ANIMAL KINGDOM

CLASSIFICATION OF ANIMALS

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Definition and introduction

- Meaning of **'Chorda' is 'a thick string'** and meaning of **'ata' is 'to have'** and over all meaning of chordata is animals having **notochord.**
- Chordates are the animals in which notochord is present in any stage of their life - span.
- Chordates are sharply distinguished from non-chordates by three fundamental characteristics
  1. **Notochord** 2. **Dorsal tubular central nervous system.** 3. **Pharyngeal gill clefts.**

CHARACTERISTICS

1. **Notochord –**

- Endoskeletal rod
- Derived from embryonic mesoderm
- Usually it occurs only during embryonic statges, as it is replaced in adult by a cartilaginous or bony vertebral column.

2. **Dorsal tubular central nervous system -**

- Chordates possess a single and hollow, tube like nerve cord, extending along mid-dorsal line above alimentary canal and notochord.
- Nerve cord develops from ectoderm.
- In most chordates, its anterior part enlarges to form a brain while the remaining part forms the spinal cord, both together forming the central nervous system (CNS).

3. **Pharyngeal gill clefts –**

- Paired gill slits, called gill clefts, are present in of embryonic pharynx in all chordates.
- In lower, aquatic chordates, gill clefts persist for respiration throughout life.
- In higher, terrestrial chordates, they close during later part of embryonic development because main respiratory organ is lung in adults.

- **Post anal tail is considered as fourth fundamental character of chordates.**

Other general characters of phylum chordata

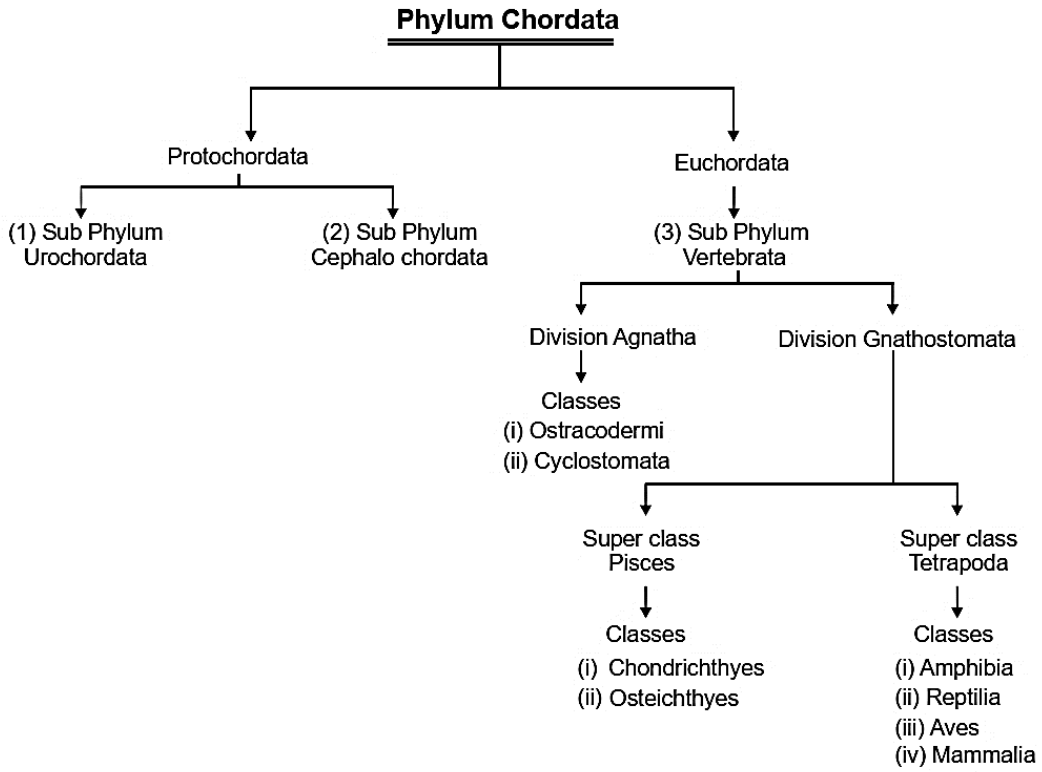
1. **Habitat and habit** –
- These animals are aquatic, terrestrial or aerial & free living.
2. **Body form** –
- Metamerism or segmentation is present.
3. **Germ layers and symmetry** –
- These are triploblastic and bilaterally symmetrical.
4. **Body cavity –**
- True coelom is found in chordates.
5. **Digestive system**
- Alimentary canal is complete.
- Digestive glands are present.
- Digestion is extracellular.
6. **Circulatory system -**
- Unlike non-chordates, chordates possess a distinct, muscular heart on the ventral side, mostly enclosed in a sac like pericardium.
- **Closed blood vascular system** - Blood flows in fixed direction within well-defined vessels.
- **Red blood corpuscles (RBCs)** - A red respiratory pigment, haemoglobin is present in the blood of chordates in special blood cells called Red blood corpuscles (RBCs) or erythrocytes.
- **Hepatic portal system** –
- Present in all chordates in which a hepatic portal vein collecting blood from alimentary canal.
- It breaks up into capillaries within the liver, instead of running straight to the heart.
- **Renal portal system** - Present in all chordates except birds and mammals.
7. **Skeleton system** –
- In chordates, endoskeleton is found which is made up of cartilage and bones.
8. **Excretory system -** Proto, meso or metanephric kidneys are found in the form of excretory organs.

9. **Reproduction -**
- Usually sexual reproduction is dominant.

- Males and females are separate.
- Development is direct with few exceptions.

Differences between chordates and non-chordates

	Chordates		Non-chordates
1	A stiff and flexible rod of tissue, notochord is present at some stage in the life cycle of chordate.	1	Notochord is not present at any stage in the life of a non-chordate.
2	Hollow central nervous system is present on the dorsal side of the body.	2	Solid central nervous system lies on the ventral side of the body.
3	Pharyngeal gill slits are present at some stage in the life cycle of chordate.	3	Pharyngeal gill slits are absent.
4	The post anal part of the body, the tail, is present at some stage in the life cycle of chordate.	4	Tail is absent.
5	Heart is ventral.	5	Heart is dorsal.
6	Blood vascular system is more developed. Blood flows in dorsal vessel in anterior - posterior direction.	6	Blood vascular system is less developed. Blood flows in dorsal vessel in posterior - anterior direction.
7	If present, RBCs contain respiratory pigment (haemoglobin).	7	If haemoglobin or other respiratory pigment is present, it is found in the blood plasma. RBCs are absent.
8	Portal system is present.	8	Portal system is absent.



