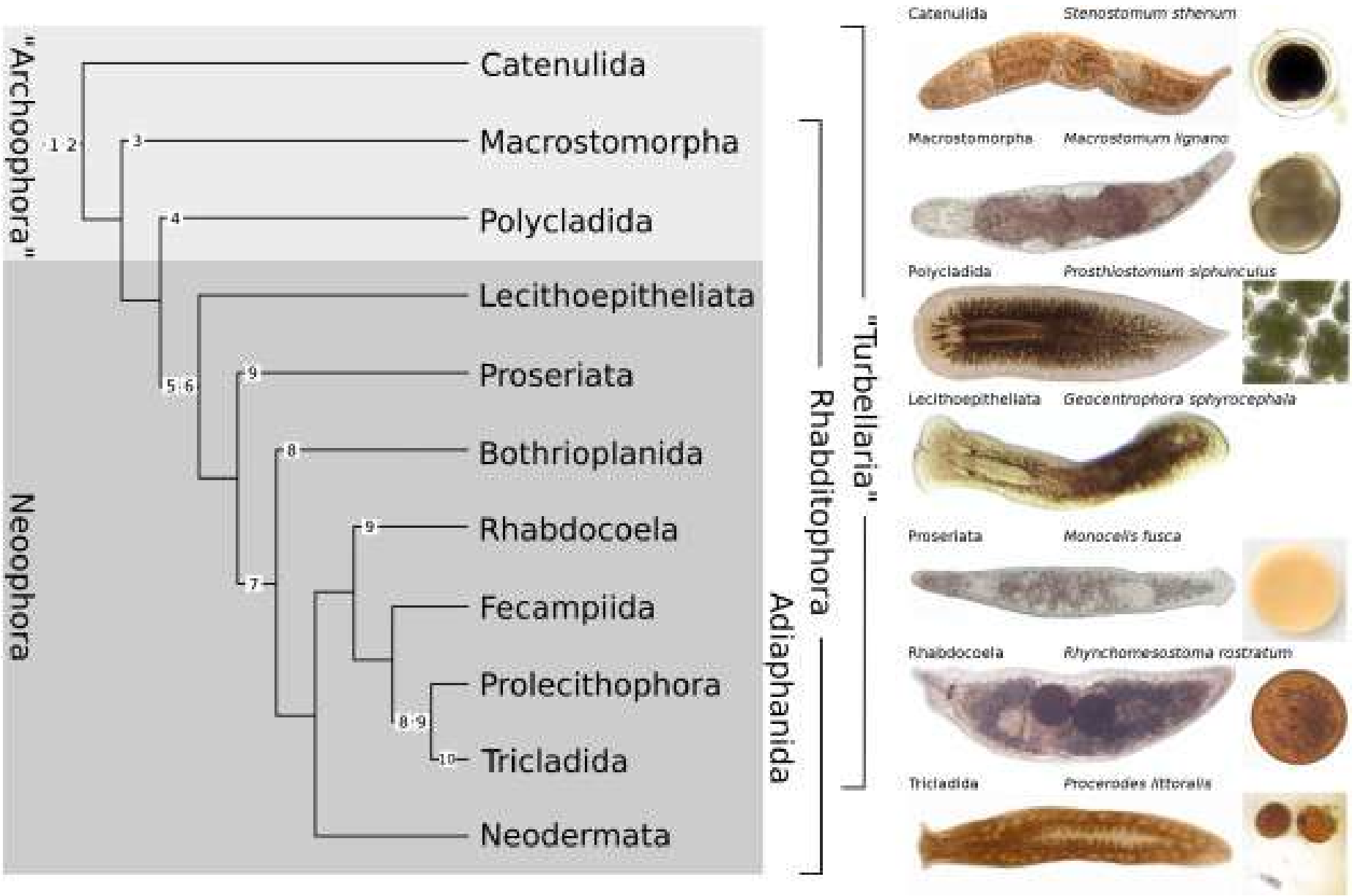
Families

Dolichomacrostomidae Rieger, 1971
Macrostomidae Beneden, 1870
Microstomidae Luther, 1907

Class Neoophora

Subclass Eulecithophora
Infraclass Adiaphanida

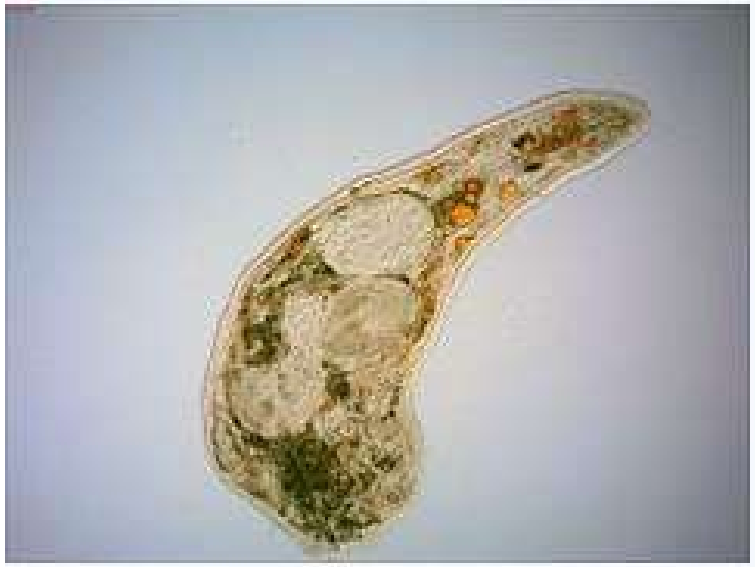
- Usually free-living forms with soft, flattened bodies; covered with ciliated epidermis containing secreting cells and rodlike bodies (rhabdites)
- Mouth usually on ventral surface sometimes near center of body
- Mostly hermaphroditic, but some have asexual fission.
- Planarians or **triclads** are widely distributed, common, and diverse. While chiefly found in freshwater ecosystems they also can be found in marine and terrestrial environments.
- Systematists have traditionally recognized three major groups of triclads: Paludicola (freshwater planarians), Maricola (marine planarians), and Terricola (land planarians), but some propose a fourth planarian infraorder Cavernicola (Carranza et al. 1998).


"Archoophora"
Neoophora
Catenulida
Macrostomorpha
Polycladida
Lecithoepitheliata
Proseriata
Bothrioplanida
Rhabdocoela
Fecampiida
Prolecithophora
Tricladida
Neodermata
1 2
3
4
5 6
9
8
9
7
8 9
10
"Turbellaria"
Rhabditophora
Adiaphanida
Catenulida
Stenostomum sthenum
Macrostomorpha
Macrostomum lignano
Polycladida
Prosthiostomum siphunculus
Lecithoepitheliata
Geocentrophora sphyrocephala
Proseriata
Monocelis fusca
Rhabdocoela
Rhynchomesostoma rostratum
Tricladida
Procerodes littoralis

Class Neoophora

Subclass Eulecithophora
Infraclass Rhabdocoela

- About 1700 species described worldwide
- Most of rhabdocoels are free-living organisms, but some live symbiotically with other animals
- All rhabdocoels have a bulbous pharynx
- Most rhabdocoels are freshwater organisms, some terestrial
- Some groups are predators. Others feed on algae and may incorporate them in their tissues
- Protonephridia paired when present; With anterior brain and ventral nerve trunks (usually one main pair) with cross connections, without statocyst
- Gonads with a tunica and mostly with ducts; testes usually compact, eggs ectolecithal, ovaries separate or sometimes joined to vitellaria (ovo-vitellaria): sexually reproducing, often with a uterus



Strongylostoma elongatum spinosum.

Class Neoophora

Subclass Neodermata
Infraclass Cestoda

- Infraclass of tapeworms
- 1000 species parasitic
- Long flat bodies
- Lack a digestive system
- Well-developed muscles
- Excretory system and nervous system are similar to other flatworms
- **SCOLEX,** for attachment to the host →provided with suckers or suckerlike organs and often **with hooks** or **spiny tentacles**
- Linear series of reproductive units or **PROGLOTTIDS**
- The chain of proglottids called a **STROBILA**
- **Germinative zone** just behind the scolex where new proglottids are formed
- Each proglottid contains a **complete male and female reproductive system**, and during mutual cross-fertilization, sperm from each strobila is transferred to the other.

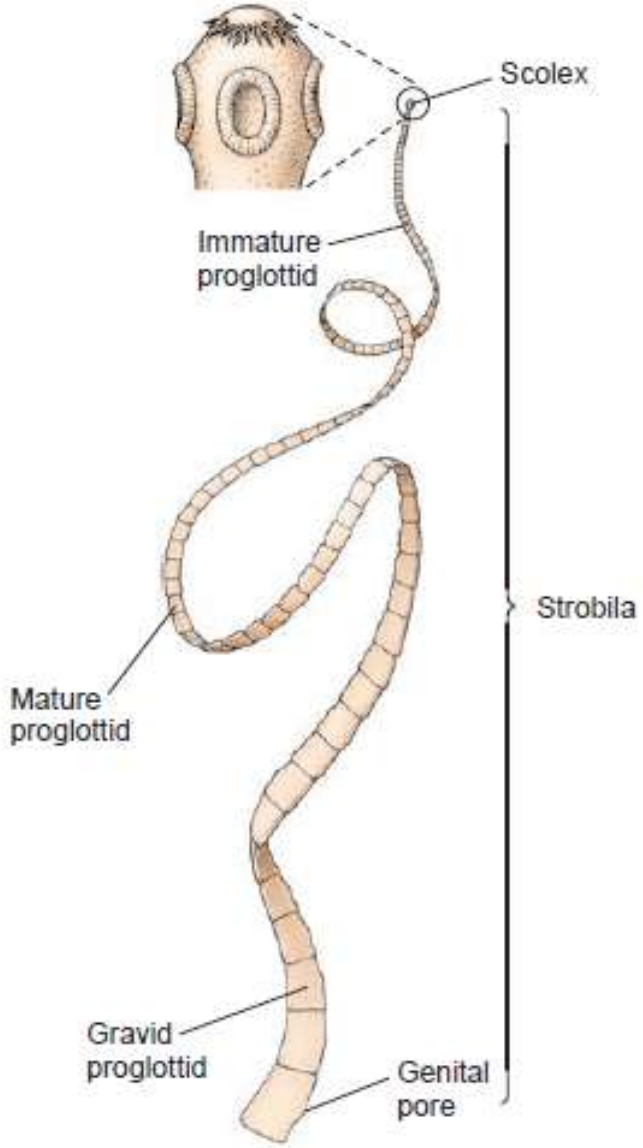


Figure 14.19
A tapeworm, showing strobila and scolex. The scolex is the organ of attachment.

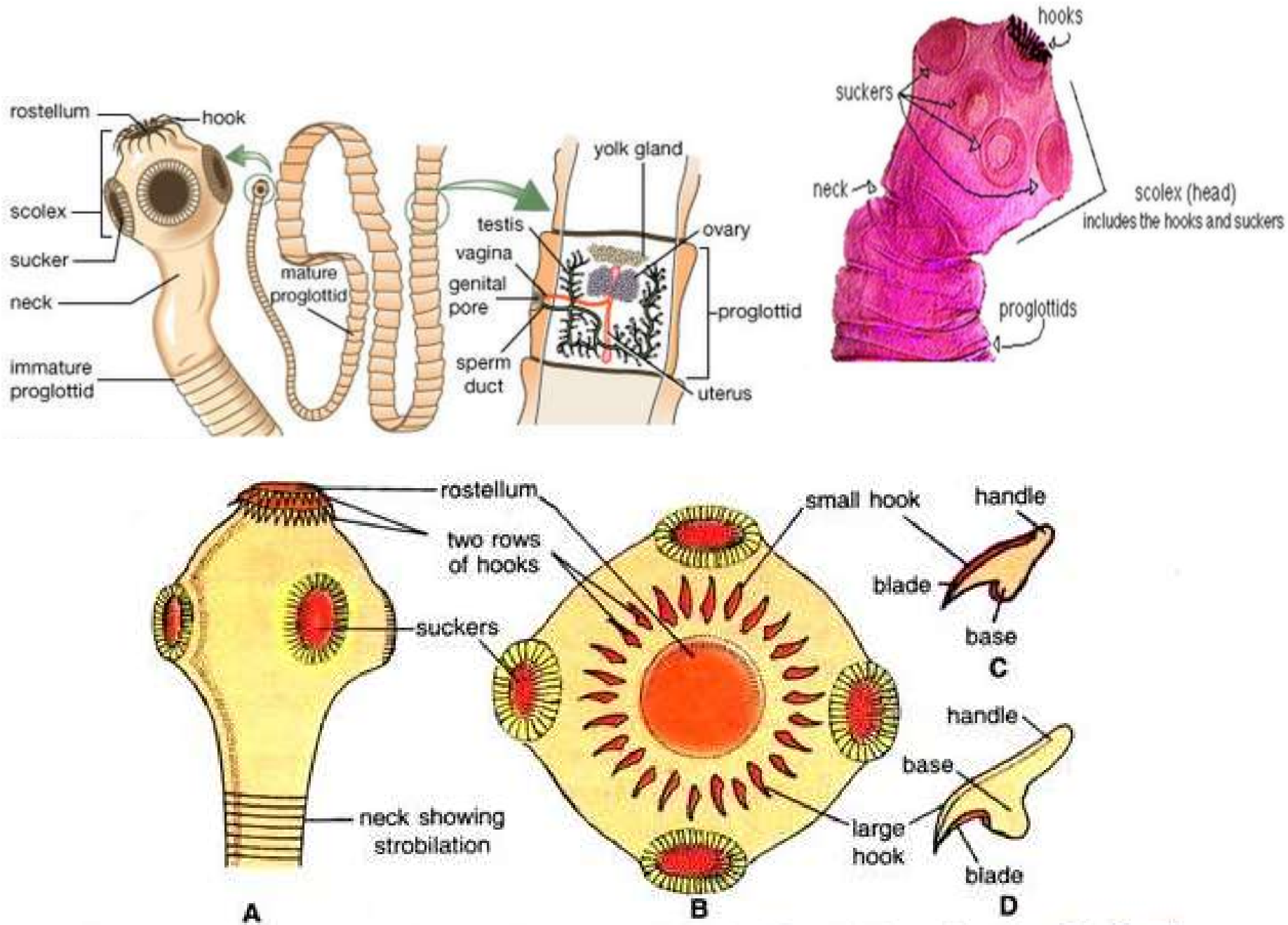


Fig. 42.2. *Taenia solium*. Scolex. A—Scolex magnified; B—Frontal view of scolex; C—Small hook; D—Large hook.

- Nervous system of *T. solium* consists of **two small cerebral ganglia** in the scolex connected together by a thick transverse nerve band and by the dorsal and ventral commissures. All these structures together are referred to as the **brain complex**.

