



NETAJI SUBHAS OPEN UNIVERSITY
Choice Based Credit System
(CBCS)

SELF LEARNING MATERIAL

HZO
ZOOLOGY

CC-ZO-01

Under Graduate Degree Programme

PREFACE

In a bid to standardize higher education in the country, the University Grants Commission (UGC) has introduced Choice Based Credit System (CBCS) based on five types of courses viz. *core, discipline specific, generic elective, ability and skill enhancement* for graduate students of all programmes at Honours level. This brings in the semester pattern, which finds efficacy in sync with credit system, credit transfer, comprehensive continuous assessments and a graded pattern of evaluation. The objective is to offer learners ample flexibility to choose from a wide gamut of courses, as also to provide them lateral mobility between various educational institutions in the country where they can carry their acquired credits. I am happy to note that the university has been recently accredited by National Assessment and Accreditation Council of India (NAAC) with grade ‘‘A’’.

UGC (Open and Distance Learning Programmes and Online Programmes) Regulations, 2020 have mandated compliance with CBCS for UG programmes for all the HEIs in this mode. Welcoming this paradigm shift in higher education, Netaji Subhas Open University (NSOU) has resolved to adopt CBCS from the academic session 2021-22 at the Under Graduate Degree Programme level. The present syllabus, framed in the spirit of syllabi recommended by UGC, lays due stress on all aspects envisaged in the curricular framework of the apex body on higher education. It will be imparted to learners over the six semesters of the Programme.

Self Learning Materials (SLMs) are the mainstay of Student Support Services (SSS) of an Open University. From a logistic point of view, NSOU has embarked upon CBCS presently with SLMs in English / Bengali. Eventually, the English version SLMs will be translated into Bengali too, for the benefit of learners. As always, all of our teaching faculties contributed in this process. In addition to this we have also requisitioned the services of best academics in each domain in preparation of the new SLMs. I am sure they will be of commendable academic support. We look forward to proactive feedback from all stakeholders who will participate in the teaching-learning based on these study materials. It has been a very challenging task well executed, and I congratulate all concerned in the preparation of these SLMs.

I wish the venture a grand success.

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Vice-Chancellor

Netaji Subhas Open University
Under Graduate Degree Programme
Choice Based Credit System (CBCS)
Subject : Honours in Zoology (HZO)
Course : Animal Diversity, Structure and Development (Practical)
Course Code : CC - ZO - 01

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**Netaji Subhas Open
University**

**UG Zoology
(HZO)**

**Course : Animal Diversity, Structure and Development
(Practical)**

Code : CC - ZO - 01

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Units : 1 □ Study of specimens with proper reasons

Structure

1.0 Objectives

1.1 Introduction

1.2 Study of different invertebrate specimens

1.3 Study of different vertebrate and invertebrate chordate specimens with proper reasons

1.0 Objectives

By studying this unit learners would be able to understand about the systematic position and identifying characteristics of different invertebrate and vertebrate species.

1.1 Introduction

Species identification has traditionally been based on morphological data and implemented in dichotomous identification keys. With easy access to increasingly affordable DNA sequencing, specimens can also be identified through sequence similarity in taxonomically curated sequence data base. In this unit, study of different invertebrate, invertebrate - chordates and vertebrates has been discussed in details.

1.2 Study of the different invertebrate specimen with proper reasons

1. *Amoeba* sp.

a) Systematic position (According to Levine et. al., 1980)

Sub-kingdom : Protozoa

Phylum : Sarcomastigophora

Sub-phylum : Sarcodina

Genus : Amoeba

Specimen : *Amoeba* sp.

b) Systematic identification with reasons

Sub-kingdom : Protozoa

- (i) Microscopic, single celled eukaryotic organisms.
- (ii) Nucleus—single or many.
- (iii) Pseudopodia, cilia and flagella are locomotory organelles.
- (iv) Chloroplast may or may not be present.
- (v) Flagella or pseudopodia, or both are present.
- (vi) The nucleus is monomorphic.

Sub-phylum : Sarcodina

- (i) Pseudopodia present.
- (ii) Body is naked or with test.

Specimen : *Amoeba* sp.

- (i) Irregular body shape.
- (ii) Blunt and finger like lobose type pseudopodia are present.
- (iii) The body can be divided into an outer ectoplasm and an inner endoplasm.
- (iv) A single contractile vacuole and several food vacuoles are clearly visible.
- (v) A single conspicuous nucleus is present.
- (vi) Body naked.

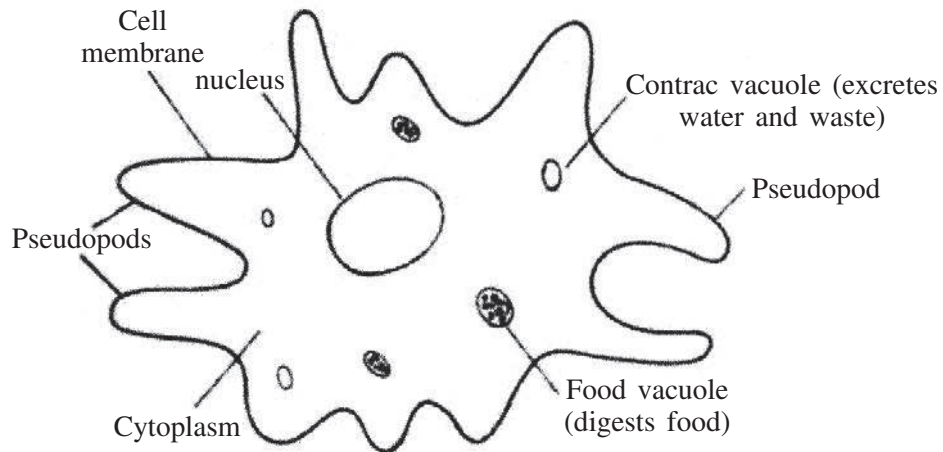


Figure 1 : *Amoeba* sp.

2. *Euglena* sp.

a) Systematic position (According to Levine et.al., 1980)

Sub-kingdom : Protozoa

Phylum : Sarcomastigophora

Sub-phylum : Mastigophora

Genus : *Euglena*

Specimen : *Euglena* sp.

b) Systematic identification with reasons

Sub-kingdom : Protozoa

Same as *amoeba* sp.

Phylum : Sarcomastigophora

Same as *amoeba* sp.

Sub-phylum : Mastigophora

(i) Presence of one or more flagella.

(ii) Pellicle cover is present in several forms.

Specimen: *Euglena* sp.

- (i) A long flagellum is present.
- (ii) Photoreceptive eye spot called stigma present.
- (iii) Chloroplast present.
- (iv) The nucleus is posterior.
- (v) The body is spindle shaped.

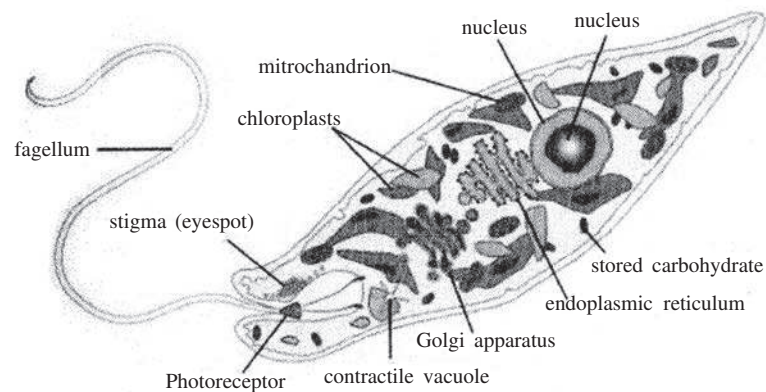


Figure 2: *Euglena* sp.

3. *Paramecium* sp.

a) Systematic position (According to Levine et.al, 1980)

- Sub-kingdom : Protozoa
- Phylum : Ciliophora
- Genus : *Paramecium*
- Specimen : *Paramecium* sp.

b) Systematic identification with reasons

Sub-kingdom : Protozoa

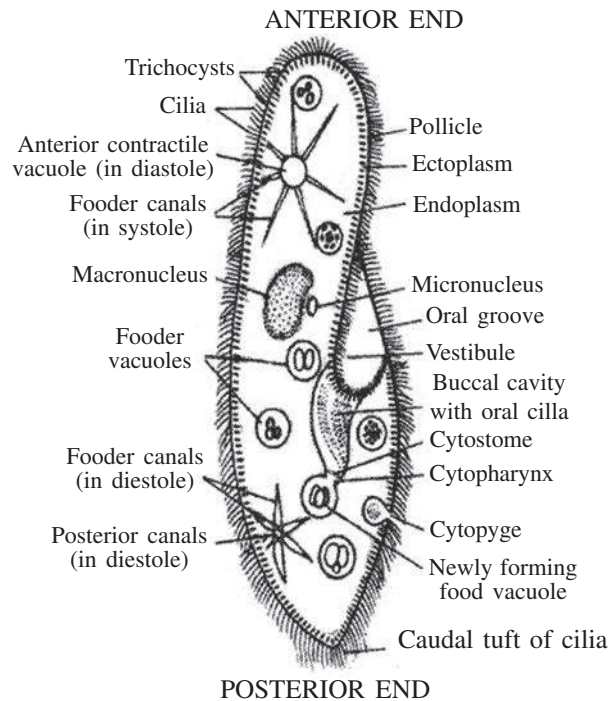
Same as *Euglena* sp.

Phylum : Ciliophora

- (i) Presence of cilia that cover the cell surface.
- (ii) Two types of nuclei present.

Specimen : *Paramecium* sp.

- (i) Slipper like body shape.
- (ii) Body is uniformly covered by cilia which are equal in length.
- (iii) Cytopharynx present.
- (iv) Presence of ventral oral groove.
- (v) The body consists of food vacuoles, macronucleus, micronucleus, anterior and posterior contractile vacuoles.

**Figure 3 : *Paramecium* sp.****4. *Plasmodium* sp.****a) Systematic position (According to Levine et.al.,1980)**

- Sub-kingdom : Protozoa
- Phylum : Apicomplexa
- Genus : Plasmodium
- Specimen : *Plasmodium* sp.

b) Systematic identification with reasons**Sub-kingdom : Protozoa**

Same as *Euglena* sp.

Phylum : Apicomplexa

- (i) Unique form of organelle called apicoplast present, which is a type of special plastid.
- (ii) An apical complex structure is present.
- (iii) Pseudopodia or cilia or flagella absent.

Specimen : *Plasmodium* sp. (Trophozoite or Signet ring state)***Plasmodium vivax***

- (i) Trophozoite stage is found within the RBC.
- (ii) Body rounded, ring like with a large central vacuole.
- (iii) Only one ring like structure is present.
- (iv) Cytoplasm of one side of vacuole is thick and broad, while the other side is thin and narrow.
- (v) Nucleus one in number and lies on the thin side.
- (vi) The haemozoin granules are scattered in the cytoplasm of the trophozoite.
- (vii) Globular Schuffner's dots are seen in the cytoplasm of RBC.

Plasmodium falciparum

- (i) Trophozoite stage is found within the RBC.
- (ii) Body rounded, ring like with a large central vacuole.
- (iii) More than one ring like structures are present.

- (iv) Thickness of cytoplasm is more or less uniform.
- (v) Nucleus may be found in segmented conditions, segmented nucleus may remain on side by side or may lie in the opposite pole of the ring.
- (vi) The haemozoin granules form a black mass in the cytoplasm.
- (vii) Elongated Mourer's dots are seen in the cytoplasm of RBC.

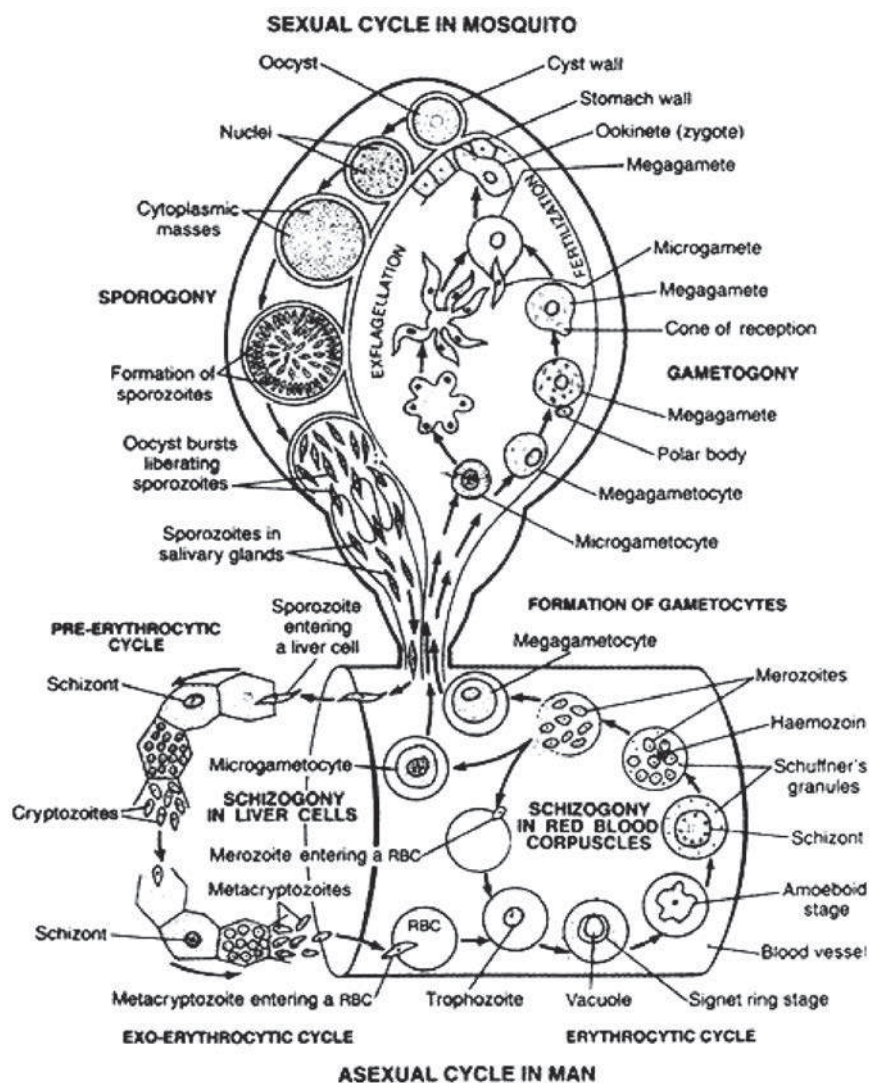


Figure 4: Life cycle of *Plasmodium vivax*

5. *Sycon* sp.

a) Systematic position (According to Brusca and Brusca, 2003)

Phylum	:	Porifera
Class	:	Calcarea
Sub-class	:	Calcarea
Genus	:	<i>Sycon</i>
Specimen	:	<i>Sycon</i> sp.

b) Systematic identification with reasons

Phylum : Porifera

- (i) Generally marine aquatic organisms, with few fresh water form.
- (ii) Bodies are asymmetrical.
- (iii) Body shape can be cylindrical, vase-like, rounded or sac-like.
- (iv) Diploblastic animals with two layers, the outer dermal layer and the inner gastral layer.

Class : Calcarea

- (i) Skeleton made of calcareous spicules.
- (ii) Vase- shaped compact structures.
- (iii) Spicules are not divisible into megascleres and microscleres.

Sub-class : Calcarea

- (i) Flagella from choanocytes arise directly from nucleus.
- (ii) Triaxon spicules with one ray characteristically longer than other two.

Specimen : *Sycon* sp.

- (i) The body is vase shaped be interconnected with each other.
- (ii) The middle portion of this vase is broad and an osculum is present on the top.
- (iii) The osculum is encircled by large giant monaxon spicules forming a funnel shaped collar or oscular fringe.
- (iv) The base is attached to the substratum.
- (v) Body surface is finely rough with projecting spicules.

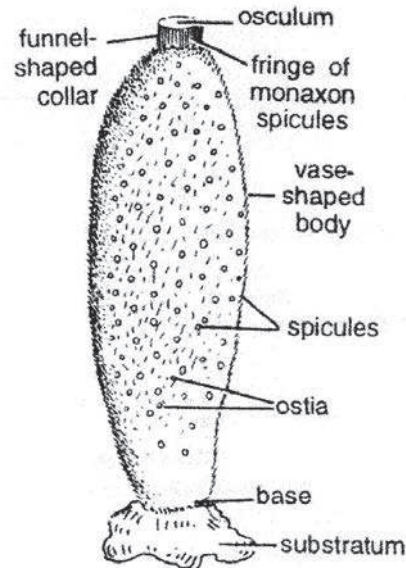


Figure 5: *Sycon* sp.

6. *Hyalonema* sp.

a) Systematic position (According to Brusca and Brusca, 2003)

- Phylum : Porifera
Class : Hexactinellida
Sub-class : Amphidiscomorpha
Genus : *Hyalonema*
Specimen : *Hyalonema* sp.

b) Systematic identification with reasons

Phylum : Porifera

Same as *Sycon* sp.

Class : Hexactinellida

They possess six rayed silicious spicules.

Sub-class : Amphidiscomorpha

Presence of amphidis spicules.

Specimen : *Hyaloneama* sp.

(i) Commonly known as glassrope sponge, since the spicules are often fused to form a lattice like skeleton giving the sponge a glass like appearance.

(ii) Cup shaped, measuring 10 to 30 cm in height. The spongocoel is well developed and the osculum contains sieve plate.

(iii) There is presence of hold fast organs like root spicules. The root spicules are compact, elongated and twisting giving a rope like appearance.

(iv) The middle portion between the cup and root spicules contains symbiotic polyps of Epizoanthus.

(v) A large number of a amphidisc spicules are present.

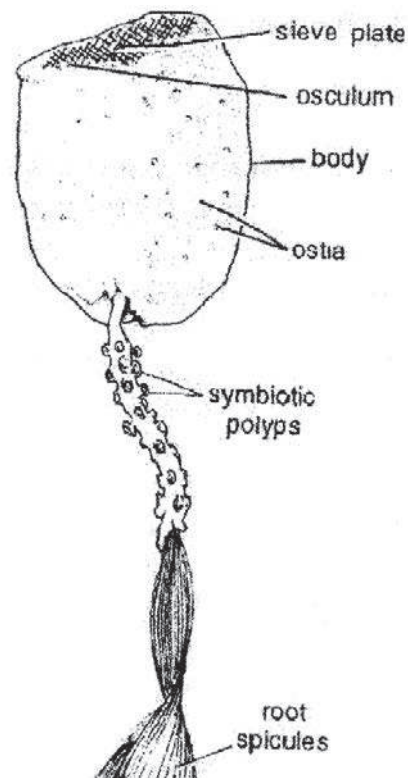


Figure 6: *Hyalonema* sp.

7. *Eupelectella* sp.

a) Systematic position (According to Brusca and Brusca, 2003)

Phylum	:	Porifera
Class	:	Hexactinellida
Subclass	:	Hexasterophora
Genus	:	Euplectella
Specimen	:	<i>Euplectella</i> sp.

b) Systematic identification with reasons

Phylum : Porifera

Same as *sycon* sp.

Class : Hexactinellida

Same as *Hyalonema* sp.

Sub-class : Hexasterophora

- (i) Skeletons composed of overlapping six-rayed spicules.
- (ii) The sponge is commonly firmly attached by its base to a hard substratum.

Specimen : *Euplectella* sp.

- (i) Has a glassy, knitted, basket like appearance and is therefore called venus flower basket.
- (ii) Knitted appearance is due to the presence of parietal gaps which formed because of interlaced four and six rayed silicious spicules which are fused at the top.
- (iii) Root tufts made a long silicious spicules are found in the bottom part, being responsible for the attachment of the animal to the mud.
- (iv) Oscular sieve plate present in the osculum.

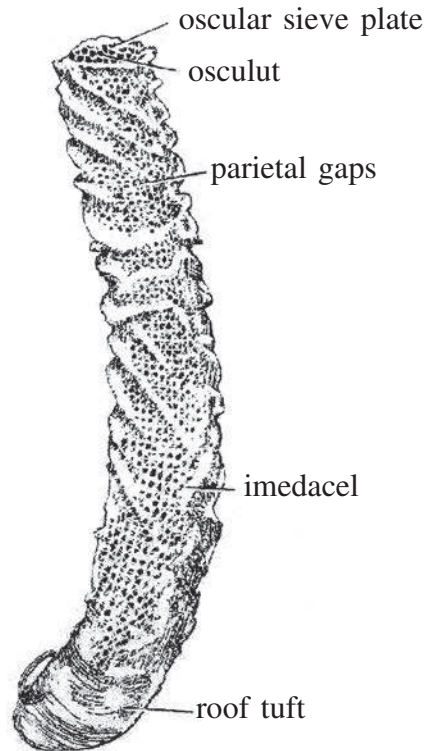


Figure 7: *Euplectella sp.*

8. *Obelia sp.*

a) Systematic position (According to Ruppert & Barnes 1994)

Phylum : Cnidaria
Class : Hydrozoa
Genus : *Obelia*
Specimen : *Obelia sp.*

b) Systematic identification with reasons

Phylum : Cnidaria

(i) Cnidoblast cells with nematocyst present, hence the name cnidaria.

(ii) Colonies are essentially dimorphic with asexual polyp and sexual medusa.

(iii) A single gastrovascular cavity or coelenteron with a single opening called mouth is present.

Class : Hydrozoa

(i) Either polypoid or medusoid or both are present.

(ii) They may be solitary or colonial.

Specimen : *Obelia* sp.

(i) The colony of *Obelia* is dimorphic (both polyp and medusa present) and resemble small seaweed filaments.

(ii) The hydrorhiza forms the basal or horizontal portion called stolon, which is responsible for attachment to substratum.

(iii) Hydrorhiza gives rise to vertical branches called hydrocaulus, which further gives alternate branches ending in terminal zooids.

(iv) The stems and zooids contain a living, hollow, cellular tube called coenosarcs.

(v) The medusas are present at the base of the polyp bearing branches and are enclosed in blastostyles.

(vi) The polyps are a bell shaped cup, with the lower portion called hydrotheca and the upper portion hypostome.

(vii) 24 nematocyst bearing tentacles are present surrounding the hypostome.

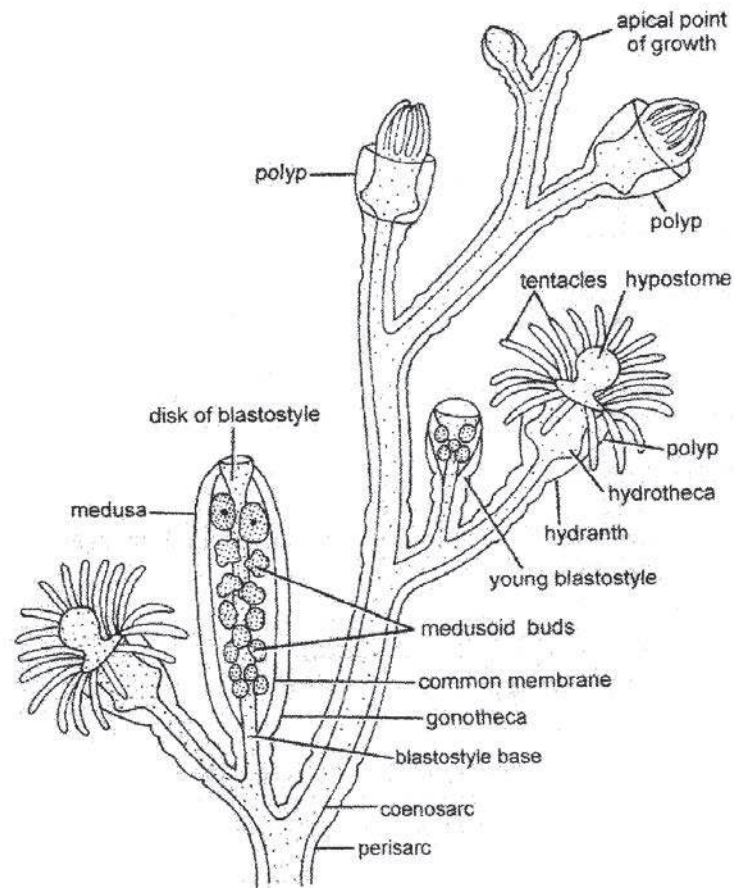


Figure 8: *Obelia sp.* colony

9. *Physalia sp.*

a) Systematic position (According to Ruppert & Barnes, 1994)

Phylum : Cnidaria
 Class : Hydrozoa
 Genus : *Physalia*
 Specimen : *Physalia sp.*

b) Systematic identification with reasons

Phylum : Cnidaria

Same as *Obelia sp.*

Class : Hydrozoa

Same as *Obelia* sp.

Specimen : *Physalia* sp.

(i) Commonly known as Portuguese man of war.

(ii) The animal is characterized by an upper large crested pneumatophore or float. Below the float lies the coenosarc from which dactylozooids, gastrozooids, gonozooids and gonodendra hang.

(iii) Batteries of pneumatocysts are present.

(iv) The gastrozooids are without tentacles.

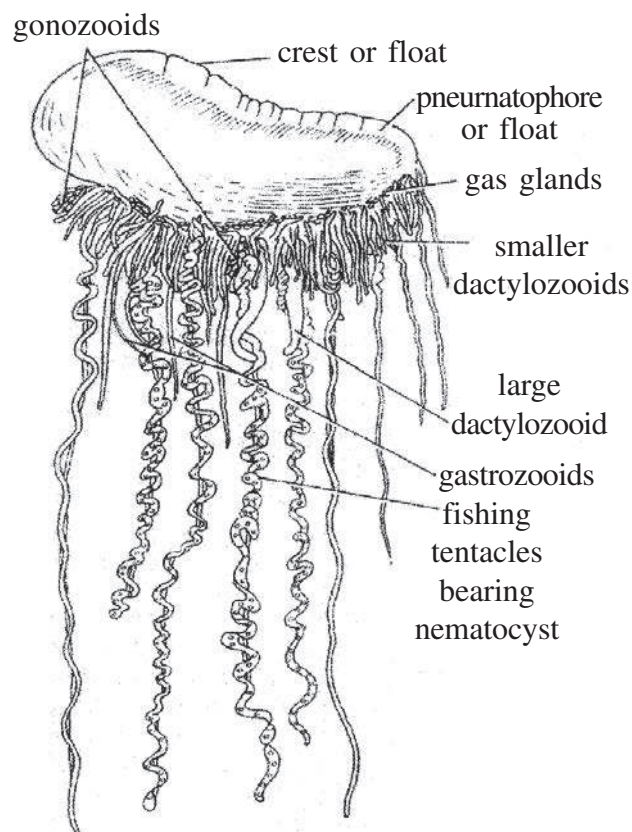


Figure 9: *Physalia* sp.

10. Jellyfish

a) Systematic position (According to Ruppert & Barnes, 1994)

Phylum : Cnidaria
Class : Schyphozoa
Specimen : Jellyfish

b) Systematic identification with reasons

Phylum : Cnidaria

Same as *Obelia* sp.

Class : Schyphozoa

- (i) Exclusively medusoid.
- (ii) Velum absent in medusoid umbrella.

Specimen : Jellyfish

- (i) The body is saucer shaped and has a convex ex-umbrellar and concave sub umbrellar surface.
- (ii) Gastric filaments, sub genital pits and velarium can be seen.
- (iii) Marginal tentacles having stinging cells are seen along the sub-umbrellar margin.
- (iv) The four cornered mouth is drawn out into four oral arms.
- (v) The body is jelly like, transparent, bluish, white, reddish or pinkish in colour.
- (vi) Four horse-shoe shaped gonads are present.

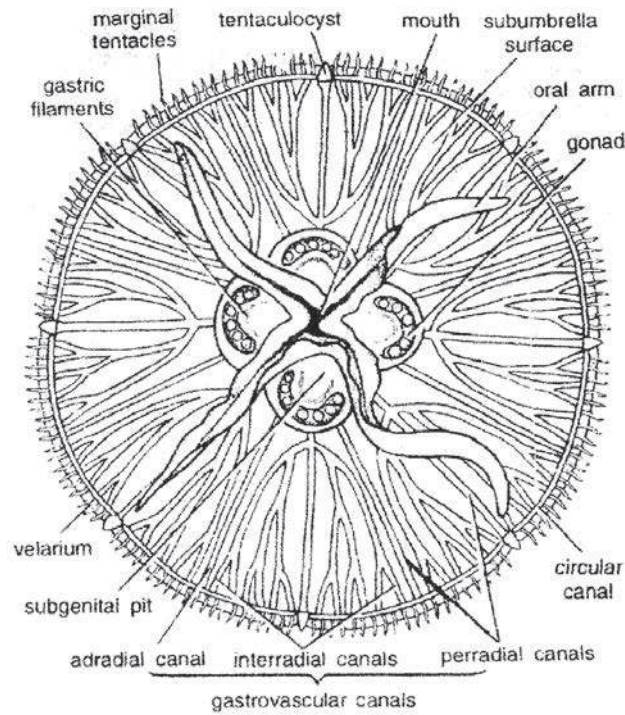


Figure 10: Jellyfish

11. Sea Anemone

a) Systematic position (According to Ruppert & Barnes, 1994)

Phylum : Cnidaria
 Class : Anthozoa
 Subclass : Hexacorallia
 Specimen : Sea anemone

b) Systematic identification with reasons

Phylum : Cnidaria

Same as *Obelia* sp.

Class : Anthozoa

- (i) Exclusively polypoid, with no medusa.
- (ii) Eight or more mesenteries divide the gastrovascular cavity.

Subclass : Hexacorallia

Tentacles and mesenteries are six or in multiples of six in number.

Specimen : Sea anemone

- (i) Body of animal divided into oral disk, column and pedal disc.
- (ii) The body is short cylindrical and radially symmetrical.
- (iii) The oral disk is expanded as a flat disc called capitulum, which bears several marginal tentacles.
- (iv) The column or the body is a thick walled structure called scapus.
- (v) The capitulum and scapus is separated by a collar which is a prominent fold.
- (vi) Cincloides or small openings perforate the wall of the scapus.
- (vii) The pedal disc which attaches the body to the substratum is a broad disc which is separated from scapus by limbus.

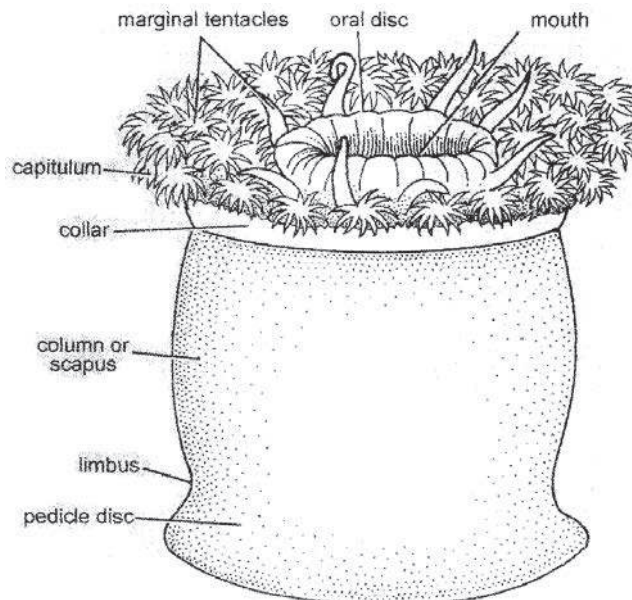


Figure : 11: Sea anemone

12. *Taenia* sp.

a) Systematic position (According Ruppert & Barnes, 1994)

Phylum	:	Platyhelminthes
Class	:	Cestoda
Genus	:	<i>Taenia</i>
Specimen	:	<i>Taenia</i> sp.

b) Systematic identification with reasons

Phylum : Platyhelminthes

- (i) Dorsoventrally flattened leaf like or ribbon like body.
- (ii) Attachment organs are present.
- (iii) Mouth may or may not be present.
- (iv) Anus absent.

Class : Cestoda

- (i) Ribbon like segmented body.
- (ii) Mouth absent.
- (iii) Suckers present.
- (iv) Cuticle present surrounding the body.

Specimen : *Taenia* sp.

- (i) The body can be divided into the head/scolex, neck, immature, mature and gravid segments called proglottids.
- (ii) Scolex serves as organ for attachment, containing four suckers and a rounded rostellum.
- (iii) The size of the proglottids increase gradually towards the posterior end.
- (iv) Mature segments contain well developed male and female reproductive organs.
- (v) The gravid segments contain branched uterus filled with oncospheres.

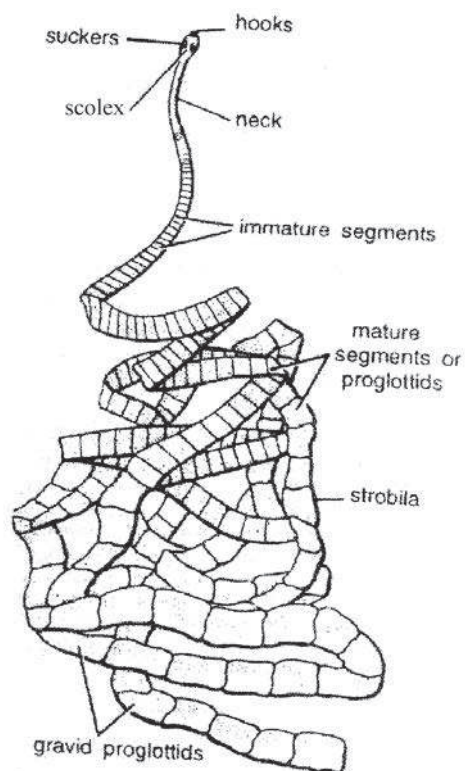


Figure : 12 : *Taenia sp*

13. Male and female *Ascaris sp.*

a) Systematic position (According to Ruppert & Barnes, 1994)

Phylum : Nematoda
 Class : Phasmida
 Genus : *Ascaris*
 Specimen : *Ascaris sp.*

b) Systematic identification with reasons

Phylum : Nematoda

- (i) Unsegmented worm like body with their ends tapering.
- (ii) Body is generally covered with thick, flexible cuticle.
- (iii) Mouth and anus are at opposite end.
- (iv) Presence of caudal phasmid which are sensory structures.
- (v) The labial amphids are pore like acting as chemosensory organ.

Specimen : *Ascaris* sp.

- (i) Elongated body with no distinct head.
(ii) Four longitudinal streaks are present on the cuticle.

Male <i>Ascaris</i>	Female <i>Ascaris</i>
(a) Tail is curved and pointed. (b) A pair of penial setae or cloacal spicules are present near the cloaca.	(a) Tail is straight and blunt. (b) No penial setae are present.

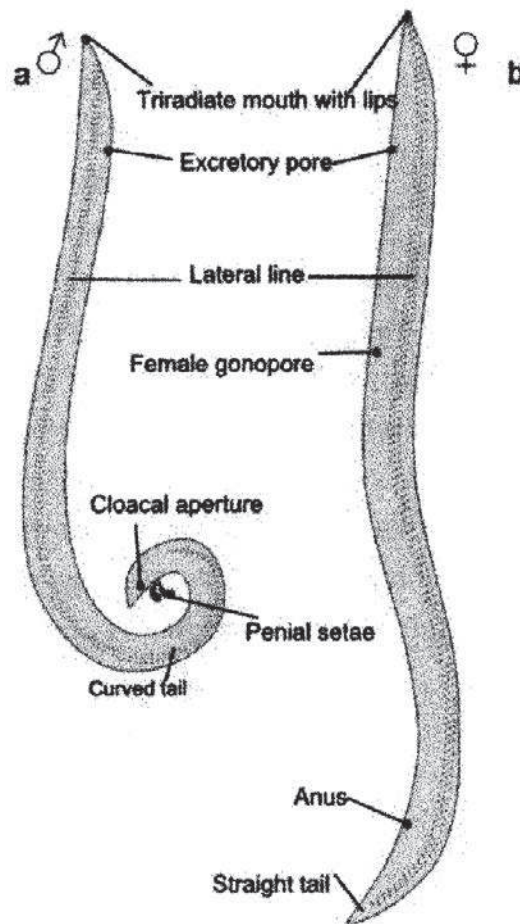


Figure : 13: Male (a) and Female (b) *Ascaris* sp.

14. *Aphrodite* sp.

a) Systematic position (According to Ruppert & Barnes, 1994)

Phylum : Annelida
Class : Polychaeta
Genus : *Aphrodite*
Specimen : *Aphrodite* sp.

b) Systematic identification with reasons

Phylum : Annelida

- (i) Bilaterally symmetrical and metamerically segmented body.
- (ii) Mouth and anus are at opposite ends.
- (iii) Setae present or parapodia or suckers present.
- (iv) Appendages, when present, are unjoined.

Class : Polychaeta

- (i) Well developed parapodia with numerous setae in each segment.
- (ii) Distinct head with appendages and eyes.
- (iii) Clitellum absent.
- (iv) Sucker absent.

Specimen : *Aphrodite* sp.

- (i) Ovoid body with 30 to 35 segments.
- (ii) Felt like setae cover the body.
- (iii) Anterior end has prostomium bearing a small median tentacle and two lateral palps.
- (iv) The structure of the parapodia is greatly modified.
- (v) The notopodia contains stiff setae, soft setae and iridescent setae.
- (vi) The soft notopodial setae form the felt.
- (vii) Neuropodial setae are brown and stiff.

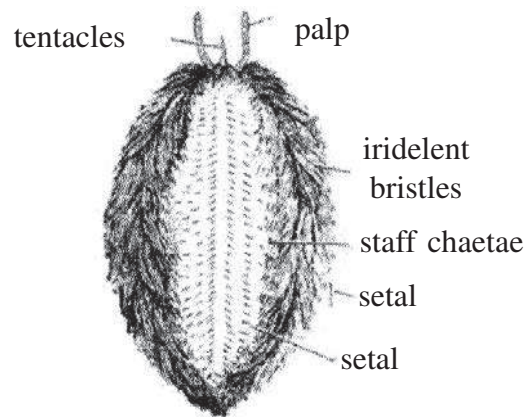


Figure : 14: *Aphrodite sp.*

15. *Nereis sp.*

a) Systematic position (According Ruppert & Barnes, 1994)

Phylum : Annelida
Class : Polychaeta
Genus : *Nereis*
Specimen : *Nereis sp.*

b) Systematic identification with reasons

Phylum : Annelida

Same as *Aphrodite sp.*

Class : Polychaeta

Same as *Aphrodite sp.*

Specimen : *Nereis sp.*

(i) Elongated and cylindrical body which is divided into several metameres or segments.

(ii) The first segment is the prostomium which bears the prostomial tentacles, palps and ocelli.

(iii) The second segment observed is the peristomium which carries anterolaterally four pairs of peristomial tentacle.

(iv) Paired parapodia on either side present on all segments except the peristomium and prostomium.

(v) Anal segment contains a pair of anal cirri.

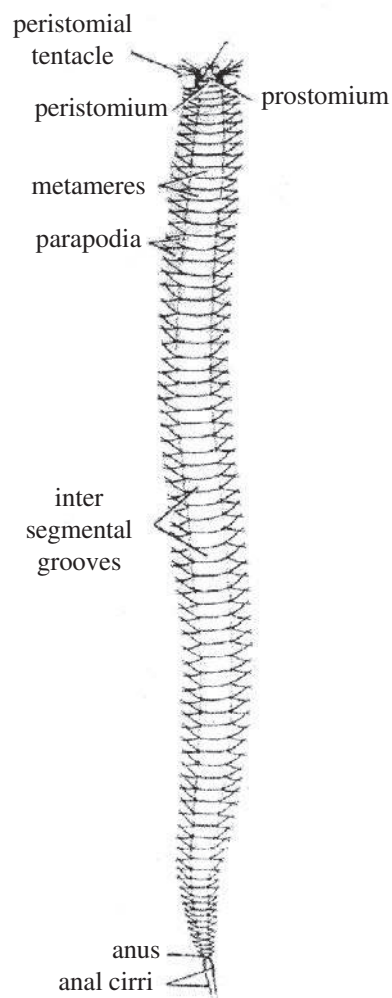


Figure : 15: *Nereis sp.*

16. Earthworm

a) Systematic position (According Ruppert & Barnes, 1994)

Phylum : Annelida
Class : Oligochaeta
Specimen : Earthworm

b) Systematic identification with reasons

Phylum : Annelida

Same as *Aphrodite* sp.

Class : Oligochaeta

- (i) Setae are present in each segment.
- (ii) Distinct clitellum present.
- (iii) Suckers absent.

Specimen : Earthworm

- (i) External and internal segmentation are distinct.
- (ii) On the ventral body wall of all the segments except the first and the last rows of setae present.
- (iii) The dorsal surface has a dark median line which is the dorsal blood vessel.
- (iv) The first segment is the prostomium which contains the ventral mouth.
- (v) Thickened region called the clitellum is present from the 14th to 16th segment.
- (vi) Spermathecal pores are found in the intersegmental grooves of 5/6th, 6/7th, 7/8th and 8/9th segments.
- (vii) Female genital pores reside in the 14th segment and a pair of male genital pore lies on 18th segment on ventral side.
- (viii) Two pairs of genital papillae lie on the ventral surface in the 17th and 19th segment.

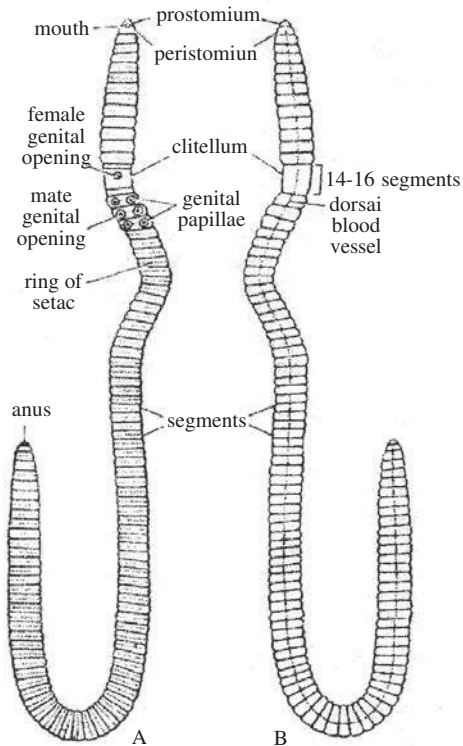


Figure : 16: Earthworm (A) ventral view and (B) dorsal view

17. *Hirudinaria* sp.

a) Systematic position (According to Ruppert & Barnes, 1994)

Phylum : Annelida
 Class : Hirudinea
 Genus : Hirudinea
 Specimen : *Hirudinaria* sp.

b) Systematic identification with reasons

Phylum : Annelida

Same as *Aphrodite* sp.

