Animal Kingdom – Part 3

Objectives

After going through this lesson, the learners will be able to understand the following:

- To develop the interest of the learner in classification of animals.
- To study the significant features of subphylums of chordates.

Content Outline

- Phylum Chordata
  - Main characteristics of chordates
  - Difference between chordates and non-chordates
  - Classification of chordates
  - Subphylum Vertebrata
  - Section Agnatha and Gnathostomata
  - Superclasses
  - Classes
- Summary

Phylum Chordata Line

The phylum Chordata consists of around 43,700 species, most of them concentrated in the subphylum Vertebrata, which makes it the third-largest phylum in the animal kingdom. Chordates are the most highly evolved among the animal groups. They are the animals which are characterised by the presence of a notochord, a dorsal hollow nerve cord and paired pharyngeal gill slits.

Characteristics Of Chordates:

Notochord	Dorsal Hollow Nerve-cord
It is a cartilaginous rod-like structure running underneath, and supporting, the nerve cord. It lies on the dorsal side between the dorsal hollow nerve cord and the alimentary canal.	It is a bundle of nerve fibers which is always hollow and lies dorsal to the notochord. It connects the brain with the lateral muscles and other organs.

Pharyngeal Gill-slits

They are a series of openings that connect the inside of the throat to the outside of the "neck" and lie on the lateral sides of the pharynx. All the chordates have it at some stage of their life.

These are bilaterally symmetrical, triploblastic, coelomate with organ-system level of organisation. They show segmentation, cephalisation (formation of head), endoskeleton, complete digestive tract, special organs for respiration and excretion. They possess separate sexes, and reproduce sexually. They also have a post anal tail (which is reduced or absent in many adults) and a closed circulatory system.

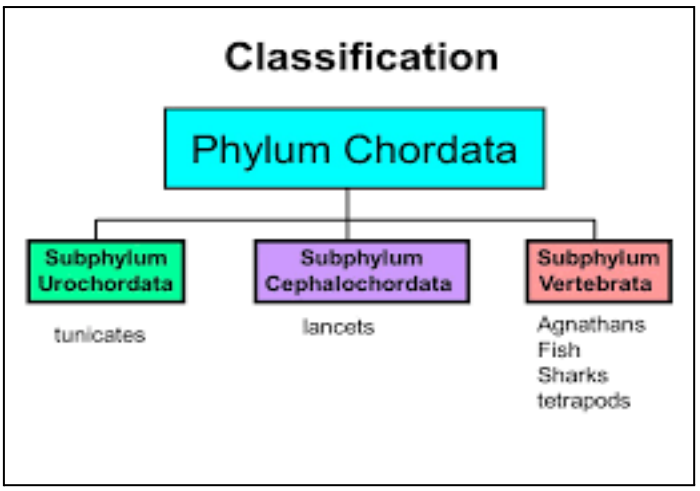
Difference between Chordates and Non-Chordates:

S. No.	Chordates	Non-Chordates
1	They have notochord at some of the stages of life.	They do not possess notochord at any stage of life.
2	Central nervous system is dorsal, hollow and single.	Central nervous system is ventral, solid and double.
3	Pharynx perforated by gill slits.	Gill slits are absent.
4	Heart is ventral.	Heart is dorsal (if present).
5	A post-anal part (tail) is present.	Post-anal tail is absent.

Classification Of Phylum Chordata

The phylum Chordata is further divided into three subphylums:

- Urochordata or tunicates
- Cephalochordata or lancelets
- Vertebrata or craniata



Subphylum Urochordata and Cephalochordata are very small containing only about 2,000 species and are often referred to as protochordates. They are exclusively marine.

<u>Urochordata</u>:

"uros" means tail, that means notochord is present in the tail of larva.

In Urochordata, notochord and the dorsal nerve cord are present only in the larval tail and they lose them when they turn into adults. Adult tunicates look like small sacs around 3 cm tall attached to the ocean floor.

Examples: *Ascidia, Salpa, Doliolum, Herdmania, Ciona, Pyrosoma.*

Ascidia

Salpa

Herdmania

Ciona

<u>Cephalochordata</u>:

"cephalos" means head i.e. the notochord is present in the head.

They are similar in appearance to small fish and have the notochord from head to tail region which persists throughout their life. They are extremely simple in structure and lack a backbone.

