Animal Kingdom

4

INVERTEBRATA OR NON-CHORDATA

BASIS OF CLASSIFICATION

Basis of classification are – Arrangement of cells, body symmetry, nature of coelom, patterns of digestive, circulatory and reproductive system.

(A) Level of Organization :

1. All members of kingdom Animalia are multicellular, all of them do not exhibit the same pattern of organisation of cells.
2. For example, in sponges, the cells are arranged as loose cell aggregates, i.e., they exhibit **cellular level of organisation.**
3. In coelenterates, the arrangement of cells is more complex. Here the cells performing the same function are arranged into tissues, hence is called **tissue level of organisation.**
4. **Organ level of organisation** is exhibited by members of Platyhelminthes and other higher phyla where tissues are grouped together to form organs, each specialised for a particular function.
5. **Organ System of organisation** – Animals like Annelids, Arthropods, Molluscs,Echinoderms and Chordates, organs have associated to form functional systems, each system concerned with a specific physiological function. This pattern is called organ system level of organisation.
6. Organ systems in different groups of animals exhibit various patterns of complexities. For example, the digestive system in Platyhelminthes has only a single opening to the outside of the body that serves as both

   mouth and anus, and is hence called **incomplete digestive system.**
7. A **complete digestive system** has two openings, mouth and anus.
8. The **circulatory system** may be of two types:

   (i) **Open type** in which the blood is pumped out of the heart and the cells and tissues are directly bathed in it.

   (ii) **Closed type** in which the blood is circulated through a series of vessels of varying diameters (arteries, veins and capillaries).

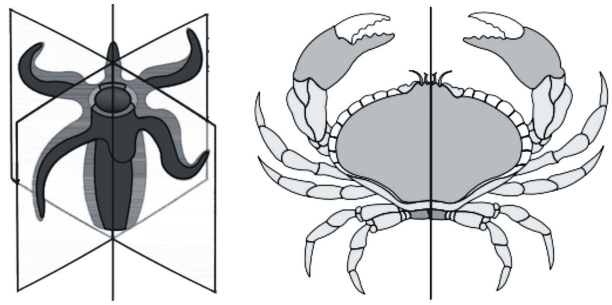
(B) Symmetry in Animals :

1. **Asymmetrical –** Organisams in which any plane that passes through the centre does not divide them into equal halves. **Eg.** Sponges.
2. **Radial Symmetry –** Any plane passing through the central axis of the body divides the organism into two identical halves.

   Eg. – Coelenterates, Ctenophores and Echinoderms.

3. **Bilateral Symmetry –** The body can be divided into identical left and right halves in only one plane.

   Eg. – Annelids, Arthropods etc.



(a) Radial symmetry (b) Bilateral symmetry

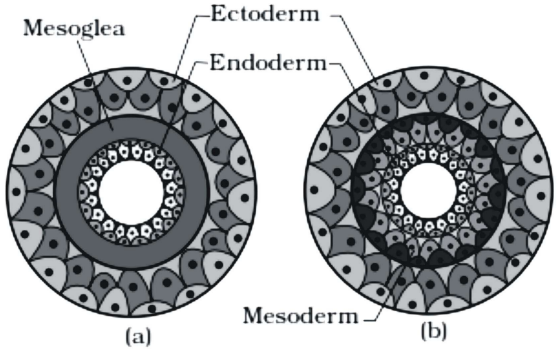
(C) Germ Layers :

1. **Diploblastic Animals** – Where cells are arranged in two embryonic layers, an external ectoderm and internal endoderm. In between these two layers an undifferentiated layer that is mesoglea is found.

   E.g. Porifera, Coelenterata.

2. **Triploblastic Animal –** Those animals in which the developing embryo has a third germinal layer, mesoderm, in between the ectoderm and endoderm, are called triploblastic animals

   Eg. – Platyhelminthes to Chordates.



Showing germinal layers
(a) Diploblastic (b) Triploblastic

(D) Coelom(Body cavity) : The body cavity which is lined by mesoderm is called coelom.

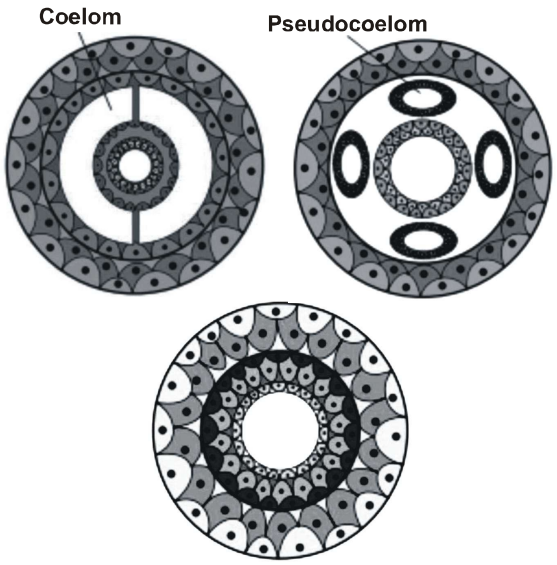
1. **Eucoelom :** Animals possessing coelom are called **coelomates or eucoelomates**.

   Eg. – Annelids, Molluscs, Arthropods, Echinoderms, Hemichordates, and Chordates.

2. **Pseudocoelom :** In some animals mesoderms is presents as scatterd pouches in between the ectoderm and endoderm. Such a body cavity is called pseudocoelom and the animal possessing them are called **Pseudocoelomates.**

3. **Acoelom :** The animal in which the body cavity is absent are called **acoelomates.**

   E.g. Platyhelminthes



Diagrammatic sectional view of :
Coelomatic (b) Pseudocoelomate (c) Acoelomate

(E) Segmentation

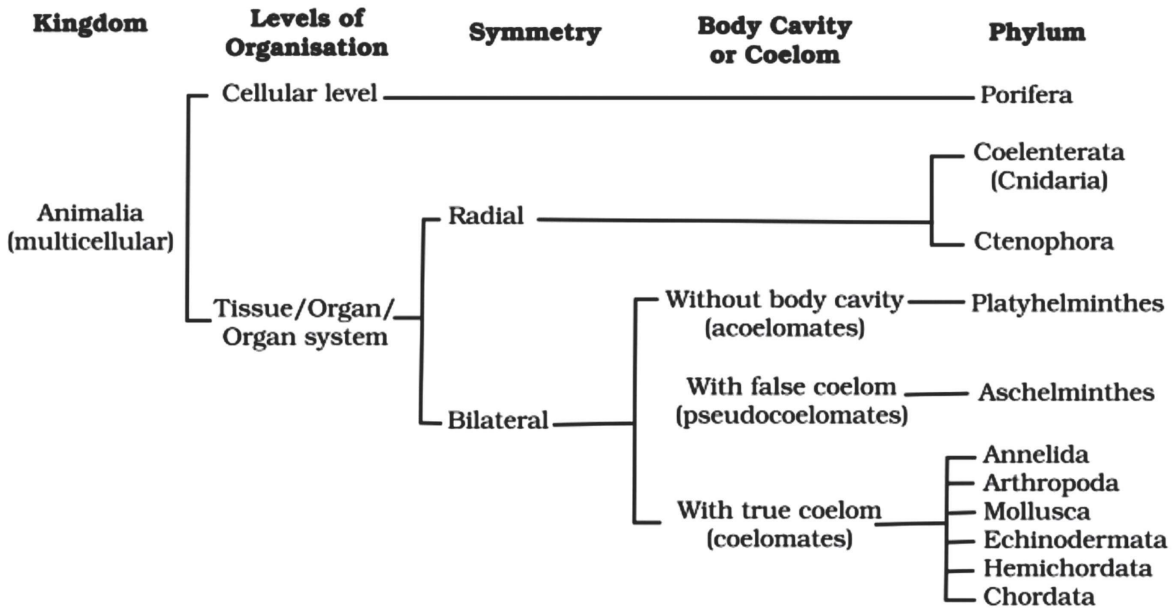
The body is externally and internally divided into segments with a serial repetition of at least some organs. For example, in earthworm, the body shows this pattern called metameric segmentation and the phenomenon is known as **metamerism**.

(F) Notochord

Animals with notochord are called chordates and those animals which do not form this structure are called non-chordates, e.g., Porifera to Echinoderms.

Notochord is a mesodermally derived rod-like structure.

