

B.Sc. 5th Semester Diversity of Non-Chordates and Economic Zoology

Question 1: Describe the morphology of Paramecium.

Answer: Morphology of Paramecium

External morphology

Paramecium is a microscopic, single-celled, slipper-shaped organism, measuring between 120 to 300 μm in length. The anterior end is blunt and rounded, while the posterior end is pointed.

Pellicle: A tough, flexible, and elastic outer membrane that gives its definite shape.

Cilia: The entire body is covered with numerous short, hair-like filaments arranged in rows used for swimming and feeding.

Oral Groove: A prominent, oblique depression on the ventral side that sweeps food particles toward the mouth.

Cytoproct: A temporary opening located on the ventral surface used to eliminate undigested waste.

Internal Morphology

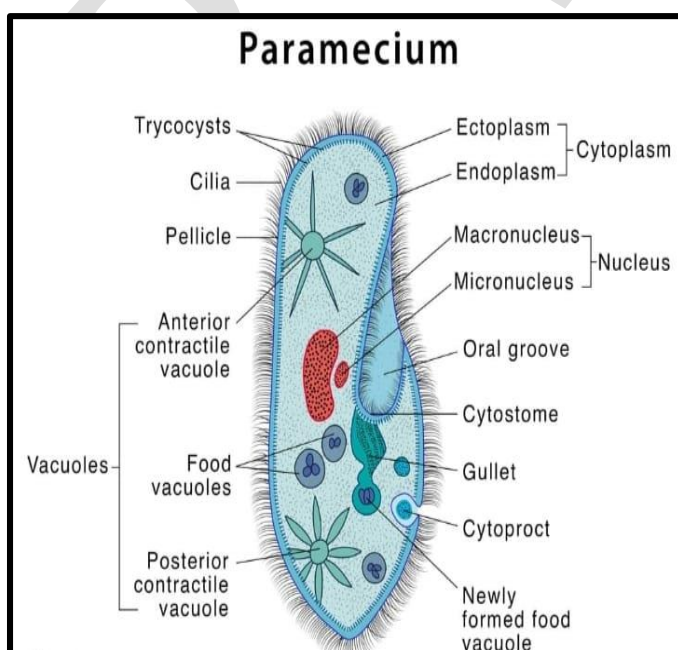
Cytoplasm: Divided into an outer, clear layer ectoplasm and an inner, fluid layer endoplasm.

Nuclei: Contains two distinct types of nuclei: a large macronucleus that controls metabolic activities and one or more small micronuclei responsible for reproduction and genetic exchange.

Contractile Vacuoles: Two star-shaped vacuoles that perform osmoregulation by pumping out excess water.

Food Vacuoles: Spherical cavities circulating in the endoplasm where ingested food is digested.

Trichocysts: Tiny, spindle-shaped defensive organelles embedded in the ectoplasm that fire thread-like filaments.



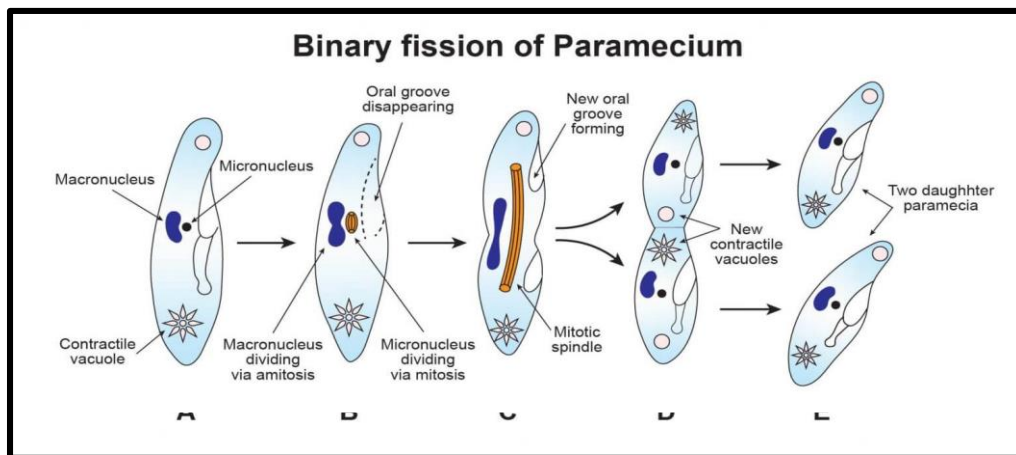
Question2: Describe Asexual reproduction in Paramecium?

Answer: Asexual reproduction in Paramecium

Paramecia reproduce both asexually through binary fission.

Asexual Reproduction: Binary Fission

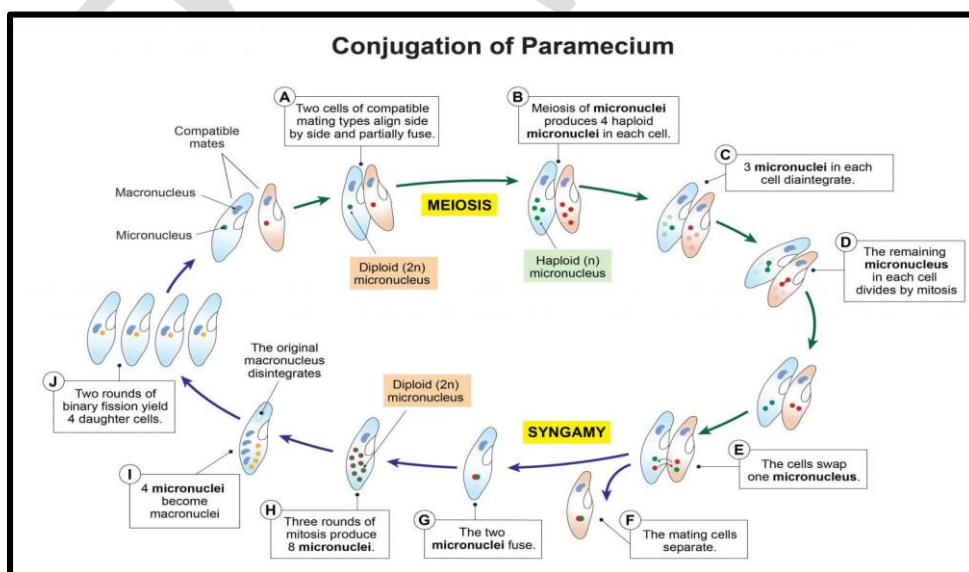
Under favourable conditions with plenty of food and warmth, a paramecium can divide two to three times a day. The cell stops feeding, and internal parts duplicate. Divides by standard mitosis to form two identical copies. Divides by simpler amitosis.



Question3: Describe Sexual reproduction in Paramecium?

Answer: Sexual Reproduction: Conjugation

Under stressfull conditions, Two compatible paramecia temporarily join along their oral grooves. Their old macronuclei dissolve, and their micronuclei undergo meiosis to form haploid nuclei. They trade some of these haploid nuclear pieces across a small bridge of cytoplasm. The cells separate, and new macronuclei and micronuclei reform inside them through division and fusion.



Question 4: Write Characters of pylum Porifera.

Answer: Characters of pylum Porifera

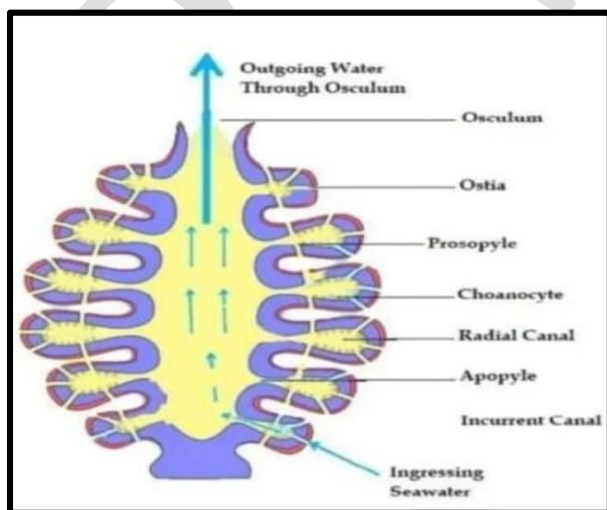
1. Mostly marine, with very few freshwater species.
2. Cellular level of organization .
3. Mostly asymmetrical, though some are radially symmetrical.
4. Body is perforated by numerous tiny entry pores called **ostia** and one or more large exit openings called **oscula**.
5. Water transport system brings in food, oxygen, and removes waste through a central cavity called the **spongocoel**, driven by flagellated **choanocytes**.
6. Supported by calcareous spicules, siliceous spicules, or flexible spongin fibers.
7. Both asexual (budding, fragmentation, gemmules) and sexual (hermaphroditic)
8. Internal fertilization and indirect development via larvae.
9. The nutrition is holozoic.
10. They have the power to regenerate the lost parts.
11. The exchange of respiratory gases and nitrogenous wastes occurs by the process of diffusion.

Examples: *Sycon* (Scypha), *Spongilla* (freshwater sponge), and *Euspongia* (bath sponge).

Question 5: Write Sycon Type Canal system.

Answer: Sycon Type Canal System

The Sycon type canal system is a radial canal system found in sponges such as Sycon. Structure. The body wall is folded to form incurrent canals and radial canals. Incurrent canals receive water through numerous dermal ostia. Radial canals are lined by choanocytes. Incurrent canals communicate with radial canals through small openings called prosopyles. Radial canals open into the spongocoel through apopyles. Water finally leaves the body through the osculum.



Water Current Path

Dermal ostia → Incurrent canals → Prosopyles → Radial canals → Apopyles → Spongocoel → Osculum → out

Importance

1. Filter feeding
2. Respiration
3. Removal of waste
4. Water circulation

Question6: Give an account of the characters of phylum Cnidaria with example.

Answer: Characteristics of Cnidarians

1. Mostly marine, few found in freshwater
- 2 solitary (sea anemone) or colonial (Corals)
3. Tissue grade of organization
4. Diploblastic
5. Radial symmetry
6. Short and slender tentacles encircle the mouth in one or two whorls.
7. The tentacles are provided with nematocysts; tentacles serve for food capture, its ingestion, serve for adhesion, and for defense.
8. They are usually carnivorous; digestion is extracellular as well as intracellular.
9. No anus.
10. Exoskeleton chitinous or calcareous
11. They possess a blind sac-like central cavity referred to as gastrovascular cavity or coelenterons
12. Sensory organs form ocelli and statocysts
13. Reproduction is both by asexual and sexual
14. Asexual reproduction is by fission, budding and fragmentation
15. Unisexual some are bisexual
16. External fertilization and cleavage is holoblastic.
17. The development indirect a free-swimming ciliated planula larva.

Example- Hydra, Obelia, Physalia, Aurelia, Adamsia, Metridium, Madrepora.

Question7: Differentiate between polyp and Medusa.

Answer: Difference between polyp and Medusa

Table 1. Differences of Polyp (Hydranth) and Medusa of *Obelia*.

Polyp	Medusa
1. Fixed, rarely free.	1. Free-swimming.
2. Body cylindrically elongated.	2. Body saucer-shaped or umbrella-like.
3. Base attached below so that manubrium is directed upwards.	3. Base above so that manubrium hangs downwards.
4. Tentacles usually 24.	4. 16 tentacles in young medusa, numerous in adult.
5. Mesogloea poorly developed.	5. Mesogloea enormously developed.
6. Body structure simple. Muscles and nervous system simple.	6. Body structure complicated. Muscles and nervous system more developed.
7. Velum absent.	7. Velum present around the margin of umbrella.
8. Mouth circular, without oral lobes.	8. Mouth rectangular, with oral lobes.
9. Gastrovascular cavity simple, without radial and circular canals.	9. Gastrovascular cavity represented by stomach, four radial canals and one circular canal.
10. Sense organs absent.	10. Bases of eight adradial tentacles possess marginal sense organs, called statocysts.
11. Without gonads.	11. With four gonads on radial canals.
12. Reproduces asexually by budding.	12. Reproduces sexually by gametes.

basal disc

Question8 : Write short note on morphology of *Obelia*.