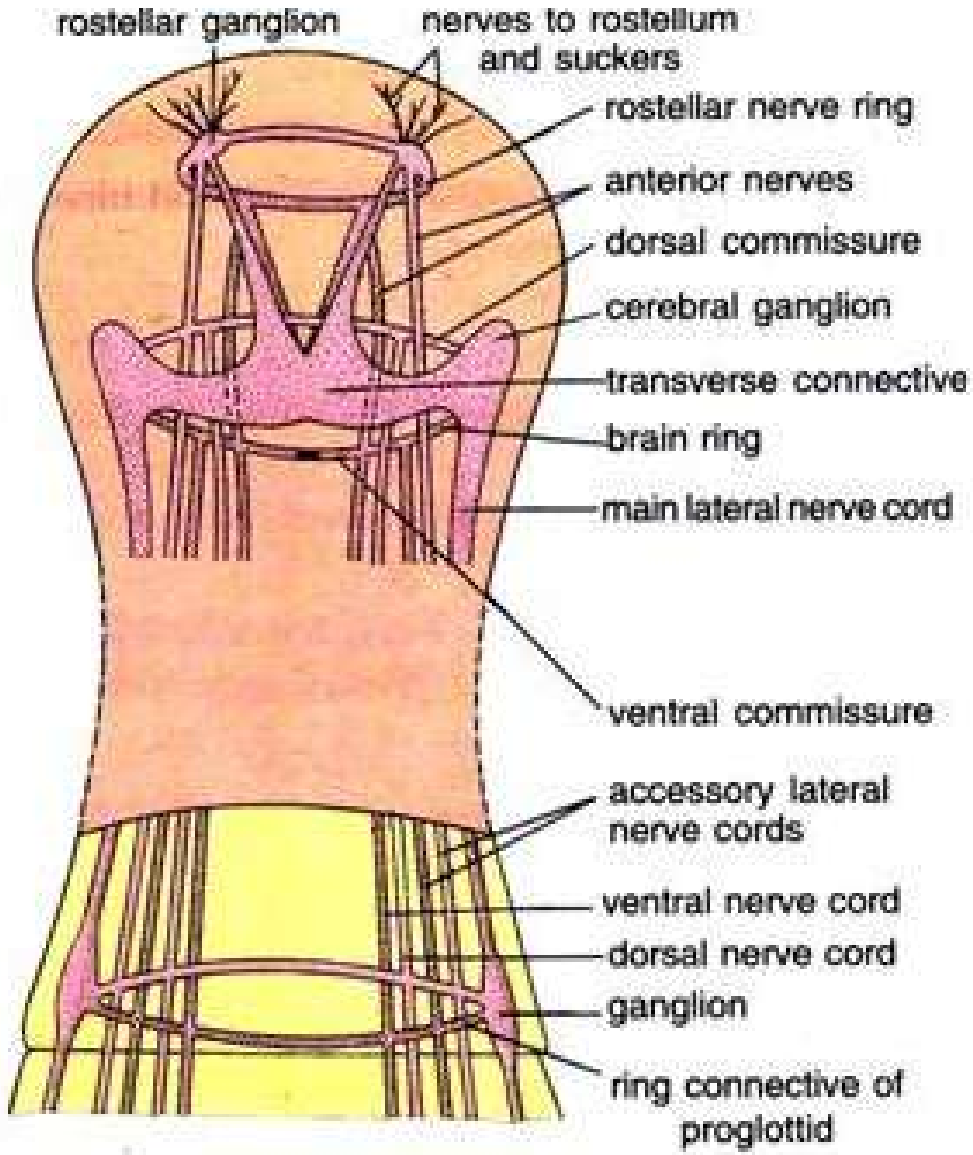


Fig. 42.5. *Taenia solium.* Nervous system.

- The metabolic waste products like **fatty acids, organic acids**, etc., are removed by the excretory system.
- This system is said to regulate the fluid contents of the body of *Taenia*, hence, also regarded to be osmoregulatory in function.

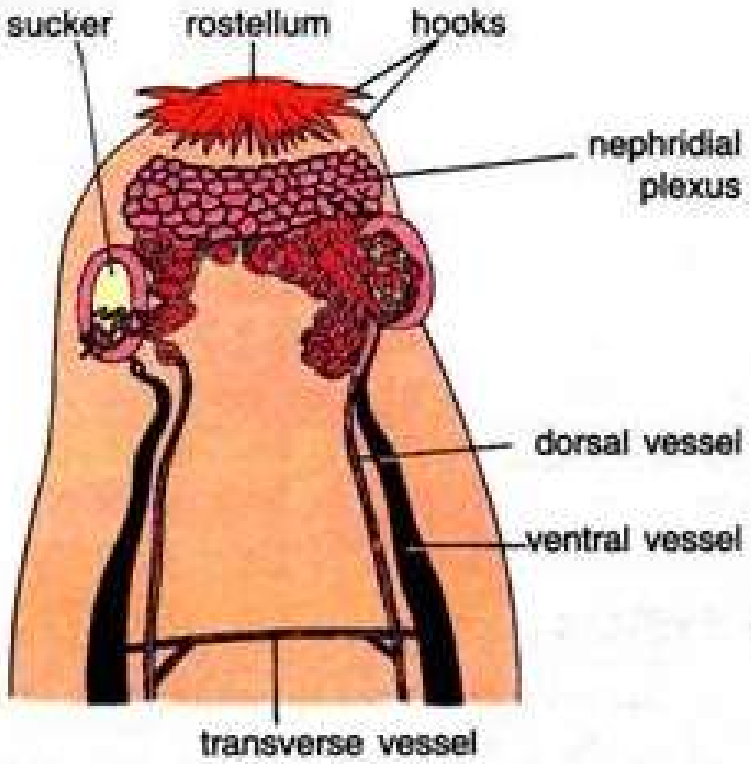


Fig. 42.6. *T. solium*. Excretory system showing excretory vessels and nephridial plexus in the anterior end.

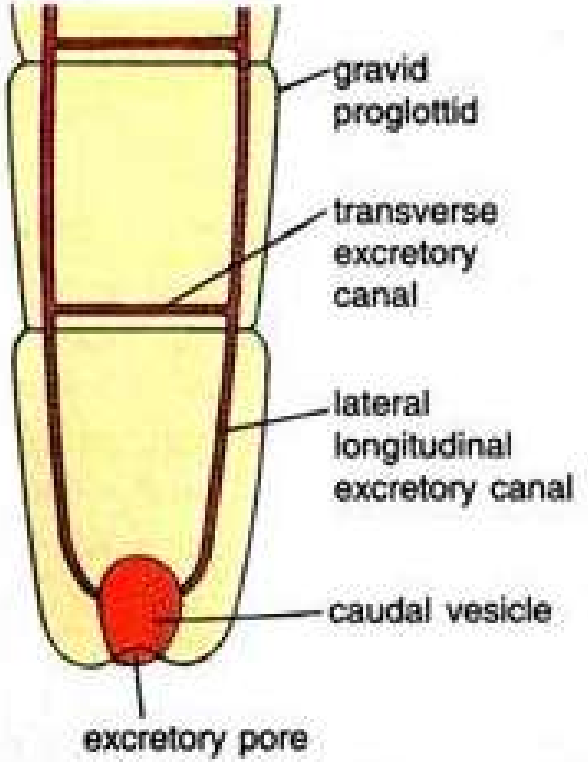


Fig. 42.7. *T. solium*. Excretory vessels with caudal vesicle in last proglottid.

- Tapeworn is Monoceous
- Two proglottids from the same individual may fertilize one another
- The **shelled embryos** form in the **uterus** of the proglottid → expelled through a uterine pore or the entire proglottid is shed from the worm as it breaks free at zones of muscle weakness between each proglottid

- Segmentation of tapeworms is best considered a replication of sex organs to **increase reproductive capacity** & is **not homologous to the metamerism**

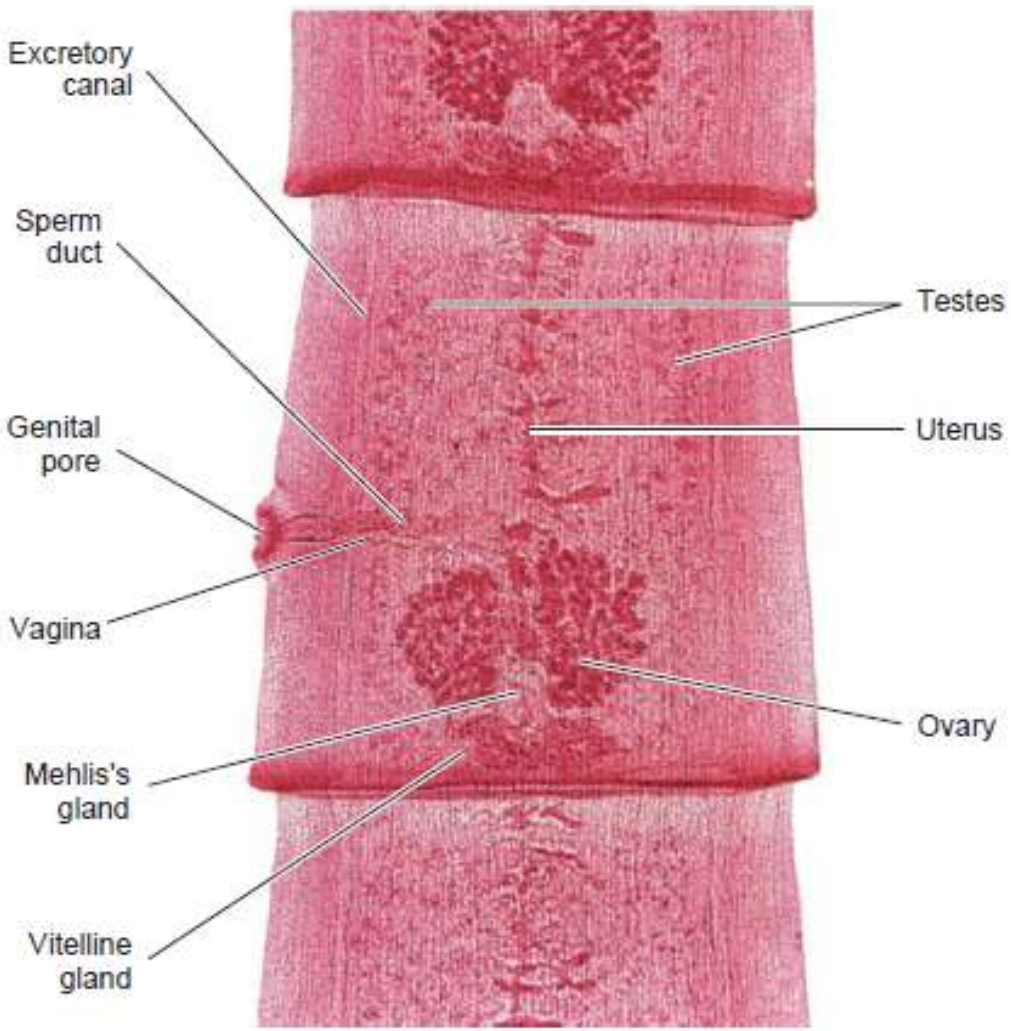
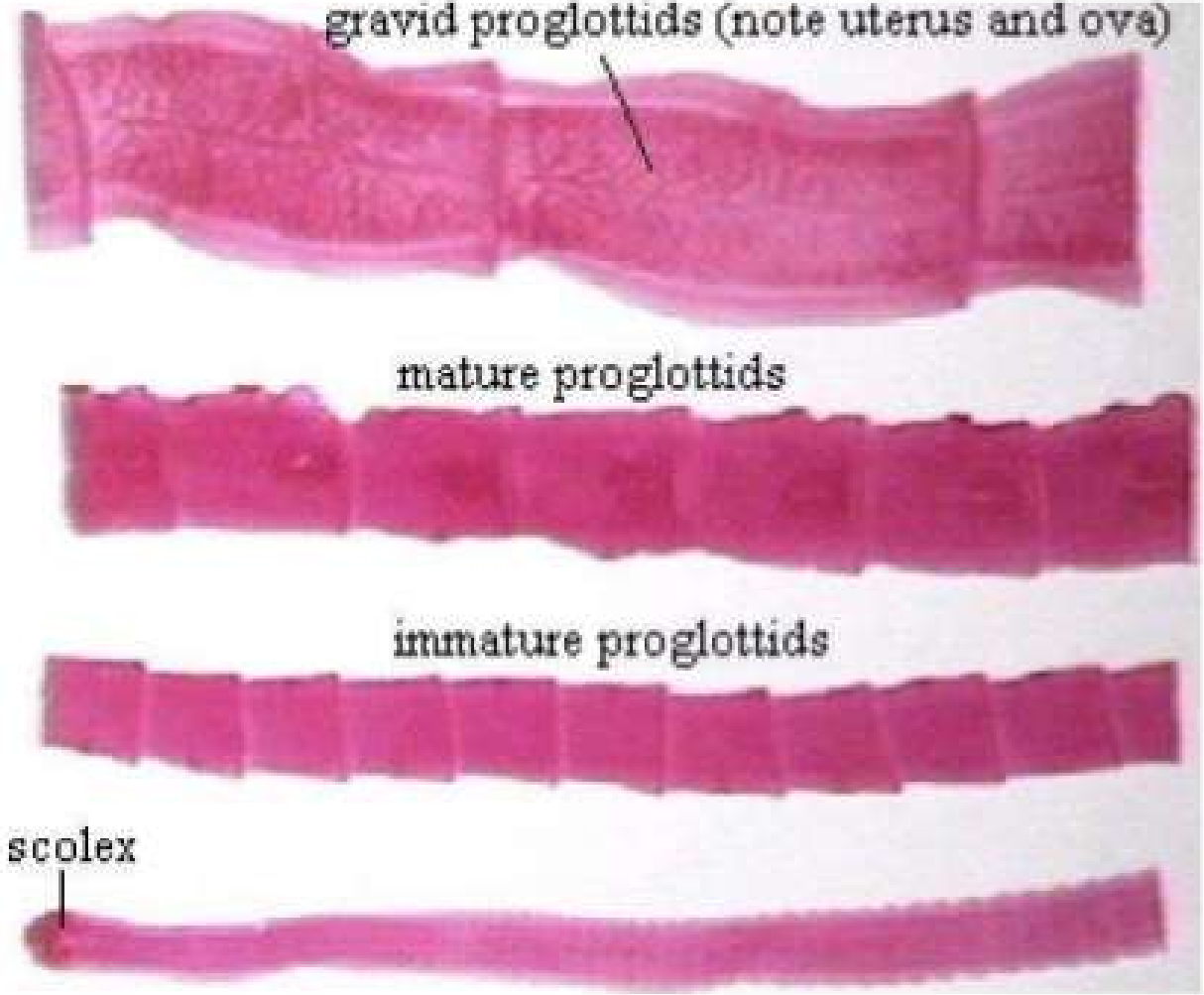


Figure 14.22
Mature proglottid of *Taenia pisiformis*, a dog tapeworm. Portions of two other proglottids also shown.


gravid proglottids (note uterus and ova)
mature proglottids
immature proglottids
scolex

MALE REPRODUCTIVE ORGANS

- Numerous testes are scattered throughout the proglottids
- **Testes produce sperm**
- Move into the copulatory organ cirrus through a duct system
- **Cirrus/ Penis** opens through a genital pore
- The male system of a proglottid matures **before** the female system
- Copulation occurs with another mature proglottlid of the same tapeworm or with another tapeworm in the same host.

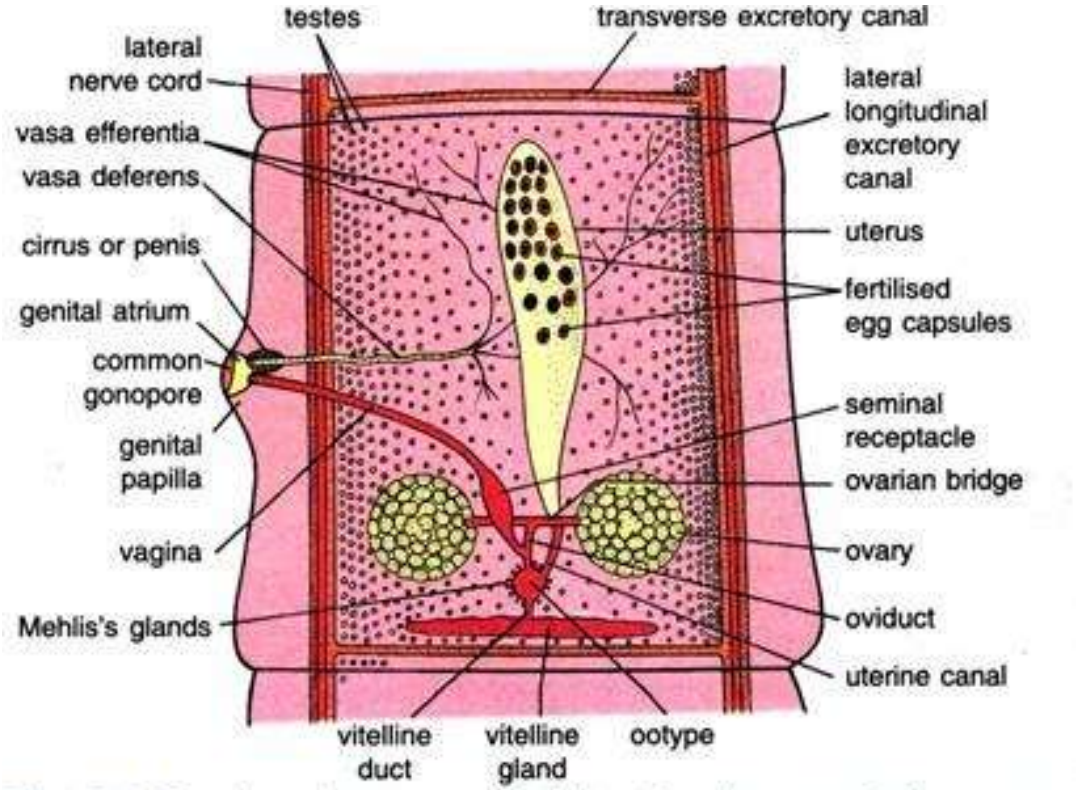


Fig. 42.8. *T. solium*. A mature proglottid to show the reproductive organs.

