

“Education for Knowledge, Science and Culture”

-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's

VIVEKANAND COLLEGE KOLHAPUR (EMPOWERED AUTONOMOUS)

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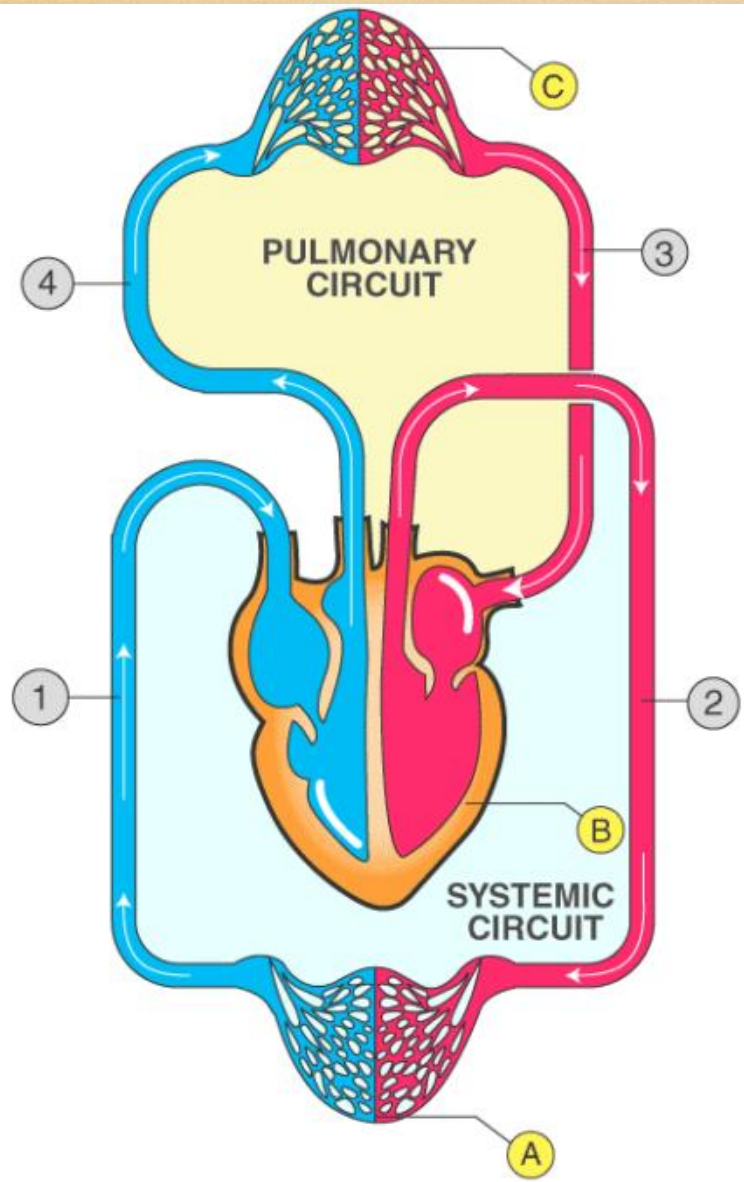
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Double Circulation & Cardiac Cycle

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Double Circulation



-
- ① Vena cava from body
 - ② Aorta to body
 - ③ Pulmonary vein from lungs
 - ④ Pulmonary artery to lungs
-

- Ⓐ Capillaries of body organs apart from the lungs
 - Ⓑ Heart
 - Ⓒ Lung capillaries
-

Pulmonary & systemic circulation-

- Human heart is four chambered & shows double circulation.
- Is "Starting from any body part & before reaching it again blood passes twice from the heart, it called as double circulation."
- In double circulation blood flows in two different routs as pulmonary & systemic circulation.

A) Pulmonary circulation-

- 1) "The flow of blood from right ventricle to left atrium via, lungs is called as pulmonary circulation
- 2) The right ventricles pump the deoxygenated blood in pulmonary arteries
- 3) The pulmonary arteries carry the deoxygenated blood towards the lungs for purification.
- 4) In lungs the purification of blood occurs & the blood becomes oxygenated.
- 5) The oxygenated blood from lungs is carried toward the left atrium by four pulmonary.
- 6) Thus pulmonary circulation occurs between heart & lungs

Portal Circulation-

The portal vein drains almost all of the blood from the digestive tract and empties directly into the liver. This circulation of nutrient-rich blood between the gut and liver is called the portal circulation. It enables the liver to remove any harmful substances that may have been digested before the blood enters the main blood circulation around the body—the systemic circulation.

b) Systemic circulation-

- 1) "The flow of blood from left ventricle to right atrium via body parts (except lungs) is called as pulmonary circulation
- 2) The left ventricles pump the oxygenated blood in aorta
- 3) The aorta carries the oxygenated blood towards the body parts (except lungs)
- 4) In body parts the oxygen is taken from blood & CO₂ is added in blood, blood become deoxygenated.
- 5) The deoxygenated blood from body parts is carried toward the right atrium by superior, inferior vena cava & coronary sinus
- 6) Thus systemic circulation is occur between heart & body parts except lungs

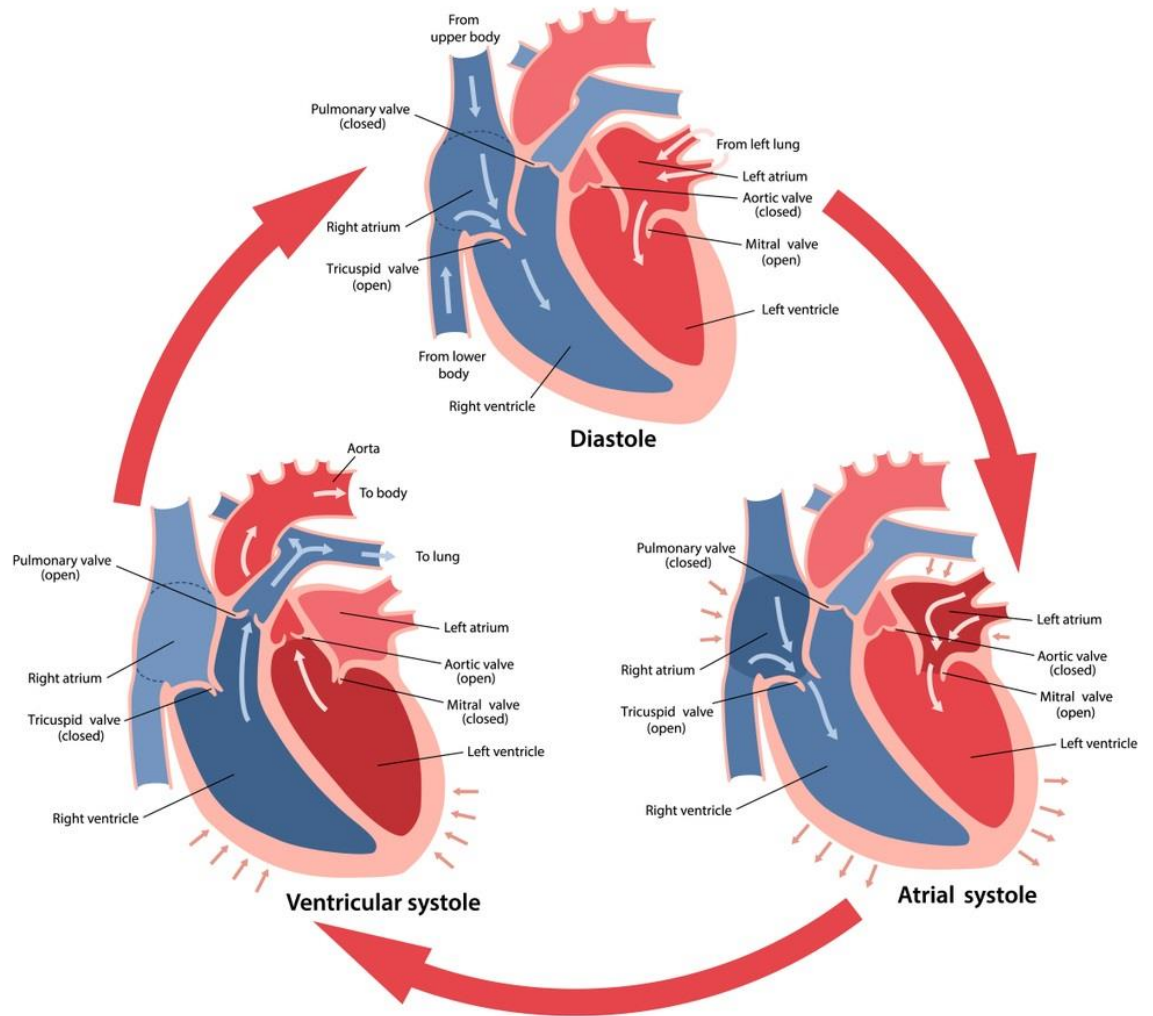
CARDIAC CYCLE

- Definition -The cardiac cycle is defined as a sequence of alternating contraction and relaxation of the atria and ventricles in order to pump blood throughout the body. It starts at the beginning of one heartbeat and ends at the beginning of another.
- Heart acts as a pumping organ
- It shows rhythmic contraction & relaxation
- **Systole**-Contraction of heart muscles is called as systole.
- **Diastole**-Relaxation of heart muscles is called as diastole.
- **Heart beat** - Rhythmic contractions and relaxations are brought about by cardiac muscles. It is known as heart beat.
- Heart beats for about 70-72 times per minute in human adult.
- Each heart beat lasts for 0.8 seconds.
- Each heart beat includes atrial systole, ventricular systole & joint diastole.

a) Atrial systole :

- 1) Contraction of atria is called as atrial systole
- 2) When atria are in relax state they are filled with blood.
- 3) Then SA node produces electrochemical impulses
- 4) These waves spread throughout wall of atria so both atria contracts simultaneously.
- 5) During atrial systole they pour blood in respective ventricles.
- 6) The deoxygenated blood from right atrium enters in right ventricle through right atrio ventricular aperture
- 7)The oxygenated blood from left atrium enters in left ventricle through left atrio-ventricular aperture.
- 8) The back flow of blood is prevented by tricuspid & bicuspid valves.
- 9) The atrial systole lasts for 0.1 seconds.

