

ZOOLOGY

ENTHUSIAST | LEADER | ACHIEVER



STUDY MATERIAL

Animal Kingdom

ENGLISH MEDIUM

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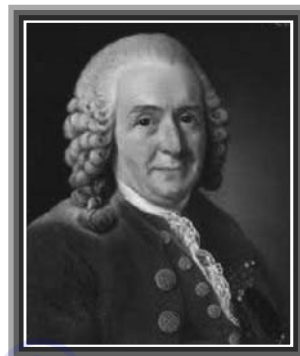
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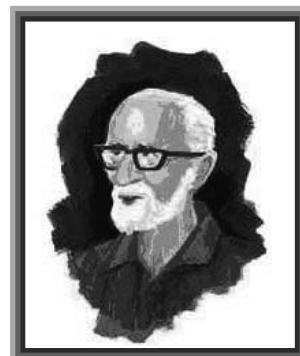
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Carolus Linnaeus (23 May 1707 - 10 January 1778), also known after his ennoblement as **Carl von Linné**, was a Swedish botanist, physician, and zoologist, who formalised the modern system of naming organisms called binomial nomenclature. He is known by the epithet "father of modern taxonomy".

He received most of his higher education at Uppsala University, and began giving lectures in botany there in 1730. where he studied and also published a first edition of his *Systema Naturae* in the Netherlands. He then returned to Sweden, where he became professor of medicine and botany at Uppsala. In the 1740s.



Salim Moizuddin Abdul Ali (12 November 1896 - 20 June 1987) was an Indian ornithologist and naturalist. Sometimes referred to as the "birdman of India", Salim Ali was among the first Indians to conduct systematic bird surveys across India and several bird books that he wrote helped popularize ornithology in India. He became the key figure behind the Bombay Natural History Society after 1947 and used his personal influence to garner government support for the organisation, create the Bharatpur bird sanctuary (Keoladeo National Park) and prevent the destruction of what is now the Silent Valley National Park. Along with Sidney Dillon Ripley he wrote the ten volume Handbook of the Birds of India and Pakistan, a second edition of which was completed after his death. He was awarded the Padma Bhushan in 1958 and the Padma Vibhushan in 1976, India's third and second highest civilian honours respectively. Several species of birds and a couple of bird sanctuaries and institutions have been named after him.



ANIMAL KINGDOM

01. INTRODUCTION

- **Introduction**
- **Basis of Classification**
- **Protozoa**
- **Kingdom : Animalia**

When you look around, you will observe different animals with different structures and forms. As over a million species of animals have been described till now, the need for classification becomes all the more important. The classification also helps in assigning a systematic position to newly described species.

TAXONOMY :

Taxonomy is the branch of science which deals the study of nomenclature, classification and principles of classification. Taxonomy word was given by "Candolle" (Taxis - arrangements. Nomia-distribution)

02. BASIS OF CLASSIFICATION

In spite of differences in structure and form of different animals, there are fundamental features common to various individuals in relation to the arrangement of cells, body symmetry, nature of coelom, patterns of digestive, circulatory or reproductive systems. These features are used as the basis of animal classification and some of them are discussed here.

IMPORTANT PHYLA

- | | | |
|--|---|---|
| 1. Protozoa (Included in kingdom - Protista) | - | <i>Amoeba</i> , <i>Paramoecium</i> etc. |
| 2. Porifera | - | Sponges (<i>Leucosolenia</i> , <i>Sycon</i>) |
| 3. Coelenterata/Cnidaria | - | <i>Hydra</i> , Jellyfish etc. |
| 4. Ctenophora (minor phylum) | - | <i>Pleurobrachia</i> , <i>Ctenoplana</i> |
| 5. Platyhelminthes | - | Flat worms (eg : Tape worm) |
| 6. Nematelminthes/Aschelminthes | - | Round worm (eg : <i>Ascaris</i>) |
| 7. Annelida | - | Earthworm , Leech etc. |
| 8. Arthropoda | - | Insects (cockroach), Scorpion , Fly etc. |
| 9. Mollusca | - | Snail, <i>Pila</i> , <i>Octopus</i> , Chiton etc. |
| 10. Echinodermata | - | Star fish, Seaurchin |
| 11. Hemichordata | - | <i>Balanoglossus</i> |
| 12. Chordata | - | Fish, Frog, Snake, Birds, Monkey etc. |

(1) LEVELS OF ORGANISATION

- Though all members of Animalia are multicellular, all of them do not exhibit the same pattern of organisation of cells.
- (A) Protoplasmic Level :**
In protozoans, unicellular body performs all biological activities.
- (B) Cellular Level :**
In sponges, cells are arranged as loose cell aggregates i.e. they exhibit cellular level of organisation. Some division of labour (activities) occur among the cells.
- (C) Tissue Level :**
In coelenterates and ctenophores, the arrangement of cells is more complex. Here the cells performing the same function are arranged into tissues, hence is called tissue level of organisation.
- (D) Organ Level :**
A still higher level of organisation, i.e., **organ level** is exhibited by members of Platyhelminthes and other higher phyla where tissues are grouped together to form organs, each specialised for a particular function.
- (E) Organ System Level :**
In animals like Annelids, Arthropods, Molluscs, Echinoderms and Chordates, organs have associated to form functional systems, each system concerned with a specific physiological function. This pattern is called **organ system** level of organisation.
 - Organ systems in different groups of animals exhibit various pattern of complexities.

(2) BODY PLAN

- (A) Cell-Aggregate Type :**
e.g. Sponges
- (B) Blind Sac Type :**
Animals in which digestive system is incomplete i.e. it has only single opening to the outside of the body that serves as both mouth and anus.
e.g. Coelenterates to Platyhelminthes
- (C) Tube-Within-Tube Type :**
Found in those animals having complete digestive tract i.e. with separate openings : mouth and anus.
e.g. Nematelminthes to Chordates.

(3) CIRCULATORY SYSTEM

- (A) Open Type :**
In which the blood is pumped out of the heart and the cells and tissues are directly bathed in it.

e.g. Arthropods, Molluscs, Echinoderms, Hemichordata and some lower chordates like tunicates

(B) Closed Type :

In which the blood is circulated through a series of vessels of varying diameters (arteries, veins and blood capillaries)

e.g. Annelids, Cephalopod molluscs, Vertebrates etc.

(4) SYMMETRY

Animals can be categorised on the basis of their symmetry.

(A) Asymmetry :

Any plane that passes through the centre does not divide the body of animal into two equal halves.

e.g. Sponges are mostly asymmetrical. (*Sycon*, *Leucosolenia* exhibit radial symmetry)

(B) Radial Symmetry :

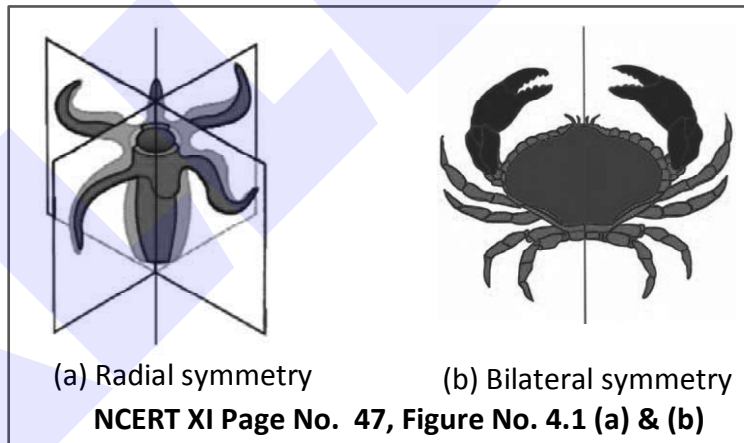
When any plane passing through the central axis of the body divides the animal into two identical halves.

e.g. Coelenterates, Ctenophores and Echinoderms (adults)

(C) Bilateral Symmetry :

When the body can be divided into identical left and right halves in only one plane.

e.g. Platyhelminthes to Chordates.



Note : Larvae of Echinodermata exhibit bilateral symmetry but their adults have radial symmetry.

(5) GERMINAL LAYERS

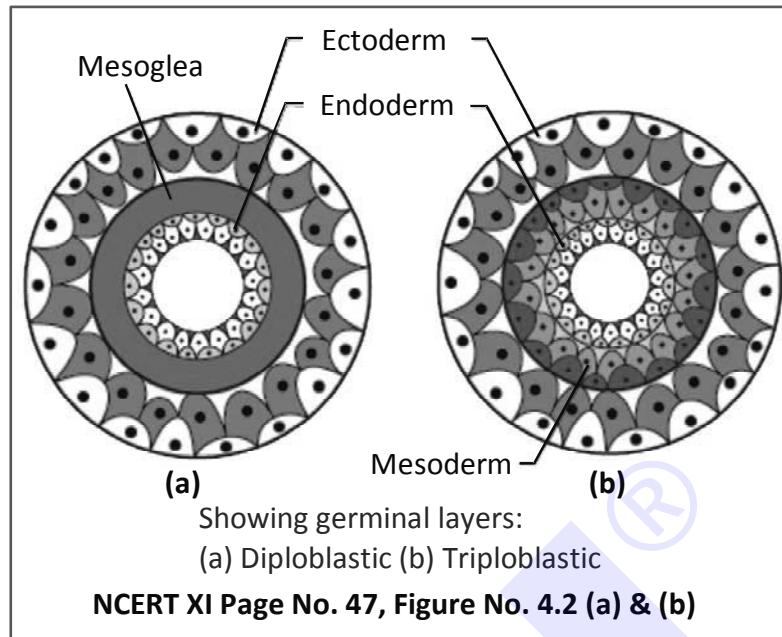
(A) Diploblastic :

Animals in which the cells are arranged in two embryonic layers **ectoderm** and **endoderm** with an intervening undifferentiated mesoglea

e.g. Coelenterates and Ctenophores.

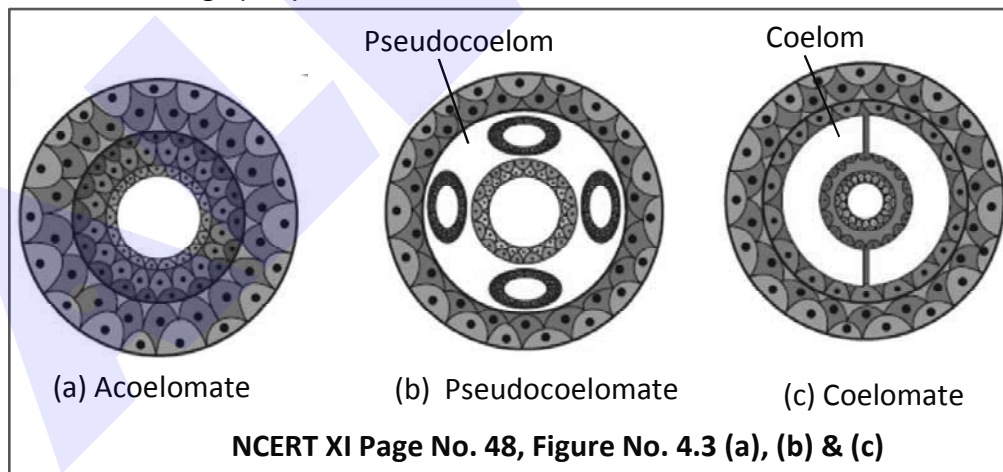
(B) Triploblastic :

Those animals in which the developing embryo has a third germinal layer—**Mesoderm** in between the ectoderm and endoderm e.g. Platyhelminthes to chordates.



(6) BODY CAVITY OR COELOM

Presence or absence of a cavity between the body wall and the gut wall is very important in classification. The body cavity, which is lined by mesoderm is called **coelom**. Animals possessing coelom are called **coelomates**, e.g., annelids, molluscs, arthropods, echinoderms, hemichordates and chordates. In some animals, the body cavity is not lined by mesoderm, instead, the mesoderm is present as scattered pouches in between the ectoderm and endoderm. Such a body cavity is called pseudocoelom and the animals possessing them are called **pseudocoelomates**, e.g., aschelminthes. The animals in which the body cavity is absent are called **acoelomates**, e.g., platyhelminthes.



(7) SEGMENTATION

(A) **Pseudometameric** : e.g. Tapeworms

(B) **Metameric** :

In Annelids, Arthropods and Chordates.

In these animals, the body is externally and internally divided into segments with a serial repetition of atleast some organs, for example in earthworm, body shows this pattern called metameric segmentaion and this phenomenon is known as metamerism.

(8) NOTOCHORD

It is a mesodermally derived rod-like structure formed on the dorsal side during embryonic development in some animals.

(A) **Non-Chordates** : Animals without notochord e.g. Porifera to Echinodermata.

(B) **Chordates** : Animals with notochord.

(9) EMBRYONIC DEVELOPMENT

On the basis of fate of blastopore, animals can be divided into two categories :

(A) **Protostomiates** :

Animals in which mouth is formed first (Blastopore → Mouth)

e.g. Platyhelminthes to Mollusca

(B) **Deuterostomiates** :

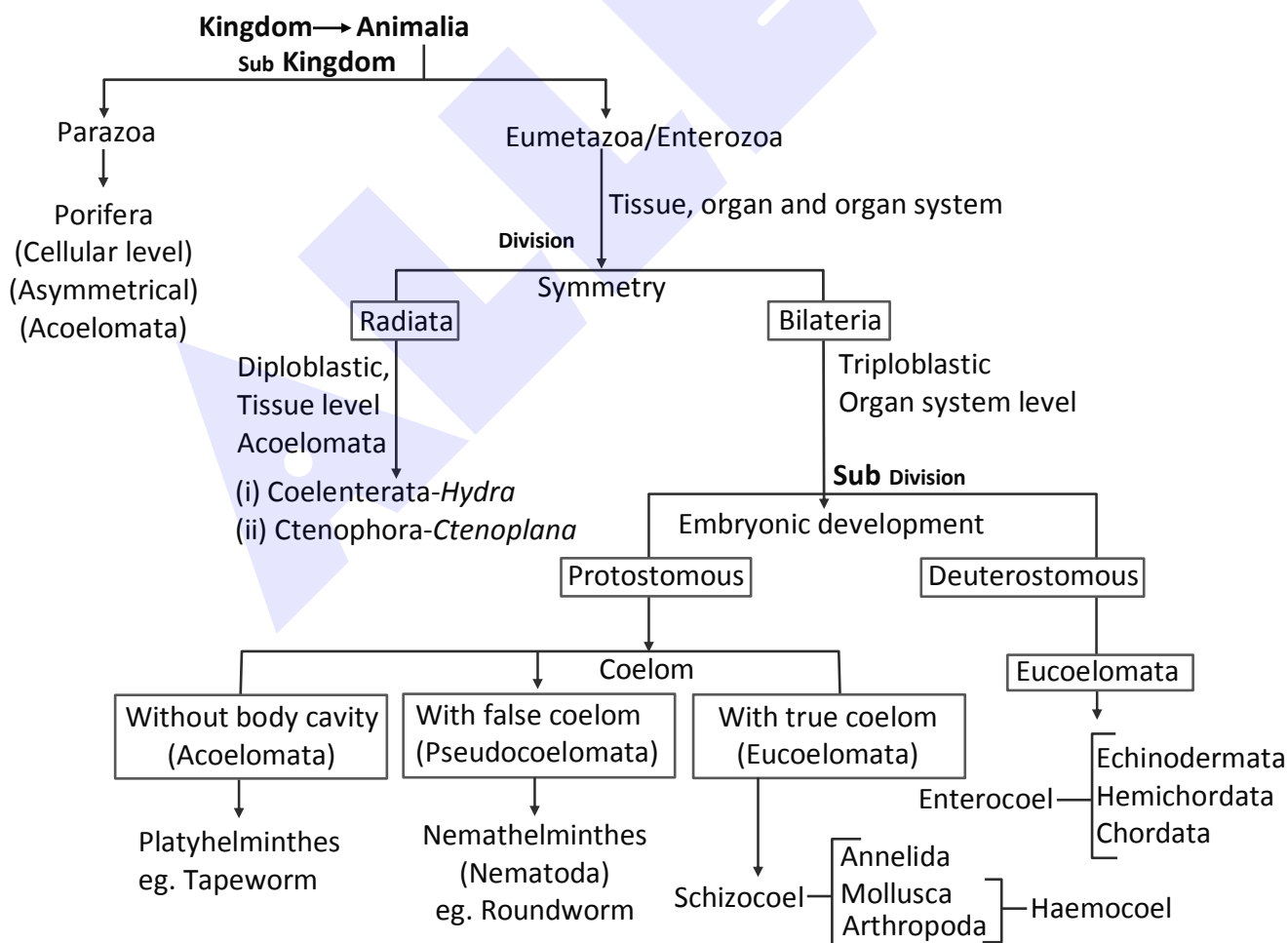
Animals in which anus is formed earlier than mouth

(Blastopore → Anus) e.g. Echinoderms, Hemichordates and Chordates.