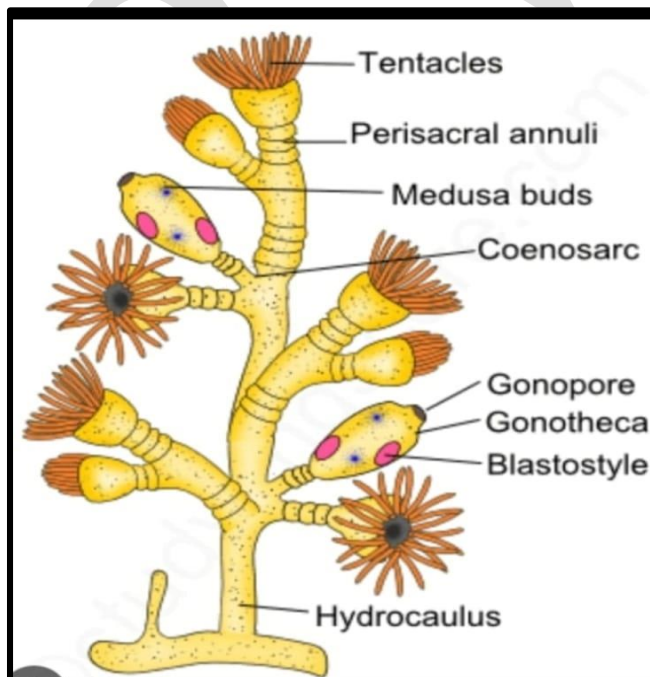
Answer: Morphology of *Obelia*

Obelia is a marine colonial hydrozoan. It shows polymorphism.

1. **Colony:** The colony is branched, tree-like and fixed to a substratum by a root-like hydrorhiza. The upright branches form the hydrocaulus. The colony is covered by a non-living protective covering called perisarc.

2. **Hydranths** (feeding zooids): Feeding individuals are called hydranths or gastrozooids. They are club-shaped and arise from the hydrocaulus. Each hydranth has a mouth surrounded by numerous tentacles. Tentacles bear nematocysts, which help in capturing prey.

3. **Blastostyle (reproductive zooids):** Reproductive individuals are called blastostyles. They are enclosed within protective gonothecae. They produce small medusa buds by asexual budding.



4. Medusa: The medusa is a free-swimming sexual form. It is umbrella-shaped and has a velum. It possesses tentacles and gonads.

5. Polymorphism

Obelia has two main types of zooids:

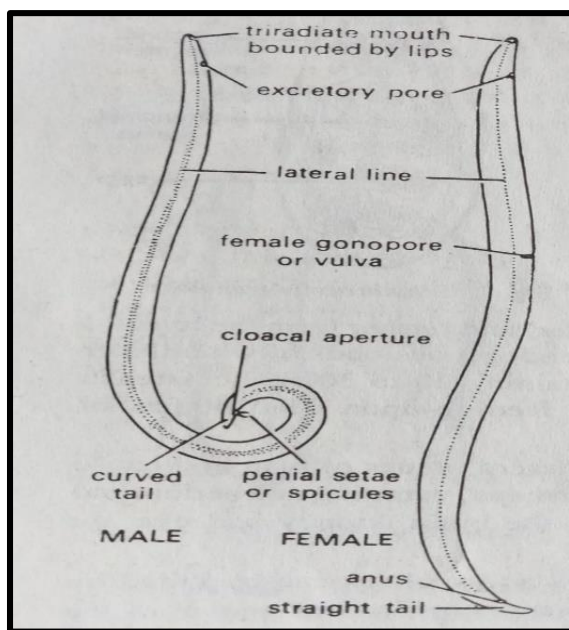
Hydranth → feeding

Blastostyle → reproduction

Question 9: Explain morphology of *Ascaris lumbricoides*,

Answer: Morphology of *Ascaris lumbricoides*

Ascaris lumbricoides, commonly known as the giant intestinal roundworm, is a large, cylindrical nematode that lives in the human small intestine.



Sexual Dimorphism

Adult Male: Measures 15 to 31 cm in length and 2 to 4 mm in diameter. Strongly curved, featuring a cloacal aperture with two copulatory spicules.

Adult Female: Larger, measuring 20 to 49 cm in length and 3 to 6 mm in diameter. Straight and conical, with a separate anus.

Morphology

Shape: Elongated, cylindrical, and tapered at both ends.

Color: Worms are yellowish-pink colored, turning white over time.

Mouth: Located at the anterior end, surrounded by three finely toothed lips with sensory papillae.

Body wall: Covered in a tough, elastic cuticle that protects the worm from human digestive juices.

Question 10: Write the characteristic features of phylum Ctenophora.

Answer: GENERAL CHARACTERS

1. Free-swimming, marine, pelagic and solitary animals.

2. Body gelatinous, transparent, pear-shaped, cylindrical or flat or ribbon-shaped
3. Biradially symmetrical body along an oral-aboral axis.
4. Comb-like eight ciliary plates on the body for locomotion.
5. Nematocysts absent, mesogloea cellular with muscular elements.
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4. Comb-like eight ciliary plates on the body for locomotion.
5. Nematocysts absent, mesogloea cellular with muscular elements.
6. Digestive system with mouth, pharynx stomach and terminates out at anal pore.
7. Colloblasts are special adhesive cells present on tentacles which help in food capture.
8. Skeletal, circulatory, respiratory and excretory systems are absent.
9. Nervous system is diffused type and the aboral end bears a sense organ, called statocyst .
10. Monoecious (hermaphrodite).
11. Development direct with a characteristic larva called cydippid.
12. Regeneration and paedogenesis are of common occurrence.
13. Body organization cell-tissue grade.

Example- Pleurobrachia, Bolinopsis, Beroe, Cestem, Coeloplana

Question11: Give an account of structure of *Taenia solium*.

Answer: Structure of *Taenia solium*.

It is commonly known as the pork tapeworm, is an elongated, ribbon-like, hermaphroditic parasite that measures 2 to 3 meters in length and lives in the human small intestine.

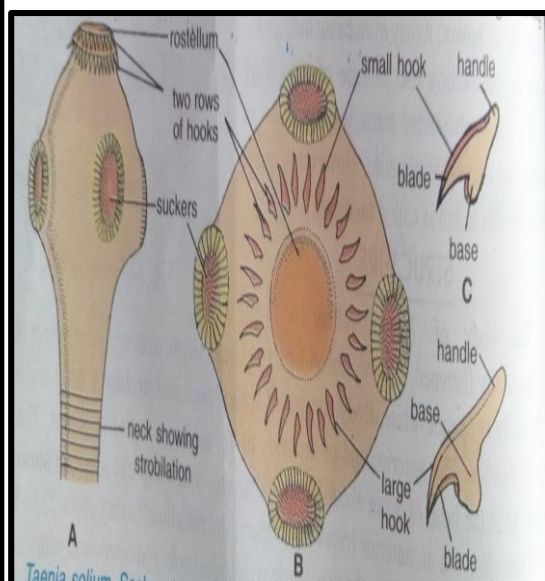
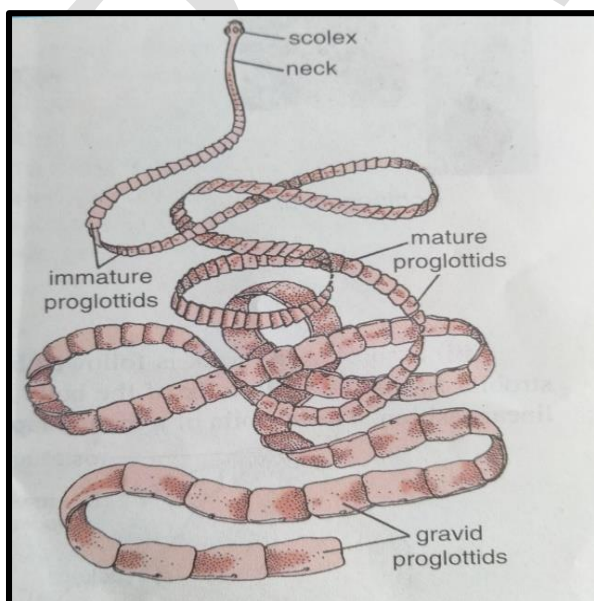
The adult body is white or cream-colored and divided into three main regions:

1. Scolex (Head)

Size and shape: Globular structure measuring about 1 mm in diameter.

Suckers: four circular, muscular suckers used to anchor to the intestinal mucosa.

Rostellum and hooks: Equipped with a central dome-shaped rostellum bearing a double crown of 22 to 32 alternating large and small hooks.



2. Neck

Structure: Short, narrow, and unsegmented region measuring 5 to 10 mm in length.

Function: Acts as the zone of proliferation or budding, continuously generating new segments.

3. Strobila (Body) Composition: A ribbon-like chain of 800 to 1,000 segments called proglottids.

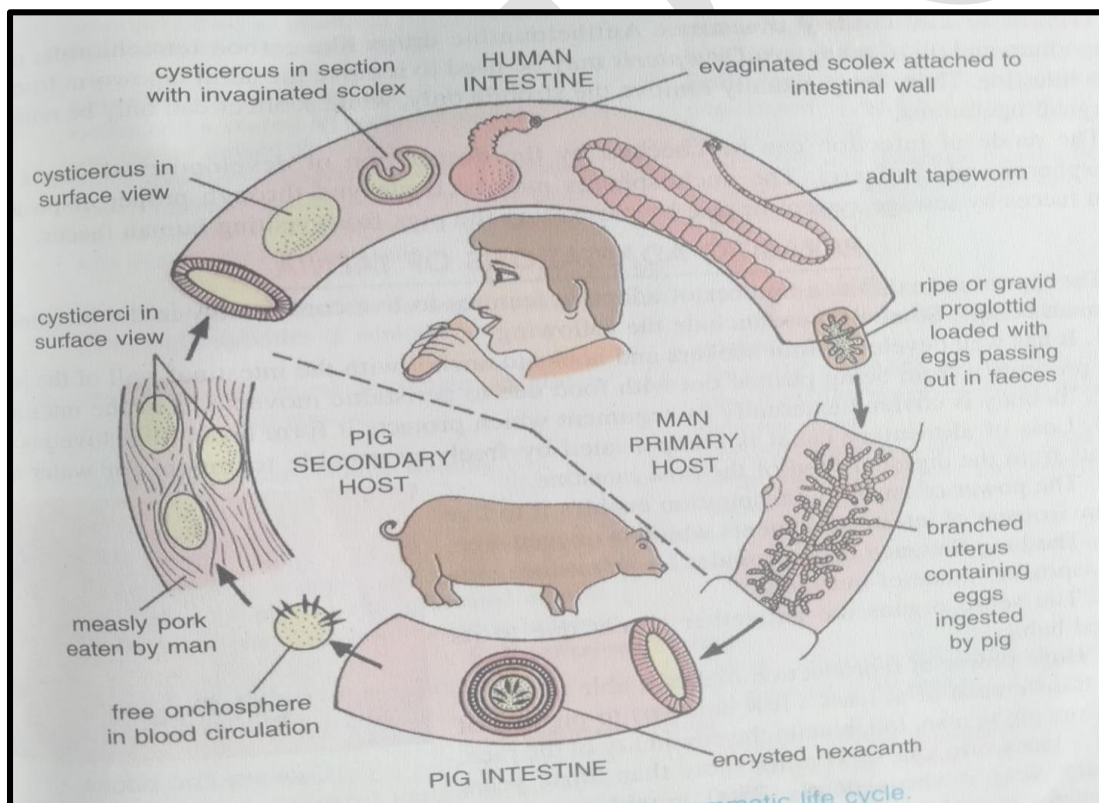
Immature proglottids: Anterior segments near the neck that are wider than they are long; reproductive organs are underdeveloped.

Mature proglottids: Middle segments containing fully developed, functional male and female reproductive systems. A marginal genital pore alternates sides segment by segment.

Gravid proglottids: Posterior segments packed with fertilized eggs. The central uterus features 7 to 13 primary lateral branches filled with thousands of eggs. These terminal segments detach and pass out via the host's feces.

Question12: Illustrated the complete life cycle of *Taenia solium* with the help of diagram only.

