

GDC MEMORIAL COLLEGE

BAHAL (BHIWANI)-127028



Lab Manual

Zoology (B.Sc.3rd & 4th Semester)

Department of Zoology

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EXPERIMENT – 1

AIM:- To study the different specimen of Protochordates

MOLGULA

Classification:-

- Phylum - Chordata
- Class - Ascidiacea
- Order - Pleurogona
- Genus - *Molgula*

Habitat:-

Molgula is a marine, solitary protochordate. It is found attached to stones, ships etc. in the intertidal zone of Atlantic and Indian oceans.

Habits:-

1. **Locomotion:-** It is a solitary and sedentary protochordate.
2. **Feeding:-** It is omnivorous in diet and takes diatoms, algae and protozoans as its food.
3. **Reproduction:-** It is hermaphrodite but undergo cross-fertilization due to protandry
4. **Development:-** indirect and includes a tadpole larva which undergoes retrogressive metamorphosis.

Morphology:-

1. Molgula has a small somewhat rounded body covered by a thin and transparent test.
2. Test is produced into a branchial and atrial siphon.
3. The shorter branchial siphon has 6-lobed branchial aperture.
4. The longer and slender atrial siphon has 4-lobed atrial aperture.
5. Stomach and intestine form a curved loop.
6. Heart is bean shaped.

DOLIOLUM

Classification:-

- Phylum - Chordata
- Class - Thaliacea
- Order - Doliolida
- Genus - *Doliolum*

Habitat:-

Doliolum is a marine, solitary, free living, pelagic urochordate inhabiting the warm water of tropical and subtropical seas.

Habits:-

1. **Locomotion:-** It is a pelagic, free swimming tunicate.
2. **Feeding:-** It produces a water current for feeding and gas exchange by ciliary action. It is omnivorous, planktonic feeder and holozoic in nutrition.
3. **Reproduction:-** In its life cycle Doliolum occurs in two phases: a solitary sexual gonozoid which alternates with a colonial asexual gregaria or oozoid, thus exhibiting an alternation of generation between two morphologically distinct phases in its life cycle.
4. Gonozoid is hermaphrodite but always shows cross-fertilization due to protogyny. Produces a trailed larva which metamorphosis into a sexual zoid. Oozoids reproduce by budding. Thus the life cycle shows polymorphism and alternation of generation.

Morphology:-

A. Sexual gonozoid or Solitaria phase:

1. Body is barrel-shaped having thin, transparent test. It is a solitary phase.
2. The mantle is encircled by eight complete muscle bands.
3. The mouth and a trail apertures are at the opposite ends of the barrel.

4. Gill slits are numerous and present in dorsal and ventral rows.

B. Asexual oozoid or Gregaria phase:

1. Bear nine complete muscle band.
2. Branchial aperture is 10 lobed and atrial aperture is 12 lobed.
3. Vertical stolon bears probuds which forms three kind of zooids (gastrozooids, phorozoids and gonozooids).



AMPHIOXUS (BRANCHIOSTOMA)

Classification:-

- Phylum - Chordata
- Class - Leptocardii (Cephalochorda)
- Family - Branchiostomidae
- Genus - *Amphioxus (Branchiostoma)*

Habitat:-

Branchiostoma is a marine, fossorial cephalochordate and inhabits the shallow coastal waters in the tropical and temperate regions just below the low tide line.

Habits:-

1. **Locomotion:-** It is fossorial animal and remains in its sandy burrows during day time. At night or dusk, it comes out of its burrows and swims actively.
2. **Feeding:-** It is a ciliary feeder and feeds on planktonic microorganisms brought along with a respiratory-cum-food water current.
3. **Reproduction:-** It is unisexual. Fertilization is external, development is indirect involving a free swimming larva.

Morphology:-

1. Both the ends of the body are sharp and pointed so that it looks like a lance, hence is commonly called as 'Lancelet'.
2. Body is transparent, compressed laterally and streamlined.
3. Body is divisible into trunk and tail. Trunk bears three openings, mouth, atriopore and anus.
4. Oral hood bears 10-11 pairs of buccal cirri.
5. Three median unpaired fins: a dorsal, ventral and caudal, are present.
6. On each lateral side of the body are a series of < - shaped myotomes or muscle bands.

Economic importance:-

1. In China and Japan, this animal is sold in bulk as food.
2. It is considered as a blue print of phylum chordate.



Botryllus

Classification:-

- Phylum - Chordata
- Class - Ascidiacea
- Order - Pleurogona
- Genus - *Molgula*

Habitat:-

It is a colonial (composite), marine and sedentary ascidian found attached to stones in shallow waters of the Atlantic and the Mediterranean Seas.

Habits:-

1. **Locomotion:-** It is absent due to sedentary mode of life.
2. **Feeding:-** It is omnivorous, planktonic feeder, holozoic and filter feeder.
3. **Reproduction:-** It shows both asexual and sexual reproduction. Asexual reproduction occurs by external budding and buds are permanently attached to the colony. Sexual reproduction. It is bisexual or hermaphrodite but always shows cross fertilization.

Morphology:-

1. Test forms a encrusting mass in which zooids (individuals) are grouped in a radiating star-shaped manner.
2. Branchial apertures of zooids are oriented outward while their atrial apertures open in a common cloacal chamber at the centre.
3. A zooid is morphologically similar to a simple ascidian and has rectangular stigmata on the pharynx and a simple U-shaped intestine but dorsal lamina is without languets.

PYROSOMA

Classification:-

- Phylum - Chordata
- Class - Thaliacea
- Order - Pyrosomida
- Genus - *Pyrosoma*

Habitat:-

It is a marine, colonial, pelagic and bioluminescent urochordate found in warmer seas.

Habits:-

1. **Locomotion:-** It is free swimming. Water current is produced out through rhythmic contractions of muscles in the body wall of pharynx and atrium.
2. **Feeding:-** omnivorous, holozoic, filter feeder.
3. **Reproduction:-** both asexual and sexual. Asexual by external budding. Sexual reproduction by cross fertilization. Fertilization is internal and development is direct.

Morphology:-

1. Colony is formed of a gelatinous tube like a hollow cylinder.
2. Zooids of the colony are called blastozooids.
3. Each zooid has a branchial aperture and an atrial aperture on inner side.
4. Each zooid has a large branchial sac, endostyle, dorsal lamina, heart and atrium.

OIKOPLEURA

Classification:-

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

Habitat:-

Marine protochordate found in tropical and temperate seas.

Habits:-

1. **Locomotion:-** swimming type with the help of vibration of tail.
2. **Feeding:-** omnivorous, planktonic feeder, holozoic.
3. **Reproduction:-** hermaphrodite, shows cross fertilization due to protandry. Fertilization is external, development indirect including a free swimming tadpole larva.

Morphology:-

1. Body is covered by a cuticular house known as test.
2. Body is divided into trunk and tail.
3. Posterior part of trunk has two testes and an ovary.
4. Single pair of gill slits present.

EXPERIMENT – 2

AIM:- To study the different specimen of cyclostomata.

MYXINE

Classification:-

- Phylum - Chordata
- Class - Cyclostomata
- Order - Myxionida
- Genus - *Myxine*

Habitat:-

It is marine and quasiparasite. Myxine is found buried in the sand, mud or sea bottom.

Habits:-

1. **Locomotion:-** It feeds as a scavenger on dead and dying fish, annelids, mollusks and crustaceans.
2. **Feeding:-** It burrows into the body of its host for consuming flesh, and hence it is also called a borer.
3. **Reproduction:-** It is unisexual and shows sexual dimorphism during breeding season only. It is oviparous and fertilization is external. The eggs hatch into miniature adults without passing through a larval stage.

Morphology:-

1. Cylindrical body, elongated, eel-like.
2. Paired fins are absent. A caudal and a ventral fin are present.
3. Fins rays are not present.
4. Body is differentiated into head, trunk and tail.
5. Body is scale-less.
6. Mouth is without jaws.

7. A single, median and terminal nostril (nasal aperture) is present.

Economic Importance:-

1. Hagfishes preserve many characteristics of early chordates and thus depict the organization of chordates before jaws were evolved.
2. It is a serious threat to fisheries in some regions.



PETROMYZON

Classification:-

- Phylum - Chordata
- Class - Cyclostomata
- Order - Petromyzonta
- Genus - *Petromyzon*

Habitat:-

It has world wide distribution except temperate and high polar regions. These are found along sea coasts and in the rivers and lakes also.

Habits:-

1. **Feeding:-** Petromyzon is a sanguivorous ectoparasite of a large healthy fish. It stops feeding during migratory phase. It breeds only once in its whole life.
2. **Locomotion:-** It actively swims in water by graceful lateral undulations of its highly muscular body.
3. **Reproduction:-** It is anadromous e.g. it ascends fresh water rivers and streams for spawning. Fertilization is external. Life history includes a larva called ammocoetes.

Morphology:-

1. Body is cylindrical, elongated and eel-like.
2. Unpaired or median fins are present. A caudal fin supported by fin-rays is also present.
3. An anal fin is present in females behind the anus.
4. The body is divided into head, trunk and tail.
5. Slimy skin due to the absence of exoskeleton.
6. Small gill slits are present.

Economic importance:-

1. It acts as a parasite of large fishes by sucking their blood.
2. Its larva is used as a bait for fishing.

AMMOCOETES LARVA

Classification:-

- Phylum - Chordata
- Class - Cyclostomata
- Order - Petromyzonta
- Genus - *Ammocoetes*

Habitat:-

It is a fresh water larva of petromyzon.

Habits:-

1. **Locomotion:-** It exhibits a prolonged larval period of 5 to 8 years. Most of the time it remain in its burrow. It swims with head down ward and can burrow very quickly.
It is anadormous in young stages and catadromous in adulthood.
2. **Feeding:-** It is a filter feeder and produces a feeling current by muscular pumping action.

Morphology:-

1. Ammocoetes larva has a long, slender body with an oral hood surrounding the mouth.
2. Exoskeleton is absent. Body is covered by thick mucus.
3. A prominent median fin without fin rays is present and Paired fins are absent.
4. Two dorsal fin and a caudal fin around the tail is present.
5. Jaws are absent, buccal cavity is guarded by dorsal and ventral lips.
6. Presence of one eye on each side and a single nostril as a median aperture.
7. Seven pairs of gill slits in the pharynx are present.

Economic importance:-

Ammocoetes larva is of great phylogenetic significance because it fills the gap between cephalochordates and vertebrates. It exhibit characters of a generalized chordate and resembles adult Amphioxus in many respects.



EXPERIMENT – 3

AIM:- To study the different specimens of class chondrichthyes.

PRISTIS

Classification:-

- Phylum - Chordata
- Class - Chondrichthyes
- Order - Hypotremata
- Genus - *Pristis*

Habitat:-

It is a marine cartilaginous fish and is found in the warm water of Mediterranean and Atlantic oceans.

Habits:-

1. **Feeding:-** It is a predaceous fish and feeds on small fishes and other marine animals.
2. **Defence:-** It uses its rostrum for offence and defense. It ascends rivers.
3. **Reproduction:-** It is unisexual and show sexual dimorphism. It is viviparous.
4. **Respiration:-** It shows branchial respiration.

Morphology:-

1. Body is differentiated into head, trunk and tail.
2. The anterior half of the body is like rays (flattened dorsoventrally) where as the posterior half is like sharks (compressed laterally).
3. Rostrum is an elongated blade-like structure armed on either lateral side which is used as an organ of defence.
4. Spiracles are present behind the eyes.
5. Dorsal fins are large with the first dorsal fin being opposite to the pelvic fin.

Economic importance:-

1. This fish is valuable for liver oil of high vitamin value.
2. It acts as a connecting link between rays and sharks.



NARCINE

Classification:-

- Phylum - Chordata
- Class - Chondrichthyes
- Order - Hypotremata
- Genus - Narcine

Habitat:-

It is a marine cartilaginous fish found in Mediterranean and Red Sea, Atlantic and Pacific Oceans on muddy bottom.

Habits:-

1. **Locomotion:-** It is a carnivorous fish and swims by flapping action of pectoral fin.
2. **Defence:-** It produces an electric current, which is used to stun the prey and to defend itself from.
3. **Reproduction:-** It is unisexual and show sexual dimorphism.

Morphology:-

1. Circular and dorso-ventrally flattened body with a number of pectoral fins for swimming.
2. Pectoral fins are joined to head and trunk, so they look like a disc.
3. Smooth skin
4. Mouth is transverse and ventral.
5. On the dorsal side a pair of large spiracles are present.

Economic importance:-

They produce a powerful electric shock of about 100 volts, Which is dangerous to humans.

ZYGAENA

Classification:-

- Phylum - Chordata
- Class - Chondrichthyes
- Order - Pleurotremata
- Genus - *Zygaena*

Habitat:-

It is a marine cartilaginous fish and is found in deep sea water of all subtropical and tropical seas and Pacific ocean.

Habits:-

1. It is carnivorous and a voracious surface feeder, taking small fishes. It is a fast swimmer.
2. It is viviparous and young are born alive.

Morphology:-

1. Body is divided into head, trunk and tail.
2. Anterior half of the head is greatly extended transversely, forming conspicuous lateral lobes with eyes at their distal ends and nares on their anterior side.
3. Have mouth on the ventral side of the head and five pairs of gill slits on the sides.
4. Pectoral fins are large and are somewhat ventrally inserted.
5. The small pelvic fins enclose the cloacal aperture and bear claspers in the male.
6. Large tail bears a heterocercal caudal fin.

Economic importance:-

It is a dangerous cartilaginous fish because it can cause harm to humans.

TRYGON

Classification:-

- Phylum - Chordata
- Class - Chondrichthyes
- Order - Hypotremata
- Genus - *Trygon*

Habitat:-

It is a marine cartilaginous fish and lie half buried in sand and is a bottom dweller along the sea-coasts. It is found in tropical and subtropical seas.

Habits:-

1. **Feeding:-** It is carnivores fish and feeds upon small fishes, crustaceans and molluscs.
2. **Defence:-** It inflicts a painful wound with its spine. It conceal itself to escape its enemies by protective colouration.
3. **Reproduction:-** It is viviparous. During development of the embryo, uterine wall forms long glandular filaments, the trophy which secrete a nutritive milky fluid as food for the embryo.

Morphology:-

1. Body is dorsoventrally flattened which is broader than long and looks like a sub-rhomboidal disc with the pectoral fins. Pectoral fins are extensive and meet together in front of the snout.
2. Pelvic fins are very small and bear claspers in the male.
3. The tail in long, slender, flexible, whip like, with a small caudal fin and armed with a stinging spine.

Economic importance:-

1. Its serrated spine can inflict a painful and dangerous, slow healing wounds.
2. It is an extremely venomous fish.

RHINOBATUS

Classification:-

- Phylum - Chordata
- Class - Chondrichthyes
- Order - Hhpotremata
- Genus - *Rhinobatus*

Habitat:-

It is a marine bottom dweller cartilaginous fish found in tropical and sub-tropical seas.

Habits:-

1. **Feeding:-** It feeds on molluscs and crustaceans.
2. **Locomotion:-** It swims by flapping actions of its pectoral fins.
3. **Reproduction:-** Male bears claspers. Fertilization is internal. It is viviparous.

Morphology:-

1. Body is depressed, subrhombic, ray-like with a row of spines on the dorsal side.
2. Head is produced into a beak-like snout, bears nares, mouth and five pairs of gill slits on the ventral side and eyes and spiracles on the dorsal side.
3. Pectoral fins are large and confluent with the sides of the head and trunk.
4. Pelvic fins are close behind the pectorals and bear claspers in the male.
5. Tail is well developed and bears two dorsal fins, a caudal fins and a longitudinal fold on each side.

Economic importance:-

1. It is used as a museum specimen.

RAJA

Classification:-

- Phylum - Chordata
- Class - Chondrichthyes
- Order - Hypotremata
- Genus - *Raja*

Habitat:-

It is a marine cartilaginous fish found at the bottom of temperate and tropical seas.

Habits:-

1. **Feeding:-** It is carnivorous and feeds on small fishes, crustaceans, etc.
2. **Locomotion:-** It swims by flapping action of its pectoral fins.
3. **Reproduction:-** It is oviparous and development is direct.

Morphology:-

1. Has a flat, kite shaped body with claw like spines on the upper surface.
2. Head bears nares, mouth and gill slits on its ventral side and eyes and spiracles on dorsal side.
3. Pectoral fins are large, but stop short of the tip of the snout.
4. Pelvic fins are deeply notched and bear claspers in the male.
5. Tail is short and sharply marked off from the trunk and bears spines, two small dorsal fins and an inconspicuous caudal fin and two longitudinal folds on each side.

Economic importance:-

1. It is an edible fish.
2. It is used as a museum specimen.

CHIMAERA

Classification:-

- Phylum - Chordata
- Class - Pisces
- Order - Holocephali
- Genus - *Chimaera*

Habitat:-

It is a marine and deep sea fish found on the coasts of Japan and Australia and west coasts of Europe and North America.

Habits:-

1. **Feeding:-** It is a carnivorous fish.
2. **Reproduction:-** It is oviparous. Fertilization is internal and development is direct.

Morphology:-

1. Body with smooth, scale less skin. Head is laterally compressed and has a blunt snout, ventral mouth, large rounded noses, or nasal grooves, large laterally directed eyes.
2. Gill slits covered by opercula.
3. Trunk bears large pectoral fins, medium sized pelvic fins and two dorsal fins.
4. Posterior dorsal fin is long but low and is continued over the tail. Tail is long and has a low caudal fin.

Economic Importance:-

It acts as a connecting link between cartilaginous fishes and bony fishes.

EXPERIMENT – 4

AIM:- To study the different specimen of class osteichthyes.

LEPISOSTEUS

Classification:-

- Phylum - Chordata
- Class - Osteichthyes
- Order - Lepisostiformes
- Genus - Lepisosteus

Habitat:-

It inhabits fresh water lakes and rivers of North and Central America.

Habits:-

1. **Feeding:-** It is a voracious feeder of small fishes.
2. **Respiration:-** It uses its air bladder as a lung, when water level falls and water become foul.
3. **Reproduction:-** It is oviparous and development is direct.

Morphology:-

1. It has a long, spindle like body covered with thick rhomboid scales which continue over the dorsal and caudal fins.
2. Head is produced into snout with elongated jaws.
3. Pectoral fins are ventrolateral and lie just behind the opercula.
4. Pelvic fins are ventral and lie near the middle of the body.
5. Tail fin is rounded and semi-heterocercal.

Economic importance:-

1. Its skin is used in the manufacturing of hand bags. Its scales are used in jewellery.

LEPISOSTEUS

Classification:-

- Phylum - Chordata
- Class - Osteichthyes
- Order - Ascipenseriformes
- Genus - *Ascipenser*

Habitat:-

Acipenser inhabits both seas and rivers of Europe, North America and Asia.

Habits:-

1. **Feeding:-** It is a bottom dwelling fish. It is carnivorous and feeds on small invertebrates.
2. **Reproduction:-** It is unisexual without sexual dimorphism. It is oviparous and development is direct.

Morphology:-

1. Body is elongated, cylindrical and shark like bearing five longitudinal rows of large keeled bony plates, the scutes.
2. Head is produced into a flat, triangular snout or rostrum bearing four slender barbells which detect the food.
3. Pectoral fins are ventrolaterally inserted close behind the opercula, which are quite low.
4. The pelvic fins are on the ventral side behind the middle of the body.
5. Dorsal and tail fins are far posterior in position. Tail fin is heterocercal.

Economic importance:-

1. Its eggs (pickled ovaries) are used as "caviar".
2. It acts as a connecting link between the cartilaginous fishes and bony fishes.

