PISCES or FISHES : (The Most flourishing Devonian Vertebrates)

- Fishes are essentially aquatic, jaw bearing vertebrates.
- They evolved during **Silurian period** and became the most flourishing group of aquatic vertebrates in Devonian period.
- Devonian period is the golden age of fishes.
- They are first group of vertebrates with biting jaws in the evolution of vertebrates.
- The earliest gnathostomes were **acanthodians (climatius)**
- Placoderms appeared shortly after acanthodians
- Acanthodians gave rise to **bony fishes**
- Placoderms gave rise to **Cartilaginous fishes**
- Smallest fish is ***Paedocypris progenetica***
- Largest fish is ***Rhinodon typus***

GENERAL CHARACTERS:

- They are cold blooded Vertebrates.
- They are aquatic live in fresh water, sea water and brackish water.
- Body is usually streamlined, but some are elongated and snake like, while a few are flattened dorsoventrally.
- Neck is absent as an adaptation to aquatic life.
- There is an **exoskeleton of scales**, denticles or bony plates developed from **mesoderm**.
- The skin glands are multicellular mucous glands. Their secretion helps in reducing the friction during locomotion.
- They have paired and unpaired fins supported by soft or spiny rays.
- Dorsal, anal and caudal fins are ***unpaired***. They help in **maintaining the balance** of the animal.
- Pectoral and pelvic fins are **paired**. They help in **steering, stopping and hovering**.(locomotion)
- The caudal fin present on the tail is helpful in propulsion.
- All fish vertebrae are **Amphicoelous**
- All viscera except kidney are enclosed by **pleuroperitoneal cavity**
- Nostrils are paired. They do not open into pharynx except in lung fishes.
- Eyelids are absent. Organs of respiration are gills.
- Gills are supported by gill arches.
- Counter current flow of blood in gills enhances **oxygenation of blood**
- The anterior or posterior wall of gill surface has **hemibranch or demibranch**
- The functional surface of hemibranchs consists of a large number of transverse folds called **Lamellae**
- The two hemibranchs of a single gill arch together with interbranchial septum constitute **Holobranchs**
- In certain fresh water bony fishes, there are **accessory respiratory organs**. In lung fishes they have a lung to meet the drought conditions.
- Heart is two chambered with one auricle and one ventricle.
- The flow of the blood is only towards gills and hence the heart is called **Branchial heart**. As the blood flows only to the respiratory organs from the heart, the circulation is called **single circulation**.
- As the blood in the heart is always impure, the heart is also called as **Venous heart**.
- Brain is covered by a single membrane **Manix primitiva**.
- Cranial nerves are ten pairs.
- Only internal ear is present and it serves mainly as a balancing function and also hearing.
- **Lateral line sense organs or neuromast** organs, characteristic of fishes. They are **Rheoreceptors** and help in maintaining **the balance** against water currents.
- Excretory organs are **Mesonephric** kidneys.
- The excretory product is Ammonia hence the fishes are called **ammonotelic** animals.
- However, Cartilaginous fishes excrete **urea.**
- Sexes are separate.
- Fertilisation is external or internal.
- Amnion is absent in the embryonic stage.
- Hence, fishes are included under Anamniota.

CLASSIFICATION OF PISCES:

- About 25,000 species of extant jawed fishes are known.
- Pisces are classified into Placodermi (extinct), **Chondrichthyes** and **Osteichthyes**.(living)

I. Class Placodermi: (Plate skin)

- They originated from ostracoderm during Silurian period and became extinct by the beginning of Mesozoic era.
- Placoderms are regarded as progenitors of modern fishes.(ancestors of Chondricthyes)

- Their body is protected by heavy bony armour, the feature which gives their name 'Placodermi'.
- The spiracle is represented as a gill.
- e.g. *Bothryolepis, Dunkelosteus*

II. Class: Chondrichthyes

- Mostly marine and predaceous.
- The **endoskeleton is entirely cartilaginous** without true bones.
- Placoid scales form the exoskeleton.
- Caudal fin is **heterocereal.**
- Mouth is long, crescentic and **ventral**.
- Gill slits are **4 to 7 pairs without operculum**.
- Gills are lamelliform
- Intestine has **Spiral valve or scroll valve**
- Air bladder is absent.
- Cloaca lies between two pelvic fins.
- Ureotelic animals. In males the pelvic fins are provided with **claspers.**
- Fertilization is internal.
- Most Sharks and all rays are **Viviparous and possess yolk sac placenta**.
- Subclass of chondrichthyes are **Elasmobranchii** and **Holocephali**

