CHAPTER

04

ANIMAL KINGDOM

- As over a million (10 Lakh) species of animals have been described till now, the need for classification becomes all the more important.
- Animals are multicellular and heterotrophic organisms without cell wall and chlorophyll.
- Kingdom Animalia includes **11 major phyla**:

1) Porifera
2) Cnidaria/Coelenterata
3) Ctenophora
4) Platyhelminthes
5) Aschelminthes
6) Annelida
7) Arthropoda
8) Mollusca
9) Echinodermata
10) Hemichordata
11) Chordata

BASIS OF CLASSIFICATION

1. LEVELS OF ORGANISATION

Based on this, animals are grouped into following levels:

01 **Cellular level of organisation:** Here, the cells are arranged as loose cell aggregates. E.g. Porifera.

Tissue level of organisation: Here, the cells are arranged into tissues. E.g. Cnidarians and Ctenophores. 02

03 **Organ level of organisation:** Here, tissues are arranged into organs to performs a specific function. E.g. Platyhelminthes

Organ system level of organisation: Here, organs are associated to form organ system and each system performs physiological function. E.g. Aschelminthes to chordates. 04

Organ systems of different animals show complexities. E.g.

1) **Digestive system :** It is of two types-
   (a) **Incomplete type :** It has only a single opening that acts as mouth & anus. E.g. Cnidaria and Platyhelminthes.
   (b) **Complete type :** It has 2 openings (mouth & anus). E.g. Higher animals.
2) **Circulatory system :** It is of two types -
   (a) **Open type :** In which tissues in cells bath into the blood. E.g. Cockroach
   (b) **Closed type :** In which blood circulation occurs inside the vessels. E.g. Higher animals

2. BODY SYMMETRY

It is the arrangement of similar body parts on 2 sides of main axis of the body. Based on symmetry, animals are of 2 types: Asymmetrical and Symmetrical.

Asymmetrical: Here, body cannot be divided into 2 equal halves. E.g. Poriferans, Snails etc.

Symmetrical: Here, body can be divided into 2 equal halves. It is of 2 types: **Radial symmetry & Bilateral symmetry**

A **Radial symmetry:** Here, body can be divided into 2 equal halves by any plane along central axis (oral-aboral axis) of the body. E.g. some Poriferans, Ctenophores and Echinoderms (adult).

B **Bilateral symmetry:** Here, body can be divided into right & left halves in only one plane. E.g. Platyhelminthes to Chordata (except adult Echinodermata).

- The body of bilaterally symmetrical animal has a **dorsal side** (upper), a **ventral side** (lower), left & right **lateral sides, anterior** (cephalic) side and posterior (anal or tail) side.

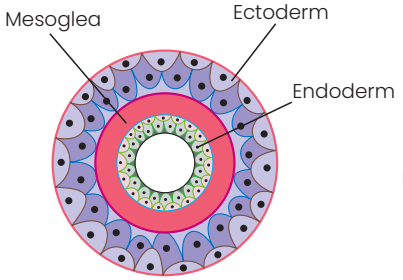
3. GERMINAL LAYERS (EMBRYONIC LAYERS)

- These are layers of embryo from which all the body organs are formed.
- Based on the number of germ layers, animals are of 2 types- Diploblastic and Triploblastic.

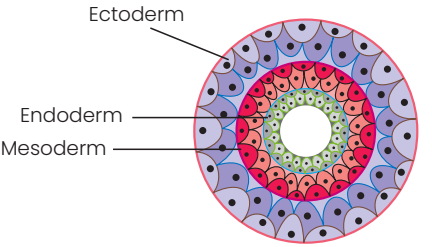
A **Diploblastic animals:** 2 germ layers- outer ectoderm and inner endoderm. In between these layers, an undifferentiated jelly-like layer called **mesoglea** is present. E.g. Porifera, Cnidaria & Ctenophora.