(10) PRESENCE AND ABSENCE OF LARVAL STAGE

- If larva is present, development is indirect
- If larva is absent, development is direct

OUTLINE OF ANIMAL CLASSIFICATION





BEGINNER'S BOX

BASIS OF CLASSIFICATION

- Which of the following phylum have radially symmetrical organisms ?
(1) Coelenterata (2) Platyhelminthes (3) Aschelminthes (4) Annelida
- Which of the following phylum possess true coelom ?
(1) Aschelminthes (2) Annelida (3) Ctenophora (4) Platyhelminthes
- Loose cell aggregate type body plan is found in _____.
(1) Protozoa (2) Porifera (3) Coelenterata (4) Platyhelminthes
- Which of the following phylum is pseudocoelomate ?
(1) Aschelminthes (2) Arthropoda (3) Annelida (4) Platyhelminthes
- When any plane passing through the central axis of body and divides the animal into two identical halves. It is called as _____.
(1) Asymmetry (2) Radial symmetry (3) Bilateral symmetry (4) Biradial symmetry
- Which of the following phylum have "Tube within tube" body plan ?
(1) Platyhelminthes (2) Coelenterata (3) Porifera (4) Nematelminthes
- Which of the following phylum has closed circulatory system ?
(1) Arthropoda (2) Annelida (3) Mollusca (4) Echinodermata
- Segmentation is found in :-
(1) Annelida, Arthropoda, Mollusca (2) Arthropoda, Mollusca, Echinoderms
(3) Annelida, Arthropoda, Chordata (4) Arthropoda, Echinoderms, Chordata
- Which of the following group is Deuterostome—
(1) Annelida, Arthropoda, Mollusca (2) Echinodermata, Hemichordata, Chordata
(3) Annelida, Mollusca, Chordata (4) Arthropoda, Mollusca, Echinodermata
- Incomplete digestive tract found in -
(1) Platyhelminthes and Aschelminthes (2) Platyhelminthes and Ctenophora
(3) Aschelminthes and Annelida (4) Coelenterates and Aschelminthes

PHYLUM - PROTOZOA (KINGDOM-PROTISTA)

- It is **3rd largest phylum**. It includes unicellular eukaryotes where one celled body performs all the biological activities like multicellular animals.
- They are cosmopolitan, **microscopic**, mostly **aquatic, free living (*Amoeba*)** or **parasitic (*Plasmodium*)**, solitary or colonial (***Proterospongia***). Some of them cause serious diseases.
- They have varying body shapes and are mostly **asymmetrical**.
- Body level of organisation is **Protoplasmic level**. Their protoplasm is uninucleated or multinucleated. Few show **nuclear dimorphism**. e.g. *Paramoecium*.

5. Some are **naked**, some have body bounded by delicate membrane or a firm **pellicle/Test/shell**. In few groups of protozoa **Silica shell** & **CaCO₃** exoskeleton is found. e.g. **Radiolarian group (silica)** & **Foraminiferan group (CaCO₃)**. (eg : *Globigerina*)
6. Locomotory structures are
- (i) Finger-like Pseudopodia e.g. *Amoeba*, *Entamoeba*
 - (ii) Whip-like Flagella e.g. *Trypanosoma*
 - (iii) Hairy Cilia e.g. *Paramecium*
 - (iv) Absent in sporozoan parasites eg. *Plasmodium*
7. All protozoans are heterotrophs and live as predators or parasites. They are believed to be primitive relatives of animals.

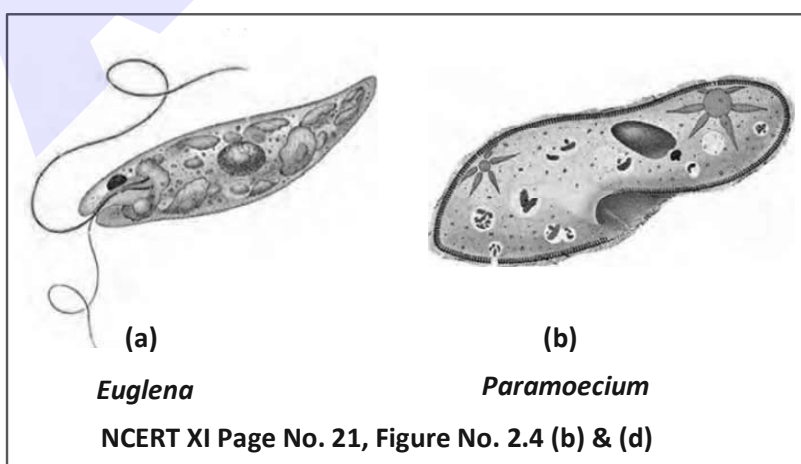
Nutrition in Protozoans is mainly **holozoic** (*Amoeba*) and **Parasitic** (*Plasmodium*).

Digestion is **intracellular** takes place in **food vacuole**.

8. **Respiration** and **Excretion** take place by general body surface. Some excretion may occur through **contractile vacuole**. Nitrogenous waste is **Ammonia**. Some fresh water protozoans get rid of excess water through contractile vacuole by the process known as **Osmoregulation**.
9. **Reproduction** takes place by

Asexual		Sexual	
(1)	Binary fission (a) Irregular – (<i>Amoeba</i>) (b) Transverse fission (<i>Paramecium</i>) (c) Longitudinal fission (<i>Trypanosoma</i>)	(1)	Syngamy eg. (<i>Plasmodium</i>)
(2)	Multiple fission (<i>Plasmodium</i>)	(2)	Conjugation eg. (<i>Paramecium</i>)

10. They do not have natural death because in unicellular animals there is no differentiation of somatoplasm & germplasm, hence these are considered **immortal**.



PROTOZOA

On the basis of locomotory organs

Mastigophora or Flagellata

Locomotory structure –
Flagella, Aquatic and
Endoparasite

e.g. *Proterospongia* –

Connecting link
Between Protozoa
& Porifera

Leishmania donovani -

Human Parasite - Digenetic
Disease - **Kala azar** or

Dumdum fever

Vector - sand fly

(***Phlebotomus***)

Trypanosoma gambiense -

Human Parasite - Digenetic
Disease - **African sleeping
sickness**

Vector - Tse-Tse fly

(***Glossina palpalis***)

Giardia intestinalis -

(Grand old man of intestine)
Human Parasite
Disease - **Giardiasis**

Trichomonas vaginalis -

Human Parasite - in vagina
of females

Disease - **Leucorrhoea**
(White discharge)

Trichonympha -

Symbiont in intestine of
termite
for digesting cellulose.
Secretes
glucosidases.

Sarcodina or Rhizopoda

(Amoeboid protozoans)

Locomotory structure

Pseudopodia – Aquatic
and Endoparasite

These organisms live in
fresh water, sea water or
moist soil. They move and
capture their prey by putting
out pseudopodia (false feet)
as in Amoeba.

(a) **Amoeboid** -

e.g. : ***Amoeba proteus***

Entamoeba histolytica

Parasite in colon of man
causes amoebic dysentery
(Dimorphic)

Entamoeba gingivalis

Parasite between teeth
of man increase
pyorrhoea

(b) **Radiolarian** -

Marine, Siliceous
Skeleton

(c) **Foraminiferan** -

Marine/Fresh water
Shell Calcareous

Sporozoa

Locomotory structure
absent. This includes
diverse organisms that
have an infectious
spore-like stage in
their life cycle

e.g. - *Plasmodium*

The most notorious
sporozoan is

Plasmodium (malarial
parasite) which causes
malaria, a disease
which has a staggering
effect on human
population.

Nosema - causes
pebrine

disease in silkworm

Babesia - texas fever
in cattle

(red water fever)

Ciliata

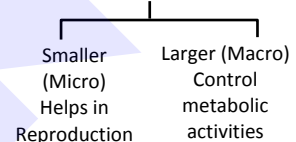
Locomotory structure Cilia –
Endoparasite and Aquatic

These are actively moving
organisms because of the
presence of thousands of cilia.
They have a cavity (gullet) that
opens to the outside of the cell
surface.

The coordinated movement
of rows of cilia causes the
water laden with food to be
steered into the gullet.

e.g. - *Paramecium*
(Slipper animalcule)

Two nuclei



Balantidium-
found in colon of man



BEGINNER'S BOX

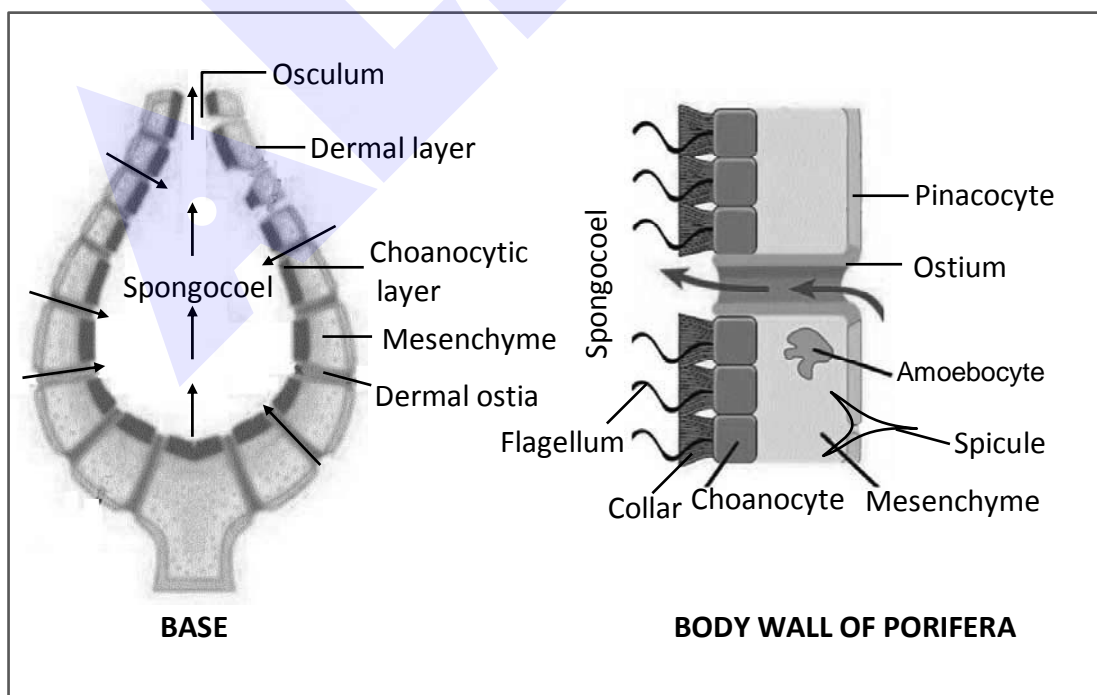
PROTOZOA

- The vector for causing sleeping sickness in man is :
 (1) House fly (2) Mosquito (3) Tse-tse fly (4) Sand fly
- In which of the following protozoans locomotory structure are absent ?
 (1) Sarcodina (2) Sporozoans (3) Ciliata (4) Mastigophores
- Kala azar disease in man is caused by :
 (1) *Leishmania donovani* (2) *Trypanosoma gambiense*
 (3) *Trichomonas* (4) *Giardia*
- Grand old man of intestine is :
 (1) *Giardia* (2) *Paramoecium* (3) *Entamoeba* (4) *Amoeba*
- Which of the following pair is correctly matched ?
 (1) *Leishmania* - kala azar (2) *Giardia* - sleeping sickness
 (3) *Entamoeba* - Malaria (4) *Plasmodium* - Dysentery
- Locomotory structure are whip like flagella is :-
 (1) *Paramoecium* (2) *Plasmodium* (3) *Trypanosoma* (4) *Amoeba*
- Nitrogenous waste in *Amoeba* is :-
 (1) Ammonia (2) Urea (3) Uric acid (4) Guanine
- Locomotory structure are hairy cilia in :-
 (1) *Paramoecium* (2) *Plasmodium*
 (3) *Trypanosoma* (4) *Amoeba*
- Body level of organisation in phylum protozoa are :-
 (1) Protoplasmic level (2) Cellular level
 (3) Tissue level (4) Organ system level
- Protozoans have varying body shape and are mostly :-
 (1) asymmetrical (2) radially symmetrical
 (3) bilaterally symmetrical (4) biradially symmetrical

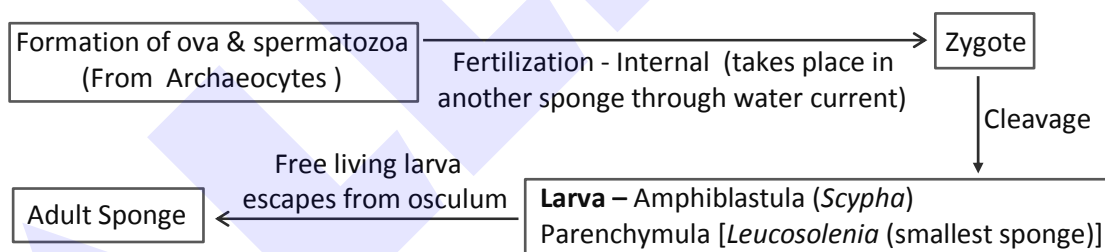
03. KINGDOM : ANIMALIA

(1) PHYLUM – PORIFERA

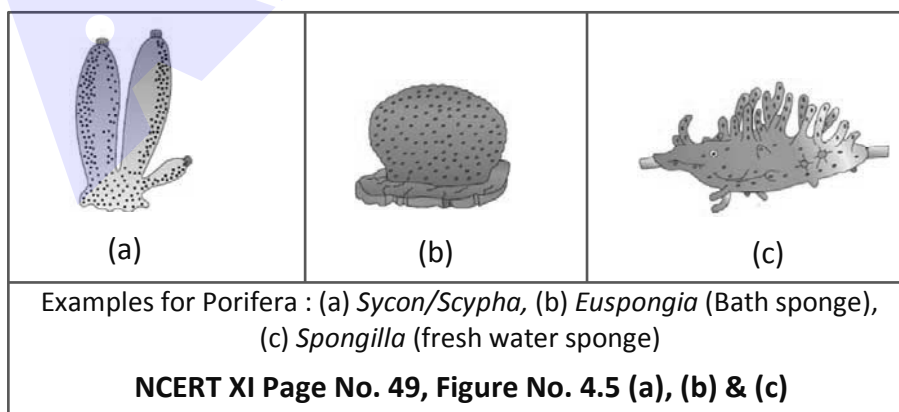
- Members of this phylum are commonly known as "**Sponges**". Study of sponges is known as **Parazology**.
- All are **aquatic and Sessile**, mostly **marine** but few are found in **fresh water** also. They are **solitary** or **colonial**. Entire body with pores i.e. numerous small **Ostia** for entry and one large opening **Osculum** for exit of water.
- Sponges have various body form and shapes with **irregular** shape **mostly Asymmetrical**. (Radial symmetry in **Sycon** and **Leucosolenia**)
- Sponges are primitive multicellular acoelomate animals and have **cellular level** of organisation.
Body wall consists of -
 - Outer Pinacoderm** – Consists of
 - Pinacocytes (Flat cells)
 - Porocytes (oval cells)
 - Inner Choanoderm**
Consists of flagellated collar cells or choanocytes (Unique Characteristic of Porifera)
 - Between these two layers a gelatinous material Mesenchyme is present which contains certain Amoebocytes cells like –
 - Scleroblasts – For formation of skeleton elements
 - Archaeocytes – Totipotent cells (Formation of ova & spermatazoa)
- Body wall encloses a large central cavity the **spongocoel** or **paragastric cavity** with small hollow canals.