Cardiac cycle



10) Atrial contraction is followed by atrial diastole.

11) During atrial diastole, atria received blood from superior vena cava, inferior vena cava and lungs.

12) Atrial diastole lasts for 0.7 seconds.

b) Ventricular systole:

- 1) Contraction of ventricles is called as ventricular systole.
- 2) The electrochemical waves produced by SA node are received by AV node & transmitted towards bundle of Hiss. Then from bundle Hiss to Purkinje fibres.
- 3) Due to these impulses both the ventricles contract simultaneously
- 4) Ventricular contraction begins at the apex of the heart.
- 5) Ventricular systole lasts for 0.3 sec.
- 6) When ventricles contract they pump the blood in respective arteries.
- 7) Deoxygenated blood from right ventricle pumped in pulmonary aorta, which carries it towards lungs for purification.

- 8) Oxygenated blood from left ventricle pumped in systemic aorta, which supplies it to whole body parts.
- 9) During ventricular systole. bicuspid and tricuspid valves close to prevent backward flow of blood in atria.
- 10) Closing of the bicuspid & tricuspid valves produces first heart sound called **lubb**. It is louder and lasts for longer period.
- 11) At the end of ventricular systole, ventricles relax Le ventricular diastole which lasts for 0.5 seconds.
- 12) In order to prevent backward flow of blood from great arteries, semilunar valves close sharply and produce second heart sound called dup dubb (diastolic sound). It is less louder.
- 13) Sometimes in heart patients abnormal heart sound is produced due to leakage of blood. Defective valves cause hissing sound called heart murmur.

c) Complete or joint diastole:

- 1) In this phase both atria and ventricles are in relaxed state
- 2) Blood from great veins flows into atria and new cardiac cycle begins
- 3) Right atria filled with deoxygenated blood brought from all body parts by superior vena cava, inferior vena cava & coronary sinus
- 4) Left atrium filled with oxygenated blood brought from lungs by pulmonary veins
- 5) Joint diastole lasts for 0.4 second

Blood vessels of heart

- 1) **Superior vena cava or pre caval vein:-** It brings deoxygenated blood from head & upper region of the body & opens into right atrium.
- 2) **Inferior vena cava or post caval vein:-** It brings deoxygenated blood from lower region of the body & opens into right atrium.
- 3) **Four Pulmonary veins:-** Transport oxygenated blood from lungs to left atrium.
- 4) **Pulmonary artery/pulmonary trunk:-** Transport oxygenated blood from right ventricle to lungs
- 5) **Great Aorta / Systematic aorta or aortic arch:-** Arises from the left ventricle & carries oxygenated blood to different parts of body.
- 6) **Coronary arteries:-** The left & right coronary arteries, arise from the base of aorta & provide oxygenated blood to wall of heart
- 7) **Coronary veins:-** The left & right coronary veins collect deoxygenated blood from wall of heart & returned to the right atrium through coronary sinus.