Group: Acraniata or Protochordata

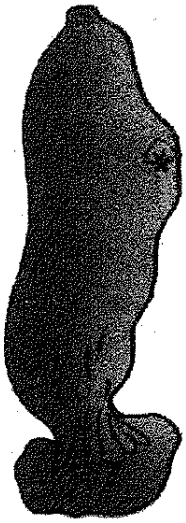
- Protochordates are exclusively marine.
- Pharyngial gill clefts are found throughout the life for respiration.
- Notochord is present in larval stages or persists throughout the life, but skull, brain and vertebral column is absent in them.
- Notochord is not replaced by vertebral column, hence they are chordate but not vertebrate.
- Protochordata is divided into two subphylum :-

Subphylum - 1-Urochordata

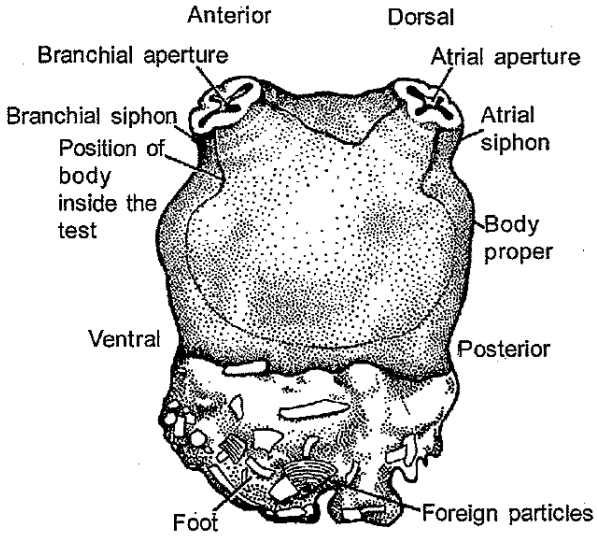
Subphylum - 2-Cephalochordata

SUB-PHYLUM-UROCHORDATA OR TUNICATA

- All the members of this subphylum are exclusively marine, free swimming or attached with rocks.
- Adults are normally fixed but larva is free swimming.



Ascidia



Herdmania

- All the adult members have test all over their body, made up of a cellulose like substance called tunicin so these animals are also called .tunicates.
- Notochord is found only in tail of larva which is lost during metamorphosis. Since chordate characters are found only in the tail region of tadpole larva, so the name Urochordata was given to this subphylum.
- Dorsal tubular nerve cord is found only in larval stage. In adult stage, this nerve cord is replaced by a neural ganglion.
- All chordate characters are found in larva. Only one chbrdate character is found in adults i.e. pharyngeal gill clefts.
- They are ciliary feeder.
- Blood vascular system is open type, heart is situated at ventral surface of body.
- Excretion is by supra neural gland/pyloric gland and nephrocytes.
- Most of the animals are bisexual.
- Fertilisation is external and mostly cross-fertilisation.

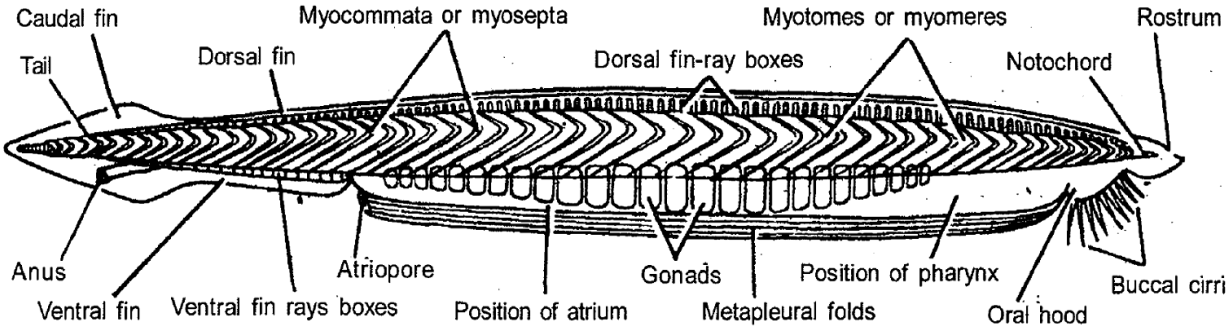
- A free swimming larval stage is found in this group, just like tadpole of Frog, it is also called tadpole larva.
- All the members of this subphylum show "Retrogressive metamorphosis". During this metamorphosis, a well developed free swimming larva is changed into less developed adult.

Endostyle absorbs iodine from water and is homologous to thyroid gland of mammals.

e.g.:

1. Ascidia
2. Doliolum
3. Salpa
4. Herdmania - Sea - potato or sea - squirts.

SUB-PHYLUM – CEPHALOCHORDATA



***Branchiostoma* : Entire animal in right side view**

- They all are found in shallow sea water.
- Both larva and adult are free swimming forms.
- Animals form burrows in sand and are nocturnal.
- Body is laterally compressed like fish, and is segmented.
- Notochord and nerve cord remain extended from anterior to tail region. Notochord persists throughout life.

- Alimentary canal is complete. Buccal opening is covered by oral hood and this collectively termed as ''Wheel organ" or "Ciliated organ of Muller". This organ helps in the ingestion of food by producing circular currents in water (Ciliary feeder).
- Blood vascular system is closed type and respiratory pigment absent.
- For excretion protonephridia are present in the form of flame cells or solenocytes. Hatschecks nepheridium (single) is present which helps in excretion.
- Fundamental chordate characters remain throughout life. Larva and adult both show chordate characters.

  Therefore, they are considered as first complete chordate animals or typical chordates.

- These are unisexual animals.
- Fertilisation is external.
- Development is indirect i.e. larval stage is found.

  e.g. :- Branchiostoma or Amphioxus (Lancelet)

SUB-PHYLUM – VERTEBRATA

1. Sybphylum vertebrata haves highly developed or advanced characters like **prominent head**, **vertebral column, jaws** and **cranium (brain box)** around brain.

2. Notochord is present in the embryonic stage only and is replaced by **vertebral column (back bone)** in the adult forms.

3. **Body form –**

- **Paired appendages**
- There is a very high degree of **cephalization** (formation of head).

4. **Body cavity –**

- **Coelom** is well developed.

5. **Body wall and musculo skeleton system –**

- It may bear an **exoskeleton of scales or feathers or hair.**

- Three types of **muscles** i.e. **striped, unstriped** and **cardiac** are present.
- The **endoskeleton** is formed of cartilage only or of **cartilage** and **bone** both.

6. **Digestive System –**

- Digestive tract is complete.

7. **Circulatory System –**

- There is **closed circulatory system.**
- Consisting of **blood vascular** and **lymphatic systems.**
- Blood contains haemoglobin.
- **Heart** is **ventral.**
- **Hepatic portal system is present.**

8. **Respiratory system –**

- **Respiratory organs** may be gills, skin, buccopharyngeal cavity and lungs.

9. **Excretory system –**

- **Excretion** by a pair of **Kidneys**.

10. **Nervous system** –

- Consists of

1. central nervous system (brain and spinal cord)
2. peripheral nervous system (cranial and spinal nerves) and
3. autonomic nervous system (sympathetic and parasympathetic nervous systems).

- **Sense organs** are eyes, ears, tongue, nasal chambers and skin.

11. **Endocrine system -**

- **Endocrine glands** are found in all vertebrates.

12. **Reproduction –**

- Animals are **unisexual.**
- Gonads are paired

- Fertilization may be external or internal.
- Development is mostly direct but in some indirect development is present.
- Only sexual reproduction found.

