

PAPER III

CHORDATA

The animal kingdom is divided into two sub-kingdoms:

- I. Chordata
- II. Non-Chordata

GENERAL CHARACTERS OF CHORDATES:

The Chordate characters appear in the developmental stage will persist in the adult or modified in the adult or disappeared in the adult

They are,

1. PRESENCE OF NOTOCHORD: It is an elastic, longitudinal stiff rod present between the nerve cord and alimentary canal. It is covered by an outer chodal sheath and inner elastic sheath or elastic-internal. Below it vacuolated, non-nucleated cells are present. Notochord is present in the embryos of the vertebrates, but is replaced by vertebral column. In less-developed vertebrates the notochord is present throughout the life.

2. PRESENCE OF PHARYNGEAL GILL SLITS: Gill slits are present on either side of the pharynx. Each gill slit develops in the embryonic stage by evaginations of endoderm in pharynx with a corresponding invagination of ectoderm on the outside of the body. They are useful for respiration. In reptiles, birds and mammals, there are several pairs of gill slits in embryonic life, but they are not functional hence they are closed.

3. PRESENCE OF DORSAL TUBULAR NERVE CORD: The nerve cord in chordates is a hollow tube, situated dorsal to the alimentary canal and the notochord. It develops from the ectoderm. The cavity of nerve cord is called neurocoel.

These chordate characters appear in the developmental stages and they may remain or change or disappear in the adult. The following characters are seen in all most all chordates.

4. TRILPLOBLASTIC NATURE:

They possess three germ layers,

1. Ectoderm,
2. Mesoderm,
3. Endoderm.

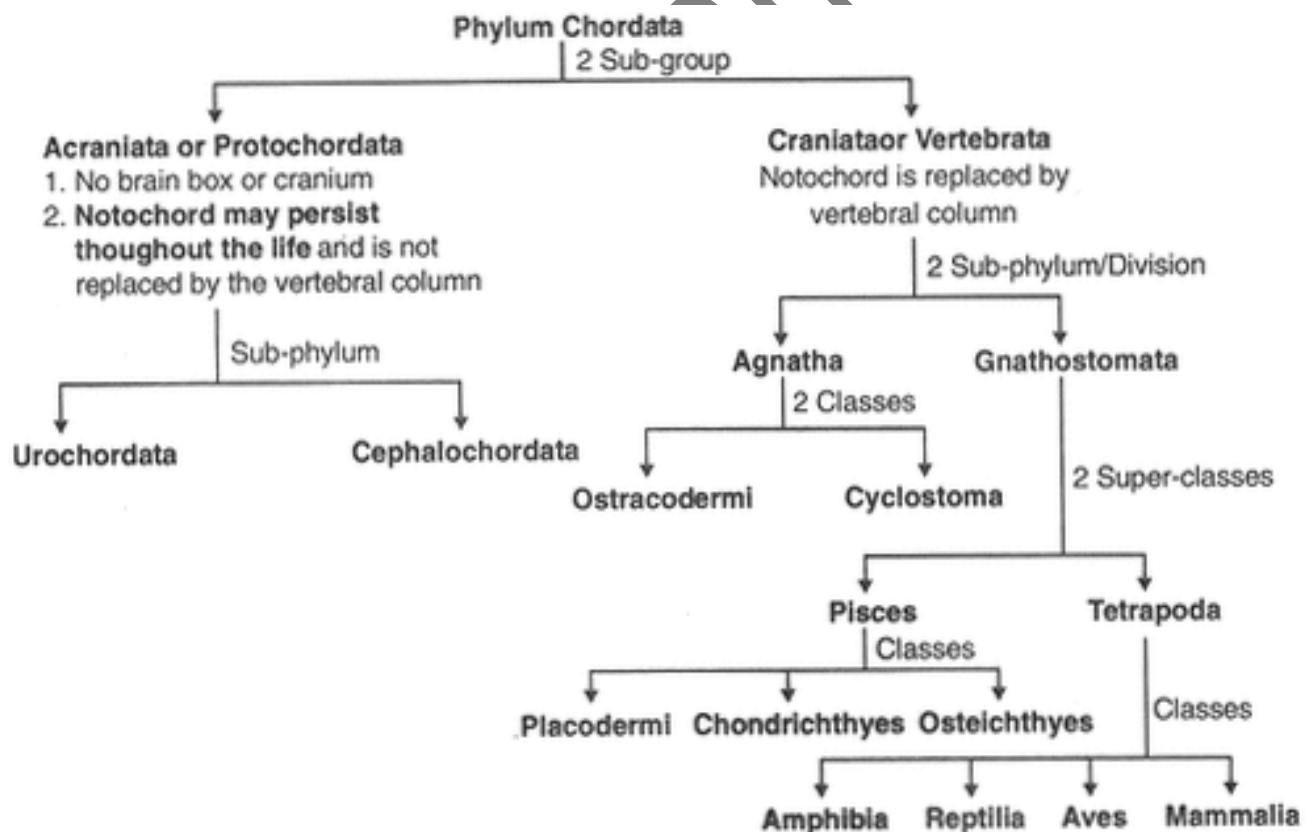
5. DEVELOPMENT OF TRUE COELOME: In all the chordates a true coelom is present. It develops from mesoderm. The coelom is developed by enterocoelic method.

6. PRESENCE OF BILATERAL SYMMETRY: The body of the chordates show bilateral symmetry. Their body can be divided into two equal halves, through a sagittal plane which passé longitudinally.

No chordate animal possesses ideal bilateral symmetry, but they are near to such condition.

7. REDUCTION OF METAMERIC SEGMENTATION: Among the chordates, metamerism is seen in the internal structures. The myomeres are seen in lower chordates and segmentation is seen in the embryonic condition of higher vertebrates.

CLASSIFICATION:



PROTOCHORDATA:

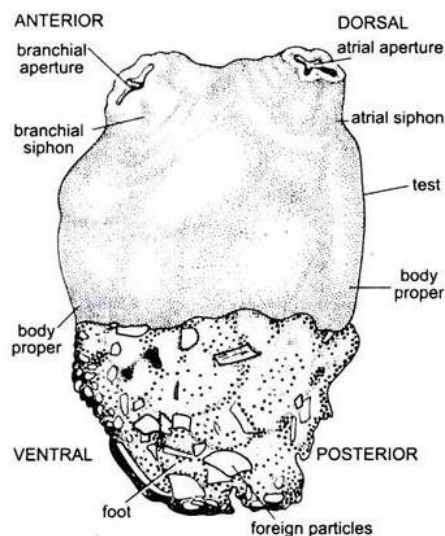
IDENTIFICATION: *Herdmania*

CLASSIFICATION:

Phylum : Chordata
Sub-phylum : Urochordata
Class : Ascidiacea
Genus : *Herdmania*

COMMENTS:

1. *Herdmania* is a simple ascidian.
2. *Herdmania* is a marine and sedentary animal. It is fixed to rocky substratum by a flat base. When it is disturbed, it suddenly contracts its body, and emits inner contents with force through its apertures. Hence it is called Sea squirt.
3. It is potato like in shape. It is pink in colour.
4. On the free side, body shows two projections, the branchial and atrial siphons. The branchial siphon is short. The branchial siphon shows a branchial aperture or the mouth. The atrial siphon is longer. It bears the atrial aperture. Both the openings are bounded by four lips.
5. The body of this animal is covered and protected by test. It is a thick, leathery covering of the body. It is secreted by the epidermis of the body wall. It has matrix, corpuscles, fibrils, blood vessels and spicules.
6. The matrix is composed of tunicin, which is cellulose. The cells in the test are of six types, large eosinophilous cells, amoeboid cells, small eosinophilous cells, vacuolated cells, receptor cells and nerve cells.
7. The body-wall of *Herdmania* is called Mantle. It is thick, and muscular in the antero-dorsal region of the body.



Herdmania

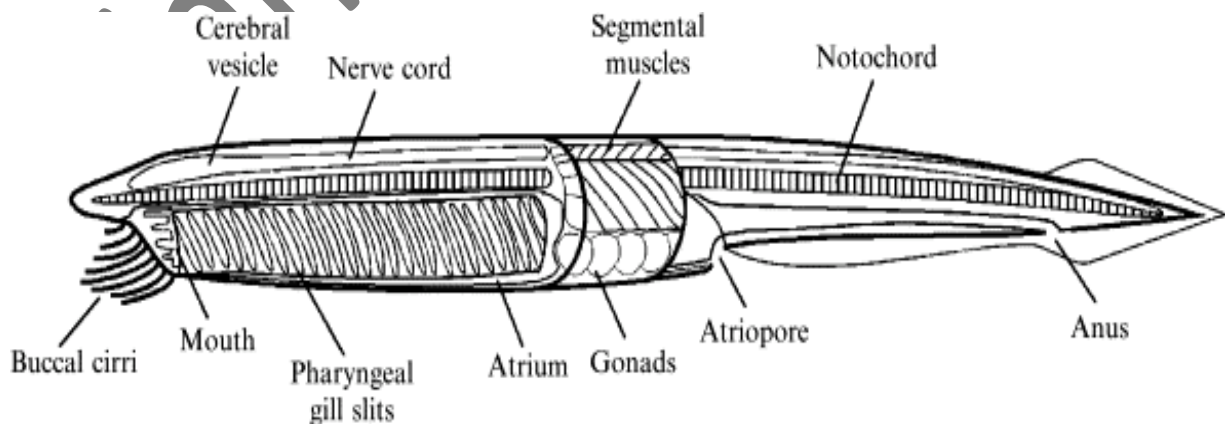
IDENTIFICATION: *Amphioxus Lanceolatum*

CLASSIFICATION:

Phylum : Chordata
Sub-phylum : Cephalochordata
Class : *Amphioxus*
Genus : *Lanceolatum*

COMMENTS:

1. Amphioxus is commonly known as the lancelet because of its shape.
2. It is a translucent, elongated, laterally compressed animal and pointed at both ends, with anterior end projecting as the rostrum.
3. It is a fish like animal found burrowing in shallow seas, with sandy bottom.
4. Fins are low and continuous with each other, a dorsal, a ventral and a caudal fin. There are two metapleural folds, extending up to atriopore.
5. From the anterior end of the ventral fin, the ventral surface of the body is flattened and lateral edges project as two longitudinal fins like folds called Metapleural folds.
6. The myotomes (muscle bands) are arranged on both the sides separated by V-shaped connective tissue partitions, the myosepta.
7. Alimentary canal is straight. The mouth is ventral to rostrum and guarded by oral hood bearing numerous oral cirri. The anus lies on the left side, a short distance in front of the posterior end.
8. The gonads consist of 26 pairs which are metamericly arranged on both sides of the pharynx.
9. Sexes are separate but sexual dimorphism is absent. Development is indirect.



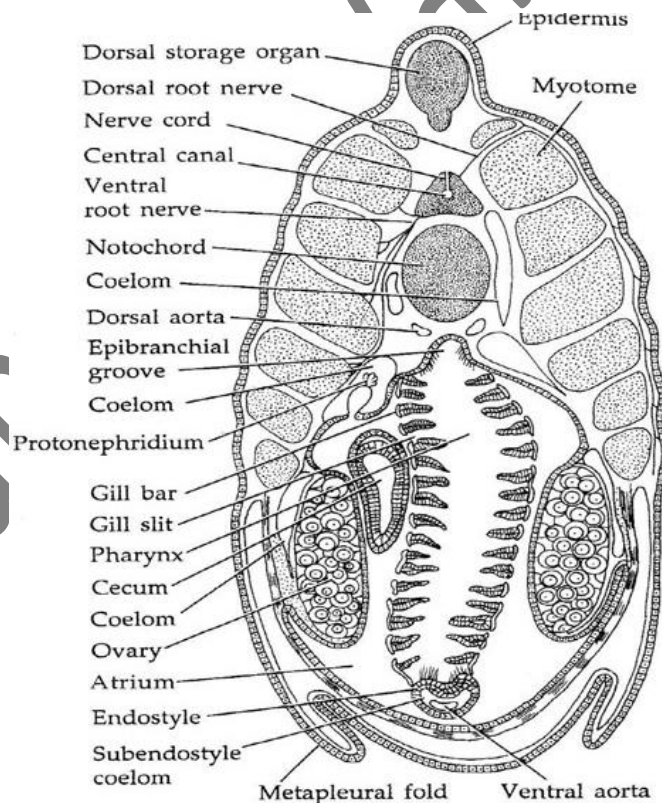
Amphioxus Lanceolatum

IDENTIFICATION: T.S of *Amphioxus* passing through pharynx.

COMMENTS:

It reveals the following features:

1. Body wall is formed by epidermis, which is composed of a single layer of simple columnar epithelium.
2. Dorsal fin containing the single row of fin rays composed of gelatinous material covered with connective tissue.
3. Dorsal tubular nerve chord is present below the dorsal fin.
4. Myotomes and myocommata of both sides alternate with each other.
5. Notochord comprising of vacuolated cells is surrounded by notochordal sheath lies below the nerve chord.
6. The pharynx is quite spacious and surrounded by atrial cavity.
7. The pharynx is perforated and supported by primary and secondary gill bars.
8. The middorsal line of pharynx, a ciliated epipharyngeal groove is present.
9. A pair of dorsal aorta is present on epipharyngeal groove.
10. In the mid ventral line, there is a glandular endostyle.
11. The coelom appears as dorsal coelomic canals on either side of the epipharyngeal groove.