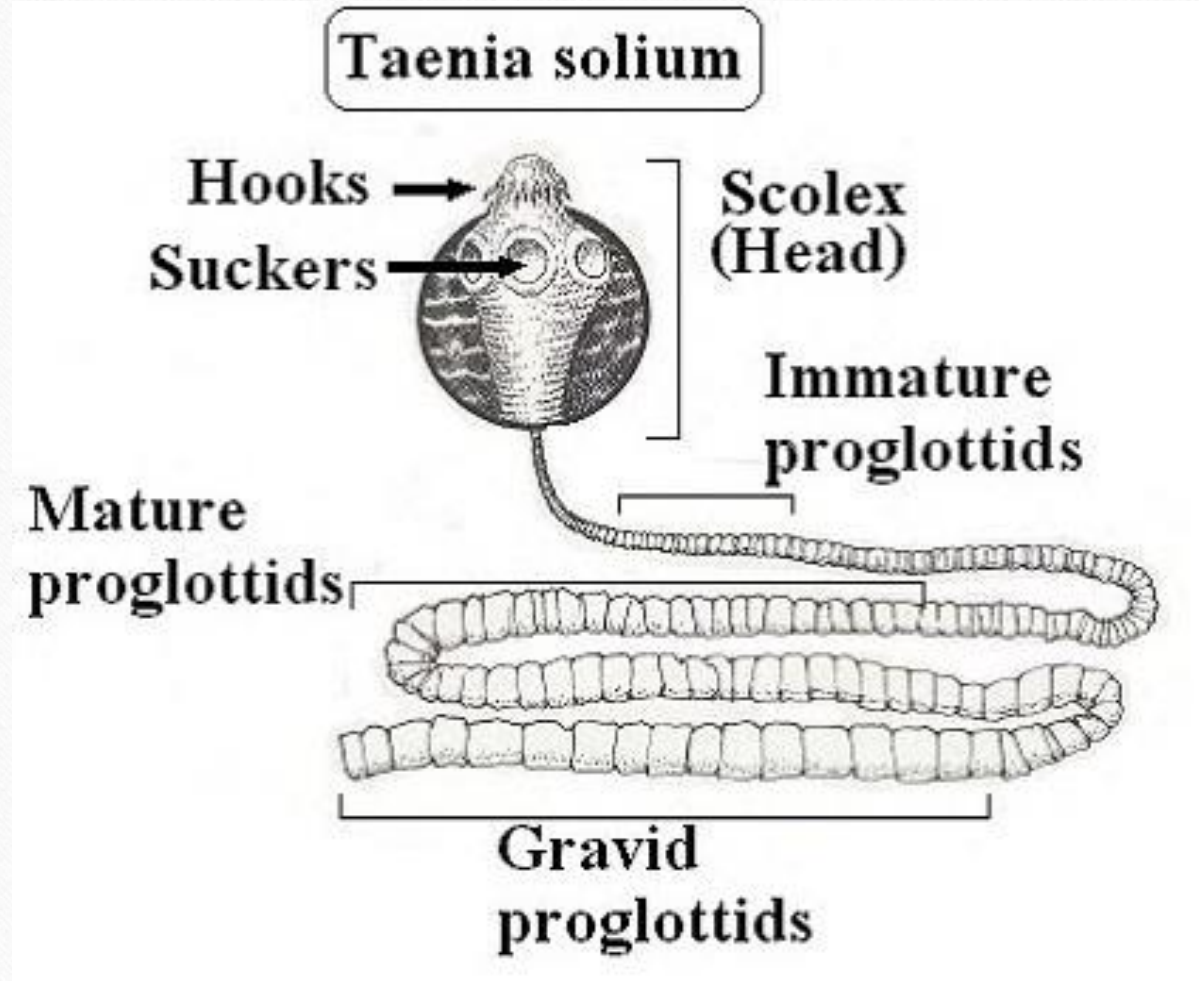
LIFE CYCLE OF TAENIA SOLIUM

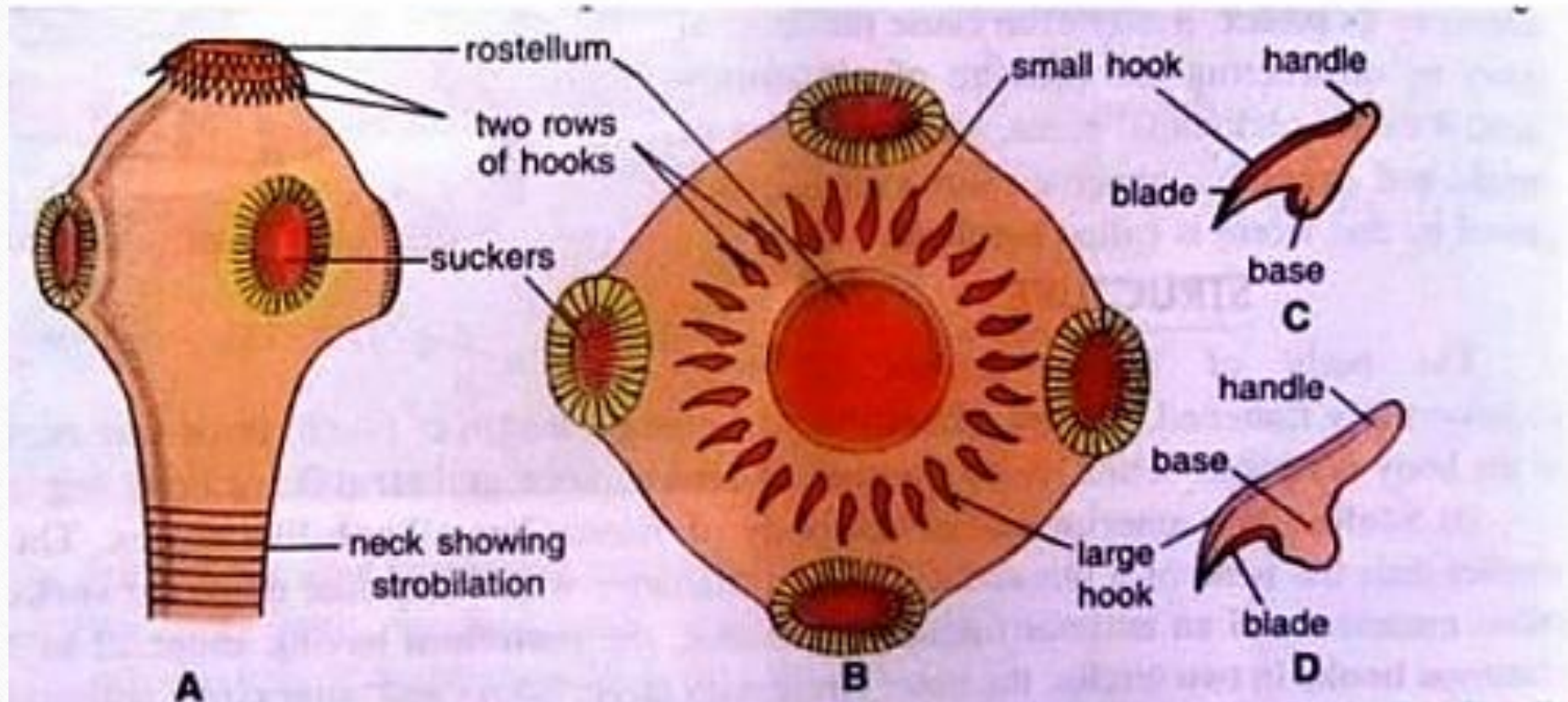
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Two Species of *Taenia* : 1) *Taenia solium*
2) *Taenia Saginata*

Adult worm:

- Adult *Taenia solium* is a flattened ribbon like tapeworm that is white in color.
- The adult worm measures about 2-3 meters in length.
- The body of parasite can be divided into 3 parts:- Head (Scolex), neck and body (strobila)





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

i. Scolex (Head):

- It measures 1 mm in diameter, about the size of a pin head.
- It is globular in shape and has 4 circular suckers.
- The head is provided with a rostellum armed with a double row of alternating large and small hooklets (130-180mm long).
- The presence of hooklets gave its name armed tape worm.

ii. Neck:

- The neck is short measuring 5-10 mm in length.

iii. Body (Strobila):

- The body or Strobila consists of segments or proglottids.
- The total number of proglottids are about 800-900.
- The proglottids may be immature, mature or gravid.
- The gravid segment measures 12 X 6 mm in diameter and looks grayish-black and transparent when fully developed.
- The worm is hermaphrodite and each segment containing both male and female reproductive organs.
- The common genital pore is marginal, thick-lipped and is situated near the middle of each segment alternating between the right and left side.

- Testes consists of 150-200 follicles. An ovary is two in number
- The gravid consists of a median longitudinal stem of uterus having 7-13 branches on each side of the segment.
- Uterus is completely filled with eggs and each gravid consist nearly 30,000-50,000 eggs.
- The gravid segment are expelled passively, in chains of 5 to 6 at a time and not singly.

Life cycle of *Taenia solium*:

The life cycle is completed in two hosts:

Definitive host: Human

Intermediate Hosts: Pig, occasionally human

- Humans acquire infection by ingestion of inadequately or improperly cooked pork infected with cysticerci.
- Inside the alimentary canal of man the scolex on coming in contact with bile evaginates and anchor to the gut wall with its hooks and suckers.
- The larvae develops into an adult worm by gradual strobilisation.

- The worm grows to sexual maturity in 2-3 months and start producing eggs which are then passes in the faeces along with the gravid segments.
- The pig gets infection by ingestion of eggs or gravid proglottids passed in human faeces.
- In the intestine of pig, the oncospheres hatch out of eggs.

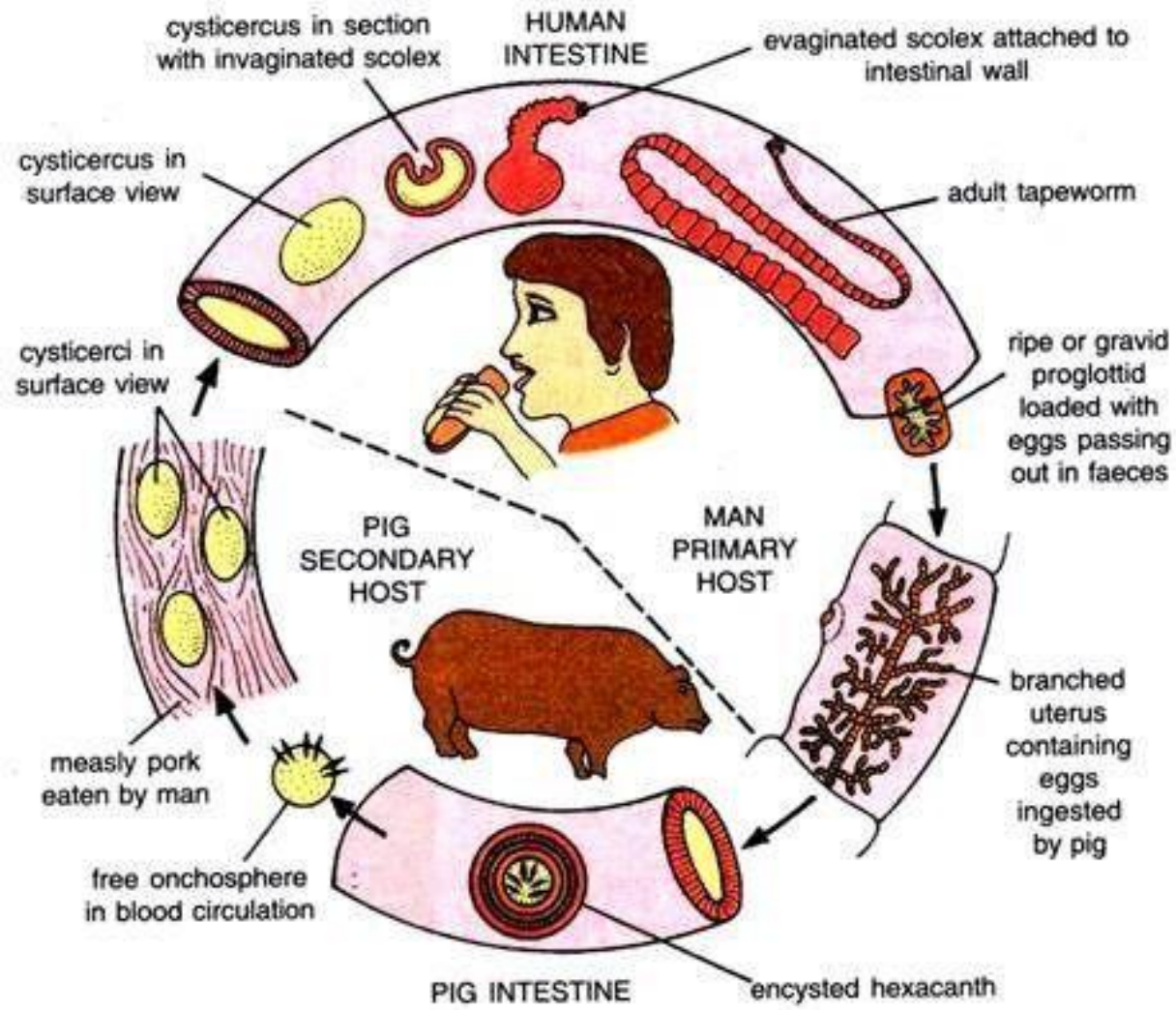


Fig. 42.15. *Taenia solium*. Diagrammatic life cycle.