HIPPOCAMPUS

Classification:-

- Phylum - Chordata
- Class - Osteichthyes
- Order - Gasterosteiformes
- Genus - *Hippocampus*

Habitat:-

It is marine and is found in coastal waters of the Indian and Atlantic Oceans.

Habits:-

1. **Locomotion:-** It swims by means of its dorsal fin with the body held in a vertical position. It clings to the sea weeds by coiling its tail around the twigs.
2. **Feeding:-** It is herbivorous and feeds upon sea weeds and minute organisms.
3. **Defence:-** It shows protective colouration.
4. **Reproduction:-** It is oviparous, female lays eggs in the brood pouch of the male.

Morphology:-

1. Body divisible into head, trunk and tail.
2. The entire body is invested by closely fitting, bony shields, which are produced into tubercles, spines or filaments of varying size at certain places.
3. The head is at right angles to the trunk and looks like that of a horse, hence its name.
4. Head is produced into a tubular snout with terminal edentulous and suckorial mouth.
5. Pectoral fin is short, and present at the base of the head. Pelvic anal and caudal fins are absent. Dorsal fin is small and spinous.
6. Operculum is fused with the body wall tail is prehensile.

7. Male bear a brood pouch for storing fertilized eggs.

Economic importance:-

1. Its dried skeleton is used as a decorative piece.



SYNGNATHUS

Classification:-

- Phylum - Chordata
- Class - Osteichthyes
- Order - Gasterosteiformes
- Genus - *Syngnathus*

Habitat:-

It is marine and inhabits the coastal waters of the Indian and Atlantic Oceans.

Habits:-

1. **Locomotion:-** It swims with the body held in a vertical position. It is omnivorous.
2. **Reproduction:-** It is oviparous and the female lays eggs in the brood pouch of the male. Thus, the male shows the parental care.

Morphology:-

1. Body is divisible into head, trunk and tail. Body is protected by exoskeleton rings.
2. Head is produced into a tube-like snout bearing a suctorial terminal mouth, nares and eyes.
3. Pectoral and dorsal fins are feeble. Pelvic fins are absent.
4. Caudal fin is slightly notched.
5. Tail is long and has a small rounded caudal fin which is slightly notched. Tail is not prehensile.

Economic importance:-

Its dried skeleton is used as a decorative piece.

EXOCOETUS

Classification:-

- Phylum - Chordata
- Class - Osteichthyes
- Order - Ascipenseriformes
- Genus - *Exocoetus*

Habitat:-

It is a marine bony fish that inhabits tropical and subtropical seas and is common in Arabian sea.

Habits:-

1. **Locomotion:-** It can leap in the air with its powerful tail and then slowly glides through the air with the help of its pectoral fins. This flight is a protective device to escape from its enemies.
2. **Feeding:-** It lives in shoals. It is carnivorous in diet.
3. **Reproduction:-** It is oviparous and the development is direct.

Morphology:-

1. Body elongated, laterally compressed, silvery yellow and bluish above.
2. Eyes are large and head is covered with cycloid scales.
3. Mouth is wide, terminal and with toothed jaw.
4. Dorsal and anal fins are short and opposite to each other near the tail region.
5. Pectoral fins are large and help the fish to glide in the air.
6. Tail is homocercal, caudal fin is large and bifid. The ventral lobe of the caudal fin is longer (this condition is called hypobatic)

Economic importance:-

It is edible.

OSTRACION

Classification:-

- Phylum - Chordata
- Class - Osteichthyes
- Order - Tetradontiformes
- Genus - *Ostracion*

Habitat:-

It is a marine bony fish that inhabits shallow water of tropical and subtropical seas.

Habits:-

1. **Feeding:-** It is a bottom dwelling carnivorous fish and feeds on the crustaceans and small fishes.
2. **Reproduction:-** It is oviparous and development is direct.

Morphology:-

1. It has a wide angulated body covered by a carapace formed of large, juxtaposed, hexagonal bony plates some of which are produced into spines.
2. Head bears mouth, nostril and eyes. Mouth is bounded by lips and armed with teeth.
3. Pectoral fins are relatively small, lateral and low. Pelvic fins are absent.
4. Dorsal and anal fins lie opposite to each other toward the hind end of the body.
5. Caudal fin is rounded.

Economic importance:-

Some species of *Ostracion* release toxic substance called Ostratoxin which kill other fishes in the water.

MURAENA

Classification:-

- Phylum - Chordata
- Class - Osteichthyes
- Order - Anguilliformes
- Genus - *Muraena*

Habitat:-

Muraena is marine bony fish and is found in tropical and temperate seas.

Habits:-

1. **Locomotion:-** It swims by lateral undulations of its body.
2. **Feeding:-** It is a carnivorous fish and feeds on other fishes. Large sized eels may attack even man.
3. **Respiration:-** It can live out of water for a short time. Cutaneous respiration is well marked.
4. **Reproduction:-** It spawn in the deep sea, the young ones, called elvers, ascend the rivers (anadromous) and mature adults return to sea.

Morphology:-

1. Body is cylindrical, snake-like with strong teeth.
2. Head bears two pairs of tubular nares, the anterior lie just above the mouth and the posterior near the eyes.
3. Both pectoral and pelvic fins are absent. Dorsal, ventral and caudal fins are continuous.

Economic importance:-

It is eaten in some countries.

MYSTUS

Classification:-

- Phylum - Chordata
- Class - Osteichthyes
- Order - Siluriformes
- Genus - *Mystus*

Habitat:-

Mystus is a fresh water bony fish and is found in rivers all over India.

Habits:-

1. **Feeding:-** It is carnivorous and predacious fish and feeds on small carps and prawns, etc. It is a fast swimmer.
2. **Reproduction:-** It is unisexual and oviparous fertilization is external. Development is direct.

Morphology:-

1. Body is long, brownish dorsally and with silvery sides.
2. Body is divisible into head, trunk and tail. Head bears four pairs of barbs.
3. Trunk bear two dorsal fins. Each pectoral fin is armed with a spine.
4. Tail fin is forked and asymmetrical.

Economic importance:-

1. It is an edible fish. It kills and eats other useful fishes and prawns.

CATLA

Classification:-

- Phylum - Chordata
- Class - Osteichthyes
- Order - Cypriniformes
- Genus - *Catla*

Habitat:-

It is a fresh water fish and inhabits rivers throughout India.

Habits:-

1. **Locomotion:-** Catla is a very active swimmer.
2. **Feeding:-** It is omnivorous and feeds on plankton and decayed vegetation.
3. **Reproduction:-** It is oviparous and prolific breeder. It lay eggs in July to August. Life history includes a larval stage.

Morphology:-

1. Body is divisible into head trunk and tail.
2. Body is blackish-grey above and silvery on the sides. Body is spindle-like but more arched dorsally.
3. Scale less head bears a large terminal mouth with prominent lips and large rounded eyes.
4. Trunk bears small-sized pectoral and pelvic fins. Also bears a large dorsal fin ahead of the anal fin.
5. Caudal fin is deeply forked.

Economic importance:-

1. It is an excellent food fish. It has a pleasant flavour.
2. It is an easy cultureable fish.

TETRADON

Classification:-

- Phylum - Chordata
- Class - Osteichthyes
- Order - Tetradontiformes
- Genus - *Tetradon*

Habitat:-

It inhabits coastal waters and estuaries of Indian rivers.

Habits:-

1. **Feeding:-** It is a carnivorous fish.
2. **Respiration:-** When taken out of water it inflates suddenly with air like a balloon and a sound is emitted by forceful expulsion of air from oesophagus.
3. **Defence:-** Contains a powerful alkaloid poison called tetradotoxin.
4. **Reproduction:-** It is oviparous and development is direct.

Morphology:-

1. Body is round or globose in shape.
2. Scales modified into small spines, especially on ventral side.
3. Mouth is narrow. Teeth fused to form beak. Eyes are large and protruding.
4. Pelvic fins are lacking. Pectoral fins are large and laterals.
5. Dorsal and fins lie opposite to each other at the hind end of the trunk.
6. Caudal fin is broad and entire.

Economic importance:-

1. Contains a powerful alkaloid poison called tetradotoxin.
2. Used in lung infection in Japan. Dried skin is used as a lantern in Japan.

ECHENEIS

Classification:-

- Phylum - Chordata
- Class - Osteichthyes
- Order - Perciformes
- Genus - *Echeneis*

Habitat:-

Echeneis is a marine fish inhabiting almost all the seas.

Habits:-

1. **Feeding:-** It is carnivorous and feeds upon small fishes.
2. **Locomotion:-** It usually attaches itself by means of its adhesive sucker to body of the larger fishes,

Morphology:-

1. Head is depressed and its upper surface bears a large, flat, oval adhesive disc or sucker made up of two rows of transverse lamellae. Sucker represent modified anterior dorsal fin.
2. Mouth has deep cleft. Eyes are directed downwards.
3. Pectoral fins are lateral and pelvic fins are almost below the pectorals.
4. Second dorsal and anal fins are long and lie opposite to each other.
5. Tail fin is entire and slightly concave posteriorly.

Economic importance:-

It is used to capture sea turtles and fishes by the natives of Africa.

LOPHIUS

Classification:-

- Phylum - Chordata
- Class - Osteichthyes
- Order - Lophiiformes
- Genus - *Lophius*

Habitat:-

It is a marine bony fish found along the coasts of Europe and North America.

Habits:-

1. **Locomotion:-** It is a bottom dweller fish.
2. **Feeding:-** It is carnivorous fish and feeds upon small fishes. It can swallow a fish almost as large as its own body due to huge gap of its mouth.
3. **Defence:-** It shows protective colouration.
4. **Reproduction:-** It is unisexual and shows sexual dimorphism. Male fish is very small and occurs attached to one of the spines of the female fish. It is oviparous and development is direct.

Morphology:-

1. Body ugly-looking, dorso-ventrally compressed. Skin leathery and scale less.
2. Head and anterior trunk portion large. Eyes dorsal.
3. Mouth a wide gap with sharp recurved teeth covered by a pigmented skin fold for camouflage.
4. Dorsal fin spinous and highly modified. It consists of three long spines of which first is on the snout and bears a fleshy bait.
5. Pectoral fins are broad, pelvic fins are small, ventral and anterior to the pectorals.
6. Caudal fin is rounded.

Economic importance:-

1. It is used as a museum specimen. It plays an important role in food chain.



SOLEA

Classification:-

- Phylum - Chordata
- Class - Osteichthyes
- Order - Pleuronectiformes
- Genus - *Solea*

Habitat:-

It is marine bony fish inhabiting all tropical and temperate seas.

Habits:-

1. **Feeding:-**It is carnivorous and feeds upon mollusks.
2. **Reproduction:-**The adult fish habitually rests on the sandy sea-floor on its left side, partly covering itself with sand. It is oviparous and development is direct.

Morphology:-

1. Body is thin, flattened, lif like.
2. Mouth is quite narrow. Both the eyes are on the same right side.
3. Pectoral and pelvic fins are reduced.
4. Dorsal and anal fins extend along the entire body. Caudal fin is reduced and entire.

Economic importance:-

1. It is edible.

EXPERIMENT – 5

AIM:- To study the different specimen of class amphibian.

SALAMANDRA

Classification:-

- Phylum - Chordata
- Class - Amphibia
- Order - Caducibranchiata
- Genus - *Salamandra*

Habitat:-

Salamander is a terrestrial tailed amphibian that inhabits the moist shady places in Europe and Eastern Asia. It lies under stones, logs, etc.

Habits:-

1. **Feeding:-** It is nocturnal. It is carnivorous and feeds upon worms, insects and mollusks.
2. **Locomotion:-** It walks slowly on land but swims actively in water.
3. **Defence:-** It has a good power of regeneration and can re-grow its lost limbs any number of times.
4. **Reproduction:-** Male sheds sperm in a capsule called spermatophore which is picked up by the female with her cloacal lips to fertilize her eggs internally. Eggs are retained and developed inside the body of the female who gives birth to larvae which complete their development in water.

Morphology:-

1. The terrestrial adult has shining black skin with yellow spots.
2. Head is depressed and is nearly as long as broad.
3. Mouth is wide, eyes are well developed and have movable eye lids.
4. Gills or gill slits are absent. Tail is cylindrical, tapering and devoid of a fin.

AMBYSTOMA

Classification:-

- Phylum - Chordata
- Class - Amphibia
- Order - Caducibranchiata
- Genus - *Ambystoma*

Habitat:-

It is terrestrial urodele and is found in the United States, North America and Mexico.

Habits:-

1. **Feeding:-** It is carnivorous and feeds upon insects, worms, etc.
2. **Reproduction:-** Male deposit sperms in spermatophores which are picked up by the female with her cloacallips to fertilize her eggs internally.
3. **Development:-** Development is indirect and includes an axolotl larva. If water and food are plenty, this larva do not metamorphose into adults, but grow, develop gonads and start breeding like the adult. This phenomenon is called neoteny.

Morphology:-

1. Body is long lizard like with yellowish spots on the back skin.
2. Head is depressed and bears a terminal wide mouth, eyes and a pair of poisonous parotid glands. Fore limbs bear four digits each and hind limbs five digits each.
3. Tail is somewhat compressed, tapering but lack tail fin.

Economic importance:-

Its axolotl larva shows neoteny.

EXPERIMENT – 6

AIM:- To study the different specimen of class reptilla.

PHRYNOSOMA

Classification:-

- Phylum - Chordata
- Class - Reptilia
- Order - Squamata
- Genus - *Phrynosoma*

Habitat:-

It inhabits arid, sandy parts of United States and Mexico.

Habits:-

1. **Feeding:-** It is insectivorous and catch insects with its tongue. It is diurnal.
2. **Defence:-** When irritated, it emits fine jets of blood from the eyes by contracting blood sinuses present at the base of the nictitating membrane.
3. **Reproduction:-** Male has a pair of hemipenes and femoral glands on the thigh. Female is ovo-viviparous Development is direct.

Morphology:-

1. Body is short, broad depressed and is covered dorsally by larger and smaller strongly keeled scales and ventrally by small regular scales.
2. Head is triangular and bears five conspicuous bony spikes on each side.
3. Small spines occur along the sides of the lower jaw.
4. Neck is short and has folded skin on the underside.
5. Tail is short and spiny.

Economic importance:-

It is useful as it feeds on ants and insects.

VARANUS

Classification:-

- Phylum - Chordata
- Class - Reptilia
- Order - Squamata
- Genus - *Varanus*

Habitat:-

It inhabits dry places under stones and rocks. It is found in Africa, Southern Asia, Indonesia etc.

Habits:-

1. **Feeding:-** It is carnivorous and feeds upon reptiles, mammals and even dead bodies.
2. **Reproduction:-** Male has a copulatory organ the hemipenes. Female is oviparous and lays eggs in hollow tree-trunks.

Morphology:-

1. Body is long and covered dorsally by very small juxtaposed scales and tubercles and ventrally by squarish scales arranged in transverse rows.
2. Head is triangular and bears eyes nostrils and mouth.
3. Mouth is wide and have a long bifid, smooth and protrusible tongue. Neck is very long.
4. Limbs are stout and bear powerful claws over the digits.
5. Tail is long and tapering.

Economic importance:-

1. It is eaten by many people. It is used in medicines by quakers.

ERYX

Classification:-

- Phylum - Chordata
- Class - Reptilia
- Order - Squamata
- Genus - *Eryx*

Habitat:-

It inhabits the plains of North-Western, Central and Southern India. It prefers dry sandy areas and inhabit rodent burrows.

Habits:-

1. **Feeding:-** It is carnivorous and feeds on rates, mice, squirrels, lizards, small birds and occasionally eats other snakes.
2. **Defence:-** If confronted by a predator such as Mongoose or a Peacock, it hides its head under the body coils and waves its tail as if it is the head to distract attention.
3. **Reproduction:-** It is oviparous and non-poisonous.

Morphology:-

1. Head is rounded and blunt bearing shovel-shaped snout with a prominent ridge adapted for digging. Eyes are very small, nostril is slit-like and is high on the snout.
2. Trunk is stout and muscular and is of uniform diameter. Have numerous minute, elliptical and keeled scales.
3. Tail is short, stumpy and rounded. Tail scales are more strongly keeled and rough.

Economic importance:-

It is non-poisonous snake.

Python

Classification:-

- Phylum - Chordata
- Class - Reptilia
- Order - Squamata
- Genus - *Python*

Habitat:-

Python occurs in jungles in Africa, India, Southern China, East Indies, Pakistan and Sri Lanka.

Habits:-

1. **Feeding:-** It is nocturnal. It is carnivorous and feeds upon reptiles, birds and mammals (pigs, deer, etc.)
2. **Reproduction:-** It is non-poisonous. It is oviparous and development is direct.

Morphology:-

1. Body is large (can grow upto 750cm), grayish-brown with red and black spots.
2. Body is divisible into head, neck, trunk and tail.
3. Head bears symmetrical shields.
4. Trunk bears small smooth scales on the upper and lateral sides and a row of broad plates on the ventral side.
5. Tail is short and prehensile and bear two rows of scales on its undersurface.

Economic importance:-

It is a non-poisonous snake.

GAVIALIS

Classification:-

- Phylum - Chordata
- Class - Reptilia
- Order - Crocodilia
- Genus - *Gavialis*

Habitat:-

It inhabits rivers like Ganges, Brahmaputra and Mahanadi and in other Asian rivers.

Habits:-

1. **Feeding:-** It is diurnal. It is carnivorous and feeds upon fishes.
2. **Locomotion:-** It aestivates during summer. It swims in water and walk on land.
3. **Reproduction:-** It is unisexual and show sexual dimorphism. Male has a copulatory organ, penis.
4. **Development:-** Female is oviparous and development is direct.

Morphology:-

1. Body is divisible into head, neck, trunk and tail.
2. The snout is extremely long and narrow, being very distinct from the head.
3. Teeth are almost of equal size.
4. Body is covered with an exoskeleton of bony and epidermal horny scales called scutes.
5. Scutes on the neck are continuous with these of the trunk.
6. Tail is strong and powerful and is laterally compressed and have vertical scutes.

CHELONE

Classification:-

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

Habitat:-

It is a marine turtle and is found in Atlantic, Indian and Pacific Oceans.

Habits:-

1. **Feeding:-** It feeds on sea weeds, but in emergency it also eat fishes.
2. **Locomotion:-** It swims actively in water with the help of its paddle-like fore and hind limbs.
3. **Reproduction:-** It comes ashore only to bask and lay eggs. It is oviparous and development is direct.

Morphology:-

1. Body is covered by exoskeleton made up of large horny scutes.
2. Carapace is low and heart shaped.
3. Plastron is joined to carapace by ligament.
4. Head and neck are not fully retractile.
5. Limbs are modified into flippers.

Economic importance:-

1. It is edible.
2. Its flesh is highly delicious.

EXPERIMENT – 7

AIM:- To study the different specimen of class Aves.

CASUARIUS

Classification:-

- Phylum - Chordata
- Class - Aves
- Order - Casuariiformes
- Genus - *Casuarius*

Habitat:-

Cassowary inhabits the forests of Australia, New Guinea and neighbouring islands.

Habits:-

1. **Locomotion:-** It is a flightless bird. But is a fast runner and a good swimmer.
2. **Feeding:-** It is nocturnal and frugivorous.
3. **Reproduction:-** It is unisexual and show sexual dimorphism. Fertilization is internal and development is direct.

Morphology:-

1. Body is divisible into head, neck, trunk and tail.
2. Head bears a tall, helmet-like, horny casque which perhaps helps the bird in pushing its way through the thick vegetation.
3. Neck is long.
4. Wings are rudimentary.
5. Each foot has three toes (2,3,4), the inner bears a long, sharp claw for defense.

