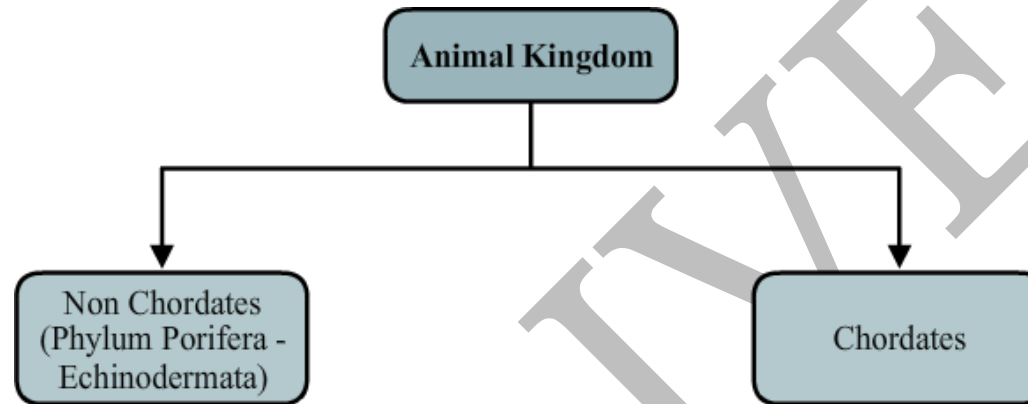


Animal Kingdom



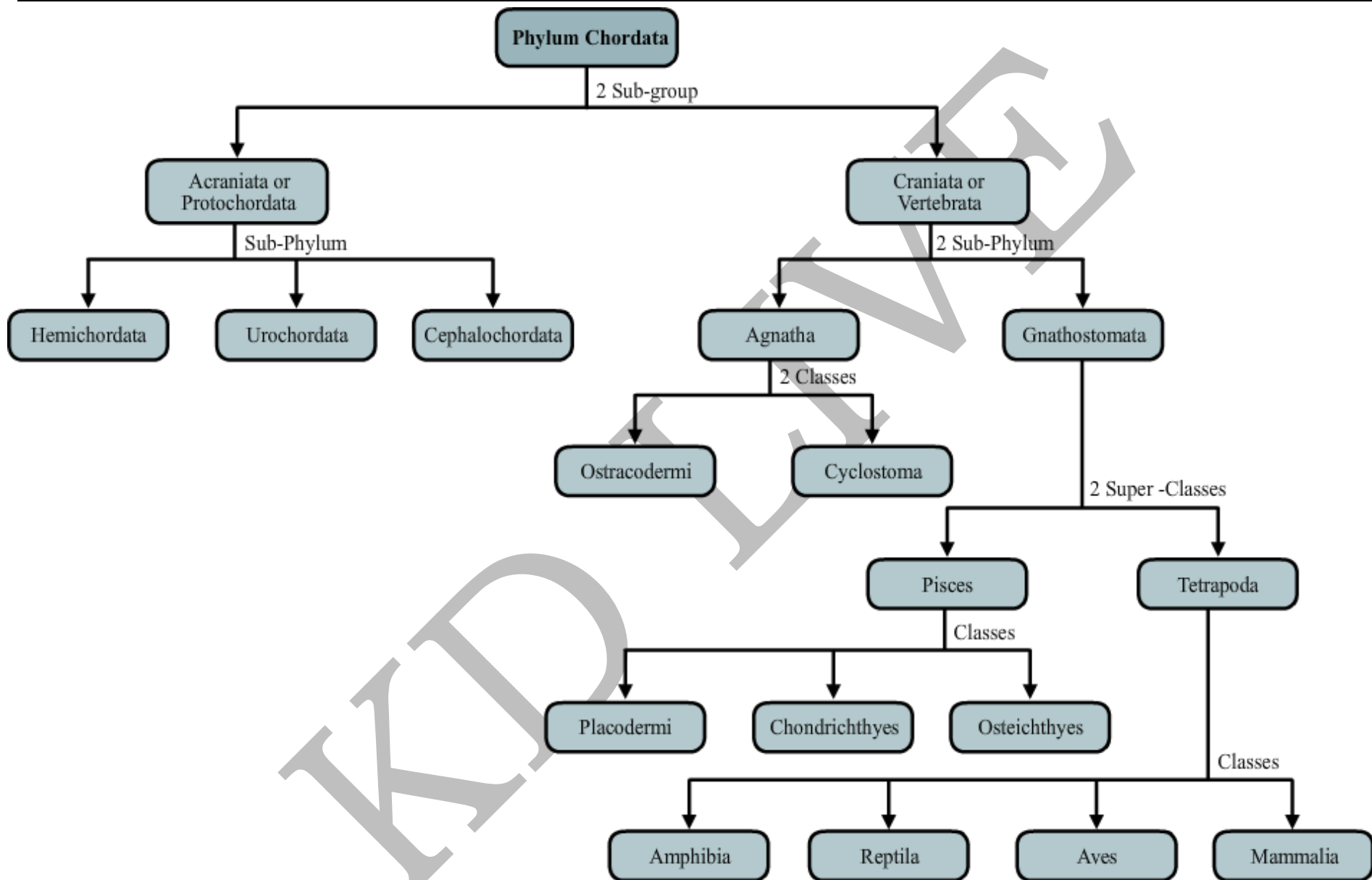
| Features | Porifera | Cnidaria (Coelenterata) | Ctenophora | Platyhelminthes | Aschelminthes | Annelida |
|------------------------------|---|--|--|---|---|---|
| Level of organisation | Cellular | Tissue | Tissue | Organ and Organ system | Organ and Organ system | Organ and Organ system |
| Body symmetry | Asymmetrical | Radially Symmetrical and diploblastic | Radially Symmetrical and diploblastic | Bilaterally symmetrical and triploblastic | Bilaterally symmetrical and triploblastic | Bilaterally symmetrical and triploblastic |
| Coelom | Acoelomate | Acoelomate | Acoelomate | Acoelomate | Pseudocoelomate | Schizocoelomates |
| Segmentation | Absent | Absent | Absent | Absent | Absent | Metameric segmentation |
| Digestive system | Absent (Intracellular mode of digestion) | Blind sac body plan with incomplete (Extracellular and intracellular) digestion | Blind sac body plan with incomplete (Extracellular and intracellular) digestion | Blind sac body plan with Incomplete digestion | Tube within tube body plan with complete alimentary canal and well developed muscular pharynx | Tube within tube body plan with complete digestive system |

