Biology

Target : Pre-Medical

Study Material for PRE-MEDICAL
(Distance Learning Programme)

Chapter # 02

ANIMAL KINGDOM (ANIMAL DIVERSITY)

path to success
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Contents

ANIMAL KINGDOM (ANIMAL DIVERSITY)

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AIPMT SYLLABUS

ANIMAL KINGDOM : *Salient features and classification of animals-nonchordate up to phyla level and chordate up to classes level (three to five salient features and at least two examples).*

ANIMAL KINGDOM

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. **Nomos** - Law)

Aristotle :- He is known as the **"father of zoology"**. (Book : **Historia Animalium**)

He is also known as the father of ancient taxonomy. He classified animals into two groups on the basis of the colour of blood.

(1) **Anaima** - Those animals which don't have **red blood** or in which RBC are absent in invertebrates like Sponges, Cnidaria, Mollusca, Arthropoda. Echinodermata.

(2) **Enaima** :- These animals have red blood. This group includes all vertebrates and it has been further divided into two sub groups.

(a) **Vivipara** :- It includes animals which give birth to young-ones. e.g. Mammals.

(b) **Ovipara** :- It includes animals which lay eggs. e.g. Pisces, Amphibians, Reptiles, Aves etc.

IMPORTANT PHYLA

1.	**Protozoa (Included in kingdom - Protista)**	-	e.g. ***Amoeba*** , ***Paramoecium*** etc.
2.	**Porifera (Kingom - Animalia)**	-	Sponges
3.	**Coelenterata/Cnidaria**	-	***Hydra,*** Jellyfish etc.
4.	**Ctenophora** (minor phylum)	-	***Pleurobrachia***
5.	**Platyhelminthes**	-	Flat worms (eg : Tape worm)
6.	**Nemathelminthes/Aschelminthes**	-	Round worm (eg : ***Ascaris***)
7.	**Annelida**	-	Earthworm , Leech etc.
8.	**Arthropoda**	-	Insects , Scorpion , Fly etc.
9.	**Mollusca**	-	Snail, ***Pila***, ***Octopus*** etc.
10.	**Echinodermata**	-	Star fishes
11.	**Hemichordata**	-	***Balanoglossus***
12.	**Chordata**	-	Fish, Snake, Birds, Monkey etc.

BASIS OF CLASSIFICATION

Level of body organisation :-

Protoplasmic level → In protozoans, acellular body performs all biological activities

↓

Cellular level → In sponges, cells are arranged as loose cell aggregates and division of labour occurs among cells (Tissues absent)

↓

Tissue level → In coelenterates and ctenophores, cells performing the same function are arranged into tissues

↓

Organ level → In platyhelminthes and Other higher phyla tissues are grouped together to form organs.

↓

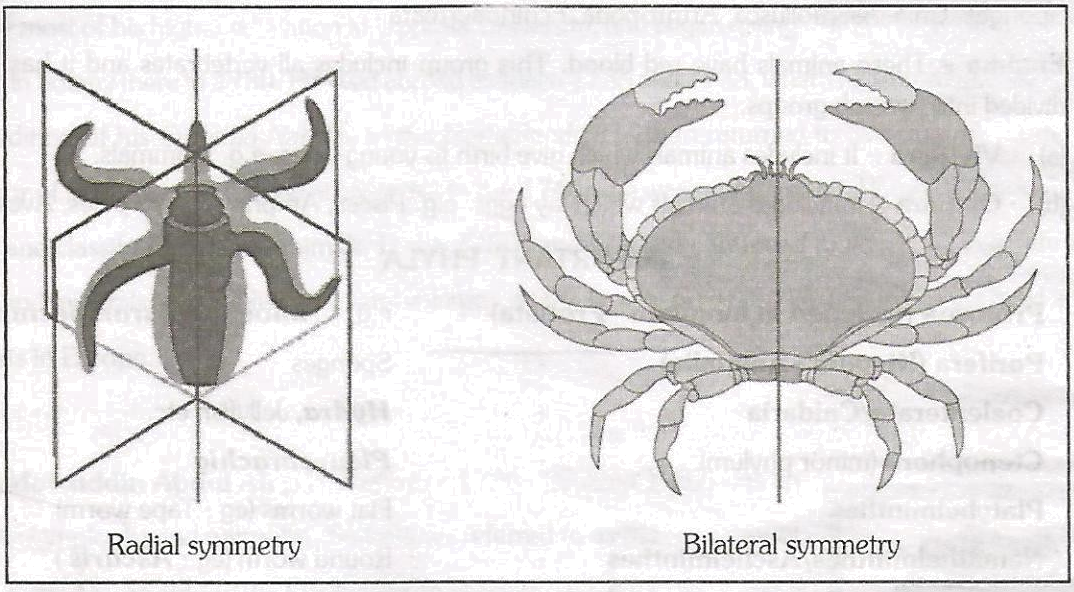
Organ system level → In higher animals, organs further organise to form organ systems e.g. Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Chordata

2. **Symmetry :**

(a) **Asymmetry :-** When any plane that passes through the centre does not divide the body of animals i two equal halves
e.g : most of the sponges are asymmetrical.

(b) **Radial symmetry :** When any plane passing through the central axis of the body divide the animal two identical halves
e.g : Coelenterates, Ctenophores and Echinoderms (adult)

(c) **Bilateral symmetry :** When the body can be divided into identical left & right halves in only one pla
e.g : Platyhelminthes to Chordates.