AREDA

Classification:-

- Phylum - Chordata
- Class - Aves
- Order - Ciconiiformes
- Genus - *Ardea*

Habitat:-

It is an arboreal and semi-aquatic bird. It inhabits Europe, Africa, Asia, Australia and Japan.

Habits:-

1. **Feeding:-** It is carnivorous and feeds upon fishes and frogs.
2. **Reproduction:-** Its breeding season is July to September and lay 3-1 eggs in a nest made in twigs lined with grass. Both parents care for the eggs and the young.

Morphology:-

1. Ardea has a tall somewhat compressed body which is divisible into head, neck, trunk and tail.
2. Head is narrow with a prominent black crest and a long, straight pointed beak.
3. Neck is long and S-shaped.
4. Trunk bears one pair of long, rounded wings and a pair of slender legs for wading in water. Each leg has four toes.
5. Tail is short.

ANAS

Classification:-

- Phylum - Chordata
- Class - Aves
- Order - Anseriformes
- Genus - *Anas*

Habitat:-

Anas is found near the standing water bodies in the Northern Hemisphere.

Habits:-

1. **Locomotion:-** It is a diurnal bird and can fly, swim and walk well.
2. **Feeding:-** It feeds on water insects.
3. **Reproduction:-** It is polygamous. It makes its nest for laying eggs on the ground near the water bodies. Nest is made from twigs and is lined with feathers pulled from mother's body. Female bird incubates the eggs.

Morphology:-

1. Body is boat-shaped with short legs, fully webbed toes, flat beak and a short tail.
2. Margins of the beak bear numerous transverse horny ridges or lamellae.

Economic importance:-

1. Both its eggs and flesh are edible.
2. It helps in biological control of mosquitoes.
3. It is a poultry bird.

PAVO

Classification:-

- Phylum - Chordata
- Class - Aves
- Order - Galliformes
- Genus - *Pavo*

Habitat:-

It is found in forests as well as in the agricultural field all over India and adjacent countries.

Habits:-

1. **Feeding:-** It is diurnal and omnivorous in diet. It feeds on grains, insects and reptiles.
2. **Locomotion:-** It flies rarely.
3. **Reproduction:-** It is polygamous. Males show a peculiar dance during breeding season. Nest is made on the ground among dense vegetation. Female lays 3-5 eggs and incubates her eggs and take care of the young.

Morphology:-

1. Peacock has a stout upper beak, long neck and strong feet with sharp claws.
2. It shows sexual dimorphism. Male bird (Peacock) has a brilliantly blue-coloured body with a crest of feathers on the head, fighting spurs on its legs, and bright, erectile tail feathers with tips having eye-like marks.
3. The female bird (Peahen) is small and dull coloured and lacks spurs, and train of tail feathers.

Economic importance:-

1. Peacock is our National Bird.
2. Its feathers are used for decorative purposes.

EUDYNAMIS

Classification:-

- Phylum - Chordata
- Class - Aves
- Order - Cuculiformes
- Genus - *Eudynamis*

Habitat:-

It is an arboreal bird and found on trees in gardens. It is found all over India, Pakistan, Sri Lanka, Bangladesh and Myanmar.

Habits:-

1. **Feeding:-** It is diurnal and omnivorous bird. It feeds upon fruits, caterpillars and insects.
2. **Reproduction:-** Breeding season extends from April to August. Eggs are laid in the nest of the crow for incubation and rearing. Eggs are similar to those of the crow. Only the male sings.

Morphology:-

1. The body of *Eudynamis* is slender with a long tail, measuring upto 42 cm in length.
2. Beak is small and curved Neck is short.
3. Two toes are directed forward and two backward.
4. Sexual dimorphism is well marked. The male is shining metallic black all over with a yellowish green beak and crimson eyes. The female is brown spotted and barred with white.

Economic importance:-

The bird Koel is known for its sweet voice (only the male sings. Female does not sing)

TYTO

Classification:-

- Phylum - Chordata
- Class - Aves
- Order - Strigiformes
- Genus - *Tyto*

Habitat:-

Owl is an arboreal bird and is found throughout India, Pakistan and Myanmar.

Habits:-

1. **Activity:-** It is nocturnal but can be seen frequently during the day time.
2. **Feeding:-** It is a bird of prey and preys upon rats, hares, birds, lizards and other reptiles, frogs and insects.
3. **Locomotion:-** It is a solitary bird and is best known for its deep double hoot.

Morphology:-

1. Head is large rounded and bears two forwardly directed eyes, sharp curved beak and a prominent collar of stiff feathers round the flat face.
2. The bird is clothed in a soft, fluffy plumage which renders it noiseless during flight.
3. It has strong legs with stout claws.

Economic importance:-

It is a good friend of farmers as it kills and eat a large number of crop pests like rodents and worms.

ALCEDO

Classification:-

- Phylum - Chordata
- Class - Aves
- Order - Coraciiformes
- Genus - *Alcedo*

Habitat:-

It is found all over India, Pakistan, Sri Lanka and Myanmar.

Habits:-

1. **Feeding:-** It is a predatory bird and feeds upon small fishes, tadpoles and insects.
2. **Reproduction:-** It breeds in March to June. Its nest consists of a horizontal tunnel in the bank of the stream. Eggs are incubated by both the parents.

Morphology:-

1. Head bears a long, straight and pointed beak.
2. Toes are adapted for perching.
3. Feet are syndactylus.
4. Tail is short and stumpy.

EXPERIMENT – 8

AIM:- To study the different specimen of class Mammalia.

ORNITHORHYNCHUS

Classification:-

- Phylum - Chordata
- Class - Mammalia
- Order - Monotremata
- Genus - *Ornithorhynchus*

Habitat:-

It inhabits rivers, streams and some lakes and is found in areas where banks are suitable for burrowing. It has a restricted distribution and is an inhabitant of East Australia and Tasmania.

Habits:-

1. **Activity:-** It lives in burrows and is nocturnal
2. **Feeding:-** It is carnivorous and feeds mainly on bottom-dwelling invertebrates like mollusks, crayfishes, worms and insects.
3. **Reproduction:-** It is oviparous. Incubation is done by mother alone. The young are naked and blind. They are fed on milk oozing from slits on the mother's abdomen.

Morphology:-

1. Body is long, cylindrical. Short, dense and waterproof fur covers the whole body except feet and bill.
2. Head is prolonged into a flat, duck-like beak, hence the specific name.
3. The limbs are short and have five clawed and webbed digits.
4. Males have a horny spur on each ankle.

5. Tail is broad and flat.

Economic importance:-

It acts as a connecting link between reptiles and mammals.



ECHIDNA

Classification:-

- Phylum - Chordata
- Class - Mammalia
- Order - Monotremata
- Genus - *Echinda*

Habitat:-

It is a terrestrial prototherian mammal found in Australia.

Habits:-

1. **Feeding:-** It is nocturnal and fossorial and insectivorous. It feeds on ants. Ants are captured from the ant hills by its sticky tongue.
2. **Defence:-** When attacked by its enemy, it quickly dig out a burrow in the ground and enter into it, protruding a few spines out of the burrow.
3. **Reproduction:-** Female lays a single egg in the burrow and transfer it into a small abdominal pouch called incubatorium, which is developed only in the breeding season.
4. It can roll into a ball for protection.

Morphology:-

1. Head is produced into a tubular, snout having terminal mouth. Pinnae are lacking.
2. Body is covered by a dense coat of hair all over. Some hair on the back are modified into short but sharp spines.
3. Tongue is long, sticky and highly protrusible.

Economic importance:-

It acts as a connecting link between reptiles and mammals.

DIDELPHYS

Classification:-

- Phylum - Chordata
- Class - Mammalia
- Order - Marsupialia
- Genus - *Didelphys*

Habitat:-

Didelphys is an arboreal mammal found in North and South America.

Habits:-

1. **Feeding:-** It is nocturnal and omnivorous. It feeds on eggs, fruits and insects.
2. **Defence:-** When disturbed, it feigns death by rolling itself into a ball and lying motionless.
3. **Reproduction:-** Female is viviparous. Young ones, which are just 11 cm long, are brought up for about two months in the marsupium.

Morphology:-

1. Head is relatively long and is produced into a snout and has mouth, nostrils, eyes and pinnae.
2. Trunk bears two pairs of pentadactyl limbs.
3. Tail is long and prehensile.
4. Male has scrotal sacs and female has a marsupium.

Economic importance:-

Didelphys is eaten.

MACROPUS

Classification:-

- Phylum - Chordata
- Class - Mammalia
- Order - Marsupialia
- Genus - *Macropus*

Habitat:-

It is a metatherian mammal inhabiting the open forests in New Zealand, Australia and Tasmania.

Habits:-

1. **Activity:-** It is terrestrial, gregarious and diurnal marsupial.
2. **Feeding:-** It is herbivorous and feeds on crops.
3. **Locomotion:-** It walks in normal way, using all its four limbs. It runs by taking long leaps on the hind limbs alone, balancing its body on the tail.
4. **Reproduction:-** It is viviparous and gives birth to a single young one after a gestation period of about 39 days. Young one born is blind, naked and helpless and is only 2.5 cm long. Mother cares it in her marsupium.

Morphology:-

1. It has a small head, large body and a long tail.
2. The hind limbs are much longer and powerful than the forelimbs. Four toe is very long.
3. Marsupium, a pouch in the belly of the female opens in front.

Economic importance:-

1. It is a good example of pouched mammals.
2. It is studied as an example of restricted distribution of animals.
3. It destroys crops.

LORIS

Classification:-

- Phylum - Chordata
- Class - Mammalia
- Order - Primates
- Genus - *Loris*

Habitat:-

It is found in Jungles of South India, Sri Lanka and Madagascar.

Habits:-

1. **Activity:-** It is arboreal and nocturnal primate.
2. **Feeding:-** It is omnivorous and feeds on fruits, leaves, insects, eggs and birds.
3. **Reproduction:-** It shows sexual dimorphism and is viviparous.

Morphology:-

1. Body is covered with a short, dense, soft brownish fur with silver look. Face covered with fur.
2. It has forwardly directed eyes, thin rounded pinnae and white rhinarium.
3. Have slender limbs of nearly equal size.
4. Tail is absent or is much reduced.

MACACA

Classification:-

- Phylum - Chordata
- Class - Mammalia
- Order - Primates
- Genus - *Macaca*

Habitat:-

It inhabits jungles in Northern India.

Habits:-

1. **Activity:-** It is terrestrial, arboreal, gregarious and diurnal primate (old world monkey)
2. **Feeding:-** It is omnivorous in diet and feeds on vegetables, fruits and insects.
3. **Reproduction:-** Usually a single young one is born at a time which is brought up with a great care and affection.

Morphology:-

1. Body is sturdy and yellowish brown.
2. Head is rounded.
3. Face is protruding and red in the adult.
4. Eyes are oval and directed forward.
5. Forelimbs (arms) are longer than hind limb (legs)
6. Hand and feet are grasping.
7. Digits bear nails.
8. Female has one pair of teats on the thorax.
9. Tail is very long.

Economic importance:-

1. It is a nice pet and easily tamable.

2. Rh-factor (in human blood) was discovered first in this primate.
3. It is a nuisance in the gardens.



HYSTRIX

Classification:-

- Phylum - Chordata
- Class - Mammalia
- Order - Rodentia
- Genus - *Hystrix*

Habitat:-

It inhabits river banks, nallas and bunds and is found in India.

Habits:-

1. **Activity:-** It is a terrestrial, nocturnal, gregarious mammal.
2. **Feeding:-** It is herbivorous and eats crops of potatoes, carrots, cabbage, etc.
3. **Defence:-** Spines form defensive tools. It can roll itself in self-defense.
4. **Reproduction:-** It is viviparous.

Morphology:-

1. Body is low and stout and bears on the dorsal side long quill-like, erectile spines.
2. Limbs bear claws.
3. Tail is non-prehensile.

Economic importance:-

It is harmful as it damages our crops.

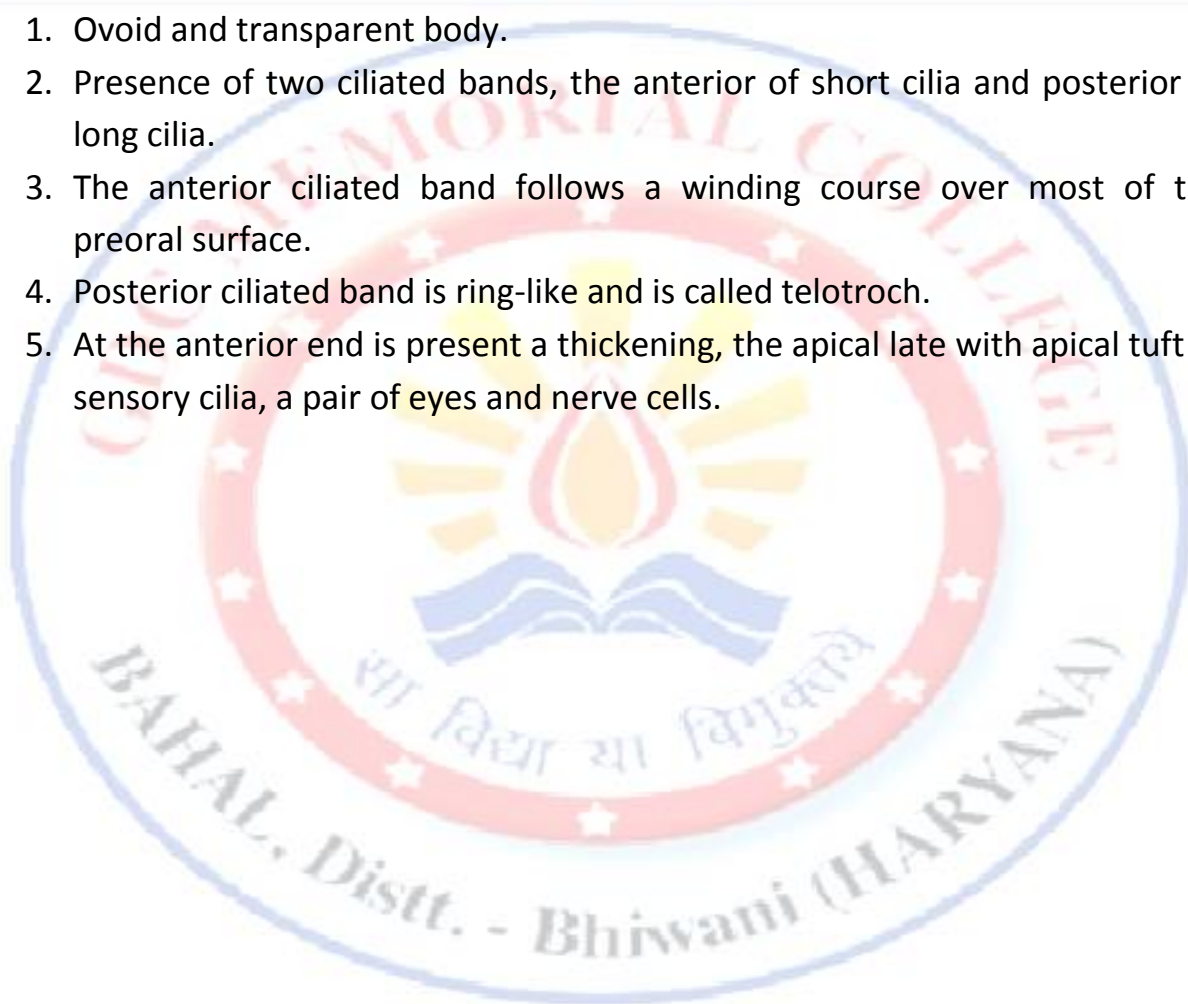
EXPERIMENT – 9

AIM:- To study the permanent given slides.

TORNARIA LARVA (W.M)

Identification points:-

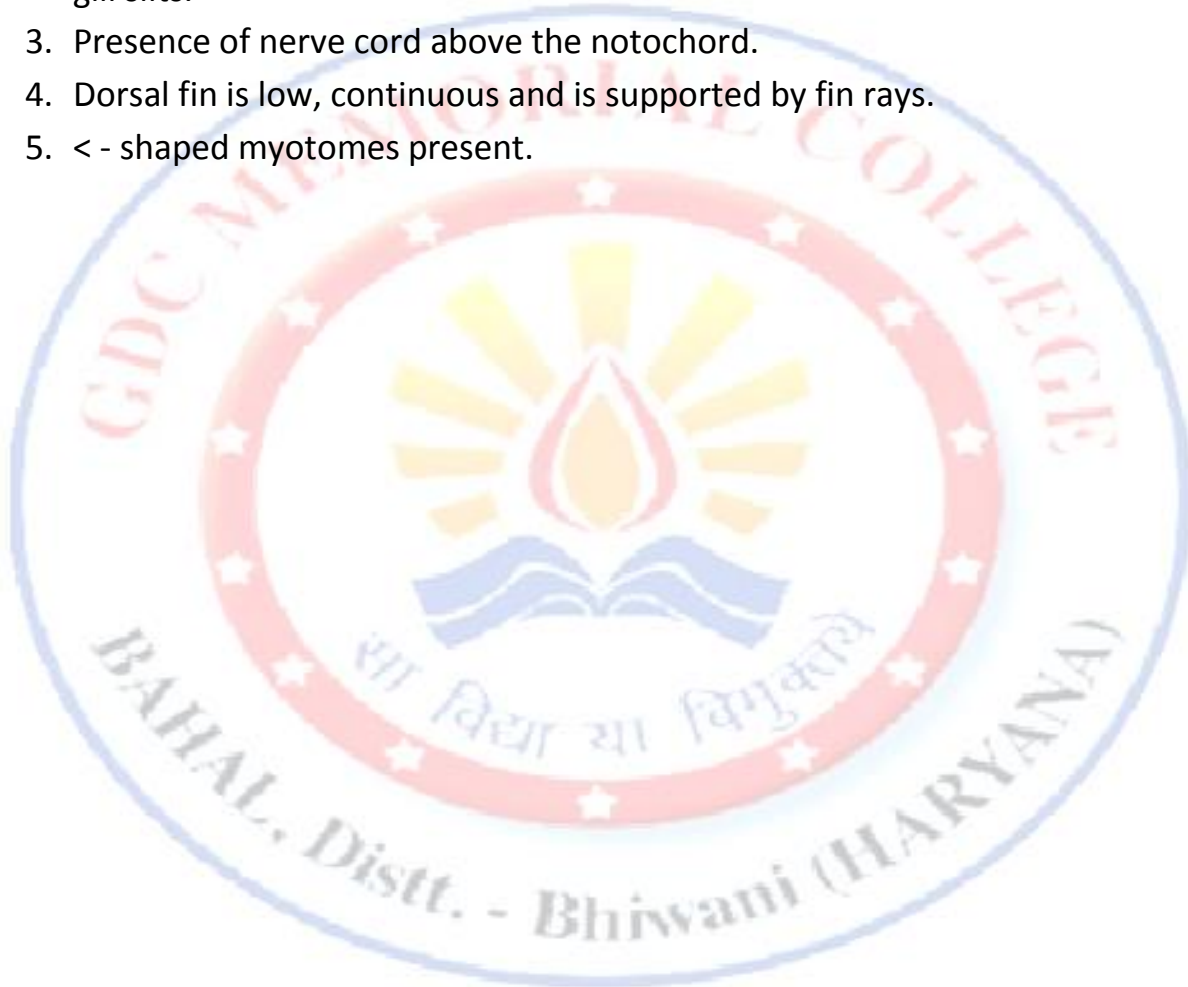
1. Ovoid and transparent body.
2. Presence of two ciliated bands, the anterior of short cilia and posterior of long cilia.
3. The anterior ciliated band follows a winding course over most of the preoral surface.
4. Posterior ciliated band is ring-like and is called telotroch.
5. At the anterior end is present a thickening, the apical lobe with apical tuft of sensory cilia, a pair of eyes and nerve cells.



