

# **PISCES:Charecters & Classification**

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# Placoderms

The Placoderms, being quite different in several respects are considered closer to the cartilaginous fishes and treated as a separate class of Gnathostomata. These were regarded as the first fishes appeared on the earth. They had plate skin (Gr. *Plakos* = a flat plate + *derma* = skin). They were jawed, heavily armoured, spiny finned and possessed paired fins. The body was flattened and they lived during Silurian to Devonian periods of Mesozoic era. They were credited as the first vertebrates blessed with jaws. Romer stated that perhaps the greatest of all advances in vertebrate history was the development of jaws causing drastic revolutionary improvement in the mode of their life.

## Systematic Position

<b>Phylum</b>	—	<b>Chordata</b>
<b>Sub-phylum</b>	—	<b>Vertebrata</b>
<b>Super class</b>	—	<b>Gnathostomata</b>
<b>Series</b>	—	<b>Pisces</b>
<b>Class</b>	—	<b>Placodermi</b>

## **Time and Place of Origin**

Placoderms originated about 400 million years ago in the Devonian period of Palaeozoic era. They flourished through Devonian and Carboniferous and became extinct by Permian about 280 million years ago. During Devonian, they underwent great evolutionary radiation when two new types (the cartilaginous and bony fishes) evolved in early carboniferous times. Placoderms originated and lived in the freshwater. But later forms invaded the seas as well (Romer, 1959).

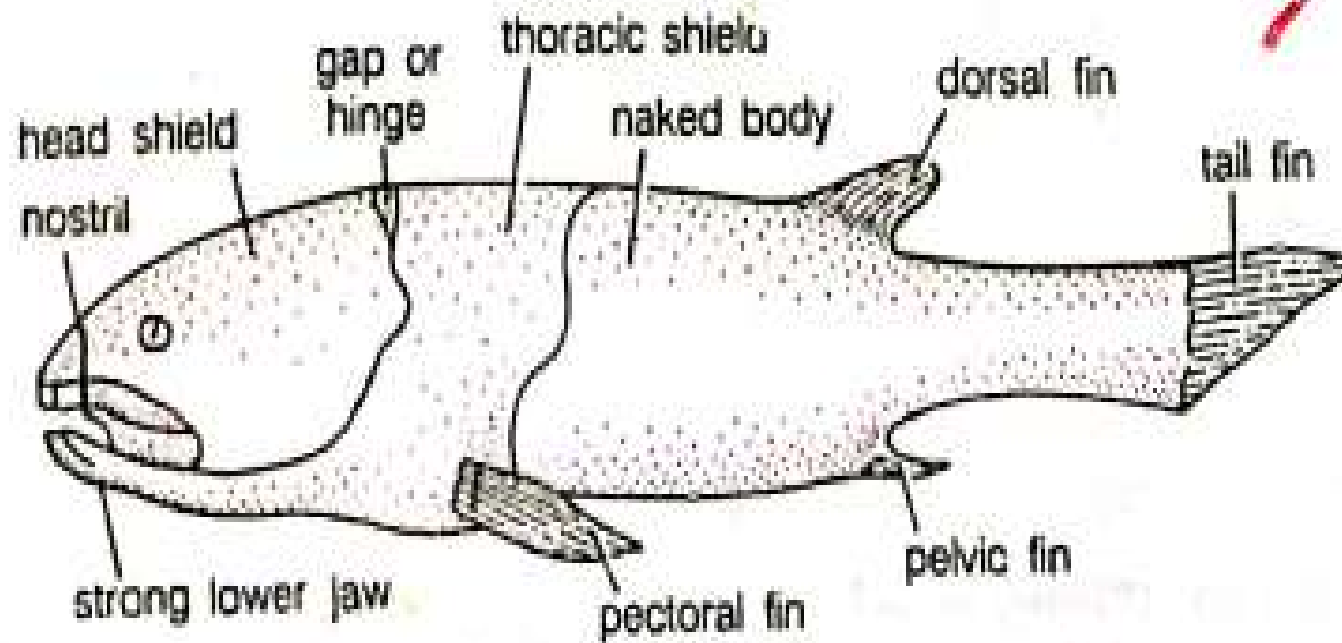
### **Ancestor of Placoderms**

It is believed that some primitive Ostracoderms were probably the ancestors of Placoderms. Smith (1960) stated that Placoderms may be the derivatives of Ostracoderms. However, their fossil record does not show any connecting link between the jawless and the jawed fishes.

