
EXERCISE 8 MOLLUSCA-I: OBSERVATION AND CLASSIFICATION OF SPECIMENS

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8.1 INTRODUCTION

Mollusca is one of the largest phylum after Arthropoda. It has more than 80,000 living species. In Latin "Mollis" means soft. The bodies of molluscs are soft but covered by hard, protective shells. This increased the chances of their preservation, which resulted in a rich fossil record; there are more than 35,000 known fossil species of phylum Mollusca. The study of Mollusca is termed as **malacology** and that of their shells **conchology**.

Molluscs are widely distributed. The phylum includes slugs, snails, chitons, oysters, clams, squids and octopuses and they greatly vary in form, structure, habits and habitats. They are highly adaptive and are found in all possible habitats, aquatic and terrestrial, except aerial. They generally inhabit shallow waters, but some are also found deep inside the sea (12,000 meters). In this exercise you will study some preserved representative molluscs and learn to classify them. Before you begin your study it would be helpful to read Unit 6 of Block 2, LSE-09 again.

Objectives

After performing this exercise you should be able to:

- identify the specimens of *Chiton*, *Pila*, *Dentalium*, *Octopus* and *Nautilus* and also two larval forms namely glochidium and veliger belonging to phylum Mollusca and give their scientific and common names.
- draw labelled diagrams of the identified genera.
- identify, describe and draw the larval stages glochidium and veliger.
- classify each of the identified mollusc up to the level of class
- list characters justifying their classification and mention special features, if any.
- mention the habit and geographical location of each of the identified genera.
- mention economic importance, if any, of each of the identified genera.

8.2 MATERIAL REQUIRED

1. Preserved specimens of *Chiton*, *Pila*, *Dentalium*, *Octopus* and *Nautilus*.
2. Prepared slides of glochidium and veliger larvae.
3. Note book and pencil, eraser, etc.

8.3 GENERAL CHARACTERS AND OUTLINE CLASSIFICATION

General Characters

1. Molluscs are generally aquatic animals, found mostly in sea water, some are freshwater forms and a few are terrestrial.
2. Triploblastic, coelomate, body not metamericly segmented (these terms have already been well explained to you in Unit 5 Block 2, LSE-09).
3. Body is fundamentally bilaterally symmetrical; members of class Gastropoda undergo **torsion** and hence become asymmetrical (see Fig. 8.1).
4. These animals have soft body, which can be divided into three parts : i) Head – foot. ii) Visceral mass and iii) Mantle.
5. The **mantle or pallium** is a membrane (not very thin) that covers the soft body.
6. The space between mantle and body is called **mantle cavity**, into which lie the gills and openings of the digestive, excretory, and reproductive systems.
7. The outer side of the mantle secretes a hard calcareous shell forming a protective covering all around the body.
8. The shells may be bivalved (two pieces) or univalve (single piece) spiral or cone like, internal or seduced or even absent in some.
9. The alimentary canal is simple, coiled and complete. In some buccal cavity has a cutting organ **radula** bearing rows of teeth.
10. Respiration is generally by gills or body wall and in some, also by pulmonary sac.
11. The circulatory system is open except in cephelopods where it is closed and the blood is confined to vessels. Respiratory pigments are carried in solution in the blood rather than confined to blood cells.
12. Excretion is by kidneys that open in the pericardial cavity.
13. Nervous system consists of paired cerebral, pleural, pedal and visceral ganglia, joined by commissures and connectives.
14. Sense organs are simple eyes, tentacles and **osphradia**.
15. The sexes are separate; fertilisation may be internal or external. Asexual reproduction not found.
16. During the embryonic development cleavage is spiral, determinate and unequal.
17. The development may be direct or indirect through larval stages like trochophore, glochidium, veliger, etc.

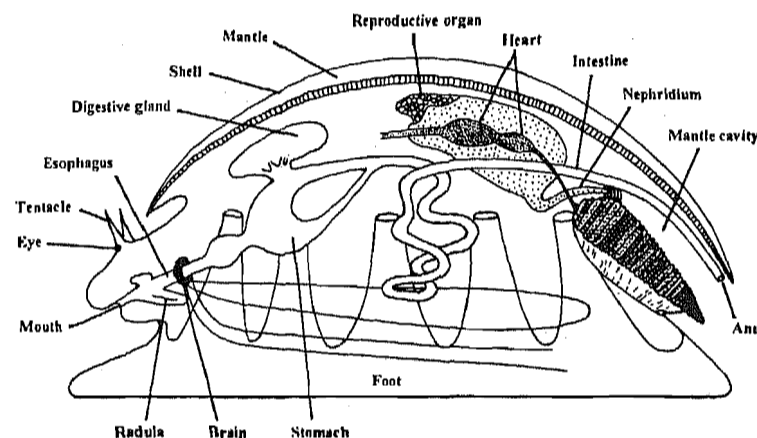


Fig.8.1: Generalised mollusc. Though this is a hypothetical plan none the less, it is useful in visualising a general body plan.

