Practical of

Zoology

R. K. GROUP OF COLLEGE

BEHIND KALWAR POLICE STATION, KALWAR, JAIPUR (RAJ.)

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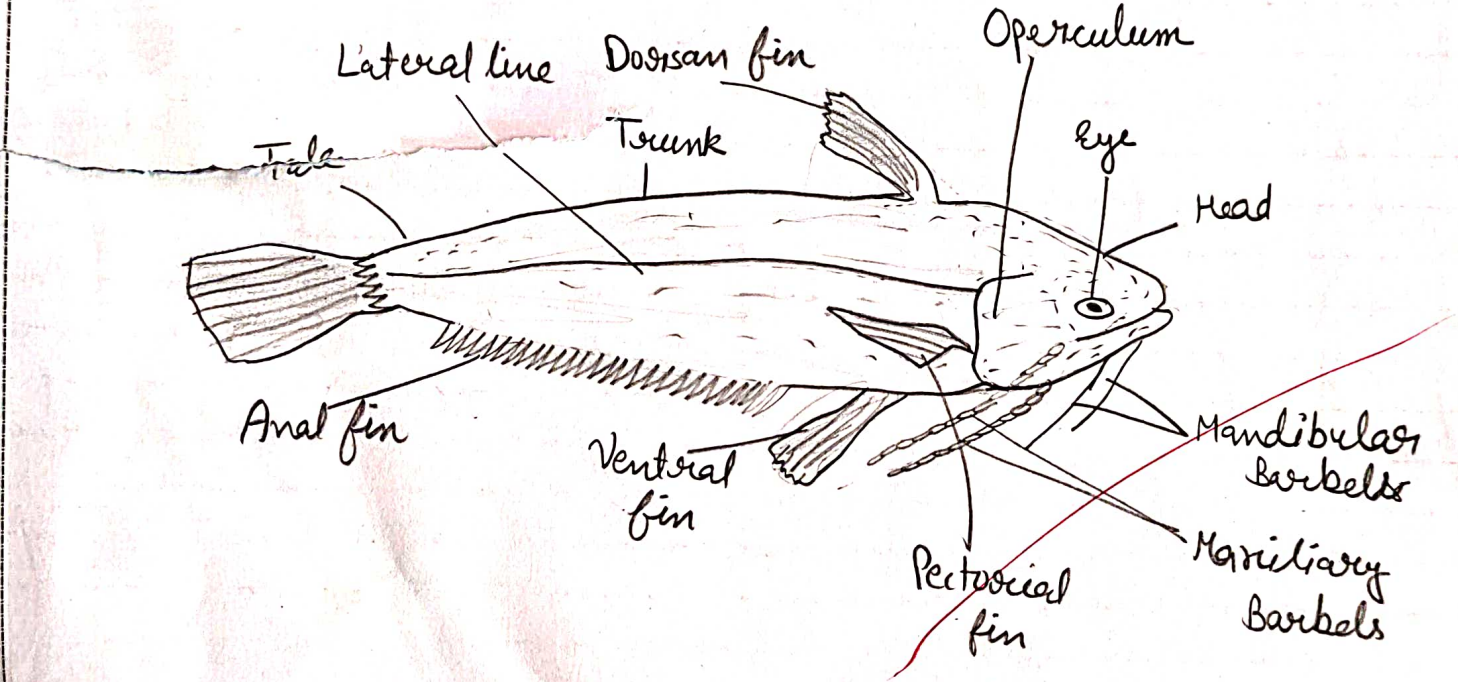

Wallago attu - External Features

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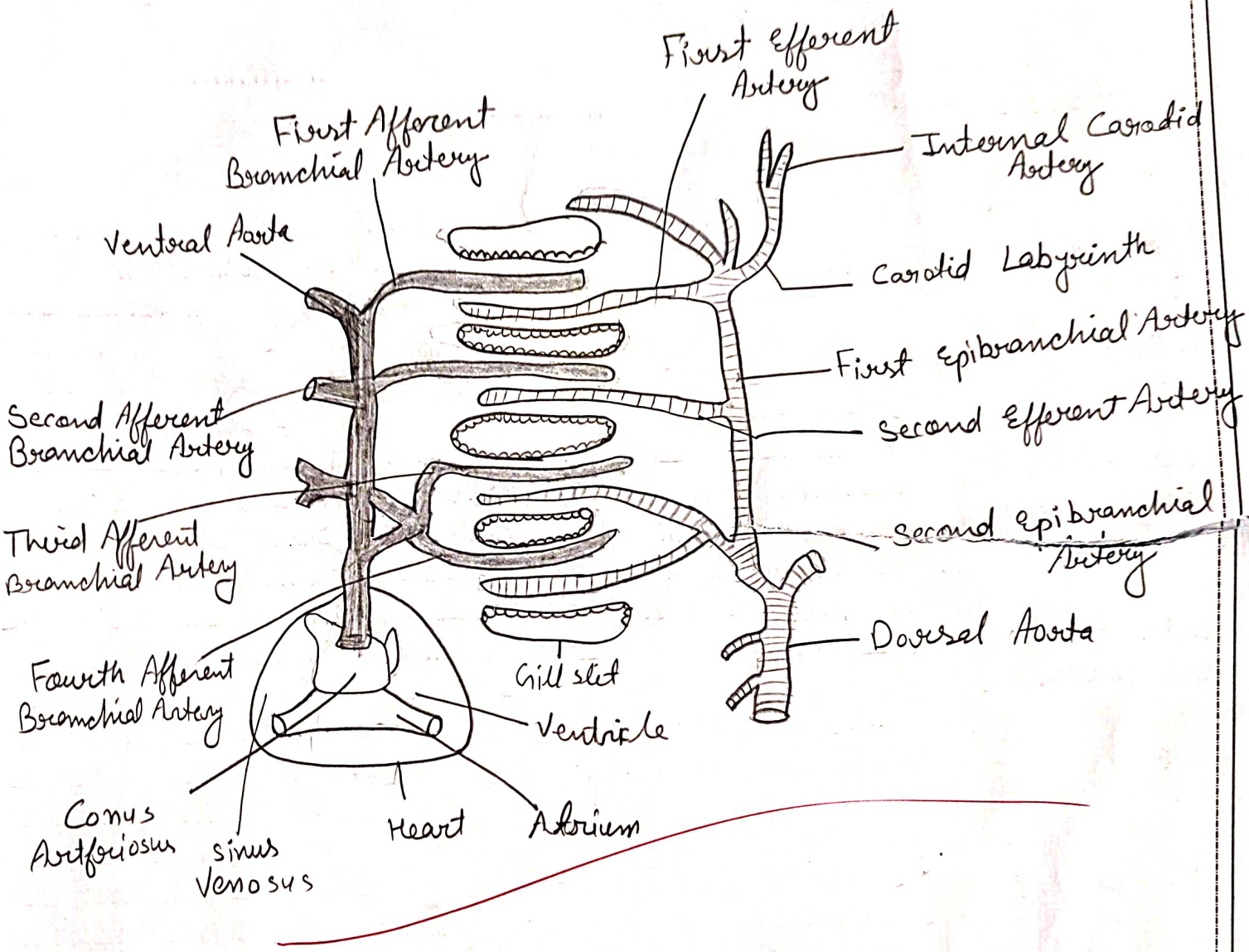

Wallaga Atty - Afferent & Efferent Branchial Arteries, Heart

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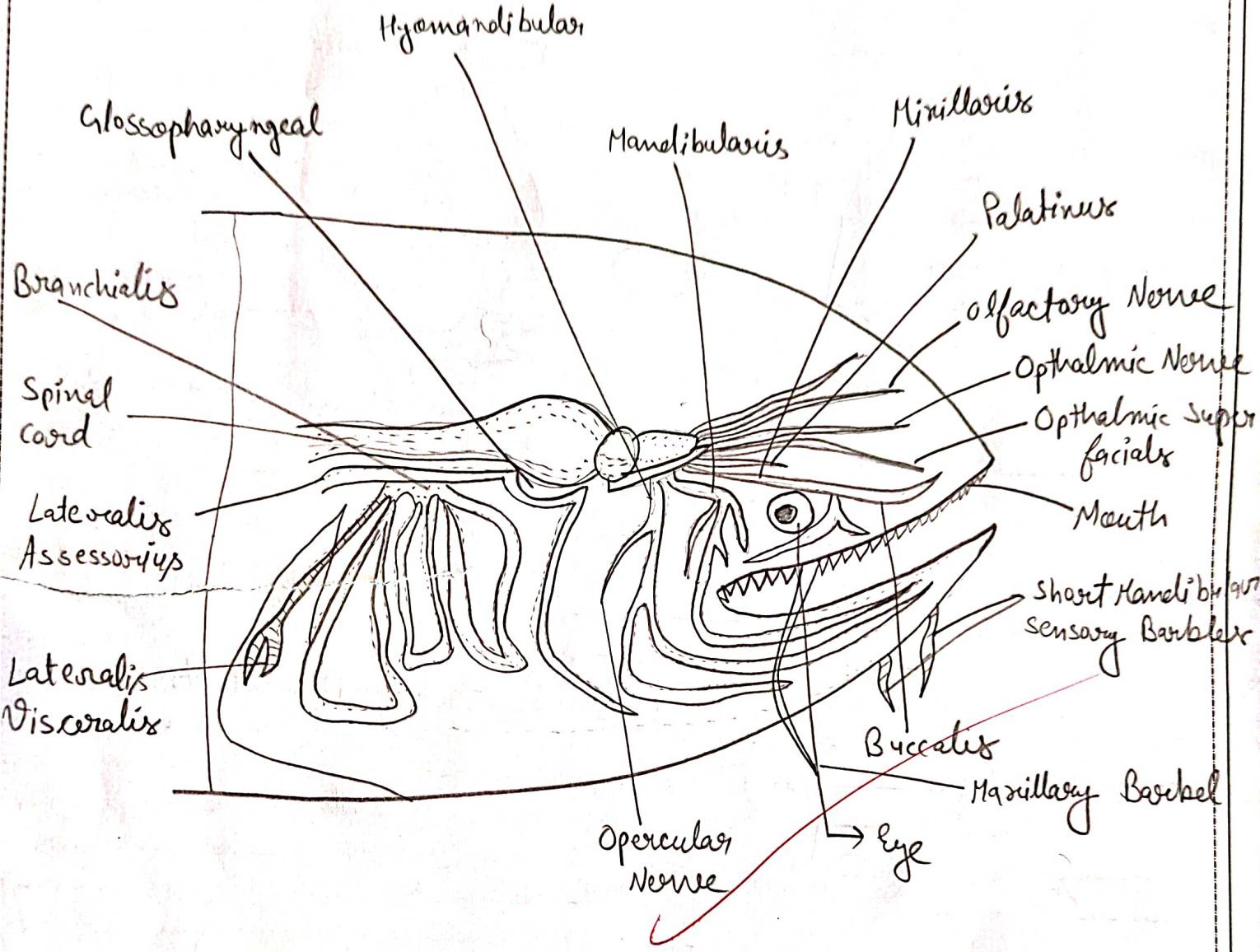

Wallago attu — Cranial nerves

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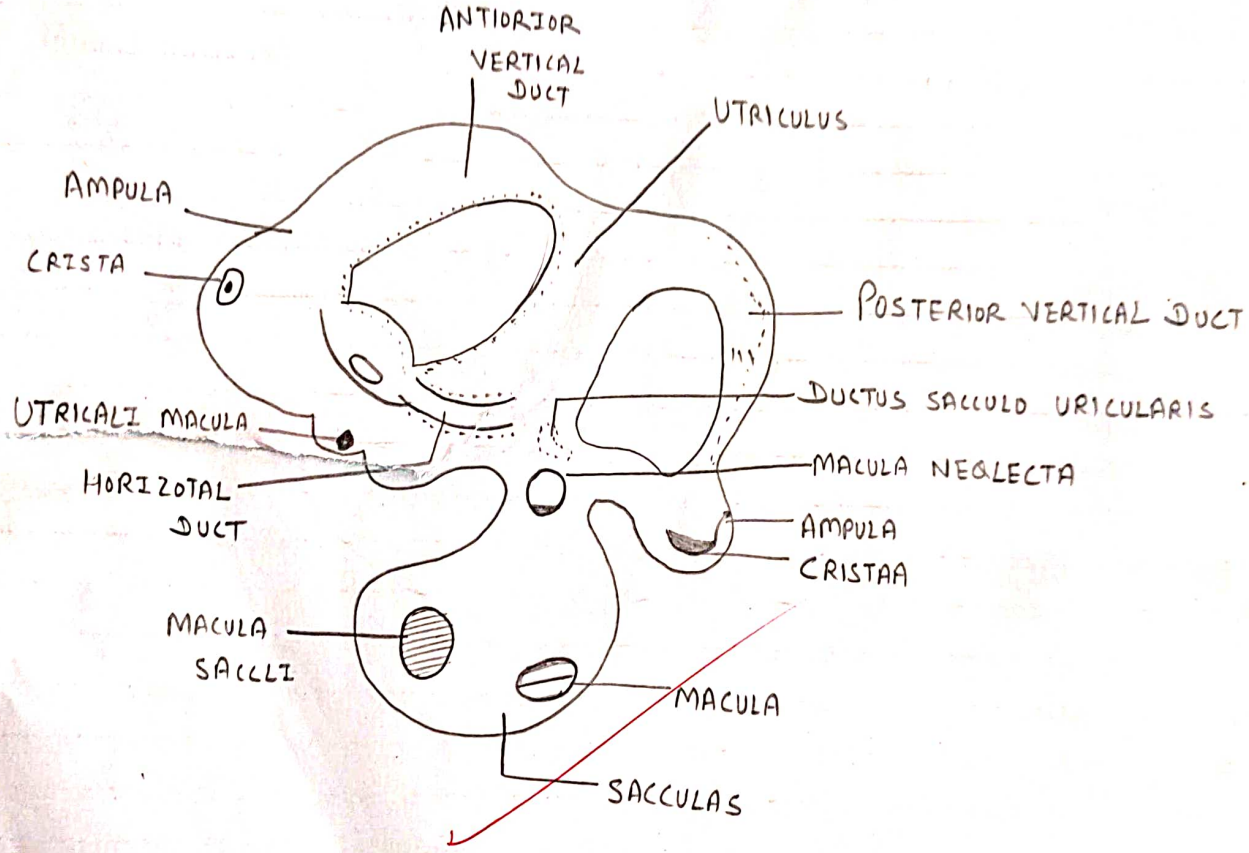
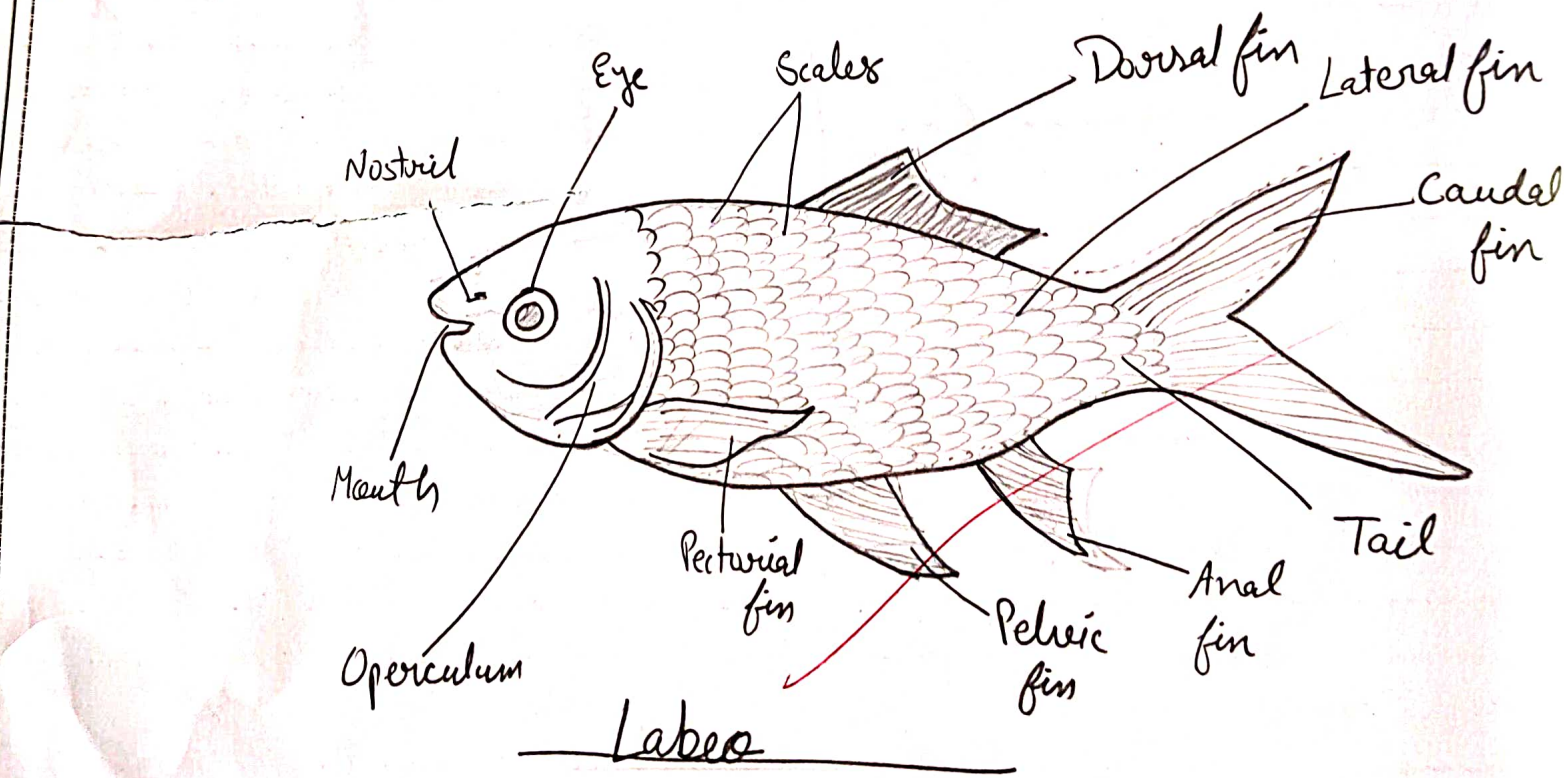

ANTIORIOR
VERTICAL
DUCT
UTRICULUS
AMPULA
CRISTA
POSTERIOR VERTICAL DUCT
DUCTUS SACCULO URICULARIS
UTRICALI MACULA
MACULA NEGLECTA
HORIZOTAL
DUCT
AMPULA
CRISTAA
MACULA
SACCLI
MACULA
SACCULAS


Eye
Scales
Dorsal fin
Lateral fin
Nostril
Caudal fin
Mouth
Tail
Pectorial fin
Anal fin
Pelvic fin
Operculum

Labeo

Phylum - Chordata
Class - Ascidiacea
order - Enterogonia
Genus - Ascidia

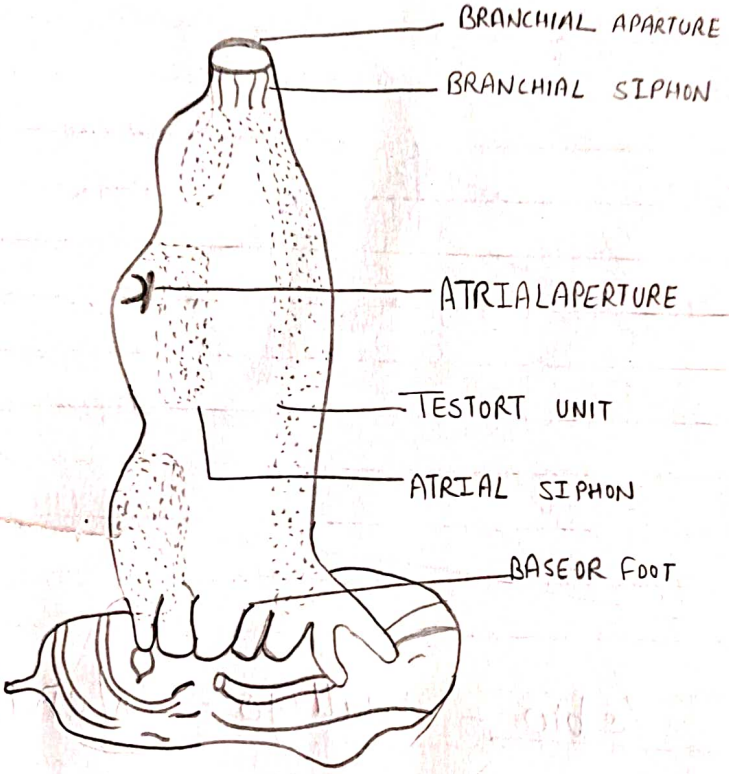


Diagram :- ASCIDIA

Teacher Signature .....

IV. 2

Ascidia

Characteristics :-

1. Solitary and sendentary ascidi found on european coasts.
2. Body oblong and enclosed in test of tunicin.
3. Branchial apeature eight-lob and atrial aperture six-lob located on branchial and atri siphons respectively.
4. Branchial siphon terminal.
5. Pharyngeal wall smooth and devo of folds.
6. Development includes retrogressi metamorphosis.

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Botryllus

Characteristics :-

1. Colonial marine form; common in Atlantic and mediterranean seas found attached to wharves, piers, ships, etc. in shallow waters.
2. The gelatinous test of the colony is flat and hard on which are borne individuals or zooids of the colony.
3. Groups of zooids are arranged in star-like fashion on the hard test.
4. The branchial apertures of zooids are present at the ends of the arms of the star, but the atrial apertures of zooids open in centre into a common cloaca.
5. Colony increases in size by asexual budding.

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Phylum - Chordata
Class - Ascidiacea
Order - Pleurogonia
Genus - Botryllus

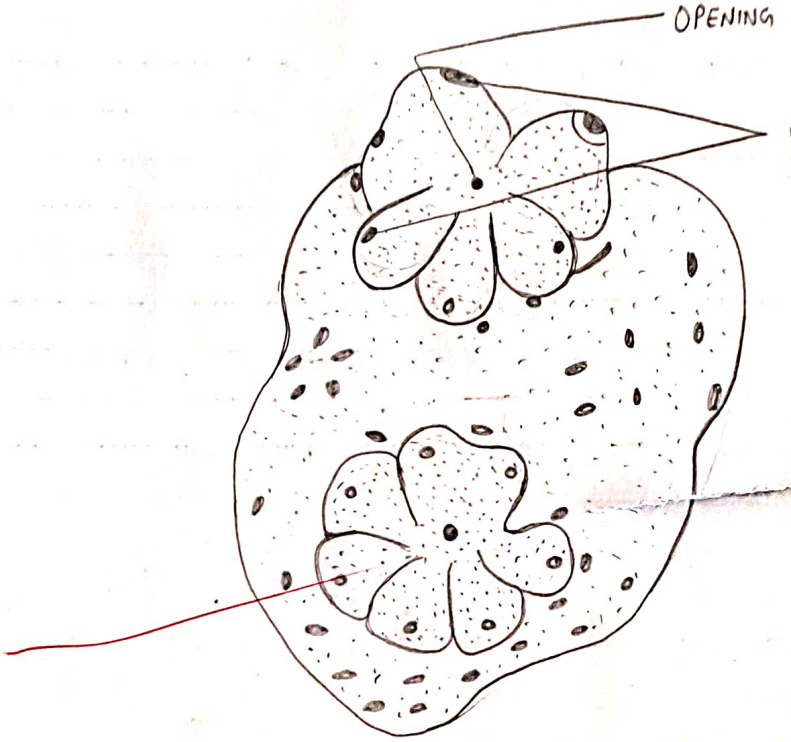

DIAGRAM :- BOTRYLLUS : COLONY

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Phylum - Chordata
Class - Cyclostomata
Order - Petromyzontes
Genus - Petromyzon

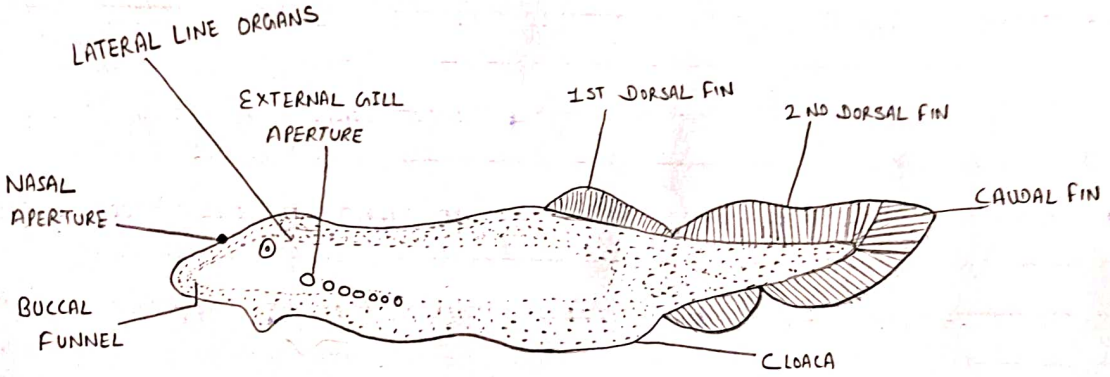

Diagram :- PETROMYZON : LAMPREY

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Petromyzon : Lamprey

Characteristics :-

1. Most primitive living vertebrates.
2. Body is cylindrical, slimy and eel-like a definite head.
3. From the mouth a tongue bearing the horny teeth protrudes which is used for rasping the skin of the prey.
4. Body is smooth without scales and profusely slimy due to mucous glands on skin.
5. Paired fins or appendages are absent.

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Page

Myxine or Bdellostoma :-

Characteristics :-

1. These are called hag-fishes as the skin surrounding the mouth is folded like an old hag.
2. The mouth also possesses a single median tooth.
3. Near the mouth are present 4 pairs of short sensory tentacles.
4. The single median nostril is terminal.
5. The eyes are degenerate and lie buried under muscles and skin

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Phylum - Chordata
Class - Cyclostomata
order - Hyperoidia
Genus - Myxine

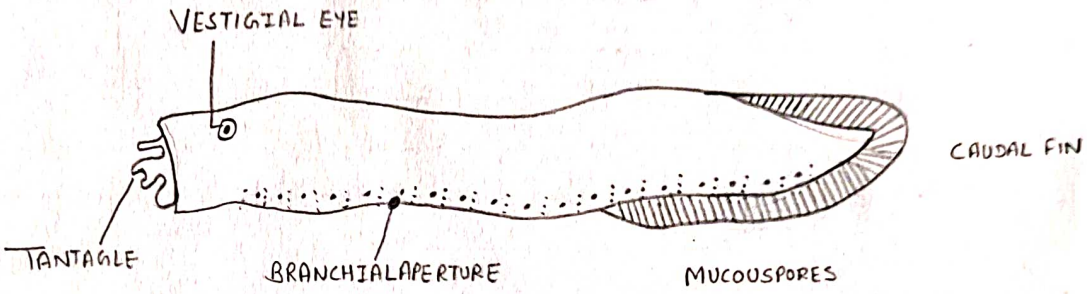

Diagram :- MYXINE LHAGFISH

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Date :.....

Phylum - Chordata
Class - Chondrichthyes
Order - Rajiformes
Genus - Torpedo

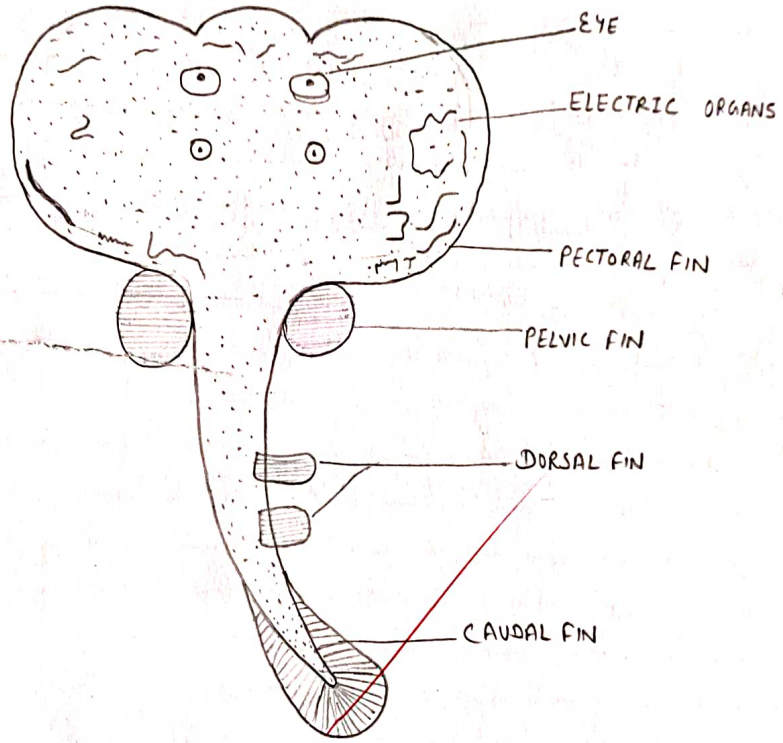

Diagram :- TORPEDO (ELECTRIC RAYS)

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Page

Torpedo :- (Electric Ray)

Characteristics :-

1. Marine, present in the Indian and Atlantic oceans. Common India species is T. marmorata.
2. Anterior end of the body is dorsoventrally flattened and round. the posterior half is continuous as a narrow trunk and tail.
3. The eyes and spiracles are dorsal, but the mouth, nostrils and the 5 pair pairs of gill - clefts are ventral.
4. The muscles between the eyes and pectoral fins are modified to produc a pair of powerful electric organs.
5. The body is smooth and devoid of scales.

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Chimaera :-

Characteristics :-

1. Marine; found at the coastal regions of Pacific and Atlantic oceans.
2. Body is about 60 cm long with a long compressed head having a blunt snout.
3. Head bears a small ventral mouth surrounded by lips and containing crushing plates instead of teeth.
4. Head also bears a pair of large lateral eyes and a terminal single nasal aperture.
5. Both pectoral and pelvic fins present. The pectoral fins are very large

Phylum - Chordata
Class - Chondrichthyes
Order - Holocephali
Genus - Chimaera

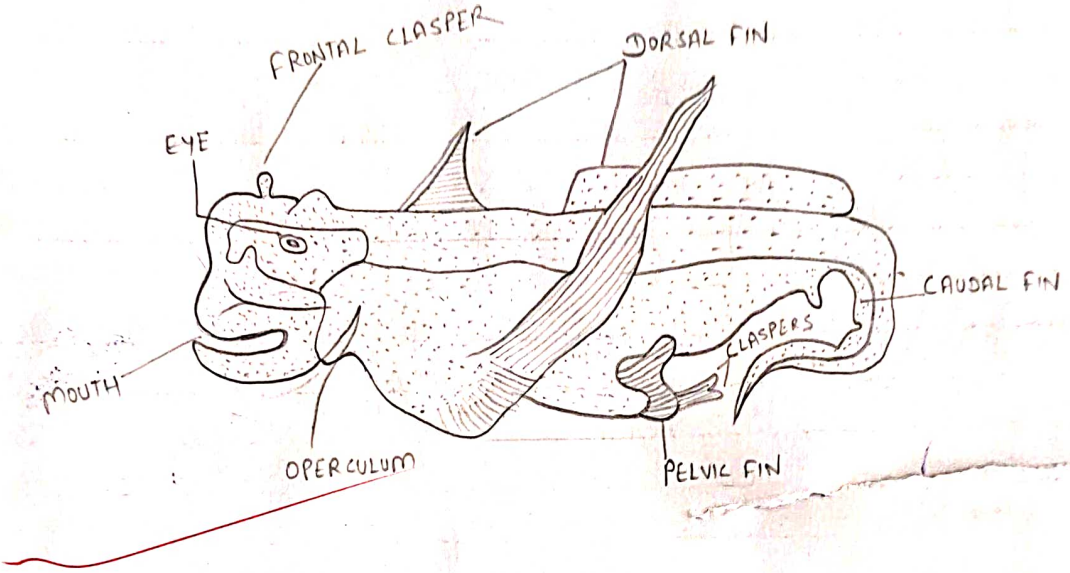

Diagram :- CHIMAERA (RAT - FISH)

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Phylum - Chordata
Class - Osteichthyes
Order - Acipenseriformes
Genus - Acipenser

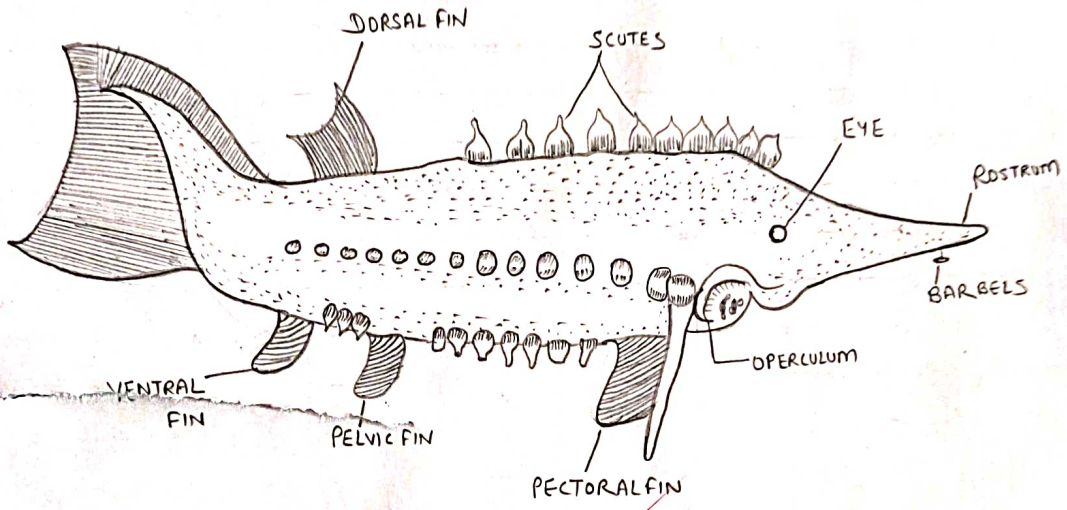

Diagram :- ACIPENSER (STURGEON)

Teacher Signature .....