Answer: Life cycle of *Taenia solium*

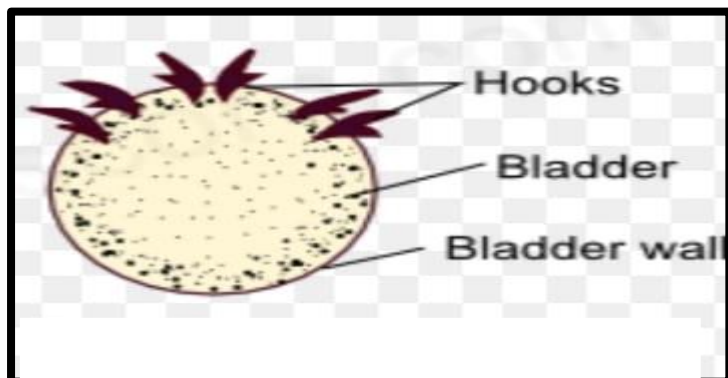


Question 13: Give an account of the structure of Hexacanth larva.

Answer: Hexacanth Larva

Hexacanth larva is the first larval stage of tapeworms (Cestoda). It is also called an oncosphere. It develops inside the egg of the tapeworm. It has three pairs of hooks (6 hooks), hence the name hexacanth (six-hooked). The hooks help it penetrate the intestinal wall of the

intermediate host It later develops into the next larval stage, such as a cysticercus in *Taenia solium*.



Question 14: Give an account of the characters of phylum Annelida with example.

Answer: GENERAL CHARACTERS

1. Annelida are mostly aquatic; marine or freshwater, some terrestrial, burrowing or living in tubes, sedentary or free-living. Some are commensal and parasitic also.
2. Body triploblastic, bilaterally symmetrical, elongated and vermiform.
3. Body metamerically segmented.
4. Organ-system grade of body organisation.
5. Outer covering of the body is cuticle secreted by the underlying epidermis.
6. Body wall is contractile, consisting of an outer epidermis, circular and longitudinal muscles.
7. Appendages when present are unjointed.
8. Locomotory organs are segmentally arranged paired setae or chaetae in most of the cases.
9. Alimentary canal is tube-like, complete, extending from mouth to anus.
10. Respiration occurs through general body surface, in some cases by gills also.
11. Blood vascular system is closed type.
12. Excretion by segmentally arranged nephridia which usually communicate the exterior.
13. Nervous system with a pair of cerebral ganglia, the brain and a double nerve o segmentally arranged ganglia.
15. Usually monoecious, ie, hermaphrodite; dioecious or unisexual .
16. Development direct in monoecious forms but indirect in dioecious forms.

Example-Aphrodite, Nereis, Pheretima, Hirudinaria

Question15: Write Morphology of Leech (*Hirudinaria*).

Answer: Morphology of Leech (*Hirudinaria*)

1) Shape size and Colouration: *Hirudinaria* is soft, vermiform, elongated and dorso ventrally flattened worm. It is 10 to 15 cm long. The body is broad near the posterior and while narrow near the anterior end. The dorsal surface is somewhat convex and the ventral surface is more or less flat. The body of the leech is brightly coloured. The dorsal surface is olive-green; the ventral surface is orange-yellow in color. Distinct stripes are seen on the body.

2) Segmentation of the body: The body is divided into 33 segments. Externally it is

divided into more segments which are called annuli. There are 109 annuli in a leech. The number of annuli varies in different segments. A typical segment of the middle part of the body includes five annuli.

3) Suckers: Body bears 2 suckers. The anterior sucker or oral sucker is oval and ventrally-directed, formed, by the first 3 segments, it includes mouth. At the posterior end of body a circular and highly muscular posterior or anal sucker is formed by union of seven body segments, meant for attachment and Locomotion.

4) Regions of the Body: The body is divided into 6 regions.

1. Cephalic region
2. Pre-clitellar region.
3. Clitellar region
4. Middle region
5. Caudal region
6. Posterior region.

5) External apertures:

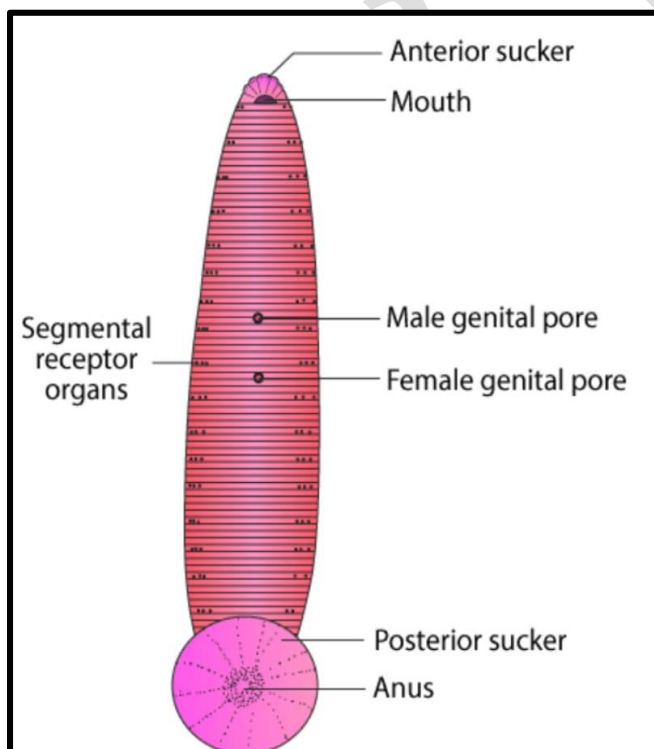
A. Mouth: Mouth is a triradiate present in the anterior sucker.

B. Nephridiopores: 17 pairs of nephridiopores are present. One pair lies ventrally on the last annulus of each segment from 6 to 22 segments.

C. Male genital opening: Male genital aperture is a mid-ventral opening in between second and third annuli of 10th segment.

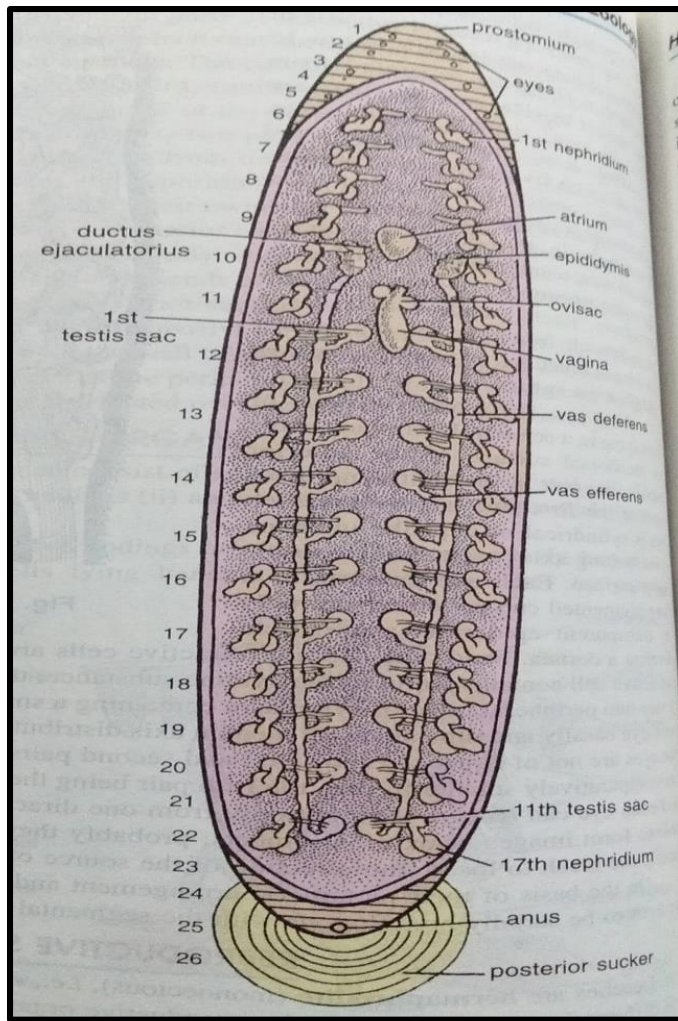
D. Female genital opening: Female genital opening lies mid-ventrally in between second and third annuli of 11th segment.

E. Anus: Anus is a small opening present mid-dorsally on the 26th segment.



Question16: Draw a well labelled diagram of Leech Reproductive System.

Answer: Leech Reproductive System



Question 17: Differentiate aquatic and aerial respiration.

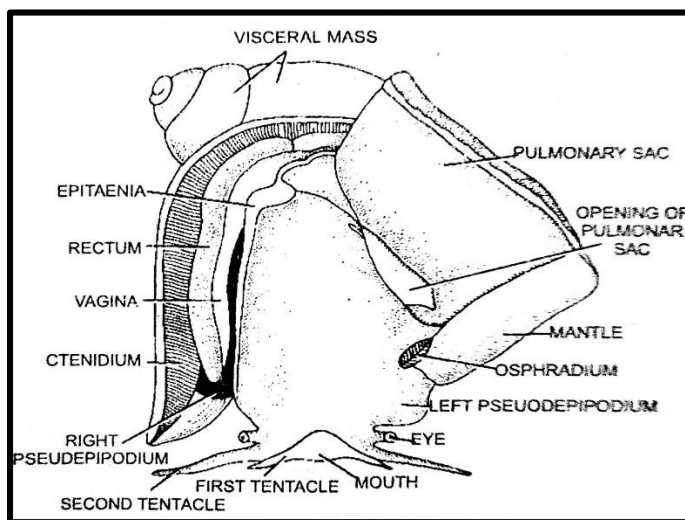
Answer:

Aquatic respiration1	Aerial respiration
Performed with the help of gills or ctenidia.	Performed with the help of pulmonary sac.
Respiratory site is the branchial chamber or the right cavity of the mantle.	Respiratory site is the pulmonary chamber or the left cavity of the mantle.
Movements of cilia of the lamellae help in the intake of water.	Contraction and relaxation of muscles of pulmonary sac and mantle wall, help in the intake of air.
Gaseous exchange takes place between the water and blood.	Gaseous exchange takes place between the air and blood.
It occurs when Pila remains in clean water.	. It occurs when Pila remains either on land or in dirty, shallow water.

Question 18: Write short note on Mantle Cavity of Pila.

Answer: Mantle cavity

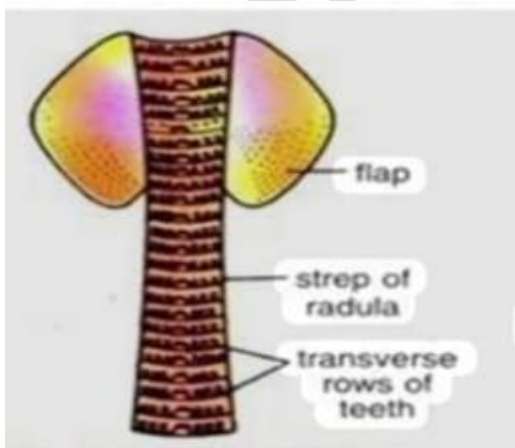
In the anterior part there is a large space between mantle and the body, this is a mantle or pallial cavity which has been shifted to the front by a process of torsion. It encloses a number of organs and the head can be withdrawn into it. The mantle cavity encloses within it a number of important organs which are collectively known as pallial complex. Near the right pseudopodium is a prominent ridge or epitaenia which runs backwards up to the end of the mantle cavity, it divides the mantle cavity into a right branchial cavity and a left pulmonary sac. In the branchial cavity lie a single gill or ctenidium, rectum and anus, the genital aperture and the anterior chamber of the kidney as a reddish mass near the posterior end of the epitaenia. Near the left pseudopodium is a fleshy osphradium a typical molluscan sense organ.



Question 19 : Write short note on radula.

