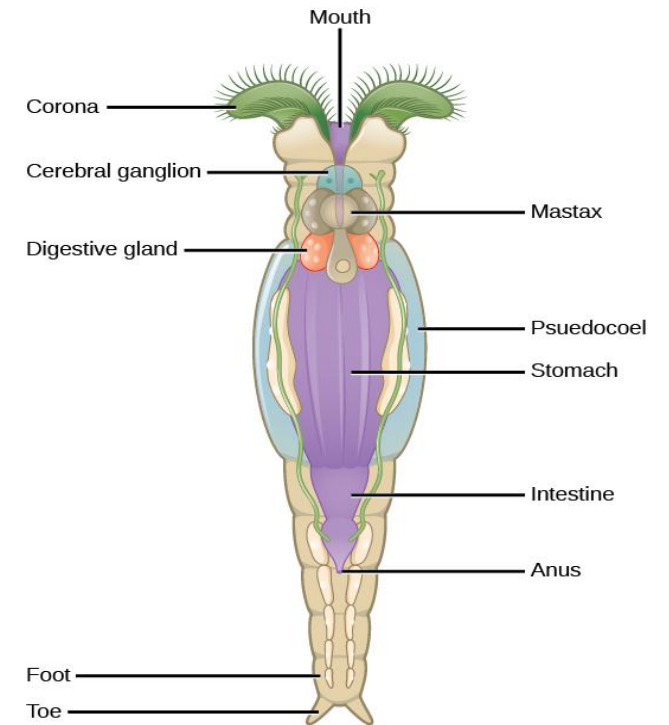


بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

# PHYLUM ROTIFERA

- The word “Rota” mean ‘wheel’ and “Fera” mean ‘to bear’.
- 1850 described species.
- 50-500 micrometer and are complex.
- Most are live in fresh water other are in salt water.
- Rotifers derived their name from “Ciliated Organ.
- The ciliated organ is “corona” (Gr. Crown).
- Cilia of Corona do not bear in synchrony.



# CHARACTERISTICS OF ROTIFERS

- Triploblastic, Bilateral, Unsegmented and Pseudocoelomates.
- Have Complete Digestive System.
- Anterior end has Corona.
- Posterior end with toes and Adhesive Glands.
- Well developed cuticle.
- Protonephridia with Flame cells.
- Male generally reduced in no. or sometimes absent.
- Parthenogenesis is common.

# OTHER ORGAN SYSTEM

- They are multicellular organisms .
- Have specialized organ system.
- Have complete digestive system.
- Protonephridia empty into cloacal bladder.
- Exchange of gases and disposed of wastes across body surfaces.
- Nervous system have two lateral nerves and one ganglionic brain.
- Sensory structures include ciliary clusters and sensory bristles.
- 1-5 photosensitive spots may be on the head.

# EXTERNAL FEATURES

- In many species, the cuticle thickens to form encasement called as lorica.
- The head contains corona , mouth ,sensory organs and brain.
- Corona surrounds a large, ciliated area called as buccal field.
- The trunk is the largest part of rotifer and is elongate and sac like.
- The anus occur on posterior trunk.
- The posterior narrow portion is called the foot.
- Terminal portion of foot bears usually one or two toes.

# FEEDING AND THE DIGESTIVE SYSTEM

- Most rotifers feed on small microorganisms and suspended organic material.
- Pharynx contains a unique structure called as mastax(Jaws),muscular organ that grinds food.
- From mastax, food passes through short ciliated esophagus to the ciliated stomach.
- Salivary and digestive glands secrete in pharynx and stomach.
- Complete extracellular digestion and absorption of food occur in stomach.
- Cloacal bladder opens to the outside via an anus.

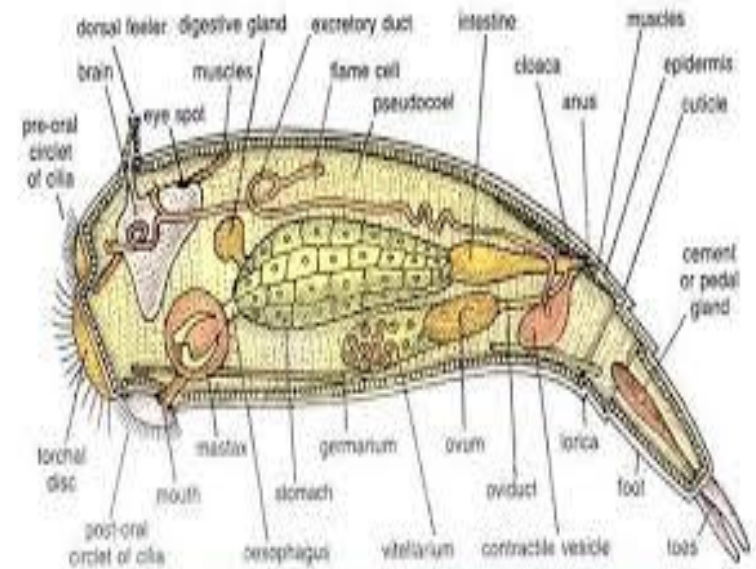
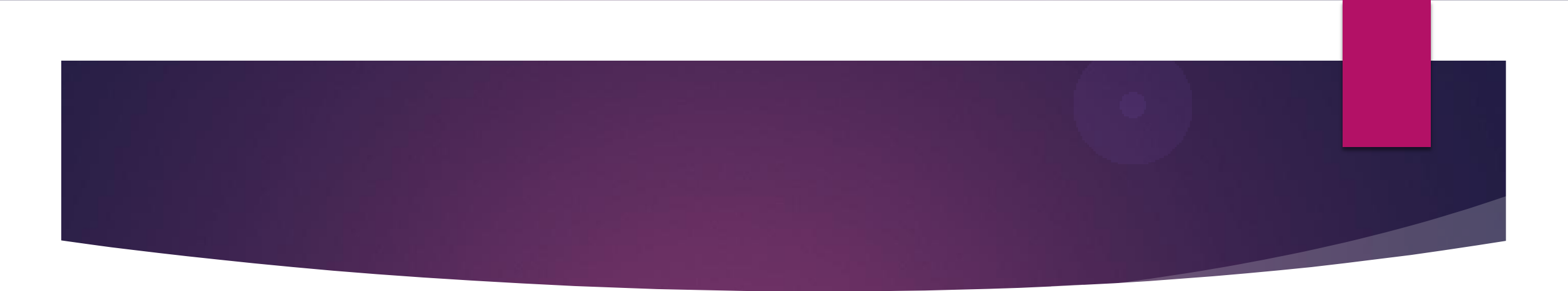


Fig. 55.3. Diagram of a rotifer showing the internal structures.

# REPRODUCTION AND DEVELOPMENT

- Rotifers are Dioecious.
- They reproduce sexually or parthenogenetically.
- Their females are always 10X larger than their males.
- In parthenogenetic species, males may be present only at certain times of the year.
- Female Reproductive System consists of :
  - One or two ovaries.
  - Each with Vitellarium Gland.
  - Together each ovary vitellarium form a single Germovitellarium.

- 
- ▶ Males have 2 parts, single testicle and sperm duct.
  - ▶ These associated with prostates.
  - ▶ Sperm duct open into gonophore.
  - ▶ Gonophore is homologous to female cloaca.
  - ▶ Class Monogononta produces two types of eggs, mictic and a-mictic.
  - ▶ Mictic are haploid and a-mictic are diploid.



# PHYLUM NEMATODA (NEMATHELMINTHES)

- ▶ Round worms, most abundant animals.
- ▶ 16,000 – 500,000 species.
- ▶ FEATURES
- ▶ Feed on organic matter, rotting substances (in living tissues).
- ▶ Microscopic to several meters long.
- ▶ Many are parasites, marine, free living and fresh water.
- ▶ In soil habitats,
- ▶ Nutrient recyclers.
- ▶ Common features between nematodes and arthropods.
- ▶ Both lack cilia.
- ▶ Sperms of nematodes and arthropods are “amoeboid”.
- ▶ Triploblastic, bilateral vermiform, unsegmented pseudocoelomate.

# EXTERNAL FEATURES

- The body nematode is slender, elongate, cylindrical, and tapered at both ends.
- Cuticle is also present in the foregut, hindgut, sense organs and parts of the female reproductive system.
- Cuticle may be smooth. Or it may contains spines, bristles, papillae, warts or smooth.
- The cuticle maintains internal hydrostatic pressure.
- It provides mechanical protection.

## **Epidermis:**

Epidermis or hypodermis is present beneath the cuticle. It surrounds the pseudocoelom.

## **Muscles:**

They have only longitudinal muscles. Contraction of these muscles produce undulatory waves. These waves pass from the anterior to posterior end of the animal. In Nematodes lack circular muscles. Therefore, they cannot crawl.

