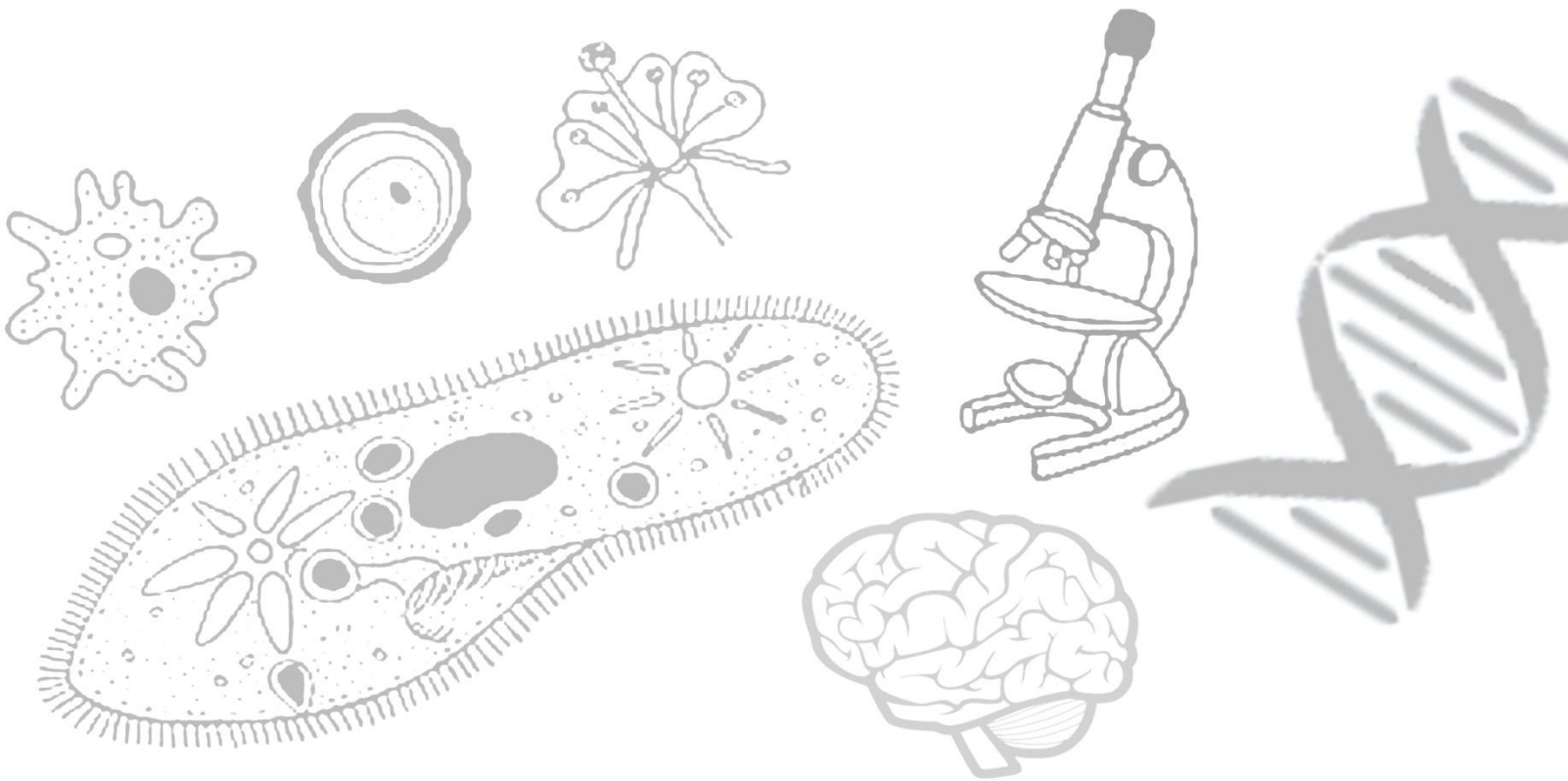


BIOLOGY



Animal Kingdom

Basis of Classification

- The animal kingdom includes all **metazoans**.
- Metazoans are multicellular animals with holozoic nutrition.
- All the animals have certain features in common which form the basis of animal classification.
- These different features are