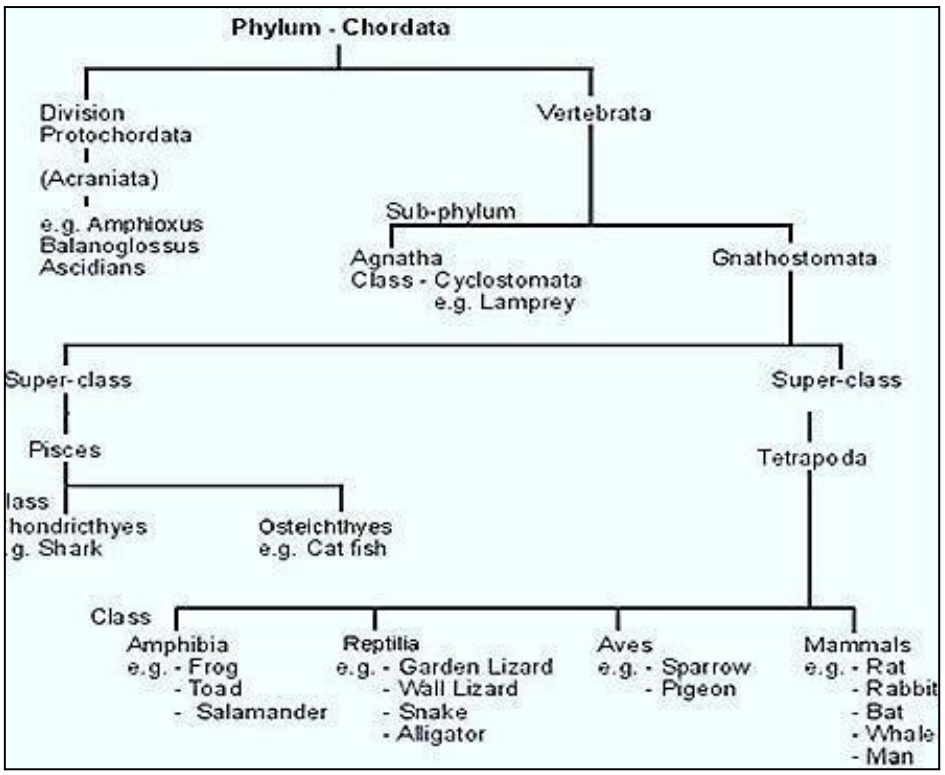
Examples: B*ranchiostoma* (Amphioxus or Lancelet).

<u>Vertebrata</u>:

It is the most important subphylum and is distinguished by the presence of notochord during the embryonic period. The notochord is replaced by a cartilaginous or bony vertebral column in the adult. Thus all vertebrates are chordates but all chordates are not vertebrates.

Besides the basic chordate characters, vertebrates have:

- cranium (brain box) around brain
- epidermis having many cells, it may bear an exoskeleton of scales, feathers or hair
- well developed coelom
- a ventral muscular heart with two, three or four chambers
- a pair of kidneys for excretion and osmoregulation
- paired appendages which may be fins or limbs
- respiratory organs may include gills, skin or lungs
- sense organs like eyes, ear, skin, tongue and nasal chamber
- presence of endocrine glands
- sexes are separate (except in hagfish)
- No asexual reproduction.



The table shows the classification of phylum chordata into subphylum.

On the basis of presence or absence of jaw the subphylum Vertebrata is further divided into two sub-groups:

1. Superclass Agnatha - The Jawless Vertebrates
2. Superclass Gnathostomata - The Jawed Vertebrates

Agnatha - The Jawless Vertebrates

The mouth of Agnatha does not possess jaws. The notochord is present throughout life.

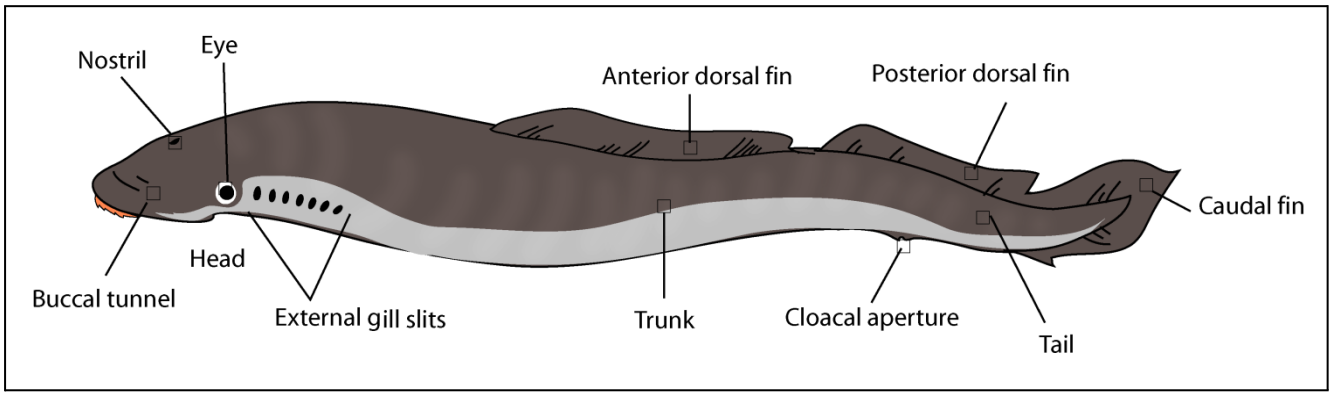
Class - Cyclostomata

It is the only one class having living members. “cyclo” means circular and “stome” is mouth.

- They have circular mouth.
- Members of this class are ectoparasites on some fishes.
- They have an elongated body having 6-15 pairs of gill slits for respiration.
- Cyclostomes have a sucking and circular mouth without jaws.
- Body is devoid of scales and paired fins.
- Cranium and vertebral columns are cartilaginous. \
- Stomach is absent.

- Lateral line sense organs are present.
- Circulation is of closed type.
- Cyclostomes are marine but migrate for spawning to fresh water. After spawning, within a few days, they die. Their larvae, after metamorphosis, return to the ocean.

Examples: *Petromyzon* (Lamprey) and *Myxine* (Hagfish).