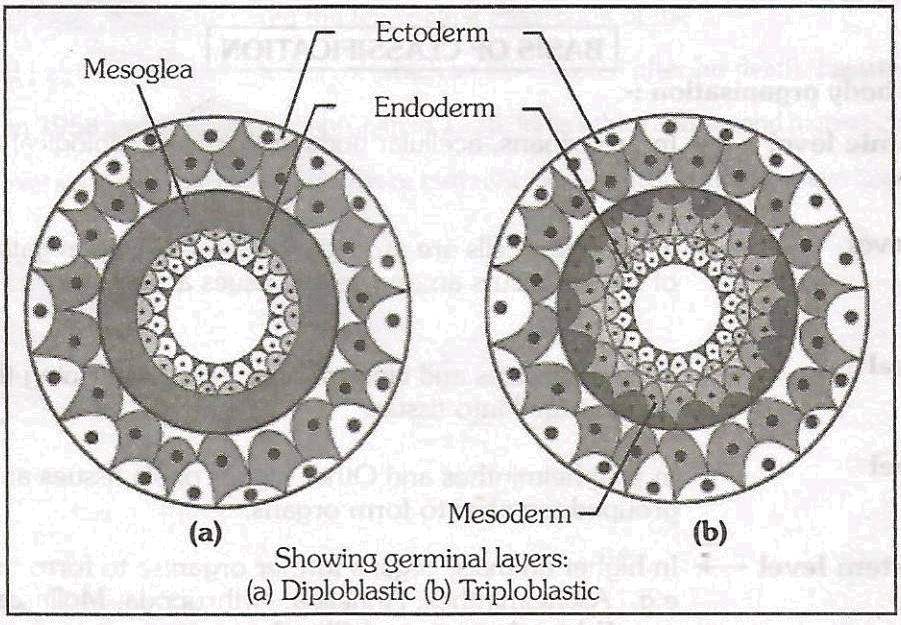


Radial symmetry Bilateral symmetry

3. **Germinal layers :-**

(a) **Diploblastic –** Animals in which the cells are arragned in two embryonic layers **ectoderm** and **en derm** with an interveining undifferentiated mesoglea e.g. Sponges, Coelenterates and Ctenophor

(b) **Triploblastic –** Those animals in which the developing embryo has a third germinal layers–**Mesod** in between the ectoderm and endoderm e.g. Platyhelminthes to Chordates.



Showing germinal layers:
(a) Diploblastic (b) Triploblastic

Body Cavity or Coelom :- Presence or absence of a cavity between the body wall and gut wall is very important in classification.

(a) **Acoelomates –** Animals in which the body cavity is absent

e.g. Platyhelminthes

(b) **Pseudocoelomates –** Animals in which 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.

e.g. Aschelminthes.

(c) **Coelomates –** Animals possessing coelom i.e. the body cavity which is lined by mesoderm on all sides

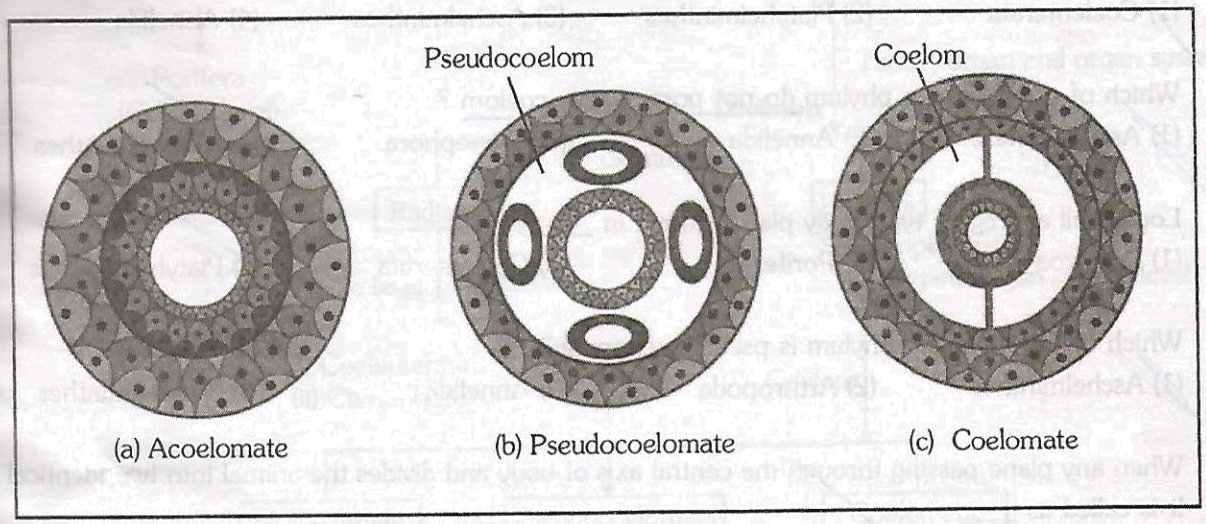
- On the basis of embryonic development, the coelom is of two types

(i) **Schizocoel** – Coelom formed by splitting of a mesodermal mass

e.g. Annelida, Arthropoda, Mollusca.

(ii) **Enterocoel** – Coelom formed by fusion of gut pouches during embryonic stage

e.g. Echinodermata, Hemichordata and Chordata.



Body plan :

(a) **Cell-aggregate type** e.g. Sponges

(b) **Blind Sac type :-** Animals in which digestive system is incomplete, 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 seperate openings mouth and anus.

e.g. Nemathelminthes to Chordates

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, this is called **metameric segmentaion** and the phenomenon is known as **Metamerism.**

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 Hemichordata

(b) **Chordates –** Animals with notochord. eg. Phylum Chordata

8. **Circulatory system :-**

(a) **Open type –** In which the blood remain filled in tissue spaces due to absence of blood capillaries. e
Arthropods, Molluscs, Echinoderms, Hemichordates and some lower Chordates like tunicates

(b) **Closed type –** In which the blood is circulated through a series of vessels of varying diameters i
arteries, veins and blood capillaries
e.g. Annelids, Cephalopod molluscs, Vertebrates etc.

9. **Embryonic development :** On the basis of fate of blastopore, animals can be divided into two categorie

(a) **Protostomiates :** Animals in which mouths is formed first (Blastopore → Mouth)
e.g. Platyhelminthes to Mollusca

(b) **Deuterostomiate :** Animals in which anus is formed earlier than mouth (Blastopore → Anus)
e.g. Echinoderms, Hemichordates and Chordates.

BEGINNER'S BOX-1

1. Which of the following phylum have radially symmetrical organisms ?
(1) Coelenterata (2) Platyhelminthes (3) Aschelminthes (4) Annelida

2. Which of the following phylum do not possess true coelom ?
(1) Aschelmithese (2) Annelida (3) Ctenophora (4) Platyhelminthes

3. Loose cell aggregate type body plan is found in _____.
(1) Protozoa (2) Porifera (3) Coelenterata (4) Platyhelmenthes

4. Which of the following phylum is pseudocoelomate ?
(1) Aschelminthes (2) Arthropoda (3) Annelida (4) Platyhelminthes

5. When any plane passing through the central axis of body and divides the animal into two identical ha
It is called as _____.
(1) Assymmetry (2) Radial symmetry (3) Bilateral symmetry (4) Biradial symmetry

6. Which of the following phylum have "Tube within tube" body plan ?
(1) Platyhelminthes (2) Coelenterata (3) Porifera (4) Nemathelminthes