B **Triploblastic animals:** 3 germ layers- Outer ectoderm, middle mesoderm and inner endoderm. E.g. Platyhelminthes to Chordata. **(AIPMT 2010)**

Diploblastic organisation

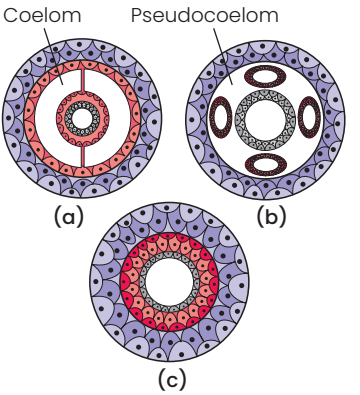


Triploblastic organisation



4. COELOM (BODY CAVITY)

- It is the cavity lined by mesoderm. It is seen between body wall and gut wall. Coelom separates the muscles of gut and body wall.



Based on the nature of coelom, animals are of 3 types:

(a) **Acoelomate:** No coelom. The space between body wall and digestive cavity is filled with matrix. E.g. Porifera to Platyhelminthes.

(b) **Pseudocoelomate:** False coelom. Here, the body cavity is not lined by mesoderm. Mesoderm is present as scattered pouches in between the ectoderm and endoderm. E.g. Aschelminthes. **(AIPMT 2010)**

(c) **Coelomate:** True coelom. Here, the coelom arises from the mesoderm. Coelom is lined by peritoneal layer and filled with coelomic fluid. E.g. Annelida to Chordata.

FUNCTIONS OF COELOM

1. Coelomic fluid reduces friction between visceral organs.
2. It acts as shock absorber.

5. METAMERISM (SEGMENTATION)

- It is the phenomenon in which the body or organs is externally and internally divided into repeated segments (metameres). E.g. Annelids (earthworm, etc.), Arthropods. **(AIPMT 2006)**

6. NOTOCHORD

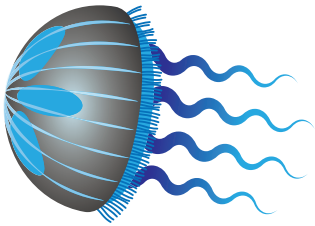
- It is a mesodermally derived supporting rod formed on the dorsal side during embryonic development in some animals. Animals with notochord are called **chordates** and those without notochord are called **non-chordates**.

Features	Porifera (Sponges)	Cnidaria (Coelenterata)	Ctenophora (Comb jellies or Sea walnuts)
Levels of organisation	Cellular	Tissue	Tissue
Symmetry	Asymmetrical, some are radial	Radial	Radial
Germ layers	Diploblastic	Diploblastic	Diploblastic
Coelom	Acoelomate	Acoelomate	Acoelomate
Habit and habitat	Aquatic (mostly marine), sedentary, solitary/colonial	Aquatic (mostly marine), sessile/ free swimming, solitary/colonial	Exclusively marine, solitary & pelagic
Digestive system	Absent, intracellular digestion	Incomplete, intracellular & extracellular digestion	Incomplete, intracellular and extracellular digestion
Respiratory system	Absent	Absent	Absent
Circulatory system	Absent	Absent	Absent

Reproduction	Asexual (fragmentation) & sexual, hermaphrodite, internal fertilization, development is indirect	Polyp reproduces asexually (budding) and medusa sexually, most are separate sexes, external fertilization, development is indirect	Only sexual, hermaphrodite, external fertilization, development is indirect
Unique features	Water canal (water transport) system, **(AIPMT 1999)** Water enters through millions of ostia into spongocoel & canals are lined with choanocytes (collar cells), **(NEET 2017)** body is supported by spicules and spongin fibres	Tentacles with cnidoblasts, a gastro-vascular cavity (coelenteron) with an opening (mouth) on hypostome, polyp & medusa forms are seen, some shows alternation of generation, **(AIPMT 2015)** corals have skeleton composed of ($CaCO_3$)	Locomotion is by 8 vertical external rows of ciliated comb plates, tentacles present, shows bioluminescence
Examples	*Sycon* (Scypha), *Spongilla* (fresh water sponge), *Euspongia* (Bath sponge)	*Hydra, Obelia, Aurelia, Physalia* (Portugese man of war), *Adamsia* (Sea-anemone), *Pennatula* (Sea pen), *Gorgonia* (Sea fan), (Brain coral) etc.	*Ctenoplana, Pleurobrachia*