***Petromyzon* (Lamprey):**

It lives in the sea/ocean but moves to freshwater bodies like rivers and ponds for breeding. It is a parasite and gets attached to big fish through its suctorial mouth to suck the blood.

***Myxine* (Hagfish)**

Gnathostomata - The Jawed Vertebrates

As we have already discussed, they have jaws. Also, the embryonic notochord in the adults of these animals is replaced by a vertebral column.

Gnathostomata has further two super classes:

1. **Pisces**: Class Chondrichthyes and Osteichthyes

2. **Tetrapoda**: Class Amphibia, Reptiles, Aves and Mammals

Super Class Pisces:

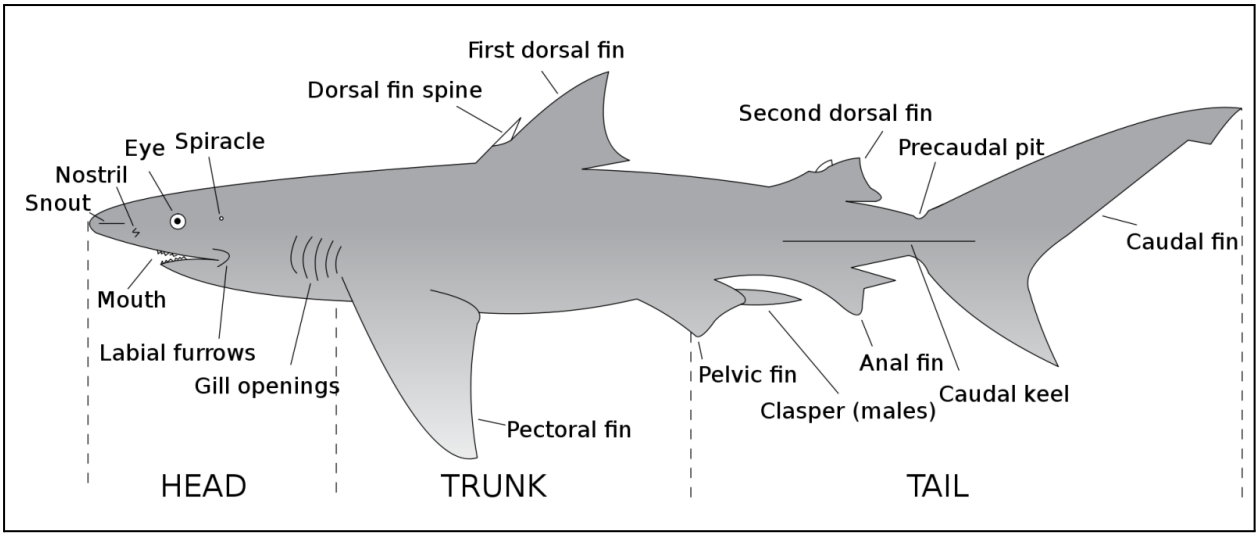
This super class includes true fishes.

Class – Chondrichthyes

In Greek, "chondros" means cartilage and "icthyes" means fish, hence they are called cartilagenous fishes.

- They are marine animals with streamlined bodies and have cartilaginous endoskeleton.
- Mouth is located ventrally.
- Notochord is persistent throughout life.
- Gill slits are separate and without operculum (gill cover).
- The skin is tough, containing minute placoid scales.
- Teeth are modified placoid scales which are backwardly directed.
- Their jaws are very powerful.
- These animals are predaceous.
- Due to the absence of an air bladder, they have to swim constantly to avoid sinking.
- Heart is two-chambered (one auricle and one ventricle).
- Some of them have electric organs (e.g., *Torpedo*) and some possess poison sting (e.g., *Trygon*).
- Lateral line system is well developed.
- There are present 10 pairs of cranial nerves.
- They are cold-blooded (poikilothermous) animals, i.e., they lack the capacity to regulate their body temperature.
- Sexes are separate.
- In males, pelvic fins bear claspers which are used for copulation.
- They have internal fertilisation and many of them are viviparous.
- Most of them are predators.

Examples: *Scoliodon* (Dog fish), *Pristis* (Saw fish), *Carcharodon* (Great white shark), *Trygon* (Stingray), *Chimaera* (Rabbit fish).



***Scoliodon* (Dog fish)**

Scoliodon

- It is a marine fish having elongated, streamlined, dorsoventrally flattened body at anterior end and laterally compressed at posterior end.
- Body measures upto 60 cm in length.
- Body is covered with minute placoid scales that can be felt when skin is rubbed from tail to snout.
- Body is divided into the head, trunk and tail.
- A crescentic mouth is present on the ventral surface of the head behind the tip. Mouth has several rows of sharp and backwardly pointed teeth on both upper and lower jaws.
- Tail is elongated with a heterocercal caudal fin (the upper and lower halves of unequal size).
- Body bears a number of unpaired and paired fins. The unpaired fins have two dorsals, a lobed caudal and a median ventral fin. Pectoral and pelvic fins are in pairs.
- Five pairs of gill slits are present laterally between mouth and pectoral fins.
- A median groove-like cloacal aperture is situated ventrally between the two pelvic fins.
- Sexual dimorphism is visible as males have midventrally situated copulatory organ.