6. **Canal system or water transport system** : It is unique feature of sponges, water enters through ostia in the body wall into spongocoel and goes out through osculum. This pathway of water transport is helpful in food gathering (Nutrition), respiratory exchange and removal of Wastes (excretion).
7. **Choanocytes** forms lining of Spongocoel and canals. Ceaseless beating of flagella helps in maintaining flow of water current.
8. Nutrition is holozoic. Digestion is **intracellular** and occurs in food vacuoles of choanocytes.
9. Skeleton is internal, consist of tiny **calcareous spicules** or **siliceous spicules** or fine **spongin fibre** located in mesenchyme. **Scleroblast** secretes spicules and **spongioblast** secretes spongin fibres.
10. **Respiration** and **Excretion** takes place by diffusion of gases through body surface. Excretory matter is **Ammonia**.
11. **Reproduction** takes place by means of :-
 - (A) **Asexual** - By Budding or Fragmentation or by Special cell mass **Gemmules** containing **Archaeocytes**.
 - Endogenous buds of asexual reproduction in sponge are known as **Gemmules** (In unfavourable condition).
 - (B) **Sexual** - Sponges are **Hermaphrodite**, fertilization is **internal** and **cross** due to **Protogynous** condition and development is **indirect** having a larval stage which is morphologically distinct from adult.



EXAMPLES OF FEW COMMON SPONGES



Hyalonema – Glass rope sponge

Euplectella – Venus flower basket (Bridal gift in japan)

Cliona – Boring sponge, harmful to pearl industry





BEGINNER'S BOX

PORIFERA

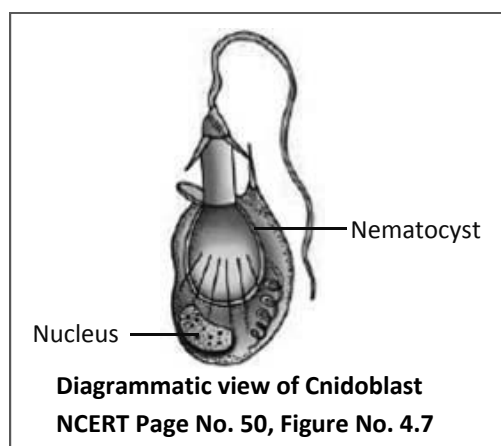
1. Which of the following cells of Porifera act as totipotent cells and responsible for high power of regeneration?
 (1) Pinacocytes (2) Choanocytes (3) Collenocytes (4) Archeocytes
2. Larval form found in sponges is :
 (1) Planula (2) Parenchymula (3) Cysticercus (4) Glochidium
3. Fertilization in *Leucosolenia* is :
 (1) Internal & Cross (2) External & Self
 (3) Internal & Self (4) External & Cross
4. Boring sponge is :
 (1) *Cliona* (2) *Spongilla* (3) *Euspongia* (4) *Hyalonema*
5. "Venus' flower basket" is :
 (1) *Hyalonema* (2) *Euplectella* (3) *Sycon* (4) *Euspongia*
6. Level of organisation in porifera is :-
 (1) Cellular (2) Tissue (3) Organ (4) Organ system
7. Digestion in porifera is :-
 (1) Intercellular (2) Extracellular
 (3) Intracellular (4) Intracellular as well as extracellular
8. _____ is smallest sponge.
 (1) *Sycon* (2) *Leucosolenia* (3) *Euplectella* (4) *Spongilla*
9. Exclusive feature of porifera is :-
 (1) Water vascular system (2) Water canal system
 (3) Ostia (4) Radial symmetry
10. Body wall of sponges encloses a large central cavity called _____ with small hollow canals.
 (1) Spongocoel (2) Coelenteron
 (3) Archenteron (4) All of the above

(2) PHYLUM – COELENTERATA OR CNIDARIA

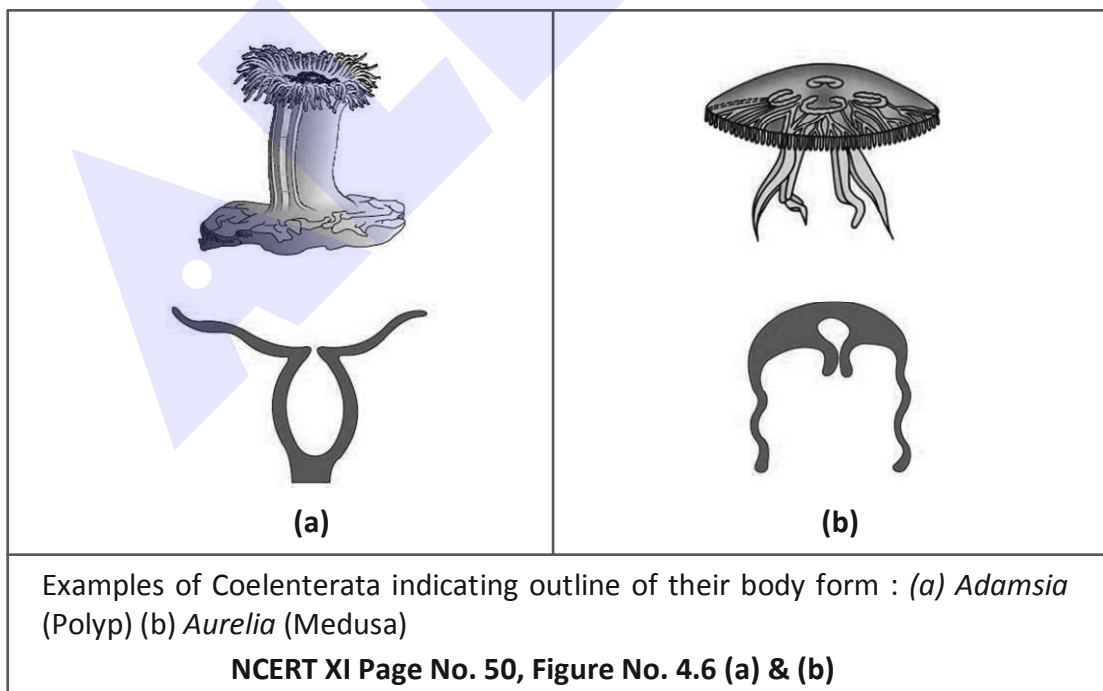
- Coelenterates are also known as **Cnidarians** due to presence of stinging cells called **Cnidoblast** or **Cnidocytes**.
- Mostly **marine**, **few fresh-water** (*Hydra*) carnivorous, sessile or free swimming.
- Radial symmetry**.
- Tissue level of organisation, acoelomate animals**.
- They develop from two germinal layers **(1) Ectoderm (2) Endoderm** i.e. they are **Diploblastic** (mesogloea between two layers) Interstitial cells are totipotent cells found in both layers of body wall.
- Coelenterates have two basic body **forms** (Dimorphic)

(1) Polyp	(2) Medusa
- Cylindrical and sessile form - May be solitary or Colonial - Mouth directed upwards e.g.- <i>Hydra</i> (Fresh water polyp), <i>Adamsia</i>	- Umbrella shaped and free swimming - Always solitary - Mouth directed downwards e.g. – <i>Aurelia</i>
 <i>Adamsia</i> (Polyp)	 <i>Aurelia</i> (Medusa)

- Either or both zooids may occur in a species.
 - If both are found in a species, two forms alternate in life cycle, Polyps produce medusae asexually and medusae form the polyps sexually, this alternation of generation is called **Metagenesis** eg :- *Obelia*
 - Group of different types of zooids in polyp or medusa shows **polymorphism**.
6. **Cnidoblast** or **Cnidocyte** (contains stinging capsule as Nematocyst) present on the tentacles and body, which are used for **anchorage** (Attachment), **defence** and for the capture of Prey (Offence).
- Body of some coelenterates may be covered by exoskeleton of calcium carbonate.
eg. :- **Corals**



7. A large central cavity called **Coelenteron** is having single aperture on **hypostome** i.e. **Incomplete digestive tract (Blind sac)**.
8. **Digestion** is **extracellular** as well as **intracellular** i.e. takes place in Coelenteron as well as in food vacuole. Mouth serves both purposes.
 - Coelenteron is also responsible for distribution of food besides partly digesting it. Due to this dual role it is named as Coelenteron or **Gastrovascular** cavity.
9. **Respiration** and **Excretion** takes place by diffusion of gases through **body surface**. Excretory matter is **Ammonia**.
10. **Nervous system** diffused type and consists of **non-polar neurons** (Nerve net).
11. Reproduction
 - Asexual by budding
 - Sexual by production of gametes
 - Development is indirect with larval stages
 - Larva of **Obelia** – Planula
 - Larva of **Aurelia** – Ephyra



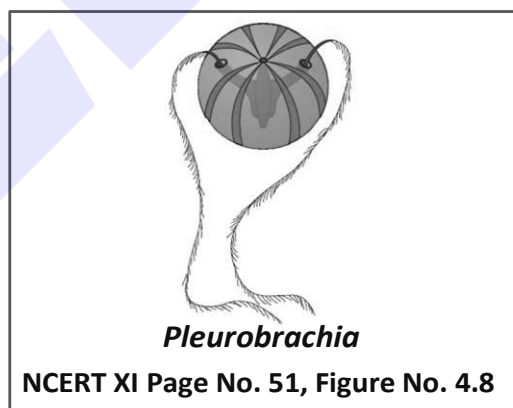
*Hydra**Physalia*
Portuguese man of war

e.g. *Aurelia* – Jelly fish
Adamsia – Sea anemone
Pennatula – Sea pen
Gorgonia – Sea fan
Meandrina – Brain coral
Obelia – Sea fur

(3) PHYLUM – CTENOPHORA

1. Ctenophores are known for their **beauty** and **delicate** nature. In sunlight their comb-plates give the effect of a **rainbow**. They are commonly known as "**Sea-gooseberries**" or "**Comb-jellies**" or "**Sea-walnuts**".
2. Nematoblasts are absent, so they are also called "**acnidarians**".
3. They are **exclusively marine**.
4. **Bioluminescence** (The property of a living organism to emit light) is well marked.
5. Body is soft **transparent** jelly like. They are **radially symmetrical**, **Diploblastic organism** with **tissue grade** body organisation.
6. Locomotion takes place by the presence of **8 ciliary comb plates** on the body surface.
7. Digestion is both extracellular and intracellular.
8. Skeletal, Excretory and Respiratory systems are **absent**.
9. They are **carnivorous**. A pair of long solid tentacles are present. In place of nematoblasts, special type of cells are present on tentacles, called **Lasso cells** (Colloblasts) which help in catching the prey.
10. Sexes are not separate. Reproduction takes place only by sexual means. Fertilization is external.
11. Development is of **indirect type**.

e.g. *Pleurobrachia*
Ctenoplana

*Pleurobrachia*

NCERT XI Page No. 51, Figure No. 4.8



BEGINNER'S BOX

COELENTERATA AND CTENOPHORA

1. Which one of the following animals is diploblastic ?
 (1) *Pennatula* (2) *Paramoecium*
 (3) *Taenia solium* (4) *Ascaris*
2. The function of nematoblast in coelenterate is :
 (1) Locomotion (2) Offence & defence
 (3) Reproduction (4) Nutrition
3. "Corals" belong to the phylum :
 (1) Porifera (2) Coelenterata
 (3) Mollusca (4) Echinodermata
4. A radially symmetrical diploblastic animal is :
 (1) *Ascaris* (2) Earth worm
 (3) Liver Fluke (4) *Hydra*
5. Medusa stage is not found in :
 (1) *Hydra* (2) *Aurelia* (3) *Obelia* (4) *Physalia*
6. "Portuguese man of war" is –
 (1) *Obelia* (2) *Physalia* (3) *Euplectella* (4) *Meandrina*
7. The characteristic feature of Ctenophora is :
 (1) External comb plates (2) Internal comb plates
 (3) Cnidoblast (4) Choanocytes
8. "Comb jellies " or "Sea Walnuts" belong to the phylum :
 (1) Coelenterata (2) Ctenophora
 (3) Mollusca (4) Echinodermata
9. Lasso cells are present in :
 (1) Coelenterata (2) Ctenophora
 (3) Porifera (4) Protozoa
10. Which one of the following is coelenterate –
 (1) Sea walnut (2) Sea cucumber
 (3) Sea fan (4) Sea horse

(4) PHYLUM – PLATYHELMINTHES

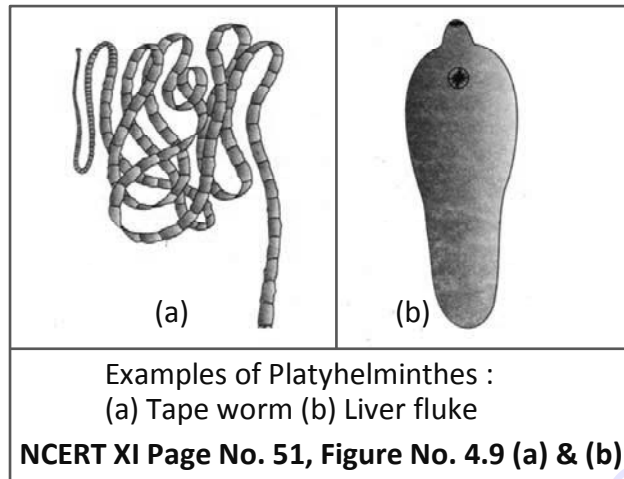
1. They have dorsoventrally flattened body hence are called **flat worms**.
2. These are **mostly endoparasites** found in animals including human being but some are Free living (aquatic).
3. Study of worms is called **Helminthology**.
4. Body is **Bilaterally symmetrical** and body organisation is of **organ grade**.
5. Body is **Triploblastic** i.e. body is formed from three germinal layers i.e. **Ectoderm, Endoderm & Mesoderm**.
6. Locomotory organs are absent in these animals but **adhesive organs** like **suckers and hooks** are present in parasitic form.
7. Epidermis is sometimes ciliated. On the body wall of parasitic animals a thick cuticle is present i.e. **Tegument**. Thick cuticle protects the parasite from the digestive enzymes of the host.
8. These are **acoelomate**. In between various organs a solid, loose mesodermal tissue called **Mesenchyma** or **Parenchyma** is present.
9. Digestive system is **incomplete** (Blind sac body plan) and without anus but in Tapeworm digestive system is completely absent. They absorb nutrients from the host directly through their body surface (Osmotrophy).
10. **Skeleton, respiratory and circulatory** systems are absent.
11. They **respire** through **body surface**. **Anaerobic** respiration is found in internal parasites like *Taenia*.
12. **Excretion** occurs through specialised cells called **Flame cells or Solenocytes (Protonephridia)**. They also help in **osmoregulation**.
13. **Nervous system** is **ladder like**, consist of a nerve ring and longitudinal nerve cords.
14. They are **Bisexual**. Reproductive system is **complex** and well developed. Fertilization is **internal**. Development **indirect** through many larva stages.
15. Some members like *Planaria* possess high regeneration capacity.