Classification

Phylum Mollusca has been divided into seven classes, the distinction is based largely on what kind of foot and shell the animal has. In this exercise you will study examples from only four classes namely, Polyplacophora (*Chiton*), Scapliopda (*Dentalium*), Gastropoda (*Pila*) and Cephalopoda (*Nautilus* and Octopus) out of the total seven. But it is useful to know about all other classes too. Table 8.1 gives a comparative account of the seven classes.

Table 8.1: Classes of Phylum Mollusca.

Aplacophora e.g. <i>Neomania</i>	Aplacophora e.g. <i>Neomania</i>	Polyplacophora e.g. <i>Chiton</i> (in your course)	Scaphopoda e.g. <i>Dentalium</i> (in your course)	Gastropoda e.g. <i>Pila</i> (in your course)	Bivalvia e.g. <i>Unio</i>	Cephalopoda e.g. Octopus and <i>Nautilus</i> (in your course)
1. Worm like	1. Elongated with broad foot	1. Elongated, dorsoventrally flattened	1. Conical, elongated body	1. Body twisted	1. Elongated bilaterally compressed	1. Body elongated
2. Shell absent, calcareous scales present	2. Univalve, limpet like shell present	2. Shell made up of eight dorsal plates	2. One piece tubular shell present	2. Coiled shell present	2. Bivalve (two pieces) shell present	2. Shell reduced and internal in octopus and well developed only in <i>Nautilus</i>
3. Bilaterally symmetrical	3. Bilaterally symmetrical	3. Bilaterally symmetrical	3. Bilaterally symmetrical	3. Asymmetrical due to torsion	3. Bilaterally symmetrical	3. Bilaterally symmetrical
4. Head absent: radula present or absent	4. Head absent, radula present	4. Reduced head, radula present	4. Head absent, radula present	4. Distinct head present, radula present	4. Head absent, radula absent	4. Very well developed head present, radula present
5. Foot not very developed	5. Foot small muscular	5. Foot, broad sole-like	5. Foot elongated tongue-like	5. Foot broad sole like	5. Foot elongated tongue like	5. Foot modified into oral arms
6. Gills absent respiration by secondary respiratory structures	6. Respiration by six pairs of gills	6. Respiration by many gills	6. Gills absent exchange of gases through mantle	6. Aquatic respiration by gills and aerial respiration by pulmonary sac	6. Respiration by pairs of gills	6. Respiration by two elongated gills
7. Poorly developed nervous system	7. Poorly developed nervous system	7. Moderately developed nervous system	7. Moderately developed nervous system	7. Well developed nervous system	7. Well developed nervous system	7. Very highly developed nervous system
8. No larval stage	8. No larval stage	8. Development through larva trochophore	8. Developed through trochophore larva	8. Developed through veliger larva	8. Developed through glochidium larva	8. No larval stage

8.4 OBSERVATION OF SPECIMENS

You will be given preserved specimen of molluscs. Observe them carefully and note their distinctive features and classify them accordingly.

8.4.1 *Chiton*

Special Characters

- i) They are commonly known as "coat-of-nail shells".
- ii) They have flat, sole-like foot, they remain attached to surface and move very slowly
- iii) They are about **2-8 cm** long and 3 to 5 cm wide and have a dull turquoise or blue coloured appearance.
- iv) The shell covers dorsal side and is made up of eight transverse movable, **overlapping** plates. The mantle forms a girdle around the plates (**Fig.8.2a**).
- v) Head, flattened with a slit-like mouth, on both sides of the body are gills (**Fig.8.2 b**).
- vi) Genital, excretory openings and anus are on ventral side towards the posterior end (**Fig.8.2 b**).
- vii) The alimentary canal is simple. The radula bears many rows of teeth, and each row has about 17 teeth.
- viii) Open circulatory system with a respiratory pigment called haemocyanin.
- ix) Specialised sensory organs absent. They have light and touch sensitive points called aesthetes.
- x) Sexes are separate, no sexual dimorphism.