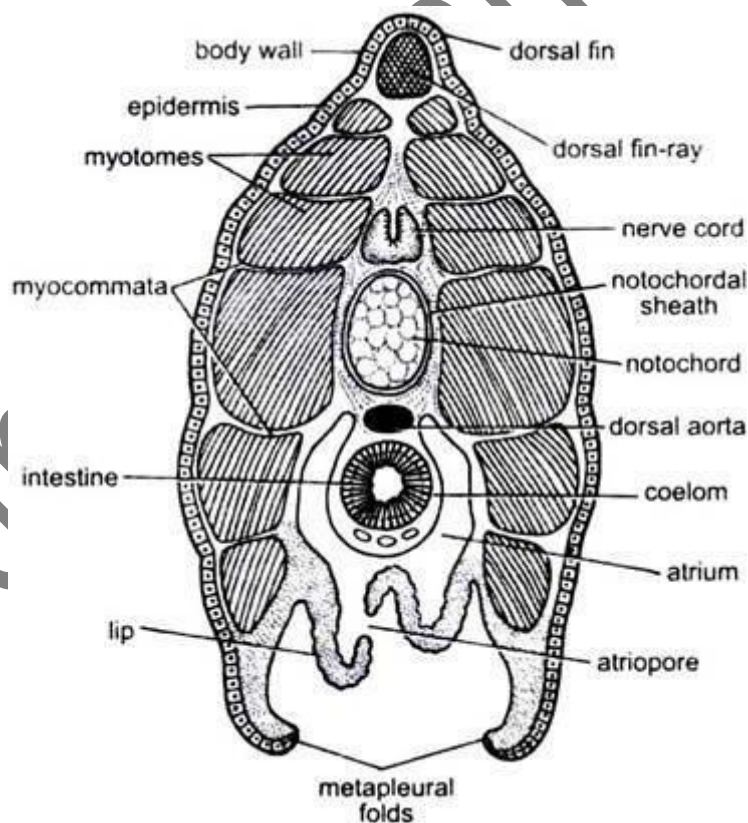
T.S of *Amphioxus* passing through pharynx.

IDENTIFICATION: T.S. of *Amphioxus* passing through intestine.

COMMENTS:

It has the following features.

1. Body wall is formed by epidermis composed of single layer of columnar epithelium.
2. Dorsal fin having the single row of dorsal fin rays.
3. Myotomes separated by myocommata are present on both side.
4. Nerve chord contains a central canal and lies below the dorsal fin ray.
5. Notochord composed of vacuolated cells and surrounded by notochordal sheath below the nerve chord.
6. Single medial dorsal aorta is seen ventral to the notochord.
7. The coelom is very well developed and surrounds the intestine by forming a coelomic cavity.
8. The intestine is oval, composed of single layer of ciliated epithelium.
9. The atrium is well developed and forms a atrial cavity, which lies ventral to coelomic cavity.
10. The atrial cavity contains several renal papillae.
11. The metapleural folds are present on the ventral side.



T.S. of *Amphioxus* passing through intestine.

CYCLOSTOMATA:

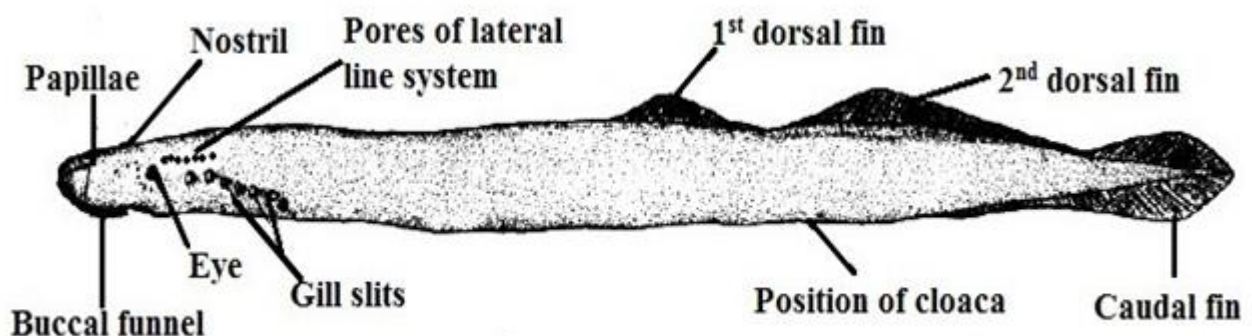
IDENTIFICATION: *Petromyzon marinus*

CLASSIFICATION:

Phylum : Chordata
Sub-phylum : Cyclostomata
Class : Petromyzontia
Genus : *Petromyzon*
Species : *marinus*

COMMENTS:

1. It is commonly called lamprey and it is found living in both salt and waters. They lead an ectoparasitic life (gets attached by buccal funnel on to the body surface of the fish and secretes anti- coagulant for sucking blood).
2. Body eel like, with two dorsal fins and one caudal fin supported by cartilaginous rays. It is divisible into Head, trunk, and tail. The skin is scaleless, slimy and heavily pigmented.
3. Mouth is circular and surrounded by a large, ventral suctorial funnel with numerous horny teeth. Tongue is piston like and toothed.
4. A pair of eyes are present without eyelids.
5. Nostril is single and dorsal. Jaws and paired fins are absent.
6. Seven pairs of external gill-apertures and well-developed branchial basket present.
7. The anus lies at base of tail and close behind it is a papilla, bearing the urinogenital aperture.
8. Sexes are separate in adults. Fertilization is external. Development includes ammocoete larva.

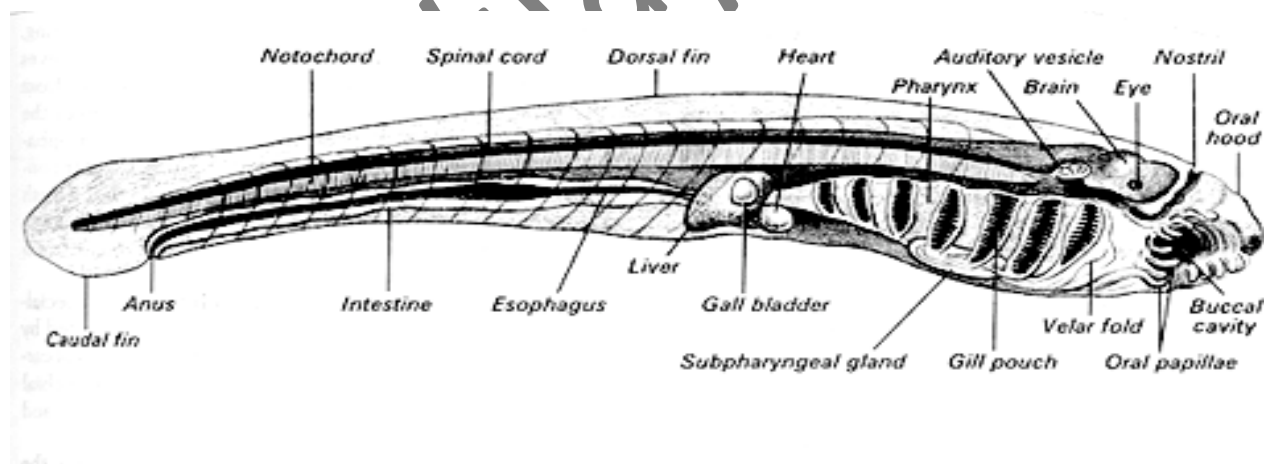


Petromyzon marinus

IDENTIFICATION: Ammocoete larva of *Petromyzon*

COMMENTS:

1. Ammocoete larva is the larva of *petromyzon*.
2. It looks like a minute translucent *amphioxus* of about 10mm long. Eel-like body is divided into head, trunk and tail.
3. The head contains a median nostril, an eye, an auditory vesicle and brain.
4. Paired eyes are present, but functionless.
5. The buccal cavity is surrounded by upper and lower lips and provided with number of buccal tentacles or oral cirri but lacks tongue and teeth.
6. At the posterior end of buccal cavity, there is velum which is followed by the pharynx.
7. Seven pairs of gills slits are present in the pharynx and endostyle lies along the ventral surface of the pharynx.
8. The alimentary canal consists of pharynx, oesophagus and intestine.
9. Three chambered heart, liver and gall bladder lies posterior to the pharynx.
10. The larval stage lasts for a long period of about 3-4 years and during this period it grows and becomes adult.



Ammocoete larva of *Petromyzon*

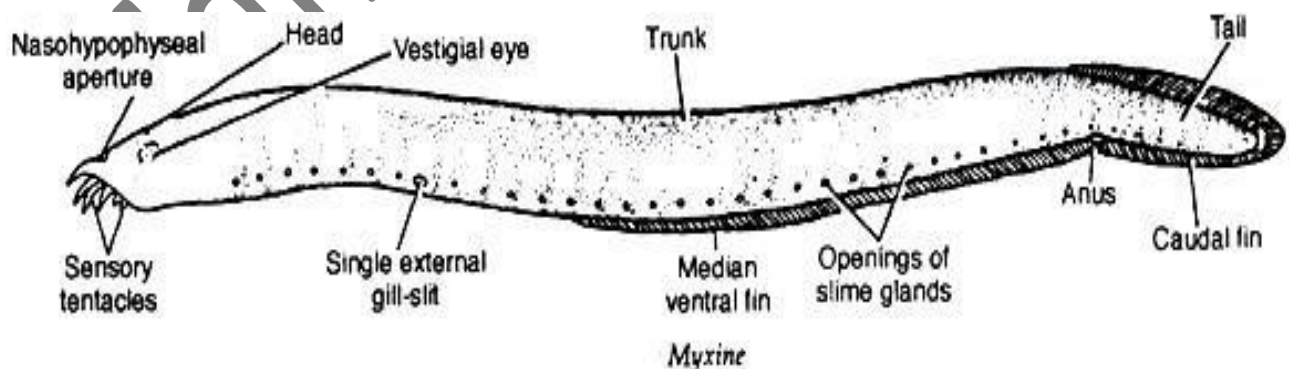
IDENTIFICATION: *Myxine glutinosa*

CLASSIFICATION:

Phylum : Chordata
Sub-phylum : Cyclostomata
Class : Myxinoidea
Genus : *Myxine*
Species : *glutinosa*

COMMENTS:

1. Myxine is commonly known as hag fish and is found buried in muddy sea bottom.
2. The body is eel like differentiated into head, trunk and tail. Body is covered with and covered with scales skin.
3. The mouth is terminal surrounded by soft lips.
4. Buckle funnel and jaws are absent; Branchial basket is also reduced.
5. Lateral to the mouth are four pairs of short tentacles supported by skeletal rods.
6. Nostril is single, lies very close to the mouth and opens terminally.
7. single pineal eye is visible on the top of the head.
8. Paired eyes are vestigial or degenerated due to bottom and opens terminally.
9. Six pairs of gills which do not open separately to the outside but open by a single external gill opening.
10. Single median fin runs from about the middle of the ventral surface extending around the tail region.
11. Large mucous glands are present which open by mucous pores.
12. Hermaphrodites. These are parasitic or quasi parasitic and nocturnal feeders.



Myxine glutinosa

PISCES:

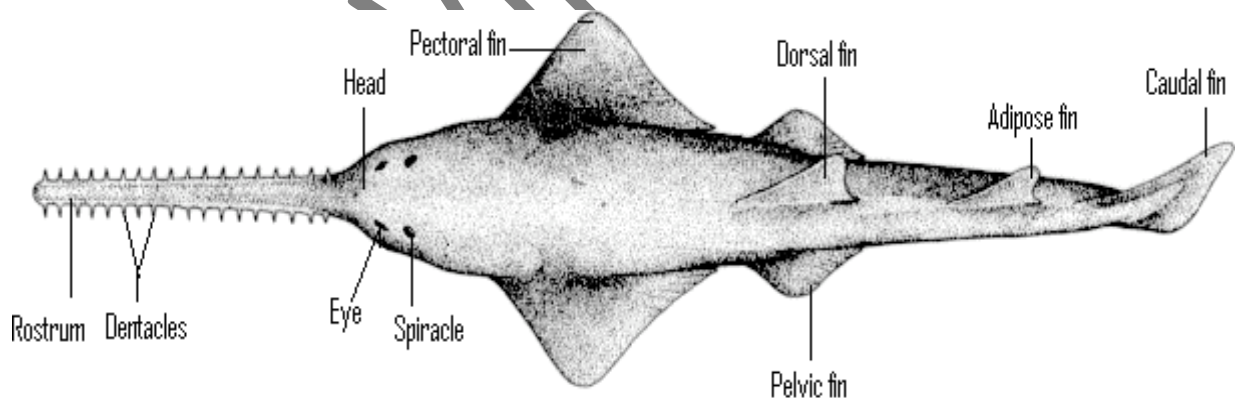
IDENTIFICATION: *Pristis* (Saw Fish)

CLASSIFICATION:

Phylum : Chordata
Class : Chondrichthyes
Order : Selachii
Genus : *Pristis*

COMMENTS:

1. It is found in Mediterranean and Atlantic Ocean.
2. Elongated body, shark like.
3. Head and skull prolonged into a long-flattened rostrum lateral margin of which is provided with a series of short tooth like denticles giving it the appearance of saw; hence it's called SAW FISH.
4. Tentacles in the rostrum are absent.
5. Spiracles (Respiratory openings) are present behind the eyes.
6. Dorsal fins are large.
7. Well-developed tail with terminating heterocercal caudal fin.



PRISTIS

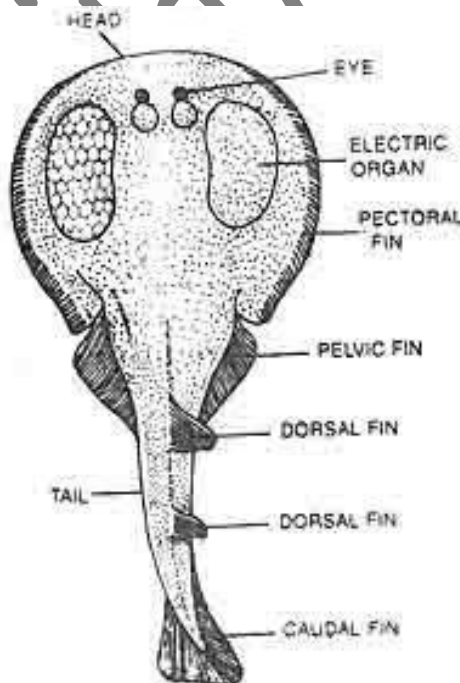
IDENTIFICATION: *Narcine* (Electric ray fish)

CLASSIFICATION:

Phylum : Chordata
Class : Chondrichthyes
Order : Selachii
Genus : *Narcine*

COMMENTS:

1. Dorsoventrally flattened body and disc shaped which is subcircular.
2. The subcircular anterior margin of the disc is supported in the centre by a branched pre-nasal rostrum and laterally by a branched pre orbital cartilages.
3. Skin is smooth without scales.
4. Pectoral fins are large and extend in front so as to be continuous with the head.
5. Eyes and spiracles are dorsal in position.
6. Mouth, gill clefts and nostrils are ventral in position.
7. Tail is fairly thick and bears two dorsal fins and a caudal fin.
8. They produce powerful electric shock.
9. The electric ray has two large electric organs on each side of its head in between pectoral fins, where current passes from the lower to the upper surface of the body.