## **Lips and skeleton:**

Some nematodes have lips surrounding the mouth. Some species develop spines or teeth on the lips. In others, the lips have disappeared.

## **Sense organs:**

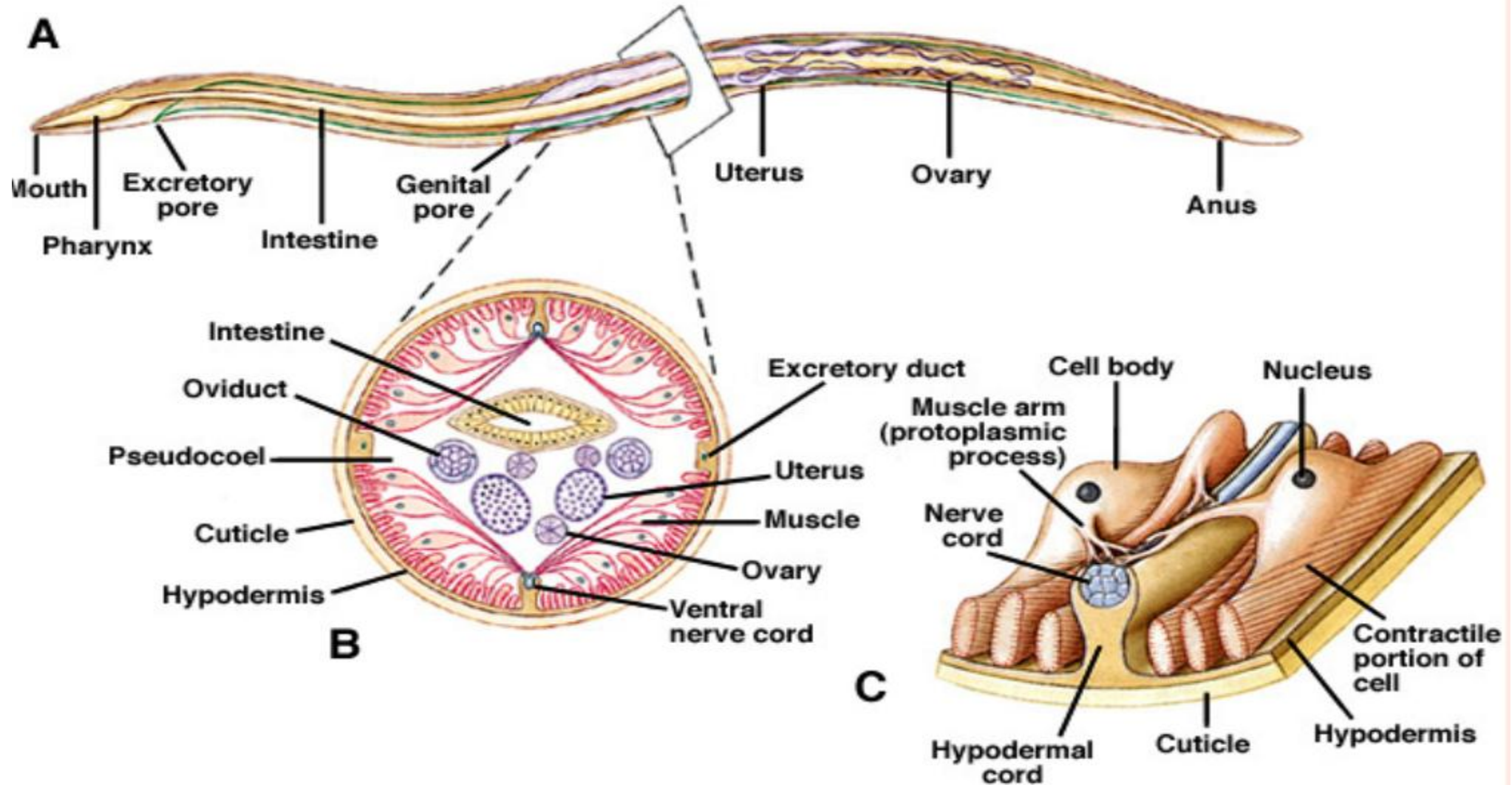
Sensory organs are amphids, phasmids and ocelli.

- **Amphids** are anterior depressions in the cuticle. It contains modified cilia. It functions in chemoreception.
- **Phasmids** are near the anus. It also functions in chemoreception.
- **Paired Ocelli** (eyes) are present in aquatic nematodes.

# INTERNAL FEATURES

- ▶ The pseudocoelom of nematode is a spacious, fluid-filled cavity.
- ▶ It contains visceral organs.
- ▶ It forms a hydrostatic skeleton.
- ▶ The body muscles contracts against the pseudocoelom. Thus fluid generates an equal outward force in all directions. Therefore all the nematodes are round.

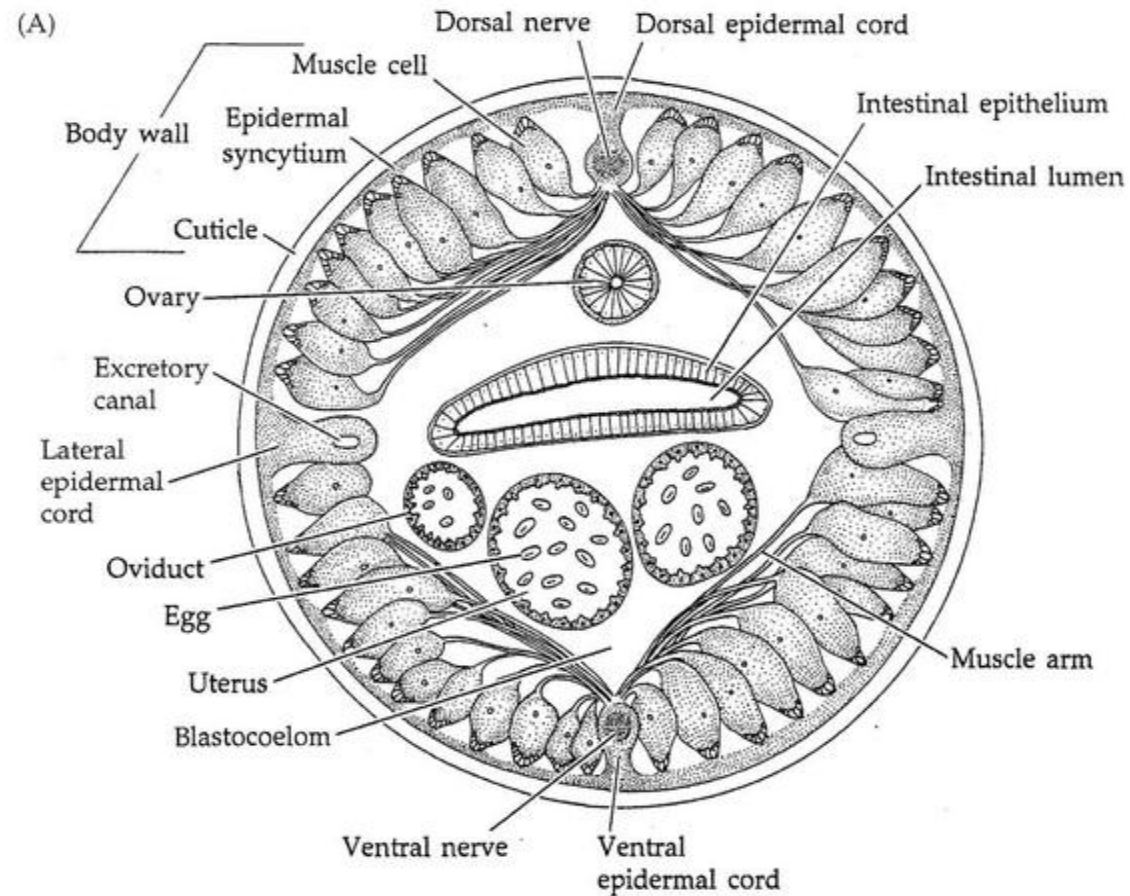
# Structures of a nematode



# OTHER ORGAN SYSTEMS

## Excretion

- ▶ The osmoregulation and excretion of nitrogenous waste products (ammonia, urea) take place by two unique systems.
- ▶ (a) **Glandular system:** It is present in aquatic species. It consists of ventral gland cells called **renettes**. It is present posterior to the pharynx. Each gland absorbs wastes from the pseudocoelom. It opens outside
- ▶ (b) **Tubular system:** Parasitic nematodes have a more advanced system. It is called the tubular system. It is developed from the renette system. In this system, the renettes unite to form a large canal. This canal opens outside through an excretory pore



## Nervous system

- The nervous system consists of an anterior nerve ring. Nerves extend anteriorly and posteriorly. They may connect to each other via **commissures**. Certain neuroendocrine secretions are involved in growth, molting, cuticle formation. and metamorphosis.



