PREFACE

With its grounding in the "guiding pillars of Access, Equity, Equality, Affordability and Accountability," the New Education Policy (NEP 2020) envisions flexible curricular structures and creative combinations for studies across disciplines. Accordingly, the UGC has revised the CBCS with a new Curriculum and Credit Framework for Undergraduate Programmes (CCFUP) to further empower the flexible choice based credit system with a multidisciplinary approach and multiple/ lateral entry-exit options. It is held that this entire exercise shall leverage the potential of higher education in three-fold ways – learner's personal enlightenment; her/his constructive public engagement; productive social contribution. Cumulatively therefore, all academic endeavours taken up under the NEP 2020 framework are aimed at synergising individual attainments towards the enhancement of our national goals.

In this epochal moment of a paradigmatic transformation in the higher education scenario, the role of an Open University is crucial, not just in terms of improving the Gross Enrolment Ratio (GER) but also in upholding the qualitative parameters. It is time to acknowledge that the implementation of the National Higher Education Qualifications Framework (NHEQF), National Credit Framework (NCrF) and its syncing with the National Skills Qualification Framework (NSQF) are best optimised in the arena of Open and Distance Learning that is truly seamless in its horizons. As one of the largest Open Universities in Eastern India that has been accredited with 'A' grade by NAAC in 2021, has ranked second among Open Universities in the NIRF in 2024, and attained the much required UGC 12B status, Netaji Subhas Open University is committed to both quantity and quality in its mission to spread higher education. It was therefore imperative upon us to embrace NEP 2020, bring in dynamic revisions to our Undergraduate syllabi, and formulate these Self Learning Materials anew. Our new offering is synchronised with the CCFUP in integrating domain specific knowledge with multidisciplinary fields, honing of skills that are relevant to each domain, enhancement of abilities, and of course deep-diving into Indian Knowledge Systems.

Self Learning Materials (SLM's) are the mainstay of Student Support Services (SSS) of an Open University. It is with a futuristic thought that we now offer our learners the choice of print or e-slm's. From our mandate of offering quality higher education in the mother tongue, and from the logistic viewpoint of balancing scholastic needs, we strive to bring out learning materials in Bengali and English. All our faculty members are constantly engaged in this academic exercise that combines subject specific academic research with educational pedagogy. We are privileged in that the expertise of academics across institutions on a national level also comes together to augment our own faculty strength in developing these learning materials. We look forward to proactive feedback from all stakeholders whose participatory zeal in the teaching-learning process based on these study materials will enable us to only get better. On the whole it has been a very challenging task, and I congratulate everyone in the preparation of these SLM's.

I wish the venture all success.

Professor (Dr.) Indrajit Lahiri
Vice-Chancellor

Netaji Subhas Open University

Four Year Undergraduate Degree Programme

Under National Higher Education Qualifications Framework (NHEQF)

& Curriculum and Credit Framework for Undergraduate Programmes

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Programme Code : NZO

Course Type : Discipline Specific Core (DSC)

Course Title : Animal Diversity–Non-chordates and Chordates (Practical)

Course Code: 5CC-ZO-01

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Open University

UG : Zoology (NZO)

Course Title :
Animal Diversity–Non-chordates and Chordates (Practical)
Course Code: 5CC-ZO-01

Unit–1 ❑ Protista – Amoeba, Euglena, Plasmodium, Paramecium

Unit–2 ❑ Metazoa without coelom – Sycon, Hyalonema or Euplectella, Obelia, Physalia, Jellyfish, Sea Anemone, Taenia, Male and Female Ascaris

Unit–3 ❑ Annelida – Aphrodite, Nereis, Earthworm, Hirudinaria

Unit–4 ❑ Arthropoda – Palaemon, Scylla, Carcinoscorpius, Penaeus, Scolopendra, Millipede, Periplaneta, Apis (any four)

Unit–5 ❑ Mollusca – Chiton, Dentalium, Pila, Lamellidens, Loligo, Sepia, Octopus (any four)

Unit–6 ❑ Echinodermata – Starfish, Ophiura, Echinus, Cucumaria and Antedon (any three)

Unit–7 ❑ Protochordata – Balanoglossus, Branchiostoma, Herdmania, Petromyzon, Ammocoetes Larva (any three)

Unit–8 ❑ Fish – Sphyrna, Pristis, Torpedo, Scoliodon, Labeo, Exocoetus, Anguilla, Echenis (any four)

Unit–9 ❑ Amphibia – Teniolosa, Ureotyphlus, Salamander, Bufo, Hyla, Rhacophorus (any four)

Unit–10 ❑ Reptilia – Turtle, Calotes, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis (any four)

Unit–11 ❑ Birds – Any three common birds from different orders available in concerned college laboratory or surroundings

Unit–12 ❑ Mammals – Sorex, Mega or Microchiroptera, Squirrel and any two common mammals of different orders around you. Supportive Techniques to Study Animal Diversity

Unit–13 ❑ Study of different techniques for Animal Preservation

Unit–14 ❑ Key for Identification of Poisonousand non-poisonous Snakes

Unit–15 ❑ Study of different scales present in Animal Body

Unit–16 ❑ Study of Molluscan Shell (Conchology)

Unit-1 Protista – Amoeba, Euglena, Plasmodium, Paramecium

Structure

1.0 Objectives

By studying this unit learners would be able to understand about the systematic position and indentifying characteristics of a few protista. This in other way would help the learners to gather knowledge of entire protistan.

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 a few protista, viz., amoeba, Englena, plasmedium, Paramoecium

1.2 Study of the different invertebrate specimen with proper reasons

I. *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 locmotory organelles.

(iv) Chloroplast may or may not be present.

(v) Flagella or pseudopodia, or both are present.

(vi) The nucleus is monomorphic.

Phylum : Sarcomastigophora

(i) Nucleus is of one type except in the stages of certain foraminifera

(ii) Locomotory organ either pseudopodia or flagella or both

(iii) Peproduction asexnal but when sexual, it is essentially by syngamy

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 consicuous nucleus is present.

(vi) Body naked.

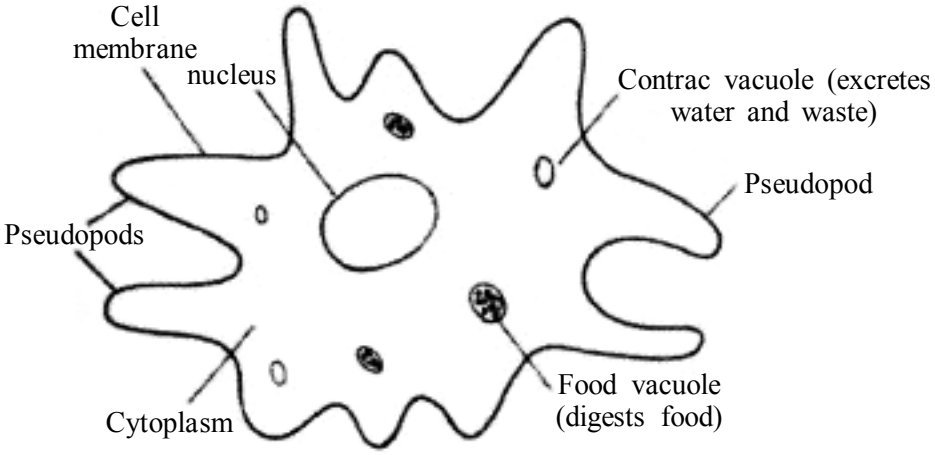

Figure 1 : *Amoeba sp.*

II. *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) The body is spindle shaped.

(ii) A long fagellum is present.

(iii) Photoreceptive eye spot called stigma present.

(iv) Chloroplast present.

(v) The nucleus is posterior.

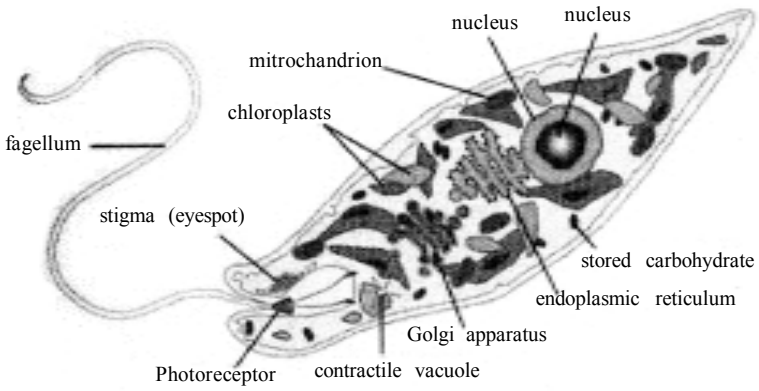

Figure 2: *Euglena sp.*

III. *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.

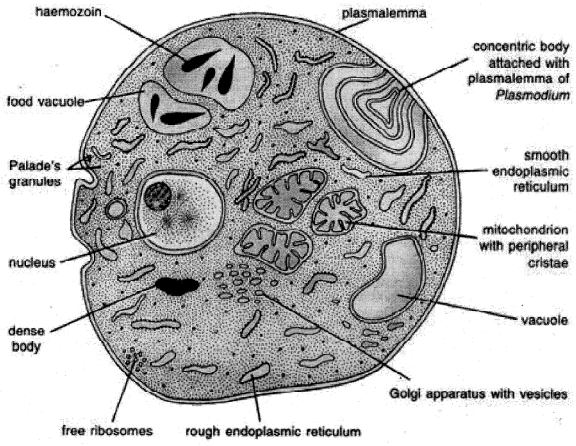

Fig 3 (I) : Plosniduyn Vivox (Cell Structure)

Plasmodium

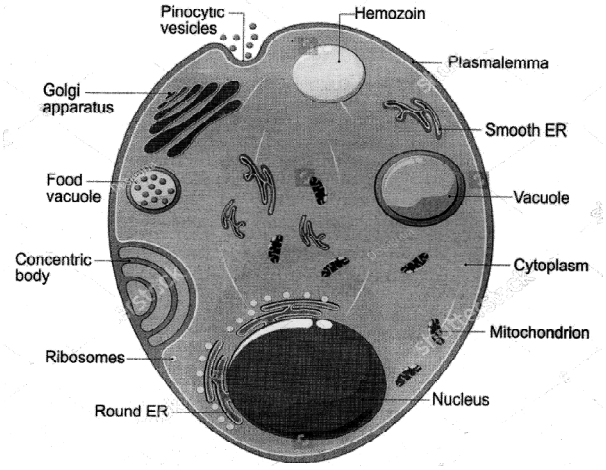

Fig 3 (II) : Plasmodium Falciperum

Plasmodium

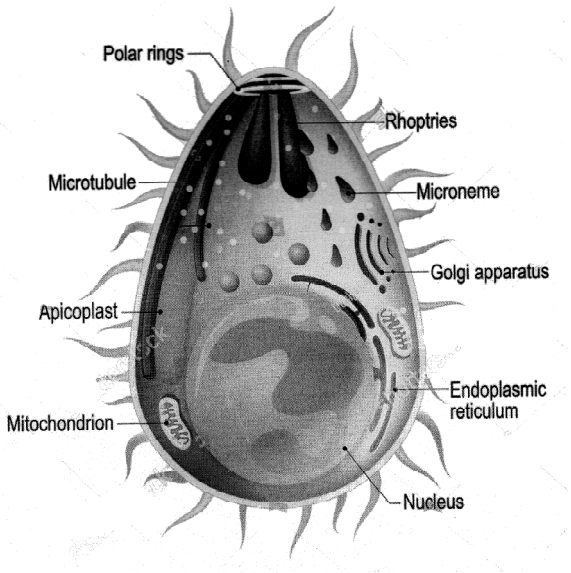

Fig 3 (III) : Plasmodium

IV. *Paramoecium* sp.

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

Sub-kingdom : Protozoa

Phylum : Ciliophora

Genus : Paramoecium

Specimen : *Paramoecium 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, i.e., macronuclei and micronuclei

Specimen : *Paramoecium* 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.

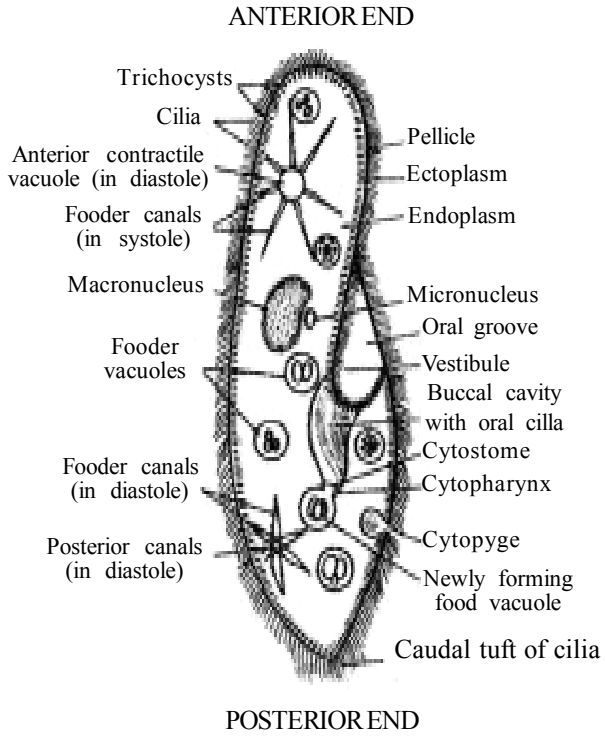

Fig 4 : *Paramecium sp.*

Unit-2 Metazoa without coelom – Sycon, Hyalonema or Euplectella,Obelia, Physalia, Jellyfish, Sea Anemone, Taenia, Male and Female Ascaris

1. *Sycon* sp.

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

Phylum : Porifera

Class : Calcarea

Sub-class : Cacaronea

Genus : Sycon

Specimen : *Sycon 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, i.e., 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 megaseleres and microselers.

Sub-class : Calcaronea

(i) Flagella form 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 and 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 firnge.

(iv) The base is attached to the substratum.

(v) Body surface is finely rough with projecting spicules.

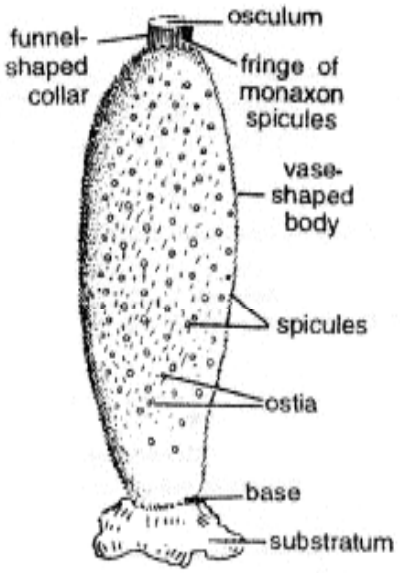

Figure 5: Sycon sp.

II. *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 sillicious spicules.

Sub-class : Amphidiscomorpha

Presence of amphidis spicules.

Specimen : *Hyalonema* 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.

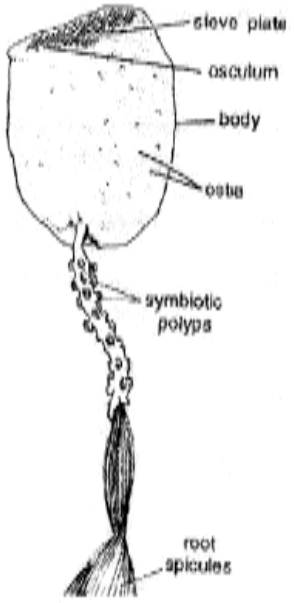

Figure 6: *Hyalonema* sp.

III. *Eupelectella* sp.

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

Phylum : Porifera

Class : Hexactinellida

Subclass : Hexasterophora

Genus : Euplectella

Specimen : *Euplectella 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 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.