Narcine

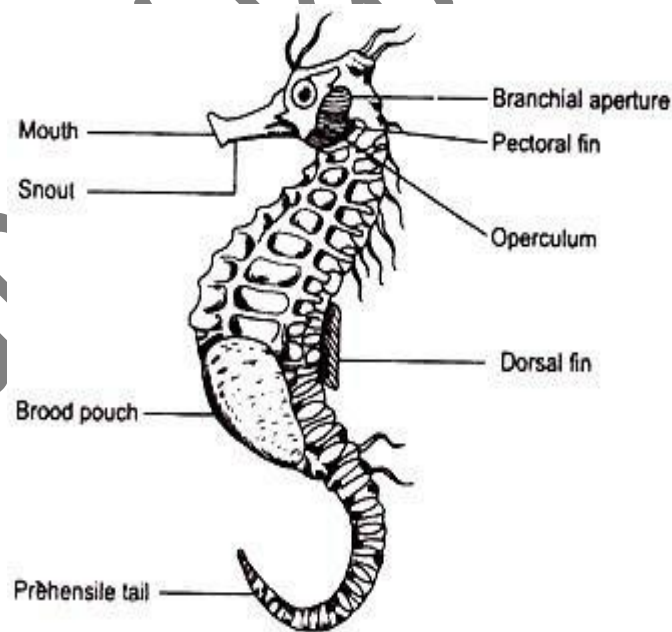
IDENTIFICATION: *Hippocampus* (Sea Horse)

CLASSIFICATION:

Phylum : Chordata
Class : Osteichthyes
Order : Syngnathiformes
Genus : *Hippocampus*

COMMENTS:

1. It is found in Indian and Atlantic seas.
2. Elongated body with an exoskeleton of rings.
3. Both jaws are prolonged into a long snout.
4. Mouth is present at the extremity of an elongated tubular snout.
5. Elevated trunk is compressed with 10-12 rings.
6. Pectoral and dorsal fins are small.
7. Pelvic and caudal fins are absent.
8. Tail is Prehensile and used for coiling around the sea weeds
9. Operculum is fused with the body wall ventrally and posteriorly leaving a small upwardly directed branchial aperture.
10. Sexes are separate. Male possess a brood pouch on the abdomen. In the brood pouch eggs are retained until they hatch as young ones.
11. It swims always in a vertical position by undulation of dorsal fin and exhibits mimicry by having numerous prominent spines.



Hippocampus

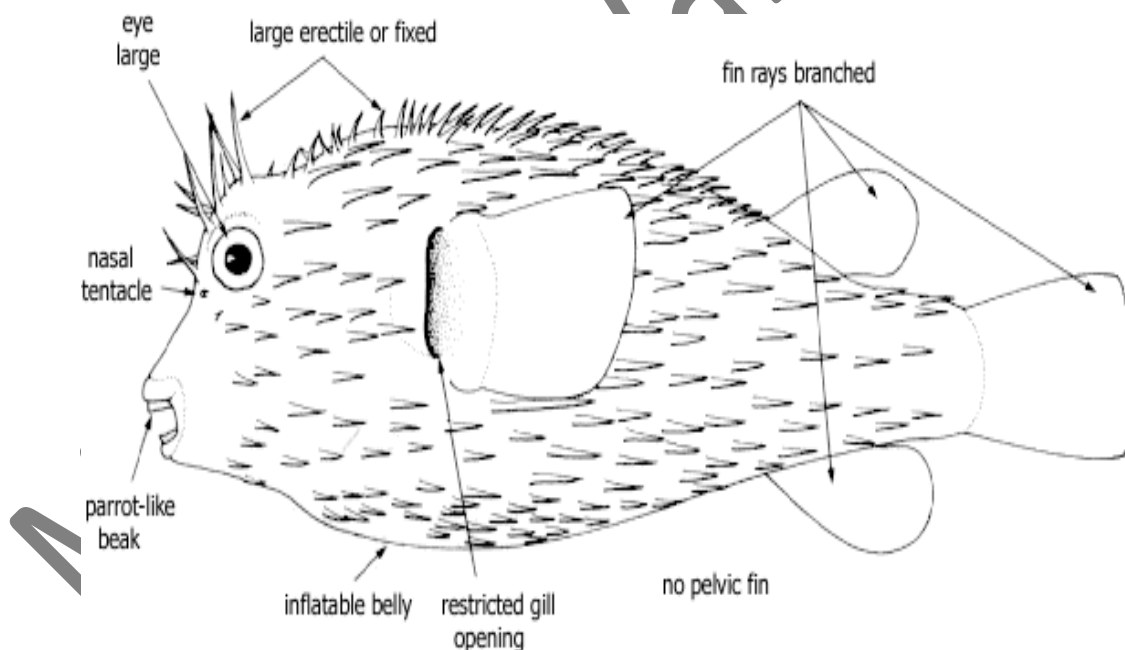
IDENTIFICATION: *Diodon*

CLASSIFICATION:

Phylum : Chordata
Class : Telostomi
Order : Tetrodoniformes
Genus : *Diodon*

COMMENTS:

1. It is found in tropical seas.
2. Body is globular.
3. Skin is covered with stiff and movable dermal spines.
4. Mouth opening is small and jaws are without median suture.
5. Dorsal and anal fins are placed opposite to each other.
6. Pelvic fins are totally absent.
7. Gills are three in number. Gill slit is situated near the pectoral fin.
8. A thin-walled inflatable gastric diverticulum is present which allows the whole body to be puffed into globular shape and the spines become defensively erected.



Diodon

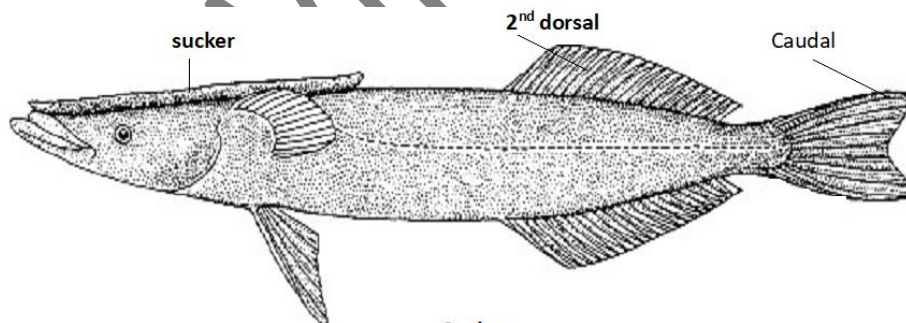
IDENTIFICATION: *Echeneis*

CLASSIFICATION:

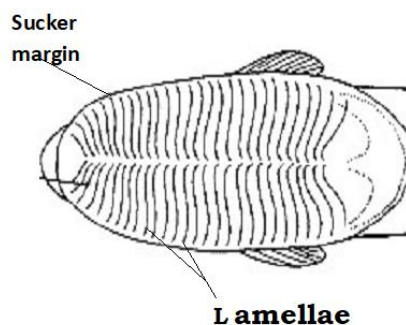
Phylum : Chordata
Class : Telostomi
Order : Echeneiformes
Genus : *Echeneis*

COMMENTS:

1. It is found in the tropical and sub-tropical seas.
2. Body is elongated, fusiform covered with small scales.
3. Head is depressed and furnished above with an adhesive organ.
4. Eyes are lateral in position.
5. Mouth cleft is wide and deep.
6. Anterior dorsal (first dorsal) fin modified as an oral sucker with a double parallel series of transverse scattered plates and ridges (called lamellae) to form an adhesive organ.
7. Second dorsal and anal fins are elongated without spines and opposed to each other.
8. Presence of Homocercal (both the lobes of caudal fin are equal sized) tail.
9. Air bladder is absent (devoid of buoyancy activity).
10. It attaches by means of adhesive organ to boats, sharks, turtles, cetaceans and other large swift swimming animals.



Echeneis



Organs of adhesion

ACCESSORY RESPIRATORY ORGANS:

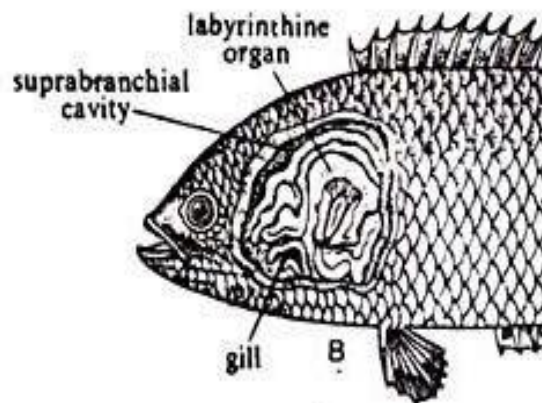
IDENTIFICATION: *Anabas* (Indian Climbing perch)

CLASSIFICATION:

Phylum : Chordata
Class : Telostomi
Order : Perciformes
Genus : *Anabas*

COMMENTS:

1. The accessory respiratory organs are well developed so as to enable the fish to live for longer durations of time out of water.
2. It has two air chambers, one on each side of head.
3. Air chambers are extensions of suprabranchial cavities as dorsal outgrowths of the gill chambers.
4. Air chamber contains concentrically arranged bony plates called labyrinthi-form organs.
5. Wavy plates are the outgrowths of first branchial arch.
6. The plates are covered with vascular mucous membrane which bring about respiration.
7. Each chamber communicates with the pharynx and the gill cavity.
8. Air is drawn in by mouth into the air chamber by the first gill slit and it passes out by the branchial aperture.
9. This fish is dependent on atmospheric oxygen to such an extent that it will drown, on denial to the surface to access the air.



Anabas

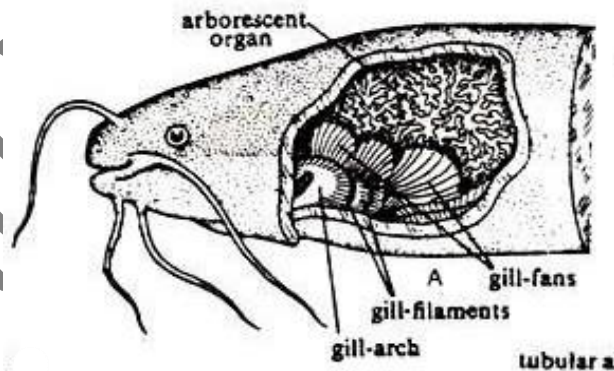
IDENTIFICATION: *Clarias* (Cat fish)

CLASSIFICATION:

Phylum : Chordata
Class : Telostomi
Order : Cypriniforms
Genus : *Clarias*

COMMENTS:

1. Accessory respiratory organs are branched tree like, especially designed to take in oxygen from the air.
2. Two air chambers (out growths of gill cavities) are arranged on either side of the head in supra branchial position.
3. Air chambers enclose complicated dendritic or arborescent organs (outgrowths of second and fourth branchial arches). Both, the air chambers and the dendritic organs are covered by vascular, mucous epithelium which function as lungs.
4. The fish comes to the surface of the water body to take in atmospheric oxygen through the mouth.



Clarias

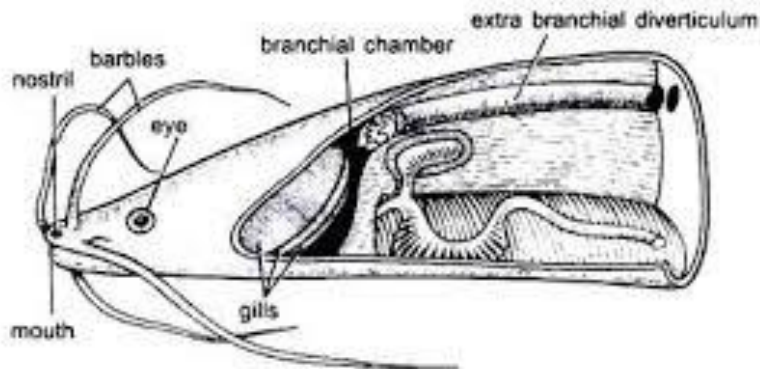
IDENTIFICATION: *Sacrobranchus/ Heteropneustes fossilis*

CLASSIFICATION:

Phylum : Chordata
Group : Telostomi
Order : Cypriniforms
Genus : *Sacrobranchus*

COMMENTS:

1. Body is elongated and laterally compressed.
2. Skin without scales.
3. Four pairs of long barbels are present.
4. Accessory breathing gill chambers present one on each side of the head.
5. The accessory respiratory organs are tubular extra branchial diverticula.
6. Branchial diverticulum are the out growths of the gill chambers.
7. They extend up-to the middle of the tail region.
8. At the end of branchial diverticulum, there are folds forming a sort of air chambers.
9. The air chambers communicate with the buccal cavity by a slit through which the air passes in and out.