AMPHIOXUS : V.S. ANTERIOR REGION

Identification points:-

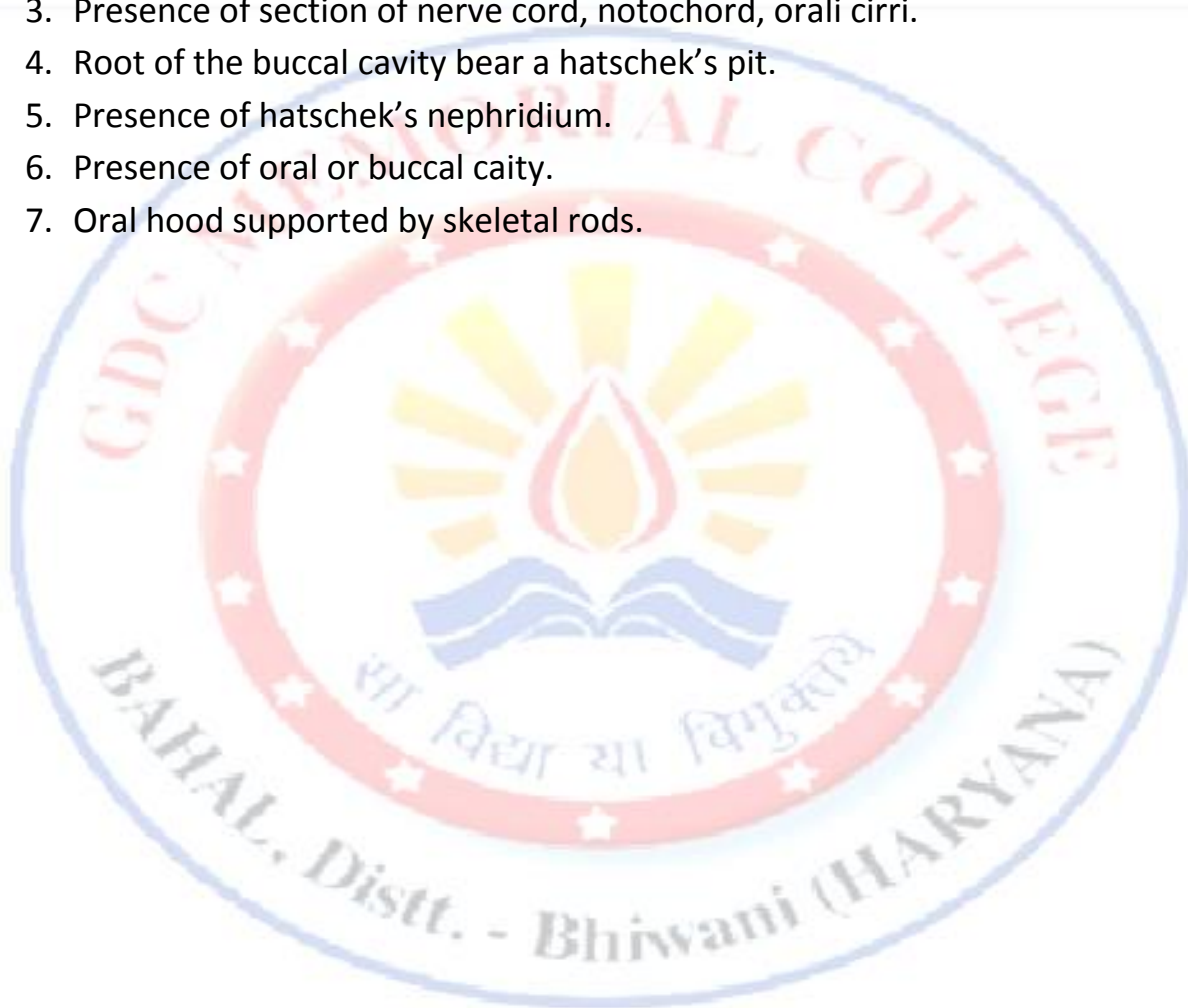
1. Anterior extension of the body is the form of rostrum supported by notochord.
2. Presence of buccal cirri, wheel organ, velum and pharyngeal basket having gill slits.
3. Presence of nerve cord above the notochord.
4. Dorsal fin is low, continuous and is supported by fin rays.
5. < - shaped myotomes present.



AMPHIOXUS : T.S. PASSING THROUGH ORAL HOOD

Identification points:-

1. Body wall composed of epidermis, dermis and muscle layer. Mycomma divide muscle layer into myomees.
2. Presence of dorsal fin supported by fin ray box.
3. Presence of section of nerve cord, notochord, orali cirri.
4. Root of the buccal cavity bear a hatschek's pit.
5. Presence of hatschek's nephridium.
6. Presence of oral or buccal cavity.
7. Oral hood supported by skeletal rods.



AMPHIOXUS : T.S. PASSING THROUGH PHARYNX

Identification points:-

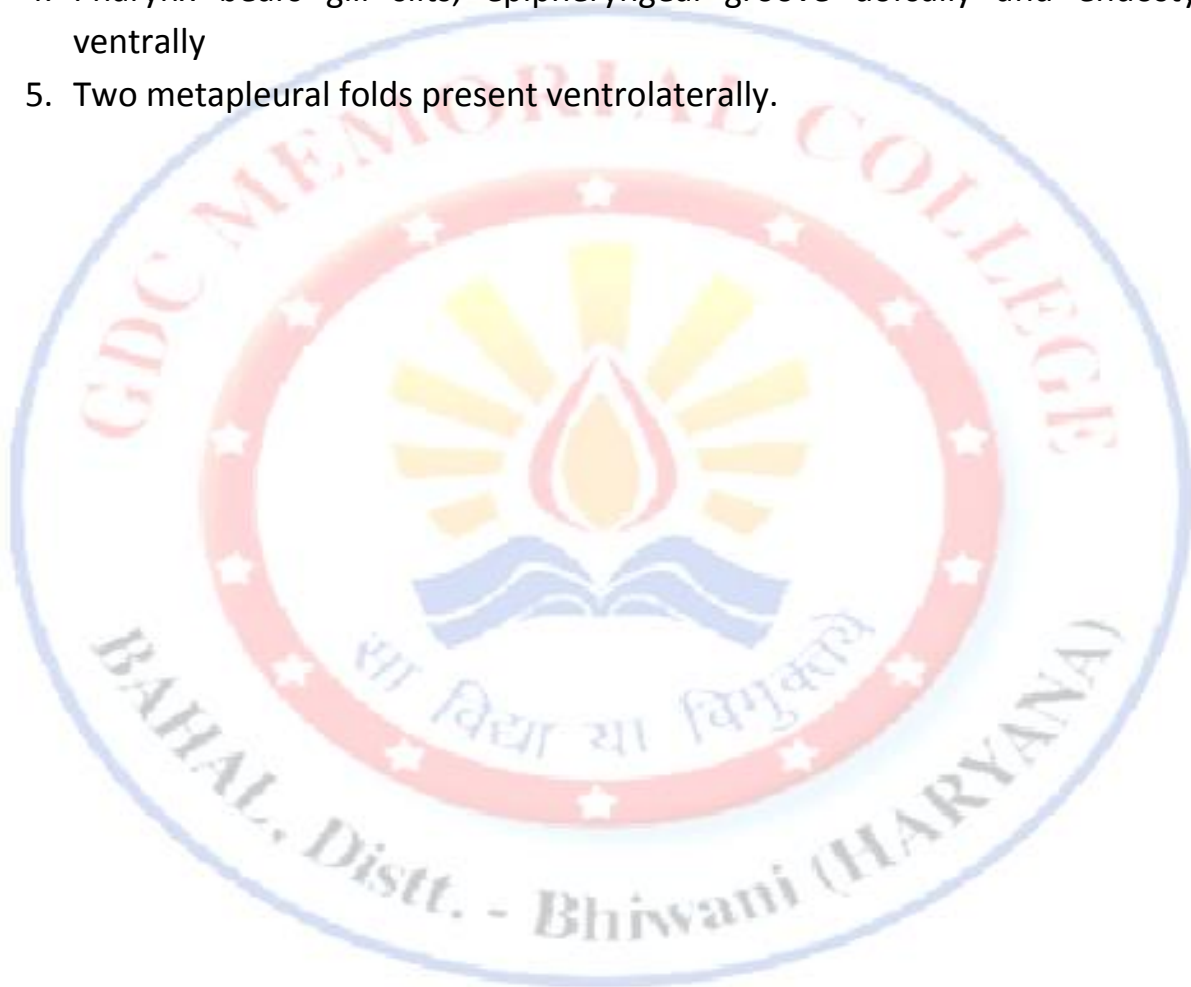
1. Body wall composed of epidermis, dermis and muscle layer.
2. Dorsal fin supported by fin ray box.
3. Section of nerve cord, notochord, pharynx, midgut and ovaries.
4. Pharynx bears gill slits, epipharyngeal groove dorsally and endostyle ventrally.
5. Two metapleural folds present ventrolaterally.



AMPHIOXUS : T.S. PASSING THROUGH OVARIES

Identification points:-

1. Body wall composed of epidermis, dermis and muscle layer.
2. Dorsal fin supported by fin ray box.
3. Section of nerve cord, notochord, pharynx, midgut and ovaries.
4. Pharynx bears gill slits, epipharyngeal groove dorsally and endostyle ventrally
5. Two metapleural folds present ventrolaterally.



AMPHIOXUS : T.S. PASSING THROUGH TESTES

Identification points:-

1. Body wall composed of epidermis, dermis and muscle layer.
2. Dorsal fin supported by fin ray box.
3. Sections of nerve cord, notochord, pharynx, midgut and testis. Testis with different stages of spermatogenesis seen.
4. Pharynx bears gill slits, epipharyngeal groove dorsally and endostyle ventrally.
5. Two metapleural folds present ventrolaterally.



AMPHIOXUS : T.S. PASSING THROUGH INTESTINE

Identification points:-

1. Body wall composed of epidermis, dermis and muscle layer.
2. Dorsal fin supported by fin ray box.
3. Sections of nerve cord, notochord, dorsal blood vessel, intestine, coelomic cavity and atrial cavity.



AMPHIOXUS : T.S. PASSING THROUGH ANAL REGION

Identification points:-

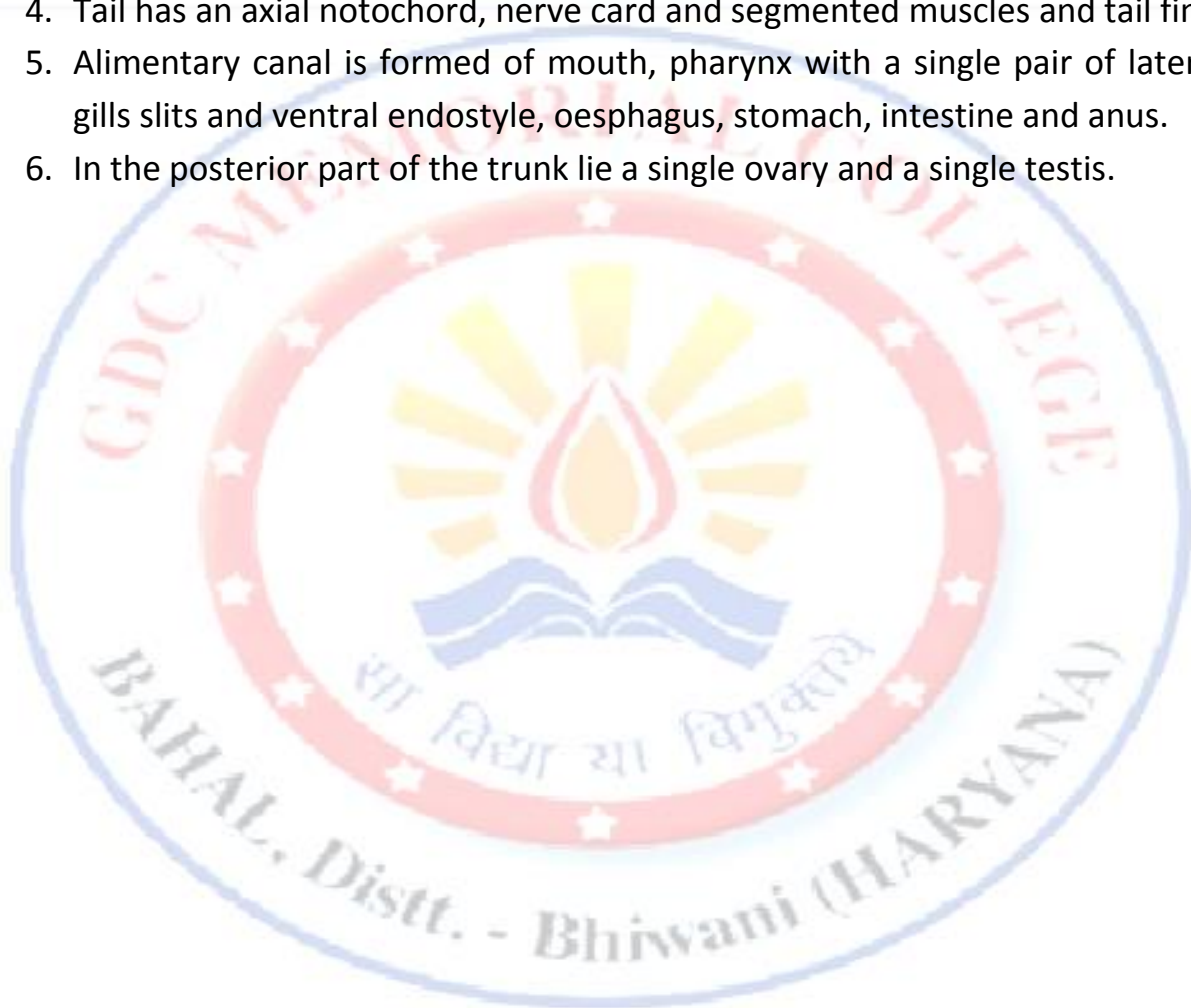
1. Body wall composed of epidermis, dermis and muscle layer.
2. Dorsal fin supported by fin ray box.
3. Section of nerve cord, notochord, dorsal aorta, splanchnocoel, intestine present in the slide.
4. Ventral fin supported by two fin ray boxes.



OIKOPLEURA (W.M.)

Identification points:-

1. Body is covered by cuticular test.
2. Body differentiated into a stout trunk and a laterally compressed tail.
3. Tail is bent forward under the trunk.
4. Tail has an axial notochord, nerve cord and segmented muscles and tail fin.
5. Alimentary canal is formed of mouth, pharynx with a single pair of lateral gills slits and ventral endostyle, oesophagus, stomach, intestine and anus.
6. In the posterior part of the trunk lie a single ovary and a single testis.



EXPERIMENT – 10

AIM:- To study the histology of compound tissues.

V.S. OF SKIN

Identification points:-

1. Skin is formed of two distinct regions: outer thin epidermis and the inner thick dermis.
2. Epidermis is formed of several layers of cells. The nature of cells varies in different layers.
3. The innermost epidermal layer is consisting of columnar cells and is known as Malpighian layer or stratum germinativum, cells of the outermost layers are thick flat and Keratinized and constitute stratum corneum and cells of the middle layers are less flattened and form a transition zone.
4. Dermis is about 2 to 3 times thick than epidermis and is composed of connective tissue containing fibers, blood capillaries, nerve fibres, pigment cells, etc.
5. Beneath the dermis is a layer of loose connective tissue containing fat lobules and is called sub-cutaneous tissue.
6. There are many sections of hair, hair follicle sweat glands and sebaceous glands.

T.S. STOMACH OF ART

Identification points:-

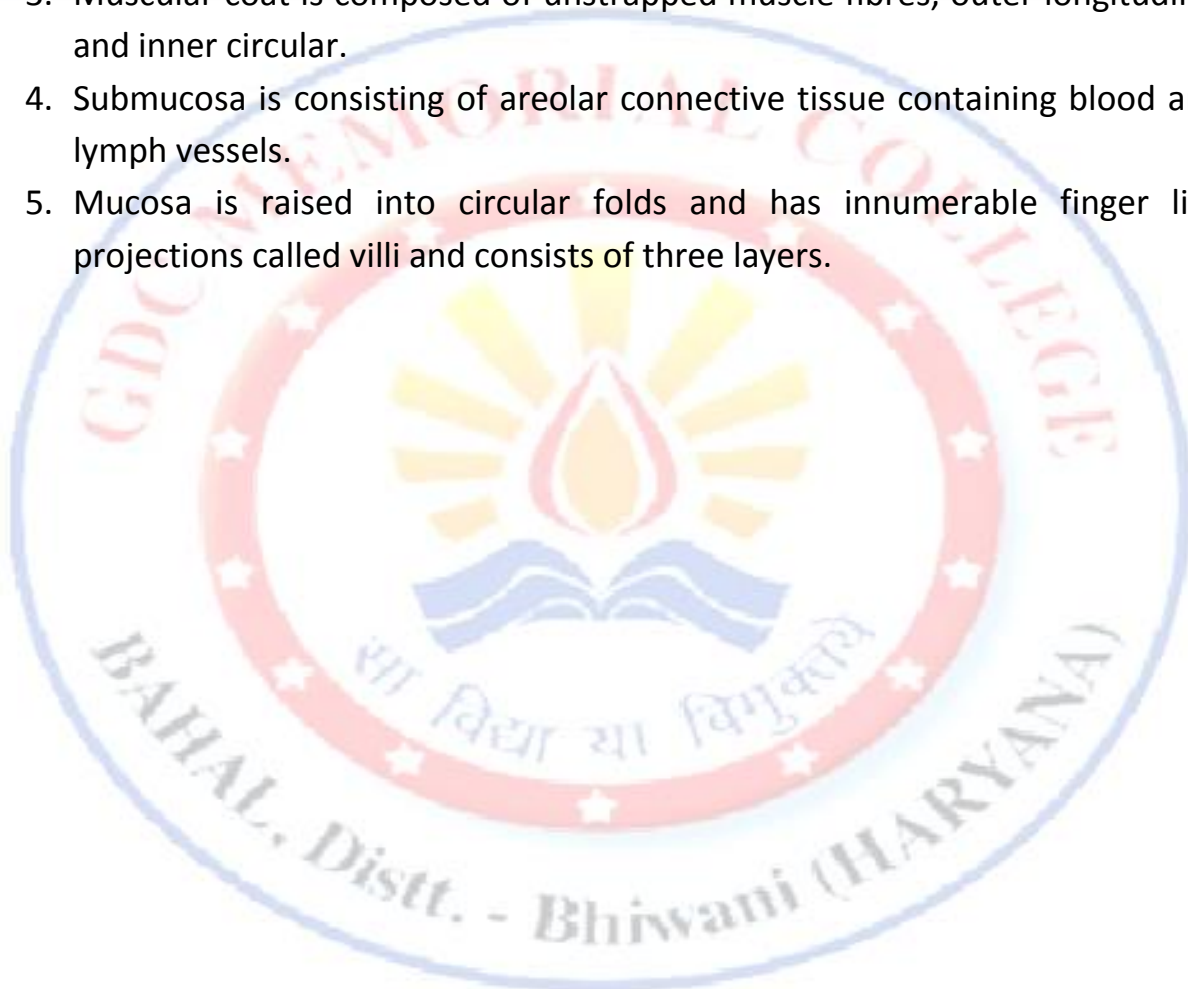
1. Wall of the stomach is formed of four coats. Beginning from outside, these coats are: serosa, muscular coat, sub-mucosa and mucosa.
2. Serosa is formed of simple squamous epithelial cells.
3. Muscular coat is formed of outer longitudinal, middle circular and inner oblique muscle fibres.
4. Sub-mucosa is formed of areolar connective tissue containing blood and lymph vessels.
5. Mucosa is consisting of three layers : outer muscularis mucosae, middle tunica propria and inner surface epithelium consisting of single layer of columnar cells.