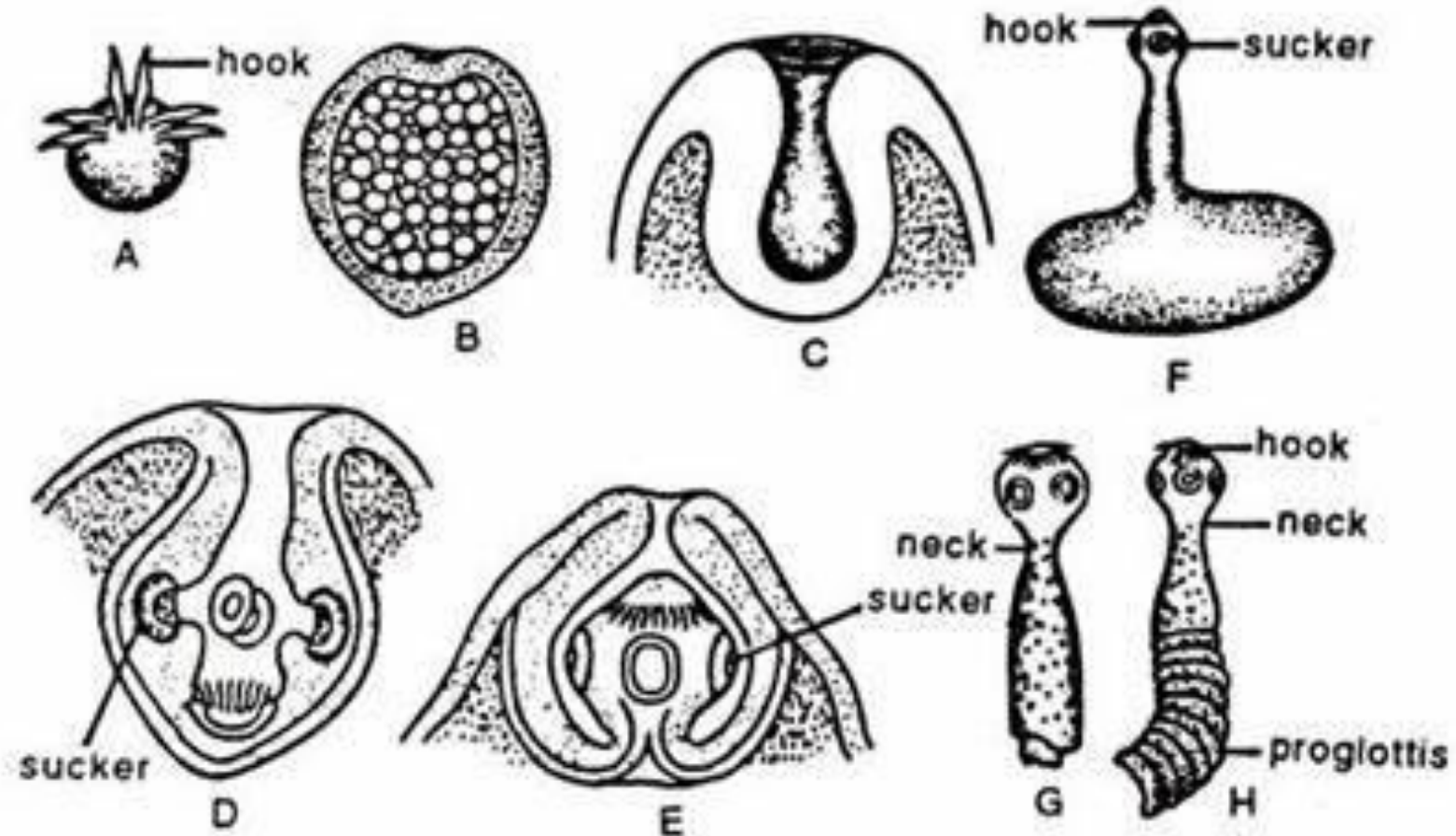


Fig. 22.14. *Taenia solium*. Life cycle.

A. An onchosphere (Hexacanth embryo). B. Bladder-like stage. C. Early invagination. D. Appearance of hooks and suckers. E. A Cysticercus. F. A Cysticercus with evaginated scolex. G. Scolex with remains of bladder. H. Anterior end of a young *Taenia*

- They attach to the intestinal mucosa by hooks, penetrate the gut-wall and gain entrance into the portal vessels or mesenteric lymphatic, finally reaching the systematic circulation.
- Usually they travel via the portal vein and successively reach the liver, right side of heart, lungs, left side of heart, brain or other tissue with high blood flow.
- The naked onchospheres are filtered out from the circulating blood into the muscular tissue where they ultimately settle down and undergo further development.
- They lose their hooklets, enlarge, and develops into a fluid-filled cyst within a period of 9-10 weeks.
- They remain viable for up to 8 weeks in muscle of pig during which they remain infective for human.

- The new host gets infection by ingestion of the infected meat of pig and the cycle is repeated.
- Occasionally humans get infection by eating food or drinking water contaminated with eggs.
- On ingestion, the onchospheres are released from the eggs in the intestine. These larva invade the intestinal mucosa and are then carried by the circulation to different tissue where they develops into cysts.
- In human most cysts are produced in the CNS, skeletal muscles, eye and subcutaneous tissue giving rise to a condition called **cysticercosis**.

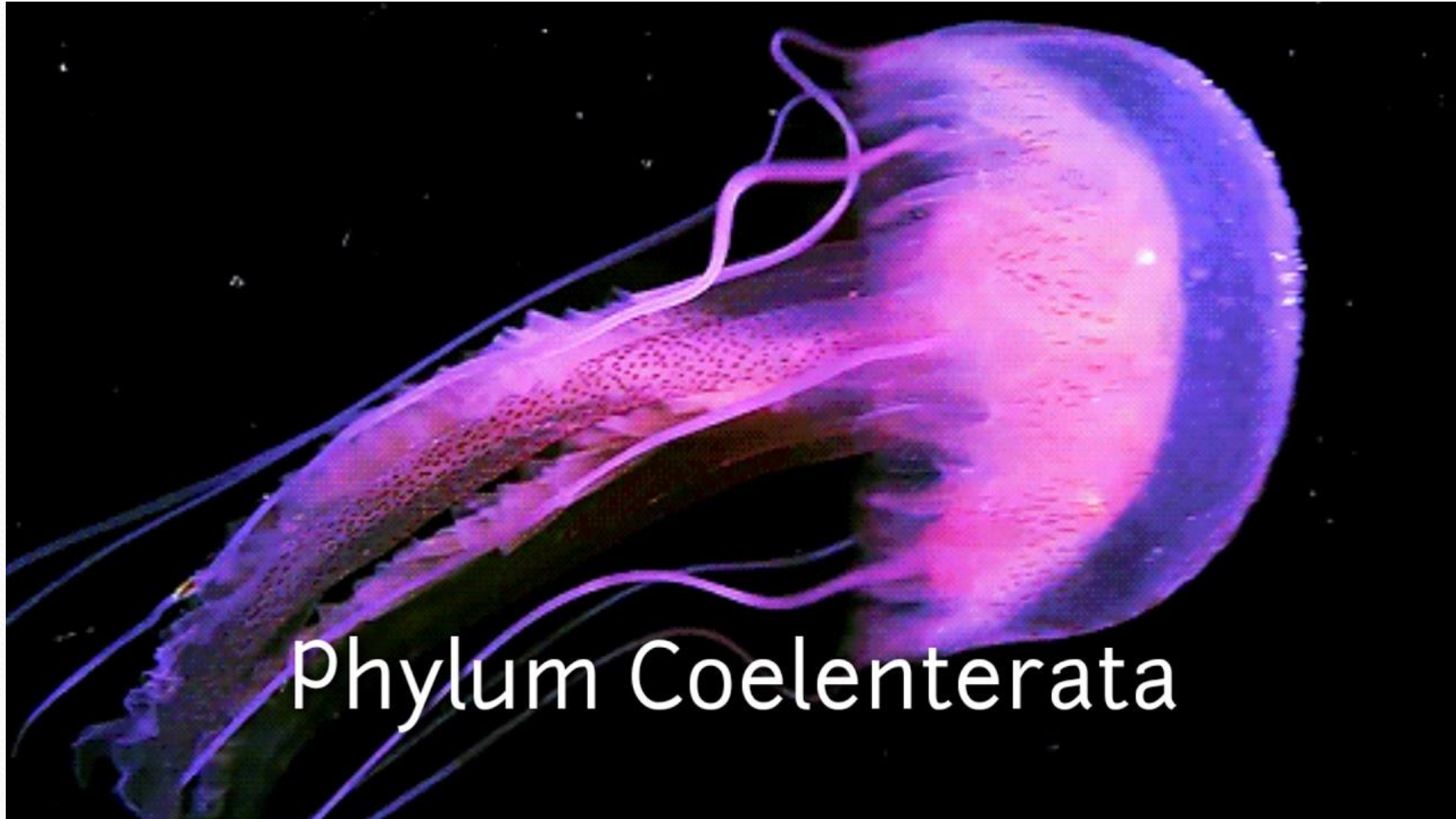
Mode of transmission:

- Ingestion of uncooked pork infected with tape worm.
- Ingestion of food and water contaminated by the eggs present in the infective faeces of a *Taenia* carrier.
- Endogenous auto infection: Anus-hand-mouth transfer of eggs by contaminated hands of person with poor personal hygiene.
- Autoinfection: Reverse peristalsis in which eggs produced by *T. solium* are thrown back to the duodenum, where they hatch and cause tissue infection.

Prevention and control of taeniasis:

- Avoidance of eating raw or insufficiently cooked pork.
- Inspection of pork for cysticerci.
- Proper sanitation facilities.
- Treatment of infected persons.
- Avoidance of eating food contaminated with eggs of *T. solium*

**Contaminated Water and food -hexacanth –Cysticercosis
Through beef and measly pork – cysticercus - taeniasis**



Phylum Coelenterata

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PHYLUM

Coelenterata

CLASS

Hydrozoa

Scyphozoa

Anthozoa

Eg: *Hydra*,
Obelia

Eg: *Aurelia*,
Rhizostoma

Eg: *Metridium*,
Adamsia

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General Character

- 1.Kingdom: Animalia
- 2.Habitat: aquatic, mostly marine.
- 3.Habit: solitary or colonial. Each individual is known as zoid.
- 4.Symmetry: radially symmetrical
- 5.Grade of organization: tissue grade of organization.
- 6.Germ layer: diploblastic, outer ectoderm and inner endoderm. Mesoglea separates these two layer
- 7.The body has a single opening called hypostome surrounded by sensory tentacles.
- 8.gastrovascular cavity or coelenteron is present .