Sacrobranchus

AMPHIBIA:

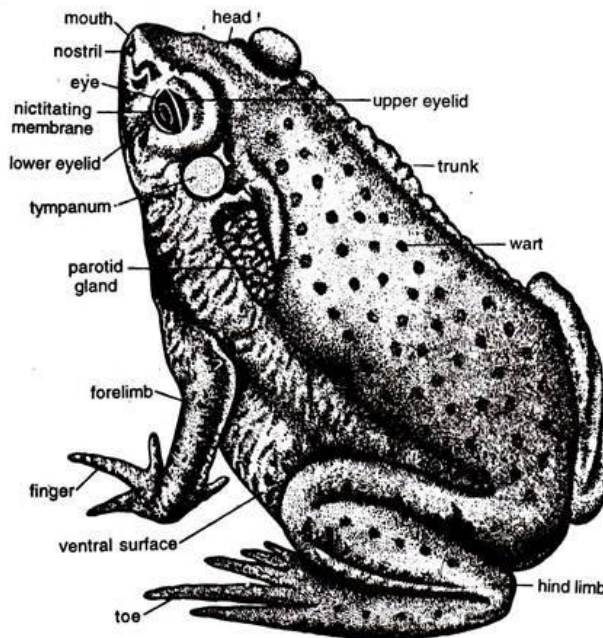
IDENTIFICATION: *Bufo melanostictus*

CLASSIFICATION:

Phylum : Chordata
Class : Amphibia
Order : Anura
Genus : *Bufo*
Species : *melanostictus*

COMMENTS:

1. *Bufo* is terrestrial and nocturnal in habit.
2. Rough skin, dry, and warty on the dorsal surface.
3. Eyes are large and nostrils are very small.
4. Well-developed Tympanum.
5. Paired parotid glands (which secrete irritating poisonous fluid) are present behind the tympanum.
6. Fore-limbs bear three webless fingers and a thumbpad that assists in copulation.
7. Hind limbs have three toes with a greatly reduced web (owing to the greater terrestrial habitat).
8. Teeth are entirely absent.



Bufo melanostictus

IDENTIFICATION: *Ambystoma* (old name: *Amblystoma*)

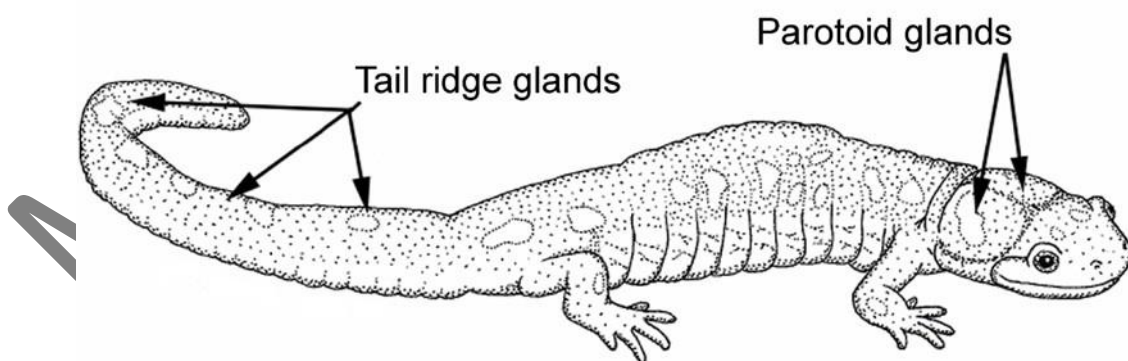
CLASSIFICATION:

Phylum : Chordata
Class : Amphibia
Order : Urodela
Genus : *Ambystoma*

COMMENTS:

1. Body is elongated and lizard like.
2. The colour of the body is black with yellow patches.
3. Body is having distinct head, trunk and tail.
4. Skin is poisonous.
5. Limbs are well developed, fore-limbs bear four fingers and hind limbs bear five toes.
6. Tail fin and external gills are absent in the adult stage.
7. Sexes are separate, fertilization is internal.
8. Development is indirect and the larval stage is known as axolotl which exhibits NEOTENY.

NOTE: Neoteny indicates extended larval period, while Paedogenesis is a condition where the larva becomes sexually mature and starts reproducing. Neoteny results when the larva grows in tyrosine deficient water consequentially resulting in the failure of thyroxine production, a hormone that regulates metamorphosis.

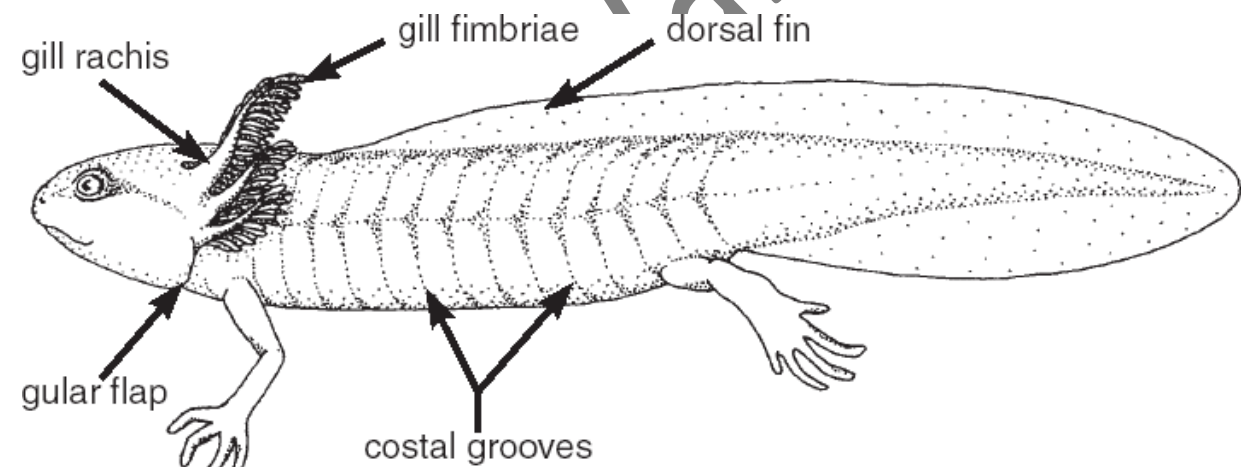


Ambystoma

IDENTIFICATION: *Axolotl larva*

COMMENTS:

1. Axolotl is larva of *Ambystoma*.
2. Body with distinct head, trunk and tail
3. Fore limbs and hind limbs are poorly developed.
4. Head with a pair of eyes, nostrils and mouth.
5. It possesses three pair of external gills and a tail having a caudal fin.
6. Axolotl larva exhibits the phenomenon of neoteny- extended larval growth. This happens due to iodine deficient water or low temperature leading to the failure of synthesis of adequate thyroxine hormone, the metamorphic hormone.
7. Axolotl larva under neotenic conditions becomes sexually mature and starts reproducing in the larval state (paedogeny). Thus, axolotl larva is both neotenic and paedogenic.
8. However, under congenial environmental conditions metamorphosis do takes place.



Axolotl larva

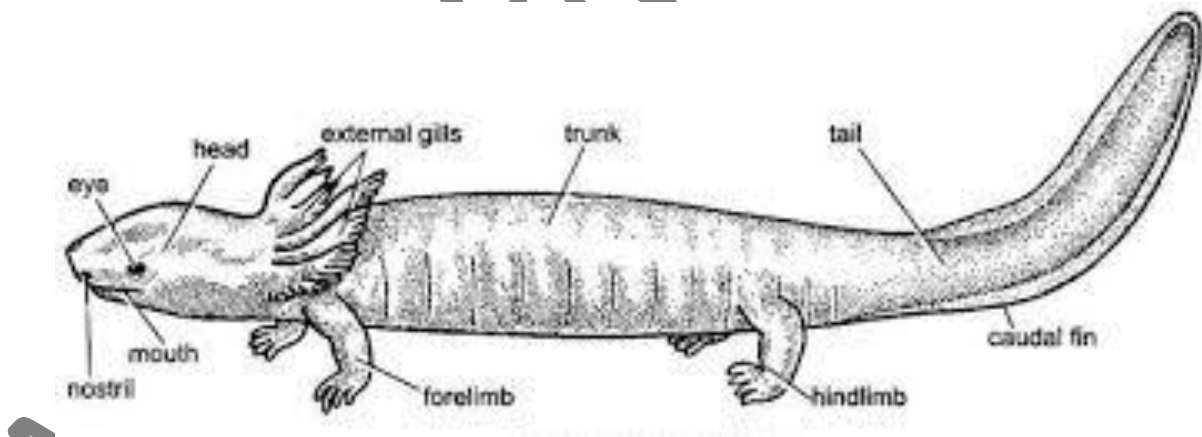
IDENTIFICATION: *Necturus* (Mud-puppy)

CLASSIFICATION:

Phylum : Chordata
Class : Amphibia
Order : Urodela
Genus : *Necturus*

COMMENTS:

- 1) Elongated body has a distinct head, trunk and tail.
- 2) Tail is long and bears a caudal fin.
- 3) The general colour of the body is rusty brown with blackish spots.
- 4) Three pairs of external gills are present in the adult.
- 5) It is a typical permanent neotenic larva and exhibits the following characters:
 - Eyes are lidless.
 - Skull largely cartilaginous.
 - Larval circulatory system.
 - Lateral line organs are present.
 - Permanently aquatic.
- 6) Lungs are present.



Necturus

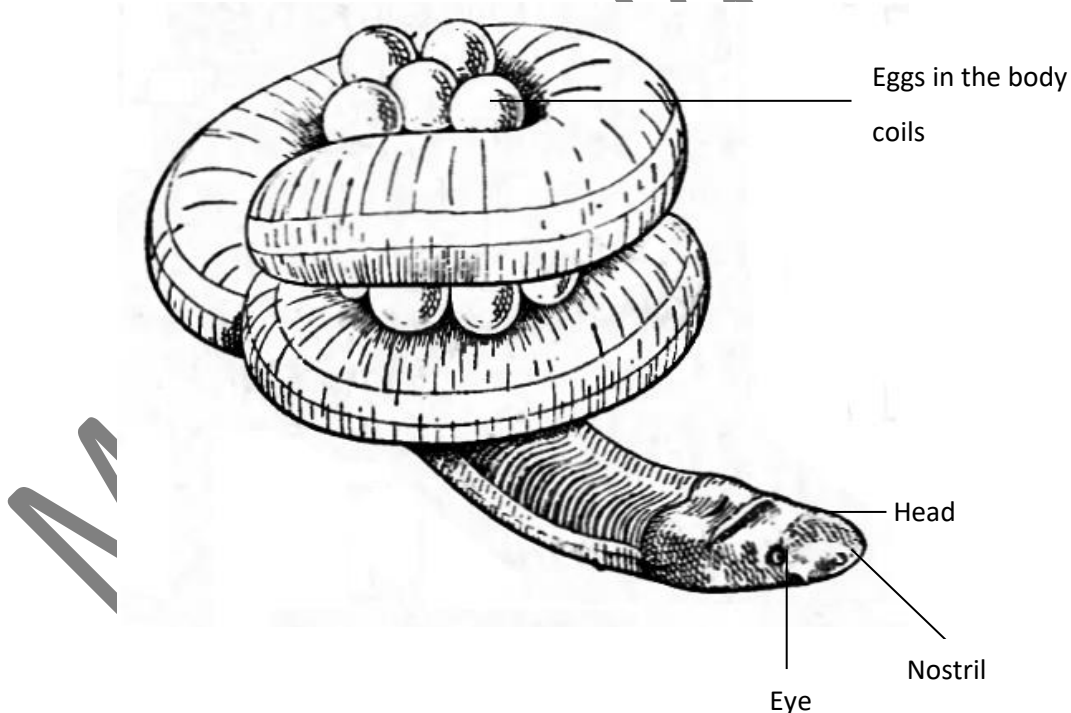
IDENTIFICATION: *Ichthyophis*

CLASSIFICATION:

Phylum : Chordata
Class : Amphibia
Order : Apoda
Genus : *Ichthyophis*

COMMENTS:

1. *Ichthyophis* is a burrowing, elongated and eel-like.
2. Body colour is dark brown or bluish black with yellow band along the side.
3. Skin is provided with numerous transverse grooves or wrinkles.
4. Minute scales are embedded in the grooves of skin.
5. Limbs and limb girdles are entirely absent. Tail is short and vestigial.
6. Eyes are minute devoid of lids buried deep in the head.
7. A protrusible tentacle present between the nostril and eye. It is a sensory organ.
8. Tympanica membrane is absent.
9. Parental care is well developed. Female coils herself around the gelatinous egg mass to protect it from ground burrowing animals.

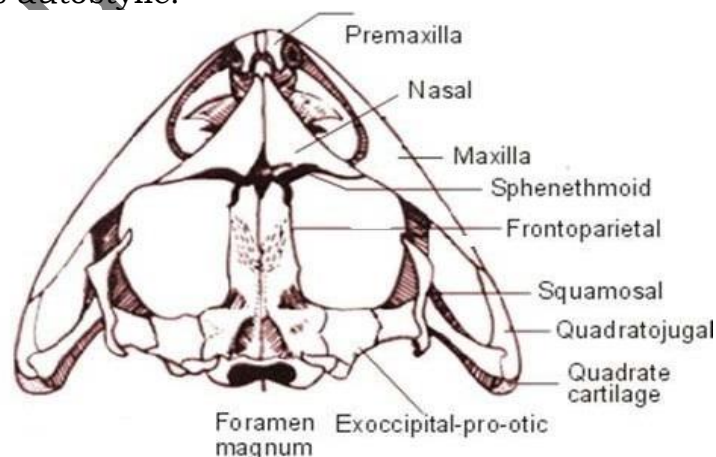


Ichthyophis

ENDOSKELTON OF FROG/ OSTEOLOGY OF FROG:

SKULL OF FROG:

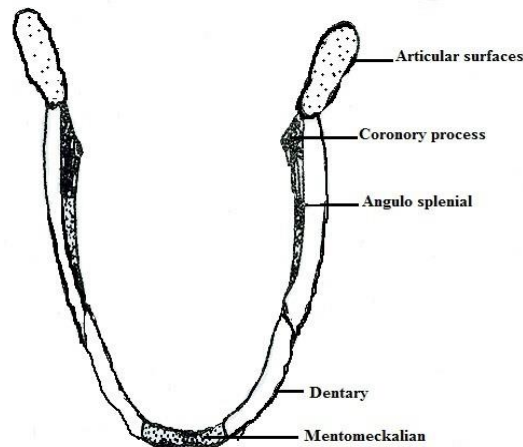
- 1) Skull of frog is triangular, broad and dorso-ventrally flattened.
- 2) It consists of three parts: Cranium, Sense capsule and Jaws.
- 3) Cranium encloses brain and consists of frontal, parietal and occipital regions.
- 4) Roof of the cranium is formed by a pair of fronto-parietals and the floor is formed by triradiate, dragger shaped para-sphenoid bone.
- 5) Sides of the cranium are made up of tubular sphenethmoid which is visible in front of the fronto- parietals.
- 6) Inter-orbital septum is absent and hence the cranium extends behind orbital hence called Platy basic skull.
- 7) Occipital region opens posteriorly through foramen magnum and is surrounded by a pair of exoccipitals each with a projection called occipital condyle, hence the skull is bicondylar.
- 8) Sense capsules include a pair of auditory capsules, enclosing organs of hearing and a pair of olfactory capsules: enclosing organs of smell.
- 9) Olfactory capsules: Situated anterior to the cranium. Dorsal side is formed by 2 triangular bones called nasals and on the ventral side are 2 irregular vomers bearing vomerine teeth.
- 10) Upper jaw forms the outer margin of the skull and is made up of two halves or ramus.
 - ✓ Each ramus consists of 3 bones viz., anterior premaxilla, middle maxilla and posterior quadratojugal.
 - ✓ Premaxilla and maxilla bear teeth.
 - ✓ The upper jaw is connected to cranium by 3 bones viz., palatines, pterygoid and squamosal.
 - ✓ Since upper jaw is fused with the cranium the jaw suspension is described as autostylic.