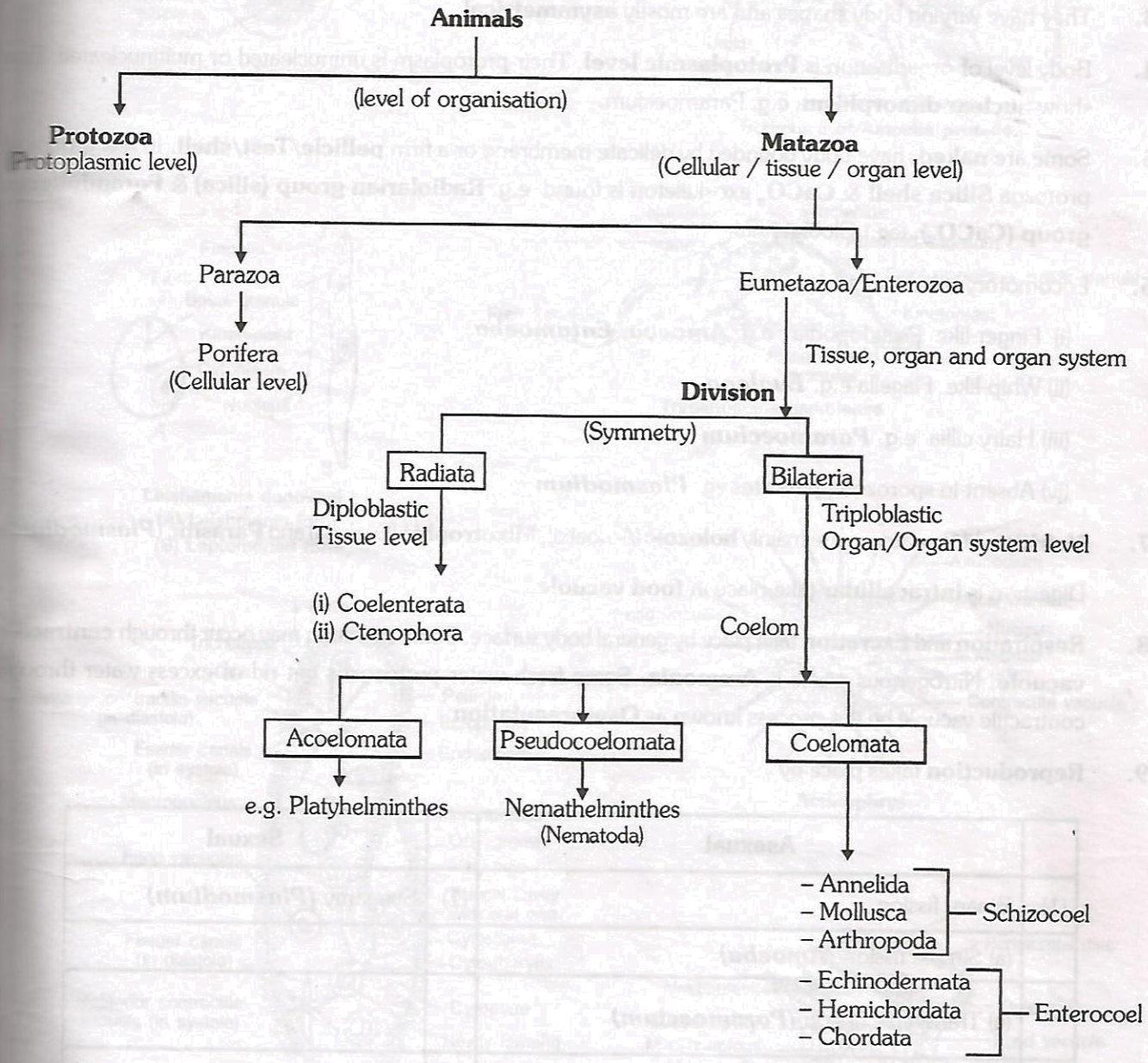
7. Which of the following phylum has closed circulatory system ?
(1) Arthropoda (2) Annelida (3) Mollusca (4) Echinodermata

8. Segmentation is found in :-
(1) Annelida, Arthropoda, Mollusca (2) Arthropoda, Mollusca, Echinoderms
(3) Annelida, Arthropoda, Chordata (4) Arthropoda, Echinoderms, Chordata

9. Which of the following group is Duterostome–
(1) Annelida, Arthropoda, Mollusca (2) Echinodermata, Hemichordata, Chordata
(3) Annelida, Mollusca, Chordata (4) Arthropoda, Mollusca, Echinodermata

10. Incomplete digestive tract found in -
(1) Platyhelminthes and Aschelminthes (2) Platyhelminthes and Ctenophora
(3) Aschelminthes and Anelida (4) Coelenterates and Aschelminthes

OUTLINE OF ANIMAL CLASSIFICATION



PHYLUM - PROTOZOA (KINGDOM-PROTISTA)

1. It is **3rd largest phylum**. In includes unicellular eukaryotes where one celled body perform all the biologi activities like multicellular animals. So they are termed as **"Acellular"** organism, proposed by **Dobell**.

2. They are worldwide, cosmopolitan, **microscopic**, mostly **aquatic, free living** (***Amoeba***) or **parasi** ***(Plasmodium)***, solitary or colonial ***(Proterospongia)***. These cause serious diseases.

3. They have varying body shapes and are mostly **asymmetrical.**

4. Body level of organisation is **Protoplasmic level**. Their protoplasm is uninucleated or multinucleated. F show **nuclear dimorphism**. e.g. Paramoecium.

5. Some are **naked,** have body bounded by delicate membrane or a firm **pellicle/Test/shell.** In few groups protozoa **Silica shell** & **$CaCO_3$** exoskeleton is found. e.g. **Radiolarian group (silica)** & **Foraminifera group ($CaCO_3$)**. (eg : Globigerina)

6. Locomotory structures are

   (i) Finger-like Pseudopodia e.g. ***Amoeba, Entamoeba***

   (ii) Whip-like Flagella e.g. ***Euglena***

   (iii) Hairy cillia e.g. ***Paramoecium***

   (iv) Absent in sporozoan parasites eg. ***Plasmodium***

7. **Nutrition** of Protozoans are mainly **holozoic** (Amoeba), **Mixotrophic** (Euglena) and **Parasitic** (***Plasmodium***

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

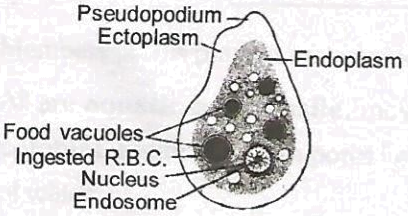
8. **Respiration** and **Excretion** take place by general body surface. Some excretion may occur through **contracti vacuole**. Nitrogenous waste is **Ammonia**. Some fresh water protozoans get rid of excess water throug contractile vacuole by the process known as **Osmoregulation**.