T.S. SMALL INTESTINE OF RAT

Identification points:-

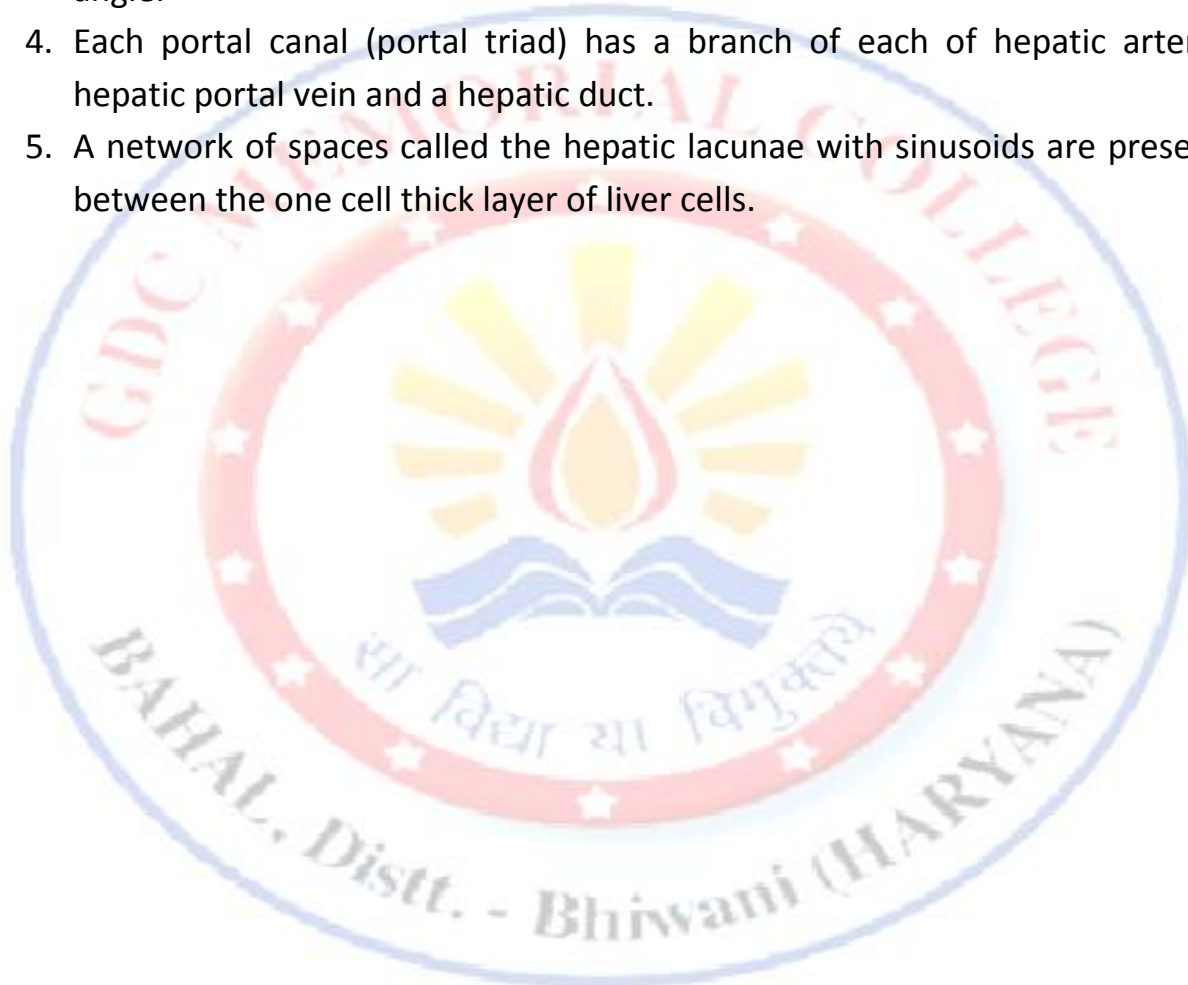
1. Wall of the intestine consists of four coats. Beginning from outside, these are : serosa, muscular coat, sub-mucosa and mucosa.
2. Serosa is formed of a single layer simple squamous epithelial cells.
3. Muscular coat is composed of unstriated muscle fibres, outer longitudinal and inner circular.
4. Submucosa is consisting of areolar connective tissue containing blood and lymph vessels.
5. Mucosa is raised into circular folds and has innumerable finger like projections called villi and consists of three layers.



T.S. LIVER OF RAT

Identification points:-

1. Consists of larger polygonal liver cells or hepatocytes.
2. Hepatocytes arranged into pentagonal lobules.
3. Each lobule has a central cannal at the centre and a portal canal at each angle.
4. Each portal canal (portal triad) has a branch of each of hepatic artery, hepatic portal vein and a hepatic duct.
5. A network of spaces called the hepatic lacunae with sinusoids are present between the one cell thick layer of liver cells.



T.S. LUNG OF RAT

Identification points:-

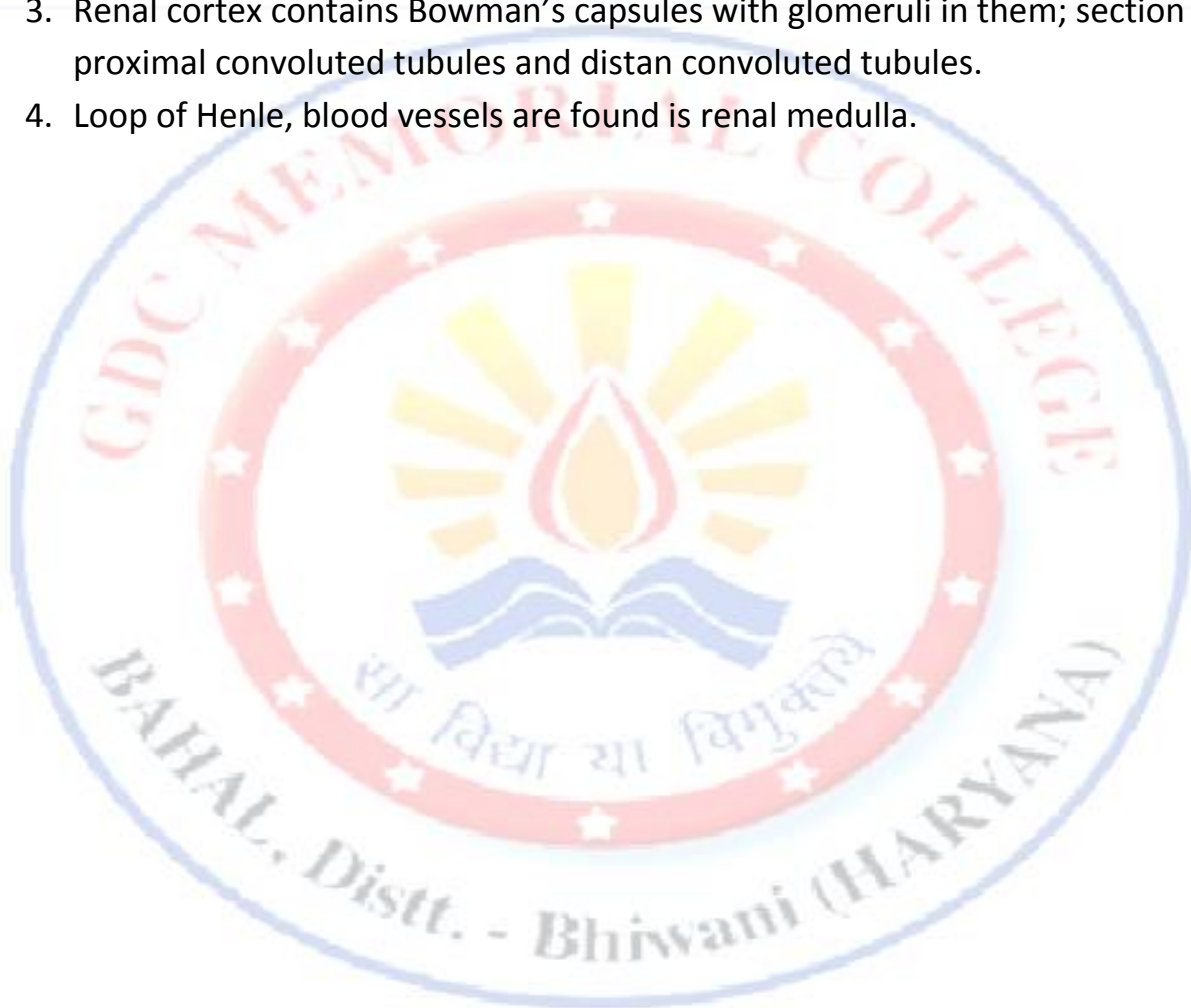
1. Wide spread connective tissue having the sections of the branches of pulmonary artery, pulmonary vein, lymph vessels and nerve fibers.
2. Each alveolus has a thin wall composed of single layered moist epithelium.
3. Consisting of a number of branches of bronchial intercom.



T.S. KIDNEY

Identification points:-

1. Kidney consists of numerous nephrons.
2. Outer part is called renal cortex and the inner part called renal medulla are clearly distinguishable.
3. Renal cortex contains Bowman's capsules with glomeruli in them; section of proximal convoluted tubules and distal convoluted tubules.
4. Loop of Henle, blood vessels are found in renal medulla.



T.S. PANCREAS

Identification points:-

1. Formed of two parts : endocrine and exocrine.
2. Exocrine part is formed of a large number of pancreatic lobules or acini.
3. Each acinus is lined by columnar epithelium.
4. Endocrine part is formed of islets of Langerhans present between the acini.
5. Allveolar connective tissue contains in it blood capillaries, nerve fibres, etc.



T.S. OVARY OF RAT

Identification points:-

1. Stroma or matrix bounded by cuboidal germinal epithelium of germ cells.
2. Stroma or matrix is differentiated into two regions : outer cortex and inner medulla.
3. Cortex contains ovarian follicles at different stages of development (primary follicles, secondary follicles, mature or Graafian follicles) corpus luteum and corpus albicans.
4. A mature or Graafian follicle is having a secondary oocyte, follicle cells and a cavity antrum.
5. Ovarian medulla is formed of connective tissue having blood capillaries, lymph capillaries, nerve fibres etc.



EXPERIMENT – 11

AIM:- To study the permanent slides of different type of scales.

PLACOID SCALE (W.M.)

Identification points:-

1. Each scale consists of a rhomboidal basal plate and a flat trident spine.
2. Basal plate has a perforation in the centre.
3. Trident spine is covered by numerous small plates arranged in transverse rows in an imbricate manner.



CYCLOID SCALE (W.M.)

Identification points:-

1. Each scale is nearly circular and have smooth free edge.
2. Each scale bears several concentric lines of growth and nucleus.



CTENOID SCALE (W.M)

Identification points:-

1. Each scale is thin, translucent plate bearing comb-like projections on the free edge.
2. The proximal end of each scale is scalloped and is with lines of growth.
3. Distal end bears a large number of teeth and a nucleus.



EXPERIMENT – 12

AIM:- To prepare permanent stained slides.

Requirements:-

Water, water bottle, beaker, watch glass or cavity slides, alcoholic grades (30%), 50% 70%, 90% and 100% ethyl alcohol), stain (borax carmine or eosine), xylene or benzene, DPX, clean and clear glass slides, coverslips, filter papers and the material to be stained.

Procedure:-

1. **Washing** :- Take the material to be stained and make it sure that the proper material is there. After this wash the material with water two or three times. This helps to remove the excess of fixative.
2. **Dehydration** :- It involves the removal of water from the material. For dehydration we use alcoholic grades prepared from Ethyl alcohol. Pass the material through different grades of alcohol like 30%, 50% and 70% keeping the material for 5-10 minutes in each. The time depends upon the nature and size of the material to be stained.
3. **Staining** :- Use alcoholic preparation of the stain. Put the material after 70% alcohol in the stain (Borax carmine or Eosina) for 3-5 minutes. Observe the material for proper staining (time of staining may vary, depends on nature of the material)
If the material gets more stained, destain it by using 70% acid alcohol before going to the next step.
4. **Dehydration** :- After staining put the material first in 90% alcohol for about 10 minutes and then into absolute (100%) alcohol for about 10-15 minutes
5. **Clearing** :- Transfer the stained and dehydrated material into the clearing agent like xylene or Benzene for about 5-10 minutes. If any turbidity (milky) is observed, that indicates incomplete dehydration. Then transfer back the material in absolute (100%) alcohol and keep it there again for 5-10 minutes.

6. **Mounting** :- Take a clean and clear glass slide and put 2 or 3 drops of Canada balsum or DPX on it. Now put the material on it and cover it with a cover slip. Make sure there should be no air bubbles in the slide.

7. **Drying the slide** :- After performing the above steps, keep the prepared slide either in sun light or in an oven at 50-60°C for a few hours.

Permanent slide is ready and can be kept for years.



EXPERIMENT -13

AIM:- To test the given sample of material for identification of simple sugars (monosaccharides), disaccharides and polysaccharides.

Requirements:-

Test tubes, test tube stand, spirit lamp, hot water bath, Molish's reagent, Fehling solution A and B, Benedict's reagent, conc. HCl, conc. H₂SO₄, iodine reagent, NaOH, 5% glucose solution, 5% sucrose solution, 1% starch solution, sodium carbonate, etc.

Procedure:-

A. General test for the identification of Carbohydrate (Molisch's test) :- Take 2-3 ml of the given sample in a test tube and add 1-2 drops of Molisch's reagent and then add 2ml of conc. H₂SO₄ along the side wall of the test tube and observe.

Observation :- The given sample contains a carbohydrate.

B. Qualitative tests for the identification of monosaccharide (Glucose)

i. Fehling's test :- Take 2-3 ml of given sample (5% glucose solution) in a test tube and add about 2ml each of Fehling's solution A and B in it and boil in a hot water bath or spirit lamp for a few minutes and observe.

Observation :- Brown red precipitates are seen.

Conclusion :- The given solution contains a monosaccharide

ii. Benedict's test :- Take 2ml of the given sample in a test tube and add equal amount of Benedict's reagent in it and boil.

Observation :- Red-yellow precipitates are seen.

Conclusion :- The given solution contains a monosaccharide.

C. Qualitative test for the identification of a disaccharide (sucrose) :- Take 5ml of 5% sucrose solution in a test tube and add 2-3 drops of conc. HCl into it. Boil the mixture for about 2 minutes so as to hydrolyse the sucrose into its monomers-glucose and fructose. Cool the contents and keep on

adding sodium carbonate to the test tube pinch by pinch till no bubbles are evolved. This is done to neutralize the contents of the test tube. Divide the contents into two parts and perform Fehling's test with one part and Benedict's test with the other part.

Observation :- Fehling solution given brownish precipitates while Benedict's solution gives yellow-red precipitates.

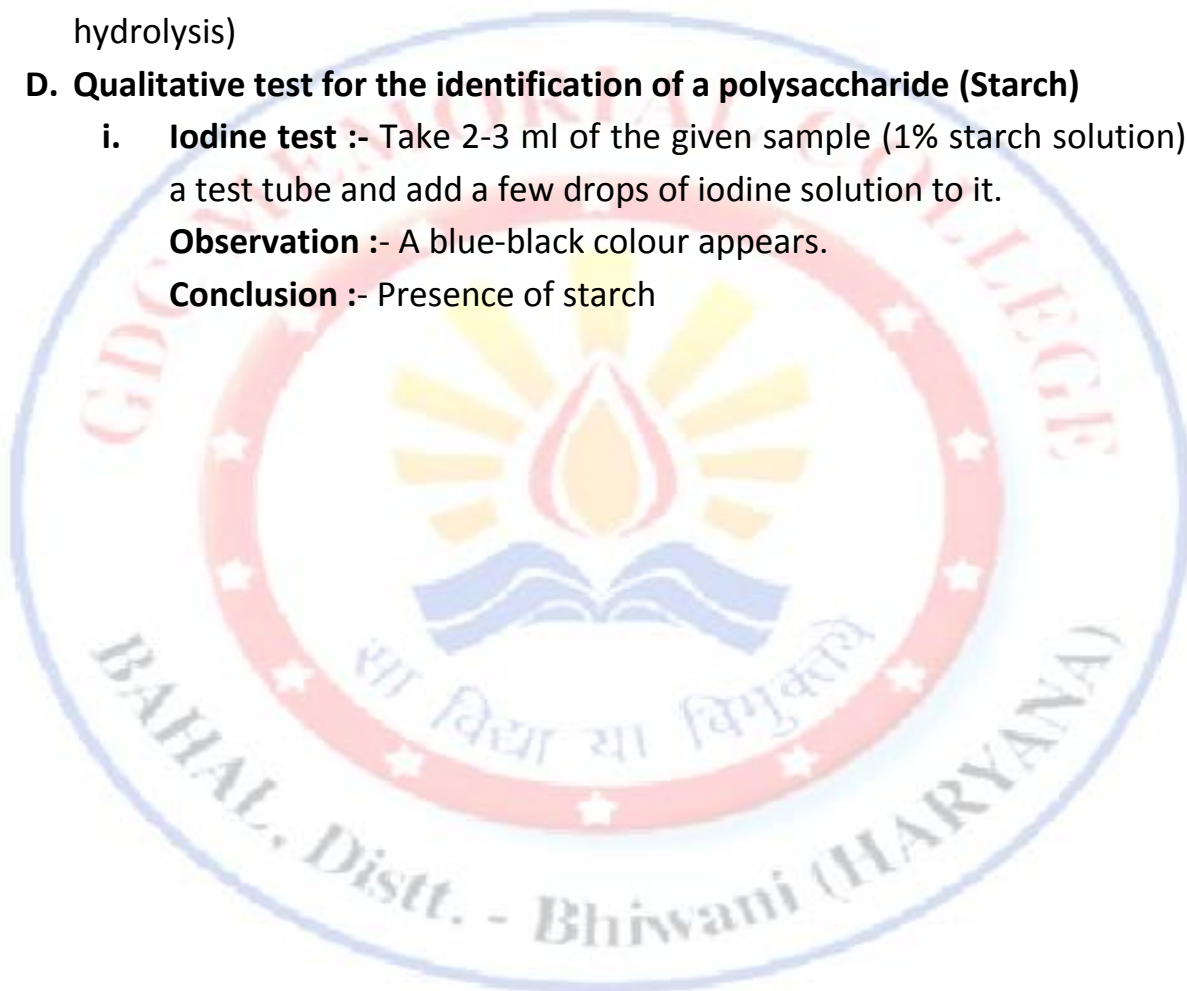
Conclusion :- Sucrose is present (Sucrose given the above test only after hydrolysis)

D. Qualitative test for the identification of a polysaccharide (Starch)

- i. **Iodine test** :- Take 2-3 ml of the given sample (1% starch solution) in a test tube and add a few drops of iodine solution to it.

Observation :- A blue-black colour appears.

Conclusion :- Presence of starch



EXPERIMENT:- 14

AIM:- To study Human salivary amylase activity on starch

Requirements:-

Test tube, test tube stand pipette, water bath, beakers, 1% NaCl solution, 1% starch solution 1% iodine solution, M/115 phosphate buffer, thermometer, rubber band saliva, distilled water, spirit lamp, stopwatch etc.

Procedure:-

Step (a) : Collection of saliva :-

Rinse your mouth with water and chew a piece of clean rubber band for about 10-15 minutes and collect enough saliva in your mouth. Pour the saliva in a clean test tube and filter it through a cotton filter.

Step (b) : Preparation of saliva solution :-

Take 1ml of saliva in a test tube and dilute it 10 times by adding distilled water. Label this tube a saliva solution and keep it in a water bath at 37°C.