Skull of frog

LOWER JAW OF FROG:

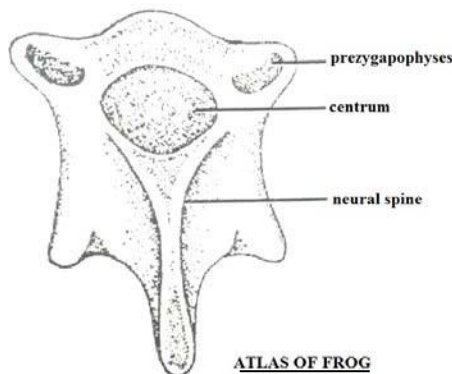
- 1) Lower jaw of frog is roughly-oval in outline, movable and without teeth.
- 2) It consists of 2 identical halves or rami which are connected anteriorly by a ligament.
- 3) Each ramus consists a core of Meckel's cartilage and 3 bone- mentomeckelian, dentary and Angulo splenial.
- 4) The Angulo splenial bears a coronary process just above the articular facet.
- 5) The lower jaw joins the pterygoids with the coronary process.



Lower jaw of frog

ATLAS VERTEBRA:

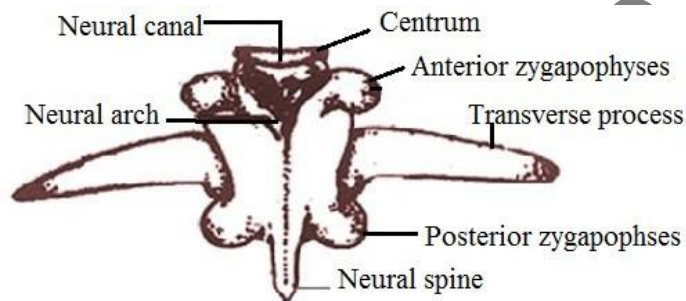
- 1) Atlas vertebra of frog is the first vertebra and articulates anteriorly with the skull.
- 2) It is a small ring-like bone.
- 3) Centrum and neural spines are reduced.
- 4) Transverse processes and pre-zygopophyses are also absent.
- 5) Anterior surface bears 2 concave facets to articulate with the occipital condyles of the skull.
- 6) Neural arch is flattened.
- 7) Post-zygopophyses are present on the posterior margin of the neural arch,
- 8) Neural canal is broad through which medulla oblongata continues as the spinal cord.



ATLAS OF FROG

CERVICAL VERTEBRA (TYPICAL VERTEBRA):

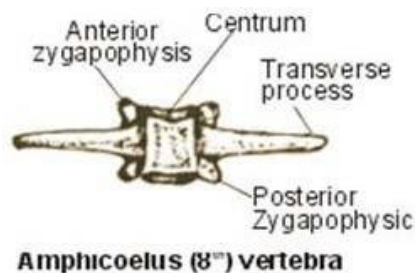
1. Second to seventh vertebrae of Frog are regarded as the typical cervical vertebrae.
2. Each vertebra consists of 5 parts viz., centrum, neural arch, neural spine, zygapophyses and transverse processes.
3. Centrum is the solid cylindrical bony part found on the ventral side. It is Procoelous - Concave in front and convex behind.
4. Neural arch arises from the dorsal surface of the centrum and form a semi-circular arch. It encloses the neural canal through which spinal cord passes.
5. Neural spine is directed backwards obliquely.
6. Zygapophyses: Pre-zygapophyses are directed upwards and inwards, while the post- zygapophyses are directed downwards and outwards.
7. Transverse processes are found on the lateral sides of the neural arch.



Typical vertebra

LUMBAR VERTEBRA: 8th vertebra of Frog

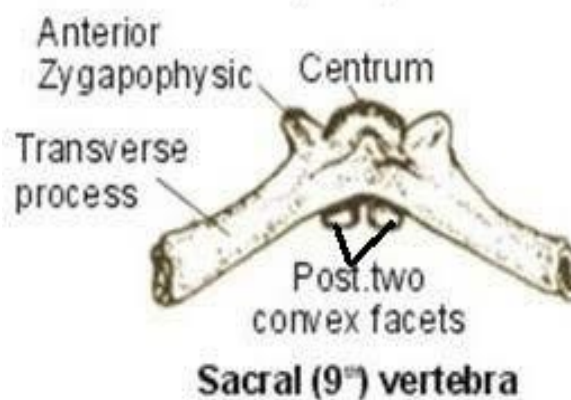
- 1) It consists of centrum, neural arch, neural spine, zygapophyses and transverse processes.
- 2) Centrum is amphicoelous i.e., concave at both ends. Anterior concavity receives the posterior convexity of 7th vertebra. The posterior concavity receives the anterior convexity of 9th vertebra.
- 3) Neural arch arises from the dorsal surface of the centrum and form a semi-circular arch.
- 4) It encloses the neural canal through which spinal cord passes.
- 5) Neural spine is obliquely directed backwards.
- 6) Zygapophyses: Pre-zygapophyses are directed upwards and inwards, while the post-zygapophyses are directed downwards and outwards.
- 7) Transverse processes found on the lateral sides of the neural arch support the dorsal body wall.



Amphicoelous (8th) vertebra

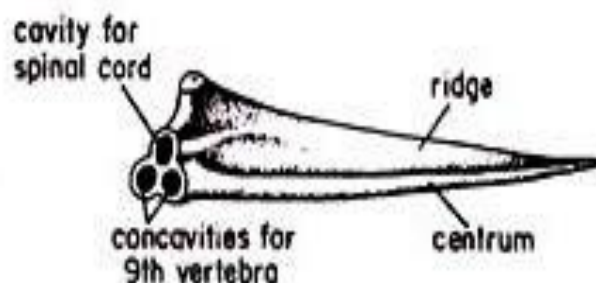
SACRAL VERTEBRA: 9th vertebra of Frog

1. Consist of 3 main parts viz., centrum, pre-zygopophyses and transverse processes.
2. Centrum is acoelous (biconvex) i.e., no cavity both the sides.
3. Anterior end has single convexity while posterior end has 2 knob-like convexities that fit into two corresponding cavities of urostyle.
4. Posterior zygapophyses absent.
5. Transverse processes are longer, thickest and strongest. Articulate with the ilia of pelvic girdle.
6. Neural arch and neural spine are greatly reduced.



UROSTYLE:

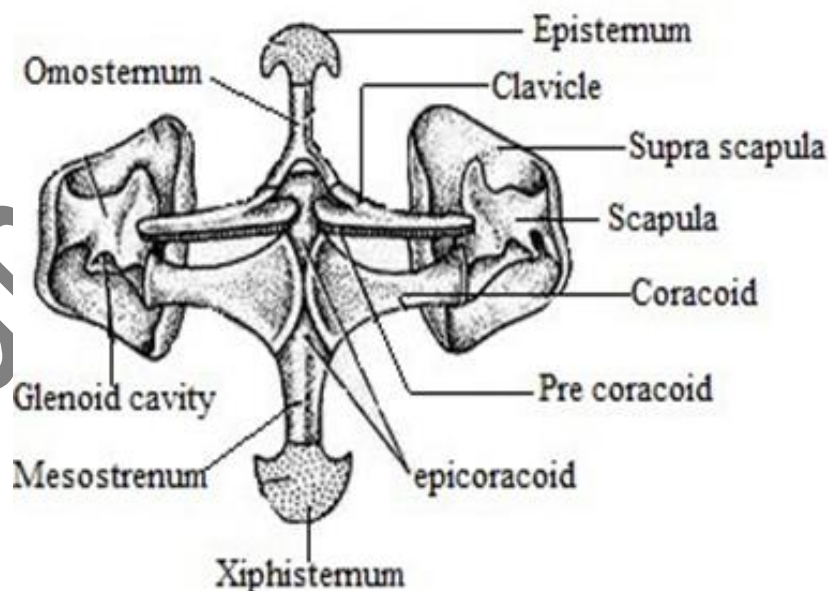
1. It is the posterior unsegmented part of vertebral column in the Frog.
2. Roughly triangular in outline with pointed apex directed backwards.
3. Centrum is rod-like with broad anterior face bearing two concavities for articulation with ninth vertebra.
4. Dorsal surface is raised into a vertical ridge and it gradually tapers posteriorly.
5. Anteriorly the ridge contains short narrow neural canal which enclose the terminal part of spinal cord.
6. Transverse processes, pre zygapophyses and post zygapophyses are absent.



Urostyle

PECTORAL GIRDLE:

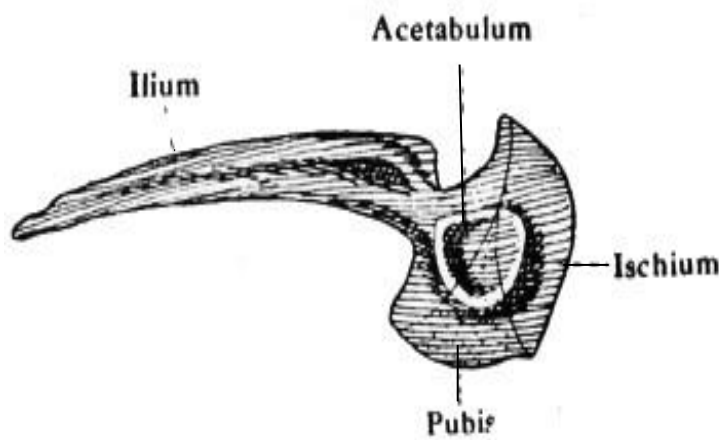
- 1) Pectoral girdle forms an arch enclosing the thoracic cavity.
- 2) It consists of 2 similar halves joined together ventrally with the sternum and separated dorsally.
- 3) Each half consists of well ossified scapula, coracoid and clavicle.
- 4) At the junction of the three bones is the glenoid cavity in which the head of the humerus articulates and makes a shoulder joint.
- 5) Scapula is cartilaginous, narrow in the middle and broad at both the ends.
- 6) Outer end has a broad, triangular calcified cartilaginous plate called supra scapula and anteriorly, near the proximal end there is a Acromion process.
- 7) Coracoid is a cartilaginous bone, narrow in the middle and broad at both the ends.
- 8) It has two cartilaginous structures: Precoracoid- attached to the clavicle and epicoracoid- connects the two coracoids posteriorly.
- 9) Clavicles are rod shaped, horizontally placed membrane bone which are slightly broad distally and narrow proximally.
- 10) Sternum consists of 4 parts - episternum, omosternum, mesosternum and xiphisternum.
 - Episternum: anterior most flat, almost circular cartilaginous plate,
 - Omosternum: inverted T shaped bony rod, connected to episternum on the anterior side and to clavicle on the posterior side.
 - Mesosternum: cartilaginous rod lying opposite to xiphisternum.
 - Xiphisternum: terminal broad cartilaginous plate lying at the tip of the mesosternum.



PECTORAL GIRDLE

PELVIC GIRDLE:

- 1) Pelvic girdle lies in the posterior region of the trunk and give support to the pelvic region and hind limbs.
- 2) It is V-shaped and composed of two similar halves called os-innominatum.
- 3) Each os-innominatum is made ilium, pubis and ischium.
- 4) Ilium is greatly elongated bone and its terminal part meet the transverse process of the 9th vertebra. It bears a prominent ridge called iliac crest on its dorsal surface.
- 5) Pubis is actually a small, triangular, calcified cartilage.
- 6) Ischium is slightly larger oval shaped bone.
- 7) Disc formed by the union of three bones contains a cup-shaped cavity called acetabulum that articulates with the head of femur bone.



