

Chapter – 4

INTRODUCTION TO SUPER CLASS – PISCES

Syllabus:

4. *Introduction to Superclass – Pisces.*

4.1 *Salient feature of Superclass – Pisces.*

4.2 *Introduction and Salient features of classes with two examples – Name only.*

Class – Chondrichthyes – Scoliodon and Chimaera &

Class – Osteichthyes – Labeo and Catla

3. *Types of Scales in Fishes.*

4. *Types of Fins in Fishes.*

Salient features of Super Class – Pisces:

1. Aquatic, either freshwater or marine, cold blooded vertebrates.
2. Body usually streamlined, spindle-shaped and differentiated into head, trunk and tail.
3. Presence of paired and unpaired fins supported by fin rays.
4. Dorsal, caudal and anal fins are unpaired, while the pectoral and pelvic fins are paired.
6. Exoskeleton of dermal scales, denticles or bony plates (in Placodermi) covering body surface. Tail is muscular and used for propulsion.
7. Endoskeleton is cartilaginous or bony. The notochord is usually replaced by vertebrae.
8. Muscles arranged into segments called myotomes, with separate dorsal and ventral parts.
9. Alimentary canal with definite stomach and pancreas and terminates into cloaca or anus.

10. Respiration is by gills but accessory respiratory organs may also be present.
11. Heart is two chambered, i.e. one auricle and one ventricle.
12. Kidneys mesonephric. Excretion ureotelic.
13. Brain with usual five parts. Cranial nerves ten pairs.
14. Nostrils are paired but do not open into pharynx except Dipnoi.
15. Tympanic cavity and ear ossicles are absent.
16. Lateral line system is well developed.
17. Sexes separate. Gonads typically paired. Gonoducts open into cloaca or independently.
18. Fertilization internal or external. Females are oviparous or ovoviviparous. Eggs with large amount of yolk.
19. Development usually direct without or with little metamorphosis.

Classification:

Thus super class Pisces is simply divided into three Classes – Placodermi (Extinct fishes), Chondrichthyes (Cartilagenous fishes) and Osteichthyes (Bony fishes) and it has been followed by all the eminent authors.

1. Class – Placodermi (Extinct fishes):

General Characters:

1. They are extinct fishes.
2. They flourished from early Devonian to Permian period.
3. Body was typically fish like. Endoskeleton was bony.
4. They had bony armour on the head and neck.
5. Jaws were not properly formed.
6. Tail was heterocercal. Paired and unpaired fins were present.

Examples: *Climatius*, *Cocosteu*, *Paleospondylus*.

2. Class Chondrichthyes or Cartilaginous Fishes:

General Characters: Examples: *Scoliodon*, *Pristis* (Saw fish), *Chimaera* (Rat Fish).

1. Most of the chondrichthyes are marine, some fresh water and all are predaceous.
2. Body is spindle shaped, laterally compressed or dorsoventrally flattened.
3. Paired and unpaired fins are present.
4. Endoskeleton is entirely cartilaginous, sometime calcified.
5. Skin covered with placoid scales and mucous glands.
6. Five or seven pairs of gills are present for respiration, gill slits are uncovered, no operculum. Caudal fin or tail is heterocercal. Heart is two chambered.
7. Stomach is 'J' shaped, intestine is short with spiral valve. Air bladder is absent.
8. Brain is large and ten pairs of cranial nerves are present. Well-developed sense organs.
9. Kidneys are mesonephric. Sexes are separate. Male usually possesses claspers.
10. Fertilization is internal. Oviparous or Ovoviviparous.
11. Development is direct, without metamorphosis.

3. Class Osteichthyes or Bony Fishes:

The Osteichthyes are popularly called the bony fishes.

General Characters:

1. They are found in all types of water.
2. Body is spindle shaped, laterally compressed.
3. Both median and paired fins are present.
4. Skin with mucous glands, cycloids, Ctenoid and ganoid scales but no placoid scales.
5. Endoskeleton is partly or wholly bony.
6. Mouth is usually terminal with numerous teeth.
7. Four pairs of gills are present covered by operculum.
8. Air bladder is generally present. Heart is two chambered.
9. Sexes are separate, fertilization is external, and development is direct.