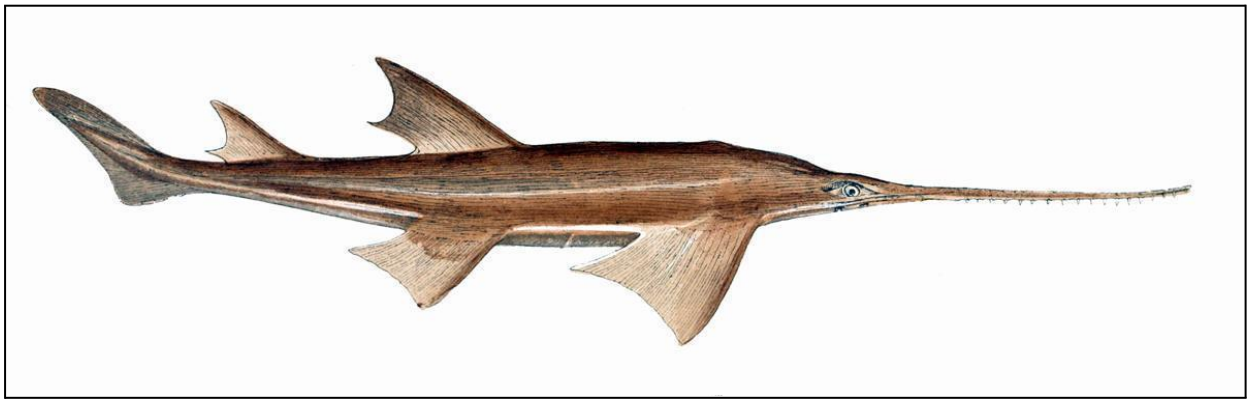
Systematic position

Phylum – Chordata

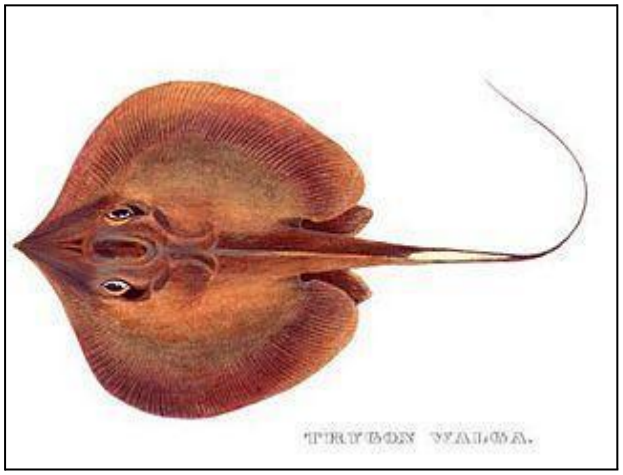
Subphylum – Vertebrata

Superclass – Pisces

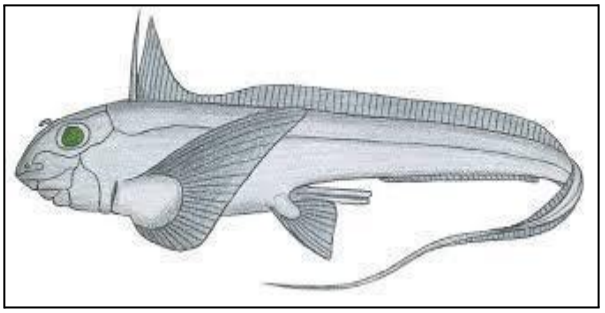
Class – Chondrichthyes



Pristis **(Saw fish)**



Trygon **(Stingray)**



Chimaera **(Rabbit fish).**

Chondrichthyes fish are advanced as compared to cyclostomata since they have paired fins, olfactory organs, movable jaws and paired gonads with gonoducts.

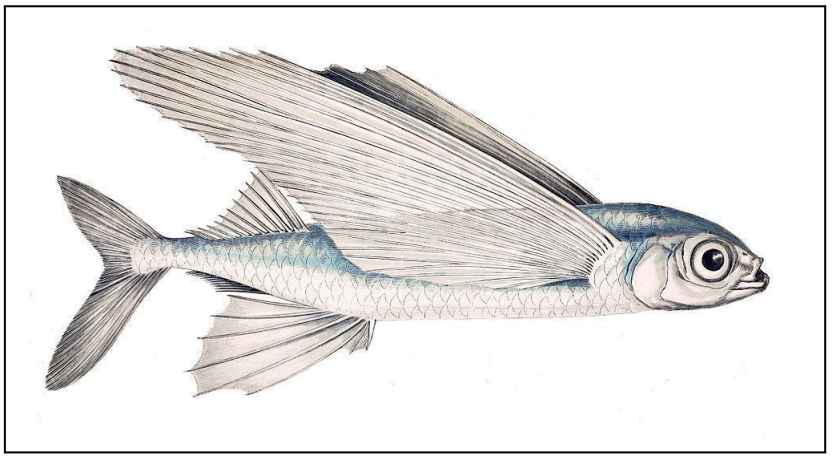
Class – Osteichthyes

In Greek, "osteon" means bone and "icthyes" means fish, hence they are called bony fishes.