Class : Hirudinea

- (i) There is definite number of body segments.
- (ii) Segments are marked externally by secondary rings or annuli.
- (iii) The clitellum is prominent during the reproductive season and is made of three segments.
- (iv) A small suckorial anterior sucker and a large and powerful posterior sucker are present.
- (v) The clitellum is prominent during the reproductive season and is made of three segments.
- (vi) Body has three segments.
- (vii) Three toothed and well developed jaw is present.

Specimen : *Hirudinaria* sp.

- (i) The body is soft, vermiform, elongated dorsoventrally flattened.
- (ii) Small anterior and large posterior suckers are well developed.
- (iii) Dorsal surface is olive green and ventral surface is orange-yellow or red.
- (iv) Both sides have black stripes.
- (v) Body divided into cephalic, preclitellar, clitellar, middle, caudal and posterior sucker region.
- (vi) The body has 33 segments, with each segment being superficially divided into 5 annuli.
- (vii) Five pairs of eyes are present dorsally.
- (viii) Four pairs of dorsal segmental receptor organs and three pairs of ventral segmental receptor organs are present.

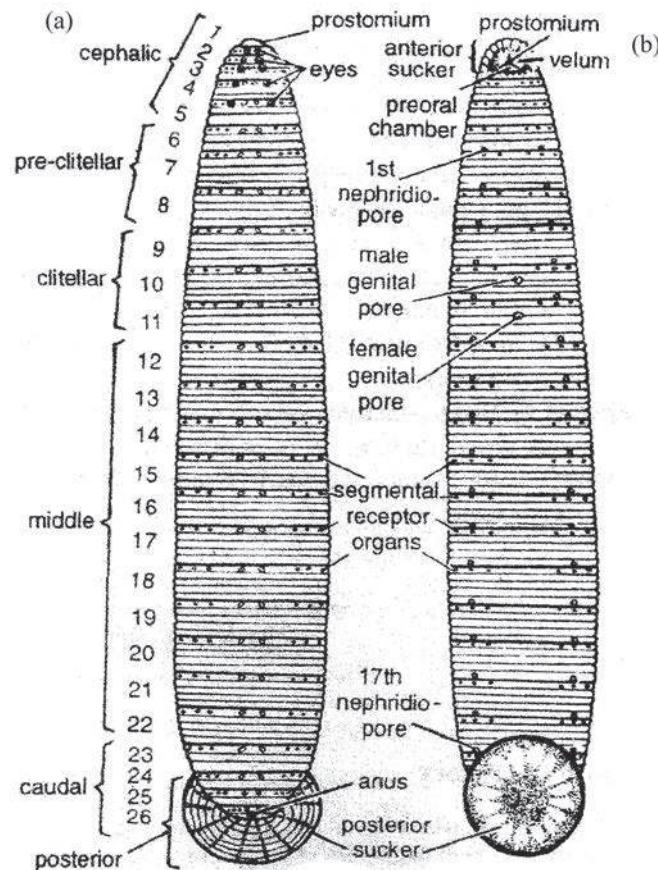


Figure : 17 : *Hirudinaria* sp. (a) dorsal view and (b) ventral view

18. *Palaemon* sp.

a) Systematic position (According to Ruppert & Barnes, 1994)

Phylum	:	Arthropoda
Sub-phylum	:	Crustacea
Class	:	Malacostraca
Sub-class	:	Eumalacostraca
Genus	:	<i>Palaemon</i>
Specimen	:	<i>Palaemon</i> sp.

b) Systematic identification with reasons**Phylum : Arthropoda**

- (i) The body is segmented and shows bilateral symmetry.
- (ii) Externally jointed appendages are present.
- (iii) Body is externally covered with a thick, tough and non-living, chitinous cuticle, forming the exoskeleton.
- (iv) Body is generally divided into head, thorax and abdomen.
- (v) The compound eyes are present.

Sub-phylum : Crustacea

- (i) Head bears five pairs of appendages which comprise of two pairs of antennae (first pair being the antennules), one pair of mandibles and two pairs of maxillae.
- (ii) The cylindrical or leaf-shaped appendages are all typically biramous, the two branches are of different size and shape.
- (iii) Head bears a pair of compound eyes, sometimes located on movable stalks and a small median dorsal naupliar eye.

Class : Malacostraca

- (i) Body comprises of a head, an eight segmented thorax and a six segmented abdomen.
- (ii) All the fourteen segments bear appendages.
- (iii) The posterior thoracic limbs beint walking legs (pereiopods), the first five pairs of abdominal ones forming swimming organs (pleopods).
- (iv) Carapace usually present.
- (v) The compound eyes are present.

Subclass : Eumalacostraca

- (i) Antennae without three flagella.
- (ii) No seventh abdominal segment.

Specimen : *Palaemon* sp.

- (i) Young stages are translucent and white but the adults are usually dull pale-blue or greenish with orange-red patches.
- (ii) Body divided into cephalothorax, abdomen, and telson.
- (iii) Cephalothorax is formed by the union of head and thorax region and consists totally of 13 segments.
- (iv) All segments of cephalothorax bear jointed appendages.
- (v) The abdomen is jointed region with 6 distinct movable segments and a terminal conical piece, the telson.
- (vi) The abdominal segments are dorsally rounded, laterally compressed and normally bent under the cephalothorax, so that the animal looks like (‘) comma shaped.
- (vii) Each abdominal segment bears a pair of jointed appendages called pleopods or swimmerets.
- (viii) Carapace anteriorly produced into rostrum.

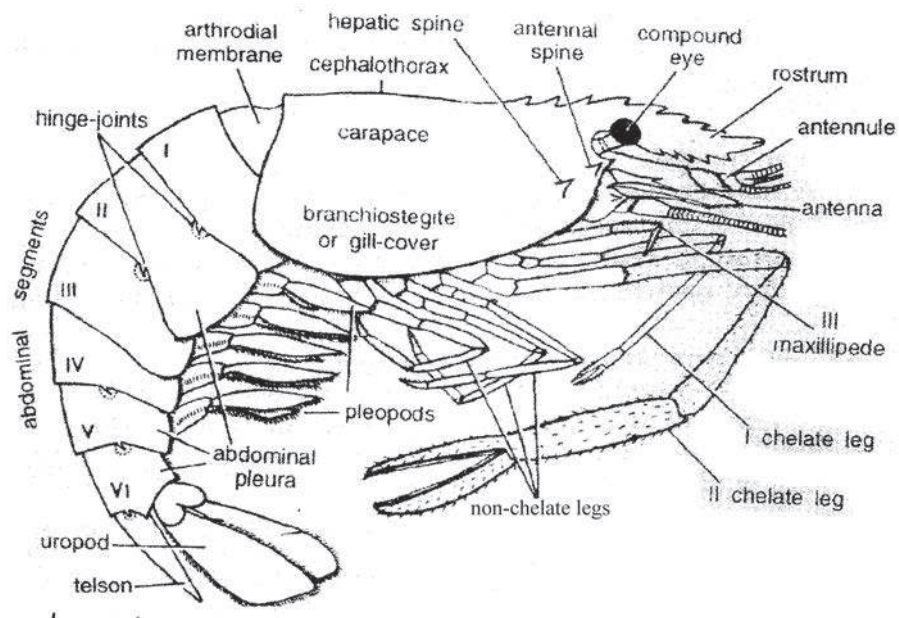


Figure : 18 : *Palaemon sp.*

19. *Scylla sp.*

(a) Systematic position (According to Ruppert of Barnes, 1994)

Phylum : Arthropoda
 Subphylum : Crustacea
 Class : Malacostraca
 Subclass : Eumalacostraca
 Genus : *Scylla*
 Specimen : *Scylla sp.*

b) Systematic identification with reasons

Phylum : Arthropoda

Same as *Palaemon sp.*

Class : Malacostraca

Same as *Palaemon sp.*

Sub-class : Eumalacostraca

Same as *Palaemon* sp.

Specimen : *Scylla* sp.

- (i) Carapace smooth, broad with strong transversal ridges.
- (ii) Anterior zone on the carapace with a deep H-shaped groove. flexed beneath caphalothorax.
- (iii) Broad teeth like structures on each anterolateral margin carapace all them with similar size and projecting obliquely outwards.
- (iv) Strong chelipeds with well developed spines.
- (v) Rostrum and uropod absent.

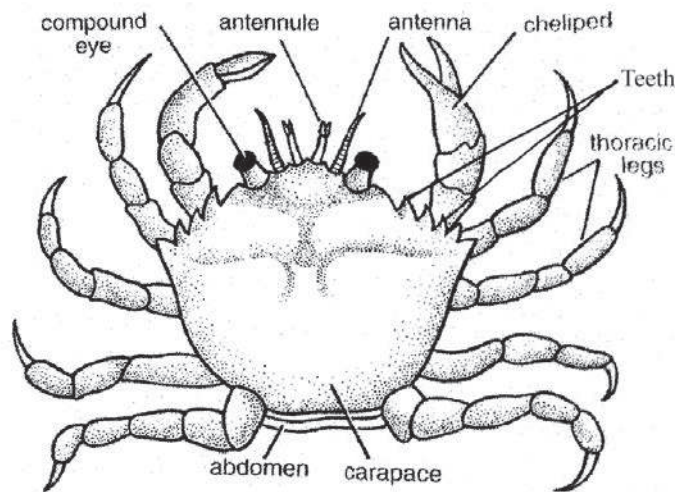


Figure : 19 : *Scylla* sp. (Crab)

20. *Carcinoscorpius* sp.**a) Systematic position (According Ruppert & Barnes, 1994)**

- Phylum : Arthropoda
- Subphylum : Chelicerata

Class : Merostomata
Subclass : Xiphosura
Genus : Carcinoscorpius
Specimen : *Carcinoscorpius sp.*

b) Systematic identification with reasons

Phylum : Arthropoda

Same as *Palaemon sp.*

Subphylum : Chelicerata

(i) Body divided into an anterior cephalothorax or prosoma, carapace, and a posterior abdomen or opisthosoma without legs.

(ii) Chelicera and pedipalp present.

(iii) Antenna and mandible absent.

(iv) Median ocellii are present.

Class : Merostomata

(i) Abdominal appendages are modified into gills.

(ii) Twelve segmented abdomen is subdivided into a seven segmented mesosoma and a five segmented metasoma.

(iii) A prominent spike like caudal spine or telson is present at the end of the body.

Subclass : Xiphosura

(i) Prosoma and opisthosoma are separated by a hinge.

(ii) A large horseshoe shaped carapace covers the prosoma.

(iii) An elongated, pointed and slender caudal spine is present.

(iv) Carapace has one median and two lateral ridges.

(v) A pair of median eye and a pair of lateral eye are present on the carapace.

(vi) Five pairs of book gills are present on and from the ninth to the thirteenth segment.

Specimen : *Carcinoscorpius sp.* (mangrove horseshoe crab)

(i) The prosoma is the large, dome-shaped frontal part at the carapace.

(ii) The smaller rear carapace with spines on the edge is the opisthosoma.

(iii) The telson or the tail is rounded.

(**N.B.** It is essentially triangular in the other species of horse shoe crabs.)

(iv) Each individual has six pairs of appendages. The first pair, the chelicerae, is relatively small and placed in front of the mouth of which the first pair is and the pusher legs remaining four pairs.

(v) Most of the appendages have straight, scissor-like claws.

(**N.B.** in males the first and second pair of walking legs have strongly hooked “scissors”.)

(vi) Located behind their legs are book gills.

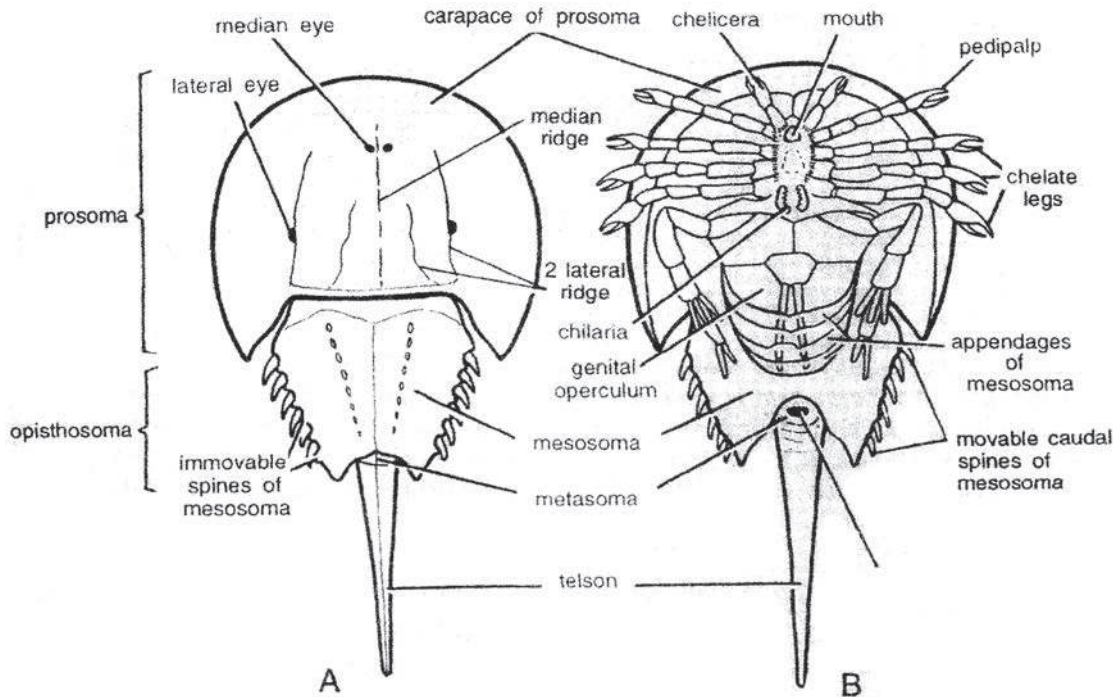


Figure 20: *Carcinoscorpius* sp. (A) Dorsal view and (B) Ventral view

21. *Penaeus* sp.

a) Systematic position (According Rupper & Barnes 1994)

Phylum : Arthropoda

Subphylum : Curstacea

Class : Malacostraca
Subclass : Eumalacostraca
Genus : Penaeus
Specimens : *Penaeus sp.*

b) Systematic identification with reasons

Phylum : Arthropoda

Same as *Palaemon sp.*

Subphylum : Crustacea

same as *Palaemon sp.*

Class : Malacostraca

Same as *Palaemon sp.*

Subclass : Eumalacostraca

same as *Palaemon sp.*

Specimen : *Penaeus sp.*

(i) The carapace and abdomen are transversely banded with alternative red bluish black and white.

(ii) Ventral surface of rostrum bears teeth.

(iii) Pleopods are biramous.

(iv) The cephalotorax is relatively smaller.

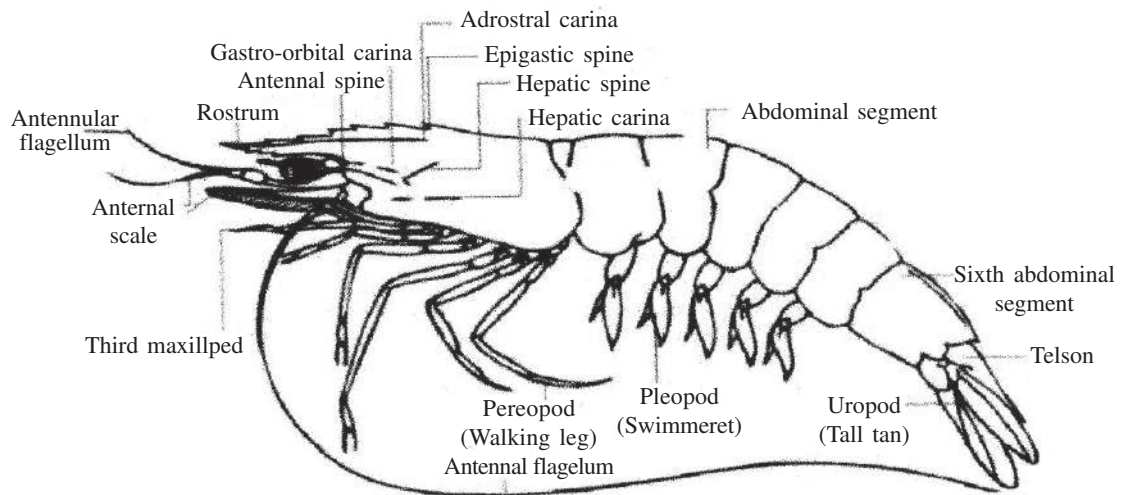


Figure 21 : *Penaeus sp.*

22. *Scolopendra sp.*

a) Systematic position (According to Ruppert & Barnes, 1994)

Phylum	:	Arthropoda
Subphylum	:	Uniramia
Class	:	Chilopoda
Subclass	:	Epimorpha
Genus	:	<i>Scolopendra</i>
Specimen	:	<i>Scolopendra sp.</i>

b) Systematic identification with reasons

Phylum : Arthropoda

Same as *Palaemon sp.*

Sub-phylum : Uniramia

(i) The body can be divided into a head and trunk.

(ii) Head appendages are one pair each of antennae, mandibles and maxillae. In addition, it has an upper lip or labrum.

(iii) The trunk bears pairs of walking legs.

(iv) Appendages uniramous.

(v) Head also comprises of compound eyes.

Class : Chilopoda

(i) Dorsoventrally flattened and elongated body.

(ii) The number of leg bearing segments varies from 15 to more; with the last two segments have no legs.

(iii) Poison claws or forcipules are the first pair of legs, which terminates in a pointed fang from which poison is released.

Subclass : Epimorpha

21 or more pairs of legs are present.

Specimen : Scolopendra sp.

(i) They are commonly known as centipede.

(ii) Body elongated, dark-greenish brown in colour.

(iii) A distinct head is present with a long segmented trunk or body.

(iv) The head bears long antennae, ocelli, maxillae and mandibles, with the maxillae being somewhat reduced.

(v) 21 pairs of walking legs are present on the body segments.

(vi) Last segment bears ventral anus, genital atrium and a pair of anal style.

(vii) Walking legs are seven segmented.

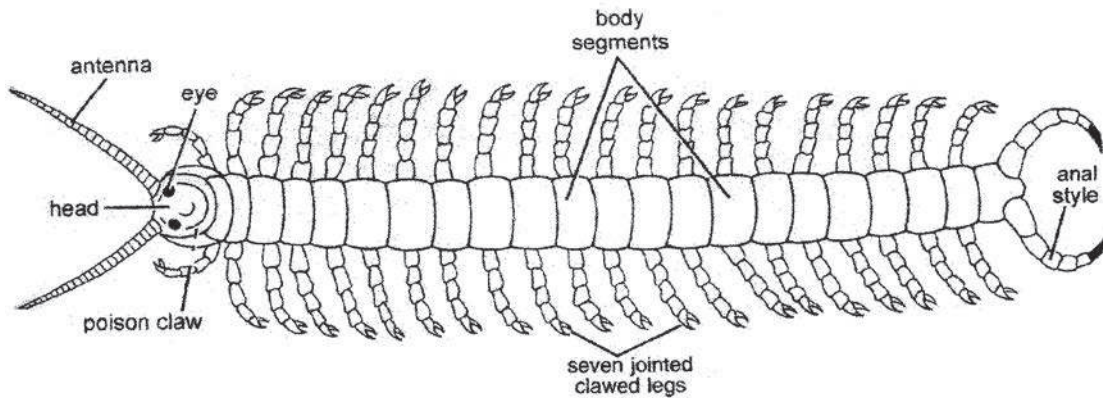


Figure 22 : *Scolopendra sp.*

23. Millipede sp.

a) Systematic position (According to Ruppert & Barnes, 1994)

- Phylum : Arthropoda
 Subphylum : Uniramia
 Class : Diplopoda
 Subclass : Helminthomorpha
 Specimen : *Millipede sp.*

b) Systematic identification with reasons

Phylum : Arthropoda

Same as *Palaemon sp.*

Subphylum : Uniramia

Same as *Scolopendra sp.*

Class : Diplopoda (commonly called millipedes)

(i) Presence of two pairs of jointed legs on most body segments. The first segment (collum) is legless, the next three segments bear a single pair of legs and the following segments have two pairs of legs.

(ii) A plate-like mouth structure comprising of fused maxillae and labium called gnathochilarium is present.

(iii) Presence of diplosomites which are double trunk segments formed from the fusion of two segments. Poison claw absent.

Subclass : Helminthomorpha

Segments are cylindrical.

Specimen : Millipede

- (i) Body differentiated into head, thorax and abdomen.
- (ii) The head is covered by cephalic shields and is bent downwards.
- (iii) The head contains antennae, simple eyes (ocelli), and only a single maxilla.
- (iv) Thorax has four segments and each of the last three segments is provided with one pair of walking legs.
- (v) Antennae are seven segmented.
- (vi) More than 200 pairs of legs present.

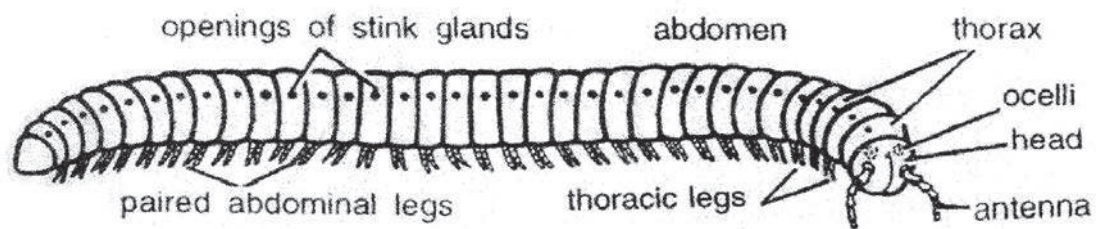


Figure 23 : *Millipede* sp.

24. *Periplaneta* sp.

a) Systematic position (According to Ruppert & Barnes, 1994)

- Phylum : Arthropoda
- Subphylum : Uniramia
- Class : Insecta
- Subclass : Ectognatha
- Genus : *Periplaneta*
- Specimen : *Periplaneta* sp.

b) Systematic identification with reasons

Phylum : Arthropoda

Same as *Palaemon* sp.

Subphylum : Uniramia

Same as *Seolopendra* sp.

Class : Insecta

(i) Three pairs of thoracic legs are present.

(ii) The head is formed by the fusion of six segments and bears one pair of antennae, one pair of mandible and two pair of maxillae.

(iii) The thorax is divided into prothorax, mesothorax and metathorax.

(iv) The mesothorax and the metathorax, bear a pair of wings.

Sub-class : Ecognatha

(i) Mouth parts are not sunk into a pouch.

(ii) Presence of compound eyes.

Specimen : *Periplaneta* sp. [Commonly called the cockroach]

(i) Body is elongated and dorsoventrally flattened with reddish brown colour.

(ii) The head is movable and contains a pair of long sensory antennae and a pair of compound eye.

(iii) The thorax contains a pair of anterior forewings and a pair of posterior hindwings.

(iv) The abdomen consists of ten segments.

(v) The mouth parts are of the chewing type.

(vi) Each leg is made up of coxa, trochanter, femur, tibia, tarsus, claws and pulvillus.

(vii) A pair of anal cerci present.

(viii) In male, a pair of anal style is present which is absent in female.

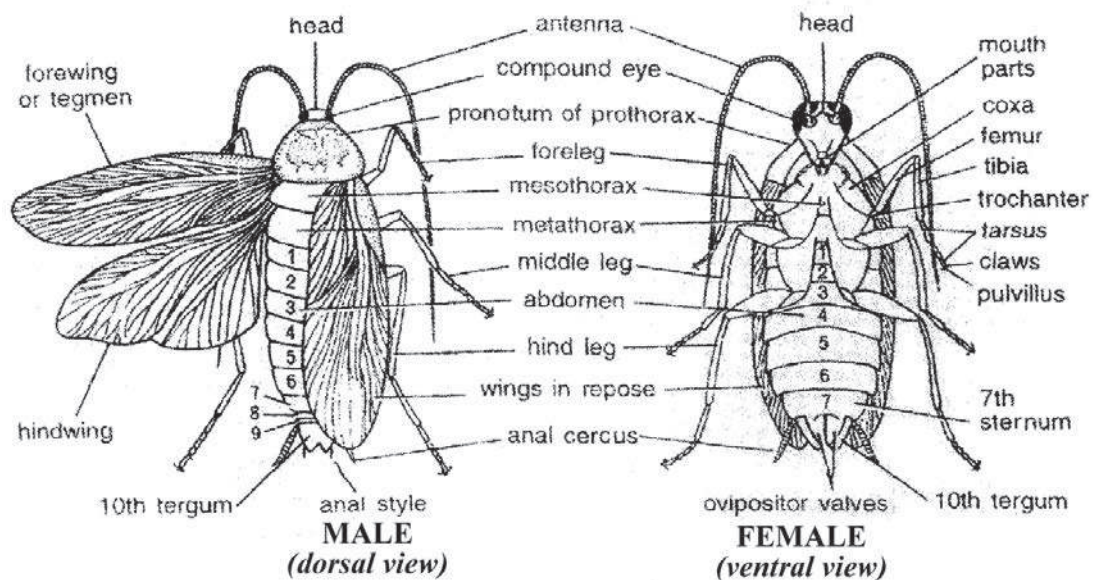


Figure 24 : Male and female *Periplaneta* sp.

25. *Apis* sp.

a) Systematic position (According to Ruppert & Barnes, 1994)

Phylum	:	Arthropoda
Subphylum	:	Uniramia
Class	:	Insecta
Subclass	:	Ectognatha
Genus	:	<i>Apis</i>
Specimen	:	<i>Apis</i> sp.

b) Systematic identification with reasons

Phylum : Arthropoda

Same as *Palaemon* sp.

Subphylum : Uniramia

Same as *Scolopendra* sp.

Class : Insecta

Same as *Periplaneta* sp.

Subclass : Ectognatha

Same as *Periplaneta* sp.

Specimen : *Apis* sp. [commonly known as honey bee]

- (i) The body is divisible into head, thorax and abdomen.
- (ii) Three castes exist in honey bee, the largest fertile queen, the sterile workers and the male drones.
- (iii) In the lateral position clypeus, labrum and other mouth parts are visible.
- (iv) The mouth parts are rasping and lapping type.
- (v) Prothoracic leg contains eyebrush, velum, and antenna comb and pollen brush.
- (vi) Mesothoracic legs contain spur, pollen brush and pulvillus.
- (vii) Meathoracic legs contain pollen basket and pollen comb.
- (viii) Wax plates and wax glands are present on the ventral surface of the last four segments.

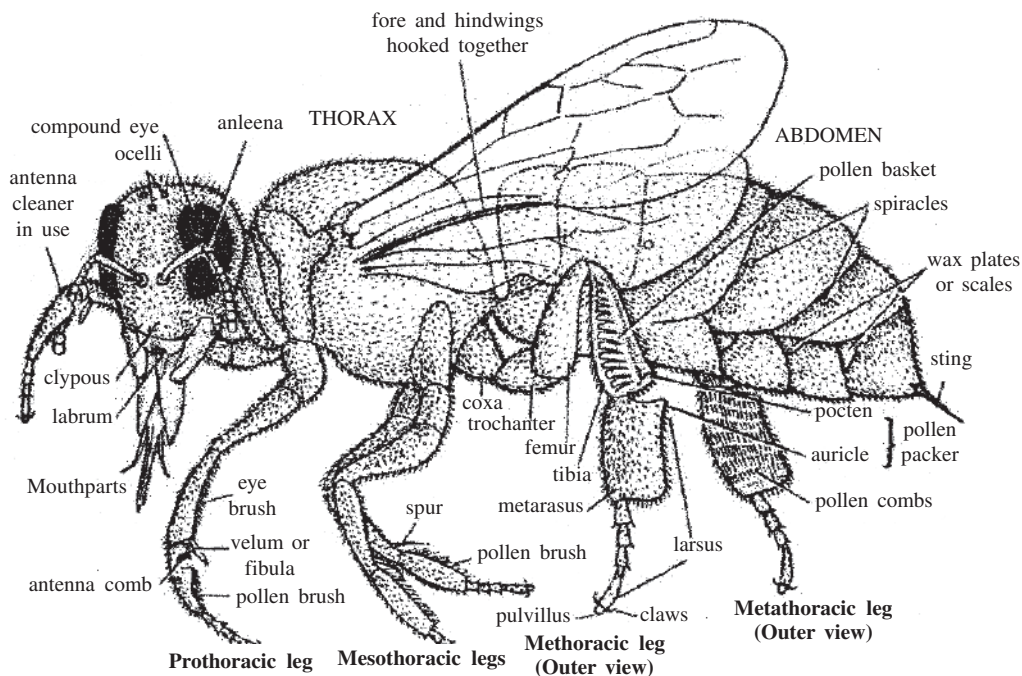


Figure 25 : *Apis* sp.

26. *Chiton* sp.

a) Systematic position (According to Ruppert & Barnes, 1994)

- Phylum : Mollusca
Class : Polyplacophora
Genus : Chiton
Specimen : *Chiton* sp.

b) Systematic identification with reasons

Phylum : Mollusca

- (i) The body is soft, unsegmented.
- (ii) A thick muscular mass called the mantle encloses the visceral mass.
- (iii) Generally external shell is present but in some cases it is internal or reduced or lost.
- (iv) A muscular ventral foot is a diagnostic feature.

Class : Polyplacophora

- (i) Body oval, elongated and dorsoventrally flattened.
- (ii) Eight plates cover the dorsal surface.
- (iii) A number of gills are present in the pallial groove between muscular ventral foot and mantle cavity.
- (iv) The surrounding mantle forms a thick 'griddle', the cuticle.
- (v) Eyes and tentacles are absent.

Specimen : *Chiton* sp. [commonly known as sea mouse]

- (i) The elliptical body can be divided into an indistinct head, a large flat foot and a dorsal mantle.
- (ii) The body is convex dorsally and flattened ventrally.

- (iii) The head contains ventral mouth and labial palps.
- (iv) Eyes and tentacles are absent.
- (v) Mouth and anus on opposite ends.

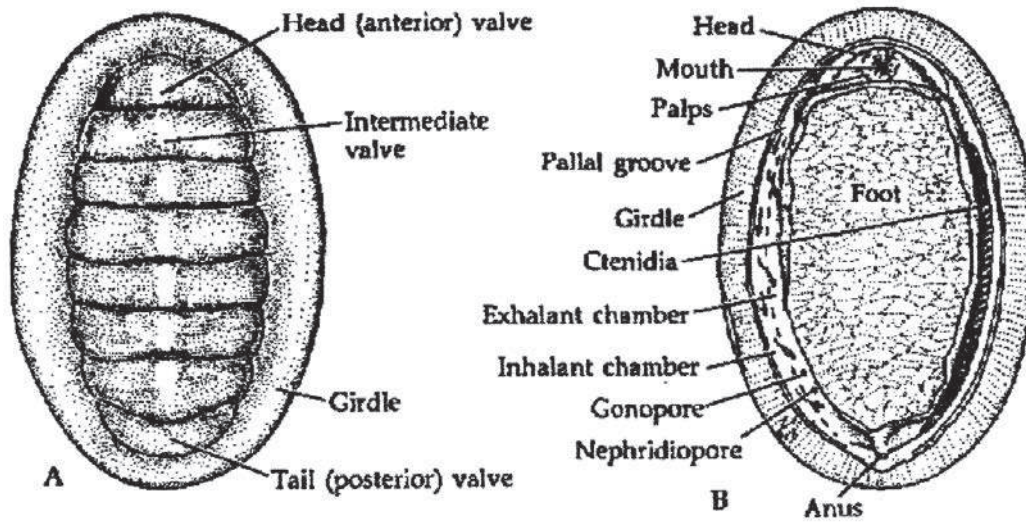


Figure 26 : *Chiton sp.* (A) dorsal view (B) ventral view

27. *Dentallium sp.*

a) Systematic position (According to Rupper & Barnes, 1994)

Phylum : Mollusca
 Class : Scaphopoda
 Genus : *Dentallium*
 Specimen : *Dentalium sp.*

b) Systematic identification with reasons

Phylum : Mollusca

Same as *Chiton sp.*

Class : Scaphopoda

- (i) A tubular tusk like shell is present which is open at both ends.
- (ii) The mantle completely encloses the elongated body.

(iii) The foot is cylindrical and projects out of the ventral side of the tusk like shell along with the buccal region.

(iv) The head is proboscis like and lacks eyes and sensory tentacles.

(v) Presence of captacula.

(vi) Gills or ctenidia are absent.

Specimen : *Dentalium* sp.

(i) Presence of a tubular but shell slightly curved shell open at both ends.

(ii) Body consists of head, foot, mantle and visceral mass.

(iii) Foot is long and conical, protrudes through the anterior opening of the shell.

(iv) Anus lies behind the base of the foot.

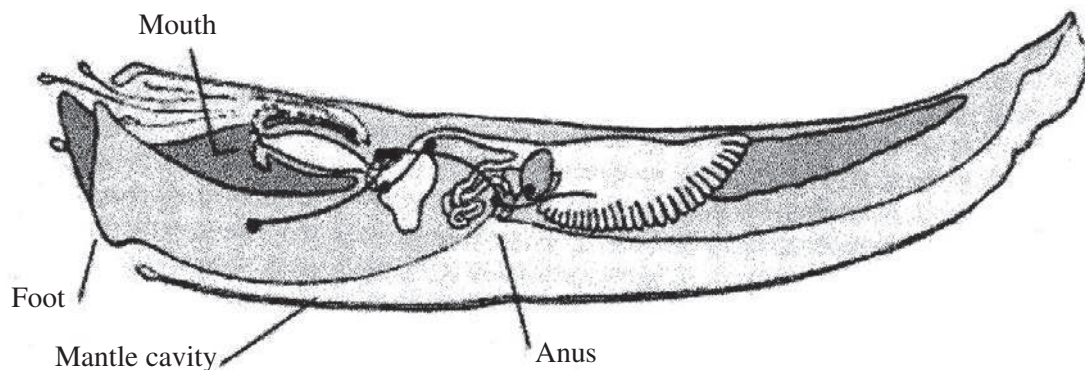


Figure 27 : *Dentalium* sp.

28 *Pila* sp.

a) Systematic position (According to Ruppert & Barnes, 1994)

Phylum : Mollusca

Class : Gastropoda

Subclass : Prosobrenchia

Genus : Pila

Specimen : *Pila* sp.

b) Systematic identification with reasons

Phylum : Mollusca

Same as *Chiton* sp.

Class : Gastropoda

- (i) Below the digestive system and the visceral mass is present a muscular foot.
- (ii) The shell is a single piece and is spirally coiled.
- (iii) One or two pairs of tentacles are present along with eyes.

Subclass : Prosobranchia

- (i) Shell opening is large and generally covered by operculum.
- (ii) Ctenidia is in front of head.
- (iii) Anus directed forward.

Specimen : *Pila* sp.

- (i) Shell is globose, spirally coiled round an axis called the collumella and opens outside by the mouth or aperture.
- (ii) Operculum is well developed and closes the aperture or the mouth of the shell.
- (iii) Foot is broad and flat.
- (iv) Head with two pairs of contractile tentacles and a pair of eyes.

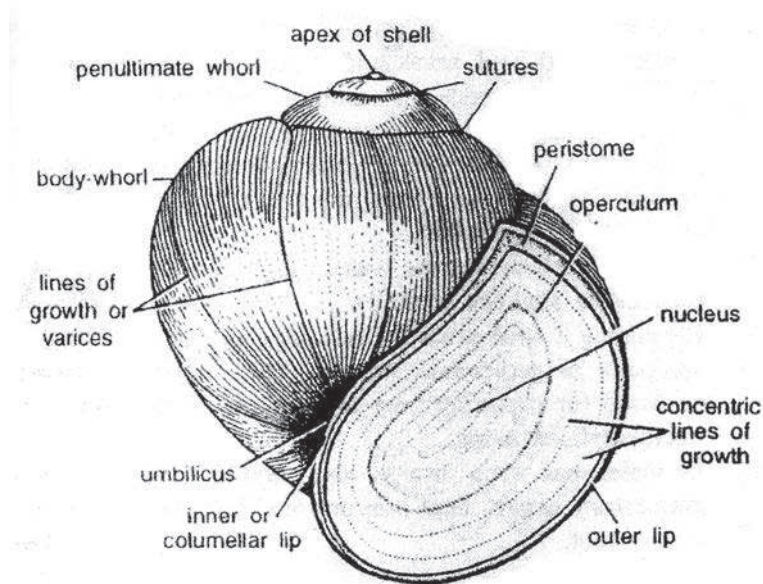


Figure 28 : *Pila sp.*

29. *Lamellidens sp.*

a) Systematic position (According to Ruppert & Barnes, 1994)

Phylum	:	Mollusca
Class	:	Bivalvia
Subclass	:	Palaeoheterodonta
Genus	:	<i>Lamellidens</i>
Specimen	:	<i>Lamellidens sp.</i>

b) Systematic identification with reasons

Phylum : Mollusca

Same as *Chiton sp.*

Class : Bivalvia

- (i) A pair of shell valves encloses a laterally compressed body.
- (ii) Shell with distinct lines of growth.

(iii) Head is indistinct without eyes and tentacles.

(iv) Foot tongue -shaped.

Subclass : Palacoheterodonta

(i) Shell is inequilateral i.e. umbo is not at the centre.

(ii) Byssus thread absent.

(iii) Mantle margins fused posteriorly.

Specimen : *Lamellidens sp.*

(i) Body is soft, bilaterally symmetrical and flattened, surrounded externally by a hard calcareous shell.

(ii) The shell consists of two separate, equal valves laterally attached by special musculature.

(iii) The two valves of the shell are united together along the dorsal side in a straight hinge line.

(iv) In front of the hinge there is a whitish knob-like structure called 'umbo', which is the thickest and the oldest portion of the shell.

(v) Inhalent and exhalent siphons are present.

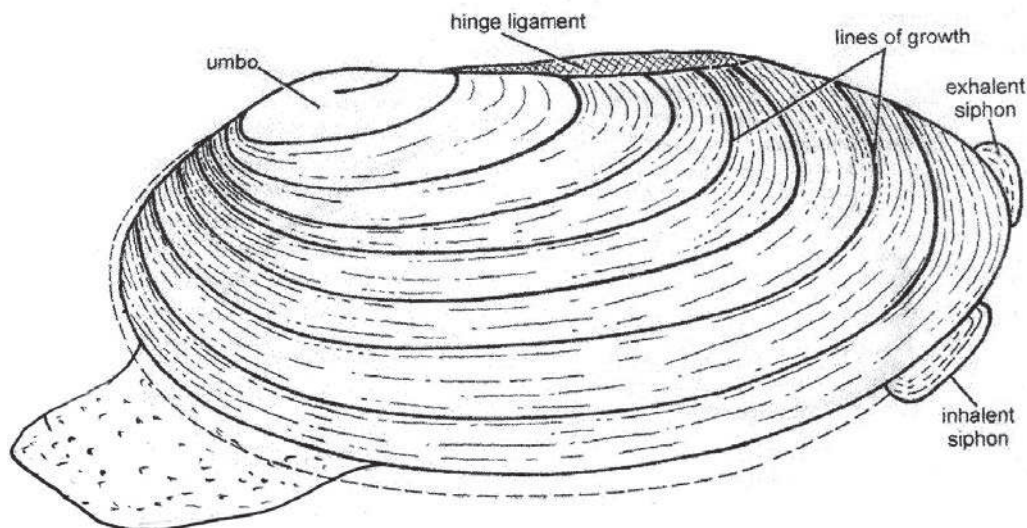


Figure 29 : *Lamellidens sp.*

30. *Loligo* sp.

a) Systematic position (According to Ruppert Barnes, 1994)

Phylum	:	Mollusca
Class	:	Cephalopoda
subclass	:	Coleoidea
Genus	:	<i>Loligo</i>
Specimen	:	<i>Loligo</i> sp.

b) Systematic identification with reasons

Phylum : Mollusca

Same as *Chiton* sp.

Class : Cephalopoda

- (i) Prehensile arms or tentacles and siphon are present.
- (ii) Shell may or may not be present.
- (iii) Head is well developed bearing large eyes.

Subclass : Coleoidea

- (i) Shell internal or reduced.
- (ii) Tentacles with suckers.

Specimen : *Loligo* sp. (commonly known as squid)

- (i) Fleshy body which is dorsoventrally flattened.
- (ii) Head bears ten oral arms and a pair of eyes.
- (iii) Head and trunk region are separated by a collar.
- (iv) Lateral fins or parapodia united posteriorly to form a triangular shape.