9. **Reproduction** takes place by

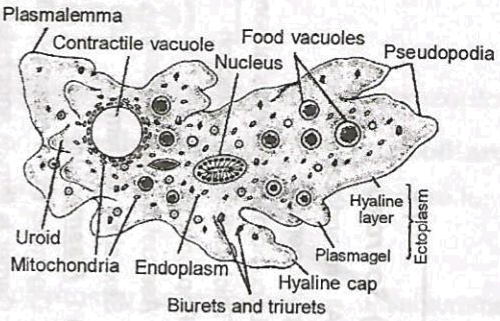
	Asexual		**Sexual**
(1)	Binary fission	(1)	Syngamy ***(Plasmodium)***
	(a) Simple fission ***(Amoeba)***		
	(b) Transverse fission ***(Paramoecium)***		
	(c) Longitudinal fission ***(Trypanosoma, Euglena)***		
(2)	Multiple fission ***(Plasmodium)***	(2)	Conjugation ***(Paramoecium)***
(3)	Budding ***(Ephelota / Sessile protozoan)***		

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

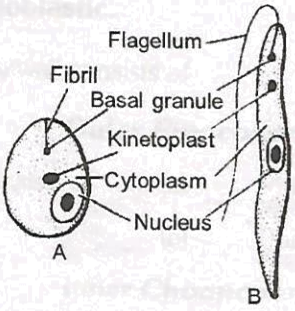
FEW COMMON PROTOZOANS



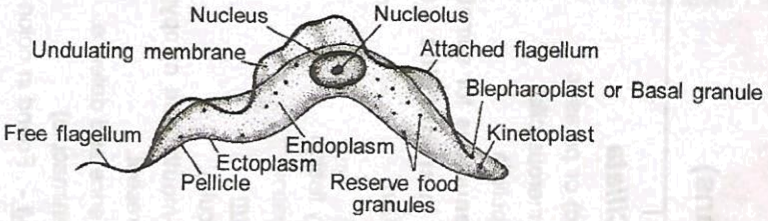
Trophozoite of Entamoeba histolytica



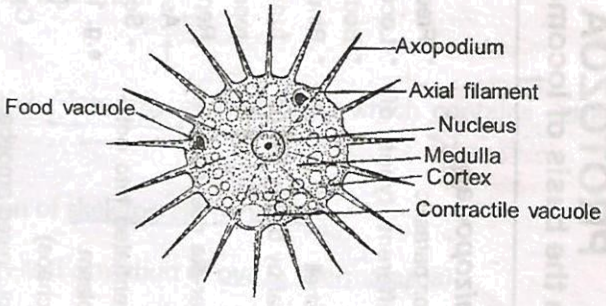
Structure of Amoeba proteus



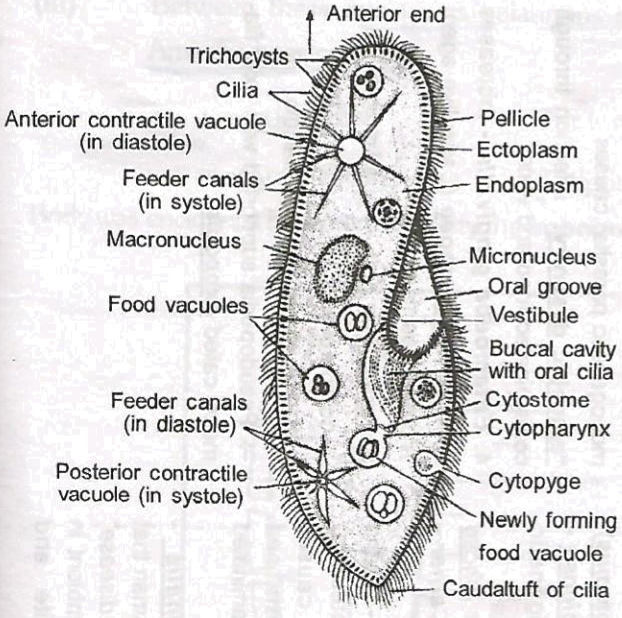
Leishamania donovani :
(A) Leishmania form,
(B) Leptomonad form



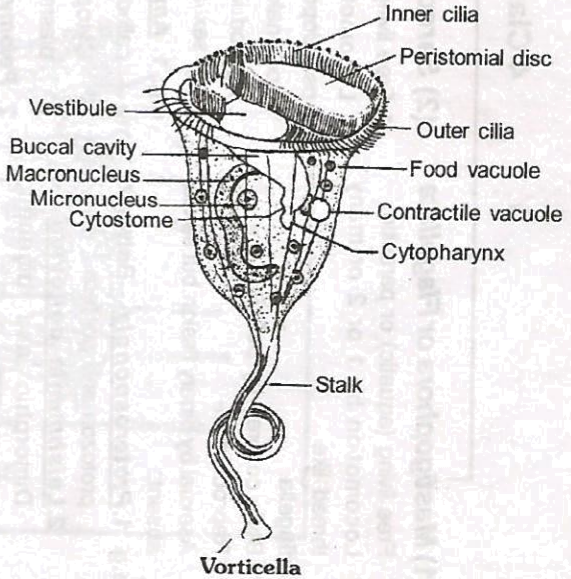
Trypanosoma gambiense



Actinophrys



Paramecium caudatum



Vorticella

PROTOZOA

4 Classes (on the basis of locomotory organs)

(1) *Mastigophora or Flagellata*

* Free living (aquatic) or parasitic
* Locomotion by 1 or 2 or many thread like flagella.
* Body covered by pellicle.
* Reproduction-
  Asexual by binary fission but sexual absent.

e.g. 1. ***Proterospongia*** - Between protozoa and porifera.

2. ***Leishmania donovani*** – Dimorphic and digenetic parasite, causes ***Kala azar* / Dum-dum fever / *Leishmaniasis*** in humans, carrier-sandfly (***Phlebotomus***)

3. ***Trypanosoma gambiense*** - Polymorphic and Digenetic parasite, causes *Sleeping sickness* or *African trypanosomiasis* , *Carrier - Tse tse fly (Glossina)*

4. ***Giardia intestinalis*** - (Grand old man of intestine) monogenetic that causes "Diarrhoea / Giardiasis" and infection through contaminated food and water.

5. ***Trichomonas vaginalis*** - Vaginal parasite of woman that causes "*Leucorrhoea disease*"

6. ***Trichonympha*** - Symbiont in intestine of termite and Cockroach

(2) *Sarcodina / Rhizopoda*

* Free living (aquatic) or parasitic
* Locomotion by different types of pseudopodia
* Body-naked or with shell
* Reproduction-Asexual by binary fission but sexual absent.

e.g. 1. ***Amoeba*** - finger-like pseudopodia called *lobopodia*

→ Cytoplasm differentiated into ectoplasm and endoplasm.