Examples – *Acipenser, Amia, Anguilla, Hippocampus, Tetradon, Rohu, Catla.*

Types of Scales in Fishes:

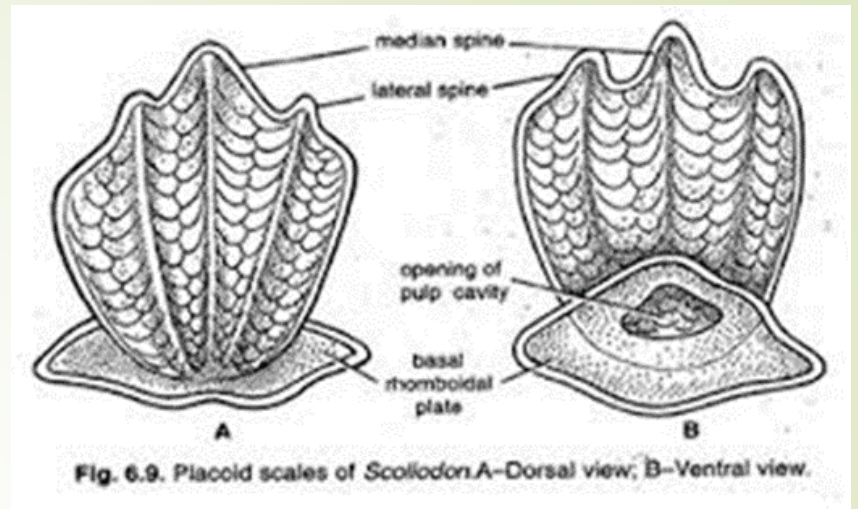
- Structurally there are two types of scales, placoid and non placoid scales.
- Both epidermis and dermis of skin participate in the formation of placoid scales.
- All the elasmobranchs or chondrichthyes possess placoid type of scales, whereas all non placoid scales are derived from dermis only and hence also called as dermal scales.
- All non-elasmobranch living fishes have non placoid type of scales.

4.3.2 Placoid Scales:

- The placoid scales or dermal denticles of elasmobranchs (Sharks, rays and skates) structurally resemble a tooth.
- They are closely set but do not overlap each other.
- They are thin plate like. The placoid scale consists of two parts the basal plate and trident spine.

Basal Plate:

- It is diamond shaped or rhomboidal plate formed of cement like material.
- It is embedded in the dermis and is firmly attached to it by strong fibers of connective tissue.
- The basal plate is perforated by a small opening which leads into the pulp cavity of the spine.
- In live condition the pulp cavity is filled with pulp made up of vascular connective tissue, blood vessels, nerves, lymph channels and numerous odontoblast cells.




The Spine:

- It is flat, backwardly directed trident structure project over the skin surface.
- The surface of the spine has stratified appearance. Chemically it is composed of calcareous substance, the **dentine**.

- The dentine is traversed by minute nearly parallel canaliculi with delicate branches.
- The dentine is covered by enamel like hard, translucent material called **vitrodentine**.
- It is secreted by the epidermis of the skin.

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- Placoid scales are derived partly from the dermis and partly from the epidermis.
 - The basal plate and the dentine of the spine are mesodermal derivatives, while the enamel is ectodermal in origin.
 - The teeth of the sharks are thought to be modified placoid scales.
 - The cured skin of shark containing placoid scales is termed **shagreen** and used for polishing and making handle covers.

4.3.3 Non-placoid or dermal scales:

- The non-placoid or dermal scales are mesodermal in origin.
- They are composed of three layers; the innermost layer of a compact bony substance termed isopedine, the middle layer of spongy vascular bone and outermost layer of dentine.
- The non-placoid scales are derived from this ancestral bony plate and can be classified into three types, which are as follows.