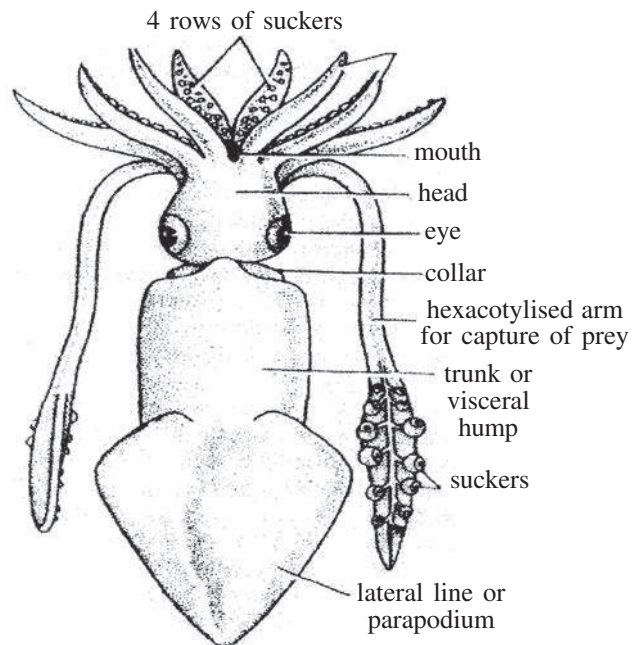


Figure 30 : *Loligo sp.*

31. *Sepia sp.*

a) Systematic position (According to Ruppert & Barnes, 1994)

Phylum : Mollusca
 Class : Cephalopoda
 Sub-class : Coleoidea
 Genus : *Sepia*
 Specimen : *Sepia sp.*

b) Systematic identification with reasons

Phylum : Mollusca

Same as *Chiton sp.*

Class : Cephalopoda

Same as *Loligo sp.*

Sub-class : Coleridea

Same as *Loligo* sp.

Specimen : *Sepia* sp. [Commonly known as cuttle fish]

- (i) Body differentiated into anterior head, middle collar or neck and posterior trunk or visceral hump.
- (ii) The head contains ten oral arms.
- (iii) Eight oral arms are smaller and have several rows of pedicellate suckers, ventrally surrounding the mouth.
- (iv) Two arms on each side are elongated, each having several pedicellate suckers at its tips are called hectocotylysed arms.
- (v) Base of the head contains a pair of eyes.
- (vi) Lateral fins narrow, present throughout the trunk and not united posteriorly.

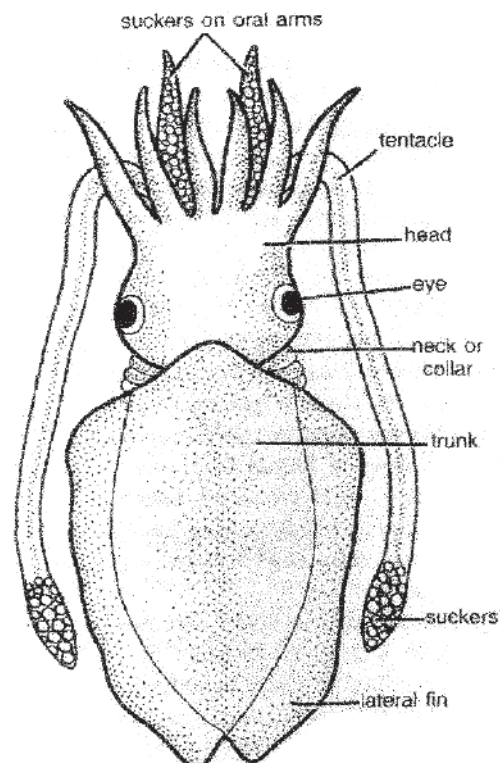


Figure 31 : *Sepia* sp.

32. *Octopus sp.*

a) Systematic position (According Ruppert & Barnes, 1994)

- Phylum : Mollusca
Class : Cephalopoda
Subclass : Coleoidea
Genus : *Octopus*
Specimen : *Octopus sp.*

b) Systematic identification with reasons

Upto Sub-class same as *Loligo sp.*

Specimen : *Octopus sp.*

- (i) Body differentiated into head and visceral hump.
- (ii) The head bears eyes, siphon and eight elongated arms.
- (iii) Two rows of cupped sessile suckers are present on the arms.
- (iv) One of the arms of the male octopus is hectocotyliised and therefore spoon shaped.
- (v) Visceral mass and mantle cavity enclosed in mantle.

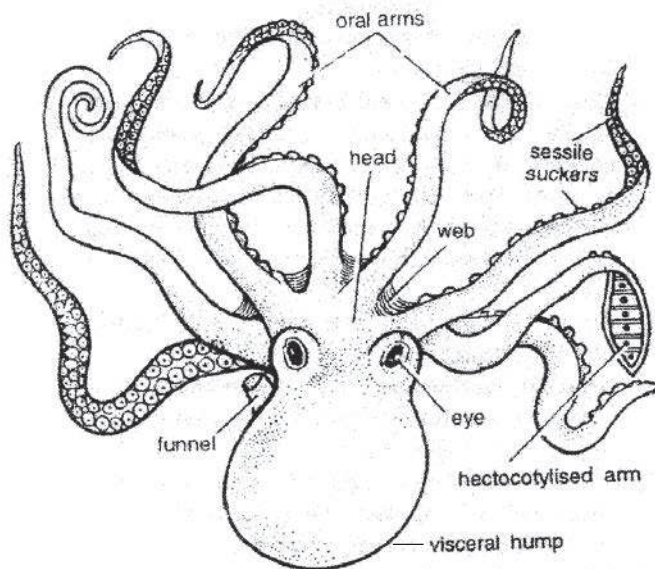


Figure 32 : *Octopus sp.*

33. Starfish

a) Systematic position (According to Ruppert & Barnes, 1994)

- Phylum : Echinodermata
Subphylum : Asterozoa
Class : Asteroidea
Specimen : Starfish

b) Systematic identification with reasons

Phylum : Echinodermata

- (i) Body show pentamerous radial symmetry.
- (ii) Body distinguishable into oral and aboral surfaces and is without any distinct head.
- (iii) Body is a flattened disc with radially projecting arms.
- (iv) Body is star shaped.
- (v) Oral surface of the ambulacra project several tube feet.

Sub-phylum : Asterozoa

- (i) A star shaped body.
- (ii) Radially divergent axes of symmetry.

Class : Asteroidea

- (i) From the central disc the arms are not sharply set off.
- (ii) The ambulacral grooves are open.
- (iii) Two to four rows of tube feet are present on the ambulacra.
- (iv) Anus and madreporite are present on the aboral surface.

Specimen : Starfish

- (i) Star shaped echinodermness having a central disc and usually five arms.
- (ii) The aboral surface may be smooth, granular or spiny and is covered with overlapping plates.
- (iii) Many species are brightly coloured with various shades of red or orange, while others are blue, grey or brown.

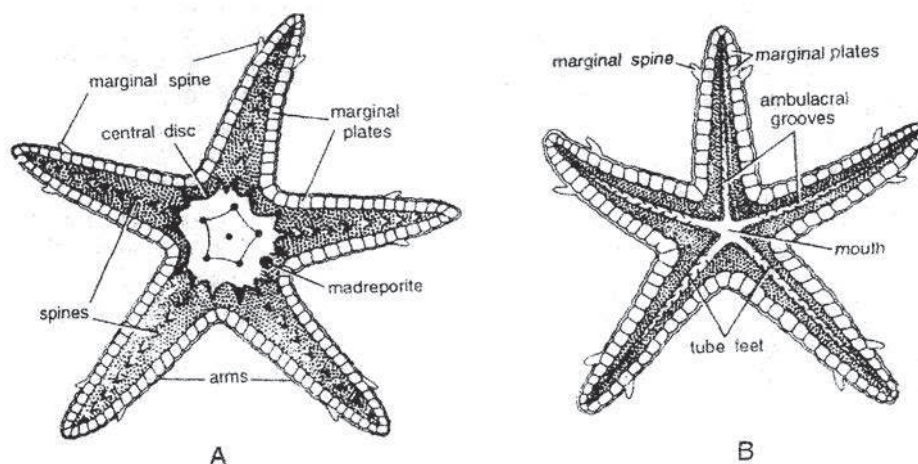


Figure 33 : Starfish (A) Aboral view and (B) Oral view

34. *Ophiura* sp.

a) Systematic position (According to Ruppert & Barnes, 1994)

- Phylum : Echinodermata
 Subphylum : Asterozoa
 Class : Ophiuroidea
 Genus : *Ophiura*
 Specimen : *Ophiura* sp.

b) Systematic identification with reasons

Phylum : Echinodermata

Same as star fish

Subphylum Asterozoa

Same as star fish

Class : Ophiuroidea

- (i) From the central disc the arms are sharply set off.
- (ii) Ambulacral grooves are not present.

(iii) Arms provided with vertebral ossicles.

(iv) Mouth and madreporite are situated on the oral surface of the body.

Specimen : *Ophiura sp.*

(i) It has a circular central disc and five radially arranged narrow arms.

(ii) Both the disc and arms are covered with calcareous plates.

(iii) Arms are highly fragile.

(iv) Small spines on the arms lie flat against the surface.

(v) Five large mouth-shield plates are on the underside of the disc which surrounds the central mouth.

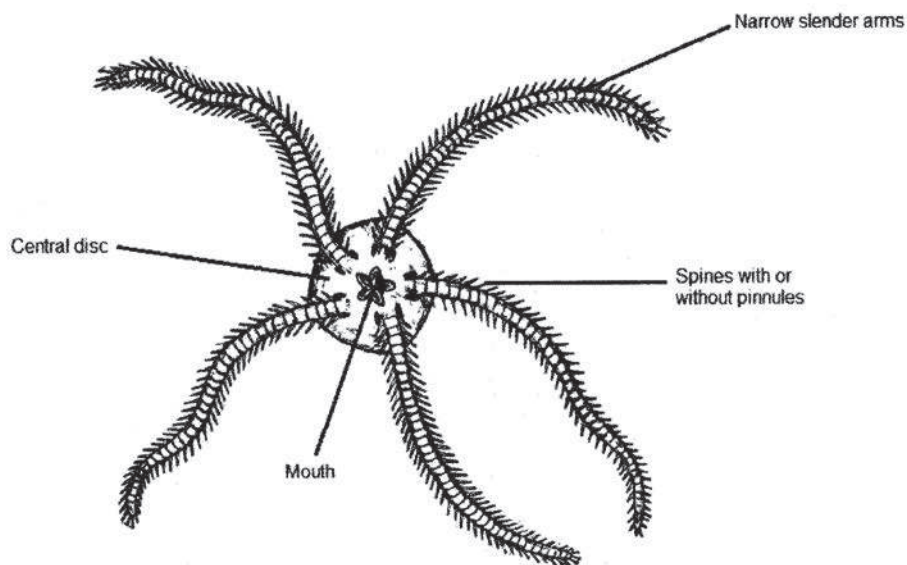


Figure 34 : *Ophiura sp.*

35. *Echinus sp.*

a) Systematic position (According Ruppert & Barnes, 1994)

Phylum : Echinodermata

Subphylum : Echinozoa

Class : Echinoidea

Subclass : Euechinoidea
Genus : Echinus
Specimen : *Echinus sp.*

b) Systematic identification with reasons

Phylum : Echinodermata

Same as star fish

Subphylum : Echinozoa

- (i) The body is globoid or discoidal without arms and is radially symmetrical.
- (ii) Madreporite and anus remain on the aboral side.

Class : Echinoidea

- (i) Body is spherical and the oral and aboral side is flattened.
- (ii) Although the ambulacral grooves are absent, the body surface is divided into alternate ambulacral and inter-ambulacral areas.
- (iii) The tube feet possess suckers.
- (iv) The ambulacral areas extend from the oral to the aboral sides of the body.
- (v) Ossicles fused to form an internal test on which moveable spines are mounted.

Sub-class : Euechinoidea

- (i) Test rigid, not flexible.
- (ii) Spines may be hollow or solid.

Specimen : *Echinus sp.* (commonly known as sea-urchin)

- (i) Approximately spherical but slightly flattened at both poles.
- (ii) There are two rows of plates in each of five ambulacral areas.
- (iii) The test is covered in spines each articulating with a tubercle.
- (iv) There is a dense covering of secondary spines and a smaller number of longer, primary spines, carried on each second or third ambulacral plate.
- (v) There is a radially symmetrical pattern of holes in the ambulacral areas through which the tube feet emerge.

(vi) On the buccal plates round the mouth on the underside are pedicellariae, defensive organs like minute pincers, each with two lateral teeth and one terminal tooth.

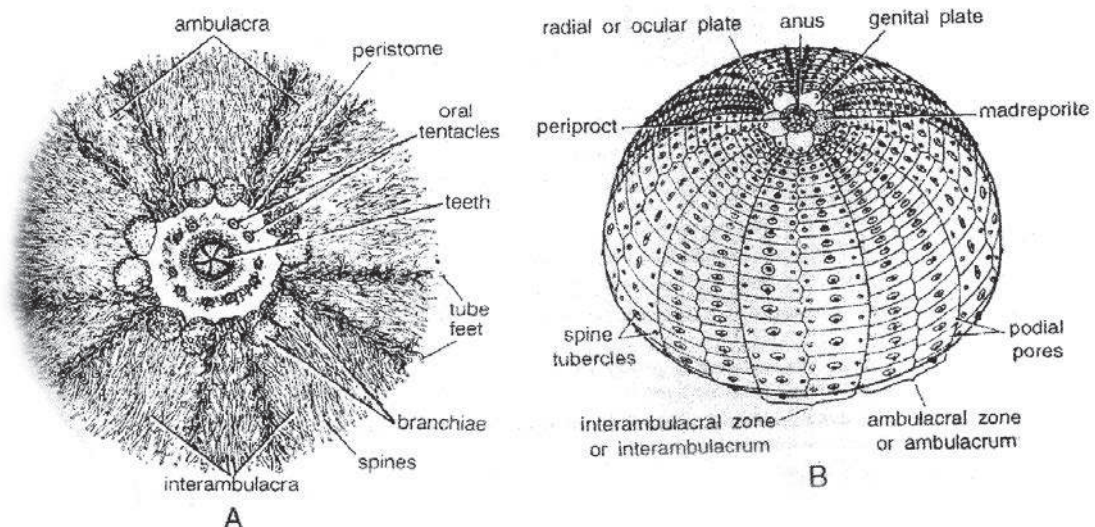


Figure 35 : (A) Oral view and (B) Test of *Echinus sp.*

36. *Cucumaria sp.*

a) Systematic position (According to Ruppert Barnes, 1994)

Phylum	:	Echinoermata
Subphylum	:	Echinozoa
Class	:	Holothuroidea
Genus	:	<i>Cucumaria</i>
Specimen	:	<i>Cucumaria sp.</i>

b) Systematic identification with reasons

Phylum : Echinodermata

Same as star fish

Subphylum : Echinozoa

Same as *Echinus sp.*

Class : Holothuroidea

- (i) Along the oral–aboral axis the body is elongated.
- (ii) Five ambulacral areas are present on the surface of the body.
- (iii) Anteriorly directed mouth with circum -oral tentacles.
- (iv) Skeleton diminished to minute ossicles.

Specimen : *Cucumaria sp.* [commonly known as sea-cucumber]

- (i) The body is thick and has five double rows of tube feet, separated by smooth, soft skin.
- (ii) Tentacles are highly branched.
- (iii) Presence of a smooth, thin collar like structure at the base of tentacles.
- (iv) Their mouth and anus are at separate ends of the body.

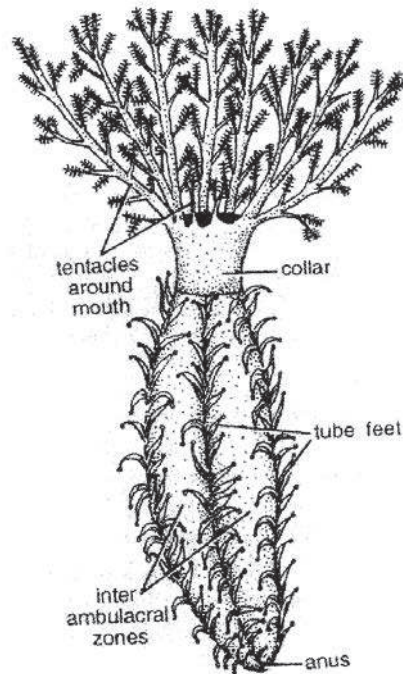


Figure 36 : *Cucumaria sp.*

37. *Antedon* sp.

a) Systematic position (According to Ruppert & Barnes, 1994)

Phylum	:	Echinodermata
Subphylum	:	Cinozoa
Class	:	Crinoidea
Subclass	:	Articulata
Genus	:	<i>Antedon</i>
Specimen	:	<i>Antedon</i> sp.

b) Systematic identification with reasons

Phylum : Echinodermata

Same as star fish

Subphylum : Crinozoa

- (i) A cup-shaped theca with arms on a radially symmetrical body.
- (ii) Either sessile or attached with a stalk.
- (iii) The oral side faces upwards.
- (iv) The oral surface bears both mouth and anus.
- (v) The cup shaped aboral side is called calyx.

Class : Crinoidea

- (i) Both stalked and free moving forms are present.
- (ii) Arms are branched and bear pinnules.
- (iii) The ambulacral grooves radiate from the mouth and extend to the tip of the pinnules.

Subclass : Articulata

- (i) Aboral cirri may or may not be present.

Specimen : *Antedon sp.* (commonly known as Sea-lilly)

- (i) Stalk absent.
- (ii) Presence of 10 feathery arms arising from a central concave disc.
- (iii) Pinnules are uniserial.
- (iv) Clawed cirri on the lower surface provide temporary attachment to the substrate.

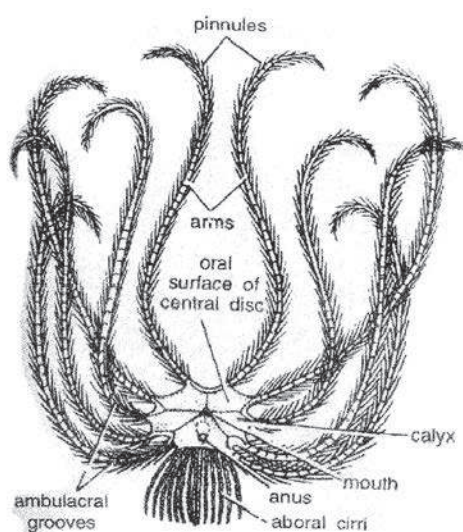


Figure 37 : *Antedon sp.*

1.3 Study of different vertebrate and invertebrate chordate specimen with proper reason

1. *Balanoglossus sp.*

a) Systematic position (According to Ruppert and Barnes, 1994)

Phylum : Hemichordata
 Class : Enteropneusta
 Genus : *Balanoglossus*
 Specimen : *Balanoglossus sp.*

b) Systematic identifications with reasons

Phylum : Hemichordata

- (i) Presence of a buccal diverticulum or stomochord.

(ii) Pharyngeal clefts are present.

(iii) Body is divided into three basic parts: the proboscis, collar, and trunk.

Class : Enteropneusta

(i) Proboscis elongated, cylindrical.

(ii) Collar is without appendages.

(iii) Trunk elongated and differentiated into branchial, hepatic and abdonural zones.

Specimen : *Balanoglossus* sp.

(i) Both proboscis and collar are more or less equal in length.

(ii) Presence of genital wings.

(iii) Pharyngeal clefts are like small pores.

(iv) Notochord present at any stage of life history.

(v) Pharyngeal gill slits present.

(vi) Presence of dorsal hollow tubular nerve cord.

(vii) Presence of post anal tail.

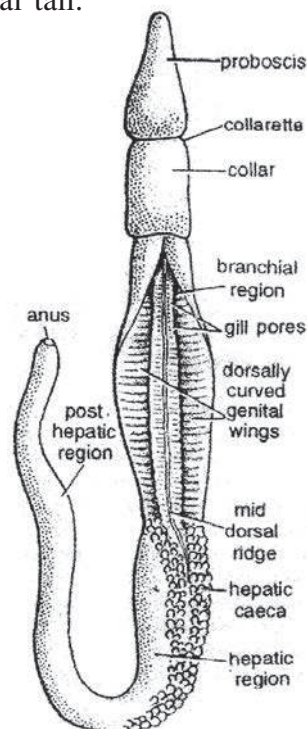


Figure 38 : *Balanoglossus* sp.

2. *Herdmania* sp.

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Urochordata
Clas	:	Ascidiacea
Genus	:	Herdmania
Specimen	:	<i>Herdmonia</i> sp.

b) Systematic identifications with reasons

Phylum : Chordata

- (i) Presence of notochord.
- (ii) Presence of dorso-tubular nerve chord.
- (iii) Presence of pharyngeal gill slits.

Subphylum : Urochordata

- (i) Body is covered by a tunic or tunic test.
- (ii) Notochord present only in the larval tail.
- (iii) Presence of an oral aperture.

Class : Ascidiacea

- (i) Sac -like body
- (ii) Muscles are scattered over the test.
- (iii) Presence of many pharyngeal gill slits.
- (iv) Test is thick.

Specimen : *Herdmania* sp. [commonly known as sea squirts]

- (i) The body can be divided into a soft sac like body proper and a foot.
- (ii) The foot forms the posterior third of the body and is dirty, leathery with lot of foreign objects attached.

(iii) On the anterior side there are present two siphons known as branchial siphon and atrial siphon, which open to the exterior via branchial aperture and atrial aperture respectively.

(iv) Both branchial siphon and atrial siphon lie on same line.

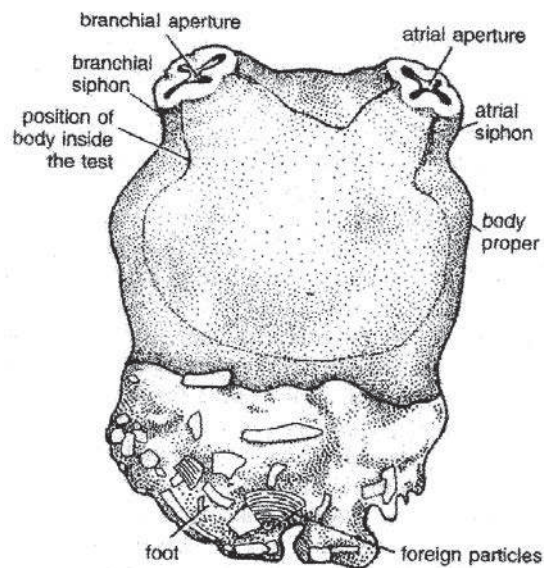


Figure 39 : *Herdmania* sp.

3. *Branchiostoma* sp.

a) Systematic position (According to J.Z Young, 1981)

Phylum : Chordata
 Subphylum : Cephalochordata
 Genus : Branchiostoma
 Specimen : *Branchiostoma* sp.

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania* sp.

Subphylum : Cephalochordata

- (i) Notochord present along the entire length of the body.
- (ii) Numerous gill slits present.

Specimen : *Branchiostoma sp.* [commonly known as lancelet or *Amphioxus*]

- (i) Body is elongated, flattened, and pointed at both ends.
- (ii) Mouth is ventral and guarded by oral hood containing oral cirri.
- (iii) The dorsal, ventral and caudal fins are low and continuous.
- (iv) There are two lateral fins and metapleural folds.
- (v) Myotomes are arranged as shaped on the sides of the bodies.

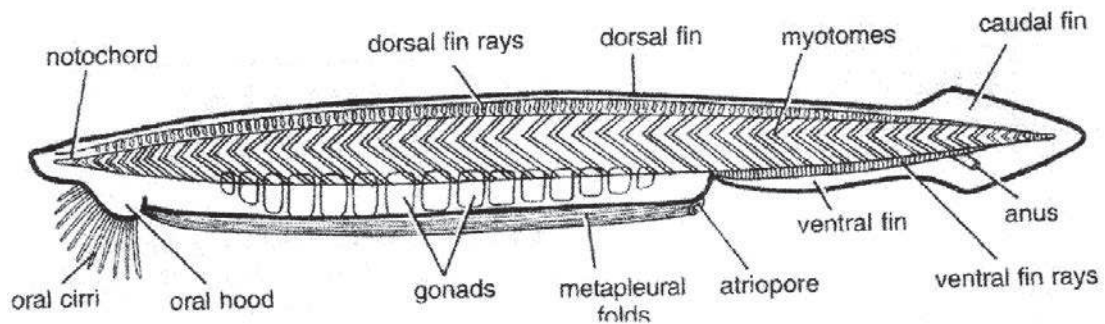


Figure 40 : *Branchiostoma sp.*

4. *Petromyzon sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Agnatha
Class	:	Cephalaspidomorphi
Order	:	Cyclostomata
Genus	:	<i>Petromyzon</i>
Specimen	:	<i>Petromyzon sp.</i>

b) Systematic identifications with reasons**Phylum : Chordata**

Same as *Herdmania* sp.

Subphylum : Vertebrata

Presence of a vertebral column which is derived from the notochord.

Superclass : Agnatha

- (i) Jaws are absent.
- (ii) Paired appendages are absent.

Class : Cephalaspidomorphi

- (i) These animals possess head shield over the brain.
- (ii) Single nasal aperture is present at the anterior tip.

Order : Cyclostomata

The mouth is suctorial and circular.

Specimen : *Petromyzon* sp. [commonly known as lampreys]

- (i) The body is eel like.
- (ii) Body differentiated into head, trunk and tail.
- (iii) First dorsal fin, second dorsal fin and caudal fin confluent.
- (iv) Scales are absent and the body is slimy.
- (v) Mouth is surrounded by a large suctorial funnel.
- (vi) Seven pairs of gill slits are present.

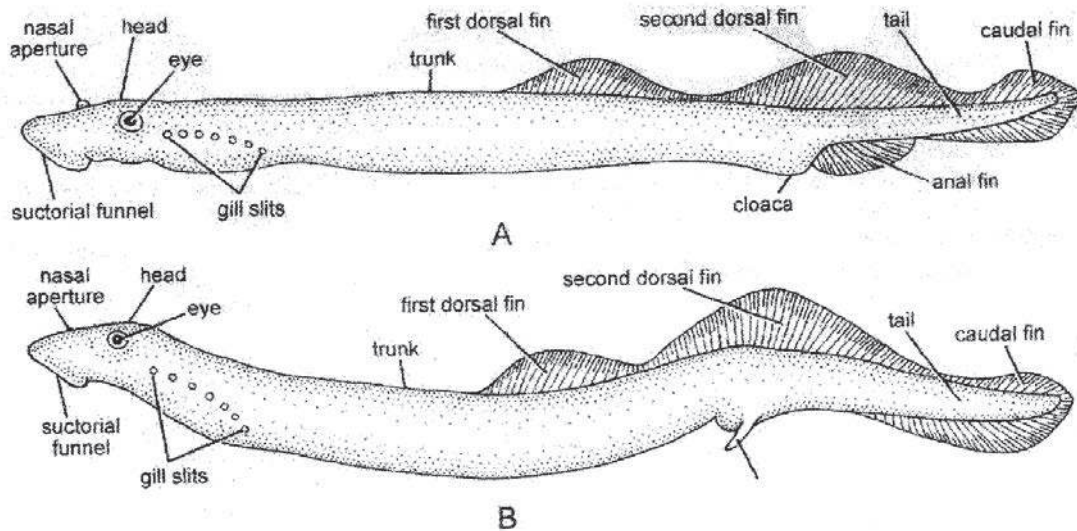


Figure 41 : *Petromyzon sp.*

5. *Sphyrna sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Chondrichthyes
Subclass	:	Elasmobranchi
Genus	:	<i>Sphyrna</i>
Specimen	:	<i>Sphyrna sp.</i>

b) Systematic identifications with resons

Subphylum : Vertebrata

Same as *Petromyzon sp.*

Superclass : Gnathostomata

- (i) Jaws present.
- (ii) Paired appendages are present

Class : Chondrichthyes

- (i) Fin with fin-rays.

- (ii) Mouth Ventral.
- (iii) External gill slits present.
- (iv) Tail heterocircal.
- (v) The scales are usually placoid.
- (vi) The endoskeleton is cartilaginous.

Subclass : Elasmobranchii

- (i) At the anterior end of the body 5 to 7 gill slits are present in each side.
- (ii) Firm and hard jaws are provided with numerous sharp teeth.

Specimen : *Sphyrna* sp.

- (i) The head is hammer shaped and hence called hammer headed shark.
- (ii) Eyes contain nictitating membrane and placed at the tip of lateral expansions of head.
- (iii) First dorsal fin is situated ahead of pelvic fin and second dorsal fin is opposite to anal fin.
- (iv) Five pairs of lateral gill slits present.
- (v) Lateral line is distinct.

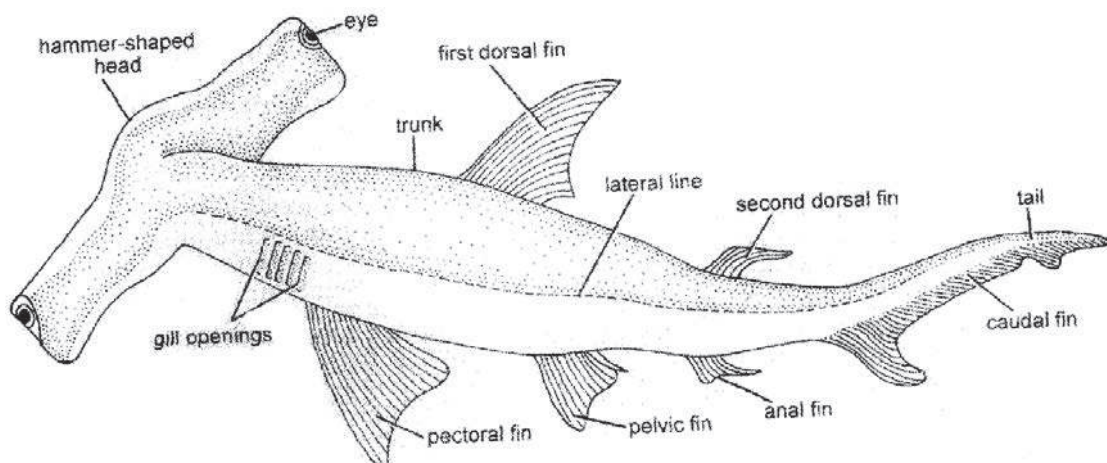


Figure 42 : *Sphyrna* sp.

6. *Pristis* sp.

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Chondrichthyes
Subclass	:	Elasmobranchii
Genus	:	<i>Pristis</i>
Specimen	:	<i>Pristis</i> sp.

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Class : Chondrichthyes

Same as *Sphyrna* sp.

Subclass : Elasmobranchii

Same as *Sphyrna* sp.

Specimen : *Pristis* sp. [commonly known as saw fish]

(i) The snout is produced into a saw like rostrum with large and small weakly embedded teeth.

(ii) Head contains a pair of eyes and a pair of spiracles.

(iii) Dorsal fins are two in number.

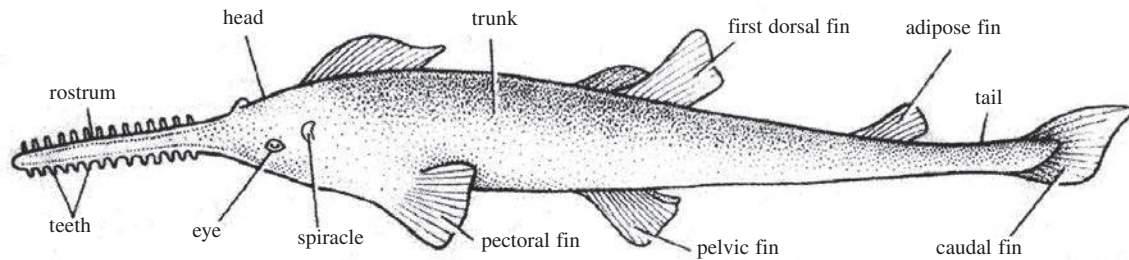


Figure 43 : *Pristis* sp.

7. *Torpedo* sp.

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vetebrata
Superclass	:	Gnathostomata
Class	:	Chondrichthyes
Subclass	:	Elasmobranchii
Genus	:	<i>Torpedo</i>
Specimen	:	<i>Torpedo</i> sp.

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Subclass : Elasmobranchii

Same as *Sphyrna* sp.

Specimen : *Torpedo* sp. [commonly known as electric rays]

- (i) Head, trunk and pectoral fins are fused to form a sub-circular disc.
- (ii) The two large, kidney-shaped electric organs are visible beneath the skin on either side of the head.
- (iii) The eyes are small and followed by spiracles of comparable size.
- (iv) The five pairs of gill slits are placed on the underside of the disc.
- (v) Tail is thick and short with two dorsal fins, a caudal fin and two lateral folds of skin.
- (vi) Pelvic fins are just below the lower margin of the pectoral fin.
- (vii) No spines.

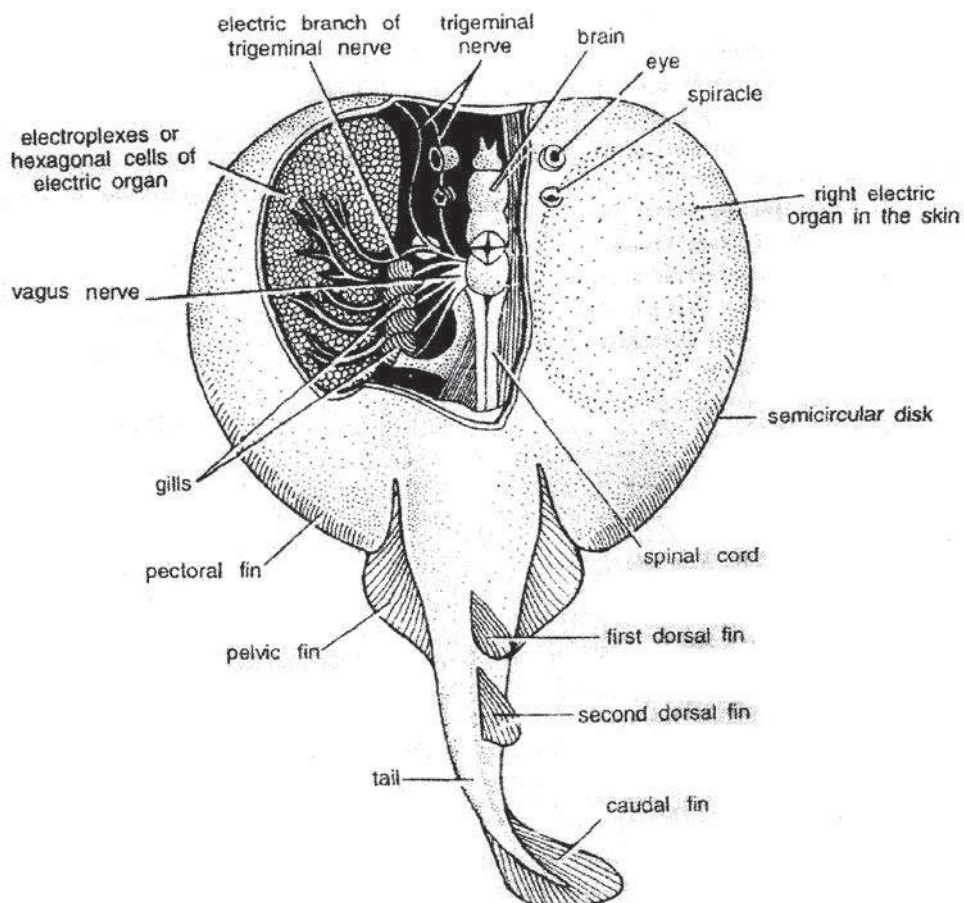


Figure 44 : *Torpedo sp.*

1.4 *Scoliodon* sp.

a) Systematic Position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Chondrichthyes
Subclass	:	Elasmobranchii
Genus	:	<i>Scoliodon</i>
Specimen	:	<i>Scoliodon</i> sp.

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Chondrichthyes

Same as *Sphyrna* sp.

Subclass Elasmobranchii

Same as *Sphyrna* sp.

Specimen : *Scoliodon* sp.

- (i) Elongated, spindle-shaped body tapered at the anterior end.
- (ii) The trunk and tail are laterally compressed, while the head region is dorsoventrally compressed.
- (iii) It has two rows of homodont or polyphyodont teeth.
- (iv) Spiracles absent.

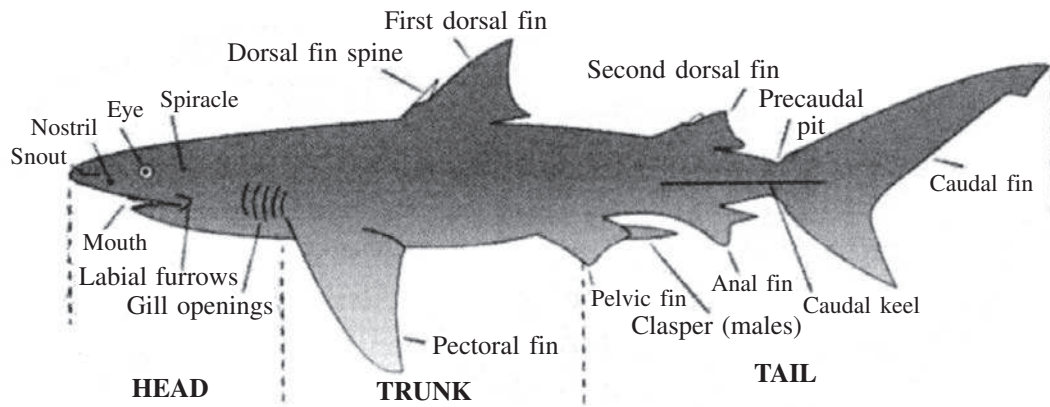


Figure 45 : *Scoliodon sp.*

9. *Labeo sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Osteichthyes
Subclass	:	Actinopterygii
Order	:	Cypriniformes
Genus	:	Labeo
Specimen	:	<i>Labeo sp.</i>

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania sp.*

Subphylum : Vertebrata

Same as *Petromyzon sp.*

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Osteichthyes

- (i) Fin with fin rays.
- (ii) Mouth terminal or sub-terminal.
- (iii) Gills are covered by operculum.
- (iv) Tail homocercal or diphyccercal.
- (v) Scales are cycloid, ctenoid or ganoid.
- (vi) Endoskeleton is bony.

Subclass : Actinopterygii

- (i) Fins are webs of skin supported by fin-rays.
- (ii) No fleshy lobe base of paired fins.

Order : Cypriniformes

- (i) Head without scales.
- (ii) Single dorsal fin.

Specimen : *Labeo* sp.

- (i) Both the lips are fleshy and thick with horny covering.
- (ii) Body is covered by large and overlapping cycloid scales.
- (iii) Snout projects beyond the narrow mouth.
- (iv) A small pair of filamentous barbels may arise from upper lips.
- (v) Lateral line is distinct.

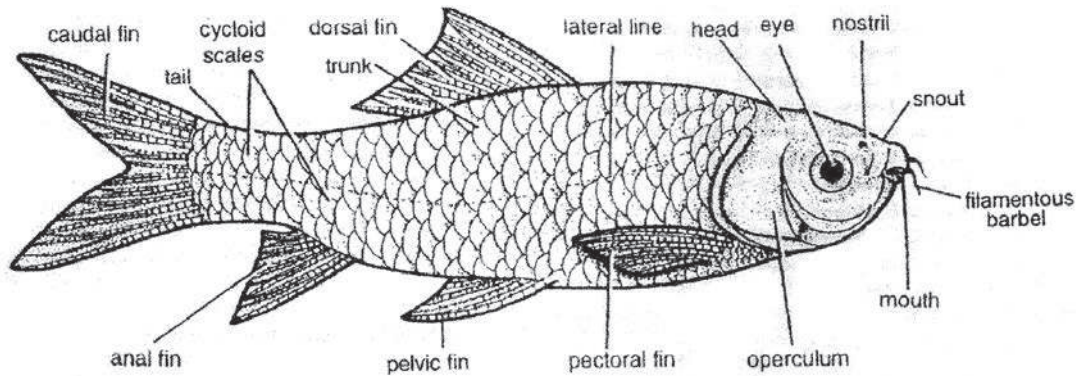


Figure 46 : *Labeo sp.*

10. *Exocoetus sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Osteichthyes
Subclass	:	Actinopterygii
Order	:	Beloniformes
Genus	:	<i>Exocoetus</i>
Specimen	:	<i>Exocoetus sp.</i>

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania sp.*

Subphylum : Vertebrata

Same as *Petromyzon sp.*

Superclass : Gnathostomata

Same as *Sphyrna sp.*

Class : Osteichthyes

Same as *Labeo* sp.

Subclass : Actinopterygii

Same as *Labeo* sp.

Order : Beloniformes

- (i) The pectoral fins are enlarged to wing like form.
- (ii) The body is covered with cycloid scales.
- (iii) The mouth is wide, and the jaws bear teeth.
- (iv) The tail has hypobatic fins as the ventral lobe is comparatively enlarged.
- (v) Lateral line is located low on the body.

Specimen : *Exocoetus* sp.

- i)
- ii)
- iii)

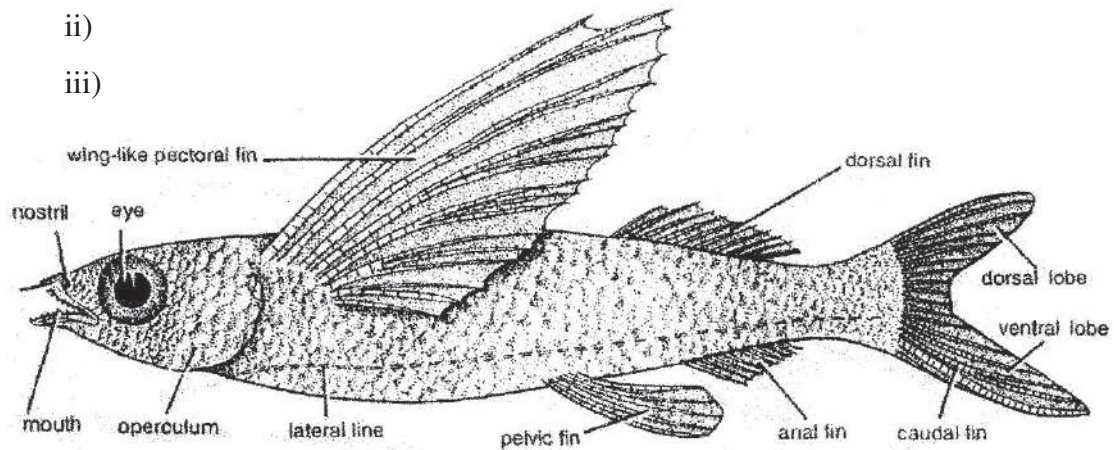


Figure 47 : *Exocoetus* sp.