2. ***Pelomyxa*** (Chaos-chaos)

→ Largest and multinucleated amoeba.

3. ***Entamoeba histolytica*** - Dimorphic and monogenetic parasite, causes **"amoebic dysentry"**: infection through contaminated food and water

4. ***Entamoeba gingivalis*** - Increases infection of ***pyorrhoea*** (Causative agent Trichomonas tinax)

5. ***Entamoeba coli*** - Found in colon as commensal.

6. ***Actinophrys*** (Sun-animalcule)

→ Pseudopodia supported with axial filaments called ***axopodia***

(3) *Ciliata*

* Free living (aquatic) or parasitic
* Locomotion by numerous cilia
* Body covered by pellicle
* Binucleated **meganucleus** for somatic functions and **micronucelus** for reproductive function.
* Reproduction

→ Asexual by binary fission

→ Sexual by conjugation

e.g. 1. ***Paramoecium*** (slipper animalcule)

→ Cytostome (cell-mouth) and cytopyge (cell-anus) are present.

→ Trichocyst for offence and defence.

2. ***Vorticella*** (Bell animacule)

3. ***Balantidium coli*** - : Found in colon of man.

(4) *Sporozoa*

* All are endoparasite and pathogenic
* Locomotory organelles absent
* Thick pellicle for protection
* Reproduction

→ Asexual by multiple fission

→ Sexual by syngamy

eg 1. ***Plasmodium***

→ Digenetic blood parasite(malaria)

→ Carrier is female anopheles

2. ***Babesia*** - Digenetic and causes "Texas cattle fever or Red water fever" in cattles/Tick fever

→ Spread by ticks

3. ***Monocystis*** : Monogenetic, found in seminal vesicle of earthworm.

4. ***Nosema*** : Causes pebrine disease in silk worm.

KINGDOM - ANIMALIA

PHYLUM - PORIFERA (Sponges)

Members of this phylum are commonly known as **"Sponges".** Study of sponges is known as **Parazoology**. 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 ***Leucosolenia)***,

Sponges are primitive multicellular animals and have **cellular level** of organisation with two germ layer i.e. **Diploblastic.**

Body wall consists of

(i) **Outer *Pinacoderm***

–Consists of (a) Pinacocytes (Flat cell)

(b) Porocytes (oval cell)

(ii) **Inner *Choanoderm***

– Consists of collar cell or choanocytes (Flagellated)

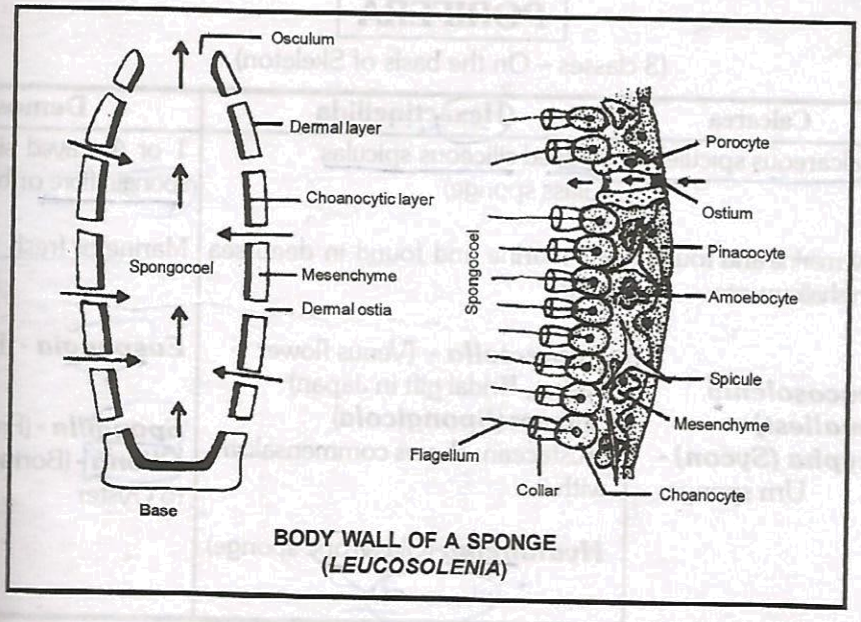
– Unique Characteristic of Porifera

(iii) Between these two layers gelatinous material *Mesenchyme* is present which contains certain Amoebocytes cells like –

✓Scleroblast – 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.



BODY WALL OF A SPONGE
(LEUCOSOLENIA)

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. Ceaselless 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 **calcarious spicules** or **siliceous spicules** or fine **spongin fibre** located in mesenchyme. ***Scleroblast*** secrete spicules and ***spongioblast*** secrete spongin fibres.

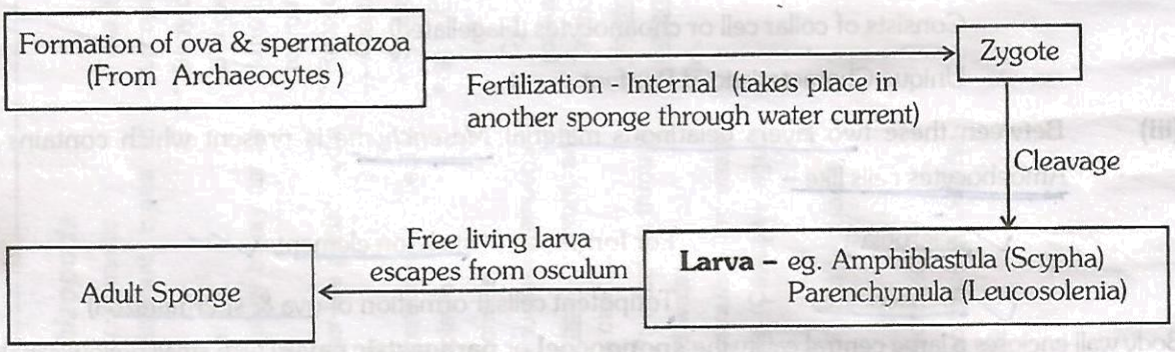
10. **Respiration** and **Excretion** takes place by diffusion of gases through body surface. Excretory matter is Ammonia.

11. **Reproduction** takes place by means of :-

(A) **Asexual** - By Budding / Fragmentation / 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 internal** and cross due to **Protogynous condition** and **development is indirect** having a larval stage which is morphologically distinct from adult.