PELVIC GIRDLE

REPTILIA:

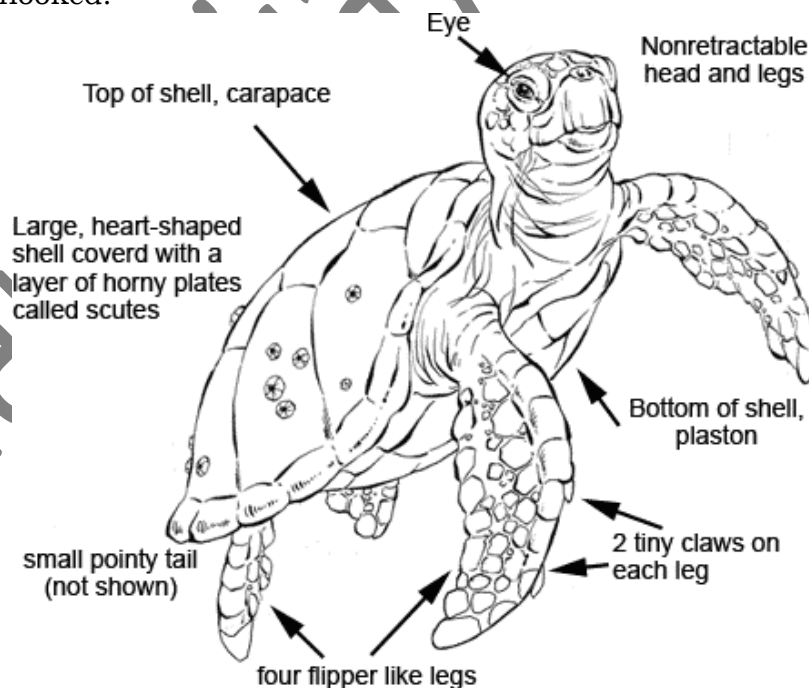
IDENTIFICATION: *Chelone* (Green turtle)

CLASSIFICATION:

Phylum : Chordata
Class : Reptilia
Order : Chelonia
Genus : *Chelone*

COMMENTS:

- 1) It is a marine form.
- 2) Body case is rigid. Carapace, flat and heart shaped and covered with smooth bony shields.
- 3) Plastron is joined to carapace by ligaments.
- 4) Dorsal shields are juxtaposed fitting closely into each other. Four pairs of costal shields are seen.
- 5) Head is covered with one pair of pre-frontal shields. The others are small.
- 6) Eyes are well developed with eyelids and nictitating membrane.
- 7) Fore and hind limbs form wing like paddles with one claw.
- 8) Tail is short. Head, tail and limbs are retractile inside the carapace, only first digit is clawed.
- 9) Jaws are not hooked.



Chelone

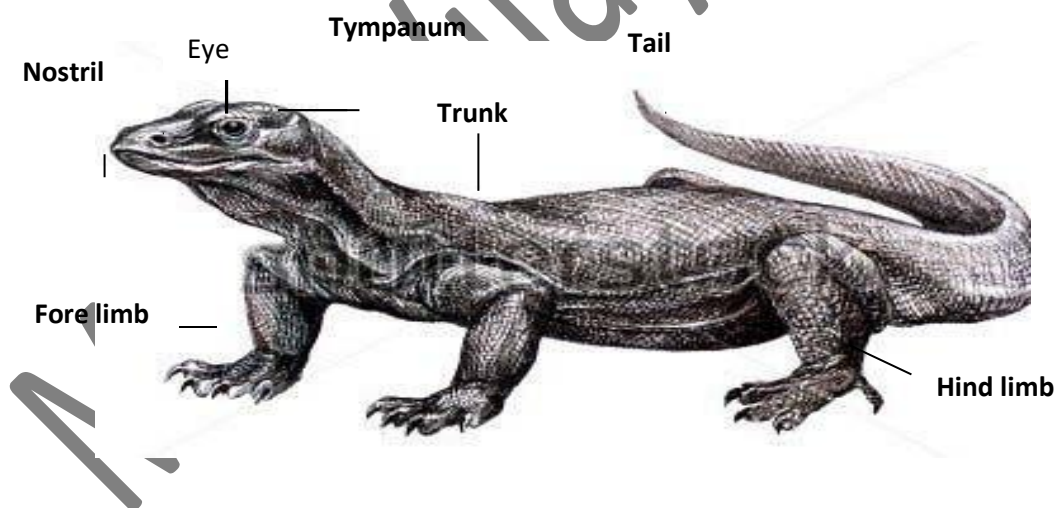
IDENTIFICATION: *Varanus* (Monitor lizard)

CLASSIFICATION:

Phylum : Chordata
Class : Reptilia
Order : Squamata
Sub Order : Lacertilia
Genus : *Varanus*

COMMENTS:

- 1) It is about 60-90cm in length and body divisible into head, neck, trunk and tail. The body has a brownish colour with dark spots.
- 2) Body covered with smooth small scales and tubercles above, while the ventral scales are squarish and arranged in transverse rows
- 3) Head is triangular and contain fixed eyes and nostrils. Neck is long.
- 4) Mouth is wide with a long bifid smooth and protrusible tongue. It can be retracted into a sheath. Pleurodont dentition is seen.
- 5) The limbs are short, strong and well developed. Powerful claws that help in climbing on the steep walls.
- 6) Tail is long, laterally compressed, thick with a fat reserve.



Varanus

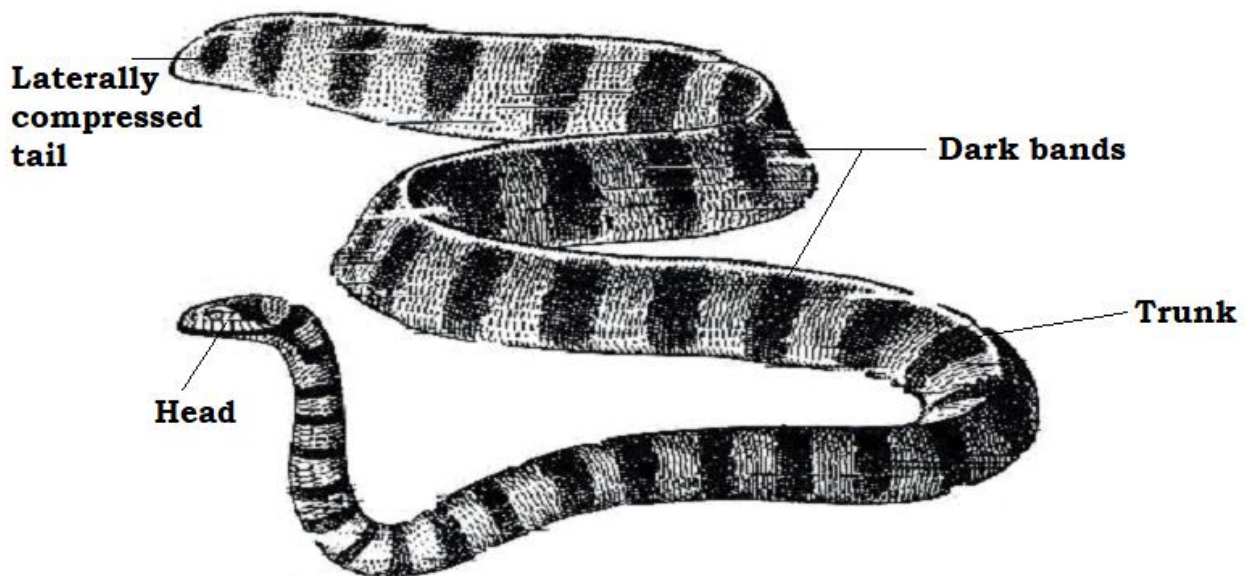
IDENTIFICATION: *Hydrophis* (Sea snake)

CLASSIFICATION:

Phylum : Chordata
Class : Reptilia
Order : Squamata
Genus : *Hydrophis*

COMMENTS:

- 1) It is poisonous (neurotoxic).
- 2) Body is elongated. Ventral scales are small.
- 3) It is generally dark olive green above with yellow cross bars and whitish below.
- 4) Head is indistinct and covered with large shields. Neck is slender.
- 5) Tail is laterally compressed and acts like paddle while swimming.
- 6) Eyes small with round pupil.
- 7) Loreal shield is absent. One pre-ocular, two post-oculars and 7-8 supra labials of which 3rd and 4th touch the eye.
- 8) Presence of 14-18 maxillary teeth behind the poison fangs.



Hydrophis

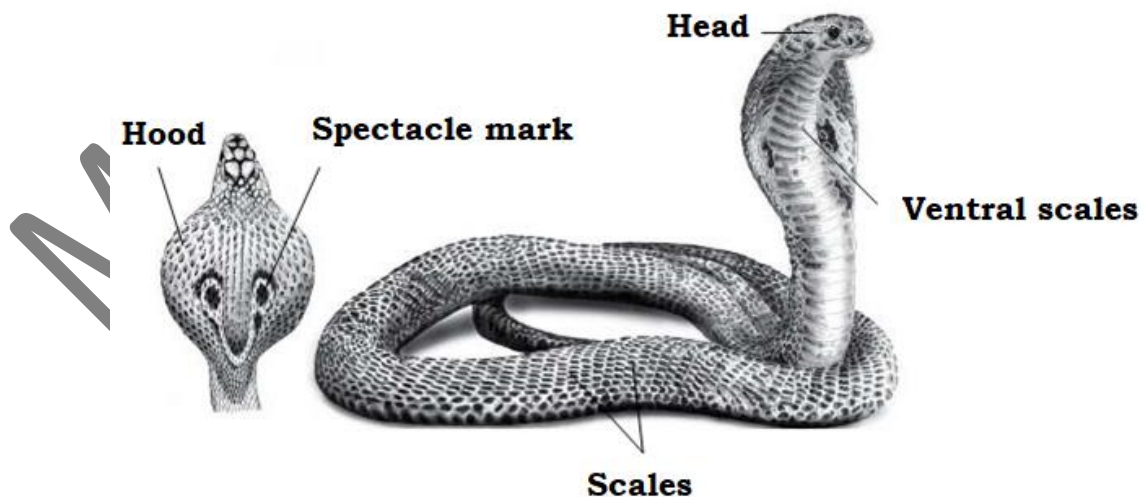
IDENTIFICATION: *Naja naja* (Indian Cobra)

CLASSIFICATION:

Phylum : Chordata
Class : Reptilia
Order : Squamata
Genus : *Naja naja*

COMMENTS:

1. Body is elongated, brown or black in colour.
2. Body is covered with smooth oblique scales with out pits and are arranged in 15-25 rows. The sub caudals form only two rows.
3. Head is not differentiated from the neck. Neck is dilatable and the cervical ribs are elongated. The expansion of the neck and cervical ribs form the hood.
4. The upper surface of head bears a binocellate, spectacle mark. However, in the same species which are found in North India monocular mark is found.
5. The lower surface of the hood bears two dark, round spots running to four scales surrounded by white lateral borders.
6. Eyes are small with round pupils.
7. Each nostril lies between two nasals and the internasal.
8. Loreal is absent. Frontal shield is truncated. 3 post ocular scales are present.
9. Third supralabial is large and touches the eye and the nasal shield.
10. Poison glands are followed by 1-3 small teeth.
11. Tail is cylindrical and tapering posteriorly.
12. Cobra is poisonous with neurotoxic venom.



Naja naja

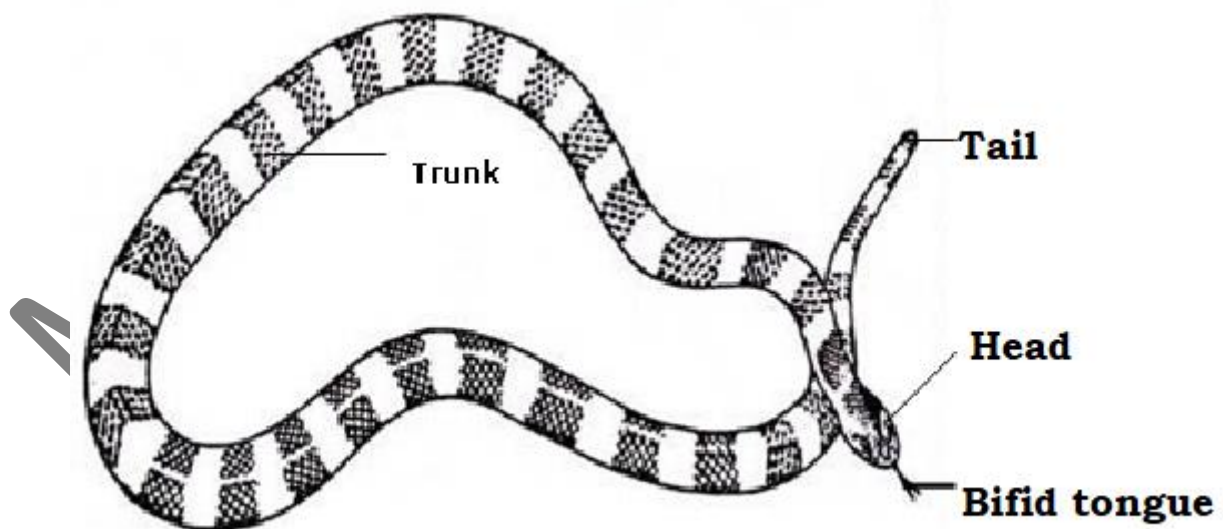
IDENTIFICATION: *Bungarus* (Krait)

CLASSIFICATION:

Phylum : Chordata
Class : Reptilia
Order : Squamata
Genus : *Bungarus*

COMMENTS:

1. It is poisonous (neurotoxic).
2. It is nocturnal, feeds on small snakes, toads and mice etc.,
3. Body is elongated and cylindrical, measuring about 1 meter in length.
4. Colour of the body is steel blue with narrow cross bars or white specks dorsally. Ventral surface is white.
5. Head with normal shields; not differentiated from the neck.
6. Third and fourth supra labials are touching the eye.
7. Eyes are of moderate size with narrow pupils.
8. Scales are smooth forming 13-17 rows, ventrals are 194-234 and caudals 42-52.
9. Enlarged chain of hexagonal scales is present on the mid dorsal side.
10. Ventral scales beyond the anal region are in a single row.
11. Oviparous and shows parental care.