9. Nematocyst: organ for capturing and paralyzing pray, present in tentacles
10. Nutrition: holozoic
11. Digestion is both intracellular and extracellular.
12. Respiration and excretion are accomplished by simple diffusion.
13. Circulatory system: absent
14. Nervous system: poorly develop
15. Many forms exhibit polymorphism i.e. Polyp and medusa
16. Polyps are sessile, asexual stage
17. Medusa are free swimming, sexual stage

Obelia:

Classification

- Kingdom - Animalia
- Phylum - Cnidaria
- Class - Hydrozoa
- Order - Leptothecata
- Family - Campanulariidae
- Genus - *Obelia*

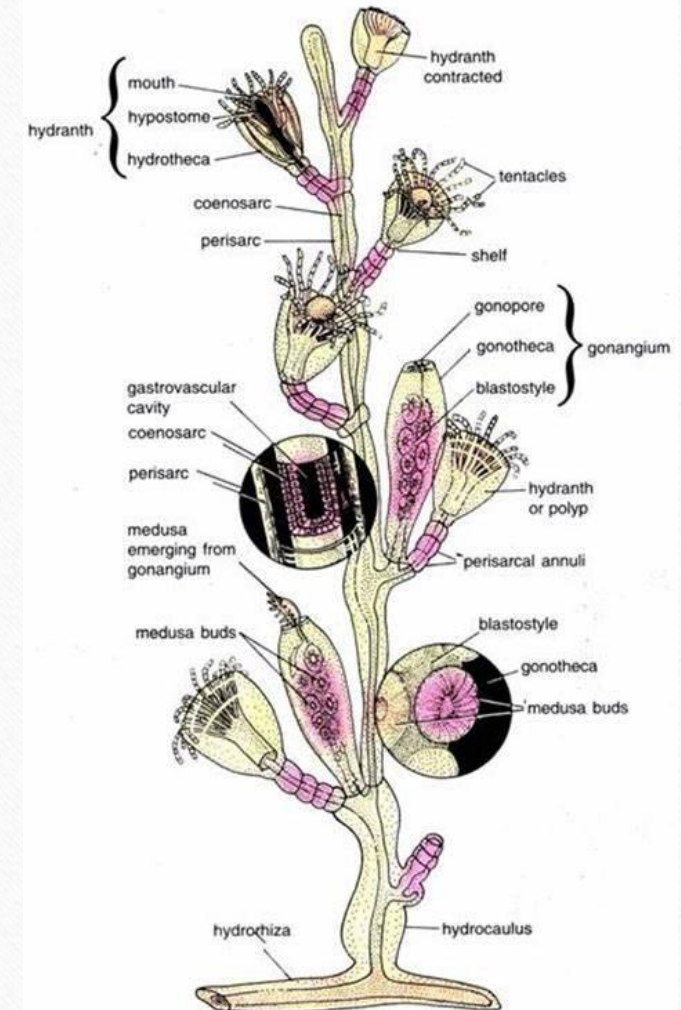


Fig. 32.1. *Obelia*. A portion of colony.

General Characters Of Obelia

1. Obelia is a colonial hydroid.
2. It is trimorphic colony in the form of small sea weed filaments, measuring several centimeters in height. The filaments may be horizontal and vertical.
3. The colony consists of a basal horizontal portion, the hydrorhiza which is attached with the substratum and a number of vertical branches known as hydrocauli arising from hydrorhiza
4. The hydrorhiza and hydrocauli are covered by a chitinous perisarc which encloses soft inner coenosarc.
5. The colony is trimorphic having three types of zooids, e.g., hydranth, blastostyle and medusa.
6. **Hydranth or polyp** has a cylindrical body attached to the axis of the hydrocaulus by its proximal end and free at its distal end. It is covered by cup-shaped hydrotheca. The hypostome is surrounded by a number of solid tentacles provided with nematocysts. It is a nutritive zooid of the colony.

7. **Blastostyle** or reproductive zooid is club-shaped without mouth and tentacles. It is an closed by a covering, gonotheca. It gives rise to buds which later become flattened and develop into small medusae.

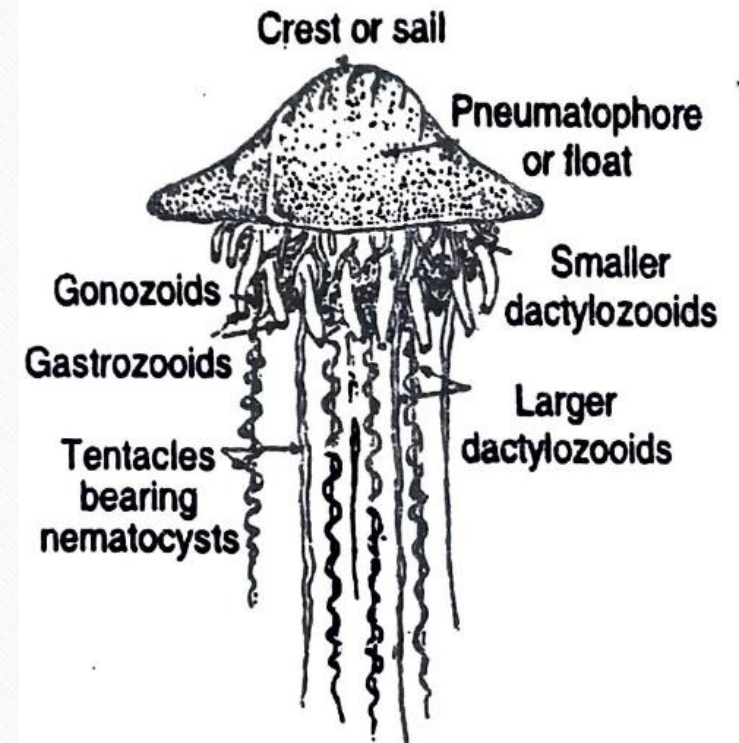
8. **Medusa** is bell-shaped with a concave and a convex side. It is provided with marginal tentacles, four radial canals, a ring canal. The medusae are free-swimming

9. Life history of Obelia exhibits an alternation of generation.

Physalia:

Classification:

Phylum- Coelenterata
Class- Hydrozoa
Order- Siphonophora
Suborder- Physophorida
Genus-Physalia



Fig; Physalia

General Characteristics Of Physalia

- 1 Physalia is a colonial hydroid commonly known as Portuguese man of war.
- 2 Colony has a large pneumatophore or float which is brilliantly coloured as blue or purple.
- 3 The float or pneumatophore is bladder-like, elongated pointed at both the ends, 6 to 12cm long
The upper surface of the float is produced into a crest or sail.
- 4 A gas gland present inside the float secretes a gas of a composition similar to air This helps the animal in floating over the surface of water.
- 5 The swimming bells or nectocalyces are absent.
6. Colony exhibits remarkable polymorphism and the phenomenon of division of labour.
7. Beneath the float are hanging down the three types of zooids and tentacles.

i) **Gastrozooids** are simple polyps with mouth but without tentacles. These are nutritive in function.

ii) **Dactylozoid** are of two types, large as well as small. These are provided with tentacles bearing numerous nematocysts. These catch the fishes and other prey, etc.

iii) **Gonozooids** are branching blastostyles bear clusters of medusae. Male medusae are reduced and remain attached. Female medusa are free swimming tentacles bearing nematocysts

8. Tentacles are large and bear stinging batteries or nematocysts to kill the large fishes and prey.

Habit and habitat. Physalia is a marine, colonial, swimming or floating pelagic animal.

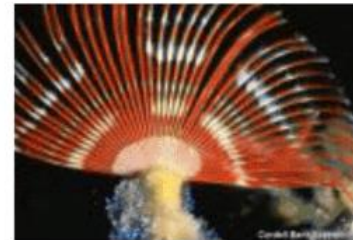
Distribution. Physalia is found in tropical and subtropical seas.



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Phylum Annelida

the segmented worms



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PHYLUM

Annelida

CLASS

Polychaeta

Eg: *Nereis*,
Arenicola,
Chaetopterus

Oligochaeta

Eg: *Pheretima*,
Lumbricus,
Tubifex

Hirudinea

Eg: *Hirudinaria*,
Hirudo

Archiannelida

Eg: *Polygordius*,
Dinophilus,
Protodrilus

General Characters-

- 1.The Annelids are coelomate and triploblastic.
- 2.They exhibit organ system level organization.
- 3.Their body is segmented.
- 4.They respire through their body surface.
- 5.Nephridia are the excretory organs.
- 6.They have a well-developed circulatory and digestive system.