## Salient Features of Placoderms

- (1) Placoderms were regarded as the first true fishes.
- (2) They were called plate-skinned fishes and they had a bony armour like that of Ostracoderms.
- (3) They were mostly the bottom dwellers and lived on invertebrates like their agnathan (ancestors) counterparts.
- (4) They were closer to the cartilaginous fishes.
- (5) The shape and the size of body widely varied but had a dorsoventrally flattened body (an adaptation for bottom living habit).
- (6) The head and trunk were covered by bony shields while the tail remained mostly naked. In a few forms the tail also had a covering of small thin scales.
- (7) They had paired fins.
- (8) The tail were heterocercal.

- (10) Jaw suspension was primitively autostylic or aphetohyoidean type.
- (11) Palatoquadrate and mandibular bones remained unossified and fused rigidly to the head shield or to the inner part of the cranium.
- (12) The hyoid arch was relatively unspecialized and did not participate in jaw suspension.
- (13) Jaw consisted of bony plates, formed by modification of dermal bones lining the jaw cartilage. Similar plates on palatoquadrate, probably assisted them in crushing shelled molluscs and arthropods.
- (14) They developed an internal ear with semicircular canals.
- (15) Spiracle probably a typical gill-slit between the mandibular and hyoid arch.
- (16) The fins in general were similar to those of early sharks. These were represented by a pair of pectoral and pelvic fins and often by large pectoral spines attached to the bony plates on the trunk.
- (17) Males had pelvic claspers.



**Fig. Cocosteus-a Devonian placoderm**

# **Class : Chondrichthyes : The Cartilaginous Fishes**

## **General Characters**

1. Mostly marine and predaceous.
2. Body fusiform or spindle shaped.
3. Fins both median and paired, all supported by fin rays. Pelvic fins bear claspers in male. Tail heterocercal.
4. Skin tough containing minute placoid scales and mucous glands.
5. Endoskeleton entirely cartilaginous, without true bones (Gr., *chondros*, cartilage + *ichthys*, fish). Notochord persistent. Vertebrae complete and separate. Pectoral and pelvic girdles present.
6. Mouth ventral. Jaws present. Teeth are modified placoid scales. Stomach J-shaped. Intestine with spiral valve.
7. Respiration by 5 to 7 pairs of gills. Gill-slits separate and uncovered. Operculum absent. No air bladder and lungs.
8. Heart 2-chambered (1 auricle and 1 ventricle). Sinus venosus and conus arteriosus present. Both renal and portal systems present. Temperature variable (poikilothermous)
9. Kidneys opisthonephric. Excretion ureotelic. Cloaca present.
10. Brain with large olfactory lobes and cerebellum. Cranial nerves 10 pairs.
11. Olfactory sacs do not open into pharynx. Membranous labyrinth with 3 semicircular canals. Lateral line system present.
12. Sexes separate. Gonads paired. Gonoducts open into cloaca. Fertilization internal. Oviparous or ovoviviparous. Eggs large, yolky. Cleavage meroblastic. Development direct, without metamorphosis.

## Classification

The class *Chondrichthyes* (Gr., *chondros*, cartilage + *ichthys*, fish), also called *Elasmobranchii* (Gr., *elasma*, plate + *branchia*, gills), including the sharks, rays, skates and chimaeras, comprises about 600 living species (according to Schultz) of cartilaginous fishes. The classification followed here

