

Subphylum Vertebrata:

- (L., 'vertebratus' = backbone).
- Notochord supplemented or replaced by a vertebral column or backbone comprising of overlapping vertebrae. Body divisible into head, neck, trunk and tail.
- Usually dioecious.
- Vertebrata is the largest chordate subphylum including about 45,000 species.
- **The Subphylum Vertebrata is divided into two divisions:**
 1. Agnatha and 2. Gnathostomata .

Agnatha and Gnathostomata:

TABLE 1.4. CONTRASTING CHARACTERS OF AGNATHA AND GNATHOSTOMATA.

Division I. Agnatha	Division II. Gnathostomata
1. True jaws absent.	1. True jaws present.
2. Paired appendages absent.	2. Paired appendages (pectoral and pelvic) present.
3. Internal ear with 2 semicircular canals.	3. Internal ear with 3 semicircular canals.
4. Notochord persistent in adults.	4. Notochord persists or replaced by vertebrae.

Division I. Agnatha:

- (Gr., a = not; gnathos = jaw). Jawless fish-like vertebrates without true jaws and paired limbs.
- **Class 1. Ostracodermi:**
 - (Gr., ostrakon = shell; derma = skin).
 - Several extinct orders of ancient primitive heavily armoured. Palaeozoic, **world's first vertebrates**, collectively called the **ostracoderms**.
 - Examples – *Cephalaspis*, *Pteraspis*, *Birkenia*, *Thelodus*.
- **Class 2. Cyclostomata:**
 - (Gr., cyclos = circular; stoma = mouth).

- Body eel-like, long, cylindrical, skin smooth; without scales, jaws and lateral fins. Mouth rounded and suctional. Gills 5 to 16 pairs. Heart 2-chambered. Parasites and scavengers. About 50 species.
- Examples- Lampreys (*Petromyzon*) and hagfishes (*Myxine*).

Division II. Gnathostomata:

- (Gr., gnathos = jaw; stoma = mouth). Jawed vertebrates having true jaws and paired limbs.
- **Gnathostomata** has been further divided into two **superclasses**:
- 1. Pisces and
- 2. Tetrapoda.
- All the fishes and fish-like aquatic gnathostomes are in the superclass Pisces, whereas all the four-footed terrestrial gnathostomes are included in the superclass Tetrapoda.

Pisces vs Tetrapoda:

TABLE 1.5. CONTRASTING CHARACTERS OF SUPERCLASS PISCES AND TETRAPODA.

Superclass 1. Pisces	Superclass 2. Tetrapoda
1. Exclusively aquatic gnathostome vertebrates.	1. Aquatic or terrestrial. Some arboreal and aerial.
2. Paired limbs, if present, as fins.	2. Paired pentadactyle limbs present.
3. Median fins present.	3. Median fins absent.
4. Skin usually moist and scaly.	4. Skin usually dry not cornified (without scales).
5. Respiration aquatic, by gills.	5. Respiration aerial, by lungs.
6. Sense organs functional in water.	6. Sense organs function in air.

Superclass 1. Pisces:

- (L., piscis = fish). Fishes or fish-like aquatic forms with paired as well as median fins, gills and scaly skin.
- **Class 1. Placodermi:** Several extinct orders of primitive earliest jawed fishes of Palaeozoic with bony head shield. Placoderms. A full-sized functional gill-arch precedes hyoid arch. Examples – *Climatius*, *Dinichthys*.
- **Class 2. Chondrichthyes:** (Gr., chondros = cartilage; ichthys = fish).

- Mostly marine. Cartilaginous endoskeleton. Skin with minute placoid scales. Gill-slits not covered with operculum. Mouth and 2 nostrils ventral. Males with claspers. Cartilaginous fishes. Approximately 600 species. Examples- *Scoliodon* (dogfish), *Chimaera* (ratfish).
- **Class 3. Osteichthyes:** (Gr., osteon = bone; ichthys = fish).
- Freshwater and marine. Bony endoskeleton. Skin having various types of scales (cycloid, ctenoid) other than placoid. Gill-slits covered with operculum. Males without claspers. Bony fishes. Approximately 20,000 species. Examples – *Labeo* (rohu), *Protopterus* (lungfish), *Hippocampus* (sea horse).

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Superclass 2. Tetrapoda:

- (Gr., tetra = four; podos = foot). Land vertebrates with two pairs of pentadactyle limbs, cornified skin with lungs.

Ectotherms / Poikilotherms / Heterotherms

- **Class 1. Amphibia:** (Gr., amphi = both; bios = life).

Larval stage usually aquatic and breathes by gills. Adults typically terrestrial and respire by lungs. Living forms with moist glandular skin, no external scales. Typically 2 pairs of limbs,

nostrils connecting mouth cavity. Heart 3-chambered. Amphibians. Approximately 2,500 species. Examples- *Rana* (frog), *Bufo* (toad), *Ambystoma* (salamander).

- **Class 2. Reptilia:** (L., reptilis = covering).

Terrestrial and aquatic tetrapods. Skin dry covered by ectodermal horny scales or scutes. Limbs typically 4, each with 5 clawed toes. Skeleton bony. Heart incompletely 4-chambered. Cold blooded. Respiration by lungs. Approx. 7,000 species. Examples- *Hemidactylus* (wall lizard), *Uromastix* (spiny-tailed lizard), *Naja* (cobra), *Sphenodon* (tuatara), *Crocodylus* (crocodile).

Endotherms / Homeotherms:

- [Endotherms, produce their own heat]
- [Homeotherms, keep body temperature constant]
- **Class 3. Aves:** (L., avis = bird).
- Body covered with feathers. Forelimbs modified as wings usually adapted for flight. Hind limbs for walking, perching or swimming. No teeth in beak. Heart 4-chambered. Lungs compact, with air-sacs. Warm blooded. Birds. About 9,000 species. Examples - *Struthio* (African ostrich), *Columba* (pigeon), *Gallus* (fowl).
- **Class 4. Mammalia:** (L., mamma = breast).
- Body usually covered with hair. Skin with various glands. Female with mammary glands which secrete milk for suckling the young. Heart 4-chambered. Warm blooded, air breathing vertebrates. Mammals. Approximately 4,500 species. Examples - *Echidna* (spiny anteater), *Macropus* (kangaroo), *Rattus* (rat), *Homo* (man).