# REPRODUCTION AND DEVELOPMENT

- ▶ Most nematodes are dioecious and dimorphic (different shapes).

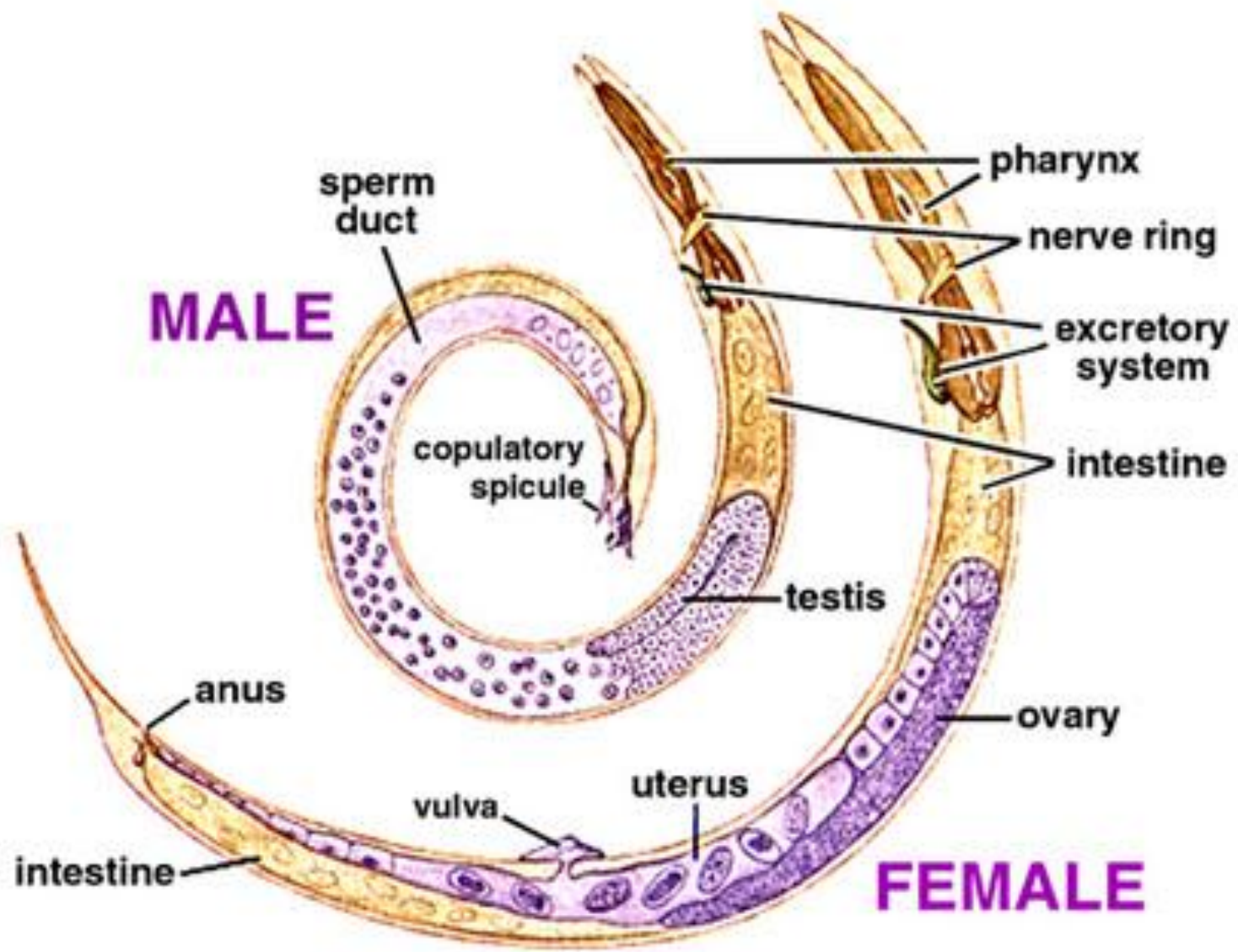
- ▶ **Female reproductive organs**

A pair of convoluted ovaries. Each ovary is continuous with an oviduct. The proximal end of oviduct is swollen to form a seminal receptacle. Each oviduct becomes a tubular uterus. The two uteri unite to form a vagina.

- ▶ **Male reproductive system**

Single testis. Continuous with a vas deferens, which opens into a seminal vesicle. Connected to the cloaca. Males contain a posterior flap of tissue called a bursa. The bursa helps in the transfer of sperm to the female genital pore during copulation.





# FERTILIZATION AND DEVELOPMENT

- ▶ Fertilization takes place during copulation.
- ▶ The hydrostatic forces in the pseudocoelom move each fertilized egg to the gonopore.
- ▶ The number of eggs produced varies with the species.
- ▶ Some nematodes produce only several hundred eggs.
- ▶ But others may produce hundreds of thousands daily.
- ▶ Some nematodes give birth to larvae (ovoviviparity).
- ▶ External factors like temperature and moisture influence the development and hatching of the eggs.
- ▶ Hatching produces a larva.
- ▶ The larva has most adult structures.
- ▶ The larva (juvenile) undergoes four molts.
- ▶ In some species, the first one or two molts may occur before the eggs hatch.

# SOME IMPORTANT NEMATODES PARASITES OF HUMANS

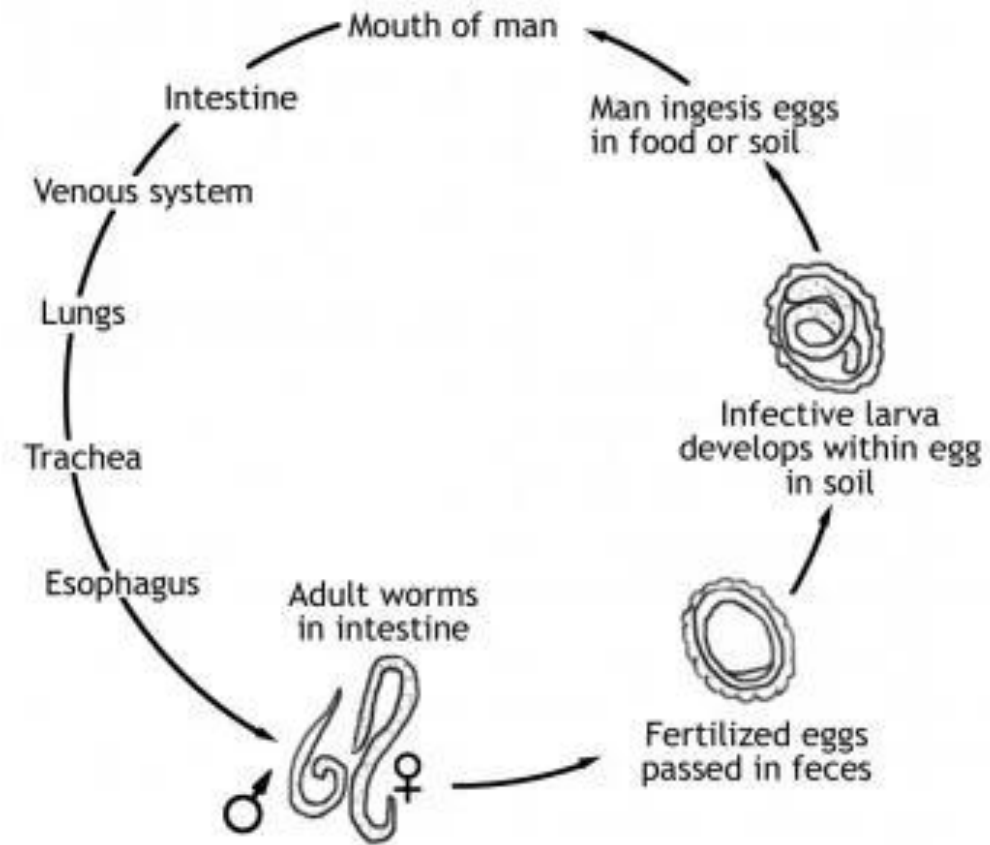
Parasitic nematodes have a number of evolutionary adaptations. These adaptations are:

- ▶ They have high reproductive potential.
- ▶ Their life cycles increase the chance of transmission from one host to another.
- ▶ They develop enzyme resistant cuticle, resistant eggs, and encysted larvae.
- ▶ Only one host is involved in the life cycle of nematodes. Therefore Nematode life cycles are not as complicated like cestodes or trematodes