11. *Anguilla* sp.**a) Systematic position (According to J.Z Young, 1981)**

Phylum : Chordata

Subphylum : Vertebrata

Superclass : Gnathostomata
Class : Osteichthyes
Subclass : Actinopterygii
Order : Anguilliformes
Genus : *Anguilla*
Specimen : *Anguilla* sp.

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Osteichthyes

Same as *Labeo* sp.

Subclass : Actinopterygii

Same as *Labeo* sp.

Order : Anguilliformes

- (i) Body long and slender.
- (ii) Gill openings small.
- (iii) Scales minute or absent.
- (iv) Dorsal, caudal and anal fins continuous.

Specimen : *Anguilla* sp.

- (i) Body slender, elongated and snake like.

- (ii) An operculum grooves the gill slits and nostril is present.
- (iii) Body covered by minute scales which are embedded in the skin.
- (iv) Gills displaced posteriorly.

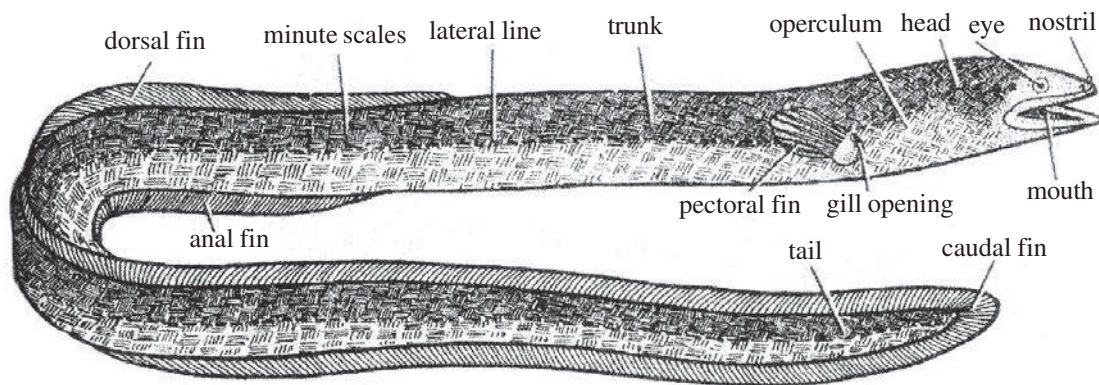


Figure 48 : *Anguilla sp.*

12. *Tenualosa sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Osteichthyes
Subclass	:	Actinopterygii
Order	:	Clupeiformes
Genus	:	<i>Tenualosa</i>
Specimen	:	<i>Tenualosa sp.</i>

b) Systematic identifications with reasons**Phylum : Chordata**

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Osteichthyes

Same *Labeo* sp.

Subclass : Actinopterygii

Same as *Labeo* sp.

Order : Clupeiformes

- (i) Fusiform body tapering toward each end.
- (ii) Typically lack a lateral line.
- (iii) Presence of dark shading on the back and bright silvery sides.

Specimen : *Tenualosa* sp.

- (i) It has no dorsal spines but 18-21 dorsal soft rays and anal soft rays.
- (ii) The belly has 30 to 33 scutes.
- (iii) There is a distinct median notch in upper jaw.
- (iv) Gill rakers fine and numerous.
- (v) The fish shows a dark blotch behind gill opening, followed by a series of small spots along the flank.

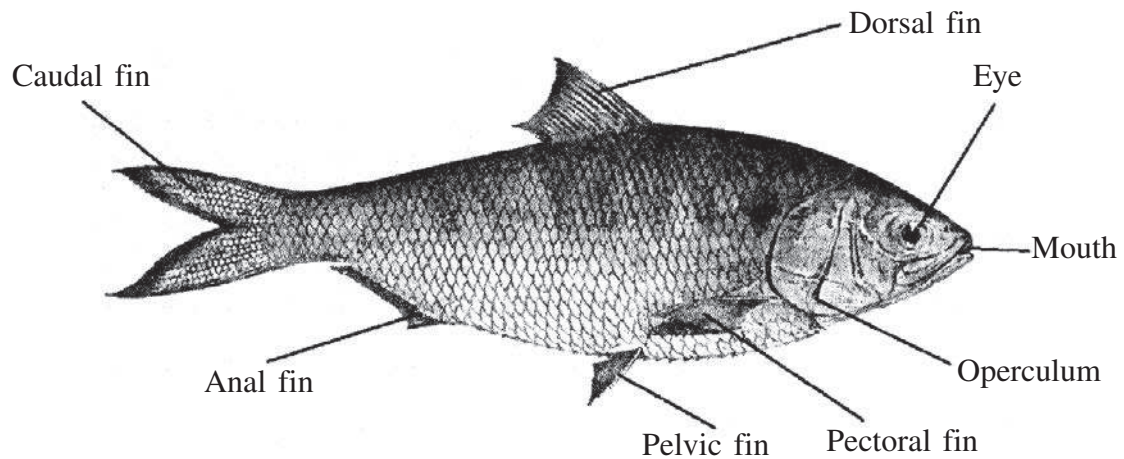


Figure 49 : *Tenualosa* sp.

13. *Uraeotyphlus* sp.

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Amphibia
Subclass	:	Lissamphibia
Order	:	Gymnophiona
Genus	:	<i>Uraeotyphlus</i>
Specimen	:	<i>Uraeotyphlus</i> sp.

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Amphibia

- (i) The skin is moist, glandular and naked.
- (ii) A distinct neck is absent.
- (iii) Forelimbs with four and hind limbs with five clawless digits.
- (iv) Two nostrils connected with the mouth cavity.

Subclass : Lissamphibia

- (i) Scaleless, smooth-skinned amphibians with glands.
- (ii) Skull is broad and the orbits are enlarged into the cheek and temporal regions.

Order : Gymnophiona

- (i) Elongated worm like body.
- (ii) Scales present but under the skin.
- (iii) Sensory tentacle present between eye and nostril.
- (iv) Tail absent or very short.

Specimen : *Uraeotyphlus* sp.

- (i) Skin with numerous transverse grooves.
- (ii) Eyes are nonfunctional and concealed beneath the slimy skin.
- (iii) Cloaca present at the terminal end.

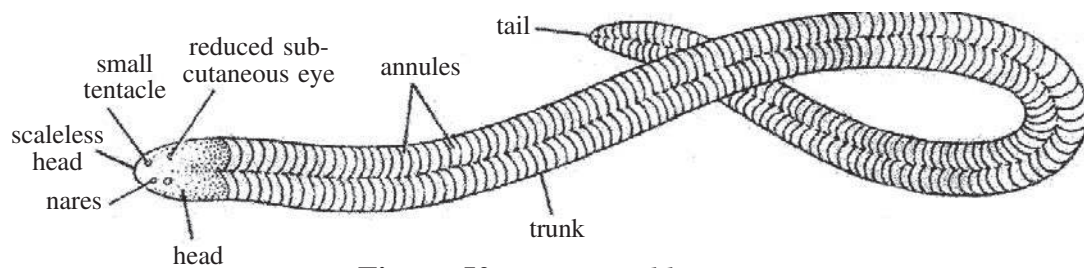


Figure 50 : *Uraeotyphlus sp.*

14. Salamander sp.

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Amphibia
Subclass	:	Lissamphibia
Order	:	Gymnophiona
Genus	:	Salamander
Specimen	:	<i>Salamander</i>

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania sp.*

Subphylum : Vertebrata

Same as *Petromyzon sp.*

Superclass : Gnathostomata

Same as *Sphyrna sp.*

1.51.2.4 Class Amphibia

Same as *Uraeotyphlus sp.*

Subclass : Lissamphibia

Same as *Uraeotyphlus* sp.

Order : Urodela

- (i) Body lizard like.
- (ii) Both fore and hind limbs are equal in size.
- (iii) Long tail present.

Specimen : Salamander sp.

- (i) Body divided into head, trunk and tail.
- (ii) Body brilliantly black with irregular patches of yellow.
- (iii) Head contains eyes, prominent mouth and nostrils.
- (iv) Eyes provided with movable eyelids.
- (v) Large parotid glands are present behind the head.

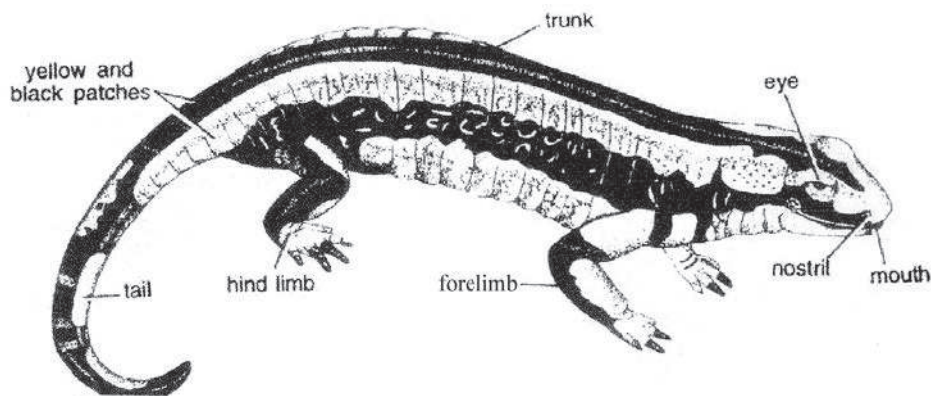


Figure 51 : Salamander sp.

15. Bufo sp.**a) Systematic position (According to J.Z Young, 1981)**

- Phylum : Chordata
- Subphylum : Vertebrata
- Superclass : Gnathostomata

Class : Amphibia
Subclass : Lissamphibia
Order : Anura
Genus : Bufo
Specimen : *Bufo* sp.

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Amphibia

Same as *Uraeotyphlus* sp.

Subclass : Lissamphibia

Same as *Uraeotyphulus* sp.

Order : Anura

- (i) Body short and broad.
- (ii) Tail is absent in adult.
- (iii) Forelimbs shorter than hindlimbs.
- (iv) Eyelids and tympanum present.

Specimen : *Bufo* sp.

- (i) Skin is rough with blackish warts dorsally.
- (ii) Body divided into head and trunk.
- (iii) Head bears large eyes, mouth, nostrils and tympanum.

- (iv) Large parotid poison gland present behind eyes.
- (v) Digits are free and without adhesive pads.
- (vi) Toes are slightly webbed.

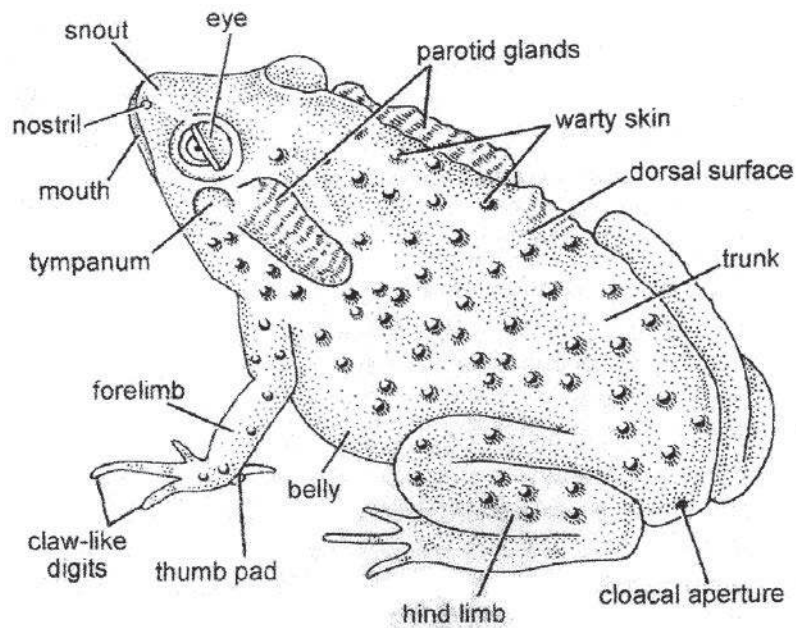


Figure 52 : *Bufo* sp.

16. *Hyla* sp.

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Amphibia
Subclass	:	Lissamphibia
Order	:	Anura
Genus	:	<i>Hyla</i>
Specimen	:	<i>Hyla</i> sp.

b) Systematic identifications with reasons**Phylum : Chordata**

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Amphibia

Same as *Uraeotyphlus* sp.

Subclass : Lissamphibia

Same as *Uraeotyphlus* sp.

Order : Anura

Same as *Bufo* sp.

Specimen : *Hyla* sp.

- (i) Body is divided into head and trunk.
- (ii) Digits of hindlimbs are webbed.
- (iii) Parotid gland absent.
- (iv) Terminal base of each digit is claw shaped.
- (v) Toes contain expanded adhesive discs.
- (vi) Eyes well developed with horizontal pupils.
- (vii) The tympanum is distinct.
- (viii) Skin of belly contains hygroscopic glands.
- (ix) Upper jaw toothed and lower jaw without teeth.

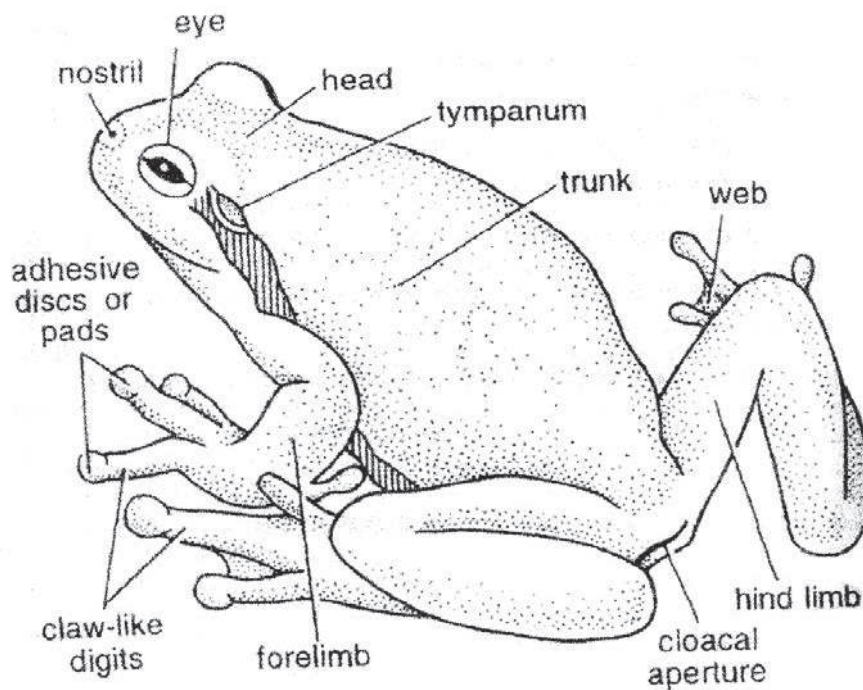


Figure 53 : *Hyla sp.*

17. *Turtle sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Reptilia
Subclass	:	Anapsida
Order	:	Chelonia
Genus	:	Turtle
Specimen	:	<i>Turtle</i>

b) Systematic identifications with reasons**Phylum : Chordata**

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Reptilia

- (i) Dry and cornified skin which is covered by scales and scutes.
- (ii) Body divided into head, neck, trunk and tail.
- (iii) Forelimb and hindlimb with five clawed digits.
- (iv) Longitudinal or transverse cloacal aperture.

Subclass : Anapsida

- (i) The skull roof is solid.
- (ii) There is no temporal fossa.

Order : Chelonia

- (i) A dorsal carapace and ventral plastron encase the body.
- (ii) Longitudinal cloacal aperture.
- (iii) Horny sheaths are present on jaws.
- (iv) Teeth are absent.

Specimen : Turtle

- (i) Carapace covered with smooth bony shields.
- (ii) Limbs modified to paddles.
- (iii) Not all the digits are clawed.

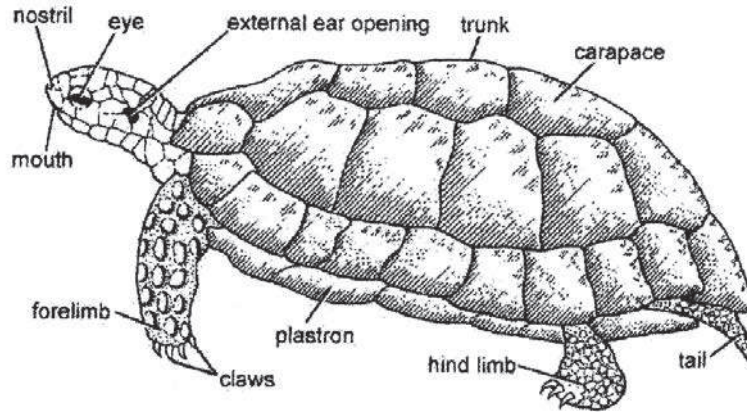


Figure 54 : *Turtle sp.*

18. *Calotes sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Reptilia
Subclass	:	Lepidosauria
Order	:	Squamata
Genus	:	<i>Calotes</i>
Specimen	:	<i>Calotes sp.</i>

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania sp.*

Subphylum : Vertebrata

Same as *Petromyzon sp.*

Superclass : Gnathostomata

Same as *Sphyrna sp.*

Class : Reptilia

Same as *Turtle* sp.

Subclass : Lepidosauria

- (i) Presence of two temporal fossa in the skull.
- (ii) Body covered with scales.
- (iii) Shell absent.
- (iv) No horny sheath in jaws.
- (v) Teeth present.
- (vi) Body elongated.

Order : Squamata

- (i) Cloacal aperture transverse.
- (ii) Scales are mostly overlapping.

Specimen : *Calotes* sp.

- (i) A spinous crest along the mid-dorsal line of the body is present.
- (ii) Overlapping rough epidermal scales cover the body.
- (iv) Head is movable and bears one or two spines.
- (v) The tail is long and cylindrical and larger than trunk with head.

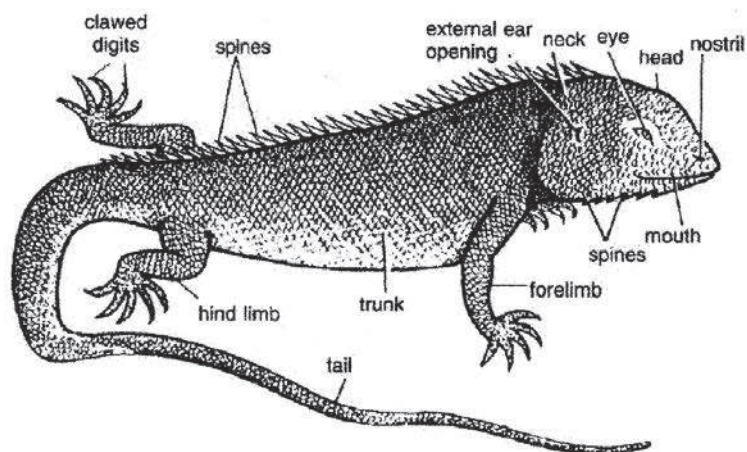


Figure 55 : *Calotes* sp.

19. *Chameleon* sp.**a) Systematic position (According to J.Z Young, 1981)**

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Reptilia
Subclass	:	Lepidosauria
Order	:	Squamata
Genus	:	Chameleon
Specimen	:	<i>Chameleon</i>

b) Systematic identifications with reasons**Phylum : Chordata**

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Reptilia

Same as *Turtle* sp.

Subclass : Lepidosauria

Same as *Calotes* sp.

Order : Squamata

Same as *Calotes* sp.

Specimen : *Chameleon* sp.

(i) Head has prominent crest.

- (ii) Body is laterally compressed.
- (iii) Eyes are large and capable of independent movement.
- (iv) Clawed digits are opposable in groups of two and three, such that the limbs are of the grasping type.
- (v) A long prehensile tail is present.
- (vi) The tongue is sticky and protrusible and shaped like a club.

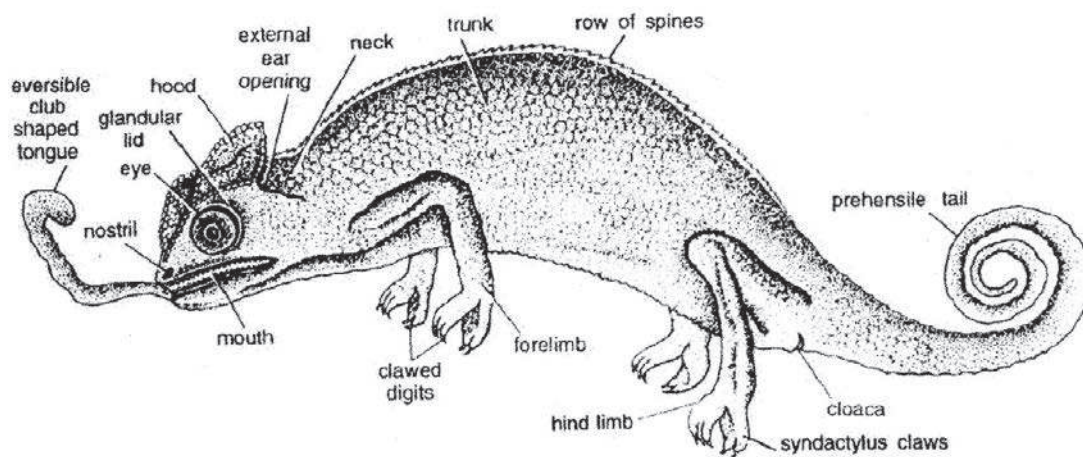


Figure 56 : *Chameleon sp.*

20. *Draco sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Reptilia
Subclass	:	Lepidosauria
Order	:	Squamata
Genus	:	<i>Draco</i>
Specimen	:	<i>Draco sp.</i>

b) Systematic identifications with reasons**Phylum : Chordata**

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Class : Reptilia

Same as *Turtle* sp.

Order : Squamata

Same as *Calotes* sp.

Specimen : *Draco* sp.

- (i) Tail is long, slender and whip like.
- (ii) Four or five ribs support a parachute like web on either side.
- (iii) Flap like structure is present below the neck on either side called the gular pouches.
- (iv) Neck with three hooks.
- (v) Eyes have movable eyelids.

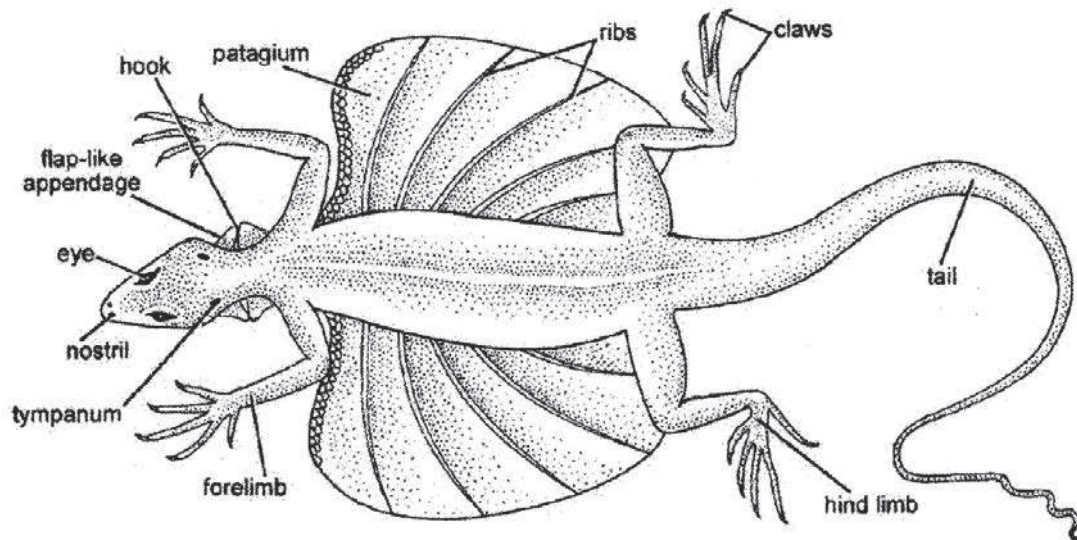


Figure 57 : *Draco* sp.

21. *Vipera* sp.

a) Systematic Position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Reptilia
Subclass	:	Lepidosauria
Order	:	Squamata
Genus	:	<i>Vipera</i>
Specimen	:	<i>Vipera</i> sp.

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Subclass : Lepidosauria

Same as *Calotes* sp.

Order : Squamata

Same as *Calotes* sp.

Specimen : *Vipera* sp.

- (i) Body elongated and slender.
- (ii) Absence of limbs

- (iii) Deep brown coloured elliptical patches on skin.
- (iv) The head is triangular with head scales which small, intricate and keeled.
- (v) Paired erectile fangs in front of upper jaw.
- (vi) No pit between nostrils and eyes.
- (vii) Large nostrils obliquely directed.

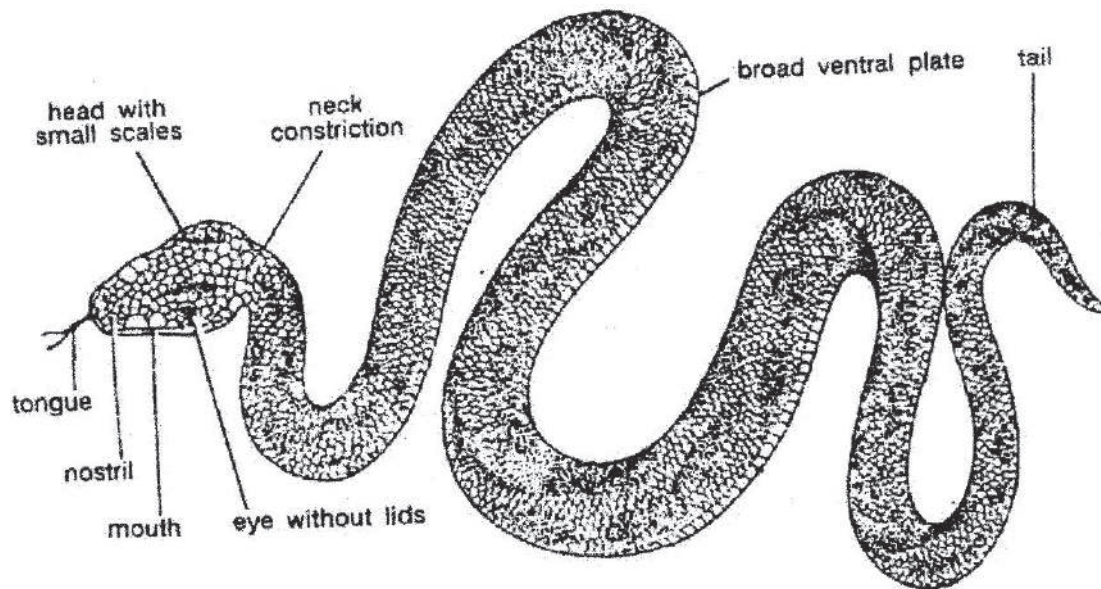


Figure 58 : *Vipera sp.*

22. *Naja sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Reptilia
Subclass	:	Lepidosauria
Order	:	Squamata

Genus : Naja

Specimen : *Naja sp.*

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania sp.*

Subphylum : Vertebrata

Same as *Petromyzon sp.*

Superclass : Gnathostomata

Same as *Sphyrna sp.*

Class : Reptilia

Same as *Turtle sp.*

Sebclass : Lepidosauria

Same as *Calotes sp.*

Order : Sqamata

Same as *Calotes sp.*

Specimen : *Naja sp.*

- (i) Hood is formed from the expanded neck region.
- (ii) Spectacle mark on the dorsal surface of the hood.
- (iii) Body is covered by smooth oblique scales.
- (iv) Caudal scales are paired.
- (v) The front of the maxilla bears tubular poisonous fangs.
- (vi) Tympanum is absent.

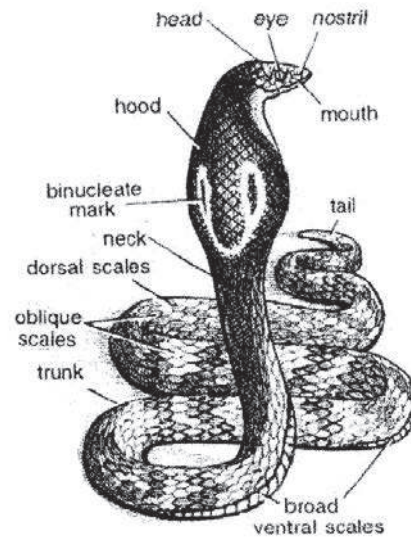


Figure 59 : *Naja sp.*

23. *Crocodylus sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vetebrata
Superclass	:	Gnathostomata
Class	:	Reptilia
Subclass	:	Archosauria
Order	:	Crocodilia
Genus	:	<i>Crocodylus</i>
Specimen	:	<i>Crocodylus sp.</i>

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania sp.*

Subphylum : Vertebrata

Same as *Petromyzon sp.*

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Reptilia

Same as *Turtle* sp.

Subclass : Archosauria

- (i) The skull is diapsid.
- (ii) Dorsal bony scutes present.
- (iii) Shell absent.

Order : Crocodylia

- (i) The tail is laterally compressed and has large crests.
- (ii) Top of the snout bears the valvular nostrils.
- (iii) Webbed digit.
- (iv) Cloaca has longitudinal opening.

Specimen : *Crocodylus* sp.

- (i) Body is elongated.
- (ii) The head is triangular and the snout is stout.
- (iii) Teeth sizes are not uniform.
- (iv) The fourth mandibular teeth fit into a notch in the upper jaw.
- (v) Body is covered by leathery armour.

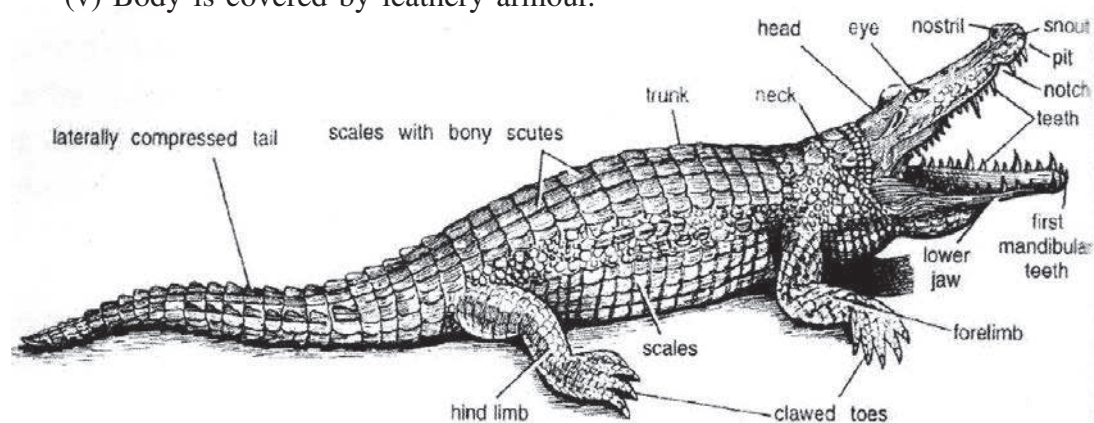


Figure 60 : *Crocodylus* sp.

24. *Gavialis* sp.

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Reptilia
Subclass	:	Archosauria
Order	:	Crocodylia
Genus	:	<i>Gavialis</i>
Specimen	:	<i>Gavialis</i> sp.

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Reptilia

Same as *Turtle* sp.

Subclass : Archosauria

Same as *Crocodylus* sp.

Order : Crocodylia

Same as *Crocodylus* sp.

Specimen : *Gavialis* sp.

- (i) Body is elongated.
- (ii) Snout is long and slender.
- (iii) Large head having conical teeth.

(iv) Teeth sizes are more or less same.

(v) The first and fourth teeth fit into a notch in the upper jaw.

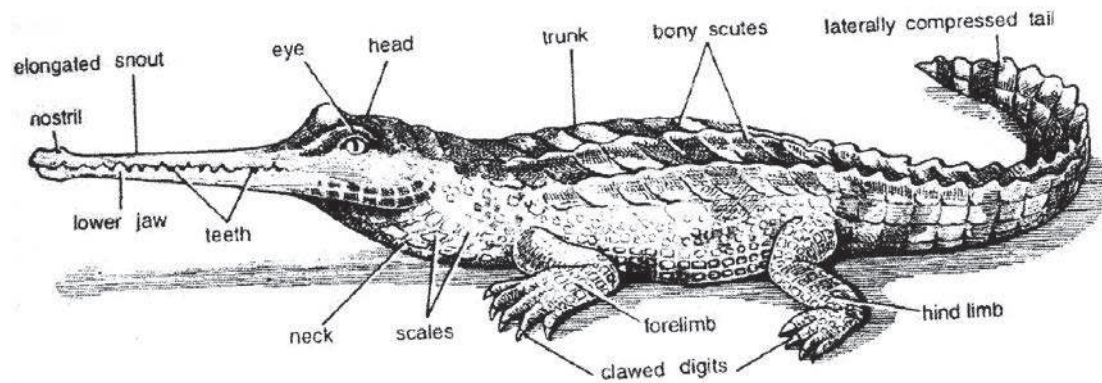


Figure 61 : *Gavialis sp.*

25. *Columba sp.*

a) Systematic position (According to J.Z Young, 1981)

- Phylum : Chordata
Subphylum : Vertebrata
Superclass : Gnathostomata
Class : Aves
Subclass : Neornithes
Superorder : Neognathae
Order : Columbiformes
Genus : *Columbia*
Specimen : *Columbia sp.*

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania sp.*

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Aves

- (i) Body covered with feathers.
- (ii) Forelimbs modified into wings.
- (iii) Presence of beak.

Subclass : Neornithes

- (i) Teeth are absent.
- (ii) Tail very short.
- (iii) Semicircular arrangement of rectrices i.e., tail feathers.

Superorder : Neognathae

- (i) Neognathous type of skull.
- (ii) Well developed remiges i.e., wing feathers and rectrices.

Order : Columbiformes

- (i) Prominent swollen cere.
- (ii) Beak is slender and curved at the tip.
- (iii) Four clawed toes in each foot, with three pointing anteriorly and one pointing posteriorly.
- (iv) The wings are long and pointed.

Specimen : *Columba* sp.

- (i) Staty -grey in colour with purple and green metallic shine on the neck and upper breast.
- (ii) Two dark bars are present on the wings.
- (iii) A band is present across the end of the tail.

(iv) There are 23 pairs of remiges and 12 pairs of rectrices.

(v) The nasal opening is slit like.

(vi) Cere is white.

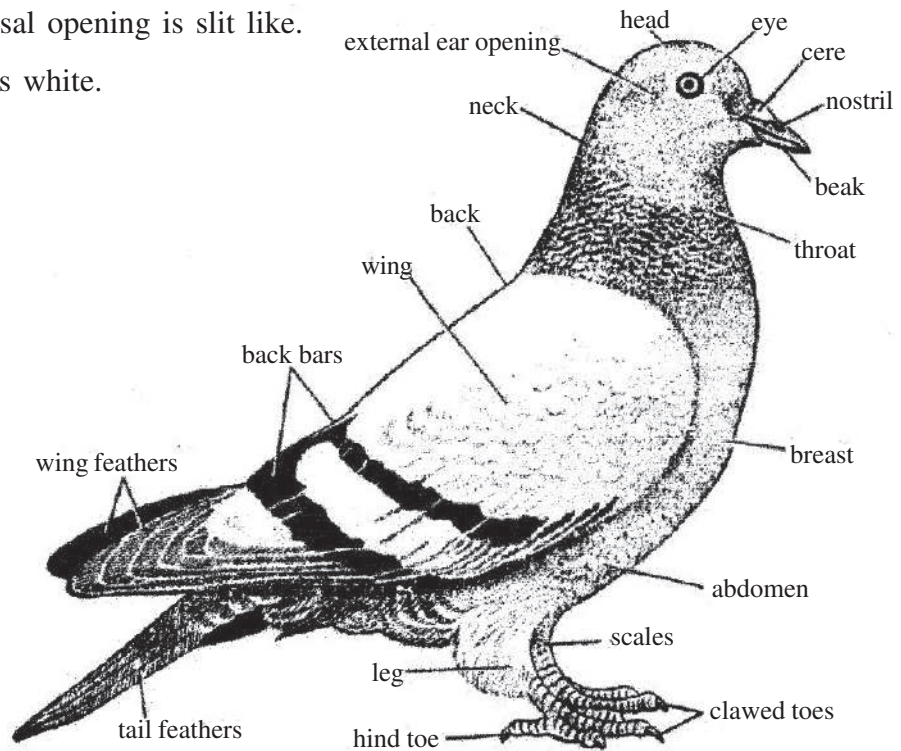


Figure 62 : *Columba sp.*

26. *Psittacula sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Aves
Subclass	:	Neornithes
Superorder	:	Neognathae
Order	:	Psittaciformes
Genus	:	<i>Psittacula</i>
Specimen	:	<i>Psittacula sp.</i>

b) Systematic identifications with reasons**Phylum : Chordata**

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Aves

Same as *Columba* sp.

Subclass : Neornithes

Same as *Columba* sp.

Superorder : Neognathae

Same as *Columba* sp.

Order : Psittaciformes

(i) Usually have brightly colored plumage (feathers).

(ii) Large head, short neck, and curved beak. with narrow hooked end of upper beak overlaps the lower beak.

(iii) Feet are zygodactyl, two toes on each foot face forward and two face backward.

Specimen : *Psittacula* sp.

(i) Beak is cherry -red coloured towards the tip.

(ii) Blue-green, yellow or red coloured feathers.

(iii) Elongated tail feathers.

(iv) Males have a black or rose pink collar.

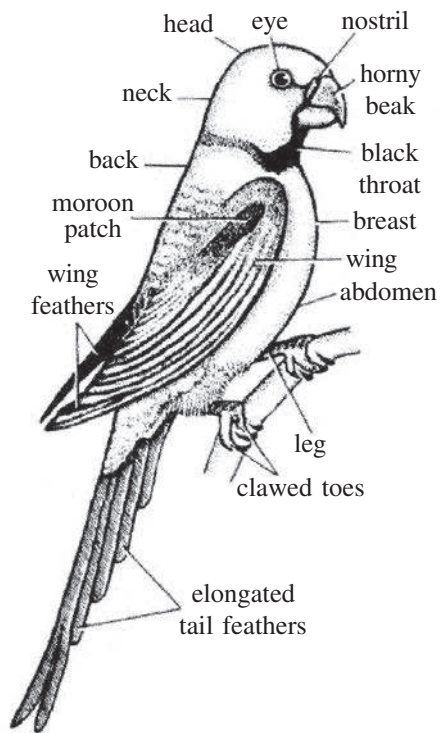


Figure 63 : *Psittacula sp.*

27. *Bubo sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Aves
Subclass	:	Neornithes
Superorder	:	Neognathae
Order	:	Strigiformes
Genus	:	<i>Bubo</i>
Specimen	:	<i>Bubo sp.</i>

b) Systematic identifications with reasons**Phylum : Chordata**

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Aves

Same as *Columba* sp.

Subclass : Neornithes

Same as *Columba* sp.

Superorder : Neognathae

Same as *Columba* sp.

Order : Strigiformes

- (i) Loosely arranged contour feathers extend upto the digits.
- (ii) Large and round frontally directed eyes.
- (iii) The ear openings are on the lateral sides of the head.

Specimen : *Bubo* sp.

- (i) Large and round head.
- (ii) The plumage normally is dark brown.
- (iii) The claws are sharp and the feet are adapted for grasping.
- (iv) Large ear openings covered by a flap.
- (v) The beak is short and strong.
- (vi) Eyes are large and round.

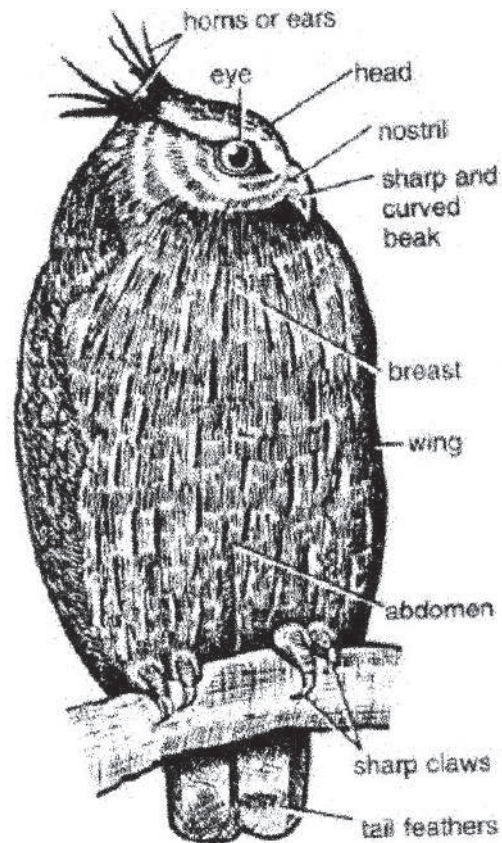


Figure 64 : *Bubo sp.*

28. *Alcedo sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Aves
Subclass	:	Neornithes
Superorder	:	Neognathae
Order	:	Coraciformes
Genus	:	<i>Alcedo</i>
Specimen	:	<i>Alcedo sp.</i>

b) Systematic identifications with reasons**Phylum : Chordata**

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Subclass : Neornithes

Same as *Columba* sp.

Superorder : Neognathae

Same as *Columba* sp.

Order : Coraciiformes

- (i) Beaks are long.
- (ii) Size is small and coloured.
- (iii) Three anterior toes united.

Specimen : *Alcedo* sp. (king fisher)

- (i) The birds have small sizes and coloured plumage.
- (ii) long and strong beak.
- (iii) Present short stump like tail.
- (iv) Short wings.
- (v) Legs are coral-red in colour.