13. Classification - Subphylum vertebrata is divided into 2 divisions.

I. **Agnatha –** Jawless vertebrates

II. **Gnathostomata** – The jawed vertebrates.

I. Agnatha -

- Consists of **Jawless fishes (false fishes)**
- Notochord persists throughout life.
- 6-15 pair gill slits present.
- Heart is two chambered called **venous heart**.
- Animals are unisexual
- Fertilization is external.

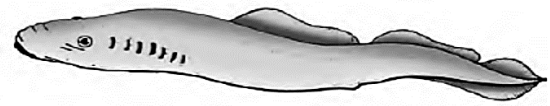


Figure: A jawless vertebrate - *Petromyzon*

Examples : 1. Petromyzon (Lamprey) living fossils and **2. Myxine** (Hagfish).

II. Gnathostomata (The jawed vertebrates)

- Vertebral column well developed.
- Movement by **paired fins or legs**.
- Animals are unisexual
- Gnathostomata is divided into five classes on the basis of locomotory organs, respiratory organs, heart and blood vascular system –

a. Pisces **b. Amphibia** **c. Reptilia**

d. Aves **e. Mammalia**

SUPER CLASS – PISCES

- This super class includes true fishes.
- "Devonian period" is called as "Golden period of fishes"
- Study of fishes is Icthyology.
- They are cold blooded {Poikilothermous) animals i.e. they lack the capacity to regulate their body temperature.
- They are aquatic, may be fresh water or marine.
- Body is long, boat shaped and stream lined, which is divided into head, trunk and tail. Neck is absent.
- Body is covered by dermal scales. But Cat fish, Torpedo & Wallagonia fishes are scale less.
- Paired fins are present for swimming. e.g. Pectoral and pelvic fins. Along with these unpaired fins are also found on the body e.g. mid dorsal fin and caudal fin.
- External nares are one pair. (Dirhynous condition)
- External and middle ears are absent, only internal ear is present which works as statoreceptor. (For balancing)
- Respiration by JJills, which are naked or covered by operculum.
- Teeth are Acrodont.
- Heart is two chambered. known as "Venous heart", because it contains only impure blood, which goes to gills for purification from heart, pure blood is then distributed to all parts of body directly from gills. i.e. single circulation of blood.
- RBC are nucleated. Sinus venosus, renal and hepatic portal systems are found in circulatory system.
- In the skull of fishes only one occipital condyle is present, so their skull is called monocondylar type.
- Cranial nerves are 10 - pairs.
- Lateral line sensory system is present in the body of all fishes and tadpole larva which includes many receptor organs which can detect vibrations (Rheoreceptor) and Electric field.
- Kidneys in fishes are mesonephric type, Urinary bladder is absent.
- Cartilagenous fishes excrete Urea, marine bony fishes excrete Trimethyl amine oxide and fresh water bony fishes excrete Ammonia.
- Fishes are unisexual.

- Fertilization is internal or external.
- Development is direct i.e. larval stage is lacking during development.
- Baby fishes are called Fry or Hatchling.
- Super class pisces classified into three classes :-

  (A) Placodermi (B) Chondrichthyes (C) Osteichthyes

PLACODERMI

- In this class, extinct fishes (Fossil fish) are included, which lived from devonian period to permian period. So these were the first fresh water true fishes.
- Their body was covered by bony plates, so these are called "Armoured fishes"
  e.g. :- Climatius - First jawed fish

(i) **Chondrichthyes** or **Elasmobranchi -** They are **marine** animals

- streamlined body
- They have **cartilaginous endoskeleton.**
- **Mouth** is located ventrally.
- Notochord is persistent throughout life.
- They have **5-7 pairs of gills** which are **devoid of the operculum (gill cover)**.
- The skin is tough containing minute **placoid scales.**
- **Teeth are** backwardly directed. Their jaws are very powerful.
- Due to the absence of air bladder, they have to swim constantly to avoid sinking.
- Venus Heart is present.
- Some of them have **electric organs** e.g:- **Torpedo** and some possess poison sting.
  e.g. **Trygon.**
- Sexes are separate.
- In males, pelvic fins bear **claspers** (copulatory organs).
- **Internal fertilization** and many of them are viviparous.

  e.g :- **Scoliodon** (Dog fish, Indian shark) – ovoviviparous.

  Pristis (saw fish)

  Trygon (sting ray)

  Torpedo (electric ray)

Carcharodon (great white shark)

Chimaera – Connecting link between cartilaginous and bony fishes.

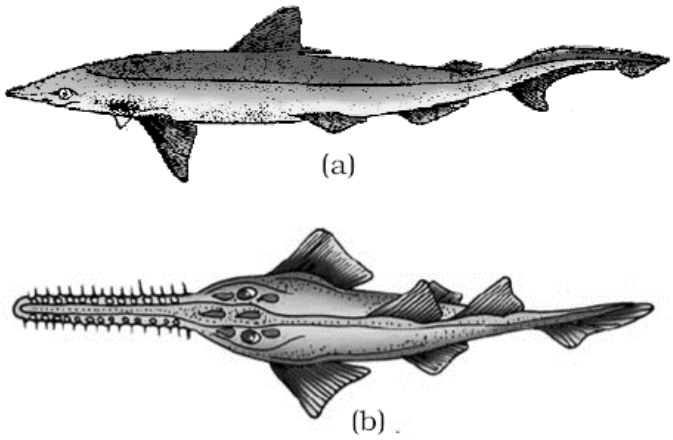


Figure :(a) Scoliodon (b) Pristis

(ii) **Osteichthyes or Teleostomi -** It includes both marine and fresh water fishes **bony endoskeleton.**

- **Mouth** is usually **terminal.**
- The exoskeleton is made up of cycloid scales.
- Respiration is by **4 pairs of gills.** These gills are covered **by operculum.**
- **Air bladder** is present.
- Sexes are separate.
- Fertilization is external.
- May be ovoviviparous or viviparous.
- Development is direct.

Examples:-

1. **Hippocampus :-** "Sea- horse" or "Pregnant male" : It swims in sea water in vertical position. A pouch like structure is present at the abdomen of male fishes known as "Brood - pouch" in this pouch male collects the eggs. Secondary vivipary and parental care is found.
2. **Exocoetus (flying fish) :-** Its dorsal fin is long, it can fly (glide} over 400 metre in sea water with the help of enlarged pectoral fin.