E.g. *Planaria* (Free living)

Taenia (Tapeworm)

Fasciola (Liver fluke)

Schistosoma (Blood fluke)



- (1) **Planaria** - Found in fresh water, nocturnal, cannibalic, slow creeping, omnivorous. Reproduce sexually as well as asexually (Transverse binary fission), good power of regeneration. Pharynx can be everted.
- (2) **Fasciola hepatica (Liver fluke)**
 - Life history involves two hosts (Digenetic parasite)
 - (1) Primary host - Sheep & Goat
 - (2) Secondary host - Garden snail (*Planorbis*, *Lymnea*)
 - Adult fluke is found in the bile ducts and liver of Sheep and causes **Liver-rot or Cirrhosis disease**.
 - Shows many larval stages namely **Miracidium** (enters into snails body) → **Sporocyst** → **Redia** → **Cercaria** → **Metacercaria** → Eaten by sheep and develops into adult fluke.
 - Infective stage for Primary host (Sheep) - Metacercaria
 - Infective stage for Secondary host (Snail) - Miracidium (Free swimming)
- (3) **Schistosoma (Blood fluke)** : Found in veins of human bladder and intestine. Unisexual , Large male carries female in a groove **gynaecophoric canal** on ventral side. It shows sexual dimorphism.
 - Life history involves two hosts (Digenetic parasite)
 - (1) Primary host - Man
 - (2) Secondary host - Garden snail (*Planorbis*, *Lymnea*)
 - **Miracidium** → **Sporocyst** → **Cercaria** larvae are found.

- Larva enters human body by boring in skin while bathing in ponds .

It damages the liver & causes intestinal disorder - **Schistosomiasis or Bilharzia disease.**

(4) *Taenia solium* (Pork tapeworm) : Flat, white ribbon like.

- Body divided into (1) head or scolex with hooks & suckers (2) Neck-for forming new proglottides (3) long strobila approx 850 proglottides. *T. solium* is human gut parasite, Attached to intestinal wall by hooks & suckers. Anaerobic respiration. Hermaphrodite, Self fertilization.

- Life history involves two hosts (Digenetic)

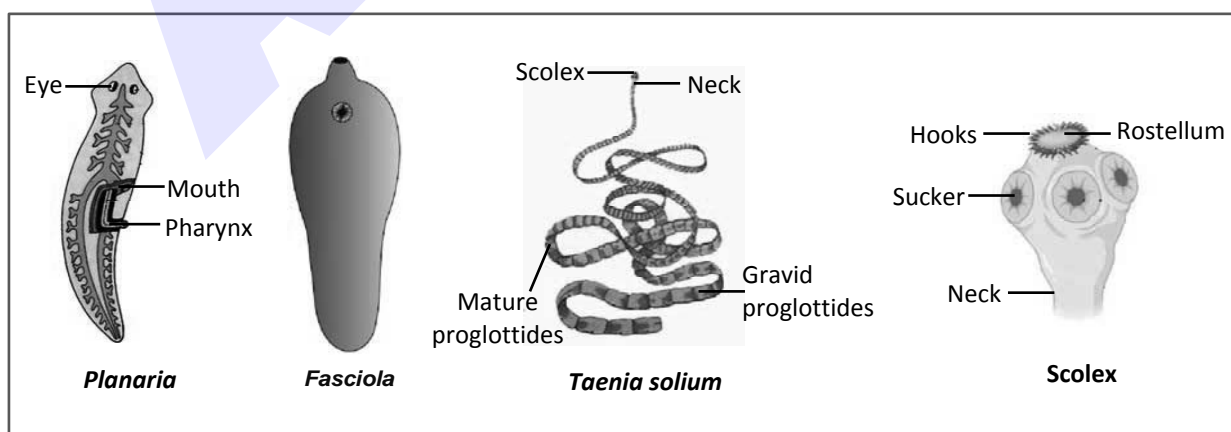
(1) Primary host - Man

(2) Secondary host - Pig

Apolysis - Detachment of gravid proglottids from the body of tape worm

- Development through many larval stages namely : **Onchosphere, Hexacanth, Bladder worm and Cysticercus**
- Man gets infection from undercooked pork containing encysted larvae cysticerci.
- Infective stage for primary host (Man) - Cysticercus.
- Infective stage for secondary host (Pig) - Onchosphere
- It causes the disease **Taeniasis** and **Cysticercosis**


FEW COMMON FLATWORMS





BEGINNER'S BOX

PLATYHELMINTHES

- Platyhelminthes are :
 - (1) Diploblastic, radially symmetrical and coelomate
 - (2) Diploblastic, radially symmetrical and acoelomate
 - (3) Triploblastic, bilaterally symmetrical and acoelomate
 - (4) Triploblastic, bilaterally symmetrical and pseudocoelomate
- The gravid proglottids having fertilized eggs in uterus of Tape worm are regularly detached, this process is known as :
 - (1) Apolysis
 - (2) Proliferation
 - (3) Strobilization
 - (4) Topolysis
- The correct sequence of various larvae in liver fluke is ?
 - (1) Miracidium, sporocyst, cercaria, redia, metacercaria
 - (2) Miracidium, sporocyst, redia, cercaria, metacercaria
 - (3) Sporocyst, redia, miracidium, cercaria, metacercaria
 - (4) Cercaria, sporocyst, redia, miracidium, metacercaria
- Protonephridia or flame cells of fresh water platyhelminthes help in :
 - (1) Excretion and osmoregulation
 - (2) Nutrition and excretion
 - (3) Reproduction and respiration
 - (4) Secretion and nutrition
- Which one of the following has mesoderm but no coelom ?
 - (1) Flatworm
 - (2) Earthworm
 - (3) Roundworm
 - (4) Leech
- Function of suckers cell in liver fluke
 - (1) Defense
 - (2) Reproduction
 - (3) Locomotion
 - (4) Absorb nutrients
- In the given diagram what does 'A' represent ?
 

(1) Hooks

(2) suckers

(3) Flame cell

(4) Ostia

(5) PHYLUM – ASCHELMINTHES OR NEMATHELMINTHES

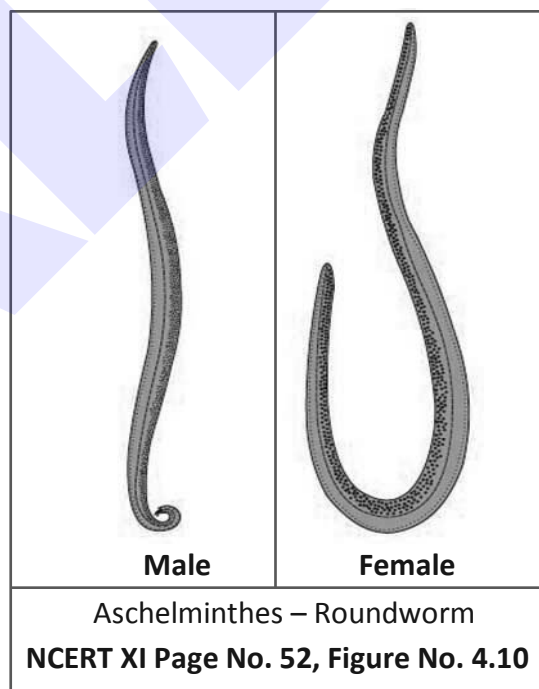
1. Phylum includes **round worms** which appear circular in cross section, also called thread worm.
2. **Nematods** are found everywhere, they may be free living (aquatic and terrestrial) or parasite in plants and animals.
3. They have long, **cylindrical** body with tapering ends and **without** segmentation.
4. **Symmetry - Bilateral, Germ layer - Triploblastic, Level of organisation - Organ-system** level and having **tube within tube body plan**.
5. Anterior end does not show distinct head (Cephalisation absent).
6. **Body wall** consists of
 - (i) **Cuticle** - Non living, thick and resistant to digestive enzymes of host.
 - (ii) **Epidermis** - Syncytial i.e. a continuous layer of cytoplasm having scattered nuclei.
 - (iii) **Muscle layer** - Only Longitudinal muscle fibres present
7. They are **Pseudocoelomate animals**, body cavity is there between body wall and digestive tract which is not lined by mesodermal epithelium i.e. **Pseudocoel** (developed from embryonic blastocoel)
8. **Skeleton** is absent but fluid pressure in the pseudocoelom maintains body shape. It is called **Hydroskeleton**.
9. **Digestive tract** is **complete** and differentiated into mouth, pharynx, intestine and anus.
Pharynx is **muscular** and well developed. It is used to suck the liquid food. Intestine is non muscular.
10. **Respiration** is through body surface by diffusion.
11. **Excretory system** is H-shaped and consists of **excretory canals (Protonephridia)** which removes body wastes from body cavity through excretory pores. They develop from an embryonic "**Renette cell**".
Excretory matter is **ammonia**.
12. **Nervous system** comprises of a nerve ring (Brain) and longitudinal nerve cords. Sense organs like **Papillae** (tangoreceptors), **Amphids** (chemoreceptor) are present on lips while **Phasmids** (chemoreceptor) are found on tail.
13. **Reproduction system** is developed and sexes are separate (**Dioecious**). Fertilization is **internal** and development may be **direct** (the young ones resemble the adult) or **indirect**.

14. Sexual dimorphism is present.

In *Ascaris* male is smaller than female and curved from its caudal end. Male has Pineal setae for copulation. Genital tract joins with digestive tract to form cloaca. Female is larger than male and straight at both ends. Genital and digestive tract open independently (Cloaca absent).

Eg.

- (1) *Ascaris* - Round worm (in small intestine), larva - **Rhabditiform**
- (2) *Ancylostoma* - Hookworm (in small intestine)
- (3) *Wuchereria* - Filarial worm (Viviparous)
 - Digenetic parasite that causes **Filariasis/Elephantiasis** disease.
 - Carrier host is female **Culex** mosquito.
 - Adult mainly infects lymph vessels and lymph nodes in humans.
- (4) *Dracunculus* - Guinea worm (madina worm) or Fiery serpent (Digenetic - *Cyclops* as intermediate host)
- (5) *Enterobius* - Pin worm or seat worm (in large intestine)
- (6) *Trichuris* - Whip worm (in intestine)
- (7) *Rhabditis* - Free living nematode
- (8) *Trichinella* - Infection in intestine and striated muscles (viviparous)



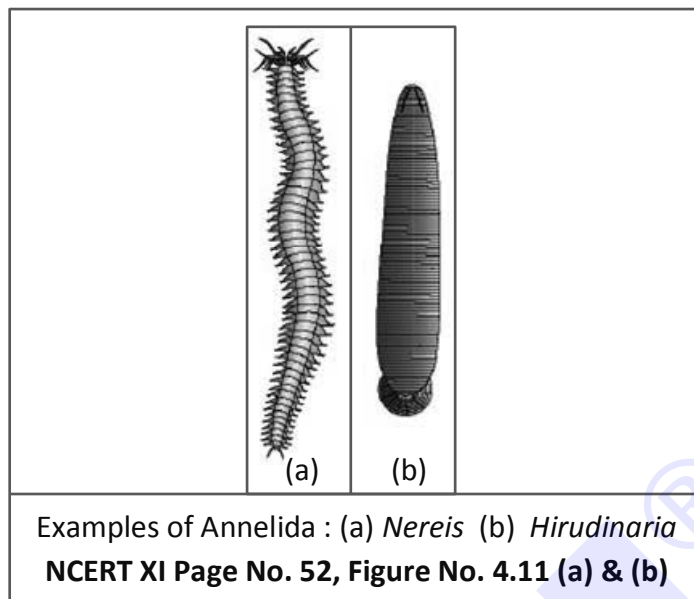

BEGINNER'S BOX
NEMATHELMINTHES

- Which of the following endoparasite of man is viviparous ?
 (1) *Ascaris* (2) *Wuchereria* (3) *Taenia* (4) *Enterobius*
- Which of the following is pseudocoelomate animal ?
 (1) Whip worm (2) Fluke (3) Flat worm (4) Tape worm
- Ascaris* is found in
 (1) Body cavity (2) Tissue (3) Alimentary canal (4) Lymph nodes
- Identify the given animal in the diagram ?
 (1) Male *Taenia*
 (2) Female *Taenia*
 (3) Male *Ascaris*
 (4) Female *Ascaris*
- The pseudocoelomate among these is
 (1) Porifera (2) Annelida (3) Mollusca (4) Aschelminthes
- Match the following columns and select the option shows correctly matched pairs

Column - I	Column - II
(p) <i>Ascaris</i>	(i) Hook worm
(q) <i>Wuchereria</i>	(ii) Round worm
(r) <i>Ancylostoma</i>	(iii) Flat worm
(s) <i>Tapeworm</i>	(iv) Filaria worm
(1) p - (ii), q - (iv), r - (iii), s - (i)	(2) p - (ii), q - (i), r - (iii), s - (iv)
(3) p - (ii), q - (iv), r - (i), s - (iii)	(4) p - (i), q - (ii), r - (iv), s - (iii)


(6) PHYLUM – ANNELIDA

- Free living found in moist soil (Terristrial), fresh water or marine but few are parasite.
- Body is soft elongated, cylindrical and divided into **segments** or **metameres** by ring like grooves called Annuli.
- They are bilaterally symmetrical, triploblastic and have organ system level of organisation with tube within tube body plan.
 - They are **metamerically segmented** and **coelomate** animals.
 - Anterior end has a distinct head with sense organs in few annelids. (eg : *Nereis*)



4. They have **chitinous setae** and lateral muscular appendages called **Parapodia** for locomotion.
5. **Body wall** consist of
 - **Cuticle** – Thin and moist
 - **Epidermis** - Living layer that secretes dead cuticle outside
 - **Muscle layer** - Contains circular and longitudinal muscles which help in Locomotion
6. **Body cavity** is **true coelom** lined by mesodermal coelomic epithelium. (**Schizocoel/First Eucoelomate**).
It is filled with coelomic fluid that serves as a **hydrostatic skeleton**.
7. **Digestive tract** is complete, straight and extends through entire body. Digestive glands are developed for the first time in Annelida.
8. **Respiration** is through **moist skin (Cutaneous respiration)**, Some have **gills** (branchial respiration).
9. **Circulatory system** is **closed** type and pulsatile heart present.
 - The blood is red with **haemoglobin** like pigment which remains dissolved in plasma (**Erythrocrutorin**). It has amoeboid corpuscles only. (RBCs absent)
10. **Excretory organ** is **Nephridia** (sing. nephridium). They also help in osmoregulation.
Excretory matter (1) **Ammonia** in aquatic form (2) **Urea** in land form
11. **Nervous system** consists of a **nerve ring** (Brain) and a **solid, double** and **ventral nerve cord** with ganglia.
12. Reproduction is sexual, *Nereis* is **dioecious** but earthworms and leeches are **monoecious**.
 - Development is direct or indirect with free swimming ciliated **trochophore** larva.