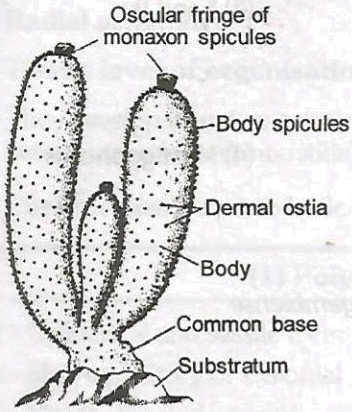


PORIFERA

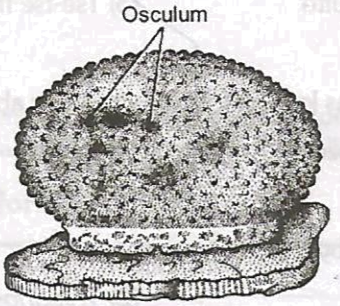
(3 classes – On the basis of Skeleton)

	Calcarea	Hexactinellida	Demospongia
Skeleton	- Calcareous spicules	6 rayed siliceous spiculas (Glass sponge)	1 or 4 rayed silicious spicules or spongin fibre or both
Habitat	- All marine and found in shallow water	All marine and found in deep sea water	Marine or fresh water sponges
e.g.	***Leucosolenia (smallest)*** ***Scypha (Sycon)*** - Urn sponge	***Euplectella*** - (Venus flower basket, Bridal gift in Japan) Shrimps (***Spongicola***) crustacean, shows commensalism with it. ***Hyalonema***-(Glass rope sponge)	***Euspongia*** - (Bath sponge) ***Spongilla*** - (Fresh water sponge) ***Cliona*** - (Boring sponge) harmful to Oyster

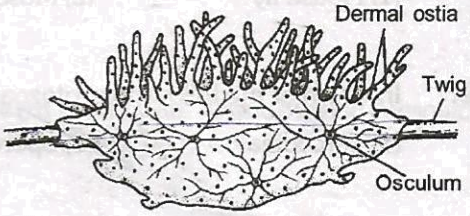
FEW COMMON SPONGES



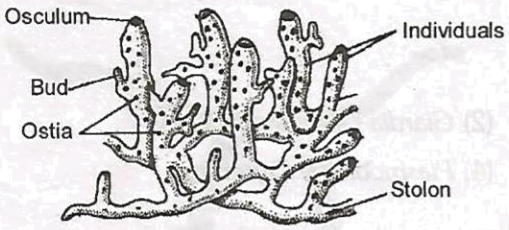
Sycon (= Scypha)



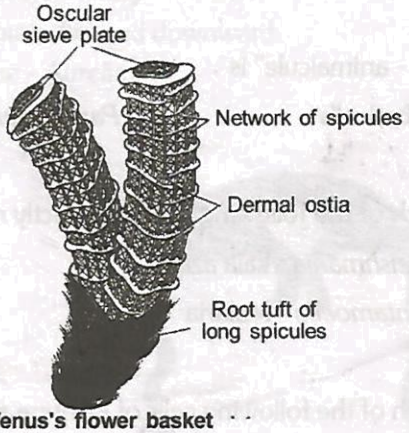
Euspongia



Spongilla around a twig



A colony of Leucosolenia

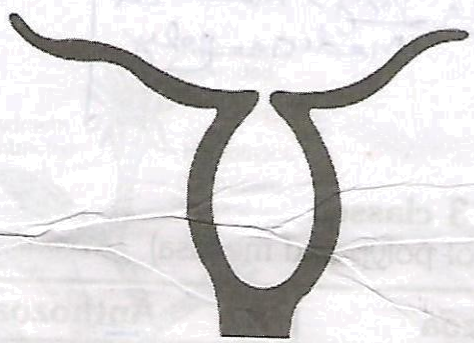


Venus's flower basket (Euplectella)

PHYLUM - CNIDARIA

- Coelenterates are also known as ***Cnidarians*** due to presence of stinging cells called ***Cnidoblast*** or ***Chidocytes.***

1. Mostly **marine**, **few fresh-water** *(Hydra.)* Carnivorous, sessile or free swimming.
2. **Radial symmetry**.
3. **Tissue level of organisation**.
4. 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.
5. Coelenterates have two basic body **forms** (Dimorphic)

(1) Polyp	(2) Medusa
- Cylindrical and sessile form - May be solitary or Colonial - Mouth directed upward - Like- Hydra, Adamsia	- Umbrella shaped and free swimming - Always solitary - Mouth directed downward. - Like - Aurelia
 *Adamsia* (Polyp)	 *Aurelia* (Medusa)

- Either or both zooids may occur in a species.
- If both are found in a species , two form alternate in life cycle, Polyps produce medusae asexully 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*** (contain stinging capsule as Nematocyst) present on the tentacles and body, which are used for **anchorage** (Attachment), **defence** and for the capture of Prey (Offence).

Diagrammatic view of Cnidoblast

Z:\NODE02\2016-17\TARGET\BIO\ENG\MODE_5\01-ANIMAL KINGDOM\V01-PROTOZOA-E.P65

- Body of some coelenterates may be covered by calcareous exoskeleton. eg. :- Corals

7. A large central cavity called **Coelenteron** is having single aperture, 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 serve both purpose.

- Coelenteron is also responsible for distribution of food besides partly digesting it. Due to this dual role named 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 consist of **non-polar neurons** (Nerve net).

11. Reproduction

– Asexual by budding

– Sexual by production of gametes

– Development is indirect with larval stages → metagenesis

– Larva of ***Obelia*** - **Planula** (free living). • la- lg. Poly - medusa / Medusa - poly

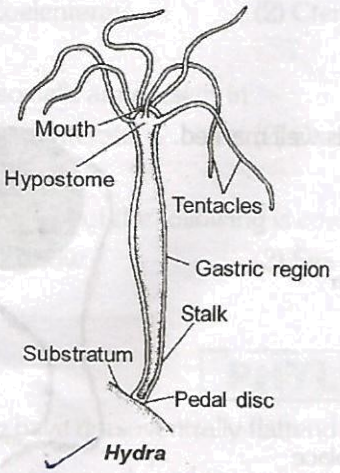
– Larva of ***Aurelia*** - **Ephyra.** → Jelly fish

Classification : 3 classes

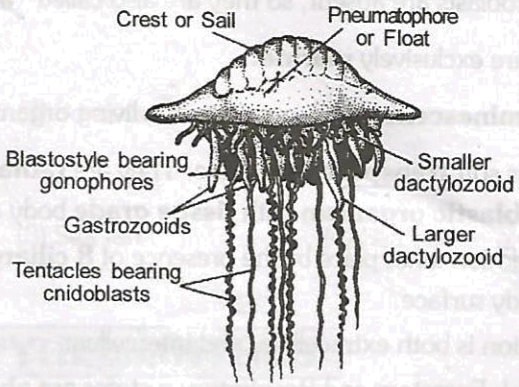
(On the basis of dominance of polyp and medusa)