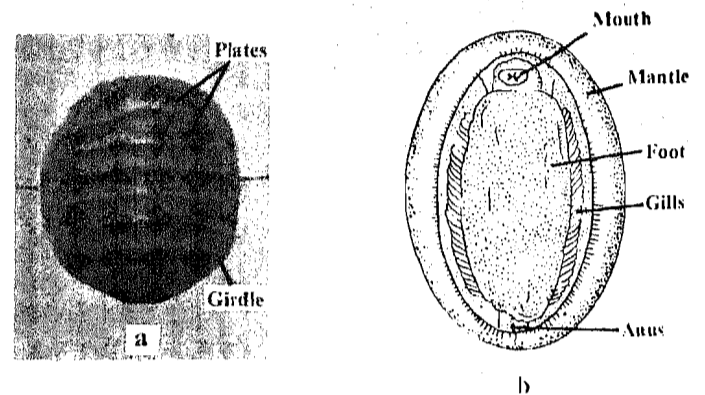


Fig.8.2: *Chiton*. (a) Dorsal view; (b) Ventral view.

Habit and Habitat

Marine. Mostly littoral or sub-littoral, occurring in shallow tidal areas. In India they are most commonly seen on the sea side rocks in Bombay and Rameshwaram. They are nocturnal and herbivorous and feed on diatoms and seaweeds.

Geographical Distribution

Chitons are found in all seas except polar seas.

Economic Importance

Chitons are eaten by Red Indians in USA therefore, sometimes also called as "Sea beef".

Classification and its Justification

Kingdom	Animalia	Animals, multi-cellular organisms with cells that lack a cell wall, many capable of movement or movement of some of their body parts or capable of movement at some time of their life cycle; heterotrophic nutrition.
Phylum	Mollusca	triploblastic, coelomate body divided into head-foot, visceral mass, and the mantle which secretes the shell; radula present in most.
Class	Polyplacophora	elongated dorsoventrally flattened body with reduced head; bilaterally symmetrical; radula present; shell of eight dorsal plates; foot broad and flat; gills multiple.
Genus	<i>Chaetoplura/Chiton</i>	
Common name	Chiton	

8.4.2 Dentalium

Special Characters

- i) Commonly known as "Elephant tooth" or "The tooth" or "Tusk shell" because it looks like a miniature elephant tusk.
- ii) *Dentalium* is about 25 cm long and 2-5 cm in diameter.
- iii) The body is completely enveloped in a tubular mantle and shell.
- iv) From the broader end of shell (which remains in the deeper side of burrow) projects out Soot, mouth and small tentacles called **captacula** (Fig.8.3).
- v) Captacula arc sensory, prehensile and tactile, their tips are sticky so they also help in food collection.
- vi) Gills are absent; exchange of gases takes place through the thin, vascular mantle.
- vii) Sexes are separate. Development includes veliger larva .

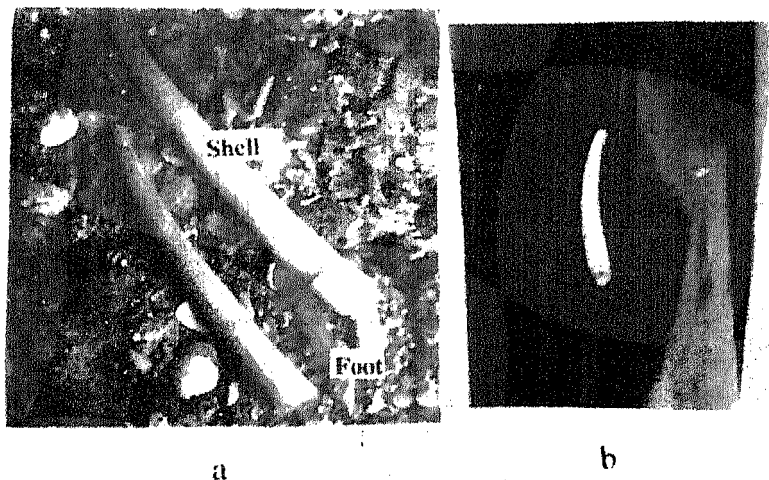


Fig. 8.3: *Dentalium*. a) In its natural habitat. b) Preserved specimen.

Habit and Habitat

Dentalium is burrowing and marine and it lives in single tubular shell open at both ends. Feeds on protozoa and detritus from the substrate.

Geographical Distribution

Widely distributed except for the cold polar waters. The common species found in Indian seas is *Dentalium octogonum*.