Step (c) : Preparation of starch solution :-

Add 1gm of starch in 10 ml distilled water and dissolve. Add 90 ml of hot distilled water (90°C) to it gradually by stirring. Boil it and leave it for overnight. Filter to get 1% starch solution and level this tube.

Step (d) : Preparation of iodine solution :-

Dissolve 1gm iodine crystals and 2.0 gm of potassium iodine in 100 ml of distilled water.

Test for activity of saliva on starch :- Mix approximately equal amounts of saliva solution and 1% starch solution in a test tube and keep it in a water bath at temperature of 37°C. Immediately pipette out 1ml of the mixture into another

test tube and add one drop of iodine solution. Shake it well and note the colour of the mixture. Keep the test tube aside in a test tube stand.

Repeat the test at intervals of 2 minutes placing each tube in the stand after adding iodine solution and observe the colour change..

Observations:-

The colour of the mixture in the first test tube at 0 minute is blue shows the presence of starch. Gradually the intensity of the colour reduces in the subsequent tubes (at different time intervals) and finally no colour appears. This is called achromatic point.

Observation Table:-

Time (minutes)	Observation
0	Blue colour
2	-
4	-
6	-
8	-
10	-

Results:- Saliva contains salivary amylase, a starch splitting enzyme. Starch gives blue colour with iodine. Salivary amylase converts starch into maltose which does not give blue colour with iodine.

Enzyme activity:- Dilution factor x Multiple factor. Where x is the time to reach the achromatic point.

EXPERIMENT – 15

AIM :- To study the effect of temperature and pH on the activity of salivary enzyme.

Requirement :-

Test tube, test tube stand pipette, water bath, beakers, 1% NaCl solution, 1% starch solution 1% iodine solution, M/115 phosphate buffer, thermomcter, rubber badn saliva, distilled water, sprit lamp, stopwatch etc.

Procedure:-

1. For temperature.

- Take 5ml of 1% starch solution in four test tubes marked I, II, III, IV.
- Place test tube I in an ice bath, test tube II at 15°C in an incubator, test tube III at 37°C in a water bath and test tube IV at 50°C in an oven.
- To each of the above test tubes add 1 ml of saliva solution and a drop of 1% iodine solution. Allow each test tube to stand for sometime and observe.

2. For pH.

- Take 5ml 1% starch solution in three test tubes marked A, B and c.
- Add 1ml of NaCl solution in each tube A, B and c. Add 1ml M/15 of buffer solution (pH 6.8) in tube A, 1ml of M/15 buffer solution (pH 5.0) in tube B and 1 ml of M/15 buffer solution (p^h 8.0) in tube C. Keep these three tubes A, B and C in a water bath at 37°Cfor about 10 minutes.
- To each of the above tubes A, B and C add 1ml of saliva solution and a drop of 1% iodine solution. Allow each test tube to stand for sometime and observe.

Observation Table:-

For temperature:-

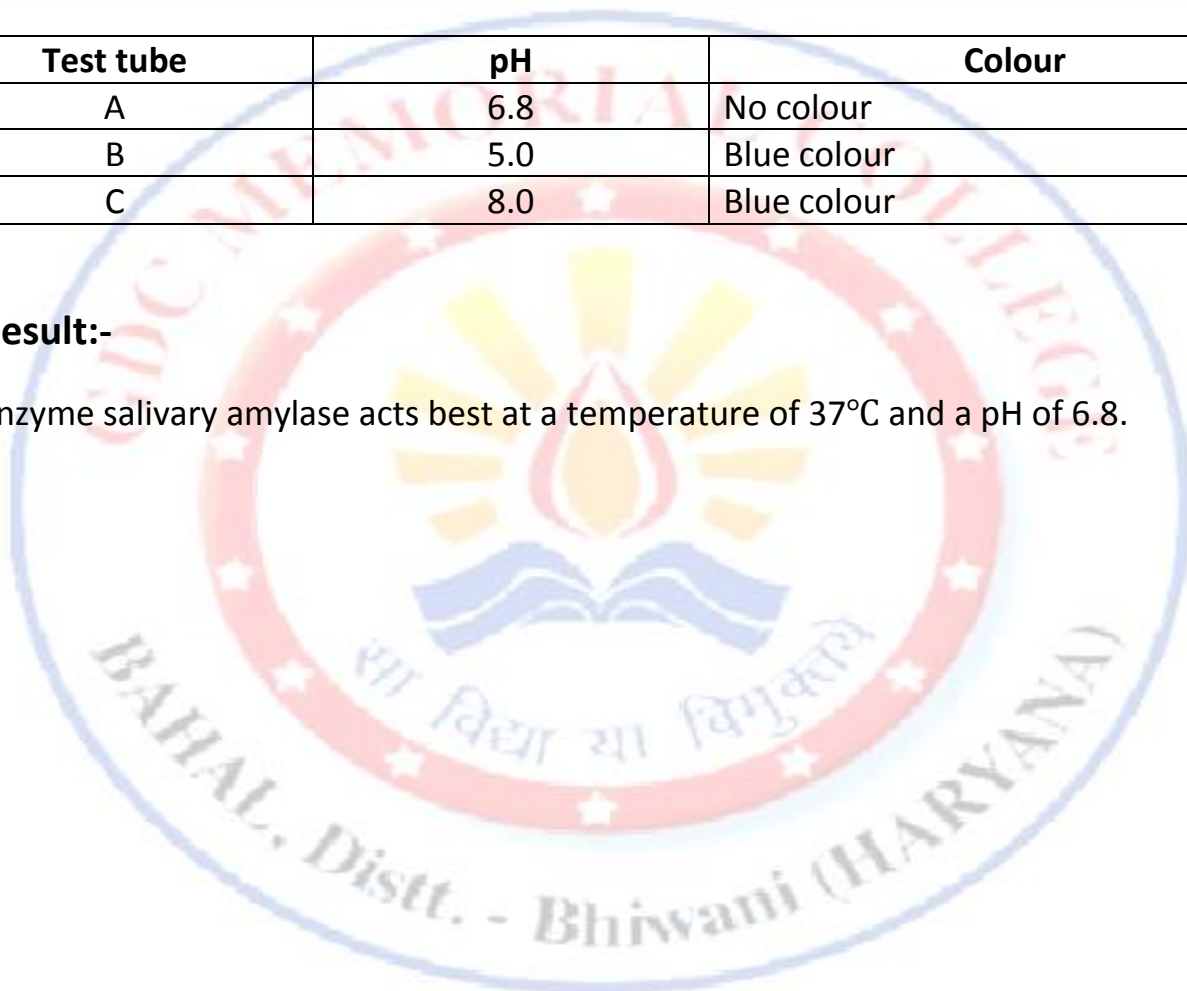
Test Tube No.	Temperature	Colour
I.	0°C	Blue colour
II.	15°C	Blue colour changes slowly
III.	37°C	No colour
IV.	50°C	Blue colour

For pH.

Test tube	pH	Colour
A	6.8	No colour
B	5.0	Blue colour
C	8.0	Blue colour

Result:-

Enzyme salivary amylase acts best at a temperature of 37°C and a pH of 6.8.



EXPERIMENT – 16

AIM:- To detect the abnormal constituents of urine.

Requirements:-

Apparatus used:- Test tube, Test tube stand, test tube holder.

Chemical used:- conc. HNO_3 , acetic acid, ninhydrin solution, urine sample.

Benedict reagent, fehling's reagent, ammonium sulphate, ammonia solution, crystal of nitroprusside.

Procedure:-

1. Test for albumen:-

- i. **Heller's nitric acid ring test:-** Take 5ml of conc. HNO_3 in a test tube and gently add urine from the side of the test tube.

Observation: White ring is formed at the junction of two solution.

Result: Albumen present.

- ii. **Ninhydrin test:-** Take 2ml of urine and add a few drops of 0.1% ninhydrin solution. Boil for a minute and then cool.

Observation: Blue colour appears.

Result : Albumen present.

2. Test for Sugar:-

- i. **Benedict's test :-** Take 5ml of urine in a test tube and add 5ml of Benedict's reagent in it. Boil for about two minutes and allow it to cool.

Observation : A colouration is formed varying from greenish to brick-red.

Result : Sugar present.

3. Test for ketone bodies:-

- i. **Nitroprusside test:-** Take 2ml of urine in the test tube and saturate it with ammonium sulphate. Add a few drops of ammonia solution. Now add a few crystals of sodium nitroprusside and shake well.

Observation: Red purple colour appears

EXPERIMENT – 17

AIM:- To prepare haematein crystals.

Requirements:-

Apparatus used: -Sterillized needle, rectified spirit, cotton, spirit lamp, galss slide, blade, cover slip, microscope, etc.

Chemical used: - glacial acetic acid, common table salt

Procedure:-

1. Clean your middle finger with rectified spirit and allow it to dry in the air.
2. Prick this sterilized finger with the help of a sterilized needle.
3. Put two or three drops of the blood on a clean and clear glass slide.
4. Let the blood to dry completely.
5. Scratch the dried blood on the slide with the help of the blade.
6. Put a drop of glacial acetic acid and a pinch of common table salt on the above slide and cover it with the help of a cover slip.
7. Slightly heat the slide over the spirit lamp.
8. Cool the slide and observe it under the microscope.

Observation:-

Haemin crystals are seen in large number.

EXPERIMENT – 18

AIM:- To find out the haemoglobin (HB) percentage of your own blood.

Requirements:-

Haldence's haemoglobinometer, 0.1 N HCl (1.2 ml of conc. HCl made upto 100ml with distilled water), distilled water, sterilized needle, rectified spirit, etc.

Procedure:-

1. Rinse the graduated tube of haemoglobinometer with distilled water and then with 90% alcohol. Dry the tube well before use.
2. Take 0.1 N HCl in the graduated tube upto 2g mark.
3. Sterilize your third finger with the help of rectified spirit and let it dry.
4. Prick this sterilized finger with a sterilized needle.
5. Wipe off the first drop of blood and then suck the micropipette by fresh blood upto the mark of 20 mm.
6. Wipe off the small amount of blood adhering to the outside of the micropipette by cotton or filter paper.
7. Transfer the blood from the micropipette to the graduated tube containing 0.1 N HCl (N/10 HCl). Introduce the pipette carefully into the tube and allow the tip of the pipette to reach the bottom of the tube into the HCl solution. Blow into the opening of the rubber tubing to transfer the blood.
8. After the blood has been expelled out into the tube rinse the pipette in distilled water and transfer the contents into the graduated tube.
9. Stir the acid haematin content in the graduated tube thoroughly with the help of a glass rod and then allow it to stand for at least 10 minutes.
10. Now dilute the contents of the graduated tube gradually by adding distilled water drop by drop. After the addition of each drop of distilled water stir the solution with the glass rod and match the colour with that of the solution in the standard scaled tubes. Continue this step until the colour of the acid haematin solution in the graduated tube exactly matches with that of the

solution in the standard tubes and becomes lighter by addition of just one drop of distilled water.

11. The reading on the graduated tube just before the colour fades away is taken as the correct and final reading.

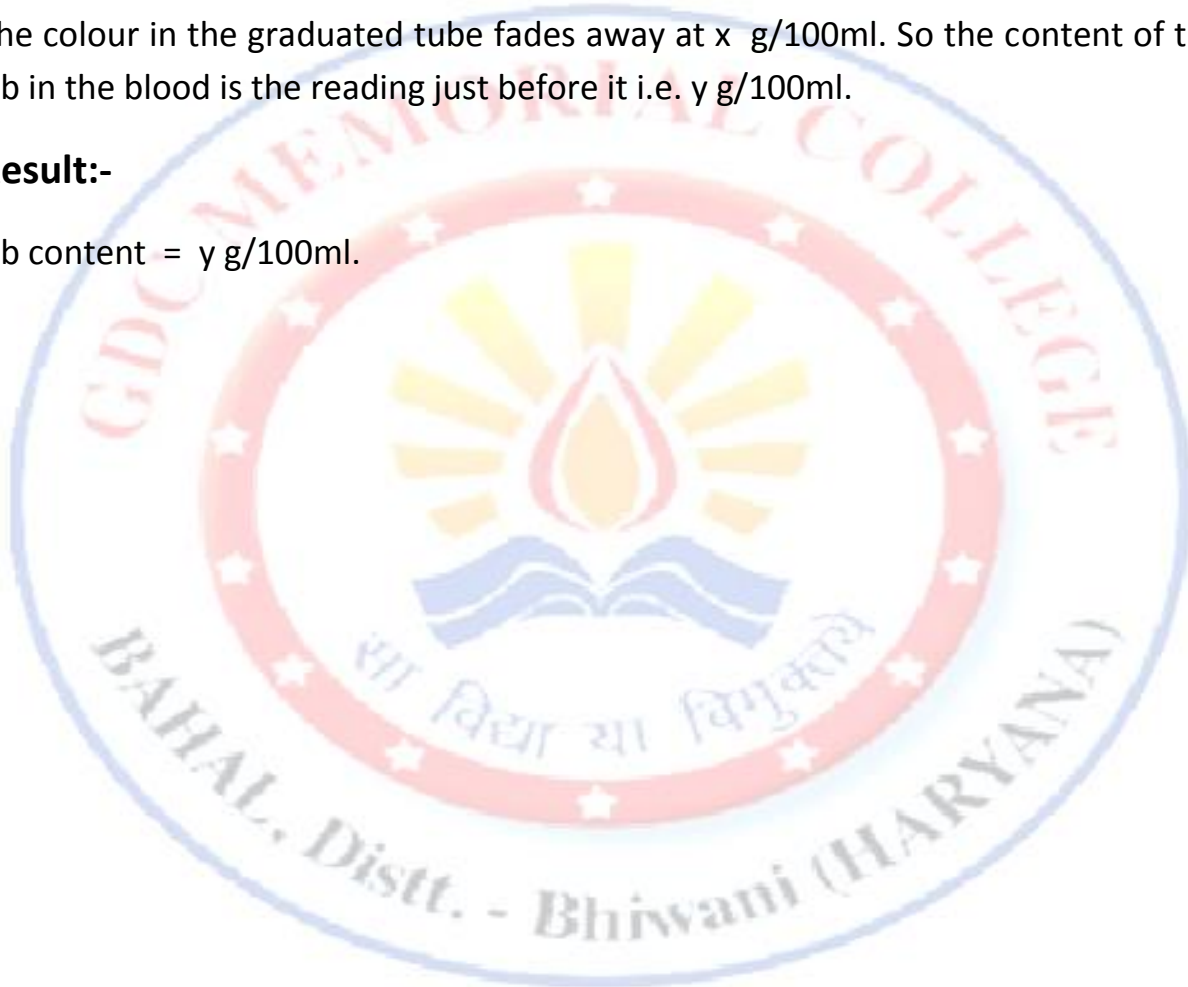
This reading is the amount of haemoglobin in gram per 100 ml of blood.

Observation:-

The colour in the graduated tube fades away at x g/100ml. So the content of the Hb in the blood is the reading just before it i.e. y g/100ml.

Result:-

Hb content = y g/100ml.



EXPERIMENT – 19

AIM:- To calculate the RBCS count of your own blood.

Requirements:-

Haemocytometer, Hayem's solution (RBC fluid), microscope, rectified spirit, sterilized needle, cotton, distilled water, filter paper etc.

Haemocytometer:-

The apparatus used for counting of blood cells is called haemocytometer. It consists of a counting slide, a cover slip and pipettes.

Counting slide:-

Counting slide bears two counting chambers. Each counting chamber has a stage on which are ruled two sets of fine lines at right angles to each other. The whole ruled area occupies 1sq. mm consists of 25 large (0.04 sq. mm) and 400 small squares (0.0025 sq. mm). On each side of the counting chamber is a ridge of glass 0.1 mm high. When a cover slip is placed on the two ridges covering the counting chamber a cubic space is enclosed. Each of the smallest cuboid has a volume of 0.00035 c. mm. The volume of the entire ruled counting chamber is 0.1 cmm.

Pipettes:-

There are two pipettes. One pipette with a red bead in the bulb of the pipette and is used for drawing blood for the counting of red blood cells. The other pipette with a white bead in it is used, for drawing the blood for the counting of WBCs.

Procedure:-

1. Clean and dry the haemocytometer (counting slide, RBC's pipette and the cover slip).
2. Place the cover slip on the counting slide.

3. Sterilize your middle or third finger with the help of rectified spirit and let it dry.
4. Prick the sterilize finger with a sterilize needle.
5. Wipe off the first drop of blood and then using the RBC pipette suck the blood accurately upto 0.5 mark. Wipe the excess of blood from the tip of the pipette.
6. Now draw, carefully into this pipette Hayem's solution upto 101 mark. Hold the pipette horizontally and rotate many times so that the blood thoroughly gets mixed with Hayems fluid.
7. Discard the first 3 or 4 drops of the diluted blood from the pipette by releasing your hand from the tube.
8. Aply the tip of the pipette between the cover slip and the plateform and allow a few drops of the blood mixture to flow in the narrow space between the cover slip and the counting chamber.
9. Keep aside the counting slide for a few minutes so that Red blood cells settle down to the bottom of the counting chamber.
10. Place the counting slide gently and carefully under the microscope for the purpose of counting.
11. Count the red blood cells in 80 small squares or 5 large squares randomly. The red blood cells lying on the middle of the line of square to your side or to the right also to be counted in the total, while those lying on the upper and left side of the line of square are not to be counted.

Observation:-

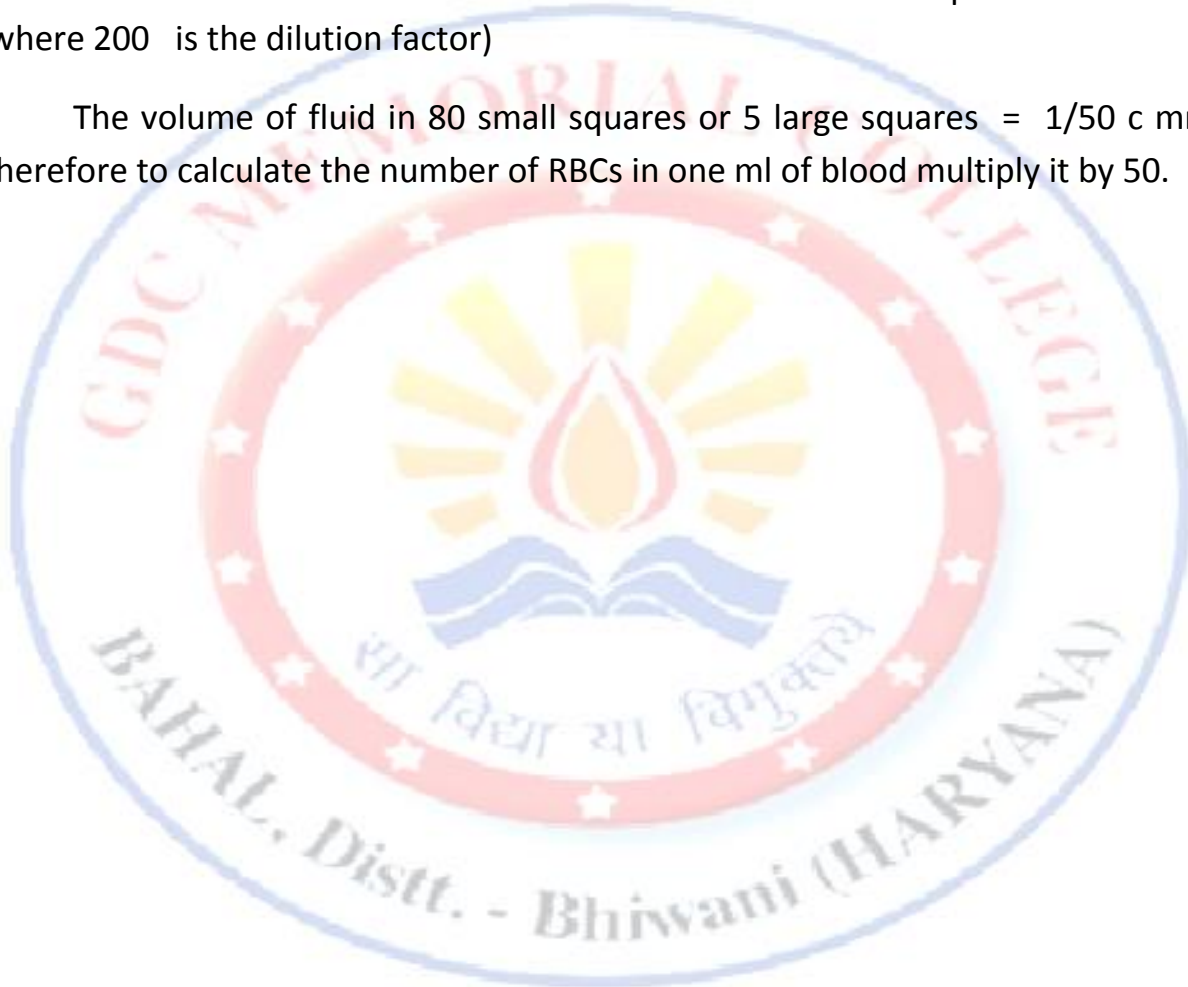
No. of Squares	No. of RBCs
1	
2	

3	
4	
5	

Total RBC's counted =

Calculation : Number of red blood cells counted in 80 small squares $\times 200 \times 50$
(where 200 is the dilution factor)

The volume of fluid in 80 small squares or 5 large squares = $1/50$ c mm.
Therefore to calculate the number of RBCs in one ml of blood multiply it by 50.