7. Their body contains hemoglobin, which gives them a red colour.
8. Regeneration is a very common characteristic of the Annelids.
9. Setae help them in movement.
10. Most of the Annelids are hermaphrodite, i.e., male and female organs are present in the same body.
11. They reproduce both sexually and asexually. The others reproduce sexually.
12. E.g., Earthworms, and leeches

Pheretima

Classification-

| | |
|-----------|------------------|
| Kingdom: | Animalia |
| Phylum: | Annelida |
| Class: | Clitellata |
| Order: | Opisthopora |
| Suborder: | Lumbricina |
| Family: | Megascolecidae |
| Genus: | <i>Pheretima</i> |
| Species: | <i>posthuma</i> |

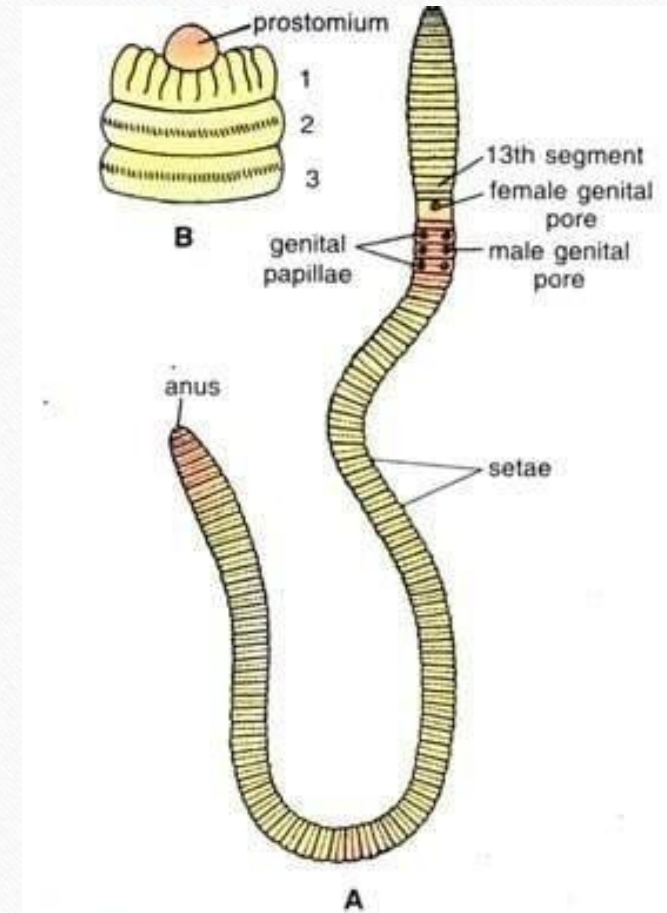


Fig. 66.2. A—*Pheretima posthuma* in ventral view; B—Anterior end in dorsal view.

General Characters -

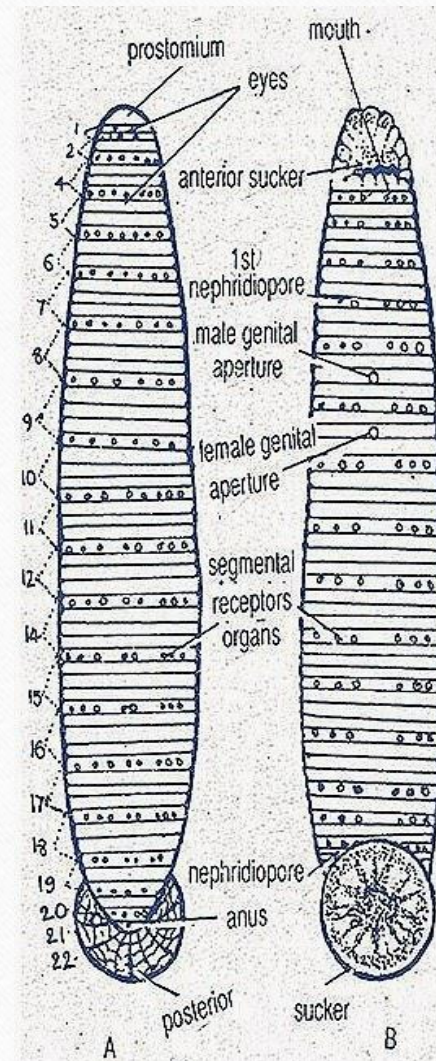
1. Pheretima is commonly known as earthworm .
2. Body has long, elongated, cylindrical in shape and 150 mm in length, brown in colour.
3. Earthworm consists of 100-120 small ring-like segments.
4. In all the segments of body except first, last and clitellum there is a setae.
5. Setae help in locomotion by holding the earth.
6. Prominent circular band of glandular tissue known as the clitellum which completely surrounds the segments from 14th to 16th.

7. Earthworm is hermaphrodite.
8. A pair of male genital apertures are situated in the 18th segment.
9. Female genital aperture situated at the ventral side in the 14th segment.
10. There are four pairs of small spermathecal apertures lying in the segments of 6,7,8,9.
11. Genital papillae are the most prominent structures present in the ventral side of segment 17 and 19.
12. Development is direct.

Hirudinaria

Classification

| | |
|-----------|--------------------|
| Kingdom: | Animalia |
| Phylum: | Annelida |
| Class: | Clitellata |
| Subclass: | Hirudinea |
| Order: | Arhynchobdellida |
| Suborder: | Hirudiniformes |
| Family: | Cylicobdellidae |
| Genus: | <i>Hirudinaria</i> |
| Species: | <i>granulosa</i> |



LEECH- HIRUDINARIA GRANULOSA

Dorsal side:

- 1) Prostomium
- 2) Eyes
- 3) Segmental receptors
- 4) Anus
- 5) Posterior sucker

Ventral side:

- 1) Mouth
- 2) Anterior Sucker
- 3) Segmental Receptors
- 4) Nephridiopore
- 5) Male Genital Opening
- 6) Female Genital Opening

Dorsal and ventral views 1 to 26 - Segments of Leech

General Characters

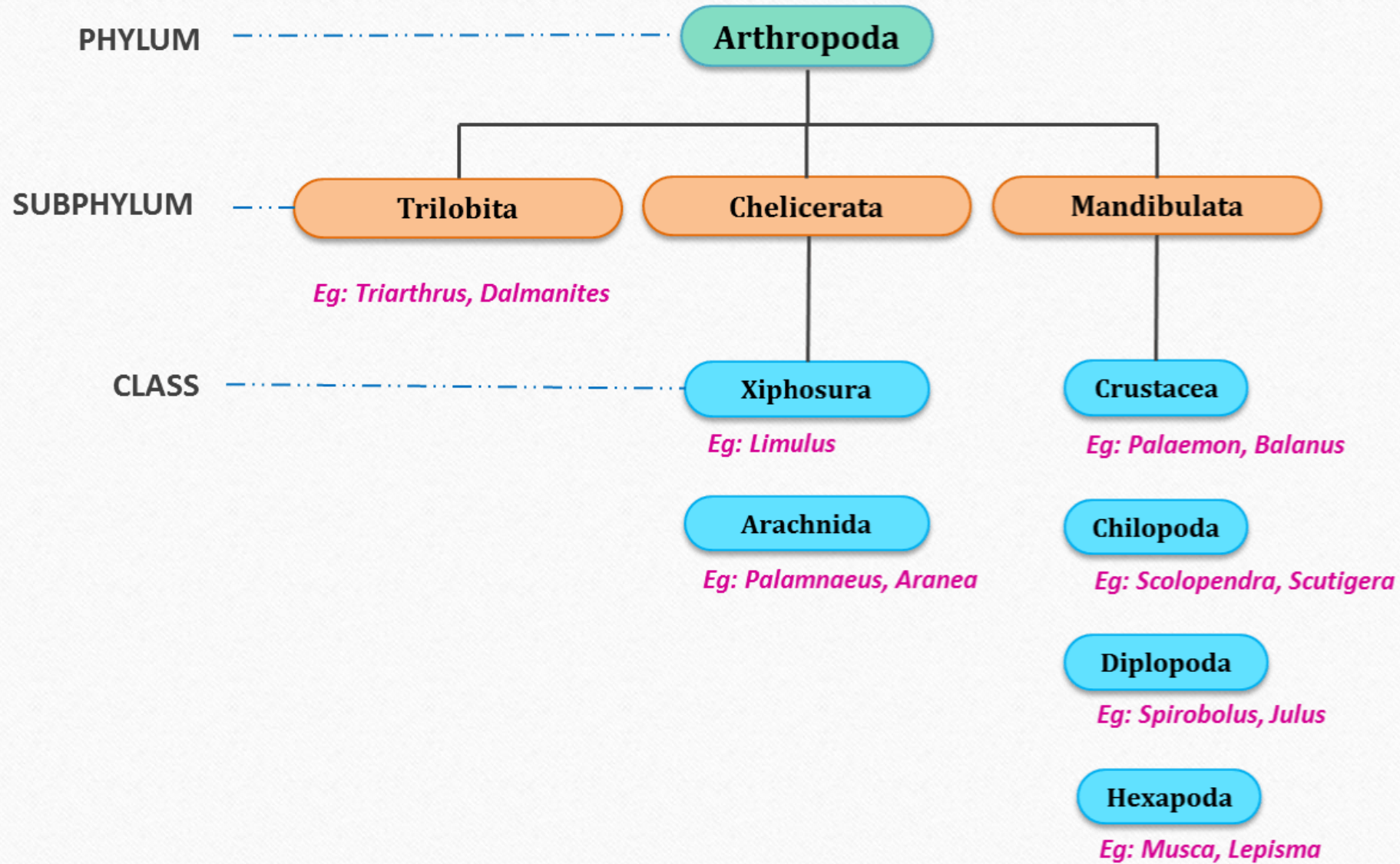
1. Hirudinaria Granulosa is commonly known as **Indian cattle leech**.
2. Mostly fluid feeders and Body is dorso ventrally flattened, Measuring 30-35 cm in length
3. The body has definite number of segments.
4. The tentacles, parapodia and setae are totally absent.
5. Both anterior and posterior ends of the body with suckers.
6. Saliva contains Hirudin and it is a powerful anticoagulant.