1. Cosmoid Scales:

- This type of scale is not seen in living fishes.
- They were seen on the bodies of extinct crossopterygii fishes and extinct lung breathing fishes (Dipnoi).
- The living lung fishes have cycloid scales without cosmine layer. These scales are found in certain Ostracoderms and placoderms.
 - a) The outermost or forth layer is thin but hard and consist of enamel like vitrodentine.

A Cosmoid scale had four distinct layers:

- a) The innermost or the lowest layer is formed of compact bone like substance called as isopedine.
- b) The second layer is formed of spongy bone with vascular spaces of pulp cavities having lining of odontoblasts.
- c) The third layer is of hard, compact, non-cellular material called cosmine.

1. Ganoid Scales: The ganoid scales are modified Cosmoid scales. These scales are usually rhomboid or diamond shaped plates closely fitted side by side like tiles. Ganoid scales are formed of bone. These scales are heavy and composed of following layers:

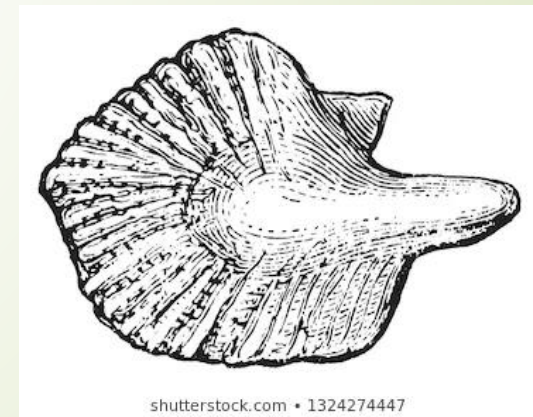
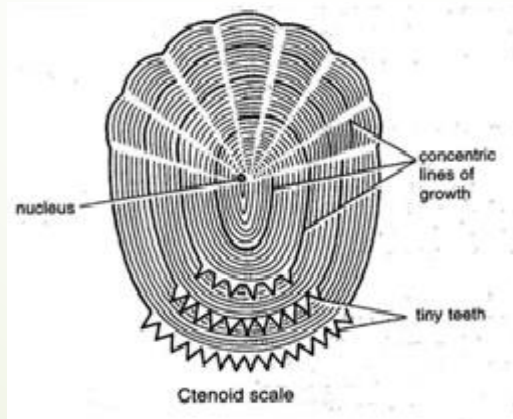
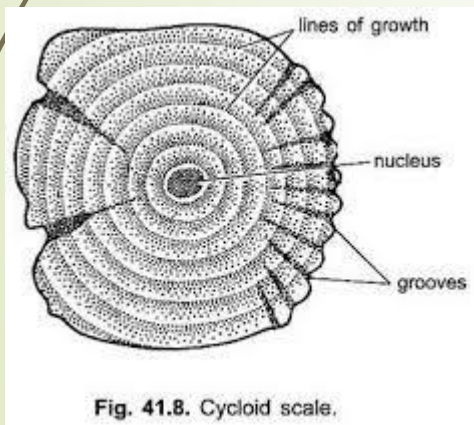
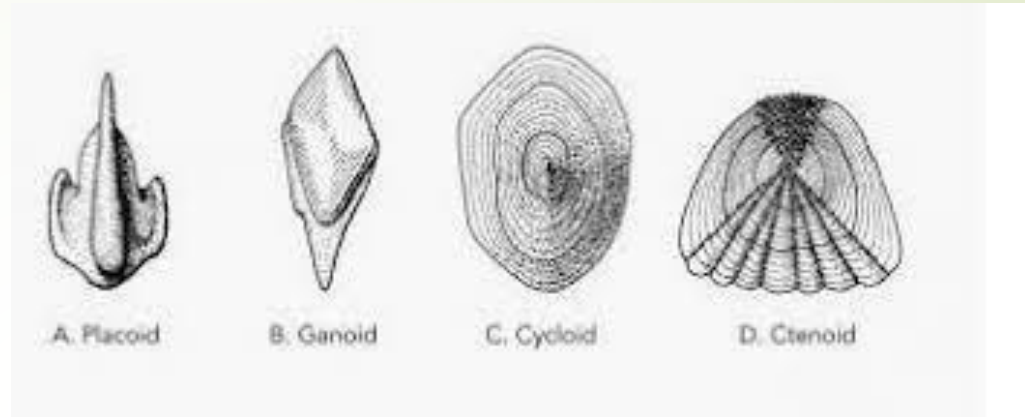
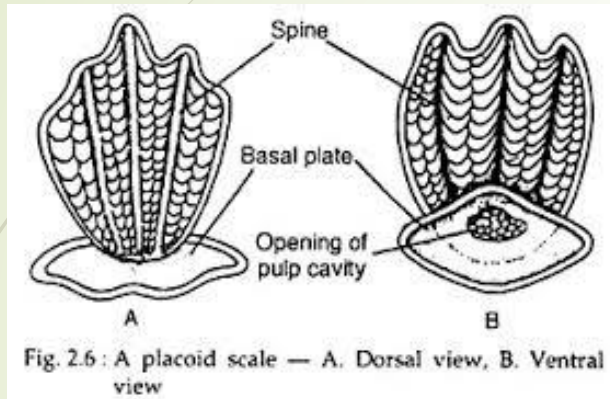
- a) The innermost layer is lamellar and made up of bony substance called isopedine.
- b) The middle layer is cosmine containing numerous branching tubules.
- c) The outermost layer consists of hard inorganic enamel like translucent material called ganoine.