# Ascaris lumbricoides: The Giant Intestinal Roundworm of Humans

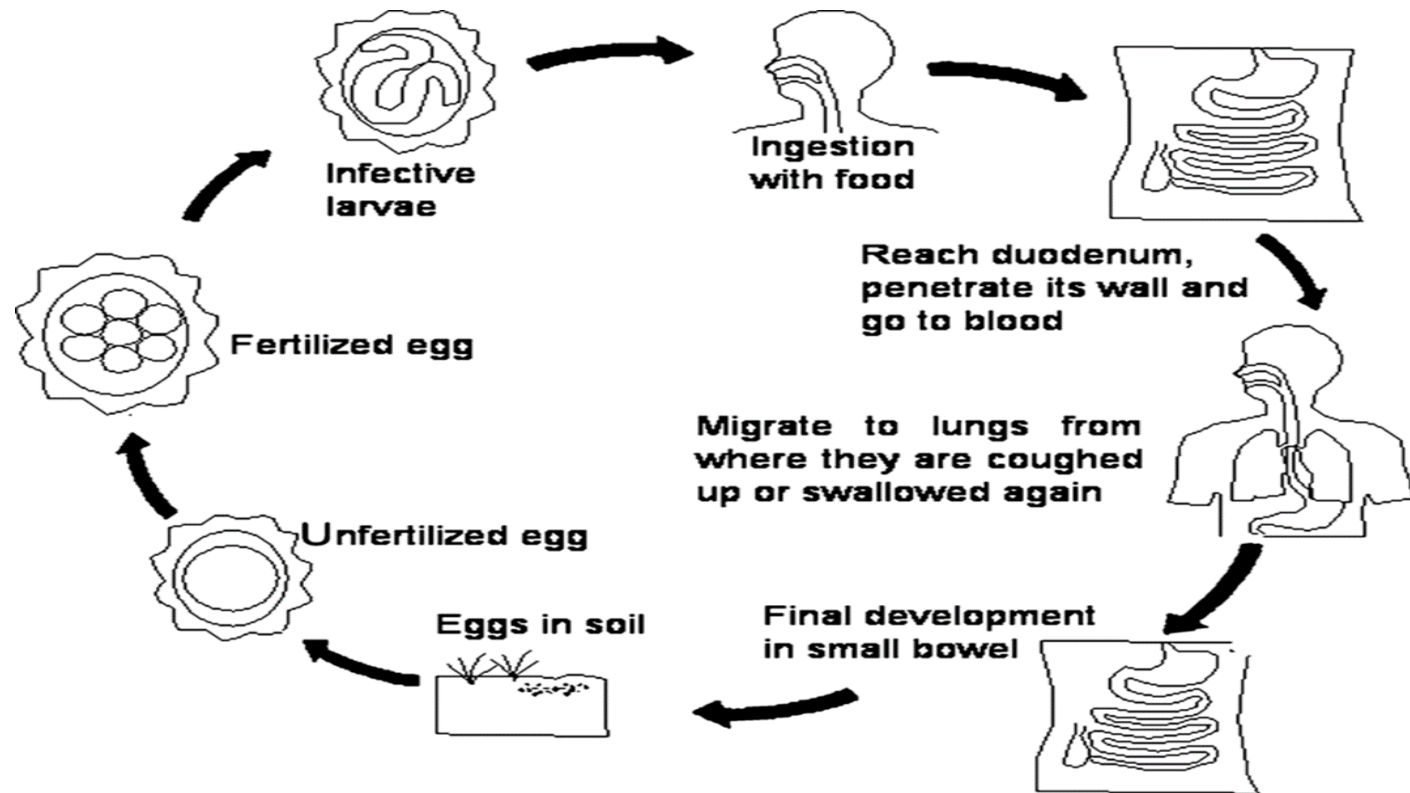
- Approximately 800 million people are infected with Ascaris throughout the world.
- Ascaris live in the small intestine of humans.
- They produce large numbers of eggs.
- These eggs pass out with feces.
- A first-stage larva develops rapidly in the egg.
- It molts and forms second-stage larva.
- Second larva is the *infective* stage.
- Human may ingest embryonated eggs.
- They are hatched in the intestine.
- The larvae penetrate the intestinal wall
- Blood carries it to the lungs.
- They molt twice in the lungs and move up into the trachea, and are swallowed.
- The worms become sexually mature in the intestine.
- It mates and begins egg production.

Ascariasis  
*Ascaris Lumbricoides*



# Enterobius vermicularis

- The Human Pinworm (enteron, intestine + bios, life)
- Pinworms are the most common roundworm parasites in the United States.
- Adult Enterobius present in the lower region of the large intestine. The gravid females move out of the caecum at night.
- It reaches into the perianal area (area around anus).
- They deposit egg there. These eggs develop first stage larva.
- The eggs then fall. The human ingest the eggs and they are hatched.
- The larva molt four times in the small intestine.
- It moves into large intestine.
- Mating takes place between the male and female and again egg production starts.

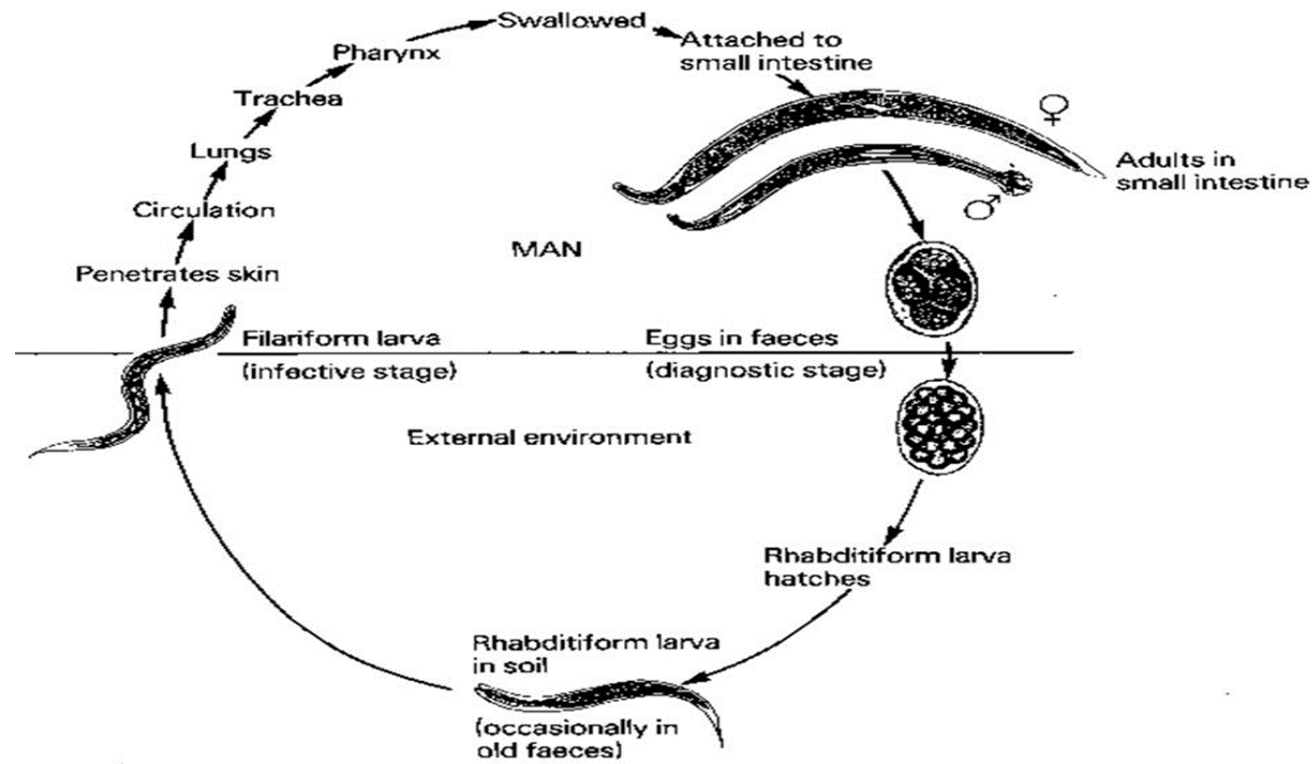


# NECATOR AMERICANS

- The New World or American hookworm, *Necator Americanus* is found in the southern United States. The adults live in the small intestine.
- They hold the intestinal wall with teeth and feed on blood and tissue fluids.
- Female may produce as many as 10,000 eggs daily.
- These eggs pass out of the body with feces.
- An egg hatches on warm and moist soil.
- It releases a small **rhabditiform** larva.
- It molts and becomes the infective **filariform larva**.
- Filariform larva penetrates the human's skin between the toes.
- The larva burrows through the skin.
- It enters into the circulatory system.
- It reaches the small intestine and becomes adult.