| | | | | | | |
|---------------------------|---|--|--|--|---|---|
| Circulatory system | Absent (Distribution of food by amoebocytes) | Absent | Absent | Absent | Absent | Closed circulatory system (but in leeches, open type circulatory system is present) |
| Respiratory system | Absent (Exchange of gases by diffusion) | Absent | Absent | Absent | Absent | Absent |
| Excretory system | Absent (Removal of metabolic waste as ammonia by diffusion) | Absent | Absent | Peculiar flame cells or solenocytes for excretion and osmoregulation | An excretory tube removes body waste by excretory pore; excretory cells called Renette cells involved in excretion | Nephridia help in osmoregulation and excretion |
| Reproduction | 1. Asexual mode of reproduction - Budding and Gemmules 2. Internal Fertilization | 1. Asexual mode of reproduction - Budding 2. Alternation of generation or metagenesis | Only sexual mode of reproduction with external fertilization | 1. Asexual mode of reproduction by transverse binary fission 2. Internal fertilization. | Sexual reproduction with separate sexes (dioecious) with internal fertilization | Sexual reproduction with both dioecious and monoecious forms |
| Development | Indirect development (larva - Amphiblastula or Parenchymula) | Direct/Indirect development | Indirect development | Indirect with one or more larval stages | 1. Direct or indirect development 2. Protostomic development as the first opening to develop in embryonic digestive tube is mouth and anus develops later. | 1. Direct development (no larvae or metamorphosis in earthworms and leeches) as well as indirect development with Trochophore larvae in Polychaeta. 2. Protostomic development as the first opening to develop in embryonic digestive tube is mouth and anus develops later. |