- The cycloid scales have a lower layer of fibrous connective tissue and a upper layer of bone like isopedine which is elaborated to form dentine.
- These scales are embedded in the dermis diagonally overlapping each other, with the posterior part of each scale overlapping the anterior part of the scale behind.
- The exposed part (posterior field) has a smooth edge while the concealed part (anterior field) may have wavy margin.

4. Ctenoid Scales (Ctenos –comb):

- The Ctenoid scales are also circular and can be distinguished from the cycloid scales by having a more or less serrated free edge.
- They have the same shape, structure and concentric lines as the cycloid scale.
- Moreover, several spines or **cteni** are present on the surface of the posterior area of the scale.
- Their anterior concealed part may have notched or scalloped margin.

➤ These scales are characteristic of modern higher teleosteans such as perch, sunfish, etc. Ctenoid scales form a dermal exoskeleton of most of bony fishes.



4.3.4 Modification of Scales:

- Fishes like electric ray and catfishes are totally scaleless.
- Eels have minute and deeply embedded scales.
- In fishes like Chimaeras scales are localized.
- In globe fish (*Tetrodon*) and porcupine fish (*Diodon*), scales are modified into large protective spines.
- In trunk fish (*Ostracion*) they form a complete bony box.
- In sturgeon (*Acipenser*) Scales are in the form of stout bony plates. the teeth of shark are nothing but modified large placoid scales.
- Sting (Barb) of sting ray is a modified placoid scale. In sawfish (*Pristis*), the teeth elongated rostrum are formed by placoid scales.

4.3.5 Importance of scales in fishes:

1. The main function of scales is protection and for that purpose only they are differently modified into spines, knobs or bony plates.
2. The structure and arrangement of scales has a taxonomic value. E.g. Ganoid scales are found in earliest primitive bony fishes. Whereas placoid scales are observed in shark and rays.
3. Scales are also useful in identification of fishes.
4. Scales form an important tool in the paleontological study of fishes, as they are well preserved and get embossed clearly on the surrounding clay.
5. The concentric lines of growth (cycloid scales) indicate the age of fish.

4.4 Types of fins in fishes:

- Fins are the chief organs of locomotion in fishes.
- These are either folds of skin or projections from the body surface.
- The fins are supported by fin-rays.
- These supporting rays may be bony, cartilaginous, fibrous or horny.
- The fins are of two types:
 1. Median unpaired fins seen along mid-dorsal and mid-ventral line of body.
 2. Paired fins like pectoral fins and pelvic fins present in the trunk region of the body.