Subclass Elasmobranchii

- Includes sharks, skates and rays
- Skin covered by placoid scales
- Operculum absent
- Gill slits are **5 to 7 pairs**, naked and without any operculum. In *Hexanchus*, there are **6 pairs** and *Heptanchus* there are **seven pairs** of gills slits

A. SHARKS:

- They occur in the warm waters of tropics.
- They have an acute sight and smell.
- Sharks are very large animals.
- They are active predaceous animals and they are **pleurotrematic** elasmobranches with lateral gill openings.
- Sharks are viviparous animals.

Rhinodon* or *Rhincodon

- It is commonly called the whale shark.
- This is the largest of all fishes and second largest vertebrate.

Scoliodon :

- It is called the **Indian dogfish**.
- This is used for study in laboratories because of their small size.
- The dried skin of shark is called **shagreen**. It is used in polishing industry.

***Stegostoma:* (Tiger or Zebra shark)**

- It exhibits brilliant colouration of dark stripes over yellow background.

***Sphyrna* (*Zygaena*) :**

- Abundant in Indian Ocean, commonly called as hammer-headed shark.
- The head is mallet shaped due to a prominent lateral lobe on either side bearing an eye on its distal end.

B. Rays and Skates:

- They are more diverse than sharks.
- They are specialised for bottom dwelling.
- Their body is greatly flattened dorsoventrally.
- They are **hypotrematic** elasmobranches with ventrally placed gill slits.

Myliobates :

- **Sea Vampire** or **Eagle ray**.

Torpedo:

- Torpedo is called **Electric ray**.
- They have well developed electric organs for defence and predation.
- Certain **dorsal muscles** have become modified to powerful **electric organs.**

Rhizomatous:

- Commonly called a **Guitar fish**.
- A skate with depressed body and tapering snout.

***Pristis*: (Saw fish)**

- Snout is greatly elongated and blade like with row of sharp teeth like scales, the saw forms a formidable weapon for defence as well as for food capture.

Trigon (Sting ray)

Raja (Skate)

Subclass II Holocephali or Bradyodontii

- In adult holocephali scales, spiracles and cloaca are **absent**
- **Gills are covered by operculum (holocephali)**

Eg; chimera, hydrolagus, callorhynchus.

III Class: Osteichthyes

- These are true bony fishes, living in both fresh water and sea water.
- Scales are of three types, **ganoid, cycloid** and **ctenoid.**
- Caudal fin is **homocercal** or **diphycercal**.
- Endoskeleton is chiefly of **bone.**
- Mouth is terminal.
- Respiration by 4 pairs of filamentous gills present. Gills are covered by an operculum on either side.
- Air bladder or swim bladder is present with a connection or no connection to the pharynx. In some it is lung like. **The air bladder is a hydrostatic organ**.
- Class Osteichthyes is divided into Acanthodii, sarcopterygii and actinopterygii

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Subclass I: Acanthodii :

- Oldest known gnathostomes
- Became extinct during **Permian period**
- Type of scales are **Ganoid scales**
- Caudal fin is **heterocercal**
- **Eg; climatius and Diplocanthus**

Subclass II: Sarcopterygii

- These are called lobe finned fishes.
- The paired fins are fleshy lobed with jointed skeleton and muscles resembling tetrapod limb.
- sarcopterygians are also called **choanichthyes**, because of the presence of internal nostrils.
- **Intestine has spiral valve**
- It includes two orders: 1. Crossopterygii and 2. Dipnoi

Order 1: Crossopterygii

- It includes Rhipidistians (eg **Osteolepis, Eusthenopteron**) and **coelocanthes**
- **Internal nares are present in rhipidistians but absent in coelocanthes**
- Scales are **cosmoid**
- Crossopterygian fishes which dominated the Devonian period have almost become extinct by the end of Cretaceous.
- Species of the family, **Coelacanthidae** are the only living examples of this group. They have been found near Comoros islands between Africa and Madagascar in the river Chalumna.
- *Latimeria chalumnae* a coelocanth fish is named after **Mrs.C.Latimer** who identified the fish. It is referred to as a **living fossil** by **Smith (1938).**
- The body of *Latimeria* is covered with cosmoid scales. Internal nostrils are absent.
- Latimeria persists since Jurassic time with very little change.
- Latimeria menadoensis is found in eastern Indian Ocean.