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Acipenser :-

Characteristics :-

1. Body is fusiform with the head produced into a long pointed snout having ventral barbels.
2. Body has a covering of spiny dermal scales which are arranged in 5 longitudinal rows.
3. Head bears a ventral mouth with reduced teeth less jaws. Feeding is suctorial and food is small invertebrates.
4. Head also bears a pair each of lateral eyes, loose - lateral nostrils and spiracles behind the eyes.
5. Tail is heterocercal.

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Lepisosteus (Lepidosteus; gar-pike)

Characteristics :-

1. Fresh-water primitive ganoid fish found in the rivers of America and Cuba. many species; some of which may attain a length of more than 3 metres.
2. Body is covered by thick close-fitting ganoid scales which bear fused dermal denticles (placoid scales.)
3. Jaws are produced into a long snout or beak are bear sharp teeth for feeding on other fishes.
4. Both paired and unpaired fins are represented. The dorsal fin is placed far back and is at level of the anal fin.
5. Tail is modified heterocercal and appears homocercal.

Phylum – Chordata
Class – Osteichthyes
Order – Semiono | Lapidosteiformes
Genus – Lepidosteus

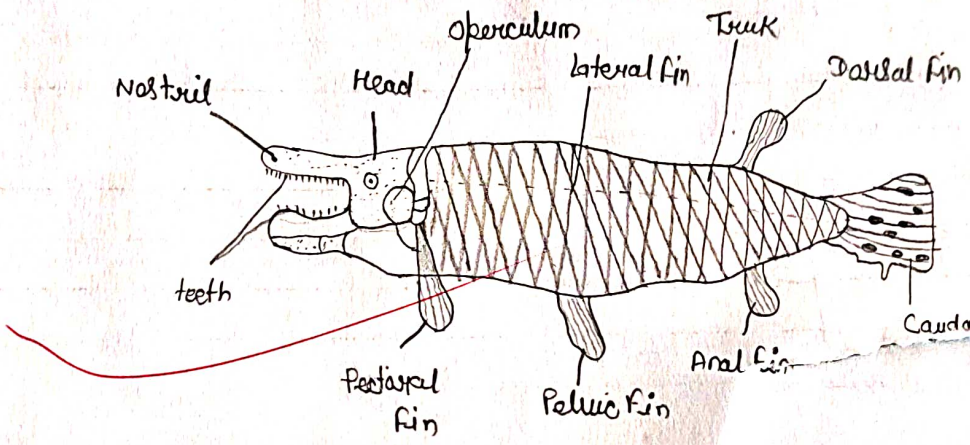

DIAGRAM – LEPIDOSTEUS

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Phylum - Chordata
Class - Osteichthyes
Order - Cypriniformes
Genus - Labeo

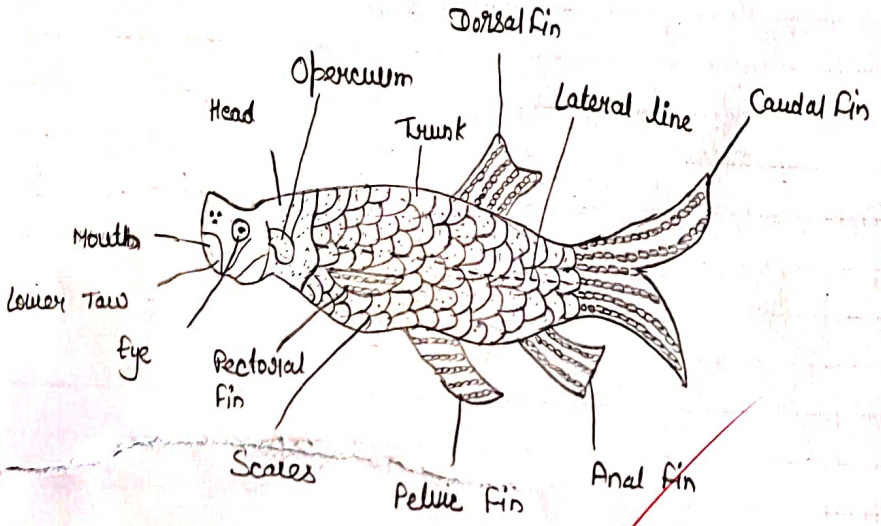

DIAGRAM :- LABEO (CARP: ROHU)

Teacher Signature ....

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Labeo (Carp; rohu)

Characteristics :-

1. Fresh-water fish found in lakes and rivers of India.
2. Body is laterally compressed and dorsoventrally elongated measuring up to 1 metre in length.
3. The large scale-less head bears a terminal mouth surrounded by thick lips, a pair of large lateral eyes, dorsolateral terminal nostrils and a pair of small maxillary barbels.
4. The trunk is covered by overlapping large transparent cycloid scales.
5. Behind the head is the bony operculum which covers the four pairs of gills on either side.

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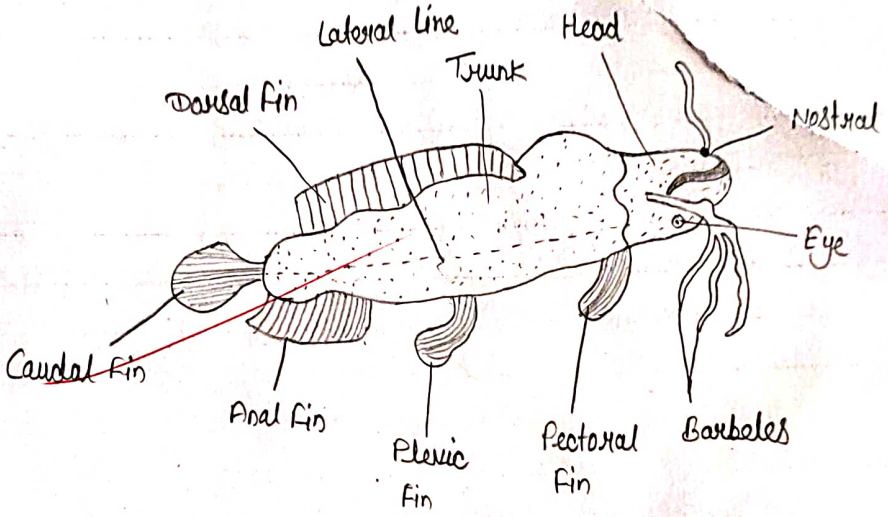
Clarias (magur)

Characteristics :-

1. Found in fresh and brackish waters in India, Burma and Srilanka.
2. Four pairs of barbles present on the head region.
3. Dorsal and anal fins very long, but not confluent with caudal fin.
4. Pectoral fins located very low along the ventro-lateral margins of abdomen and have first ray spinous.
5. Feeds upon prawns, insects and crustaceans.

Phylum - Chordata
Class - Osteichthyes
order - Cypriniformes
Genus - Clarias



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Phylum - Chordata
Class - Osteichthyes
order - Anguiliformes
Genus - Anguilla

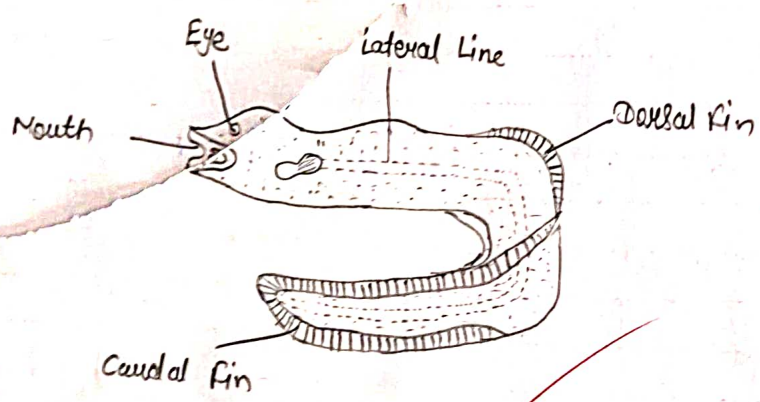

DIAGRAM :- ANGEUILLA (EEL)

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Anguilla (EEL)

Characteristics

1. Anguilla anguilla is found in the rivers, lakes and ponds of Europe and America.
2. Body is long snake-like yellow green in colour and measures about 1 metre in length.
3. Skin is smooth, but minute scales are embedded in the dermis.
4. After breeding the adults die.
5. The elvers when reach fresh water transform into adults.

(17) =)

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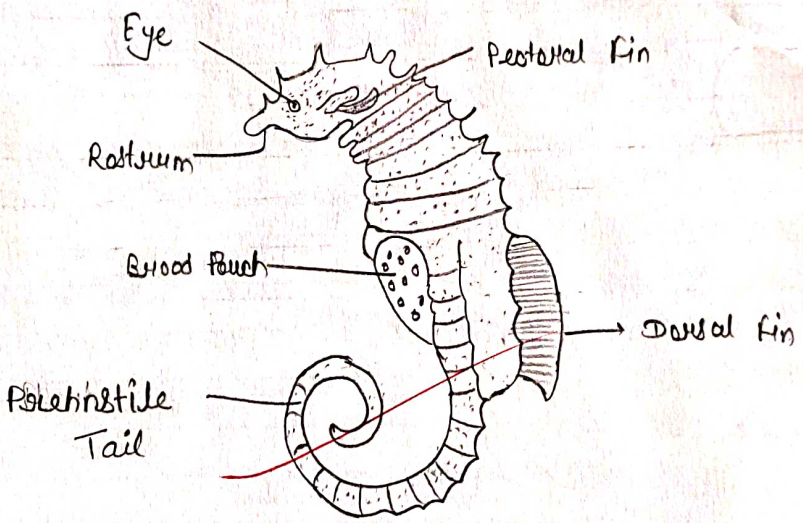
HIPPOCAMPUS (Sea-Horse)

Characteristics :-

1. Marine, present in the Indian and Atlantic oceans at the bottom near the coast in the sea-weeds.
2. Extremely modified body is covered completely by large shield-like bony scales. Body size never exceeds more than 10 cm.
3. Head is produced into a tooth-less snout or rostrum and resembles a horse's head and hence the name sea-horse.
4. The pectoral fins are reduced and lie just behind the operculum. The pelvic fins are absent.
5. The tail is prehensile and curved. It is used for anchoring to the sea-weeds

Phylum - Chordata
Class - Osteichthyes
Order - Syngnathi formes
Genus - Hippocampus



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Phylum - Chordata
Class - Osteichthyes
Order - Beloniformes
Genus - Exocoetus

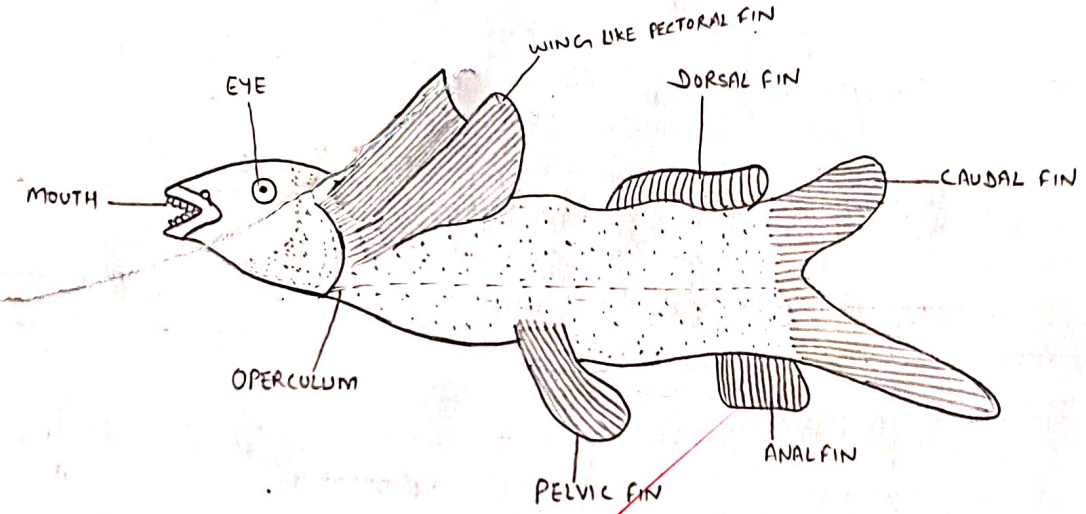

Diagram :- EXOCOETUS (FLYING FISH)

Teacher Signature .....

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Exocoetus (Flying-fish)

Characteristics :-

1. Marine present in all oceans near the surface of the sea.
2. Body is silvery in colour, measures about 30 to 40 cm and covered with large cycloid scales.
3. Head is large and blunt, but the jaws are not produced into a beak as in Belone.
4. Head bears large lateral eyes and dorso-lateral nostrils, besides the terminal mouth.
5. The median fins are also typically present.

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BLIND WORMS (Ichthyophis/Gengenophis/Uraeotyphlus)

Characteristics :-

1. Body is worm-like elongated and cylindrical without any trace of limbs and measures about 25 to 30 cm.
2. Skin is smooth, moist and slimy and has ring-like grooves on its surface minute scales are embedded in the dermis and are not visible.
3. Between the eyes and nostrils is a pair of protrusible sensory tentacles in pits.
4. Anus is present just anterior to the posterior end of the body, hence a very small post anal tail is present.
5. Male has an eversible copulatory organ bearing hooks. fertilization is internal.

Phylum - Chordata
Class - Amphibia
Order - Apoda
Genus - Ichthyophis

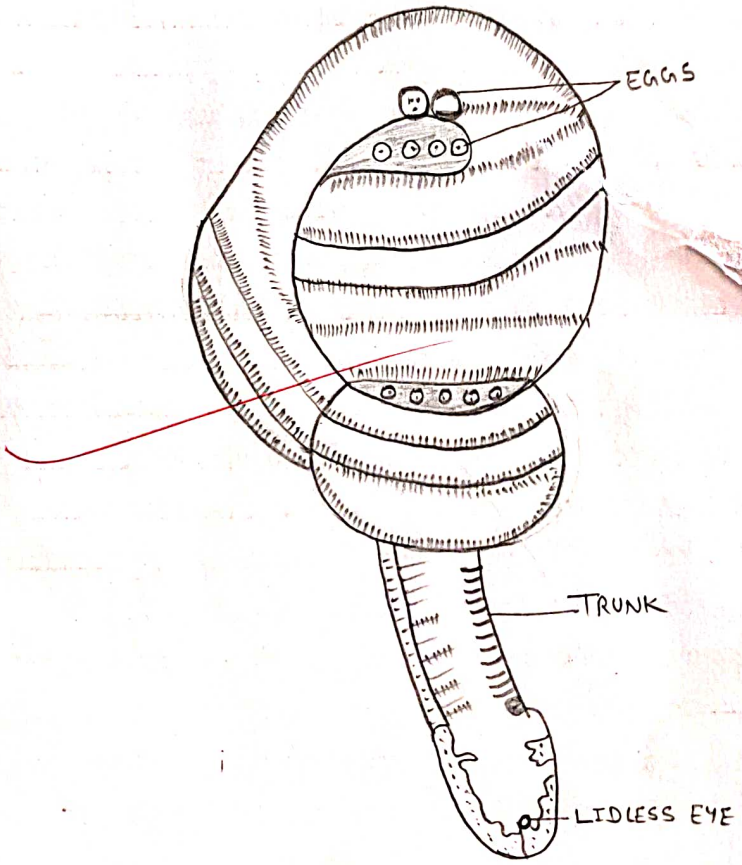

Diagram :- ICHTHYOPHIS (BLIND-WORM)

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Phylum - Chordata
Class - Amphibia
Order - Urodela
Genus - Proteus

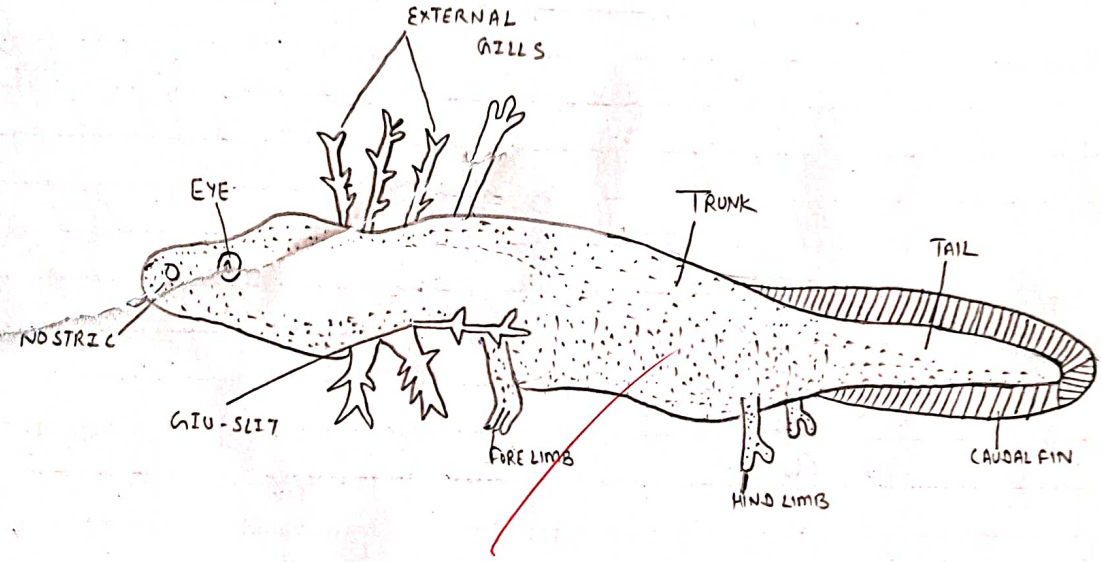

Diagram :- PROTEUS

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PROTEUS (Olm or Cave-Salamander)

Charetristics :-

1. found in waters of completely dark caves of central European mountains. It has accordingly modified itself.
2. Body is elongated and eel-like measuring about 25 cm
3. Skin is smooth, unpigmented and whitish in colour.
4. Behind the head are present laterally, three pairs of bright red external gi and two pairs of open gill-clefts.
5. Tail is laterally compressed and bears a caudal fin.

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Ambystoma (Amblystoma; Tiger salamander)

Characteristics:-

1. Terrestrial, semi-aquatic salamander found near fresh-water springs and rivers of north america.
2. Body is divided into a large well-developed head, neck, trunk and long slightly laterally compressed tail.
3. Head bears a terminal mouth and a pair each of nostrils and well-developed eyes with movable eye-lids.
4. The fore and hind limbs are well-developed.
5. External gills and caudal fins are absent in adults.

Phylum - Chordata
Class - Amphibia
Order - Urodela
Genus - Ambystoma

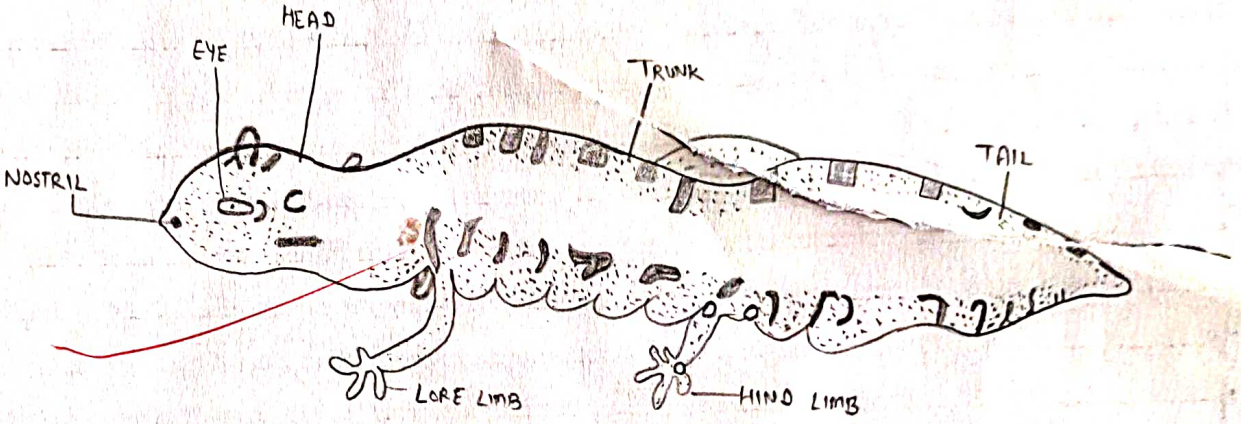

Diagram :- AMBYSTOMA (TIGER-SALAMANDER)

Phylum - Chordata
class - Amphibia
Order - Urodela = Caudata
Genus - Siren

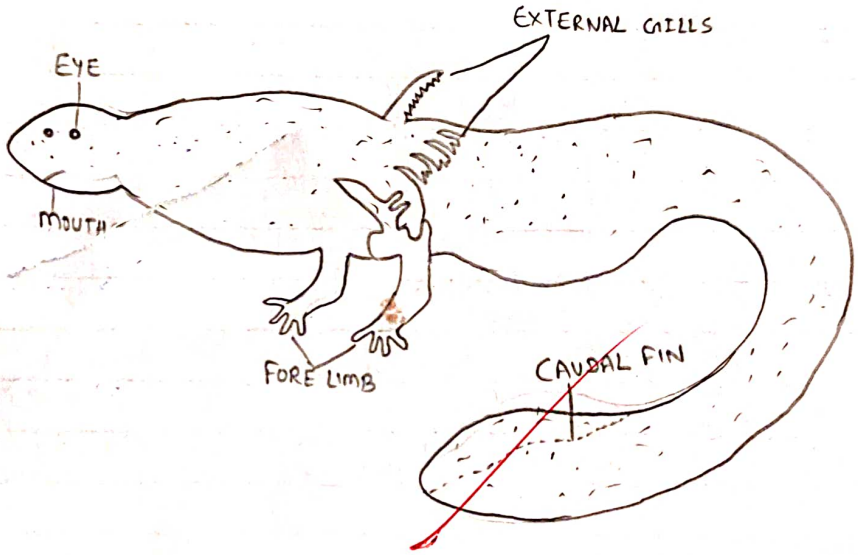

Diagram of STREN

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SIREN (MUD-EEL)

Characteristics :-

1. Aquatic urodelan found in the muddy swamps and pea ponds of North America. It is a permanently neotenous form.
2. Body is long, cylindrical and eel-like measuring about 60 cm in length.
3. Head bears terminal mouth and a pair each of nostrils and lid-less eyes (a larval feature).
4. Behind the head are present 6 pairs of lateral external gills (a larval feature).
5. Only very small fore limbs with 4 digits are present. The hind limbs are absent.

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ALYTES (MID-WIFE TOAD)

Charetristics :-

1. Present in France and Italy. The specific name is o. obstetrecons as the males show a peculiar type of parental care.
2. Skin is dark with papillae on both the dorsal and ventral side
3. Large triangular head joins insensibly with the large dorsally humped trunk.
4. Fore limbs bear 4 unwebbed digits and the long hind limbs bear 5 slightly webbed digits.
5. Head bears a large terminal mouth and pairs of nostrils, eyes with movable eyelids and tympanic membranes behind the eyes.

Phylum - Chordata
Class - Amphibia
Order - Anura
Genus - Alytes

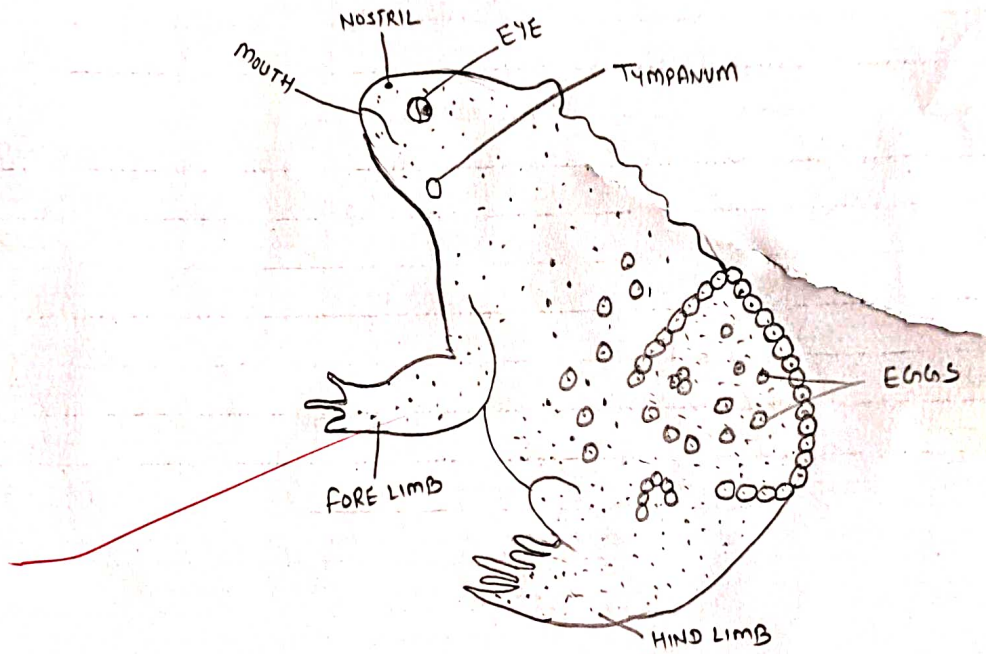

Diagram :- ALYTES

Phylum - Chordata
Class - Amphibia
Order - Anura : Salientia
Genus - Hyla

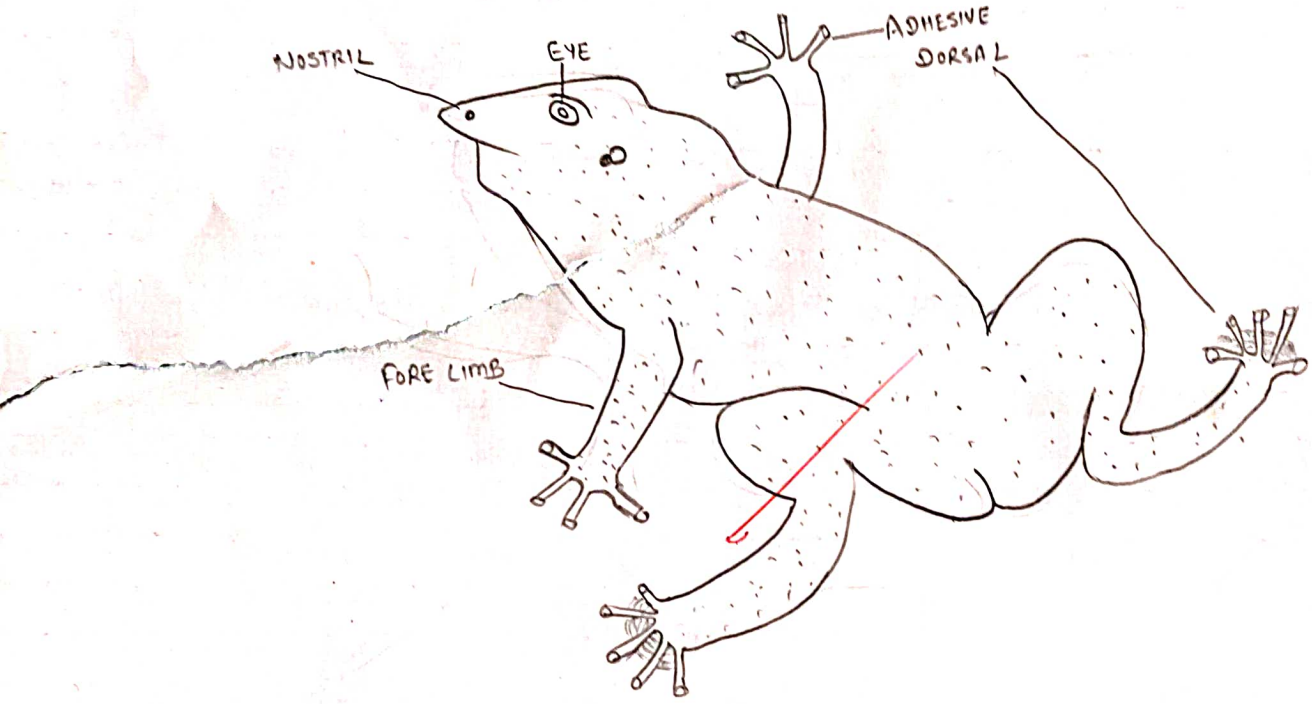

Diagram :- HYLA (TREE-FROG)

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HYLA (TREE FROG)

Characteristics:-

1. Found on trees in damp tropical forests of the world, including India. These are small frogs measuring only 10 cm on the average.
2. Skin is smooth and moist on the dorsal surface but there are papillae present on the ventral side. The colour varies according to species and may be green etc.
3. The triangular head joins insensibly with the slender trunk. Neck tail are absent.
4. Fore limbs are small with 4 digits without web. Hind limbs are long with 5 digits with very little web between them.
5. Many species have strong poison glands on the skin.

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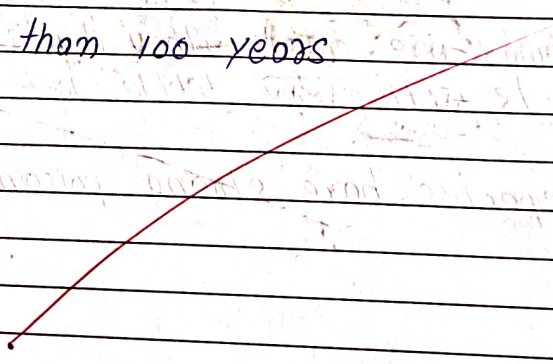
TESTUDO (Land Tortoise)

Characteristics :-

1. Carapace is about 30 to 40 cm in length and body colour is yellowish-brown with star-shaped scales on the carapace.
2. The head, neck limbs and tail are covered with scales.
3. Limbs are pentadactyle with 5 claws and modified for terrestrial locomotion.
4. On disturbance it withdraws completely the head, neck, tail and limbs into the carapace.
5. It is said to live for more than 100 years.