Basis of Classification	Description
<p>Levels of Organisation</p>	<ul style="list-style-type: none"> • Cellular Level Organisation: <ul style="list-style-type: none"> ○ Cells are loosely arranged, but they do not form tissues. Example: Sponges • Tissue Level Organisation: <ul style="list-style-type: none"> ○ Similar cells are arranged in groups to form tissues. Example: Coelenterates • Organ Level Organisation: <ul style="list-style-type: none"> ○ Tissues are grouped together to form organs which perform specific functions. Example: Arthropods
<p>Body Symmetry</p>	<ul style="list-style-type: none"> • Symmetry is the similarity of the parts of the body in different regions of the body. • Asymmetrical Animals: The body of these animals cannot be divided into equal halves in any plane which passes through the centre. Examples: Sponges • Radially Symmetrical Animals: The body of these animals can be cut into two or more equal parts in any plane passing through the centre. Example: Jelly fish • Bilaterally Symmetrical Animals: The body of animals can be divided into equal right and left halves only in one plane. Example: Crab
<p>Germ Layers</p>	<ul style="list-style-type: none"> • In all metazoans, the cells are arranged in germinal layers from which the body develops. • Based on the number of germinal/embryonic layers, there are two types of animals. • Diploblastic Animals: <ul style="list-style-type: none"> ○ Two layers are present, an outer ectoderm and an inner endoderm. ○ Between these two layers, an undifferentiated layer called mesoglea is present. ○ Example: Coelenterates • Triploblastic Animals: <ul style="list-style-type: none"> ○ Three layers are present, an outer ectoderm, a middle mesoderm and an inner endoderm. ○ Example: Platyhelminthes

Coelom	<ul style="list-style-type: none"> • The coelom is the body cavity present between the body wall and the gut, lined with the mesoderm. • In coelomates, the coelom is present. Example: Annelids • In acoelomates, the coelom is absent. Example: Platyhelminthes • In pseudocoelomates, the coelom is present but not lined by the mesoderm. It is scattered in the form of pouches between ectoderm and endoderm. Example: Aschelminthes
Segmentation	<ul style="list-style-type: none"> • It is the repetition of a series of units called segments or metameres. • Segmentation leads to the repetition of muscles, locomotory appendages and some organs. • Metamerism: The body is divided into segments externally and/or internally. All the segments are of the same age. Example: Earthworm • Pseudometamerism: Segments are not of the same age. New segments are added from the neck throughout life. Example: Taenia
Notochord	<ul style="list-style-type: none"> • The notochord is a rod-like structure derived mesodermally on the dorsal side. • Animals with a notochord are called chordates, and the ones without a notochord are called non-chordates.

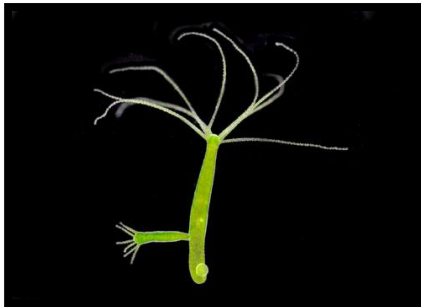
Phylum Porifera

- **Phylum Porifera** includes **pore-bearing animals**.
- They are also called **sponges**.
- They are **marine, diploblastic**, either **radially symmetrical or asymmetrical animals**.
- They show **cellular level of organisation**.
- Body has a number pores called **ostia**.
- The central cavity called **spongocoel** open outside through the **osculum**.
- In the canal system, the water current enters through ostia, passes through the spongocoel and exits the body through the osculum.
- **Choanocytes** or **collar cells** line the spongocoel.
- The body skeleton is made up of **spicules** or **sponging fibres**.
- Sponges are **hermaphrodites**.
- They reproduce asexually by **fragmentation** and sexually by the **formation of gametes**.
- Fertilisation is internal and the development is indirect.
- Examples: *Sycon*, *Euspongia*