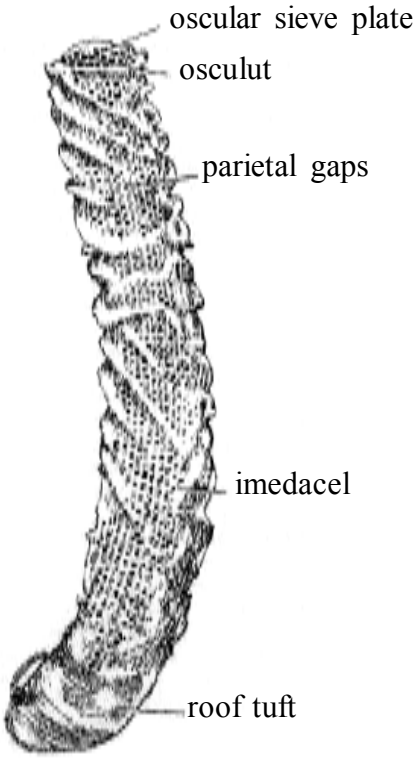

Figure 7: *Euplectella sp.*

IV. *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.

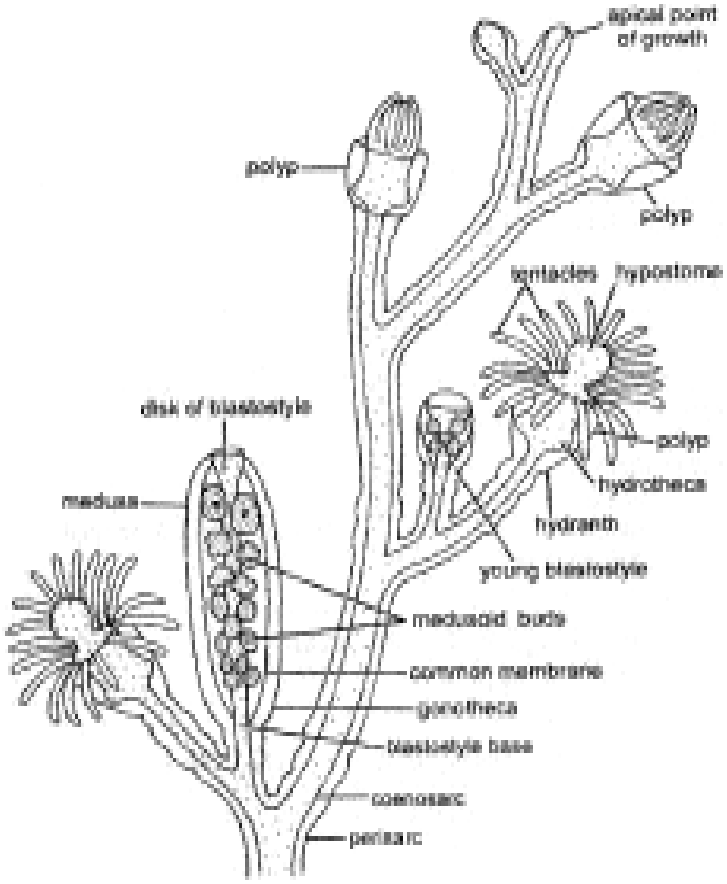

Figure 8: *Obelia sp.* colony

V. *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) Tentacles bearing pneumatocys are present.

(iv) The gastrozooids are without tentacles.

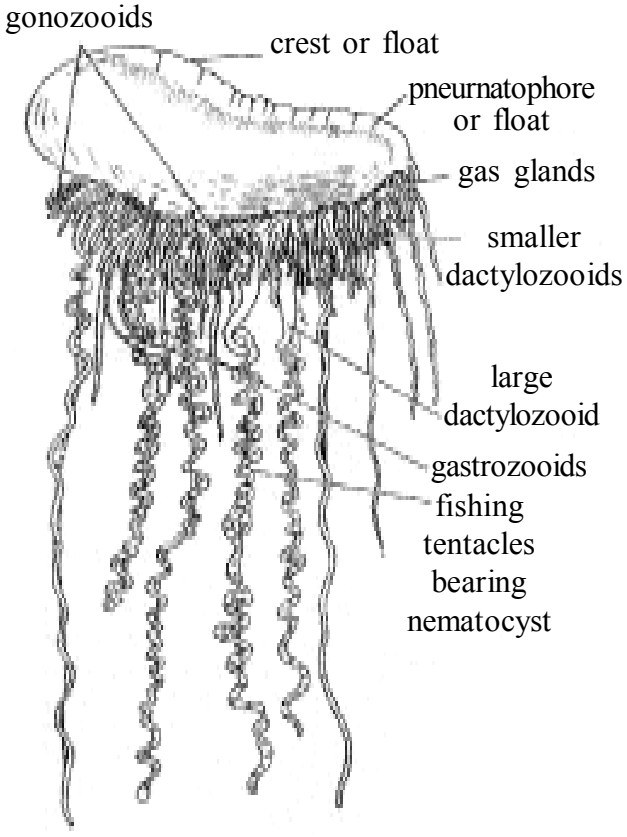

Figure 9: *Physalia sp.*

VI. 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.

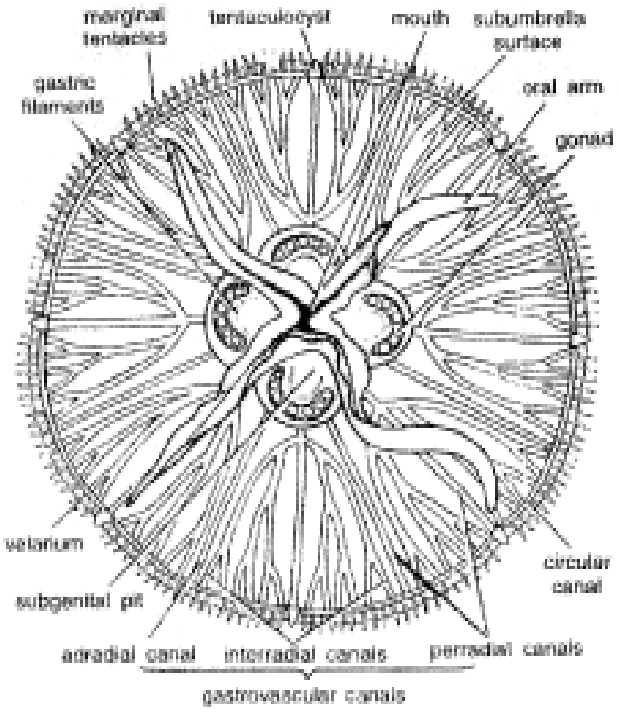

Figure 10: Jellyfish

VII. Sea Anemone

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

Phylum : Cinidaria

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 coloumn 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) Cinclides 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.

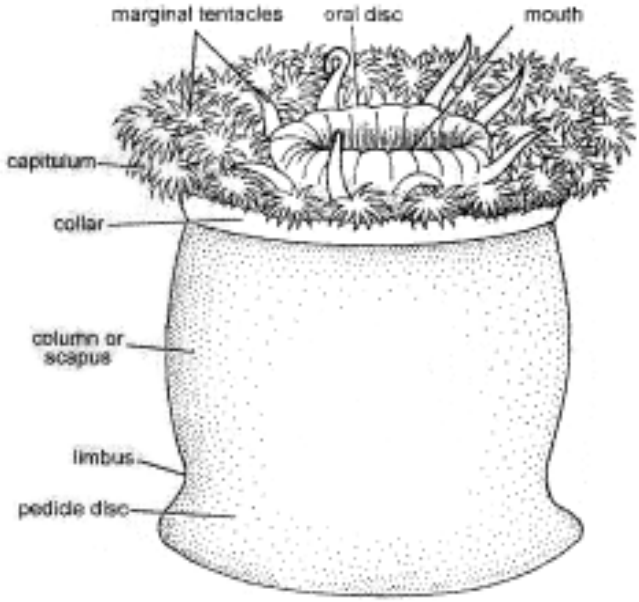

Figure : 11: Sea anemone

VIII. *Taenia* sp.

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

Phylum : Platyhelminthes

Class : Cestoda

Genus : Taenia

Specimen : *Taenia* 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 progtottids 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.

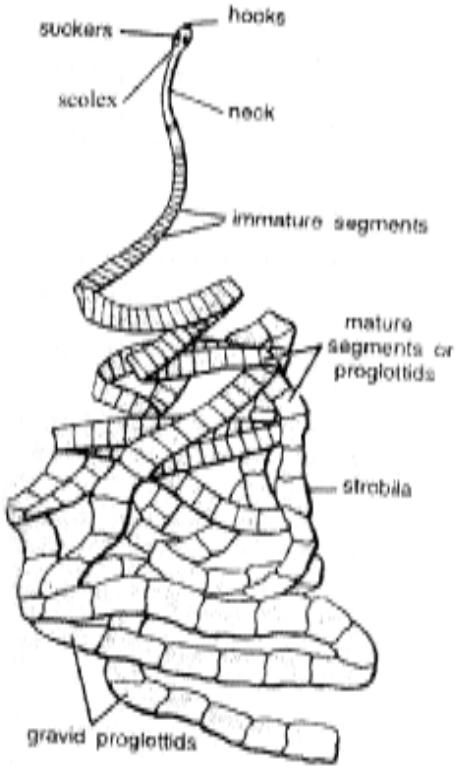

Figure : 12 : *Taenia sp*

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 *Ascaris*	Female *Ascaris*
(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.

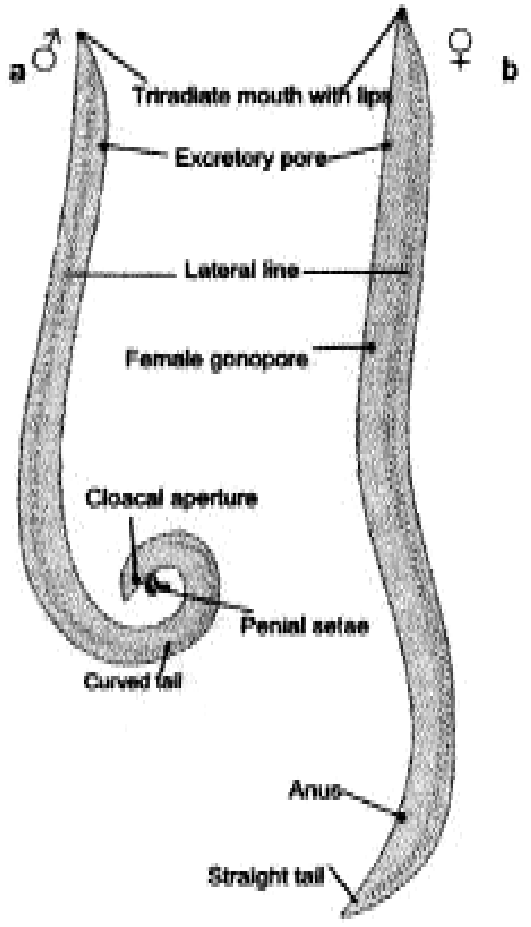

Figure : 13: Male (a) and Female (b) *Ascaris sp.*

Unit-3 Annelida – Aphrodite, Nereis, Earthworm, Hirudinaria

I. *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 sengmented body.

(ii) Mouth and anus are at opposite ends.

(iii) Setaet 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 irridescent setae.

(vi) Neuropodial setae are brown and stiff.

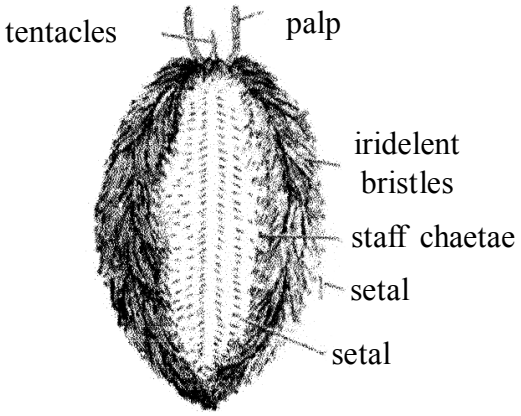

Fig. 1 : *Aphrodite sp.*

II. *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 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 cotains a pair of anal cirri.

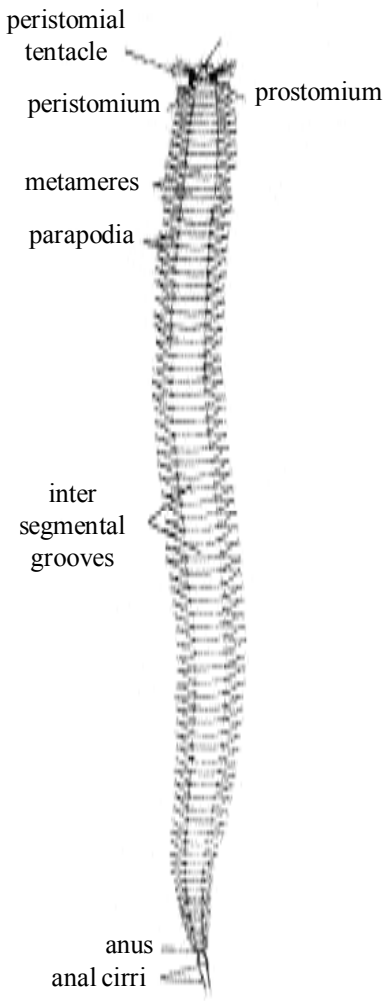

Fig. 2 : *Nereis sp.*

III. 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 cliteuum 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) 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 $^{5}/_{6}$th, $^{6}/_{7}$th, $^{7}/_{8}$th and $^{8}/_{9}$th 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.

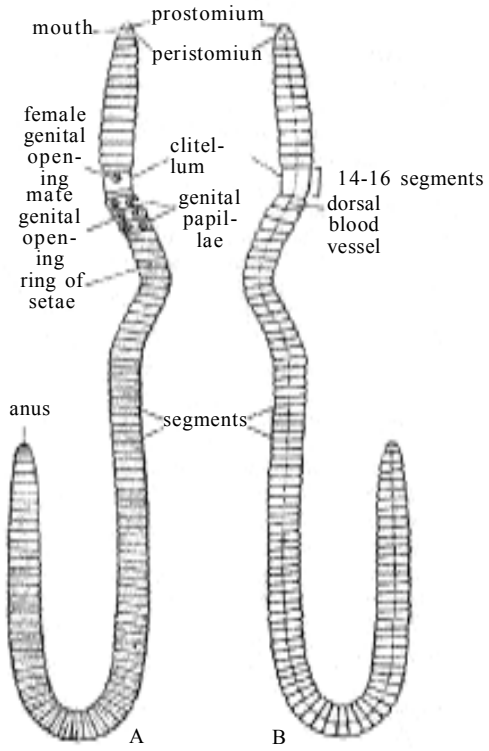

Fig. 3 : Earthworm (A) ventral view and (B) dorsal view

IV. *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 suctorial 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) Three toothed and well developed jaw is present.

Specimen : *Hirudinaria* sp.

(i) The body is soft, vermiform, elongated and 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.

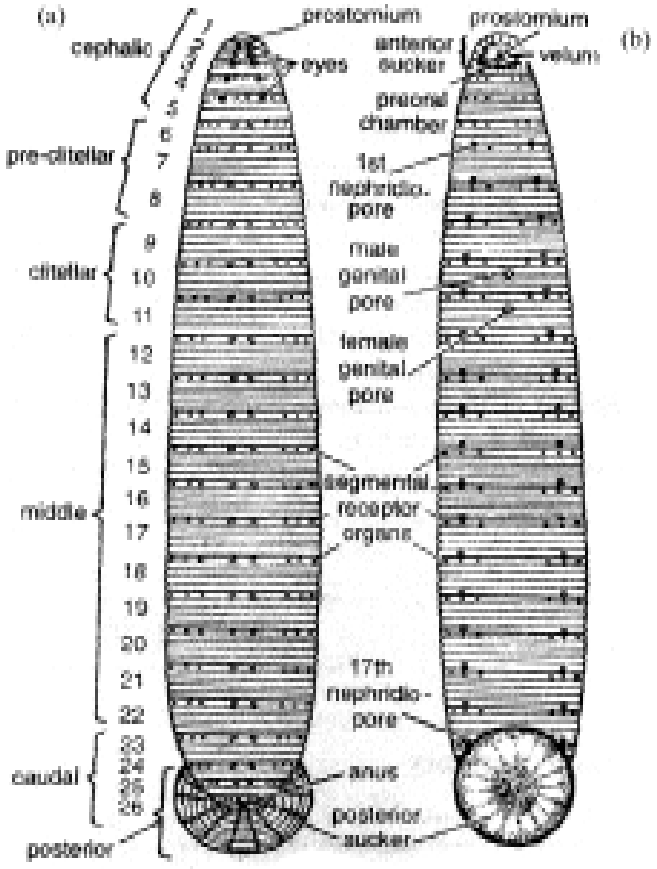

Fig. 4 : *Hirudinaria sp.* (a) dorsal view and (b) ventral view

Unit-4 Arthropoda–Palaemon, Scylla, Carcinoscorpius, Penaeus, Scolopendra, Millipede, Periplaneta, Apis

I. *Palaemon* sp.

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

Phylum	:	Arthropoda
Sub-phylum	:	Crustacea
Class	:	Malacostraca
Sub-class	:	Eumalacostraca
Genus	:	Palaemon
Specimen	:	*Palaemon 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 mandible 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 bent 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) Anennae without three flagella.

(ii) No seventh abdominal segment.

Specimen : *Palaemon* sp.

(i) Young stages are transluscent and white but the adults are usually dull pale-blue or greenish with orangered 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 cephlalothorax 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 cooma (‘) shaped.

(vii) Each abdominal segment bears a pair of jointed appendages called pleopods or swimmers.

(viii) Carapace anteriorly produced into rostrum.