FEMALE REPRODUCTIVE ORGANS

- Single pair of ovary in each proglottid. It produces eggs. Sperm are stored in a seminal receptacle.
- They fertilize eggs as the eggs → **Oviduct** → **Vitelline Gland** (yolk gland) → **Otype** (expanded region of the oviduct, forms capsules around the eggs, surrounded by the Mehlis' gland. This gland helps in the formation of the egg capsule)
- Most tapeworms have a blind- ending uterus. The eggs are stored in the uterus.

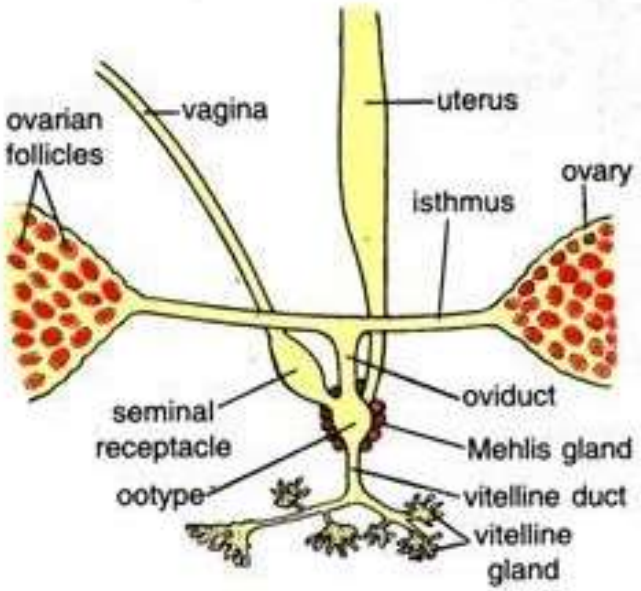


Fig. 42.11. *T. solium.* Details of the arrangement of ducts of female reproductive organs.

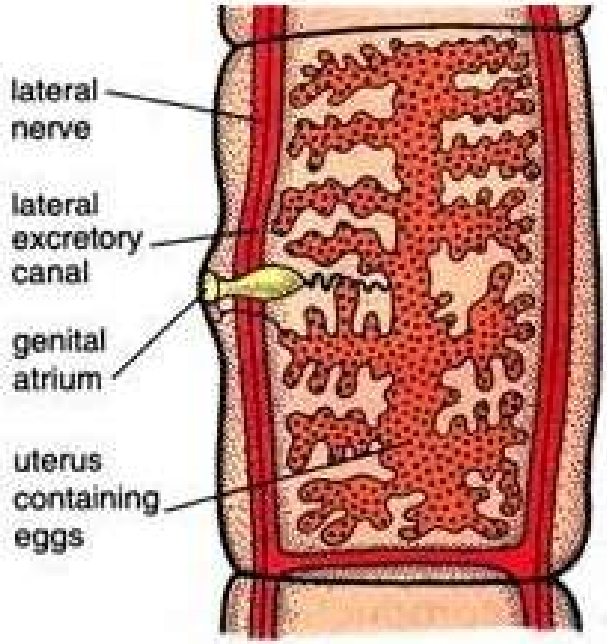
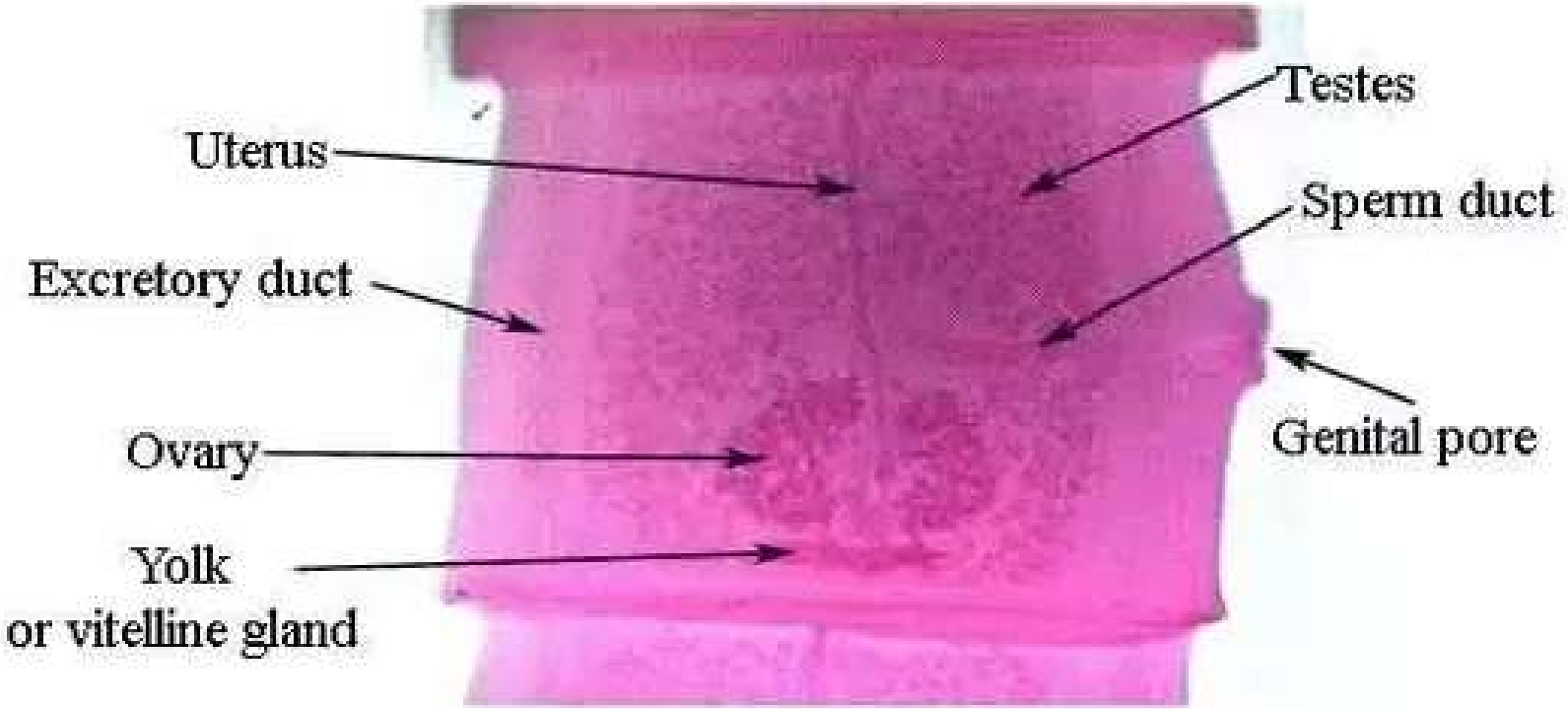


Fig. 42.12. *T. solium.* A gravid proglottid showing branched uterus.

Taenia pisiformis Dog tapeworm

40x



Mature proglottid

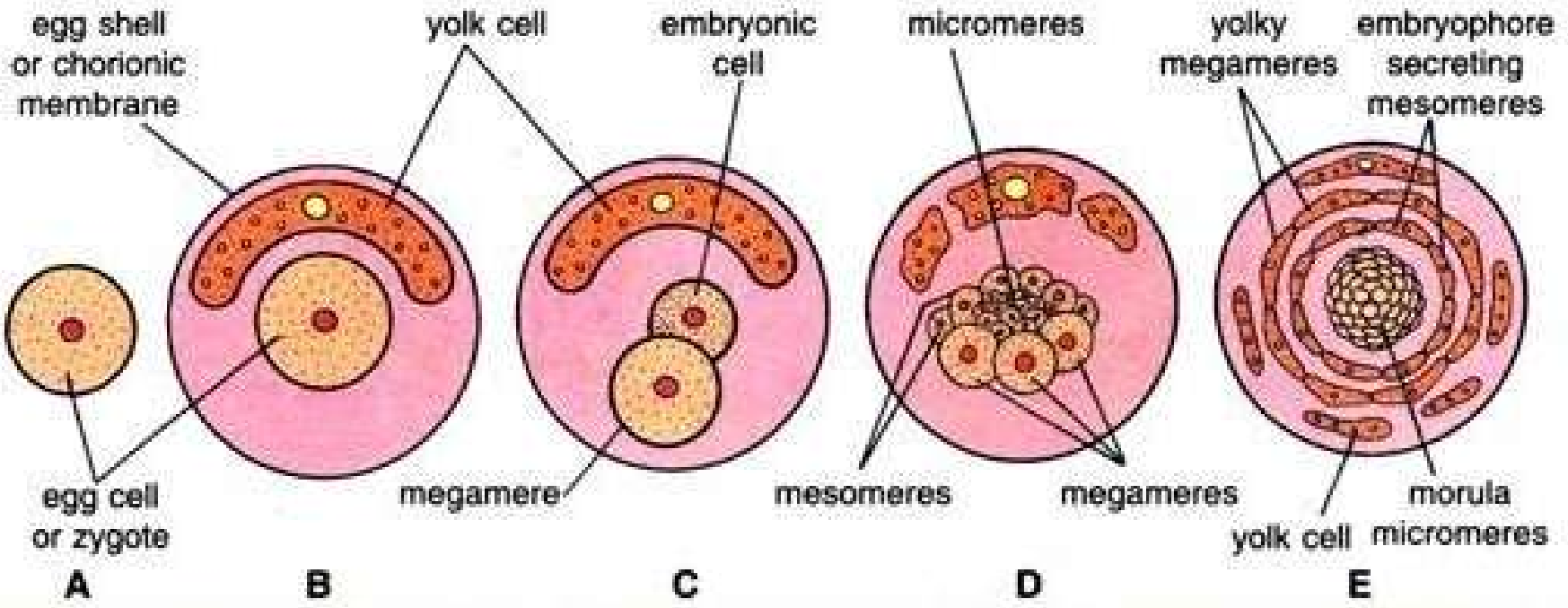


Fig. 42.13. *T. solium.* A—Zygote; B to E—Stages illustrating the formation of onchosphere.

- No special sense organs but do have sensory endings in the tegument that are modified cilia
- **Microtriches (sing. microthrix) greatly enlarge the surface** area of the tegument, which is a **vital adaptation** for a tapeworm since it must absorb all its nutrients across its tegument

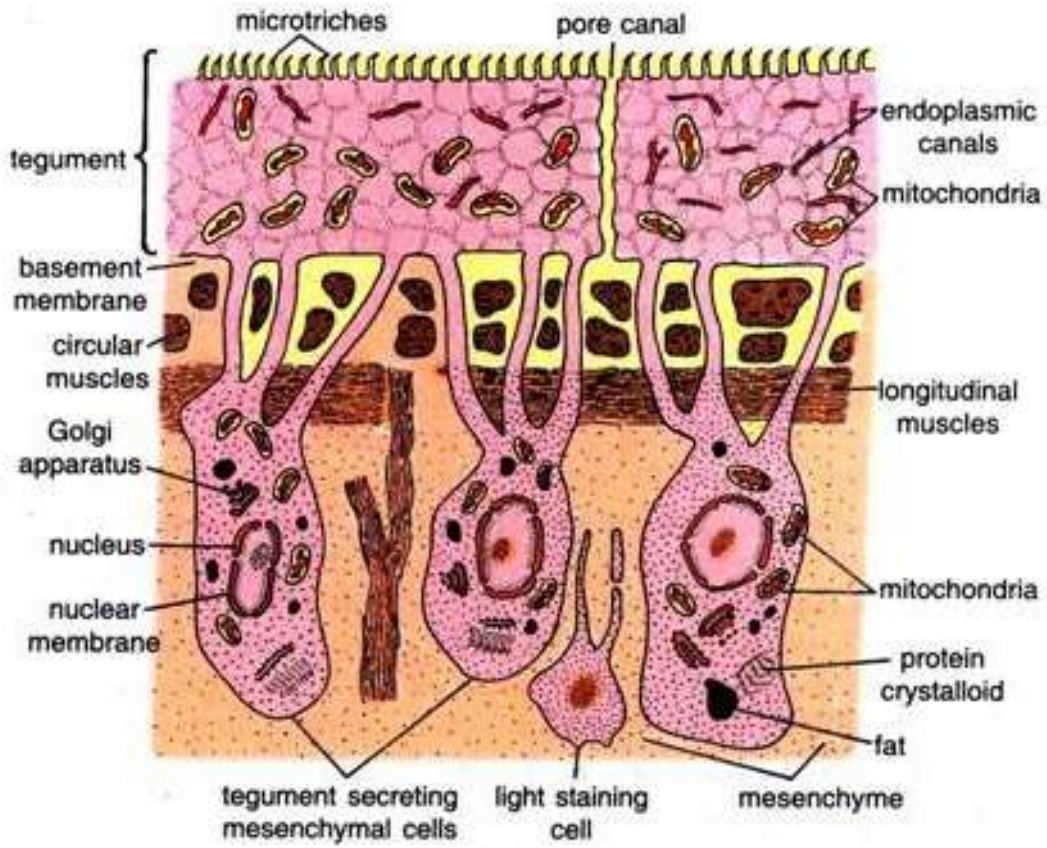


Fig. 42.4. *Taenia solium*. T.S. of body wall as seen under electron microscope.