### Subclass I. Selachii

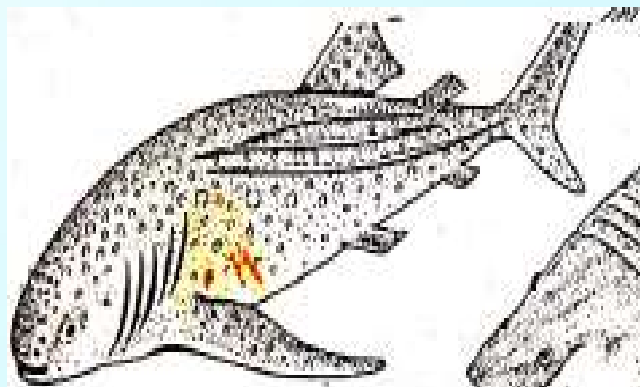
(Gr., *selachos*, a shark)

1. Multiple gill slits on either side protected by individual skin flaps.
2. A spiracle behind each eye.
3. Cloaca present

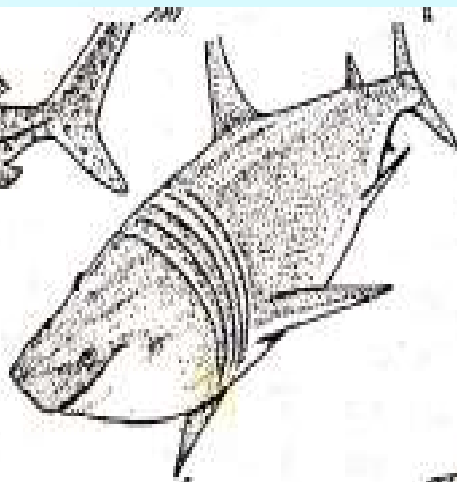
Examples. True sharks. About 250 living species. Dogfishes (*Scoliodon*, *Chiloscyllium*, *Mustelus*, *Carcharinus*), spiny dogfish (*Squalus*), seven gilled shark (*Heptanchus*), zebra shark (*Stegostoma*), hammer-headed (*Sphyrna*), whale shark (*Rhineodon*).

Examples: Skates and rays. About 300 species. Skate (*Raja*), stingray (*Trygon*), electric ray (*Torpedo*), eagle ray (*Myliobatis*), guitar fish (*Rhinobatus*), sawfish (*Pristis*).