Economic Importance

Red Indians of USA use the empty shells to make ornaments.

Classification and its Justification

Kingdom	Animalia	Animals, multi-cellular organisms with cells that lack a cell wall, many capable of movement or movement of some of their body parts or capable of movement at some time of their life cycle; heterotrophic nutrition.
Phylum	Mollusca	triploblastic coelomate unsegmented body divided in to head-foot, visceral mass, and the mantle which secretes the shell; radula present in most.
Class	Scaphopoda	body enclosed in a one piece shell open at both ends; conical foot; mouth with radula and tentacles; head absent; mantle for respiration
Genus	<i>Dentalium</i>	
Species	<i>octogonum</i>	
Common Name	Elephant tusk shell	

8.4.3 Pila**Special Characters**

- i) The body undergoes **torsion** and is protected by a spiral univalved shell (Fig.8.4).
- ii) The largest part of shell is called **body whorl**. The shell is coiled clockwise around an imaginary column and is thus called **dextral**.
- iii) The soft visceral hump **remains** projected inside the shell, whereas head, foot **are** exposed. At the time of danger these two are also withdrawn in the safe environs of shell.
- iv) The head **bears** tentacles, eyes and mouth, bordered with left and right nuchal lobes (**siphons** to draw and drive water).
- v) Alimentary canal very well developed with radula.
- vi) A large well-developed digestive **gland** present. Respiration by **one** pair of gills for **aquatic condition** and by **pulmonary sac** when on land.
- vii) Excretion by kidneys, circulatory system open, nervous **system** well developed and **forms the figure of 8** due to torsion.
- viii) Sense organs are **osphradium**, eyes, statocyst and tentacles.
- ix) Males and **females** separate, breed in rainy season. **Development** through veliger larva.

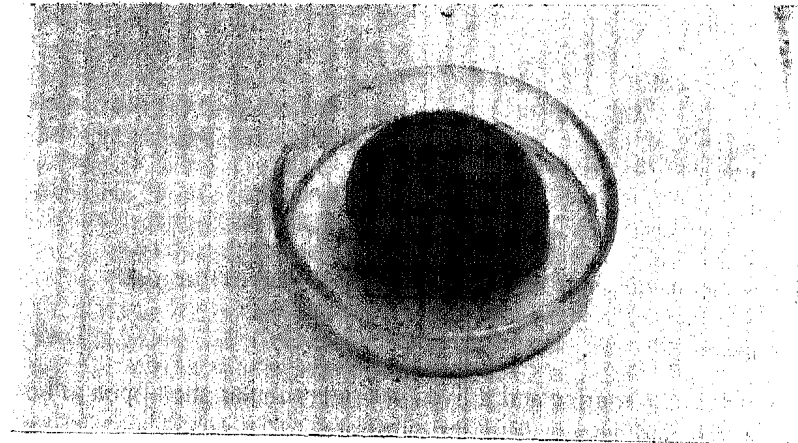


Fig.8.4: *Pila globosa*.

Habit and Habitat

Pila undergone extensive adaptive radiation and has invaded two habitats water and land. Food consists chiefly of succulent aquatic vegetation.

Geographical Distribution

Very widely distributed in fresh water and moist land around the oriental (in India, Myanmar, Sri Lanka, Vietnam, Philippines) and Ethiopian (in Africa, Arabia and Madagascar) regions.

Economic Importance

Used as food, shell used for decoration. It is a favorite item for dissection in biology laboratories

Classification and its Justification

Kingdom	Animalia	Animals, multi-cellular organisms with cells that lack a cell wall, many capable of movement or movement of some of their body parts or capable of movement at some time of their life cycle; heterotrophic nutrition.
Phylum	Mollusca	triploblastic coelomate unsegmented body divided in to head-foot, visceral mass, and the mantle which secretes the shell; radula present in most.
Class	Gastropoda	body asymmetrical; usually in univalve coiled Shell; head well developed with radula; foot large and flat; shows torsion
Subclass	Prosobranchia	gills present; operculum present; mostly marine only a few freshwater species
Genus	<i>Pila</i>	
Species	<i>globosa</i>	
Common Name	apple snail	