*Sycon**Euspongia*

Phylum Cnidaria

- The old name of this phylum is **Coelenterata**.
- **Aquatic** mostly **marine**. Only hydra is a freshwater form.
- They are **sessile** or **free swimming**.
- They are **radially symmetrical** and **diploblastic**.
- They show the **tissue level of organisation**.
- There is a **gastro-vascular cavity** with a single opening called **hypostome**.
- **Digestion** is **extracellular** and **intracellular**.
- **Cnidoblasts** are the stinging cells of cnidarians found around the mouth and on the tentacles. They are used for the defense and catching prey. The name 'Cnidaria' is derived from the cnidoblasts.
- Cnidarians show two body forms, a **polyp** and a **medusa**. Cnidarians exhibiting both these body forms show **alternation of generation**.
- Polyps reproduce medusa asexually, and medusa produce polyps sexually.
- Examples: Hydra, *Physalia*



Hydra

*Physalia*

Phylum Ctenophora

- These animals were earlier placed in the phylum Cnidaria but later separated in different phylum because of lack of cnidoblasts.
- They are commonly known as **sea walnuts** or **comb jellies**.
- They are exclusively **marine, radially symmetrical** and **diploblastic animals**.
- They show **tissue level organisation**.
- Ctenophores bear cilia which are arranged in eight external rows called **comb plates** which help in locomotion.
- Digestion is both **extracellular** and **intracellular**.
- **Bioluminescence** is commonly seen in ctenophores. It is the property of living organisms to emit light.
- Examples: *Pleurobranchia*, *Beroe*



Pleurobranchia



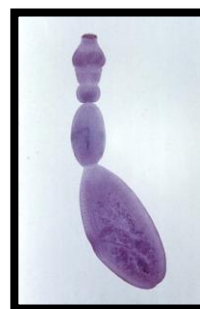
Beroe

Phylum Platyhelminthes

- They are also called **flatworms** because of their dorsoventrally flattened body.
- Flatworms are **endoparasites**.
- They are **bilaterally symmetrical, triploblastic** and acoelomates.
- They show **organ level of organisation**.
- In parasitic forms, there are organs of adhesion such as **hooks, suckers** and **spines**. Some also absorb nutrients from the host by their body surface.
- They show the presence of **flame cells** which help in excretion and osmoregulation.
- **Fertilisation** is **internal** and the life cycle show many larval stages.
- Examples: Liver fluke, *Taenia*



Liver fluke



Taenia

Phylum Aschelminthes

- Phylum Aschelminthes is also known as Phylum **Nematoda** or **Nemathelminthes**.
- Their body in the cross-section looks round and hence, they are also known as **round worms**.
- They are **free-living or parasitic, aquatic or terrestrial**.
- They show **organ level of body organisation**.
- They are **bilaterally symmetrical, triploblastic, pseudocoelomate** animals.
- **Alimentary canal** is complete and a **muscular pharynx** is present.
- Sexes are separate. The male is smaller than the female, and its posterior end is curved.
- **Fertilisation is internal. Development may be direct or indirect.**
- Examples: *Ascaris*, *Wuchereria*



Ascaris



Wuchereria

Phylum Annelida

- Animals of this phylum have a body made of ring-like segments, and hence, the phylum is named Annelida. 'Annulus' is a Latin word which means 'little ring'.
- They may be **terrestrial or aquatic**. They are **free-living** but **some are parasitic**.
- They show **organ level of body organisation**.
- They are **bilaterally symmetrical, triploblastic, metamerically segmented, coelomate** animals.
- **Nephridia** act as excretory organs.
- The nervous system shows the presence of **paired ganglia** connected by the **lateral nerves** to a **double ventral nerve cord**.
- Some animals are **hermaphrodites** and some are **unisexual**, i.e. sexes are separate.
- **Reproduction is sexual.**
- Examples: Earthworm, *Nereis*