- ***Hydra*** : In *hydra* nerve cells are present but brain is absent. **(AIPMT 2002)**
- **Alternation of generation (Metagenesis):** The phenomenon in which polyps produce medusae asexually and medusae form the polyps sexually. E.g. *Obelia*.
- **Hermaphrodite:** Male and female sex organs are seen in same individual.
- **Tentacles:** Finger-like structures which surrounds the mouth of coelenterates. Used for food capture & defense.

Polyp & Medusa: 2 types of body forms in cnidarians.



- Polyp is tubular attached asexual form, with upwardly directed mouth & tentacles. E.g. *Hydra*, *Adamsia*.
- Medusa is umbrella like, free-swimming sexual form, with downwardly directed mouth & tentacles. E.g. *Aurelia* (Jelly fish).
- **Bioluminescence:** It is the property of some animals to emit light from the body. E.g. *Pleurobrachia* (comb jelly)

Features	Platyhelminthes (Flatworms)	Aschelminthes [Roundworms]	Annelida	Arthropoda
Levels of organisation	Organ	Organ system	Organ system	Organ system
Symmetry	Bilateral	Bilateral	Bilateral	Bilateral
Germ layers	Triploblastic	Triploblastic	Triploblastic	Triploblastic
Coelom	Acoelomate **(NEET 2020)**	Pseudocoelomate	Coelomate	Coelomate
Habit and habitat	Mainly aquatic, endoparasites, some are free-living	Aquatic and terrestrial, free living or parasitic in plants & animals	Terrestrial, fresh water or marine, free living or parasitic	Cosmopolitan, over two third of all named species on earth are arthropods
Digestive system	Incomplete	Complete. Tubular alimentary canal with well-developed muscular pharynx	Complete	Complete
Respiratory system	Absent	Absent	Cutaneous respiration, some have bronchial (gill) respiration	Gills/ book gills/ trachea/book lungs
Circulatory system	Absent	Absent	Closed type	Open type
Reproduction	Asexual (fragmentation) and Sexual, hermaphrodite, internal fertilization, development is indirect (many larval stages)	Dioecious, sexual reproduction, internal fertilization, development is direct or indirect	Sexual, earthworms & leeches are monoecious, *neries* is dioecious, development is both direct & indirect.	Mostly dioecious, usually internal fertilization, mostly oviparous, development is direct or indirect

Unique features	Unsegmented (except tapeworm), dorso- ventrally flattened body (except tape worms), excretion by flame cells (protonephridia), Hooks & suckers in parasitic forms, some absorb nutrients from the host through their body surface	Syncitial epidermis, thick cuticle, an excretory tube to remove body waste through excretory pore, sexual dimorphism (females are longer than males)	True segmentation, longitudinal and circular muscles help in locomotion, locomotory organs are setae (in earthworm) or parapodia (in *Nereis*), excretion by Nephridia, paired ganglia connected by lateral nerves to a double ventral nerve cord	Jointed appendages, body has 3 regions: head, thorax & abdomen, body is covered by chitinous cuticle (exoskeleton), excretion by malpighian tubules, sensory organs are antennae, compound & simple eyes, statocysts (balance organs)
Examples	*Taenia solium* (Tape worm), *Fasciola* (Liver fluke), *Planaria* (shows high regeneration capacity)	*Ascaris* (Roundworm), *Ancylostoma* (Hookworm), *Wuchereria* (Filarial worm)	*Pheretima* (earthworm), *Hirudinaria* (blood sucking Leech), *Nereis*	Spider, Scorpion, Crab, Prawn, Insects etc, **Economically important insects:** *Apis*, *Bombyx*, *Laccifer*, **Vectors:** Mosquitoes (*Anopheles*, *Culex* & *Aedes*), housefly etc, **Gregarious pest**: *Locusta* **Living fossil:** *Limulus* (King crab).