8.4.4 Octopus

Special Characters

- i) The body (Fig.8.5) contains visceral mass but to a lay person it looks like a head, though the head is present but it is small.
- ii) The muscular foot modifies and gives rise to 8 long arms (Fig. 8.5).
- iii) Each arm has double rows of suckers.
- iv) Arms are used for locomotion, food capturing and ingestion also in offense and defense.
- v) In males tip of 3rd right arm is broad spoon like called **hectocotyl**, it is used to transfer spermatophores into the mantle cavity of female.
- vi) The typical molluscan shell is absent; it is actually reduced and found embedded into the body wall, therefore, not visible.
- vii) Octopus has a very well developed "**ink gland**", it releases a dark coloured fluid from it at the time of danger blinding the predator and making a fast escape from that area.
- viii) This animal makes its movements using undulating arms but in emergency situations, it squirts out a lot of water through the funnel (Fig. 8.5 a) with a force and dashes away in the opposite direction (based on the law of equal and opposite reaction) through "**jet propulsion**".
- ix) The food is captured by arms, the mouth has powerful beak-like jaws to ingest it into small pieces and then further grinding is done by radula.

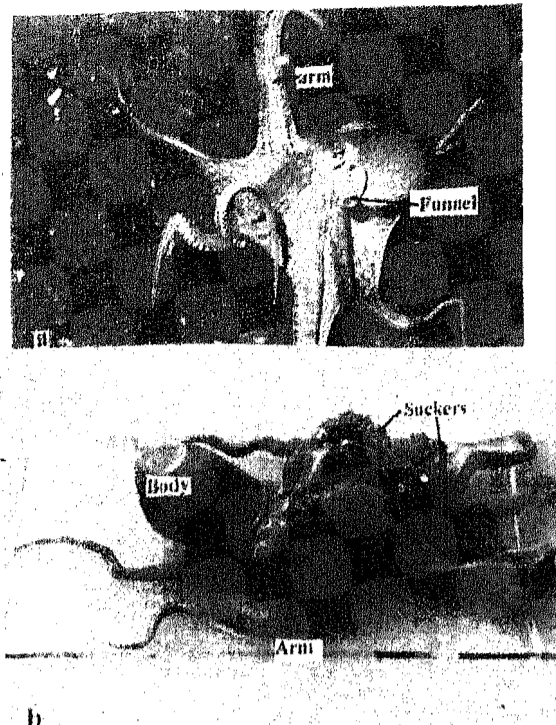


Fig.8.5: Octopus. a) In its natural habitat. b) Preserved specimen.

Habit and Habitat and Distribution

Octopuses are marine, bottom dwelling, nocturnal animals. Their food is crab, bivalves, snails, fish, etc. Experiments in labs have identified them as intelligent learners.

Geographical Distribution

Octopuses are very widely distributed; found in Europe, India, and Atlantic and Pacific coasts – Alaska to lower California and Cape Cod.

Economic Importance

In many countries its meat is considered a delicacy.

Classification and its Justification

Kingdom	Animalia	Animals, multi-cellular organisms with cells that lack a cell wall, many capable of movement or movement of some of their body parts or capable of movement at some time of their life cycle; heterotrophic nutrition.
Phylum	Mollusca	triploblastic coelomate unsegmented body divided in to head-foot, visceral mass, and the mantle which secretes the shell; radula present in most.
Class	Cephalopoda	shell often reduced or absent; head well developed with radula; head with arms or tentacles; foot modified in the form of a funnel; nervous system of well developed ganglia, centralised to form a brain; sexes separate; development direct.

Genus *Octopus*
Species *punctatus*
Common Name Devil- fish

8.4.5 *Nautilus*

Special Characters

- i) *Nautilus* is the only living cephalopod which has a well developed beautiful slightly spiral shell (Fig. 8.6 c). The shell is divided internally by simple partitions (Fig. 8.6 b).
- ii) The large part of body remains enclosed inside the shell in the body chamber, the rest empty chambers are filled with air to give buoyancy to animal.
- iii) 60-90 prehensile tentacles without suckers surround the mouth and project, out of the shell (Fig. 8.6 a). Two thick tentacles form protective hood.
- iv) Mouth has strong beak and radula.
- v) Ink gland is absent.
- vi) It can swim by "jet propulsion" like octopus.