- It includes both marine and fresh water fishes with bony endoskeleton.
- Their body is streamlined.
- Mouth is mostly terminal.
- Have four pairs of gills which are covered by an operculum on each side.
- Skin is covered with cycloid or ctenoid scales.

- Air bladder is present which regulates buoyancy.
- Heart is two chambered (one auricle and one ventricle).
- Lateral line is well developed.
- There are present 10 pairs of cranial nerves.
- They are cold-blooded animals.
- Sexes are separate.
- Fertilisation is usually external.
- They are mostly oviparous and development is direct.

Examples: Marine – *Exocoetus* (Flying fish), *Hippocampus* (Sea horse); Freshwater – *Labeo* (Rohu), *Catla* (Katla), *Clarias* (Magur); Aquarium – *Betta* (Fighting fish), *Pterophyllum* (Angel fish), *Anabas*(The Climbing Perch), *Mystus* (Catfish).



***Exocoetus* (Flying fish)**

It is marine and carnivorous. The special feature is that it takes leaps from water with its powerful tail and glides slowly through the air with large pectoral fins.

***Hippocampus* (Sea horse)**

It has a horse-like appearance due to its head and neck like that of a horse. It is marine and herbivorous. The special feature is that it swims vertically with the help of its dorsal fin. Male shows parental care.

***Labeo* (Rohu)**

Labeo

- Streamlined and laterally compressed body, which is grey or black on the dorsal side; and silvery on the ventral surface. Size may reach up to 1m in length.
- Body is divisible into head, trunk and a tail with homocercal (dorsal and ventral lobes are of equal size) caudal fin.
- Head is extended between the snout and the posterior end of the operculum (i.e., gill cover). Snout is depressed and obtuse. The operculum is free and open along the posterior and ventral margins.
- Mouth is a transverse opening near the tip of the snout, which has fleshy lips.
- The margin of the lower lip is fimbriated.

- The whole body is covered with overlapping cycloid dermal scales.
- Both unpaired and paired fins are present on its body. The unpaired fins are a dorsal fin, a caudal fin and an anal fin. Pectoral and pelvic fins are paired.

Systematic position

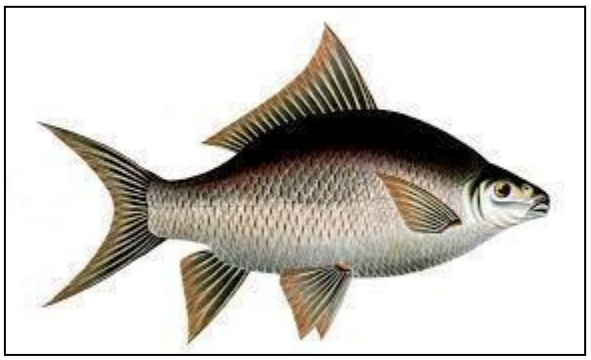
Phylum - Chordata

Subphylum - Vertebrata

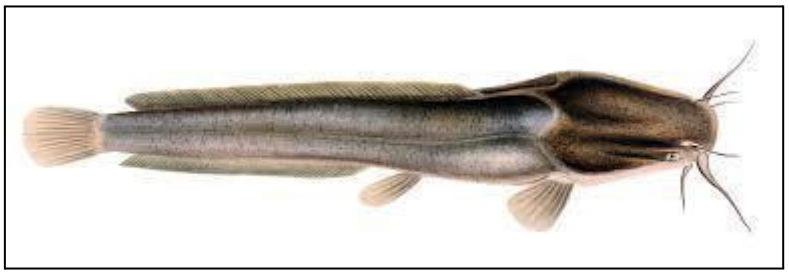
Super Class - Pisces

Class - Osteichthyes

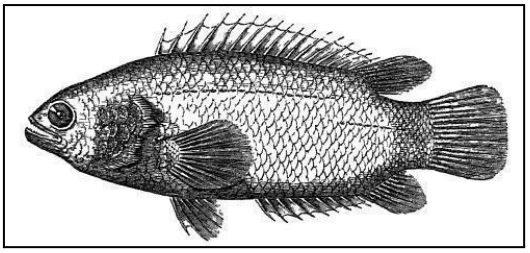
Note: *Labeo rohita* or Rohu is one of the major freshwater carps having bony endoskeleton found in rivers and ponds in the Indian subcontinent.



***Catla* (Katla)**



***Clarias* (Magur)**



***Anabas* (The Climbing Perch)**

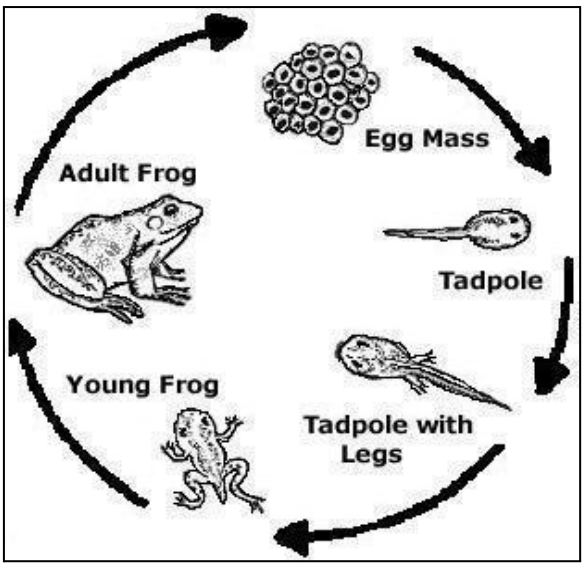
These osteichthyes (bony) fish are advanced over chondrichthyes (cartilaginous fish) as they possess a bony endoskeleton, a hydrostatic swim bladder, homocercal tail and a more developed brain.