4.4.1 Median unpaired fins:

- There are median unpaired fins of these one or two dorsal fins are present along the mid-dorsal line, a ventral anal fin behind the anus or cloaca and a tail or caudal fin around the tip of a tail.
- Dorsal fins may be in series (first dorsal or anterior dorsal fin and second dorsal or posterior dorsal fin).
- It may be reduced or absent or there is sometimes a continuous median fin extending along the back and round the end of the tail to the vent or cloaca.
- Anal fin or ventral fin may be absent in bottom dwelling fishes.

4.4.2 Paired lateral fins:

- These occur in two pairs.
- The anterior fins are known as pectoral fins and posterior are known as pelvic fins. these fins correspond to the arms and legs of other vertebrates.

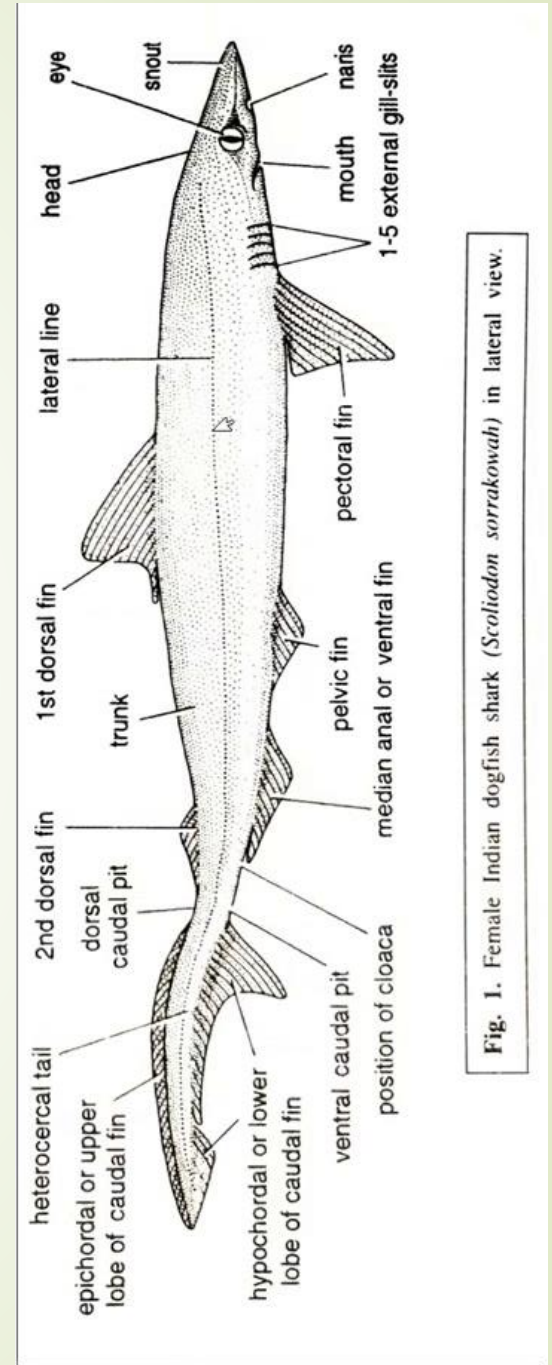


Fig. 1. Female Indian dogfish shark (*Scoliodon sorrakowah*) in lateral view.



i) Pectoral Fin:

- Pectoral fins are located on both sides usually just behind the operculum.
- It provides supports during swimming.
- It creates dynamic lifting force and also helps the fish to turn left or right.

ii) Pelvic Fin:

- In fishes, a pair of pelvic fins is present which are located ventrally below and behind the pectoral fins.
- In some fishes, they are situated in front of the pectoral fins.
- This type of fins for moving upwards and downwards in the water.