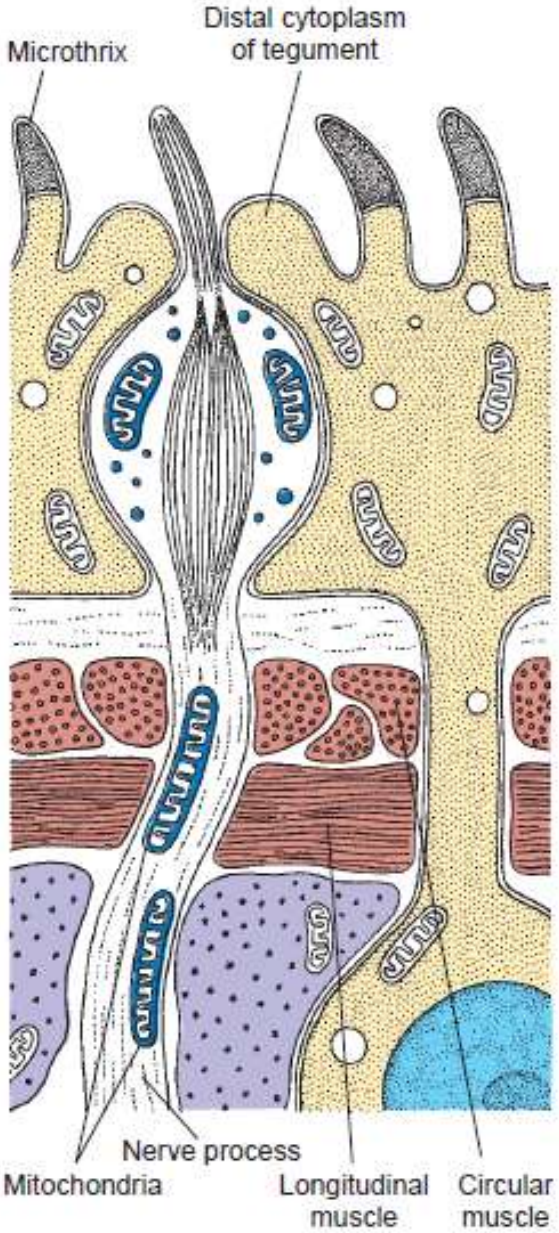


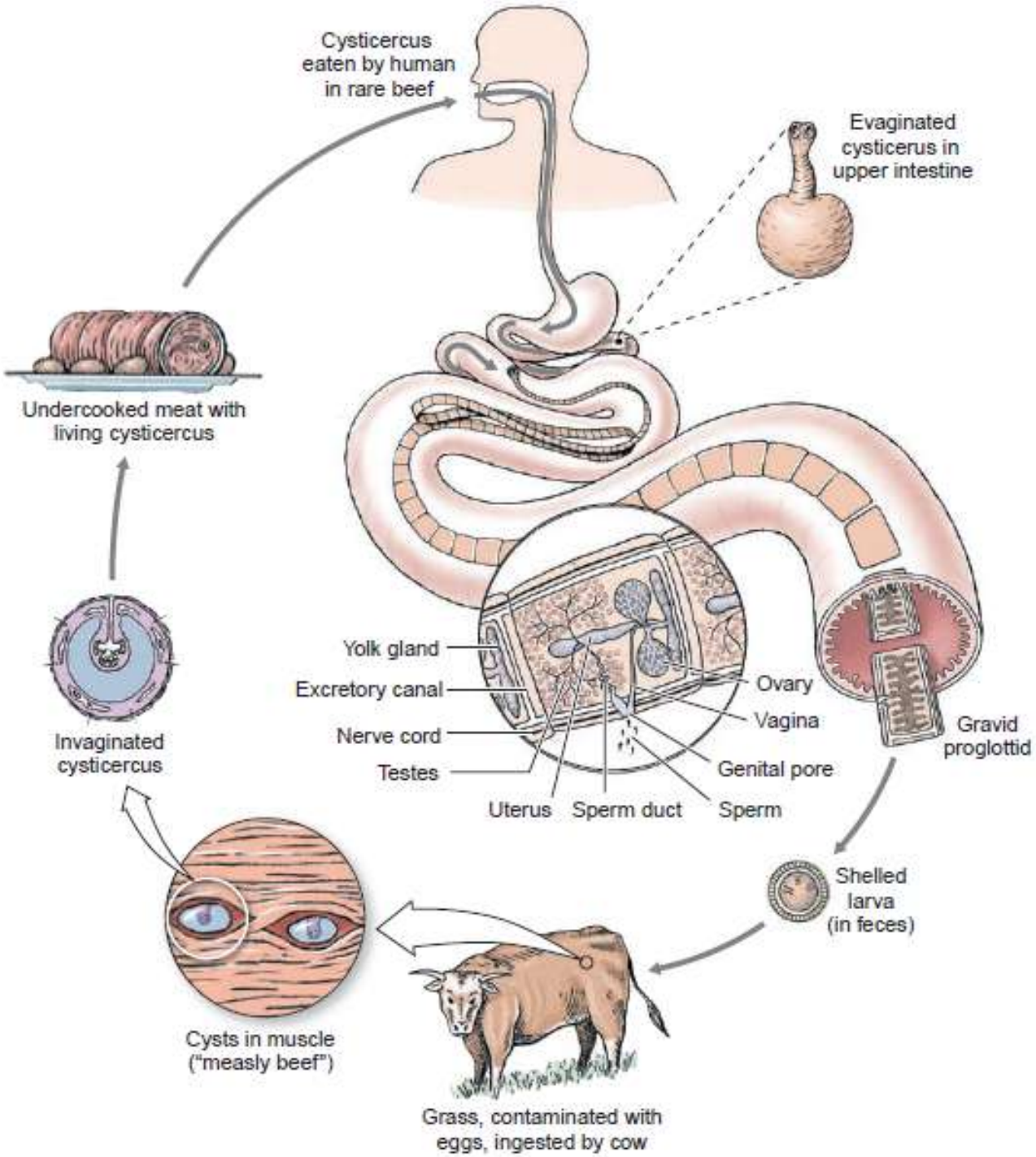
Figure 14.20
Schematic drawing of a longitudinal section through a sensory ending in the tegument of *Echinococcus granulosus*.

Common Cestodes of Humans

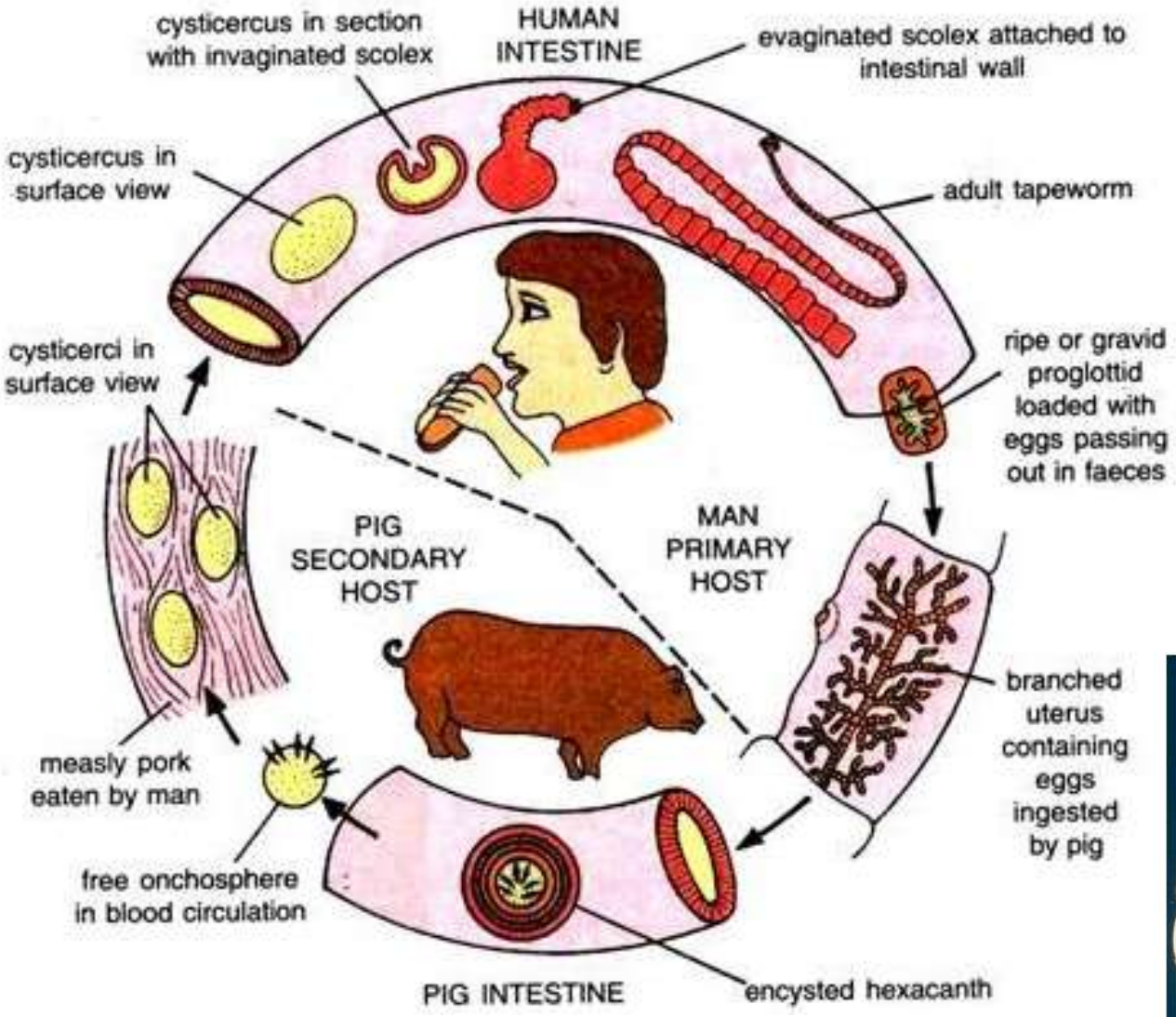
Common and Scientific Name	Means of Infection; Prevalence in Humans
Beef tapeworm (*Taenia saginata*)	Eating rare beef; most common of all tapeworms in humans
Pork tapeworm (*Taenia solium*)	Eating rare pork; less common than *T. saginata*
Fish tapeworm (*Diphyllobothrium latum*)	Eating rare or poorly cooked fish; fairly common in Great Lakes region of United States, and other areas of world where raw fish is eaten
Dog tapeworm (*Dipylidium caninum*)	Unhygienic habits of children (juveniles in flea and louse); moderate frequency
Dwarf tapeworm (*Hymenolepis nana*)	Juveniles in flour beetles; common
Unilocular hydatid (*Echinococcus granulosus*)	Cysts of juveniles in humans; infection by contact with dogs; common wherever humans are in close relationship with dogs and ruminants
Multilocular hydatid (*Echinococcus multilocularis*)	Cysts of juveniles in humans; infection by contact with foxes; less common than unilocular hydatid

VISIT:

http://tapewormdb.uconn.edu/



Taenia saginata



Taenia solium

Figure 14.23
Section through the brain of a person who died of cerebral cysticercosis, an infection with cysticerci of *Taenia solium*.

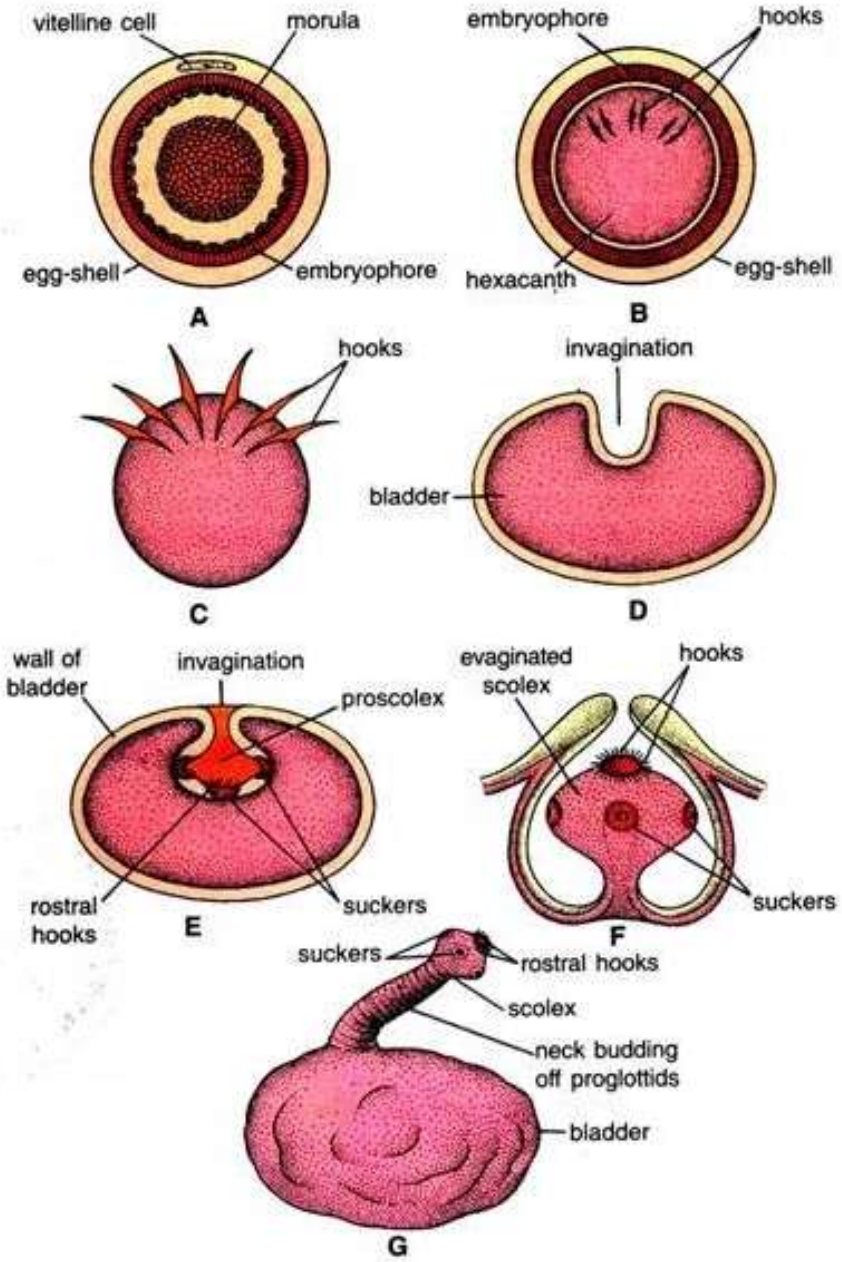


Fig. 42.14. *T. solium.* Stages in the life cycle. A—Young onchosphere; B—Mature onchosphere; C—Free hexacanth; D—Bladderworm with invagination; E—Bladderworm with proscolex; F—Bladderworm with evaginated scolex and G—Cysticercus with neck budding off proglottids.