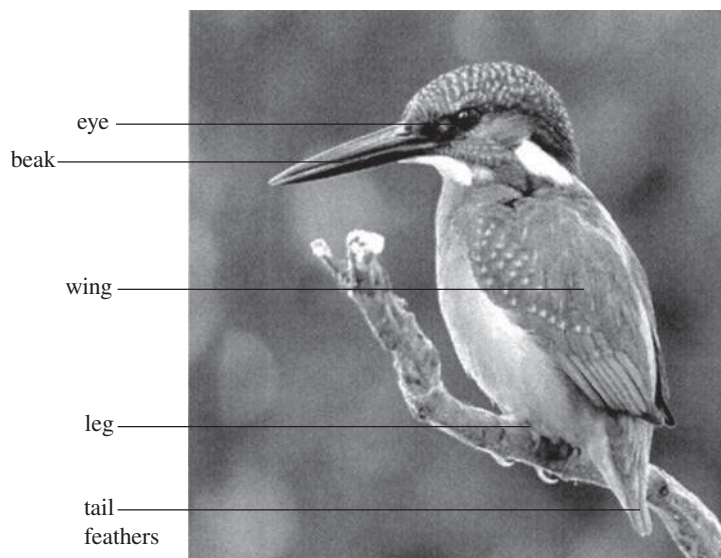


Figure 65 : *Alcedo* sp.

29. *Passer* sp.**a) Systematic position (According to J.Z Young, 1981)**

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Aves
Subclass	:	Neornithes
Superorder	:	Neornithes
Superorder	:	Neognathae
Order	:	Passeriformes
Genus	:	Passer
Specimen	:	<i>Passer</i> sp.

b) Systematic identifications with reasons**Phylum : Chordata**

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Aves

Same as *Columba* sp.

Subclass : Neornithes

Same as *Columba* sp.

Superorder : Neognathae

Same as *Columba* sp.

Order : Passeriformes

- (i) The birds are small with rounded head.
- (ii) Small and hard beak.
- (iii) Three toes point anteriorly and one posteriorly helping the birds to perch.

Specimen : *Passer sp.*

- (i) The body is small and delicate.
- (ii) Male is deep gray brown in colour with black spots, while the female is ash gray brown and does not have black spots.
- (iii) The beak is short and hard and conical.

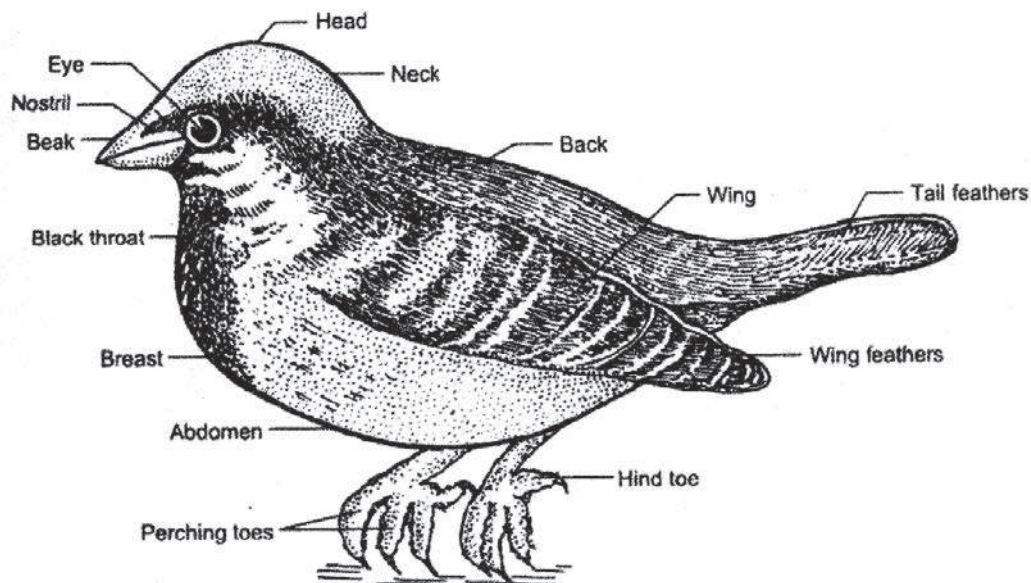


Figure 66 : *Passer sp.*

30. *Dinopium sp.*

a) Systematic position (According to J.Z Young, 1981)

- Phylum : Chordata
- Subphylum : Vertebrata
- Superclass : Gnathostomata

Class : Aves
Subclass : Neornithes
Superorder : Neognathae
Order : Piciformes
Genus : *Dinopium*
Specimen : *Dinopium sp.*

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania sp.*

Subphylum : Vertebrata

Same as *Petromyzon sp.*

Class : Aves

Same as *Columba sp.*

Subclass : Neornithes

Same as *Columba sp.*

Superorder : Neognathae

Same as *Columba sp.*

Order : Piciformes

(i) The tail feathers are stiff.

(ii) Long firm and pointed beak is characteristic feature.

(iii) Zygodactylous toes with two facing the anterior side and two facing the posterior side.

Specimen : *Dinopium sp.*

(i) The dorsal surface shows black spots on a yellow background.

(ii) Crimson coloured crown and occipital crest.

(iii) The beak is long and hard.

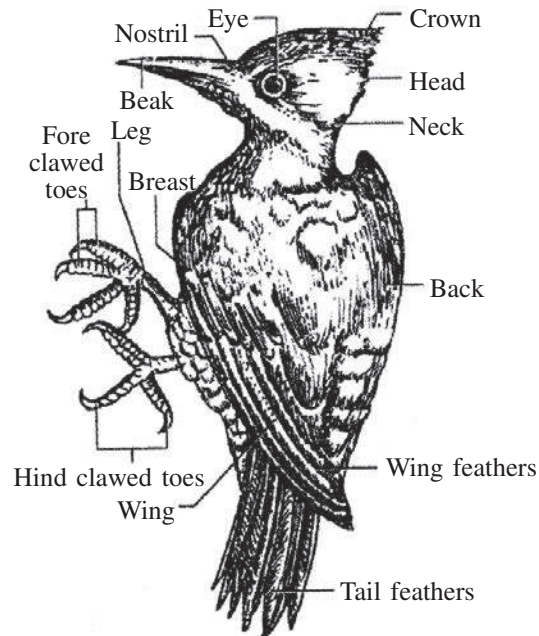


Figure 67 : *Dinopium sp.*

31. *Sorex sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Mammalia
Superclass	:	Gnathostomata
Class	:	Mammalia
Subclass	:	Theria
Infraclass	:	Eutheria
Cohort	:	Unguiculata
Order	:	Insectivora
Genus	:	<i>Sorex</i>
Specimen	:	<i>Sorex sp.</i>

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Mammalia

- (i) Body covered with hair.
- (ii) Mammary glands present.
- (iii) External pinna present.

Subclass : Theria

Mammary gland with teats.

Infraclass : Eutheria

Anus and uninogenital apertures are separate.

Cohort : Unguiculata

Nails and claws present.

Order : Insectivora

- (i) Long Snout present.
- (ii) There are several mammary glands distributed on the ventral surface.
- (iii) Testes are internal and scrotum is absent.
- (iv) Teeth have sharp molar cusps.

Specimen : *Sorex* sp.

- (i) Body is covered with short and soft fur.
- (ii) Head contains snout, eyes and vibrissae.

(iii) Elongated tail is present which is covered in spines.

(iv) Eyes are small and rudimentary.

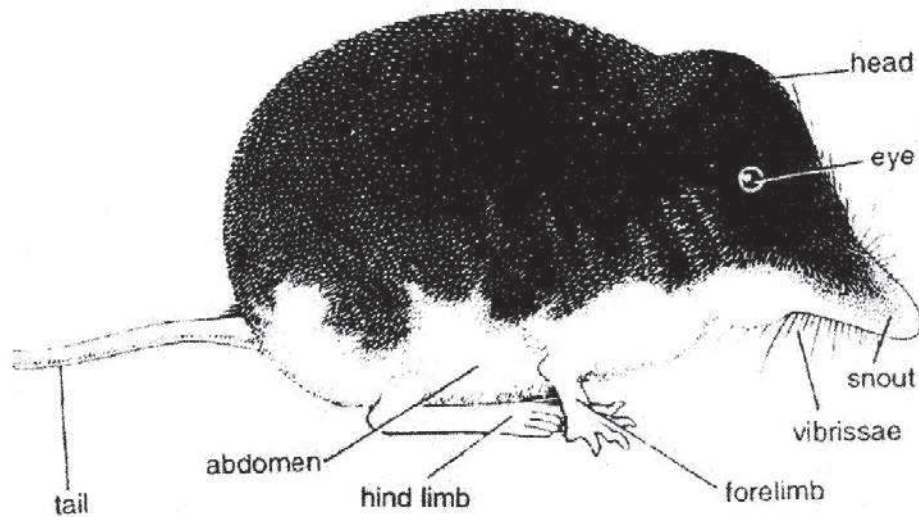


Figure 67 : *Sorex sp.*

32. *Megachiroptera sp.*

Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Mammalia
Subclass	:	Theria
Infraclass	:	Eutheria
Cohort	:	Unguiculata
Order	:	Chiroptera
Specimen	:	<i>Megachiroptera</i>

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania sp.*

Subphylum : vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Mammalia

Same as *Sorex* sp.

Subclass : Theria

Same as *Sorex* sp.

Infraclass : Eutheria

Same as *Sorex* sp.

Cohort : Unguiculata

Same as *Sorex* sp.

Order : Chiroptera

- (i) Wings are modified forelimbs.
- (ii) Bones of the forelimbs are elongated with the exception of pollex.
- (iii) Interfemoral membrane present between the femurs.
- (iv) First finger with claw and forwardly directed.

Specimen : *Megachiroptera*

- (i) The ears are small and the base of pinna forms a complete ring.
- (ii) Second finger also clawed.
- (iii) Tail is either short or lacking.
- (iv) Interfemoral membrane is reduced.
- (v) Snout long and pointed.

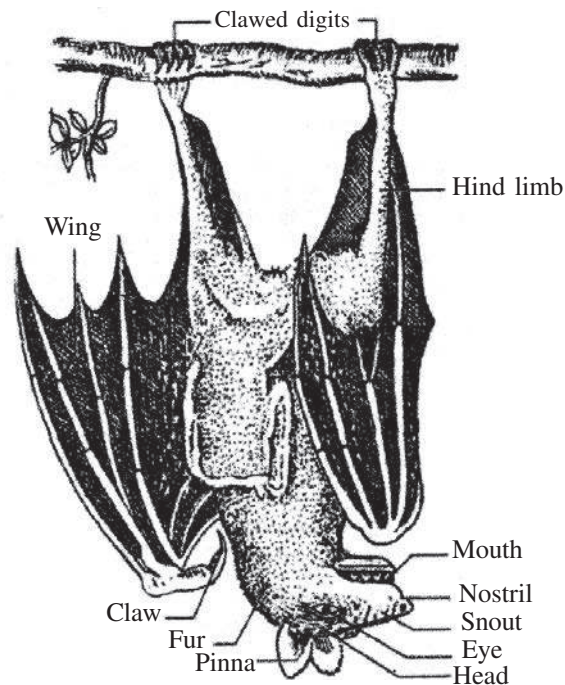


Figure 69 : *Megachiroptera sp.*

33. *Microchiroptera sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Mammalia
Subclass	:	Theria
Infraclass	:	Eutheria
Cohort	:	Unguiculata
Order	:	Chiroptera
Specimen	:	<i>Microchiroptera sp.</i>

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmanie* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Mammalia

Same as *Sorex* sp.

Subclass : Theria

Same as *Sorex* sp.

Infraclass : Eutheria

Same as *Sorex* sp.

Cohort : Unguiculata

Same as *Sorex* sp.

Order : Chiroptera

Same as *Megachiroptera* sp.

Specimen : *Microchiroptera*

- (i) Base of pinna does not form a complete ring.
- (ii) Pinnae are large.
- (iii) No claws on the second digit.
- (iv) Snout is not elongated.

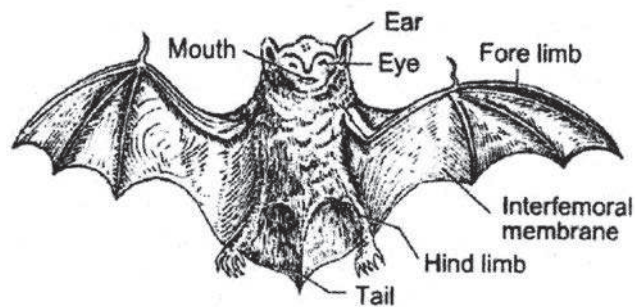


Figure 70 : *Microchiroptera sp.*

34. *Squirrel sp.*

a) Systematic position (According to J.Z Young, 1981)

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Mammalia
Subclass	:	Theria
Infraclass	:	Eutheria
Cohort	:	Unguiculata
Order	:	Rodentia
Specimen	:	<i>Squirrel sp.</i>

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania sp.*

Subphylum : Vertebrata

Same as *Petromyzon sp.*

Superclass : Gnathostomata

Same as *Sphyrna sp.*

Class : Mammalia

Same as *Sorex sp.*

Subclass : Theria

Same as *Sorex* sp.

Infraclass : Eutheria

Same as *Sorex* sp.

Cohort : Unguiculata

Same as *Sorex* sp.

Order : Rodentia

- (i) One pair of incisors in each jaw (upper and lower).
- (ii) A large gap (diastema) behind incisors.
- (iii) No canine teeth present.

Specimen : *Squirrel* sp.

- (i) Three white and grey stripes on dorsal side.
- (ii) Small gray hairs present on ventral side and limbs.
- (iii) Tail is elongated and bushy.
- (iv) Incisors exposed and chisel like.

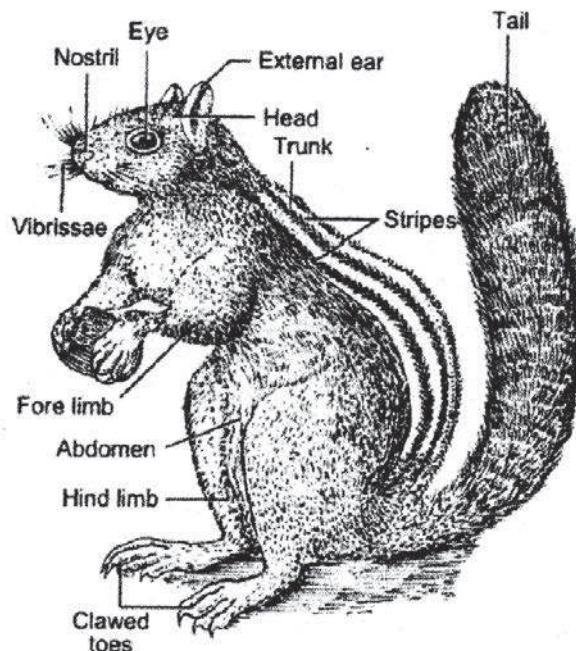


Figure 71 : *Squirrel* sp.

Unit : 2 □ Study of permanent slides

Structure

2.0 Objectives

2.1 T.S. and L.S. of *Sycon* sp.

2.2 Study of the life history stages of mosquito

2.3 Study of the life history stages of toad

2.4 T.S of male and female *Ascaris*

2.0 Objectives

By studying this unit learners would be able to learn about

- (i) Transverse and longitudinal section *Sycon* sp.
- (ii) Life history stage of mosquito and toad.
- (iii) Transverse section of male and female *Ascaris* sp.

2.1 T.S. and L.S. of *Sycon* sp.

2.1.1 Transverse section (T.S.) of *Sycon* sp.

(i) The body wall shows a loose two layered organization, with the outer pinacoderm (with pinacocyte cells) and inner choanoderm (with flagellated choanocyte cells).

(ii) Between the pinacoderm and choanoderm is present a layer of mesenchyme or mesohyll. This layer is jelly like and contains monaxon spicules, collenocytes, amoebocytes, archaeocytes and scleroblast cells. Reproductive cells are also present in this layer.

(iii) Choanoderm containing flagellated choanocyte cells line the radial canals.

(iv) The incurrent canals alternate with the radial canals and these chambers are connected through prosopyles. The radial canal opens into spongocoel through apopyles.

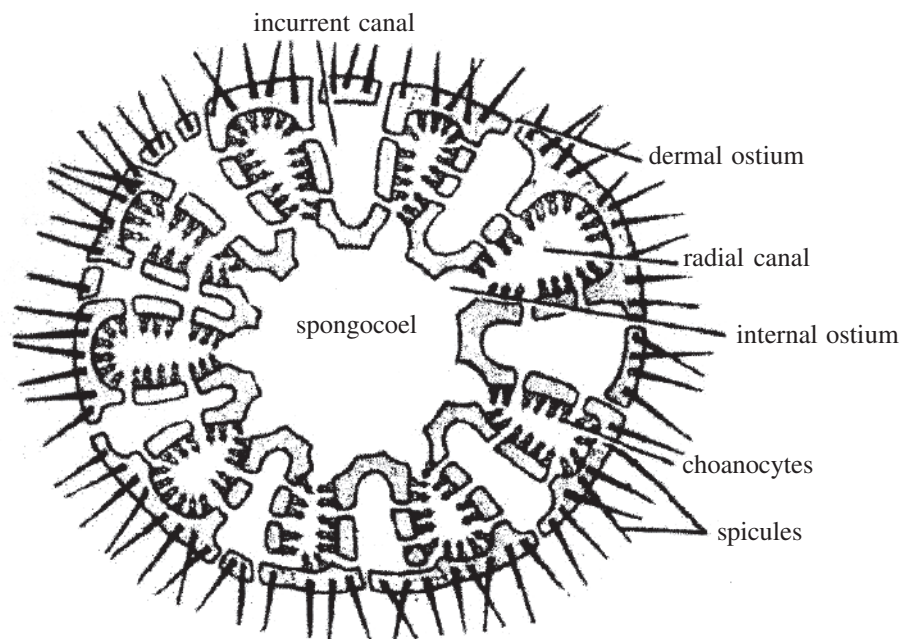


Figure 1 : T. S. of *Sycon* sp.

2.1.2 Longitudinal Section (L. S.) of *Sycon* sp.

(i) A loose two layered organization of outer pinacoderm and inner choanoderm is found.

(ii) The pinacoderm is perforated with several ostia.

(iii) The mesohyll or mesenchyme containing spicules, collagenocytes, amoebocytes, archaeocytes and scleroblasts make up the bulk of the sponge.

(iv) The monaxon spicules protrude out from the body wall.

(v) The incurrent canals communicate with the radial canals via prosopyles.

(vi) The radial canal communicates with the spongocoel through apopyles.

(vii) Spongocoel opens to outside through osculum.

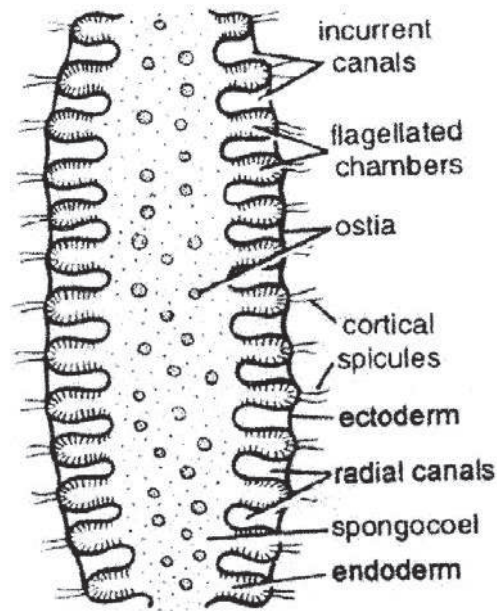


Figure 2 : L. S. of *Sycon* sp.

2.2 Study of the life history stages of mosquito

The egg, larva, pupa and imago or adult stages make up the total life history of mosquito.

2.2.1 Eggs

(i) Shallow and stagnant water is the ideal place where the female mosquito lays a cluster of around 300 eggs, after fertilization.

(ii) Eggs of *Culex* float as a single unit, while the eggs of *Aedes* and *Anopheles* float freely.

(iii) Two central extensions known as air floats are attached laterally to the individual eggs of the *Anopheles*.

(iv) The eggs float horizontally of the water surface.

(v) The larvae hatch from the eggs in two to three days.

2.2.2. Larva

(i) The body of the larva is elongated and divisible into head, thorax and abdomen.

(ii) A pair of compound eyes, a pair of antennae and a pair of feeding brush is present on the head.

(iii) The thorax is unsegmented and bears a cluster of bristles.

(iv) Respiratory siphons are present on the abdomen.

(v) For respiration, during its stay in water it comes to the surface.

(vi) The larvae are very active and feeds on algae and other microorganisms which are present.

(vii) The larva metamorphoses into the pupa in around 8 days.

2.2.3 Pupa

(i) The pupa is a comma like structure and the head is comparatively larger.

(ii) The dorsal siphon remains above the surface of water for respiration.

(ii) Unlike other insects the pupa is not stationary, but is non feeding as they do not have any mouth aperture.

(iv) The duration of the pupal stage is around two days.

2.2.4 Adult or Imago

(i) Metamorphosis results in the formation of imago or adult.

(ii) The adult comes out by breaking of the pupal shell and the adult mosquito remains sometime over the shell and flies away when its wings harden.

(iii) The life cycle of a mosquito is usually completed in 15 days and the adult usually lives for about one month.

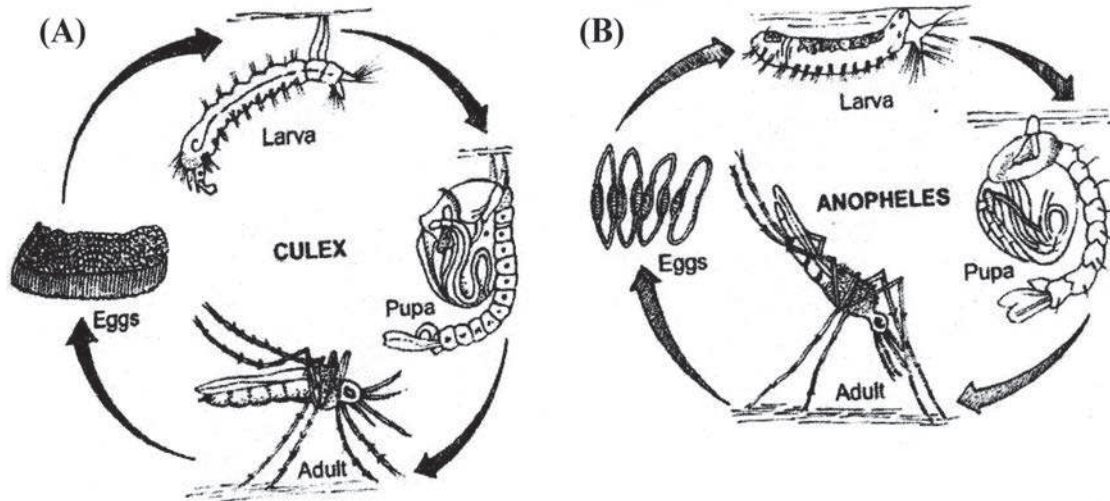


Figure 3: (A) Life history stages of *Culex* (B) Life history stages of *Anopheles*

2.3 Study of the life history stages of toad

2.3.1 Breeding

Breeding occurs during the rainy season. The male calls the female with characteristic harsh sounds. The females are attracted and approach the male. The male then firmly clasps the female with forelimbs and hind limbs in a position called axillary amplexus. Post amplexus, the female lays eggs in water. Males possess black vocal sac and nuptial thumb-pad at each innermost finger of the hand. A single female may lay over a thousand eggs in any convenient patch of water.

2.3.2 Germ cells

The eggs are spherical cells and mesolecithal type. Each egg has a blackish animal pole and whitish vegetal pole. The animal pole is full of protoplasm and the vegetal pole is full of yolk. Such a type of egg is called telolecithal type. Each egg is surrounded by vitelline membrane. The egg gets a coating of jelly like albumen while passing through the convoluted part of the oviduct. The spermatozoa are highly specialized cells with an oval head containing nucleus, a short neck having centrosome, and a long wavy protoplasmic tail.

2.3.3 Fertilization

Fertilization is external. The female toads lay their pigmented eggs in quiet water inside the weeds or around the stem, leaves within a translucent slimy tube and the males discharge their spermatozoa or milt over the eggs as they are expelled out. The outer membrane of the egg gives an impass to one sperm after which the outer membrane becomes impervious to other sperms. Only the head portion of the spermatozoa enters the cell-body of ovum and the tail is left out. The sperm nucleus is called male pro-nucleus and the egg nucleus is known as female pro-nucleus. During fertilization, the male and female pro-nuclei fuse to form a single nucleus. The egg, thus fertilized is known as zygote.

2.3.4 Embryonic development

The zygote undergoes rapid division known as cleavage and results in the production of a large number of blastomeres. The cells now arrange to form a cellular ball known as blastula. The blastula then enters into a complicated stage known as gastrula and the process is known as gastrulation. The gastrulation is essentially a process of cell movement when the different cells take up their respective position for future differentiation. During this process three primary germinal layers-ectoderm, mesoderm and endoderm are differentiated. All the structures of the adult are developed out of these three primary germinal layers. After about two weeks a small embryo is seen moving and writhing.

2.3.5 Newly hatched tadpole

A freshly hatched tadpole larva has a limbless body. The body is divided into an ovoid head, a short trunk and a slender tail. A small opening situated ventrally at the root of the tail is known as anus. An adhesive sucker is present on the ventral side of the head by which the tadpole larva attaches itself to the aquatic weeds. The mouth is lacking and as a result it cannot take anything from outside. The yolk material provided the nutrition. The respiratory organs comprise of three pairs of highly vascular and branched feathery external gills. After a few days mouth is

formed near the sucker. A pair of horny jaws surrounds the mouth. The tail becomes more elongated. The tadpole larva then develops a dorsal and ventral fin. S-shaped myotomes develop on both the sides of the tail. At this time free-swimming tadpole larva ingests aquatic weeds, as a result, the alimentary canal becomes extremely elongated.

2.3.6 Advanced tadpole larva

The pharynx of the tadpole larva becomes perforated by gill-slits. External gills disappear and internal gills are formed between the gill slits. The gills and the gill-slits are covered by the operculum. In the larval stages, the arterial arches show modifications in terms of both external and internal gills. The operculum fuses with the trunk on all sides except a small opening called spiracle on the left side. Water enters into the pharynx through the mouth and goes out through the spiracle. During this transit of water the internal gills are bathed with water containing oxygen dissolved in it. While the internal gills are functioning, a pair of lungs develops as outgrowths from the pharynx on the ventral surface. The hind limbs appear prior to the forelimbs. The forelimbs initially remain hidden under the operculum and subsequently emerge through it. At this stage both the internal gills as well as the newly formed lungs are functional. When the lungs become fully developed, the internal gills become degenerated. At this stage it looks like a miniature toad except having a tail. As the limbs are developing, the animal enters into a period of starvation. The material of the tail becomes eventually absorbed into the body.

2.3.7 Metamorphosis

The young tadpole larva resembles a fish. It leads an independent and self-supporting life. This fish-like tadpole larva completely metamorphoses to toad is exclusively a progressive process. Development is rapid, being completed in 34-52 days. The metamorphosis is controlled by the thyroid glands. Removal of thyroid glands in the tadpole larva retards metamorphosis. Anterior pituitary indirectly plays an important role during metamorphosis by stimulating and controlling the function of the thyroid glands.

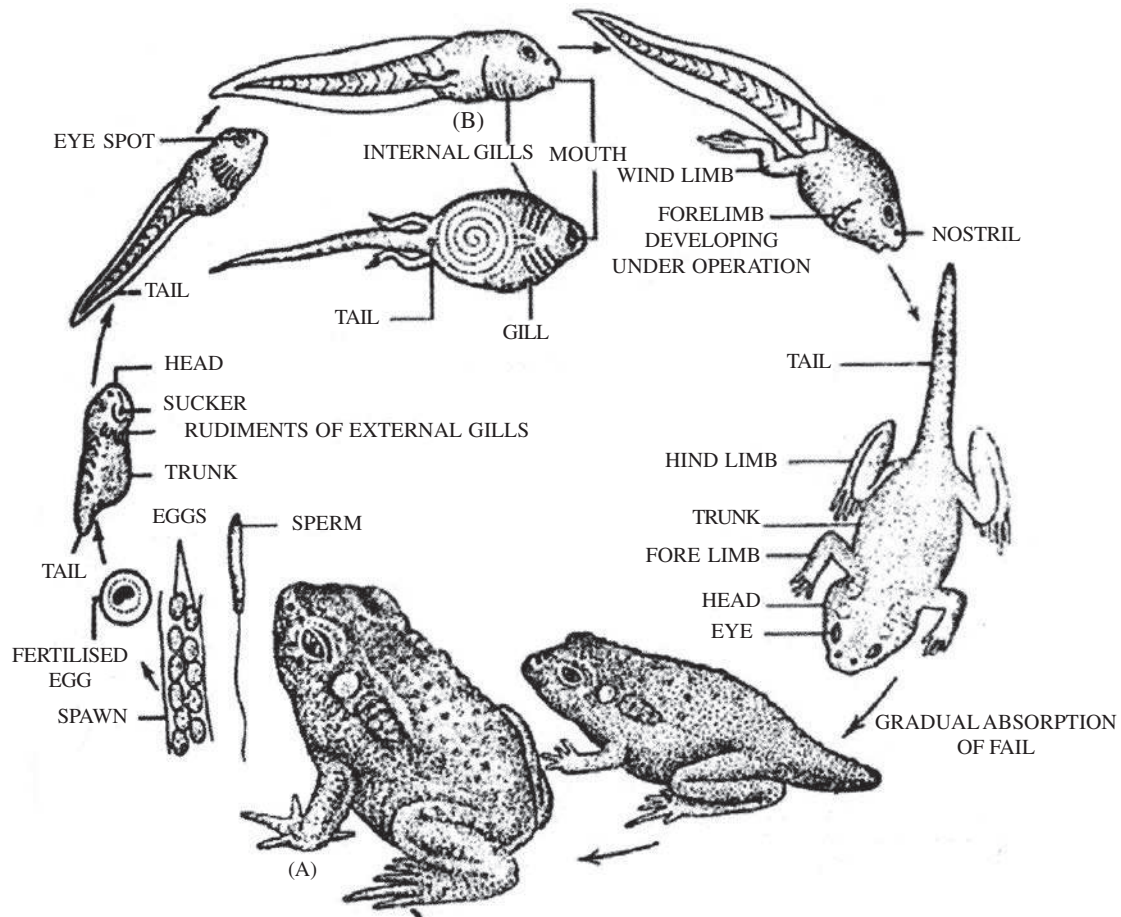


Figure 4: Life history stages of toad. (A) Adult, (B) Older tadpole

2.4 T.S of male and female *Ascaris*

2.4.1 T.S. of male *Ascaris*

(i) A section through the middle of the body shows sections of alimentary canal (intestine). Testis, seminal vesicle, vas deferens, and other minor structures are visible.

(ii) The cuticle, hypodermis, muscle layer and pseudocoelom make up the body wall.

(iii) The hypodermis is a syncytial layer and protrudes into the pseudocoelom middorsally, midventrally and laterally. This forms the four longitudinal chords which is a characteristic feature.

(iv) The musculature is also divided into four quadrants.

(v) Presence of pseudocoelom which is not a true coelom, between digestive tube and body wall.

(vi) Various rounded cut sections of coiled testis are present, which are without lumen but with a central rachis.

(vii) Sperm duct and seminal vesicle have a wide lumen filled with spermatozoa.

(viii) Dorsal longitudinal chord harbours the dorsal nerve cord, the ventral longitudinal chord harbours the ventral nerve cord and the two lateral longitudinal chords harbour the lateral nerve cords.

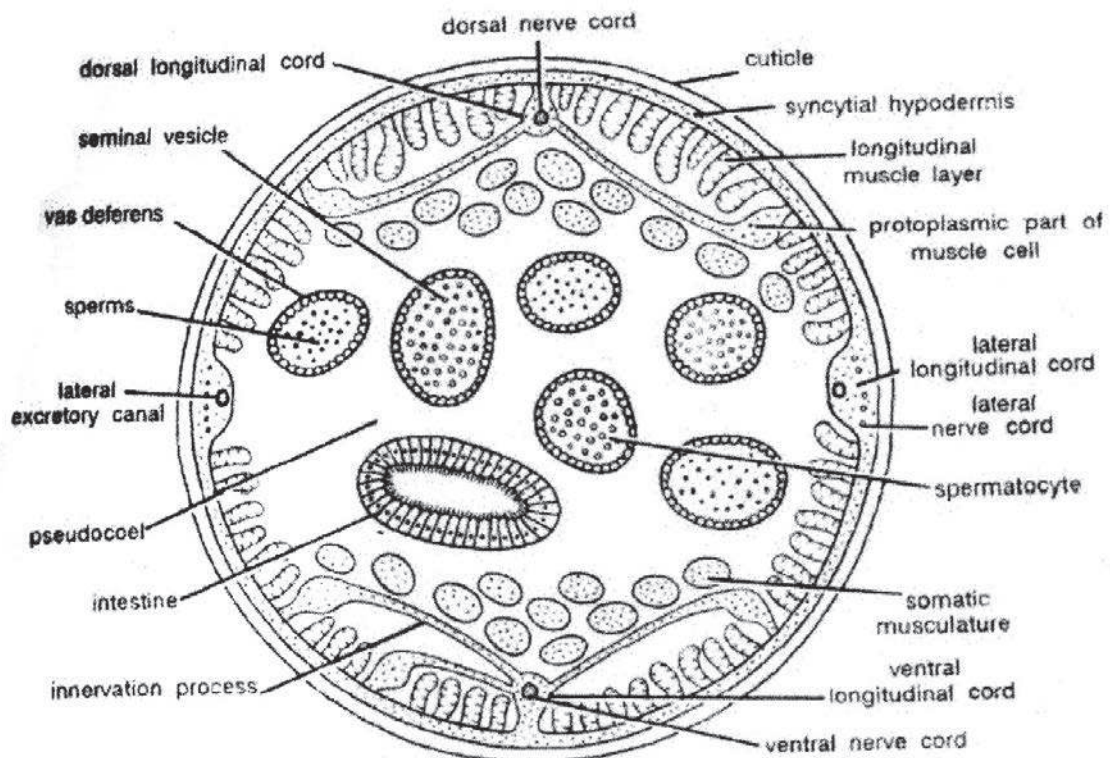


Figure 5 : T. S. of male *Assaris* sp.

2.4.2 T.S. of female *Ascaris* sp.

(i) A section through the middle of the body shows sections of ovary, oviduct, uterus and the digestive tube.

(ii) The cuticle, hypodermis, muscle layer and pseudocoelom make up the body wall.

(iii) The hypodermis is syncytial layer and protrudes into the pseudocoelom middorsally, midventrally and laterally. This forms the four longitudinal chords which is a characteristic feature.

(iv) The musculature is also divided into four quadrants.

(v) Presence of pseudocoelom which is not a true-coelom, between digestive tube and body wall.

(vi) Ovary has no lumen, and the section of oviduct is wider than the ovary section.

(vii) The uterus has a wide lumen full of eggs.

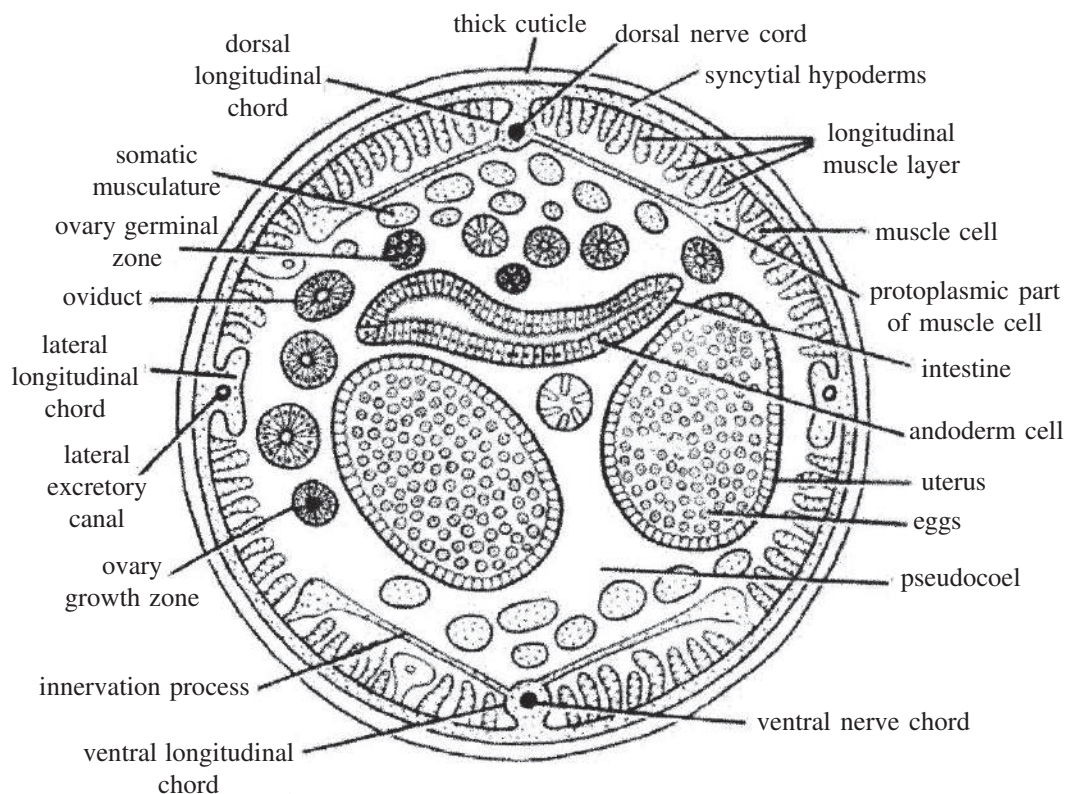
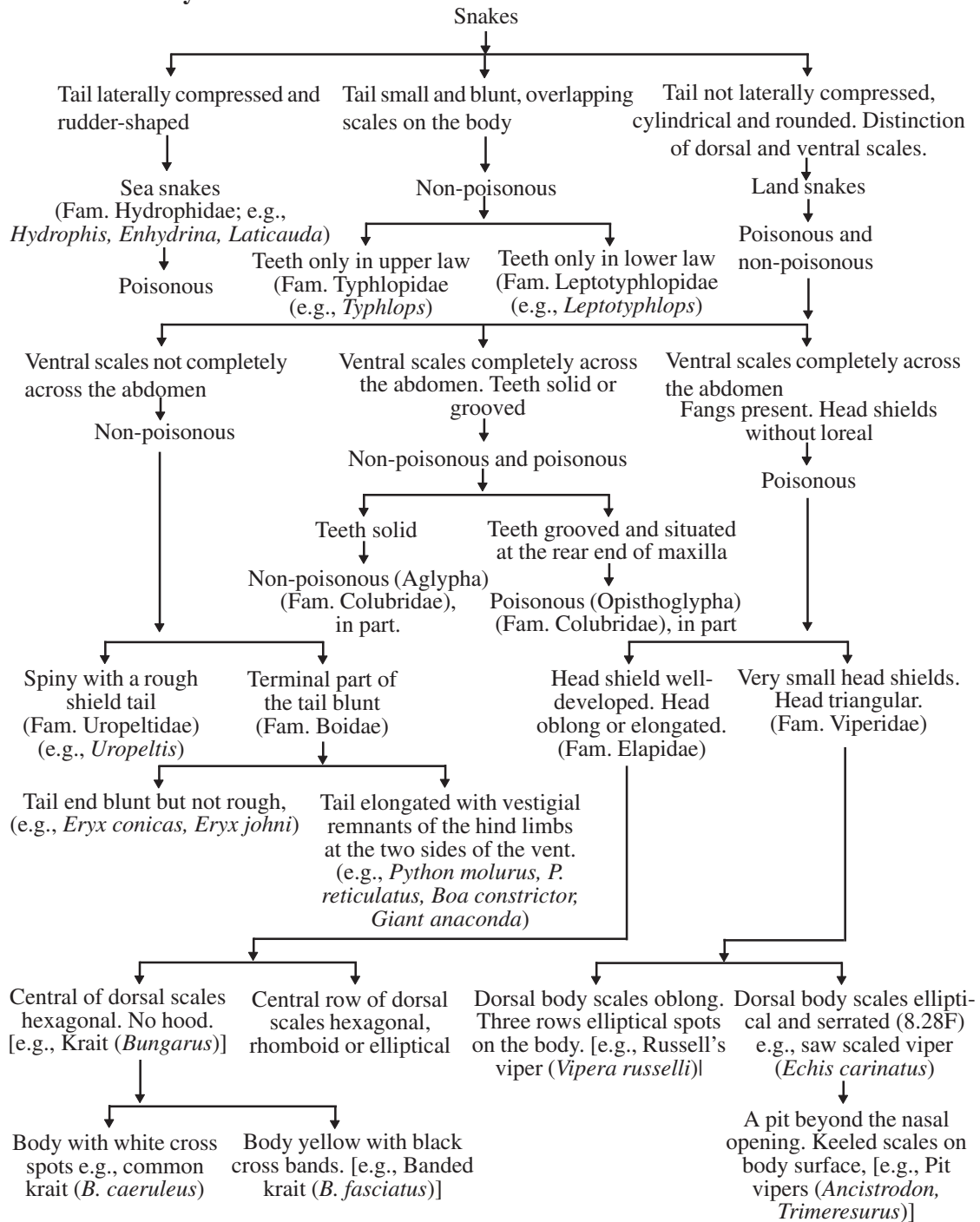


Figure 6 : T. S. of Female *Ascaris* sp.