Answer: Radula

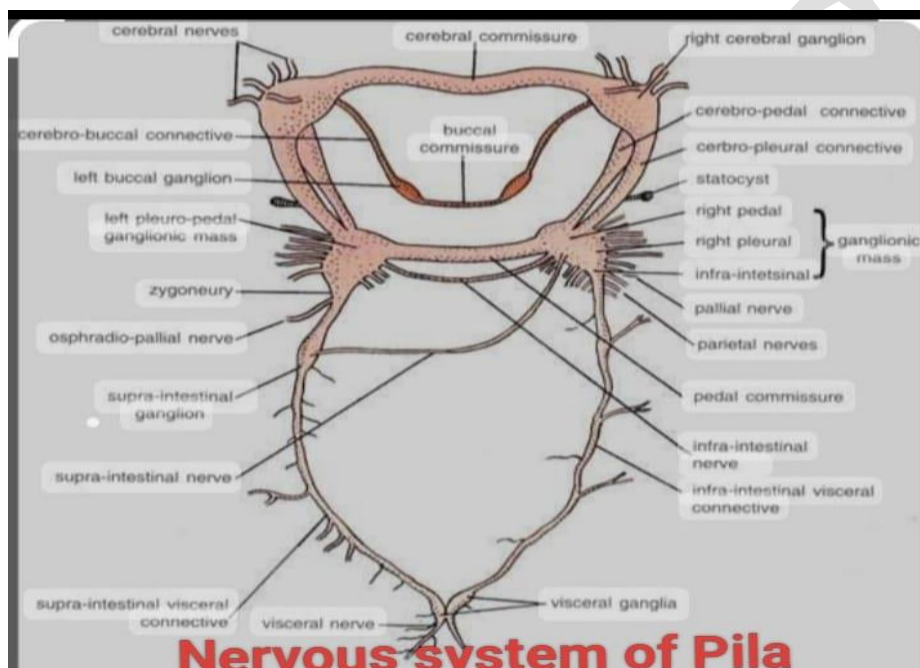
On the floor of buccal cavity lie a chitinous curved, ribbon-like structure called the radula or lingual ribbon, its anterior end bearing a while posterior end lodged in radular sac flexed behind and below the buccal mass. Radula itself is formed by secretion of the epithelial lining of the radular sac



Below the radula lies a delicate and elastic sub-radular membrane. Dorsal surface of the radula bears teeth arranged in numerous transverse rows. Each row contains 7 teeth, one central (rachidium) and one lateral and two marginalia on its either side giving the formula 2,1,1,1,2. The chain-saw movement of radula on the odontophore makes it an efficient organ for rasping of food particles. The wear and tear of anterior part of the radula is maintained by regular addition of new material at its posterior end. It works like a rasping organ. With the help of this organ *Pila* will cut the food into bits.

Question 20: Draw a well labelled diagram of nervous system of *pila*.

Answer:



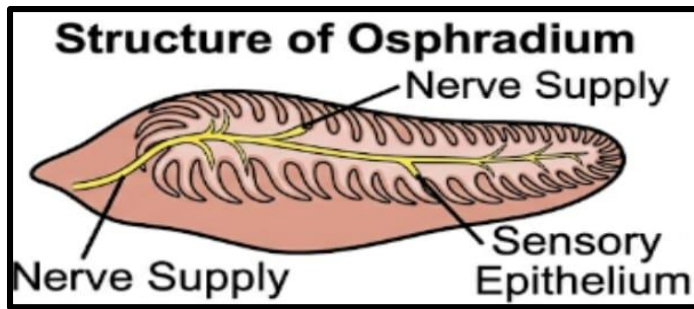
Question 21: Explain Osphradium.

Answer: Osphradium.

It links directly to the nervous system, specifically attached to the visceral ganglia. *Pila* has a single gill-like osphradium in the left pulmonary area. It is used to detect materials entering gills and hangs from the roof of the mantle cavity. In mollusk, a single or paired sensory attachment to the visceral ganglia is called osphradium.

Structure

It sits inside the mantle cavity near or on the gills (ctenidia) or near the respiratory inhalant siphon. It is a pigmented patch of sensory epithelium. In some snails like *Pila*, it looks like a bird's feather and is called *bipectinate*.



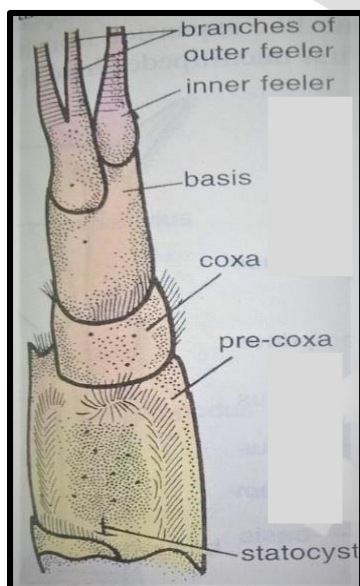
Functions

- **Water Testing:** It checks incoming water for silt, dirt, and sediment before the water reaches the delicate gills.
- **Chemoreception and Smell:** It acts as a chemical sensor (chemoreceptor) to detect food particles or locate prey in the surrounding water.

Question 22: Write a short note on Antennule.

Answer: Antennules

The antennules are situated, one on either side, immediately below the bases of eye-stalks. Antennules are uniramous. Each antennule consists of a protopodite having podomeres, precoxa, coxa and basis and a pair of slender many jointed feelers. The precoxa is very large and bears a depression, containing the opening of statocyst on its dorsal side and a spiny lobe called stylocerite on its outer margin. The coxa is short and cylindrical. The basis is longer than coxa. From the basis arises a pair of long, jointed feelers which are probably not homologous with the exopodite and endopodite of a typical appendage. The outer feeler is divided into two unequal branches. Antennule is tactile and its statocyst is for equilibration.



Question 23: Write short note on Hastate plate.

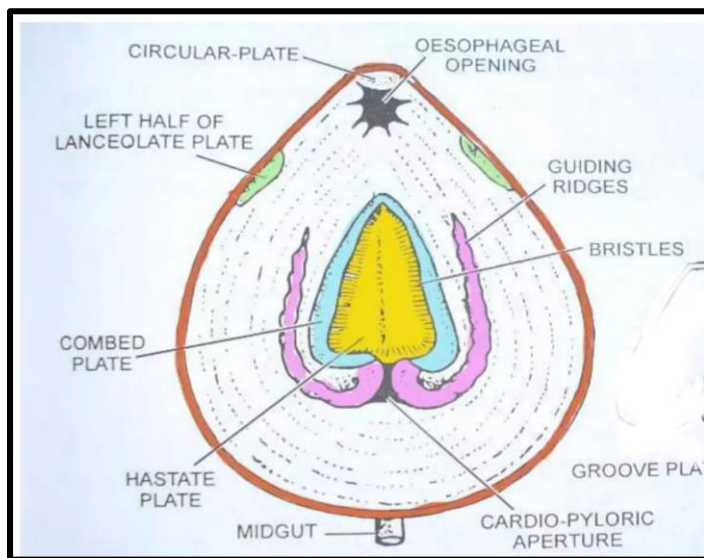
Answer: Hastate plate

The hastate plate is a calcified cuticular plate located on the mid-ventral floor of the cardiac stomach in a freshwater prawn (*Palaemon*).

Structure

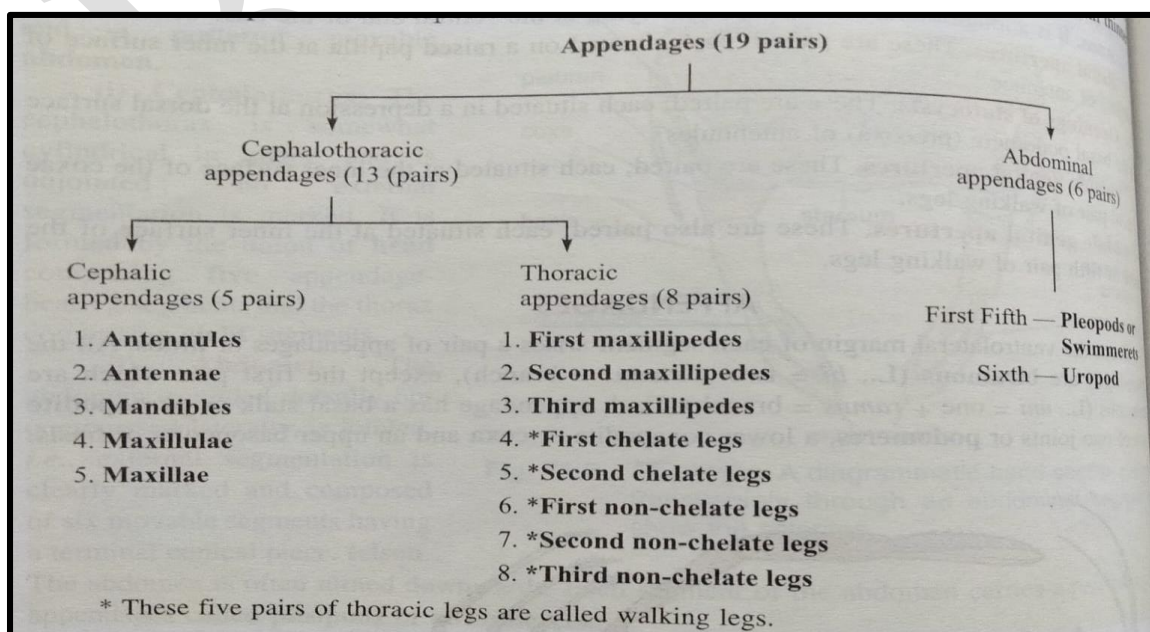
It is triangular or spear-shaped, with the wider anterior part and a depressed posterior end fringed with delicate setae (bristles). It lies on the floor of the cardiac stomach, flanked by lateral grooves and bounded by comb plates and groove plates. The outer side is bounded by a rigid plate. These bristles always keep moving in a living prawn. The posterior part of the hastate plate forms cardiac pyloric aperture. It guides the food towards the cardiac-pyloric aperture. Further cardiac pyloric aperture is guarded by four valves, a hastate plate makes anterior valve, and a semilunar fold of stomach wall makes posterior valve.

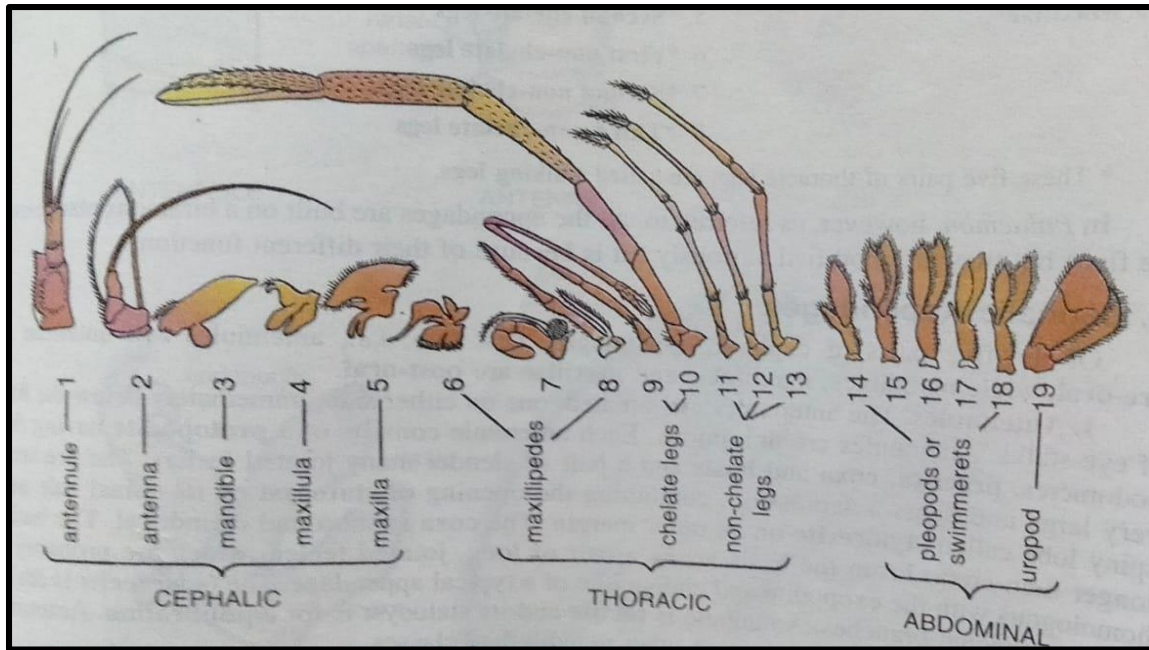
Function: It guides masticated food toward the narrow, X-shaped cardio-pyloric aperture leading into the pyloric stomach. Its edges and associated folds act as valves that regulate the passage of food particles.



Question24: How many Appendages are found in Prawn? Write their name as well .