★ Golden Key Points ★

- During course of evolution metameric segmentation, true coelom, closed circulatory system and pumping heart appeared first in annelids.

e.g

- Nereis*** - Sandworm
 - Cephalisation is present.
 - Parapodia helps in locomotion.
 - Unisexual
 - Larva is trochophore
- Pheretima*** - Earthworm
 - Cephalisation absent
 - Setae for locomotion
 - Bisexual or hermaphrodite
- Hirudinaria*** - Fresh water leech (Blood sucking leech)
 - Cephalisation and setae absent
 - Parapodia and setae absent
 - Bisexual
 - Hirudin (anticoagulant) present
- Aphrodite*** - Sea mouse



BEGINNER'S BOX

ANNELIDA

- Parapodia are locomotory structures in :

(1) <i>Fasciola</i>	(2) <i>Nereis</i>	(3) Centipede	(4) Earth worm
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- Animals showing metameric segmentation are :

(1) Poriferans	(2) Annelids	(3) Tape-worms	(4) Aschelminthes
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- Aphrodite*, commonly known as "sea mouse" is an :

(1) Annelid	(2) Mollusc	(3) Insect	(4) Mammal
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- Which is correct for earthworm

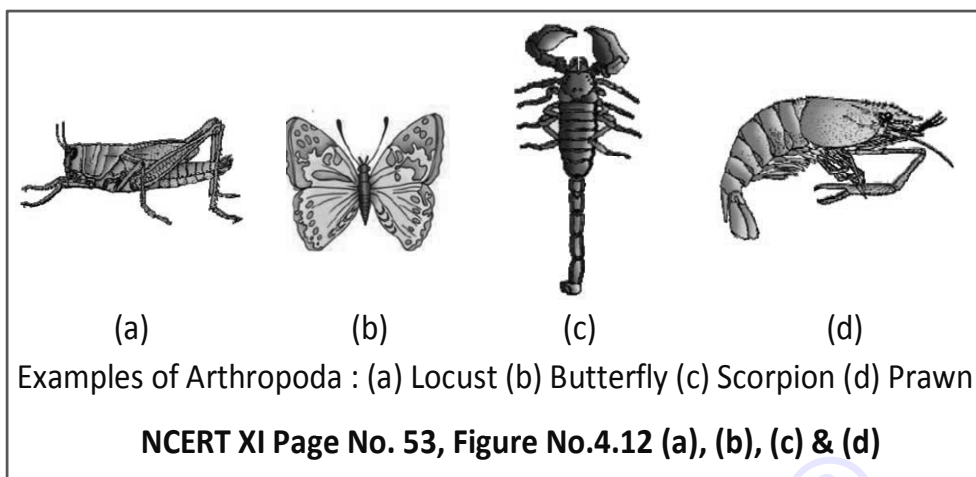
(1) Segments	(2) Monoecius	(3) Nephridia	(4) all of given
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- Neural system consists of paired ganglia connected by lateral nerves to double___ in annelida.

(1) ventral nerve cord	(2) dorsal nerve cord
(3) Anterior nerve cord	(4) posterior nerve cord
- Blood sucking animal is

(1) <i>Nereis</i>	(2) Earthworm	(3) 1 & 2	(4) Leech
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(7) PHYLUM – ARTHROPODA

1. Arthropoda is **the largest phylum** of animalia which includes insects. Over two-thirds of named species on earth are arthropods.
2. They may be aquatic (marine and fresh water) or terrestrial, free living and sometimes parasitic.
3. Body is **Bilaterally symmetrical, Triploblastic** with **organ system level** of organisation
4. They are **metamerically segmented** and **coelomate** animals.
5. Body is divided into three region **Head, thorax & abdomen**, but in some head and thorax fused to form cephalothorax (Prosoma)
6. **Unique features**
 - They have **jointed appendages** for different functions. (arthro - jointed, poda - foot/appendages).
 - The body of Arthropods is covered by **Chitinous exoskeleton**.
7. **Body cavity** around viscera contains blood and the coelom filled with blood is called the **haemocoel**.
8. **Digestive Tract** is complete and they can feed upon all kind of food substances.
9. **Respiration** by **gills** (e.g. Prawn), **Book-gills** (e.g. King crabs). **Tracheal system** (e.g. Insects), **Book-lungs** (e.g. Scorpion), Trachea carry oxygen directly to the body cells.
10. **Circulatory system** is **Open** type i.e. blood flows in open tissue spaces and haemocoel instead of blood vessels. Blood is colourless called **Haemolymph** (e.g. Insect). Respiratory pigment absent. Copper containing pigment **haemocyanin** is found in some arthropods (e.g. Prawn).
11. **Excretory organs** are - **Antennary** or **green glands** (e.g. Prawn), **Coxal gland** (e.g. Scorpion), **Malpighian tubules** (e.g. Insects) opening into the gut.
12. Excretory matter is **Ammonia** in aquatic animals and **Uric acid** in land animals.
13. **Nervous system** comprises of a **nerve ring** and a **double, solid** and **ventral nerve cord** bearing ganglia.
14. Head is distinct [High degree of cephalization]
15. Sensory organs like simple eyes, or compound eyes or both, antennae, statocyst and anal cerci are found.
16. They are mostly **dioecious**. **Fertilization** is **usually internal** but few aquatic form has external fertilization. Gonads have ducts. Sexual dimorphism may be present. They are **mostly oviparous**.
17. Development may be **direct** or **indirect**.
18. Animals of **Arthropoda** are most **successful invaders of terrestrial** environment among invertebrates due to presence of (i) **Cuticle** (ii) **Appendages** (iii) **Wings**

**Examples :-**

- Insects
- Economically important insects - ***Apis*** (Honey bee), ***Bombyx*** (Silk worm), ***Laccifer*** (Lac insect)
 - Vectors - ***Anopheles***, ***Culex***, ***Aedes*** (mosquitoes)
 - Gregarious pest - ***Locusta*** (Locust)

Living Fossil - ***Limulus*** (King crab) / horse shoe crab

- Others - **Butterfly, Scorpion, Prawn, Spider, Cyclops, Centipede, Millipede, Peripatus** etc.
- **Dragon flies** - Larvivorous (Mosquitoes)
- **Lepisma** – Silver fish (book louse/worm), wingless insect.

HARMFUL ARTHROPODS (VECTOR FOR DISEASES)

Anopheles - Malaria

Culex - Elephantiasis

Aedes - Dengue/Yellow fever

Tse-Tse fly - African sleeping sickness

Sand fly - Kala-azar

House fly - Cholera, Diarrhoea, Dysentery, Gangrene, Intestinal fever

Louse - Trench fever

Larvae & Pupae

Caterpillar - Silkworm and Butterfly

Grub - Honey bee

Maggot - House fly

Wiggler - Mosquito

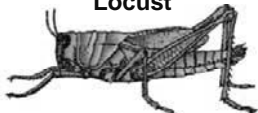

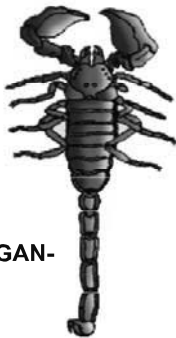

Nauplius – Prawn

★ Golden Key Points ★

● MOUTH PARTS IN INSECTS

- (i) **Biting and chewing** - Grasshopper, Cockroach, Termites, Caterpillars.
- (ii) **Piercing- sucking** - Mosquitoes, Bugs, Tse-tse fly
- (iii) **Chewing- lapping type** - Honey Bee
- (iv) **Sponging type** - Housefly.
- (v) **Siphoning type** - Butterflies, moths

PHYLUM - ARTHROPODA

INSECTA	ARACHNIDA	CRUSTACEA
		
6-LEGS	8-LEGS	10-LEGS
BODY PARTS <ul style="list-style-type: none"> HEAD THORAX ABDOMEN 	BODY PARTS <ul style="list-style-type: none"> CEPHALO-THORAX ABDOMEN 	BODY PARTS <ul style="list-style-type: none"> CEPHALO-THORAX ABDOMEN
RESPIRATORY ORGANS-TRACHEA	RESPIRATORY ORGANS-BOOK LUNGS	RESPIRATORY ORGANS-GILLS
ANTENNAE- 1 PAIR	ANTENNAE ABSENT	ANTENNAE- 2 PAIR
EXCRETORY ORGAN- MALPIGHIAN TUBULES	EXCRETORY ORGAN- COXAL GLAND	EXCRETORY ORGAN -GREEN GLANDS
EXCRETORY MATTER AMMONIA & URIC ACID	EXCRETORY MATTER- GUANINE	EXCRETORY MATTER- AMMONIA
COMPOUND EYES-PRESENT Ex. Termite, Beetle 	SIMPLE EYES PRESENT Ex. Tick, Mites, spider 	

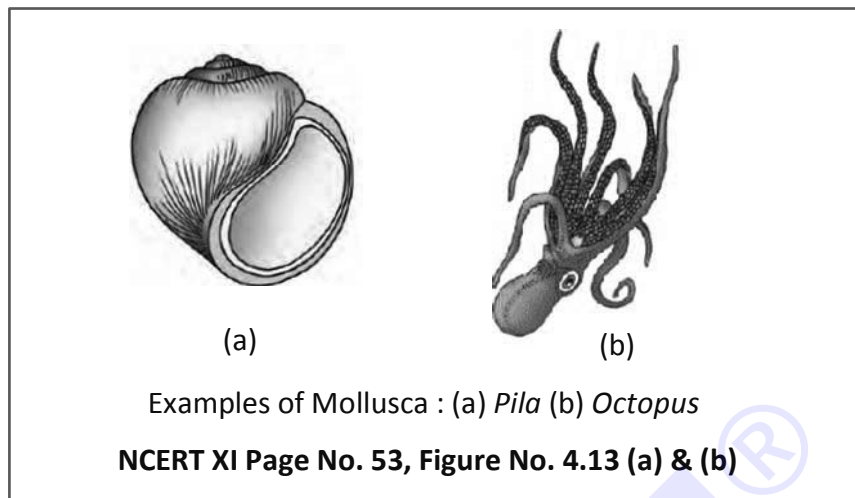


BEGINNER'S BOX

ARTHROPODA

1. Green glands are found in :-
 (1) Insects (2) Crustaceans (3) Annelida (4) Arachnida
2. The phylum Arthropoda is characterised by :-
 (1) Chitinous exoskeleton, external segmentation and paired appendages
 (2) Chitinous exoskeleton and antennae
 (3) Chitinous exoskeleton, antennae and compound eye
 (4) Chitinous exoskeleton, external segmentation and paired jointed appendages
3. Excretion in Arthropod animals takes place by :-
 (1) Malpighian tubules (2) Green glands
 (3) Coxal glands (4) All of the above
4. Book - lungs are found in :-
 (1) Scorpion (2) Prawn (3) *Limulus* (4) Cockroach
5. Which one of the following is most important feature of insects :-
 (1) Compound eyes (2) Long abdomen
 (3) Three pairs of legs (4) Two pairs of wings
6. Number of walking legs in a spider are :-
 (1) Three pairs (2) Four pairs (3) Six pairs (4) Two pairs
7. Which of the following is a wingless insect?
 (1) *Lepisma* (2) Termite (3) Moth (4) *Apis*
8. Book gills for respiration are found in ?
 (1) House - fly (2) Termites (3) Ant (4) King-Crab
9. Members of phylum Arthropoda lack one of the following features :-
 (1) External skeleton made of chitin
 (2) Compound eyes
 (3) Excretion by malpighian tubules
 (4) Usually a close type of blood vascular system
10. Which of the following animal is not an insect ?
 (1) Tick (2) Honey bee (3) Beetle (4) Silkworm

(8) PHYLUM – MOLLUSCA



1. It is **second largest** phylum which includes "Soft bodied and shelled" animals.
2. They are aquatic (**marine or fresh water**) or terrestrial.
 - Study of molluscs is known as **Malacology** & study of shells of molluscs is known as **Conchology**.
3. Molluscs are **bilaterally symmetrical**. Few are secondarily **asymmetrical** (snail) due to **twisting /Torsion** during growth. They are **triploblastic** and coelomate animals with **Organ system** level of organisation.
4. Body is unsegmented with variety of shapes and covered with **calcareous** shell.
5. Body is divisible into three parts :
 - **Head** with sense organs like eyes and sensory tentacles.
 - Dorsal **visceral mass/ hump** containing all visceral organs of body.
 - Ventral **muscular foot** for locomotion.
6. Soft and spongy layer of skin form a **mantle or pallium** over the visceral hump.
 - The space between hump and mantle is called mantle cavity.
 - The mantle usually secretes an external **calcareous shell**. Shell is made up of **Calcium carbonate and Conchiolin protein**.
7. **Digestive tract** is complete. Buccal cavity contain a file-like rasping organ for feeding called **Radula**, with transverse rows of teeth. Anus opens into the mantle cavity.
8. **Respiration** is usually by feather like **gills (Ctenidia)** located in the mantle cavity which also helps in excretion. **Pila** respire by **pulmonary sac** on land and by **gills** in water.
9. **Circulatory system** is **open** type. It includes dorsal pulsatile heart and a few arteries that open into sinuses.

(Cephalopoda has **closed** type of circulatory system eg Octopus, Sepia, Loligo)

 - **Coelom** is greatly **reduced**. Spaces among the viscera contain blood and form **haemocoel**.
 - Blood usually has a copper containing respiratory pigment called **haemocyanin (Blue or green)**.

10. **Excretory system** includes 1 or 2 pairs **Keber's organs** or **Organ of Bojanus**, which open into the mantle cavity. Excretory matter is **ammonia** or **uric acid**.
11. **Nervous system** with ganglia.
12. Senses organs :
 - (1) **Eye** - present over a stalk called **ommatophore** in some molluscs.
 - (2) **Statocyst/Lithocyst** - for body equilibrium in foot
 - (3) **Osphradium** - chemoreceptor/olfactory receptor for testing chemical nature of water (pH).
13. They are usually **dioecious**, they are mostly oviparous. Fertilization may be **external** or **internal**.
 - Development is - **Mostly indirect**. **Trochophore** is common larva of Molluscs and Annelids, Glochidium (Larva of *Unio*) and Veliger (Larva of *Pila*).

EXTRA POINTS

- Precious pearl of the size of tennis - ball is made by a giant mollusc - ***Tridacna***
- "**Nacre layer**" is called "**Mother of Pearl**": This layer is made up of CaCO_3 and choncheolin protein.
- Molluscs are classified on the basis of **shell and foot into six classes**.
e.g.
 1. ***Neopilina*** – Living fossil (Connecting link between Annelida and Mollusca)
 2. ***Chaetopleura* – *Chiton*** - "Coat of mail shell" or Sea-mica
 3. ***Dentalium*** -Tusk - shell
 4. ***Pila*** - Apple-snail
 5. ***Aplysia*** - Sea hare
 6. ***Doris*** - Sea lemon
 7. ***Turbinella***- Shankh
 8. ***Planorbis*** -Land snail
 9. ***Lymnea*** - Land snail
 10. ***Pinctada*** - Pearl oysters
 11. ***Unio***- fresh water mussel
 12. ***Teredo***- Ship worm
 13. ***Octopus*** - Devil fish (8 arms) - Shell is absent
 14. ***Sepia***-Cuttle fish (10 arms) - Shell is internal
 15. ***Loligo*** - Squid (Radula absent)

Shell is spirally coiled so animals becomes asymmetrical

Belongs to class Cephalopoda in which closed blood vascular system is present.



BEGINNER'S BOX

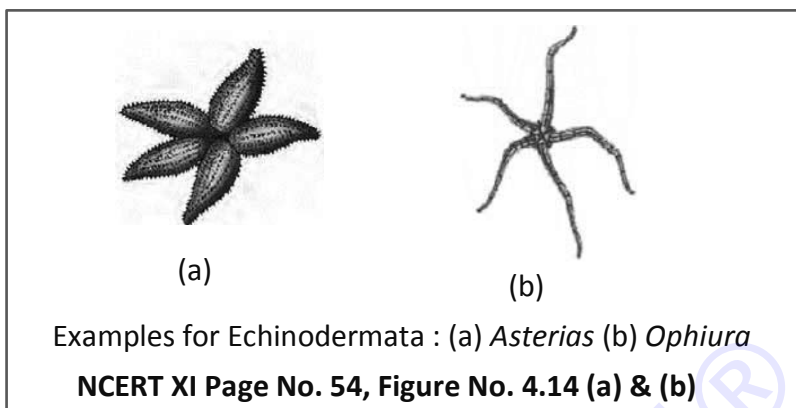
MOLLUSCA

- The connecting link between Annelida and Mollusca is :-
 (1) *Peripatus* (2) *Hirudinaria* (3) *Neopilina* (4) *Teredo*
- Organ of Bojanus** are found in :-
 (1) Chordata (2) Echinodermata (3) Annelida (4) Mollusca
- Molluscan which form hole in wood of ships is ?
 (1) *Doris* (2) *Chiton* (3) *Teredo* (4) *Nereis*
- Which animal becomes assymetrical due to torsion in body and shell :-
 (1) Land snail (2) Apple snail (3) Sea lemon (4) All of the above
- Which of the following is a mollusc ?
 (1) Sea-horse (2) Sea-mouse (3) Sea-hare (4) *Limulus*
- Which of the following is not the feature of Mollusca?
 (1) Three parts of body-head, visceral hump and muscular foot
 (2) Soft and spongy layer of skin form a mantle over the visceral hump
 (3) Radially symmetrical animals
 (4) Radula in buccal cavity
- Coat of mail shell is :-
 (1) *Chiton* (2) *Dentalium* (3) *Pila* (4) *Pinctada*
- Which mollusc is commonly called "tusk shell"?
 (1) *Doris* (2) *Dentalium* (3) *Unio* (4) *Teredo*

(9) PHYLUM – ECHINODERMATA

- All are **Marine**. Generally live at **bottom** and slow moving.
 - Body shape is **star like, cylindrical, melon-like or disc-like**.
- The adult Echinoderms are **radially symmetrical** but larvae are **bilaterally symmetrical**.
- They are **triploblastic** and **coelomate** animals with **organ - system level** of organisation. Echinoderms have true **Coelom**
 - They do not have distinct **head**.