Unit : 3 □ Key to identification of poisonous and Non-poisonous snakes

1. If the small scales are present on the belly and back, it is a non-poisonous snake.
2. If the belly scales are not broad enough to extend right across it, it is a non-poisonous snake.
3. If small scales are present on the head, it is poisonous and a viper.
4. If small scales or shields are present on the head and a pit lies between the eye and the nostril, it is poisonous and a pit-viper.
5. If dorsal side of the head has both small scales and large shields, the snake may or may not be poisonous.
6. If the third supra labial scale touches the eye and the nostril, the snake is a cobra or a coral snake. If the neck is with hood and markings, it is cobra. If neck is without hood and coral spots are present on the belly, it is a coral snake. Both cobra and coral snakes are poisonous.
7. If vertebral (scales on the middle of the back) are hexagonal and larger than other scales over the back and the fourth infra-labial scale is the largest, it is poisonous and a krait.
8. If the snake has small scales and large shields on the head but does not have the characters of cobra, coral snake or krait, then it is non poisonous.

Key to identification of Poisonous and Non-Poisonous Snakes



Unit : 4 □ Osteology

Structure

4.0 Objectives

4.1 Disarticulated skeleton of fowl

4.2 Disarticulated skeleton of white rat

4.3 Carapace and plastron of turtle

4.4 Mammalian skull

4.0 Objectives

By studying this unit learners would be able to learn about

- (i) Disarticulated skeleton of fowl.
- (ii) Disarticulated skeleton of white rat.
- (iii) Carapace and plastron of turtle.

4.1 Disarticulated skeleton of fowl

A. Skull of fowl

1. Numerous bones united together enclosing a central cavity.
2. Foramen magnum, occipital condyle present.
3. Olfactory, optic and otic capsules are present.

Hence, it is a skull.

1. Light in weight, thin walled structure.
2. Single occipital condyle.
3. Well-developed beak present.
4. Tri-radiate premaxilla.

Hence, it is a skull of bird.

1. Teeth absent.
2. Double headed quadrate bone.

Hence, it is a neognathous skull.

1. Vomer absent or short.
2. Maxillopalatine processes are slender and not united with one another.

Hence, it is a schizognathous skull.

1. Vomer short.
2. External nostril is oval in shape.
3. Short but strong and curved beak.

Hence, it is a skull of fowl.

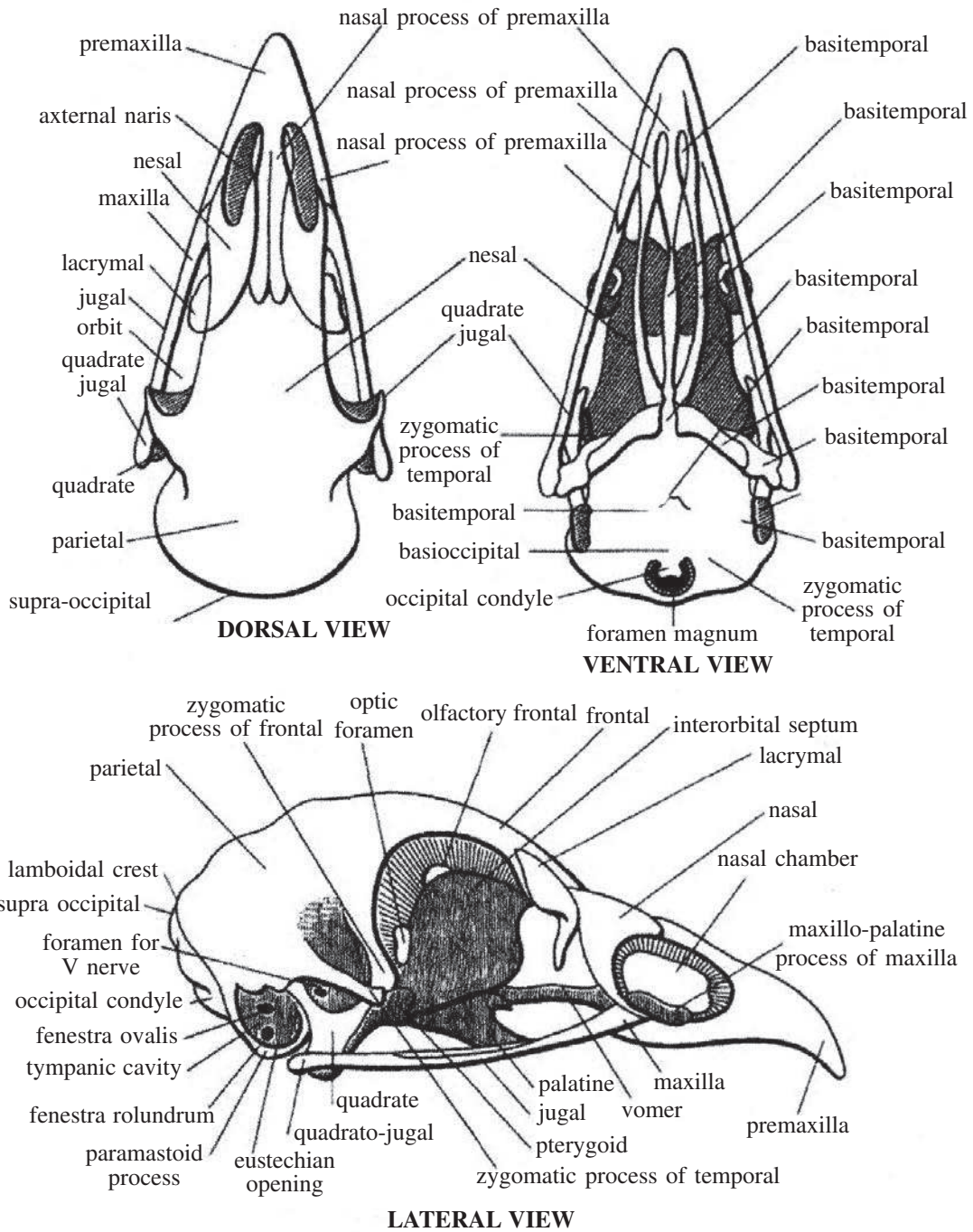


Figure 1 : Dorsal, ventral and lateral view of skull of fowl

B) Vertebrae of fowl

a) Atlas vertebra

1. Centrum present as bony structure.
2. Neural arch, neural canal, neural spine present.
3. Zygapophysis present.
4. Transverse process present.

Hence, it is a vertebra.

1. Light in weight.
2. Centrum heterocoelous.

Hence, it is a vertebra of bird.

1. Small, ring like structure.
2. Centrum, neural spine, transverse process, prezygapophysis absent.
3. A ventral piece and two dorsolateral pieces make the structure by uniting middorsally.
4. Ventral part bears a median condylar facet on the anterior face and a median odontoid notch on the posterior face.
5. Very small postzygapophysis present.

Hence, it is the first vertebra or atlas of fowl.

b) Axis or 2nd vertebra of fowl

Upto vertebra of a bird same as atlas.

1. Elongated centrum.
2. The neural arch is notched and short.
3. Rudimentary neural spine is present.
4. The cervical ribs are short, spine like, directed backwards being fused with the transverse processes.
5. Pre-and post-zygapophyses present.
6. The hypapophysis is a ventral spine like process borne on the centrum.

Hence, it is a typical cervical vertebra of fowl.

C) Free thoracic vertebra of fowl

Upto vertebra of a bird same as atlas.

1. Centrum short and stout.
2. Neural spine is elongated, flat, plate-like.
3. Transverse processes are well-developed and laterally directed.
4. Pre-and post-zygapophyses are well-developed.
5. Facets for ribs are present on centrum and transverse process.
6. Hypapophysis prominent beneath the centrum.

Hence, it is a free thoracic vertebra of fowl.

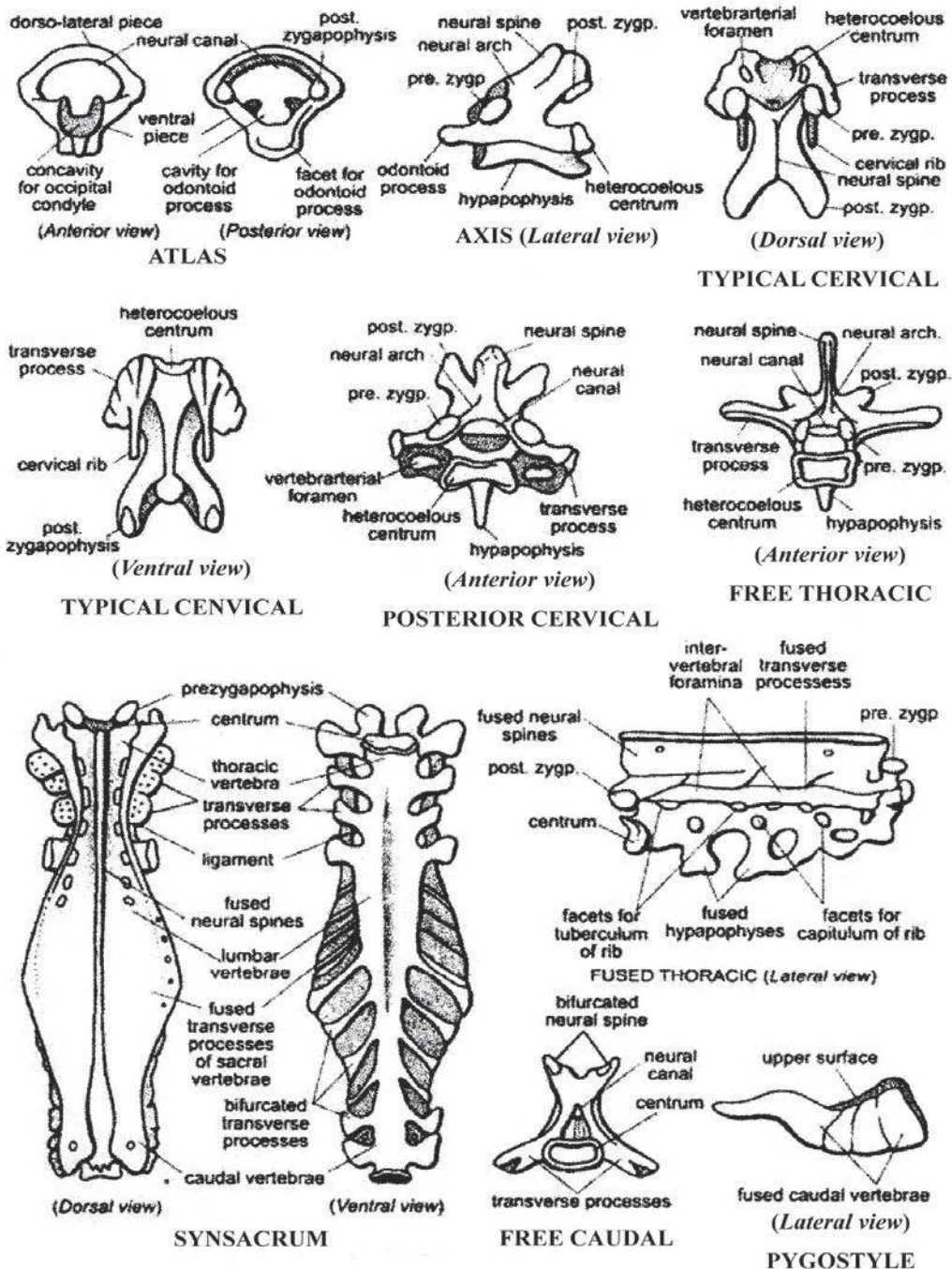


Figure 2 : Vertebrae of fowl

D) Fused thoracic vertebra of fowl

Upto vertebra of a bird same as atlas.

1. Several vertebrae united to form a compound structure.
2. Vertical neural spines of vertebrae fused together to form a dorsal median ridge.
3. Similarly, hypophyses united ventrally to form a ventral median ridge.
4. Laterally directed flat transverse processes fused together to form a pair of wing-like structure on both sides.
5. Inter-vertebral foramina present.
6. Presence of facets for rib attachment.
7. Zygapophyses present.

Hence, it is the fused thoracic vertebra of fowl.

E) Synsacrum of fowl

Upto vertebra of a bird same as atlas.

1. A large thin plate like structure which is narrow anteriorly but broad and rectangular posteriorly.
2. It includes last thoracic, six lumbers, two sacra and five anterior caudal vertebrae.
3. Each vertebra possesses all the characteristic features of a typical vertebra.
4. Anteriormost vertebra clearly shows the heterocoelous centrum.
5. A vertical crest is formed by the fusion of neural spine.
6. Transverse processes, except for the first three vertebrae, fused together to form a thin, plate like structure on each side.
7. Sacral vertebrae with sacral ribs originating from the centrum.

Hence, it is the synsacrum of fowl.

F) Free caudal vertebra of fowl

Upto vertebra of a bird same as atlas.

1. Small and bifid neural spine.
2. Transverse processes are cylindrical and directed downwards.
3. Zygapophyses are not prominent.

Hence, it is a free caudal vertebra of fowl.

G) Pygostyle of fowl

Upto vertebra of a bird same as atlas.

1. Last four caudal vertebrae become fused to form this structure.
2. It is laterally compressed, plough shaped structure.
3. Centra and neural spines are indistinguishable.
4. Zygapophyses are absent.

Hence, it is pygostyle of fowl.

H) Pectoral girdle of fowl

As it is a compound structure consisting of coracoid, scapula, united clavicle and interclavicle, and a large sternum, so all the structures are discussed separately.

(a) Coracoid and scapula: -

1. Two bones are attached together by strong ligament.
2. Coracoid is stout, rod-like with acro-coracoid process anteriorly and a flat, expanded posterior end.
3. Scapula is sword -shaped with an anterior acromion process.
4. At the anterior end of scapula there is a shallow depression called glenoid cavity.
5. Both the bony structures are light and pneumatic.

Hence, it is coracoid and scapula of fowl.

(b) Fercula: -

1. The bony structure is v-shaped.
2. Very light in weight.
3. It is formed by fusion of clavicles and interclavicle.

4. Each limb i.e. clavicle is slender, slightly curved and flattened.
5. Dorsal end of each limb with a concave articular facet.
6. Both the ends of each limb meet ventrally where very reduced interclavicle joins.
7. There is a disc-like structure at the junction point.

Hence, it is fercula of fowl.

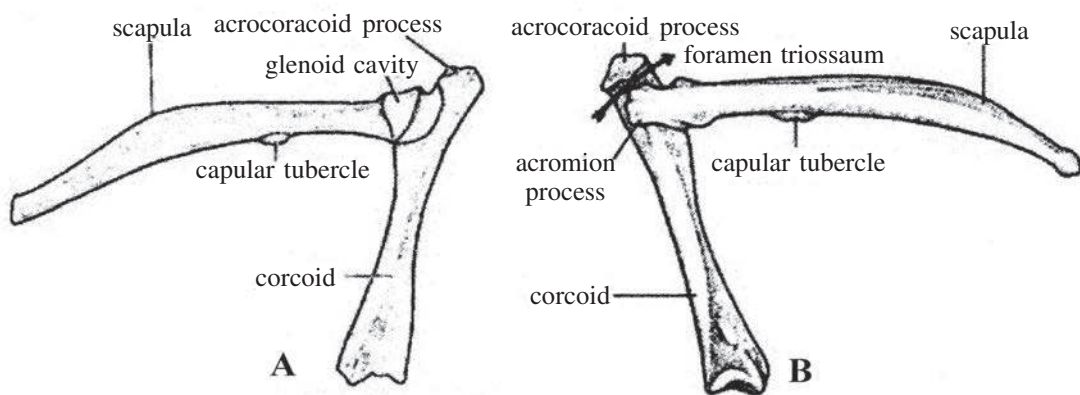


Figure 3: (A) Right half of pectoral girdle of fowl (outer view); (B) inner view of pectoral girdle of fowl.

(c) Sternum:

1. Boat-shaped, thin bony structure.
2. Anterior end broad while posterior end narrow.
3. A deep keel or carina sterni present on the ventral surface while dorsal bony plate is known as metasternum.
4. The metasternum is a dorsally concave ventrally convex, broad plate-like structure.
5. Metasternum bears a pair of costal processes, 5 pairs of costal facets and a pair of backwardly directed xiphoid processes from anterior to posterior.
6. Metasternum also bears a pair of coracoid grooves at the anterior end.
7. From the ventral surface of metasternum a small plate-like structure. Hence, it is sternum of fowl, arises vertically from the anterior end, called manubrium.

I) Pelvic girdle of fowl :

The pelvic girdle is formed by two but separate bones is known as os-innominatum and similar, halves. Each half consists of the following.

1. Thin, broad bony structure and light in weight.
2. It is composed of 3 bones—ilium, ischium and pubis.
3. Ilium is thin, broad, flat, anteriorly concave but posteriorly convex.
4. Ischium broad and fused with ilium at the posterior end.
5. Pubis slender, long, curved, parallel to ischium but extended beyond ischium.
6. At the junction of three bones, there is a cavity called acetabulum.
7. At the junction of ilium and ischium exists ischiadic foramen.
8. An obturator foramen is present at the junction of ischium and pubis.
9. An elongated obturator notch is present in between ischium and pubis.
10. A prepubic process exists near acetabulum.

Hence, it is the os-innominatum or half of the pelvic girdle of fowl.

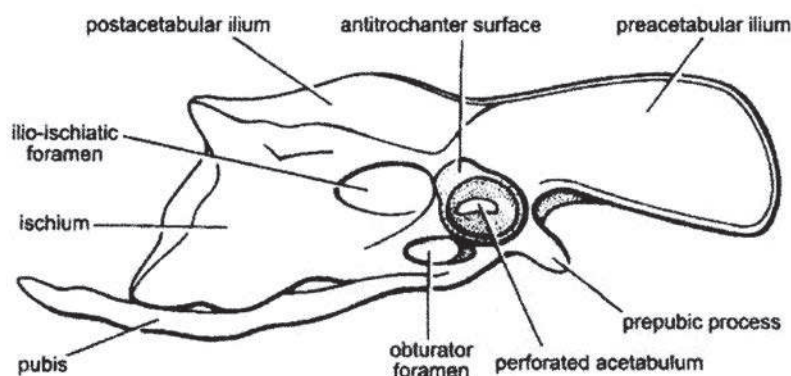


Figure 4 : Right os-innominatum, pelvic girdle of fowl.

J) Limb bones of fowl

a) Humerus of fowl :

1. A rod-like single, slightly curved bone with a narrow shaft and broadened both ends.
2. A round head present at the proximal end called head of humerus.
3. Deltoid ridge present.

Hence, it is humerus bone.

1. The bone is light.
2. Proximal end broad than distal end and bears the head.
3. Greater tuberosity bears a prominent pneumatic foramen ventrally.
4. Distal end bears two condyles and two epicondyles.
5. No supra-trochlear foramen present.

Hence, it is humerus bone of fowl.

b) Radius and ulna of fowl: -

1. Two long, unequal bones unite at both ends.
2. One is slender and nearly straight -known as radius while the other is slightly curved and stout-known as ulna.
3. Proximal end of ulna bears a cup-like semilunar notch and an olecranon process.
4. Distal end of ulna bears articular surfaces.

Hence, it is radius and ulna bones.

1. The bones are light.
2. Proximal end of radius is slightly concave while the distal end is convex.
3. Distal end of ulna bears three convex articular surfaces.
4. Presence of a nutrient foramen in ulna.

Hence, it is radius-ulna of fowl.

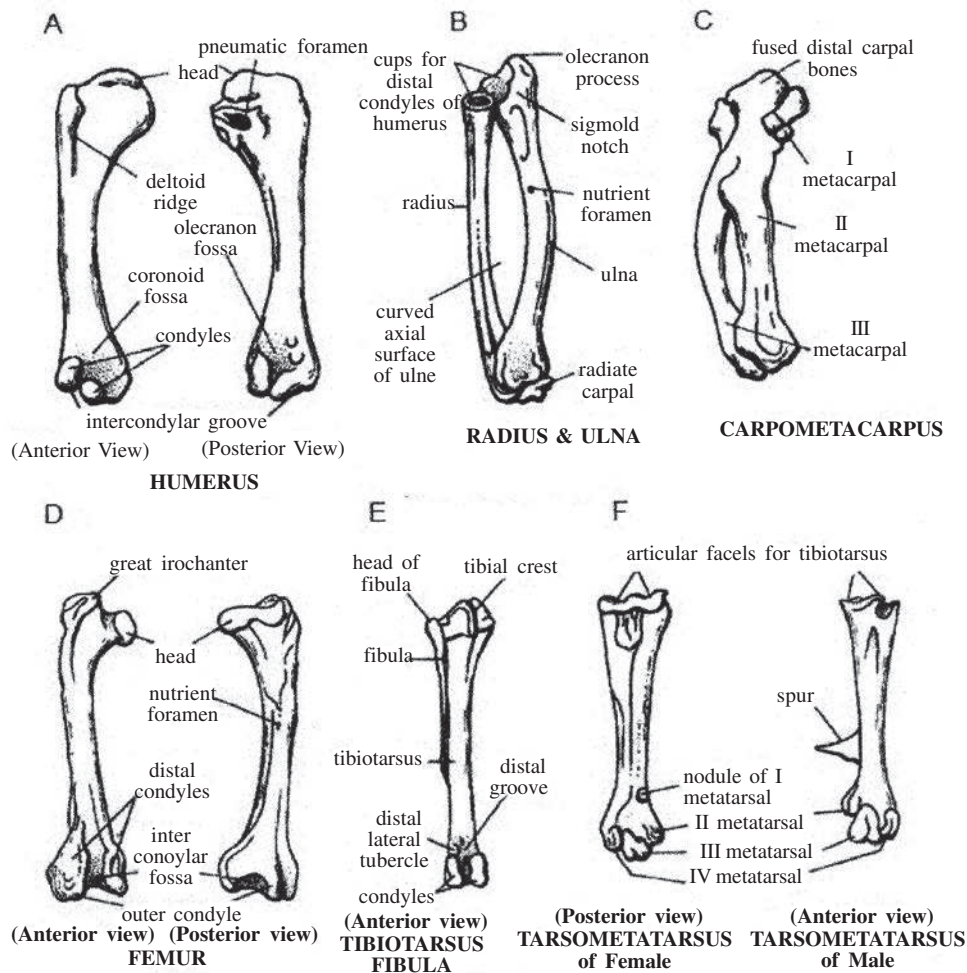


Figure 5 : Limb bones of fowl. (A – C) Forelimbs, (D – F) Hindlimbs

c) Carpometacarpus of fowl :

1. Compound bony structure consisting of two bones.
2. Both the bones fused completely at both ends leaving a wide gap in the middle.
3. The bones are light in weight.
4. Thickness of the bones are unequal.

5. One bone is straight and cylindrical while the other bone is curved and Thinly flattened.
6. Proximal end with a large convexity and a short rod-like process.
7. Distal end with three articular surfaces.

Hence, it is carpometaacarpus of fowl.

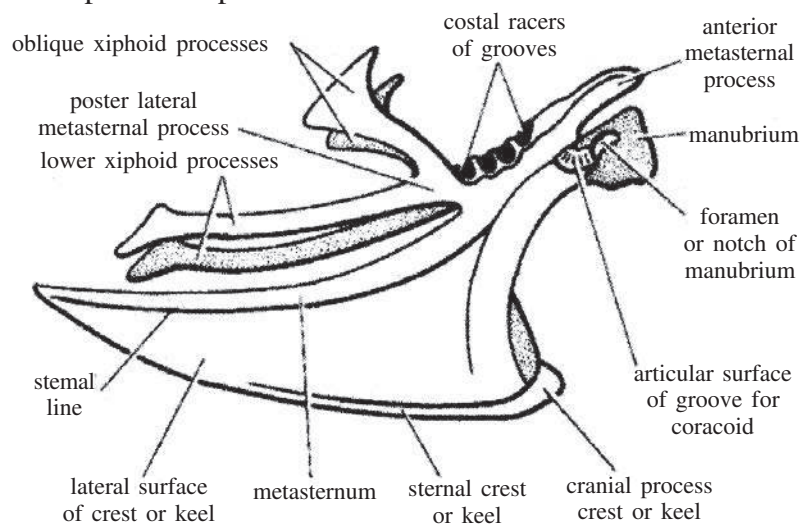


Figure 6 : Sternum of fowl

d) Femur

1. A long, stout, cylindrical bone and both ends are broadened.
2. Proximal end bears a round head extending a way from the shaft called head of femur.
3. A trochanter present near the head.
4. The distal end bears pulley-like condyles.

Hence, it is a femur bone.

1. It is light in weight.
2. Head of femur is situated approximately at right angle to the shaft. Trochanter pointed.
4. The distal and pulley-like condyles are separated by intercondylar groove.

5. Shaft is made up of bone while the ends are made up of calcified cartilage.
Hence, it is the femur of fowl.

e) Tibio-tarsus and fibula of fowl

1. Two long bones are partially fused.
2. Bones are grossly unequal in thickness and slightly unequal in length.
3. The stout, long bone is tibia and the slender bone is fibula.
4. Crenial crest present in the proximal end of tibia.

Hence, it is tibia and fibula bone.

1. The bones are light in weight.
2. Astragalus and calcaneum, and the proximal tarsal bones fused with tibia forming tibio-tarsus bone.
3. Tibio-tarsus bears two articular concavities and two prominent crenial crests at the anterior end while the distal end is pulley-like.
4. Fibula is slightly expanded at the anterior end and gradually tapers at the posterior end.
5. Anterior end of fibula is fused with the lateral surface of tibio-tarsus while the tapering posterior end is free and extends close to the distal end of tibio-tarsus.

Hence, it is the tibio-tarsus and fibula bone of fowl.

f) Tarso-metatarsus of fowl

1. Compound bony structure formed by complete fusion of three elongated bones except at their distal ends.
2. Light in weight.
3. Proximal end with 2 articular concavities, 2 foramina and a prominent ventral crest.
4. The bones are separate at distal end, each ending in a pulley-like structure.
5. The distal end also bears a single foramen.

Hence, it is tarso-metatarsus bone of fowl.

k) Thoracic rib of fowl

1. Elongated, thin and flattened bone
2. Light in weight, two articulating surfaces.
3. The proximal end is bifurcated into a dorsal tuberculum and a ventral capitulum.
4. Approximately at the middle region a backwardly directed thin process is present called unciniate process.

Hence, it is a thoracic rib of fowl.

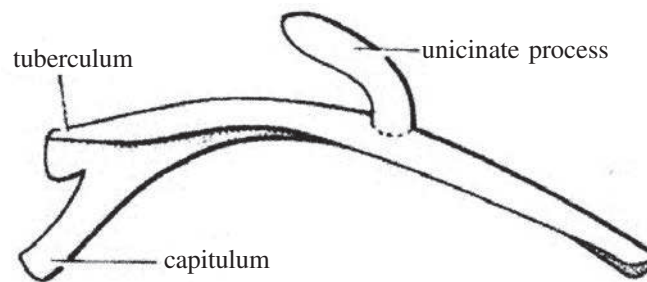


Figure 7 : Thoracic rib of fowl

4.2 Disarticulated skeleton of white rat

A) Skull of white rat

1. Compound structure, numerous bones united together enclosing a central cavity.
2. Foramen magnum, occipital condyle present.
3. Olfactory, optic, otic capsules are present.

Hence, it is a skull.

1. Presence of double occipital condyle.
2. Thecodont and heterodont dentition.
3. Sutures distinct.
4. Secondary palate present.

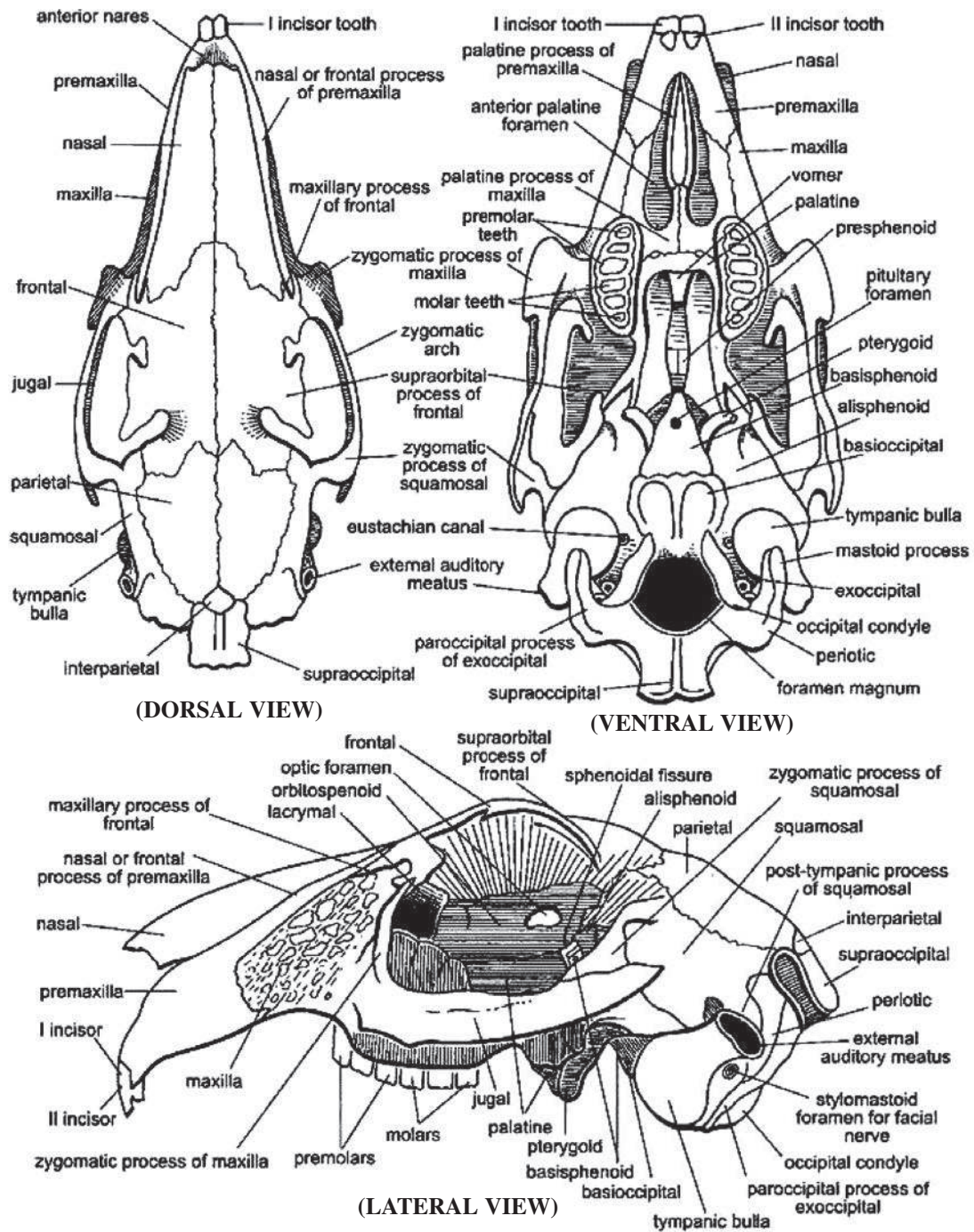


Figure 8 : Skull of white rat

5. Well developed zygomatic arch.

Hence, it is a skull of a mammal.

1. Tympanic bone fused with the skull.
2. Secondary palate without large posterior vacuities.
3. Base of zygomatic arch is not perforated.

Hence, it is a skull of eutherian mammal.

1. Orbit incomplete.
2. Slender zygomatic arch.
3. Incisor chisel shaped and one in each half.
4. Temporal and orbital fossa confluent.
5. Canine teeth absent, well-developed diastema.

Hence, it is a skull of rodentia

1. Incisor slightly curved.
2. Premolar absent.
3. Dental formula : $\frac{1.0.0.3}{1.0.0.3}$

Hence, it is the skull of rat/white rat (*Rattus* sp.)

B) Vertebrae of white rat:-

a) Atlas of white rat: -

1. Centrum present on bony structure.
2. Neural arch, neural canal, neural spine present.
3. Zygapophyses present.
4. Transverse process present.

Hence, it is a vertebra.

1. Centrum acoelous.
2. Intervertebral foramen present.

Hence, it is a vertebra of a mammal.

1. Ring like structure without centrum.
2. Neural canal large.
3. Two concave facets on the anterior side for articulation with double occipital condyles of the skull.
4. Transverse process wing like and bears vertebrarterial foramen.
5. Neural spine reduced.
6. A small mid - ventral hypapophysis present.
7. Pre-zygapophysis absent but post-zygapophysis present.

Hence, it is atlas vertebra of white rat.

b) Axis of white rat: -

Upto vertebra of a mammal same as atlas.

1. Centrum bears an anterior tooth -like odontoid process.
3. Transverse process short, rod-like, backwardly directed.
4. Both pre-and post-zygapophyses are well developed.
5. Vertebrarterial foramen present at the base of transverse process.

Hence, it is 2nd/Axis vertebra of white rat.

c) Anterior and posterior thoracic vertebra of white rat:-

Upto vertebra of a mammal same as atlas.

1. Neural spine long, pointed and directed vertically upward.
2. Facets for articulation of ribs on transverse process and centrum present.
3. Transverse process short, stumpy and not perforated at the base.

Hence, it is anterior thoracic vertebra of white rat.

1. Neural spine small and directed backwardly upward.
2. No facet for articulation of rib on transverse process.
3. Transverse process short, stumpy and not perforated at the base.

Hence, it is posterior thoracic vertebra of white rat.

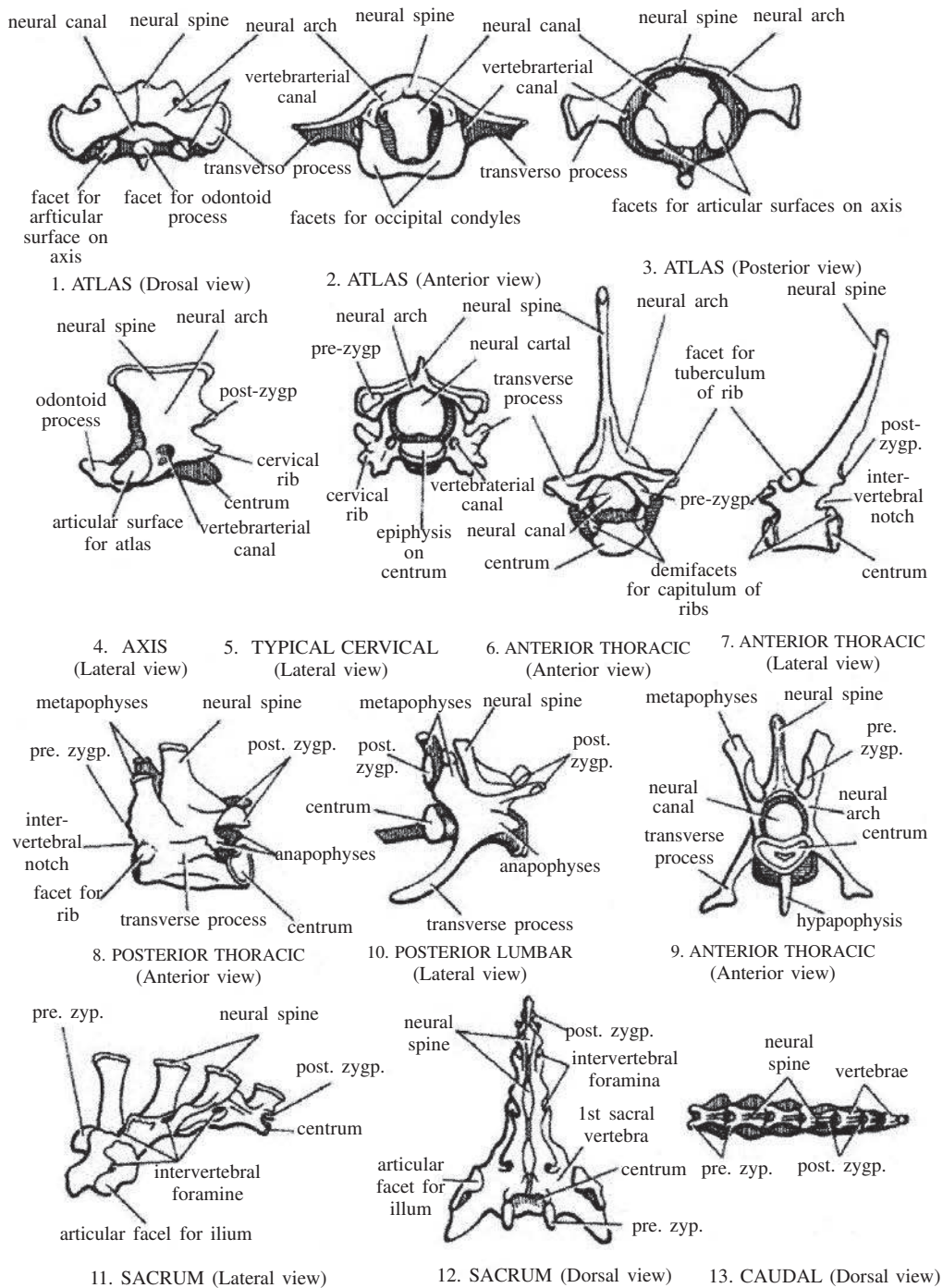


Figure 9: Vertebrae of white rat

d) Lumbar vertebra of white rat: -

Upto vertebra of a mammal same as atlas.

1. Stout and large bone.
2. Neural spine well developed and directed forward and upward but obliquely.
3. On the dorsal side of pre-zygapophysis a pair of metapophyses is present.
4. A pair of anapophyses is present below the post-zygapophyses.
5. Prominent epiphysis as a ventromedian ridge.

Hence, it is a typical lumbar vertebra of white rat.

e) Sacrum of white rat: -

Upto vertebra of a mammal same as atlas.

1. Compound structure formed by the fusion of 4 sacral vertebrae.
2. Approximately triangular in shape, broad anteriorly and gradually narrowing posteriorly.
3. Each vertebra of compound structure possesses centrum, neural canal, neural arch, transverse process etc.
4. Narrow neural canal.
5. Neural spines are flattened, ridge like.
6. Intervertebral foramina present in between two adjacent vertebrae.
7. Pre-zygapophis is well developed on the anteriormost vertebra.
8. Transverse process on the anterior most vertebra is stout, laterally expanded and with rough dorsal area; while the same of the posterior regions is not laterally expanded and gradually reducing in size.

Hence, it is the sacrum of white rat.

f) Caudal vertebrae of white rat :

Upto vertebra of a mammal same as atlas.

1. Neural spine short and directed upward.
2. Transverse processes absent.
3. Pre-and post -zygapophyses are very small.
4. Size of the vertebra is comparatively small.

Hence, it is a caudal vertebra of white rat.

N.B. –There are 16 caudal vertebrae in white rat. Size of the vertebrae gradually decreases posteriorly and the last two are rod -like.

g) Pectoral girdle of white rat:-

The pectoral girdle consists of two separate equal halves. Each half consists of the followings: -

1. Compound structure made up of scapula, supra–scapula and coracoid bones.
2. Triangular in shape, anteriorly narrow and posteriorly wide.
3. Scapula is thin, flat, plate-like large structure.
4. Presence of a dorsal, anteriorly directed scapular spine which bears acromion and metacromion processes at its anterior.
5. Coracoid is a knob-like small bone fused at the narrow end of scapula.
6. Presence of a short, curved, hook-like coracoid process.
7. Supra-scapula is a thin rim of cartilage situated on the wide posterior border of scapula.
8. Glenoid cavity is present which is a concave facet at the narrow end of scapula.

Hence, it is one-half of pectoral girdle of white rat.

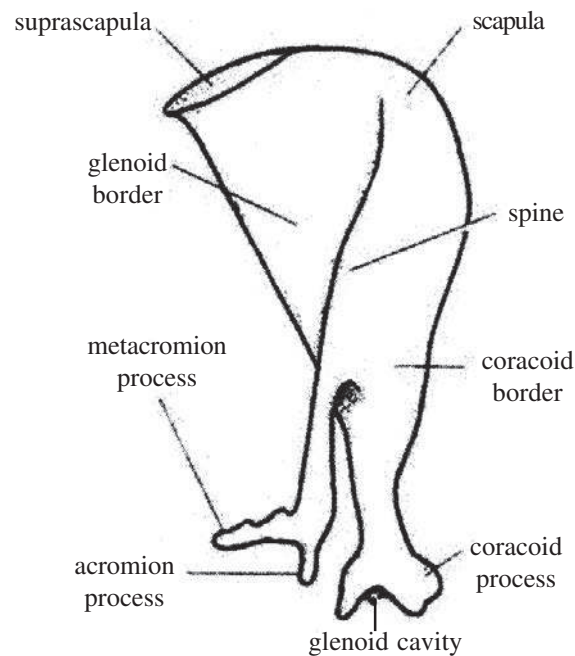


Figure 10 : Pectoral girdle of white rat

h) Pelvic girdle of white rat

The pelvic girdle consists of two equal halves and each half is known as os-innominatum. Each half consists of the following: -

1. Compound structure made up of complete fusion of three bones—ilium, ishium and pubis.
2. Ilium is flat, elongated and stout bone with a broad distal end.
3. Ischium is short, stout and L-shaped with ischial spine.
4. Pubis is flat, thin and curved.
5. At the junction of 3 bones there is a cavity called acetabulum.
6. A large obturator foramen present which seperates ischium and pubis. Hence, it is one-half of pelvic Indte or os-innominatum of white rat.
7. Both the halves joined together mid-ventrally by pubic symphysis to form a stout and Strong Irdle.

Hence, it is complete pelvic girdle of white rat.