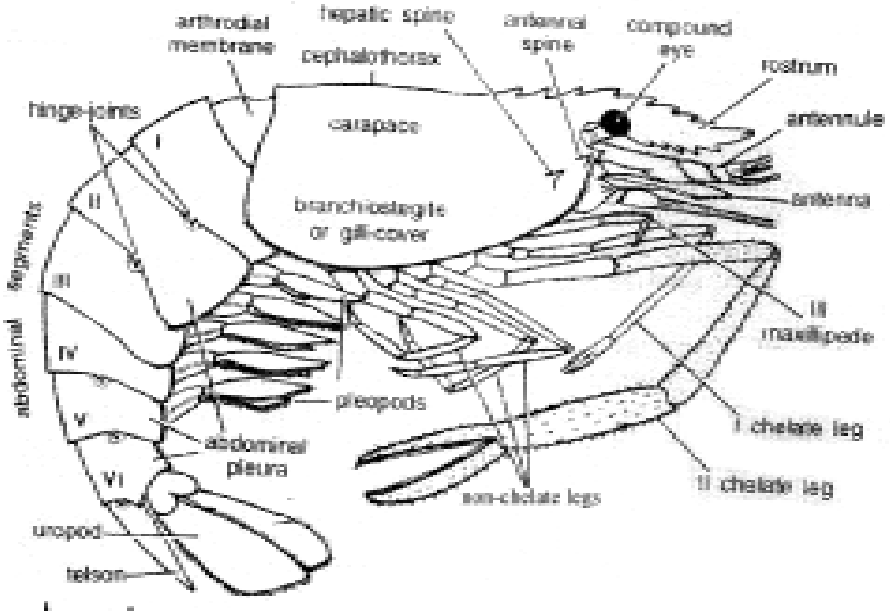

Figure : 1 : *Palaemon sp.*

II. *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 rides.

(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.

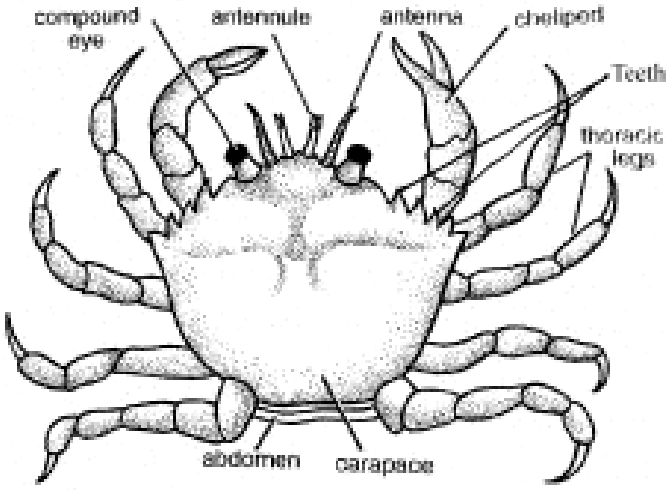

Figure : 2 : *Scylla* sp. (Crab)

III. *Carcinoscorpius* sp.

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

Phylum : Arthropoda

Subphylum : Chelicerata

Class : Merostomata

Sublclass : 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 abodmen is subdivided into a seven segmented mesosoma and a five segmented metsoma.

(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 hing.

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

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

(iv) Carapace has one median end and two lateral rides.

(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.

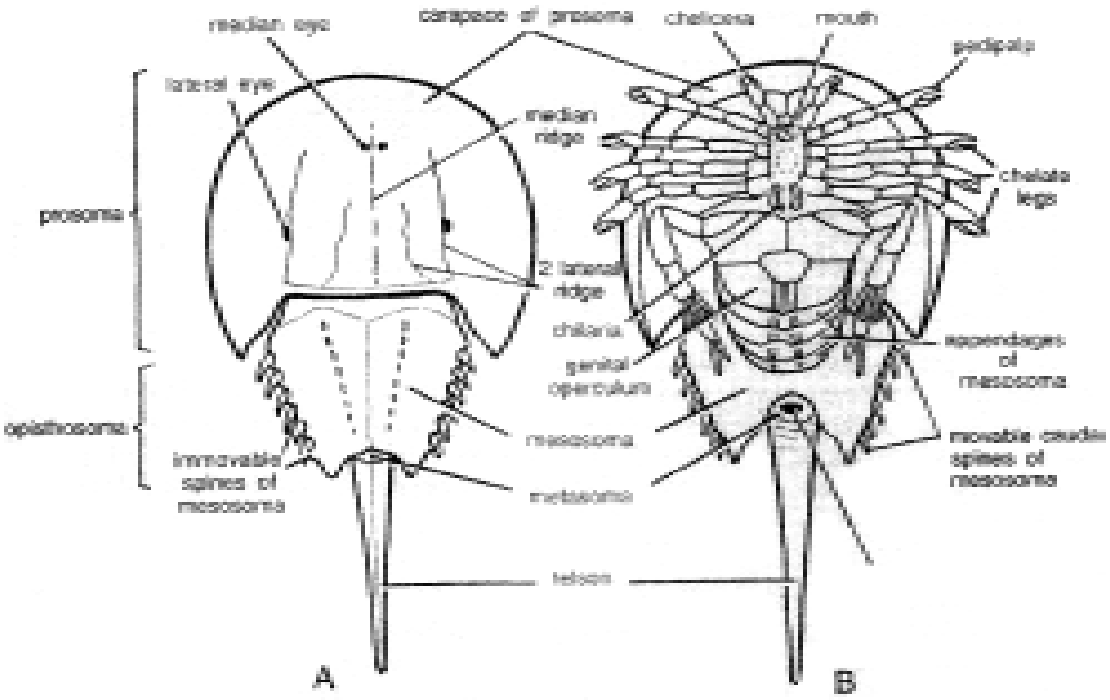

Fig. 3 : *Carcinoscorpius* sp. (A) Dorsal view and (B) Ventral view

IV. *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 bended with alternative red bluish black and white.

(ii) Ventral surface of rostrum bears teeth.

(iii) Pleopods are biramous.

(iv) The cephalotorax is relatively smaller.

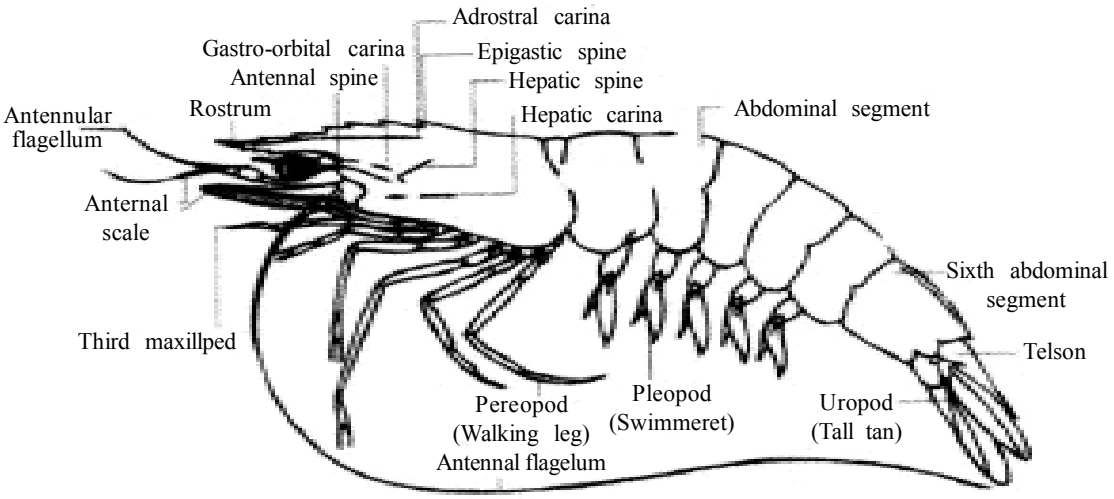

Figure 4 : *Penaeus sp.*

V. *Scolopendra* sp.

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

Phylum : Arthropoda

Subphylum : Uniramia

Class : Chilopoda

Subclass : Epimorpha

Genus : Scolopendra

Specimen : *Scolopendra sp.*

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.

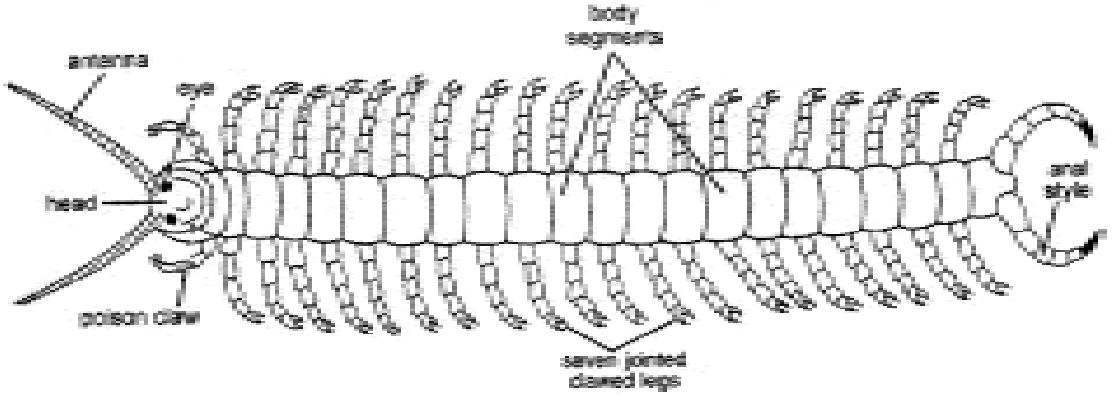

Figure 5 : *Scolopendra sp.*

VI. *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.

(iv) Poison claw absent.

Subclass : Helninthomorpha

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) Anennae are seven segmented.

(vi) More than 200 pairs of legs present.

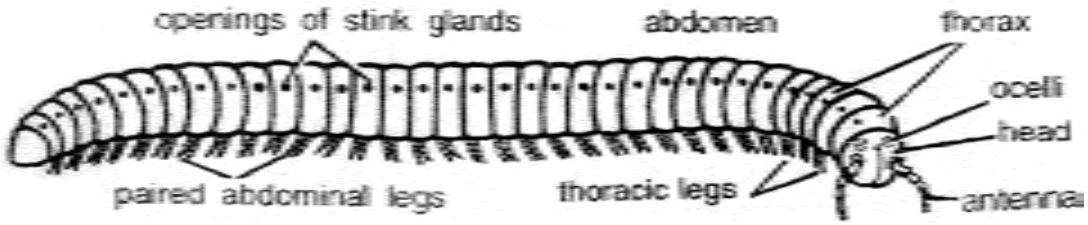

Figure 6 : *Millipede* sp.

VI. *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.

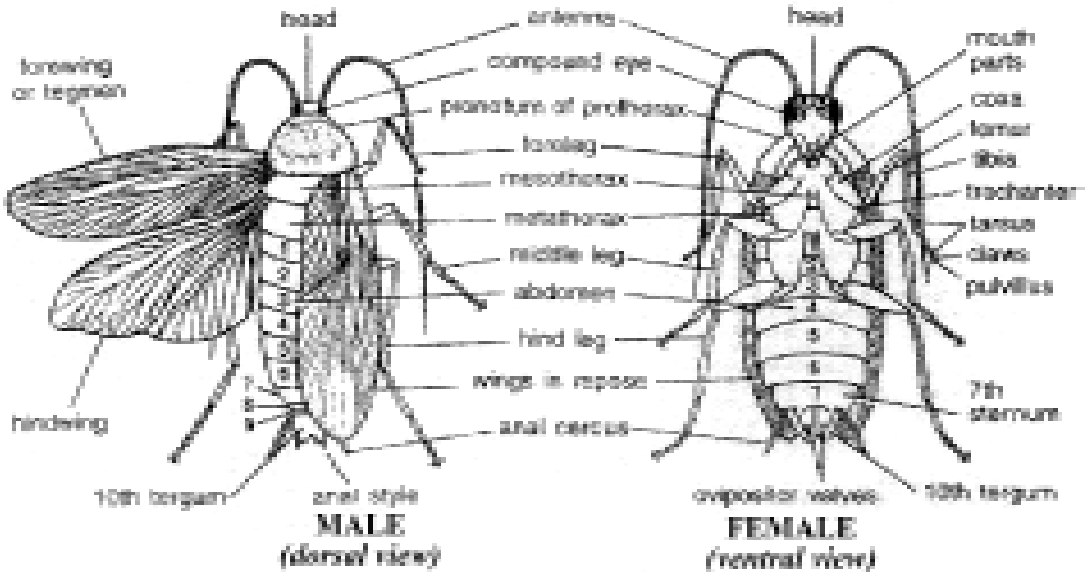

Figure 7 : Male and female *Periplaneta* sp.

25. *Apis* sp.

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

Phylum	:	Arthropoda
Subphylum	:	Uniramia
Class	:	Insecta
Subclass	:	Ectognatha
Genus	:	Apis
Specimen	:	*Apis 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.

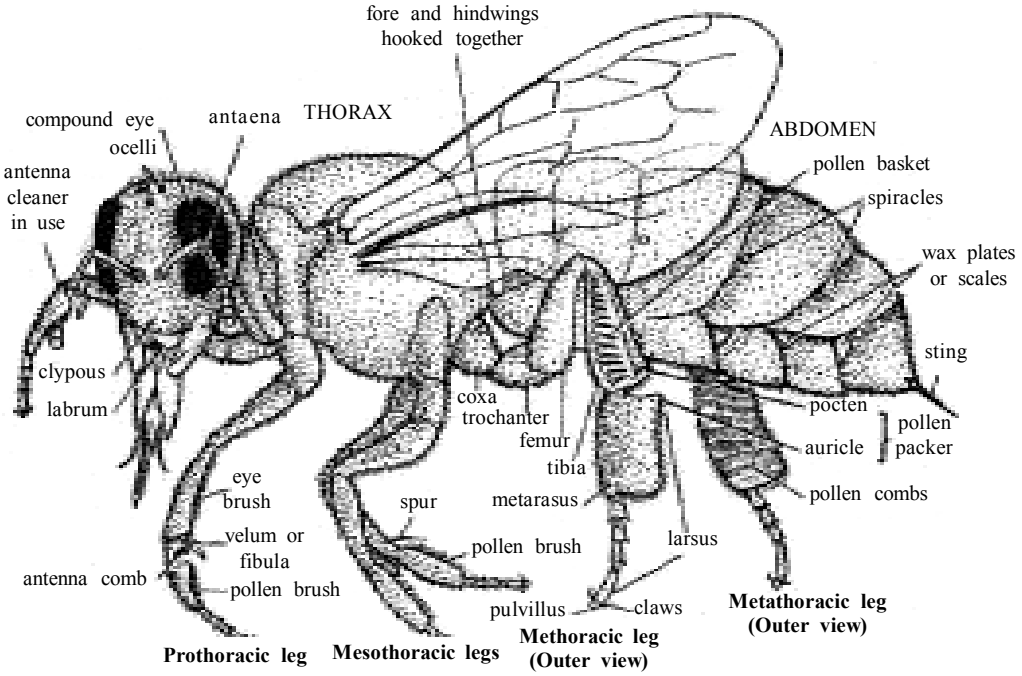

Figure 25 : *Apis sp.*

Unit-5 Mollusca – Chiton, Dentalium, Pila, Lamellidens, Loligo, Sepia, Octopus

I. *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 diagnositc 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 froms a thick 'gridle', 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.

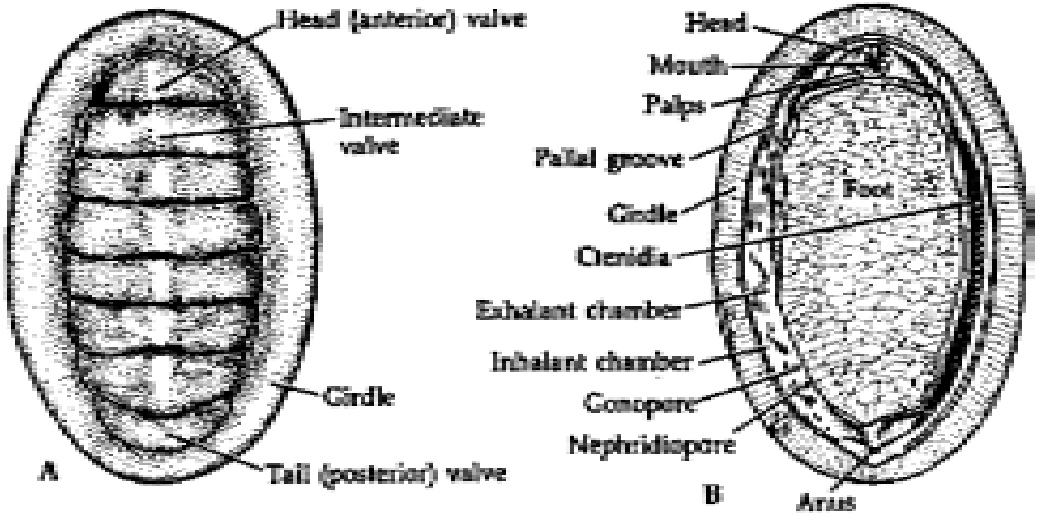

Figure 1 : *Chiton sp.* (A) dorsal view (B) ventral view

LL. *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 lack eyes and sensory tentacles.

(v) Presence of captaula.

(vi) Gills or ctenidia are absent.

Specimen : *Dentalium* sp.

(i) Presence of a tubular but 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.