CLASSIFICATION CHART

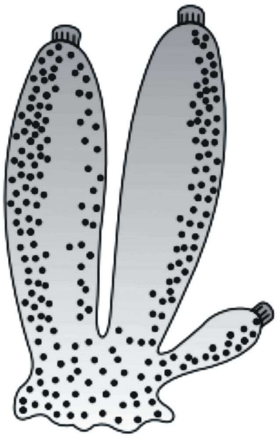


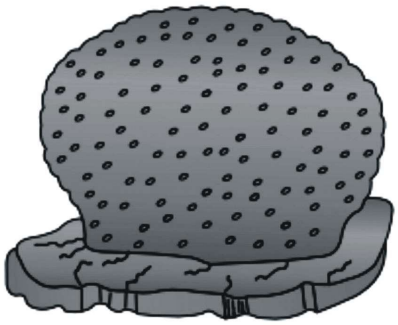
PHYLUM - PORIFERA

Pori = pore or Minut holes
Fera = to Ferre = to bear
} Pore bearing animals

Characteristic Features of Porifera

- Porous body, **Many ostia** (mouth) and **single osculum** (Anus) and presence of flagellated choano cytes.
- Presence of **water canal system** (Not waster vascular system because it is found in **Echinoderms**)
- Presence of spicules or spongin fibers as exoskeleton.
- Central body cavity **spongocoel**


(a)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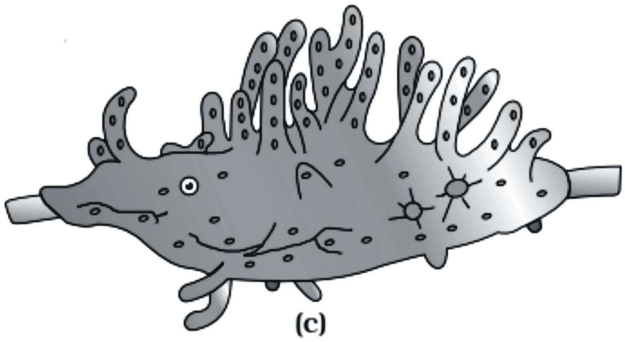
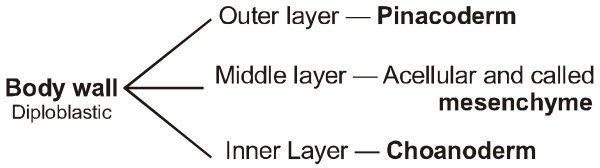

(c)

Example for Porifiera :
(a) Sycon, (b) Euspongia, (c) Spongilla

Some other Charecters of Porifera–

(1) Diploblastic, cellular level of body organization, mostly asymmetrical, rarely radialy symmetrical, free living.



(2) All are aquaitic, mostly marine and some are fresh water.

(3) Water canal system is the characteristic feature that is helpfull in –

(i) Food gathering (ii) Gaseous exchange
(iii) Removal of wastes

There are Three types of canal systems.

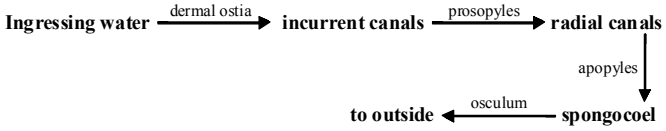
(i) Asconoid

(Simplest canal)

Ingressing water ⟶ Canal ⟶ Spongocoel ⟶ Osculum

Ex. Lencosolenia, Olynthus

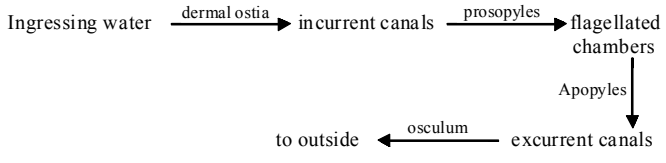
(ii) Syconoid



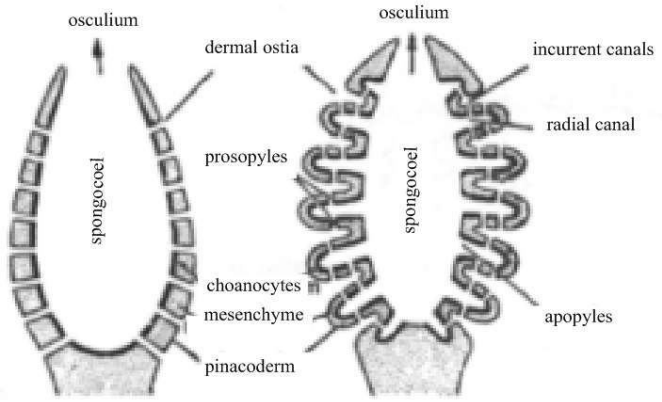
Ex. Scypha

(iii) Leuconoid

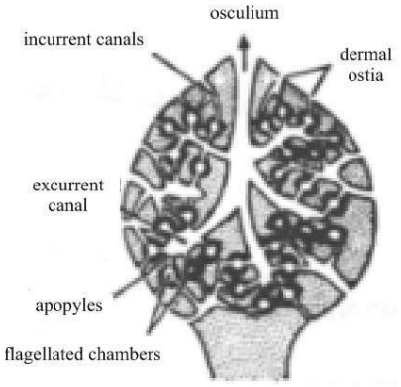
(complex and most efficient canal system)



Ex. Euspongia Spongilla



Asconoid **Syconoid**



Leuconoid

(4) Flagellated **choanocytes** line the **spongocoel** and **flagellated canals** and responsible for –

◆ Maintaing unidirectional water current means ostia towards osculum.

◆ Intracellular digestion

(5) Exoskeleton supports body and made up of **spicules** (calcium carbonate or silicious) or spongin fibres (proteinous and used as bath sponge)

(6) **Digestion –** Sponges are carnivorous, feeds upon microfauna (small animals), Intracellular digestion with in food vacuole of choanocytes and amoeboid cells.

(4) **Respiration and excretion –** General body surface

(8) **Sexuality –** Hermaphrodite

(9) **Reproduction –**

◆ **Asexual** – Internal budding (Gemmule)

◆ **Sexual** – oogamous type because sperms are flagellated and motile while ovum are spherical, non-motile.

(10) Fertilization – External and cross fertilization because of protandrous condition i.e. sperm get matured before ovum hence even being hermaphrodite, cross fertilization occurs.

(11) Cleavage – Holoblastic, unequal

(12) Development – Indirect means larval stages are present or comes during development which are morphologicaly different from the adult. **Amphiblastula** and **parenchymula** larva present in life cycle.

(13) Young sponge – ***Olynthus*** is **young sponge** that contain many ostia and single osculum and represent individual sponge.

Representative of the Phylum –

(1) ***Scypha*** – Sycon

(2) ***Spongilla –*** Fresh water sopnge

(3) ***Euspongia –*** Bath sponge

(4) ***Euplectella –*** Venus flower basket, a wedding gift in Japan as the token of together upto death.

(5) ***Hyalonema –*** Glass rope sponge.

PHYLUM-COELENTERATA OR CNIDERIA

Coelentron = Coel + interon
↓ ↓
Cavity Intestine → Intestinelike cavity or Gastrovascular covity

Cnideria = Cnidae = Stinging cells

(cnidocyte present)

Characteristic Features:

- Presence of central gastrovascular cavity coelentron.
- Presence of highly specialised cells among all animals are cnidocytes or stinging cells.

Some other characters of Coelentrata:

(1) Habit and Habitat: All aquaitic, Mostly marine and some are fresh water (***Hydra***), sessile (Sedentary and fixed in a place) or free swimming.

(2) Symmetry: Radial

(3) Body organization: Tissue level

(4) Body wall: Diploblastic

Body wall
- Outer layer - Epidermis (Ectodermal)
- Middle acellular layer - Mesogloea
- Inner layer - Gastrodermis (Endodermal)

(5) Cnidocytes: These are highly specialysed stining cells that contain stinging capsule filled with toxic hypnotoxic chemical.

There cells are meant for-

(i) Anchorage

(ii) Defence

(iii)Prey capturing

(6) Coelentron: Central gastrovascular cavity for extracellular digestion, with single opening hypostome (mouth)

(7) Skeleton: Some member of phylum coelentrate and mainly the member of class Anthozoa have exoskeleton ($CaCO_3$) responsible for formation of coral reef and source of coral. **Eg.** ***Coralium*** - Red coral.

(8) Polymorphism: Some members of phylum coelentrata exhibit or persist in at least two form, **polyp** and **medusa** mean exhibit polymorphism.

(i) Polyp form: Cylendrical asexual form **Eg.** ***Hydra, Adamsia***

(ii) Medusa: Umbrella shaped free swimming and sexual form. **Eg.** ***Aurelia (Jelly fish)***

(9) Metagenesis: Metagenesis is the alternation of generation in sexual reproduction,in which polyp asexually produce medusa and medusa sexually produces polyp.

(10) Sexuality: Mostly hermophrodite but some are unisexual like *Hydra Viridisma.*

(11) Gametogenesis: Sex cells (gametes) are formed by Interstitial cells through meiosis.

(12) Fertilization: Cross fertilization due to protondrous condition.

(13) Cleavage: Holoblastic, unequal

(14) Embryonic development: Indirect means larval stages are present. **Larva - Hydrula, Planula, Ephyra**

Representative of the Phylum:

Example of Colelenterata indicating outline of their body form:

(a) Aurelia (Medusa) (b) Adamsia (Polyp)

Coelentrata Organism	–	Common Name
Hydra	–	water devil
Physalia	–	Portuguese man of war
Adamsia	–	Sea anemone
Pennatula	–	Sea pen
Gorgonia	–	Sea fan
Meandrina	–	Brain coral
Coralium	–	Red coral

- **Coral Reef:** Formed by deposition of merine coelentrates belong to class anthozoa and reefs are diversity rich.