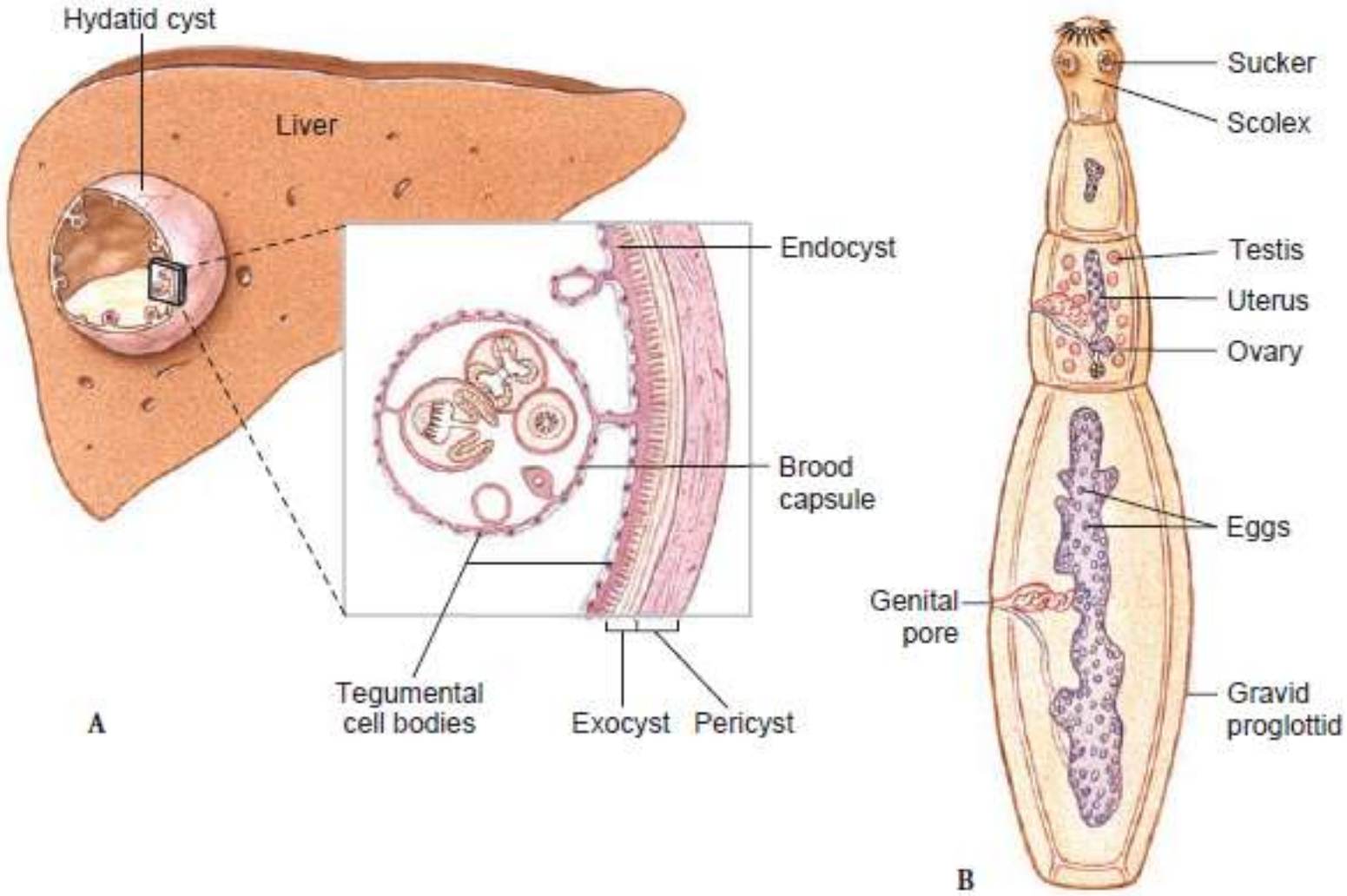
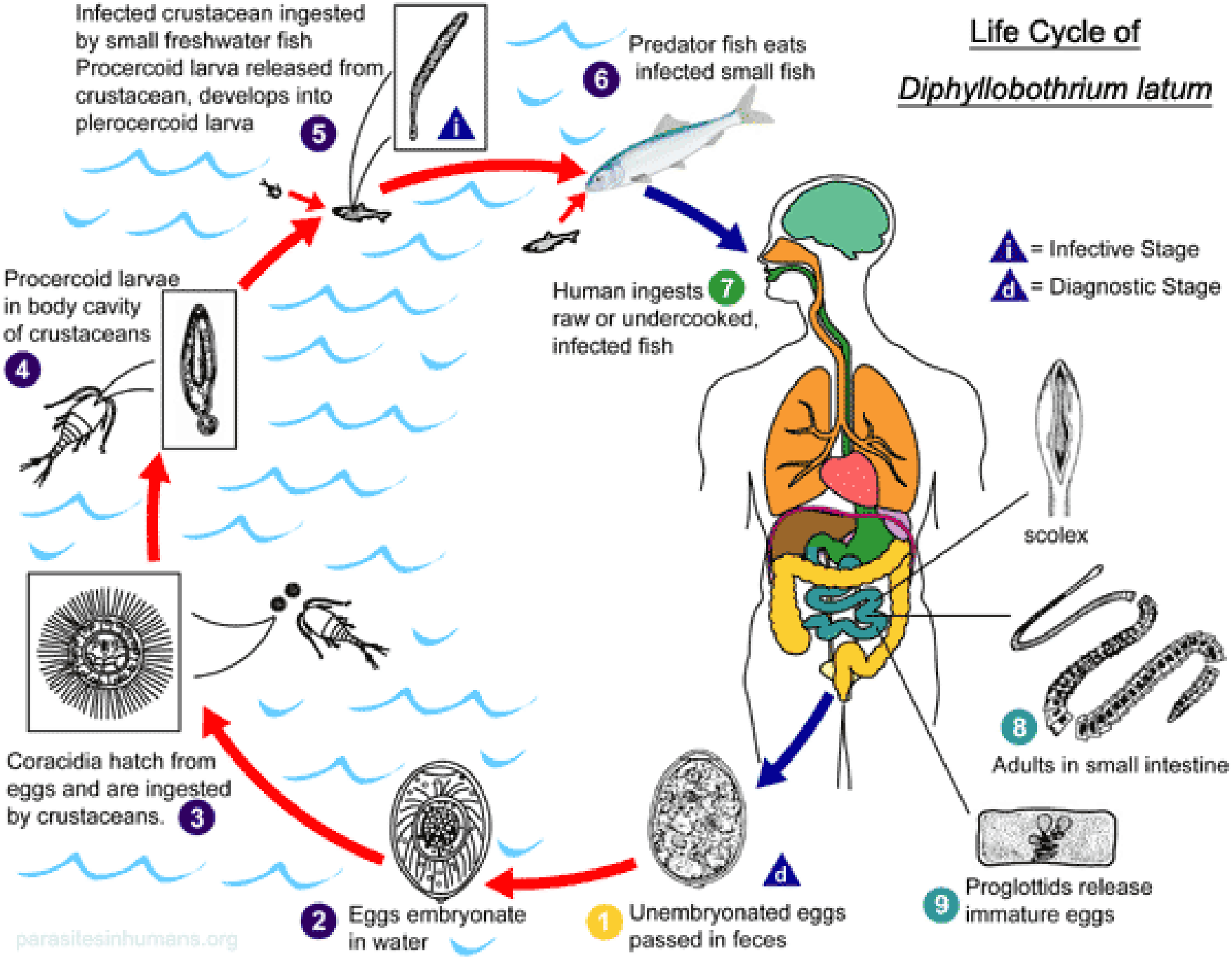
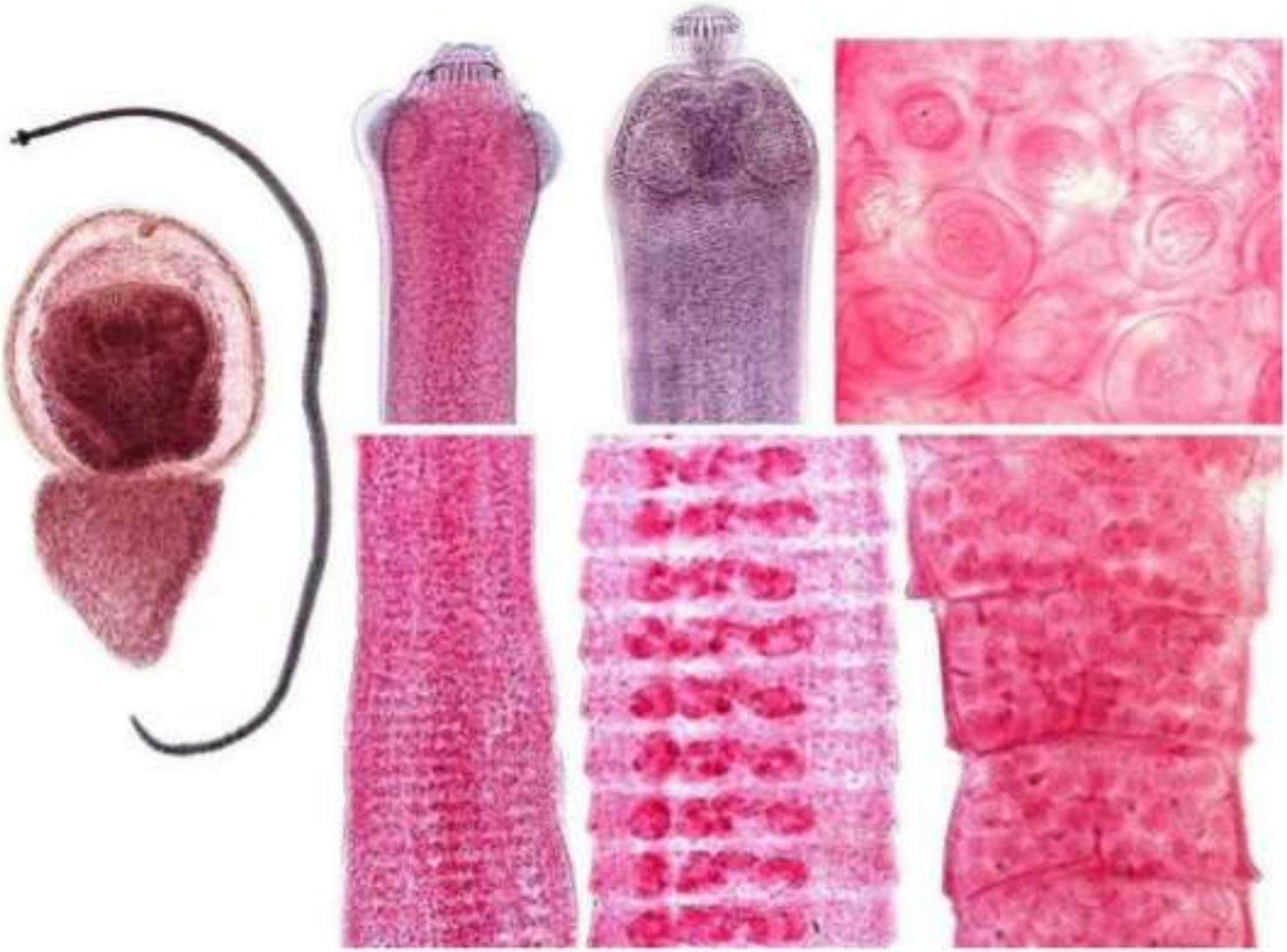


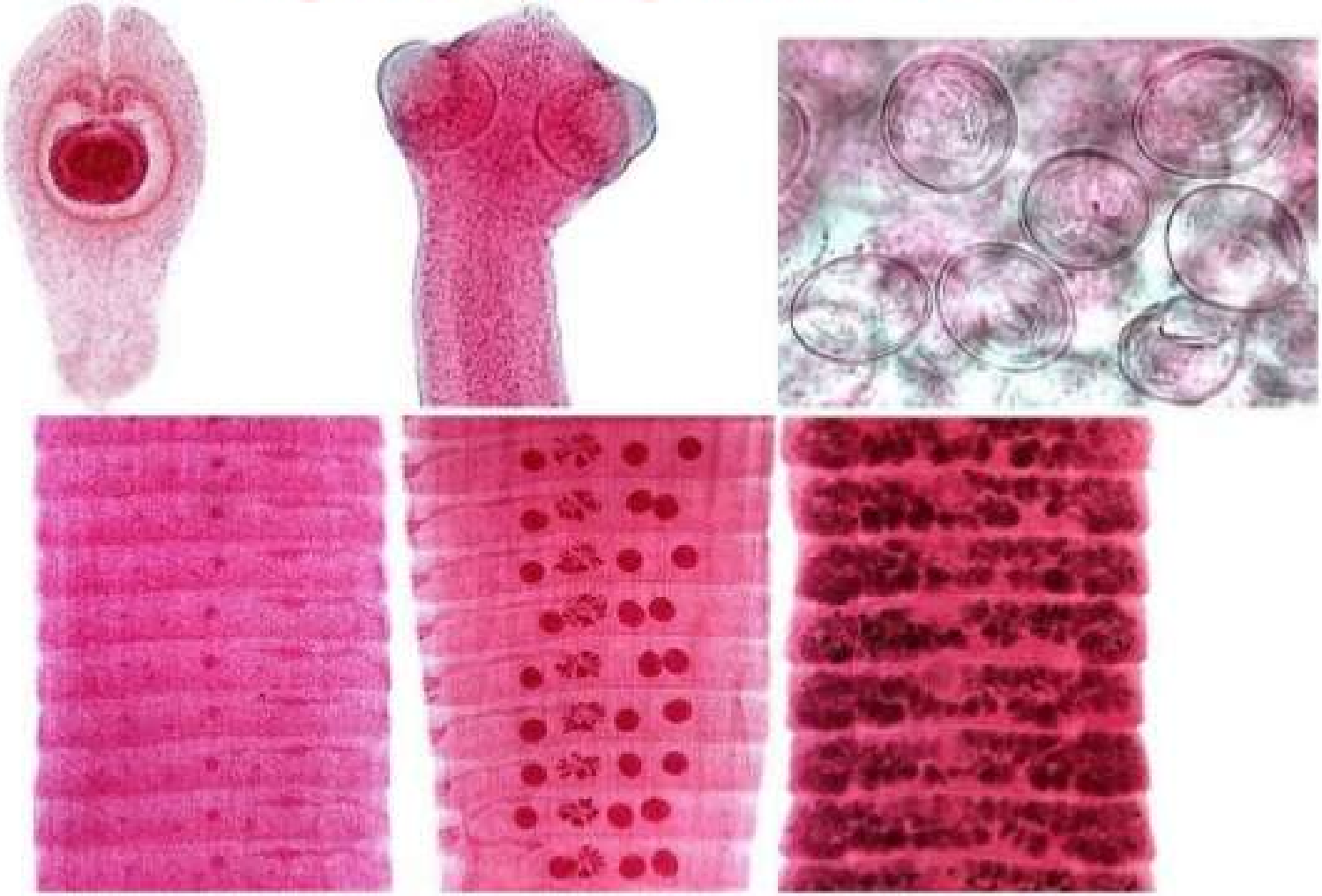
Figure 14.24

Echinococcus granulosus, a dog tapeworm, which may be dangerous to humans. **A,** Early hydatid cyst or bladder-worm stage found in cattle, sheep, hogs, and sometimes humans produces hydatid disease. Humans acquire disease by unsanitary habits in association with dogs. When eggs are ingested, liberated larvae encyst in the liver, lungs, or other organs. Brood capsules containing scolices are formed from the inner layer of each cyst. The cyst enlarges, developing other cysts with brood pouches. It may grow for years to the size of a basketball, necessitating surgery. **B,** The adult tapeworm lives in intestine of a dog or other carnivore.


Life Cycle of
Diphyllobothrium latum
Infected crustacean ingested by small freshwater fish
Procercoid larva released from crustacean, develops into plerocercoid larva
5
Predator fish eats infected small fish
6
i = Infective Stage
d = Diagnostic Stage
Procercoid larvae in body cavity of crustaceans
4
Human ingests raw or undercooked, infected fish
7
scolex
8
Adults in small intestine
Coracidia hatch from eggs and are ingested by crustaceans.
3
9
Proglottids release immature eggs
2
Eggs embryonate in water
1
Unembryonated eggs passed in feces
parasitesinhumans.org



Hymenolepiasis nana



Class Neoophora

Subclass Neodermata
Infraclass Monogenea

- Body of adults covered with a **syncytial tegument without cilia**
- Body usually leaflike to cylindrical in shape; posterior attachment organ with hooks, suckers, or clamps, usually in combination
- Monoecious; development direct, with single host and usually with freeswimming,
- Ciliated larva; all parasitic, mostly on skin or gills of fish. Examples: *Dactylogyrus, Polystoma, Gyrodactylus.*
- few are found in the urinary bladder of frogs and turtles, and one parasitizes the eye of a hippopotamus
- Egg hatches to produce a ciliated larva (**oncomiracidium),** that attaches to its host. oncomiracidium bears hooks on its posterior, which in many species become the hooks on the large posterior attachment organ **(opisthaptor) of the adult**
- Force of water flow over the gills or skin, **adaptive diversification opisthaptors** in different species

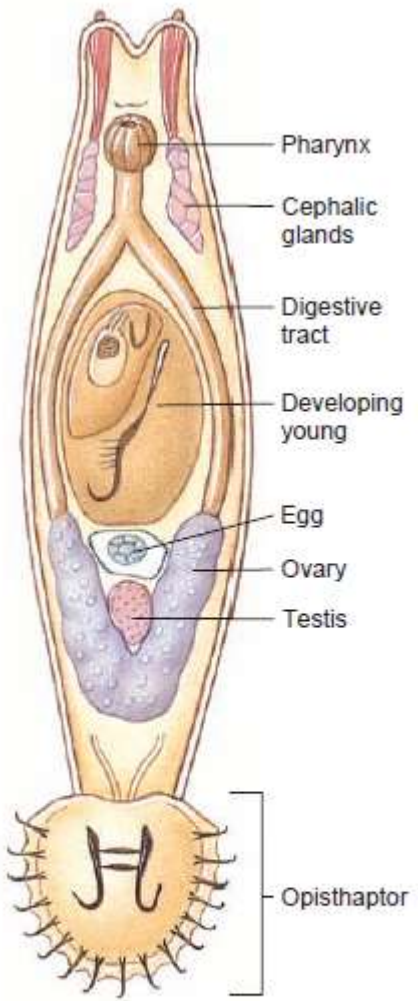


Figure 14.18
A monogenetic fluke *Gyrodactylus cylindriformis*, ventral view.