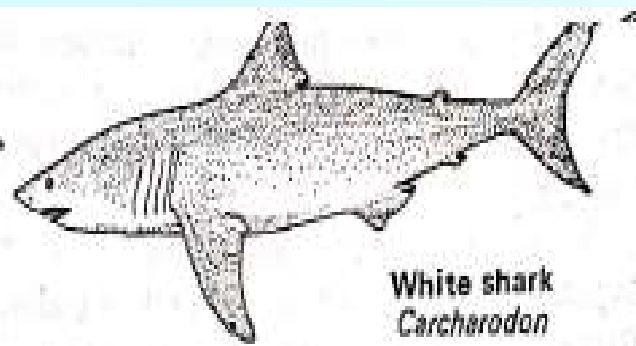




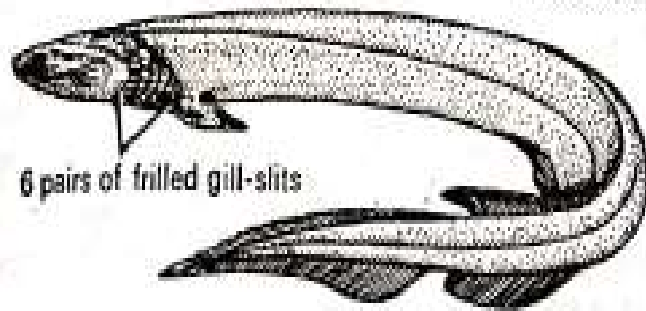
Whale shark  
*Rhincodon typicus*



Basking shark  
*Cetorhinus maximus*

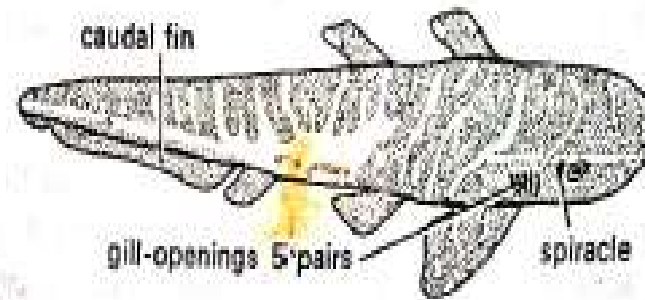


White shark  
*Carcharodon*

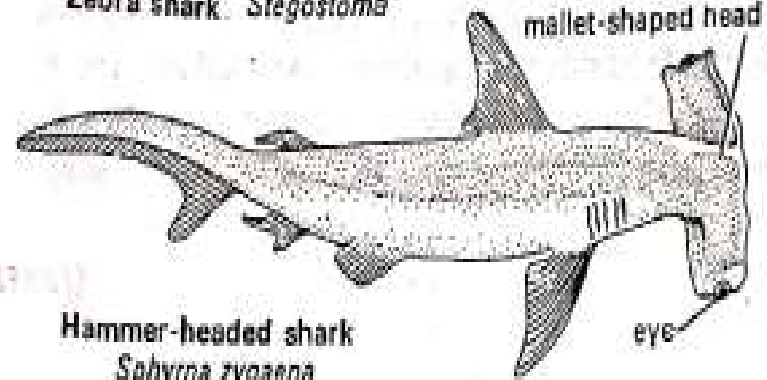


6 pairs of frilled gill-slits

Frilled shark *Chlamydoselachus*



Zebra shark *Stegostoma*



Hammer-headed shark  
*Sphyrna tiburo*

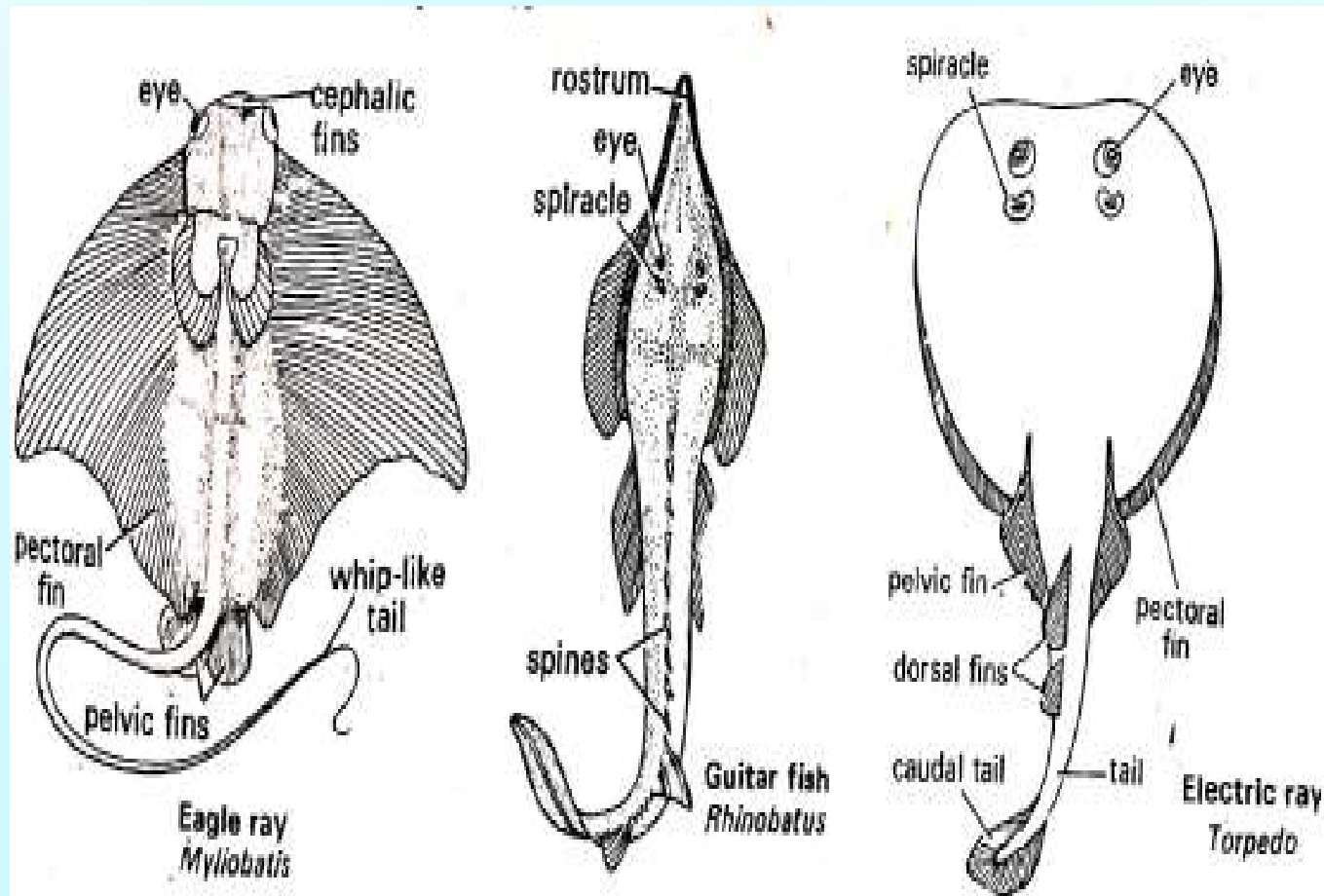
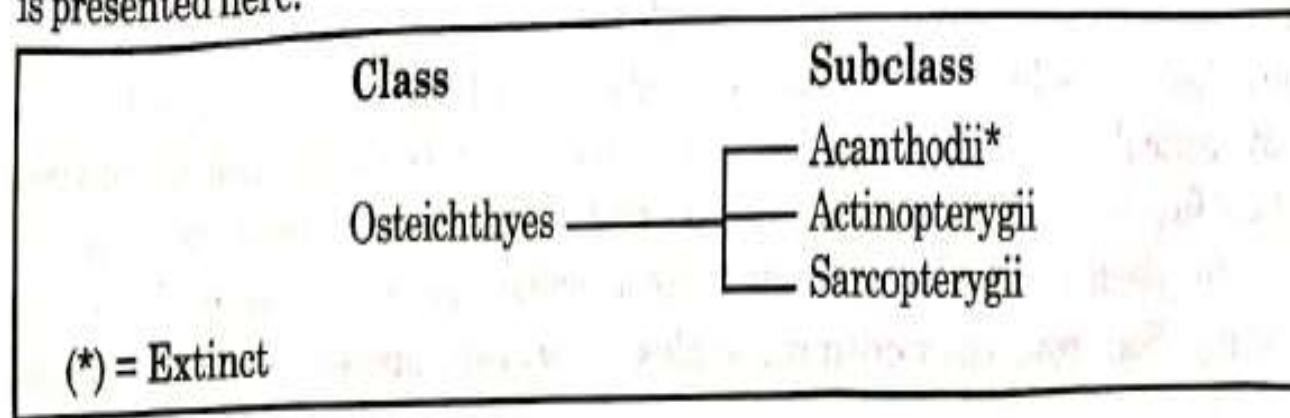


Fig. 15-1 Class Chondrichthyes. Some cartilaginous fishes.

## Class Osteichthyes:

The scheme of classification of Class Osteichthyes, according to Young (1981), is presented here.



## Class Osteichthyes

- (i) Marine and fresh water species.
- (ii) **Skeleton bony**, vertebrae numerous; tail usually **homocercal**.
- (iii) Skin with mucous glands and embedded dermal scales (*ctenoid, ganoid, or cycloid*); some without scales; no placoid scales.
- (iv) Fins median and paired with fin rays.
- (v) **Mouth terminal** with many teeth fused with the jaws (some toothless).
- (vi) Respiration by gills supported by bony gill arches and covered by a common **operculum**.
- (vii) **Swim bladder** often present. Lung present in a few cases.
- (viii) Circulation consists of a two-chambered heart, arterial and venous systems, and four pairs of aortic arches.
- (ix) Brain with small olfactory lobes and cerebrum. Large optic lobes and cerebellum.
- (x) Lateral line sense organ present.
- (xi) The labyrinth in the inner ear contains large otoliths.
- (xii) Most species are oviparous and fertilisation is external.