PHYLUM-CTENOPHORA

Cteno = comb

Phora = ferre = to bear

Body bear 8 external rows of cilliated comb plates

(1) Habitat and habit : All are exclusively marine, free living and feeds upon zooplankton.

(2) External morphology : Main feature is the presence of cilliated comb plates that helps in locomotion

(3) Symmetry : Radial or biradial symmetry.

(4) Body organization : Tissue level

(5) Body wall : Diploblastic
- Outer - Ectoderm
- Middle - cellular mesenchyme
- Inner - Endoderm

(6) Bioluminiscence : Member of ctenophora emits light and this property called bioluminiscence

(7) Sexuality : Hermaphrodite (Bisexual)

(8) Reproduction : Only sexual reproduction

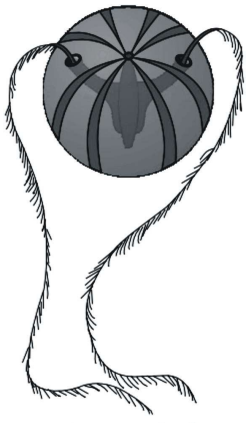
(9) Fertilization : External

(10) Cleavage and development : Spiral cleavage and indirect development with **cydippid larva.**

Something specific about ctenophores

- Ctenophore formely included in coelentrata
- Present from sea surface to depth of 3000 metre.
- Commonaly called comb jellies, or sea walnuts or sea gooseberry.
- They reproduce only by sexual method but no alternation of generation.
- Self fertilization also occurs.

Eg. *Pleurobranchia, Ctenoplana, Velamen, Beroe.*



Example of Ctenophora *(Pleurobrachia)*

PHYLUM – PLATYHELMINTHES

Platy = Flat
Helminthes+Worm } Flatworm

(1) Habit and Habitat – Mostly parasite (Endoparasite) and few are free living aquitic (*Planaria*).

Note: Hooks and **suckers** are present in **parasitic forms**.

(2) External morphology – Generally body **asegmented** or non-segment (*Planaria and Fasciola*) but **pseudosegmented** (*Taenia*)

(3) Symmetry – Bilateral symmetrical

(4) Locomotory organ – Generally absent but **cillia** as locomotory organ in **Planarian**.

(5) Body wall – Triploblastic

(6) Coelome – Acoelomate. (No space b/w body wall and Alimentary canal)

(7) Level of Body organisation – organ level.

(8) Alimentary Canal and Digestion – Generally alimentary canal absent but incomplete alimentary canal present in Turbellaria and Trematoda). Mouth present and Anus absent. Poor digestion is seen.

(9) Excretion and Osmoregulation – First excretory Organ originated in platyhelminthes as **flame cells or Solenocytes or Protonephridia.**

(10) Respiration – Anaerobic Respiration in parasitic forms but free living form respire through general body surface.

(11) Sexuality – All are bisexual (hermapbrodite)

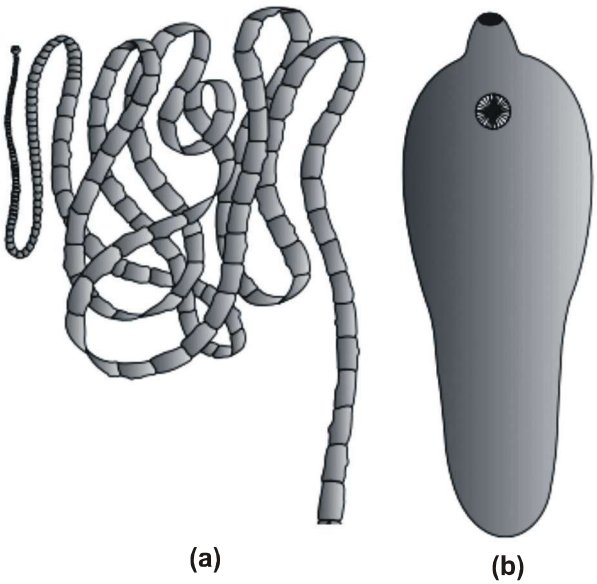
(12) Reproduction and Fertilisation – Sexual, Cross and self fertilization both, Internal fertilisation.

(13) Development – Indirect Mostly with many larval stage.

Larva: Tape worm (*Taenia*) – Onchosphere, Hexacanth, Cysticercus or bladder worm.

Fasciola (Liver fluke) – Miracidium, sporocyst, radia, cercaria, Metacercaria.

Eg. ***Taenia solium*** – Pork tapeworm
Taenia saginata – Beef tapeworm
Echinococcus granulosus – Dog tapeworm
Schistosoma haematobium – Blood fluke
Paragonimus – Lung fluke
Diplozoon – Gill fluke of fishes
Fasciola hepatica – Sheep liver fluke.
Planaria – Highest regeneration power.



Example of Platyhelminhes :
(a) Tape worm (b) Liver fluke

Something specific about platyhelminthes: –

- Body segmentation but pseudosegmentation, Bilateral symmetry, Excretory organ (flame cells) first developed in this group
- **Digenetic parasite –** Two host , primary and secondary host are needed

Fasciola hepatica { P.Host – Sheep; S.Host – Snail }

Taenia solium { P.Host – Man; S.Host – Pig }

- Parasitic form absorb nutrient through sucker or general body surface.
- Cuticle on bodywall is the parasitic adaptation which prevent the organism from digestive enzymes.

PHYLUM – ASCHELMINTHES

(1) Habit and Habitat – Free living (Aquaitic and Terrestrial). Parasite (Endoparasite in animals and plants)

Note: ***Meloidegyne incognitia*** – It is a parasite nematode in plants. Actually it infects the roots of Tobaco plant and causes a great reduction in yield.

(2) External Morphology – Body asegmented, cylendrical, Clear sexual dimorphism (Male and female are recognized by their morphological appearance and generally females are larger than males).

(3) Symmetry – After being cylendrical, they represent bilateral symmetry because dorsal and ventral surface are recognised by **Dorsal** and **Ventral Nerve cord**.

(4) Locomotory organ – Absent

(5) Body wall –

Triploblastic
- Outer cuticle layer.
- Middle **syncytial epidermis.**
- Inner muscular layer.

(6) Coelome – Pseudocoelomate (Clear space present between body wall and alimentary canal but not lined with mesoderm hence called pseudocoel or false coelome)

(7) Level of body organisation – Organ-system level.

(8) Alimentary canal and Digestion – Complete alimentary canal with well developed **muscular pharynx**. Mouth and anus are clear. Incomplete digestion of food.

(9) Excretion and osmoregulation – H-shaped excretory system is present that is derived from single **rennet cell** in *Ascaris*. Excretory product-NH_3 that is excreted through separate excretory pore (Separate means not through cloaca)

(10) Respiration and Gaseous Exchange – Parasitic forms are anaerobic *(Ascaris)* but aerobic in free living forms but no respiratory organs are present and gaseous exchange occurs through general body surface.

(11) Sexuality – Bisexual (Dioecious)

- **Male animal** – Smaller with curved posterior end, contain copulatory pineal setae.
- **Female animal** – Larger with straight body.

(12) Reproduction – Sexual reproduction, Internal fertilisation.

- **Male gamete** – Sperm without tail and generally amoeboid
- **Female gamete** – Ova

(13) Embryonic development – Spiral cleavage with Direct or

Indirect development.

- **Direct development** – The young ones resemble the adult.
- **Indirect development** – Larval stage present
- **Larva** -- Rhabdity form (*Ascaris*) , Filarae (*Wucheria*)

Eg.

Ascaris	–	Round worm and parasite of intestine
Wuchereria	–	Filaria worm and parasite of lymph capillaries of hind limb.
Ancyclostoma	–	Hook worm
Enterobius	–	Pin worm and parasite of human caecum, appendix
Loa-loa	–	Eye worm and causes eyeflu

Something specific about Nematodes

- Parasitic forms are digenetic and monogenetic both

Digenetic–

Wuchereria – P.Host – Man; S.Host – Culex mosquito

Monogenetic–*Ascaris* – Parasite of human intestine

PHYLUM – ANNELIDA

Annulus – Small ring form

(1) **Habit and Habitat –** May be aquatic (Marine & Fresh water) and terrestrial both, mostly free living but some are parasite (Leach).

(2) **External Morphology-** Body rounded and flat both type but metamerically segmented (true segmented).

(3) **Symmetry-** Bilateral

(4) **Locomotory organ-** Chitinous setae that are connected with **protractor** and **Retractor** muscles for pulling in and out.

(5) **Body wall-** Triploblastic, L.M.L. and C.M.L. both present in muscular layer which helps in locomotion also.

(6) **Coelome-** first time coelome (Eucoelome) appeared in annelids.

(7) **Level of body organization-** Organ-system

(8) **Body plan-** Tube with in the tube plane in T.S.

(9) **Alimentary canal and Digestion-** Complete alimentary canal and extra cellular digestion.

(10) **Excretion and Osmoregulation-** Excretory organ-Nephridia. Excretory substance-NH_3 and urea.