## Life cycle of hookworm

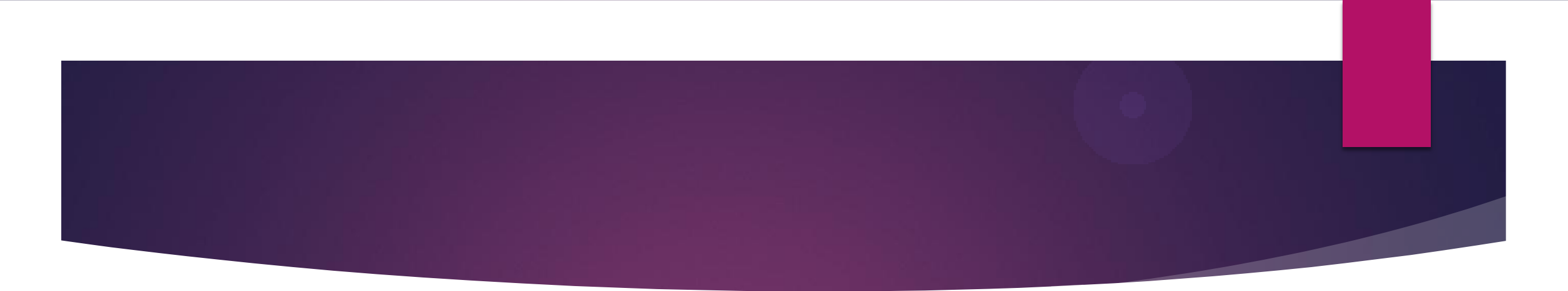


# PHYLUM NEMATOMORPHA

- ▶ **G.R (NEMA=THREAD+MORPHA=FORM)**
- ▶ Phylum Nematomorpha includes a number of threadlike elongated animals belonging to two families: the Nectonematidae and the Gordiidae. They are free-living in sexual phase and are parasitic in asexual stage in the body cavity of Arthropods.
- ▶ The family Gordiidae is exemplified by Gordius (Fig. 15.16A). It is a fresh-water or terrestrial form. The outer surface of the body is covered with a cuticle (Fig. 15.16B). The muscles are made up of epithelio-muscular cells. The body encloses four canal-like cavities—one mid-dorsal, one mid-ventral and two lateral in position. These cavities are separated by parenchymatous partitions.

# STRUCTURE AND BODY FORM

- ▶ Phylum Nematomorpha includes a number of threadlike elongated animals belonging to two families: the Nectonematidae and the Gordiidae.
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- ▶ The body encloses four canal-like cavities—one mid-dorsal, one mid-ventral and two lateral in position
- ▶ These cavities are separated by parenchymatous partitions.

- 
- The alimentary canal is placed in the mid-ventral canal and the lateral cavities contain reproductive apparatus.
  - The nervous system is represented by a greatly thickened pharyngeal nerve ring which is continued posteriorly as a ventral nerve cord.
  - The excretory organs are absent and the sexes are separate.
  - Fertilization is internal
  - Complete degeneration of the alimentary canal is encountered in the sexual stage.

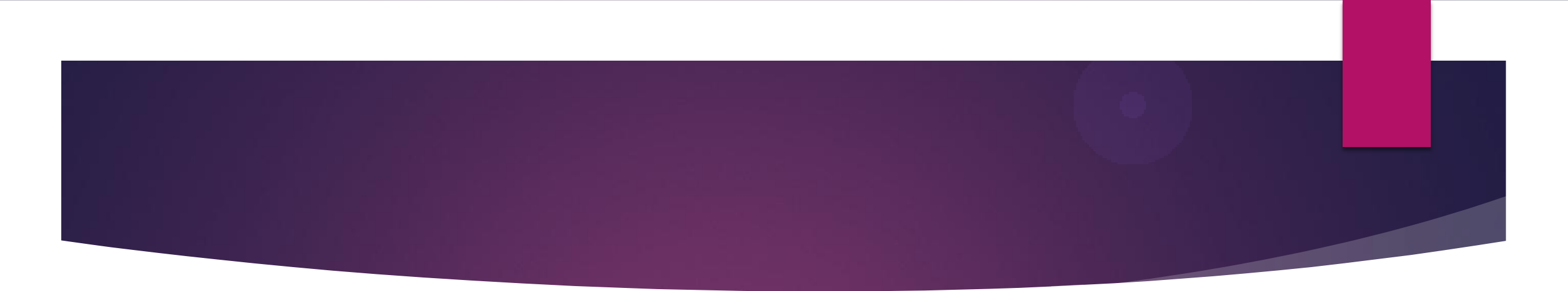
# Taxonomic Retrospect of Phylum

## Nematomorpha:

1. In the earlier years of taxonomy, the zoologist regarded the horse-hair worms (Gordiaceans) as nematodes related to filarioids.
2. Von Siebold (1843) created the class Gordiacea on the basis of morphological studies of previous zoologists and also included Mermis, a nematode with Gordiacea.
3. Vijdovsky created also the name Nematomorpha (for Gordiaceans) and separated from nematodes in 1866.
4. Hyman (1951) included Nematomorpha as a class under the phylum Aschelminthes.

# Characteristic Features of Phylum Nematomorpha

1. Body of Phylum Nematomorpha is long, hair-like, un-segmented and worm-like.
2. Length of the body ranging from 0.5 m to 1.0 m.
3. External collagenous cuticle.
4. Cuticle with small papillae, molted periodically.
5. Absence of locomotory cilia in Phylum Nematomorpha.
6. Presence of only longitudinal body wall muscles

- 
7. Gut reduced, non-functional in adult stage.
  8. Pseudocoel is mostly fluid-filled body cavity and filled with parenchyma.
  9. Circulatory, respiratory and excretory systems are absent in Phylum Nematomorpha.
  10. Nervous system of Phylum Nematomorpha consists of cerebral ganglion with an epidermal midventral nerve cord.
  11. Absence of constancy of cell numbers (eutelic condition).
  12. Sexes gonochoristic (= dioecious).



13. Simple gonads.

14. The sperm ducts open into a cloaca but there are no penial spicules (Fig. 15.16A).

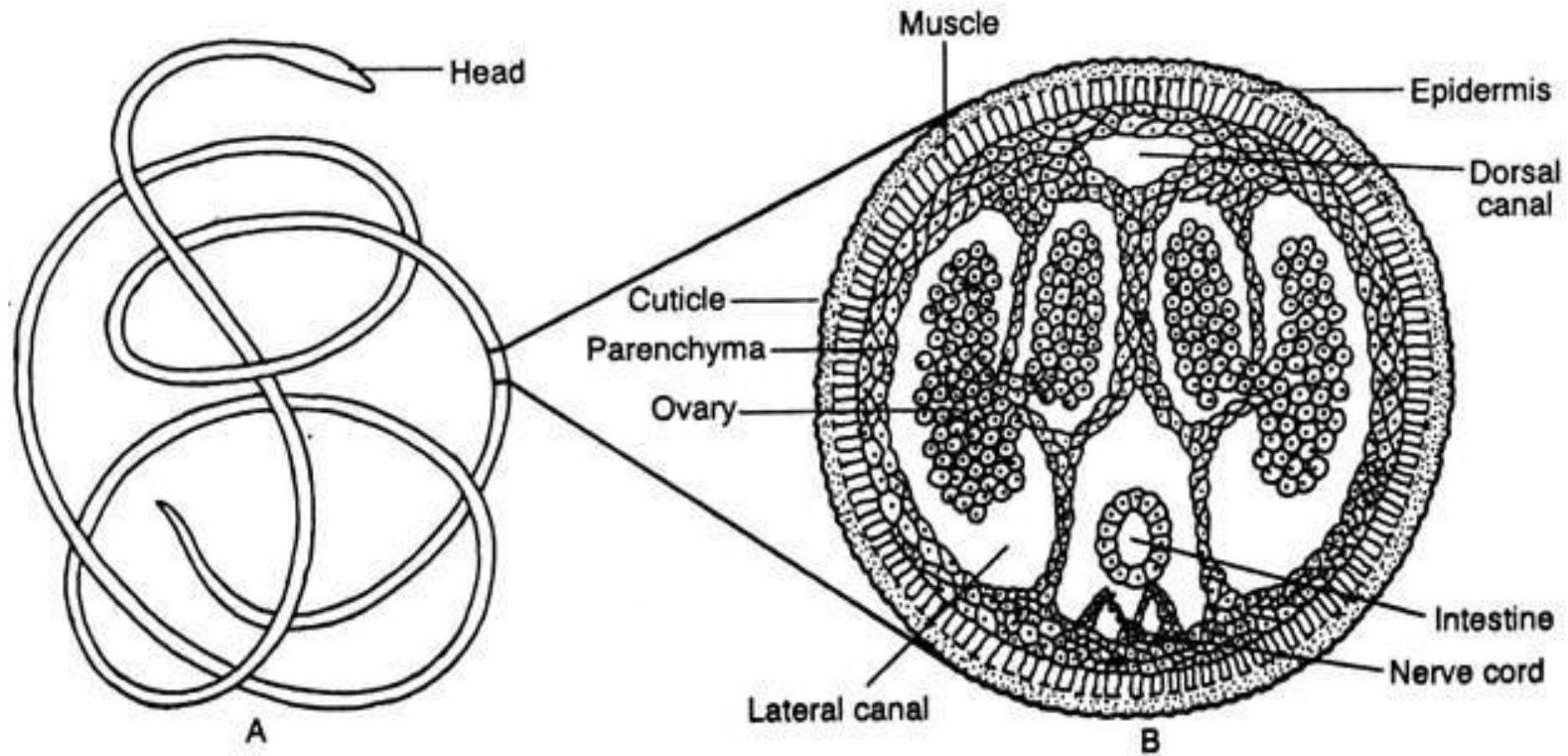
15. Fertilization is internal in Phylum Nematomorpha.