Phylum - Chordata
Class - Reptilia
Order - Chelonia
Genus - Testudo

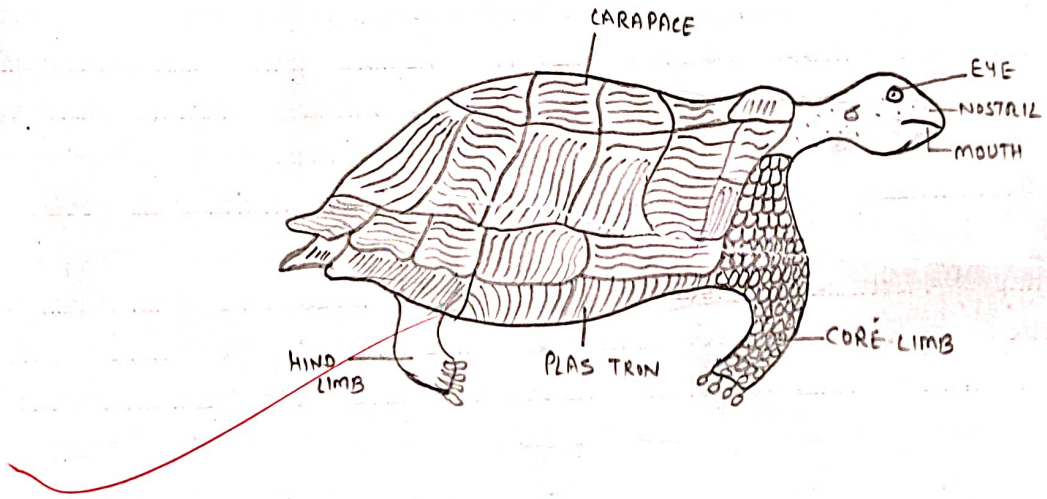


Diagram :- TESTUDO (LAND-TORTOISE)

Phylum - Chordata
Class - Reptilia
order - Chelonia
Genus - Chelone

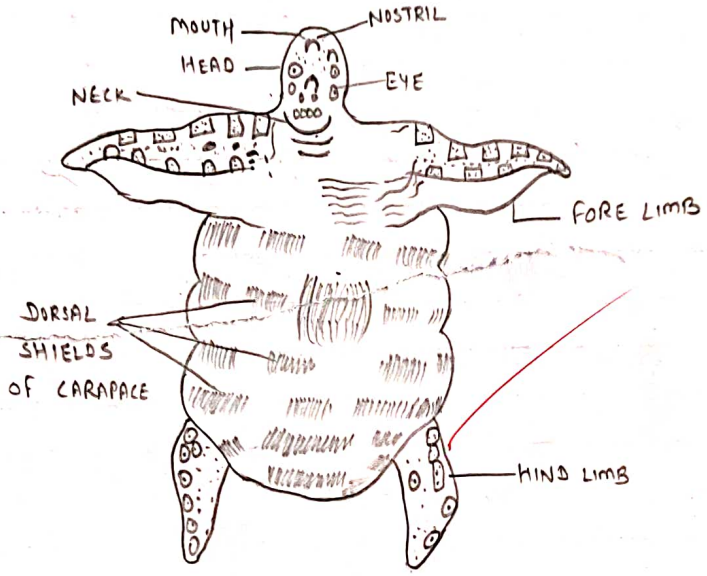


Diagram :- CHELONE (SEA GREEN TURTLE)

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Page

CHELONE (Sea-Turtle; green Turtle)

Characteristics :-

1. marine; found in Indian, Pacific and Atlatic, oceans. Common Indian species from the Bay of bengal are C. mydas and C. virgata.
2. The dorsal carapace is flat and heart-shaped and is attached to the ventral plastron only by ligaments.
3. Small head is attached to a long neck which is not completely retractile into the carapace.
4. Tail is very short.
5. Turtle soup is considered very delicious. Turtle eggs are also eaten.

Date
Page

(2)

FRESH-WATER TORTOISE

Characteristics :-

1. Fresh-water tortoises are very common in ponds, lakes, rivers and even wells. They include numerous genera and species. Common are Lissemys punctata, the pond tortoise; Trionyx gangeticus is common in Indian rivers; and Kachuga is also common in Indian rivers.

2. On the average the length of the carapace does not exceed more than 60 to 70 cm. River specimens may be larger.

3. Both carapace and plastron are soft without scales and covered with skin.

4. The long neck with the pointed head, limbs and tail can be more or less completely retracted into the carapace.

5. The limbs are modified for swimming and the clawed digits are fully webbed.

Phylum - Chordata
Class - Reptilia
order - Chelonia
Genus - Tortoise

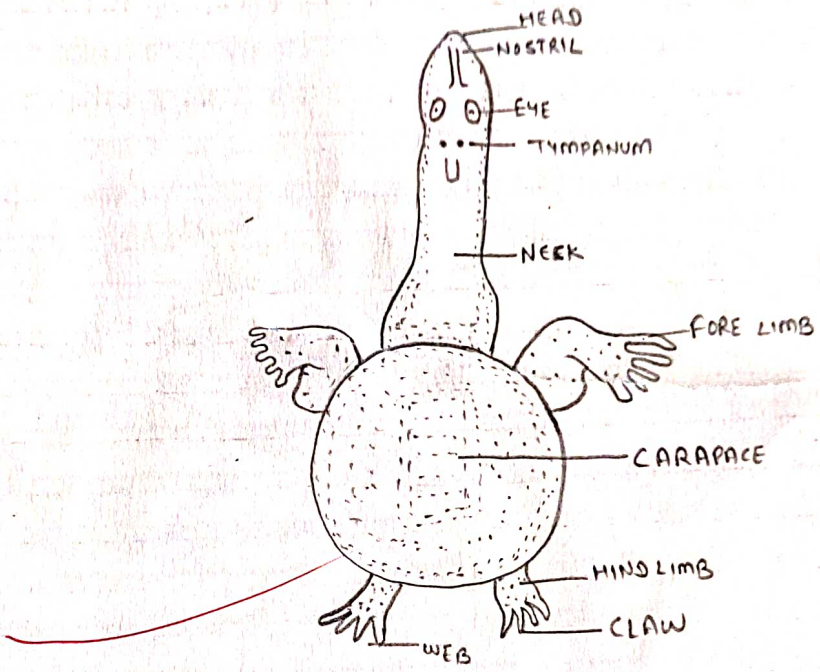

Diagram :- FRESH WATER - TORTOISE

Page No. :.....

Date :.....

Phylum - Chordata
Class - Reptilia
Order - Rhynocephalia
Genus - Sphenodon

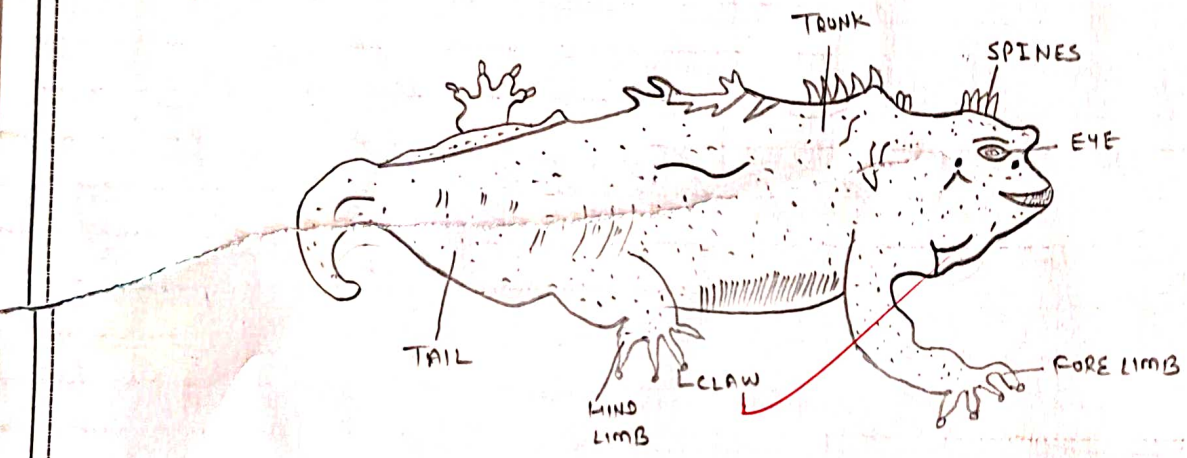

Diagram :- SPHENODON (TUATARA)

Date
Page

SPHENODON (Hatteria; Tuatara)

Characteristics :-

1. It is present in new zealand and found in burrows. It is nocturnal and insectivorous in habit.
2. Lizard - like body has the average size of 60 cm The colour is dull olive-green white and yellow spots
3. Tail is thick and laterally compressed.
4. Limbs are pentodactyle with claws on the tips of the digits.
5. It is the only reptile where the male is without a copulatory organ or penis.

CHAMAELEON

Characteristics :-

1. Completely sub-tropical parts. In India.
1. Completely arboreal lizard with many species; found in Asia, Africa and Europe in tropical and sub-tropical parts.
2. Laterally compressed body is about 40 cm long and is covered with scales which are reduced to small tubercles.
3. Eyes are large and are completely covered by the eyelids except in the centres which have small pin-hole openings.
4. Digits of the fore limbs are modified for grasping twigs and branches of trees.
5. Tail is long and prehensile, used for anchoring to twigs and branches of trees.

Phylum - Chordata
Class - Reptilia
Order - Squamata
Genus - Chamaleon

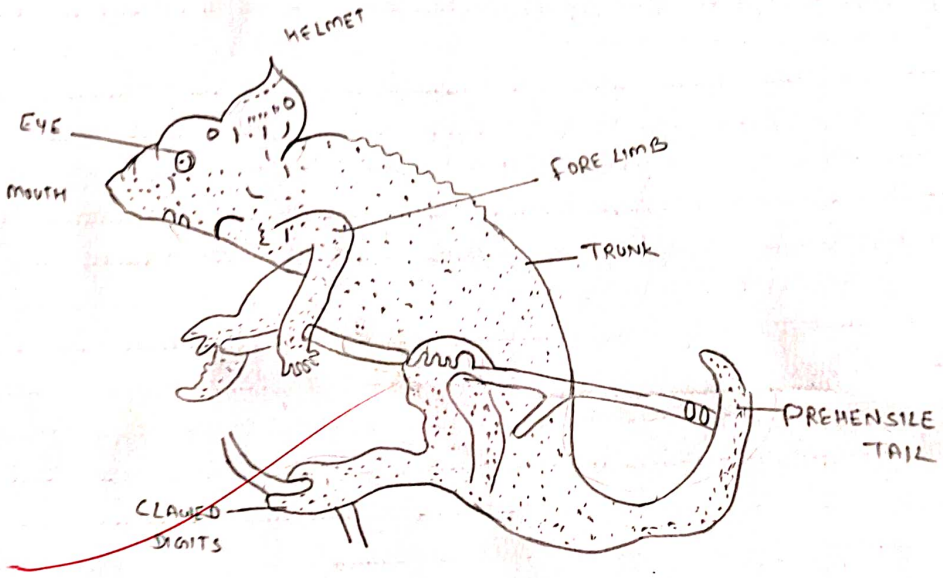

Diagram :- CHAMALEON

Page No. :.....

Date :.....

Phylum – Chosidata
Class – Reptilia
Order – Squamata
Genus – Eryx

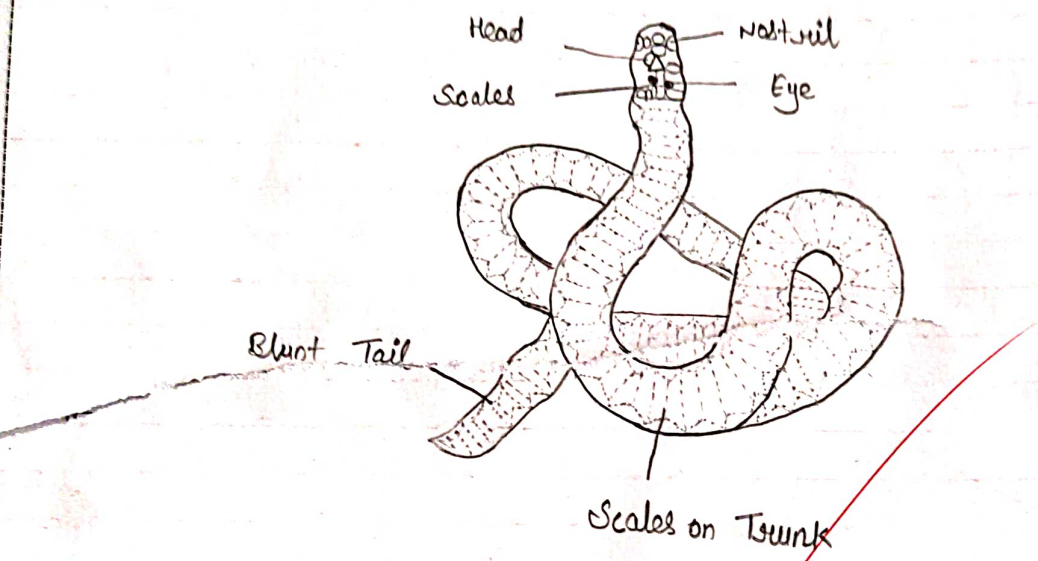

DIAGRAM :- ERYX (SAND – BOA)

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ERYX CS.AND-BOA; "Do-MUHI")

Characteristics:-

1. Eryx is present in arid and semi-arid parts of India and found living in burrows of rats and gerbils on which it also feeds.
2. Body is thick and cylindrical, of a uniform brown colour and measures about 80 cm in length.
3. The skin is covered dorsally with small smooth scales and ventrally by slightly large plate-like scales.
4. Head bears besides a terminal mouth, a pair each of nostrils and small eyes
5. It is a harmless non-poisonous sluggish snake

Sea - snake

Charetaistics :-

1. Body is long and may reach a length of 2 metres.
2. These are beautifully coloured sky blue with dark cross bands.
3. The body scales are small.
4. The tail is laterally compressed and used for swimming.
5. The venom is deadly and their bite is usually fatal.

Phylum - Chordata
Class - Reptilia
Order - Squamata
Genus - Hydrophis

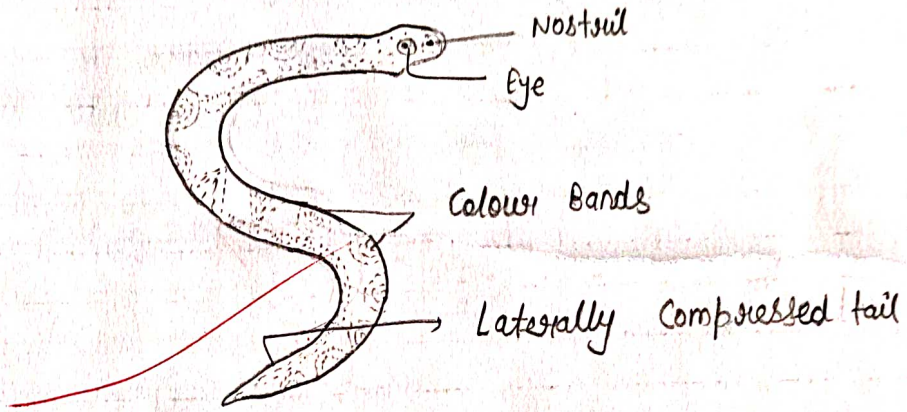

DIAGRAM:- HYDROPHIS (SEA - SNAKE)

Page No. :.....

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Phylum - Chordata
class - Reptilia
order - Squamata
Genus - Naja

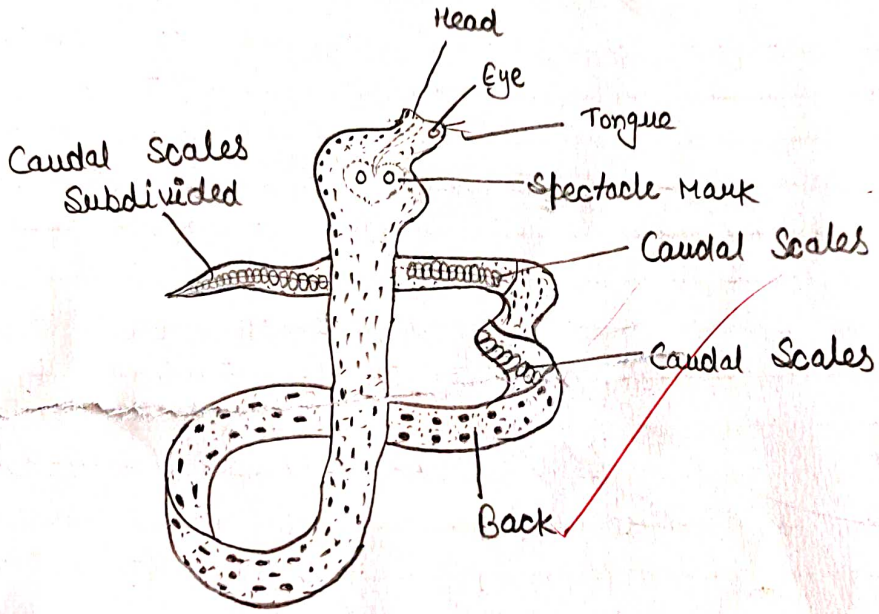

DIAGRAM :- NAJA (COBRA)

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NAJA (COBRA; "NAG")

Charetristics :-

1. The cobra, Naja (tripudians) is common throughout India with numerous varieties. The King cobra N. hannah is found at the foot-hills of the Himalayas and reaches a lengh of 5 metres or more.

2. The colour of the cobra varies from brownish to black and it reaches a length of nearly 2 metres.

3. Body is covered by uniform smooth scales on the dorsal side The ventral scales form large transverse plates which extend fully across the ventral side.

4. The arrangement of head scales is used for identifying it from other snakes. Dorsally the head bears small scales and anteriorly larger shields.

5. The ribs of the neck can be extended laterally to stretch the skin of the neck into an expanded hood.

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Page

VIPERA (RUSSELL'S VIPER)

Characteristics :-

1. Large viper is found throughout India. It measures about 1.5 metre or more in length and is of a pale brown colour above and with arranged in 3 longitudinal rows on the dorsal side.
2. Scales on the dorsal side of the body are plate-like. The ventral scales extend fully across the ventral side of the body to form a single row of overlapping ventral plates.
3. Body is thick-set. Head is large, followed by a narrow neck, a thick trunk and a short pointed tail.
4. Russell's viper is a deceptively sluggish snake but strikes like lightening opening its mouth wide and injecting the fatal poison by its long erect fangs.
5. It is a pit-less viper as there is not sensory depression, the loreal pit, between the nostrils and the eyes.

Phylum - Chordata
Class - Reptilia
Order - Squamata
Genus - Vipera

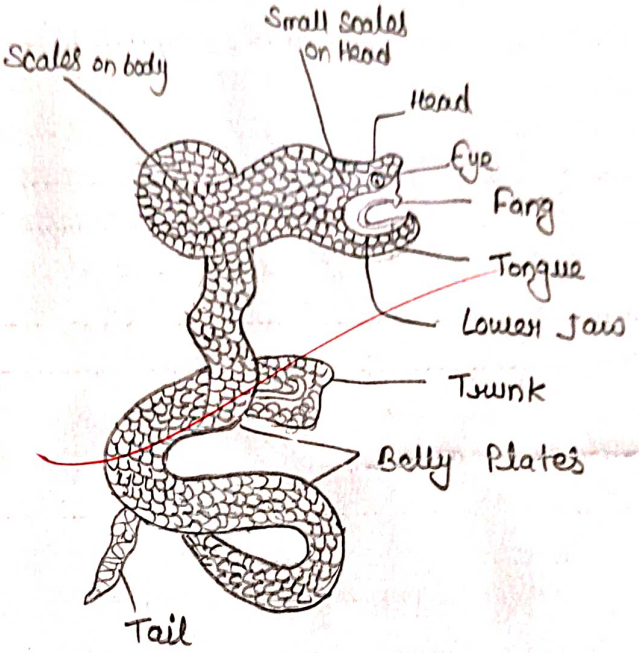

DIAGRAM :- VIPERA (RUSSELL'S VIPER)

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Phylum - Chordata
Class - Chondrichthyes
Order - Pleurotremata
Genus - Sphyrna

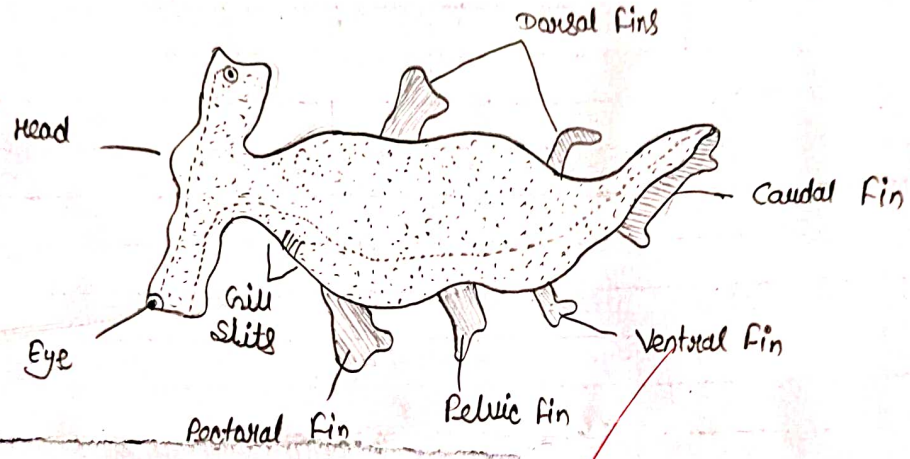

DIAGRAM :- SPHYRNA (HAMMER HEADED SHARK)

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ZYGAENA (SPHYRNA, HAMMER-HEADED SHARK)

Characteristics :-

1. The eyes are present at the terminal ends of the lateral stalks.
2. The nostrils are situated at the front edge of the head.
3. Crescentic mouth is ventrally present on the head.
4. Male bears a pair of copulatory claspers fused with the pelvic fins.
5. Tail is heterocercal.

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ARCHAEOPTERYX

Charetaristics :-

1. It was a typical bird about the size of a crow.
2. Body was covered with feathers except the head and neck
3. The jaws possessed small equal-sized pointed thecodont teeth.
4. It could not efficiently fly, but only volplane (glide) from tree to tree in forests.
5. A beak with teeth is present.

Phylum - Chordata
Class - Aves
Order - Archaeopteryx
Genus - Archaeopteryx

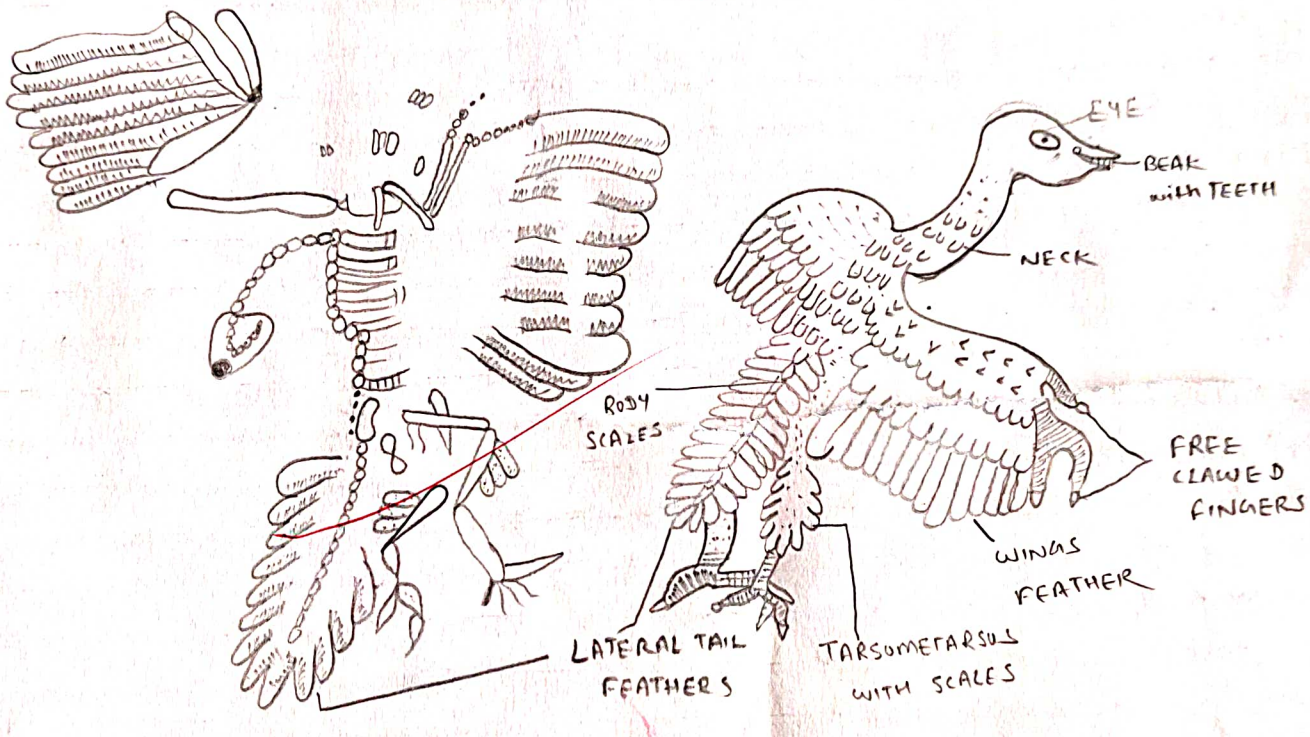

Diagram :- ARCHAEOPTERYX

Page No. :.....

Date :.....

Phylum ÷ Chordata
Class ÷ Mammalia
Order - Marsupialia
Genus - Kangaroo

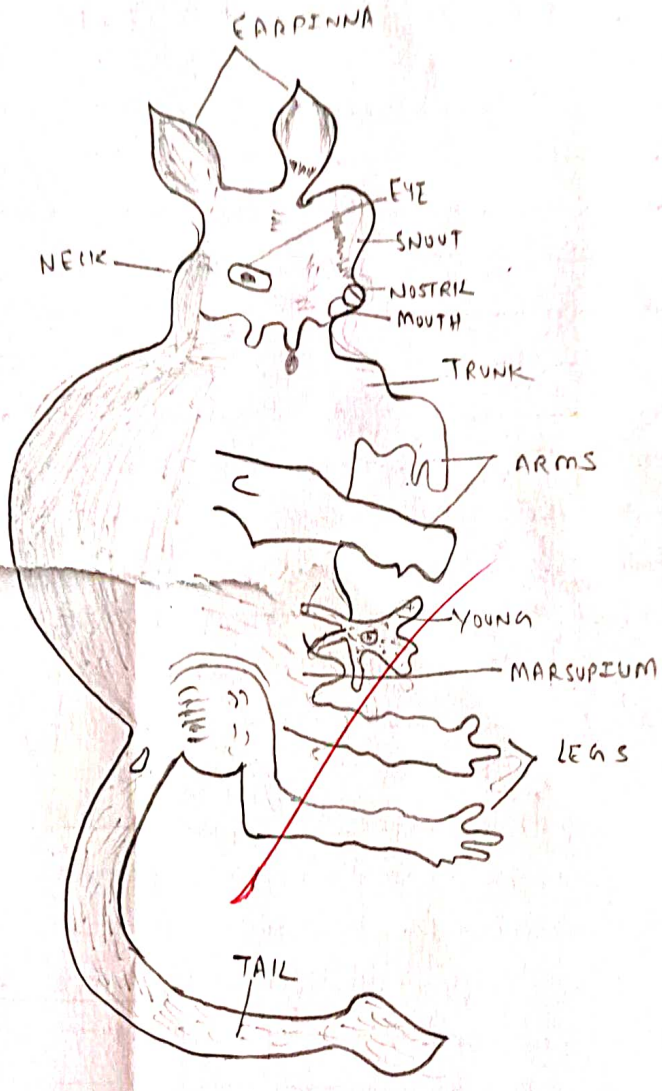

Diagram : MACROPUS (KANGAROO)

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MACROPUS (KANGOROO)

Charetaristics :-

1. females with a ventral pouch or marsupium which surround the nipples on the abdomen.
2. Young are born prematurely and undergo development in the marsupium by attaching and sucking milk from the nipples.
3. Fore limbs are small and do not touch the ground.
4. Tail is long thick and used as a support when the animal rests on the ground.
5. Kangaroos are herbivorous marsupials and do great damages to Australian food crops.

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Page

RHINOPOMA (RAT-TAILED BAT)

Characteristics :-

1. It is small insectivorous bat present throughout North-West India and is characterised by a long free tail. Other more common Indian genera of microchiropteran bats are Scotophilus the yellow bat, and Megaderma the false vampire bat.

2. These bats are nocturnal; during the day they rest in great colonies in caves, rocks, crevices and old abandoned buildings and wells.

3. The wings or patagia cover the greatly elongated fore limbs and digits and extend downwards to cover the hind legs and tail.

4. Of the fore limb digits only the I digit is clawed.

5. The fecal matter or droppings of these bats is called guano. It is collected from their habitats and used as a fertilizer.