4.4.3 Uses of fins:

- Fish swims mainly by lateral movements of tail and tail fin.
- Other fins are principally used as steering devices and rudders.
- When the body is at rest, the paired lateral fins serve to maintain equilibrium.
- Fins are also modified to serve other purposes. Lungfishes use them as legs in walking.
- The flying fish use their large and extended pectoral fins for gliding. Pelvic fins in some male.
- Chondrichthyes become modified as claspers.
- In remoras, anterior dorsal fin forms an adhesive disc or sucker or head.
- In some teleost the anal fin forms an intromittent organ or ovipositor.

4.4.4 Types of caudal fins or tails:

1) **Diphycercal or Protocercal tail:**

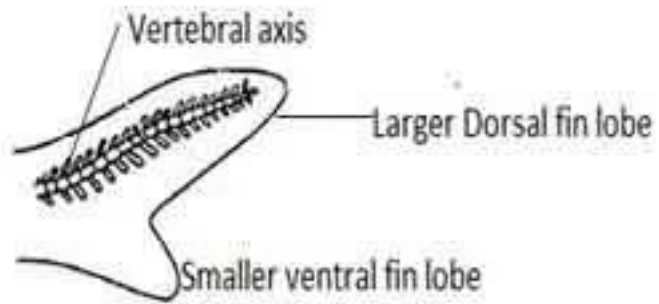
- It is most primitive type of tail or caudal fin. It is not seen in many living fishes.
- The vertebral column or notochord extends straight back to the tip of the tail dividing the fin symmetrically and equally into the dorsal epichordal and ventral hypochordal lobes.
- Diphycercal caudal fin is found in modern cyclostomes, primitive sharks, chimaera, living lung fishes, many teleost and deep sea fishes.
- *Latimaria* and extinct coelacanths have unique symmetrical three-lobed tail with distinct median lobe.

2) Heterocercal tail:

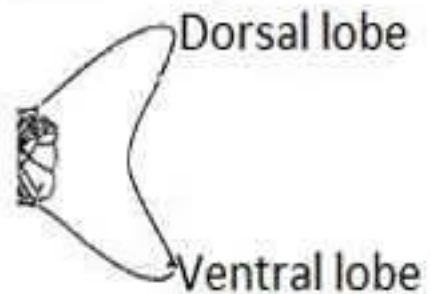
- It is the intermediate type of caudal fin, in which vertebral column bends upwards and reaches up to the tip of the more prominent dorsal lobe, thus making the caudal fin strongly asymmetrical.
- It is found in chondrichthyes, extinct osteoipid crossopterygians, extinct dipnoans and living holosteans.
- Heterocercal tail is characteristic of bottom feeder. In flying fish, some primitive fishes and ostracoderms, the condition is opposite to the heterocercal, in which the vertebral column terminate into a larger ventral lobe and the tail is known as hypocercal.
- Larger ventral lobe helps the flying fish to attain maximum speed for gliding as it leaves the water.

3) Homocercal tail:

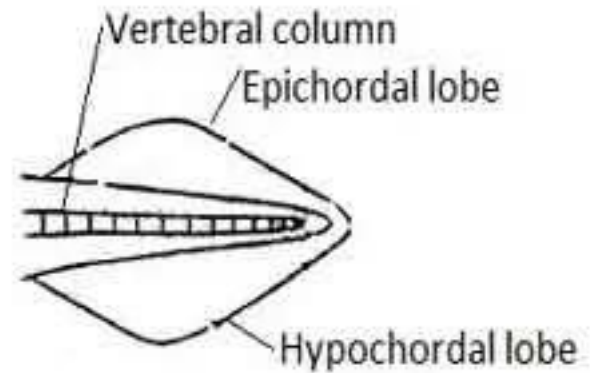
- This is the advanced and most common type of tail found in majority of higher bony fishes (teleosts).
- This type of tail consists of both the lobes equal in size. Hence it is called as homocercal tail.
- It is externally symmetrical but internally it is asymmetrical.
- The vertebral column is slightly upturned into the dorsal lobe.
- The vertebral column is not reach up to the posterior part of the tail.
- Homocercal type has several variations. In cod and tuna, the upturned urostyle of vertebral column is reduced or absent.
- In some deep sea fishes, the terminal part of vertebral column is straight and greatly elongated to form isocercal tail.