16. Bilateral cleavage pattern.

17. The larvae bear a protrusible proboscis which bears spines

18. Juveniles parasitize arthropods (e.g., crickets, grasshoppers and other insects) but adults are free-living.





**Fig. 15.16:** A. An entire *Gordius*. B. Transverse section of a female *Gordius*.

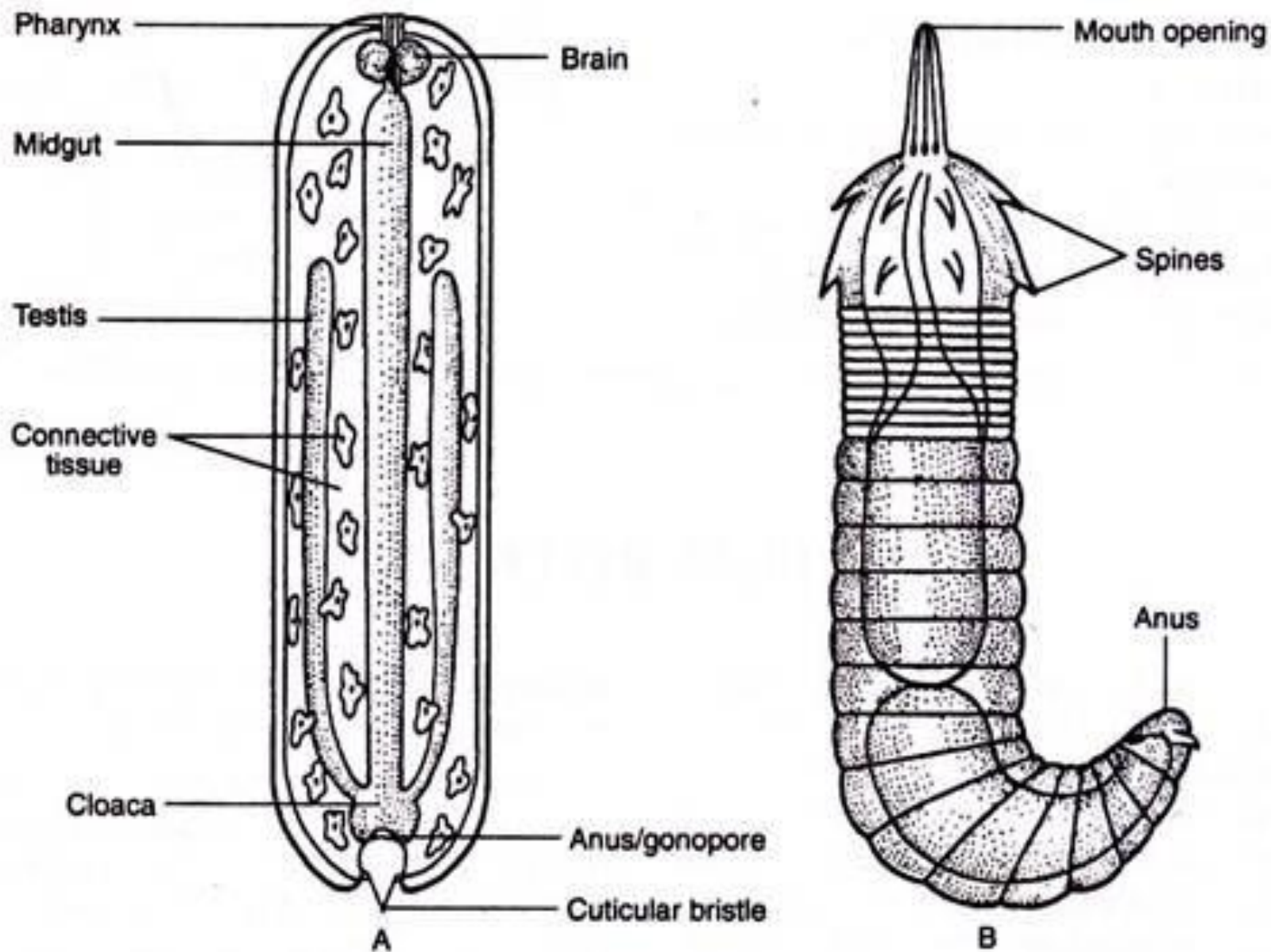


Fig. 15.17: A. Generalized anatomy of *Gordius* (a nematomorph). B. Larva of the gordioid, *Paragordius*.

# PHYLUM KINORHYNCHA

## ***Habitat of Phylum Kinorhyncha:***

- They live in the marine mud or in the interstitial spaces of marine sand.
- They are found in the intertidal zone to the depths of several thousand metres.

## ***Features:***

- ▶ Phylum Kinorhyncha are microscopic, marine animals.
- ▶ Body length of Phylum Kinorhyncha is less than 1 mm.
- ▶ Short, grub-like, segmented with flattened ventral surface.
- ▶ Body of Phylum Kinorhyncha is covered by an external chitinous divisible cuticle.

# Body surface:

- The body surface of kinorhynch is devoid of cilia.
- It is composed of 13 or 14 zonites.
- The head is represented by zonite 1.
- The neck, represented by zonite 2, contain spines called **scalids** and plates called **placids**.
- The trunk consists of remaining 11 or 12 zonites and terminates with anus.
- The pseudocoelom is large and contains amoeboid cells.

# *Digestive and Nervous System:*

- It consists of a mouth, buccal cavity, muscular pharynx, esophagus, stomach, intestine and anus.
- Most kinorhynchs feed on diatoms, algae, and organic matter. A pair of protonephridia is present on zonite 11.
- The **nervous system** consists of **brain** and single ventral nerve cord.

## *Reproduction and Development:*

- Kinorhynchs are dioecious with paired gonads.
- Several spines surround the male gonopore. These spines are used in copulation.
- The young hatch into larvae.
- The larva does not have all of the zonites. As the larvae grow and molt, the adult morphology appears. Molting no longer occurs in adult.