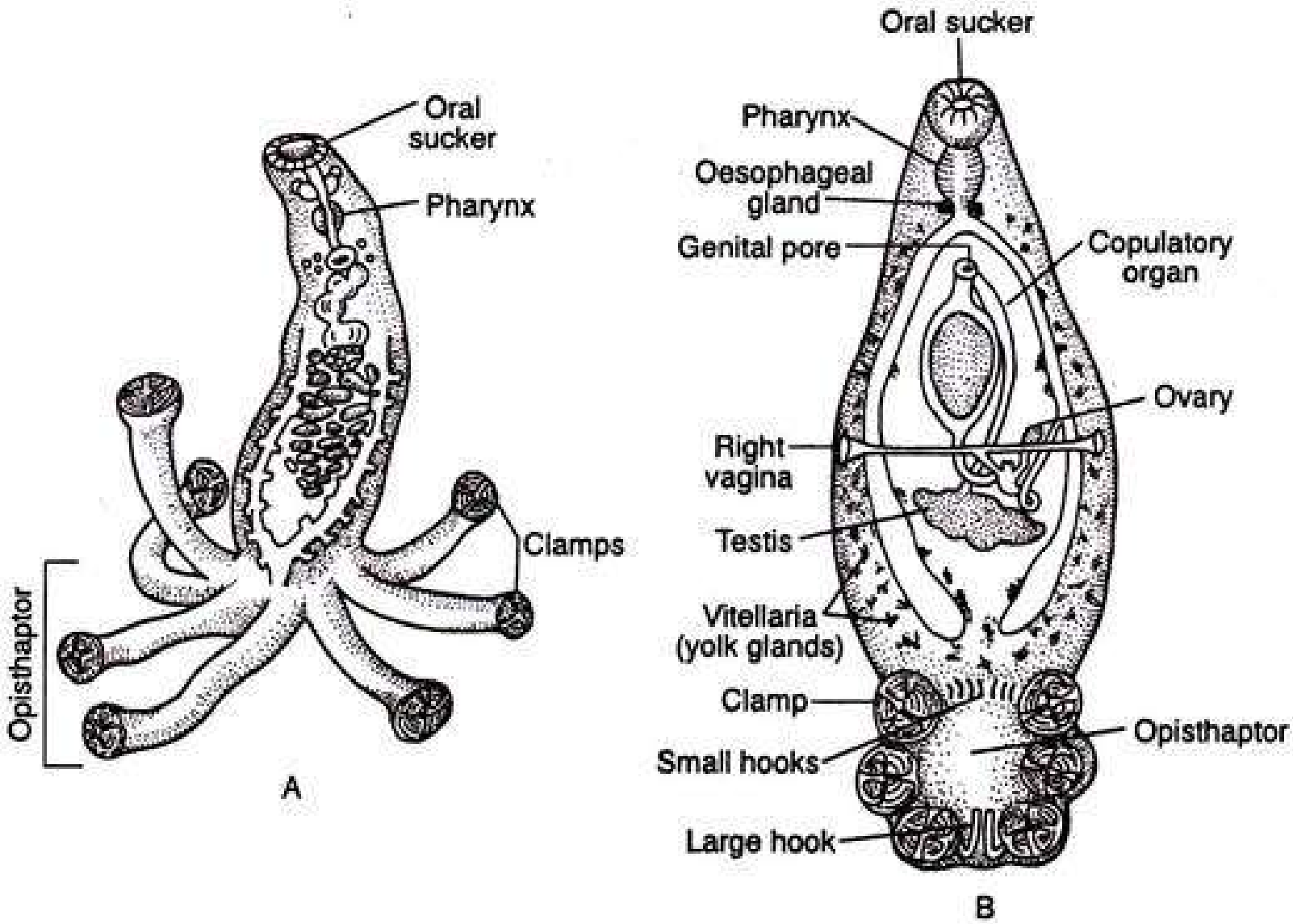
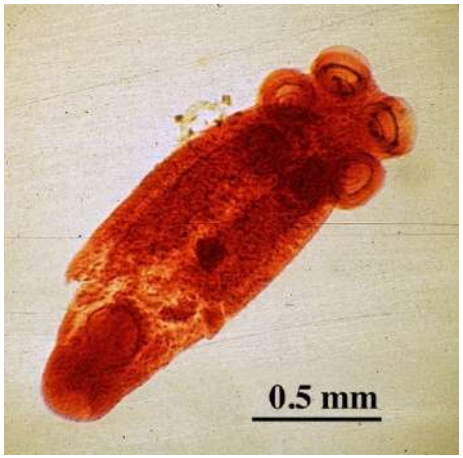


Fig. 15.25: Monogenean parasites. A. Entire view of a *Choriocotyle* sp.showing the complex haptor. B. *Polystomoidella* sp. showing the hooks and haptor (From Pechenik).



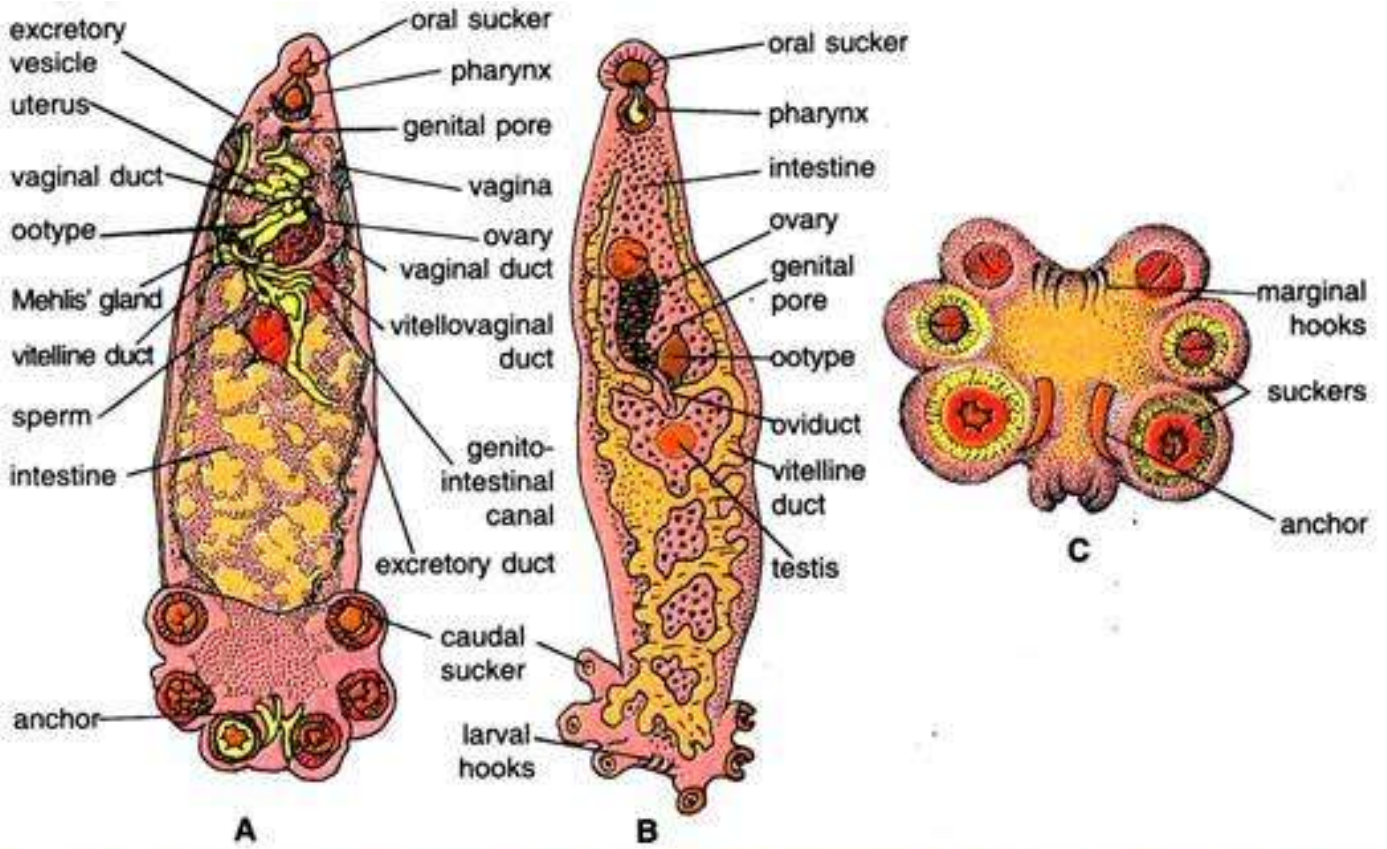


Fig. 40.1. *Polystoma integerrimum.* A—Bladder generation from urinary bladder of frog; B—Gill generation; C—Opisthaptor.

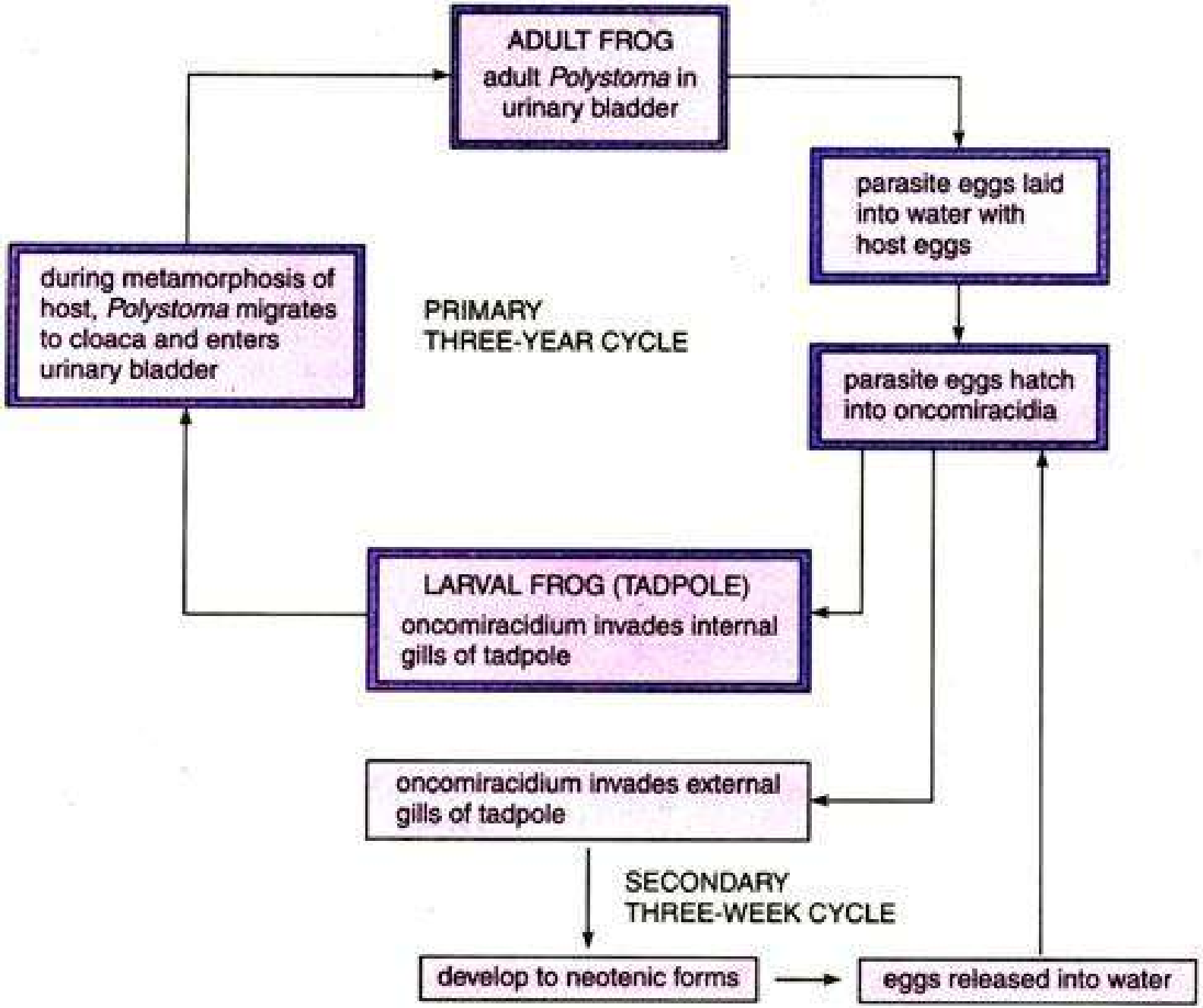


Fig. 40.3. *Polystoma integerrimum*. Site selection and migration in Amphibia.

Class Neoophora

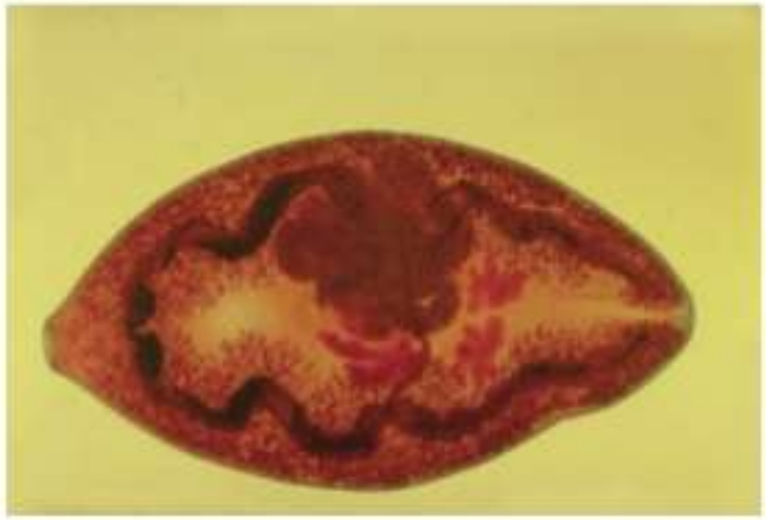
Subclass Neodermata
Infraclass Trematoda

- Body of adults covered with a syncytial tegument without cilia; Leaflike or cylindrical in shape
- Usually with oral and ventral suckers, no hooks
- Alimentary canal usually with two main branches
- Mostly monoecious
- Development indirect, with first host a mollusc, final host usually a vertebrate; parasitic in all classes of vertebrates
- Different species vary widely in detail, a typical example would include an **adult**, **egg** (shelled embryo), **miracidium (free-swimming, ciliated larva)**, **sporocyst (in snail tissue, reproduksi aseksual mjd bnyak sporocyst)** , **redia (berasal dr sporocyst)**, **cercaria**, Cercariae emerge from the snail and can either penetrate the final host directly (for example, the blood fluke *Schistosoma mansoni*), penetrate a second intermediate host (for example, the lung fluke *Paragonimus westermani*), or encyst on aquatic vegetation (for example, the intestinal fluke *Fasciolopsis buski*) and **metacercaria (juvenille)** stages