Earthworm



Nereis

Phylum Arthropoda

- Phylum Arthropoda is the largest phylum of Kingdom Animalia.
- They can be **terrestrial** (found on land, in the soil) or **aquatic** (either marine or freshwater).
- They show **organ level of organisation**.
- They are **bilaterally symmetrical, triploblastic, segmented** and **coelomate** animals.
- A thick, tough exoskeleton covers the body which is formed **chitin**.
- The body of arthropods is divided into the **head, thorax** and **abdomen**. In crustaceans, the head and thorax fuse to form the **cephalothorax**.
- Arthropods have **jointed legs**.
- Respiration is by **trachea** or **book lungs** in terrestrial forms. In aquatic forms, it is by **gills** or **book gills**.
- They have an **open type circulatory system**.
- They have **well developed sense organs** such as antennae and compound eyes.
- **Excretion** is by **malpighian tubules**.
- **Sexes** are **separate**.
- **Fertilisation** is external in some aquatic forms and internal in terrestrial forms.
- They are **oviparous**. **Development** may be **direct or indirect**.
- Examples: Crab, Cockroach



Crab



Cockroach

Phylum Mollusca

- **Phylum Mollusca** is the **second largest animal phylum**.
- Molluscs are **marine animals**. Some are also found in **freshwater or damp soil**.
- They show **tissue level of organisation**.
- They are **bilaterally symmetrical, triploblastic, unsegmented** and **coelomate animals**.
- Body is divided into a distinct **head, muscular foot** and **visceral hump**.
- The visceral hump is further covered by the **mantle**.
- The cavity between the hump and the mantle is called the **mantle cavity**.
- Respiration is by **ctenidia** or **gills** present in the mantle cavity.
- The anterior region of the body i.e. head possesses tentacles.
- The mouth contains a rasping organ which is a tongue-like structure called **radula**.
- Sexes are **separate (dioecious)**.
- They are **oviparous** and the **development** is **indirect**.

- Examples: Octopus, Oyster



Octopus



Oyster

Phylum Echinodermata

- They are called echinoderms because they bear spines on their body.
- They are **marine**.
- They show the **organ level of body organisation**.
- **Adults** are **radially symmetrical**. **Larvae** are **bilaterally symmetrical**.
- They are **triploblastic** and **coelomates**.
- **Digestive tract is complete**.
- **The water vascular system** is a unique characteristic of echinoderms. It helps in locomotion, capture and transport of food.
- **Excretory system is absent**.
- **Sexes are separate**.
- **Fertilisation is external**. **Development is indirect**, with a free-swimming bilateral larval stage.
- Examples: Star fish, Sea urchin.



Star Fish



Sea Urchin

Phylum Hemichordata

- Phylum Hemichordata was considered a sub-phylum under Chordata.
- Recently, it was placed under non-Chordata as a separate phylum.
- They are **marine, bilaterally symmetrical** and **triploblastic animals**.
- They show **organ level of organisation**.
- Body is composed of anterior **proboscis**, a **collar** and a **trunk**.
- **The circulatory system** is of **open type**.
- **Respiration** is by **gills**.
- **Proboscis gland** is the excretory organ.
- **Sexes** are **separate**.
- **Fertilisation** is **external** and **development** is **indirect**.
- Example: *Balanoglossus*



Phylum Chordata

- Animals which belong to this phylum have three basic characteristics:

Notochord

- It is a flexible rod-like structure present dorsally.
- It extends throughout the length of an animal and supports its body.
- In adults, it is replaced by the vertebral column.

Dorsal Hollow Nerve Cord

- It is a tubular structure.
- It lies dorsal to the notochord and is differentiated into brain and spinal cord.