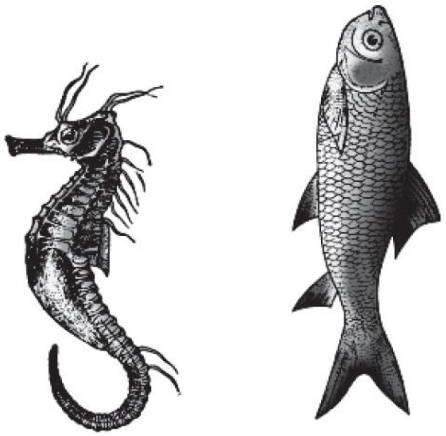
3. **Labeo :-** "Rohu" or "Indian carp" (fresh water fish}.
4. **Clarias :-** "Cat fish" or Magur (Fresh water}
5. **Catla :-** Katla (Fresh water}
6. **Betta :-** Fighting Fish (Aquarium fish}
7. **Pterophyllum :-** Angel Fish (Aquarium fish}
8. **Latimeria or coelacanth :-** living fossll or oldest living vertebrate known till now.
9. **Gambusia :-** Larvivorous fish and is viviparous.
10. **Wallagonia :-** Lachi (scale less)

LUNG FISHSES (GROUP - DIPNOI) :- Uncle of amphibian

- These are freshwater bony fishes and have some amphibian like characters
- Air bladder helps in respiration and can survive out of water.
- Three chambered heart is present.
- External and internal both the nares are present.
- Scales are cycloid type.

e.g. :-

- **Protopterus :-** African lung fish (living fossil)
- **Lepidosiren :-** South American lung fish



(a) (b)

Figure :(a) Hippocampus (b) Catla

Differences between cartilaginous and bony fishes

	Characteristics	Cartilaginous fishes	Bony fishes
1.	Habitat	Mostly marine	Marine and fresh water
2.	Mouth	Ventral	Anterior
3.	Scales	Placoid	cycloid
4.	Operculum	Absent	Present
5.	Endoskeleton	Cartilaginous	Partly or completely bony
6.	Gills	5-7 pairs	4 pairs
7.	Swim bladder	Absent	Present
8.	Excretory matter	Urea	Ammonia

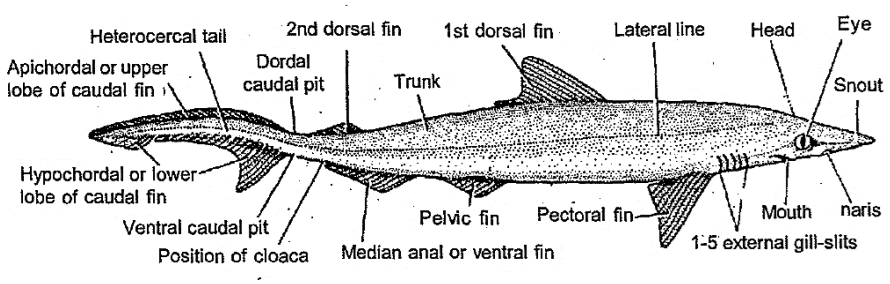
GOLDEN KEY POINTS

- Shagreen is dried skin of Cartilaginous fish (shark) .
- Cod liver oil is rich in Vitamin D,Shark liver oil is rich in Vitamin A
- Maltese cross is found in vertebrae of Shark for supporting vertebrae.
- Mermaid's purse refers to Egg capsule of Shark.
- Isinglass is a gelatinous product obtained from air bladder of certain fish and used for making cement, Jelly & for clarification of wine & beer.
- Smallest fish Mystichthyes- Goby fish- Pandaka (8-10 mm)
- Stone fish is the most poisonous fish.
- Fishes can change their direction suddenly, with help of caudal fin.
- Fishes show a seasonal migration in a particular season.

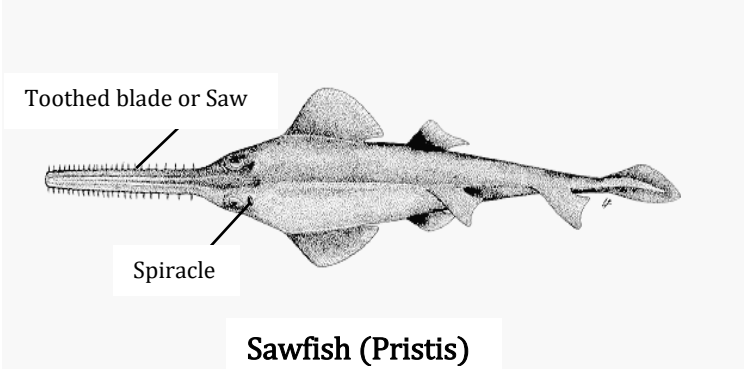
(A) Catadromous migration :- Migration of fishes from fresh water to marine water.
e.g. Anguila

(B) Anadromous migration :- Migration of fishes from marine water to fresh water.
e.g. (1) Salmon, (2) Sturgeon, (3) HiLsa

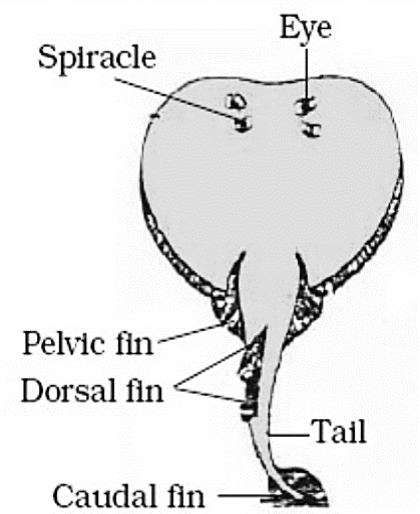
- Pyrosoma - Bioluminescence is found. (Strongest light among marine organism)
- Rhincodon :-Whale shark- It is the largest true fish. Its length is 13 - 14 meters.



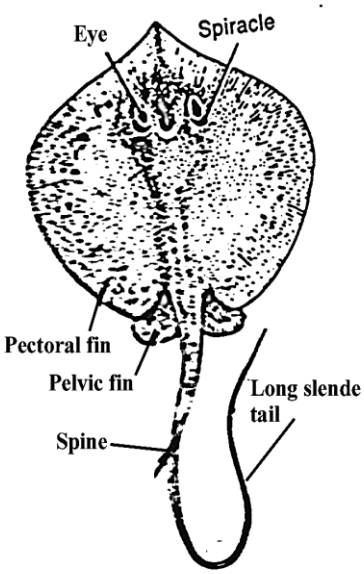
Female Indian dogfish shark (***Scoliodon***)



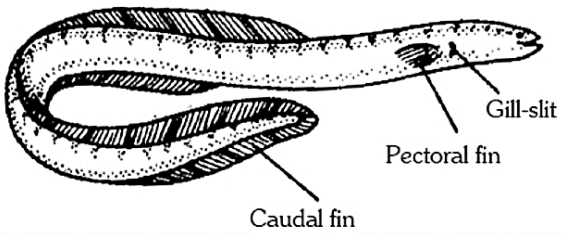
Sawfish (Pristis)



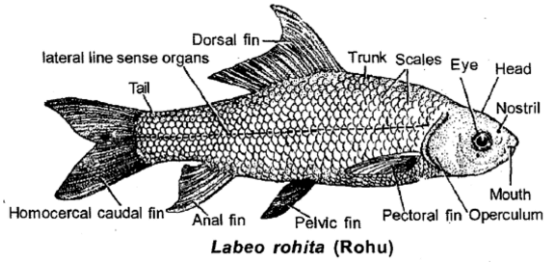
Electric ray (Torpedo)



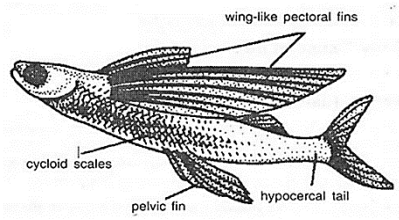
Sting ray (Trygon)



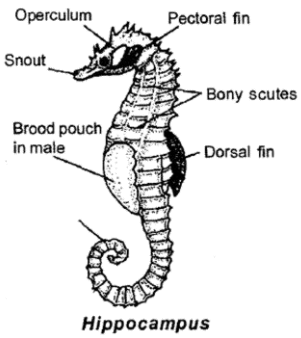
Anguilla (european eel)



***Labeo rohita* (Rohu)**



Exocoetus



Hippocampus

AMPHIBIA (THE VERTEBRATES WITH DUAL LIFE)

(Gk. Amphi = two or both; bios = life)

General characters:

1. They were the first cold blooded vertebrates.
- They are amphibious in nature i.e. they can live on land as well as in water.
2. Body is divided into head, trunk and tail. Some amphibians lack tail. e.g. frog, toad etc.
3. Two pairs of limbs help in swimming in water or moving on land.