Features	Mollusca (Soft-bodied animals)	Echinodermata (Spiny-skinned animals)	Hemichordata
Levels of organisation	Organ system	Organ system	Organ system
Symmetry	Bilateral	Radial (Bilateral in larval stage) **(AIPMT 2004)**	Bilateral
Germ layers	Triploblastic	Triploblastic	Triploblastic

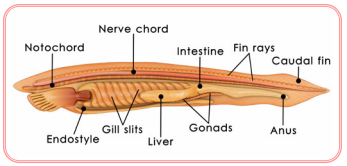
Coelom	Coelomate	Coelomate	Coelomate
Habit and habitat	Aquatic, few are terrestrial	Exclusively marine	Marine
Digestive system	Complete	Complete	Complete
Respiratory system	Gills in aquatic forms and pulmonary sac in terrestrial forms	Dermal branchiae (skin gills or papulae) and tube feet	Gills **(NEET 2017)**
Circulatory system	Open type	Reduced and open type.	Open type
Reproduction	Dioecious, oviparous, development is indirect	Dioecious, external fertilisation, development is indirect, ciliated free-swimming larva	Dioecious, external fertilisation, development is indirect
Unique features	Body has head, visceral mass (visceral hump) and mascular foot, head has sensory tentacles, univalve or bivalve calcareous shell, feather-like gills for respiration & excretion, mantle & radula are seen.	Body is covered with spines for protection, head is absent, calcareous endoskeleton (ossicles) present, water vascular system present, excretory system absent, shows autotomy & regeneration.	**Worm-like** cylindrical body composed of an anterior proboscis, a collar and a long trunk, **proboscis gland**.
Examples	*Pila* (Apple Snail), *Pinctada* (Pearl Oyster), *Sepia* (Cuttlefish), *Loligo* (Squid), *Octopus* (Devil fish), *Aplysia* (Sea Hare), *Dentalium* (Tusk shell), *Chaetopleura* (Chiton)	*Asterias* (Starfish), *Echinus* (Sea Urchin), *Echinocardium, Antedon* (Sea Lily), *Cucumaria* (Sea Cucumber), *Ophiura* (Brittle Star)	*Balanoglossus* (Tongue worm), *Saccoglossus*.

1. **Mollusca** is the second largest phylum.
2. **Radula:** File-like rasping organ present in the mouth of molluscs. It is used for feeding.
3. **Mantle (Pallium):** The membrane which covers visceral mass. Space between the hump and mantle is called mantle cavity.
4. **Water vascular (ambulacral) system:** In this system, sea water enters through a porous plate called madreporite and reaches the radiating canals and tube feet (podia). Its functions are locomotion, respiration, food capture & transport.

5. The larvae of echinoderms are bilaterally symmetrical while adult echinoderms exhibit radial **pentamerous symmetry** **(AIPMT 2004)**

6. Important characteristic that hemichordates share with chordates is pharynx with gill slits **(NEET 2017)**

PHYLUM CHORDATA



- It includes animals with notochord, dorsal tubular nerve cord and paired pharyngeal gill slits. Notochord is a flexible rod located in the mid dorsal line between the alimentary canal and the nerve cord in the embryo.