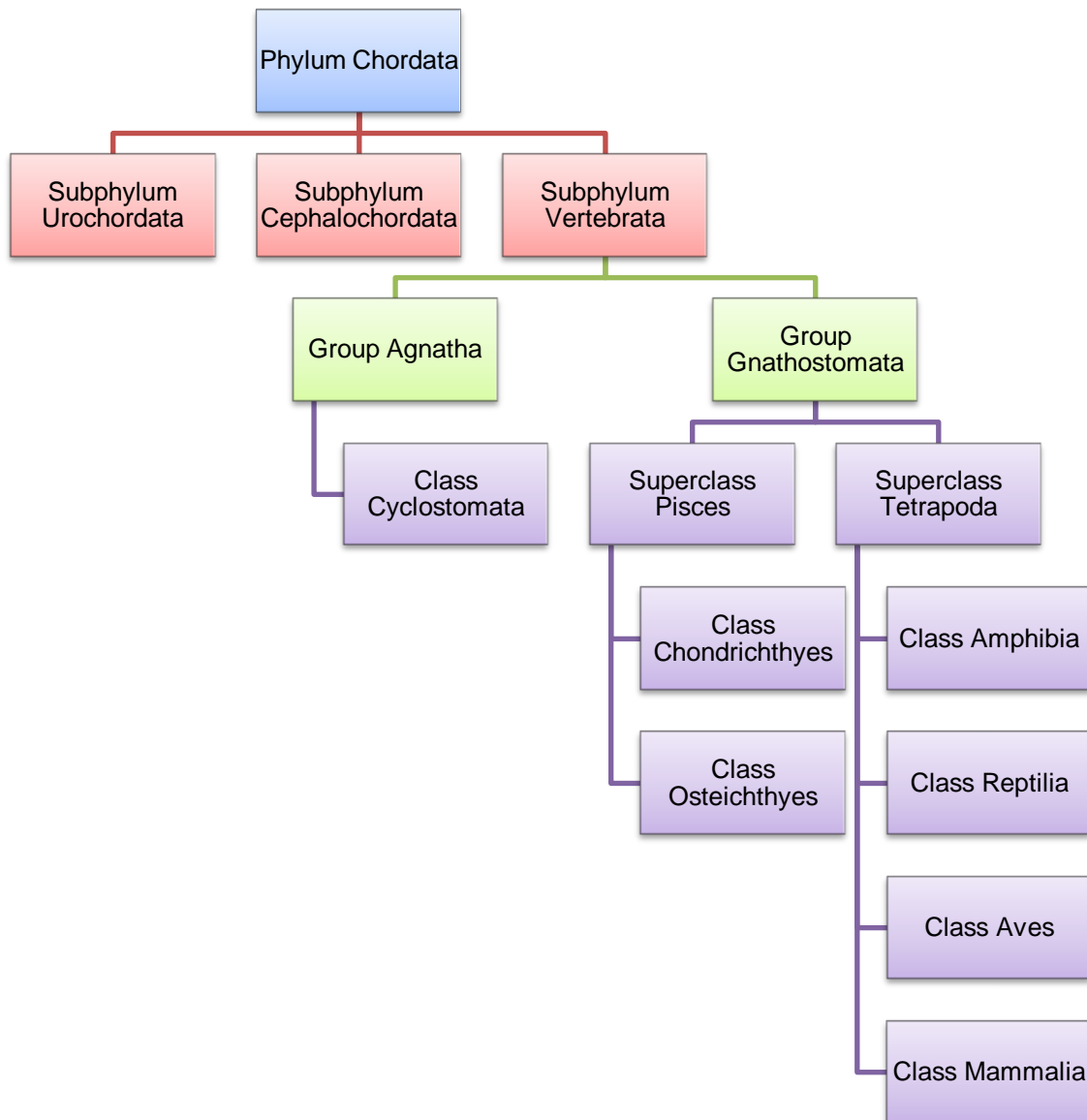
Paired Pharyngeal Gill Slits


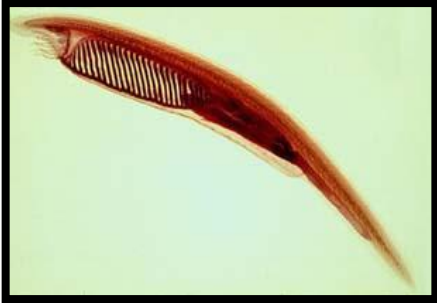

- All chordates bear pharyngeal gill slits at some point during their life cycle.

- They are **bilaterally symmetrical, triploblastic, coelomate** animals.
- They show **organ level of body organisation**.
- The **circulatory system** is of **closed type**.