4. The respiratory organs are **lungs, buccopharyngeal cavity, skin** and **gills.**
5. These are cold blooded or poikilothermal animals.

- Heart is three chambered, 2 auricles and 1 ventricle (arteriovenous).-Sinus venosus and Truncus arteriosus are well developed.
- R.B.Cs are biconvex, oval and nucleated.
- Renal portal system and hepatic portal system are present.

Eyes have eyelids.

- Cranial nerves are 10 -

6. Endoskeleton is made up of bones.
7. Skull has two occipital condyles (dicondylic skull).
8. **Nervous system & sense organs -**

- Ear consists of internal and middle ear.
- **Tympanum** (ear drum) covers the middle ear.

9. Kidneys (one pair) are **mesonephric type.**

- Larvae are **ammonotelic** while adults are **ureotelic**.

10. They are **unisexual.**

- Fertilization is **external** and **inside the water.**
- These are oviparous.
- Development is indirect e.g. **Tadpole larva** – in frog.

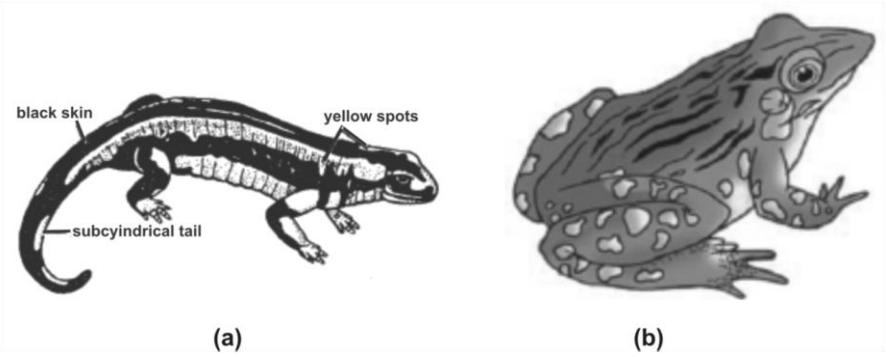


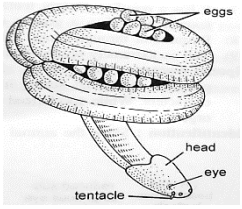
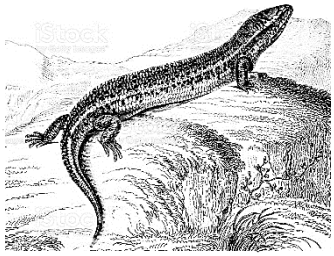
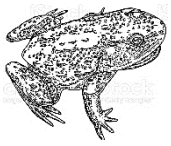
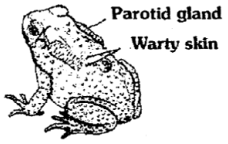
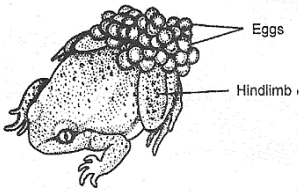
Fig : (a) European fire Salamander (Salamandra salamandra) ; (b) Rana

This class is divided into three orders :-

(A) Gymnophiona or Apoda

(B) Caudata or Urodela

(C) Anura or salientia

Gymnophiona (Apoda)	**Caudata (Urodela)**	**Anura (Salientia)**
e.g. ***Ichthyophis*** (limbs absent)  Wormlike Primitive Limbless Scales present Blind and deaf	Head, trunk and tail present (Tailed amphibia) **e.g.** **1.** ***Salamandra*** -  Viviparous, Axolotl larva. Sometimes show neoteny **2.** ***Amphiuma*** - Congo-eel Largest RBC is present.	**e.g.** **1.** ***Rana tigrina*** -  Indian bull frog. **2.** ***Bufo*** - Common toad  **3.** ***Hyla*** - Tree frog **4.** ***Alytes*** - Midwife toad 

REPTILIA – THE CREEPING VERTEBRATES

(L.Reptare = to creep)

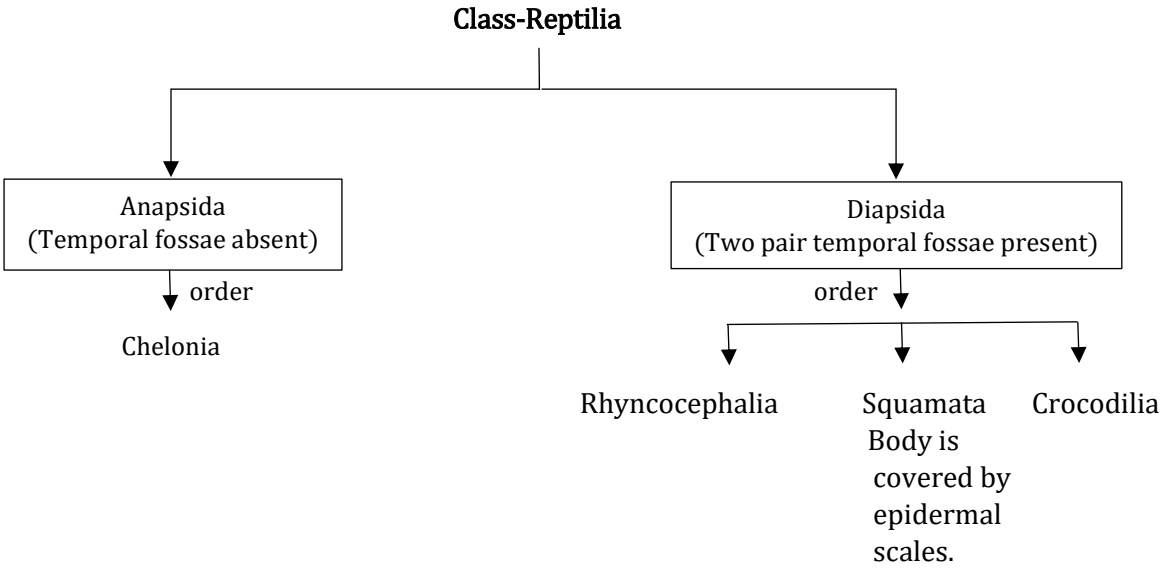
- Class name refers to creeping or crawling mode of Locomotion. (Latin reptum- To creep or Crawl)
- Mesozoic era was the Golden age of Reptiles.
- Study of reptiles is known as "Herpetology".
- These are Cold blooded/Poikilothermal animals.
- Reptiles were the first successful terrestrial vertebrates but some are also found in aquatic habitat.
- Body is divided into head. neck, trunk and tail.
- Exoskeleton is made up of horny epidermal scales or scutes.
- Skin is dry, cornified, rough and nonglandular. Snakes & Lizard shed their scales as skin cast.
- Limbs, when present are two pairs and each limb has five digits. Each digit has incurved nails. (Snakes are limbless)
- A complete alimentary canal is found in these animals, which opens into cloaca.
- Teeth are acrodont, pleurodent and thecodont type. Tounge is protrusible.
- Respiration occurs through lungs throughout the life.
- Heart is usually 3 chambered but 4 chambered in crocodiles, right and left both systemic arches are present.
- Sinus venosus is ill developed and trunkus arterious is absent. RBCs are oval and nucleated.
- Only one occipital condyle is present in skull,(monocondyler skull).
- Ribs are present in neck and thorax region.
- One pair of Metanephric kidneys are present for excretion and osmoregulation. These animals are uricotelic for water conservation.
- Brain is well developed and 12- pairs of cranial nerves are present. They do not have external ear opening. Tympanum represents ear.
- Lateral line system is absent. At the roof/cieling of buccal cavity Jacobson's organ (olfactory) is present.
- Ureters, genital ducts and alimentary canal open into a single cloacal aperture.
- These are unisexual animals. Fertilization is internal. One or two penis (Hemipenis) is found in male animals as copulatory organ.