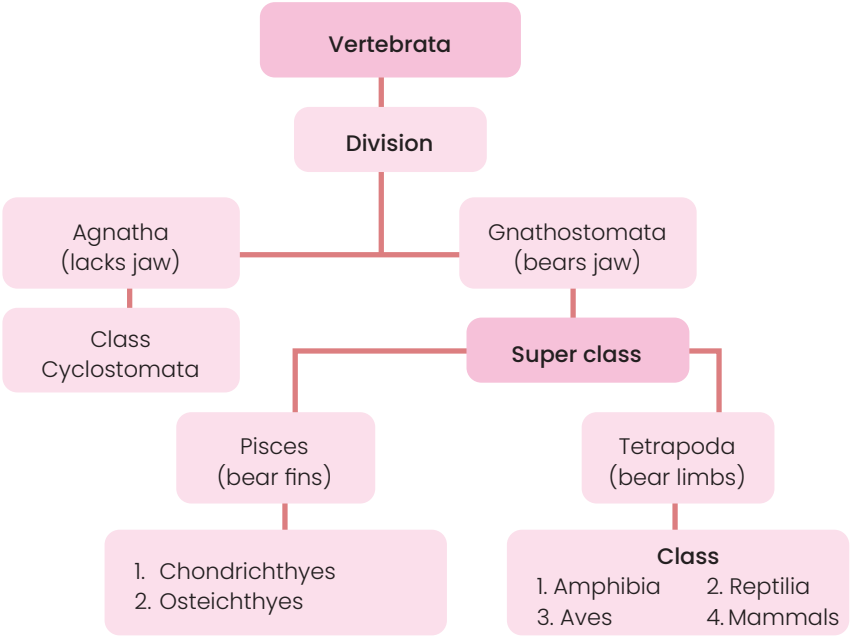
Differences between Chordata and Non-Chordata

Chordata	Non-Chordata
Notochord is found in the embryonic stage	Notochord is absent
Central nervous system is dorsal, hollow and single	Central nervous system is ventral, solid and double
Pharyngeal gill slits present	Gill slits are absent
Ventral heart	Dorsal heart (if present)
A post-anal part (tail) is present	Post-anal tail is absent

- Phylum Chordata is classified into 3 subphyla: Urochordata, Cephalochordata & Vertebrata.

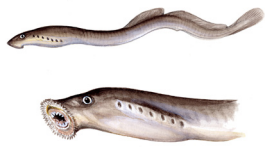
Urochordata (tunicata)	Cephalochordata	Vertebrata (craniata)
Notochord present only in larval tail. Body is covered by test made up of tunicin. Exclusively marine. Hermaphrodite. E.g. *Ascidia*, *Salpa* & *Doliolum*.	Notochord from head to tail region and is persistent throughout the life. Fish- like body. Exclusively marine, sexes are separate. E.g. *Branchiostoma* (*Amphioxus* or *Lancelet*).	Possess notochord during the Embryonic period. **(NEET 2020)** Notochord is replaced by a cartilaginous or bony vertebral column in the adult. Ventral muscular heart. Kidneys for excretion & osmoregulation Paired appendages (fins or limbs). E.g. *Homo sapiens* and *Myxine*

CLASSIFICATION OF VERTEBRATA



CLASS CYCLOSTOMATA

All are ectoparasites on some fishes
Elongated body without scales and paired fins
6-15 pairs of gill slits for respiration
Sucking and circular mouth without jaws **(NEET-II 2016)**
Cartilaginous cranium and vertebral column



Petromyzon

- Circulation is closed type
- Marine, but migrate for spawning to fresh water. After spawning, they die. Their larvae, after metamorphosis, return to ocean.

E.g. *Petromyzon* (Lamprey) and *Myxine* (Hagfish).

SUPERCLASS PISCES (FISHES)

Class Chondricthyes	**Class Osteichthyes**
Marine. Stream-lined body. Predaceous.	Marine & fresh water. Stream-lined body.
Cartilaginous endoskeleton. **(NEET-I 2016)** **Notochord is persistent throughout life.**	Bony endoskeleton.
Ventral mouth.	**Terminal** mouth.
Gill slits **without operculum**. Powerful jaws.	**4 pairs** of gills covered by **operculum** on each side.
Skin with placoid scales. Teeth are modified **placoid scales** which are backwardly directed.	Scales are **cycloid, ctenoid** etc.
No air bladder. So, they have to swim constantly to avoid sinking.	**Air bladder** for buoyancy.
Poikilotherms (cold-blooded).	**Poikilotherms** (cold-blooded).
Two-chambered heart (one auricle and one ventricle).	Two-chambered heart (one auricle and one ventricle).
Sexes are separate. In males, pelvic fins bear claspers. Internal fertilisation. Many of them viviparous.	Sexes are separate. External fertilization. Mostly oviparous. Development is direct.
Examples *Scoliodon* (Dog fish), *Pristis* (Saw fish), *Carcharodon* (Great white shark), *Trygon* (Sting ray has poison sting), *Torpedo* (Electric ray has electric organ).	**Examples** Marine: *Exocoetus* (flying fish), *Hippocampus* (sea horse) Fresh water : *Labeo* (Rohu), *Catla* (Katla), *Clarias* (Magur) Aquarium : *Betta* (Fighting fish), *Pterophyllum* (Angel fish).