**A** Subclass Actinopterygii (Ray-finned fishes): Actinopterygii, is a major taxonomic subclass of fish, known as the ray-finned fishes. The ray-finned fishes are so called because they possess lepidotrichia or "fin rays," their fins being webs of skin supported by bony or horny spines (rays). The actinopterygians include the most familiar fish, such as sturgeons, gars, eels, carp, herrings, anchovies, catfishes, goldfishes, piranhas, oarfish, seahorses, bass, cichlids, pickerel, salmon, and trout. General characteristics are—

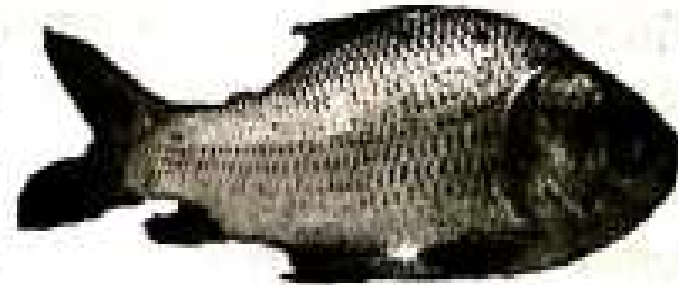
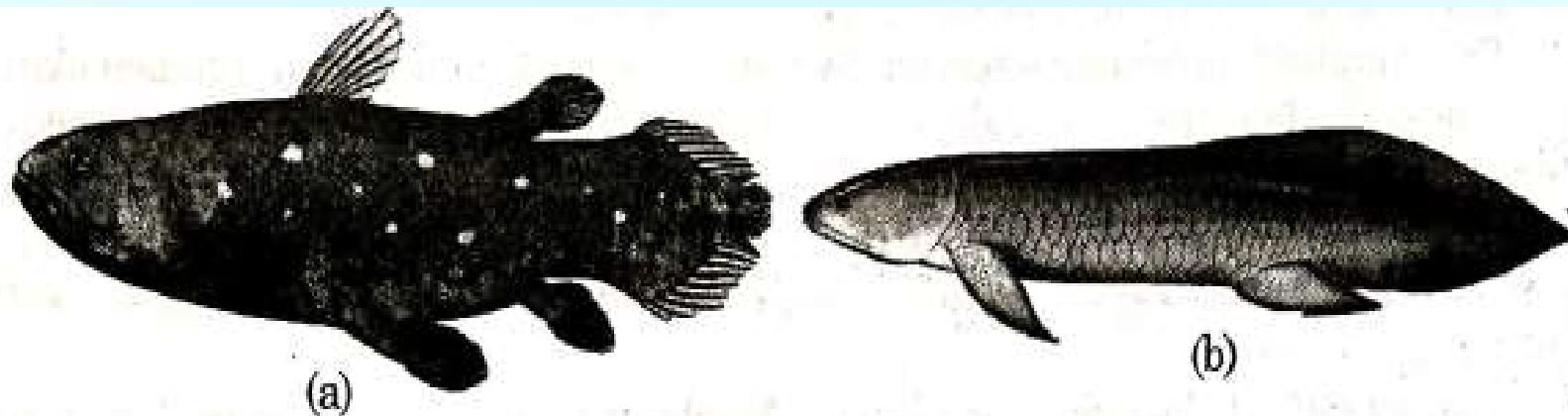


Fig. 1.19. *Kalla fish*.

- (i) Body generally covered by cycloid, ctenoid or ganoid scales. In some cases, scales are absent.
- (ii) Spiracles generally absent.
- (iii) External nares situated at the top of the head; internal nares absent.
- (iv) The conus arteriosus in heart is much reduced but bulbus arteriosus well developed.
- (v) Tail fins homocercal or heterocercal.