Class – Amphibia

As the meaning of its name indicates, these vertebrates have dual life since "amphi" is two and "bios" is life.

The amphibian class is the smallest of the vertebrate classes and includes about 4,000 species.

- Amphibians can live in aquatic as well as terrestrial habitats.
- Most of them have two pairs of limbs.
- Body is divisible into the head and trunk.
- Tail may be present in some.
- Skin is moist (without scales).
- Eyes have eyelids.
- A tympanum represents the ear.
- Alimentary canal, urinary and reproductive tracts open into a common chamber called cloaca which opens to the exterior.
- Respiration is by gills, lungs and through skin.
- Heart is three chambered (two auricles and one ventricle).
- 10 pairs of cranial nerves.
- These are cold-blooded animals.
- Sexes are separate.
- Fertilisation is external.
- They are oviparous and development is indirect. They return to water for breeding. Male lacks copulatory organs.
- Metamorphosis is usually present in which a fish-like larva called tadpole is seen.
- They live in freshwater and moist soil.



Metamorphosis in Frog

Examples: *Bufo* (Toad), *Rana* (Frog), *Hyla* (Tree frog), *Salamandra* (Salamander), *Ichthyophis* (Limbless amphibia), *Necturus* (Mud puppy), *Rhacophorus* (Flying frog).

Why do amphibians lay eggs in water?

Amphibians do not lay amniotic eggs i.e. the eggs do not contain a fluid-filled sac called the amnion surrounding the developing embryo due to which the eggs dry out quickly in the air, forcing all amphibians to lay their eggs in the water.

Amphibians are more advanced than fish due to the presence of limbs for movement, eyelids for protecting eyes on land and a middle ear to transmit sound waves to the internal ear.

***Rana* (Frog)**

- The body consists of the head and trunk, and the neck is absent.
- Highly placed external nasal opening, eyes are bulging and covered by a nictitating membrane. The outer boundary of the middle ear is covered by a membrane, called *tympanic membrane*.
- Skin is naked, (that is without any type of scales) and slimy (secretion of mucous glands present in the skin)
- Mouth is terminal, having protrusible bifid tongue.
- Upper jaw is beset with several rows of spiny teeth, the lower jaw has no teeth.
- Forelimbs are smaller than the hindlimbs. The forelimbs have four, and hindlimbs have 5 clawless digits. An interdigital web-like membrane is present in the hind-limbs, which is used for swimming.

Systematic position

Phylum – Chordata

Subphylum – Vertebrata

Class – Amphibia

Note: There is a distinct sexual dimorphism between male and female frog. Males are comparatively smaller in size and the base of the first digit of the forelimb becomes thick and pad-like. This is called a nuptial pad, which helps in holding the females during mating. On the ventral surface of the lower jaw, two vocal sacs are present for making nuptial calls during breeding season.

***Bufo* (Toad)**

***Hyla* (Tree Frog)**

***Rhacophorus* (Flying frog)**

***Salamandra* (Salamander)**

Class – Reptilia

The animals of this class are often referred to as "creeping vertebrates" due to their creeping or crawling mode of locomotion. In *Latin*, "*repere* or *reptum*" is to creep or crawl.

- They are mostly terrestrial animals.
- Skin is dry, cornified and without glands, with epidermal scales or scutes.
- They do not have external ear openings.
- Tympanum represents the ear.
- Limbs, when present, are two pairs.
- Respire through lungs.
- Heart is usually three-chambered, but four-chambered in crocodiles.
- 12 pairs of cranial nerves.
- Lateral line system is absent.
- They are poikilotherms or cold blooded.

- Snakes and lizards shed their scales as skin cast (molting).
- Sexes are separate.
- Fertilisation is internal. The developing embryo has a special membrane present around them called amnion.
- They are oviparous and development is direct.
- Generally carnivores or insectivores, except the tortoise which feeds on vegetation.

Today reptiles include about 7,000 species, although before the extinction of the dinosaurs reptiles were the dominant vertebrate animal.

Examples: *Chelone* (Turtle), *Testudo* (Tortoise), *Chameleon* (Tree lizard), *Calotes* (Garden lizard), *Crocodilus* (Crocodile), *Alligator* (Alligator). *Hemidactylus* (Wall lizard), *Draco* (Flying lizard), Poisonous snakes – *Naja* (Cobra), *Bangarus* (Krait), *Vipera* (Viper), *Hydrophis* (Sea snake).

Reptiles are more advanced than the amphibians due to presence of scales on their body, claws for defense and amniotic egg with protective shell.

***Calotes* (Garden lizard)**

***Calotes* (Garden lizard)**

- Body is divided into head, neck, trunk and elongated tail.
- Body is covered with rough epidermal scales.