Bungarus

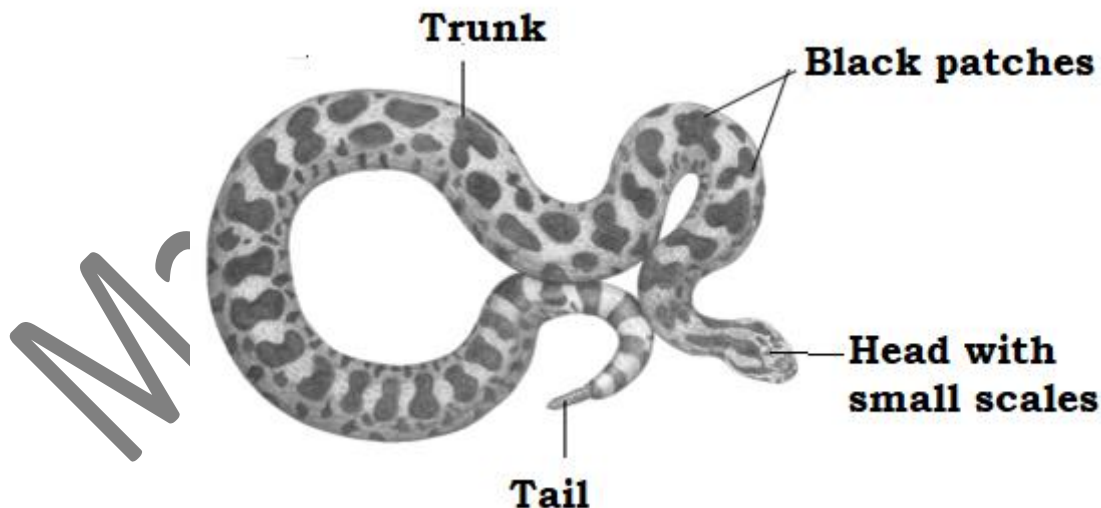
IDENTIFICATION: *Viper* (Russel's Viper)

CLASSIFICATION:

Phylum : Chordata
Class : Reptilia
Order : Squamata
Genus : *Viper*

COMMENTS:

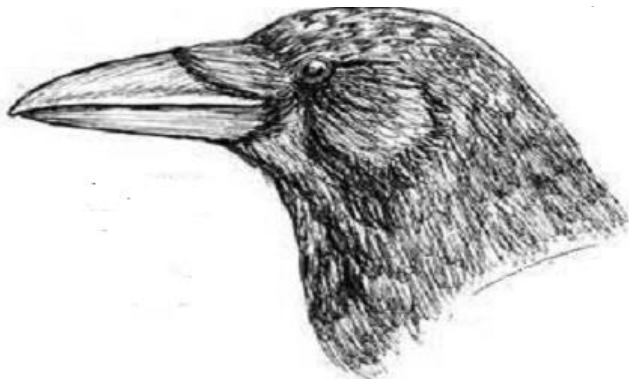
1. It is poisonous; venom is hemotoxic.
2. Carnivorous snake feeding mainly on small mammals, lizards and birds.
3. Body is elongated and measures up to 1 ½ mts.
4. Body colour pale brown above with three longitudinal series of black spots and underparts are yellowish white.
5. The scales form about 30 rows on the body.
6. Head is triangular and covered with very small imbricate scales on the upper surface.
7. Snout is angulate; the nasal openings are prominent the eyes are with golden iris and elliptical pupil.
8. Supra labials are 10-12. Fourth supra labial is the largest and does not touch the eye.
9. Most of the times shows octate resting position, in the form of '8'.



Viper

BEAK MODIFICATION IN AVES

1. **CROW**- The beak is long, strong, pointed and triangular for cutting and biting. It is provided with sharp horny cutting edges. This can be used for various purposes (omnivorous type of food)
2. **PARROT**- The beak is sharp, massive and deeply hooked. It is modified for fruit eating. The upper beak is movably articulated. This type of beak is well adapted for tearing, crushing and scooping out the flesh of the fruit and gnawing hard nuts and seeds
3. **KING-FISHER** - The beak is long, sharp, straight, heavy and pointed for plunging into water and for picking fishes. The beak acts like a forceps to catch the fish in flight.
4. **DUCK**- It is mud straining beak which is flat and broad. The margins of the beak are provided with transverse lamellae or horny striations making it an efficient filter or the sieve. The mud and water pass out leaving the food in the mouth
5. **HAWK**- It is adapted for piercing and tearing the flesh. The beak is short, the upper beak is deeply hooked and pointed with sharp edges. It helps in tearing upon the body of the prey and flesh and scoop out the flesh to feed on

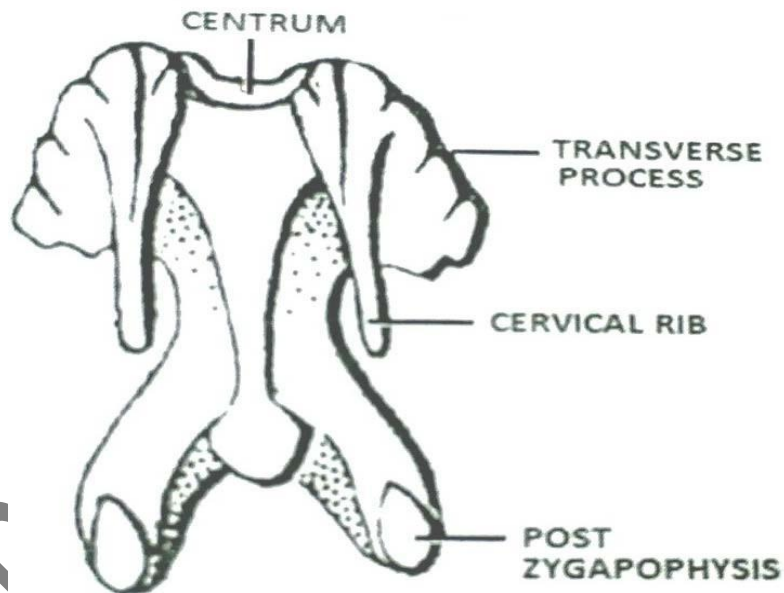


Beak of Crow, Hawk and Kingfisher

AVIAN ENDOSKELETON

HETEROCOELOUS VERTEBRA/Typical cervical vertebra of bird:

1. Composed of an elongated centrum, short neural arch, a rudimentary neural spine, transverse processes and zygapophyses.
2. Centrum is heterocoelous bearing saddle shaped articular surfaces.
3. Transverse processes are short and irregular arising laterally at the anterior end. They enclose vertebroarterial canals at their base.
4. Each process is fused with backwardly directed rudimentary cervical rib
5. Prezygapophyses and postzygapophyses are present.



HETEROCOELOUS VERTEBRA

SYNSACRUM:

1. It is a composite bone of thoracic region formed by the fusion of 14-16 vertebrae.
2. Synsacrum is a characteristic feature of birds which gives immense strength to back which is a necessity for aerial adaptation.
3. It is formed by the fusion of 16 vertebrae (last thoracic, 6 lumbar, 2 sacral and about 7 caudal vertebrae) Supports the ilium of pelvic girdle on both sides.
4. Last thoracic vertebra bears a pair of free thoracic ribs and hypophysis is absent.
5. Neural spines of last thoracic and lumbar vertebrae are fused to form a continuous vertical crest.
6. Transverse processes are free and stout. They touch the ilia of pelvic girdle.
7. Posterior region of the synsacrum is formed by the remaining caudal vertebrae.

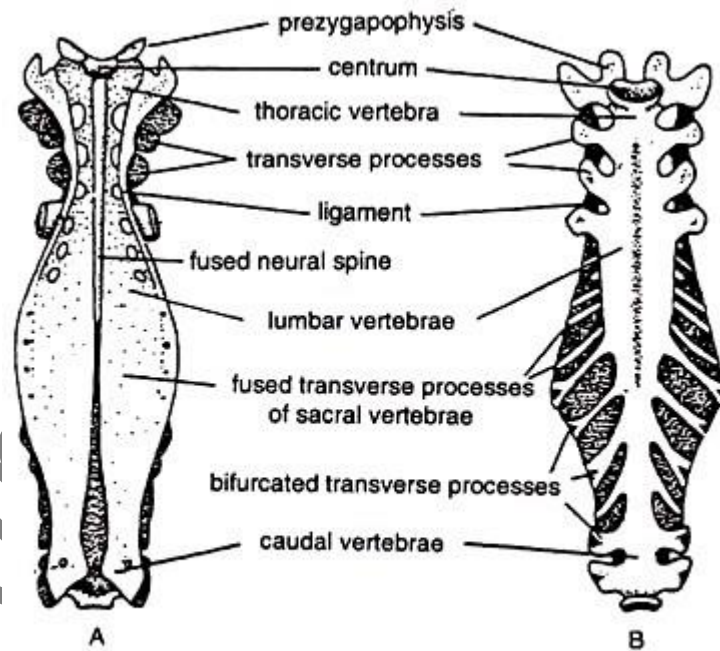
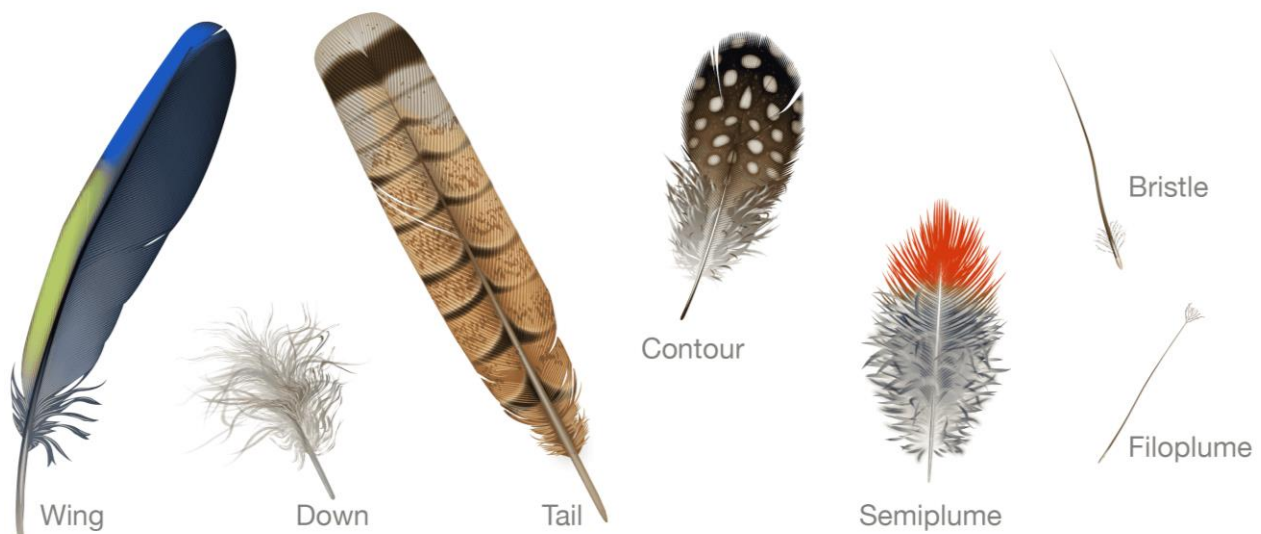


Fig. 42.39 : Columba sp. Synsacrum. A. Dorsal view, B. Ventral view

TYPES OF FEATHERS:

1. **Wing feathers:** The wing feathers specialized for flight are characterized by uniform windproof surfaces, or vanes, on either side of the central shaft that are created by an interlocking microstructure. Also called remiges, these feathers are asymmetric with a shorter, less flexible leading edge that prevents mid-air twisting.
2. **Tail feathers:** Most tail feathers, or rectrices, feature an interlocking microstructure similar to wing feathers. Arranged in a fan shape, these feathers support precision steering in flight. Typically, birds have six pairs of feathers on the tail, which display increasing levels of asymmetry toward the outer pairs. In some birds, tail feathers have evolved into showy ornaments that are useless in flight.



3. **Contour feathers:** Contour feathers are what you see covering the bird's body and streamlining its shape. Arranged in an overlapping pattern like shingles, the waterproof tips are exposed to the elements and the fluffy bases are tucked close to the body. Sometimes brilliantly coloured or uniformly drab, contour feathers can also help the bird show off or stay camouflaged. Contour feathers on the wing, called coverts, shape it into an efficient air foil by smoothing over the region where the flight feathers attach to the bone.
4. **Semiplume:** Mostly hidden beneath other feathers on the body, semiplumes have a developed central rachis but no hooks on the barbules, creating a fluffy insulating structure.
5. **Down:** Similar to semiplumes with an even looser branching structure but little or no central rachis, down feathers are relatively short and positioned closest to the body where they trap body heat.
6. **Filoplume:** Short simple feathers with few barbs, filoplumes function like mammal whiskers to sense the position of the contour feathers.
7. **Bristle:** Bristles are the simplest feathers, with a stiff rachis that usually lacks barb branches. Most commonly found on the head, bristles may protect the bird's eyes and face.

MAMMALS

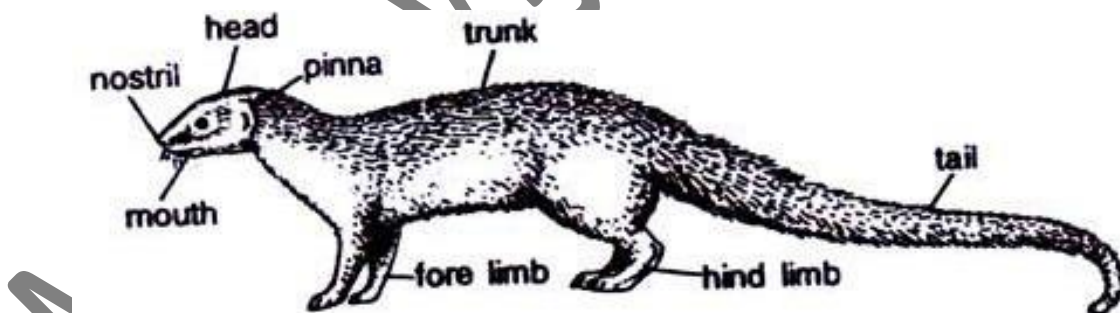
IDENTIFICATION: *Herpestes* (Mongoose)

CLASSIFICATION:

Phylum	: Chordata
Sub-Phylum	: Vertebrata
Group	: Gnathostomata
Super Class	: Tetrapoda
Order	: Carnivora
Class	: Mammalia
Genus	: <i>Herpestes</i>

COMMENTS:

1. Nocturnal, burrowing and carnivorous mammal that feeds on small mammals, reptiles, birds and eggs.
2. Body is small, elongated and covered with yellowish grey fur. Divisible into head, neck, trunk and tail.
3. Head elongated and anteriorly produced into a pointed snout. Bears mouth, paired nostrils, vibrissae, small eyes and external ear pinnae.
4. Heterodont dentition; canines well developed for tearing flesh.
5. Fore limbs and hind limbs are pentadactyl with strong clawed digits (fossorial).
6. Tail is long and bushy.