Phylum - Chordata
Class - Mammalia
Order - Chiroptera
Genus - Small Bat

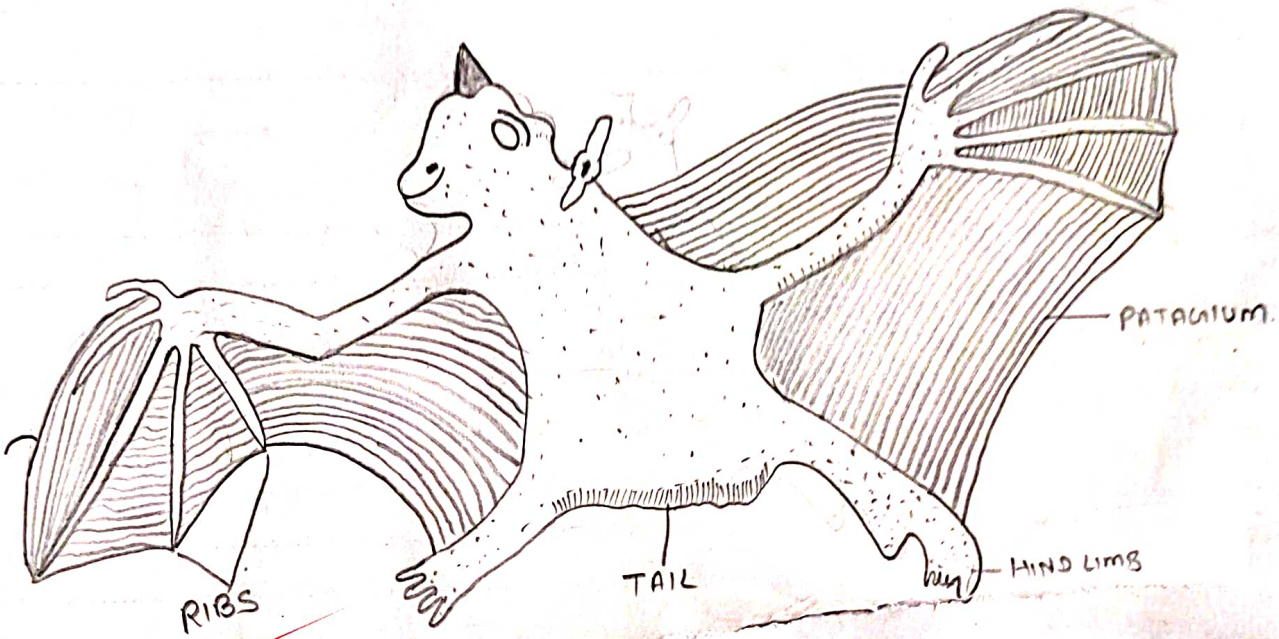
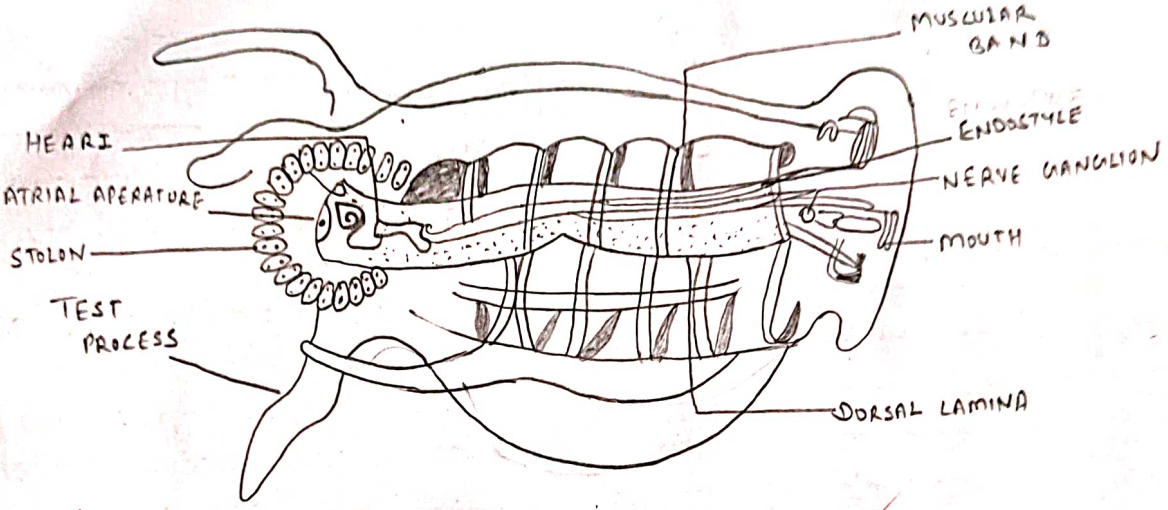
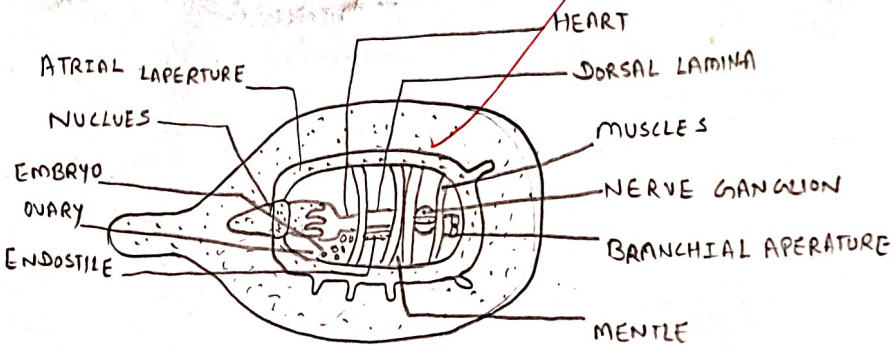


Diagram :- SMALL BAT

Phyllum - Chordata
Class - Thaliacea
order - Salpida
Genus - Salpa



(A) ASEXUAL



(B) SEXUAL

SALPA

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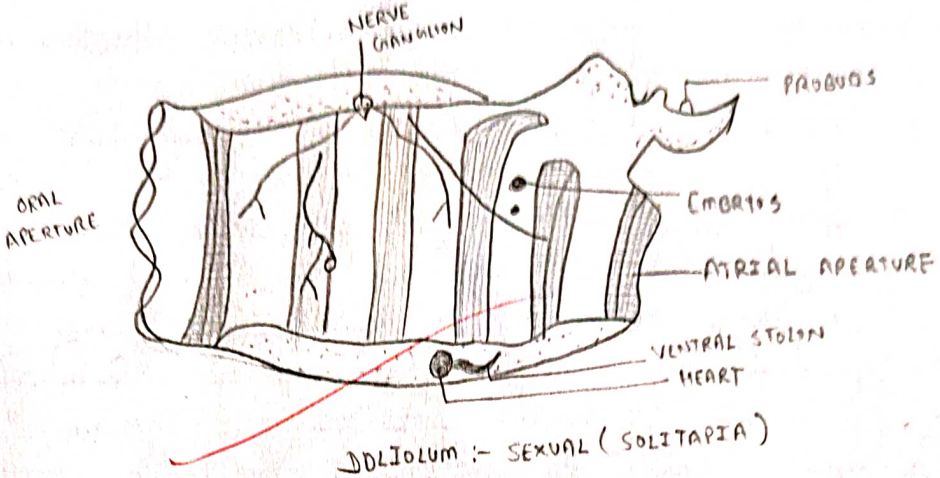
SALPA

Characteristics

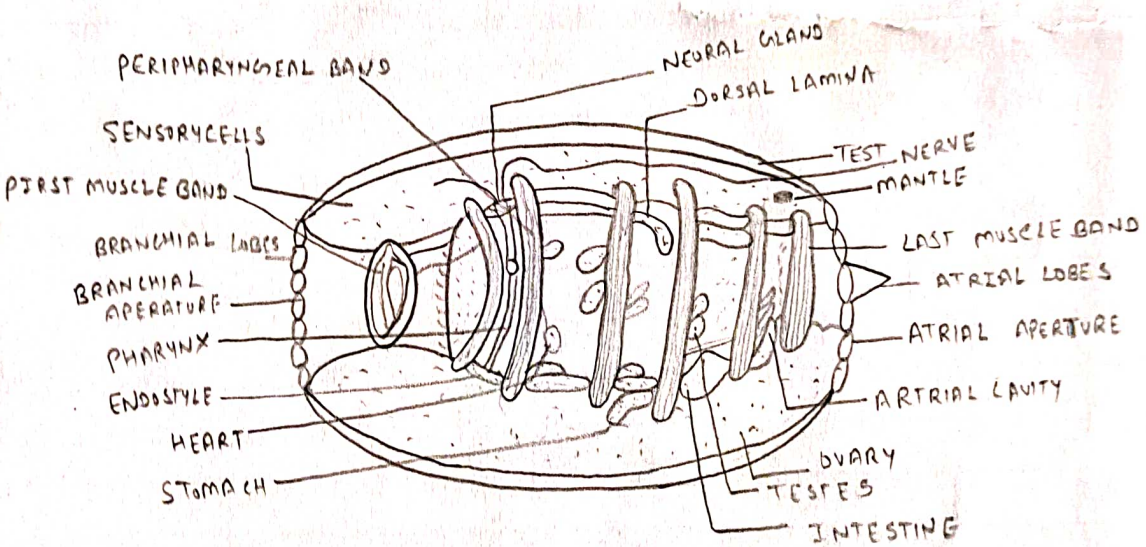
1. Cosmopolitan, free-swimming pelagic, marine form present in almost every sea
2. Body is transparent, barrel-shaped and measures from 1 to 2 cm.
3. The oral or branchial aperture and atrial aperture are situated at opposite ends.
4. Salpa is dimorphic are exhibits alternation of generations.
5. After sexual reproduction, development is internal (a larval stage is absent) and an asexual form is produced.

Page No. .....

Phylum- Chordata
Class - thaliacea
Order - Doliolum
Genus - Doliolum

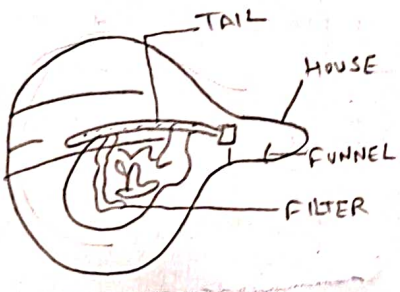


DOLIOLUM :- SEXUAL (SOLITARIA)

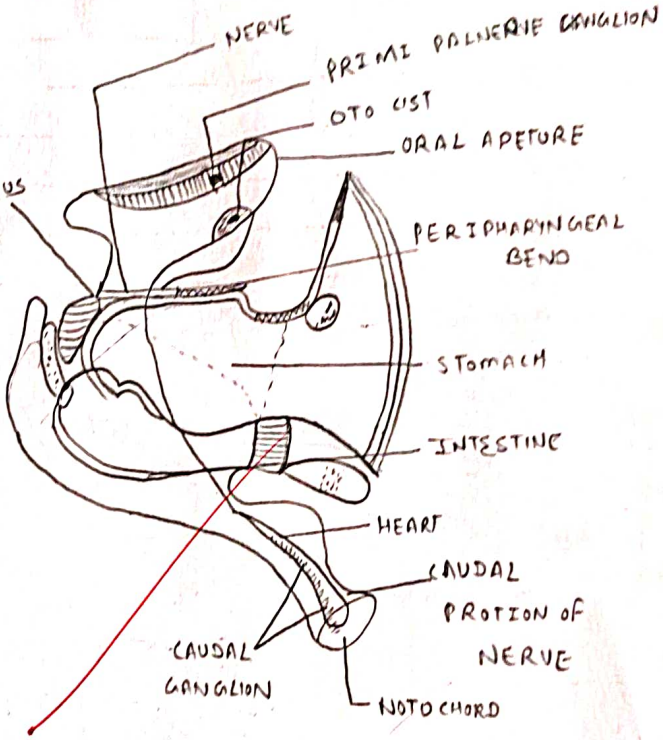


Teacher Signature .....

Phylum - Chordata
Class - Larvacea
Order - Endostylophora
Genus - Oikopleura



(A) ANIMAL INTEST



(B) INTERNAL STRUCTURE

Diagram :- OIKOPLEURA

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Page

DOLIOLUM

Characteristics :-

1. Cosmopolitan, free-swimming, pelagic, marine form present in almost every sea.
2. Body is transparent, barrel-shaped and measures from 1 to 2 cm.
3. Test is thin and transparent below which are present 8 complete muscle bands. The contractions of these muscles results in propulsion of the animal.
4. The oral (mouth) or branchial aperture and the atrial aperture are situated at opposite ends.
5. Doliolum is dimorphic and exhibits alternation of generations.

OIKOPLEURA

Characteristics :-

1. Cosmopolitan free-swimming, pelagic, marine form present in almost every sea.
2. Test is transparent, large and contains the animal which is about 8 mm in length.
3. Body is differentiated into an oval trunk and vibratile tail attached at right angles to the trunk.
4. Besides the nerve cord the tail has the notochord also.
5. Exhibits the phenomenon of neoteny by retaining larval characters throughout life.

II.12

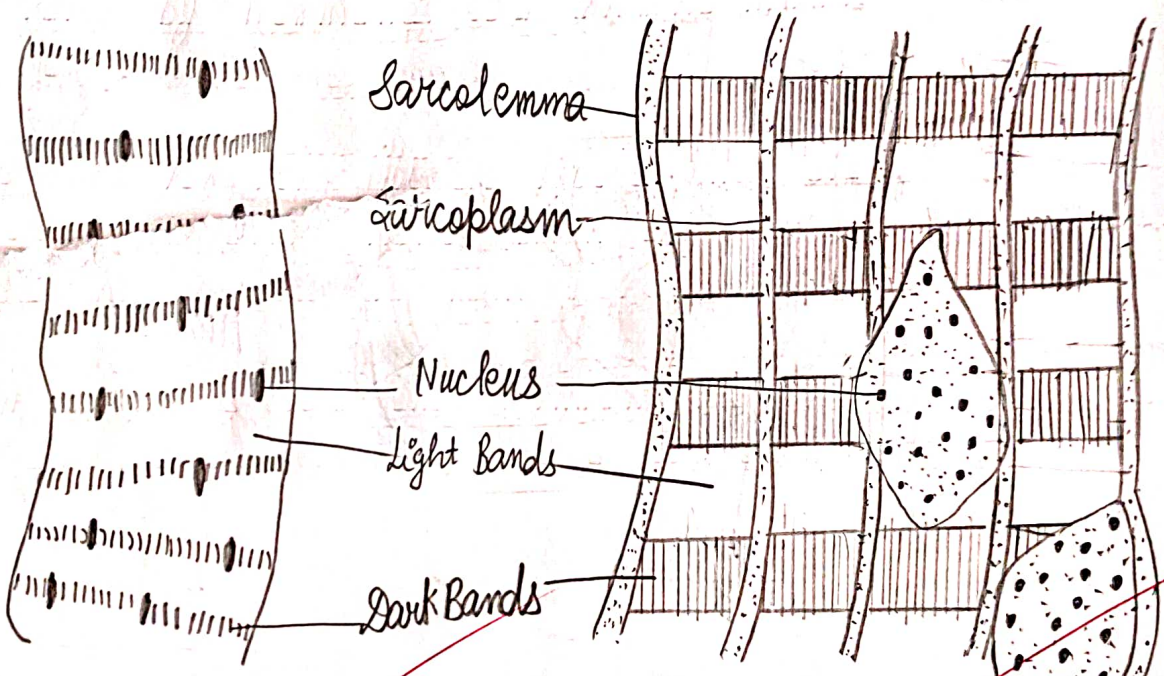

fig. 11.3 : Striated muscle fibre cells.

Permanent Slide

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STRIPERD MUSCLE FIBRES

Charetristics

1. Striated muscle fibres are also known as voluntay, staiped or skeletal muscles.
2. Each fibes is a very long, cylindrical, multinucleated, syncitial cell, whic is enclosed by a thin membrance called sarcolemma.
3. The cytoplasm of the muscle fibre is known as sarcoplasm.
4. The sarcoplasm of each muscle fibre has embedded in it many longitudinal myofibrils.
5. Each myofibril is made up of alternating light dark coloured discs of striations.

SMOOTH MUSCLE FIBRES

Charetaistics:-

1. Smooth muscle is called smooth because it lacks the arrangement in sarcomers that makes striated muscle appear striated.
2. Often polyneural.
3. Often activated by hormones (e.g uterine muscle; oxytosin contracts, progesterone relaxes).
4. As in the striated tonic muscle fibres, the signals in smooth muscle cells are sum-mated, which gives a gradual contraction (as opposed to an all-or-none response).
5. The smooth muscle is slow and although the metabolism is mixed glycolytic and oxidative, the oxidative component is poorly developed.

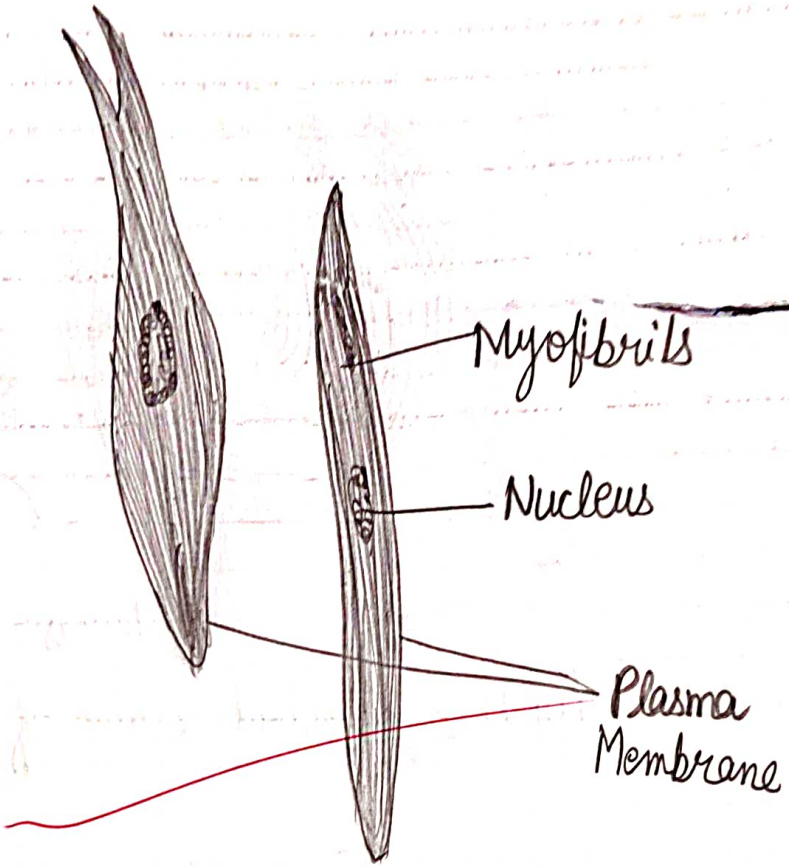

Fig. 11.4 : Smooth muscle fibres.

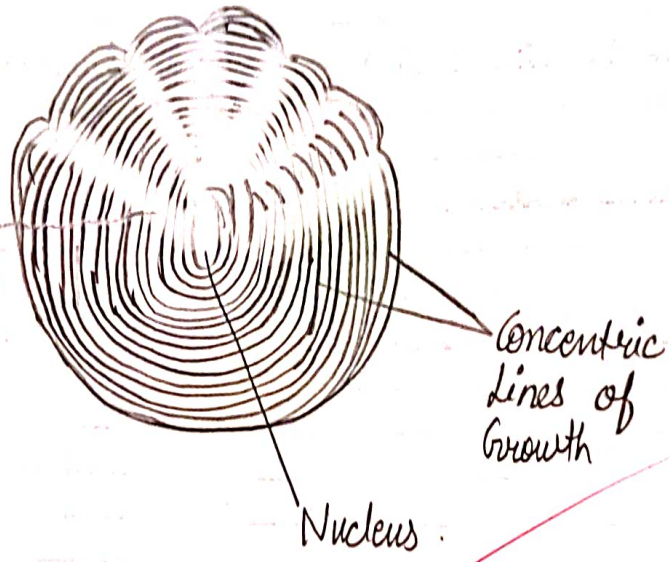

Fig. 11.5: Cycloid scales of an edible fish.

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SCALES of EDIBLE FISH

Characteristics :-

1. Cycloid scales are found in Labeo
2. Cycloid scales are bigger in size as compared to placoid scales.
3. Growth lines can be seen in cycloid scales. These grow with the age of fish, due to the presence of growth lines, scales look like a wheel.

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FROG: SKULL (Dorsal view)

Comments :-

1. The sphenethmoid bone dorsally appears as diamond-shaped and lies just behind the nasals.
2. The frontoparietals lie posterior to the sphenethmoid.
3. The exoccipitals are present at the posterior end of the skull. They bear 2 condyles.
4. The prootics and exoccipitals fuse and connect laterally with the frontoparietals in the posterior region.
5. The squamosals are hammer-shaped bones which lie lateral to the prootics.

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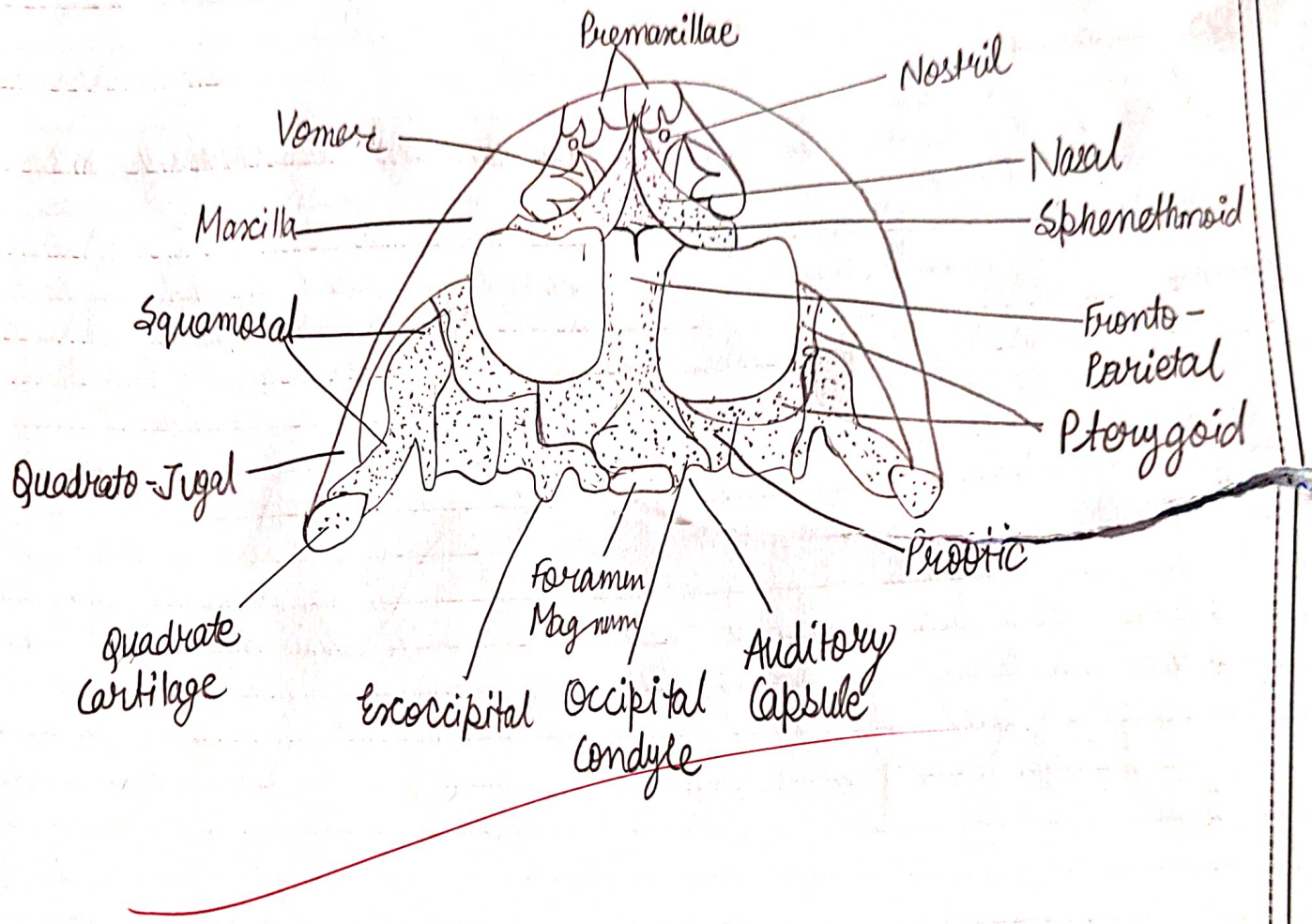
J. 6



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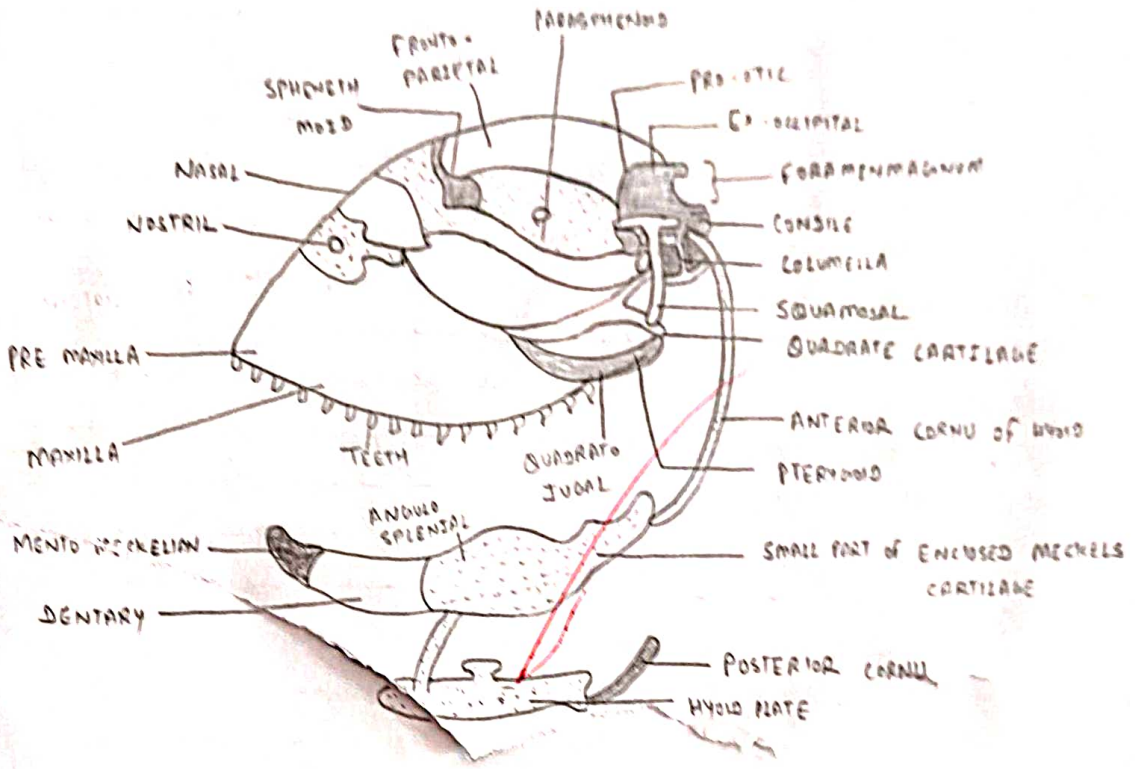

FROG :- SKULL (~~DORSAL~~ Lateral VIEW)

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Page

Frog: skull (Lateral view)

Comments:-

1. The thin, broad and teeth-bearing vomers lie just posterior to the premaxillae. posteriorly, the vomers articulate with the large sphenethmoid bone.
2. The sphenethmoid articulates laterally with a rod-like transverse palatines. The palatines articulate with the maxillae by their distal ends.
3. An inverted 'T'-shaped parasphenoid forms the base of the cranium.
4. The laterally placed tri-radiate pterygoids are clearly visible.

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Page

Lateral Aspect

Comments :-

1. The prootics and exoccipitals fuse and connect laterally with the frontoparietal in the posterior region.
2. The squamosals are hammer-shaped bones which lie lateral to the prootics.
3. The postero-dorsal limb of each squamosal is connected with the prootic while the antero-dorsal limb is free. Its ventral limb is connected posteriorly with the quadratojugal.
4. The tri-radiate pterygoids lie just below the squamosals. The anterior limb of each pterygoid articulates with the maxilla of its side, the posterior limb articulates with the prootic and the prootic and the third limb is connected ventro-laterally with a small jaw.

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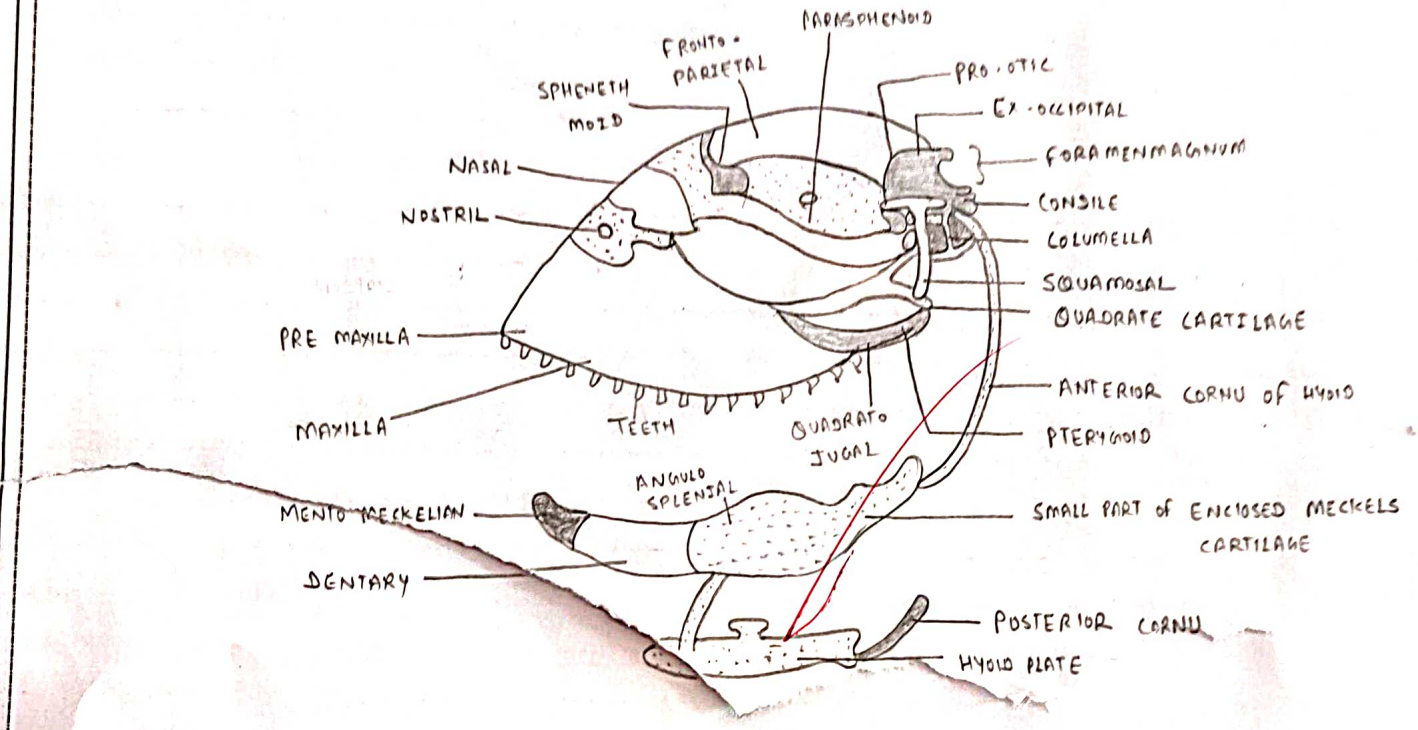

FROG :- SKULL (~~DORSAL~~ Lateral VIEW)

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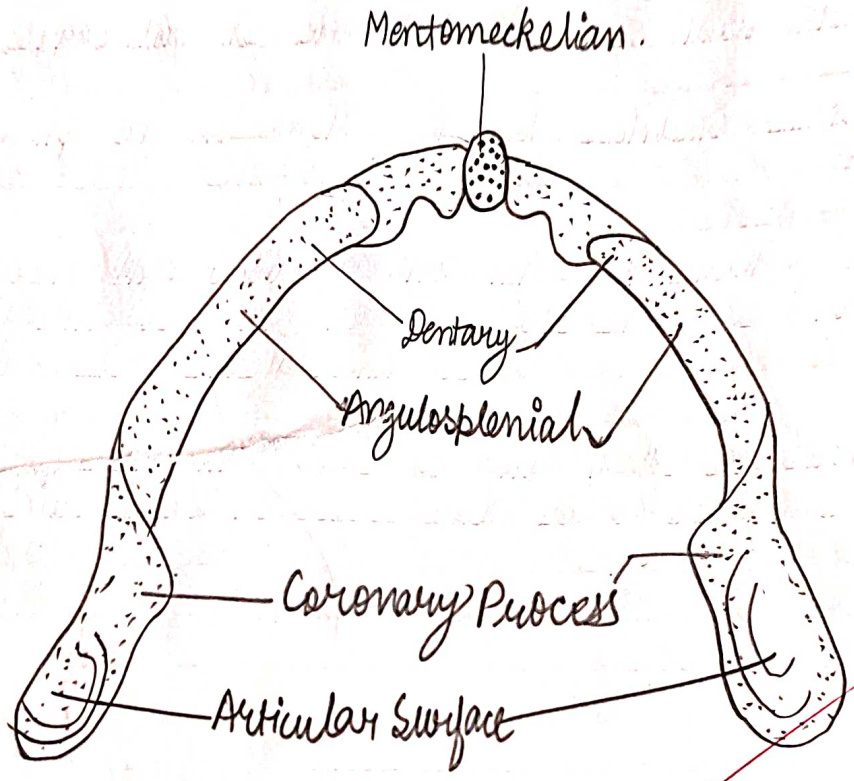
V.16


Mentomeckelian.
Dentary
Angulosplenial
Coronary Process
Articular Surface

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MANDIBLE (LOWER JAW)

COMMENTS :-

1. Lower jaw or mandible is a bironous structure.
2. Each half consists of an anterior small mento-meckelion, an outer dorsal dentary and an inner ventral long angulosplenial
3. The posterior articular surface articulates with the quadrate of the upper jaw.
4. The long meckel's cartilage is covered almost entirely by the dentary and the angulosplenial

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HYOID APPARATUS

FROG

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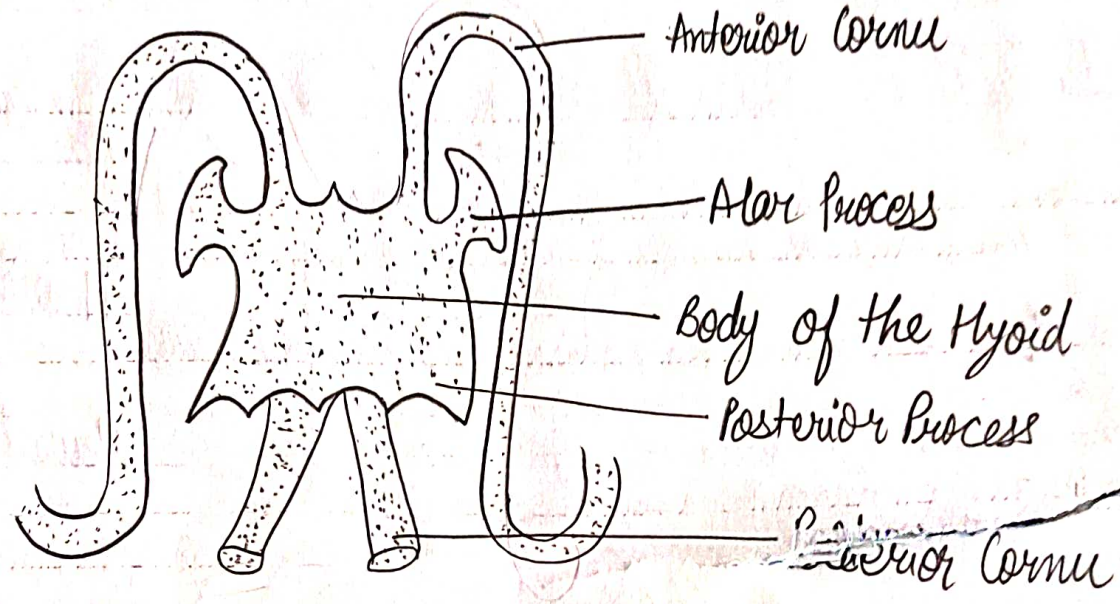
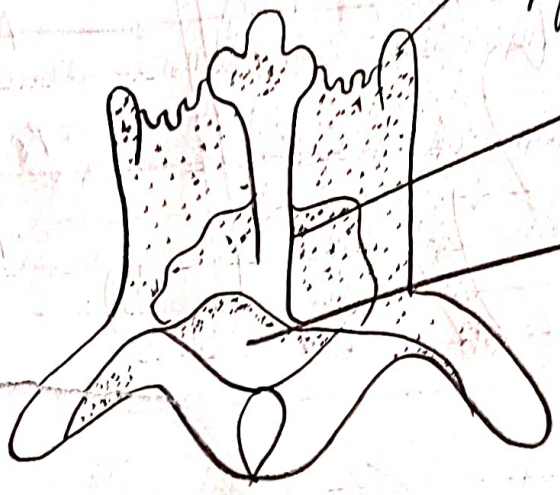
Comments :-

1. The hyoid apparatus is situated on the floor of the buccal cavity.
2. It is made up of a shield - shaped cartilage called the body of the hyoid.
3. Anteriorly, from the body of the hyoid project 2 long lateral anterior cornu. similarly, from the postero - lateral sides project - 2 posterior cornu which are small bony rods.
4. Laterally, in between the anterior and posterior cornu is present a pair each of anterior alar processes and posterior processes.