EXPERIMENT – 20

AIM:- Estimation of white blood cells in the blood (total leucocyte count TLC)

Requirements:-

Haemocytometer, Thoma's fluid (W.B.C. fluid), distilled water, rectified spirit, spirit lamp, cotton, sterilized needle, etc.

Principle:-

WBCs are counted in the four corners of 1 square millimeter in the central ruled area on both the sides of the counting chamber of the haemocytometer. The WBCs are recognized by the refractile appearance and by the slight violet colour. The cells touching the boundary lines are not to be counted.

Procedure:-

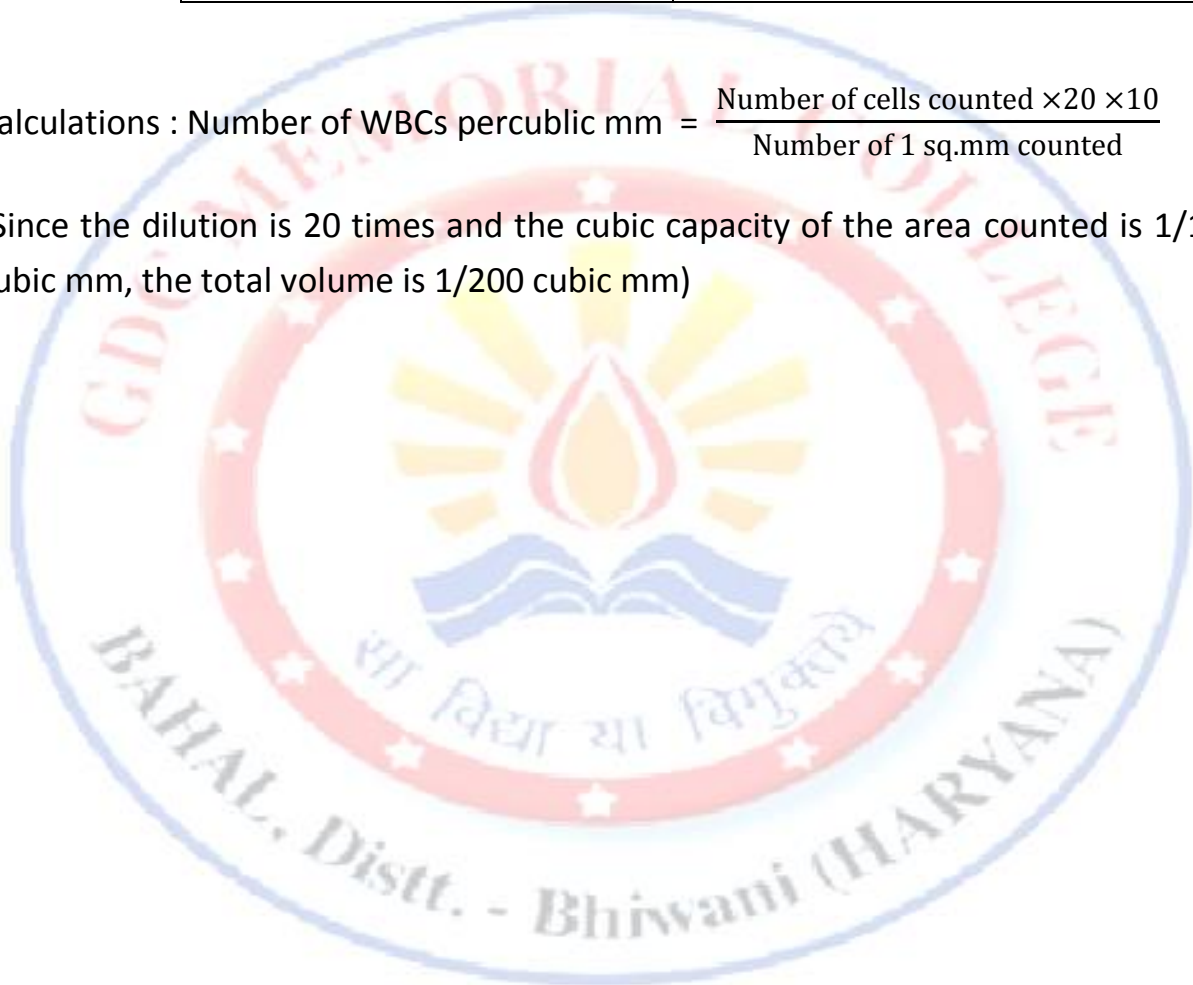
1. Clean and dry the haemocytometer and place the cover slip on it.
2. Sterilize the tip of your middle finger or third finger with the help of sterilize cotton and let it dry.
3. Prick the sterilize finger with the help of the sterilized needle.
4. Wipe off the first drop of blood and suck the blood in the WBC pipette upto 0.5 mark and immediately dilute the blood with Thomas fluid (WBC fluid) by sucking upto 11 mark.
5. Rotate the pipette slowly so as to mix the blood with the diluting solution.
6. Discard the first 3 or 4 drops of the diluted blood from the pipette.
7. Apply the tip of the pipette between the cover slip the platform and allow a few drops of the blood mixture to flow in the narrow space between the cover slip and the counting chamber.
8. Keep aside the counting slide for few minutes so that WBC's settle down.
9. Place the counting slide gently and carefully under the microscope for counting.
10. Count the number of WBC's in the four corners.

Observation:-

No. of Squares	No. of WBC's
1	
2	
3	
4	
5	

Calculations : Number of WBCs per cubic mm = $\frac{\text{Number of cells counted} \times 20 \times 10}{\text{Number of 1 sq.mm counted}}$

(Since the dilution is 20 times and the cubic capacity of the area counted is 1/10 cubic mm, the total volume is 1/200 cubic mm)



EXPERIMENT – 21

AIM:- To show the use of respirometer.

Requirements:-

Two 4 OZ. bottle, two one holed rubber stoppers, two 2ml graduated pipettes, filter papers small piece of wire gauze (about 1" square), 15% KOH solution, live cockroaches.

Procedures:-

1. Fit the 4 OZ bottle with one holed rubber stopper.
2. Insert a 2ml graduated pipette through the hole in such a way that only 1/4 or 1/5 of the pipette is inside the bottle and rest is projecting out.
3. Take filter paper bits and soak them in 15% KOH solution. After soaking wrap a small piece of wire gauze around them and place at the bottom of the bottle.
4. Weigh a cockroach and put in into the respirometer and close tightly.
5. Similarly prepare a control respirometer without the cockroach.
6. Take a tray containing water and place both of the respirometers into it in such a way that the open end of the pipette of each respirometer remain outside the water. Keep them as such for fifteen minutes. After this open the respirometers into the water.

Observations:-

Observe the slow entry of H_2O into the graduated tube as the insect consumed O_2 and released CO_2 . This released CO_2 is absorbed by the KOH. Record the volume of H_2O that has entered into the pipette after one hour. This represents the amount (volume) of O_2 consumed by the cockroach in milliliters or cubic centimeters in one hour.

Results:-

Volume of O₂ consumed by the insect = volume recorded in the experimental respirometer \pm volume recorded in the control respirometer.

The rate of O₂ consumed per gm. Weight of the body of the

Cockroach per unit time = $\frac{\text{Weight of O}_2 \text{ consumed in one hour}}{\text{Weight of the insect}}$



EXPERIMENT – 22

AIM:- To study the skeleton of Scoliodon.

Skeleton of scoliodon is formed entirely of cartilage. Skull is formed of three parts : Cranium, sense capsules and visceral arches.

A. Cranium:

- It is an oblong box with an arched roof and a flat floor.
- It is divided into four regions which beginning from behind are occipital, auditory, orbital and ethmoidal.

B. Sense capsules:

- **Auditory capsules:** Lie on the side of the posterior part of the cranium.
- **Orbits:** Lie on the sides of the middle part of the cranium.
- **Olfactory capsules:** Lie at the anterior end of the cranium.

C. Visceral Arches:

- The first visceral arch forms the jaw and is called the mandibular arch.
- The second arch is called hyoid arch. This arch suspends the jaw from the cranium.
- The remaining five visceral arches called the branchial arches support the pharyngeal wall and the gills.

Vertebral column

Vertebral column is made up of 130 vertebrae and divided into two regions:- trunk region and caudal region.

A. Trunk vertebrae:

- A trunk vertebra is ring-like with opening of the ring called neural canal.
- The floor of the neural canal (base of the ring) is thick and disc-like and is called the body or centrum.

B. Caudal vertebrae:

- Have long backwardly directed neural spines.
- Their transverse processes extend downward and inward, meet in the middle line to form the haemal arch. The space enclosed between the haemal arch and the centrum is called haemal canal.

Pectoral girdles and fins

A. Pectoral Girdle:

- Each pectoral girdle is U-shaped and consists of two half hoops which meet. Midventrally.
- Each half hoop consists of two parts : a flat ventral coracoids, and a thick rod-like arched dorsal scapula.

B. Pectoral fin:

- Each pectoral fin is supported by three sets of elements : basal cartilages, radial cartilages and fin rays.
- There are three basal cartiges : propterygium, mesopterygium and metapterygium. These cartilages articulate with the triplet facet or glenoid surface of the pectoral girdle.

Pelvic girdle and fins

A. Pelvic girdle:

- Each pelvic girdle is made of a single cartilage called ischiopubis bar.
- This bar is straight in the middle but bent at the ends which are produced dorsolaterally into short, blunt iliac processes.

B. Pelvic fin:

- Each pelvic fin is supported by three sets of elements : basal cartilage, radial cartilages and fin rays.
- Basal cartilage is a long, stout rod called the basipterygium.

EXPERIMENT – 23

AIM:- To study the skeleton of Labeo.

Skull

Skull is formed of three main regions : cranium, sense capsules and visceral arches.

A. Cranium:

- It is the posterior median hollow part of the skull and comprises three segments : occipital region, parietal region and frontal region.

B. Sense capsules:

- **Auditory capsules:-** Lie on the hinder part of the cranium.
- **Orbits:-** These are triangular cavities on the sides of the anterior part of the skull.
- **Olfactory capsules:-** Formed of nine bones : Mesethmoid, rostral, a pair of nasals, a pair of ectoethmoids, a pair of lacrymals and a vomer.

C. Visceral arches:

- These are seven in number.
- Each consisting of two similar half hoops united in the midventral line.

Vertebral column

Labeo has 37 or 38 fully ossified amphicoelous vertebrae.

A. Trunk Vertebrae:

- Vertebrae from 5th to 17th or 18th are alike are called typical vertebrae.
- The first four and the last three or four vertebrae are modified.

B. Caudal Vertebrae:

- These are 16 or 17 in number.

- A typical caudal vertebra is basically has the same structure as the trunk vertebra but lack structures for ribs articulation.

Pectoral Girdle

A. Primary part:

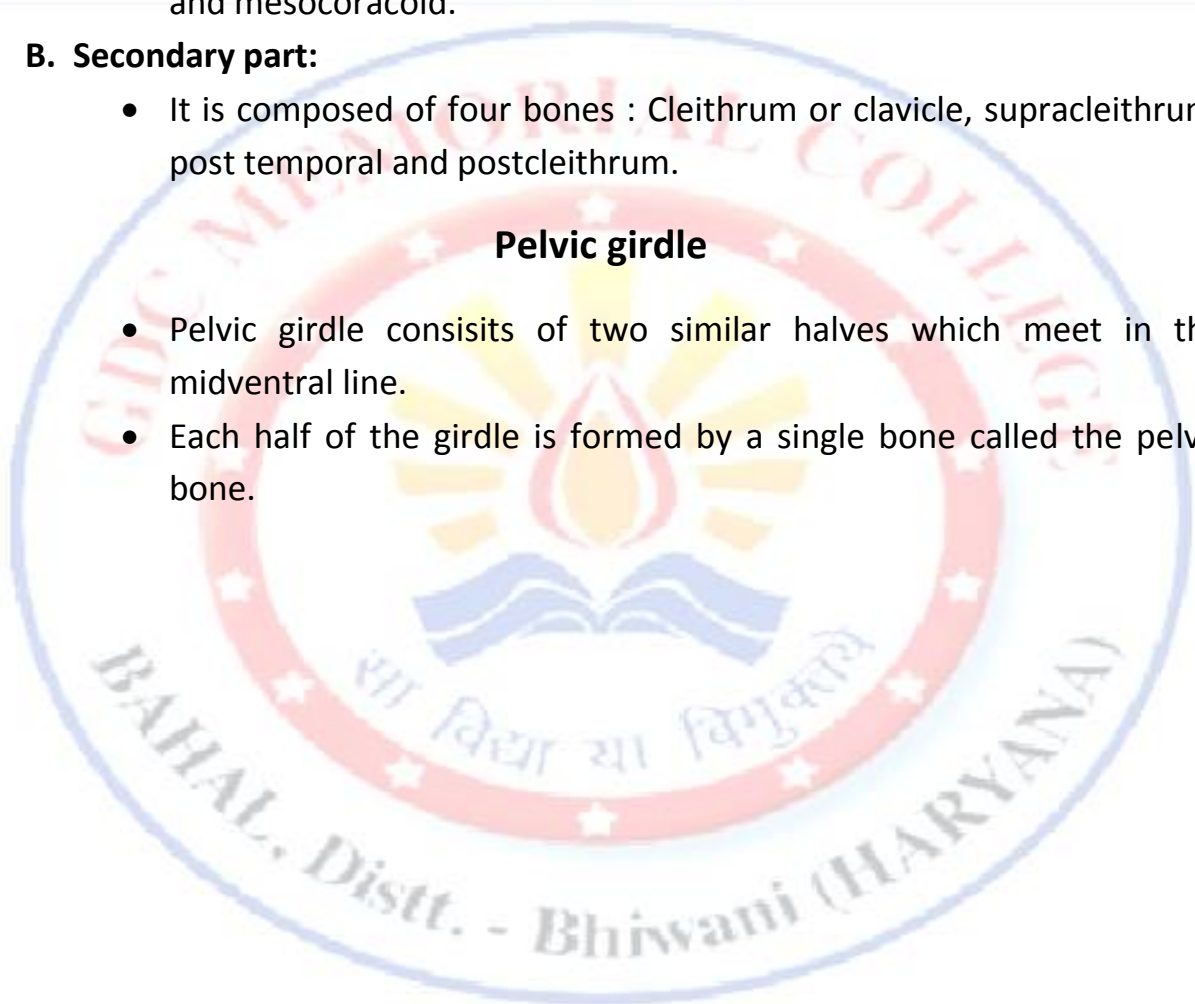
- It is highly reduced and is formed of three bones : scapula, coracoids and mesocoracoid.

B. Secondary part:

- It is composed of four bones : Cleithrum or clavicle, supracleithrum, post temporal and postcleithrum.

Pelvic girdle

- Pelvic girdle consists of two similar halves which meet in the midventral line.
- Each half of the girdle is formed by a single bone called the pelvic bone.



EXPERIMENT – 24

AIM:- To study the skeleton of Frog.

Skull

In frog skull is triangular in shape, broad and dorso-ventrally flattened.

A. Cranium:-

- Forms the middle hollow part of the skull.
- It encloses a cavity the crania cavity.

B. Sense capsules:-

- **Auditory capsules:-** They enclose the internal ears and lie at the side of the posterior end of the cranium.
- **Olfactory capsules:-** They enclose organs of smell.
- **Orbits:-** The rabbits are dorsally placed and optic capsule is not fused with the skull.

C. Upper Jaw:-

- Each half of the upper jaw is formed by premaxilla, maxilla and quadratojugal bones on the outer side.

D. Lower Jaw:-

- It is semi-oval in outline and devoid of teeth.
- Each half of the lower jaw consists of a core of Meckel's cartilage surrounded by three bones : Metomeckelian, angulosplenic and dentary.

Vertebral column

A. Typical Vertebrae (2nd to 7th) :-

- Each has ring-like form with a large passage called neural canal.
- The centrum is procoelus (it anterior side is concave and posterior face is convex).

B. Atlas Vertebra (The First Vertebra) :-

- This vertebra is simply in the form of a bony ring with reduced centrum and neural spine.
- C. Eighth Vertebra:-** This vertebra resembles a typical vertebra very much except its centrum which is amphicoelous (both faces concave).
- D. Ninth Vertebra:-** This is also known as sacral vertebra.
- E. Urostyle:-** It is the posterior unsegmented part of the vertebral column and represents the fused tail vertebrae of the tadpole.

Pectoral girdle and sternum

A. Sternum:-

- It lies midventrally intimately connected between the two halves of the pectoral girdles.
- It is consisting of four parts : episternum, omosternum, mesosternum and Xiphisternum.

B. Pectoral Girdle:-

- Each half of the pectoral girdle is made up of four bones : supra scapula, scapula, coracoids and clavicle bones.

Pelvic Girdle

- Each half of the pelvic girdle is called innominatum and comprises : ilium, ischium and pubis.
- Ilium is a compressed bony rod. The two ilia meet posteriorly at an iliac symphysis.