- Head is triangular with a cone-shaped snout having a wide mouth. A pair of nostrils and eyes present on the head. Eyes are dorso-lateral in position on head.
- Two pairs of pentadactyl (five digits) limbs; the digits are clawed.
- The skin provides the animal with protective colouration in its environment.

Systematic position

Phylum – Chordata

Subphylum – Vertebrata

Class – Reptilia

Note: Garden lizard is an arboreal (tree dweller) reptile commonly found among the bushes, shrubs and trees.

Chelone **(Turtle)**

Testudo **(Tortoise)**

Chameleon **(Tree lizard)**

Alligator **(Alligator)**

***Draco* (Flying lizard)**

***Naja* (Cobra)**

***Vipera* (Viper)**

Snake Charming: It is a myth that snakes dance to the tune of the flute. Actually the snake just follows the movement of the tip of the flute and the swaying motion of its master.

How to differentiate between a poisonous (venomous) and non-poisonous (non-venomous) snake?

- Arrangement and size of their scales, plates and shields which cover the body help in the identification of snakes.
- Usually the non poisonous snakes have small scales on their belly and back.
- A poisonous snake has the small scales present on its head.

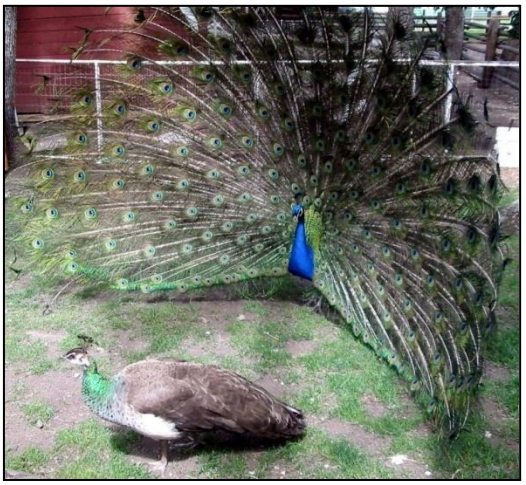
Class – Aves

In Latin, "avis" means bird. Class Aves has about 9000 species.

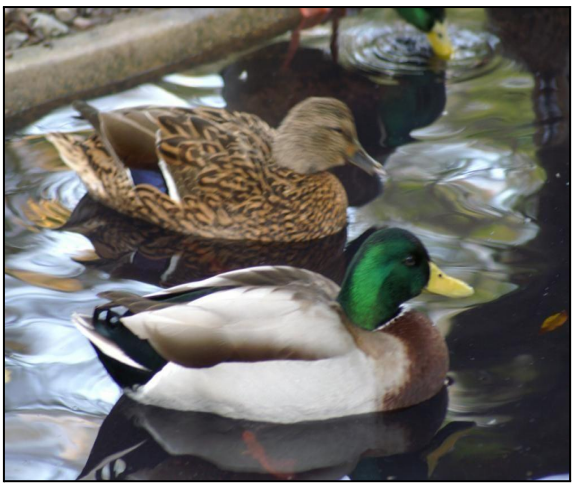
The characteristic features of Aves (birds) are:

- Presence of feathers.

- Most of them can fly except flightless birds (e.g., Ostrich).
- Upper and lower jaws are modified into beak. They lack teeth.
- Forelimbs are modified into wings.
- Hind limbs generally have scales and are modified for walking, swimming or clasping the tree branches.
- Skin is dry without glands except the oil gland at the base of the tail.
- Endoskeleton is fully ossified (bony) and the long bones are hollow with air cavities (pneumatic).
- Digestive tract of birds has additional chambers, the crop and gizzard. Crop stores and softens the food and gizzard helps in crushing and churning the food.
- Heart is completely four chambered.
- They are warm-blooded (homoiothermous) animals, i.e., they are able to maintain a constant body temperature.
- Respiration is by lungs. ‘
- 12 pairs of cranial nerves are present.
- Sharp eyesight, but poor sense of smell.
- Air sacs connected to lungs supplement respiration.
- Sexes are separate. Many of them show sexual dimorphism.



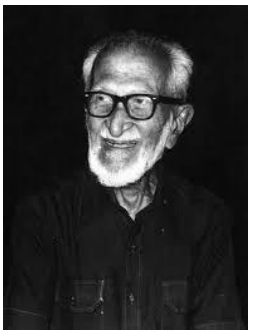
Sexual dimorphism in peacock - The peacock, on the right, is courting the peahen, on the left



Mallard-male bottom has an unmistakable green head

Mandarin ducks, male (left) and female (right)

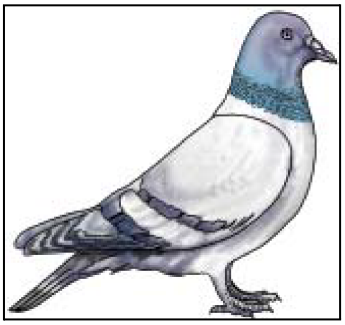
- Fertilisation is internal.
- They are oviparous and development is direct.
- They show courtship, nest making, migration, parental care and territorial behaviour.



Famous Ornithologist Dr. Salim Ali is known as the “Bird man of India”.

Birds are more advanced than reptiles due to presence of feathers on their body, complete separation of oxygenated and deoxygenated blood, muscular diaphragm for efficient respiration and a well developed brain.