- They are mostly oviparous.
- Eggs are leathery and cleidoic, i.e. eggs are covered by a shell made up of $CaCO_3$
- Development direct i.e. larva stage is absent.
- Parental care is often marked.

GOLDEN KEY POINTS

In reptiles, birds and mammals, All the three embryonic membranes amnion, chorion and allantois are present in the embryo. Yolksac is also attached with embryo these classes are grouped under Amniota group, so reptiles are first amniotes, while fishes and amphibians are grouped under Anamniota group because extra embryonic membranes are absent in them.

- Class Reptilia is classified on the basis of presence or absence of temporal fossae in the temporal region of skull and on their number.



Order - Chelonia ***** They are terrestrial, marine and fresh water animals. ***** Whole body is covered by firm bony shell, dorsal plate is called carapace and ventral plate called plastron. ***** Jaws are homy beak like and teeth less. ***** Scales are found on neck, limbs and tail. All these three organs can be pushed into the carapace. ***** Thoracic vertebrae and ribs are attached with carapace. ***** Cloacal aperture is vertical and it helps in respiration (cloacal respiration). ***** Single copulatory organ is found in male animal. e.g. 1. Testudo - Land tortoise 2. Chelone - Marine Turtles 3. Trionyx – Fresh water Terrapins (Edible) 4. Kachhuga tactum - Roofed tectum	**Order- Rhynchocephalia Sphenodon punctatum** - Commonly called Tuatara in local language of **Newzealand. (living fossil)**	***** Study of lizards is called "Saurology" ***** Eyelids are movable Lizards have limbs, urinary bladder, tympanum, girdles and nictitating membrane in the eye. ***** Foramen of panizzae is present in the heart of lizard. e.g. 1. Hemidactylus - Common lizard/wall lizard. It can shed its own tail at the time of emergency. It is called autotomy. Power of regeneration is well marked. 2. Calotes - Blood sucker/ Garden lizard/Girgit. It can change its colour according to environment. 3. Chameleon - Tree lizard (Viviparous) 4. Draco- Flying lizard. It can glide from one tree to another tree with the help of lateral skin extensions called patagia. 5. Varanus - Goh or Monitor lizard. Varanus komodoensis (Komodo Dragon) is the Largest living lizard 6. Ophiosaurus - It is limbless lizard. It is also called glass - snake. 7. Heloderma – Gila-monster. It is the only poisonous lizard. Its poison glands are modified sublingual salivary glands (Mexico & USA).	***** The study of snakes is called ophiology or serpentology. ***** Girdles and limbs are absent (Limbless). ***** Eyelids are immovable and nictitating membrane in eyes are absent. ***** Urinary bladder absent. ***** Tympanum, middle ear absent. ***** Tongue thin, long and bifid and sensitive to odour and vibration. ***** Left lung is ill developed.	***** These are amphibious in nature and live in lakes or rivers. ***** These are largest modern reptiles. ***** Skin is covered by bony scutes/bony plates. ***** Body is solid and massive. ***** Snout is long. External nares are situated at the distal end of snout and nares have cover also. ***** They have some mammal like features diaphragm, thecodont teeth and 4-chambered heart. ***** Urinary bladder absent. e.g. 1. Crocodilus (Crocodile) -It is found only in Indian subcontinent. 2. Alligator - Maxican crocodile. 3. Gavialis -Gharial. Snout very long.

e.g.

1. **Vipera** - Viper snake : Head is differentiated from bcx:ly. Poisonous and viviparous snake. Its venom is haemotoxic/Cardiotoxic. Loreal pit is found which is a thermoreceptor.
2. **Bangarus -** Krait : Poisonous snake (neurotoxic).
3. **Naja naja -** Indian cobra. Poisonous snake (Neurotoxic).
4. **Naja bungarus or N.Hannah -** King cobra, poisonous snake. It is the largest snake among poisonous snakes (Head with one or two circular mark).
5. **Hydro phis -** Marine, deadly poisonous, tail is laterally compressed and viviparous snake.
6. **Crotalus -** It produces a characteristic rattling sound of "Rate - rate- rate", so it is called rattle snake. It is poisonous and ovoviviparous snake.
7. **Python molurus -** Ajgar, the largest non-poisonous snake (25 feet). Rudiments of hind limbs are found on the body.
8. **Ptyas mucosus or Zamenis -** Rat snake. It is commonly called Dhaman. It feeds on rats, so it is also called "Friend of farmers". It is a non-poisonous snake.
9. **Eryx Johni -** Sand boa, Dumuhi, a non-poisonous snake.

GOLDEN KEY POINTS

- Poison glands of poisonous snakes are modified labial glands. Probably these glands are homologous to parotid salivary glands of Mammals.
- Poisonous teeth (fangs) are modified maxillary teeth.
- Treatment of poisonous snake bite is done by antivenom dose. It is produced at

(1) Central Research Institute, Kasauli- Shimla

(2) Haffkine Institute, Mumbai.

- Biggest Serpentarium is located in India – Chennai
- Characteristic features of poisonous snakes :

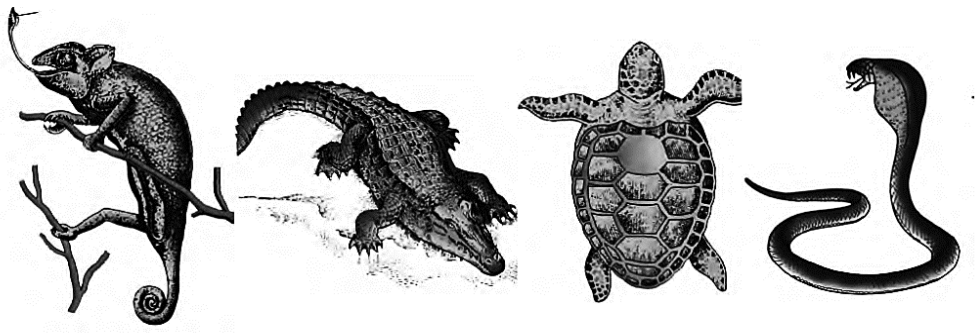
(1) Small scales are found on head or hood.