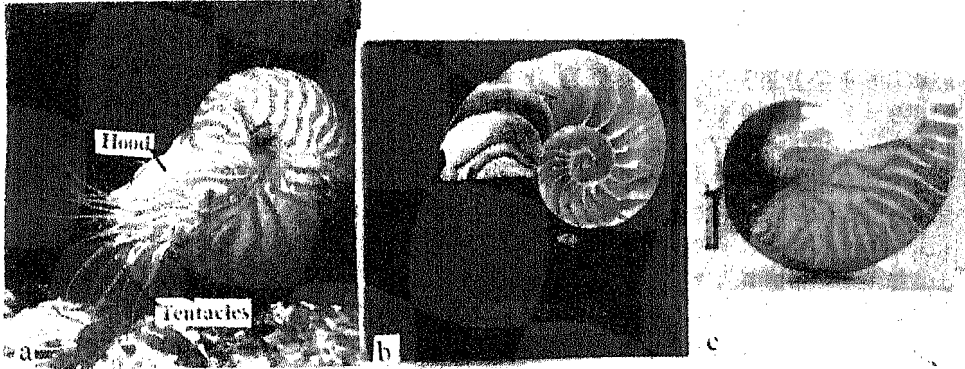


Fig. 8.6: a) *Nautilus* showing tentacles. b) Internal chambers in the shell. c) Shell of *Nautilus*.

Habit and Habitat

Marine, prefers deep tropical waters, gregarious, nocturnal, crawls at the bottom; feeds on crabs and shellfish.

Geographical Distribution

Nautilus is found in tropical waters of Indian and Pacific Oceans.

Economic Importance

1. The animal is eaten in many European, Far Eastern countries.
2. The shells are used in making ornaments and also as decorative pieces.

Classification and its Justification

Kingdom	Animslia	Animals, multi-cellular organisms with cells that lack a cell wall, many capable of movement or movement of some of their body parts or capable of movement at some time of their life cycle; heterotrophic nutrition.
Phylum	Mollusca	triploblastic coelomate unsegmented body divided into head-foot, visceral mass, and the mantle which secretes the shell; radula present in most.
Class	Cephalopoda	shell often reduced or absent; head well developed with radula; head with arms or tentacles; foot modified in the form of a funnel; nervous system of well developed ganglia, centralized to form a brain.

Genus *Nautilus*
 Species *pompillus*
 Common Name "Pearly Nautilus".

8.5 LARVAL STAGES OF MOLLUSCA

You would recall from Unit 6 of Block 2, LSE 09, that many aquatic molluscs pass through free swimming larval stages like the trochophore, and veliger. Fresh water bivalves, however, have another larval stage, the glochidium which develops internally and is discharged with the excurrent flow. We will study the glochidium and the veliger in this exercise.

8.5.1 Glochidium Larva

Glochidium is the larva of freshwater bivalves, for example, *Unio*.

- i) Glochidium means "Point of an arrow".
- ii) A glochidium measures 0.2 mm in length and is 0.5 mm wide.
- iii) In *Unio*, fertilisation is internal. The male releases the sperms near the female. With the water current sperms enter the female's body (due to chemo attraction) through inhalant siphon. From there they reach the infrabranchial chamber, then they swim up to gills, where ova are already present in water tubes, and fertilisation takes place.
- iv) The early development takes place inside the gill (in such females gills are called brood pouch or marsupiums), when the glochidium larvae are ready they move to the suprabranchial chamber, and then out of their mother's body through the exhalant siphon.
- v) Glochidium has a bivalve shell, mantle, sensory bristles, hooks, teeth and a byssus thread (Fig. 8.7),
- vi) They keep lying in this position until a fish passes by; getting in contact with fish they snap close their shells and get a firm grip on the gills of the fish with the help of hooks and teeth.
- vii) The byssus bores through the tough skin of the fish, this makes the attachment stronger and allows the developing mouth to ingest food through that hole.
- viii) The glochidium gets good quality protein from fish and grows faster.
- ix) After a few days, the byssus disappears, so do hooks and teeth. Mouth and gills develop. The larva leaves the fish and settles to the bottom and starts feeding on aquatic micro food particles and grows into a young *Unio*.

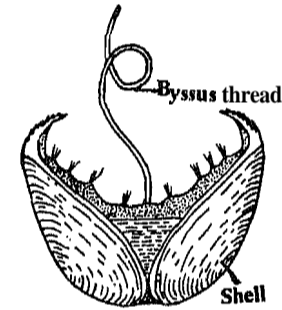


Fig. 8.7: A glochidium larva of *Unio*.

8.5.2 Veliger Larva

After the eggs are laid, the gastrula first changes to trochophore (not in *Pila*) and then to free-swimming veliger larva (not in *Pila*). Place the permanent mount of the larva under the low power of the microscope and observe the following features:

- i) Veliger is the larval stage in the development of most aquatic molluscs, especially in gastropods and bivalves.
- ii) The larva looks like a face with turban on the head (fig. 8.8).

3. What is the function of osphradia?

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