4. **Skin** of echinoderms contains **calcareous spines**, pedicellariae and endoskeleton consists of **calcareous plate (dermal ossicle)**.



5. The most distinctive feature of echinoderms is presence of water filled **ambulacral** or **water vascular system** with tube feet to help in **locomotion**, **capture** and **transport of food**, **excretion** and **respiration**. A perforated plate madreporite permits entry of water into ambulacral system.
6. **Digestive tract** is **complete** with mouth on lower side (ventral) and anus on the upper side (dorsal).
7. **Respiration** takes place by body surface or **gills** called **dermal branchiae** or papulae in most of Echinoderms like Starfish.
8. **Circulatory system** is reduced and **open type**. No heart or pumping vessel.
9. There is no **excretory system**. Nitrogenous waste **ammonia** diffuses out through body surface.
10. **Nervous system** is simple and less developed includes a Nerve ring and radial nerves with simple sense organ. They don't have head and brain.
11. Reproduction is sexual, sexes are separate (unisexual).
12. **Fertilization** is usually **external** and development is **indirect** with free swimming larva.

★ **Golden Key Points** ★

- Echinoderms have some chordate like characters like **enterocoelic coelom**, **mesodermal skeleton** and **deuterostomic embryonic development**.
- Few echinoderms (Star fish) have great power of **regeneration**. They break off their arms for defence purpose. This phenomenon is known as **Autotomy**.
- Sea cucumbers in angry or frightened state vomits out viscera (internal organ). This phenomenon is known as **Evisceration**.

Pre-Medical

e.g.

1. *Asterias* - starfish
2. *Ophiura* - Brittle star
3. *Ophiothrix* - Brittle star
4. *Echinus* - sea urchin (arms are absent)

Mouth - with **Aristotle's lantern**

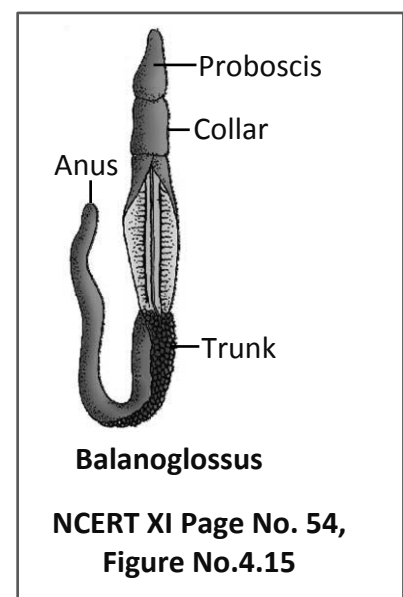
i.e. Masticating apparatus with 5 calcareous teeth.

5. *Cucumaria* (Sea cucumber)
6. *Holothuria* (Sea cucumber)] (Arms are absent)
7. *Antedon* - (Sea lily)

(10) PHYLUM – HEMICHORDATA

Hemichordata is a connecting link between Non-chordata & Chordata.

1. Hemichordata was earlier considered as a sub-phylum of chordata. But now it is placed as a **separate phylum** under **non-chordata**.
2. This phylum consists of a small group of **worm like** marine animals with organ system level of organisation.
3. They are **bilaterally symmetrical, triploblastic** and **coelomate** animals.
4. The body is cylindrical, unsegmented and divided into **three parts** : anterior **proboscis**, **middle collar** and a posterior long **trunk**.
 - Body cavity is **enterocoelus**, which is divided into **Protocoel, Mesocoel** and **Metacoel**.
5. Digestive tract is complete.
6. Hemichordata have a rudimentary structure in the collar region called stomochord, a structure similar to notochord.
7. Respiration takes place through **gills**.
8. Circulatory system is **open type**. **Heart** is situated **dorsally**.



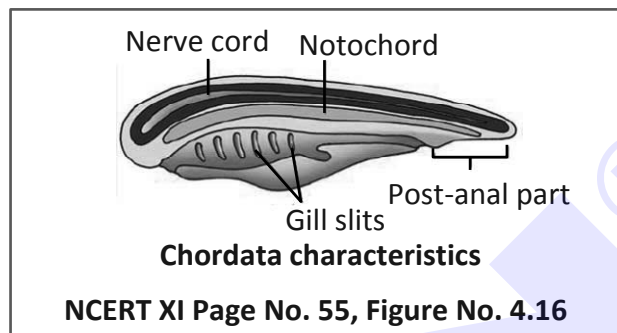
9. **Excretion** occurs through a **single glomerulus** or **proboscis gland**.
10. **Central nervous system** is just **like non chordates**.
11. Reproduction is sexual and Mostly animals are **unisexual**
- Fertilization is **external**.
 - **Development** is **indirect** with **Tornaria larva** which is similar to **Bipinnaria larva** of echinodermata in their developmental stages.
- eg.** 1. *Balanoglossus* :-Tongue worm or Acorn worm
2. *Saccoglossus*

**BEGINNER'S BOX****ECHINODERMATA, HEMICHORDATA**

1. Water vascular system is found in :-
 (1) Sycon (2) Leech (3) Fish (4) Star-fish
2. The animal with tube-feet is :-
 (1) Star-fish (2) Jelly-fish (3) Silver-fish (4) Cray-fish
3. Which is the characteristic feature of Echinodermata ?
 (1) Smooth skin and radial symmetry
 (2) Spiny skin and radial symmetry
 (3) Spiny skin and bilateral symmetry
 (4) Smooth skin and bilateral symmetry
4. Excretory organ of *Balanoglossus* is :-
 (1) Protonephridia
 (2) Supra neural gland
 (3) Solenocytes
 (4) Proboscis gland
5. The larval form of Hemichordata is called :-
 (1) Trochophore (2) Tornaria
 (3) Tadpole (4) Ammocoete

(11) PHYLUM CHORDATA

- The term chordata is originated by the two words of Greek language the '**Chorda**' and the '**ata**'. Meaning of '**Chorda**' is '**a thick string**' and meaning of '**ata**' is '**to have**' and over all meaning of chordata is animals having **notochord**.
- So, chordates are the animals in which notochord is present in any stage of their life – span.



Fundamental Characters of Chordates :-

These are as follows :-

1. **Presence of notochord/Chorda dorsalis :-** In the embryonic stage of chordates there is a solid rod like structure (Just below the nerve cord and above the alimentary canal), this is called **notochord**.
 - Notochord is extended from anterior end to posterior end of the body at the dorsal surface.
 - Notochord is mesodermal in origin. It forms a primary endoskeleton which gives support to body.
 - In - **Protochordata** group , notochord is not replaced by vertebral column but in **vertebrata**, it is replaced by **back bone** or **vertebral column** in adults.
2. **Presence of Dorsal Hollow Nerve Cord :-**
 - In chordates central nervous system is situated at the dorsal surface of body.
 - In these animals, **single, hollow, tubular** nerve cord is present beneath the bodywall and just above the notochord.
 - Nerve cord is ectodermal in origin.
3. **Presence of paired pharyngeal gill – slits :-**
 - In each chordate there are present paired lateral **gill clefts** in the walls of pharynx for **respiration** in any stage of its life span.

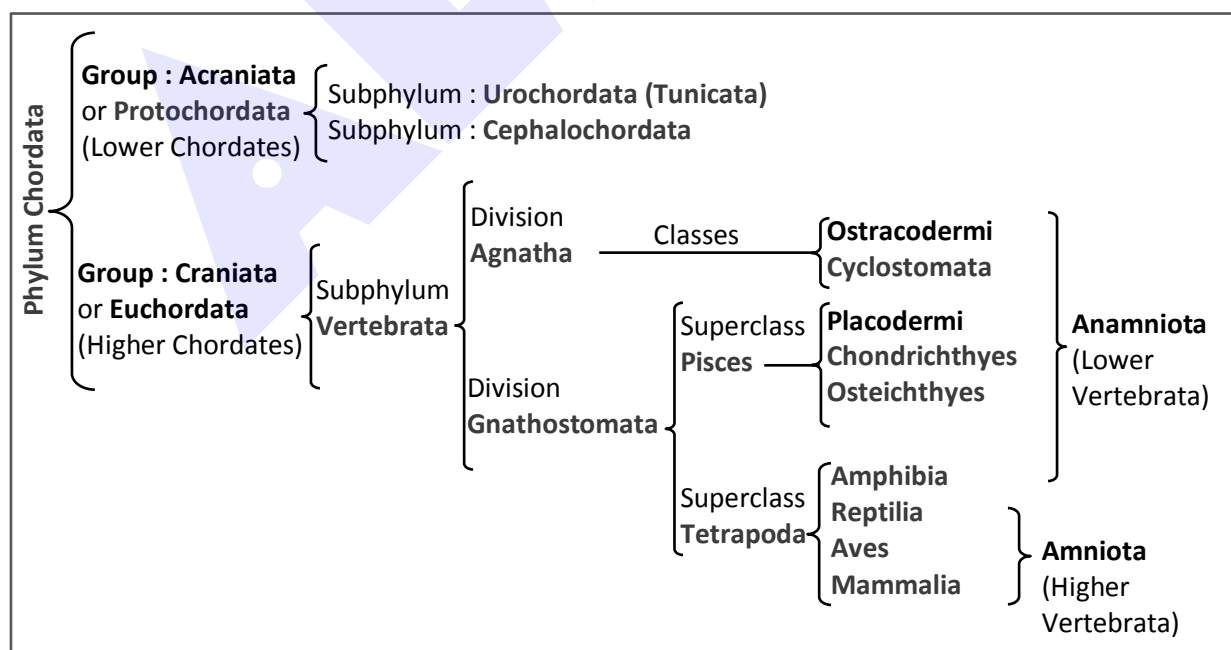
- In **aquatic chordates** (pisces) and **lower chordates**, pharyngeal gill clefts are present **throughout their life span** for respiration.
 - In **terrestrial chordates**, gill clefts are found only in embryonic stage and are absent in adults, because main respiratory organs are **lungs** in them.
4. **Post anal tail** :- In chordates tail if present is the post anal part of the body. Tail is reduced or absent in many adult chordates.

S.No.	Chordates	Non-chordates
1.	Notochord present.	Notochord absent.
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.

- Chordates are bilaterally symmetrical, triploblastic, coelomate with organ system level of organisation. They have a closed circulatory system.

CLASSIFICATION OF CHORDATA

Outline Classification of Phylum Chordata :





BEGINNER'S BOX

FUNDAMENTAL CHARACTERS OF CHORDATA

1. Chordates are distinguished from non chordates by the presence of :-
 - (1) Brain
 - (2) Dorsal hollow tubular nerve cord
 - (3) Ventral nerve cord
 - (4) Dorsal nerve cord
2. In which one of the following group, brain box is absent :-
 - (1) Cyclostomata (2) Pisces (3) Amphibia (4) Urochordata
3. Which of the following is not found in the phylum chordata?
 - (1) A dorsal hollow nerve chord
 - (2) Lateral paired gill slits during development
 - (3) A notochord at some stage of development
 - (4) Double solid nerve cord
4. Which of the following is not a characteristic unique to all members of phylum chordata?
 - (1) A notochord, a dorsal hollow (2) A ventral heart
 - (3) An endoskeleton (4) Vertebrae
5. Chordata have :-
 - (1) Dorsal, hollow and single CNS (2) Ventral heart
 - (3) Post-anal tail (4) All

(A) Group : Acraniata or Protochordata :

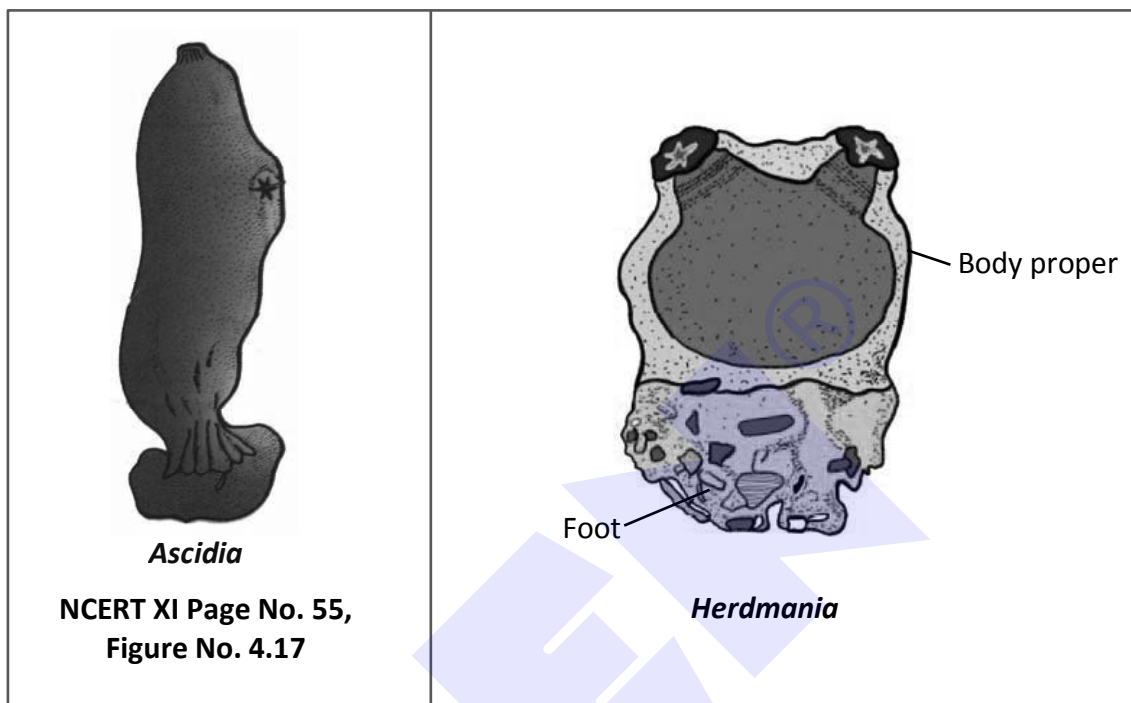
- Protochordates are exclusively **marine**.
- **Pharyngeal gill clefts** are found throughout the life for respiration.
- **Notochord** is present in larval stages or persists throughout the life, but **skull, brain** and **vertebral column** is **absent** in them.
- Notochord is not replaced by vertebral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

Subphylum – 1–**Urochordata**

Subphylum – 2–**Cephalochordata**

(i) **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.