(11) **Respiration-** Aerobic and gaseous exchange through general body surface-skin (Cutaneous Respiration)

(12) **Body fluids and circulation-** Closed blood circulatory system

(13) **Neural Control-** Neural system consists of paired ganglia connected by lateral nerves to a double ventral nerve cord.

(14) **Sexuality-**

- Mostly hermaphrodite (bisexual) **Eg.** Earthworm, leech.
- Some are unisexual (Dioecious) **Eg.** Neries (aquatic)

(15) **Reproduction and Fertilization-** Sexual reproduction and cross-external fertilization in bisexual species.

(16) **Development-** Mostly direct but rarely indirect

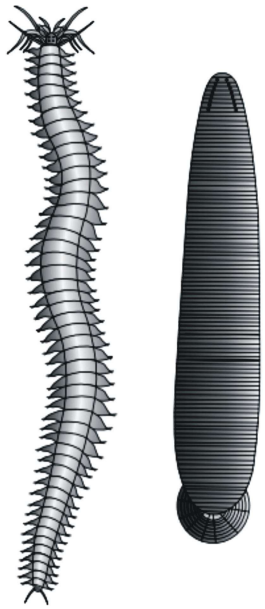
- Larva-Trochophore.

Eg. ***Neries*****-** Aquatic and commonalty called sand worm/Clamworm/Ragworm

Polynoe**-** Bioluminescent and commonly called scale worm.

Pheretima**-** Earth worm.

Hirudinaria**-** Blood sucking leech.



Examples of Annelida : (a) *Nereis* (b) *Hirudinaria*

- **Parapodia-** Locomotory organ of **Nereis** and parapodia are fleshy with setae.

PHYLUM – ARTHROPODA

Arthros = Jointed

Podas = Legs or Appendages

Largest phylum of kingdom Animalia because 80% (two third) animal species belongs to phylum – Arthropoda.

(1) **Habit and Habitat:** Found in land, water, air and from snowy tops of the high mountain to the depth of the ocean. Free living and parasite (ecto-parasite) both with great economic importance also.

(2) **External morphology:** Body segmented and divided in to head, thorox, Abdomen or cephalothorax and abdomen with jointed appendages.

(3) **Symmetry:** Bilateral

(4) **Body wall:** Triploblastic, outer layer is chitinous cuticle as exoskeleton.

(5) **Coelome:** Eucoelomate but in adult form of some arthropod it reduced and replaced by haemocoel and restricted around gonads.

(6) **Level of Body organization:** Organ-system

(7) **Alimentary canal and Digestion:** Complete alimentary canal with well developed muscular pharynx. Extra-cellular digestion

(8) **Excretion and osmoregulation:** Malpighian tubules and green or coxal glands while excretory substance

- **Uric acid** – Terrestrial arthropods
- **Ammonia** – Aquatic Arthropods

(9) **Respiration:** Aerobic and Respiratory organs are – **Gills, Trachea, Book lungs**

(10) **Body fluid and their circulation:** Open circulatory System.

(11) **Sensory organs:**

- **Compound and simple eyes** – Photoreceptor
- **Antennae** – Olfactory and tangoreceptor
- **Statocyst** – For balancing

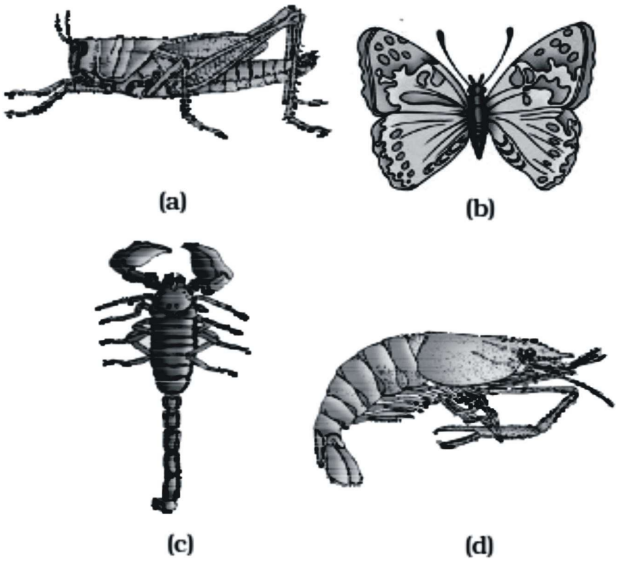
(12) **Sexuality:** Unisexual with clear sexual dimorphism.

(13) **Reproduction and fertilization:** Sexual and internal fertilization but embryonic development is outside the body.

- **Oviparous** – most of the insects
- **Viviparous** – Scorpion

(14) **Development:** Direct and indirect both

- **Larva:** **Nymph** – Cockroach
  Maggot – House fly
  Caterpillar – Butterfly and Moth



Example of Arthopoda :(a) Locust (b) Butterfly (c) Scorpion (d) Prawn

Eg. Economically important arthropod

Apis	–	Honey bee
Bombyx	–	Silk worm
Laccifer	–	Lac insect
Palaemon	–	Prawn

- **Vector**–

Musca	–	Cholera and diorrhea (Bacteria + Protozoa)
Anopheles	–	Malaria (Plasmodium)
Culex	–	Filariasis (Nematod)

- **Poisonous** –

  Scorpion, wasps, Bees, *Scolopendra* (centipede)

PHYLUM MOLLUSCA

Mollis = Soft

Soft body that is covered by calcarious shell. **Second Largest phylum.**

(1) **Habit and Habitat:** Mostly aquatic (Marine and fresh water both) but some are terrestrial (***helix***-land snail). Mostly mollusc are predator (Squid and octopus)

(2) **External morphology:**

- Body unsegmented with distinct –

(i) Head

(ii) Muscular foot

(iii) Visceral hump (covered by soft mantle)

- Body covered by hard calcarious shell
- **Mantle** – It is skin fold that coveres visceral hump and secretes calcareous shell.

Note: Body is internally segmented in *Neopelina.*

(3) **Symmetry:** Bilateral symmetrical but may become asymmetrical due to torson.

(4) **Locomotory organ:** Muscular foot as locomotary organ which helps in creeping, swimming and burrowing.

(5) **Body wall:** Triploblastic

(6) **Coelome:** Eucoelome (true coelome) but reduced at the adult stage and restricted to pericardial cavity, exeretory and reproductive organs.

(7) **Level of body organization:** Organ-System.

(8) **Alimentary canal and digestion:** Well developed and Mouth contain file-like rasping organ, called **radulla**.

(9) **Respiration:** Aerobic respiration. A space between shell and mantle called mantle cavity and this cavity contains feather like gills for respiration (Gills called ctenidia).

(10) **Body fluid and their circulation:** Open circulatory system and Haemocyanin as blue coloured respiratory pigment.

(11) **Excretion and Osmoregulation:** Basic excretory organ are metanephridia but gills also perform it. Excretory product – NH_3

(12) **Sensory organs:**

(i) Eyes-Photoreceptor and in octopus analogous to vertebrate eyes.

(ii) Tentacle – Tangoreceptor present in anterior body part or head.

(iii) Ospharadium-Chemoreceptor for water taste and determine purity of water also.

(13) **Sexuality:** Most of the molluscans are unisexual (Dioecious) and oviparous.

(14) **Reproduction and fertilization:** sexual, External and internal fertilization, all are oviparous.

(15) **Development:** Direct but usually indirect

Eg. ***Neopilina*** **–**
Connective link b/w Annelida and Mollusca.

Pila	–	Apple snail
Pinctada	–	Pearl oyster
Sepia	–	Cuttle fish
Loligo	–	Squid
Octopus	–	Devil fish
Aplysia	–	Sea hare
Dentalium	–	Elephant tusk shell
Chaetopleura	–	Chiton

(a)

(b)

Examples of Mollusca : (a) Pila (b) Octopus

PHYLUM – ECHINODERMATA

(1) These animals have an endoskeleton of calcareous ossicles and, hence, the name Echinodermata (Spiny bodied).

(2) All are marine with organ-system level of organisation.

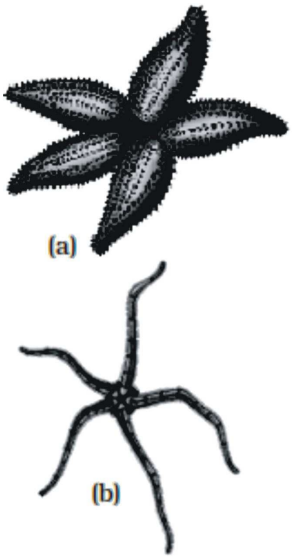
(3) The adult echinoderms are radially symmetrical but larvae are bilaterally symmetrical.

(4) They are triploblastic and coelomate animals.

(5) Digestive system is complete with mouth on the lower (ventral) side and anus on the upper (dorsal) side.

(6) The most distinctive feature of echinoderms is the presence of water vascular system which helps in locomotion, capture and transport of food and respiration.

(7) An excretory system is absent.