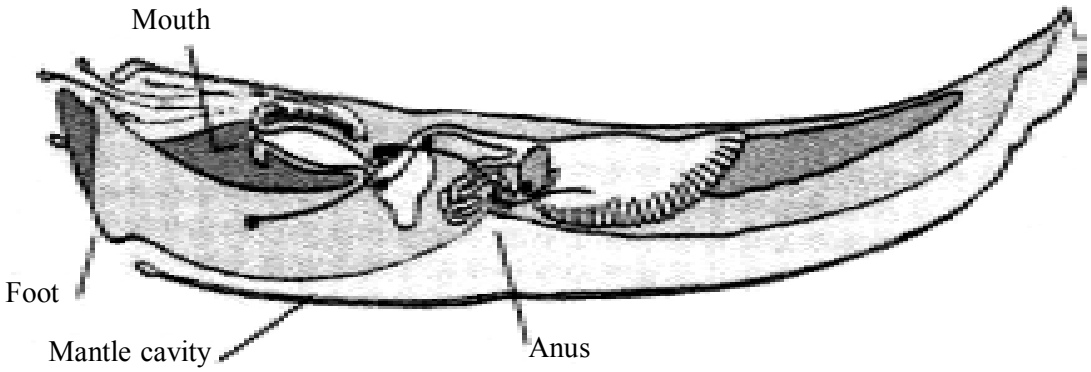

Figure 2 : *Dentalium sp.*

III. *Pila* sp.

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

Phylum : Mollusca

Class : Gastropoda

Subclass : Prosobranchia

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.

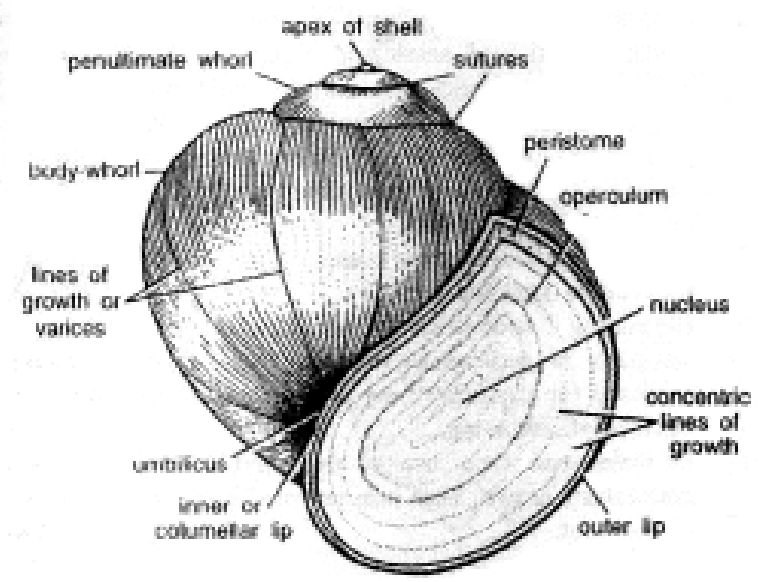

Figure 3 : *Pila sp.*

IV. *Lamellidens* sp.

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

Phylum : Mollusca

Class : Bivalvia

Subclass : Palaeoheterodonta

Genus : Lamellidens

Specimen : *Lamellidens sp.*

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) Mentle 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 musculture.

(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.

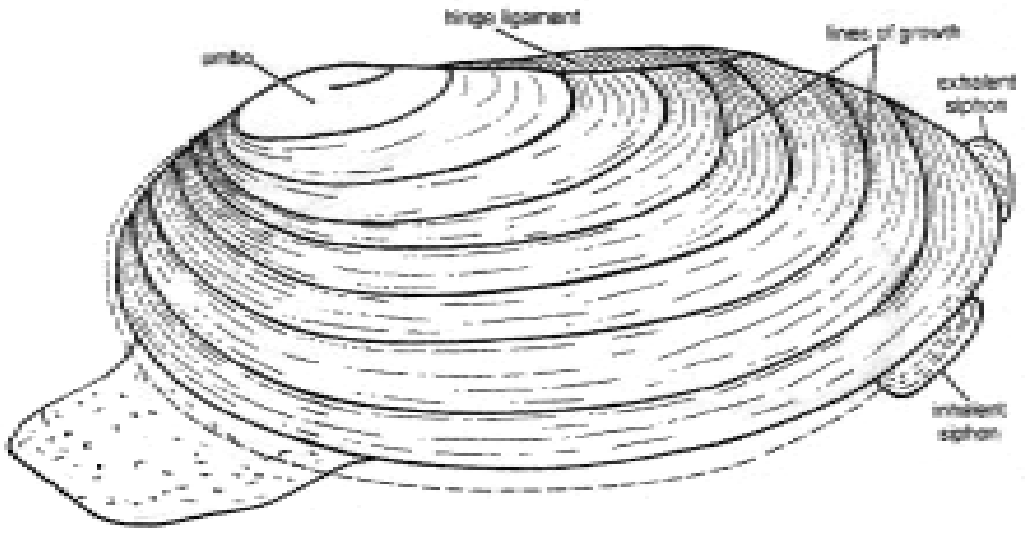

Figure 4 : *Lamellidens sp.*

V. *Loligo* sp.

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

Phylum : Mollusca

Class : Cephalopoda

subclass : Coleoidea

Genus : Loligo

Specimen : *Loligo 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.

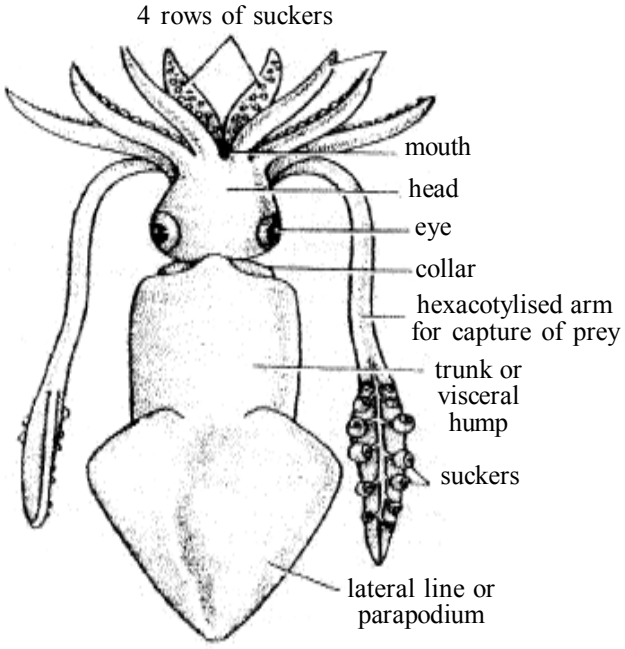

Figure 5 : *Loligo sp.*

VI. *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.

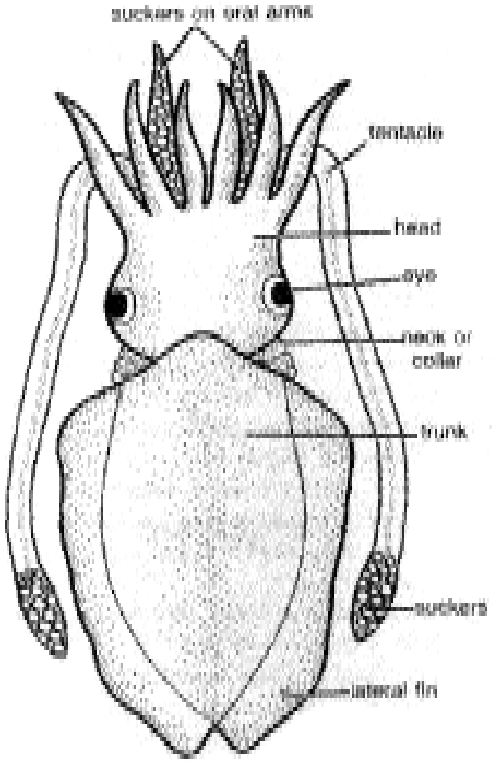

Figure 6 : *Sepia sp.*

VII. *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 hectocotylised and therefore spoon shaped.

(v) Visceral mass and mantle cavity enclosed in mantle.

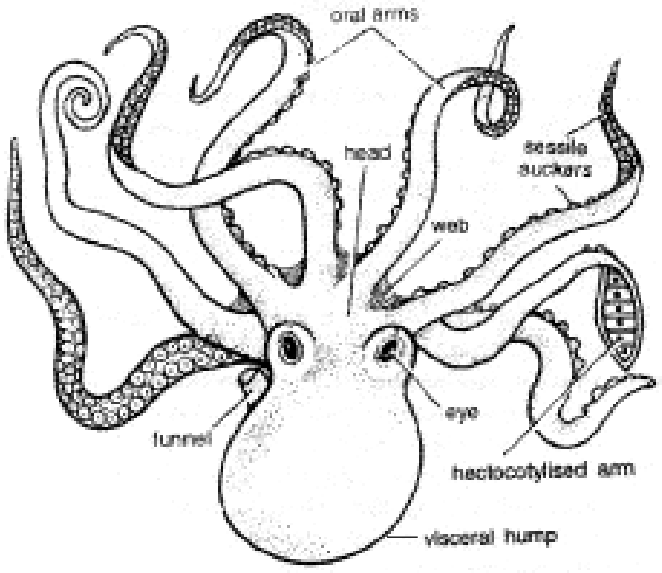

Figure 7 : *Octopus sp.*

Unit-6 Echinodermata – Starfish, Ophiura, Echinus, Cucumaria and Antedon

I. 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 projected 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 echinoderness 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.

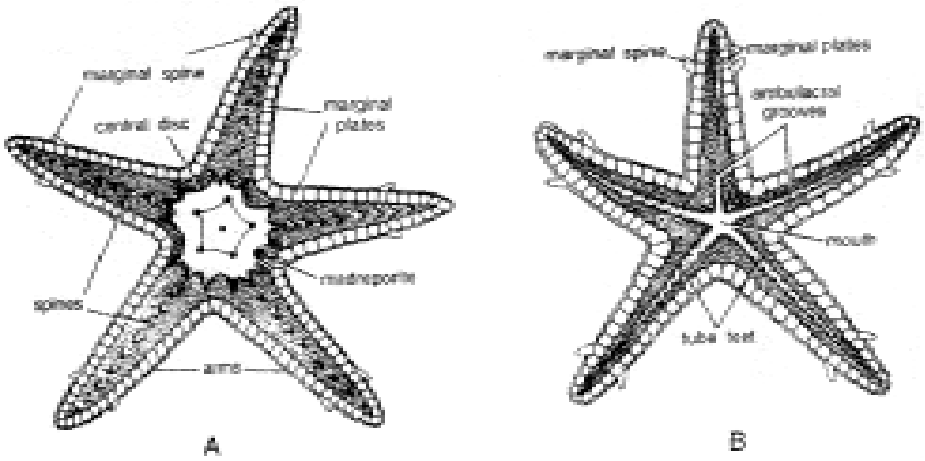

Figure I : Starfish (A) Aboral view and (B) Oral view

II. *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.

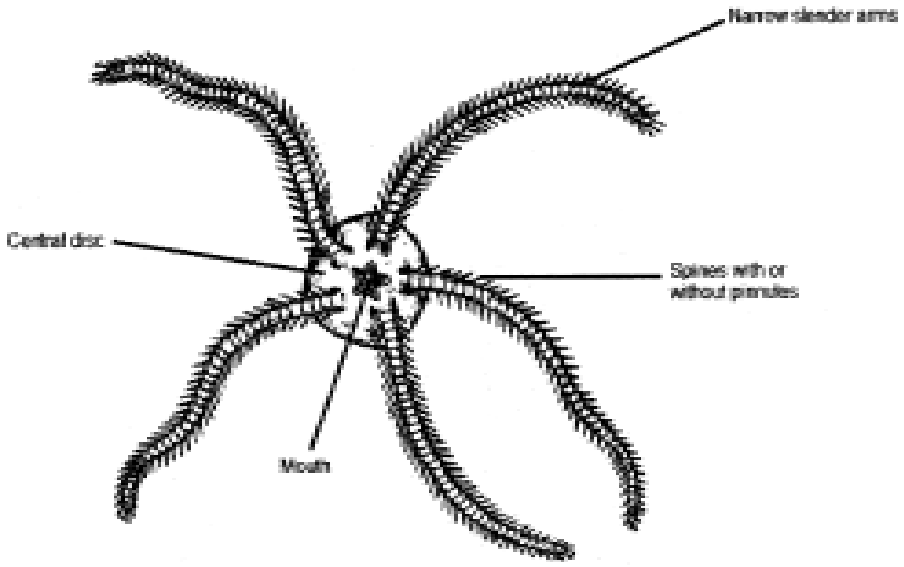

Figure 2 : *Ophiura sp.*

III. *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.

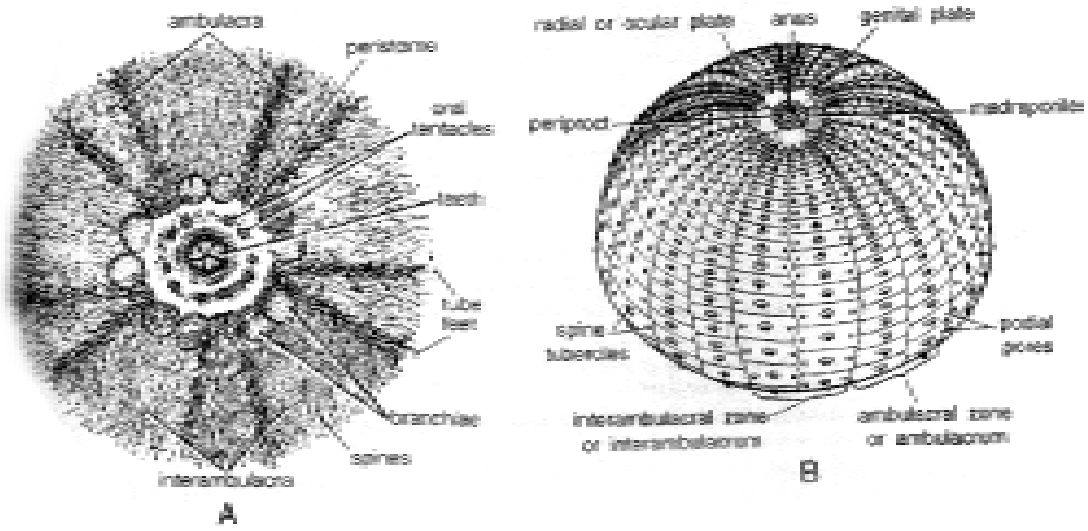

Figure 3 : (A) Oral view and (B) Test of *Echinus sp.*

36. *Cucumaria* sp.

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

Phylum	:	Echinoermata
Subphylum	:	Echinozoa
Class	:	Holothuroidea
Genus	:	Cucumaria
Specimen	:	*Cucumaria sp.*

b) Systematic identification with reasons

Phylum : Echinodermata

Same as star fish

Subphylum : Echionozoa

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 tantacles.

(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 and soft skin.

(ii) Tentacles are highly branched.

(iii) Presence of a smooth, thin collar like structure at the base of tentacles.

(iv) Mouth and anus are at separate ends of the body.

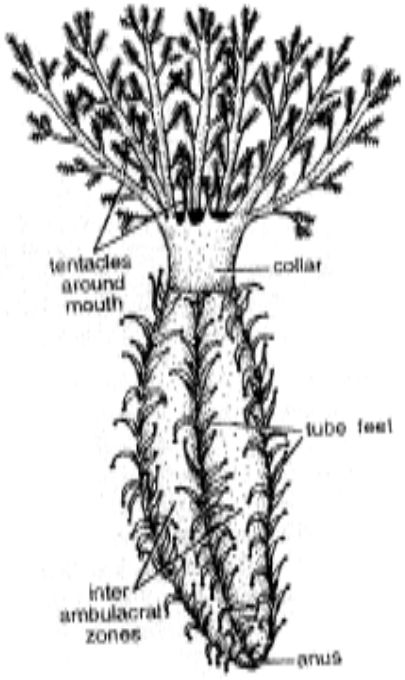

Figure 4 : *Cucumaria sp.*

V. *Antedon* sp.

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

Phylum : Echinodermata

Subphylum : Cinozoa

Class : Crinoidea

Subclass : Articulata

Genus : Antedon

Specimen : *Antedon 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.

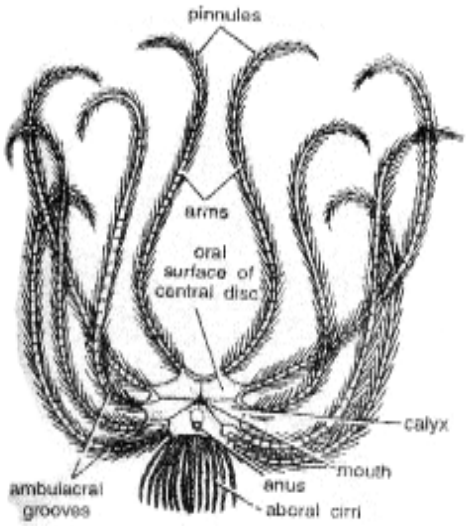

Figure 5 : *Antedon sp.*

Unit-7 Protochordata–Balanoglossus, Branchiostoma, Herdmania, Petromyzon, Ammocoetes Larva

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.