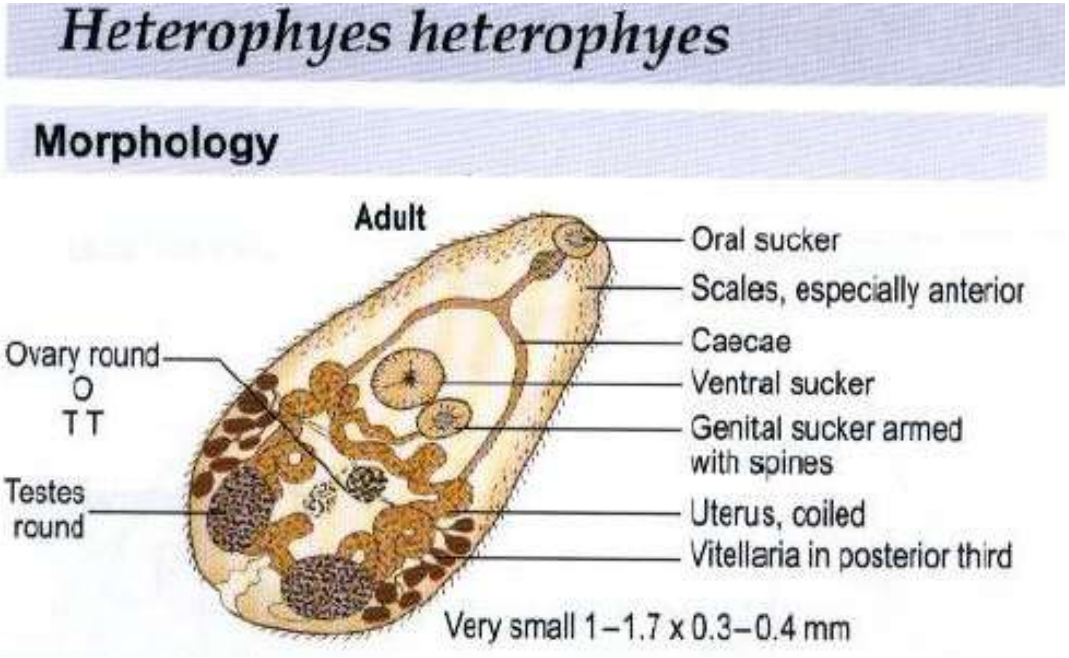
Blood Fluke

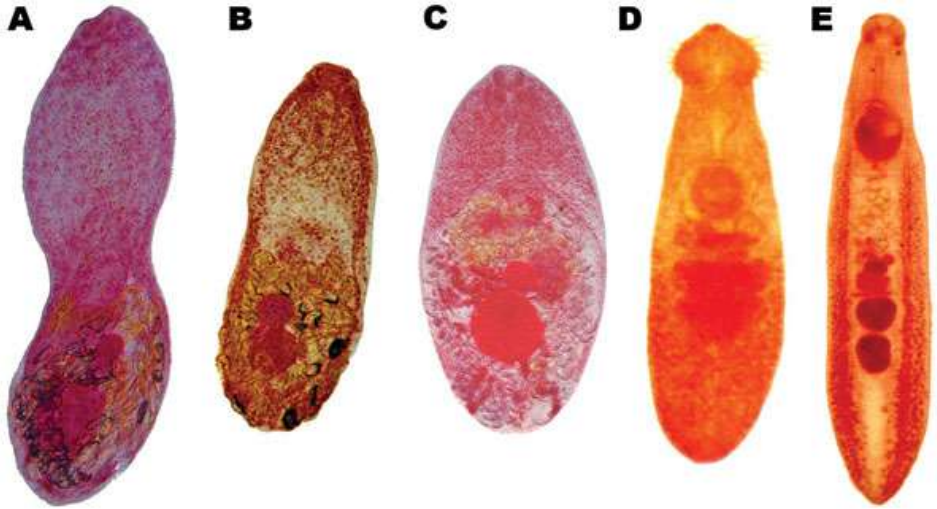
Liver fluke

Intestinal fluke



Lung Fluke

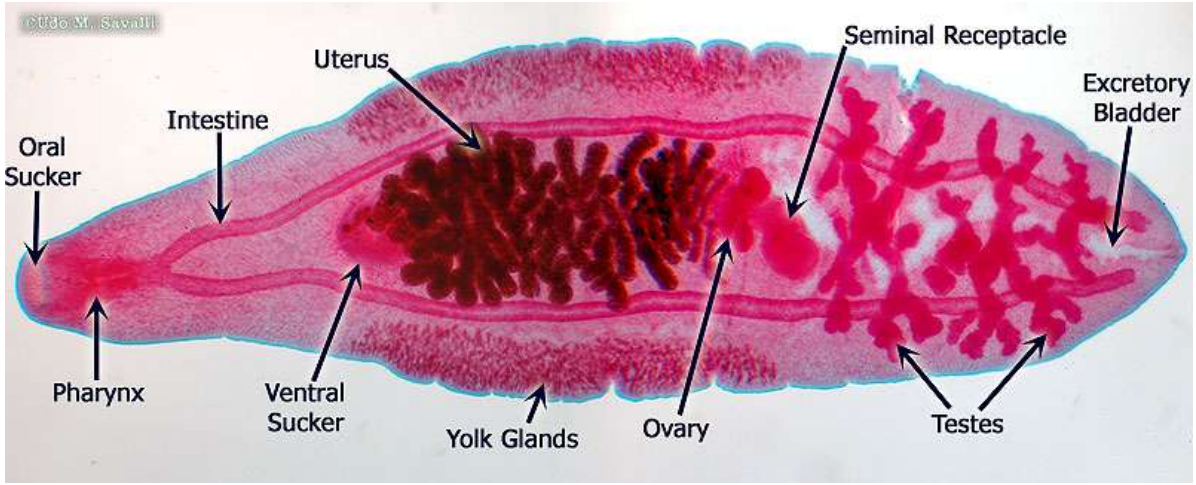




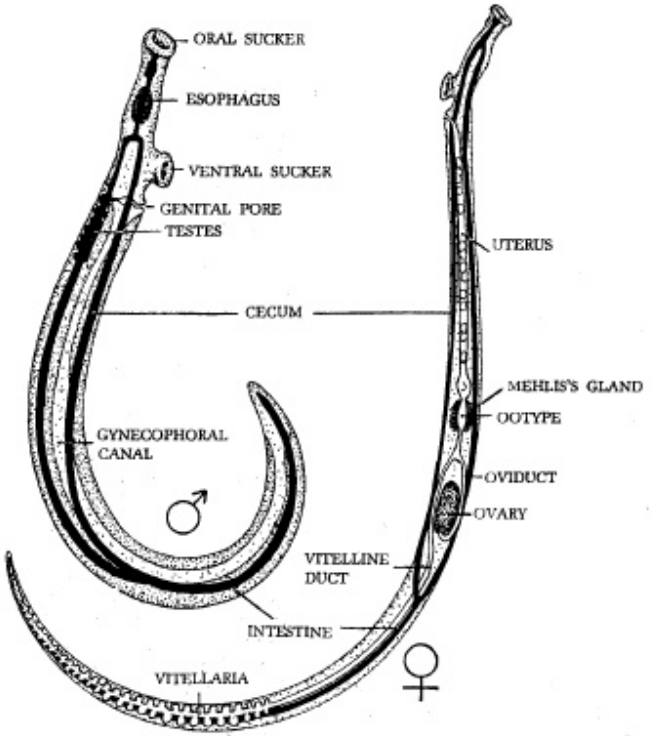
Adult trematodes recovered from domestic animals
A) *Haplorchis taichui*; B) *H. pumilio*; C) *H. yokogawai*; D) *Echinochasmus japonicus*; E) *Echinostoma cinetorchis*

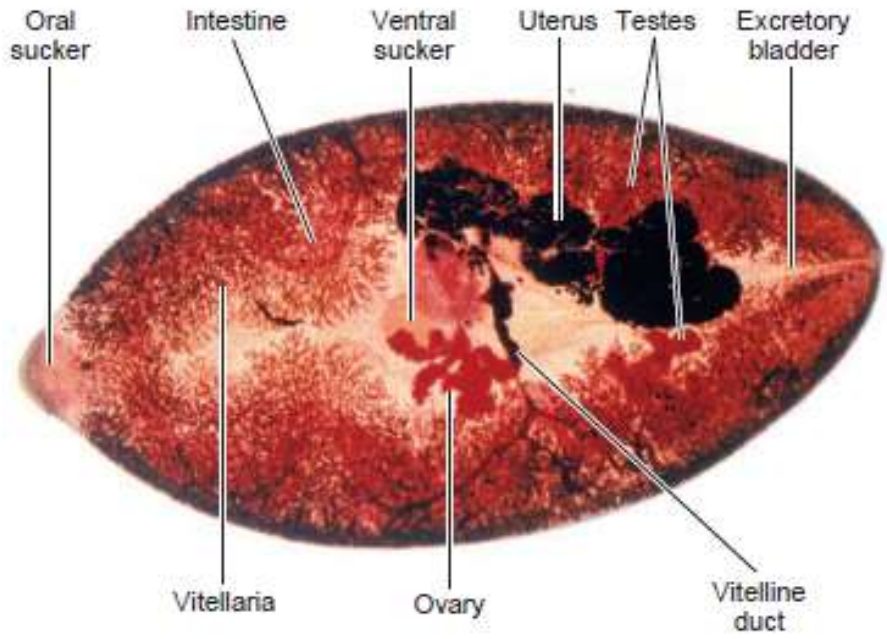
Fasciolopsis buski

INTESTINAL FLUKE



Liver Fluke *Clonorchis*





Lung Fluke *Paragonimus westermani*

Blood Fluke

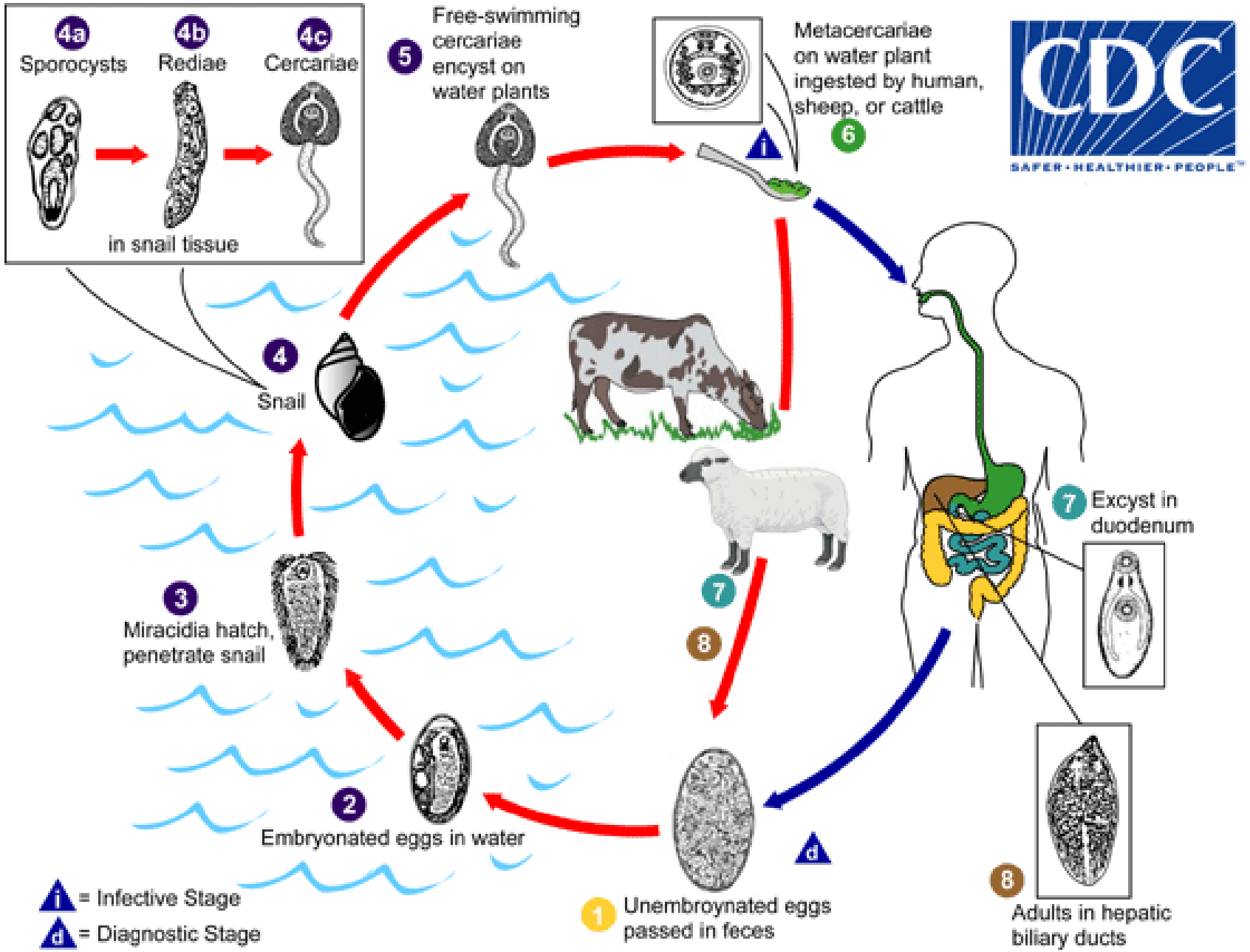
Examples of Flukes Infecting Humans

Common and Scientific Names	Means of Infection; Distribution and Prevalence in Humans
Blood flukes (*Schistosoma* spp.); three widely prevalent species, others reported	Cercariae in water penetrate skin; 200 million people infected with one or more species
S. mansoni	Africa, South and Central America
S. haematobium	Africa
S. japonicum	Eastern Asia
Chinese liver flukes (*Clonorchis sinensis*)	Eating metacercariae in raw fish; about 30 million cases in eastern Asia
Lung flukes (*Paragonimus* spp.), seven species, most prevalent is *P. westermani*	Eating metacercariae in raw freshwater crabs, crayfish; Asia and Oceania, sub-Saharan Africa, South and Central America; several million cases in Asia
Intestinal fluke (*Fasciolopsis buski*)	Eating metacercariae on aquatic vegetation; 10 million cases in eastern Asia
Sheep liver fluke (*Fasciola hepatica*)	Eating metacercariae on aquatic vegetation; widely prevalent in sheep and cattle, occasional in humans

Immature *Fasciola* **eggs** are discharged in the biliary ducts and in the stool (1). Eggs become embryonated in water (2), eggs release **miracidia** (3), which invade a suitable snail intermediate host (4), including the genera *Galba, Fossaria* and *Pseudosuccinea*. In the snail the parasites undergo several developmental stages (sporocysts (4a), rediae (4b), and cercariae (4c)). The **cercariae** are released from the snail (5) and encyst as **metacercariae** on aquatic vegetation or other surfaces. Mammals acquire the infection by eating vegetation containing metacercariae. Humans can become infected by ingesting metacercariae-containing freshwater plants, especially watercress (6). After ingestion, the metacercariae excyst in the duodenum (7) and migrate through the intestinal wall, the peritoneal cavity, and the liver parenchyma into the biliary ducts, where they develop into adult **flukes** (8).

In humans, maturation from **metacercariae** into **adult flukes** takes approximately 3 to 4 months. The adult flukes (*Fasciola hepatica*: up to 30 mm by 13 mm; *F. gigantica*: up to 75 mm) reside in the large biliary ducts of the mammalian host. *Fasciola hepatica* infect various animal species, mostly herbivores (plant-eating animals).