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|-------------------------|------------------------------------|--|---|----------------------|---------------------------|------------------------------|
| Special features | Complex system of pores and canals | Cnidoblast for anchorage, defence or capture of prey | Bioluminescence and presence of eight median comb plates as locomotory organs | Regeneration ability | Worm-shaped and elongated | Body segmentation like rings |
|-------------------------|------------------------------------|--|---|----------------------|---------------------------|------------------------------|

| Features | Phylum – Mollusca | Phylum – Arthropoda | Phylum - Echinodermata |
|------------------------------|---|---|---|
| Level of organisation | Organ and Organ system | Organ and Organ system | Organ and Organ system |
| Body Symmetry | Bilaterally symmetrical and Triploblastic | Bilaterally symmetrical and Triploblastic | Bilateral symmetry in larvae and pentamerous radial in adults, and Triploblastic |
| Coelom | Schizocoelomates | Schizocoelomates | Entereocoelomates |
| Body Structure | 1. Unsegmented with distinct head, muscular foot and visceral hump. 2. Body is covered by skin fold mantle which secretes the shell of calcium carbonate that protect and supports their soft tissues. | 1. Body is covered by chitinous cuticle (exoskeleton). 2. Body is divided into head, thorax and abdomen (thoracic segments have legs and wings in insects) | Body surface bears calcareous spines as tubercles. |
| Circulatory system | Open, respiratory pigment – Haemocyanin | Dorsal heart, Open, body cavity is full of haemolymph called haemocoel | Open type with haemal and perihemal system; blood without respiratory pigment |
| Respiratory system | Gills, Pulmonary sac or both and body surface | Gills, body surface, book gills, book lungs or tracheal system | Dermal branchia or papulae in star fish, peristomial gills in sea urchin, genital bursae in brittle stars and cloacal respiratory trees in holothurians |

| | | | |
|----------------------------|---|--|---|
| Excretory system | Paired organ of Bojanus; another excretory organ as Keber's organ (pericardial gland) | Green glands or Malpighian tubules | No specialised excretory organ, nitrogenous waste diffuse out via gills or dermal branchia |
| Sense organ | Eyes, Statocysts and Osphradia (Chemoreceptor to test chemical nature of water) | Antennae, statocysts or balance organs and sound receptors, compound eyes, gustatory receptors (honey bees, butterflies, moth and insects) | |
| Reproductive System | Usually dioecious and oviparous with indirect development. Free larval form as Trochophore, Veligar (in <i>Pila</i>) | Mostly oviparous but in scorpion, eggs hatch within female body and bring forth their young ones and are viviparous. Internal fertilization with direct or indirect development | Indirect development (Bipinaria and brachiolaria larva in star fish) |
| Special Features | Mouth contain feeding organ as radula, armed with rows of chitinous teeth and worked back and forth to rasp the food into fine particles. | On the basis of mode of development, insects are divided into four groups as Ametabolous (without metamorphosis) Paurometabolous (gradual metamorphosis) Hemimetabolous (Incomplete metamorphosis) Holometabolous (Complete metamorphosis) | <p>1. Tube within tube plan with deuterostomic and enterocoelom, mesodermal skeleton made up of calcareous plates. These three characters make echinoderms closer to chordates.</p> <p>2. Ambulacral system (water vascular system) is a characteristic feature.</p> <p>3. Retrogressive metamorphosis as bilateral symmetry in larvae and pentamerous radial in adults</p> |



Phylum Chordata

General Characteristics of Chordates

- Bilateral symmetry, triploblastic organisation, and true coelom.
- Organ system level of organisation.
- Closed circulatory system.
- Ventral heart.

Essential Characteristics of Chordates

- Presence of notochord (at least at some stage of life).
- Presence of dorsal hollow nerve cord.
- Presence of paired pharyngeal gill slits.
- Presence of post anal tail.