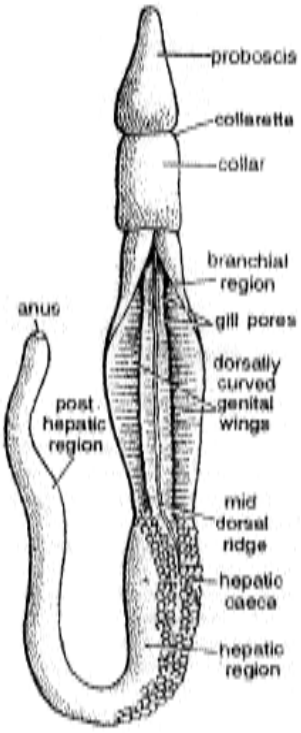

Figure 1 : *Balanoglossus sp.*

II. *Branchiostoma* sp.

a) Systematic postion (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.

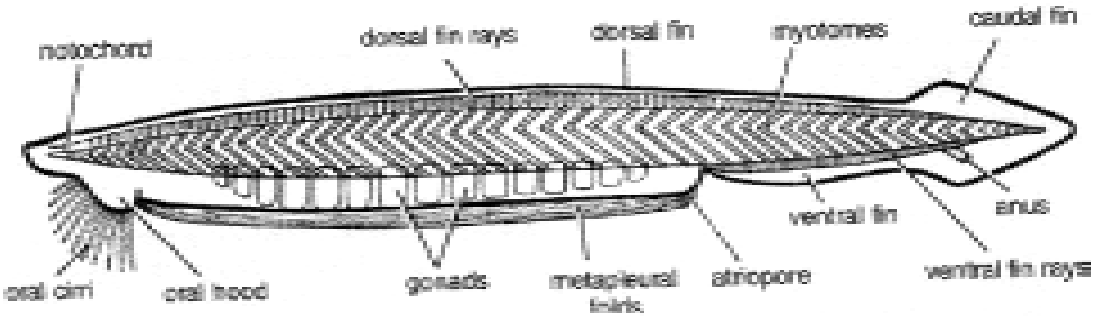

Figure 2 : *Branchiostoma sp.*

III. *Herdmania* sp.

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

Phylum	:	Chordata
Subphylum	:	Urochordata
Clas	:	Ascidiacea
Genus	:	Herdmania
Specimen	:	*Herdmonia* 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 knows 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.

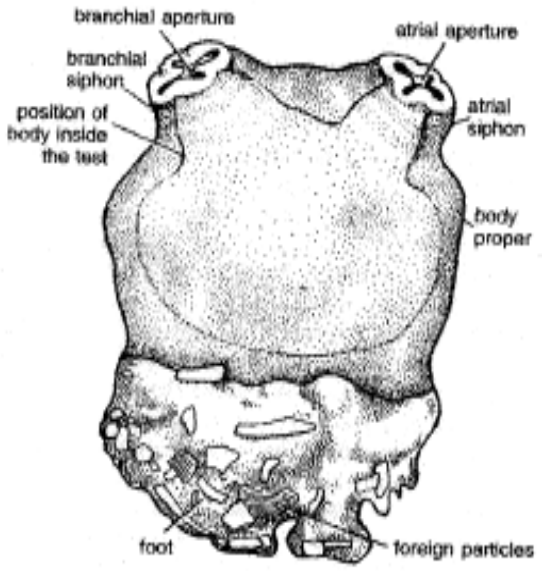

Figure 3 : *Herdmania sp.*

VI. *Petromyzon* sp.

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

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Agnatha
Class	:	Cephalaspidomorphi
Order	:	Cyclostomata
Genus	:	Petromyzon
Specimen	:	*Petromyzon sp.*

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.

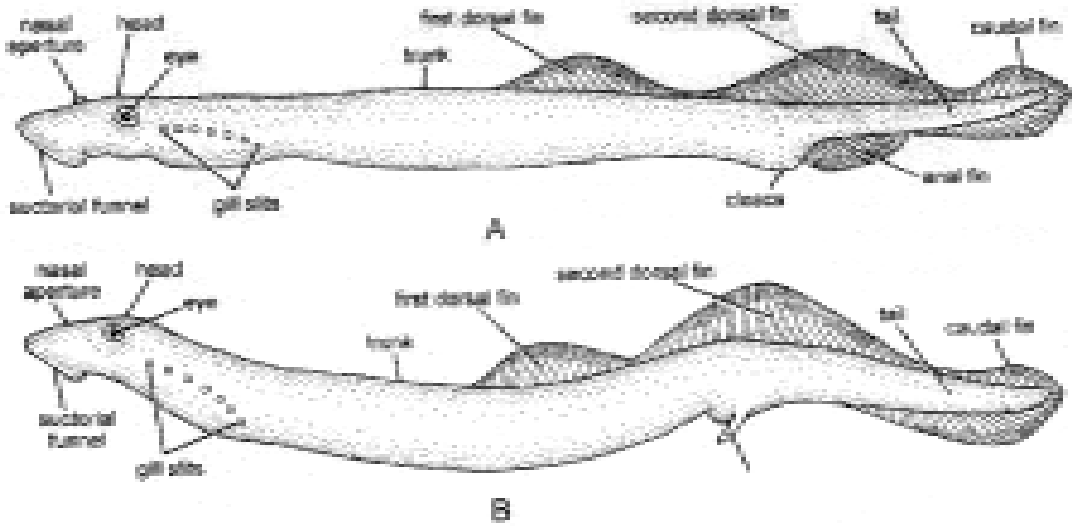

Figure 4 : *Petromyzon sp.*

Unit-8 Fish – Sphyrna, Pristis, Torpedo, Scoliodon, Labeo, Exocoetus, Anguilla, Echenis

I. *Sphyrna* sp.

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

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Chondrichthyes
Subclass	:	Elasmobranchi
Genus	:	Sphyrna
Specimen	:	*Sphyrna sp.*

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.

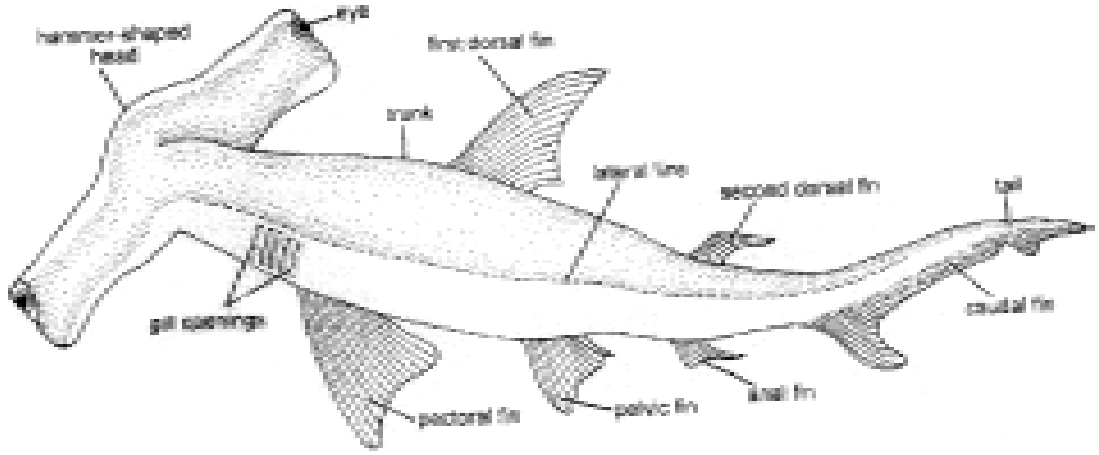

Figure 1 : *Sphyrna sp.*

II. *Pristis* sp.

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

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Chondrichthyes
Subclass	:	Elasmobranchii

Genus : Pristis

Specimen : *Pristis 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.

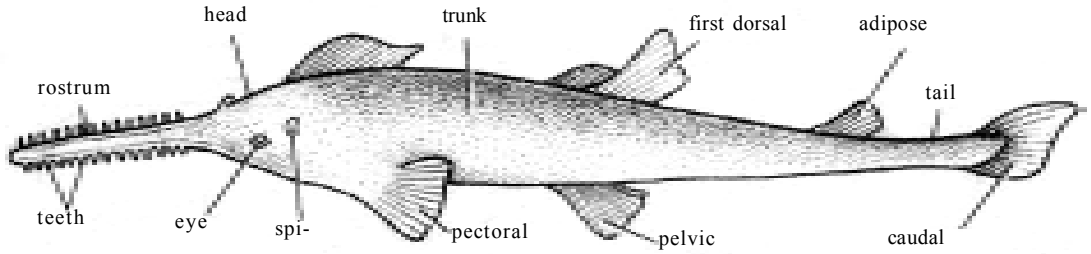

Figure 2 : *Pristis* sp.

III. *Torpedo* sp.

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

Phylum	:	Chordata
Subphylum	:	Vetebrata
Superclass	:	Gnathostomata
Class	:	Chondrichthyes
Subclass	:	Elasmobranchii
Genus	:	Torpedo
Specimen	:	*Torpedo sp.*

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Subclass : Elsmobranchii

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.

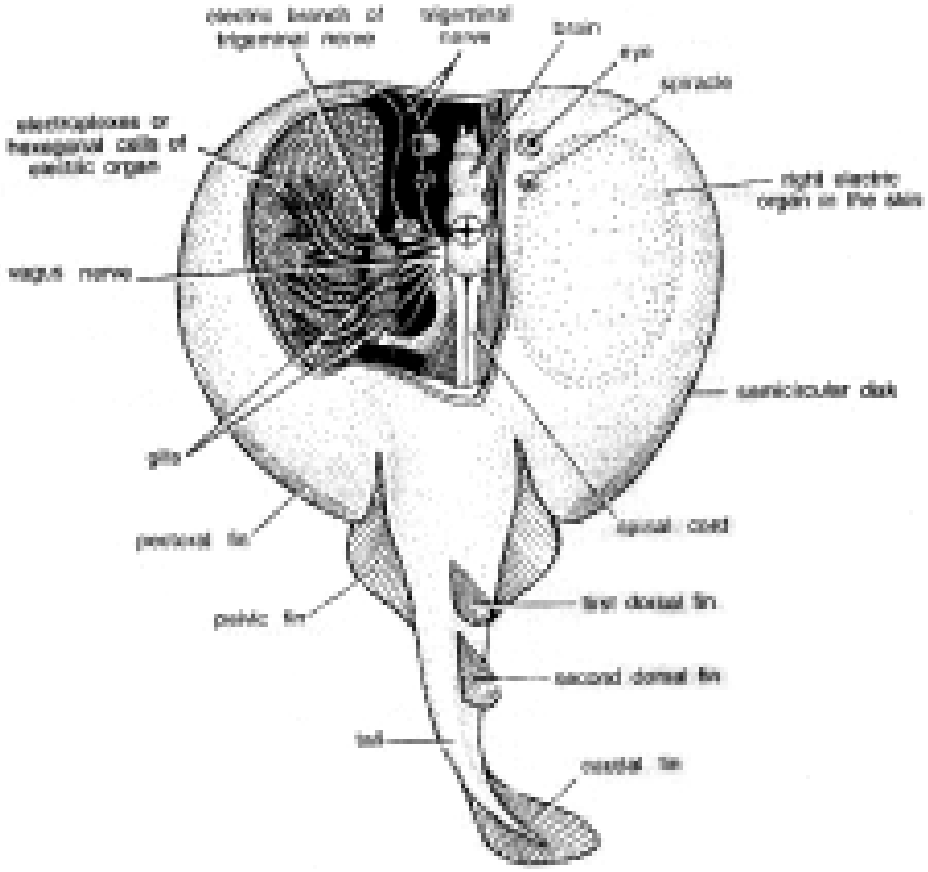

Figure 3 : *Torpedo sp.*

IV *Scoliodon* sp.

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

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclas	:	Gnathostomata
Class	:	Chondrichthyes
Subclass	:	Elasmobranchii
Genus	:	Scoliodon
Specimen	:	*Scoliodon 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.

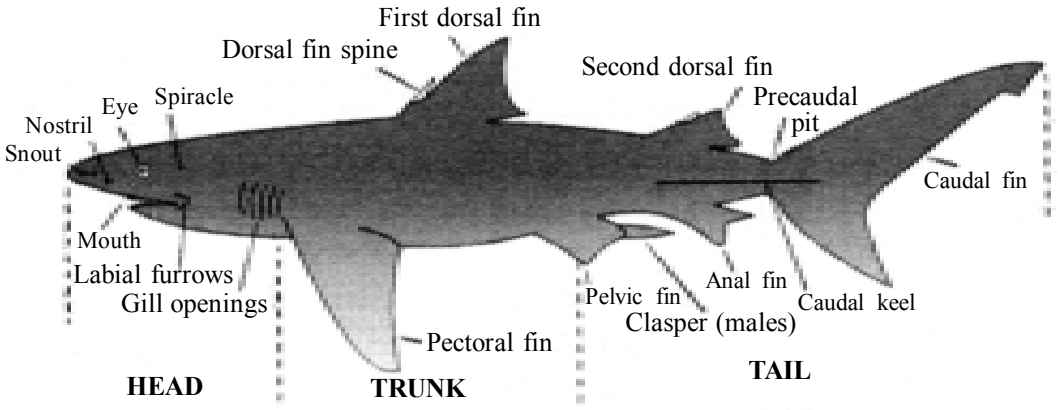

Figure 4 : *Scoliodon sp.*

V. *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	:	*Labeo 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

(i) Fin with fin rays.

(ii) Mouth terninal or sub-terminal.

(iii) Gills are covered by operculum.

(iv) Tail homocercal or diphycercal.

(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.

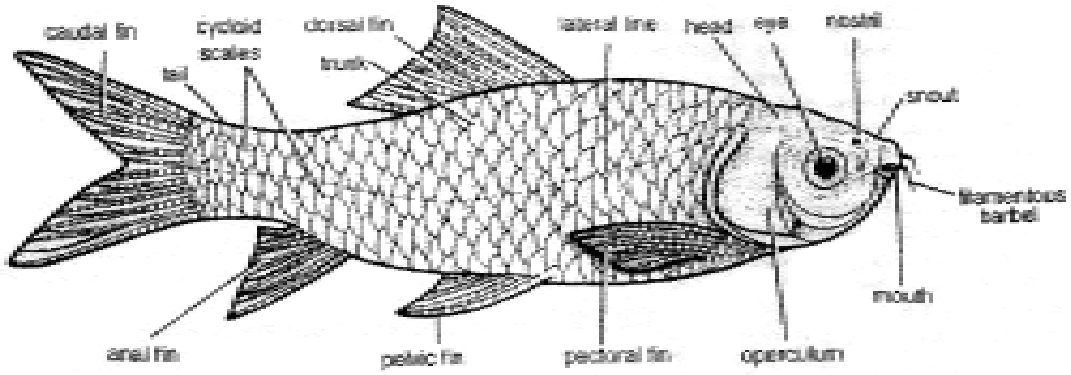

Figure 5 : *Labeo sp.*

VI. *Exocoetus* sp.

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

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Osteichthyes
Subclass	:	Actinopterygii
Order	:	Beloniformes
Genus	:	Exocoetus
Specimen	:	*Exocoetus 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 : 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***.