(2) Laterally compressed tail is present in marine snake.

(3) Ventrally placed scales of the body are broad.

(4) Two deeper teeth mark is of poisonous snake. (A - shaped - Non posionous)

- Phrynosoma - Homed toad (viviparous)



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

Examples :

1. **Bufo** (Toad)
2. **Rana** (Frog)
3. **Hyla** (Tree frog)
4. **Salamandra** (Salamander)
5. **Ichthyophis** (Limbless amphibia).

AVES – THE BIRDS

(L. Avis = Bird)

All types of birds are included in this class.

- Study of birds is known as "Ornithology"
- Dr. Salim Ali was the great ornithologist of India and regarded as "Birdman of India"
- Birds are also known as "Feathered bipeds or glorified reptiles"
- Birds are warm blooded or Homeothermic or endothermic animals i.e. Body temperature remains almost constant. (Approx 102°F)

General characters

1. Birds are bipedal, feathered and **warm blooded.**
- Their **forelimbs** are **modified into wings.**

2. Body is **boat shaped.** It is divided into **head, neck, trunk** and **tail.**
- Soft feathers present all over the body.
- No skin gland is present except **oil gland** on the tail.

3. The upper and lower jaws are modified into beak which lack teeth.
- The alimentary canal has additional chambers, the **crop** and **gizzard.** The crop stores and softens the food whereas gizzard helps in crushing and churning the food.

4. Skin is dry and without glands. But oil glands or Preen glands are found on tail or Uropygium. These glands secrete oil, which lubricates feathers.
5. A three chambered cloaca is present in the birds.
- Jaws are modified into horny beak, which is toothless.
- Spongy lungs are present for respiration Air sacs are also found. Air sac connected to lungs for supplement respiration.
- Sound producing organ at the junction of trachea and bronchi of birds is called syrinx.
- Heart is four chambered. Double circulation is found.
- Hepatic portal system is well developed in birds, but renal portal system is ill developed. Sinus venosus is absent. Only Right aortic arch is present. R.B.Cs are nucleated.

6. Endoskeleton is bony. Long bones are hollow. with air filled cavities and these bones are called pneumatic bones. These make the body light in weight and help in flying.
- Skull is monocondylic.
- Last four caudal vertebrae fuse to form pygostyle. Which helps in wagging of tail.
- Sternum is large. Swollen basal part of sternum is called "Keel" This keel offers sites for attachment of flight muscles.

7. Two bones, clavicle and interclavicle fuse to form V- shaped bone called furcula or Wish bone or Merry thought bone. Which Act as a spring between two pectoral girdles.
- Pygostyle, Keel and Furcula are absent in flight less birds.
- Kidneys are metanephric. Ureters open into cloaca. They are mostly Uricotelic.
- Most of the birds do not have urinary bladder and copulatory organ.

- Brain is large, smooth, highly developed. Cerebellum is well developed for aerial mode of life.
- Cranial nerves are 12 - Pairs.
- Eyes are large and nictitating membrane is present in eye. Vision is monocular.
- A specific comb like structure Pecten is found in the eyes of all birds except kiwi. Pecten helps in accomodation of eye and provides nutrition to eye balls. Acute vision and telescopic vision of birds is due to pecten.

8. External ears are present but ear pinnae are absent. Only one ossicle columella (Stapes) is found in middle ear.
- Olfactory organs are less - developed.
- Birds are monodelphic i.e. only left ovary and left oviduct is functional in females.
- Birds are unisexual. Sexual dimorphism is well marked.

9. **Reproduction –** Birds are **monodelphic** i.e. only left ovary and left oviduct is functional in females. Birds are oviparous vertebrates.
- Birds are unisexuals.
- Sexual dimorphism is well marked.
- Fertilization is **internal.**

All the birds form nests. Parental care is well marked.

e.g.

1. **Archaeopteryx - Lizard bird**. (Extinct in Cretaceous period) Its fossil was discovered by Andreas Wagner in 1861 from Bavaria (Germany).

(a) Bones were non-pneumatic.
(b) Teeth were present in the jaws of skull.
(c) They are considered as the connecting links between reptiles and birds.
(d) Wings were ill developed, i.e. capacity of flying was very less.

2. **Aptenodytes** - Penguin, also called "sea bird of Antarctica"
- Forelimbs are modified into flippers for swimming.

3. **Struthio** - African ostrich or Camel-bird - It is the largest living bird of modern period. It is almost 8 feet in height. Polygamous, male incubate the eggs (Largest eggs).

4. **Rhea** - American ostrich.

5. **Apteryx** - Kiwi - It is National bird of New zealand. It has hair like feathers all over its body. It is smallest flightless bird.

6. **Dromaeus** - Emu - It is a monogamous bird in which only males look after their young ones and eggs.

- 3 to 6 are large and massive birds, which are flightless in nature.
- These are able to run fast wings are reduced or absent.
- Caudal vertebrae are free and pygostyle is absent.
- Lacks Keel.
- Oil glands or preen glands absent.
- Sound producing organ syrinx is absent.
- Usually urinary bladder and copulatory organ in males present.

7. **Pavo- cristatus** - Peacock - It is the national bird of India.

8. **Psittacula** - Indian parrot (Upper jaw movable)

9. **Columba Iivia** - Blue rock pigeon - Its crop glands secrete pigeon milk

10. **Neophron** - Vulture (Scavenger bird)

11. **Corvus splendens** – Crow

12. **Passer domesticus** - Sparrow - It shows commensalism with man.

13. **Helena** - Humming bird or sunbird. It is the smallest flying bird. It is found in cuba. It can fly in forward and backward both the directions .It can fly like helicopter. Its size is about 3 to 4 cm.

- For 7 to 13 small sized flight birds of modern era. Wings are well developed

- Pygostyle is present
- Keel in sternum is highly developed.
- Oil glands or preen glands are found.
- Sound producing organ syrinx is present.
- Urinary bladder and copulatory organ absent.