Examples for Echinodermata :
(a) *Asterias*
(b) *Ophiura*

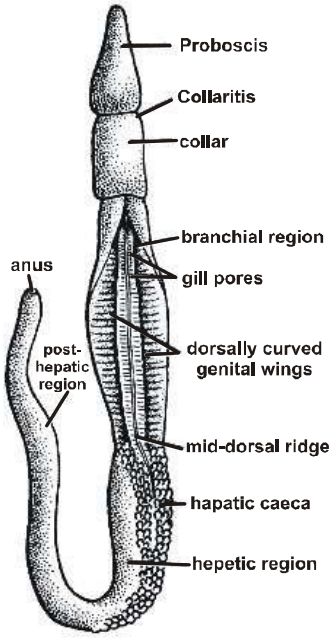
(8) Sexes are separate. Reproduction is sexual. Fertilisation is usually external. Development is indirect with free-swimming larva.

Eg.	***Asterias***	-	Star fish
	Echinus	-	Sea urchin
	Antedon	-	Sea lily
	Cucumaria	-	Sea cucumber
	Ophiura	-	Brittle star

PHYLUM : HEMICHORDATA

(Connective links between Non-Chordates and Chordates)

- Body is soft and unsegmented divided into proboscis, collar and trunk.
- Bilaterally symmetrical; triploblastic; coelomate.
- Digestive tract complete; respiration occurs through gills.
- Blood colourless without corpuscles. A circulatory system is open type.
- Sexes separate, development direct or indirect, larva **tornaria**, external fertilization
- Restriction of `notochord' to the anterior part of the body draws the name Hemichordata.
- Notochord as such is not present, while buccal diverticulum with glomerulus is called stomochord.



Balanoglossus: External features in dorsal view

- Resemble the chordates in having all the three primary chordate structures, namely gill slits, notochord and dorsal hollow nerve cord.
- Respiration takes place through gills.
- Excretory organ is proboscis gland.
- **Differ from the chordates in**

(i) Lacking cephalization, metamerism, paired appendages, tail, exoskeleton, cloaca, living endoskeleton, haemoglobin and RBC.
(ii) Containing dorsal heart
(iii) Having open neurocoel
(iv) Bearing numerous gonads
(v) Gill slits are dorsal in position instead of lateral as in chordates
(vi) Resemble the echinoderms in nervous system, coelom and larval form. They also have common habits, ecological niche and possess remarkable power of regeneration.

- Important from evolutionary point of view as they link the chordates with non chordates.
E.g. *Balanoglossus* (tongue worm or acorn worm), *Saccoglossus*.

VERTEBRATA OR CHORDATES

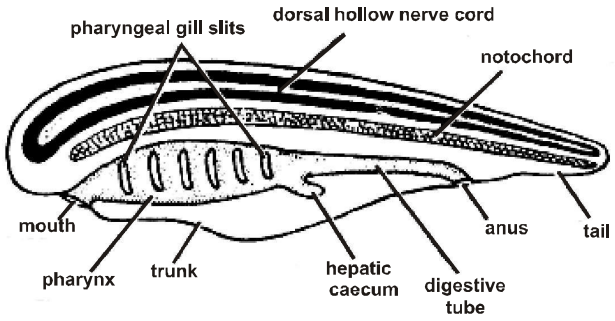
INTRODUCTION

Chordata is the most advanced animal phylum and includes about 45,000 living species. All the chordates have certain diagnostic features. These are present at least in some stages of development and may be retained even in the adult as notochord; central nervous system; gill slits; tail etc. This subkingdom of vertebrates from the stand-point of efficiency in the higher chordates includes the largest and best known groups of animals. All the vertebrates are chordates, but then all the chordates are not vertebrates.

PHYLUM – CHORDATA

All the chordates possess three unique characteristics at some stage in their life history. These diagnostic features are :

- The dorsal hollow or tubular nerve cord
- A longitudnal supporting notochord
- A series of pharyngeal gill slits present at a stage of life cycle.
- These are bilaterally symmetrical, triploblastic, coelomate with organ-system level of organisation. Largest of the deuterostome phyla.



Diagrammatic side view of a chordate showing the three

- Phylum chordata is divided into two groups :
  A. Acrania (Protochordata)
  B. Craniata (Euchordata)

A. Acrania (Protochordata) : All marine small, primitive chordates, lack a head, skull or cranium, verte bral column, jaws and brain. It is divided into two subphyla- **Urochordata** and **Cephalochordata,** chiefly on the basis of notochord present (Recent opinion removes Hemichordata as a separate phylum of invertebrates).

B. Craniata (Euchordata) : It includes single subphyla **Vertebrata** which is divided into two subdivisions

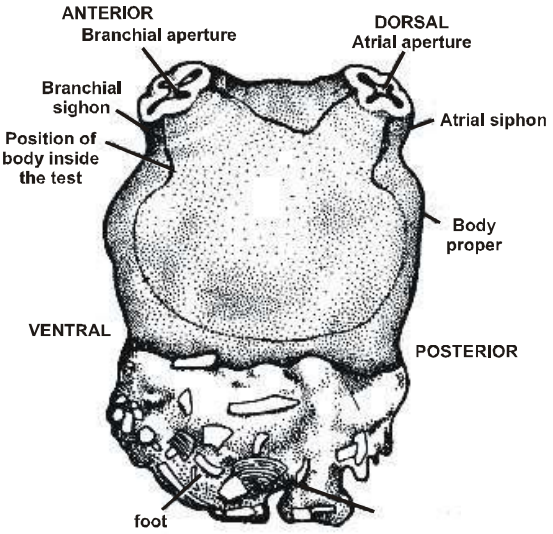
a. Agnatha (Jawless vertebrates) : It has two classes - **Ostracodermi** and **Cyclostomata.**

b. Gnathostomata : It is further divided into two superclasses :

(i) Pisces : It is divided into three classes - **Placodermi, Chondrichthyes** and **Osteichthyes.**
(ii) Tetrapoda : It is divided into four classes - **Amphibia, Reptilia, Aves** and **Mammalia.**

SUBPHYLUM : UROCHORDATA

- Body is unsegmented and usually lacks tail, covered by a test or tunic composed largely of **tunicin,** allied to cellulose. Appendages absent.
- The **notochord** is only **present in the tail of larva** and **disappears in the adult**.
- Coelom absent; digestive tract complete
- Respiratory system has two to numerous gill slits in the pharyngeal wall
- Circulatory system open type; simple tubular ventral heart.
- Nervous system is represented in the adult by a single dorsal ganglion.
- Urochordata often referred to as protochordatas.



Herdmania: External features in left view

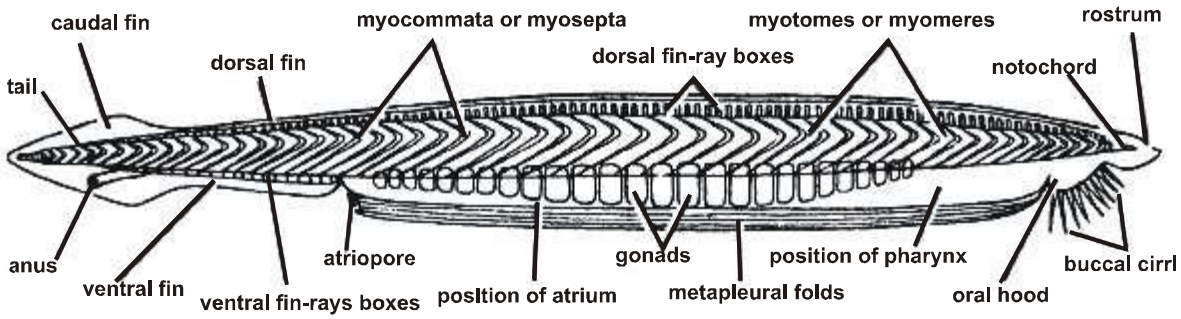
- Larva has a hollow nerve cord.

- Excretion is carried out by nephrocytes, pyloric gland or neural gland.
- Sexes united, always cross and external fertilization; asexual reproduction by budding; some forms exhibit alternation of generations.
- Larva undergoes retrogressive metamorphosis.
- The larva is known as Ascidian tadpole.

  Eg. *Herdmania* (Sea squirt), *Salpa, Doliolum, Ascidia.*

SUBPHYLUM : CEPHALOCHORDATA

- Body fish-like adapted for burrowing and swimming. It lacks head, but possesses a tail.
- Paired appendages absent, median fins (dorsal, ventral and caudal) are present.
- Notochord extends the entire length from head to tail of the body and passes ahead of the nerve cord in front. **Notochord persistent throughout life.**
- A true enterocoelous coelom is present. It is however reduced in the pharyngeal region of atrium.



Branchiostoma: Entire animal in right side view

- Brain is indistinct; no paired sense organs - eyes, ears, nares.
- Excretory system includes paired protonephridia with solenocytes.
- Sexes separate; fertilization external; Holoblastic segmentation.
- Larva undergoes progressive metamorphosis. e.g. *Branchiostoma* (*Amphioxus* or Lancelet).