7. They are hermaphrodite and Fertilization is internal and a larval stage is absent.
8. True coelom is restricted to excretory and reproductive system other area is filled with special tissue called Botryoidal tissue.
9. Reproduction is sexual.

Phylum Arthropoda



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General Characters –

- The body of arthropods is bilaterally symmetrical.
- These animals are triploblastic, and the body is segmented into the head, thorax, and abdomen.
- They have jointed appendages that help in movements.
- The body cavity is filled with white coloured blood that is known as haemocoel.
- The exoskeleton structure is hard and made of complex sugar, namely chitin.
- Arthropoda species can be both terrestrial and aquatic.
- These animals have compound eyes on their head, capable of mosaic vision.

- Their nervous system is well-developed.
- Their heads bear the brain and all the sensory organs such as antennae, hair, statocysts, and auditory organs.
- One of the most important features of arthropods is their open circulatory system with arteries and dorsal heart.
- In an Arthropod diagram, the digestive tract is found with the mouth at one end and the anus at the opposite part of the body.
- The aquatic arthropods excrete waste through coaxial glands, and the terrestrials use Malpighian tubules to excrete.
- Phylum Arthropoda shows sexual dimorphism that is either internal or external.
- These animals are unisexual.

Palaemon

Classification

Phylum Arthropoda

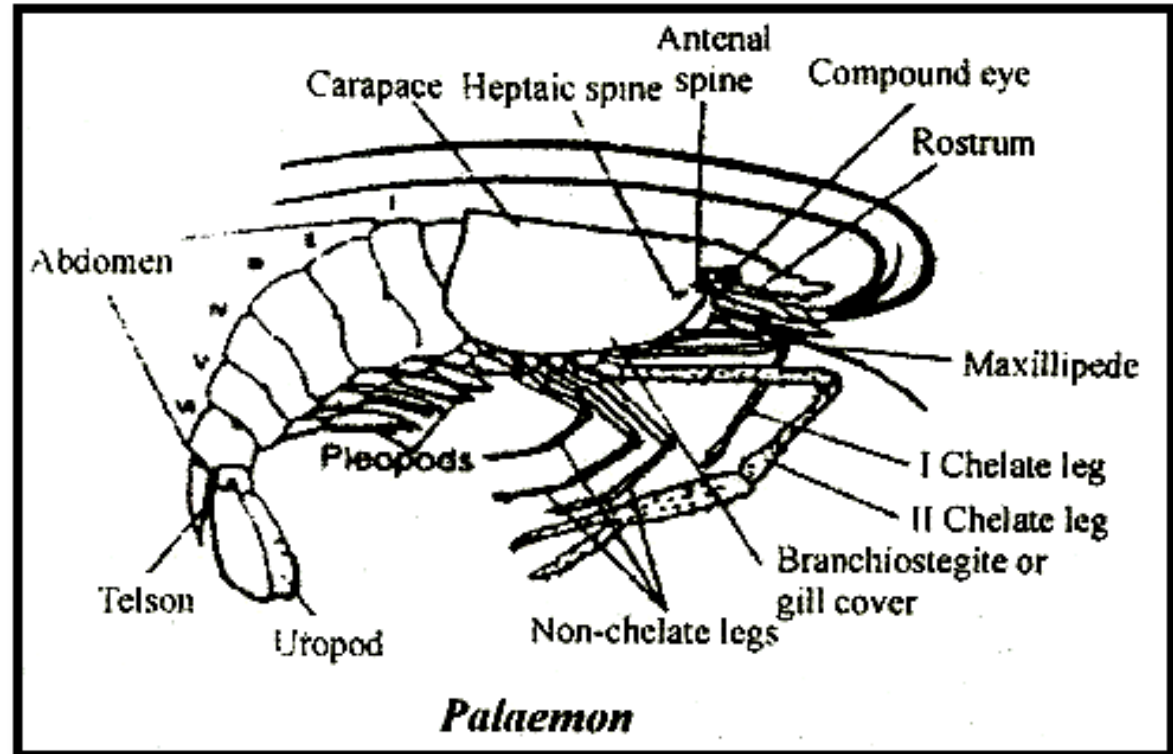
Subphylum: Mandibulata

Class : Crustacea

Subclass : Malacostraca

Order : Decapoda

Genus: Palaemon



General Characters

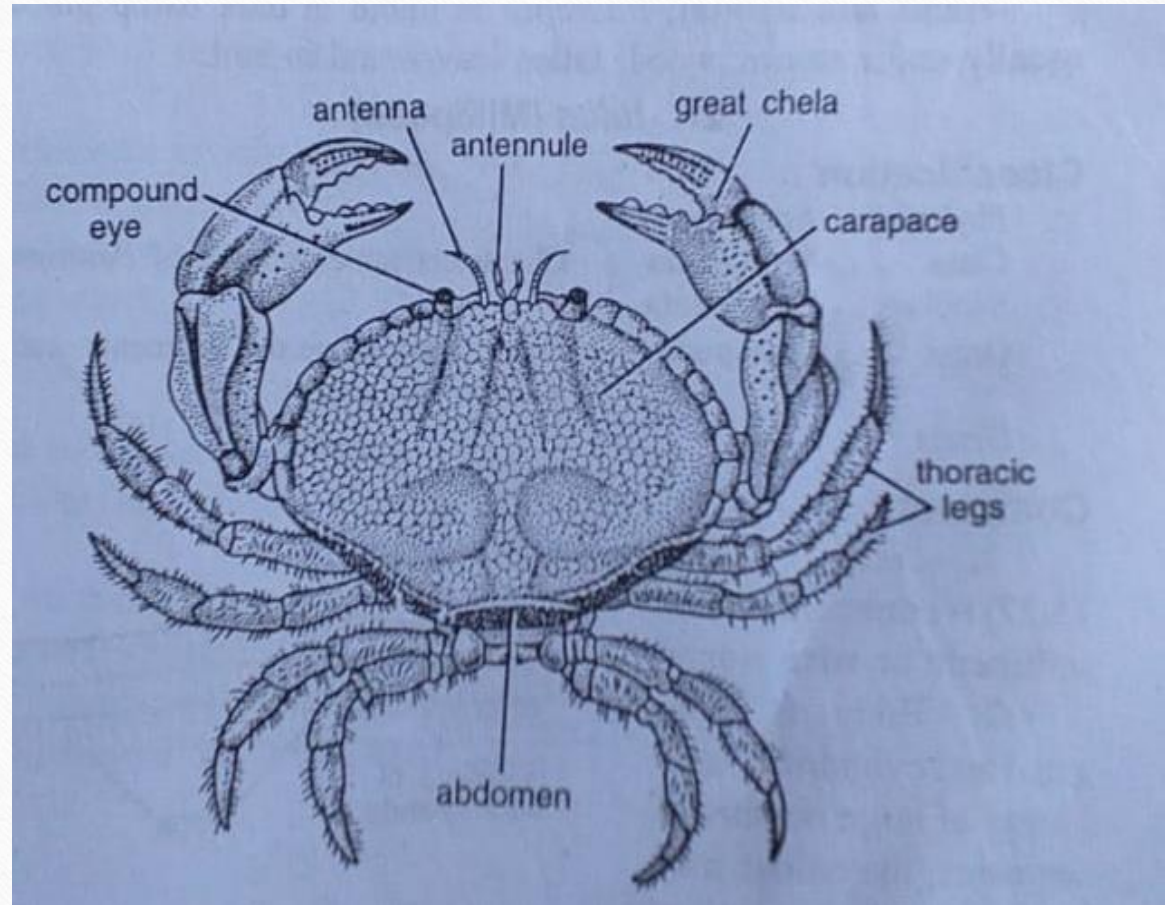
- Prawn is common in rivers, ponds and marine water areas.
- The body of prawn is divided into Cephalothorax and Abdomen.
- Cephalothorax have 13 pairs of appendages on the ventral side.
- First five pairs of appendages are Antennule, Antenna, Mandible, First maxilla and Sec maxilla.
- Remaining 8 pairs appendages are 3 pairs of maxillipeds and 5 pairs of walking legs.
- Cephalothorax is covered by a hard covering known as Carapace.

- Abdomen consists of six segments.
- Every segment of the abdomen there is a pair of appendages called Pleopods.
- Pleopods used for swimming.
- Gills are primary respiratory organs in prawn.
- Excretory organs of Prawn are known as green glands.