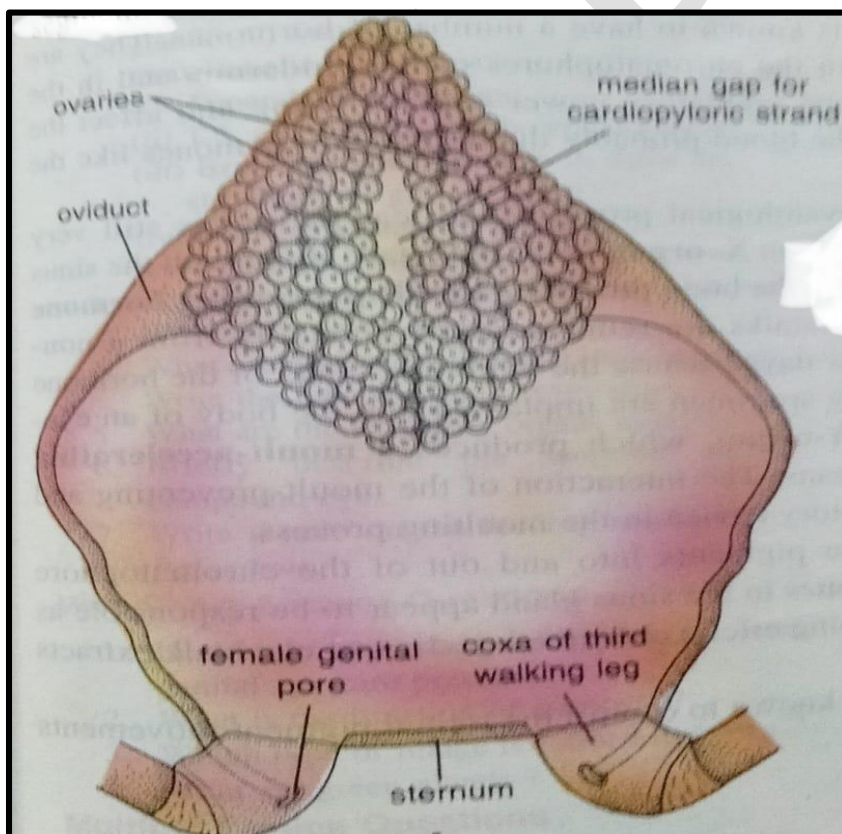
Answer: Prawn Appendages



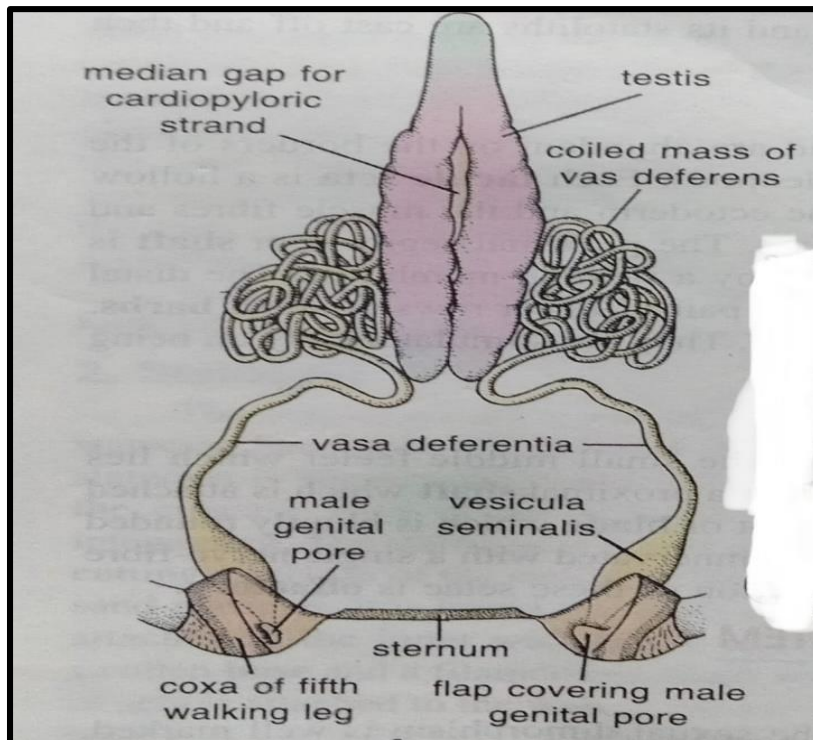


Question25: Draw well labelled diagram of Reproductive System of prawn.

Answer: Female Reproductive System of Prawn.



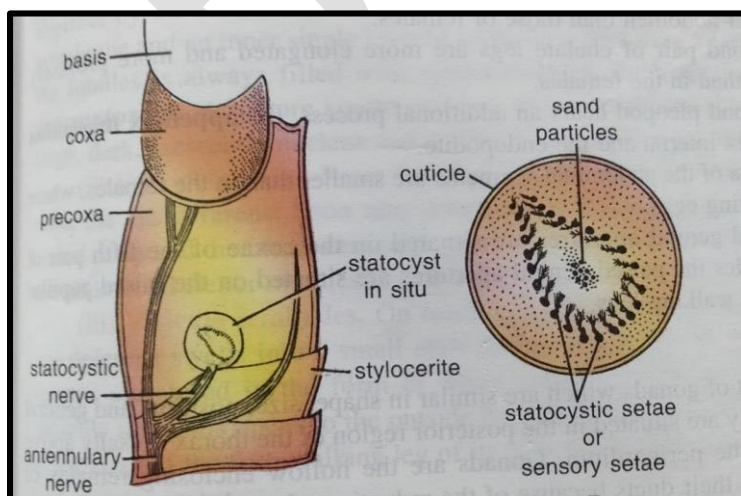
Male Reproductive System of Prawn



Question26: Write short note on Statocysts.

Answer: Statocysts

The statocysts are a pair of small white, cuticular, hollow, sub-spherical structures each statocyst lies inside the precoxa of each antennule, attached to its dorsal wall. The base of each statocyst is slightly depressed and the neck opens to the outside by a minute aperture situated on the concave roof of the precoxa of antennule. The opening is covered by a small fold of integument. The statocyst is innervated by a small statocystic branch of the antennular nerve. On cutting a section of the statocyst, its cavity is found full of minute



sand-particles. On removing the sand-particles, it is found that there is an oval ring of elongated delicate receptor setae, which are attached to the inner wall of the statocyst in an oval outline. Each receptor seta consists of a swollen base and a filamentous shaft which is sharply bent about the middle of its length. The base of seta is attached to the wall of the sac by a very thin arthrodial membrane and the shaft bears fine bristles beyond the bend. Each receptor seta is innervated at its base by a fine branch of statocystic nerve.

The statocysts perceive the direction of the force of gravity and function as the organs of orientation and equilibrium. The sand particles function as statoliths. With the change position of prawn in water, the sand particles press on the receptor setae and stimulate them. The stimulated setae convey the information to the brain through the nerves and, thus, animal becomes aware of its position and maintains it. The function of the statocysts is to maintain the balance and position. In moulting of prawn, the lining of the statocyst and its statoliths are cast off and then renewed.

Question27: Give an account of the characters of phylum Echinodermata with example.

Answer: GENERAL CHARACTERS

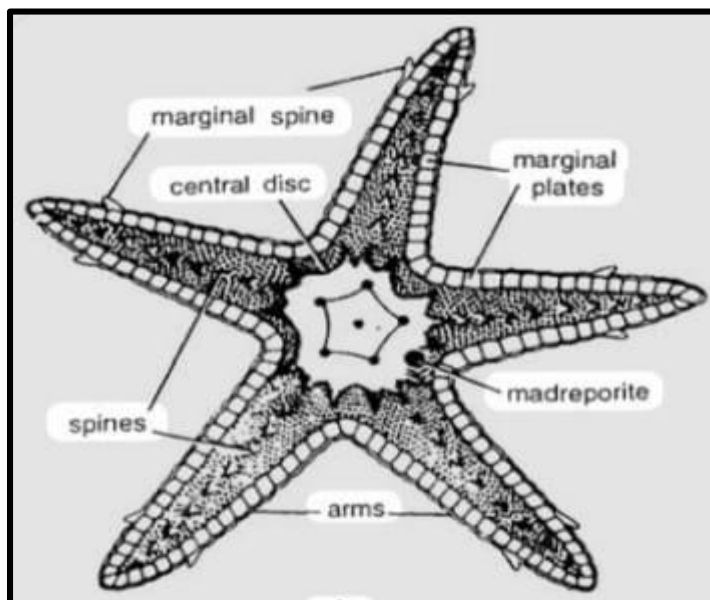
1. They are exclusively marine and are among the most common and widely distributed marine animals.
2. They occur in all seas from the intertidal zones to great depths.
3. They have an organ grade system of body organization.
4. Symmetry usually radial, nearly always pentamerous.
5. The body is triploblastic, coelomate with distinct oral and aboral surfaces, and without definite head and segmentation.
6. They are moderate to considerable size but none are microscopic.
7. Body shape globular, star-like, spherical, discoidal, or elongated.
8. The surface of the body is rarely smooth, typically covered by 5 symmetrically radiating grooves called ambulacra with 5 alternating inter-radii or inter-ambulacra.
9. The body wall consists of an outer epidermis, a middle dermis, and an inner lining of the peritoneum.
10. Endoskeleton consists of closely fitted, plates forming a shell usually called theca or test or may be composed of separate small ossicles.
11. The coelom is spacious lined by peritoneum, occupied mainly by the digestive and reproductive system, and develops from embryonic archenteron i.e. enterocoel.
12. Coelom of enterocoelous type constitutes the perivascular cavity of water vascular system; coelom fluid with coelomocytes.
13. Water -vascular system of coelomic origin, including podia or tube feet for locomotion and usually with a madreporite.
14. The alimentary canal is usually a coiled tube extending from the mouth located on the oral surface to the anus on the aboral or oral surface.
15. Vascular and haemal or blood lacunar system, enclosed in coelomic peripheral channels.
16. Respiratory organs include branchiae, tube-feet, respiratory tree, and bursae.
17. A nervous system without a brain and with a circumoral ring and radial nerve.
18. The excretory system is wanting.
19. Poorly developed sense organs include tactile organs, chemoreceptors, terminal tentacles, photoreceptors, and statocysts.
20. Sexes are usually dioecious with few exceptions.

Example: *Asterias, Echinus, Cucumaria, Ophiura*

Question 28: Write morphology of *Asterias*.

Answer: Morphology of *Asterias*

At the center of the oral surface of the central disc, a five-rayed aperture called mouth or actinosome is present. This opening is surrounded by a membranous peristome and it also possesses five groups of oral papillae. Five narrow grooves, called ambulacral grooves, one on each arm, run orally from the five-rayed aperture to the extremity of the arms. The edges of these grooves are provided with two or three rows of movable calcareous ambulacral spines. The aboral side contains numerous irregular rows of short and stout spines supported by ossicles. The oral and aboral surfaces of the body are separated by a row of prominent spines. Many dermal pores are situated in the spaces between the ossicles on the aboral side. From each dermal pore projects a very small delicate, finger-like, membranous retractile process, called dermal branchia or papula. It is respiratory in function.

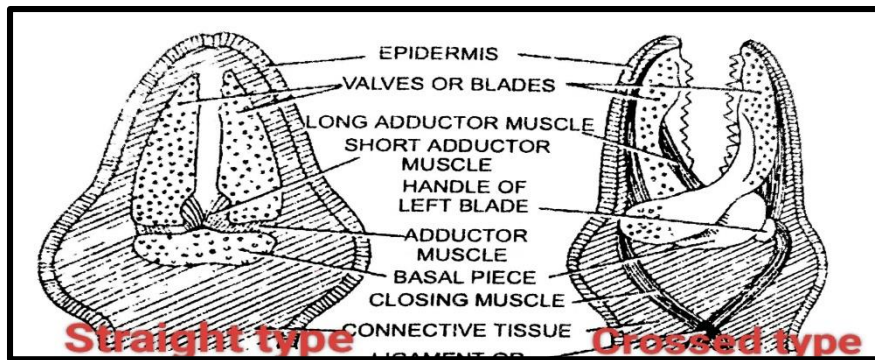


Question 29: Write short note on Pedicellariae.

Answer: Pedicellariae

Besides the spines and gills, entire aboral surface is covered by many whitish modified spine-like tiny jaws called pedicellariae. The oral surface also bears pedicellariae. Each pedicellaria consists of a long or short, stout, flexible stalk having no internal calcareous support. The stalk bears three calcareous plates: a basilar piece or plate at the extremity of the stalk and jaw. Pedicellariae having three calcareous pieces and a stalk are called forcipulate pedunculate pedicellariae. *Asterias* possesses two types of forcipulate pedunculate pedicellariae.