Fasciola hepatica (Liver Fluke) Life Cycle



A list of some intermediate snail hosts of *Fasciola hepatica* with geographical distribution

Country	Snail host
Africa, Europe, North America, India and other countries of Asia	*Lymnaea truncatula*
East and West Africa	*Lymnaea natalensis*
West Africa	*Lymnaea rufescens*
Europe	*Lymnaea stagnalis, Lymnaea glabra, Lymnaea palustris*
Australia	*Lymnaea tomentosa*
New Zealand	*Lymnaea columella*
Philippines	*Lymnaea philippensis, Lymnaea swinhoe*
Malayasia	*Lymnaea rubiginosa*
Japan	*Lymnaea japonicum, Lymnaea pervia*
Argentina	*Lymnaea viator*
Peru	*Lymnaea viatric*
China	*Radix cucunorica, Radix lagotis*
Romania	*Radix peregra, Radix auricularia*
USA	*Fossoria modicella, Fossoria stagnicola*

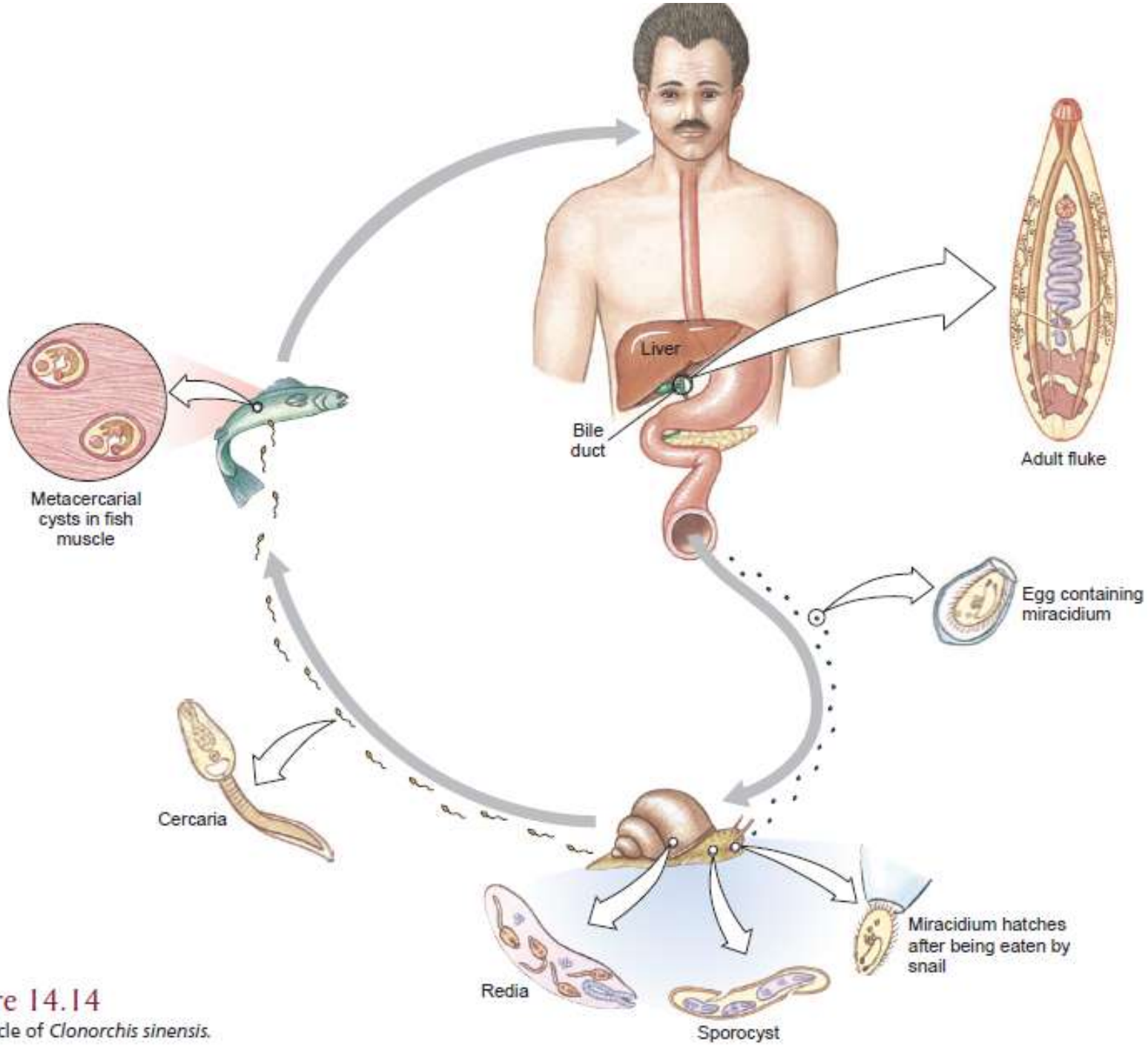


Figure 14.14
Life cycle of *Clonorchis sinensis*.

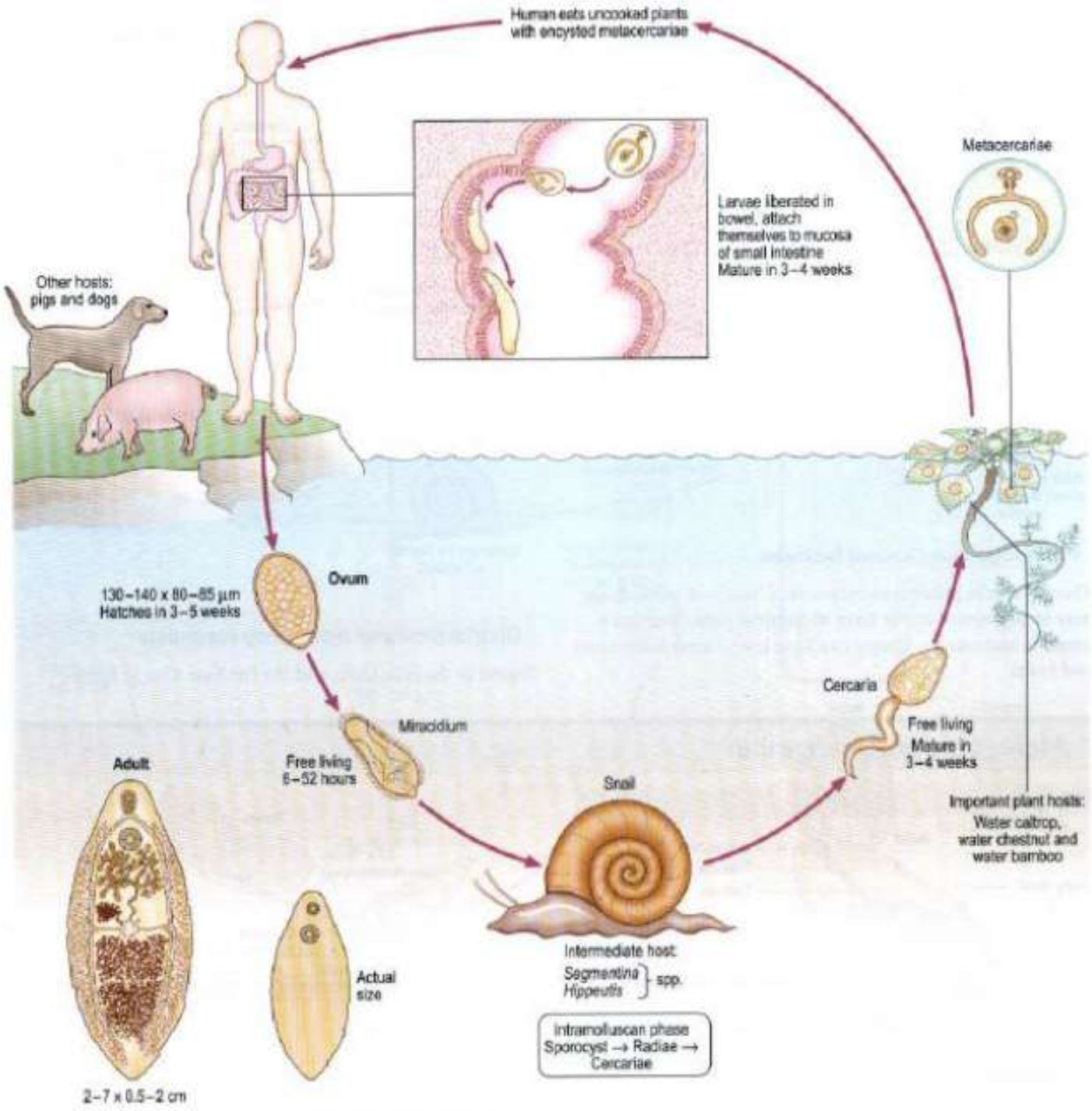

Human eats uncooked plants with encysted metacercariae
Metacercariae
Larvae liberated in bowel, attach themselves to mucosa of small intestine Mature in 3–4 weeks
Other hosts: pigs and dogs
Ovum
130–140 x 80–85 µm
Hatches in 3–5 weeks
Miracidium
Free living 6–32 hours
Snail
Cercaria
Free living Mature in 3–4 weeks
Important plant hosts: Water caltrop, water chestnut and water bamboo
Adult
2–7 x 0.5–2 cm
Actual size
Intermediate host: Segmentina Hippeutis spp.
Intramolluscan phase Sporocyst → Radiae → Cercariae

Figure 14.15

A, Adult male and female *Schistosoma japonicum* in copulation. The male has a long gynecophoric canal that holds the female. Humans are usually hosts of adult parasites, found mainly in Africa but also in South America and elsewhere. Humans become infected by wading or bathing in cercaria-infested waters. **B,** Life cycle of *Schistosoma mansoni.*

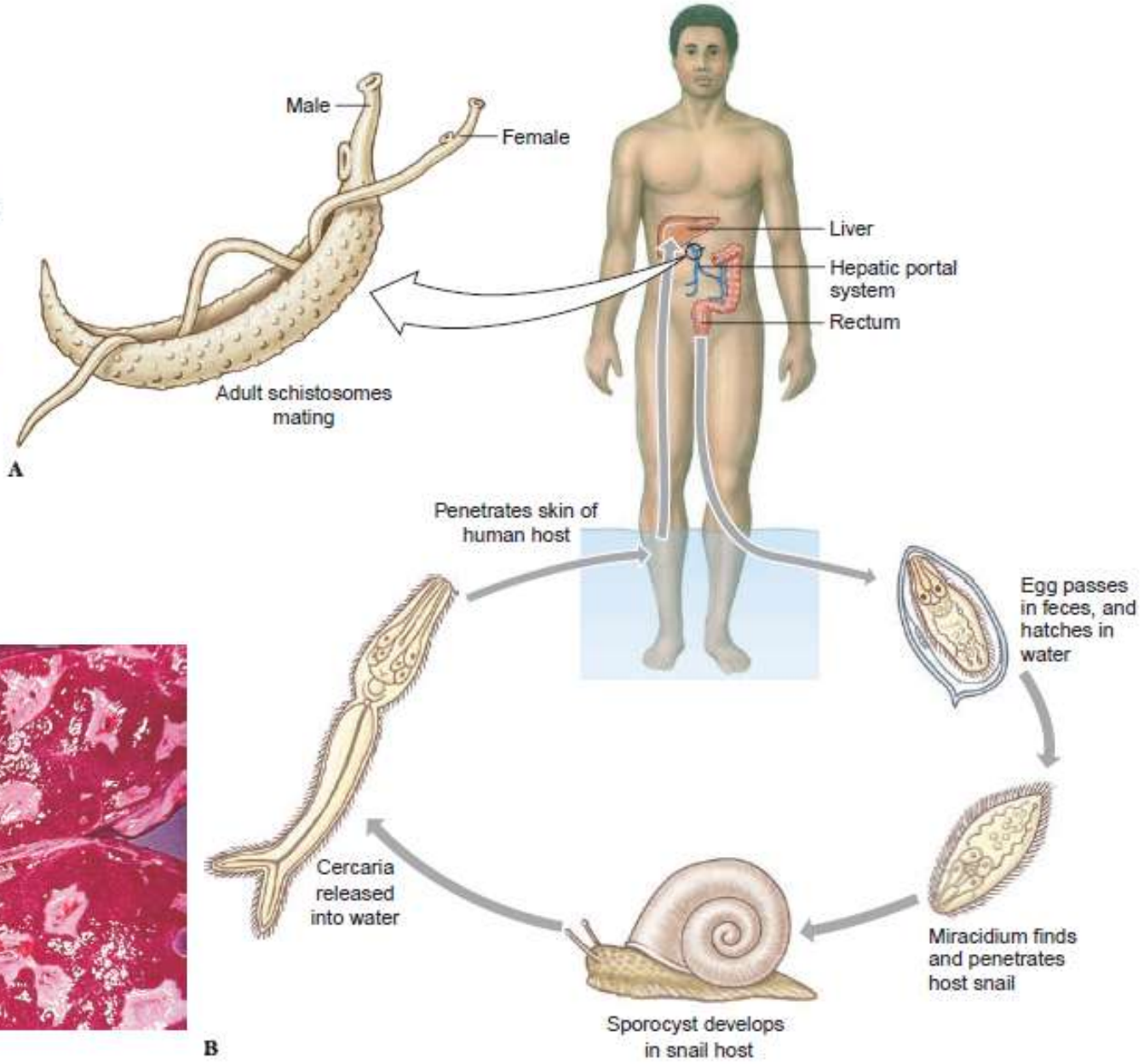


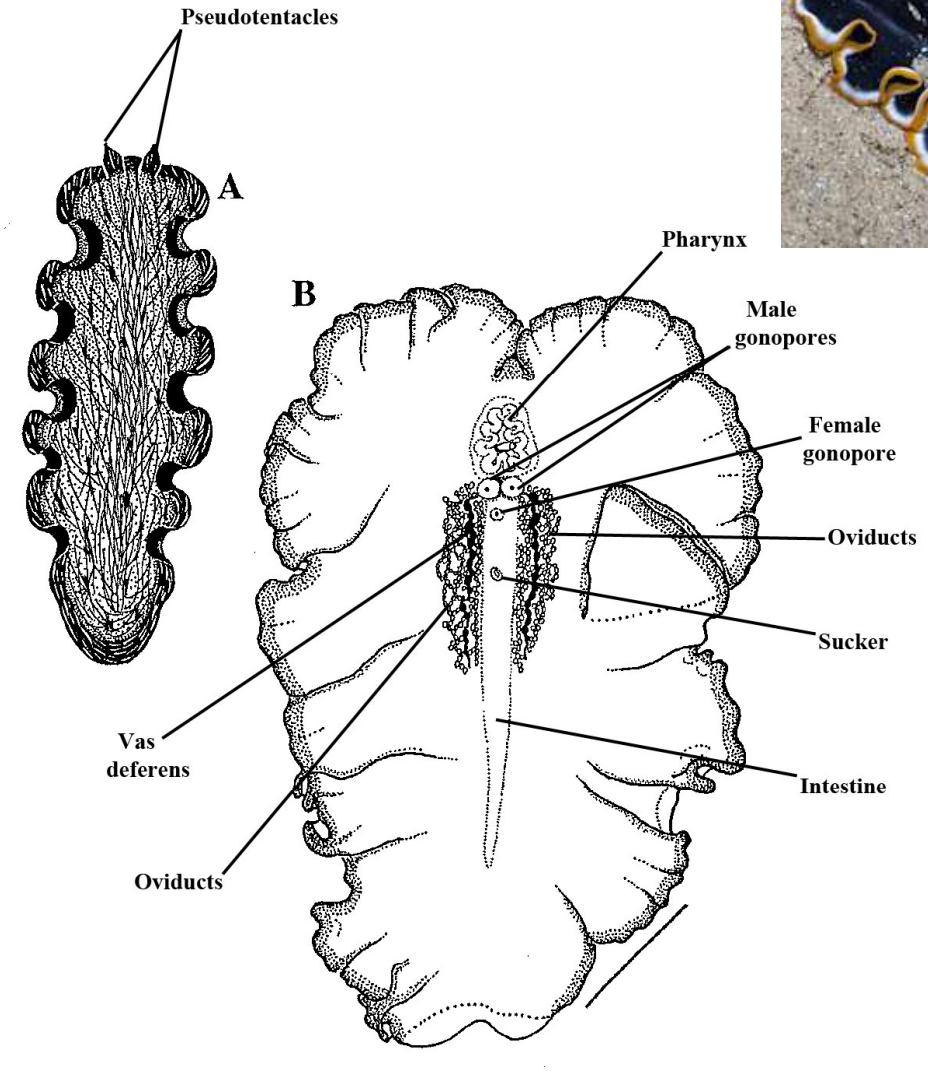
Figure 14.16

Cut surface of a liver showing severe fibrosis. The patient was a 27-year-old man who died from hematemesis (vomiting blood) associated with spleen and liver enlargement. Over 180 pairs of adult *Schistosoma mansoni* were counted at autopsy.

Courtesy A. W. Cheever/From H. Zaiman, A Pictorial Presentation of Parasites.

Class Polycladidea

- The *Polycladida* represents a highly diverse clade of free-living marine turbellarian flatworms
- Pharynx simple, bulbose, or plicate (many ridges); intestine may have short diverticula, or pockets; protonephridia paired
- Testes usually numerous; penis papilla generally present
- nervous system with 3–4 trunks; nearly 800 species.



Diagrams of *Ps7eudobiceros fulgor*. (A) Dorsal color pattern; (B) Morphology of the ventral surface. Scale: 5 mm. Modified from Newman & Cannon, 1994.

“ Ada kehidupan dalam kehidupan kita, bahkan di tempat yang tidak kita bayangkan sebelumnya“

TUGAS

TULIS DI BUKU TUGAS

1. Peranan Platyhelminthes bagi manusia