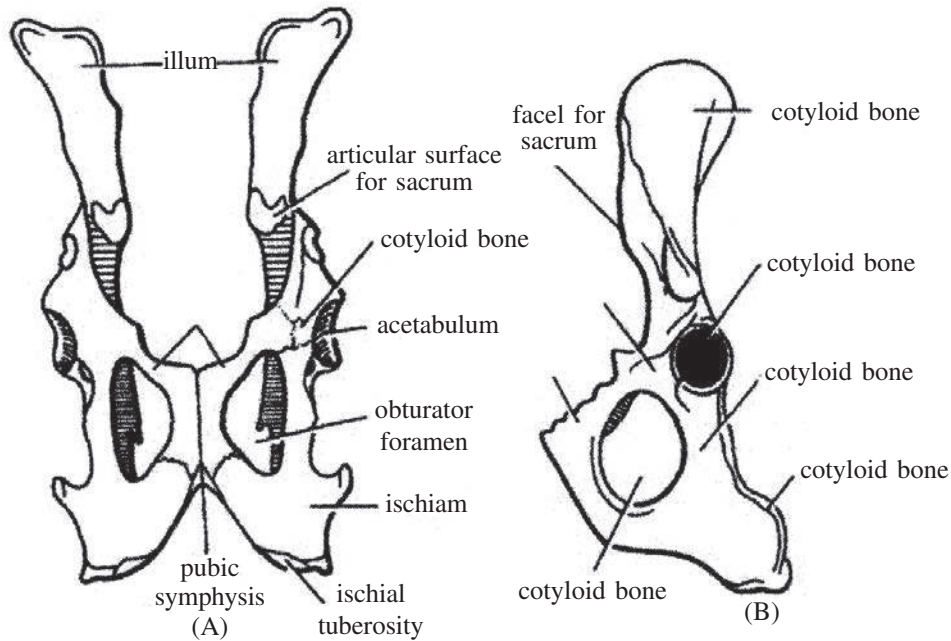


Figure 11 : Pelvic girdle of rabbit (A) Complete; (B) One half

i) Limb bones of white rat

Humerus of white rat: -

1. A rod-like single slightly curved bone with a narrow shaft and broadened at both ends.
2. A round head present at the proximal end called head of humerus.
3. Deltoid ridge present.

Hence, it is a humerus bone.

1. Shaft stout and both ends are more or less equally broad.
3. A bicipital groove is present in between head of the humerus and greater tuberosity.
4. Distal end bears a pulley-like trochlea with two lateral epicondyles.
5. A supra trochlear foramen is present at distal end.

Hence, it is a humerus bone of white rat.

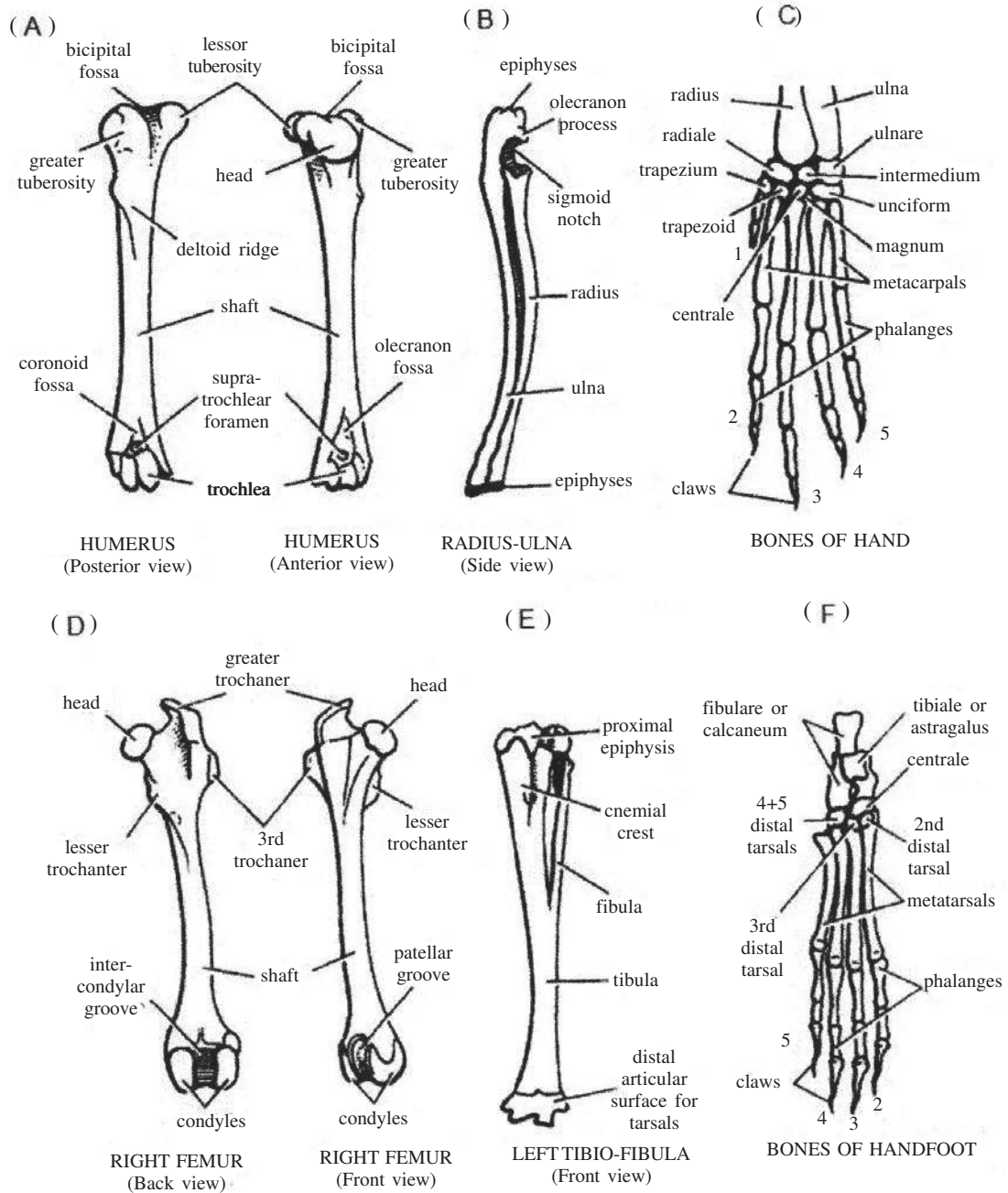


Fig. 12 : Limb bones of rabbit-(A-C) Forelimbs (D-F) Hindlimbs

Radius-ulna of white rat: -

1. Two long, unequal bones unite at both ends.
2. One is slender and nearly straight known as radius while the other is slightly curved and stout known as ulna.
3. Proximal end of ulna bears a cup-like sigmoid or semilunar notch and an olecranon process.
4. Distal end of ulna bears articular processes.

Hence, it is radius-ulna bone.

1. Both the bones are of equal thickness but are of unequal in length.
2. Radius is shorter than ulna.
3. Both the bones are joined at both ends leaving a small gap in the middle.
4. Sigmoid notch is situated at the neck of ulna.
5. Distal end of both ulna and radius bears articular processes or styloid processes.

Hence, it is the radius-ulna of white rat.

Femur of white rat :

1. A long, stout, cylindrical bone and its both ends are broadened.
2. Proximal end bears a round head extending away from the shaft called head of femur.
3. A trochanter present near the head.
4. The distal end bears pulley-like condyles.

Hence, it is a femur bone.

1. Shaft of the bone is stout, straight and some what flattened.
2. Head of the femur is borne on a distinct neck.
3. A large greater trochanter, a small lesser trochanter near the neck of femur is present.
4. Distal end bears two large lateral condyles separated by intercondylar or patellar groove.

5. A prominent lateral crest extends down the shaft for some distance.

Hence, it is a femur bone of white rat.

Tibio-fibula of white rat: -

1. Two long bones are partially fused.
2. Bones are grossly unequal in thickness and slightly unequal in length.
3. The stout, long bone is tibia and the slender bone is fibula.
4. Crenial crest present in the proximal end of tibia. Hence, it is tibio-fibula bone.
1. Both the bones are lying close together but narrowly separated at the proximal end.
2. Proximal end of tibia bears two concave articular surfaces along with a crenial crest, while the distal end of it bears two irregular articular surfaces.
3. Ends of both these bones are covered by cartilagenous cap.

Hence, it is tibio-fibula of white rat.

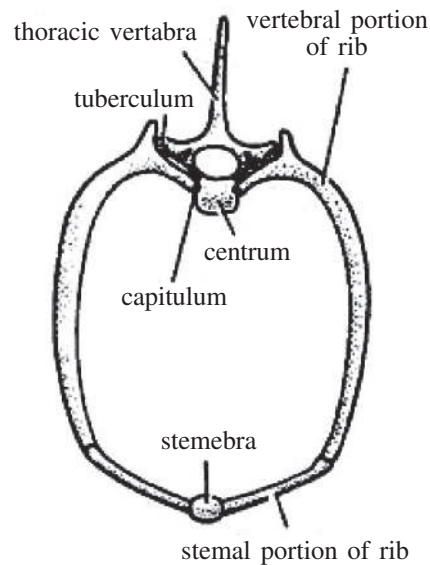


Fig. 13 : A thoracic vertebra with its ribs in rabbit

Sternum of white rat:-

1. The thorax is bounded mid-ventrally by the sternum which consists of five elongated bony pieces, known as sternebrae.

2. The sternebrae constitute the main body of the sternum, called mesosternum.
3. The first anterior most sternebra is the longest and called manubrium or presternum.
4. The sternum is ventrally produced into a keel.
5. The first pair of sternal ribs articulate with keel in the middle.
6. Sixth sternebrae is the smallest of all and the last one is long and slender.
7. Except first rib, all the sternal ribs called xiphisternum terminating into an expanded xiphoid cartilage are attached at the inter-sternebraal junctions.

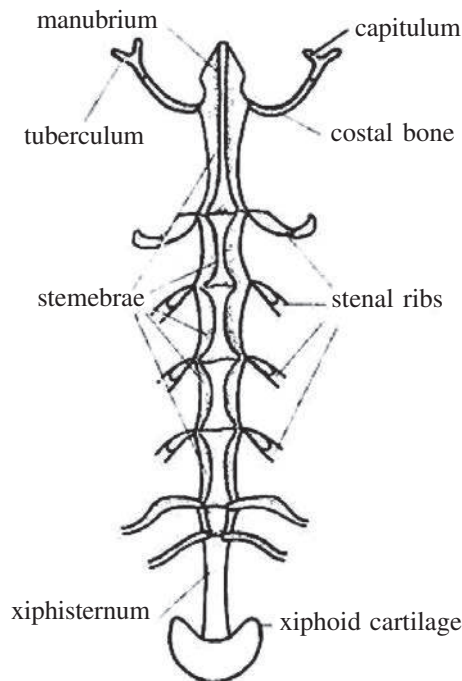


Fig. 14 : Sternum in rabbit

4.3 Carapace and plastron of turtle

Both these structures form the shell of turtle.

4.3.1 Carapace of turtle

1. The dorsal half/portion of the shell of turtle is known as carapace and structurally it is convex in nature.

2. It is made up of an inner plate of bones, covered by separate outer plate of horny materials compared to the scales of other reptiles.
3. Inner plate is formed by the fusion of dermal bone with expanded ribs and vertebrae.
4. On the surface of carapace, keratinized shields/plates of epidermis cover the underlying inner plate.
5. The inner bony plate of carapace consists of the followings: -
 - (a) A median row of 8 neural plates.
 - (b) A single, large nuchal plate joining with the first neural plate.
 - (c) 3 pygal plates lie behind the 8th neural plate.
 - (d) 8 pairs of large, rectangular, transversely arranged costal plates, 8 on each side of neural plates.
 - (e) First two pygal plates are united to form a suprapygal which joins with the 8th neural plate.
 - (f) The costal plates are fused with the ribs which project beyond the outer margin of costal plates.
 - (g) Each rib ends in one of the marginal plates which form the boundary of carapace.
 - (h) There are usually two pairs and one unpaired posteromedian marginal plates.
 - (i) First marginal plate is attached to the side of nuchal plate, while the last one joining with the last pygal plate.
 - (j) The nuchal, pygal and marginal plates are of endodermal derivatives while the neural and costal plates are regarded to be the expanded portion of endoskeletal structures.
6. The dorsal surface of carapace is externally covered by the horny shields and are regularly arranged as follows: -
 - (a) A median row of 5 vertebral shields.
 - (b) Two lateral rows of costal shields consisting of four on each side and attached with the vertebral shields.
 - (c) A marginal row of 24-25 marginal shields.

- (d) Of the marginal shields, the anteromedian is known as nuchal shield while the posteromedian one is known as pygal or supracandal shield.

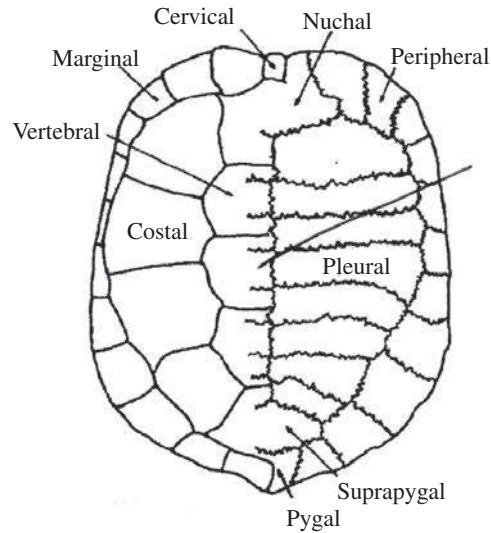


Figure 15 : Carapace of turtle

4.3.2 Plastron of turtle

1. The ventral half/portion of the shell of turtle is known as plastron and structurally it is flat in nature.
2. It is made up of an inner plate of bones, covered by separate outer plate of horny materials compared to the scales of other reptiles.
3. The inner plate forms the floor of the shell and it represents the fused dermal bones along the belly.
4. On the surface of plastron, keratinized plates of epidermis cover the inner plate.
5. The dermal bones of inner plate of plastron consists of nine plates –one entoplastron, and a pair of each epiplastra, hyoplastra, hypoplastra and xiphiplastra.
6. The entoplastron is supposed to correspond to interclavicle while the epiplastra composed of clavicle.
7. All the pieces are in close contact by their margins to form a continuous plate.
8. The plastron is covered externally by 6 pairs of horny shields which are known

as gular, humeral, pectoral, abdominal, femoral and shields and all these are paired.

9. One or two intergular shields are present in front of gular shields.

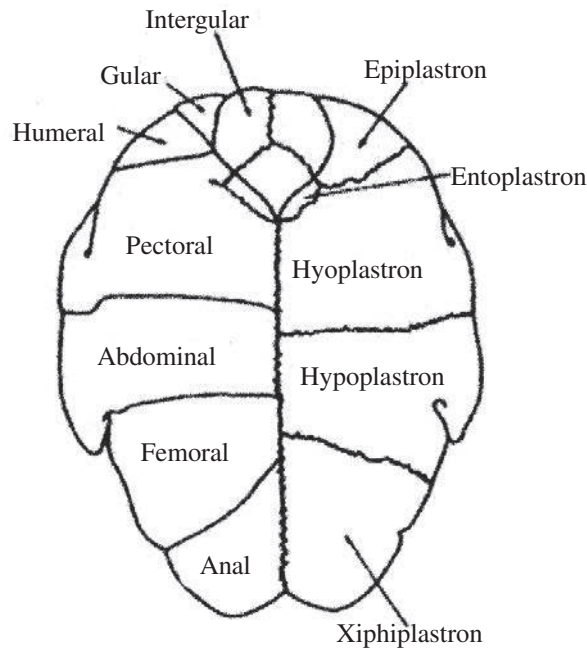


Figure 16 : Plastron of turtle

4.4 Mammalian skulls : one herbivorous (rat) and one carnivorous (dog) animal

4.4.1 One herbivorous skull (e.g. Rat)

Same as skull of white rat.

4.4.2 Skull of dog (a carnivorous mammal)

Upto skull of eutherian mammal same as white rat.

1. The skull is strongly built.
2. Temporal and orbital fossa confluent.
3. Incomplete posterior border of orbit.
4. Zygomatic arch is strong and outwardly curved.

5. Presence of well-developed sagittal and lambdoidal crest.
6. Canine is large, pointed and slightly curved.
7. Carnassial teeth present.
8. Incisors are $\frac{3}{3}$ and comparatively small.

Hence, it is the skull of order canivora.

1. Elongated facial part.
2. Paroccipital process small.
3. Dental formula: $\frac{3.1.4.2}{3.1.4.3}$

Hence, it is the skull of Dog (*Canis sp*).

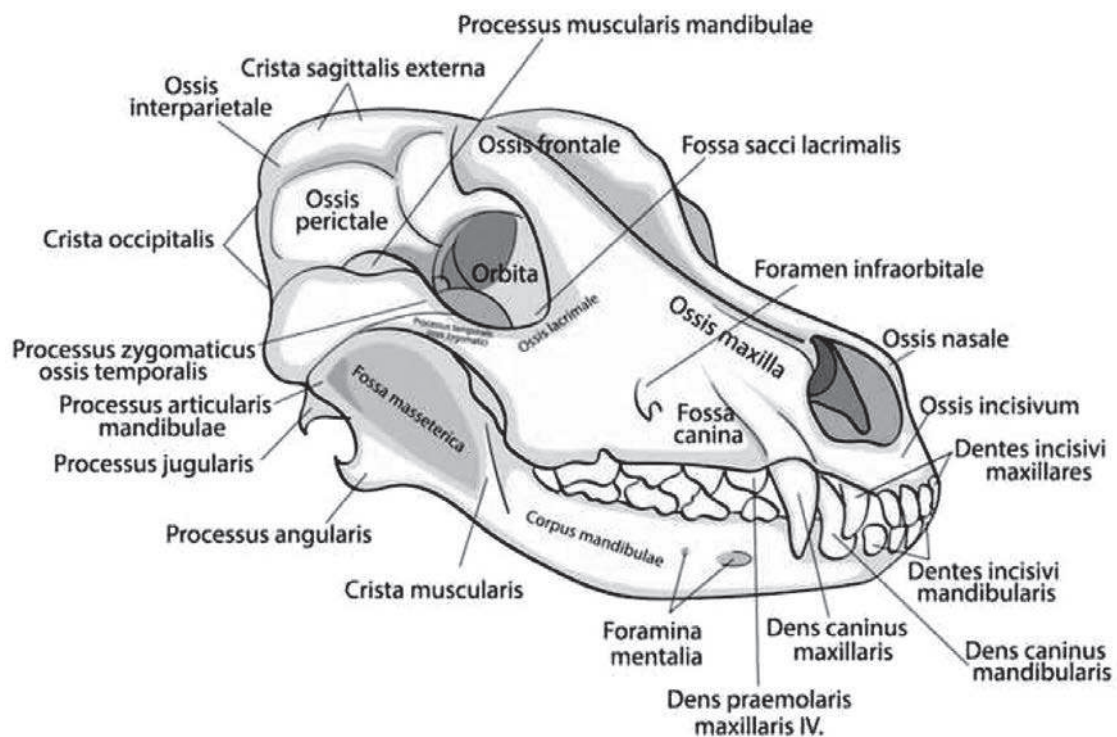


Figure 17 : Skull of Dog

Unit - 5 □ Examination of gametes

Structure

- 5.1 Introduction
- 5.2 Ultrastructure of sperm
- 5.3 Sperm of frog
- 5.4 Sperm of rat
- 5.5 Ultrastructure of ovum
- 5.6 Ovum of frog
- 5.7 Ovum of rat

5.1 Introduction

Gametes are the highly specialised sex cells developed within the primary sex organs—the testis in male and ovary in female. There are two types of gametes or reproductive cells, viz., spermatozoa and ova. These reproductive cells originate from the germ cells. Within the gonad the primordial germ cells are known as primary gametogonia which multiply rapidly by mitosis. In male the gametogonia produce sperm cells and are called spermatogonia, while in female gametogonia giving rise to ova or egg cells are known as oogonia.

Sperm and ovum are responsible for bringing together of hereditary factors in the new individual from the parents and to provide material substance from which the new individual will arise. The gametogonia in both the sexes transform to fulfil these two purposes. The development of male gametogonium or spermatogonium to sperm is called *spermatogenesis* and change of female oogonium to ovum is known as *oogenesis*. The gametogonia then transform into the specific gametes and in both cases, the transformation involves reduction of diploid to haploid number of chromosomes and considerable preparation in different components of the cell.

5.2 Ultrastructure of sperm

Sperm or spermatozoon may be defined as the small highly differentiated male haploid sex cell which is nutrientless, genetic material packed active motile cell developed within the seminiferous tubules of the testis.

Sperm consists of three distinct parts—head, middle piece and tail.

Head: Head contains nucleus and acrosome. Nucleus forms the major part of the head. It contains densely packed genetic material within the nuclear membrane. The nucleus contains DNA and histone protein. Acrosome is present at the tip of the nucleus. It is double-walled sac containing dense granules. Two important enzymes such as hyaluronidase and acrosin which functions during sperm entry into the ovum at the time of fertilization.

Middle piece: The tubular extended part in the posterior region of the nucleus is known as middle piece. It is connected with the nucleus by a narrower neck. Middle piece consists of two centrioles, mitochondria and ring centriole. The two centrioles present in the middle piece are at right angle to one another. The anterior centriole is called proximal centriole which is present in the depression at the posterior part of the nucleus. The posterior centriole is known as distal centriole which is responsible for the formation of the microtubules of the sperm tail. The filamentous structure associated with the distal centriole is known as axoneme or axial filament.

Around the axial filament of the middle piece spiral mitochondria are present. Due to the presence of mitochondria, it is thought that the middle piece is a 'power plant' which provides energy during the locomotion of sperm. At the posterior extremity of the middle piece lies another dark, dense ring called the ring centriole.

Tail: The tail forms the longest part of the spermatozoon. It is divided into two regions—the principal piece and the end piece. The principal piece is structurally similar with the cilia or flagella. In the principal piece, the arrangement of axial filament (9+2) and 9 longitudinal fibres have been found but no mitochondrial sheath is noticed. The axial filament is surrounded by a thin layer of cytoplasm and plasma membrane.

The end piece is a short portion of the sperm tail. It consists of only axial filament and is covered with cytoplasm and plasma membrane.

5.3 Sperm of frog

Identifying characters:

1. Mature spermatozoon of a frog is made up of three parts, viz. head, middle piece and tail.
2. The head is long and cylindrical. It consists of nucleus and acrosome. The acrosome secretes enzyme like hyaluronidase which help penetration into the egg.

3. Middle piece region is very small as compare to that of the other sperms.
4. The middle piece of spermatozoon is composed of almost entirely of mitochondria and centrioles.
5. The mitochondrial apparatus supplies the required amount of energy in the form of ATP.
6. The tail of sperm is flagellar and very long. It helps in locomotion and thus is very essential for the mobility of the sperm.

5.4 Sperm of rat

Identifying characters:

1. Mature spermatozoon is a microscopic, elongated and highly specialised cell.
2. It measures about 60-70 μm long with a head measuring about 8-10 μm .
3. Sperm is divided into head, middle piece and tail.
4. Head is hook-shaped and it contains nucleus and acrosome.
5. Middle piece is connected with the head by a narrower neck.
6. At the neck region of sperm two centrioles lying at right angle to one another.
7. Anterior centriole called the proximal centriole which is situated in the depression at the posterior part of the nucleus.
8. The posterior centriole called the distal centriole which is present next to the proximal centriole.
9. The distal centriole acts as the basal body for axoneme or axial filament.
10. Throughout the whole middle piece, the mitochondria are present spirally twisted around the axial filament and form one continuous body.
11. Ring centriole is present at the posterior extremity of the middle piece.
12. The tail has two regions, namely, principal piece and end piece.
13. The principal piece forms the longest part of the tail and it consists of peripheral fibrous sheath.
14. The end piece is a short part of the sperm tail and it consists of only the axial filament covered with cytoplasm and plasma membrane.

5.5 Ultrastructure of ovum

Ovum is much larger in size than the body cells in general. Special cytoplasmic substances are accumulated in the cytoplasm which are used up during development either directly, or by becoming transformed into the various structures. The size of egg varies greatly in different animals. The size is chiefly attributable to the quantity of yolk present. The egg is surrounded by plasma membrane (oolemma) which encloses cytoplasmic part called vitellus. Within the vitellus, most prominent is nucleus which is 200-300 times larger than the ordinary cell nucleus. The nucleus contains single large nucleolus rich in RNA and enveloping chromatin materials. Immediately beneath the plasma membrane, there is a thin layer of cytoplasm called cortex. In many eggs, the cortex contains special granules, called cortical granules which play an important role during fertilization. The cytoplasm contains various organelles like mitochondria, Golgi complex and reserve food materials in the form of yolk. The egg or ovum contains one or more membranes are described as primary, secondary and tertiary membranes.

The ovum has three basic functions:

- (i) to contribute a nucleus containing half of the chromosomal component of the future embryo.
- (ii) to supply almost all the cytoplasm to the zygote,
- (iii) to supply food reserves that will enable the embryo to develop upto a stage when it can begin to feed upon exogenous materials.

Yolk plays a vital role in determining the egg types. Depending upon the amount of yolk in various quantities, eggs are microlecithal or oligolecithal, mesolecithal and megalecithal.

According to the distribution of yolk in the cytoplasm of the egg, it may be Homolecithal or Isolecithal, Centrolecithal and Telolecithal.

5.6 Ovum of frog

Identifying characters:

1. The ovum or egg of frog is spherical and it measures about 1.6 mm in diameter.
2. It is surrounded by three egg membranes, viz., outer jelly coat, middle vitelline membrane or oolemma.

3. The egg shows well marked polarity.
4. Because of uneven distribution of yolk, such an egg is said to have an animal pole where the concentration of yolk is small amount.
5. The opposite pole is termed as vegetal pole where the cof yolk is large amount.
6. The nucleus of the ovum is approximated to the animal pole.
7. The ovum contains moderate amount of yolk, hence it is moselecithal type of egg.
8. The egg shell is absent, hence it is non-cleidoic egg.

5.7 Ovum of rat

Identifying characters:

1. The ovum or egg of rat is round or spherical and is about 270 μm in diameter.
2. The ovum contains three egg membranes, such as vitelline membrane, zona pellucida and corona radiata.
3. Thin vitelline membrane remains closely associated with the plasma membrane around the cytoplasm.
4. Zona pellucida is present outside the vitelline membrane.
5. Presence of corona radiata around the ovum and exterior to the zona pellucida.
6. Corona radiata is formed by a singly layer of columnar cells.
7. Perivitelline space is present in between plasma membrane and zona pellucida.
8. Nucleus is large in size and it is about 55 μm in diameter. It enlarges to form a germinal vesicle.
9. The ovum of rat contains very little amount of yolk, hence it is microlecithal egg.

Unit : 6 □ Chick : developmental stages

Structure

6.1 Chick embryo of 24 hours of incubation

6.2. Chick embryo of 48 hours of incubation

6.3 Chick embryo of 72 hours of incubation

6.1 Chick embryo of 24 hours of incubation

Identifying characters:

1. Distinguishable into central area pellucida and a peripheral area vasculosa.
2. Neural folds are well developed at the cephalic end.
3. Sub-cephalic pocket present on each side of head fold.
4. Distinct anterior border of foregut and margin of anterior intestinal portal.
5. Presence of distinct median notochord.
6. Four pairs of somites are visible in the middle of the body.
7. Primitive streak in a reduced state.
8. Hensen's node located posteriorly.
9. Non-segmental mesoderm and lateral mesoderm present.
10. Blood islands are restricted to the posterior end of the embryo.

Hence, it is the whole mount of chick embryo of 24 hours of incubation.

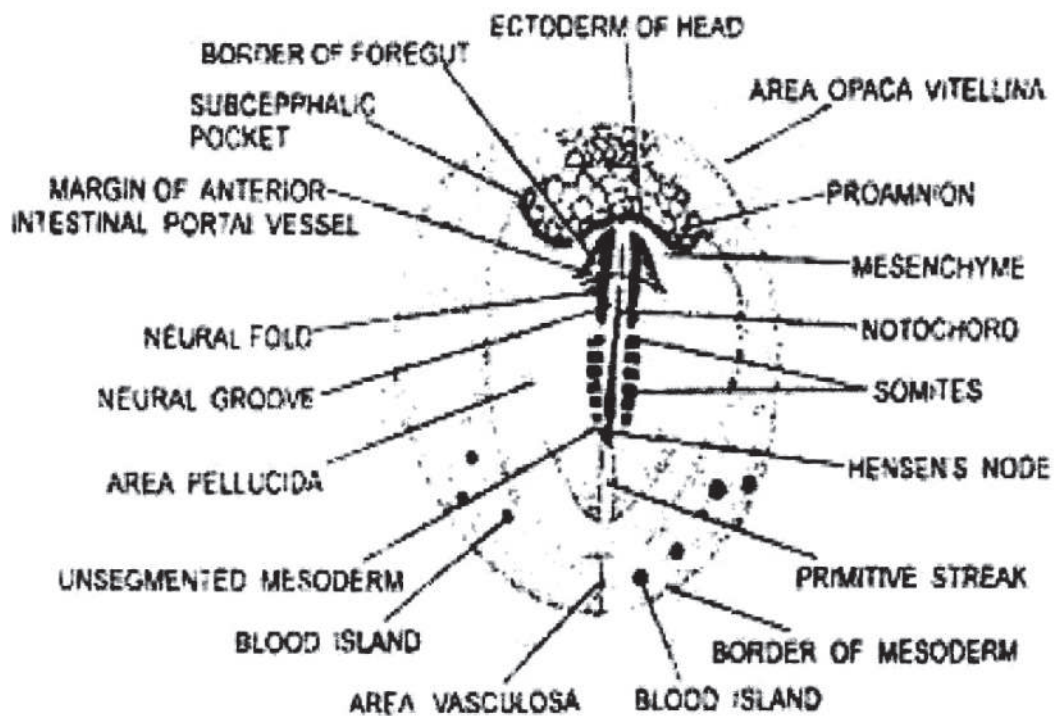


Figure 1 : 24 hours chick embryo

6.2. Chick embryo of 48 hours of incubation

Identifying characters:

1. Embryo consists of a downwardly bent head, an elongated trunk and a short tail region.
2. Anterior half of the body is twisted and lies on the left side.
3. Cranial flexure and cervical flexure well developed.
4. Neural tube differentiated into brain and spinal cord.
5. Optic cup distinct.
6. Auditory vesicles prominent.
7. Amniotic head fold covers the anterior half of the body, a small tail fold of amnion present posteriorly.
8. Presence of well developed heart.
9. Three pairs of arterial arches arise from the ventral aorta.
10. Twenty six pairs of somites are present.
11. Vitelline blood vessels well developed.

Hence, it is the whole mount of chick embryo of 48 hours of incubation.

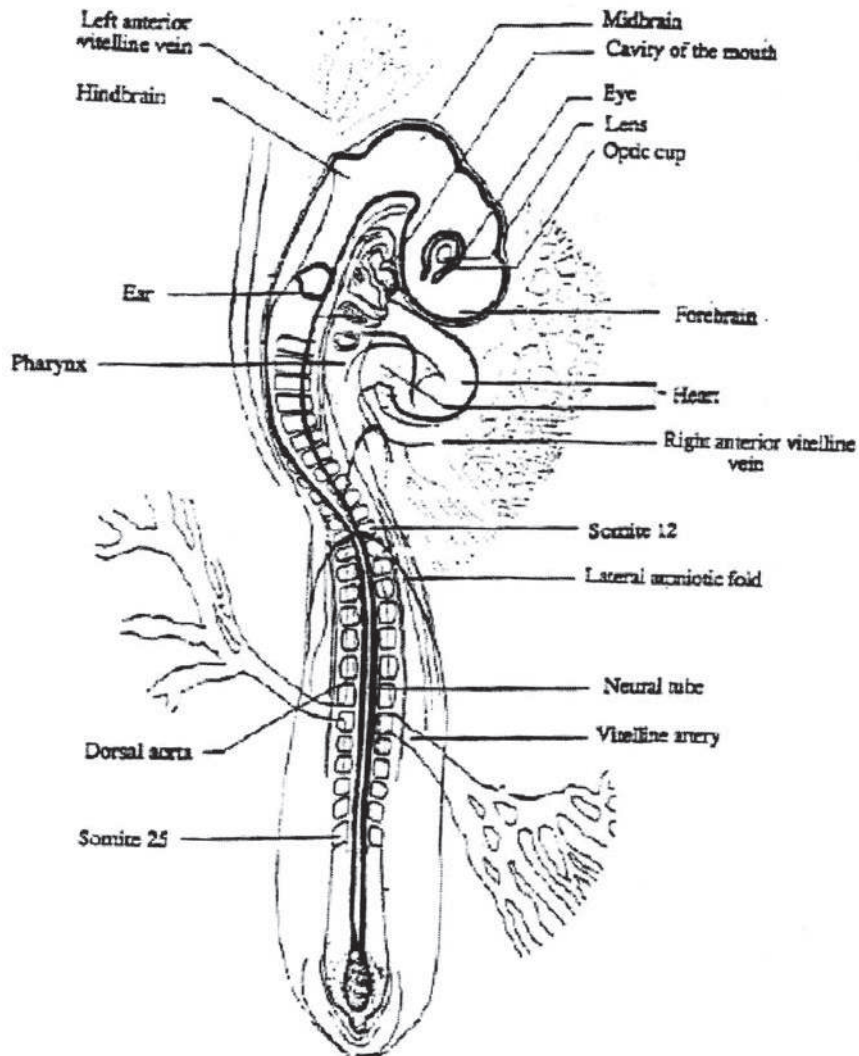


Figure 2 : 48 hours chick embryo

6.3 Chick embryo of 72 hours of incubation

Identifying characters:

1. Embryo consists of a swollen, downwardly bent (flexed) head, an elongated trunk and a short upwardly bent (flexed) tail.
2. Both cranial and cervical flexures prominent, caudal flexure well developed.

3. Amnion completely encloses the body except posterior opening.
4. Large optic vesicle with distinct outer pigment layer and inner sensory layer.
5. Presence of well developed eyes, lens and auditory vesicles.
6. Telencephalon located below the level of heart, diencephalon with an epiphysis.
7. Presence of well differentiated heart with four aortic arches.
8. Presence of paired wing bud and hind limb bud.
9. Vitelline blood vessels present.
10. Pharynx and four pharyngeal pouches visible.
11. 36 pairs of mesodermal somites are present.
12. Appendages rudiments are present.

Hence, it is the whole mount of chick embryo of 72 hours of incubation.

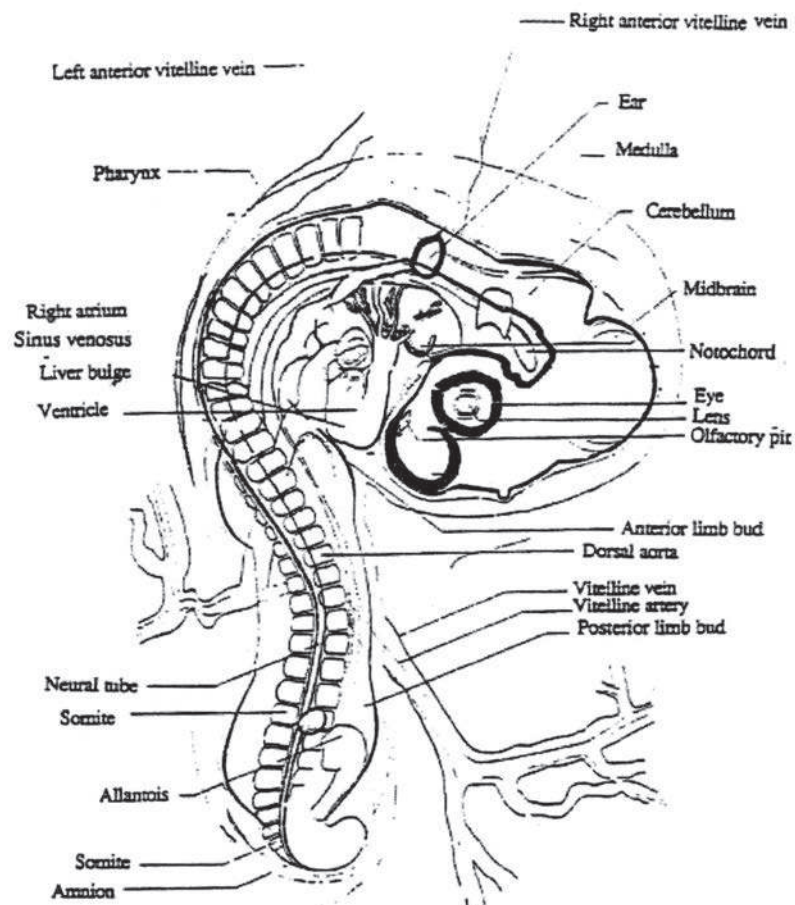


Figure 3 : 72 hours chick embryo

Unit 7 □ Demonstration of whole mount preparation of chick embryo

Structure

7.1 Introduction

7.2 Materials required

7.3 Experimental methodology

7.1 Introduction

The egg of hen is telolecithal type. It develops only on a limited range of temperature (about 37-39°C) which is approximately the body temperature of the adult bird. The temperature of incubator must be carefully controlled.

7.2 Materials required

(i) Fertilized hen's egg, (ii) Forceps, (iii) Fine scissors, (iv) Scalpel, (v) Petridishes, (vi) Saline, (vii) Distilled water, (viii) Alcohol grades, (ix) Eosin stain, (x) Incubator, (xi) Binocular microscope, (xii) Microscope.

7.3 Experimental methodology

1. Clean the egg surface with cotton wool soaked in 50% alcohol to kill the organisms.
2. Incubate the egg at 38°C temperature.
3. Remove the egg from incubator after specific time of incubation and crack a small area of egg shell at the broad end with the help of handle of scalpel.
4. Remove the egg shell pieces gently till the opening is large enough to pore out the contents without damaging the vitelline membrane around the yolk.
5. Transfer the contents of egg in a clean sterilized petridish containing saline. Care must be taken to ensure that the whole mass of yolk and embryo must be completely immersed in saline.
6. Observe the embryo under binocular microscope. In the animal pole, the embryo appears as a small white body on the surface of the yolk at the centre.

7. Hold the vitelline membrane with a pair of fine forceps and cut it close to the embryo with a pair of fine sharp scissors.
8. Carefully separate the embryo from the underlying yolk and transfer it to a watch glass containing physiological solution, i.e. saline.
9. Wash out the yolk with a fine brush.
10. Pass the embryo by alcohol series of 30% → 50% →70%→90% alcohol (10-15 minutes in each change) for dehydration.
11. Stained the embryo with eosin stain for 3 minutes.
12. Cleaning in 100% alcohol.
13. Wash and clear in xylene for 10 minutes.
14. Mount the embryo on a clean glass slide in canada balsam or DPX.
15. Observe the whole mount of the embryo under microscope.

For unstained preparation of the whole mount of chick embryo:

- (a) Procedural steps upto point 10 -same as stated above.
- (b) Mount the embryo, which is free from yolk and other materials, on a glass slide with 1-2 drops of glycerine.
- (c) Observe the whole mount of the embryo under microscope.

Unit - 8 □ Animal album

Structure

- 8.0 Objectives**
- 8.1 Protozoa**
- 8.2 Porifera**
- 8.3 Cnidaria**
- 8.4 Platyhelminthes**
- 8.5 Nemathelminthes**
- 8.6 Annelida**
- 8.7 Arthropoda**
- 8.8 Mollusca**
- 8.9 Echinodermata**
- 8.10 Hemichordata**
- 8.11 Urochordata**
- 8.12 Cephalochordata**
- 8.13 Cyclostomata**
- 8.14 Chondrichthyes**
- 8.15 Osteichthyes**
- 8.16 Amphibia**
- 8.17 Reptilia**
- 8.18 Aves**
- 8.19 Mammalia**
- 8.20 Selected reading**

8.0 Objectives

By studying this unit learners would be able to know about habit, habitat and distribution of different invertebrate and vertebrate phyla.

8.1 Protozoa

1. *Amoeba sp.*

Habit and habitat:

1. Fresh water, commonly found on the surface of mud and rotten vegetation at the bottom of ponds, lakes and slow running streams.
2. It occurs in abundance in the water which contains bacteria and organic substance such as leaves, twigs and other aquatic vegetation in abundance.
3. Nutrition holozoic-feeds on bacteria, algae, protozoans and small multicellular organisms like rotifers.
4. Food is captured by pseudopodia.

Distribution: It is found all over the world.

2. *Euglena sp.*

Habit and habitat:

1. Euglena is a solitary and free living freshwater flagellate.
2. Found in surface of fresh water ponds, abundant in stagnant ponds with greenish water. Also found in fresh water pools, ditches and slow running streams.
3. When euglenas are in abundance, they impart green colour to the water.
4. Nutrition holophytic but becomes saprophytic in absence of light.
5. Synthesize carbohydrate by the process of photosynthesis.

Distribution: Cosmopolitan.

3. *Plasmodium sp.*

Habit and habitat:

1. *Plasmodium* lives as an endoparasite, found in the RBC of man in the form of mature adult stage or trophozoite stage.
2. It causes malarial fever in man, transmitted by female anopheles mosquito.
3. In the life cycle of *Plasmodium* having two hosts, man and female anopheles mosquito. Man is considered to be definitive host in which asexual phase of the life cycle of parasite is completed. Female anopheles is considered as an intermediate host in which sexual phase of the life cycle of parasite is completed.
4. In 1898, Sir Ronald Ross (Nobel Prize winner in Medicine, 1902) proved that malarial parasites are sucked by female anopheles mosquito and later injected into human blood.
5. Four species of *Plasmodium* causing four types of malarial fever:
 - (i) *P. vivax*-benign tertian fever
 - (ii) *P. falciparum*-malignant tertian fever
 - (iii) *P. malariae*- quartan fever
 - (iv) *P. ovale* - ovale tertian fever

Distribution: Malarial parasites are found in all countries. The tropical zone is the endemic of all malarial parasites. *P. vivax* is the prevailing species of the temperate zone while *P. malariae* is a parasite of subtropical zone. The distribution of *P. ovale* has been reported from Africa and Philippines.