Comparison between non-chordates and Chordates


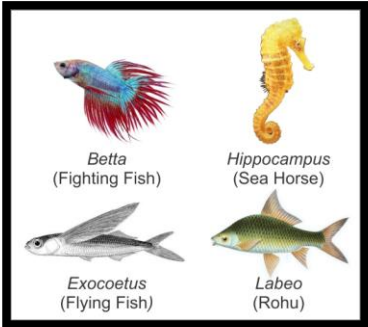
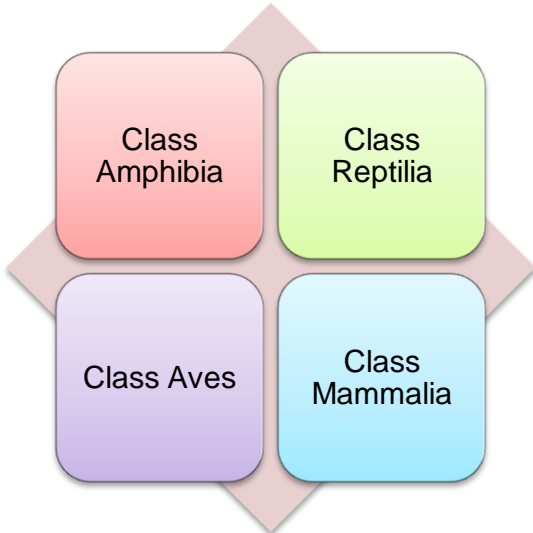
Chordates	Non-Chordates
<ul style="list-style-type: none"> • Notochord is present. 	<ul style="list-style-type: none"> • Notochord is absent.
<ul style="list-style-type: none"> • Pharynx bears gill slits. 	<ul style="list-style-type: none"> • Gill slits are absent.
<ul style="list-style-type: none"> • Heart is ventral. 	<ul style="list-style-type: none"> • Heart is dorsal.
<ul style="list-style-type: none"> • Tail, i.e. the post-anal part is present. 	<ul style="list-style-type: none"> • Tail (post-anal part) is absent.
<ul style="list-style-type: none"> • Nerve cord is located dorsally above the notochord. 	<ul style="list-style-type: none"> • Nerve cord is located ventrally below the alimentary canal.



Subphylum Urochordata (Tunicata)	Subphylum Cephalochordata	Subphylum Vertebrata
<ul style="list-style-type: none"> • Notochord is present in the tail region only in the larval stage. • It is absent in adults. 	<ul style="list-style-type: none"> • Notochord extends throughout the body length and is present throughout life. 	<ul style="list-style-type: none"> • Notochord is present during the embryonic development. • It is replaced by the vertebral column in adult stage.
<ul style="list-style-type: none"> • Example: <i>Ascidia</i> 	<ul style="list-style-type: none"> • Example: <i>Amphioxus</i> 	<ul style="list-style-type: none"> • Examples: Tiger 