V.19


Anterior Cornu
Alar Process
Body of the Hyoid
Posterior Process
Posterior Cornu

V.22



Facet for Occipital condyles

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Page

Cervical:-

Comments:-

1. Atlas is the first vertebra and the only cervical vertebra present in frog.
2. It is a ring-shaped bone with an extremely reduced centrum.
3. Neural canal is large, but neural spine is reduced.
4. Transverse processes are absent.
5. ~~Transverse has~~ prezygapophyses are absent, but postzygapophyses are present.

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Page

Frog: Typical vertebra

Comments :-

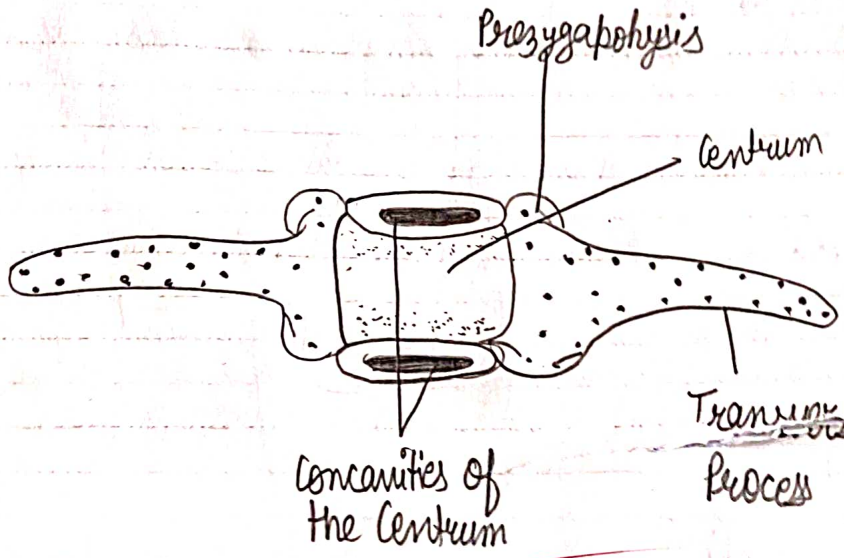
(i) VV - Vertebra:

1. Eighth vertebra differs from the rest of the typical trunk vertebrae in having an amphicoelous, i.e., it is concave at both ends.
2. The neural canal, neural arch and spines are well-developed.
3. Transverse processes, pre- and post-zygapophyses are present.
4. Anterior concavity of the centrum fits into the posterior convexity of the vertebra.

(ii) Typical:-

1. Typical vertebra of frog has a well-developed centrum which is procoelous, i.e., it is anteriorly concave and posteriorly convex.
2. The neural canal is wide with well-developed neural arches and neural spines
3. Transverse processes are well-developed.
4. Both pre- and post-zygapophyses are present.

V.25


Prezygapohysis
Centrum
Transverse Process
Concavities of the Centrum

J-23
J-24

Date
Page

Sacral:

IX. vertebra:

1. It has a biconvex centrum possessing a single anterior convexity and 2 posterior convexities which fit into the concavities of the urostyle.
2. The neural spine is reduced.
3. Transverse processes are long thick, backwardly and obliquely directed; these articulate with the iliums of the pelvic girdle
4. Prezygapophyses are present, but the postzygapophyses are absent.

X. Urostyle:

1. It forms the posterior end of the vertebral column and probably represents the caudal or x-vertebra.
2. It is a large tapering rod with median dorsal ridge or crest
3. Anteriorly it has 2 concavities which fit into the convexities of the centrum of the IX vertebra.

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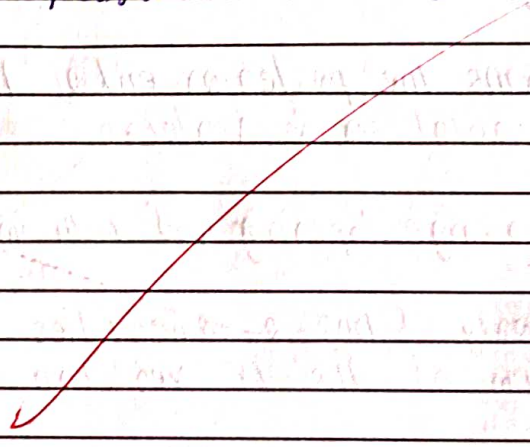
STERNUM : FROG

Comments :-

1. Ventral sternum of frog is elongated, rod-like and fused with the pectoral girdle in the mid-line.
2. It is made up of 4 parts.
3. Episternum is the anterior-most cartilaginous flat disc of the sternum.
4. Omosternum is present behind the episternum and is posteriorly connected with the clavicles.
5. Mesosternum is present behind the epicoracoid and is a cartilaginous rod.



V.35

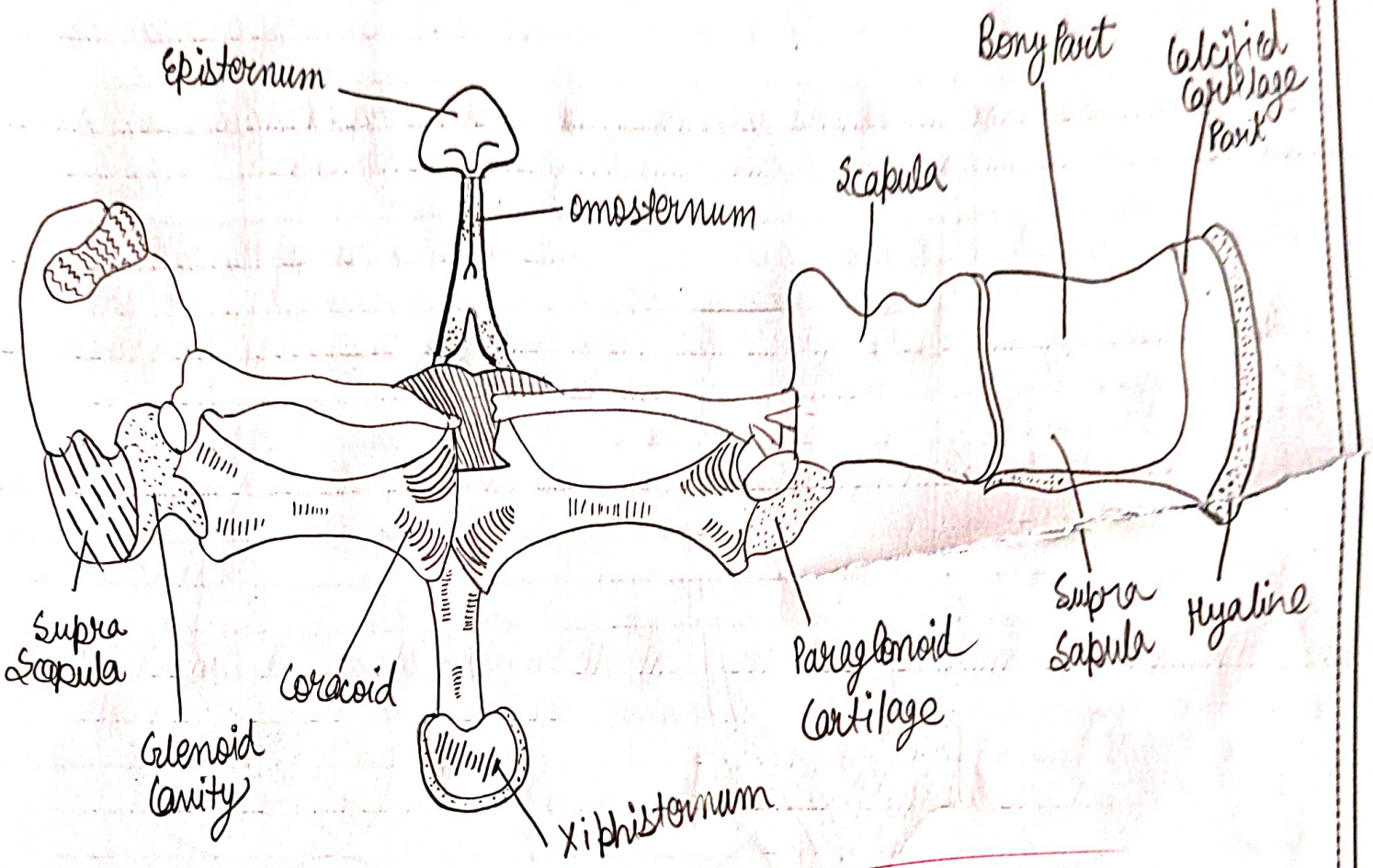


Fig. V. 41: Frog: Pectoral girdle and sternum.

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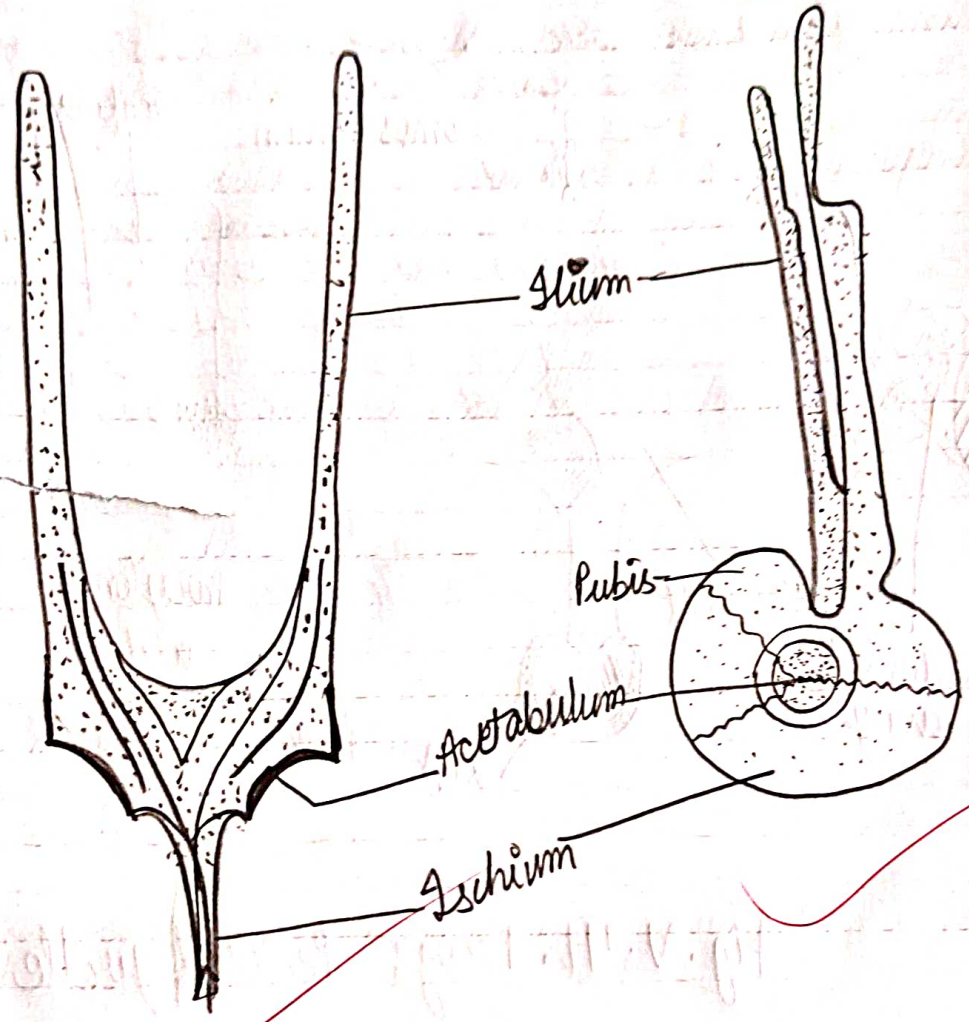
V.40



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Pelvic Girdle

Comments :-

1. The hip or pelvic girdle is composed of two identical halves fused in the middle to form a 'v' shape.
2. Each half of os-innominatum is composed of three bones : an antero-dorsal ilium, an antero-ventral pubis, and a postero-dorsal ischium.
3. Ilium is a long rod-like bone and bears a dorsal iliac crest.
4. Pubis and ischium are crescentic and meet half-way to form the disc of the girdle.
5. In the centre of the disc is a large articular facet, the acetabulum, into which fits the head of the femur.

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Fore-Limb

(i) Humerus

1. It is the upper arm bone and consists of a slightly curved shaft.
2. The proximal end of the shaft is produced into a round head which fits into the glenoid cavity of the pectoral girdle.
3. The distal end of the shaft has a round trochlea or capitulum which bears a condylar ridge for articulation with the radio-ulna.

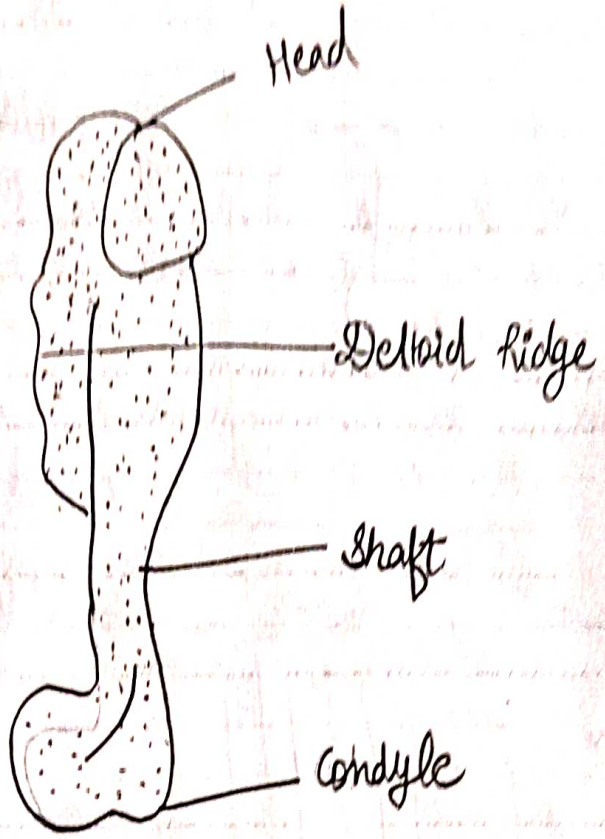
(ii) Radio-ulna.

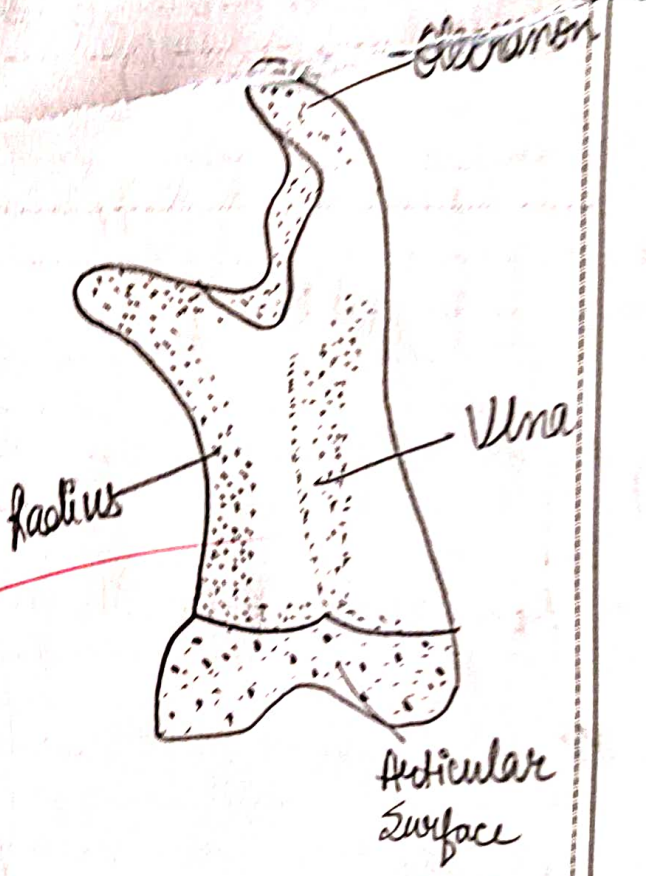
1. The two bones, the radium and the ulna fuse, to form a compound bone of the fore-arm.
2. A median longitudinal groove demarcates the 2 bones.
3. ~~A median~~
The proximal end bears a deep concavity for articulation with the capitulum of humerus.

(iii) Carpals and Metacarpals

1. The wrist bones are the 6 carpals which are arranged in 2 rows, the proximal and the distal.
2. The distal carpals articulate with the 4 metacarpals to which are attach the phalanges.

V.46


Head
Deltoid Ridge
Shaft
Condyle


Olecranon
Ulna
Radius
Articular Surface

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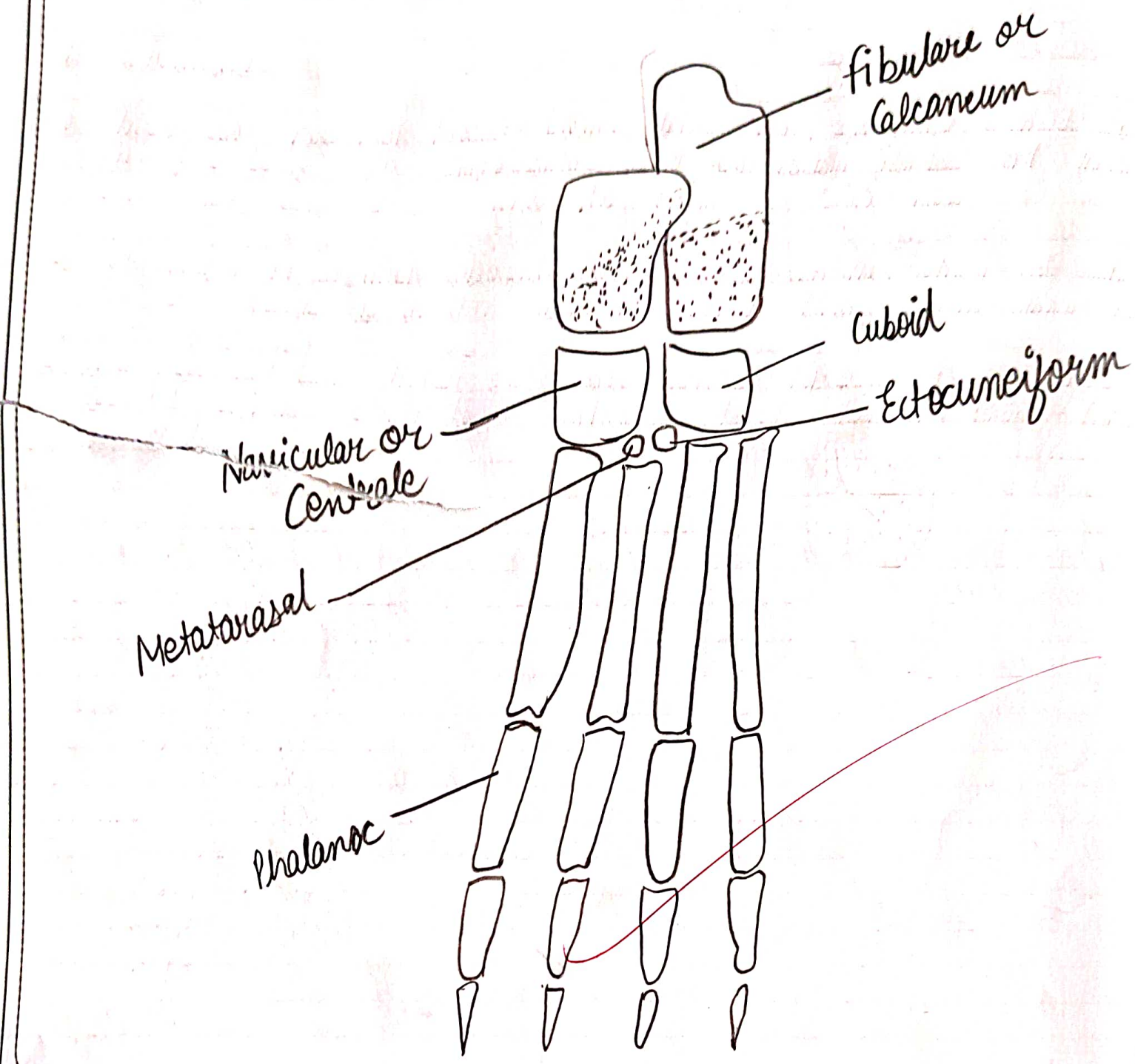
V.61



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IInd - Limb

(i) Femur

Comments →

1. The thigh bone has a slightly curved shaft in the shape of 'S'.
2. The proximal end of this shaft is produced into a head which articulates with the acetabulum of the pelvic girdle.
3. The distal end of femur articulates with the tibia - fibula.

(ii) Tibia - fibula

Comments :-

1. These are elongated bones of the shank which fuse longitudinally to form a compound bone.
2. The tibia has a tibial crest at the proximal region.
3. In the centre of the median groove between the two bones is a nutrient foramen.
4. Tibia - fibula at their proximal end have an articular facet for the femur and at the distal end bear an articular facet for the astragalus calcaneum.

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Astragalus - Calcaneum (proximal Tarsals)

* Comments:-

1. These are proximal tarsal bones which are elongated considerably. The two bones, the astragalus and calcaneum unite at their proximal and distal ends to form the ankle bone.
2. Calcaneum is a thick straight bone present on the other side, whereas the astragalus is a thin slightly curved bone at the inner side.
3. The proximal and distal ends are covered by ossified cartilages termed epiphyses which form articular facets for the tibia, fibula and the tarsals.

V.48

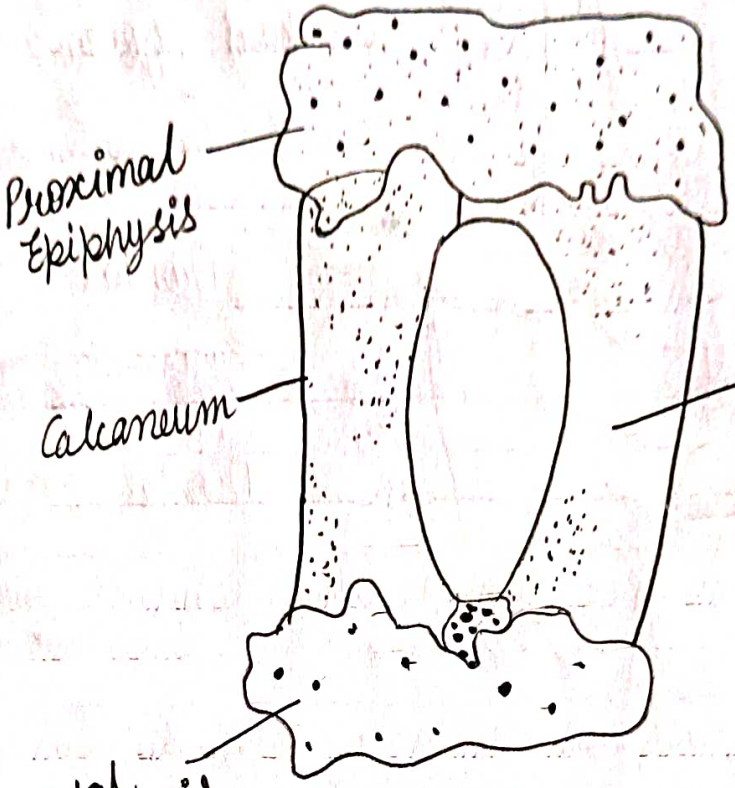
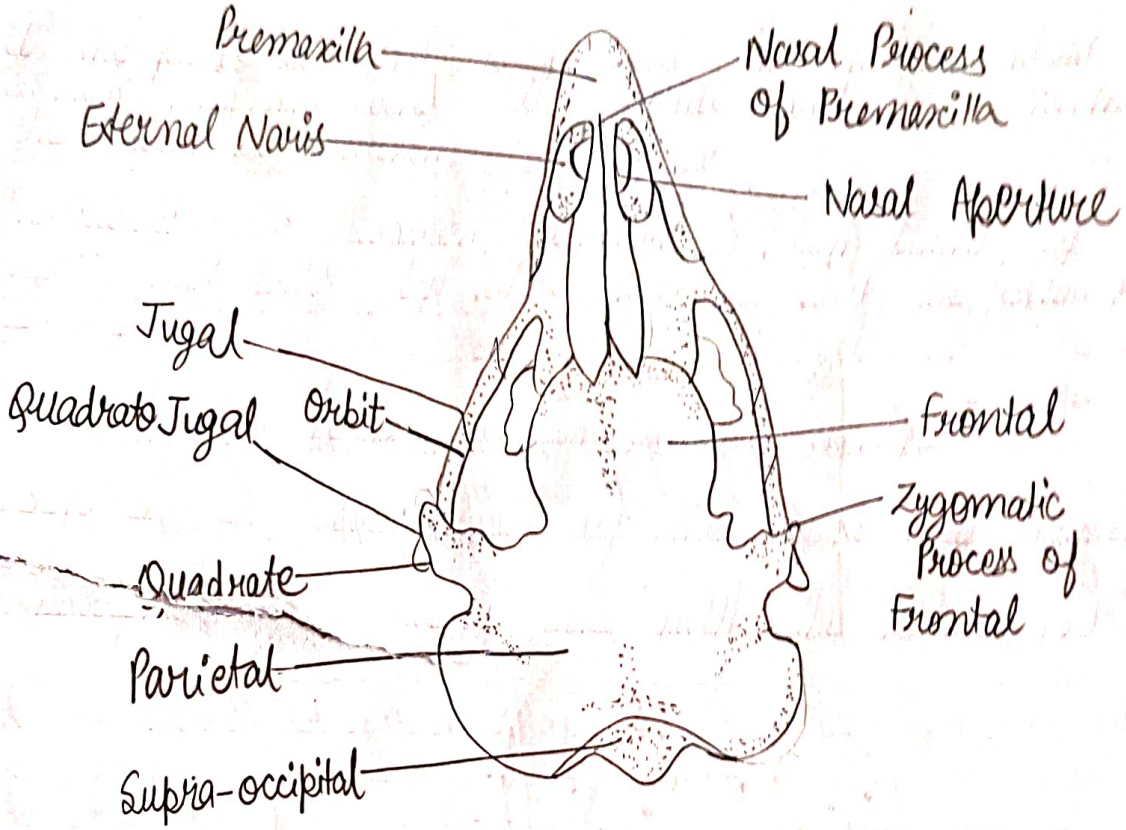


Fig. V.62: frog: Astragalus - calcaneum.

V 9/2


Premaxilla
External Naris
Jugal
Quadrato Jugal
Orbit
Quadrate
Parietal
Supra-occipital
Nasal Process of Premaxilla
Nasal Aperture
Frontal
Zygomatic Process of Frontal

(5)

Date
Page

FOWL

1. The skull of bird is distinct in being light in weight having a round cranium with the foramen magnum facing downwards, presence of a long pointed beak without any trace of teeth and a single occipital condyle

Dorsal Aspect

2. The anteriormost premaxillae are united to form a large triradiate bone which forms almost the whole of the upper beak.

3. The median process of the premaxilla joins with the nasals while the 2 ~~late~~ lateral processes join with the maxillae.