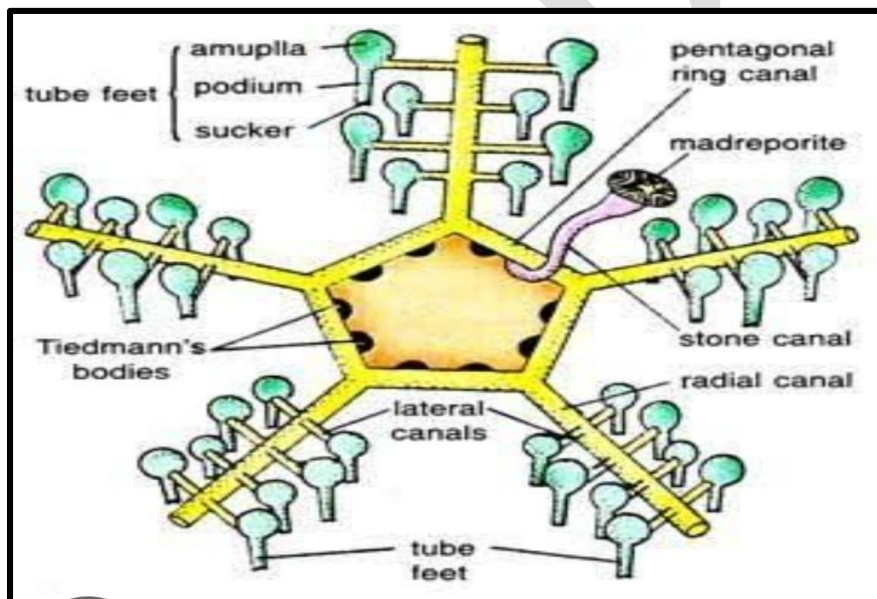
(i) Straight type (ii) Crossed type.



Question 30: Briefly describe the water vascular system of *Asterias*.

Answer: Water vascular system

- 1. Madreporite-** Madreporite is a rounded calcareous plate occurring on the aboral surface of the central disc in inter-radial position. Its surface bears a number of radiating, narrow or furrows. Each furrow contains many minute pores at its bottom. Each pore leads into a very short, fine, tubular pore canal which passes inward in the substance of the madreporite.
- 2. Stone canal.** The ampulla opens into S-shaped stone canal. The stone canal extends downwards (orally) and opens into a ring canal, around the mouth.



3. Ring canal. The ring canal or water ring is located to the inner side of the peristomial ring of ossicles and directly above to the hyponeural ring sinus. It is wide and pentagonal or five sided.

4. Tiedemann's bodies. The ring canal gives out inter-radially nine small, yellowish, irregular or rounded glandular bodies called Tiedemann's bodies.

5. Polian vesicles. The ring canal gives off on its inner side in the inter-radial position one, two or four, little, pear-shaped, thin-walled,

6, Lateral canals. In each arm, the radial canal gives out two series of short, narrow, transverse branches called lateral or podial canals. Each lateral canal is attached to the base of a tube foot.

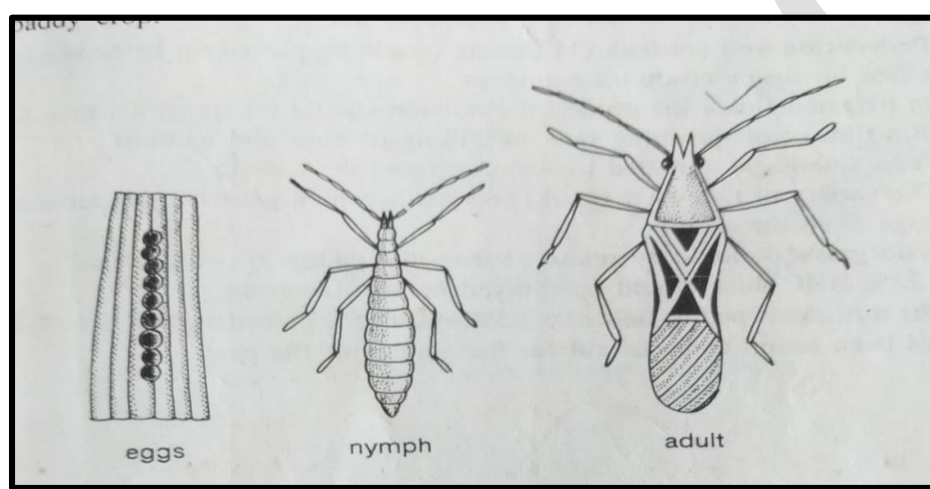
7. Tube feet. There are four rows of tube feet in each ambulacra groove. A tube foot is a hollow, elastic, thin-walled, closed cylinder or sac-like structure having an upper sac-like ampulla. The tube feet are locomotory and respiratory organs of Asterias.

Question 31: Write damage and control of Gundhi bug.

Answer: Gundhi bug

They are found clustering on paddy crop, although they are not of gregarious nature. Five generations have been recorded in paddy growing season. The whole life cycle is completed in 4 to 5 weeks. This pest multiplies from July to November hibernates from December to February and feeds on grasses from March June.

Damage. This is a major pest of rice and attacks the paddy field at the milky stage. The nymphs and adults both suck the juice from developing grains in months of August to October as a result of which the ears become white and do not form the mature grains. The attacked seeds are marked by black of fungus which appears around the punctured point.



Prevention and control. (1) Insects should be picked up by hand net and killed by strong-crude oil emulsion.

(2) In irrigated fields the crude oil emulsion should be sprayed which forms thin film of oil resulting into the killing of bugs and nymphs.

(3) Pests should be attracted by light trap and destroyed.

(4) The variety of rice used should be such in which grains come out at a late stage from the sheath.

(5) 0.25% BHC dust should be sprayed before flowering.

(6) The dusting of paddy fields by 2.5% aldrin, 5% chlordane and 5-10% BHC has been found to be useful for the control of the pest.

Question 32: Write short notes on Sugarcane leaf hopper.

Answer: Sugarcane leaf hopper

The Sugarcane Leafhopper, scientifically known as *Pyrilla perpusilla*, is a major destructive sap-sucking pest that targets sugarcane.

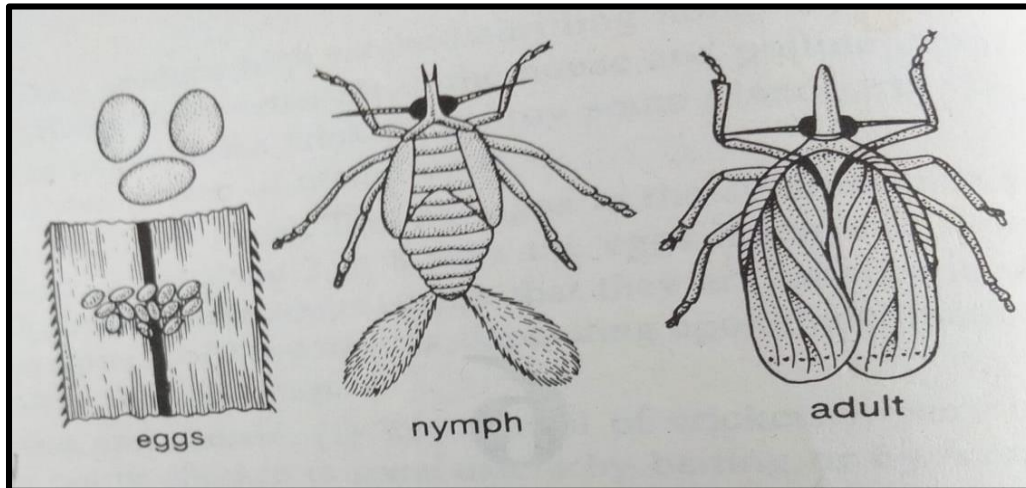
Life cycle

Adult: Brownish insect about 7–8 mm long with a distinct forward-pointing snout and translucent wings.

Eggs: Laid in clusters on the shaded lower surface of leaves, covered in a pale waxy material.

Nymph: Soft, pale brown to greenish body with characteristic white anal wax filaments.

Control.



Control

1. By collecting and destroying egg clusters. Use of hand net for nymphs and adults collection.
2. Clean cultivation should be done.
3. Lady bird beetle and epipyros spp. Are important biological control agents of this pest.
4. Granular insecticides used for the control of borers are equally effective against

Question33: Mention the major methods of rodent control.

Answer: Control of Rodents

1 Environmental sanitation

- * Keep surroundings clean and remove garbage regularly.
- * Store food and grains in rodent-proof containers.
- * Clear indoor and outdoor clutter, brush, and debris piles.

2 Mechanical methods

Use traps such as snap traps and cage traps.

Seal holes and cracks.

3 Chemical control

- * Rodenticides may be used to control rodent populations.

4 Biological control

Natural predators such as owls, snakes, and cats can help reduce rodent populations.

Question34: What are termites?

Answer: Termites

Termites are small, social insects that live in colonies and mainly feed on cellulose-rich materials such as wood, leaves, and plant debris. They are commonly called white ants, although they are not ants. Termites can cause serious damage to wooden structures and crops.

Caste System & Roles

Workers: Sterile, wingless, pale; forage for food and feed the colony.

Soldiers: Blind and wingless; possess large dark heads and jaws for defense.

Reproductives (Alates): Winged swarmers that leave mature colonies to mate and start new nests.

Control of Termites

Sanitation: Remove wood debris, dead plants, and other cellulose materials from around buildings.

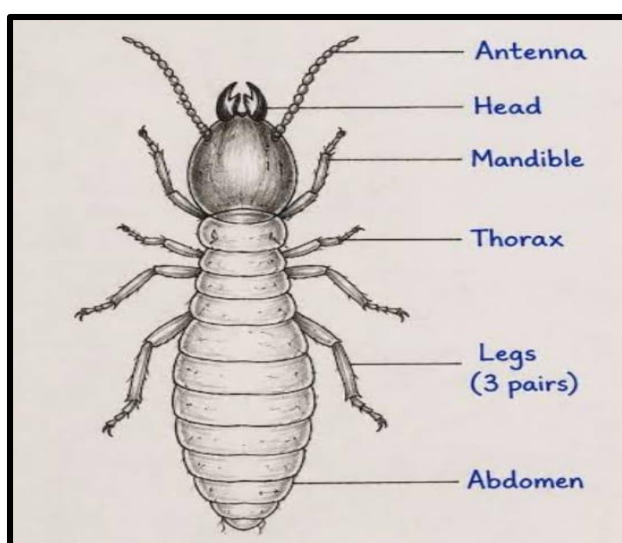
Physical barriers: Use termite-resistant materials.

Chemical control: Apply suitable termiticides to soil, wood, or affected areas.

Wood treatment: Treat wooden structures with approved preservatives to prevent termite attack.

Moisture control: Keep buildings and wooden materials dry.

Regular inspection: Check buildings, furniture, and wooden structures regularly for termite infestation.



Question 35: How can mosquitoes be controlled?

Answer: Control of mosquitoes

1. Personal protection. (a) In mosquito-infected area protective clothing may be used, such as will cover the exposed parts of the body, especially after sunset

(b) Mosquito repellents are also useful, like mosquito cream and odomos.

(c) While sleeping fine mesh mosquito nets prevent them from biting and houses could be screened to prevent entry of mosquitoes. (d) Painting walls with creos repels mosquitoes.

2. Destruction of adults. (a) Killing of mosquitoes can be done by spraying liquid insecticides like flit or D.D.T.

(b) Fumigation of dwellings with sulphur dioxide is also useful.

3. Destruction of larvae. It is easier and more effective to kill mosquitoes.

(a) **Oiling:** The breeding places of mosquitoes are spread with petroleum oils.

(b) **Natural enemies:** fishes and *Gambusia* live on larvae and Pupae of mosquitoes and their introduction in breeding place is helpful.

(c) **Chemical larvicide:** One part of D.D.T. emulsion in thirty million parts of water is used most extensively as a spray to kill larvae.

- 4. Elimination of breeding places.** For those mosquitoes which breed in rain-filled containers and cisterns
- 5. Preventive medicine.** Daily doses of quinine are effective against mosquito bites, but a successful vaccine has yet to be found for yellow fever.

Question 36: Write short note on Pisciculture.

Answer: Pisciculture

It is the farming of economically important fishes under controlled conditions. Pisciculture helps in integrated rural development by generating employment and income to fishing community and fish farmers.