- 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 chordate 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.

e.g. :

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

(ii) Sub Phylum - Cephalochordata

- 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 extends from head to tail region and is persistent throughout their life.
 - Alimentary canal is **complete**.
 - Blood vascular system is **closed type** and respiratory pigment **absent**.
 - For excretion **protonephridia** are present in the form of **flame cells** or **solenocytes**.
 - 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)



BEGINNER'S BOX

PROTOCHORDATA

1. Which one of the following is a chordate but not a vertebrate :-
 (1) *Scoliodon* (2) *Hag fish* (3) *Amphioxus* (4) Star fish
2. Cephalochordate is :-
 (1) *Amphioxus* (2) *Ascidia* (3) *Salpa* (4) *Herdmania*
3. First complete/typical chordate is :-
 (1) *Herdmania* (2) *Amphioxus* (3) *Balanoglossus* (4) All the above
4. "Sea - squirt" is common name of :-
 (1) *Balanoglossus* (2) *Herdmania* (3) *Amphioxus* (4) *Ascidia*
5. Notochord is found only in the tail of Larva in -
 (1) All chordata (2) Hemichordata (3) Urochordata (4) Cephalochordata

(B) Sub Phylum – Vertebrata / Craniata / Euchordata :

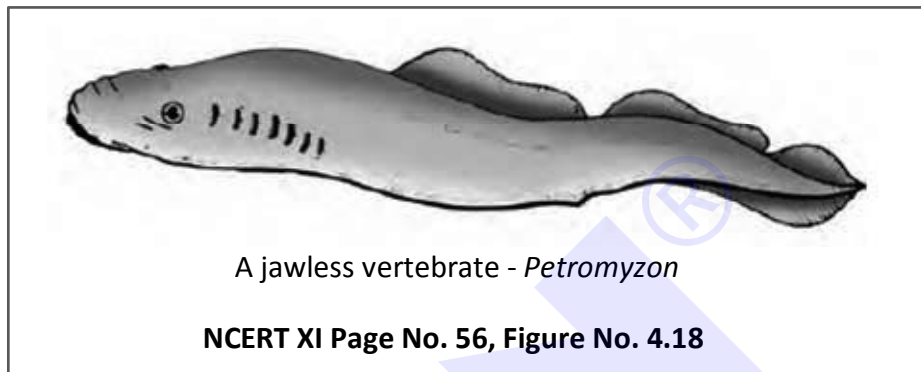
- The members of subphylum Vertebrata possess notochord during the embryonic period. The notochord is replaced by a cartilaginous or bony vertebral column in the adult. Thus **all vertebrates are chordates but all chordates are not vertebrates**. Besides the basic chordate characters, vertebrates have a ventral muscular heart with two, three or four chambers, kidneys for excretion and osmoregulation and paired appendages which may be fins or limbs.
- In these animals, notochord is **completely** or partially replaced by cartilaginous or bony **vertebral column**.
- Brain is covered by a protective covering. It is made up of **bones** or **cartilage**, it is called **cranium**.
- There is a prominent head and a well developed and complicated **brain, spinal cord remains enclosed** within the **vertebral column**.

Sub-phylum Vertebrata is further divided into two divisions :-

(a) Agnatha
(b) Gnathostomata
(a) Agnatha – Jawless vertebrates :

- Agnatha is further divided into two classes
 - (i) Class – Ostracodermi (ii) Class – Cyclostomata
- (i) Class – Ostracodermi**
 - All the members of this class are **extinct**. These were **freshwater fishes** which were **first vertebrates**.
 - Their body was covered by a protective covering made up of hard scales.
e.g. :- Cephalaspis.
- (ii) Class – Cyclostomata**
 - This class includes **Jaw less fishes (false - fishes)**.
 - Most of the members of this class are marine but migrate for spawning to fresh water. After spawning within few days they die. Their larvae, after metamorphosis, return back to Ocean.
 - All living members of the class cyclostomata are **ectoparasite** on some fishes.
 - They have elongated body bearing **6-15 pairs** of gill slits for respiration.
 - They have a sucking and circular mouth **without jaws**.
 - **Scales and paired fins are absent**.
 - Notochord and vertebral column both are present. Cranium and vertebral column are cartilaginous. Bones are absent.

- Circulation is closed type, Heart is two - chambered. It is called **Venous - heart**.
- Kidneys are **protonephric** or **mesonephric** type.
- Internal ear present for balancing.
- Animals **unisexual**, fertilization **external**, larval stage absent. Except **Ammocoete** larva is found during development of **Petromyzon**.



- e.g. 1. *Petromyzon* or *Lamprey* :-** It is an ectoparasite (Sanguivorous) on true fishes. Many teeth are found in mouth and it shows **Anadromous** migration. Its larva is **Ammocoete**. This Ammocoete larva is considered as **connecting link** between Cephalochordata and Cyclostomata.
- 2. *Myxine* or *Hag fish* :-** It has wrinkled lips just like an old woman. It usually remains attached with the gills of host.

(b) Gnathostomata :

(I) Super Class – Pisces

- This super class includes **true fishes**.
- Study of fishes is **Ichthyology**.
- 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 (Mesodermal origin) 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 and middle ears are absent, only internal ear is present which works as statoreceptor. (For balancing)
- Respiration **by gills**, 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 :-

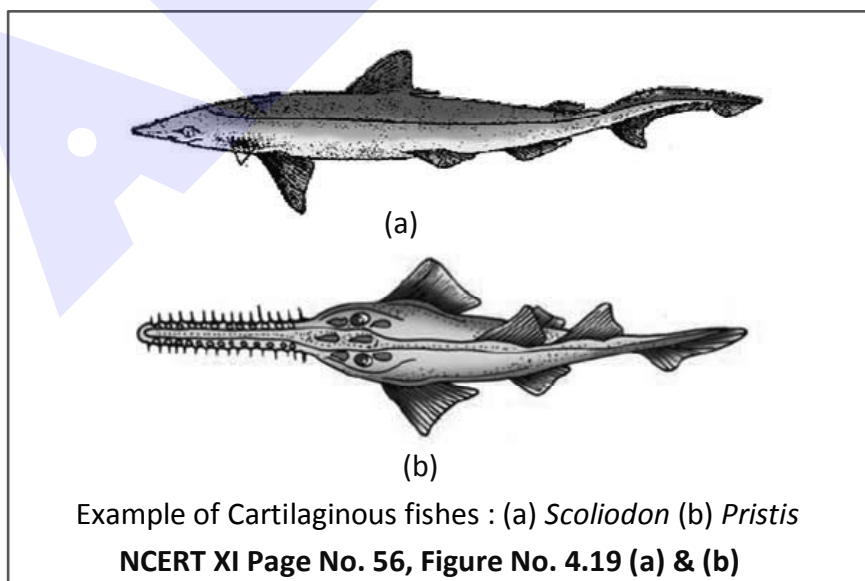
(i) Placodermi (ii) Chondrichthyes (iii) Osteichthyes

(i) **Class – 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

(ii) **Class – Chondrichthyes or Elasmobranchi :**

- This class includes **cartilaginous fishes**.
- They are exclusively marine.
- Endoskeleton is made up of **cartilage**. Notochord is persistent through out the life.
- Exoskeleton over the skin is made up of **placoid** scales. Teeth are modified placoid scales, which are backwardly directed.
- In these fishes, **5 - 7 pairs** of gills are present, which open directly outside the body by gill slits. operculum is normally absent in these fishes.
- Mouth is present at the **ventral surface** of head. Jaws are very powerful. These fishes are **predaceous**.
- Due to absence of air - bladder they have to swim constantly to avoid sinking.
- A **spiral valve** or **scroll valve** is found in intestine (To increase absorptive surface area).
- Cloacal aperture is present. Genital ducts open into cloacal aperture.
- There is a special structure at the dorsal surface of head in these fishes, which is called "**Ampulla of Lorenzini**", which works as **electroreceptor organ**.
- Male fishes have "**Claspers**" as copulatory organs, which are developed on pelvic fins.
- They have internal fertilisation and many of them are **Viviparous**.

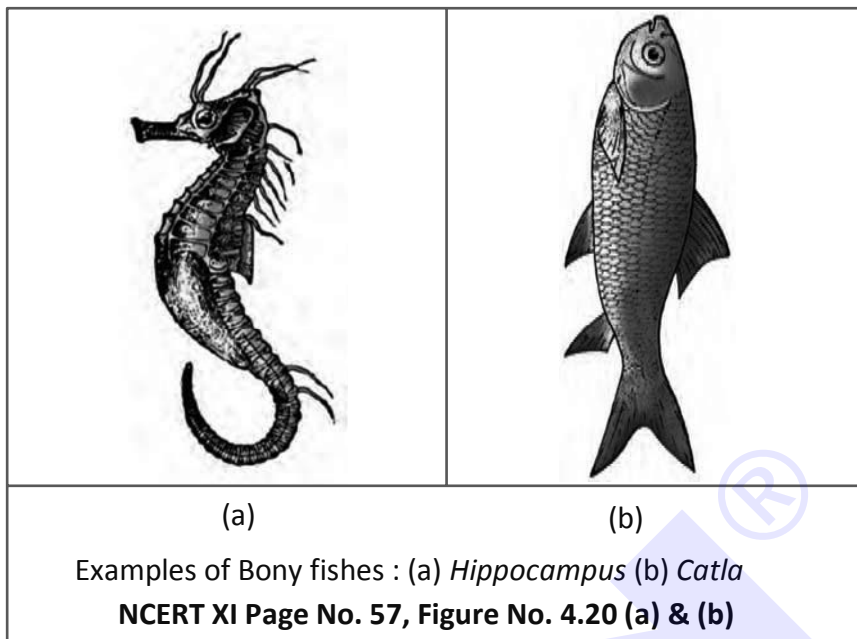


e.g. :-

- **Scoliodon** :- Dog fish or common Indian shark - Dog like sense of smell. It is **viviparous**
- **Pristis** :- Saw - fish
- **Trygon** :- Sting ray - Its dorsal fin has poisonous spines.
- **Torpedo** :- **Electric ray** - In this fish an electric organ is found which is a modified muscle, it can give shock averaging 100–400 volts.
- **Carcharodon** – Great white shark
- **Chimaera** :- "Rat fish" or "King of herrings" or Ghost fish. Connecting link between bony & cartilaginous fish. Operculum present and cloaca absent like in bony fishes.

(iii) Class – Osteichthyes or Teleostomi :

- This class includes **Bony fishes**.
- They are found in fresh water as well as marine water.
- **Endoskeleton** is made up of **bones**, so these fishes are called "**Bony - fishes**"
- Their **exoskeleton** is made up of scales, which may be **Cycloid** or **Ctenoid** or **Ganoid** type. (**Placoid** scales absent).
- Respiration by **4 - pairs** of gills. These gills are covered by **operculum** at each side of body.
- Mouth is normally terminal or sub-terminal.
- Air bladder present which regulate buoyancy.
- Scroll valve in intestine is absent.
- Cloaca absent, in place of cloacal aperture **anus** is present. Genital ducts open outside the body through separate apertures.
- Ampulla of Lorenzini is absent.
- Fertilization is **usually external**, **claspers** are absent in male fishes.
- They are mostly **oviparous**.



e.g.

- ***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.
- ***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.
- ***Labeo*** :- "Rohu" or "Indian carp" (fresh water fish).
- ***Clarias*** :- "Cat fish" or Magur (Fresh water)
- ***Catla*** – Katla (Fresh water)
- ***Betta*** – Fighting Fish (Aquarium fish)
- ***Pterophyllum*** – Angel Fish (Aquarium fish)
- ***Latimeria or coelacanth*** – Living fossil or oldest living vertebrate known till now.
- ***Gambusia*** – Larvivorous fish and is viviparous.
- ***Wallagonia*** :- Lachi (scale less)

★ 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.

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

- 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
- *Neoceratodus* :- Australian lung fish.



BEGINNER'S BOX

CYCLOSTOMATA AND PISCES

1. Which of the following is the larva of *Petromyzon* ?
 (1) Ammocoete (2) Trochophore (3) Tadpole (4) Tornaria
2. Circular and suckorial mouth is present in :-
 (1) *Labeo* (2) *Petromyzon* (3) *Scoliodon* (4) All the above
3. Jaw less fishes are included in :-
 (1) Chondrichthyes (2) Osteichthyes (3) Cyclostomata (4) Lung fishes
4. Air bladder is present in :-
 (1) Dog fish (2) Flying fish (3) Hag fish (4) Electric fish
5. Ampulla of Lorenzini are found in :-
 (1) *Scoliodon* (2) *Labeo* (3) *Rattus* (4) *Hippocampus*
6. Which of the following fish is a connecting link between cartilaginous and bony fishes
 (1) *Chimaera* (2) *Betta* (3) *Latimaria* (4) Whale
7. American lung fish is :-
 (1) *Scoliodon* (2) *Lepidosiren* (3) *Protopterus* (4) *Pristis*
8. Which of the following are viviparous usually :-
 (1) Lung fishes (2) Frog (3) Sharks (4) Bony fishes
9. "King of Herrings" is a common name of :-
 (1) *Scoliodon* (2) *Chimaera* (3) *Torpedo* (4) *Trygon*
10. The fish that swims vertically :-
 (1) *Scoliodon* (2) *Hippocampus* (3) *Exocoetus* (4) *Trygon*

(II) **Tetrapoda** :- It divides into 4 classes :

- (i) Amphibia (ii) Reptilia (iii) Aves (iv) Mammalia

(i) **Class – Amphibia** :

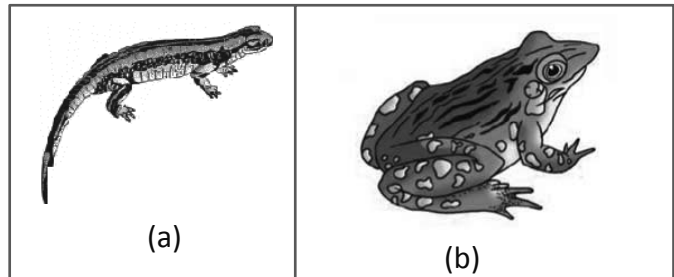
- **Carboniferous** period is the golden age of Amphibians
- As the name indicates (Gr., Amphi : dual, bios, life), amphibians can live in aquatic as well as terrestrial habitats (Never found in marine water).
- These are the first chordate animals which came out of water but these are not able to live on land permanently, They depend on water for their reproduction. Their eggs do not have protecting covering to check the evaporation.

- These animals undergo **hibernation** or **aestivation** to prevent themselves from extreme cold and heat and to overcome unfavourable conditions.
- Body is divided into **head & trunk**. Tail may be present in some. Neck is totally absent.
- Skin is **moist, smooth** and **scale less**.
- Numerous **mucus glands** are found in skin which help in the moistening of skin. So these animals respire mainly through moist skin (**Cutaneous respiration**).
- Most of them have two pairs limbs. Forelimbs have four fingers and hindlimbs have five fingers.
- Mouth is bigger in size. Upper or both the jaws have teeth. Teeth are **pleurodont**, **homodont** and **polyphyodont**. (Frog - Acrodont)
- A well developed and complete alimentary canal along with digestive glands are present in digestive system (Salivary glands are absent in frog).
- Alimentary canal, urinary bladder and genital ducts open into a common chamber called **cloaca**, which opens to the exterior.
- Respiration by **gills, skin, lungs** or **buccopharyngeal** cavity.
- 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.
- 1 pair of kidneys are **mesonephric** or **opisthonephric** type. They are mostly **Ureotelic**. But tailed amphibians and larvae are **Ammonotellic**.
- Skull has two occipital condyles (**dicondylic skull**).
- A tympanum represent the ear. Only one ear ossicle **columella (stapes)** is present in middle ear.
- Eyes have eyelids.
- Cranial nerves are **10 - pairs**.
- Sexes are separate.

- Fertilization is **external** and takes place in the **water**, but some animals show **internal** fertilization.
- These are **oviparous**, which lay their eggs in water.
- Development is **indirect** through larva

i.e. **Tadpole larva** - In Frog,
Axolotl larva - In Salamander
 Iodine is necessary for metamorphosis.