Examples: *Corvus* (Crow), *Columba* (Pigeon), *Rhea* (Rhea), *Anas* (Duck), *Psittacula* (Parrot), *Struthio* (Ostrich), *Pavo* (Peacock), *Aptenodytes* (Penguin), *Neophron* (Vulture).



Pigeon

Pigeon is one of the most common birds showing flight adaptations and having cosmopolitan distribution.

The external features are as follows:

- Body covered with feathers.
- Streamlined body divisible into head, neck and trunk.
- A small and round head, having a beak without teeth. In addition the head bears a pair of nostrils, large eyes and opening of the ears (covered with feathers).
- Eyes are provided with movable eyelids and nictitating membranes.
- Cylindrical neck is very flexible to facilitate mobility of the head.
- Forelimbs are modified into two wings for flying. The hindlimbs have four-clawed digits of which the first one is backwardly directed and the remaining three are forwardly directed. It helps in perching and bears the weight of the body while standing.
- Cloacal aperture is situated at the posterior end of the trunk.

Systematic position

Phylum - Chordata

Subphylum - Vertebrata

Class - Aves

***Rhea* (Rhea)**

***Neophron* (Vulture)**

***Struthio* (Ostrich)**

Class – Mammalia

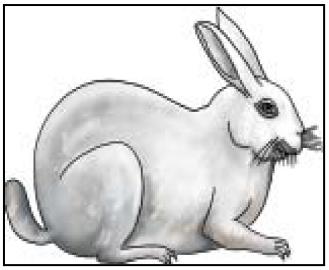
In Latin, "mamma" means breasts, hence mammals are the animals having breasts. There are about 4500 species of mammals found in the world.

- Found in a variety of habitats – polar ice caps, deserts, mountains, forests, grasslands and dark caves.
- Some of them have adapted to fly (like bats) or live in water (like whales).
- The most unique mammalian characteristic is the presence of milk producing glands (mammary glands) by which the young ones are nourished.
- Have two pairs of limbs, adapted for walking, running, climbing, burrowing, swimming or flying.
- Skin of mammals is unique in possessing hair.
- Oil glands and sweat glands are present in the skin.
- External ears or pinnae are present.
- Different types of teeth (heterodont) are present in the jaw.
- Heart is four chambered.
- 12 pairs of cranial nerves.
- They are warm blooded or homoiothermous.
- Respiration is by lungs.
- Sexes are separate and fertilisation is internal.
- They are viviparous with few exceptions and development is direct.
- They are dominant animals and have the power to learn due to the presence of a well developed brain.

We, the mammals, dominate the world due to well developed ability of speech, opposable thumb and logical thinking.

Mammals are the most advanced animals having insulating hair with sweat glands to regulate body temperature, salivary glands for digestion, complete separation of oxygenated and deoxygenated blood, muscular diaphragm for efficient respiration, well developed brain and development of foetus in mother's womb.

Examples: 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), Bats.



Rabbit

Oryctolagus Lagomorpha **(RABBIT)**

Rabbit is a fossorial (burrowing) mammal. However, it can lead a terrestrial life in the thick vegetation. The external features include:

- A medium sized animal, about 40 cm in length when adult.
- Body is covered with hair, and is divisible into the head, neck, trunk and a small tail.
- *Head is pear-shaped with a blunt snout. Anteriorly it bears a mouth and a pair of external ears, the pinna. The upper lip has a median cleft through which the incisor teeth get exposed. Few prominent and stiff hairs are present laterally on the upper lip. These are touch-sensitive (tactile) and called vibrissae or whiskers.
- A short but highly flexible neck is present between the head and the trunk.

- *Males have a small, cylindrical and muscular penis, a pair of scrotal sacs in which a pair of testes are lodged. Females have slit-like vulva. Females also have four to five pairs of mammary glands, which open ventrally as teats or nipples along the thorax and abdomen. Animals are viviparous.
- Tail is short, upwardly directed and furry.

Systematic position

Phylum - Chordata

Subphylum - Vertebrata

Class - Mammalia

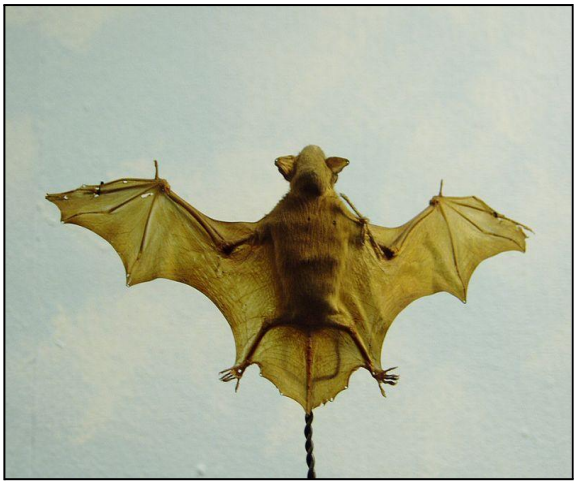
Macaca **(Monkey)**

Rattus **(Rat)**

Felis **(Cat)**

Balaenoptera **(Blue whale)**

***Panthera tigris* (Tiger)**



Bat

Summary

The distinguishing features of all the phyla under animal kingdom are shown in this module.