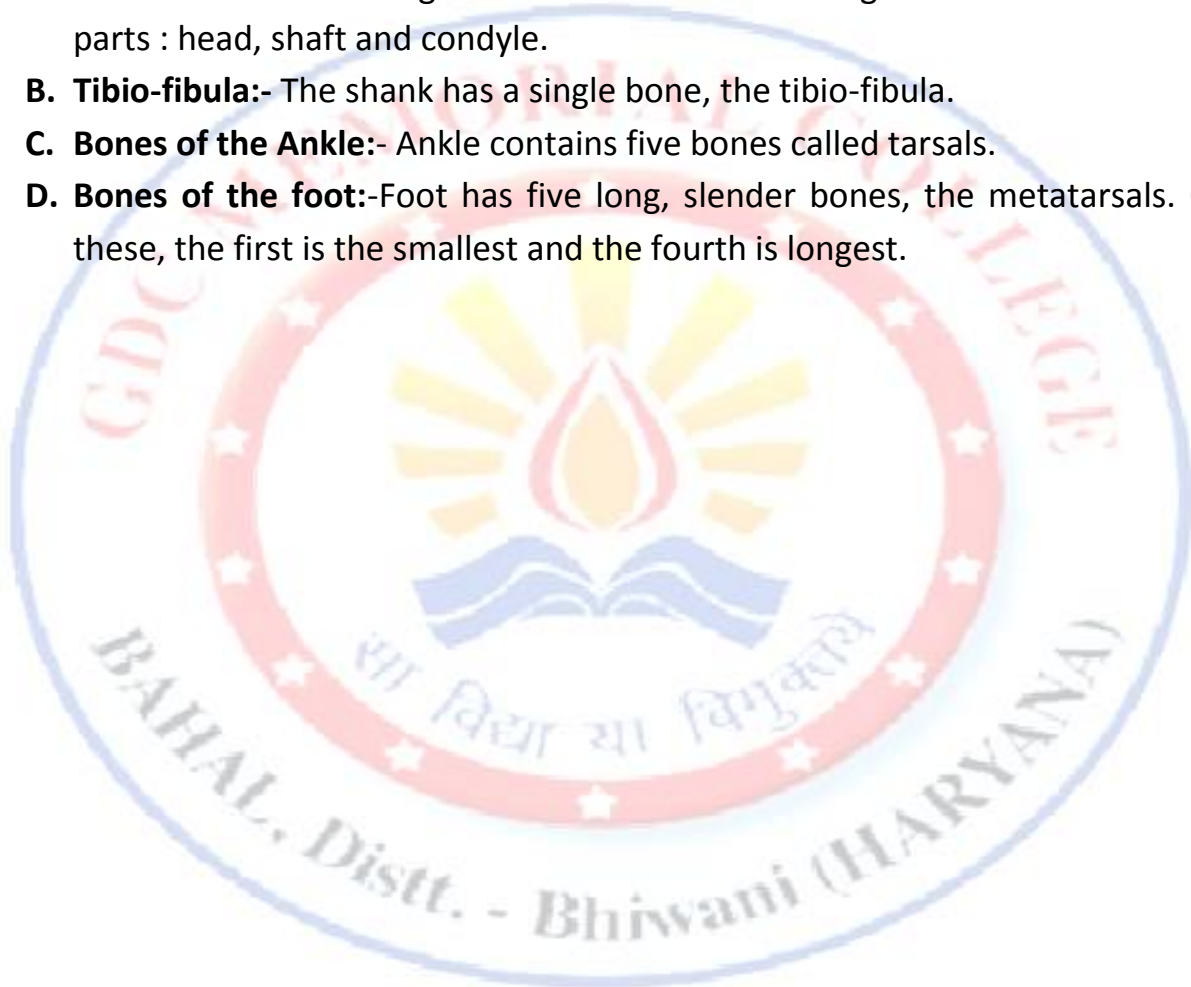
Bones of the forelimb

- A. Humerus:-** Humerus is a short cylindrical bone of the upper arm of forelimb.
- B. Radio-Ulna:-** It is the composed bone of the fore-arm, formed by the fusion of two bones : radius and ulna.
- C. Bones of the hand:-**
- Bones of the wrists are called carpals. Carpals are six in number and are arranged in two rows.

- The palm has five slender rod-like bones, the metacarpals, the first one is rudimentary.
- The digits has short rod-like bones called phalanges. Phalanges formula is 02233.

Bones of the hind limb

- A. Femur:-** Femur is a long and slender bone of the thigh and consists of three parts : head, shaft and condyle.
- B. Tibio-fibula:-** The shank has a single bone, the tibio-fibula.
- C. Bones of the Ankle:-** Ankle contains five bones called tarsals.
- D. Bones of the foot:-**Foot has five long, slender bones, the metatarsals. Of these, the first is the smallest and the fourth is longest.



EXPERIMENT – 25

AIM:- To study the skeleton of Varanus.

Skull

Skull of varanus is fully ossified and is divided into four main regions : cranium, sense capsules, jaws and hyoid apparatus.

A. Cranium:-

- Forms the median hollow part of the skull.
- It is formed of nine bones and is divided into three regions : occipital region, parietal region and frontal region.

B. Sense capsules:-

- **Auditory capsules:-** Enclose internal ears and lie on the sides of the posterior end of the cranium.
- **Optic capsules or orbits:-** They enclose eyes and are separated from each other by a thin, longitudinal, vertical partition, the interorbital septum.
- **Olfactory capsules:-** They contain organs of smell and lie side by side in front of the cranium.

C. Upper jaw:-

- Upper jaw is semi oval in outline and consists of two similar halves or rami.
- Each ramus consists of nine bones, divisible into two sets : the outer and the inner.

D. Lower Jaw:-

- It is semi oval and consists of two similar halves or rami.
- Each ramus is formed of six bones : dentary, suprangular, angular, articular, coronoid and splenial.

Vertebral column

A. Cervical Vertebrae:-

- **Typical cervical vertebra:-** It is more or less ring-like with a cavity called neural canal.
- **First cervical vertebra (Atlas Vertebra):-** It consists of three distinct bony pieces : a small median ventral piece and two larger dorsolateral pieces.
- **Second Cervical Vertebra (Axis Vertebra):-** Anteriorly its centrum bears a broad odontoid process.
- **Third Cervical Vertebra:-** It is similar to the typical cervical but lacks the capitular facets.

B. Thoracolumbar Vertebrae:-

- They lack transverse processes.
- They are comparatively stout.

C. Sacral Vertebrae:-

- These are two sacral vertebrae and both are firmly united.
- Have small neural spines.

D. Caudal Vertebrae:-

- These are numerous and become gradually reduced in size backwards.
- Anterior caudal vertebrae have a long centrum, slender transverse processes, and a long narrow neural spine and Y-shaped chevron bone. The space enclosed between the centrum and the chevron bone is called the haemal canal.

Sternum and ribs

A. Sternum:-

- Sternum also called breast bone and is a thin, flat, rhomboidal plate.
- It has narrow coracoids grooves along its anterolateral margins.

B. Ribs:-

- Ribs are slender, curved rods with the head at their dorsal end.
- Cervical ribs are short and do not reach the sterum.

Pectoral girdle

- It consists of two similar halves.
- Each half of pectoral girdle is consisting of bones : Coracoid, epicoracoid, scapula and suprascapula, interclavicles and clavicle.

Pelvic girdle

- It consists of two similar halves. Each half is called the Osinnomatum.
- Each half consists of three bones: ilium, pubis and ischium.

Bones of forelimb

A. Humerous:-

- Humerous is the bone of upper arms.

B. Radius and ulna:-

- Radius is a slender bone on the inner side and consists of a long shaft and a small epiphysis at either end.
- Ulna is a stout bone on the outer side and consists of a long shaft and a small epiphysis at either end.

C. Bones of the hand:-

- Wrist is formed by 10 carpals arranged in three rows.
- Palm contains five slender bones, the metacarpals.
- Fingers contain small bones, the phalanges. Phalanges formula is 2,3,4,5,3.

Bones of hind limb

A. Femur:-

- Femur is the bone of thigh and is differentiated into three parts : head, shaft and condyles.

B. Tibia and Fibula:-

- These are the bones of the shank.
- Each tibia and fibula consists of a long shaft with the small epiphysis at either ends.

C. Bones of the foot:-

- Ankle contains five small bones, tarsals arranged in two rows.
- Instep contains five slender bones, the metatarsals.



EXPERIMENT – 26

AIM:- To study the skeleton of Fowl.

Skull

It is very light due to pneumatic bones.

A. Cranium:-

- Cranium is large and rounded to accommodate well developed brain and forms the posterior median hollow part of the skull.
- Cranium comprises three segments : occipital, parietal and frontal.

B. Sense Capsules:-

- **Auditory capsules:-** They enclose internal ears.
- **Optic capsules:-** Large eye orbits are separated from one another by a narrow longitudinal interorbital partition formed by mesethmoid together with presphenoid and orbitosphenoid.
- **Olfactory capsules:-** Lie side by side in front of the cranium.

C. Upper Jaw:- A toothless beak is formed by the jaw bones.

D. Lower Jaw:- Each half of the lower jaw, called ramus is made up of five bones, articular, angular, supra-angular, sphenoid and dentary.

Vertebral column

A. Cervical Vertebrae:-

- Fowl has 14-16 cervical vertebrae.
- Cervical vertebrae consists of Atlas vertebra, Axis vertebra, Typical vertebrae (3-10), posterior cervical vertebrae.

B. Thoracic Vertebrae:-

- These are seven in number.
- Second to fifth thoracic vertebrae are fused together into a common mass.

C. Synsacrum:-

- 16 vertebrae are fused to form a rigid girder, the synsacrum to support the pelvic region.

D. Caudal region:- It is short and includes 4 or 5 free vertebrae and a pygostyle.

Sternum & Ribs

- Sternum in Fowl is a broad plate, concave dorsally from side to side and is produced anteriorly into an anteroposterior keel or carina.
- Seven pairs of ribs are present in Fowl.
- Each rib consists of two distinct portions : Vertebral and sterna.

Pectoral girdle & Pelvic girdle

- Pectoral girdle consists of two similar halves joined in the midventral line. Each half is formed of three bones : scapula, coracoids and clavicle.
- Pelvic girdle consists of two similar halves and each half is formed of three bones : ilium, ischium and pubis.

Bones of the forelimb

- A. Humerus:-** It is the bone of upper arm.
- B. Radius and Ulna:-** Radius and ulna are the bones of the forearm.
- C. Carpals:-** These are the two small bones of the wrist.
- D. Carpometacarpus:-** Palm contains carpometacarpus, a characteristic of the avian hand. It is formed by the fusion of three distal carpals and three (1-3) metacarpals. The three metacarpals are clearly distinguishable.
- E. Phalanges:-** These are the small bones of the fingers.

Bones of the hindlimb

- A. Femur:-**
 - It is the bone of thigh and is a cylindrical, stout and slightly curved bone with flattened ends.
 - It is differentiated into three parts : head, shaft and condyles.
- B. Tibiotarsus and fibula:-**

- **Tibiotarsus:-** These are the bones of shank region.
- **Fibula:-** It is a small slender bone found attached to the outer surface of tibiotarsus.

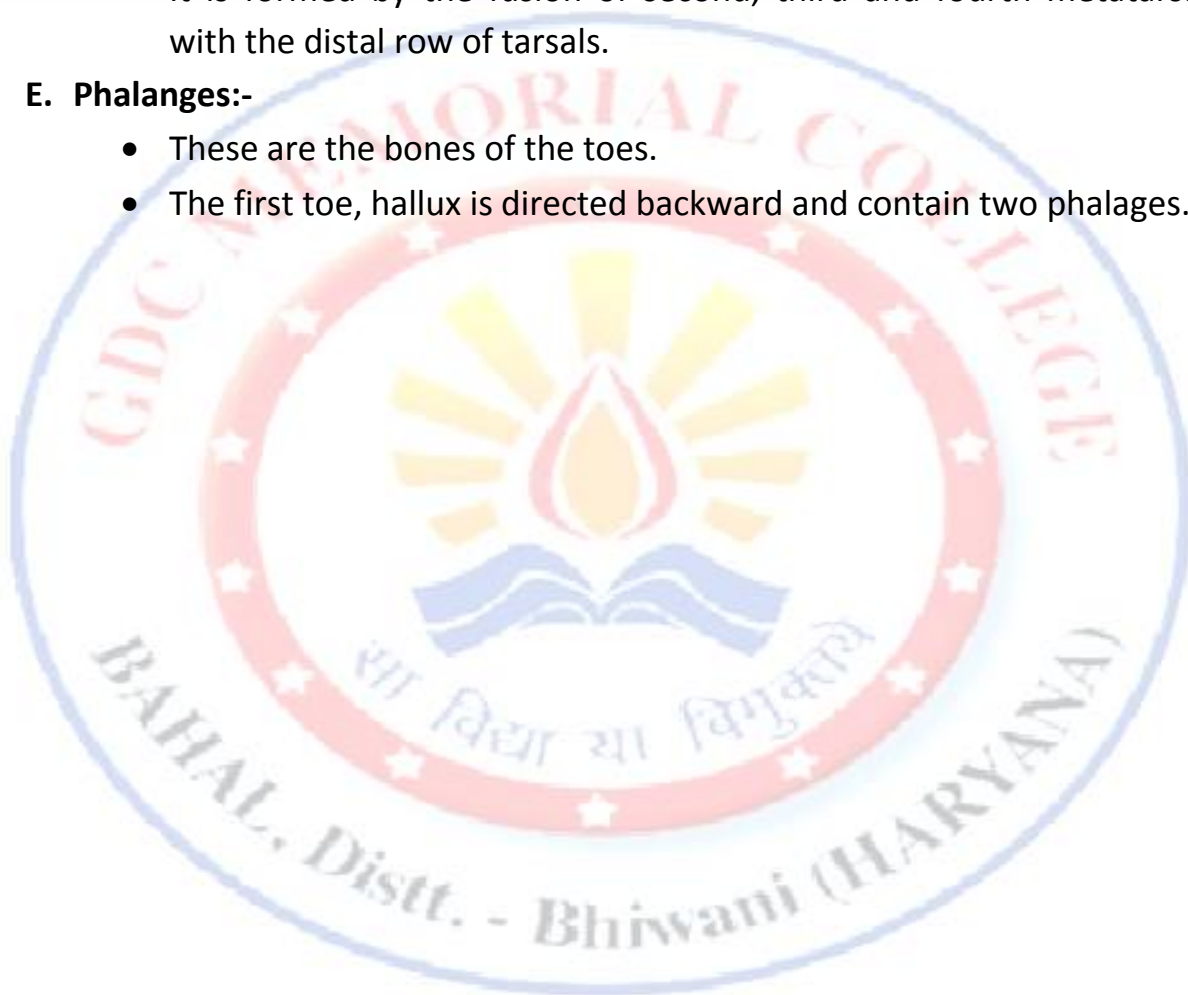
C. Tarsals:- No free tarsals are present in the fowl.

D. Tarsometatarsus:-

- Foot contains a long, stout, straight bone, the tarsometatarsus.
- It is formed by the fusion of second, third and fourth metatarsals with the distal row of tarsals.

E. Phalanges:-

- These are the bones of the toes.
- The first toe, hallux is directed backward and contain two phalanges.



EXPERIMENT – 27

AIM:- To study the skeleton of Rabbit.

A. Cranium:-

- **Occipital segment:-** Has a wide aperture, the foramen magnum, on the posterior side.
- **Parietal segment:-** It is composed of six bones : two partial, one interparietal, two alishphenoids and a basis-phenoid.
- **Frontal segment:-** It comprises five bones : two frontals, two orbitosphenoids and a presphenoid.

B. Sense capsules:-

- **Auditory Capsules:-** Situated on the sides of the cranium between the occipital and parietal segments.
- **Olfactory Capsules:-** Lie side by side in front of the cranium.
- **Optic Capsules (orbits):-** These are two large sockets on the sides of the frontal segment.

C. Upper Jaw:-

- Fused with the cranium.
- Consists of two halves and each half is formed of six bones : premaxilla, maxilla, jugal, palatine, pterygoid and squamosal.
- **Lower Jaw:-** Consists of two halves or rami and each ramus is formed of a single bone called the dentary.

Vertebral column

A. Cervical vertebrae:-

- **Atlas Vertebra (1st Cervical Vertebra):-** It is ring-like in form
- **Axis Vertebra (2nd Cervical Vertebra):-** Centrum well developed and bears a peg-like odontoid process.
- **Typical Cervical Vertebrae (3rd to 7th Cervical Vertebrae):-** Neural spine is much longer, centrum bears at its posterior end a pair of half facets.

B. Thoracic Vertebrae:-

- **Typical thoracic Vertebrae:-** Centrum on anterior and posterior faces bear half facets. Half facets of the preceding and succeeding centra together form capitular facets.
- **Other thoracic Vertebrae:-** Bear capitular facets on the anterior surface of the centra only.

C. Lumber Vertebrae:-

- Centrum of first two or three lumbar vertebrae bear hypapophysis.
- Neural spines are large and extend forward.

D. Sacral Vertebrae:-

- Centrum is wide laterally.
- Neural spine is long and vertical.

E. Caudal Vertebrae:-

- Gradually decrease in size and lose their processes from before backward.
- Neural arch is short, neural spines are directed backward.

Sternum and ribs

A. Sternum:-

- It is long, slender rod consisting of seven bony pieces called sternebrae.
- The first sternebra is largest and is called manubrium.

B. Ribs:-

- There are twelve pairs of slender, curved bars which movably articulate with the thoracic vertebrae dorsally and unite with the sternum ventrally.
- First pair of ribs are shortest, increase in length upto 6th and then again decrease.

Pectoral girdle

A. Scapula:-

- It is a large, thin, flat, triangular bone having a shallow pit, the glenoid cavity at its apex.

- Its inner (ventral) surface is smooth and slightly concave.
- B. Suprascapula:-** It is a thin strip of cartilage along the base or upper margin of the scapula.
- C. Coracoid process:-** It is an inwardly curved, small hook-like projection in front of the glenoid cavity.

Pelvic girdle

- It is consisting of two halves usually called as innominatum. The right and left innominatum look like the letters 'b' and 'd' respectively.
- Each innominatum is formed of three bones : ilium, ischium and pubis.

Bones of forelimb

A. Humerus:-

- It is a long stout and a straight bone distinguished into three regions : head, shaft and trochlea.
- Rounded head is at the proximal end and is directed inwards.

B. Radius and Ulna:-

- These are two long, slender and curved bones firmly attached to each other all along their length.
- Radius is shorter than ulna with slightly broader anterior end and expanded lower end.

C. Carpals:-

- These are 8 small bones of the wrist (carpals) and are arranged in two rows : proximal and distal.
- The proximal row has three carpals namely radiale, intermedium and ulnare.

D. Metacarpals:-

- These are five long, slender bones of the palm and are of unequal size. The first is the shortest and the third one is the longest.
- Each metacarpal is formed a long shaft with a small epiphysis at either end.

E. Phalanges:- These are 14 small bones of fingers or digits.

Bones of hindlimb

A. Femur:-

- It is the bone of thigh and is a long, stout, slightly curved bone formed of head, shaft and condyles.
- At its proximal end is a small, rounded head.

B. Tibia and fibula:-

- These are the bones of the thigh and are fused in their distal halves but are free in their proximal halves.
- Tibia is a thick, stout and straight bone and lies on the inner side. It is the longest bone of the body.

C. Tarsals:-

- These are six small bones of the ankle and are arranged in three rows : proximal, middle and distal.
- Proximal row contains two tarsals : smaller astragalus and larger calcaneum.

D. Metatarsals:-

- These are four long, slender bones of the sole.

E. Phalanges:-

- These are twelve small bones of the toes.
- Phalanges formula is 0,3,3,3,3.

EXPERIMENT – 28

AIM:- To study the different type of feathers.

A. Quill feather:-

- They are found in the wings and tail.
- Has a long, stiff central shaft or stem or scapus.
- Shaft is differentiated into a proximal hollow calamus or quill free form the vane and a distal tapering rachis which supports the vane.

B. Contour feather:-

- They resemble the quills but are small in size and cover the body to provide shape or contour.
- Their barbs are not strongly joined and can be separated easily.

C. Coverts feather:-

- They fill the gaps between quills on wings and tail.
- They are like the quills, except that they are smaller in size and have short calamus.

D. Filoplume feathers:-

- These are very small in size and occur beneath the contour feathers.
- Each is formed of a long, slender calamus bearing at the tip a few weak, free barbs with barbules.

E. Down feathers:-

- Down feather found in newly hatched birds called nestling downs.
- Each is formed of a long, slender calamus bearing at the tip a few weak, free barbs with barbules.