Hydrozoa	Scyphozoa	Anthozoa
– Polyp & medusa often show metagenesis. e.g. ***Hydra*** - Fresh water polyp (Medusa absent) ***Obelia*** - **Sea fur**, (Polyp and Medusa shows metagenesis) ***Physalia*** - **Portuguese man-of-war.** (Neurotoxic, gas gland present)	– Medusa form is more common, polyp may be reduced or absent e.g. : ***Aurelia*** - Jelly fish, Moon jelly.	– Only polyp form dominant, medusa may be reduced or absent. This class has two types of animal (1) **Sea Anemones** (Skeleton absent) e.g. : ***Adamsia*** : ***Metridium*** – Shows commensalism with Hermit crab (2) **Coral** ($CaCO_3$ Skeleton) : ***Pennatula*** - Sea pen : ***Gorgonia*** - Sea fan : ***Meandrina*** - Brain coral : ***Tubipora*** - Organ - pipe coral : ***Alcyonium*** - Dead man's finger (Soft coral) : ***Corallium*** - Red coral (Moonga)

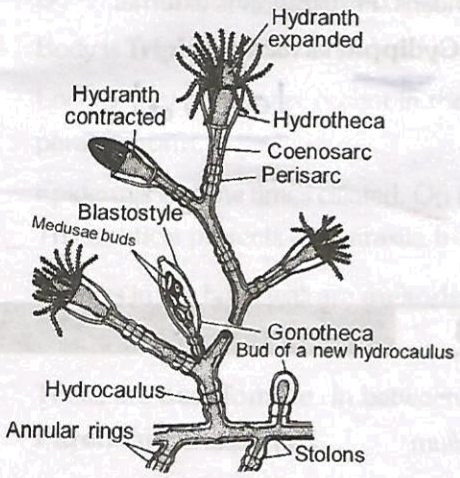
FEW CNIDARIANS



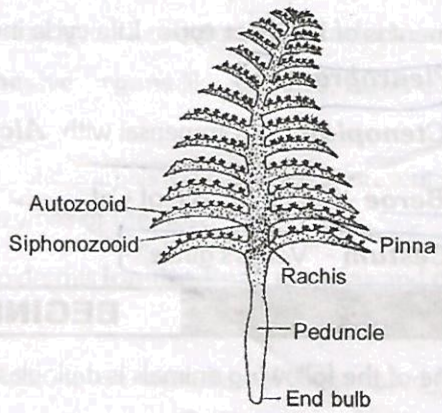
Hydra



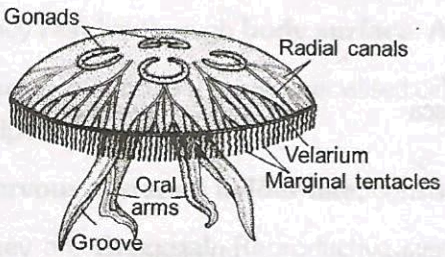
Physalia



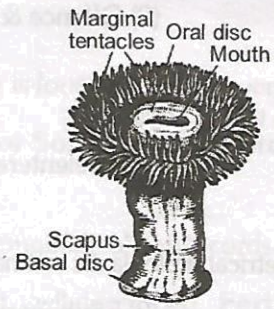
A hydrocaulus of *Obelia* colony



Pennatula



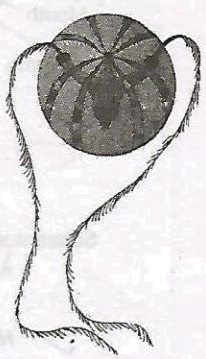
Aurelia



Metridium

PHYLUM - CTENOPHORA

1. Ctenophores are known for their **beauty** and **delicate** nature. In sunlight their comb-plate 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 **radial symmetrial, 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 intracelluar.
8. Skeletal, Excretory and Respiratory systems are **absent**.
9. They are **carnivorous**. A pair of long solid tentacles are present. In place of nematablasts on the tentacles a special type of cells are present called **Lasso-cells** which help in catching the prey.



Pleurobrachia

10. Sexes are not separate. Reproduction takes place only by sexual means. Fertilization is external.
11. Development is of **indirect type**. Life cycle involves a free living **Cydippid** larval stage.

e.g. : ***Pleurobrachia***

: ***Ctenoplana*** - Commensal with ***Alcyonium***.

: ***Beroe*** - Swimming eye of Cat.

Cestum - "Venus's girdle"

BEGINNER'S BOX-3

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" belongs 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 the coelenterate of class
   (1) Hydrozoa (2) Scyphozoa (3) Sporozoa (4) Anthozoa

6. "Portaguese man of war" is –
   (1) Obelia (2) Physalia (3) Eupectella (4) Meandrina

7. The characteristic larva of Ctenophora is
(1) Cydippid (2) Veliger (3) Nauplius (4) Trochophore

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 coelentrate –
(1) Sea cow (2) Sea cucumber (3) Sea fan (4) Sea horse

PHYLUM - PLATYHELMINTHES

1. They have dorsoventrally flattend 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 causing parasitic infestation in human is called **Helminthology**.
4. Body is **Bilaterally symmetrical** and body organisation is of **organ /organ-system grade.**
5. Body is **Triploblastic** i.e. body is formed from three germinal layers i.e. **Ectoderm, Endoderm** & **Mesoderm**.
6. Locomotary organs are absent in these animals but **adhesive organs** like **suckers**, **hook** etc are present in parasitic form.
7. Epidermis is some times 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.
- Muscles in the body-wall are **mesodermal**. Below the epidermis **longitudinal**, **circular** and **oblique** muscles are present.
8. These are **acoelomate**. In between various organs a solid, loose mesodermal tissue called Mesenchyma or **Parenchyma** is present.
9. Digestive system **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.
10. **Skeleton, respiratory** and **circulatory** systems are absent.
11. They **respire** through **body surface**. **Anaerobic** respiration is found in internal parasite 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.