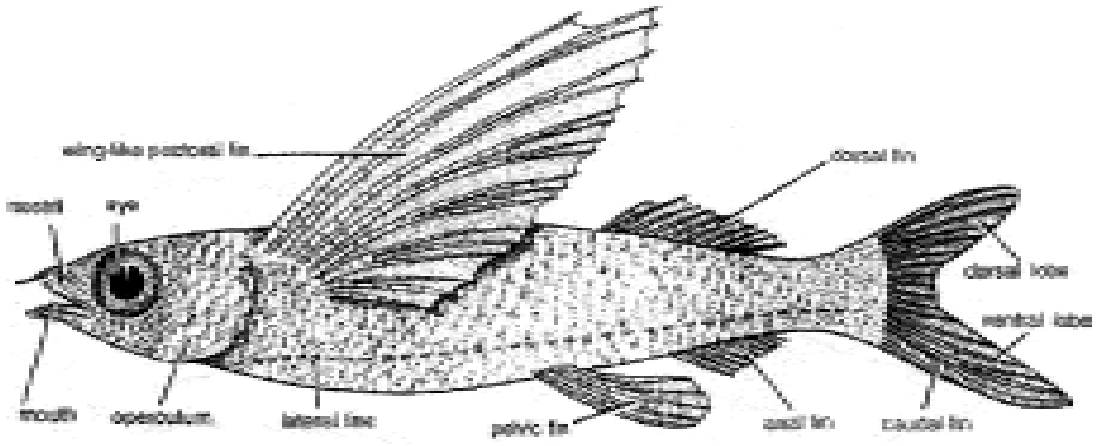

Figure 6 : *Exocoetus sp.*

VII. *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.

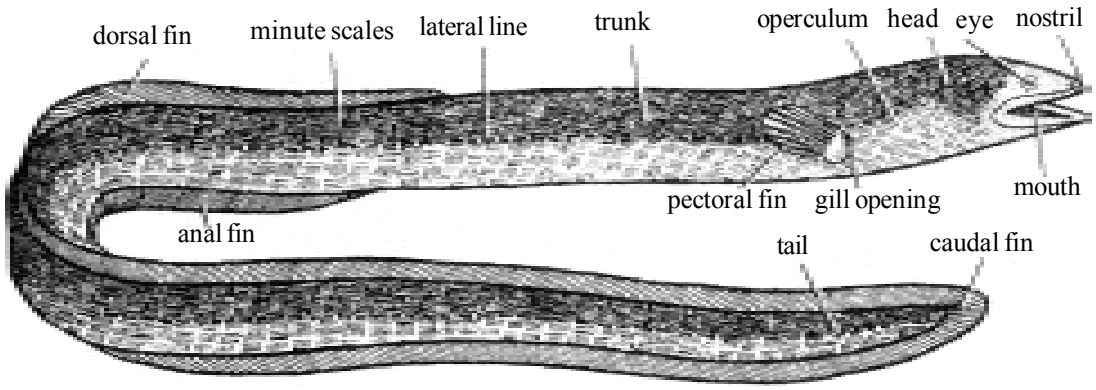

Figure 7 : *Anguilla sp.*

VIII. *Tenualosa* sp.

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

Phylum : Chordata

Subphylum : Vertebrata

Superclass : Gnathostomata

Class : Osteichthyes

Subclass : Actinopterygii

Order : Clupeiformes

Genus : Tenualosa

Specimen : *Tenualosa* 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 *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.

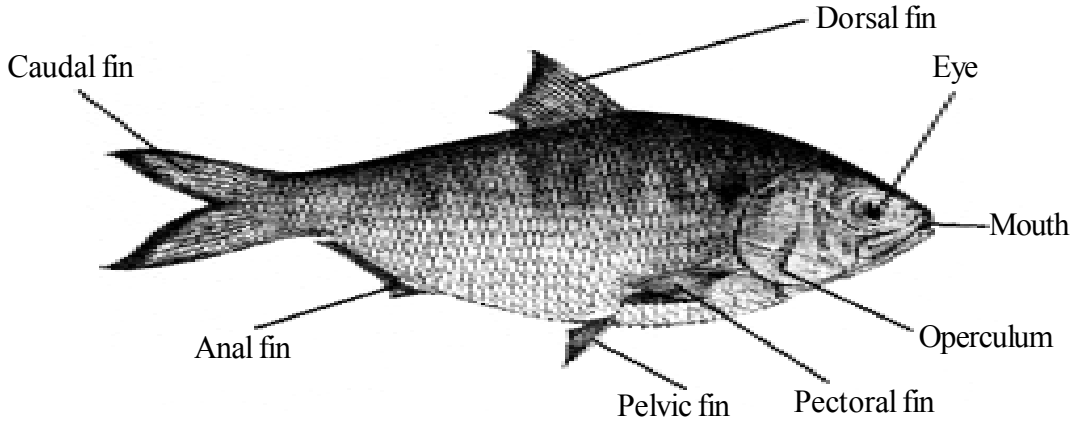

Figure 8 : *Tenualosa sp.*

Unit-9 Amphibia – Teniolosa, Ureotyphlus, Salamander, Bufo, Hyla, Rhacophorus

I. *Uraeotyphlus* sp.

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

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Amphibia
Subclass	:	Lissamphibia
Order	:	Gymnophiona
Genus	:	Uraeotyphlus
Specimen	:	*Uraeotyphlus* 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 : *Uraeotyphylus* sp.

(i) Skin with numerous transverse grooves.

(ii) Eyes are nonfunctional and concealed beneath the slimy skin.

(iii) Cloaca prescent at the terminal end.

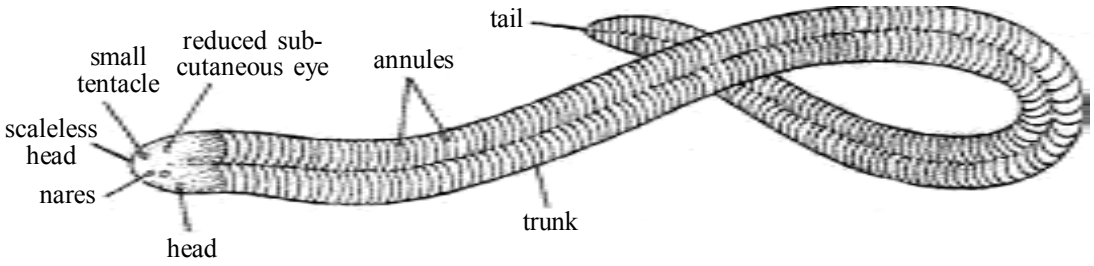

Figure 1 : *Uraeotyphlus sp.*

II. *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	:	*Salamander Sp.*

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

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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.

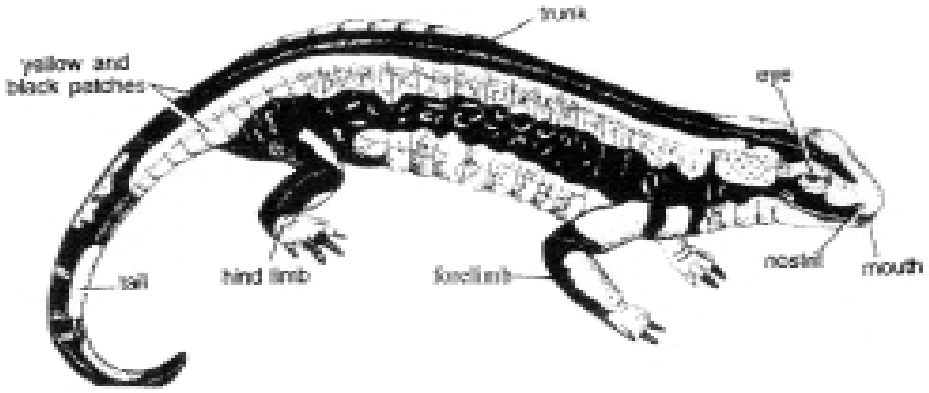


Figure 51 : *Salamander sp.*

III. *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.

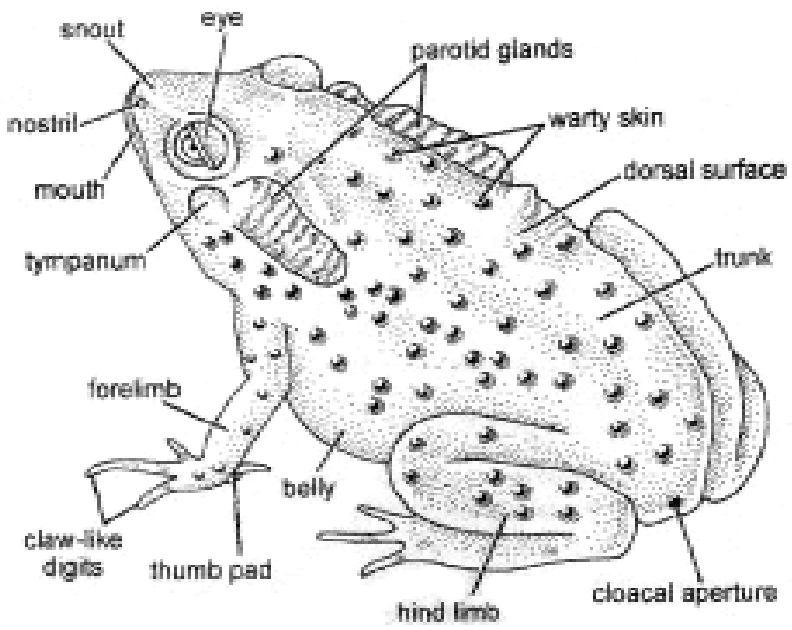


Figure 3 : *Bufo sp.*

IV. *Hyla* sp.

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

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Amphibia
Subclass	:	Lissamphibia
Order	:	Anura
Genus	:	Hyla
Specimen	:	*Hyla 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.

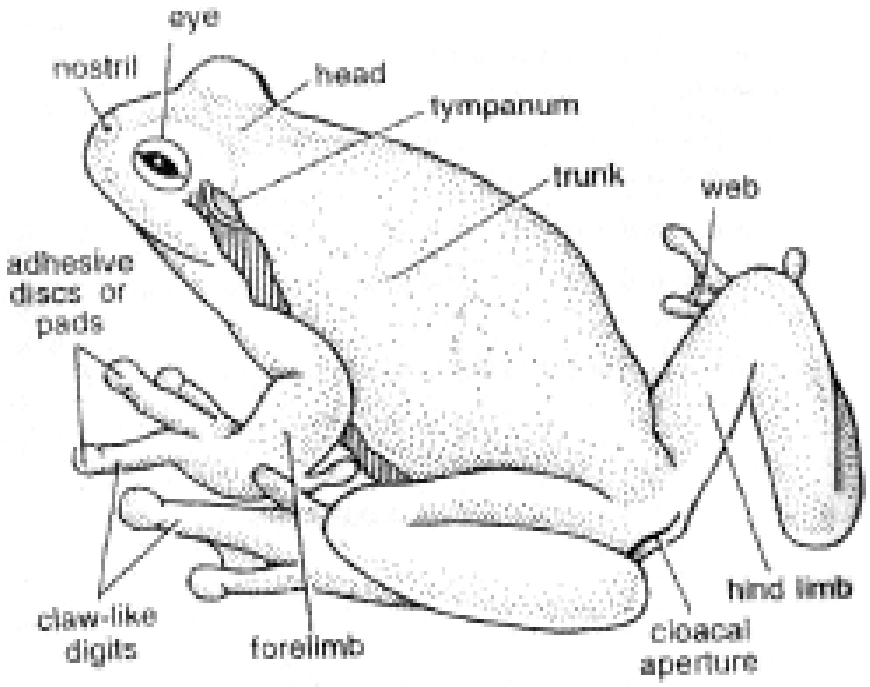


Figure 4 : *Hyla sp.*

Unit-10 Reptilia–Turtle, Calotes, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis

I. *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	:	*Turtle 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

(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.

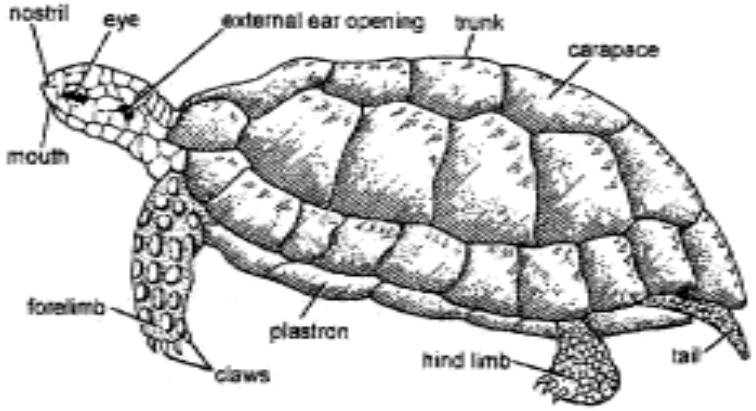


Figure 1 : *Turtle sp.*

II. *Calotes* sp.

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

Phylum : Chordata

Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Reptilia
Subclass	:	Lepidosauria
Order	:	Squamata
Genus	:	Calotes
Specimen	:	*Calotes 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.

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 enlongated.

Order : Sqamata

(i) Cloacal aperture transverse.

(ii) Scales are mostly over lapping.

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.

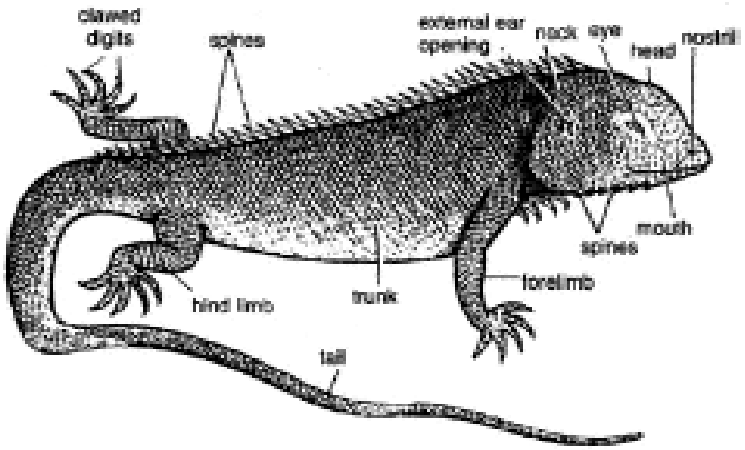


Figure 2 : *Calotes sp.*

III. *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	:	*Chameleon*

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Superclass : Gnathostomata

Same as *Sphyrna* sp.

Class : Repitilia

Same as *Turtle* sp.

Subclass : Lepidosauria

Same as *Calotes* sp.

Order : Sqamata

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.

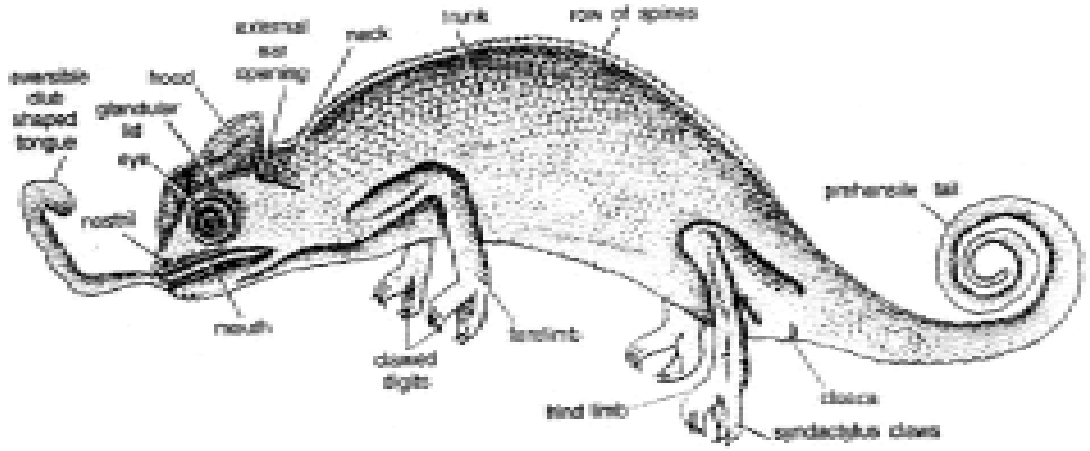


Figure 3 : *Chameleon sp.*

IV. *Draco* sp.

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

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Reptilia
Subclass	:	Lepidosauria
Order	:	Squamata
Genus	:	Draco
Specimen	:	*Draco* sp.

b) Systematic identifications with reasons

Phylum : Chordata

Same as *Herdmania* sp.

Subphylum : Vertebrata

Same as *Petromyzon* sp.

Class : Reptilia

Same as *Turtle* sp.

Order : Sqamata

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.

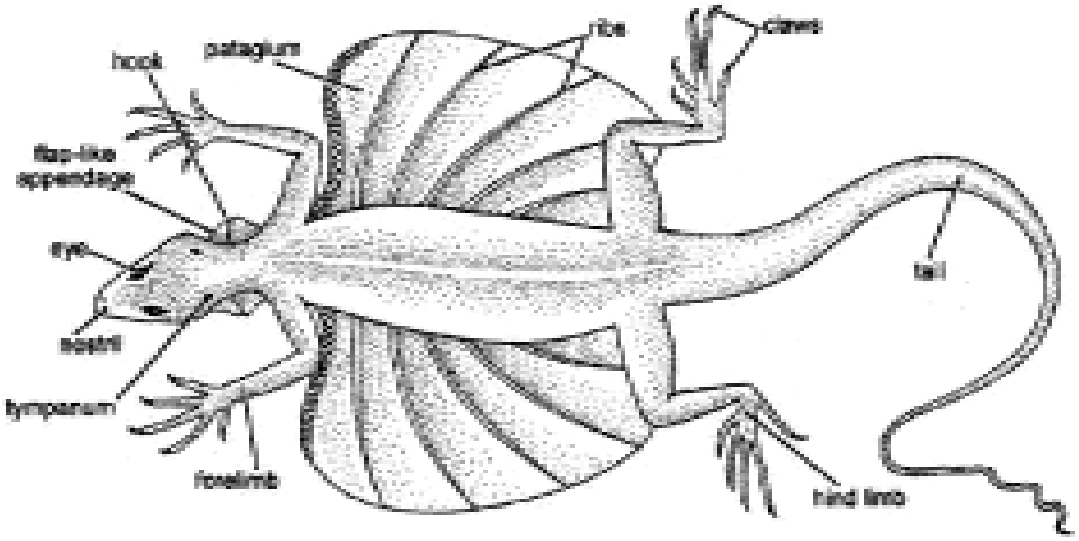


Figure 4 : *Draco sp.*

V. *Vipera* sp.

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

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Reptilia

Subclass : Lepidosauria

Order : Squamata

Genus : Vipera

Specimen : *Vipera 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 : Sqamata

Same as *Calotes* sp.