**Subclass Sarcopterygii (Fleshy-finned fishes):** Sarcopterygians are known as fleshy-finned fishes, consisting of living and fossil lungfishes and coelacanths, and related extinct fishes. Members of this group are characterized by lobed paired fins, joined to the body by a single bone and two dorsal fins with separate bases. The fins of sarcopterygians differ from those of all other fish in that each is borne on a fleshy, lobe like, scaly stalk extending from the body. Pectoral and pelvic fins have articulations resembling those of tetrapod limbs. These fins evolved into legs of the first tetrapod land vertebrates, amphibians. General characteristics are—

- (i) Each median fin is provided with a median outgrowth, covered by scales.
- (ii) Body covered by **cosmoid scales**. They are composed of a layer of dense, lamellar bone called isopedine, above which is a layer of spongy bone supplied with blood vessels. The bone layers are covered by a complex dentine layer called cosmine and a superficial outer coating of vitrodentine.
- (iii) Swim bladders are transformed into lungs.
- (iv) Olfactory sacs remain connected to buccal cavity by internal nares or **choanae**. Due to presence of choanae, the animals are known as **Choanichthyes**.



**Fig. 1.20.** *Sarcopterygians* ; (a) *Coelacanth*, (b) *Australian Lung fish*.

- (v) Primitive forms had heterocercal tail but recent forms possess have diphyccercal tail.
- (vi) Dorsal fin reduced.
- (vii) Vertebral column extended up to the tip of the tail, thus dividing it into two equal upper and lower lobes.

**Examples :** This Subclass is divided into two Orders- **Crossopterygii** or **lobe-fin fishes** and **Dipnoi** or **lungfishes**. At present, this Subclass has only four living Genus, of which the crossopterygian is the Coelacanth—*Latimeria* (a living fossil) and the examples of dipnoans are- Australian *Neoceratodus*, South American *Lepidosiren* and African *Protopterus*.

### Comparison between Chondrichthyes and Osteichthyes

Features	*Chondrichthyes	*Osteichthyes
1. Habitat	Mostly marine.	Both fresh water and marine.
2. Exoskeleton	The body is covered by placoid scales. The teeth are modified placoid scales.	The body is provided with thin overlapping scales. The scales are of cosmoid, ganoid, cycloid or ctenoid types.
3. Caudal fin	The caudal fin is upturned and asymmetrical (Heterocercal).	Symmetrical (Homocercal). The caudal fin may be secondarily isocercal, gephyrocercal, abbreviated homocercal or diphyccercal.
4. Topography of mouth	The mouth is situated on the ventral surface of the head. The position is actually sub-terminal.	The mouth lies terminally.



<b>Features</b>	<b>*Chondrichthyes</b>	<b>*Osteichthyes</b>
<b>5. Gill-openings</b>	In most of the fishes, except in certain primitive sharks, there are usually five pairs of gill-openings. In holocephalans, operculum is developed.	The gill-openings are covered by operculum so that a single exit is visible on each side.
<b>6. Spiracles</b>	In all the rays and some sharks, a pair of spiracles open just behind the eyes.	Spiracular openings are absent.
<b>7. Claspers</b>	The males are provided with claspers to introduce sperms into the genital tracts of females.	The claspers are absent.
<b>8. Endoskeleton</b>	Cartilaginous, Membrane bones are present.	Mostly bony. Membrane bones are absent.
<b>9. Jaw suspension</b>	Hyostylic.	Mostly amphistylic.
<b>10. Intestine</b>	Short and its lumen contains complicated spiral valve.	Long and devoid of spiral valve.
<b>11. Cloaca</b>	Present.	Absent.
<b>12. Swim-bladder</b>	Absent.	Present.
<b>13. Eggs</b>	Females lay a few large eggs or give birth to live youngs.	Females lay numerous small eggs.
<b>14. Fertilization</b>	Internal.	The eggs and sperms are shed into the surrounding water and fertilization is external.
<b>15. Cerebral hemispheres</b>	Undivided.	Divided—two in number.
<b>16. Restiform bodies</b>	Present.	Absent.
<b>17. Ampulla of Lorenzini</b>	Present.	Absent.
<b>18. Retina</b>	Lacks cones.	Cones are present.