SUPERCLASS TETRAPODA

Class Amphibia	Class Reptilia	Class Aves (Birds)	Class Mammalia
They live in aquatic & terrestrial habitats and need water for breeding.	Dry & cornified skin, epidermal scales or scutes. **(NEET 2013)**	Presence of feather and beak. Forelimbs are modified into wings.	Presence of mammary glands (milk producing glands).
Body has head & trunk. Some have tail. Moist skin without scales. Most have 2 pairs of limbs.	Snakes and lizards shed their scales as skin cast. Limbs- 2 pairs (if present). Crawling mode of locomotion.	Dry skin without glands except the oil gland at the base of the tail. Hind limbs have scales and are modified for walking, swimming or clasping tree branches. Long, hollow, pneumatic bones.	Skin with hair. 2 pairs of limbs for walking, running, climbing, burrowing, swimming or flying.
Tympanum represents ear.	Tympanum represents ear.	Tympanum represents ear.	External ear (Pinnae).
3-chambered heart (2 auricles + 1 ventricle).	3-chambered heart (but a septum partially separates ventricle). Heart is 4- chambered in crocodiles.	Heart is 4-chambered	Heart is 4-chambered
Poikilotherms	Poikilotherms	Homoiotherms	Homoiotherms
Alimentary canal, urinary & reproductive tracts open into a cloaca which opens to exterior.	Well-developed alimentary canal.	Digestive tract has additional chambers, the crop & gizzard.	Well-developed alimentary canal. Heterodont, thecodont & diphyodont.
Respiration is by gills (in larva), lungs & skin	Respiration by lungs.	Double respiration. Air sacs connected to lungs.	Respiration by lungs.

Sexes are separate. External fertilisation. Oviparous. Development is indirect.	Internal fertilisation. Oviparous. Development is direct.	Internal fertilisation. Oviparous. Development is direct.	Sexes are separate. Internal fertilisation. Viviparous (except Echidna and Platypus). **(Karnataka NEET 2013)** Development is direct.
Examples : *Bufo* (Toad), *Rana* (Frog), *Hyla* (Tree frog), *Salamandra* (Salamander), *Ichthyophis* (Limbless amphibia)	**Examples :** *Chelone* (Turtle), *Testudo* (Tortoise), *Chameleon* (Tree lizard), *Calotes* (Garden lizard), *Crocodilus* (Crocodile), Alligator, *Hemidactylus* (Wall lizard). venomous snakes : *Naja* (Cobra), *Bangarus* (Krait), *Vipera* (Viper) etc. Non-venomous snakes: *Python* etc.	**Examples :** *Corvus* (Crow), *Columba* (Pigeon), *Psittacula* (Parrot), *Struthio* (Ostrich), *Pavo* (Peacock), *Gullus* (Fowl), *Bubo* (Owl), *Aptenodytes* (Penguin), *Neophron* (Vulture) etc.	**Examples :** *Ornithorhynchus* (Platypus), *Macropus* (Kangaroo), *Pteropus* (flying fox), *Camelus* (Camel), *Macaca* (Monkey), *Rattus* (Rat), *Canis* (dog), *Felis* (Cat), *Elephas* (Elephant), *Equus* (Horse), *Delphinus* (Common dolphin), *Balaenoptera* (blue whale), *Panthera tigris* (Tiger), *Panthera leo* (lion)

Notes