Specimen : *Vipera* sp.

(i) Body elongated and slender.

(ii) Absense of limbs.

(iii) Deep brown coloured elliptical patches on skin.

(iv) The head is triangular with head scales which small, inbricate and keeled.

(v) Paired erectile fangs in front of upper jaw.

(vi) No pit between nostrils and eyes.

(vii) Large nostrils obliquely directed.

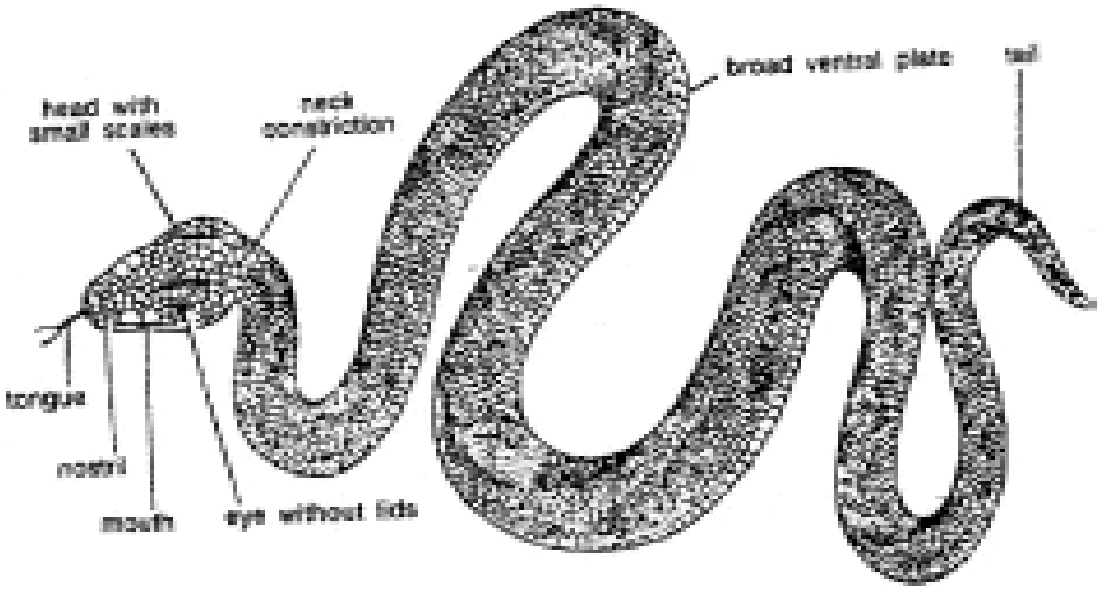


Figure 5 : *Vipera sp.*

VI. *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.

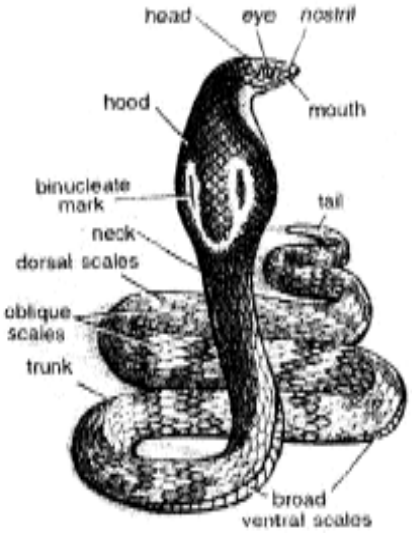


Figure 6 : *Naja sp.*

VII. *Crocodylus* sp.

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

Phylum	:	Chordata
Subphylum	:	Vetebrata
Superclass	:	Gnathostomata
Class	:	Reptilia
Subclass	:	Archosauria
Order	:	Crocodilia
Genus	:	Crocodylus
Specimen	:	*Crocodylus 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.

Sublclass : Archosauria

(i) The skull is diapsid.

(ii) Dorsal bony scutes present.

(iii) Shell absent.

Order : Crocodilia

(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.

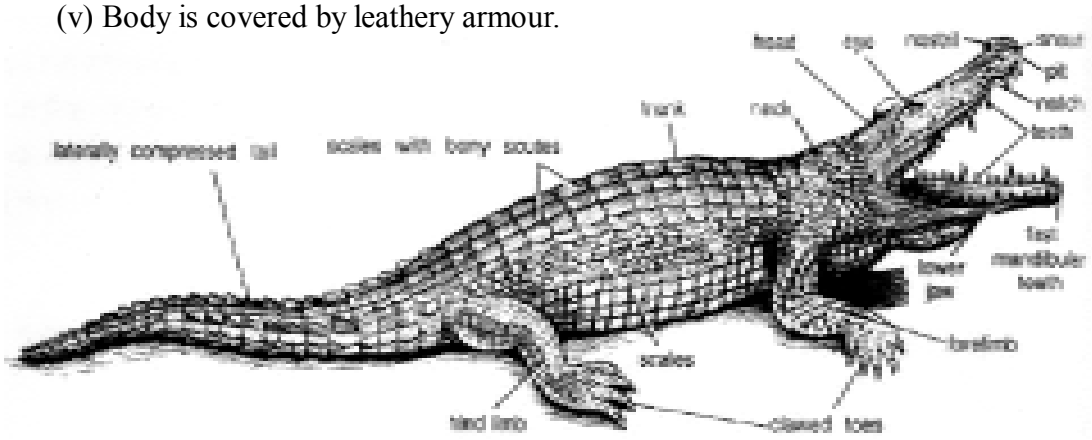


Figure 7 : *Crocodylus sp.*

VIII. *Gavialis* sp.

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

Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Reptilia
Subclass	:	Archosauria
Order	:	Crocodilia
Genus	:	Gavialis
Specimen	:	*Gavialis* 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 : Crocodilia

Same as *Crocodylus* sp.

Specimen : *Gavialls* 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.

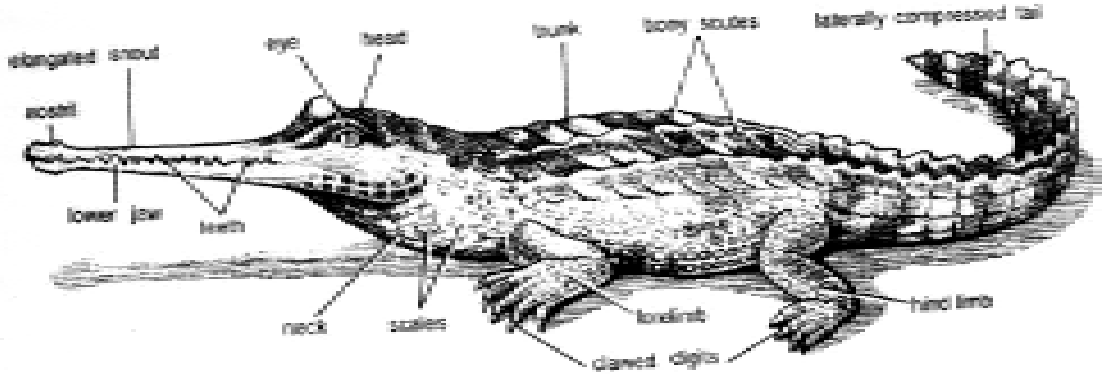


Figure 8 : *Gavilis sp.*

Unit-11 Birds – Any three common birds from different orders available in concerned college laboratory or surroundings

I. *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 retrices i.e., tail feathers.

Superorder : Neognathae

(i) Neognathous type of skull.

(ii) Well developed reminges i.e., wing feathers and rectrices.

Order : Columbiformes

(i) Prominet swollen ciric.

(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 mettalic 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.

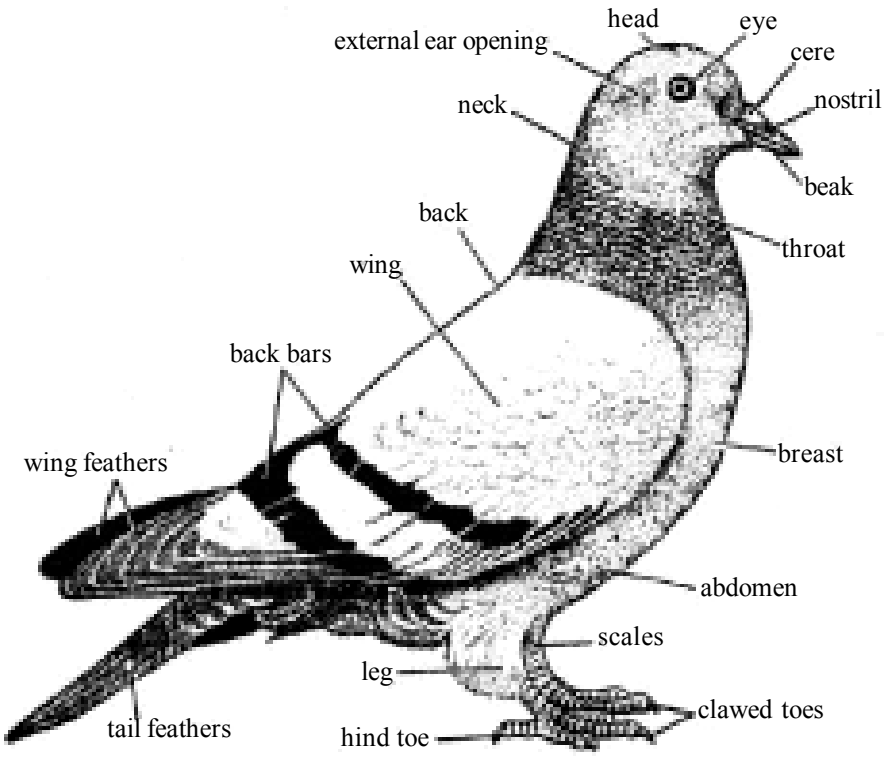


Figure 1 : *Columba sp.*

II. *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	:	Psittacula
Specimen	:	*Psittacula* 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 : 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.

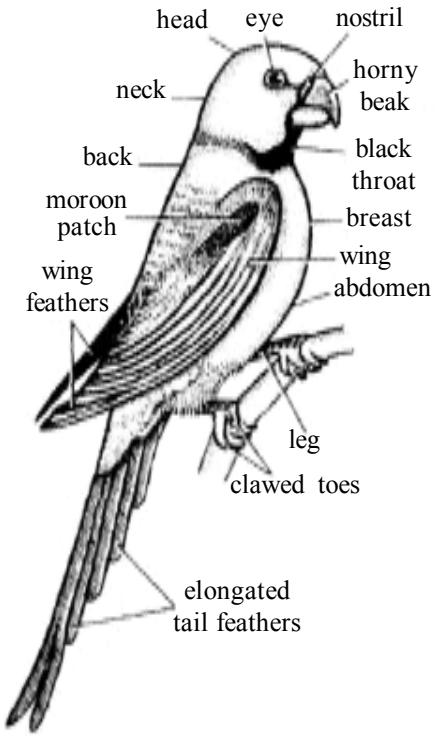


Figure 2 : *Psittacula sp.*

III. *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	:	Bubo
Specimen	:	*Bubo 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 : 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.

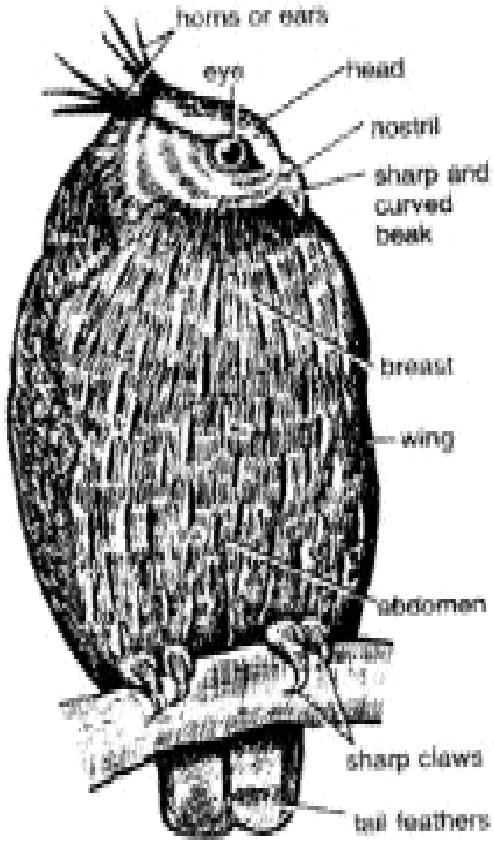


Figure 3 : *Bubo sp.*

IV. *Passer* sp.

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

Phyum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Class	:	Aves
Subclass	:	Neornithes
Superorder	:	Neornithes
Superorder	:	Neognathae

Order : Passeriformes

Genus : Passer

Specimen : *Passer 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.

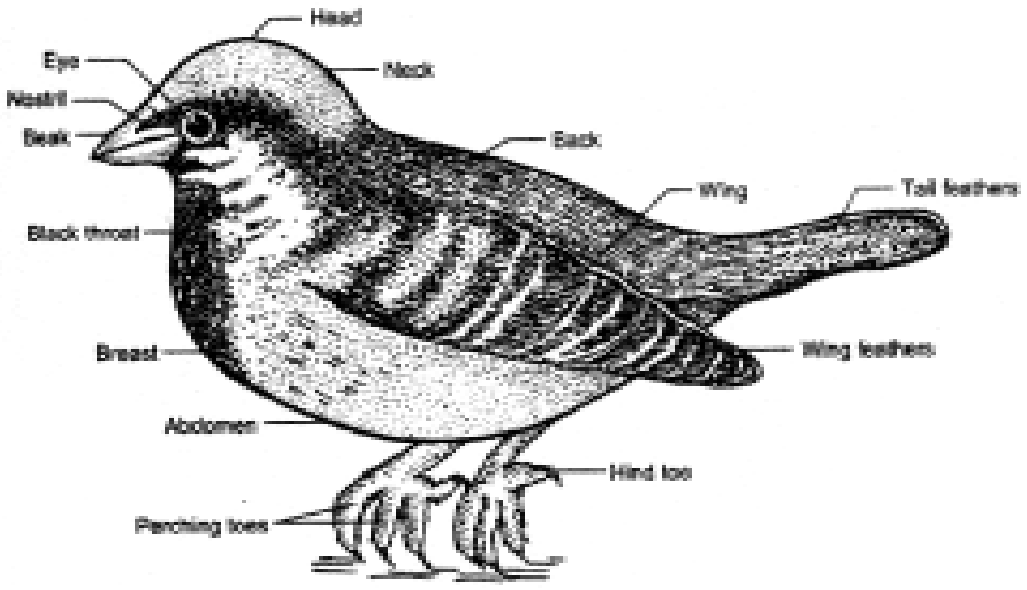


Figure 4 : *Passer sp.*

Unit-12 Mammals – Sorex, Mega or Microchiroptera, Squirrel and any two common mammals of different orders around you

I. *Sorex* 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	:	Insectivora
Genus	:	Sorex
Specimen	:	*Sorex 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 : 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 seperate.

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.

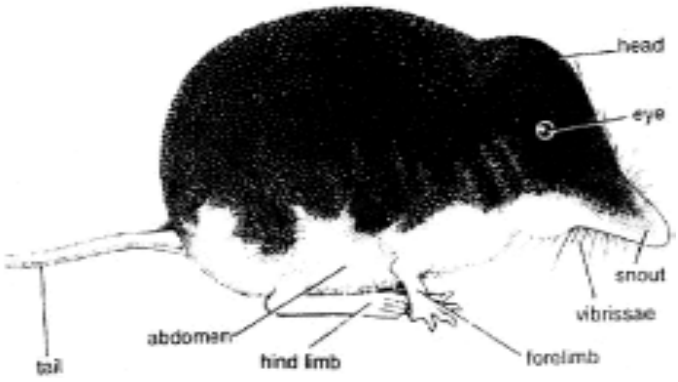


Figure 1 : *Sorex sp.*

II. *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	:	*Megachiroptera*

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.

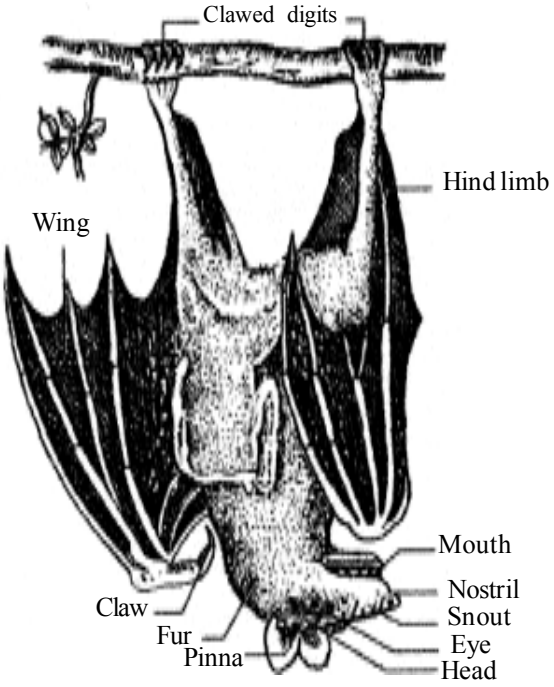


Figure 2 : *Megachiroptera sp.*

III. *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	:	*Microchiroptera* sp.

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.