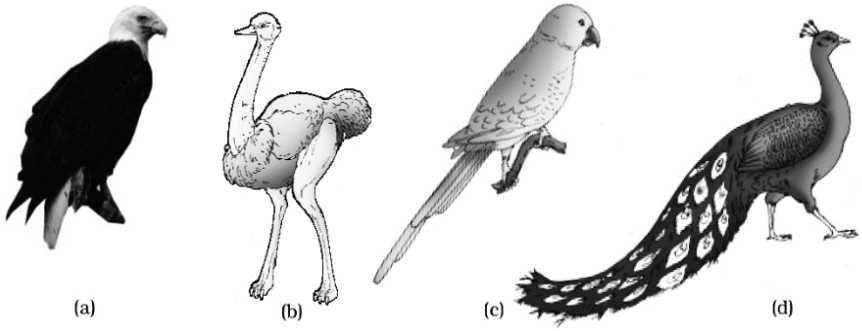


Fig : (a) Neophron (b) Struthio (c) Psittacula (d) Pavo

MAMMALIA

(L. Mamma = Breast)

- Coenozoic era (Recent) is golden era of mammals.
- Study of mammals is known as Mammology.
- The members of this class are cosmopolitan and found in a variety of habitats - polar ice. Deserts, mountains, forest, grasslands and dark caves. Some of them adapted to fly or live in water.
- Mammals are warm blooded or homeothermic or endothermic animals
- Body is divided into head, neck, trunk and tail.
- The most unique mammalian characterstic is the presence of milk producing glands (mammary glands) by which the young ones are nourished.
- A horizontal, diaphragm is present in between thorax and abdomen of all the members without any exception. Diaphragm helps in respiration, defaecation, micturition and parturition.
- The skin of mammals is unique in possessing hair.
- Skin of mammals is thick and glandular. So many types of glands are present in the skin as sweat glands, sebaceous glands and mammary glands. (Mostly modified sweat glands)

- Two pairs of limbs are present in trunk. Limbs are pentadactyl which help in swimming, walking, running
  etc. Hind limbs are absent in some aquatic mammals.
- Alimentary canal is complete. Anus and urinogenital apertures are separate. Cloaca is absent
- Teeth are Thecodont (embedded in bony sockets), Heterodont (different types) and mostly Diphyodont (comes twice).
- Respiration is by one pair of lungs (Enclosed in pleural cavity).
- Larynx or sound organ is found in the neck region for the production of sound.
- Heart four chambered. Double circulatory system is present. No sinus venosus. Only left aortic (systemic) arch present.
- RBCs small, circular and enucleated.
- Skull is dicondylic.
- Neck is having 7 cervical vertebrae except : Bradypus/Sioth has 9 or 10 cervical vertebrae and Sea- cow/Manatee has 6 cervical vertebrae.
- One pair of Metanephric kidneys are situated in abdominal cavity, They are ureotelic.
- Brain is comparatively large. Cerebrum and cerebellum are highly developed.
- A special structure is present for the connection of both the cerebral hemispheres of brain, that is called corpus- callosum. (Present only in higher mammals)
- Cranial nerves are 12 – pairs
- External ear is present in the form of ear pinna.
- Malleus, Incus and stapes are the three ear ossicles in middle ear.
- Mammals are unisexual animals. Testes of males are situated outside the abdominal cavity in the scrotal sacs. A distinct penis is present in males for copulation.
- Fertilization is internal and it takes place in fallopian tubes.
- Embryo is attached with the uterus of mother by placenta in higher mammals, so these animals are also called placental animals.
- Mostly mammals are viviparous, which give birth to their young ones. Some mammals are oviparous [Prototherians].
- Parental care is well marked in mammals. Mother feeds the child from milk secreted from her mammary glands and looks after her child.

Livings mammals are classified into following 3 groups :-

(i) Prothotherians or Monotremes

- It includes primitive reptile like egg laying mammals.
- Mammary glands are without nipples.
- Gynaecomastism is found in these animals. Mammary glands are functional in males and females both.
- Cloaca is present.
- Testes in males are situated inside the body as their body temperature is low.
- These are partially homeothermic animals.
- Pinnae are absent.
- Corpus- callosum is absent in brain.
- A toothless horny beak is found in adult animals, but teeth are present in childhood only (Monophyodont).
- They are found in Australia, New Guinea and Tasmania.
- These are considered as Connecting links between reptiles and mammals.

e.g.

1. Ornithorhynchus (Duck-billed platypus) :- Poison glands are present in the claws of male platypus.
2. Echidna/Tachyglossus (spiny ant-eater)

(ii) Metatherians or Marsupials

- An abdominal pouch called marsupium is found in these animals, in which immature young ones are kept after delivery.
- Mammary glands with nipples are situated in marsupium.
- Two vagina, two clitoris and two uteri are present in a female animal and bifid penis present in male.
- Yolk sac or false placenta are found.
- Corpus callosum is absent.

e.g.

1. **Macropus** - Kangaroo- Found in Australia only. Saltatoriallocomotion.

2. **Didelphys** - Opossum - It has Shortest gestation period (12-13 days).

(iii) Eutherians

- These are true placental mammals, that give birth to a mature baby. A true placenta is found, which provides both attachment and nutrition to baby.
- Nipples are well marked in mammary glands.
- Uterus and vagina are single in female.
- Corpus callosum is found in brain.

e.g.

(1) **Pteropus (Flying fox) :** It is Frugivorous bat. These are true flying mammals. Ecolocation sensory system (Radar system) present. Their order is chiroptera.

(2) **Camelus (Camel)**

(3) **Macaca (Monkey)**

(4) **Rattus (Rat)**

(5) **Canis (Dog)**

(6) **Felis (Domestic cat)**

(7) **Panthera leo (Lion)**

(8) **Panthera tigris (Tiger)** - National Animal of India

(9) **Zalopus (Sea lion)** [Order of carnivorous mammal is Carnivora. They have digitigrade locomotion and Carnassial Teeth. Their upper last premolar and lower first molar are modified for tearing the flesh, these are called carnassial Teeth.]

(10) **Delphinus (Common dolphin)**

(11) **Balaenoptera musculus (Blue whale)** - Found in Antarctic ocean. A Horny sheet called Baleen plate (for filtration) is found in upper jaw instead of teeth. Milk is squirted down to the throat of baby by the muscle contraction of mother. Retea mirabile is found in thoracic region which helps in respiration in under water.
[Order of fish like marine mammals is called Cetacea in which whale, dolphin are included. They have no hind limb, Hair and Ear Pinna.]

(12) **Elephas** (Indian elephant)

(13) **Loxodonta (African elephant)** - It is the largest living land animal.

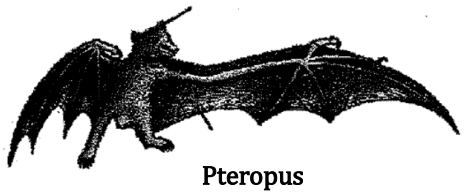
(14) **Equus (Horse)**

(15) Rhinoceros (Single horn Genda) - It is found in Kaziranga national park, Assam.

(16) Hippopotamus (River horse)

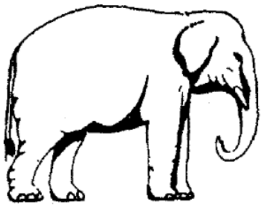
Ornithorhynchus

Macropus

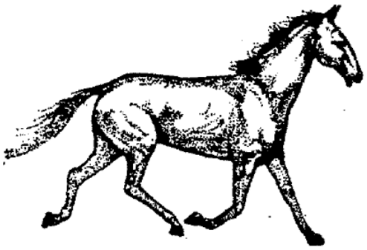


Pteropus

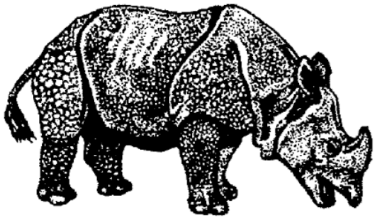
Balaenoptera



Asiatic elephant
(Elephas maximus)



Domestic horse
(Equus caballus)



Indian rhinoceros
(Rhinoceros unicornis)