Herpestes

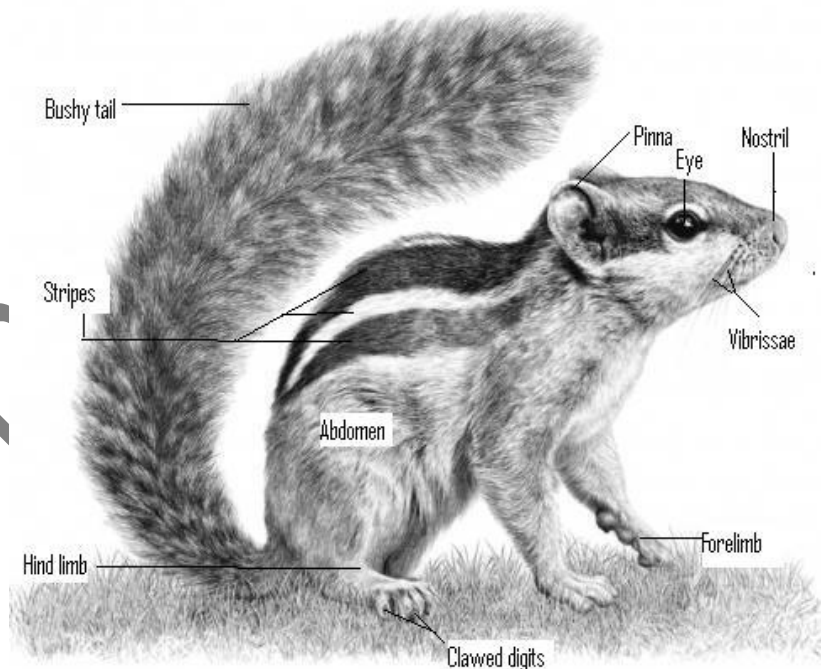
IDENTIFICATION: *Funambulus* (Squirrel)

CLASSIFICATION:

Phylum : Chordata
Sub-Phylum : Vertebrata
Group : Gnathostomata
Super Class : Tetrapoda
Order : Rodentia
Class : Mammalia
Genus : *Funambulus*

COMMENTS:

1. Squirrel is an arboreal, diurnal, herbivorous, cursorial rodent and feeds on fruits, nuts and seeds.
2. Body is elongated and divisible into head, neck, trunk and tail. It is covered with soft fur marked by the presence of 3 to 5 white and grey longitudinal stripes on the dorsal side.
3. Head contains snout with vibrissae, nostrils, mouth, large eyes and well-developed pinnae.
4. Fore limbs have an inconspicuous thumb and hind limbs have four clawed digits. The soles of fore limbs are naked and those of hind limbs are hairy.
5. Tail is long and bushy.



Funambulus

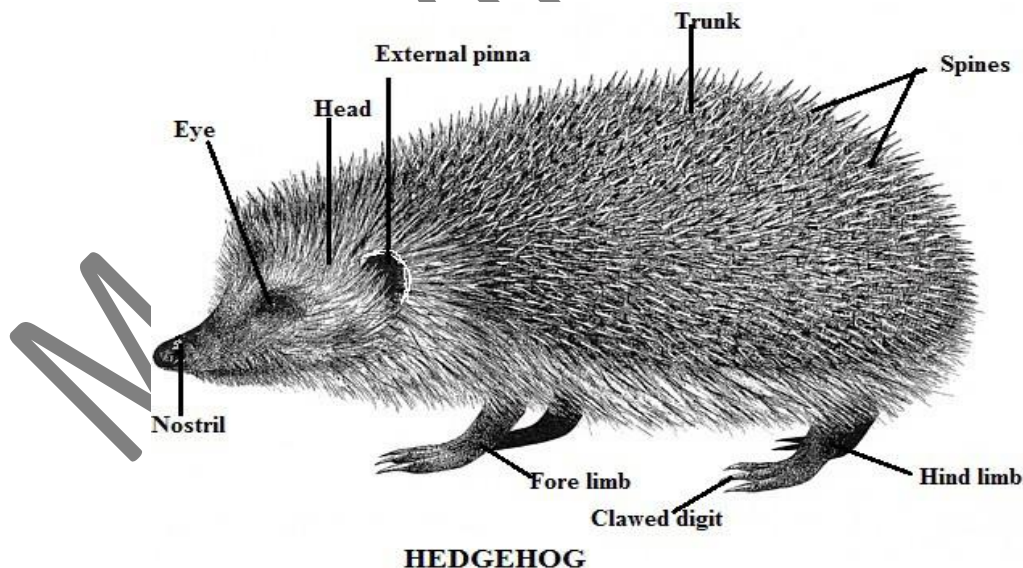
IDENTIFICATION: *Erinaceus* (Hedgehog)

CLASSIFICATION:

Phylum : Chordata
Sub-Phylum : Vertebrata
Group : Gnathostomata
Super Class : Tetrapoda
Order : Insectivora
Class : Mammalia
Genus : *Erinaceus*

COMMENTS:

1. Hedgehog is nocturnal, omnivorous and an insectivorous mammal. It remains hidden in holes and bushes during day time.
2. Body is divisible into head, neck, trunk and tail. Dorsal and lateral side are covered with sharp backwardly directed spines while the ventral surface has soft fur.
3. Head is conical and produced into small snout.
4. Bears nostrils, mouth, small eyes and small ear pinnae.
5. Fore limbs and hind limbs are short, pentadactyl with powerful clawed digits.
6. Exhibits a peculiar habit of rolling itself into a ball with spines projected when attacked. Spines are moved by muscle bands found over neck and sides of the body.
7. It hibernates in winter.



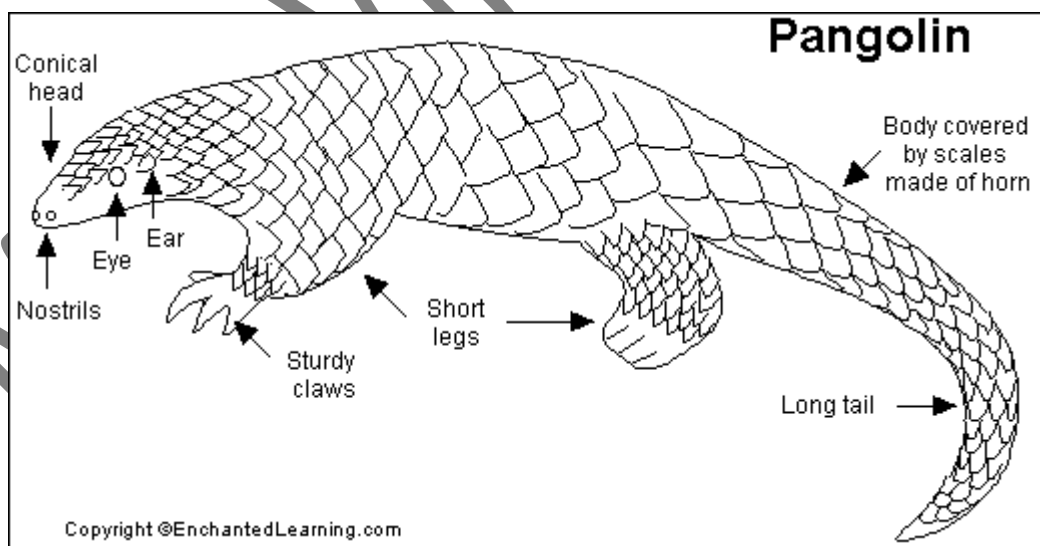
IDENTIFICATION: *Pangolin*

CLASSIFICATION:

Phylum : Chordata
Sub-Phylum : Vertebrata
Group : Gnathostomata
Super Class : Tetrapoda
Order : Pholidota
Class : Mammalia
Genus : *Pangolin*

COMMENTS:

1. Pangolins, are known as scaly anteaters.
2. Pangolins have large, protective keratin scales covering their skin; they are the only known mammals with this feature.
3. They live in hollow trees or burrows, depending on the species.
4. Pangolins are nocturnal, and their diet consists of mainly ants and termites, which they capture using their long tongues.
5. The pangolin's scaled body is comparable in appearance to a pine cone.
6. It can curl up into a ball when threatened, with its overlapping scales acting as armor, while it protects its face by tucking it under its tail.
7. The scales are sharp, providing extra defence from predators.
8. Pangolins can emit a noxious-smelling chemical from glands near the anus, similar to the spray of a skunk.



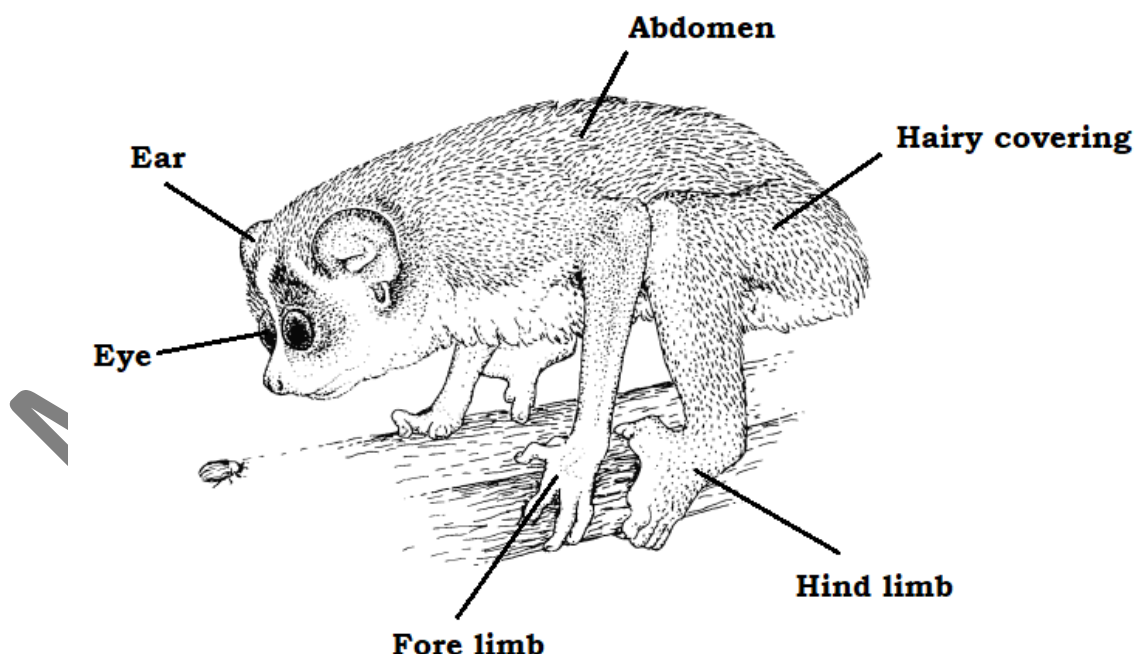
IDENTIFICATION: *Loris*

CLASSIFICATION:

Phylum	: Chordata
Sub-Phylum	: Vertebrata
Group	: Gnathostomata
Super Class	: Tetrapoda
Family	: Lorisidae
Class	: Mammalia
Genus	: <i>Loris</i>

COMMENTS:

1. Lorises are nocturnal and arboreal.
2. Loris locomotion is a slow and cautious climbing form of quadrupedalism.
3. These animals are about 25 cm long and have long, thin arms.
4. Their most prominent feature is the pair of two large, closely set, brown eyes.
5. Apart from insects they are also known to eat leaves, flowers, slugs and sometimes eggs of birds.
6. The body is slender with thick fur covering all over.
7. Sexual dimorphism is well observed.
8. Females leave their young ones in their nest while they go for hunt.



Loris

WHOLE MOUNT PREPARATION

AIM: To prepare a wholmount of the given material.

REQUIREMENT: Glass/ Cavity Block, Microslides, Coverslips, Camlin brush, Needle, Blotting Paper, Medicine droppers etc.

CHEMICALS: 70%, 80%, 90% and absolute alcohol grades, xylene, DPX mountant (DPX stands for Distyrene Plasticizer Xylene -A mixture of distyrene (a polystyrene), a plasticizer (tricresyl phosphate), and xylene, called DPX, was introduced in 1939)/ Glycerine.

STAIN: Spirit soluble eosin.

MATERIAL: Piscian Scales [CTENOID/ CYCLOID]

PROCEDURE:

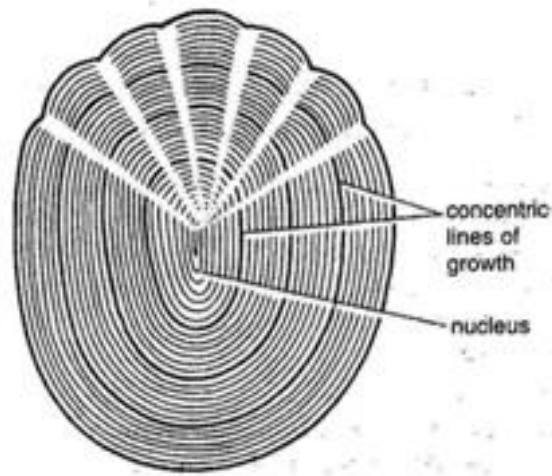
1. Scales from bony fish are plucked intact and washed in water. The scales are kept in 2% KOH for five minutes.
OR
2. The preserved piscian scales are taken in a clean watch glass or cavity block containing 70% alcohol.
3. The scales are subjected to upgradation or dehydration and then stained with eosin as per the flow chart given below:
 - 70% C₂H₅OH- 5 minutes
 - 80% C₂H₅OH- 5 minutes
 - 90% C₂H₅OH- 5 minutes
 - Eosin Stain – 5 minutes
 - 90% C₂H₅OH- 2 minutes
 - Absolute alcohol – 2 minutes
 - Xylene - 5 minutes
4. Transfer the stained scales onto a clean micro slide.

MOUNTING:

- The scales are mounted using DPX mountant for permanent preparations or Glycerine for temporary preparations.
- Care is taken to avoid air bubble while mounting.

OBSERVATION:

Whole mount preparation is observed under the microscope and shape of scale is identified as _____



CYCLOID SCALE

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