Eg. **Ichthyophis** – Limbs absent
Salamandra – Salamander
Rana tigrina – Indian bull frog
Bufo - Common toad
Hyla - Tree frog



Examples of Amphibia : (a) *Salamandra* (b) *Rana*
 NCERT XI Page No. 57, Figure No. 4.21 (a) & (b)



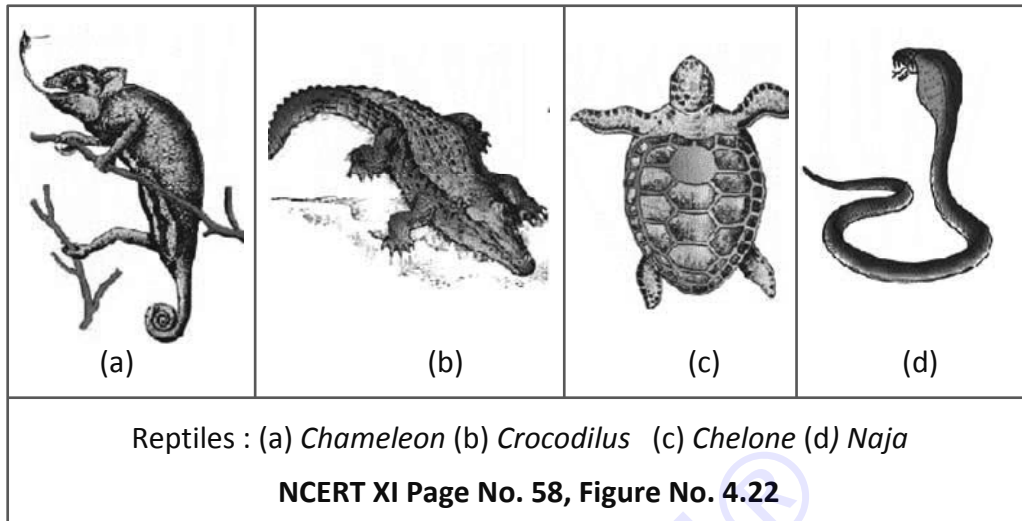
BEGINNER'S BOX

AMPHIBIA

- Amphibians have :-
 - (1) Three chambered heart
 - (2) Four chambered heart
 - (3) Open circulation
 - (4) Two chambered heart
- The amphibians are characterized by :-
 - (1) Only aquatic habit
 - (2) Monocondylar skull
 - (3) Scaleless, smooth moist and glandular skin
 - (4) Scaly and non-glandular skin
- Tree frog is –
 - (1) *Salamandra*
 - (2) *Hyla*
 - (3) *Alytes*
 - (4) *Ichthyophis*
- Rana tigrina* is scientific name of
 - (1) Tree frog
 - (2) Common toad
 - (3) Indian bull frog
 - (4) Sting ray
- Terrestrial amphibians are :-
 - (1) Ammonotelic
 - (2) Ureotelic
 - (3) Uricotelic
 - (4) Excrete TMAO

(ii) Reptilia :

- Class name refers to creeping or crawling mode of Locomotion. (Latin reptum - To creep or Crawl)
- 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**. (Snakes are limbless)
- A complete alimentary canal is found in these animals, which opens into cloaca.
- Teeth are **acrodont, pleurodent** and **thecodont** type. Tongue 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 truncus 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. (absent in snakes)
- 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.
- 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.



e.g. *Chelone* (Turtle), *Testudo* (Tortoise), *Chameleon* (Tree lizard), *Calotes* (Garden lizard), *Crocodilus* (Crocodile), *Alligator* (Alligator), *Hemidactylus* (Wall lizard), *Poisonous snakes* – *Naja* (Cobra), *Bangarus* (Krait), *Vipera* (Viper), Non poisonous snakes - *Eryx*, python and rat 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. (●● - shaped - $\begin{matrix} \bullet & \bullet \\ \bullet & \bullet \end{matrix}$ Non poisonous)

Phrynosoma – Horned toad (viviparous)

Draco – Flying lizard.

Vipera - Viper snake : Viviparous snake. Its venom is **haemotoxic/Cardiotoxic**.

<i>Bangarus</i>	-	Krait : Poisonous snake (neurotoxic).
<i>Naja naja</i>	-	Indian cobra . Poisonous snake (Neurotoxic).
<i>Hydrophis</i>	-	Marine, deadly poisonous , tail is laterally compressed and viviparous snake.
<i>Crotalus</i>	-	It produces a characteristic rattling sound of "Rate - rate- rate", so it is called rattle snake . It is poisonous and ovoviviparous snake.
<i>Python</i>	-	Ajgar , the largest non-poisonous snake (25 feet). Rudiments of hind limbs are found on the body.
<i>Ptyas mucosus</i> or <i>Zamenis</i>	-	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.
<i>Eryx Johni</i>	-	Sand boa, Dumuhi , a non-poisonous snake.



BEGINNER'S BOX

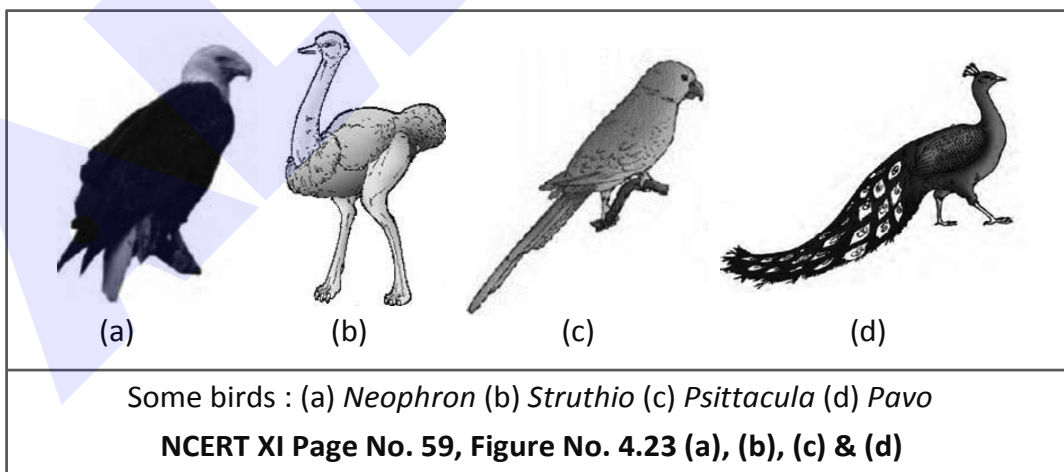
REPTILIA

- Non poisonous snake is:-
(1) *Python* (2) *Vipera* (3) *Naja* (4) *Bongarus*
- Which of the following is a non poisonous snake:-
(1) Cobra (2) *Eryx* (3) Viper (4) Krait
- Group amniota includes:-
(1) Birds and mammals (2) Birds and reptiles
(3) Mammals and reptiles (4) Reptiles, birds and mammals
- Which of the following pair is unmatched for the animals of Reptilia class :-
(1) Temperature constant and external fertilisation
(2) Sexes separate and lack of Metamorphosis
(3) 12 pairs cranial nerves and rough skin
(4) Skull monocondylic and skin with scales
- In which of the following tympanum is absent:-
(1) Birds (2) Frogs (3) Lizards (4) Snakes
- Number of cranial nerves in a reptile :-
(1) 8- pairs (2) 10- pairs (3) 12- pairs (4) 14- pairs
- Chelone belongs to:-
(1) Amphibia (2) Reptilia (3) Protochordates (4) Fishes
- Flying lizard is –
(1) *Chameleon* (2) *Draco* (3) *Exocetus* (4) *Varanus*
- Poikelothermic amniotes are :-
(1) Birds (2) Amphibians (3) Reptiles (4) Mammals
- Tree lizard :-
(1) *Calotes* (2) *Chameleon*
(3) *Hemidactylus* (4) *Chelone*

(iii) **Class – Aves :**

- 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)
- Body is boat shaped. It is divided into **head, neck, trunk** and **tail**. Neck is **long** and **flexible**.
- The characteristic features of birds are **presence of feathers** all over the body and most of them can fly except flightless bird. Feathers keep them warm and also make body weight light. Feathers are modification of epidermal scales.
- 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.
- Forelimbs are modified into wings, which help in flying.
- Hind limbs are best adapted for clasping the branches of trees or for perching or for walking swimming. Scales are found only on hind limbs.
- Digestive tract has additional chambers - the **crop** and **gizzard**.
- **Oesophagus** is modified into **Crop** for quick food ingestion and storage and **Gizzard** for crushing the food which is swallowed unmasticated. **Pigeon** or **crop milk** is secreted by **both sexes** (Crop product).
- 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 **syrix**.
- Heart is four **chambered**. Double circulation is found.
- 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**.

- 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.
- 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.
- 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.
- Fertilization is **internal**. They are oviparous and development is direct.
- 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**"
 3. ***Struthio*** - African ostrich or Camel-bird - It is the **largest living bird** of modern period. It is almost 8 feet in height. (Largest eggs).
 4. ***Rhea*** - American ostrich.
 5. ***Apteryx*** - Kiwi - It is National bird of New Zealand.
 6. ***Dromaeus***- Emu – Flightless bird of Australia.
 7. ***Pavo*** - Peacock - It is the national bird of India.
 8. ***Psittacula*** - Indian parrot (Upper jaw movable)
 9. ***Columba*** - Blue rock pigeon - Its crop glands secrete pigeon milk
 10. ***Neophron*** - Vulture (Scavenger bird)
 11. ***Corvus*** - Crow
 12. ***Passer domesticus*** - Sparrow - It shows commensalism with man.
 13. ***Helena*** - Humming bird or sunbird. It is the smallest flying bird. It can fly in forward and backward both the directions. It can fly like helicopter.



BEGINNER'S BOX

AVES

1. Characteristic of birds is:-

(1) Unisexual and sexual dimorphism absent	(2) Bisexual and sexual dimorphism absent
(3) Unisexual and sexual dimorphism present	(4) Bisexual and sexual dimorphism present
2. 'Pecten' is a structure found in the eyes of:-

(1) Reptiles	(2) Fishes	(3) Birds	(4) Mammals
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3. Fercula / wish bone is characteristic of :-

(1) Snakes	(2) Lizard	(3) Birds	(4) Monotremes
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4. Which of the following group of animals have monocondylar skull:-

(1) Amphibia & mammals	(2) Reptilia & mammals
(3) Aves & mammals	(4) Reptilia & aves
5. *Archaeopteryx* shows the characters of:-

(1) Reptiles and birds	(2) Reptiles and mammals
(3) Birds and mammals	(4) Fishes and amphibia
6. Birds differ from reptiles in which one of the following character:-

(1) Skin has scales	(2) They lay eggs
(3) They are vertebrates	(4) There is regulation of body temperature

(iv) Class - Mammalia :

- **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**.
- They have two pairs of limbs, adapted for walking, running, climbing, burrowing, swimming or flying.
- The most unique mammalian characteristic 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)
- Limbs are **pentadactyl**. **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/Sloth** 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**.
- Development is direct.
- 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.

Eg. **Ornithorhynchus** (Duck-billed platypus) (Prototherians or Monotremes), male platypus has poisonous gland.

Macropus – Kangaroo (Metatherians or Marsupials)

Pteropus (Flying fox)

Camelus (Camel)

Macaca (Monkey)

Rattus (Rat)

Canis (Dog)

Felis (Domestic cat)

Panthera leo (Lion)

Panthera tigris (Tiger)

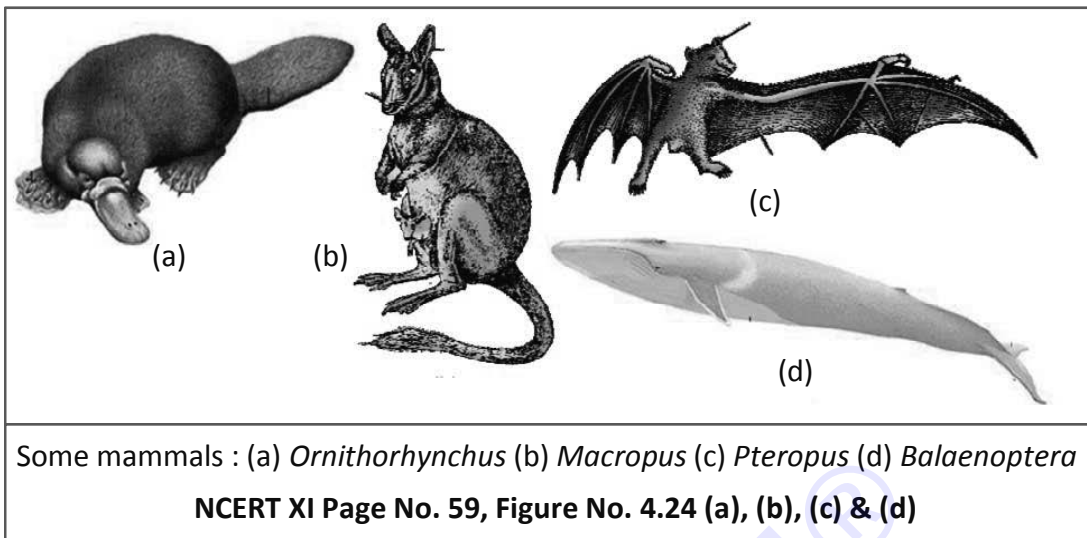
Delphinus (Common dolphin)

Balaenoptera musculus - (Blue whale)

Elephas (Indian elephant)

Equus (Horse)

Eutherians



BEGINNER'S BOX

MAMMALIA

- Which of the following animal has poison glands:-
 (1) Male platypus (2) Female lizard (3) Male rabbit (4) Male rat
- External ear pinna is found in:-
 (1) Reptiles (2) Mammals (3) Amphibians (4) Fishes
- Respiratory organs of whale are:-
 (1) Book lungs (2) Lungs (3) Gills (4) Skin
- Character found only in mammals:-
 (1) Homeothermy (2) Viviparity (3) Dicondylic skull (4) Muscular diaphragm



A, B, and C animals are respectively :-

- (1) Pteropus, Balaenoptera, Macropus (2) Macropus, Balaenoptera, Pteropus
 (3) Balaenoptera, Pteropus, Macropus (4) Balaenopter, Macropus, Pteropus
- A trait is found in all mammals :-
 (1) Muscular diaphragm (2) Mammary glands
 (3) 4 chambered heart (4) All
- Which is viviparous (give birth to young ones) ?
 (1) Kangaroo, Dolphin (Delphinus), flying fox (Pteropus), Blue whale
 (2) Lion, Bat, Whale, Ostrich
 (3) Platypus, Penguin, Bat
 (4) Shrew, Bat, Cat, Corvus


BEGINNER'S BOX
ANSWERS KEY
BASIS OF CLASSIFICATION

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	1	2	2	1	2	4	2	3	2	2

PROTOZOA

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	3	2	1	1	1	3	1	1	1	1

PORIFERA

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	4	2	1	1	2	1	3	2	2	1

COELENTERATA AND CTENOPHORA

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	1	2	2	4	1	2	1	2	2	3

PLATYHELMINTHES

Que.	1	2	3	4	5	6	7
Ans.	3	1	2	1	1	4	2

NEMATHELMINTHES

Que.	1	2	3	4	5	6
Ans.	2	1	3	3	4	3

ANNELIDA

Que.	1	2	3	4	5	6
Ans.	2	2	1	4	1	4

ARTHROPODA

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	2	4	4	1	3	2	1	4	4	1

MOLLUSCA

Que.	1	2	3	4	5	6	7	8
Ans.	3	4	3	4	3	3	1	2

ECHINODERMATA, HEMICHORDATA

Que.	1	2	3	4	5
Ans.	4	1	2	4	2

FUNDAMENTAL CHARACTERS OF CHORDATA

Que.	1	2	3	4	5
Ans.	2	4	4	4	4

PROTOCHORDATA

Que.	1	2	3	4	5
Ans.	3	1	2	2	3

CYCLOSTOMATA AND PISCES

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	1	2	3	2	1	1	2	3	2	2

AMPHIBIA

Que.	1	2	3	4	5
Ans.	1	3	2	3	2

REPTILIA

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	1	2	4	1	4	3	2	2	3	2

AVES

Que.	1	2	3	4	5	6
Ans.	3	3	3	4	1	4

MAMMALIA

Que.	1	2	3	4	5	6	7
Ans.	1	2	2	4	1	4	1