Cancer

Classification

| | |
|------------|--------------|
| Kingdom: | Animalia |
| Phylum: | Arthropoda |
| Subphylum: | Crustacea |
| Class: | Malacostraca |
| Order: | Decapoda |
| Suborder | Brachyura |
| Genus | Cancer |



General Characters

1. Cancer is commonly known as rock-crab or true-crab.
2. Body is oval and flat
3. Cephalothorax is frequently much broader than long .
4. Eye stalks and antennules are contained in sockets of carapace.
5. Antennules and antennae are small.
6. Third maxillipeds are broad, flat and valve-like and cover the other mouth parts.
7. Five pairs of thoracic legs are well developed.
8. The first pair of legs is chelate.

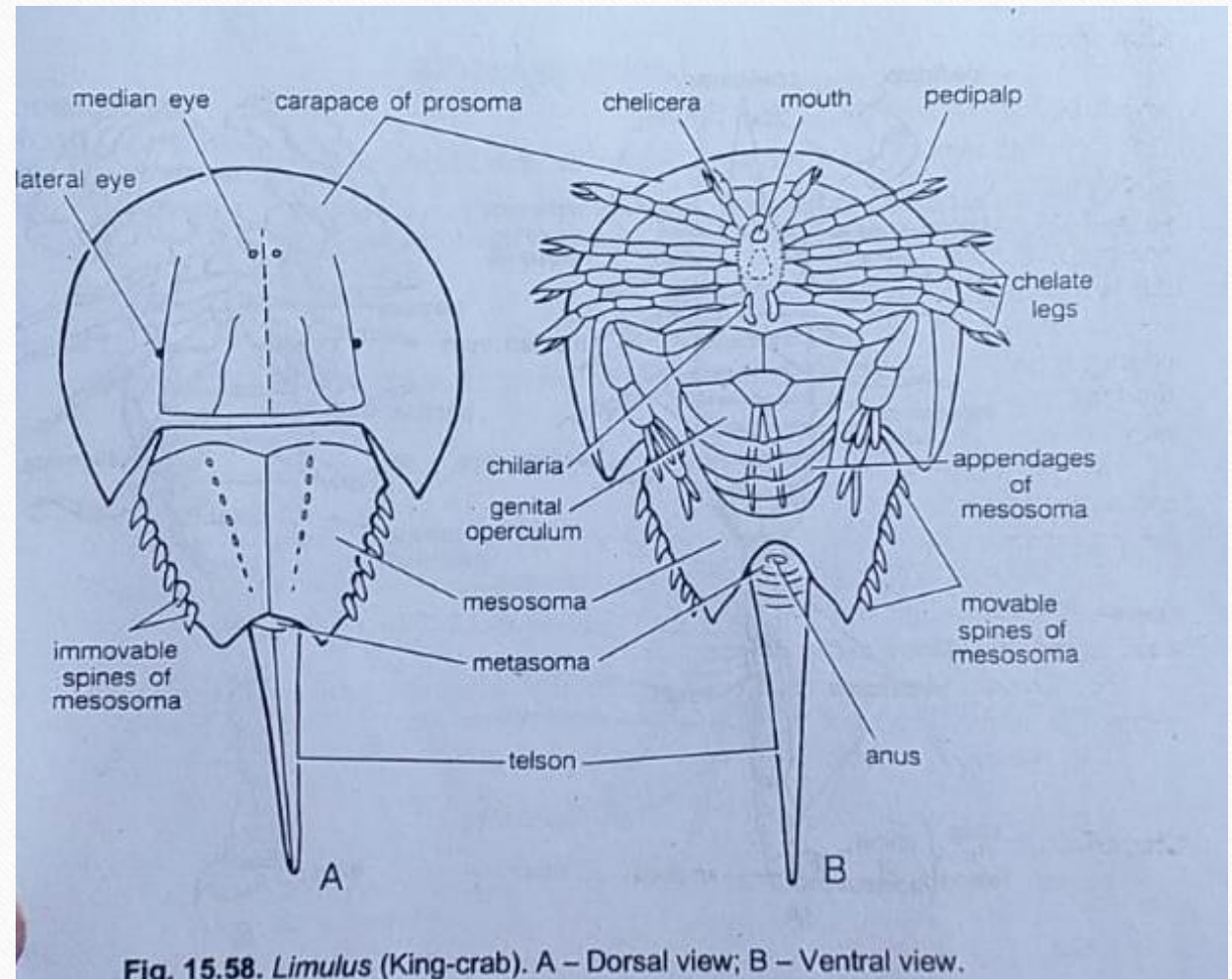
9. Abdomen is greatly reduced and lies permanently flexed in a groove on the very broad thoracic sternum
10. Pleopods are much reduced, the male retaining only two pairs as copulatory organs, while female four pairs for attachment of the eggs.
11. Uropods are absent.
12. The eggs are carried about by the female attached to abdominal legs
13. Metamorphosis comprises zoea and megalopa larva.

Habit and habitat. Cancer is found buried among rocks or in sand.

Limulus

Classification

| | |
|------------|----------------|
| Kingdom: | Animalia |
| Phylum: | Arthropoda |
| Subphylum: | Chelicerata |
| Order: | Xiphosura |
| Family: | Limulidae |
| Genus: | <i>Limulus</i> |



General Characters

1. It is commonly known as king-crab and is a marine arthropod.
2. Body is comprised of cephalothorax and abdomen.
3. Cephalothorax (prosoma) is broad, covered by horse shoe shaped carapace.
4. Abdomen comprises of six segments and bear 6 pairs of flattened and plate-like appendages.
5. First pair of appendage is united to form a genital operculum.
6. Remaining five pairs bear book gills for respiration.
7. Excretion through coxal or brick red glands.

8. Metastoma is much reduced . It bears the mid ventral anus.

9. Development through trilobite larva.

Scolopendra

Classification

| | |
|------------|--------------------|
| Kingdom: | Animalia |
| Phylum: | Arthropoda |
| Subphylum: | Myriapoda |
| Class: | Chilopoda |
| Order: | Scolopendromorpha |
| Family: | Scolopendridae |
| Genus: | <i>Scolopendra</i> |

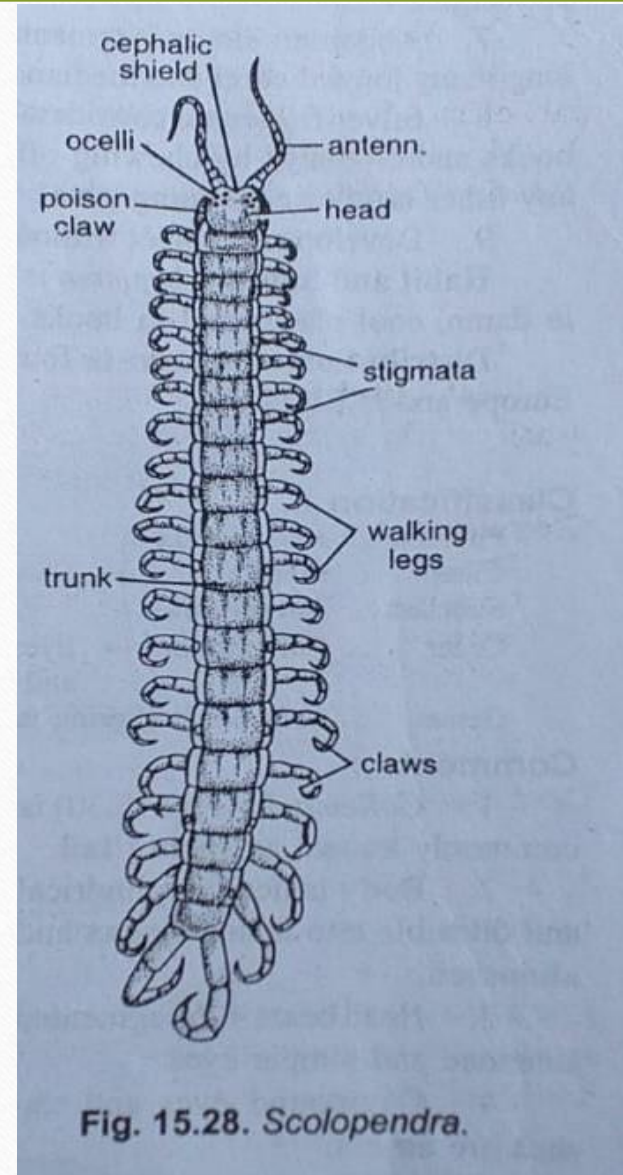


Fig. 15.28. *Scolopendra*.

General Characters

1. Scolopendra is commonly called centipede.
- 2 Body is elongated, dark greenish brown in colour and dorsoventrally flattened with numerous segments.
3. Body is divisible into head and trunk.
4. Head is distinct and bears a pair of antennae, a pair of mandibles and two pairs of maxillae.
5. Trunk segments are 22 in number and are nearly all alike.
6. Each trunk segment from 2-22 carries one pair walking legs.
7. First pair of trunk appendages or maxillipedes bears a sharp claw connected with the poison gland.

8. Paired oval spiracles or stigmata lie on the pleural areas, above the leg bases, on segments 4, 6, 9, 11, 13, 15,17, 19 and 21.

9. Sexes are separate.

10. Genital opening situated in the last segment.

11. Carnivorous, feeding on insects, spiders, worm, slugs etc.