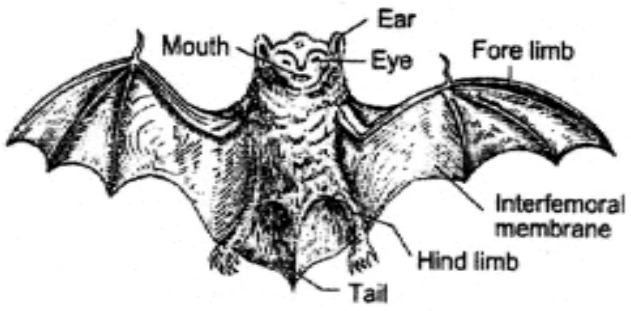


Figure 3 : *Microchiroptera sp.*

IV. *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	:	*Squirrel* 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 : Mammalia

Same as *Sorex* sp.

Subclass : Theria

Sam 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.

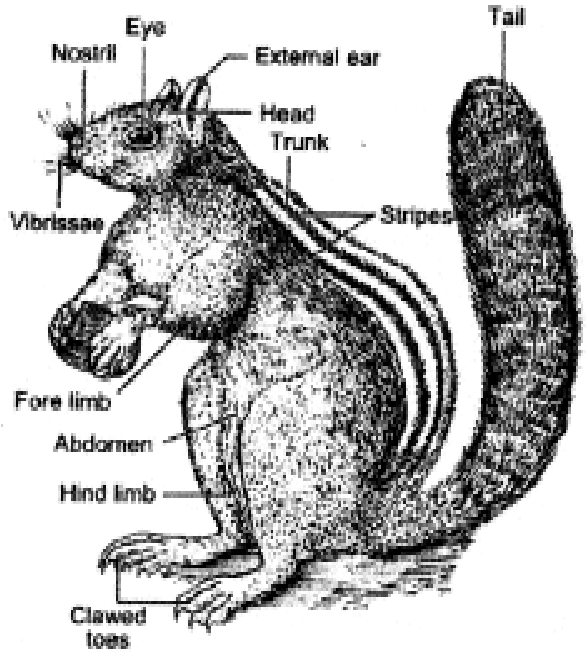


Figure 71 : *Squirrel sp.*

Unit-13 Study of different techniques for animal preservation

Structure

13.1. Definition of Specimen

A zoological specimen is an animal or part of an animal preserved for scientific use. There are lot of examples to explain specimen, i.e., mammalian skin, endocrine and exocrine glands of animals, mounted specimens, skeletal material, pinned insects, microscope slides etc.

13.2. Specimen Preservation

Specimen preservation means long term preservation of organisms in suitable medium like formalin, alcohol, etc. in the best possible natural condition.It is a fundamental requirement in biological/medical science, agriculture, biotechnology etc.

13.3 Objectives of Preservation

The scientific description of an animal species requires detailed examination, description of a representative type specimen, catalogued and maintained in a museum, reference for other workers in the future. The preserved specimens are important in biodiversity conservation,documentation, environmental monitoring, andclimate change studies. Moreover, the samples can be used in pathological studies, medical research, and forensic investigations, including the examination of illness patterns, heredity, and the impact of the environment on living things.By comparing populations from the past and now, specimens gathered across time assist scientists in their studies of evolutionary trends, species adaptations, and environmental changes.

13.4 Types of preservation Techniques

13.4.1 Taxidermy

- This process is used for preparing, stuffing, and mounting the skins of animals so that they appear aslifelike form.
- Skull and other bones are retained to create a dummy or mannequin.
- This involves removal of skin of animals.
- Preservation and tanning of the skin.
- Mounting on a mannequin made from wood, wool, etc.
- Research institutes, and museums frequently use this technique.

13.4.2 Entire fluid-preservation

- This type of preservation involves immersing the whole animal in a fluidor liquid preservative.
- Liquid preservatives prevent decomposition of the sample and maintain structural integrity.
- This technique helps in long-term preservation of the samples.
- But as its limitation, fluid preservation may change the fur colour, skin coat or integument properties.

- The most commonly used liquid preservatives are formalin (formaldehyde solution), alcohol (ethanol or isopropanol), glycerin, and acetic acid.

13.4.3 Dry preservation

Dry preservation is frequently applied to hard-bodied objects such as insects, bones, skins, and shells.This type of preservation has following attributes.

- For studying anatomy and histology, it involves preserving the specimens by applying some chemicals in dry conditionsand this also help to study skins with skulls / partial skeletons (some bones in skin)
- This are also useful in studying colour, hair quality and moulting patterns in animal objects.

· This technique provides longevity and durability to the specimen.

- Dry preservation is advantageous as the samples can be preserved in lightweight condition andrelativelyeasy to store.
- Its limitations are the samples may become fragile and are more prone to damage from pests, humidity, and environmental conditions.

13.4.4. Freeze drying preservation

- A special form of drying that removes all moisture, specimen is freeing, and then placing in a strong vacuum
- The water then sublimates, that is, it directly changes to vapors.
- This technique is also employed in studying mounted skins with partial or entire skeleton.

13.5 Preservatives used for Animal Preservation

A. Formalin (most commonly used fixative)

- Formalin is a 37-40% aqueous solution of formaldehyde.
- It is used for vertebrates only.
- Proteins are cross-linked by formalin, which inhibits enzymatic and microbial degradation.

- It is avoided for long-term storage since it is acidic and difficult to handle.
- Mostly it is used where colour is important since alcohol dissolves most colours almost immediately.
- It penetrates more rapidly and internal organs remain in better condition

B. Industrial Alcohol (for both fixing and storage)

- Alcohol is usually not used for vertebrates
- Used for long-term storage of the animals
- Colours of specimen is lost immediately
- Glycerine in alcohol is used to presreve colours and flexibility
- For long-term preservation, 70-75% alcohol is used

C. Isopropyl alcohol

- It is cheap and easy to obtain. There are different strengths available (70% and 90%)
- 40% alcohol is preferred solution
- It can be hard on the specimens and tends to make them brittle with time

D. Buffering:

The preservatives can be buffered with a few drops of glycerin and a pinch of calcium carbonate. It is useful to maintain pH stability and preventing the damage, hardening, and shrinking of tissues in the specimens.

13.6 Steps for Specimen Preservation

A. Killing and relaxing of animals

B. Fixation

a. Stops cellular respiration

b. Kills decomposers like bacteria and fungi in the organisms

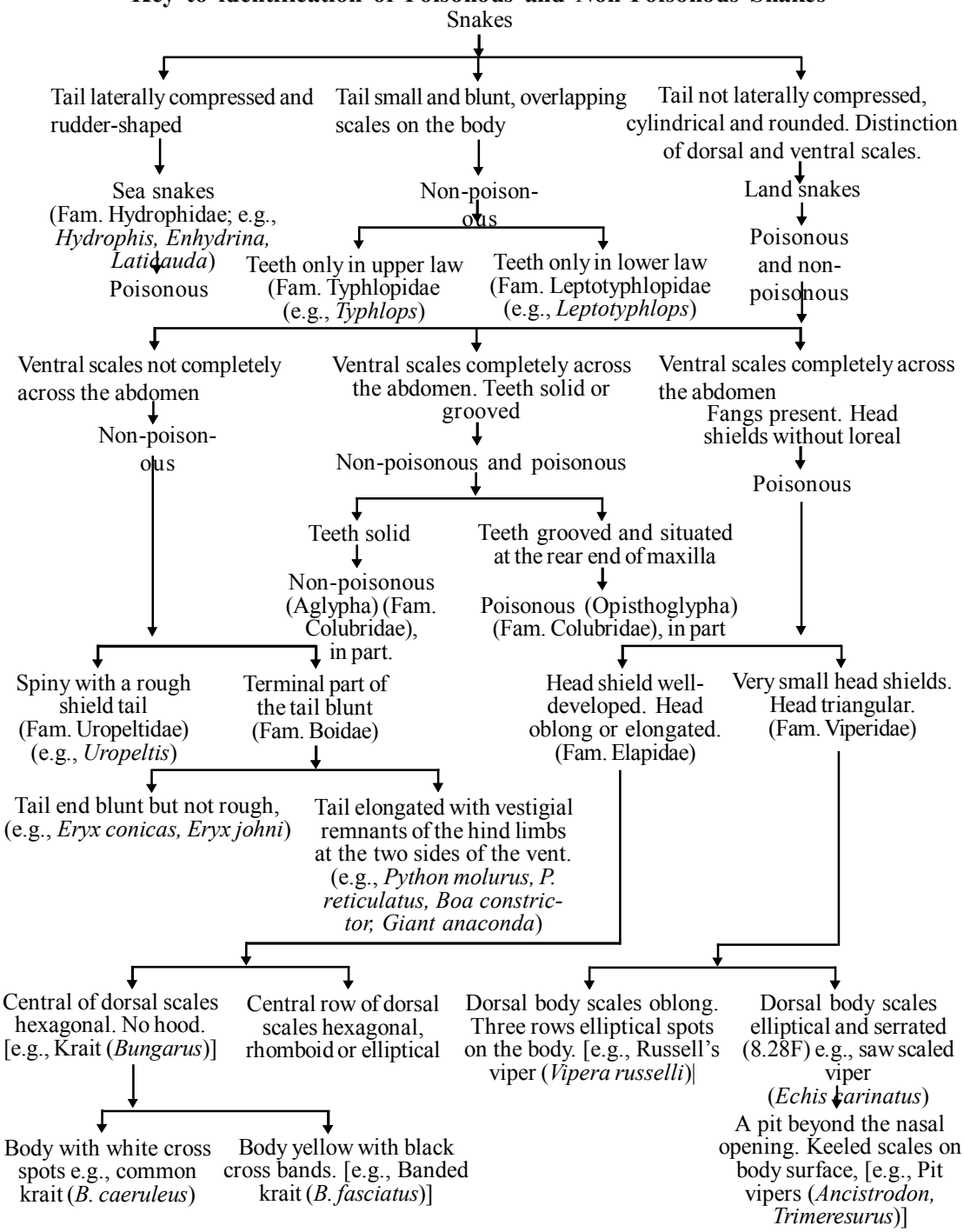
c. Good penetrating ability

C. Storage in bottles, jars vials, trays.

Unit-14 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-15 Study of different scales present in Animal Body

Structure

15.1 Introduction

A scale is a small, inflexible plate that outgrows from the creature's skin to give security. In lepidopteran species, scales are plates on the outside of the wings of the insect. They help in providing shading to the animal. Scales are very normal and have advanced on numerous occasions through focalized development, with changing design and capacity. Epidermal scales are horny, with extreme augmentations of the layer corneum. They were created in reptiles, and are additionally regular on uncovered skin in birds and vertebrates. Such scales are intermittently shed or shed step by step alongside the remainder of the layer corneum. The animal possesses different types of scales, namely, cosmoid, ganoid, placoid, and leptoid.

15.1 Fish Scales

Fish scales are dermally determined, explicitly in the mesoderm. This helps in recognizing and distinguishing them from the reptiles paleontologically. They do not have clawlike epidermal scales. The different scales that are present in fishes are:

- **Cosmoid Scales:** They are found on the Sarcopterygians. The internal layer of the scale is made of lamellar bone. On top of this lies a layer of elastic or vascular bone and afterwards a layer of dentine-like material called cosmine. The upper surface is keratin. The coelacanth has altered cosmoid scales that need cosmine and are more slender than genuine cosmoid scales.

- **Ganoid Scales:** Ganoid scales can be found on gars (family Lepisosteidae), bichirs, and reedfishes. Ganoid scales are like cosmoid scales, yet a layer of ganoin lies over the cosmine layer and under the enamel. Ganoin scales are jewel molded, glossy, and hard. Inside the ganoin are guanine compounds, glowing subsidiaries of guanine found in a DNA molecule. The brilliant property of these synthetic substances gives the ganoin its sparkle.
- **Placoid Scales:** Placoid scales are found on cartilaginous fish including sharks. These scales, likewise called denticles, are comparative in design to teeth and have one middle spine and two sidelong spines.
- **Leptoid Scales:**Leptoid scales are found on the surface of hard fish. As they develop they add concentric layers. They are organized in order to cover in a head-to-tail bearing, similar to rooftop tiles, permitting a smoother stream of water over the body and in this manner decreasing drag. They come in two structures which are cycloid scales that have a smooth external edge, and are generally normal on fish with delicate blade beams, like salmon and carp and ctenoid scales have a toothed external edge and are typically found on fish with sharp blade beams, like bass and crappie.

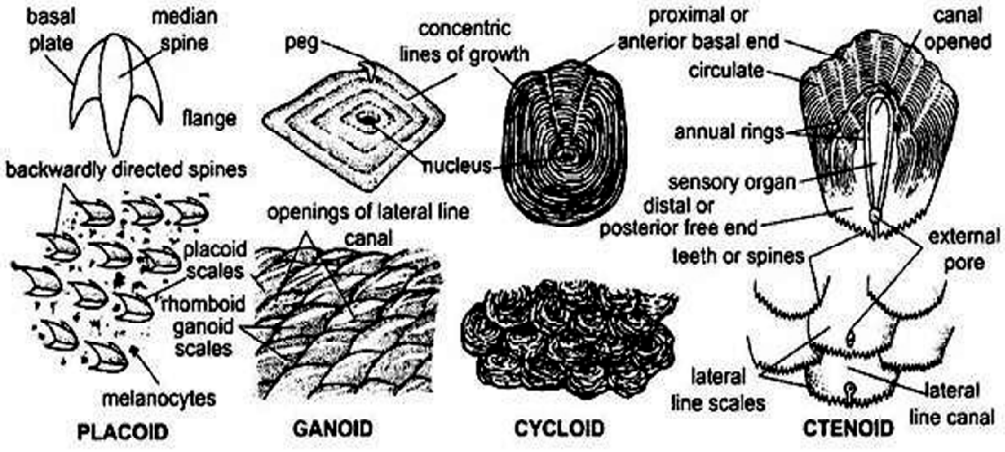


Figure: Different types of dermal scales found in fishes. Lower row show part of skin with numerous scales. Upper row shows single scales.(Source: https://www.notesonzoology.com/phylum-chordata/fishes/scales-of-fishes-with-diagram-vertebrates-chordata-zoology/8069#google_vignette)

15.2 Reptilian Scales

Reptile scales are cycloid and granular in nature that is uneven in shape. Scales ordinarily change in size, the stouter, bigger scopes cover parts that are frequently presented to actual pressure, while scales are little around the joints for adaptability. Most snakes have additional wide scales on the gut, each scale covering the stomach from one side to another.

Sizes of all reptiles have an epidermal part, however numerous reptiles, like crocodilians and turtles, have osteoderms fundamental to the epidermal scale. Such scales are all the more appropriately named scutes. Snakes, tuataras, and numerous reptiles need osteoderms. All reptilian scales have a dermal papilla fundamental the epidermal part, and it is there that the osteoderms, if present, would be shaped.

Table: Structure, Function, and examples of Animals Carrying Different Types of Scales.

Type of Scale	Structure	Function	Example
Cycloid	Smooth, rounded, and overlapping	Gives flexibility for movement	Snakes and some lizards
Granular	Small, bead-like, and non-overlapping	Used to camouflage and in reducing friction	Geckos and some lizards
Keeled Scales	Raised ridge (keel) along the center of each scale, making them rough	Improves grip, enhances camouflage, and helps in thermoregulation	Rattlesnakes, iguanas, and some skinks
Tuberculate	Small, wart-like raised	Provides rough texture for climbing and camouflage	Some geckos and iguanas
Scutes	Large, thick, bony, and non-overlapping	Provides strong protection and prevents water loss	Turtles, crocodiles, and some lizards
Hinged Scales	Specialized scales connected by flexible joints	Helps to curl into a ball for defense	Armadillo lizards
Imbricate Scales	Overlapping, shingle-like scales	Helps in smooth movement and flexibility	Many snakes and skinks

15.3 Mammalian Scales

These are present in the pangolin. Its scales are made of keratin and are utilized for insurance, like an armadillo's protection. They have been concurrently advanced, being irrelevant to warm-blooded animals' removed reptile-like progenitors, then again, actually, they utilize a comparable quality. The musky rodent kangaroo has scales on its feet and tail. The exact idea of its indicated scales has not been concentrated exhaustively, yet they give off an impression of being primarily unique in relation to pangolin scales. Foot cushion epidermal tissues in most warm-blooded animal species have been contrasted with the sizes of different vertebrates. They are likely gotten from cornification measures or hindered hide similar to avian reticulate are taken from hindered feathers.