Key Concepts

(1) *Herdmania* Larva (tadpole) is free swimming while adult is fixed.

(2) Tunicates reverses the direction of its heart beat periodically.

(3) Blood of tunicates is unique as it has respiratory pigment. It is rich in both sulphuric acid and vanadium. Vanadium is green coloured pigment.

(4) *Pyrosoma*, an example of tunicates is brightly luminous at night.

(5) Tadpole larva of *Herdmania* is more complex than adult.

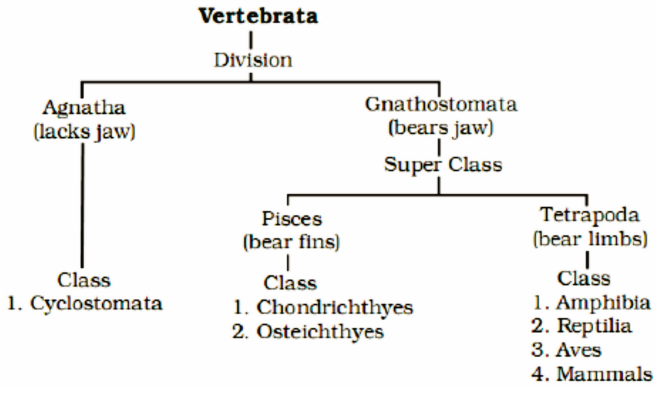
EUCHORDATA/ CRANIATA

SUBPHYLUM - VERTEBRATA

- Body divided into head, neck, trunk and tail. Some notable exceptions are there : Fishes lack the neck, amphibians lack both the neck and tail (exceptions are there), apes and man have vestigial tail.
- Have two pairs of appendages, which are in the form of fins in the fish and limbs in other vertebrates. Certain forms have secondarily lost one pair or both the pairs of appendages.
- Have integument basically of two parts : an outer epidermis of stratified epithelium derived from the ectoderm and an inner dermis of connective tissue developed from the mesoderm.
- Endoskeleton is formed of cartilage or of cartilage and bone.
- Have a large coelom that contains viscera suspended by mesentries. It is divided into a pericardial sac

and a general body cavity. Mammals possess a separate thoracic cavity also.

- The complete digestive tract of vertebrates is ventral to the nerve cord, and gives rise to digestive glands pancreas and liver.
- In lower vertebrates respiratory organs are paired gills, whereas in land forms lungs are present.
- Besides the basic chordate characters, vertebrates have a ventral muscular heart, Closed circulatory system; heart 2, 3 or 4 chambered; lymphatic system present; erythrocytes and haemoglob in are present.
- Notochord is only present in the embryonic stage, it is replaced by vertebral column in adult forms.
- Kidneys for excretion and osmoregulation and paired appendages which may be fins or limbs.
- A pair of kidneys are present for excretion, and osmoregulation.
- Endocrine glands are well developed.
- Unisexual and have single pair of gonads.
- Thus all vertebrates are chordates but all chordates are not vertebrates.



(A) DIVISION - AGNATHA (JAWLESS VERTEBRATES)

- Jawless primitive fish like vertebrates without true Jaws and paired limbs.

Class : Cyclostomata

- All living members of this class are ectoparasites on some fishes.
- Skin soft and scale less.
- Mouth without jaws and remains permanently open.
- Mouth circular and suctorial
- Median fins with cartilaginous rays, but no paired appendages. Tail diphycercal
- Cartilaginous endoskeleton. Cranium and vertebral column are carlilaginous.
- Digestive system lacks stomach. Intestine with a fold, typhlosole
- They are marine animals for spawning they migrate to fresh water after spawning within a few days they die. After metamorphosis their larvae return to the ocean.
- Gill slits 5 to 16 pairs
- Heart 2 chambered; poikilothermous.
- Two mesonephric kidneys
- Dorsal nerve cord; 8 to 10 pairs of cranial nerves
- Single median olfactory sac and nostril.
- Auditory organ with 1 or 2 semicircular canals.
- Sexes separate or united; fertilization external; development direct or with prolonged larval stage (larva is ammocoete e.g. lamprey). e.g., Lamprey (*Petromyzon)*, Hag fish (*Myxine*).

Fig : A jawless vertebrate - *Petromyzon*

(B) DIVISION - GNATHOSTOMATA

- Jawed vertebrates having true jaws and paired limbs.
- All the fish and fish-like aquatic gnathostomes are placed in the **superclass Pisces,** whereas all the four footed terrestrial gnathostomes in the **superclass Tetrapoda**

Difference between Pisces and Tetrapoda	
Pisces	**Tetrapoda**
1. Exclusively aquatic	1. Aquatic or terrestrial. Some arboreal and aerial.
2. Paired limbs, if present, as fins.	2. Paired pentadactyl limbs present.
3. Median fins present.	3. Median fins absent.
4. Skin usually moist and scaly.	4. Skin usually dry and cornified.
5. Respiration aquatic, by gills.	5. Respiration aerial, by lungs.
6. Sense organs functional in water	6. Sense organs functional in air.

SUPER CLASS-I : PISCES

It is divided into two classes :

CLASS I : Chondrichthyes (Cartilaginous fishes)

- Body may be laterally compressed or dorsoventrally flattened. It consists of head, trunk and tail.
- Fins are supported by horny fin-rays.
- The pelvic fins bear **claspers in the male** which are posterior in location.
- There are generally two dorsal fins. The caudal fin is asymmetrical (heterocercal).
- Skin has unicellularal epidermal mucous glands and dermal scale (placoid scales)
- Endoskeleton is entirely cartilaginous. Notochord is persistent throughout life.
- Mouth is ventral. Jaws well developed. The alimentary canal opens into the cloaca. Intestine has a **scroll valve.**

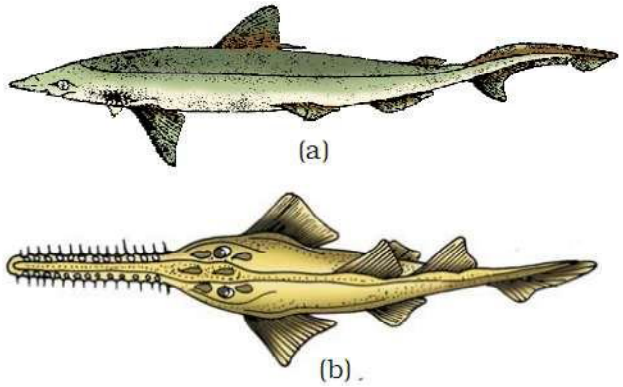


Fig : Example of Cartilaginous fishes : (a) *Scoliodon* (b) *Pristis*

- Teeth are modified placoid scales which are backwoardly directed.
- Respiratory system includes 5-7 pairs of lamelliform (plate-like) gills. Gill slits are without gill covers **(opercula)** except *Chimaera* (connecting link between chondrichthyes & osteichthyes)
- Swim bladder, which regulates buoyancy, is absent due to the absence of air bladder, they have to swim contantly to avoid sinking.
- Heart is two-chambered, having one auricle and one ventricle. Sinus venosus and conus arteriosus are present. Renal portal system is well developed. Red blood corpuscles are oval. biconves and nucleated. They are **poikilothermal** animals. They lack the cpacity to regulate their body temperature.
- There are 10 pairs of cranial nerves.
- Nitrogenous waste matter is urea.
- Sexes are separate. The reproductive ducts discharge into the cloaca. Male usually has claspers which are used for copulation. Fertilization is internal. Most forms are ovoviviparous or oviparous. Some areviviparous. Life history is simple.
- Most chondrichthyes are marine. All are predaceous.
- Some of fishes have electric orgons (*Torpedo*).

Examples :

Scoliodon	-	Dog fish
Torpedo	-	Electric ray
Trygon	-	Sting ray
Chimaera	-	Rat or Rabbit Fish or king of herrings.