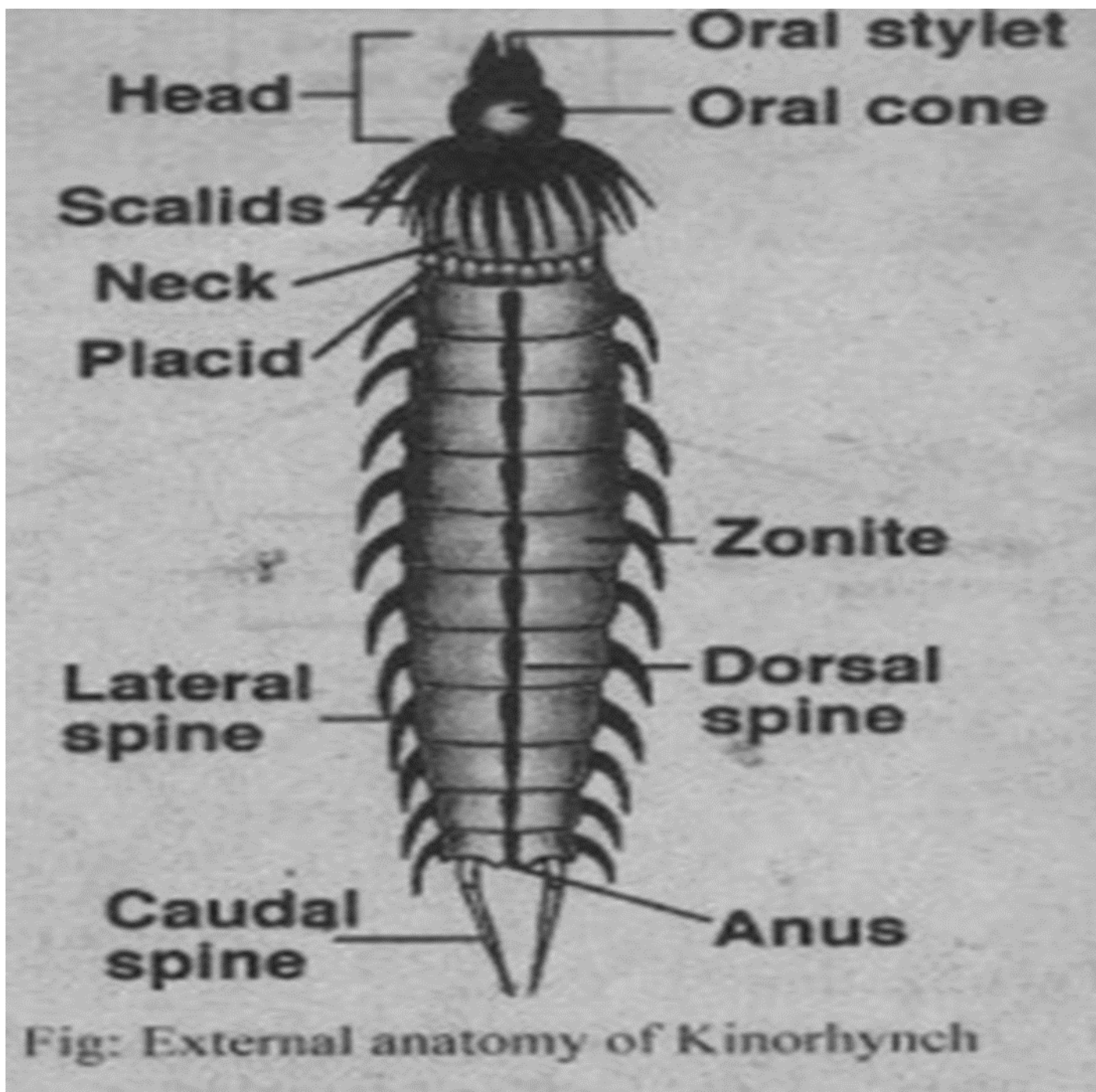


Fig: External anatomy of Kinorhynch

# PHYLUM ACANTHOCEPHALA

- The acanthocephalans or thorny headed worms, occur as endoparasites requiring two hosts to complete the life cycle.
- While the adults live in the digestive tract of aquatic and terrestrial vertebrates, especially fishes, the juveniles on the other hand, are parasitic within crustaceans and insects.
- Most acanthocephalans are white, but some may vary between red and brown in colour.

## ***Features :***

- Body vermiform and bilaterally symmetrical, without segmentation.
- Body more than two cell layer thick, with tissues and organs.
- Epidermis is a thick syncytial epithelium, with a well-developed web of protein filament that support and toughens the integument. Cuticle absent.

# DIGESTIVE SYSTEM AND NERVOUS SYSTEM

- Digestive system is absent in acanthocephalan.
- They absorb food directly through the tegument from the host. Protonephridia may be present.
- The nervous system is composed of a ventral, anterior ganglionic mass.
- Anterior and posterior nerves arise from it.
- Sensory organs are poorly developed.



# Reproduction and Development:

## ***Reproduction:***

- The sexes are separate.
- The male has a protrusible penis.
- Fertilization is internal. Eggs develop in the pseudocoelom.

## ***Development:***

- The eggs pass out of the host with the feces. These eggs must be eaten by certain insects like cockroaches or grubs (beetle larvae). They are also eaten by aquatic crustacean (e.g. amphipods, isopods, ostracocis). The larva emerges from the egg in the host. It is now called an acanthor. It burrows through the gut wall and reaches the hemocoel. It develops into an acanthella in hemocoel. It finally changes into a cystacanth. Mammal, fish or bird eats the intermediate host. The cystacanth comes out of cyst. It attaches to the intestinal wall with its spiny proboscis and develops into adult.

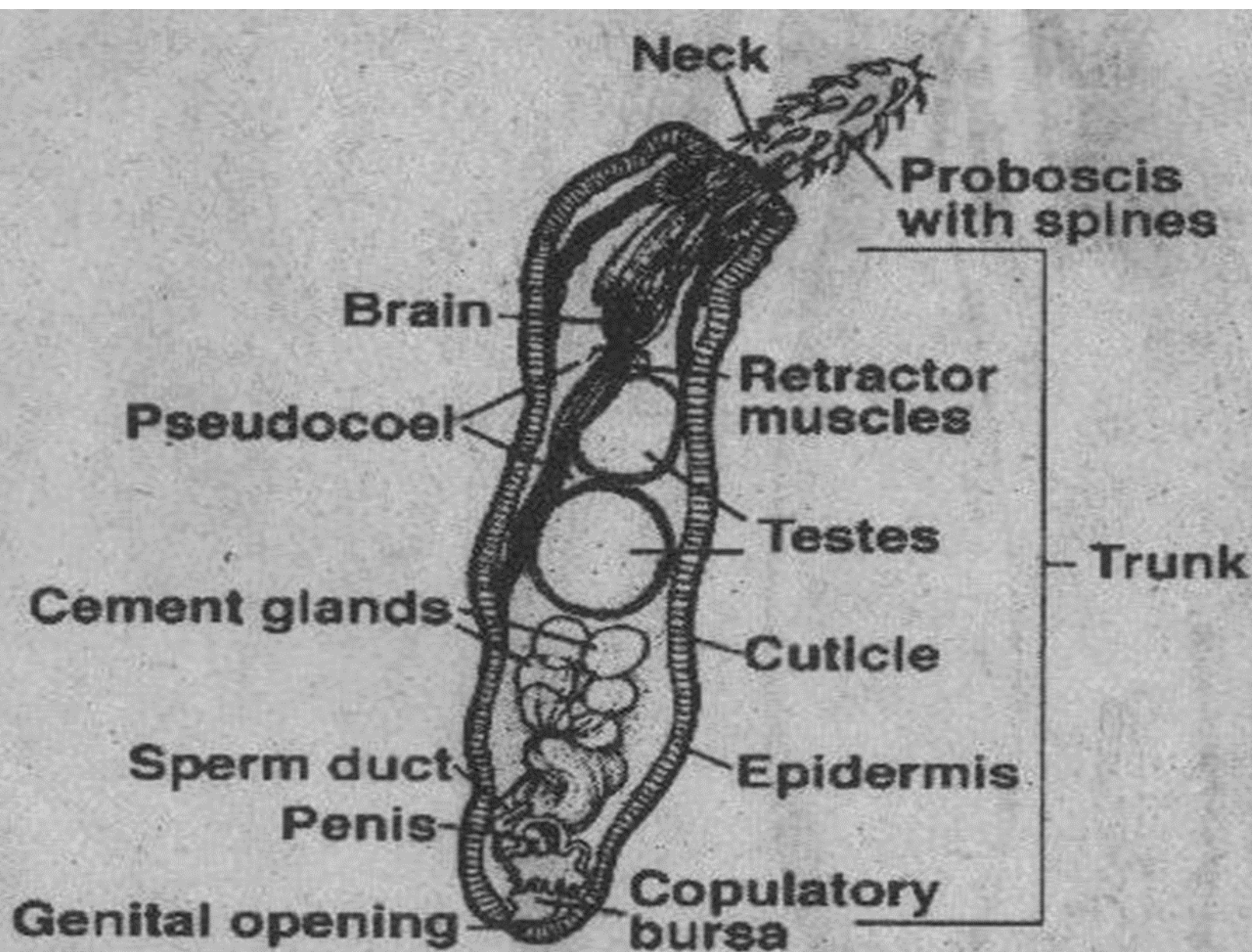


Fig: Phylum Acanthocephala

# PHYLUM LORICEFERA

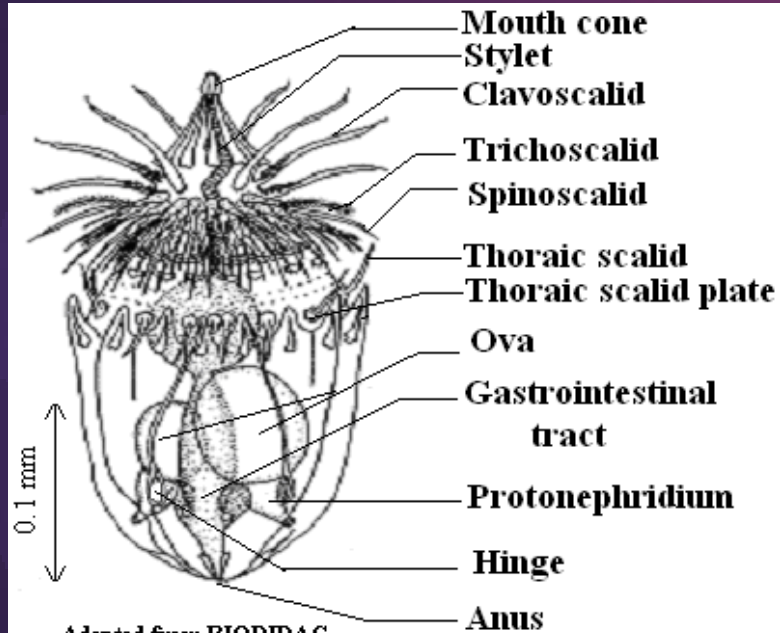
## ▶ Introduction to Phylum Loricifera:

- ▶ Loricifera, described by the Danish zoologist, R. M. Kritensen in 1983, is by far the most recently discovered phylum.
- ▶ They comprise of minute animals, about 250  $\mu\text{m}$  in length, that lives in the interstitial spaces of shelly, marine gravel at depths from 15 to almost 8300 m.
- ▶ These animals adhere so firmly to the gravel substrate that they cannot be removed easily, which probably accounts for their late discovery.