Classification of Subphylum Vertebrata

Subphylum Agnatha	<ul style="list-style-type: none"> • Jawless animals. • Notochord is present through life. 											
	<table border="1"> <tr> <td data-bbox="342 1297 574 1367" rowspan="8"> Class Cyclostomata </td> <td data-bbox="574 999 1544 1037"> <ul style="list-style-type: none"> ○ They are ectoparasites. </td> </tr> <tr> <td data-bbox="574 1037 1544 1075"> <ul style="list-style-type: none"> ○ Body is elongated. </td> </tr> <tr> <td data-bbox="574 1075 1544 1113"> <ul style="list-style-type: none"> ○ Respiration is by 6–15 pairs of gill slits. </td> </tr> <tr> <td data-bbox="574 1113 1544 1150"> <ul style="list-style-type: none"> ○ Mouth is sucking without jaws. </td> </tr> <tr> <td data-bbox="574 1150 1544 1188"> <ul style="list-style-type: none"> ○ 8–10 pairs of cranial nerves are present. </td> </tr> <tr> <td data-bbox="574 1188 1544 1226"> <ul style="list-style-type: none"> ○ The circulatory system is of the closed type. </td> </tr> <tr> <td data-bbox="574 1226 1544 1297"> <ul style="list-style-type: none"> ○ After spawning, adults die. The larvae migrate back to the ocean after metamorphosis. </td> </tr> <tr> <td data-bbox="574 1297 1544 1654"> <ul style="list-style-type: none"> ○ Example: <i>Petromyzon</i> (Lamprey)  </td> </tr> </table>	Class Cyclostomata	<ul style="list-style-type: none"> ○ They are ectoparasites. 	<ul style="list-style-type: none"> ○ Body is elongated. 	<ul style="list-style-type: none"> ○ Respiration is by 6–15 pairs of gill slits. 	<ul style="list-style-type: none"> ○ Mouth is sucking without jaws. 	<ul style="list-style-type: none"> ○ 8–10 pairs of cranial nerves are present. 	<ul style="list-style-type: none"> ○ The circulatory system is of the closed type. 	<ul style="list-style-type: none"> ○ After spawning, adults die. The larvae migrate back to the ocean after metamorphosis. 	<ul style="list-style-type: none"> ○ Example: <i>Petromyzon</i> (Lamprey) 		
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	<ul style="list-style-type: none"> ○ Example: <i>Petromyzon</i> (Lamprey) 											
Subphylum Gnathostomata	<ul style="list-style-type: none"> • Mouth is bounded by the body jaws. • Notochord is replaced by the vertebral column in adults. 											
	<table border="1"> <tr> <td data-bbox="342 1854 574 1923" rowspan="6"> Superclass Pisces </td> <td data-bbox="574 1736 1544 1774"> <ul style="list-style-type: none"> ○ Superclass Pisces includes all fish. </td> </tr> <tr> <td data-bbox="574 1774 1544 1812"> <ul style="list-style-type: none"> ○ Body is streamlined. </td> </tr> <tr> <td data-bbox="574 1812 1544 1850"> <ul style="list-style-type: none"> ○ Heart is two-chambered. </td> </tr> <tr> <td data-bbox="574 1850 1544 1887"> <ul style="list-style-type: none"> ○ They are poikilotherms, i.e. cold-blooded animals. </td> </tr> <tr> <td data-bbox="574 1887 1544 1959"> <ul style="list-style-type: none"> ○ It is further divided into the following two classes: </td> </tr> <tr> <td data-bbox="574 1959 1544 2037"> <table border="1"> <tr> <td data-bbox="591 1959 1109 1997"> Chondrichthyes </td> <td data-bbox="1109 1959 1528 1997"> Osteichthyes </td> </tr> <tr> <td data-bbox="591 1997 1109 2037"> <ul style="list-style-type: none"> ○ Endoskeleton is cartilaginous. </td> <td data-bbox="1109 1997 1528 2037"> <ul style="list-style-type: none"> ○ Endoskeleton is bony. </td> </tr> </table> </td> </tr> </table>	Superclass Pisces	<ul style="list-style-type: none"> ○ Superclass Pisces includes all fish. 	<ul style="list-style-type: none"> ○ Body is streamlined. 	<ul style="list-style-type: none"> ○ Heart is two-chambered. 	<ul style="list-style-type: none"> ○ They are poikilotherms, i.e. cold-blooded animals. 	<ul style="list-style-type: none"> ○ It is further divided into the following two classes: 	<table border="1"> <tr> <td data-bbox="591 1959 1109 1997"> Chondrichthyes </td> <td data-bbox="1109 1959 1528 1997"> Osteichthyes </td> </tr> <tr> <td data-bbox="591 1997 1109 2037"> <ul style="list-style-type: none"> ○ Endoskeleton is cartilaginous. </td> <td data-bbox="1109 1997 1528 2037"> <ul style="list-style-type: none"> ○ Endoskeleton is bony. </td> </tr> </table>	Chondrichthyes	Osteichthyes	<ul style="list-style-type: none"> ○ Endoskeleton is cartilaginous. 	<ul style="list-style-type: none"> ○ Endoskeleton is bony.
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		<ul style="list-style-type: none"> ○ Mouth is located ventrally. ○ Gills are not covered by the operculum. ○ Skin is tough and covered with placoid scales. ○ Air bladder is absent. Hence, they have to swim continuously to avoid sinking. ○ Fertilisation is internal ○ They are viviparous. ○ Some of these animals have special organs such as electric organs as seen in <i>Torpedo</i> (Electric ray) and poison stings as observed in <i>Trygon</i>. <p>Examples:</p>  <p style="text-align: center;"><i>Scoliodon</i> (Shark)</p>	<ul style="list-style-type: none"> ○ Mouth is terminal. ○ Gills are covered by the operculum. ○ Skin is covered with cycloid scales. ○ Air bladder is present and helps in buoyancy. ○ Fertilisation is external. ○ They are oviparous and development is direct. <p>Examples:</p> 
	<p style="text-align: center;">Superclass Tetrapoda</p>	<ul style="list-style-type: none"> ○ Superclass Tetrapoda includes all land vertebrates. ○ Endoskeleton is bony. ○ Skin is covered either with scales, feather or hair. ○ Respiration is by the lungs. ○ It includes four classes. They are <div style="text-align: center;">  </div>	