CLASS II : Osteichthyes (Bony fishes)

- Including both marine and fresh water fishes with bony endoskeleton.
- Body is often spindle-shaped and stream lined. It facilitates movement through water.
- Fins are supported by cartilaginous or bony fin-rays. Pectoral and pelvic fins act as balancers and brakes during swimming. The fins lack claspers in both the sexes. There is generally a single dorsal fin. Caudal fin is homocercal. The tail helps to propel the fisn by its lateral movements.
- Skin has unicellular mucous glands and dermal scales and skin is covered with cycloid/clenoid scales.
- Endoskeleton is partly or wholly bony, replaced by distinct vertebrae.
- Mouth is terminal or subterminal. Alimentary canal opens out by anus. Intestine generally lacks a scroll valve.
- Respiratory system includes 4 pairs of gills. Gill slits covered by gill covers (opercula).
- Air bladder is present which regulates buoyancy.
- As-filled swin bladder is often present which acts as a buoyancy regulator. In some bony fishs, the swim bladder is used as a lung for breathing air.
- Heart is 2-chambered, having one auricle and one ventricle. Sinus venosus and Conus arteriosus are present.They are poikilothermal animals, they are **cold-blooded** animals.
- There are 10 pairs of cranial nerves.
- Nitrogenous waste matter is mostly ammonia.
- Sexes are generally indistinguishable externally. Fertilization is generally external. Most forms are ovipa rous. Some are ovoviviparous or even viviparous. Some fishes show parental care of eggs.
- The bony fishes occur in fresh, brackish, salt, warm and cold water. Many deep sea fishes are lumines cent. Some fishes can change colours, and some can leave water and crawl on land. Most fish used as food are bony fishes. The common food fishes of India are :

(a) Freshwater Species

(b) Marine Species

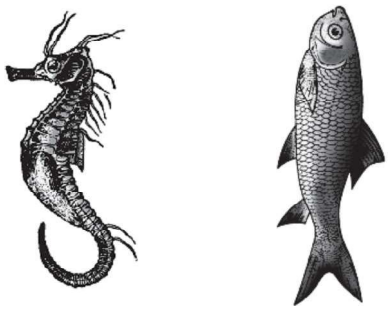
(i) *Labeo rohita* (Rohu)

(i) *Harpodon* (Bombay Duck)

(ii) *Catla catla* (Catla)

(ii) *Hilsa* (Hilsa)

Examples : *Solea* - flat fish, *Exocoetus* (Flying fish), *Catla* (Katla), *Clarias* (Magur), Aquarium - *Betta* (fighting fish), *Pterophyllum* (Angel Fish)



(a) **(b)**

Fig : Examples of Bony fishes :

(a) Hippocampus (b) Catla

SUPER CLASS-II : TETRAPODA

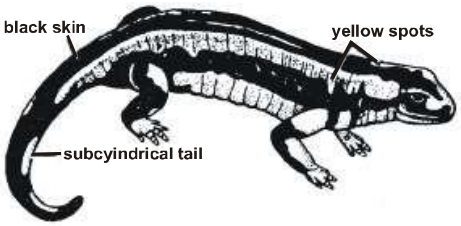
CLASS : AMPHIBIA

The name indicates (**Gr.**, **Amphi :** dual, **bios :** life), amphibians can live in aquatic as well as terrestrial habitats, **without scales on the skin**.

- First cold blooded vertebrates from evolution point of view which came to the land. They can live on land as well as in water.
- Body varies in form. It may be divisible into head, neck, trunk and tail or only into head and trunk.
- There are two pairs of pentadactyl limbs, each with 4-5 or fewer digits. The digits are without claws, nails or hoofs, and often have webs.
- Skin is smooth moist, rich in mucous and poison glands. It is vascular and respiratory in most species. Scales are generally absent.
- Endoskeleton is mostly bony. Skull is **dicondylic,** means has two occipital condyles. Most vertebrae are procoelous.

- Mouth is large and armed with teeth in the upper or lower or both the jaws. The teeth are **acrodont. Vomerine teeth** may also occur. Amphibians are the **first vertebrates to have a true tongue.** (A true tongue has muscles and is protrusible). Alimentary canal with urinary and reproductive tract leads into the **cloaca**.
- **Respiration** takes place by **gills, lungs**, lining of **buccopharygeal** cavity and **skin**, either separately or in combination. Some forms have vocal cords and vocal sacs.
- The heart is 3-chambered (Two auricles and one ventricle): **Hepatic Portal system** and **Renal portal system** is **well developed**. RBC are **oval, biconvex and nucleated**.
- There are 10 pairs of cranial nerves.
- The olfactory sacs are paired and dorsal. They communicate with anterior part of the bucco pahryngeal cavity by internal nares. Eyes often have **movable eye lids**. Middle ear with a single auditory oscicle **(Collumela)**. There is no external ear represents by **tympanum**. Lateral-line sense organs present in the larvae.
- Waste material is removed mostly as urea. Urinary bladder is present. Kidney is **mesonephric** but the larva has pronephric kidney.
- Alimentary canal, urinary and reproductive tracts open into a common chamber called cloaca which opens to the exterior.
- Sexes are separate.
- Male usually lacks copulatory organ. Fertilization is external. Most forms are oviparous and development is indirect
- Some frogs live on trees, e.g. *Hyla*. Many amphibians show parental care. Male midwife toad (*Alytes*) carries eggs round the thighs, female Surinam toad (*Pipa*) carries eggs in special pits on its back till tadpoles become small frogs.

  Eg. *Bufo* (Toad), *Rana* (frog), *Hyla* (Tree frog), *Salamandra* (Salamander), *Ichthyophis* (Limbless amphibia).



European fire Salamander *Salamandra salamandra*

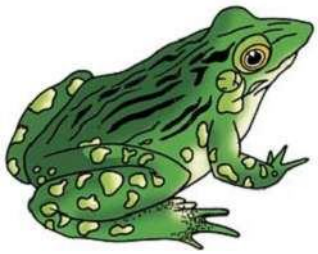


Fig :Examples of Amphibia : *Rana*

CLASS- REPTILIA

(Repere or Reptum = Creep or Crawl)

- Reptiles represent the first class of vertebrates fully adapted for the life in dry places on land.
- Predominantly terrestrial, **creeping** or **burrowing, mostly carnivorous, air-breathing, cold-blooded, oviparous** and **tetrapodal vertebrates.**
- Limbs 2 pairs, **pentadactyl**. Digits provided with horny claws. Limbs absent in all snakes.
- Exoskeleton of horny epidermal **scales, shields, plates** and **scutes**.
- **Skin dry, cornified** and **devoid** of **glands**.
- Mouth terminal. Jaws bear simple conical teeth. In turtles teeth are replaced by horny beaks.
- Alimentary canal terminates into a cloacal aperture.
- Endoskeleton bony. **Skull** with **one occipetal condyle (Monocondylic)**.
- Respiration occurs by lungs. Only ribs help to expand and contract the trunk, making lung respiration more efficient than in amphibians.
- The heart usually 3 chambered and is **incompletely four-chambered**. **Sinus venosus** is **present**, but **truncus arteriosus** is **absent**. **Crocodiles** have a **completely four-chambered heart** like the birds and mammals. **Renal portal system** is **reduced**. RBC are **oval, biconvex** and **nucleated**.

- There are 12 pairs of cranial nerves.
- Waste material is removed chiefly as uric acid in land forms and as urea in aquatic forms. Urinary bladder may be present.
- They do not have external ear, **tympanum** represents ear
- exes separate. Male usually with a muscular copulatory organ.
- ertilization internal. Mostly oviparous.
- Large yolky eggs covered with leathery shell's embryonic membranes (amnion, chorion, yolk sac and allantois) appear during development.
- Snakes and lizard shed their scales as skin cast.
- Direct development.
- Parental care usually absent.

Eg. : *Chelone* (Turtle), *Testudo* (Tortoise), *Chameleon* (Tree lizard), *Calotes* (Garden lizard), *Crocodilus* (Crocodile), *Alligator* (Alligator).

Poisonous snakes - *Naja* (Cobra), *Bungarus* (Krait), *Vipera*(Viper)

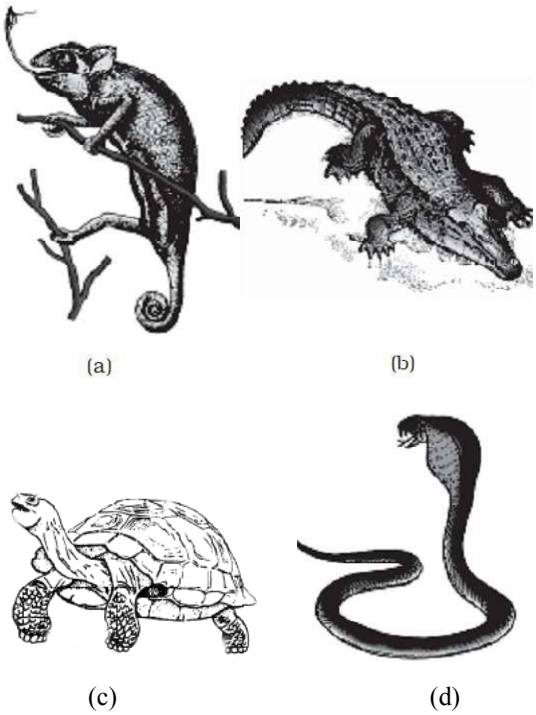


Fig : Reptiles : (a) *Chameleon* (b) *Crocodilus* (c) *Chelone* (d) *Naja*

CLASS – AVES

- Feather-clad, air-breathing, warm-blooded (homoiothermous), oviparous, bipedal flying vertebrates.
- Body divisible into four distince regions : head, neck, trunk and tail. Jawed bones prolonged into a toothless **beak** or bill. Neck is long and flexible. Tail is short and stumpy.
- Limbs are two pairs. Forelimbs are modified as wings for flying. Hindlimbs or legs are large, and variously adapted for walking, running, scratching, perching, food capturing, swimming or clasping the tree branches.
- Exoskeleton is epidermal; feathers form a non-conducting body covering for warmth, scales on the legs, similar to those of reptiles; claws on the toes, and sheaths on the beaks.
- Endoskeleton fully ossified. **Long bones** are **hollow** with air cavities so that called as **pneumatic**.
- **Skin is dry and devoid of glands except the oil or preen gland at the root of tail.**
- **Pectoral muscles** of **flight** are well developed.
- **Vertebral column short. Centrum of vertebrae heterocoelous (saddle-shaped).**
- **Sternum large**, usually with a vertical, mid-ventral keel for attachment of large **flight muscles**.
- Both **clavicles** and single **interclavicle fused** to form a **V-shaped bone**, called furcula or wishbone.
- Pelvic girdle large, strong and fused with synsaccrum throughout its length.
- **Skull** is **monocondylic**.
- **Oesophagus frequently** dilated into a **crop** for quick feeding and storage.
- **Heart completely 4-chambered**. There is neither sinus venosus nor truncus arteriosus. Only right aortic (systemic) arch persists in adult. **Renal portal system vestigeal**.
- **Birds are the first vertebrates to have warm blood.**
- **Respiration by compact, spongy, non-distensible lungs continuous with thin-walled air sacs.**