4. The nasals are large pointed bones which anteroventrally articulate with the maxillae and posterolaterally with the lacrymals and posteriorly with the frontals

5. The frontals form the roof of the skull and also the dorsal and posterior margins of the large orbits.

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Page

(4)

Ventral Aspect

1. At the posterior end is present the large ventral median foramen magnum and the skull articulates vertically with the vertebral column.
2. Anteriorly, the foramen magnum is bordered by the squamous pital, laterally by the exoccipitals and posteriorly by the basioccipital.
3. The basioccipital bears a median occipital condyle.
4. Adherent of the basioccipital is the large basitemporal.
5. The parasphenoid anteriorly joins with the median rod-like vomer

V.12

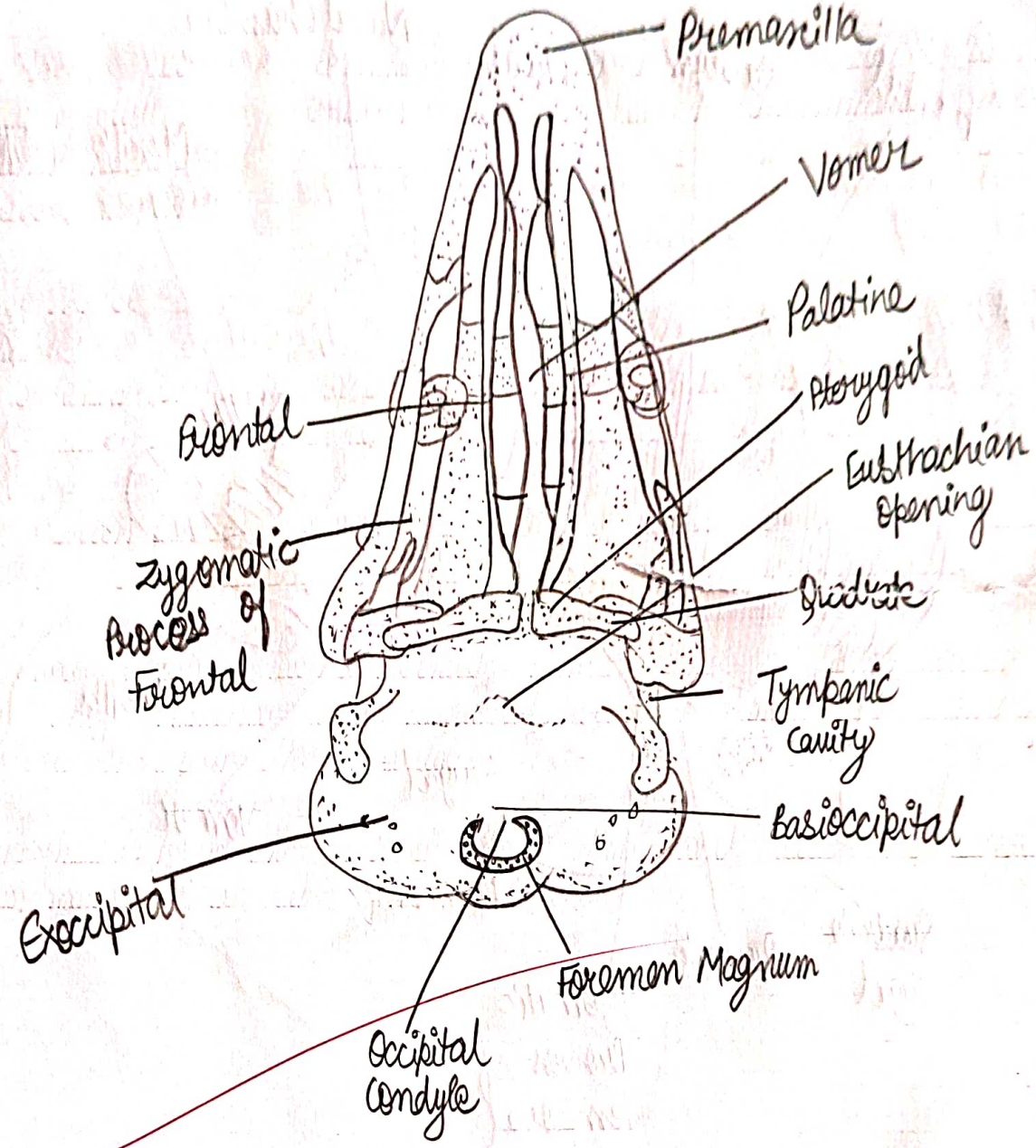
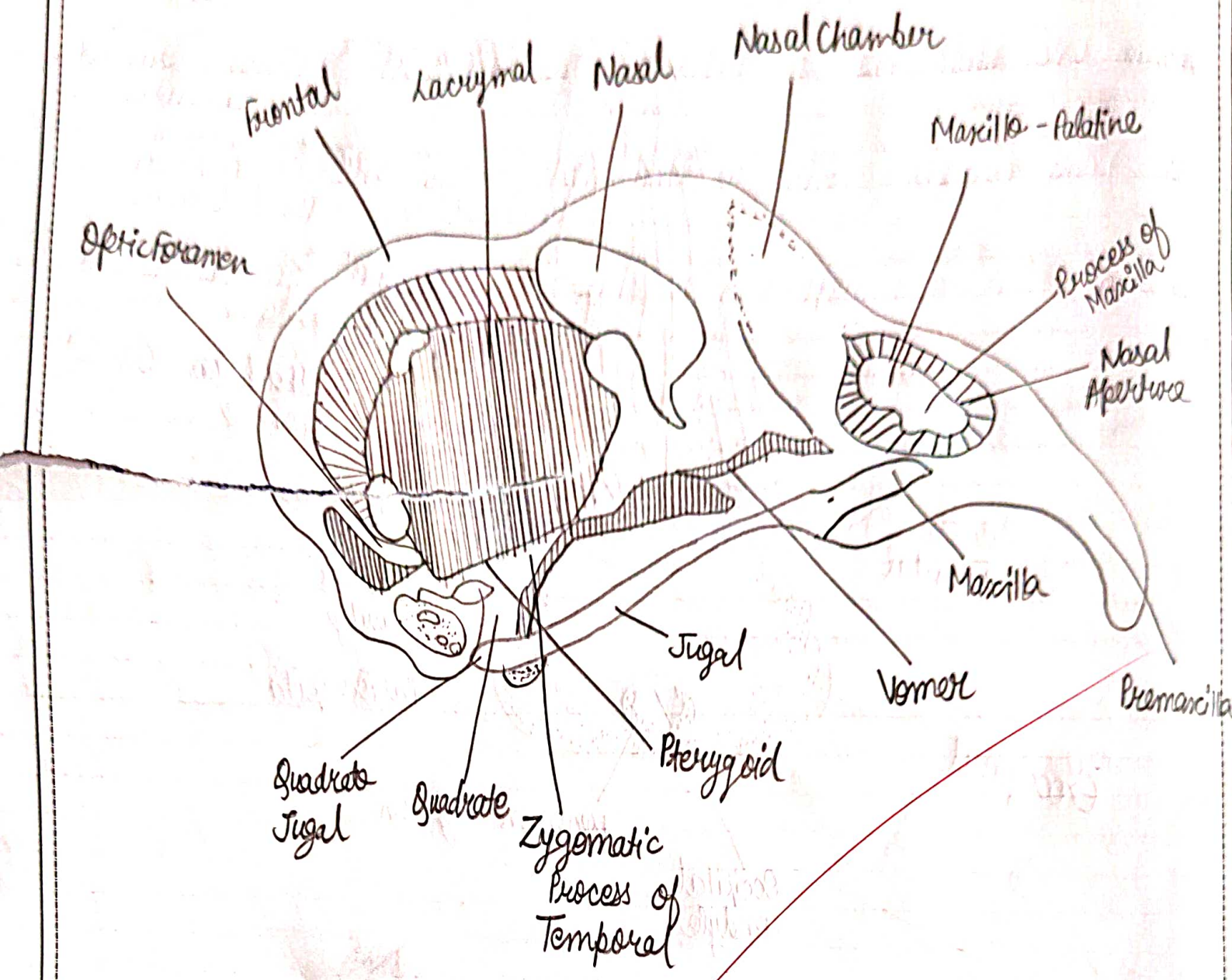


Fig. V. 7B. : Fowl : Skull : (Ventral view)

V.13



Fowl : Skull : (Lateral View)

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Lateral Aspect

1. At the posterior end in the otic region is seen the large tympanic which the fused epiotic and supraoccipital. posteroventrally with the opisthotic which is fused and anterolaterally with the stout tripodite quadrate.

2. The lower process of quadrate articulates with quadratojugal and lateral pterygoid; ventrally it bears a facet for the articulation of the lower jaw.

3. A thin inter-orbital septum formed by the posterior prespheno and dorsal mesethmoid is present between the large orbits.

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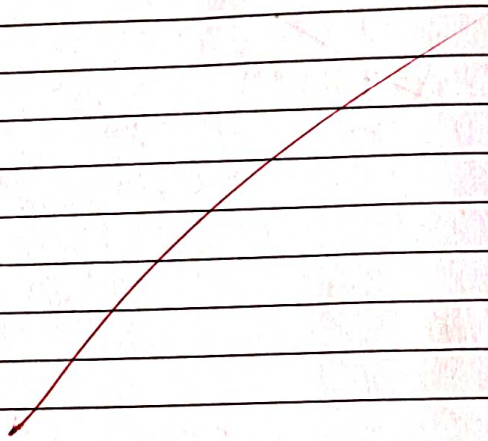
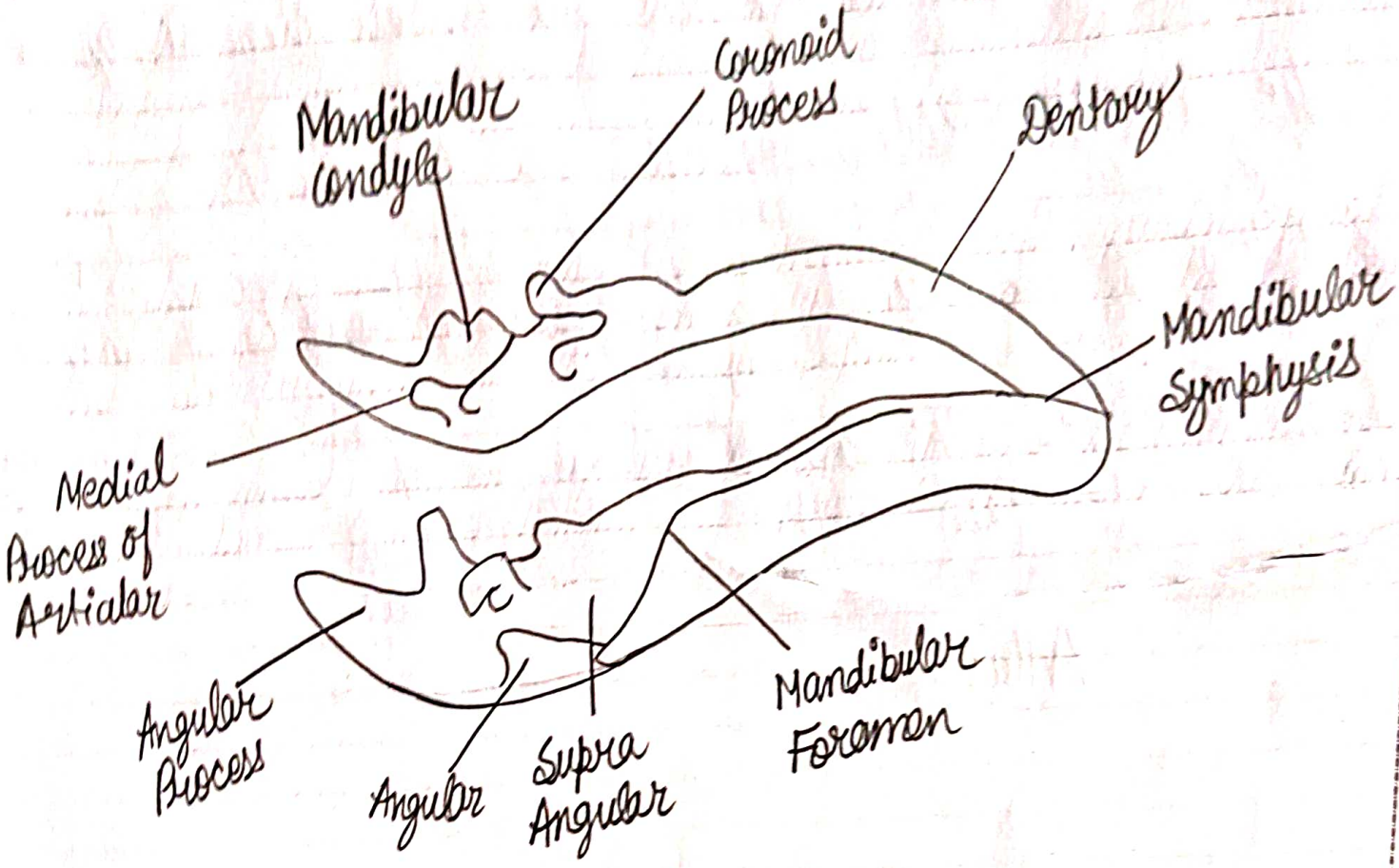
FOWL

1. The tooth lower jaw or mandible is bixanous and anteriorly pointed.
2. In each xanous more than half of the anterior part is formed by the dentary.
3. Behind the dentary are the inner splenial, the coronoid the supra-angular.
4. The articular bears an inner articular process.



PTC

V.17
V.20



Fowl : Mandible (Lateral View)

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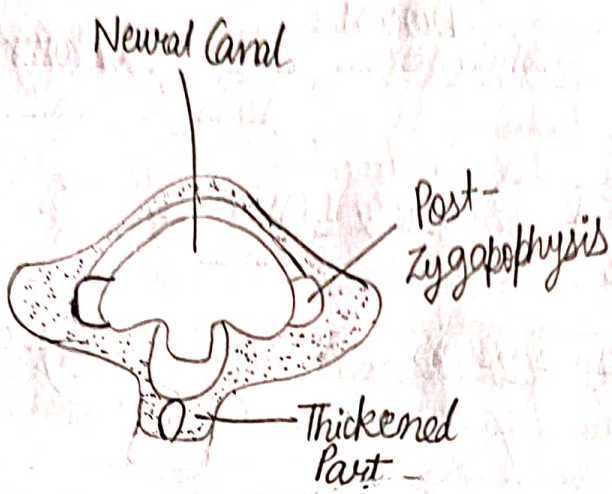
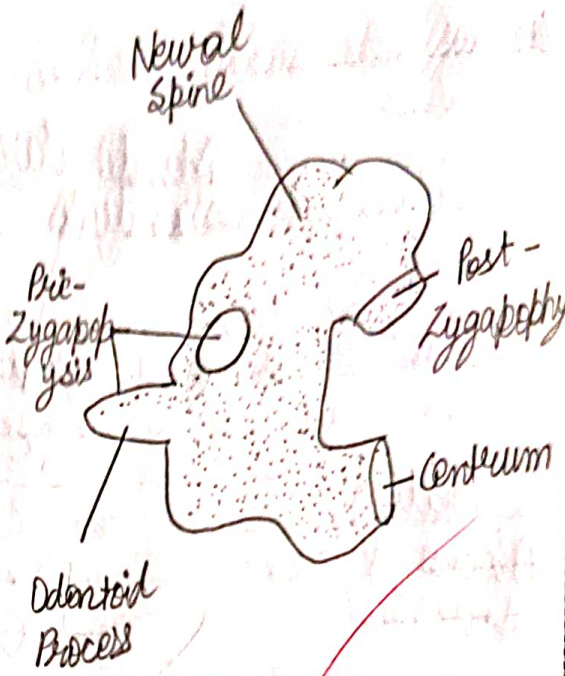
V.28


Neural Canal
Post-
Zygapophysis
Thickened
Part

Atlas


Neural
Spine
Pre-
Zygapophysis
Post-
Zygapophysis
Centrum
Odontoid
Process

Date
Page

Atlas

1. The first cervical vertebra is the atlas which articulates anteriorly with the occipital condyle of the skull.
2. It is a ring - like single - piece bone which is laterally expanded into wing - like processes.
3. Distinct centrum, neural spine, cervical ribs and prezygapophyses are absent.
4. On the anterior ventral surface is a concave articular facet for the occipital condyle.

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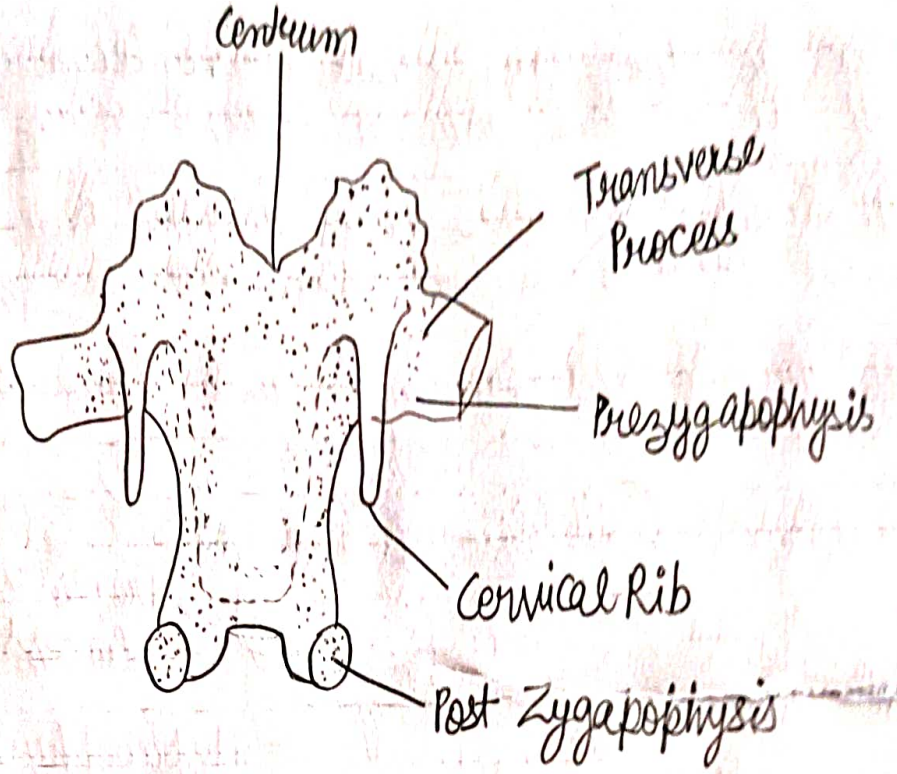
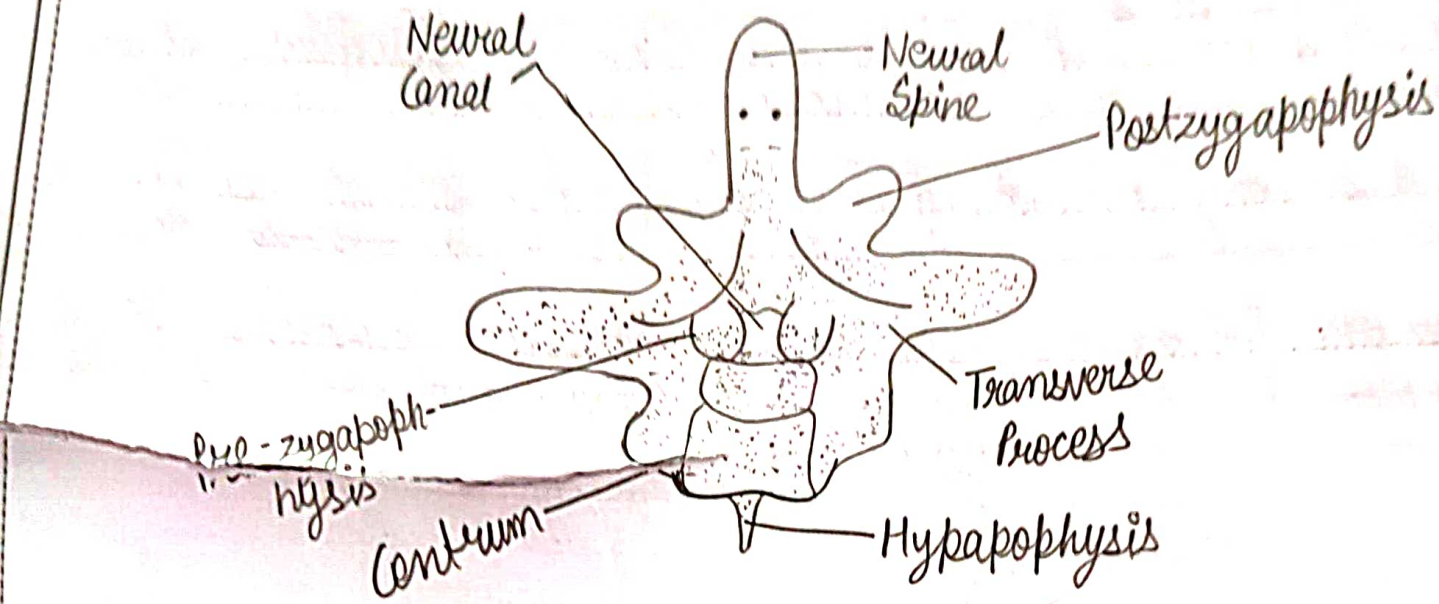
Typical Cervicals.

1. The remaining 14 neck vertebrae are the identical typical cervical vertebrae
2. The neural arches are small and the neural spine is very much reduced
3. Lateral to the neural canal is present a pair of large vertebrarterial canals
4. The centrum is typically heterocoelous.

V.28


Centrum
Transverse Process
Prezygapophysis
Cervical Rib
Post Zygapophysis

J. 22



Free Thoracic

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Page

Free Thoracic

1. The I and XI thoracic vertebrae are free unlike other thoracics.
2. The neural spine is prominently wide and plate-like.
3. Pre- and post-zygapophyses are present.
4. Prominent centrum is heterocoelous.

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Synsacrum

1. Posterior to the free thoracic vertebra about 15 to 16 bones firmly unite to form a large compact synsacrum.
2. The synsacrum is made up of last (VII) thoracic, 6 lumbar, 2 sacral and 5 caudal vertebrae.
3. The VII thoracic vertebra has wide transverse processes and has costal facets for the ribs.
4. The synsacral vertebrae do not have the ventral hypapophyses.

V. 29

Syn Sacrum

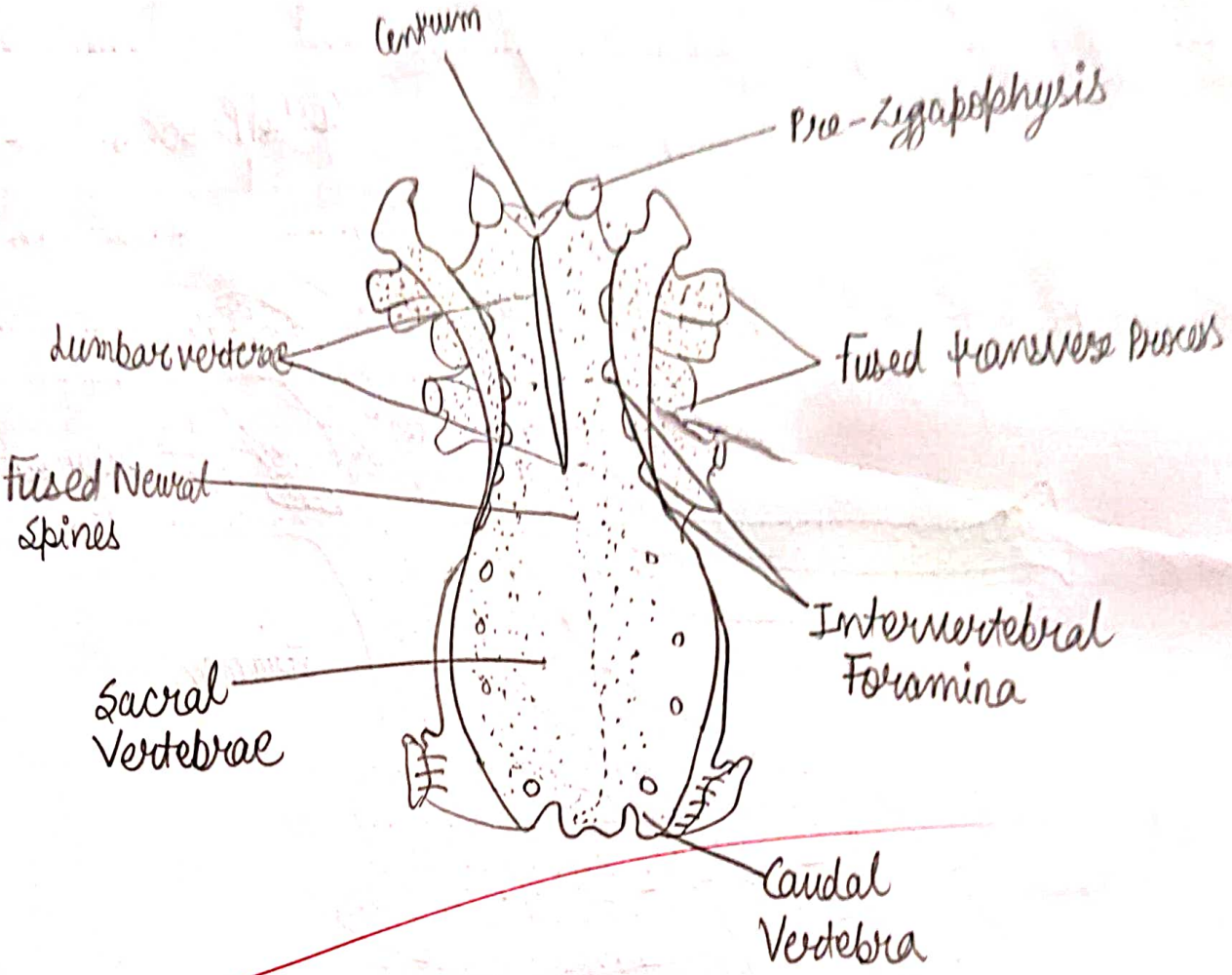
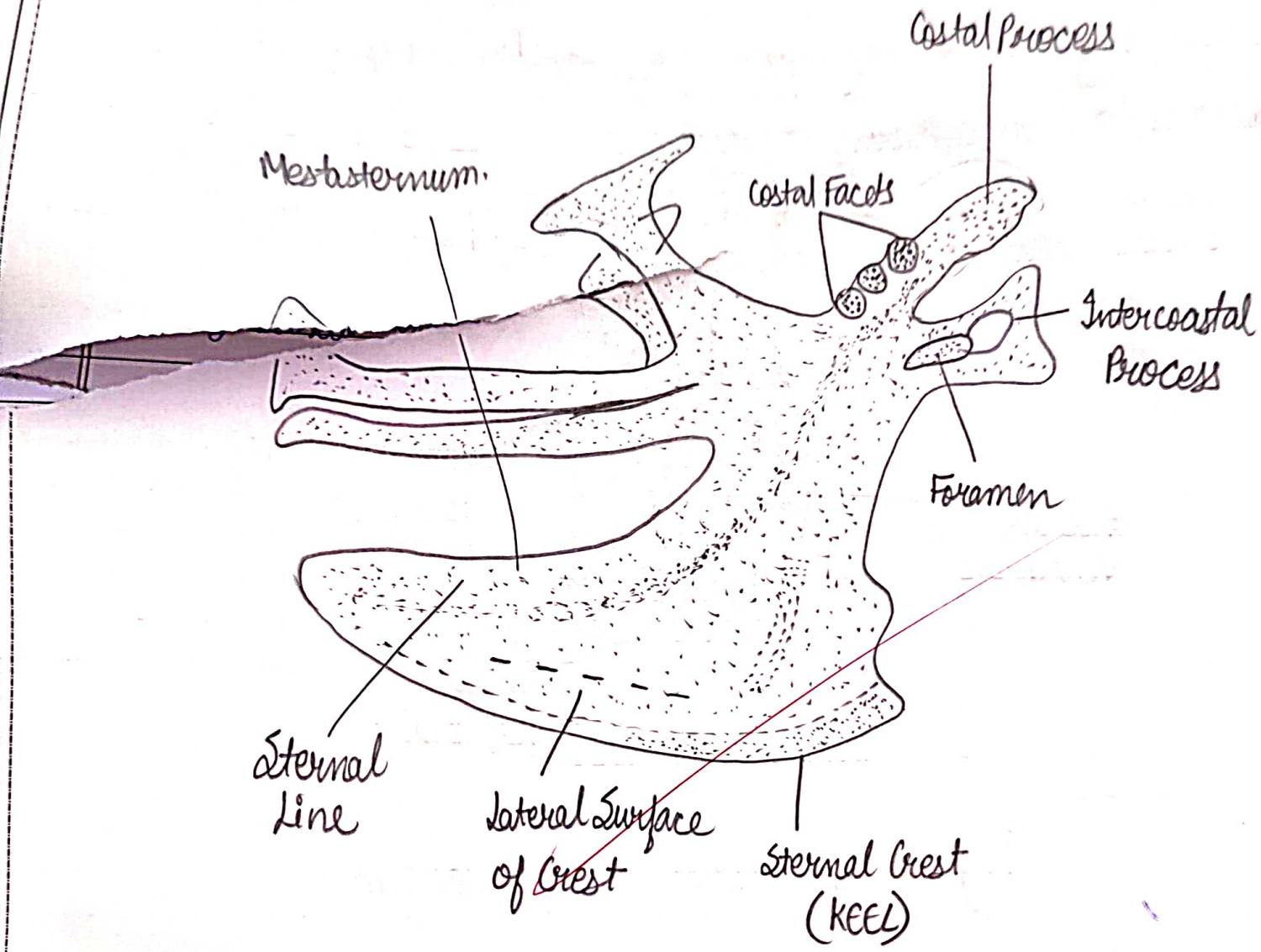


Fig. V. 31 : Fowl : Synsacrum.

V.36



Fowl : Sternum.

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Page

FOWL : sternum

1. The breast bone or sternum of fowl is greatly enlarged for attachment of the power flight muscles of the breast.
2. Sternum is purely bony and even the sternal ribs are completely ossified.
3. Ventrally a long curved metasternum forms a long backwardly directed keel (carina ossi).
4. Above the intercostal process is present a costal process.

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IV, 36

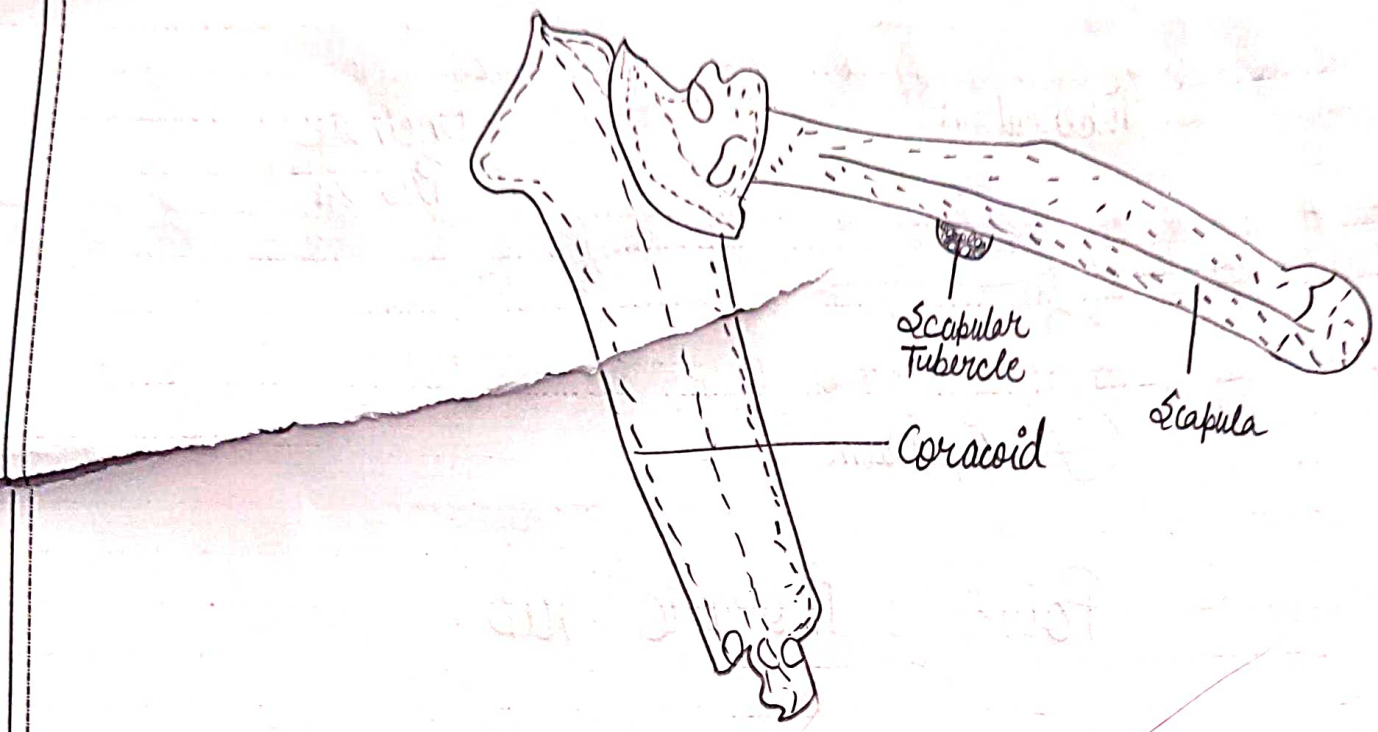
FOWL : Thoracic rib

1. The fowl possesses 7 pairs of bony ribs.
2. I and II and sometimes the VI ribs do not reach the sternum.
3. Each rib of the III, IV, V and VI pair consist of an upper vertebral part and a lower sternal part.
4. The sternal end of the rib fits into the costal facet of the sternum.

V.36
V.38

Fowl : Thoracic rib.

V.42
V.43



Fowl : Pectoral Girdle

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FOWL

1. Pectoral girdle

1. The shoulder-girdle is made up of scapula, coracoid and clavicle bones
2. The two halves of the girdle are separate, but for the clavicles which connect them anteriorly.
3. Each half of the pectoral girdle is made up of a narrow, thin and slightly curved scapula which lies parallel to the vertebral column.
4. The coracoid is a large stout obliquely directed rod-like bone

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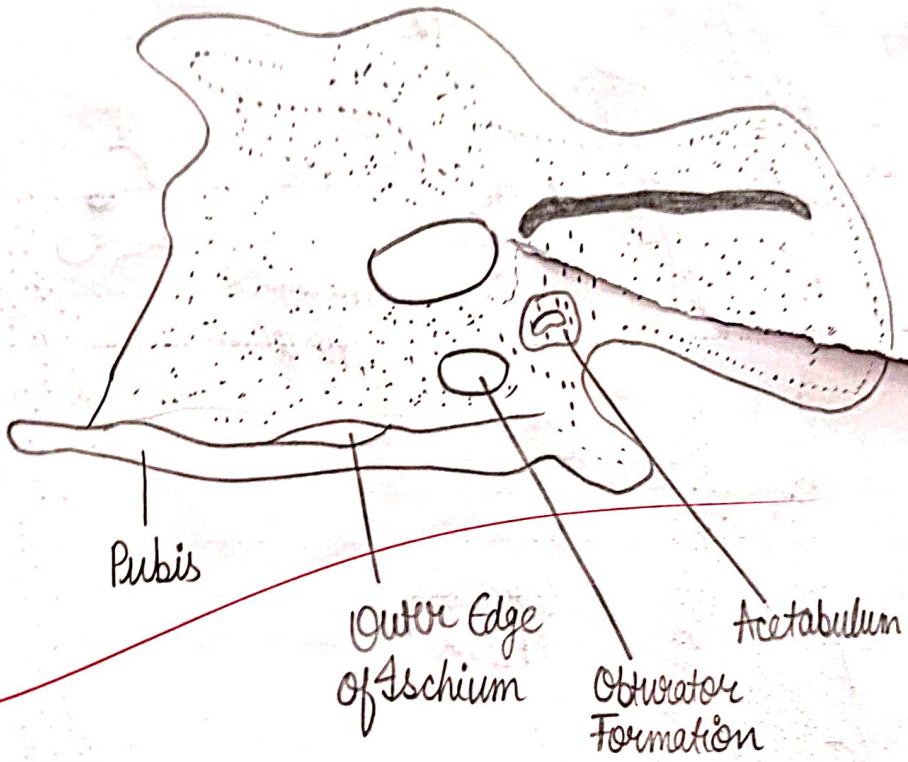
Pelvic girdle

1. The two halves of the hip girdle are not united in the middle.
2. Each half of os. innominatum is made up of 3 bones: ilium, and pubis.
3. The ilium is the largest bone of the girdle and is roughly divisible into preacetabular and postacetabular regions.
4. The ischium is smaller than the ilium and is continuous with it.