Sub Group 1. Acraniata or Protochordata

| Protochordata (No brain box or cranium) (Notochord may persist throughout life and is not replaced by vertebral column) | | | |
|--|--|--|---|
| Features | Hemichordata | Urochordata | Cephalochordata |
| General Characteristics | Worm-like marine triploblastic and coelomate animals with bilateral symmetry and organ-system level of organization. Body-Cylindrical (anterior proboscis, collar, and a long trunk with anus). | Exclusively marine and mostly sedentary. Solitary or can be colonial; triploblastic and coelomate animals with bilateral symmetry and organ-system level of organization. | Marine and mostly sedentary, lie buried with the anterior body projecting above the sand Body small, fish-like and transparent, triploblastic and coelomate animals with bilateral symmetry and organ-system level of organization |

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|---------------------------|--|--|---|
| Notochord | Absence of notochord and post anal tail (Earlier considered as chordates because of stomochord). Stomochord is a hollow outgrowth, arises from the roof of buccal cavity called 'buccal diverticulum'. | Notochord present only in larval tail, disappears in adult. | Notochord extends from rostrum to tail, Persists throughout life. |
| Digestive System | Complete Digestive system. | Ciliary feeders with complete alimentary canal | Digestive tract complete with large pharynx and numerous gill slits |
| Circulatory System | Open Circulatory system. | Open, Heart – present | Closed without heart and respiratory pigment |
| Respiratory System | Paired pharyngeal gills and dorsal gill slits. | gill slits | Pharyngeal gill slits are more numerous and better developed |
| Excretory System | Proboscis gland. | Excretion by neural gland, pyloric gland and nephrocytes. | Protonephridia and Solenocyte cells. |
| Reproduction | Sexes-separate, Fertilization – external, Development – indirect (presence of tornaria larva). | Mostly hermaphrodites, Fertilisation-cross and external Asexual reproduction through budding | Sexual, sexes separate, Fertilisation – external, Development – Indirect |
| Special Features | Half chordates; believed to be connecting link between non-chordates and chordates. Dorsal heart, ventral nerve cord and no respiratory pigment. | Larva undergo Reterogressive metamorphosis, i.e., change from better developed larva to less developed adult. In adults, Dorsal ganglion is formed from dorsal tubular nerve cord of larva. | Dorsal nerve cord lacking ganglia and brain. Lacks head and paired appendages, although median fins are present. |
| Examples | <i>Balanoglossus</i> (acorn or tongue worm), <i>Saccoglossus</i> . | <i>Doliolum</i> , <i>Herdmania</i> (sea squirt), <i>Ascidia</i> , <i>Salpa</i> | <i>Branchiostoma</i> , (Amphioxus or Sea Lancelet) |

Sub Group 2. - Vertebrata

- Notochord replaced by vertebral column in adult
- Complete Digestive tract
- Gills, skin and lungs as Respiratory system
- Closed, ventral heart (2, 3 or 4 chambered) as circulatory system
- Paired kidneys as excretory system
- Nervous system – CNS and PNS, Sense organs and Chemical coordination
- Sexual mode of reproduction with separate sexes.
- Internal or External Fertilization.

Sub Phylum 1. Agnatha

Class – Cyclostomata (Jawless Fishes)

- Ectoparasites with sucking and circular mouth. The body is devoid of scales and paired fins. Head and brain are poorly developed.
- Cranium and vertebral column are cartilaginous with persistent notochord
- Respiration – gill slits
- Circulation – closed, Heart – 2 chambered
- Cranium and vertebral column – cartilaginous
- Reproduction: Sexes (separate or united)
- Fertilization – external,
- Development – direct or indirect
- Example: *Petromyzon* (lamprey), *Myxine* (hagfish)

Sub Phylum 2. Gnathostomata

Advanced Vertebrates with following features like embryonic notochord is usually replaced by vertebral column, Paired fins or limbs are present, paired nostrils are found and internal ear has three semicircular canal. Gnathostomata are divided into two super classes as Pisces and Tetrapoda.