Types of ponds

- a) Breeding pond:** Healthy and sexually mature male and female fishes are collected and introduced in this pond for breeding. The eggs released by the female are fertilized by the sperm and fertilized eggs float in water as frothy mass.
- b) Hatchling pits:** The fertilized eggs are transferred to hatching pits for hatching. Two types of hatching pits are hatcheries and hatching hapas.
- c) Nursery ponds:** The hatchlings are transferred from hatching pits after 2 to 7 days. The hatchlings grow into fry and are cultured in these ponds for about 60 days with proper feeding till they reach 2 - 2.5 cm in length.
- d) Rearing ponds:** Rearing ponds are used to culture the fry. The fish fry are transferred from nursery pond to rearing ponds and are maintained for about three months till they reach 10 to 15 cm in length. In these rearing ponds the fry develops into fingerlings.
- e) Stocking pond:** The stocking pond is also called as culture pond or production pond. These ponds are used to rear fingerlings upto the marketable size. Before releasing the fingerlings, the pond is manured with organic manure and inorganic fertilizers.

Cultivable food fishes in India

Indian major carps (Kendai) – Catla, Rohu, Mrigal, catfishes (Keluthi), Murrels (Veral) and Tilapia (Jilebi kendai) are cultured in freshwater. Sea bass (Koduva), Grey mullet (Madavai) and Chanos chanos (Milk fish) are the fishes cultured in marine water.

Question 37: What Is Induced Breeding?

Answer: Induced Breeding

Induced breeding is a technique where by ripe fish breeders are stimulated by pituitary hormone or any other synthetic hormone introduction to breed in captive condition. Then the carps being excited lay eggs in the pond water and the process is called induced breeding. This process of breeding is also known as hypophysation . Major carps are most important species from the point of view of their high food and nutritive values. Hence they have kept attention of scientists and aqua farmers. They have peculiar habit of breeding in running waters of rivers and streams where they have large space for movement.

Principle:

Environmental Factors

↓

Brain

↓

Hypothalamus (Releasing Hormone)



Pituitary Gland (Gonado Tropic Hormone (FSH & LH))



Gonads (Gonadotrophic Hormones)



Gamets (Spawning) Collection

Advantages of Induced Breeding

1. A pure spawn of a desired species is made available. The spawn obtained from the rivers are not pure. They are mixed with the spawns of other species and sorting of pure seed from the mixed spawn is not possible.
2. Desired species of carps can be cultured through the induced breeding.
3. Large numbers of eggs are available from a fish through induced breeding.
4. In the same season, a carp can be induced to breed more than once.

Question 38: Write a note on Composite Fish Farming.

Answer: Composite Fish Farming

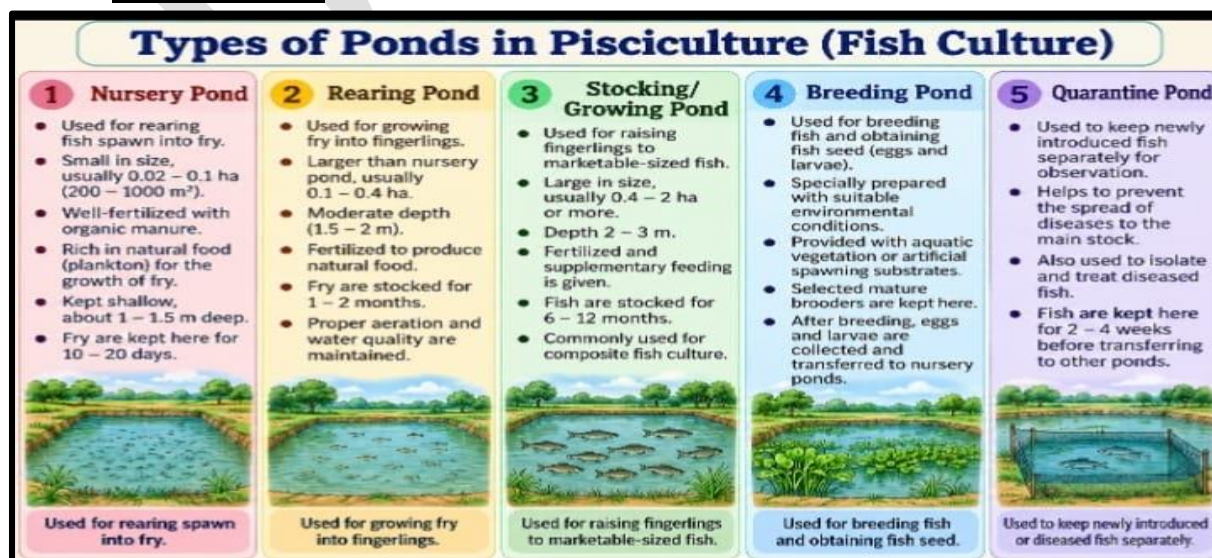
Composite fish farming or polyculture is the practice of rearing different compatible species of fish together in the same pond to obtain maximum fish production. Selected fishes should be fast-growing and compatible. Composite fish farming is a system where five or six compatible fish species with different feeding habits are grown together in a single pond to maximize productivity and resource use. They should have different feeding habits. Different species utilize different food resources and zones (niches) of the pond.

Advantages

1. Fully utilizes all available niches of the pond.
2. Reduces competition for food.
3. Compatible species do not harm one another.
4. Makes better use of available natural food.
5. Produces higher fish yield than monoculture.

Question39: Write types of pond in pisciculture.

Answer: Types of pond



Question40: Write Economic Importance of Fishes.

Answer: Economic Importance of Fishes

Economic Importance of Fishes

1. Fish as Human Food

- Rich source of high-quality protein, fat and vitamins A & D.
- Flesh contains 13–20% protein and provides 300–1600 calories per pound.
- Contains essential amino acids (at least 5) and minerals like phosphorus.
- Important marine fishes: salmon, cod, tuna, mackerel, sardines, etc.
- Important freshwater fishes: catla, rohu, trout, bass, perch, etc.
- Eggs of some fishes (e.g., sturgeon) are eaten as caviar.
- Used as food in many countries (sharks, rays, etc.); shark meat is sold as “gray fish”; shark fins are used in soups in SE Asian countries.
- Fresh fish is cooked, refrigerated, salted, smoked, canned or pickled.
- Fisheries provide food, trade and employment to thousands of people.

2. Fish as Food for Cattle

- Scrap and whole fish not fit for human use are dried and ground into fish meal.
- Used as artificial food for poultry, pig and cattle.
- Mainly prepared in Maharashtra, Andhra Pradesh, Tamil Nadu, Bengal and Kerala (from sardines, mackerel, ribbon fish, etc.).
- Cooked, pressed, dried and stored (airtight, sterilised).
- Contains ~60% protein and high calcium phosphate.
- Useful and low-cost feed; can be a cottage industry.

3. Fish Manure

- Unfit fish are dried and ground to make manure.
- Contains high nitrogen and phosphate.
- Used as rich fertiliser for fields.
- Mostly sardines are used; called fish guano.
- About 8.9% nitrogen and phosphate; much richer than ordinary cattle manure.

4. Fish Oils

- Two types: body oil and liver oil.
- Liver oil contains vitamins A & D; body oil has them in traces.
- Used in painting, varnishing, soap, candle, leather and steel industries.
- Medicinal value: source of vitamins A & D.
- Liver oil: 55–75% fat, 5–10% protein; used in medicines.

5. Fish Skin and Leather

- Shark and ray skin used for polishing material.
- Shark skin leather used for shoes, bags, etc.
- Puffer fish skin used for lanterns (Japan) and tribal war helmets.
- Shark and ray skins used by carpenters and metal workers.
- Tanned skin with scales called shagreen (abrasive).

6. Fish Glue

- Prepared from skin, head and trimmings.
- Has strong adhesiveness for paper, wood, leather and glass.

7. Isinglass

- Gelatinous product from air-bladders of sturgeon, carps, etc.
- Used for clearing wine, beer, making jelly and adhesive material.
- Air-bladder washed, flattened, dried and exported (best quality from Russia).

8. Fish Fin

- Fins of sharks are exported to China.
- Used for preparing soup.

9. Medicines and Disease Control

- Fish oil reduces risk of heart disease, stroke, cancer and other disorders.
- Helps in asthma, brain and eye health, prevents dementia, depression, diabetes and prematurity.
- Fishes like *Gambusia*, *Trichogaster*, etc., control mosquito larvae (prevent malaria, yellow fever).
- Useful in Ayurvedic and Unani medicines for ulcers, skin diseases, night blindness, etc.

10. Sports and Recreation

- Sport fishing is a popular recreation.
- Freshwater perch and trout, marine tarpon are common game fishes.
- Aquarium fishes (goldfish, angelfish, guppy, etc.) are kept as pets.

11. Fancy Articles

- Scales of garpike used for jewellery and novelties.
- Certain fish scales give a pigment (pearl essence) used for artificial pearls (especially in France).

12. Scientific Study

- Used in research on genetics, embryology, behaviour and pharmacology.
- Fishes like *Latimeria* and dipnoans have special anatomical features.
- Used for anatomical study (dogfish, perch, carp, etc.).

13. Industries

- Supports fishing, refrigeration, preservation, canning and manufacture of fish products and by-products.
- Provides livelihood to millions of people directly and indirectly.

Question41: Write Species of Silk worm.

Answer: Species of Silkworm

1. Mulberry silkworm (*Bombyx mori*)- it belongs to the family Bombycidae . The natural food of this worm is mulberry leaf, it is called mulberry silkworm. The silk produced by this moth is white in colour

2. Tasar silkworm (*Antheraea paphia*) - It belongs to the family Saturniidae . The caterpillar feeds on ber, oak and fig plants. The cocoon produced by this moth is hard and of hen's egg are which produces reelable brown coloured silk.

3. Muga silkworm (*Antheraea assama*) - It also belongs to the family Saturniidae and semi-domesticated in nature. The native place of this species Assam. The caterpillars of this worm feed on Machilus plant and the silk produced by this moth is known as Muga silk.

4. Eri silkworm (*Attacus ricinii*)- It also belongs to the family Saturniidae. It feeds on castor leaf. Cocoons cannot be reeled as in mulberry cocoons, therefore, it has to be spun. The cocoons this worm have very loose texture and the silk produced is called as "Arandi" .The threads are not glossy but much durable.

5. Oak silkworm (*Antheraea pernyi*) - It belongs to the family Saturniidae.They produce good quality of silk.

6. Giant silkworm (*Attacus altas*)- It belongs to the family Saturniidae is found in India and Malaysia. It is the largest of the living insects reaching up to eleven inches in wing-span.

Question 42: Write short note on life cycle of Silkworm.

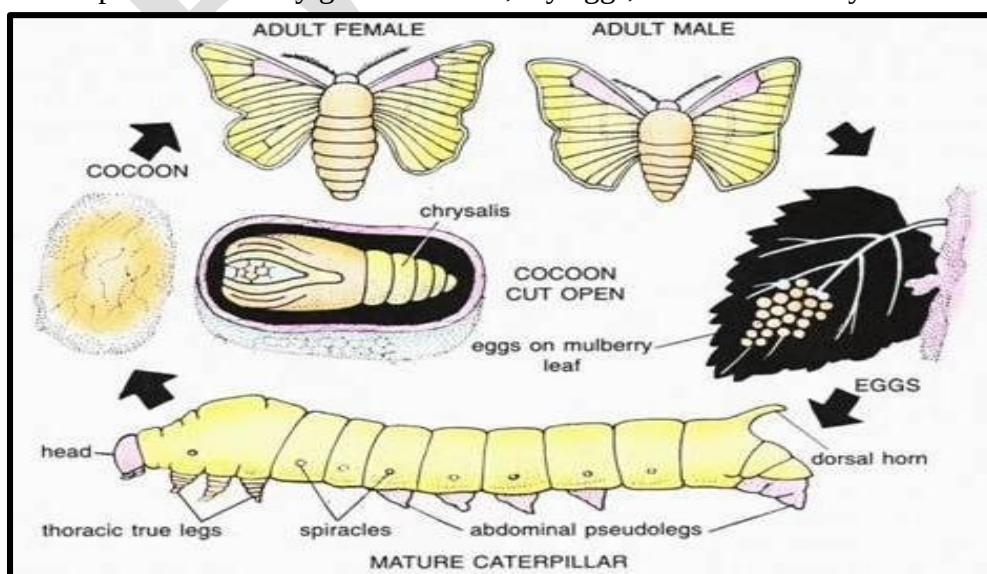
Answer: Life cycle of Silkworm (*Bombyx mori*)

Egg: A female silk moth lays 300 to 500 tiny eggs on mulberry leaves during spring.The dot-sized eggs to hatch after about 10 to 14 days.