4. *Paramoecium sp.*

Habit and habitat:

1. *Paramoecium* found in fresh water ponds, pools, lakes, ditches, streams etc. containing decaying vegetable matter. It is popularly known as slipper animalcule or 'Ladies slipper'.
2. Nutrition holozoic, feeds on bacteria, small protozoans, algae, diatoms etc.

3. Can be easily cultured in hay infusion.
4. Reproduces sexually by conjugation.

Distribution: World wide distribution.

8.2 Porifera

1. *Sycon sp.*

Habit and habitat:

1. *Sycon* is a small, solitary colonial, marine sponge found in shallow water upto a depth of 50 fathoms (1 fathom= 6 feet) and in well oxygenated water.
2. It is a branching colonial sponge, though solitary individuals are also found.
3. Attached by a sticky secretion with submerged solid objects like rocks, wooden structures, shells of molluscs, corals etc.
4. They thrive well where wave action is not too strong and at low tide mark.

Distribution: Cosmopolitan in marine and freshwater, but is best known from North Atlantic shores.

2. *Hyalonema sp.*

Habit and habitat:

1. Marine, found in 10-15 meters deep in sea.
2. Vase-shaped, generally measuring 30-45 cm.long.
3. Due to presence of hyalonemic root-tuft often spirally twisted like rope, hence they are called glass-rope sponge.

Distribution: Found in USA and Coast of England at the depth of 10-15 meters.

3. *Euplectella sp.*

Habit and habitat:

1. *Euplectella* is solitary animal found abundantly in deep sea water at the depths from 500 to 5000 meters in slow running water.

2. It is popularly known as 'venus flower basket' due to its beautiful elegant glossy shape.
3. Sponge is fastened in mud of sea bottom by a root-tuft, root-spicules are adapted to anchor sponge to unstable substratum.
4. Euplectulla exhibit an interesting commensal association with certain species of shrimps. Young shrimps enter into spongocoel and after growth they are unable to escape through the minute sieve plates of osculum. Their entire life is passed in sponge prison.
5. Skeleton of Euplectella is in great demand in Japan for good wedding gift in marriage ceremony.

Distribution: Deep sea near Philippines and West Indies.

8.3 Cnidaria

1. *Obelia sp.*

Habit and habitat:

1. *Obelia* is a typical sedentary, exclusively marine and colonial form. It is commonly known as 'Sea-fur'.
2. They are found attached on the surface of sea-weeds, molluscan shells, rocks and wooden piles in shallow water up to 80 meters in depth.
3. It exists in two principal forms, the polyp and the medusa.
4. The polyp or hydroid form represents the asexual phase of its life history and the medusoid form represents the sexual phase.
5. There is an alternation of these two phases or generations in its life cycle and thus shows typical instance of 'Metagenesis'.

Distribution: Cosmopolitan distribution, abundant in both Atlantic and Pacific coastal waters.

2. *Physalia sp.*

Habit and habitat :

1. Marine, colonial, free-floating pelagic animal of warm sea, commonly known as 'Portuguese man-of-war'.
2. Presence of bladder like brightly coloured float or pneumatophore which supports the colony on water surface.
3. A gas in the float chamber contains 90% nitrogen, 9% oxygen and 1% argon.
4. Mainly feeds on fishes.
5. Tentacles are useful in capturing prey, chiefly fish.
6. They can cause painful injuries to man.

Distribution: Found in Tropical and sub-tropical oceans.

3. Jelly fish [*Aurelia aurita*]

Habit and habitat:

1. Marine, solitary, free-swimming, pelagic animals in medusoid forms, popularly known as moon jelly.
2. It is carnivorous, feeding on small planktonic animals with the help of its long oral arms.
3. It responds to various stimuli and is most active in diffuse light.
4. It inhabits coastal water of all oceans.

Distribution: Cosmopolitan in distribution, abundantly found in temperate, tropical and subtropical waters, very common along the entire Atlantic and Pacific coast.

4. *Sea Anemone*

Habit and habitat:

1. Marine, brightly coloured solitary animal.

2. They are sessile, live in shallow water or littoral zone, remain attached with rocks, sea-weeds, molluscan shells, sandy and muddy bottom etc.
3. They are represented only by hydroid or polyp stage and the medusoid generation is absent.
4. Carnivorous, feeding on minute organisms, small crustaceans.
5. It is very sensitive and highly contractile, when touched the animal contracts its body immediately.

Distribution: Cosmopolitan, more abundant in tropical and sub-tropical waters along the Atlantic and Pacific coast.

8.4 Platyhelminthes

1. *Taenia sp.*

Habit and habitat:

1. Digenetic endoparasite, involves mainly two hosts-man and pig.
2. Adult lives in intestine of man, cysticercus stage lives in the muscles of pig, hence it is known as the pork tape worm.
3. Man is the primary host and pig is the secondary host.
4. Infection occurs by eating undercooked pork meat containing cysticerci.
5. *Taenia* causes loss of appetite, continuous indigestion, vomiting, abdominal pain, anaemia, insomnia etc. These effects are together known as 'Taeniasis'

Distribution: *Taenia* is found endemic in the pork consuming areas. Its infection is abundant in China, India and European countries.

8.5 Nematelminthes

1. *Ascaris sp.*

Habit and habitat:

1. Monogenetic endoparasite, involves only one host, no secondary host.

2. It lives in the small intestine of man which is commonly known as 'round worm'.
3. Shows sexual dimorphism with separate male and female individuals.
4. Infection occurs by eating raw and uncooked vegetables.
5. *Ascaris* causes abdominal pain accompanied with peritonitis, diarrhoea, vomiting, intestinal obstruction. Migratory larvae in the lung produce cough, dyspnoea and a slight temperature which are altogether symptoms of pneumonia. This disease is generally referred to as ascariasis.

Distribution: Cosmopolitan distribution but chiefly found in India, China, Korea, Philippines and Pacific Islands.

8.6 Annelida

1. *Aphrodite sp.*

Habit and habitat:

1. Marine, inhabiting in shallow waters below the low-tide mark.
2. It lives buried in soft sea bottom with the posterior end projecting into water.
3. Capable of digging burrow from 5 to 50 meters deep or crawls on sea bottom.
4. Carnivorous.
5. Since the animal has distinct stiff and iridescent bristles, hence it is known as 'sea mouse'.

Distribution: Cosmopolitan.

2. *Nereis sp.*

Habit and habitat:

1. Marine polychaete, found in the inter-tidal zone, lives in the sea shore in shallow water, in mud or muddy sand, under stones, in the crevices of rocks or in the sea weeds, some live in the tubular burrows lined by mucous in sand or mud at the tidal level.

2. They are commonly known as Sandworm or clam worm.
3. Nocturnal in habit, very active during night and passive during the day.
4. During night they come out from burrow or from their hidden places, start crawling over the sand and swimming by lateral wriggling of the body.
5. Carnivorous, feeds on worms, soft body of small molluscs, small insects etc.

Distribution: Cosmopolitan, found abundantly along the North Atlantic coast, Pacific coast and in Europe.

3. *Earthworm*

Habit and habitat:

1. Terrestrial, burrower, lives in 12-18 inches below the surface of slightly damp soil much in decaying organic matters in gardens, irrigated farm land, near the banks of the ponds.
2. Nocturnal in habit, during night they come out of their burrows in search of food and reproduction.
3. Feeds on dead organic matter which is taken along with the soil. Soil and undigested food matters are voided as castings.
4. Earthworms are better known as the friend of farmers due to improve the fertility of soil. Their habit of burrowing and soil feeding make the soil porous which permit both aeration and manuring the soil. So these worms are also known as natural ploughman of the soil.
5. In Some cases, earthworms become harmful. Their burrows may cause loss of water by seepage from ditches in irrigated lands. They also damage the grass lands by making tunnels in the ground when present in huge numbers.

Distribution : Cosmopolitan.

4. *Hirudinaria*

Habit and habitat:

1. Found in ponds, lakes, swamps and slow-flowing streams.

2. Sanguinivorous (blood -sucking) and ectoparasitic in nature, sucking the blood of fishes, frogs and also cattle and man. It is commonly known as Indian cattle leech.
3. If full meal is ingested, it can live more than one year without taking further meal.
4. Saliva contains 'hirudin'—blood anticoagulant.
5. Feeds on worms, small snails and insect larvae.

Distribution: Cosmopolitan and specially found in India, Bangladesh, Burma, Srilanka.

8.7 Arthropoda

1. *Palaemon sp.*

Habit and habitat:

1. Inhabits fresh water ponds, lakes, streams and rivers.
2. Nocturnal, lies hidden at the bottom during the day and comes to the surface during night in search of food.
3. It is a good swimmer but also capable of crawling on the surface and at the time of danger can jump backwardly with the help of a pair of uropods.
4. Omnivorous, feeding on small organisms like algae, mosses, weeds, small insects, decaying leaves, detritus etc.
5. Migrate to brackish water for breeding.
6. During the breeding period (May to July) the female is seen carrying a large number of eggs between its abdominal appendages.
7. It has edible value and commonly known as prawn.

Distribution: World -wide in distribution.

2. *Squilla sp.*

Habit and habitat:

1. Marine, found in shallow water, lives in burrows in the sand or mud at the bottom of sea or in existing holes and crevices in the substratum.

2. *Squilla* is active and predatory, it catches hold of the prey with the powerful maxillipedes, hence called “mantis shrimp”.
3. Raptorial carnivore, feeds on small invertebrates including crustaceans, molluscs and small fishes.

Distribution: India, Gulf of Mexico and Southern Coast of Florida, USA.

3. *Carcinoscorpius sp.*

Habit and habitat:

1. Marine and estuarine, found near the shore in sandy or muddy bottom in which remain partly buried.
2. It is commonly known as ‘King Crab’.
3. It can dig by the help of cephalothorax and may remain buried.
4. Active at night. The full grown horse-shoe crabs usually crawl by using legs, while the youngs can swim invertedly with the help of abdominal appendages.
5. They feed on polychaete worms, small bivalves and bottom algae.
6. It comes sandy beaches in the early summer to breed, eggs are laid in holes in the intertidal zone.
7. During breeding season, both male and female come on land and dig holes at the upper limit of high tides to lay eggs.

Special notes: It has been reported from paleozoic period when it was abundant and known since Triassic period, are living today, hence called a ‘living fossil’.

Distribution : It inhabits eastern coast of Asia and its Island, Eastern coast of North America from Nova Scotia to Florida. *Carcinoscorpius rotundicauda* is found in West Bengal.

4. *Penaeus sp.*

Habit and habitat:

1. Inhabits freshwater ponds, lakes, streams and also brackish water.

2. They are bottom dwellers, mostly crawling over the muddy bottom, occasionally swimming with the help of swimmerets.
3. Feeds on polychaetes, crustaceans, insects, small molluscs, fish remains, detritus etc.
4. It has edible value, commonly known as 'Tiger shrimp'.

Distribution: Commonly in India.

5. *Scolopendra sp.*

Habit and habitat:

1. Terrestrial, lives in crevices, protecting damp places such as under bark, stones, logs or thick vegetation.
2. It is commonly known as centipede.
3. Very active, fast moving.
4. Carnivorous, kill their prey with their poison claws, feeding on insects, spiders, worms etc.
5. Poison is an apalescent, acidic fluid, painful bite causing severe local pain and swelling in man, but not fatal.

Distribution: Cosmopolitan.

6. *Millipede sp.*

Habit and habitat:

1. Terrestrial, lives in dark, damp places under logs, stones, barks of dead trees, leaves etc.
2. They are commonly known as 'thousand beggers'.
3. Millipede are sluggish and timid. In spite of their numerous legs, they move very slowly, when touched or lifted they curl up in a flat spiral like a watch spring. Some may roll themselves into a ball.

4. Mostly herbivorous (vegetarian) or saprophytic (scavenger), food mainly consists of dead and decaying vegetable matters.
5. It burrows in the soil to feed on the roots of the living plants to which it causes great damage.

Distribution: Cosmopolitan but specially in tropical countries.

7. *Periplaneta sp.*

Habit and habitat:

1. Terrestrial, nocturnal, very active runner, found close to human habitation, avoiding the day light.
2. Lives in kitchen, grocery stores, bakeries, godowns, drains, latrines, sewage etc.
3. Omnivorous and scavengers, they devour any animal and vegetable substances and even paper, cloth, leather etc. causing great loss.
4. They produce a pungent secretion from the abdominal glands are regarded as the defensive mechanism of this insect.
5. Act as a transmitter of variety of pathogenic bacteria.

Distribution: Cosmopolitan.

8. *Apis sp.*

Habit and habitat:

1. Social, colonial, lives in a hive containing a queen, some drones(male) and numerous workers (sterile female) exhibiting polymorphism and division of labour.
2. Queen and drones are concerned solely with reproduction, while workers perform all other duties.
3. Mouth parts suctorial, collects nectar, pollen and fruit juice to be used as food.

4. They produce honey and wax.
5. They are active throughout the year but in winter season they do little work and do not rear the brood.
6. In spring season i.e., at the time of flowering they prepare a colony with honey rich combs.
7. The bee hives with thousands of individuals are observed hanging down from the branches of trees and ceilings of houses.
8. The workers communicate informations for the location of the food sources through the 'round dance' and 'waggle dance', a phenomenon called as "Bee language" by the eminent biologist Karl Von Frisch.
9. In India three species of *Apis* are commonly found viz. *Apis cerana indica*, *A. dorsata* and *A. florea* of which *A. cerana indica* is the domesticated species.

Distribution : Cosmopolitan.

8.8 Mollusca

1. *Chiton* sp.

Habit and habitat:

1. Marine, sluggish polyplacophoran mollusc, well adapted for life in rocky shores attached to rocks and other hard uneven surface in the intertidal littoral zone.
2. It is mostly nocturnal (i.e. active at night) and remains concealed under rocks during day-time.
3. Feeds on algae and sea weeds.
4. Development includes a trochophore larva.
5. All members of the class are commonly called chitons.

Distribution: Widely distributed in Tropical and subtropical waters.

2. *Dentalium sp.*

Habit and habitat:

1. Marine, living in clean sand in various depths from shallow water to 2600 fathoms in the sub-littoral zone.
2. The shell is a slightly curved tube, opening at both ends resembling an elephant's tusk, hence it is called as 'Elephant's tusk shell'
3. Development includes veliger larva.

Distribution: Found in all seas except the polar.

3. *Pila sp.*

Habit and habitat:

1. *Pila globosa* is one of the largest fresh water gastropod abundantly found in ponds, lakes, tanks, pools, paddy fields and in water having succulent vegetation.
2. *Pila* is a voracious eater, feeds on aquatic plants like *Pistia*, *Vallisneria*.
3. They are amphibious being adapted for life in water and on land. They respire in water by ctenidium and by pulmonary sac on land.
4. The animal creeps very slowly by its muscular foot, covering about five centimeter per minute.
5. To facilitate movement over a hard dry surface, the snail secretes slime which when dried, leaves a silvery trail behind.
6. Sensing any danger, it immediately retreats into the shell and shuts the aperture with the operculum attached to its foot.
7. During rainy season *Pila* comes out of ponds and makes long terrestrial tours. It can overcome long periods of drought in a dormant condition and buried in the mud, this period of inactivity is called 'aestivation or summer sleep'.

Distribution: Confined to Oriental and Ethiopian regions, found all over India except Punjab and Sindh.

4. *Lamellidens sp.*

Habit and habitat:

1. Freshwater mussels are found in freshwater ponds, lakes, streams and rivers, inhabiting the surface layers of the muddy beds of rivers and lakes.
2. Exhibiting sedentary life but ploughs slowly through the mud or sand by its wedge-shaped muscular foot at the bottom of the pond or river.
3. They do not go deep in the burrow, because the posterior extremities of the valves is to be kept exposed for the ingress and egress of respiratory water current.
4. They usually stay in shallow water during night, but migrate to deeper water during daytime.
5. Filter-feeder, comprises microscopic organisms both plants and animals.

Distribution : Found throughout Indian Subcontinent including Burma and Srilanka.

5. *Loligo sp.*

Habit and habitat:

1. Marine, rapid swimmers, found in shallow coastal water.
2. *Loligo* is a very common cephalopod and is commonly called 'squid'.
3. Carnivorous, feed on small shrimps, prawns, crabs and fishes.
4. Short tentacles are called arms, shell internal, hectocotylied arms act as capturing the prey.
5. Ink sac secretes the ink and serves for defence.
6. *Loligo* is used as food by Chinese and Italians and also as bait for marine fishing.

Distribution: World-wide, abundant in Tropical and Subtropical waters.

6. *Sepia sp.*

Habit and habitat:

1. *Sepia* is exclusively marine, found in shallow coastal waters.

2. They are good swimmers and can swim either forward or backward by its fins, funnel and the arms.
3. They are found in groups, either swimming freely or resting on the sea bottom.
4. Carnivorous, feeds on small crabs, shrimps, prawns, fishes and other animals.
6. Ink sac secretes ink which serves for defence.
7. Sepia is popularly known as 'cuttle fish'.

Distribution: Widely distributed specially in warmer seas like Mediterranean.

7. *Octopus sp.*

Habit and habitat :

1. Marine, found in shallow coastal water, bottom dweller, lives in crevices and under rocks.
2. Slow swimmer, most of the time crawls over the substratum.
3. Shell is absent, secretes inky fluid used for defence from the enemies.
4. Carnivorous, feeds on crabs, prawns, fishes and other molluscs.
5. Octopus is popularly known as 'devil fish'.
6. Octopus has the property of changing colour of the body when it is irritated.

Distribution: Cosmopolitan in distribution and is specially found in Atlantic and Pacific Coasts.

8.9 Echinodermata

1. *Starfish sp.*

Habit and habitat:

1. Marine, bottom dwelling or benthic animal, lives on sandy or muddy bottoms and crawls over rocks and shells.
2. They are abundant on various types of sea-bottoms, specially at places where bivalves are available as food.

3. They move slowly on hard substratum or adhere firmly to it with the help of their locomotary podia or tube feet.
4. Carnivorous, feeds on crustaceans, tubicolous polychaetes, molluscs and other echinoderms.
5. Exhibit remarkable power of autotomy and regeneration.

Distribution: World-wide in distribution.

2. *Ophiura sp.*

Habit and habitat :

1. Marine, bottom dwelling or benthonic animal, found in shallow or deep water.
2. It is commonly called 'brittle star'.
3. Nocturnal, remain quiet in daytime and become active during night.
4. Detritus feeder.
5. Possesses a great power of regenerating its lost arm.

Distribution: World-wide.

3. *Cucumaria sp.*

Habit and habitat :

1. Marine, inhabits about 200 fathoms deep wholly or partially buried in mud.
2. **Cucumaria** is commonly known as Sea Cucumber.
3. It displays a creeping movement on the bottom surface.
4. It feeds on detritus and plankton.

Distribution: Found in Tropical and Subtropical waters.

4. *Echinus sp.*

Habit and habitat:

1. Marine, benthonic animal, occurring from intertidal zone to a depth of 5000m.
2. They habitually live in hard or rocky bottoms, found in gregarious forms.

3. Omnivorous, feeds on sea weeds and small animals.
4. Echinus is commonly known as 'Sea urchin.'

Distribution: World-wide in distribution.

5. *Antedon sp.*

Habit and habitat:

1. Marine, prefers shallow water rich in nutrients
2. Found at moderate depths of water attached to hard substratum like rocks and stones by aboral cirri, but with the attainment of adulthood it breaks off from its stalk and swims about actively by the arms.
3. Microphagous, feeds on minute planktonic organisms and detritus,
4. They are gregarious forms and commonly known as 'Feather star' or 'Sea -lily.'

Distribution: Found in sea waters of the Atlantic, Western Africa, the Mediterranean and West of Tropical America.

8.10 Phylum—Hemichordata

Balanoglossus sp.

Habit and habitat :

1. *Balanoglossus* is a marine, tubicolous, living inside the U-shaped burrows excavated in the sandy bottom of shallow coastal waters of intertidal zone.
2. The walls of the tube are lined with mucous secreted by the mucous gland of the animal. The burrows are open at both ends and faecal matter is expelled to the outside in the form of castings, very similar to those of earthworms, may be seen at the posterior opening.
3. Ciliary feeder; food, comprises of microscopic organisms and minute organic particles, is taken in along with large amount of sand and mud.

4. Fragile body has considerable power of regeneration.
5. It is commonly known as Acorn worm or Tongue Worm.

Distribution: World-wide in distribution.

Note: Presence of hollow buccal diverticulum or stomochord extend into the proboscis, earlier considered as 'Notochord' for a long time by many workers. Hence, Balanoglossus included a subphylum in Hemichordata under Phylum chordata in lower Chordates or Protochordates. Because they believed that 'buccal diverticulum' is homologous with notochord. But most recent workers denied such homology and thus Hemichordata has been removed from phylum Chordata. Now it is placed as a separate Phylum of non-chordata.

8.11 Sub-Phylum-Urochordata

Herdmania sp.

Habit and habitat:

1. Exclusively marine, found in shallow waters along the sea coast.
2. It is a solitary and sedentary ascidian, found attached to a rocky sea bottom by its base or foot.
3. Sometimes living as commensal in association with the gastropod shell. *Herdmania* conceals and protects the mollusc from enemies, being unpalatable due to its spicules.
4. The tunic of *Herdmania* provides shelter for many organisms. Green algae commonly grows on the tunic which sometimes hides the whole animal.
5. Microphagous, ciliary feeder, feeding on microscopic animals and plants like algae, diatoms etc.
6. Indirect development, free-swimming tadpole larva undergoes retrogressive metamorphosis to become the degenerated sessile adult.

Distribution: Widely distributed, found in Pacific, Atlantic and Indian ocean.

8.12 Sub-Phylum-Cephalochordata

Branchiostoma sp.

Habit and habitat :

1. Marine, found in shallow waters, both in marine and estuarine habitats, commonly known as amphioxus or lancelet.
2. It leads a dual life. Mostly it is buried in sand in an upright position with only the anterior end protruding above the sand. However, at night it comes out of the sand and swim vertically in water.
3. Ciliary feeder, feeds on planktonic micro-organisms.

Distribution: Cosmopolitan but abundant in temperate and tropical sea coasts.

8.13 Class-Cyclostomata

Petromyzon sp.

Habit and habitat :

1. Marine and freshwater in habit, highly active, lives near the water surface, commonly known as 'Lamprey'
2. Semiparasitic, remain attached on the ventral surface of fishes, turtles and many other aquatic animals with the help of suctorial buccal funnel which acts as a vacuum cup.
3. They attached to the fishes, rasp the flesh by the horny teeth on the buccal funnel and suck blood of fish, hence they are sanguinivorous.
4. Lampreys usually live in the sea and migrate to the river for the purpose of spawning. After spawning they usually die.
5. The larval stage is known as Ammocoetes larva which inhabits in freshwater.

Distribution: World-wide distribution.

8.14 Class-Chondrichthyes

1. *Sphyrna sp.*

Habit and habitat :

1. Marine, lives beyond the continental shelf, strong and active swimmer.
2. They are very ferocious in nature.
3. Voracious feeder, preys on small fishes.
4. Shark oil is extracted from the liver of this shark.
5. It is commonly known as 'Hammer-headed shark.'

Distribution: Tropical and subtropical seas and the Pacific ocean.

2. *Pristis sp.*

Habit and habitat :

1. Marine, few species inhabit in fresh water.
2. Carnivorous, feeds on small fishes, crustaceans and other benthic invertebrates by slashing them with its saw.
3. It is commonly known as 'saw fish' because the rostrum is in the form of elongated saw-like toothed structure.
4. The cartilaginous fish is economically beneficial as its liver oil is rich in vitamin value and its skin is used for scale boards.

Distribution: Found in coastal areas of Tropical and subtropical seas. Common species of Indian Coasts are *Pristis cuspidatus* and *P. microdon*.

3. *Torpedo sp.* [Electric ray]

Habit and habitat :

1. Torpedo is a marine fish, found on flat sandy or muddy bottom at a depth of 40-50 fathoms.

2. Carnivorous, food consists of small fishes and benthic invertebrates which are stunned by electric discharge.
3. Torpedo contains a pair a large kidney-shaped electric organs, one on either side of the body between head and the pectoral fins. Each is composed of several rows of hexagonal cells called 'electroplaxes'. The dorsal surface of electric plate is positive and ventral negetive. The electric current of 50-60 volts passes from dorsal to ventral surface. By discharging electricity from the electric organs they paralyse the preys, enemies and which may be fatal to man even.

Distribution: Found in Tropical and subtropical seas.

4. *Scoliodon sp.*

Habit and habitat:

1. They are predaceous and voracious feeder, attacking their prey with powerful jaws and sharp teeth.
2. Food comprises of fishes, lobsters, crabes and other marine animals.
3. Sharks are used as human food in many countires. Shark's fins are dried and then boiled yield a gelatinous, substance favoured for soups.
4. The tanned skin shagreen is used for cleaning furniture during polishing.
5. Liver oil is extracted from the liver of sharks.
6. It is popularly known as 'dogfish'.

Distribution: Widley distributed in the Indian, Pacific, West Indies and eastern coasts of South America and Atlantic oceans.

8.15 Class-Osteichthyes

1. *Labeo sp.*

Habit and habitat:

1. *Labeo rohita* is commonly known as 'Rohu fish.'
2. Exclusively freshwater, lives in ponds, rivers and lakes, very active and strong swimmer.

3. They are column feeders and feed only algae, vegetable debris, microscopic aquatic plants, decaying higher plants etc.
4. They have great food value as they are consumed as food fish all over India.
5. They are very responsive to induced breeding.

Distribution: Widely distributed in Tropical and temperate regions specially found in India and Burma.

2. *Exocoetus sp.*

Habit and habitat:

1. Exocoetus is commonly known as 'flying fish'.
2. Exclusively marine, active swimmer, lives in large group near water surface.
3. They are famous for the ability to glide above the water surface for about 400 meters by the help of expanded pectoral fins.
4. Carnivorous, feeds on prawns, small fishes and their eggs.

Distribution: Distributed in Tropical and warmer Atlantic, Pacific and Indian oceans. Only one species *Exocoetus volitans* occurs in India.

3. *Anguilla sp.*

Habit and habitat:

1. Anguilla is a freshwater fish, commonly known as 'eel'.
2. The adult-eels live in ponds, rivers, estuaries and coastal areas, also live in damp grass or moss outside water.
3. They can live and are often found buried in mud.
4. They migrate from river to sea for laying eggs in the sea exhibiting catadromous migration.
5. They are voracious feeder, feed on shrimps, fishes, insect larvae etc.

Distribution: Common in Tropical and temperate regions of the world; found in Europe, Africa, Australia, West Indies, Mexico and Temperate Asia. *Anguilla bengalensis* is common throughout India.

4. *Tenualosa sp.*

Habit and habitat :

1. Marine and brackish water, lives in large group near coastal areas of the sea.
2. *Tenualosa ilisha* is popularly known as 'hilsa fish.'
3. Feeds on phytoplankton, algae and small aquatic plants.
4. They are well known as migratory fish and exhibits anadromous migration to lay eggs in the river.
5. Used as high quality of food fish.

Distribution: Found all over India including Bay of Bengal.

8.16 Class-Amphibia

1. *Uraeotyphlus sp.*

Habit and habitat :

1. Limbless amphibians or caecilians, sometimes called blindworms as the eyes are rudimentary, concealed and functionless.
2. They burrow in moist ground at depths of 20-30 cm beneath the top soil with their strong head.
3. They can feel their way about by means of protrusible sensory tentacles.
4. Feeds mostly on earthworms, small arthropods and other small invertebrates.

Distribution: Found in Tropical and subtropical regions of America, Africa and Asia; in India-in Malabar and Cochin.

2. *Salamander sp.*

Habit and habitat :

1. The Indian Salamander **Tylototriton** found in Eastern Himalayas.
2. They are aquatic and live in freshwater small ponds of Darjeeling, Sikkim and Manipur.

3. They are carnivorous and feed on worms, insect larvae, tadpoles and small fishes.
4. During winter season they hide in the hole and hibernate. From April to August, Salamander wanders on swampy areas and are found in pools.

Distribution: There are 6 species of *Tylotriton* of which only *T. verrucosus* is found in India (Darjeeling, Sikkim and Manipur) and declared as endangered species.

3. *Bufo* sp.

Habit and habitat :

1. *Bufo* is terrestrial, nocturnal, hiding under logs and stones or in burrows in broad daylight.
2. Lives in moist and shady areas.
3. They become active at night when they feed on worms, earthworms and insects trapping them with their sticky tongue.
4. During winter they undergo through a phase of winter sleep or hibernation.
5. The parotid glands of the toad secrete two toxic substances bufotalus and bufogus. These toxins if swallowed cause nausea, respiratory and muscular disturbances.

Distribution: Found all over the world.

4. *Hyla* sp.

Habit and habitat:

1. *Hyla* is arboreal in habit and adapted for life in trees, hence the animal is commonly known as 'Tree frog'.
2. The terminal phalanges are claw-like and swollen at the base to form adhesive pads by which it can climb the trees and rocks.
3. Nocturnal and feeds on insect
4. They exhibit parental care, lay their eggs in a foam nest on vegetation above water.
5. They change their colour according to their environment and show camouflage or mimicry.

Distribution: Cosmopolitan in distribution, found in damp forests in India, China, America, Africa and Canada.

8.17 Class–Reptilia

1. *Turtle (Trionyx gangeticus)*

Habit and habitat:

1. It is most wide spread turtle, popularly known as soft-shelled freshwater turtle.
2. They are aquatic, living in freshwater rivers of India.
3. Carnivorous, feed on fishes, frogs and molluscs.
4. The female lays twenty spherical eggs at a time and bury the eggs in same distance from water.

Distribution: Found in River Ganges and its tributaries of India.

2. *Chamaeleon sp.*

Habit and habitat:

1. Arboreal in habit, limbs are modified for grasping, additional security is provided by a prehensile tail.
2. The eyes are elevated in small cones and move independently.
3. They are insectivorous and capture grasshoppers, flies, locusts and other insects.
4. It preys upon the insect by throwing its sticky club-shaped tongue far away from mouth.
5. Possesses a great power of colour change rapidly to blend with their surroundings. This is controlled by an autonomic nervous system and thus it is commonly known as 'Bohurupee'.
6. Female lays about thirty eggs in holes.

Distribution: Distributed in Africa, Madagascar, Europe and India. Only single Indian species *chamaeleon(= chamaeleo) zeylanicus* occurs in the plains of South India.

3. *Calotes sp.*

Habit and habitat:

1. Calotes is adapted for arboreal life, very common in garden, open jungles, bushes and hedges.
2. It is often seen running swiftly on the ground. It can swim, if necessary.
3. It feeds on insects, insect larvae and spiders.
4. Calotes is famous for colour changes. The original colour is olive green but on excitement colour changes to yellow and head becomes red. The colour changes largely governed by temperature, environment and also by hormones of pituitary.
5. The colour pigments are present in the skin.
6. Female lays eggs in holes in the ground.

Distribution: It is widely distributed in India, Malayasia and Southern China. *Calotes versicolor* is the only Indian specis.

4. *Draco sp.*

Habit and habitat:

1. Draco shows extreme adaptation for flying life with the help of their expanded patagium.
2. They can glide from one tree to nearby tree but at rest patagium remains folded.
3. During gliding patagia are used parachutes adapted for passive flight.
4. It is commonly known as 'flying lizard' or 'flying dragon.'
5. Draco is indentified by yellow to orange, red patagia and bluish underside with black spots.
6. They are insectivorous, feeds on tree ants, insects and insect larvae.
7. It is brilliantly coloured and shows camouflage (mimicry).
8. Female lays 2-5 -eggs at a time.

Distribution: Distributed in Philippines, Malayasia to Indonesia, Java, Borneo of South East Asia; India.

Draco dussumieri occurs in South India while *D. maculatus* occurs in Assam and Nagaland.

5. *Vipera sp.*

Habit and habitat:

1. Russell's viper (*Vipera russelli*) is found in rocky and bushy areas, usually remains coiled with the head in the centre of coil. It is commonly known as 'Chandrabora'.
2. Carnivorous, feeds on rats, mice, birds and lizards.
3. With least provocation or disturbance bifid tongue is protruded, body rhythmically swell and hissing sound is produced, most active during night.
4. It is deadly poisonous, maxilla bears only one pair of tooth modified into large hollow poison fang. The fangs are largest in length among Indian poisonous snakes and are about 16 mm.
5. Poison fangs remain folded back within the mouth cavity but become erect during strike.
6. The poison glands contain about 108 mg venom. 72 mg venom may be injected at per strike. 15mg dose of venom thought to be the fatal dose for man.
7. The venom is haemotoxic and acts on the blood vascular system causing circulatory failure, internal bleeding and tissue destruction (gangrene).
8. Viviparous, giving birth to about fifty youngs at one time.

Distribution: It is common throughout the Indian subcontinent, Thailand, Burma, Srilanka in the plains and in the hills.

6. *Naja sp.* [Cobra]

Habit and habitat:

1. Cobra is terrestrial and nocturnal, living in holes, understones, mud walls, open fields, thick vegetation and even near human inhabitation where their foods are available.
2. They are carnivorous and feed on rats, mice, frogs, toads and even other small snakes.

3. Deadly poisonous, anteriormost maxillary tooth modified into a large, grooved poison fang which remains erect and cannot be folded back into the mouth cavity.
4. Venom is neurotoxic, acts on nervous system causing paralysis and respiratory failure.
5. The amount of venom injected per strike is about 211mg. 12mg dose of venom becomes lethal for a man. The poison glands contain about 317 mg venom.
6. Three varieties of Cobra are found in India having three types of marking pattern are seen on its hood:
 - (a) Binocellate form having spectacle-like mark connected by 'U'
 - (b) Monocellate form with single oval mark surrounded by ellipses.
 - (c) Acellate form without mark.

Distribution: It is found throughout India including parts of U.P. Bihar, Assam, Odisha, West Bengal etc.

7. *Crocodylus sp.*

Habit and habitat:

1. Crocodiles are amphibious reptile, spending mainly in water and part on dry land.
2. They live in rivers, lakes, marshlands, swamps, brackish waters and estuaries. On land they inhabit forests, grasslands and savannas.
3. Crocodiles are efficient predators, mostly nocturnal hunters, diet of young crocodilians include small fishes, snails, crabs, shrimps, tadpoles and frogs. Food of subadult and adult crocodilians consists of a bulk of fishes, crabs, turtles, small and large mammals.
4. Crocodiles dig deep tunnels in the sand to deposit their eggs.

Distribution: Found in Africa, Asia, Australia, South and Central America. In India two species occur: *Crocodylus porosus* and *C. palustris*.

8. *Gavialis sp.*

Habit and habitat:

1. Amphibious reptiles, lives in the banks of rivers in which it swims and searches for food.
2. Food consists of fishes.
3. In spite of its large size it is completely harmless.
4. It is commonly known as 'Gharial'

Distribution: Found in India, Burma, Malaysia.

In India their presence are recorded in the river Ganges, Mahanadi, Indus and its tributaries. Indian species is *Gavialis gangeticus*.

8.18 Class-Aves

1. *Columba sp.*

Habit and habitat :

1. *Columba livia* is the most common and familiar bird nesting in forts, old unused buildings, grain warehouses, temples, railway stations but never nests on trees.
2. They fly in flocks during day and rest together at night.
3. Pigeons are grain and seed eater, feeding on grains, pulses, seeds of fruits, ground nuts etc.
4. Pigeons lead a monogamous and partnership last for entire life.
5. Breeding continues throughout the year. The youngs are fed on 'pigeon's milk' formed in the crop of adult.
6. Pigeons are considered living symbol of peace, harmony and happiness all over the world.

7. Pigeon has homing instinct. If pigeons are sent in a closed basket, they will return to their loft which they can recognise without any mistake.
8. Pigeons can sometimes become pests in the houses and in the fields by consuming large quantities of grains.

Distribution: Found throughout the world specially in Tropical and Temperate regions.

2. Parrot (*Psittacula krameri*)

Habit and habitat:

1. One of the common bird is known as Indian parakeet or 'Tia' in Bengal.
2. The bird is identified by grass green colour of the body with distinct rose-pink collar and black band in front of the neck.
3. Feet are adapted for grasping, holding and climbing.
4. Parrot lives in holes of the tree trunk or in those excavated by the bird itself. Nesting season varies from February to April.
5. Flocks of parrot are seen in the crop fields and orchard fruit, feeds on fruits grains and berries.
6. They destroy more crops or ripening fruits by gnawing rather than eating.
7. Intelligent bird famous for mimicking or copying and can learn to speak like man.

Distribution: Distributed in Indian subcontinent (Pakistan, Srilanka, Bangladesh and Myanmar).

3. Kingfisher (*Alcedo atthis*)

Habit and habitat:

1. Kingfisher is a common little bird found near the lakes, streams, tanks and the sea shore.
2. On searching of fish they suddenly jump into the water and dive to catch the fish by their long bill. Hence, this bird is commonly known as 'machhranga'.
3. They prey upon small fish, tadpoles and aquatic insects.
4. They produce characteristic sound during flight.

Distribution: They are distributed throughout India.

4. Koel (*Eudynamys scolopaceous*)

Habit and habitat is associated with romantic Bengali poetry.

Distribution: Found throughout India, Bangladesh, Burma, Srilanka, Pakistan.

5. House Sparrow (*Passer domesticus*)

Habit and habitat:

1. House sparrow is the most familiar companion bird in the house. They are found to nest in the houses.
2. Nest is made by the collection of straw, rubbish and feathers in the hole of ventilator, inverted lamp shade or any suitable place of the building. They nest throughout the year.
3. They are recognised as 'Charui' in Bengal. A chirping call like 'Cheer-Cheer' utter during flight.
4. Feet are adapted for perching with three toes anterior and the first toe or halux posterior.

5. Omnivorous; eats grains, insects, flower nectar and kitchen scraps.

Distribution: Cosmopolitan.

6. Indian Woodpecker (*Dinopium benghalense*)

Habit and habitat:

1. This bird is commonly called 'kath-thokra' in Bengal, found in single or in pairs on trunk of coconut plantations, orchards, mango trees and also in scrub jungle.
2. A nest is a unlined hole on the tree stem, chiselled out by the bird in rotten wood. The nesting season ranges from March to August.
3. Woodpecker digs into rotten wood by the help of long and strong beak.
4. Mainly insectivorous, feeds on insects, beetles, grubs, ants, insect larvae hiding under the bark within rotten tree trunks. They also eat pulp of ripe fruits.

Distribution: India, Bangladesh, Burma, Srilanka, Pakistan.

8.19 Class-Mammalia

1. *Sorex* (*Sorex minutes*)

Habit and habitat:

1. **Sorex** is the smallest mammal commonly known as 'Shrew' which is superficially resemble of mice.
2. They are terrestrial and burrower.
3. Voracious eaters, feeds mainly on insects, spiders and other invertebrates.
4. Cats avoid eating them because of their bad odour secreted from scent glands.

Distribution: All over the Oriental region.

2. Megachiroptera (*Pteropus Sp.*)

Habit and habitat:

1. Large in size among the Chiropterans and nocturnal in habit.
2. They are adapted for arboreal and aerial mode of life.
3. In the daytime they live in caves, crevices, old abandoned building, thick bamboo forest, large trees etc. hanging upside down by the help of hind limb claws with wings folded.
4. They are called the 'flying fox' because of fox like head, long snout and large eyes.
5. They are capable of active and sustained flight, skeletal system light in weight, Sternum has a carina.
6. Frugivorous, feeds mainly on juicy and sweet fruits like guavas, figs, bananas and mangoes etc.

Distribution: Found only in Ethiopian, Oriental and Australian regions. The Indian species is *Pteropus giganteus*.

3. Microchiroptera (*Synotus/Scotophilus sp.*)

Habit and habitat:

1. Microchiropterans are also arboreals and nocturnal in habit, active at dark and night.
2. During daytime they live in caves, crevices, old abandoned buildings, large trees etc., hang head downwards.
3. They are capable of active and sustained flight, skeletal system light in weight, sternum has a carina.
4. Most are insectivorous but may be frugivorous, nectarivorous (feeds on honey), carnivorous or sanguinivorous.

5. They are capable of echolocation.

Distribution: Found all over the world except cold arctic, antarctic and alpine climates.

4. Squirrel

Habit and habitat :

1. Squirrels are diurnal and arboreal, climb the trees very fast.
2. They can jump by pushing off the body with powerful hind limbs and steering with the bushy tail.
3. Herbivorous, feeding on nuts, fruits, grains, seeds, pine cones etc., while feeding they hold the nut in the fore limbs and gnaw it.

Distribution: World-wide distribution, common throughout the plains of India, particularly near human habitation. *Funambulus pennanti* is commonly found in Bengal.

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Notes

Notes

মানুষের জ্ঞান ও ভাবকে বইয়ের মধ্যে সঞ্চিত করিবার যে একটা প্রচুর সুবিধা আছে, সে কথা কেহই অস্বীকার করিতে পারে না। কিন্তু সেই সুবিধার দ্বারা মনের স্বাভাবিক শক্তিকে একেবারে আচ্ছন্ন করিয়া ফেলিলে বুদ্ধিকে বাবু করিয়া তোলা হয়।

— রবীন্দ্রনাথ ঠাকুর

ভারতের একটা mission আছে, একটা গৌরবময় ভবিষ্যৎ আছে, সেই ভবিষ্যৎ ভারতের উত্তরাধিকারী আমরাই। নূতন ভারতের মুক্তির ইতিহাস আমরাই রচনা করছি এবং করব। এই বিশ্বাস আছে বলেই আমরা সব দুঃখ কষ্ট সহ্য করতে পারি, অস্বকারময় বর্তমানকে অগ্রাহ্য করতে পারি, বাস্তবের নিষ্ঠুর সত্যগুলি আদর্শের কঠিন আঘাতে ধূলিসাৎ করতে পারি।

— সুভাষচন্দ্র বসু

Any system of education which ignores Indian conditions, requirements, history and sociology is too unscientific to commend itself to any rational support.

— **Subhas Chandra Bose**

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