Superclass 1. - Pisces

Class 1. - Chondrichthyes

- Cartilaginous endoskeleton
- Poikilothermous
- Notochord present in young and replaced by cartilage in adults
- Presence of placoid scales

- Heart – 2 chambered
- Respiration – gills are not covered with operculum (with exception)
- Pelvic fin in males bear claspers
- Ureotelic
- Reproduction – Sexes-separate, Fertilisation-internal, oviparous or ovoviviparous
- Examples: *Carcharodon* (Great white shark), *Scoliodon* (Dog fish), *Torpedo* (electric ray), *Trygon* (sting ray), *Chimaera* (rabbit- or rat-fish)

Class 2. Osteichthyes

- Bony endoskeleton in adult stage
- Poikilothermic with 2-chambered heart (lung fishes have 3-chambered heart)
- Presence of cycloid, ctenoid or ganoid scales
- Air bladder is usually present
- Gills covered with an operculum
- Ammonotelic
- Sexes – separate, Fertilisation-external, oviparous (some fishes exhibit parental care)
- Examples: *Exocoetus* (flying fish), *Hippocampus* (sea horse) are marine; *Labeo* (rohu), *Catla* (carp), *Clarias* (cat fish or magur) are fresh water forms

Superclass 2. Tetrapoda

Class 1. Amphibia

- First vertebrates to invade land but not fully adapted to life on land (amphibious)
- Thin and moist skin (glandular), scales generally absent
- Poikilothermic
- 3-chambered heart (2 auricles and 1 ventricle)
- Body divided into head and trunk; adult forms lack tail
- Generally, 2 pairs of pentadactyl limbs (4 or 5 digits)
- Tympanum represents ear
- Gaseous exchange through gills in young ones while through lungs or moist skin surface in adults
- Larvae ammonotelic while adults ureotelic
- Reproduction – Sexual, sexes separate, external fertilisation (need water), oviparous.
- Development – external and indirect (metamorphosis)

Adaptations for Land Life

- Pentadactyl limbs
- Presence of eyelids and tear glands
- Two auricles
- True tongue
- Ureotelic

For True Land Animals

- Epidermal scales on skin (keratinized skin)
- Internal fertilisation
- Shell around egg and amnion around embryo

Class 2. Reptiles

- Mostly terrestrial
- Skin – Thick, rough, dry, presence of scales or scutes (non-glandular)
- Poikilothermi
- Exhibit moulting (snakes and lizards)
- Body divided into head, neck, trunk and tail
- Limbs – 2 pairs, directed outwards (if present)
- Respiration through lungs
- Excretion – Uricotelic, crocodiles – ammonotelic and alligators and turtles – ureotelic
- Heart incompletely four-chambered (exception, crocodile: 4-chambered heart)
- Reproduction – Sexual, sexes separate, internal fertilisation and external direct development.
- Eggs macrolecithal with calcareous shells.

Class 3. Aves

- Presence of feathers and majority can fly.
- Skin – Dry and non-glandular (except for oil gland on tail)
- Body – streamlined, divisible into head, neck, trunk and tail
- Limbs – 2 pairs, forelimbs modified into wings, hindlimbs – 1 to 4 digits
- Homeothermic with four-chambered heart
- Endoskeleton -Bony, light (pneumatic bones)

-
- Lungs possess air sacs
 - Uricotelic
 - sexes separate, internal fertilisation and external development
 - Lay amniotic, cleidoic egg

Advancement Over Reptiles

- Homeothermy
- High metabolic rate
- Efficient respiration
- Complete separation of oxygenated and deoxygenated blood

Class 4. Mammalia

- Diverse habitat
- Presence of mammary glands
- Two pairs of limbs with different adaptations
- Glandular skin with hair and Presence of external ear (pinnae)
- Endoskeleton-bony; Skull-dicondylic
- Homeothermous and 4 chambered heart
- Brain has large cerebrum and cerebellum, 12 pair of cranial nerves
- Digestion – Starts in the buccal cavity itself, Thecodont, Diphyodont, Heterodont, Alimentary canal opens outside by anus
- Respiration – through lungs
- Excretion – By kidneys, Ureotelic
- Reproduction – Sexes-separate, Fertilisation – Internal, Viviparous (with few exceptions), Development – direct.

Sub Class 1 - Prototherians

- Primitive, reptile-like
- Egg-laying mammals
- Found in Australia and Tasmania
- Example: Duck-billed Platypus, Echidna (spiny ant eater)

Sub Class 2 - Marsupials

- Mother has marsupium (brood pouch) on her belly
- Found in Australia and Tasmania
- *Example: Macropus* (Kangaroo)

Sub Class 3 – Eutherians

- Includes modern viviparous mammals
- Have true allantoic placenta, pinna and mammary glands