Larva (caterpillar): A tiny caterpillar emerges from the egg. It eats mulberry leaves day and night for about 30 days, growing thousands of times larger.

Pupa (Cocoon): When fully grown, the silkworm stops eating and spins a protective cocoon around itself. Inside the cocoon, the in transforms into a pupa over 2 to 3 weeks. **Adult**

Moth: The fully developed white, hairy silk moth secretes a fluid to soften the cocoon and emerges. Adult silk moths cannot fly well and do not eat because they lack functional Mouth parts. Their only goal is to mate, lay eggs, and restart the cycle.



Question43: Write short note on Silk.

Answer: Silk

Silk is a natural protein fiber. The protein fiber of silk is composed mainly of fibroin (75-80%) and a smaller coating of sericin (20-25%). It is most commonly produced from the cocoons of certain insect larvae. The best-known silk is obtained from the cocoons of the larvae of the mulberry silkworm *Bombyx mori*, which are reared in captivity. It is produced by the silk glands of the larvae.

Applications of Silk

Textile industry – Used to make sarees, dresses, scarves, ties and other fine fabrics.

Medical field – Used in surgical sutures because of its strength and flexibility.

Decorative items – Used for embroidery, curtains, wall hangings and handicrafts.

Home furnishings – Used in upholstery, cushion covers and luxury bedding.

Industrial uses – Used in some specialized products because of its high tensile strength and durability.

Cosmetics and biomedical research – Silk proteins are used in some cosmetic formulations and biomaterial.

Question44: Write short note on Pebrine disease.

Answer: Pebrine disease

Pebrine is a serious and fatal protozoan disease that affects silkworms, caused mainly by the microsporidian parasite [*Nosema bombycis*]

Symptoms

- **Eggs:** Infected eggs show poor attachment to egg cards and fail to hatch uniformly.
- **Larvae:** Worms grow slowly, show uneven sizes, refuse to eat, and develop characteristic black or brown pepper-like spots on their skin.
- **Moths:** Adult moths show deformed wings and fail to fly or reproduce properly.

Prevention and Control

- **No Cure:** There is no chemical treatment or cure once a silkworm gets infected.
- **Microscopic Examination:** Grainages use mother moth examination to reject infected batches.
- **Disinfection:** Strict hygiene and chemical disinfection of rearing houses help stop the spread of spores.

Question 45: Define castes of honey bee.

Answer: Castes of honey bee

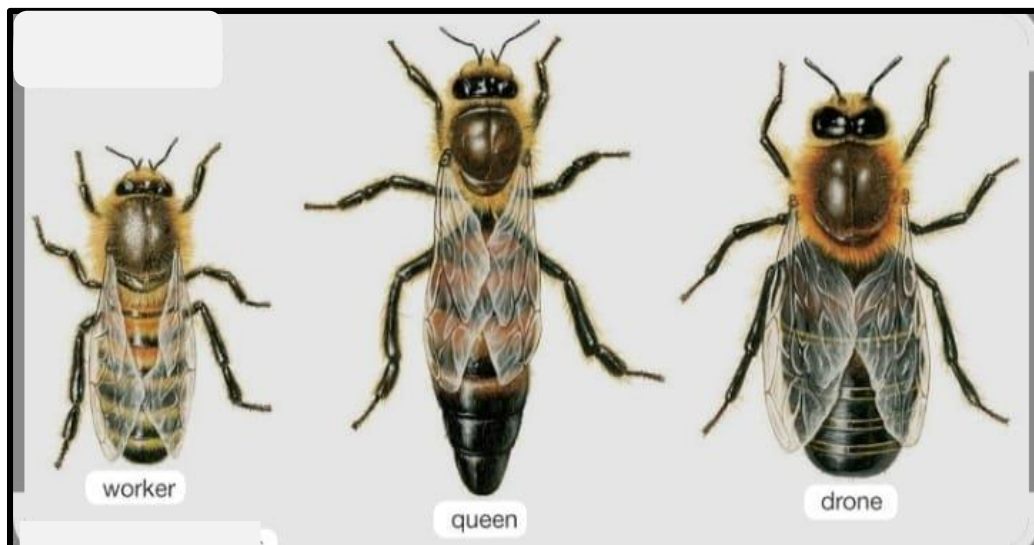
A honey bee colony consists of three distinct types of adult bees:

The Queen Bee: The only fertile, fully developed female in the colony; her main jobs are laying eggs (up to 2,000 a day) and producing pheromones to maintain hive order. Hatches from a fertilized egg and is fed exclusively on royal jelly throughout her larval stage. Queen can live for 2 to 3 years.

Worker Bees: Sterile females that make up the vast majority of the hive population. They handle cleaning, building combs, feeding larvae, guarding the hive, and foraging for nectar and pollen. Develop from fertilized eggs but receive royal jelly only for the first few days before switching to a diet of pollen and honey. Life span around 4 to 8 weeks depending on the active season.

Drones: The male bees of the colony. They do not have stingers and do not gather food; their sole purpose is to mate with a virgin queen. Develop from unfertilized eggs via

parthenogenesis (haploid). Lifespan Roughly 50 to 60 days, and they are often driven out of the hive before winter.



Question 46: Write species of Honey bee.

Answer: Species of Honey Bees

1. ***Apis dorsata* F.** (Rock bee). This is the largest bee, about 20 mm. in length, named as GIANT HONEY BEE SARANG and BOMBARA. A single comb may yield 60 pounds of honey which is the maximum amount for a comb. The workers are very smart and active which may pollinate 12,000 flowers daily, But due to its ferocious and irritable nature and migratory habit it is very difficult to domesticate them.

2. ***Apis indica* F.** (Indian bee) This is smaller than *A. dorsata*. They prefer to live in dark places and construct several parallel combs across the protected places like cavities of tree trunks, mud walls, earthen pots, thick bushes, wells and walls of the buildings. This species is very gentle in nature, so can be domesticated easily. The production of honey is 6 to 7 pound per comb

3. ***Apis florea* F.** (Little bee) This is smaller than *A. indica* and yields very small amount of honey. The bees are not of gregarious nature and form a single comb. Due to its docile nature and rare stinging behaviour the combs can be removed easily for the honey extraction.

4. ***Apis mellifera* F.** (European bee). Due to their docile nature they can be domesticated easily. Out of its several varieties, the Italian variety is reared everywhere in Europe and America in artificial hives for honey.

Question 47: Write short note on Honey and its importance.

Answer: Honey

Honey is a sweet, viscous natural substance produced by honeybees (*Apis* species) from the nectar of flowers. It is stored in the honeycomb and serves as food for bees.

Composition of honey

Fructose: ~38%

Glucose: ~31%

Water: ~17–18%

Sucrose: ~1–2%

Other sugars: ~5–10%

Minerals: calcium, potassium, iron, phosphorus, etc.

Organic acids: mainly gluconic acid

Enzymes: invertase, diastase, glucose oxidase

Small amounts of proteins, amino acids, vitamins and pigments.

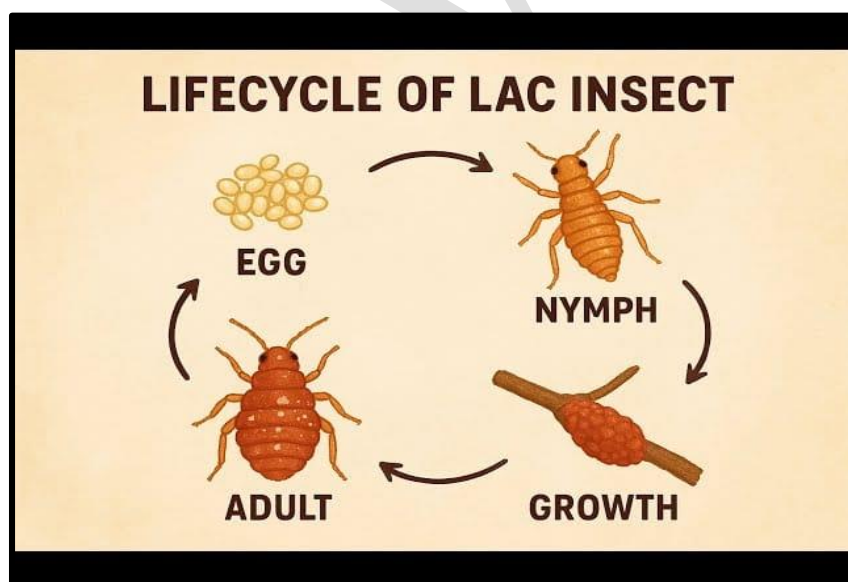
Importance of Honey

1. **Food:** Honey is a nutritious natural food and sweetener.
2. **Energy source:** It provides quick energy because it contains simple sugars like glucose and fructose.
3. **Medicinal use:** It is traditionally used in various medicinal properties.
4. **Food preservation:** Its low water availability and acidic nature can help inhibit the growth of many microorganisms.
5. **Cosmetics:** Honey is used in some skin-care and cosmetic products.
6. **Pollination:** Honeybees help pollinate many crops while collecting nectar, benefiting agriculture.

Question48: Describe briefly the Life Cycle of Lac Insect.

Answer: Life Cycle of Lac Insect

Female insect is viviparous, producing about 1000 nymphs, deep red in colour with black eyes. The larvae settle down on a suitable place of the host plant gregariously. A day or two after settlement, the larvae start secreting lac all around the body except on the rostrum, spiracles and on the tip of abdomen. The insect moults twice before reaching maturity. The male larvae produce elongated lac cells while the females produce oval cells. After the first moult larvae lose their legs, antennae and eyes and become bag like. After the 3rd moult the larvae pass on to a pseudo-pupal stage. Males emerge and copulate with the females and die. The female larvae never regain appendages and continue to remain under the lac cell, become



adults and reproduce. As the lac insects remain close together, lac secretion from adjacent cells coalesces with each other and forms a continuous encrustation on the tree branch.

Question49: Write uses of lac.

Answer: Uses of lac

Electrical Insulation: Acts as a good electrical insulator and coating for spark plugs, cables, and lamp sockets.

Surface Finishes: Used to make high-quality varnishes, shellac flakes, wood polishes, and lacquers for musical instruments like violins.

Adhesives & Molding: Applied as a glue for optical frames and ceramics, and in laminating paper boards.

Mirror Manufacturing: Used in the silvering process on the back of mirrors.

Tablet Coatings: Utilized as a protective glaze and finish for medicine pills and vitamin micro-encapsulation.

Food Glazing: Acts as an edible coating to preserve and add shine to fruits (like apples and citrus), chocolates, and candies.

Food Coloring: Derived lac dye is used to tint certain juices, candies, and sauces.

Beauty Products: Incorporated into formulations for nail polish, lipsticks, and skin cosmetics.

Traditional Crafts: Used for traditional bangle making, filling gold and silver ornaments, and molding toys.

Sealing Wax: Traditionally used for sealing official documents and by postal services.

Question50: Write short note on Vermiculture.**Answer: Vermiculture**

Vermiculture is the scientific process of breeding and raising earthworms to convert organic waste into nutrient-rich fertilizer called vermicompost.

How to do Vermiculture?**Step 1: Setting Up Your Vermicompost Bin**

The vermiculture process begins with setting up a worm bin, a container designed to hold the worms and their food.

Step 2: Choosing the Right Materials

The next step in vermiculture is to choose the right materials to feed your worms.

Step 3: Adding the Worms

After your worm bin is filled with suitable materials, it's time to add the worms.

Step 4: Maintaining the Worm Bin

Once your worm bin is set up, it is important to maintain it properly.

Step 5: Harvesting the Compost

After several months of vermicomposting, the worms will have converted the organic waste into nutrient-rich compost.

Benefits

1. Earthworms feed on decomposing organic matter.
2. The final product vermicompost, improves soil fertility.
3. Produces high-grade organic manure superior to chemical fertilizers.
4. Enhances soil structure, water retention, and microbial activity.
5. Diverts household and farm waste away from landfills.
6. It is an eco-friendly method of waste management.