V.43



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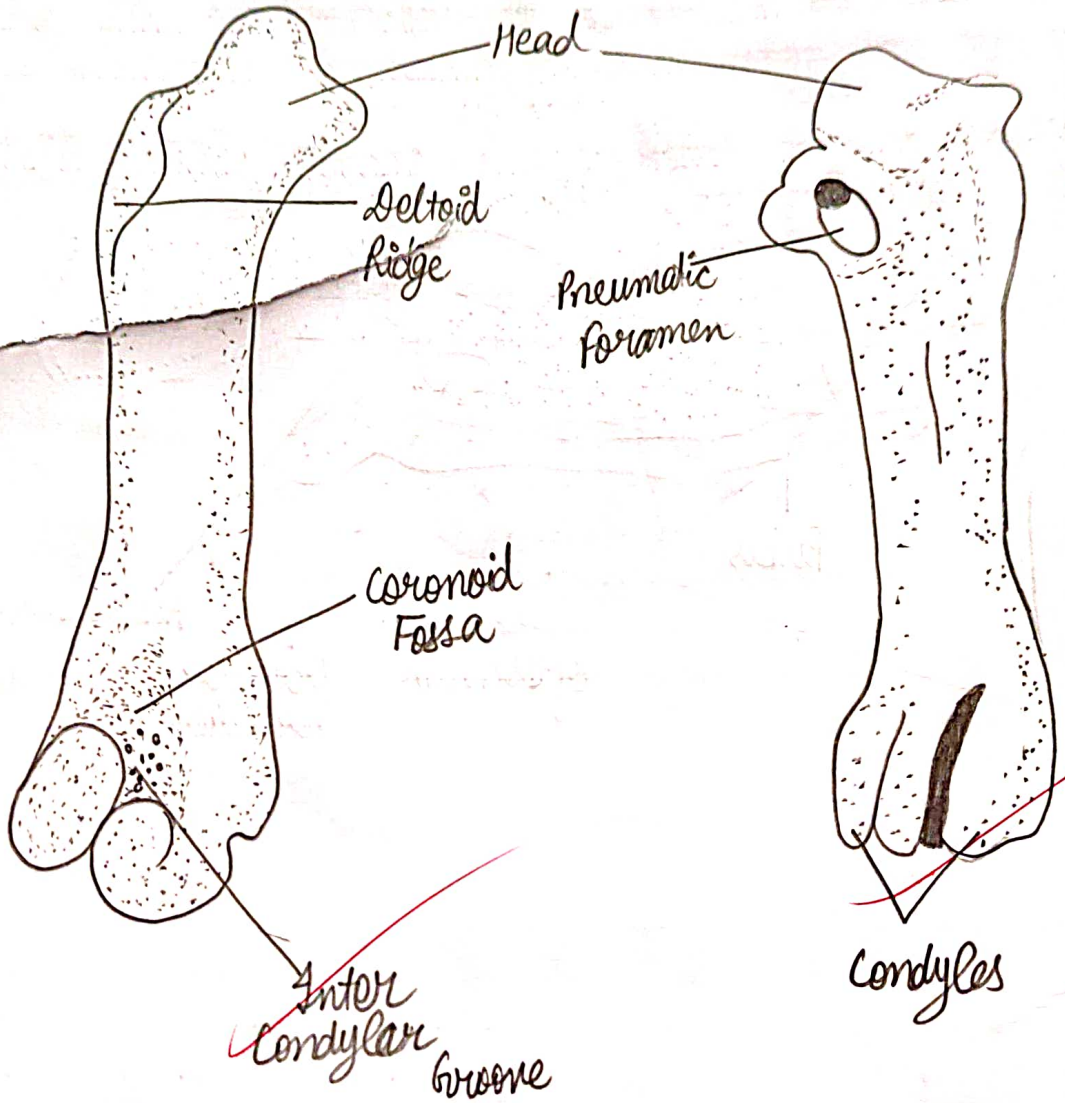

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Fore - limb

(i) Humerus

1. The upper arm bone or humerus is a stout slightly curved pneumatic bone.
2. The proximal end bears an ovoid head for articulation with the pectoral girdle.
3. On either side of the head is a prominent tubercle.
4. The distal end bears a convex condyles for articulation with the fore - arm bones, the radius and the ulna.

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Carpometacarpus

1. The carpometacarpus consists of 2 small little bones which are fused at their ends.
2. This single bone is formed by the fusion of distal carpals with the first 3 metacarpal bones.
3. Distally the bone bears the bones of the 3 digits.

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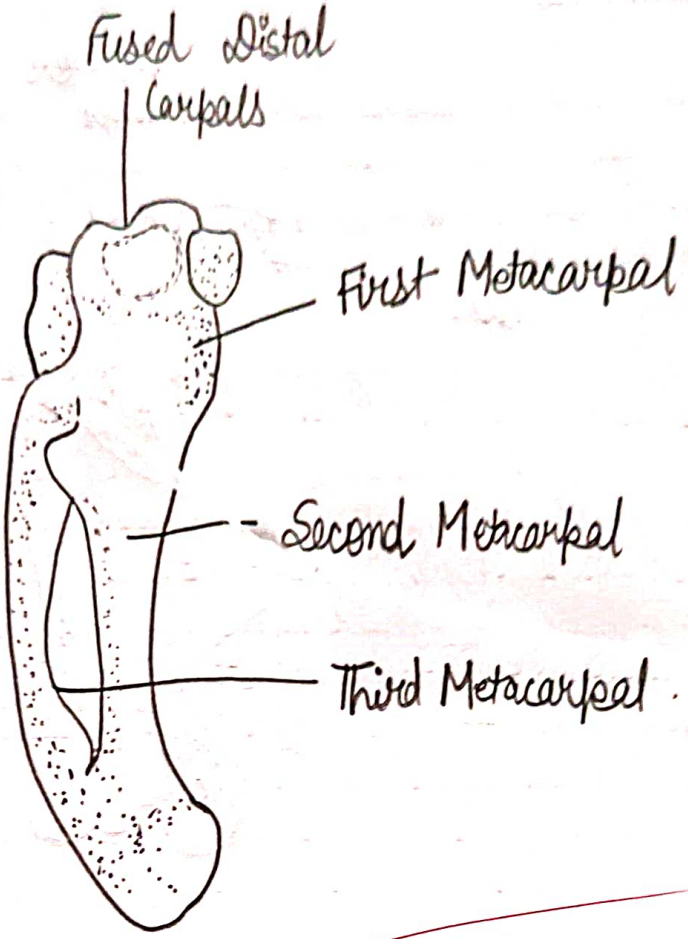
~~V.09~~ V.54



Fowl : Carpometacarpus

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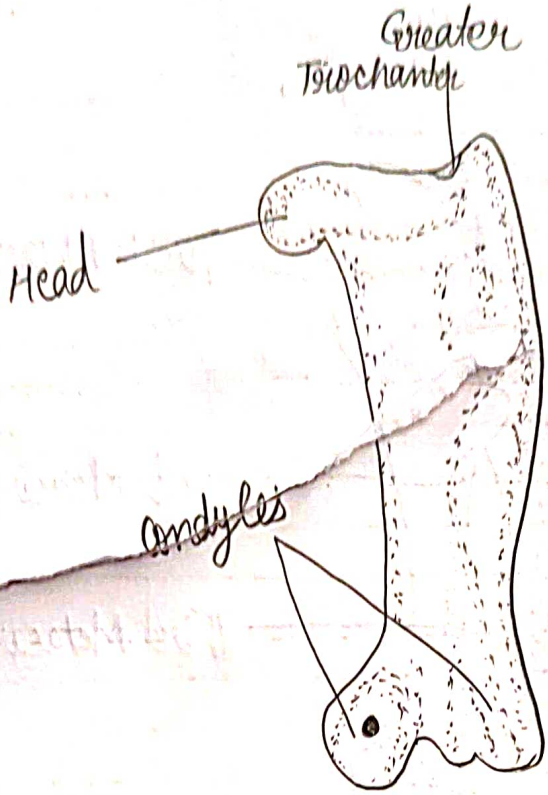

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(20)

Tibiotarsus and fibula.

1. The shank bones are stout and long tibiotarsus and the slender fibula.

2. The tibiotarsus is a long straight bone with an irregularly expanded proximal end which articulates with the thigh bone.

3. The tibiotarsus is made up of the tibia of the shank and of the proximal tarsals which fuse with the distal end of the tibia.

4. The fibula is a feebly developed bone which is produced rounded proximal head which articulates with the condyle of the femur.

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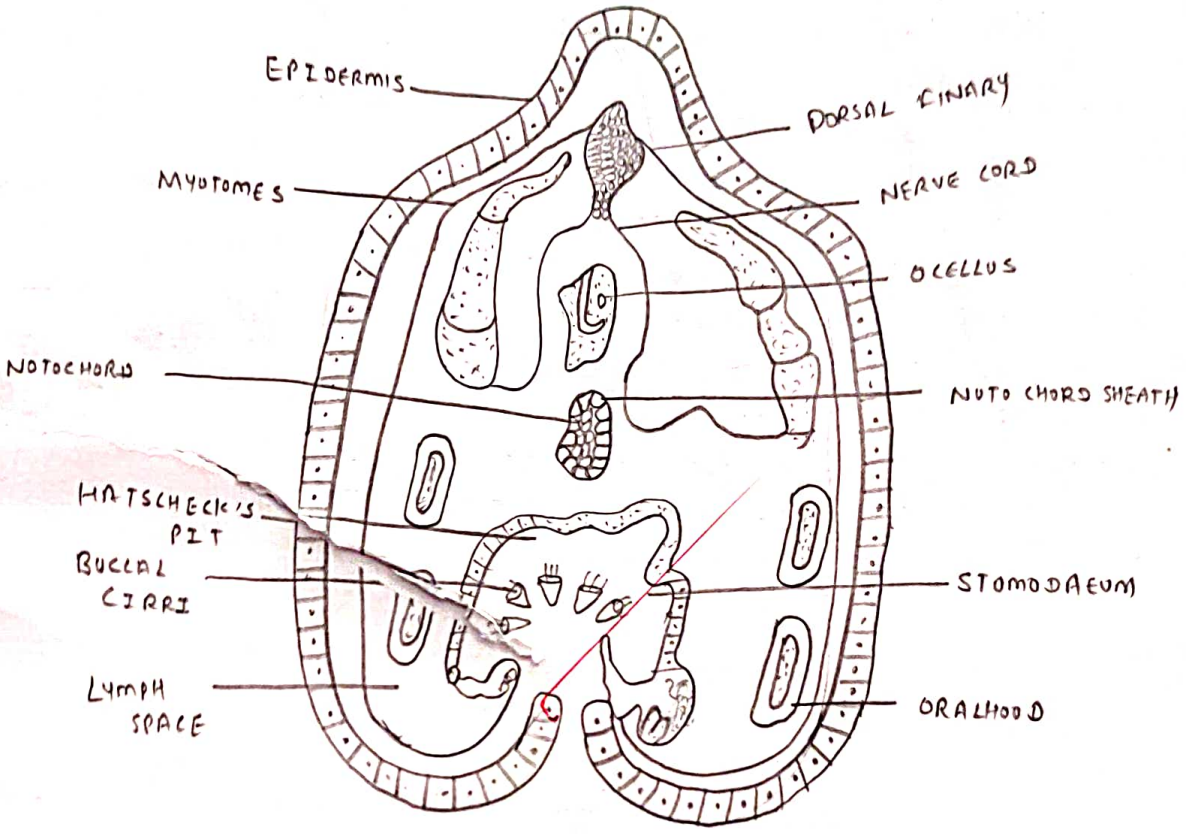
Tarsometatarsus

1. Independent ankle bones or tarsals are absent in the bird as the proximal row of tarsals fuse with the tibia and the distal row bones fuse with the metatarsals to form a tarsometatarsus.
2. The proximal end is irregular and bears 2 concavities which articulate with the condyles of the tibiotarsus.
3. The distal end has 3 articular projections for the II, III and IV digit bones.
4. In the males the bone bears a bony projection for the spur on the inner side.

V.S.G



AMPHIOXUS : T.S. BODY THROUGH ORALHOOD REGION

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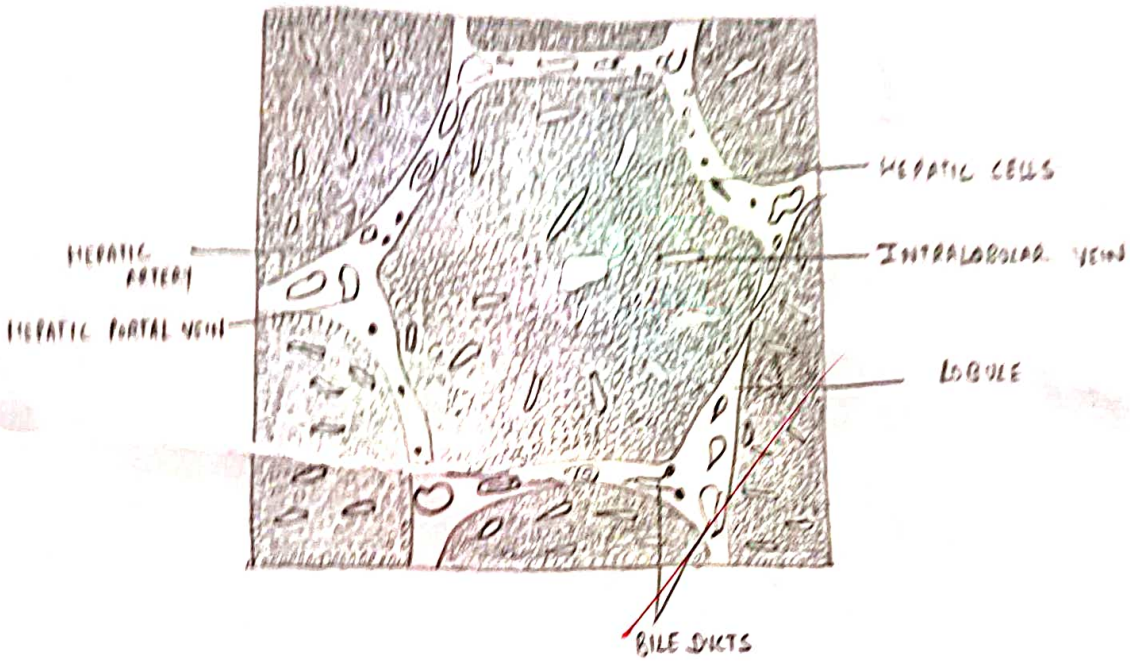
Amphioxus (Branchiostoma): oral Hood

1. The round-shaped oral hood is present just below the rostrum (snout).
2. The oral hood guards the buccal cavity or vestibule
3. Internal skeleton is present in an oral hood which is made up of cartilagenous rod emerges into each cirrus.
4. It stops sea sand to enter into the buccal cavity.



MAMMALS : T.S of LIVER

(73)

Mammal: TS Through Liver

1. Histologically, the mammalian liver is composed of smaller polygonal units or lobules.
2. The lobules are known as glisson's capsules.
3. In the lobules the small hepatic cells are radially arranged in linear cords called hepatic cords.
4. Small bile canaliculi are present in the centre of the hepatic.

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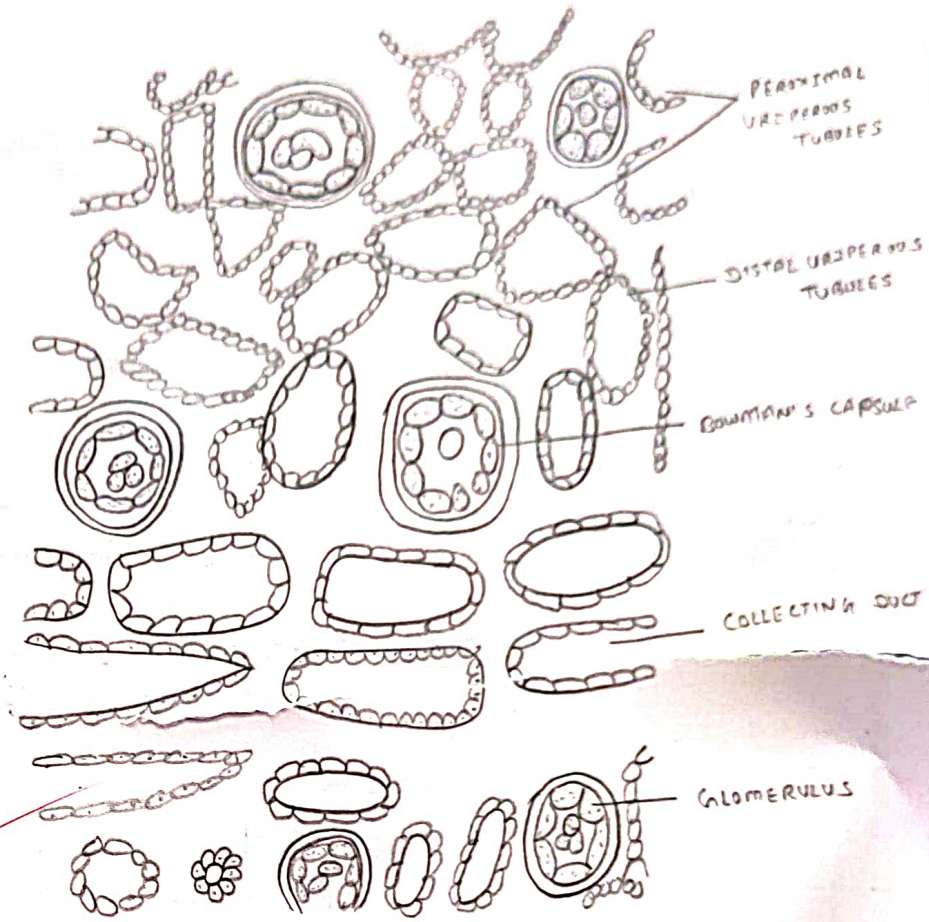
Mammal: T.S Through Kidney

1. The Kidney is made-up of large number of uriniferous or renal tubules.
2. Each uriniferous tubule is composed of a round malpighian body and a long tubule which can be divided into proximal and distal limbs.
3. In section, the malpighian bodies appear as round globular structures.
4. The remainder of the tissue is occupied mostly by connective tissue.



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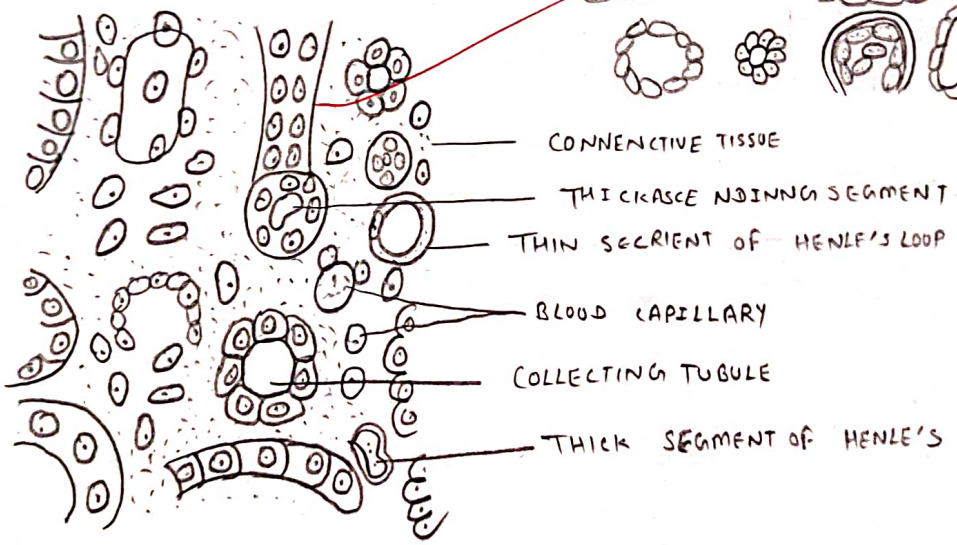
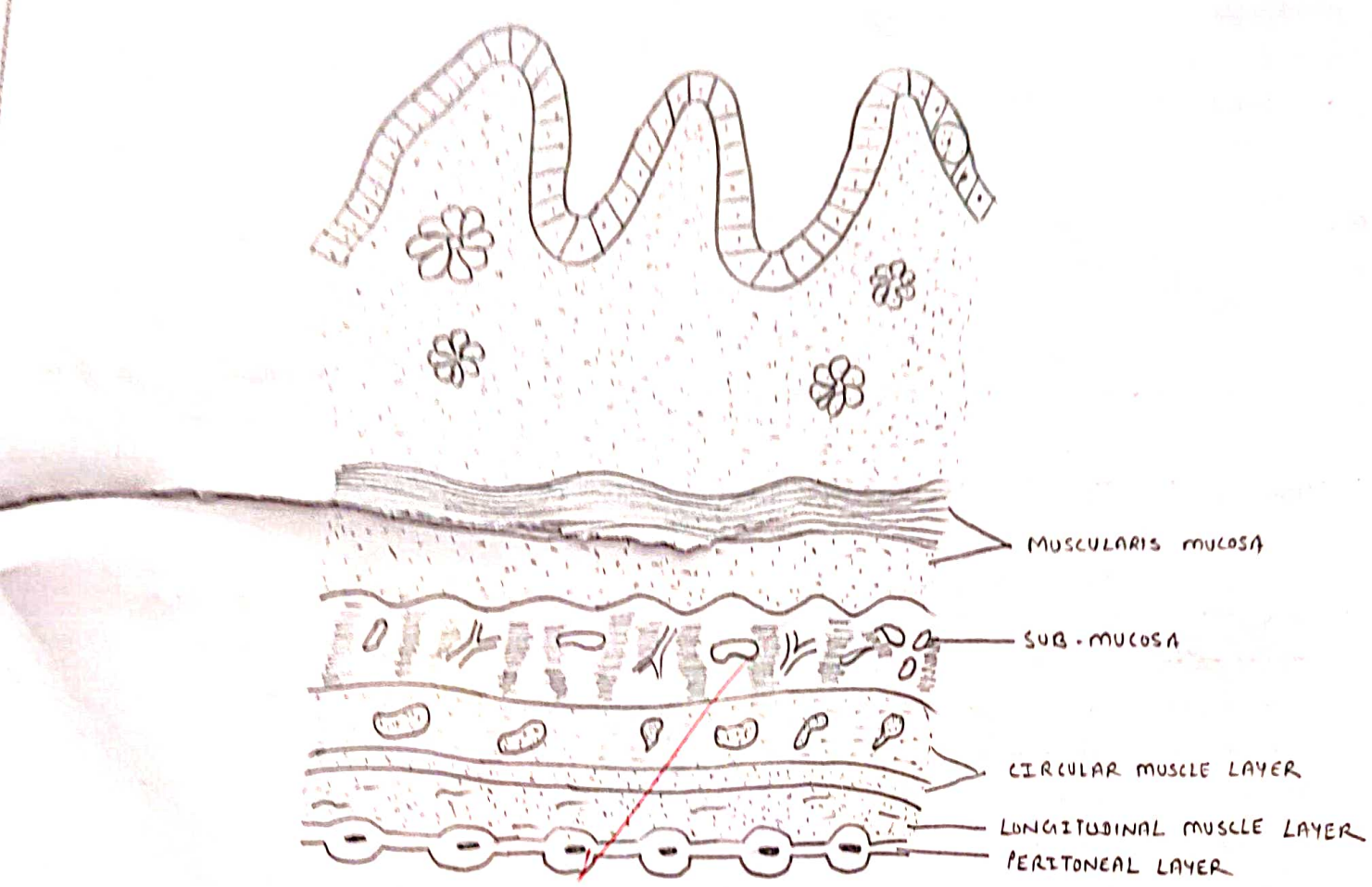


MAMMAL : T.S. OF KIDNEY



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(75)

Mammal: T.S. Thorough stomach

1. Section of the stomach reveals 4 main zones: an other serosa, muscular zone sub-mucosa and mucosa.
2. Serosa: It is made up of peritoneal epithelium and fibrous tissue
3. Muscular zone: Below the serosa is a layer of longitudinal muscle fibres.
4. Sub-mucosa: It is made up of loose connective tissue containing blood vessels, lymph vessels and nerves.

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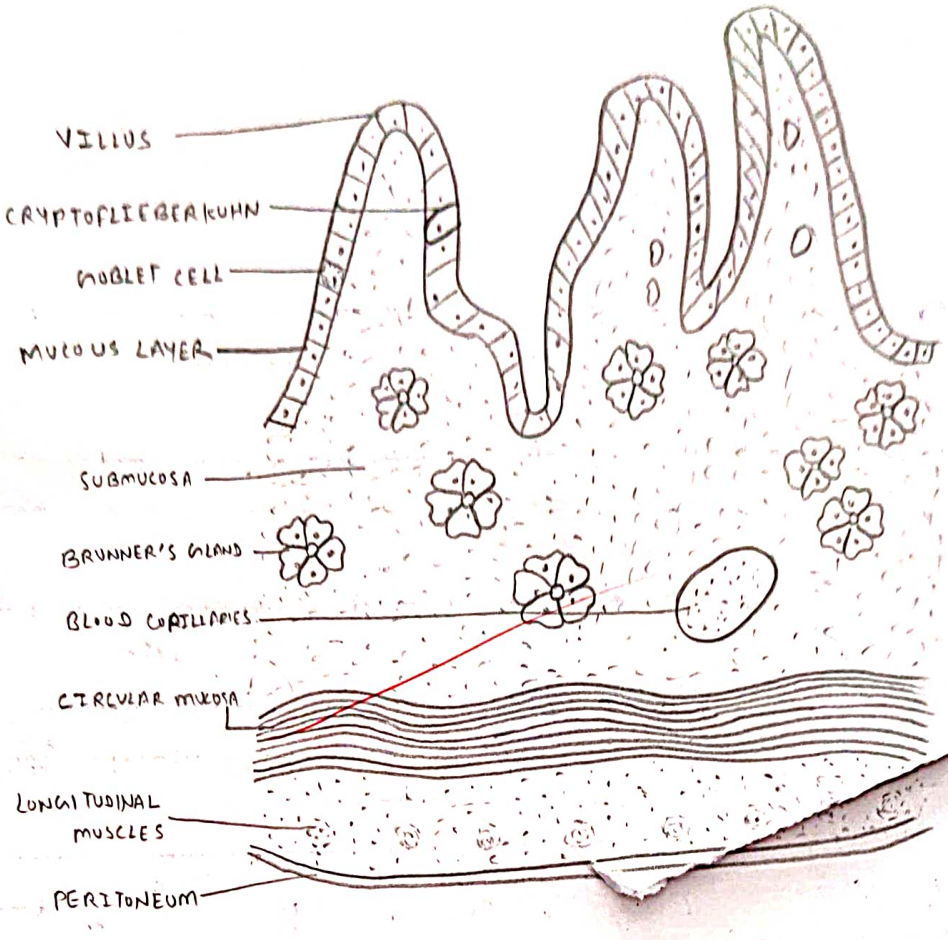
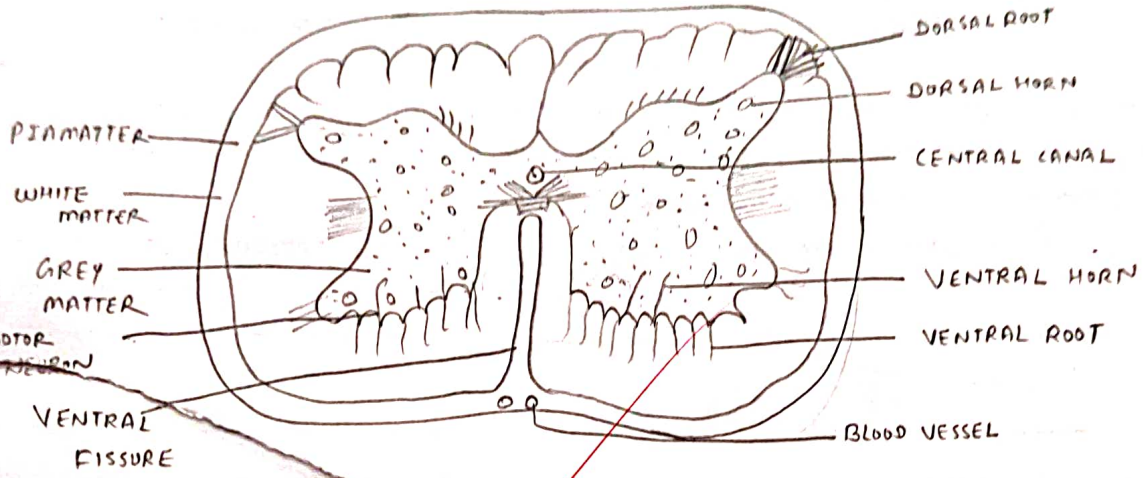
Mammal : T.S. through Duodenum

1. Section of the duodenum reveals 4 main zones: outer peritoneum or serosa, muscular zone, sub-mucosa and mucosa.
2. Peritoneum: It is made up of a single-layered peritoneal epithelium.
3. Muscular zone: Below the peritoneum is an other layer of longitudinal muscle fibres and an inner layer of circular muscle fibres.
4. The crypts of Lieberkuhn secrete the succus entericus which contains numerous digestive enzymes.



MAMMAL :- T.S. of INTESTINE



MAMMAL :- T.S. of SPINAL CORD

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Mammal: T.S Through spinal cord

1. Spinal cord is covered by the membranes: the dura-matter and the pia-matter.
2. The pia-matter centers into the oval spinal cord to little depth in the mid-dorsal and mid-ventral region and forms.
3. In the centre a narrow central canal surrounded by a single layer of columnar epithelial cells is present.
4. The spinal cord has 2 types of nervous tissues the grey matter and white matter.