# MORPHOLOGY

- ▶ The animals have a head, mouth and digestive system as well as a lorica.
- ▶ The armor-like lorica consists of a protective external shell.
- ▶ There is no circulatory system and no endocrine system.
- ▶ Many of the larvae are acoelomate, with some adults being pseudocoelomate, and some remaining acoelomate.
- ▶ The animals have two sexes as adults.

# MODE OF LOCOMOTION



Adapted from BIODIDAC  
Illustrator by Livingston

- ▶ Animals move by extending anterior end allowing scalids, spines that look like an umbrella skeleton, catch on substrate.

# HABITAT

- ▶ All known loriciferan species are microscopic (80–800  $\mu\text{m}$ ) and occur in marine sediments, such as mud, sand, and shell gravel.
- ▶ The most extreme **habitat** for **Loricifera** is the hypersaline anoxic deep basin in the Mediterranean Sea, where members of this phylum are metabolically active.

# DIGESTIVE SYSTEM

- ▶ They have ahead, **digestive system**, as well as a lorica.
- ▶ They are bottom feeders that inhabit sediment **and** mud flats at all depths **and** latitudes of the ocean.

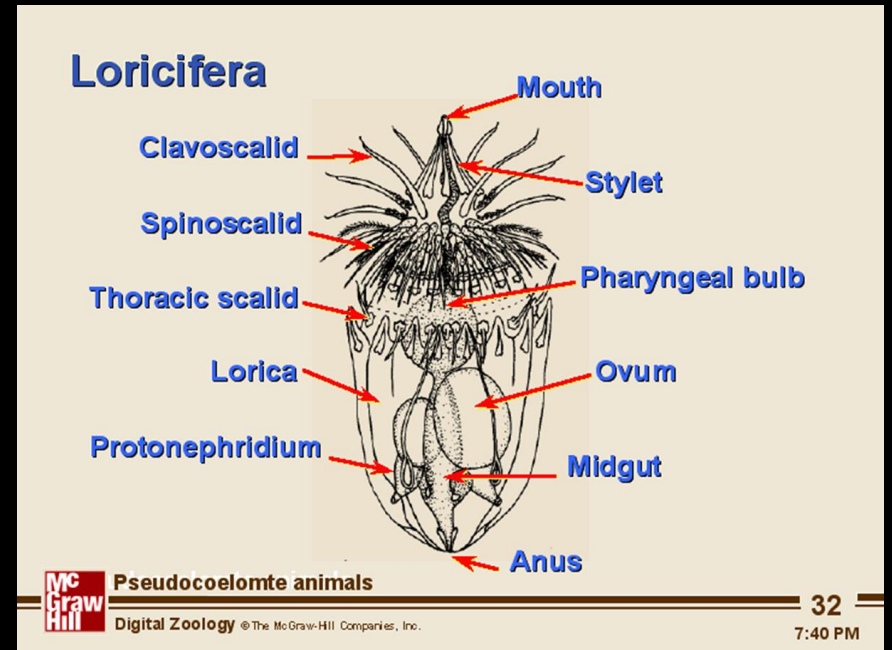
## NERVOUS SYSTEM

- ▶ Their presence inside the gonads is unique to **Loricifera**.
- ▶ In addition to these organ **systems**, the body of **loriciferans** contains a complex muscular **system** as well as a **nervous system** with a large brain and ventral **nerve** cord with ganglia (groups of **nerve** cells located outside the brain).



# REPRODUCTION

- ▶ **Loricifera** have very complicated life cycles with both sexual and asexual forms of **reproduction**.



# PHYLUM PRIAPULIDA

## INTRODUCTION

- ▶ Priapulida (pri´a-pyu´li-da) (Gr. *priapos*, phallus, + *ida*, pl. suffix) are a small group (only 18 species) of marine worms found chiefly in colder waters of both hemispheres.

## HABITAT

- ▶ They have been reported along the Atlantic coast from Massachusetts to Greenland and along the Pacific coast from California to Alaska.
- ▶ They live in mud and sand of the sea floor and range from intertidal zones to depths of several thousand meters.



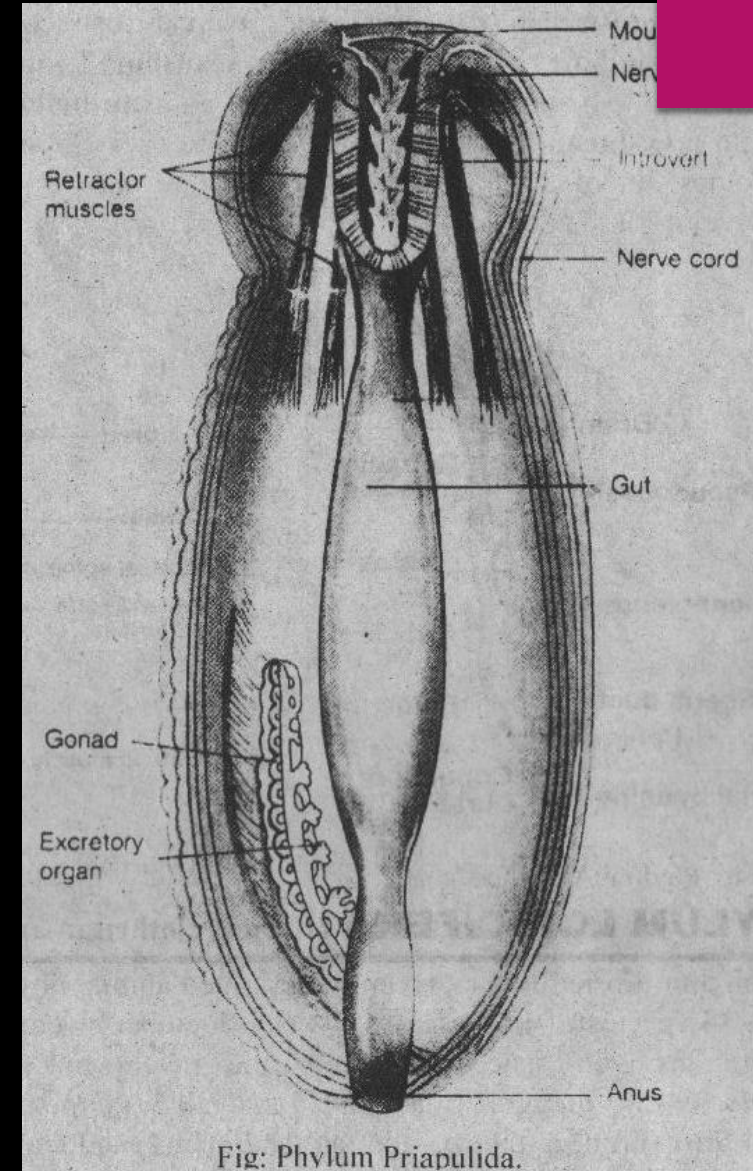
# MORPHOLOGY

- ▶ Priapulids are cylindrical worm-like animals, ranging from 0.2–0.3 to 39 centimetres ( 0.08–0.12 to 15.35 in) long, with a median anterior mouth quite devoid of any armature or tentacles.
- ▶ The body is divided into a trunk or abdomen and a somewhat swollen proboscis region ornamented with longitudinal ridges.

## MODE OF LOCOMOTION

The presoma, or anterior end of the body, with the mouth at the tip, can be retracted into the trunk and is used in **locomotion** as well as in feeding.

- It forms spines on the presoma, especially around the mouth, within the pharynx, and to a lesser degree elsewhere on the body, and it molts as the worm grows to an adult.



# DIGESTIVE SYSTEM

- The alimentary canal is straight, consisting of an eversible pharynx, an intestine, **and** a short rectum.
- The pharynx is muscular **and** lined by teeth.
- The anus is terminal, although in Priapulus one or two hollow ventral diverticula of the body-wall stretch out behind it.

# NERVOUS SYSTEM

- The **nervous system** consists of a **nerve** ring around the pharynx and a prominent cord running the length of the body with ganglia and longitudinal and transversal neurites consistent with an orthogonal organization.

## **REPRODUCTION:**

- The sexes are separate.
- A pair of gonads is suspended in the pseudocoelom.
- It shares a common duct with the protonephridia.
- The duct opens near the anus and gametes are shed into the sea.
- Fertilization is external.