- Larynx without vocal cords. A sound box or syrinx, produces voice.
- Kidneys metanephric. **Urinary bladder absent**. Birds are uricotelic i.e.excrete uric acid.
- Cerebrum, cerebellum and optic lobes greatly developed. Cranial nerves 12 pairs.
- Olfactory organs poor. Middle ear contains a single ossicle. Eyes large and possess nictitating membranes, and a vascular pecten.
- Male has a pair of abdominal testes. **A copulatory organ absent except in ratitae, ducks, geese**, etc. Female has a single functional left ovary and oviduct.
- Fertilization internal. Females oviparous. Eggs large with much yolk and hard calcareous shell.
- Extra-embryonic membranes present.
- Parental care is well marked.
- The digestive tract of birds has additional chambers the crop and gizzard.

Eg. *Couous* (Crow), Columba (Pigeon), *Psittacula* (Parrot), *Struthio* (Ostrich), *Pavo*(Peacock), *Aptenodytes* (Penguin), *Neophron* (Vulture.)

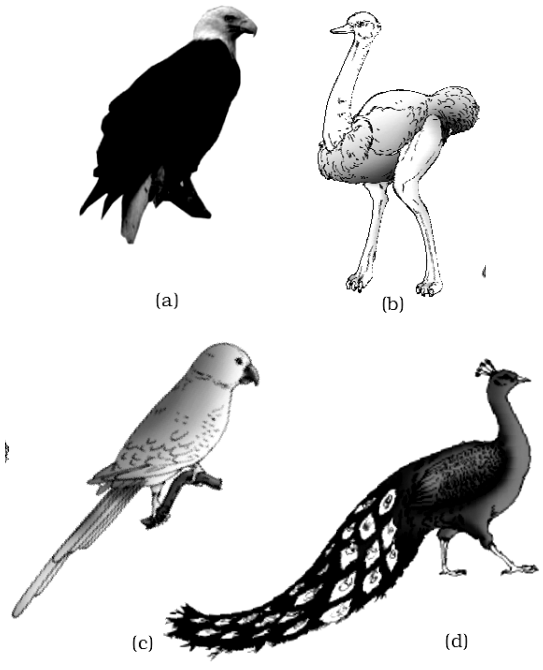


Fig : Some birds : (a) *Neophron*
(b) *Struthio* (c) *Psittacula* (d) *Pavo*

CLASS – MAMMALIA

(Mammae = Mammary gland)

- They are found in a variety of habitats polar ice caps, deserts, mountains, forests, grasslands and dark caves. Body distinctly divisible into head, neck, trunk and tail.
- Limbs 2 pairs, pentadactyle, and variously adapted for walking, running, climbing, burrowing, swimming or flying. Hindlimbs absent in cetaceans and sirenians.
- Hair-clad, mostly terrestrial, air-breathing, warm-blooded, viviparous, tetrapod vertebrates. Exoskeleton includes horny, epidermal hair, spines, scales, claws, nails, hoofs, horns, bony dermal plates, etc. Skin richly glandular containing sweat, sebaceous (oil) and sometimes scent glands in both the sexes. Females have mammary glands with teats skin of mammals is unique in possessing hair.
- A muscular partition, called diaphragm, separates the thoracic cavity from the abdominal cavity.
- Endoskeleton of bone. Skull dicondylic. A single zygomatic arch present. Each half of lower jaw made of a single bone,the dentary. Alimentary canal terminates by anus, there being no cloaca except monotremes. Teeth are of several types (heterodont), borne in sockets (thecodont) and represented by two sets (diphyo dont).
- The most unique mammalian characteristics is the presence of milk producing gland (mammary g lands) by which the young one are nourished. Respiration always by lungs (pulmonary). Glottis pro tected by a epiglottis. Larynx contains vocal cords.
- Heart 4-chambered with double circulation. Only the left aortic arch present. Renal portal system absent, R.B.C. small, circular and non-nucleated.
- Homiothermous animals.
- Kidneys metanephric. Excretion is ureotelic.
- Brain highly evolved. Both cerebrum and cerebellum large and convoluted. Corpora quadrigemina and Corpus callosum present. Cranial nerves 12 pairs.

- Sense organs well developed. Eyes protected by lids, the upper of which is movable. External ear opening protected by a large fleshy and cartilaginous flap called pinna. Middle ear cavity with 3 ear ossicles-malleus, incus and stapes. Cochlea of internal ear spirally coiled.
- Sexual dimorphism generally well marked. Male has an erectile, copulatory organ or penis. Testes com monly placed in a bag or scrotum outside abdomen. They are viviparous with few exceptions and development is direct.
- Fertilization internal. Except egg-laying monotremes, mammals are viviparous, giving birth to living young ones. Parental care well developed. Mammals show greatest intelligence among animals.

Eg. Oviparous - *Ornithorhynchus* (Platypus) ; *Viviparous-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).

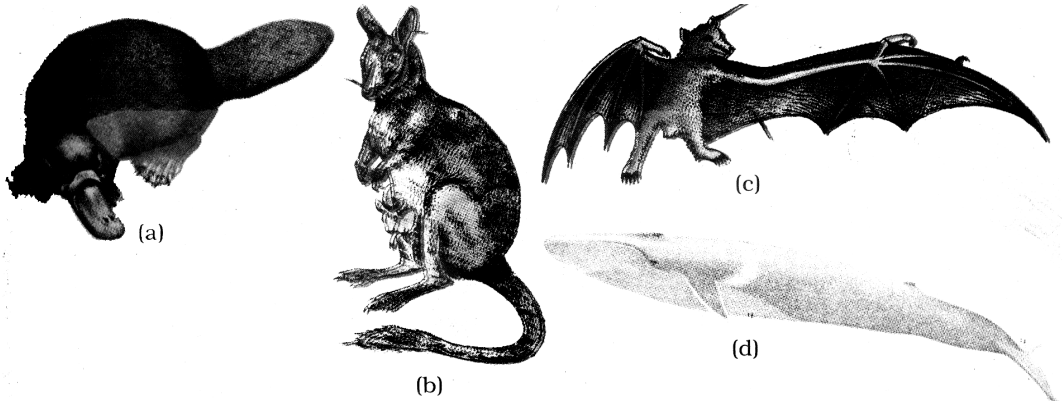


Fig : Some mammals : (a) *Ornithorhynchus* (b) *Macropus* (c) *Pteropus* (d) *Balaenoptera*

Salient Features of Different Phyla in the Animal Kingdom

Phylum	Level of Organisation	Symmetry	Coelom	Segmentation	Digestive System	Circulatory System	Respiratory System	Distinctive Features
Porifera	Cellular	Many	Absent	Absent	Absent	Absent	Absent	Body with pores and canals in walls.
Coelenterata (Cnidaria)	Tissue	Radial	Absent	Absent	Incomplete	Absent	Absent	Cnidoblasts present.
Ctenophora	Tissue	Radial	Absent	Absent	Incomplete	Absent	Absent	Comb plates for locomotion.
Platyhelminthes	Organ & Organsystem	Bilateral	Absent	Absent	Incomplete	Absent	Absent	Flat body, suckers.
Aschelminthes	Organsystem	Bilateral	Pseudo coelomate	Absent	Complete	Absent	Absent	Often wormshaped, elongated.
Annelida	Organsystem	Bilateral	Coelomate	Present	Complete	Present	Present	Body segmentation like rings.
Arthropoda	Organsystem	Bilateral	Coelomate	Present	Complete	Present	Present	Exoskeleton of cuticle, jointed appendages.
Mollusca	Organsystem	Bilateral	Coelomate	Absent	Complete	Present	Present	External skeleton shell usually present.
Echinodermata	Organsystem	Radial	Coelomate	Absent	Complete	Present	Present	Water vascular system, radial symmetry.
Hemichordata	Organsystem	Bilateral	Coelomate	Absent	Complete	Present	Present	Worm-like with proboscis, collar and trunk.
Chordata	Organsystem	Bilateral	Coelomate	Present	Complete	Present	Present	Notochord, dorsal hollow nerve cord, gill slits with limbs or fins.