Classification of Superclass Tetrapoda

Features	Class Amphibia	Class Reptilia	Class Aves	Class Mammalia
Habitat	<ul style="list-style-type: none"> • Cold-blooded • Live on land and in water. 	<ul style="list-style-type: none"> • Cold-blooded • Live on land. 	<ul style="list-style-type: none"> • Warm-blooded • Terrestrial. 	<ul style="list-style-type: none"> • Warm-blooded • Deserts, grasslands, mountains, forests and polar ice caps. Some also fly in the air and some live in water.
Body	<ul style="list-style-type: none"> • Body is differentiated into head, trunk and tail. 	<ul style="list-style-type: none"> • Body is differentiated into head, neck, trunk and tail. 	<ul style="list-style-type: none"> • Body is streamlined. • It is divided into head, trunk and tail. • The forelimbs are modified into wings. 	<ul style="list-style-type: none"> • Body is divided into head, neck and trunk. • Possess pentadactyl limbs.
Exoskeleton	<ul style="list-style-type: none"> • Skin is moist and devoid of scales. 	<ul style="list-style-type: none"> • Skin is dry and cornified and covered by scales. 	<ul style="list-style-type: none"> • Skin is dry and covered by feathers 	<ul style="list-style-type: none"> • Skin is covered by hair.
Endoskeleton	<ul style="list-style-type: none"> • Bony 	<ul style="list-style-type: none"> • Bony 	<ul style="list-style-type: none"> • Hollow bone 	<ul style="list-style-type: none"> • Bony
Respiration	<ul style="list-style-type: none"> • By gills, lungs or skin surface. 	<ul style="list-style-type: none"> • By the lungs 	<ul style="list-style-type: none"> • By the lungs 	<ul style="list-style-type: none"> • By the lungs
Circulation	<ul style="list-style-type: none"> • Heart is three-chambered. 	<ul style="list-style-type: none"> • Heart is three-chambered 	<ul style="list-style-type: none"> • Heart is four-chambered 	<ul style="list-style-type: none"> • Heart is four-chambered
Excretion	<ul style="list-style-type: none"> • Ureotelic 	<ul style="list-style-type: none"> • Ureotelic 	<ul style="list-style-type: none"> • Uricotelic 	<ul style="list-style-type: none"> • Ureotelic
Reproduction	<ul style="list-style-type: none"> • Sexes are separate • Fertilisation is external. • Development includes tadpole larva. 	<ul style="list-style-type: none"> • Sexes are separate • Fertilisation is internal • Development is direct. 	<ul style="list-style-type: none"> • Sexes are separate. • Fertilisation is internal • Development is direct. 	<ul style="list-style-type: none"> • Sexes are separate. • Fertilisation is internal • Development is direct.

Cloaca	<ul style="list-style-type: none"> Alimentary canal, urinary bladder and genital ducts open into the same chamber called cloaca. 	<ul style="list-style-type: none"> Not Present 	<ul style="list-style-type: none"> Not Present 	<ul style="list-style-type: none"> Not Present
Mammary Glands	<ul style="list-style-type: none"> Not Present 	<ul style="list-style-type: none"> Not Present 	<ul style="list-style-type: none"> Not Present 	<ul style="list-style-type: none"> It is a unique feature of mammals. Female mammals possess milk-producing mammary glands for nourishing young ones.
Examples	Frog, Salamander	Crocodile, Turtle	Parrot, Sparrow	Dog, Bear