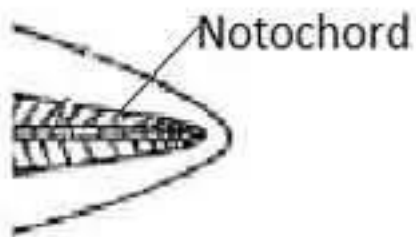
Heterocercal fin



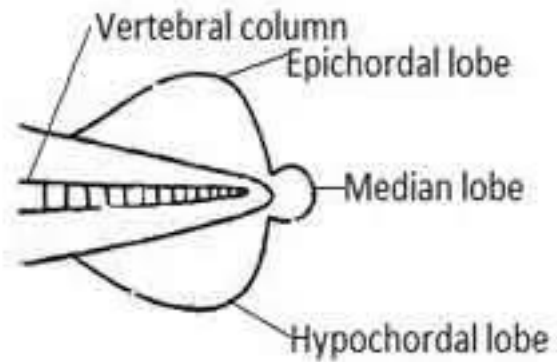
Homocercal fin



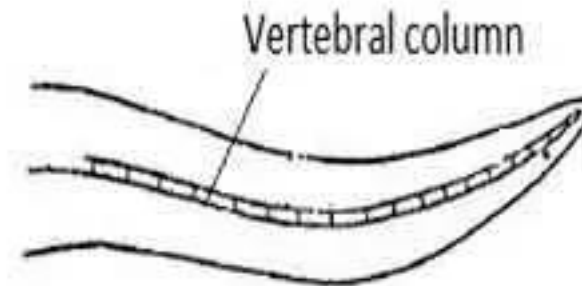
Dephycercal fin



Protocercal fin



Modified Dephycercal fin



Isocercal fin

QUESTIONS

Q.1 Multiple choice Questions:

- 1) Which of the following is a cartilaginous fish
 - a. Chimaera
 - b. Acipencer
 - c. Hippocampus
 - d. Rohu
- 2) Cartilaginous fishes are characterized by the presence of
 - a. Terminal mouth
 - b. Ventral mouth
 - c. A homocercal tail
 - d. A heterocercal tail
- 3) In Pisces heart is
 - a. One chambered
 - b. Two chambered
 - c. Three Chambered
 - d. Four Chambered
- 4) Which fins are paired in fishes
 - a. Dorsal fin and anal fin
 - b. Pelvic fin and ventral fin
 - c. Pectoral fin and pelvic fin
 - d. Caudal fin and dorsal fin.
- 5) Placoid scales are found in
 - a. Paleontological fishes
 - b. Lung fishes
 - c. Bony fishes
 - d. Cartilaginous fishes

6) Cosmoid scales are found in.....

- a. Dipnoi
- b. Ostracoderms
- c. Placoderms
- d. All of these.

7) Which of the following scales are diamond shaped

- a. Placoid
- b. Cycloid
- c. Ctenoid
- d. Ganoid

8) A homocercal tail is found in

- a Bony fishes
- b. Sharks
- c. Rays
- d. Lung Fishes

9) Extinct fishes are included in.....

- a. Elasmobranchii
- b. Osteichthyes
- c. Crossopterygii
- d. Placodermi

10) Tail in Chondrichthyes is.....

- a Homocercal
- b. Heterocercal
- c. Hypocercal
- d. Hypercercal



Q.2. Define or explain in one sentence:

a) Chondrichthyes b) Median c) First Pectoral fin

Q.3. Give any two examples of :

a) Heterocercal tail b) Osteichthyes c) Homocercal tail

Q. 4 Write short notes on:

a. Give general Characters of class Osteichthyes

b. Give general Characters of class Chandrichthyes

c. Describe Placoid scale

d. Describe Cosmold scale

e. Describe Ganoid scale