Order 2: Dipnoi

- Median fins continue to form **diphycercal** tail fin.
- Body covered by **cycloid** scales
- Internal nostrils are present. Lungs are single or paired.
- Spiracles are absent
- There are only three genera that are living today.
- The dipnoans inhabit the rivers and are capable of breathing ‘air’ by Lungs.
- Commonly called as lung fishes

***Neoceratodus*:**

- Restricted to Burnett and Mary rivers of Queens land, Australia.
- It is known as Burnett Salmon.
- There is a single lung.
- Paired fins are paddle like.
- It is inactive and sluggish in habit.

Protopterus:

- It is present in the White Nile on North of Congo basin and Zambezi Rivers in South Africa.
- Dorsal and caudal fins are united.
- Lungs are double.
- Paired fins are filamentous.
- During unfavourable seasons it undergoes **aestivation.**

Lepidosiren:

- This is a South American lung fish and occurs along the course of main Amazon River.
- Dorsal and caudal fins are united and form the principal organs of locomotion.
- Two lungs are present.
- Paired fins are short.
- It also undergoes aestivation.
- The living dipnoans have special relationship despite the oceanic barriers separating them. Such organisms constitute an example for **discontinuous distribution**.
- Romer called them **uncles of Amphibia** because they are closely related to the ancestors of amphibians, the Rhipidistian stock.

Subclass III – Actinopterygii :

- These fishes are called **ray finned** fishes; since the fins are supported by **dermal fin rays**.
- Nostrils are not connected to the mouth cavity.
- This is divided into 3 infra classes. **Chondrostei, Holostei, Teleostei.**

Infra class I - Chondrostei :

- Endoskeleton cartilaginous.
- It includes primitive ray finned fishes
- Mouth opening is **large.**
- Skin is covered with **ganoid scales** or scutes.
- Caudal fin is **heterocercal** but **diphycercal type present in Bichir**.
- All of them are North American fishes.
- Intestine has spiral valve
- Air bladder is connected to pharynx and functions as lung

  E.g. ***Acipencer* (Sturgeon), *Polypterus*. (Bichir)**

Infra class II -Holostei :

- This includes intermediate ray finned fishes
- Mouth opening is **small.**
- **Ganoid or cycloid scales** form the exoskeleton.
- Tail fin is **heterocercal**.
- Spiracles are absent
- Air bladder is mainly hydrostatic and connected to pharynx
- Vestigial spiral valve is present
- North American fishes.

  E.g. ***Amia* (Bowfin), *Lepidosteus* (garpike).**

Infra class III – Teleostei

- This includes advanced ray finned fishes
- World wide in distribution.
- **Mouth is small and terminal**
- Scales are **ctenoid or cycloid**.
- Tail fin is **homocercal.**
- Air bladder or swim bladder, a hydrostatic organ is usually present.
- Spiracle is absent
- Spiral valve is absent

Some examples:

***Echeneis*:**

- The **sucker** fish or **Remora** is found in all seas.
- The head is depressed with a sucker made of two rows of transverse lamellae.
- The **anterior dorsal fin** is modified into a sucker.
- These fishes attach themselves to other fishes and lead an ectocommensal life.

***Hippocampus*:**

- This marine fish is called '**Sea horse**'.
- The skin is covered by bony plates.
- It can swim vertically.
- Tail is prehensile.
- The male has a **brood pouch** formed by the combined pelvic fins.
- The young ones develop in the brood pouch.

***Exocoetus*:**

- It is a **flying fish** of tropical seas.
- The pectoral fins become greatly elongated and sustain the fish in its gliding leaps, like a parachute
- Fish takes a leap with the powerful tail and glides for a few meters.
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***Eel*:** (Anguilla)

- It lives in marshy areas.
- Pectoral fins are present.
- Pelvic fins are absent.
- Dorsal and anal fins are continuous with caudal fin.
- Adults migrate to sea in autumn.
- It is an example for **catadromous** fish.(migration from fresh water to sea water)
- Spawn in deep water and die.