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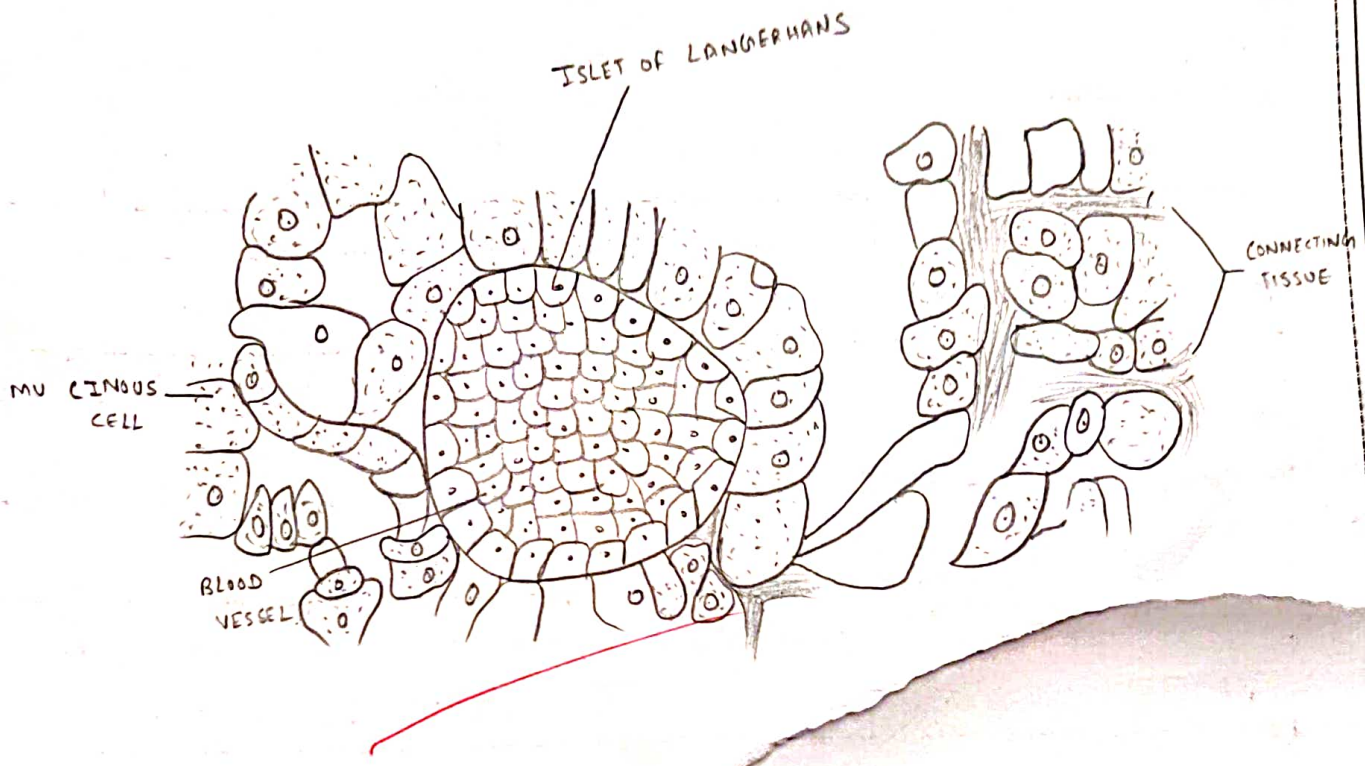
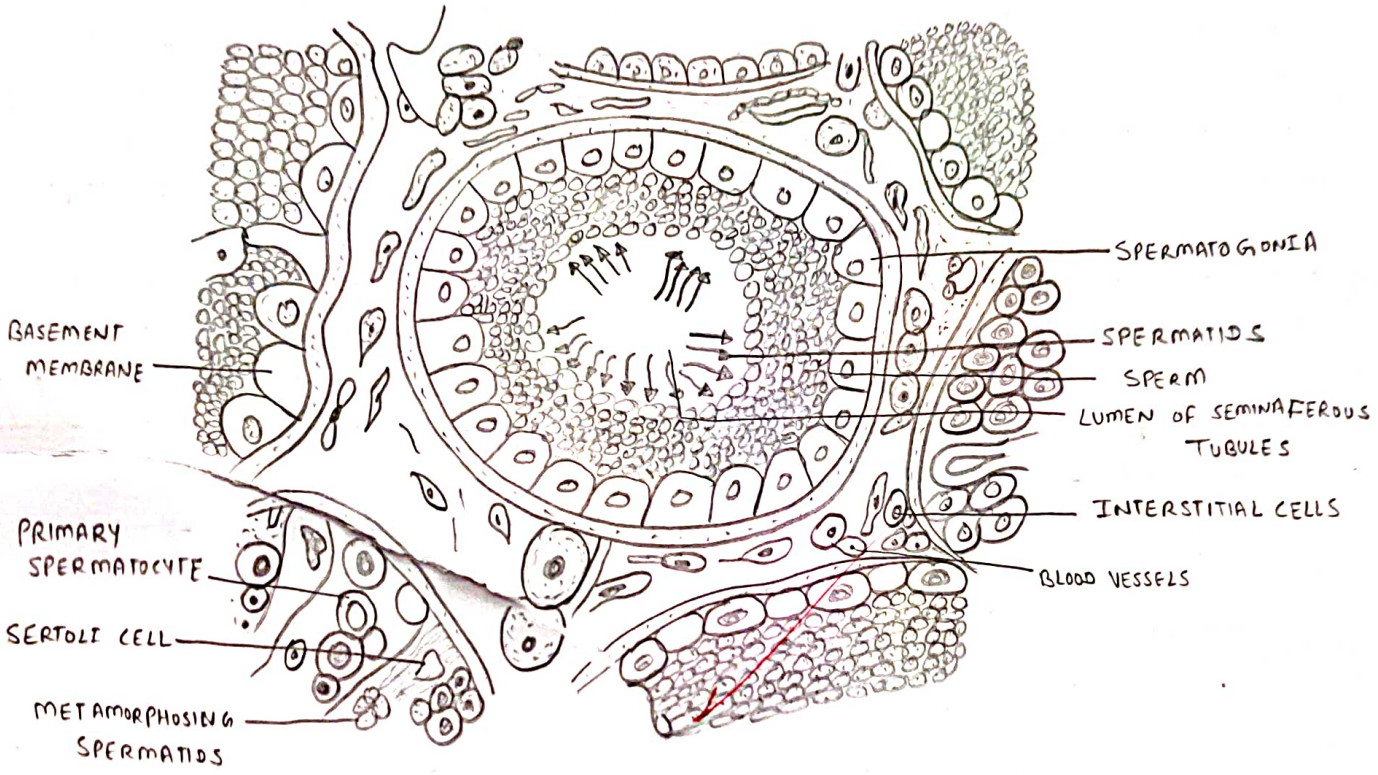
Mammal: T.S Pancreas

1. Pancreas is a diffused gland consisting of branched tubules whose terminal swellings are called alveoli.
2. Each acinus in section appears as a ring of columnar or cuboidal cells having large nuclei and clear non-granular cytoplasm.
3. The lumina of the acini and tubules are connected by small pancreatic ductules which unite to form a large pancreatic duct which finally opens into the common bile duct.
4. The cells of the lobules or acini secrete the pancreatic juice which contains enzymes responsible for digestion of proteins.



MALLAL :- T.S OF PANCREAS



MAMMAL :- T.S. OF TESTIS

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Mammal : T.S. Testis

1. Testis is covered by a fibrous capsule of connective tissue called as tunica albuginea.
2. The testis contains large number of seminiferous tubules.
3. The germ cells of the seminiferous tubules are made up of spermatogonia.
4. In between the spermatogonial cells there are several large cells called sertoli cells to which the spermatogonial cells there attach by their heads for nourishment.

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Mammal: T.S ovary

1. The ovary of covered by the peritoneal of the coelom below which lies the germinal containg oogonial cells which give rise to ova.
2. The space inside the ovary known as the ovarian stroma is filled by fibrous and vascular connective tissue.
3. In the stroma are present ova at various stages of development.
4. The developing ova are surrounded by germinal epithelial cell which form a double covering.

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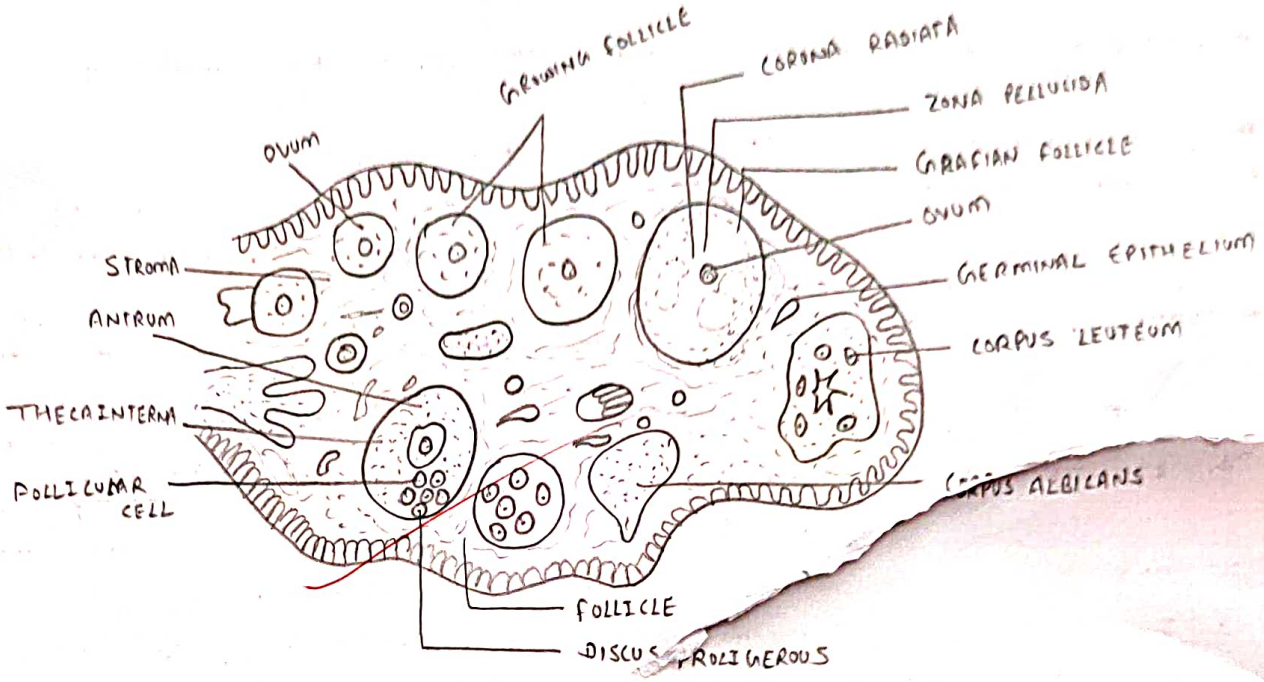

MAMMAL : T.S. OF OVARY

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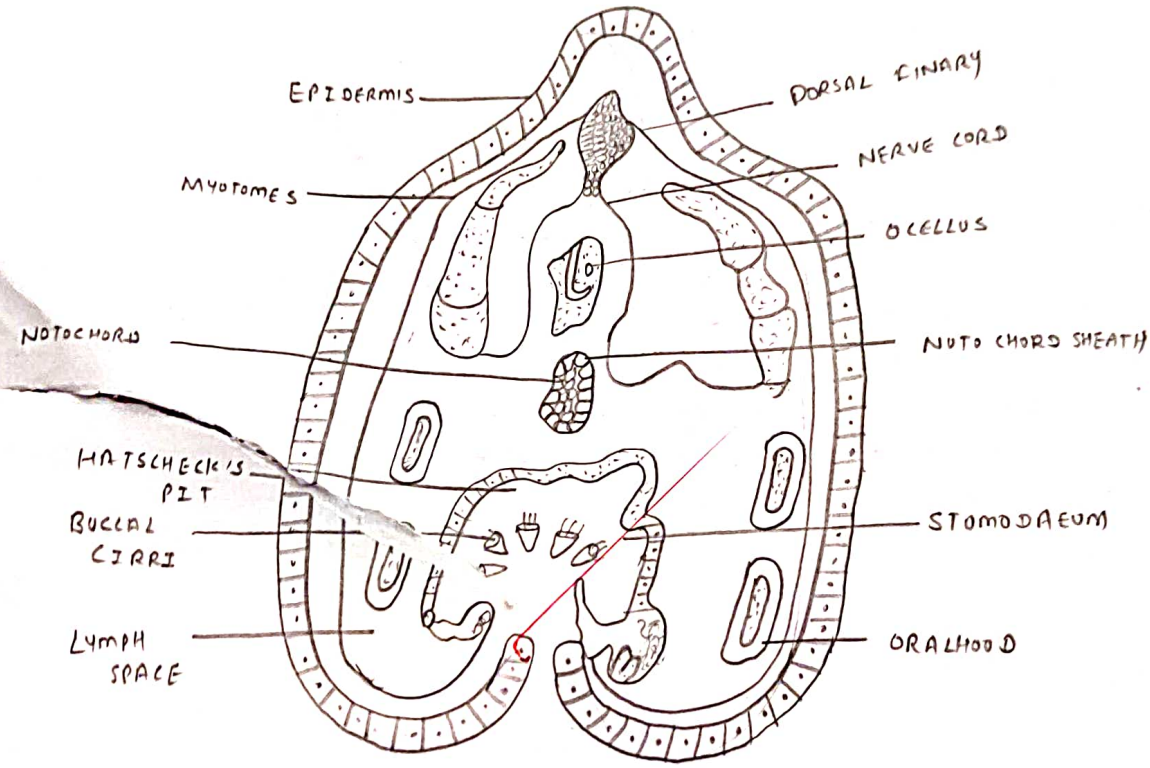

AMPHIOXUS : T.S. BODY THROUGH ORALHOOD REGION

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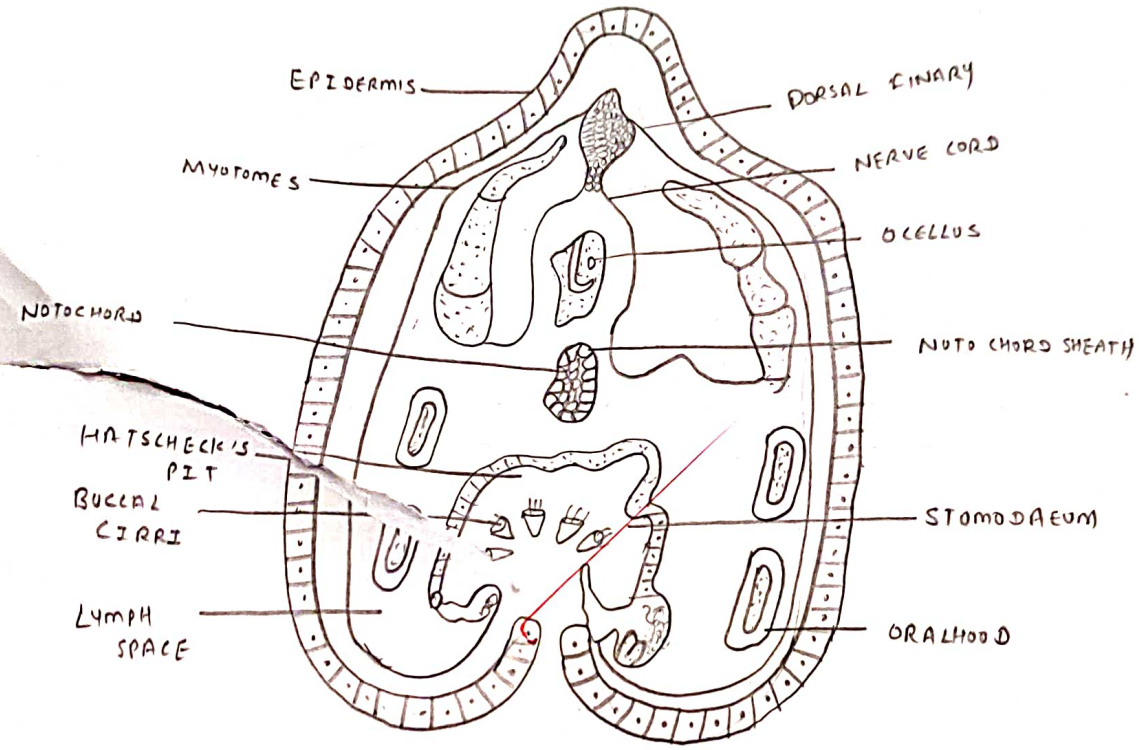

AMPHIOXUS & T.S. BODY THROUGH ORALHOOD REGION

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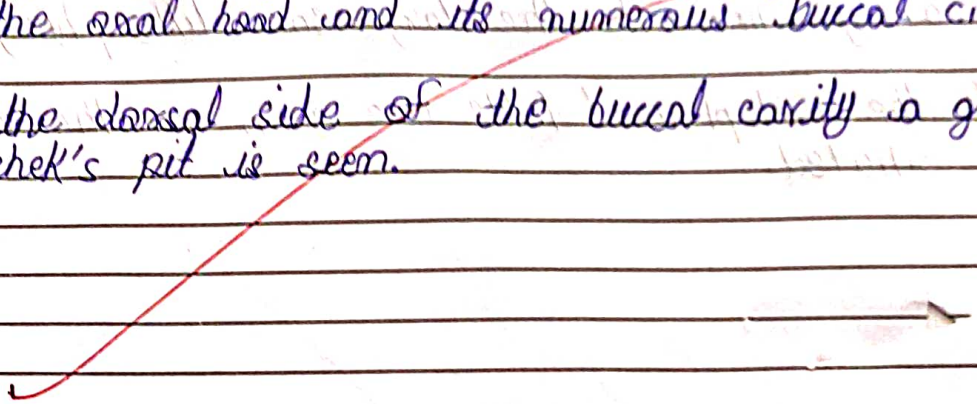
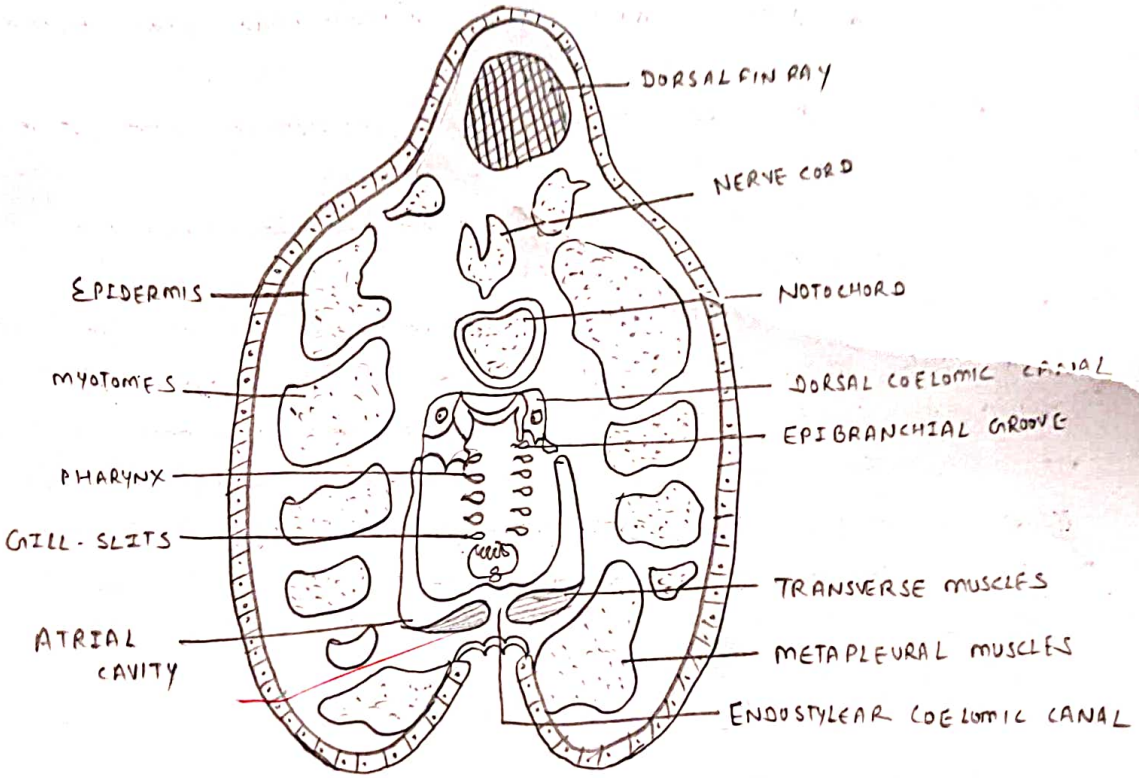
Amphioxus: Ts. oral hood region

1. In the dorsa - median region sections of the nerve cord and notochord are seen.
2. In the ventral half of the section the large stomodeum is visible.
3. In the ventral region of the buccal cavity is seen the section of the oral hood and its numerous buccal cirri.
4. On the dorsal side of the buccal cavity a groove - like Hatschek's pit is seen.



Amphioxus: T.S. pharyngeal region

1. This section passes through the anterior region of the sac-like pharynx.
2. In the dorso-median region sections of the nerve cord and notochord are seen.
3. The atrial cavity surrounds the large sac-like pharynx.
4. Sections of the metapleural folds are seen on the ventral side is the ciliated.



AMPHIOXUS :- T.S. BODY THROUGH PHARYNGEAL REGION

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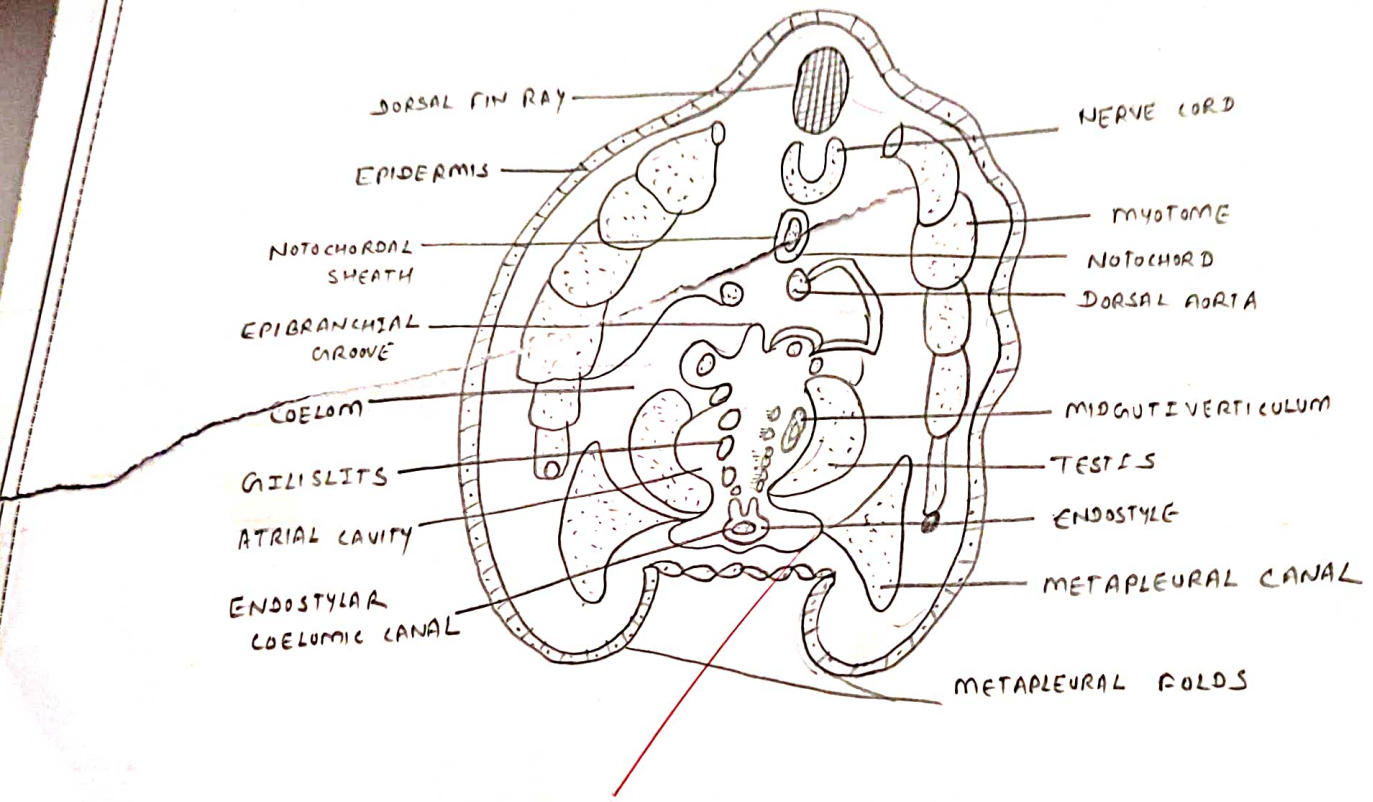

AMPHIOXUS :- T.S. BODY THROUGH PHARYNX AND TESTIS

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Amphioxus: T.S. Pharynx and testes

1. The section passes through the posterior pharyngeal region of a male Branchiostoma and contains the section of the testes
2. Below the notochord section of the dorsal aorta is visible
3. Section of the mid-gut diverticulum is seen on the right side in between the pharynx and testes, inside the atrial cavity
4. Section of the metapleural folds are distinct on the ventral side

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Amphioxus (Branchiostoma) Pharynx and ovaries.

1. The section passes through the posterior pharyngeal region of female Branchiostoma and contains the sections of the ovaries.
2. Below the notochord, section of the dorsal aorta is also visible.
3. Sections of the ovaries containing large round ova are visible on either side of the pharynx enclosed in coelomic sacs.
4. Sections of the metapleural folds are distinct on the ventral side.

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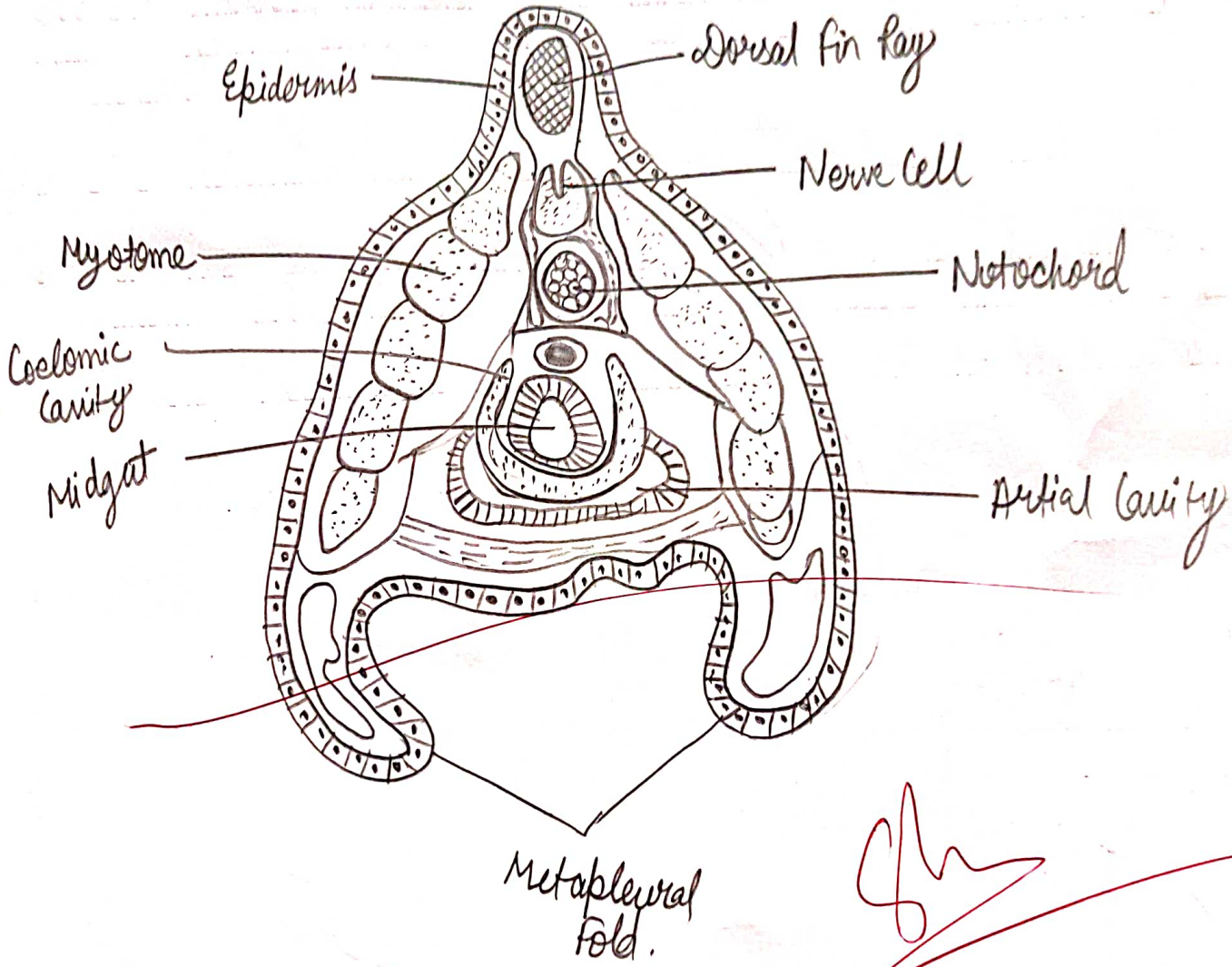

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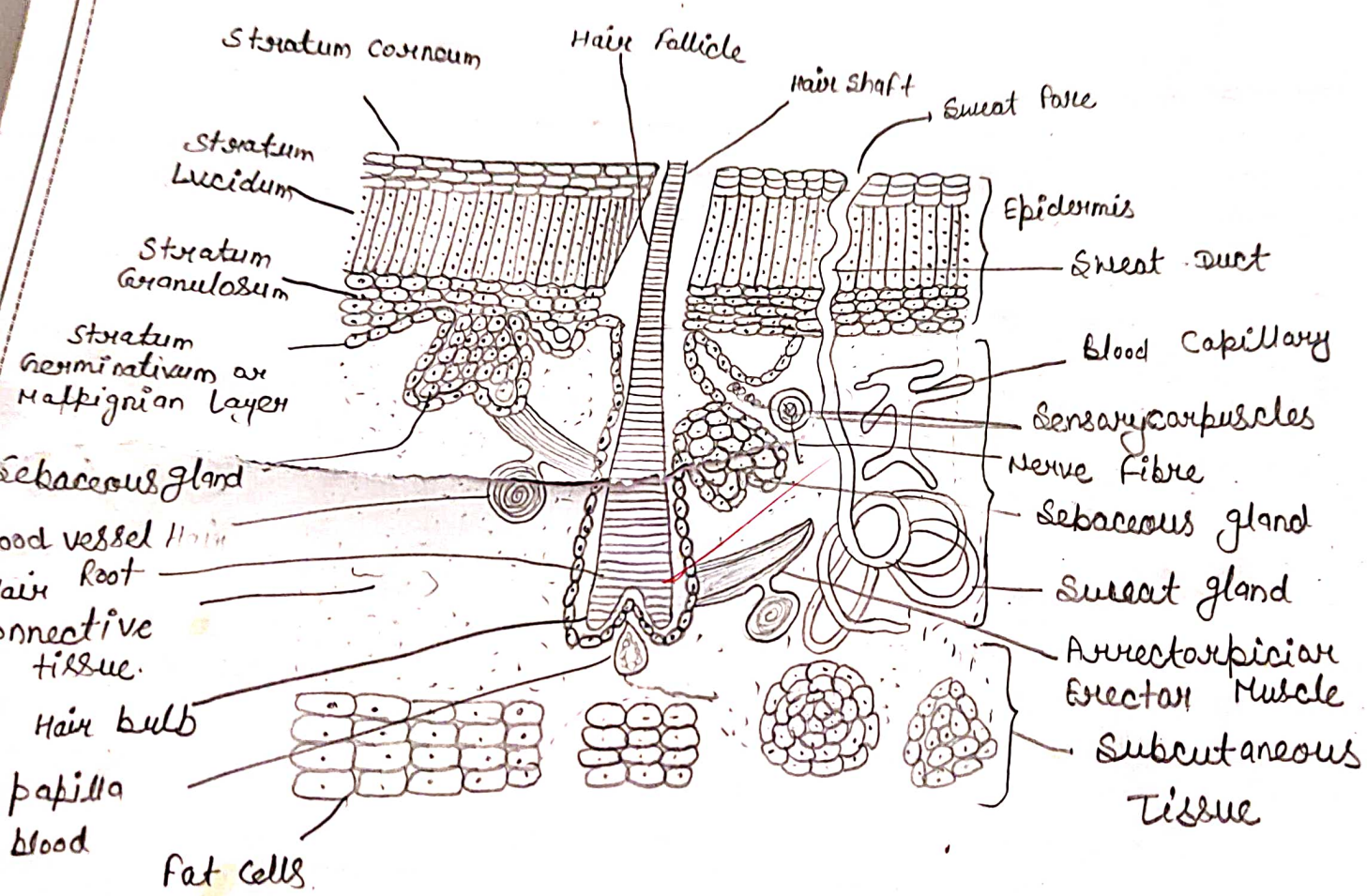

MAMMAL :- VS OF SKIN

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Mammal ÷ V.S of Skin

Comments ÷

1. स्तनी की सूखी त्वचा दो स्तरों में विभाजित होती है बाहरी अधिचर्म व भीतरी चर्म।

2. त्वचा की ग्रंथियाँ ~~एक~~ एक ग्रंथिया होती है जो त्वचा के तल पर छिद्रों द्वारा ~~ही~~ खुलती है तथा ये परनीना बनाती है।

3. चर्म के सबसे भीतरी भागों में पर्त में व्यवस्थित कई गोलाकार वसा कोशिकाएँ होती है।

4. चर्म में केश पुटक के आधार पर केश जूड होती है तब सिबेशियस ग्रंथियाँ केश पुटक में खुलती है एवं केश पुटक से केश त्वचा के बाहर आता है।

5. चर्म स्तर योजी ~~अक~~ एवं अरेखित पेशी तंतुओं का बना होता है किंतु अधिचर्म अरक्तीय (Non Vasoular) बाहरी स्तर कई परतों का बना होता है अर्थात् स्तरित उपकलीय कोशिकाओं (Epithilial) का बना होता है।