Divided into three classes

Turbellaria	Trematoda	Cestoda
– Fresh water / Marine water – Mostly free living called Eddy worms e.g. : ***Dugesia or Planaria***	Mostly Endoparasite, body is flat and leaf like so called flukes e.g. : ***Fasciola*** (Sheep liver flukes) : ***Schistosoma*** (the blood flukes) : ***Paragonimus*** (Lung fluke worm) (in lungs of man and pig) : ***Opisthorchis*** - Human liver fluke or chinese liver fluke	Endoparasite, mostly intestinal parasite, body is ribbon-like and segmented so called tape worms *e.g.* : ***Taenia solium*** - Pork tapeworm : ***Taenia saginata*** - Beef tapeworm : ***Echinococcus*** - Dog tapeworm : ***Hymenolepis*** - Smallest tapeworm in man's intestine - 200 proglottids (monogenetic)

- **Planaria** - Found in fresh water, nocturnal, cannibalism, slow creeping, omnivorous. Reproduce sexually as well as asexually (Transverse binary fission), good power of regeneration. Pharynx can be everted.
- **Fasciola hepatica (Liver fluke)**
- Life history involve 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 swiming)
- **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 involve two hosts (Digenetic parasite)

  (1) Primary host - **Man**

  (2) Secondary host - **Garden-snail (*Planorbis, Lymnea*)**
- Larva enters human body by boring in skin while bathing in ponds .

  It damages the liver & causes intestinal disorder - **Schistosomiasis or Bilharzia disease.**
- **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 fertislization.
- Life history involve two hosts (Digenetic)

  (1) Primary host - **Man**

  (2) Secondary host - **Pig**
- 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**

- There are three types of Proglottids (segments).

(1)	(2)	(3)
Immature proglottids	**Mature proglottids**	**Gravid proglottids**
- with developing sex organs	- Fully formed sex organs - Each has set of testis and ovary.	- Uterus packed with capsule (Fertilised eggs)

↓

Detached from strobila (Known as Apolysis) & pass out in host faeces as a capsules (egg+yolk cell in a shell)

↓

- Development of embryo
- Pig swallowing egg with Onchosphere larva - It is infective stage for Pig

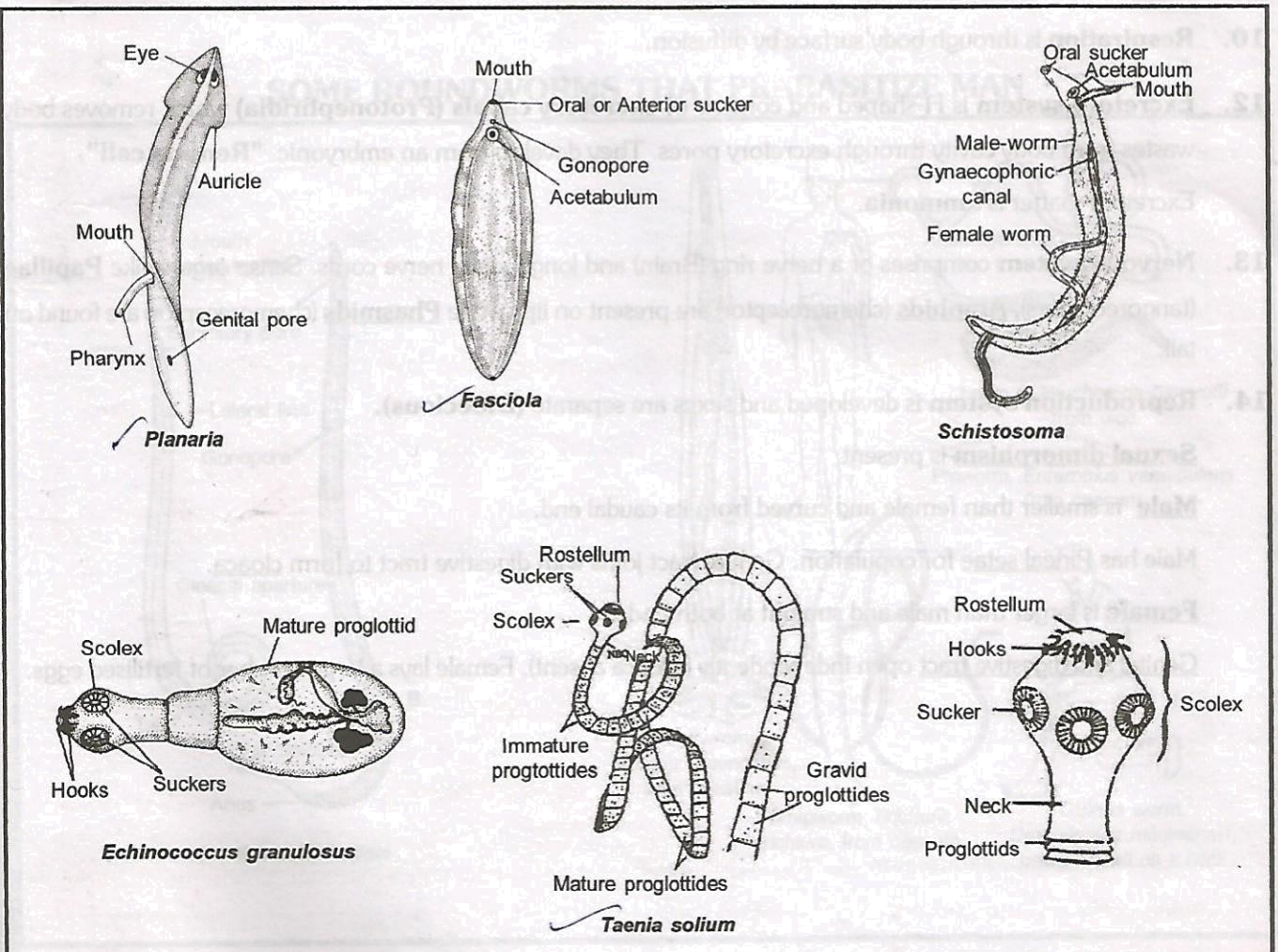
←

- Development of Hexacanth into bladder worm.
- It develops into Cysticercus larva Remain alive in the pig muscles for 5-6 years (Infective stage for Man)

←

Man gets infection from undercooked pork.
(Measly pork - having cysticerci)

FEW COMMON FLAT WORMS



PHYLUM - NEMATHELMINTHES (ASCHELMINTHES)

1. Phylum includes **round worms** which appears circular in cross section.
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** consist 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.
12. **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**.
13. **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.
14. **Reproduction system** is developed and sexes are separate **(Dioecious).**
    Sexual dimorphism is present.
    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), Female lays a large number of fertilised eggs.

Fertilization is **internal** and development may be **direct** or **indirect**.

Eg.

(1) ***Ascaris*** - Intestinal round worm (in small intestine), larva - **Rhabditiform/Rhabditoid**

(2) ***Ancylostoma*** - Hookworm (in small instestine)

(3) **Wuchereria** - Filarial worm

- Viviparous and 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) (Oldest discovered Nematod)

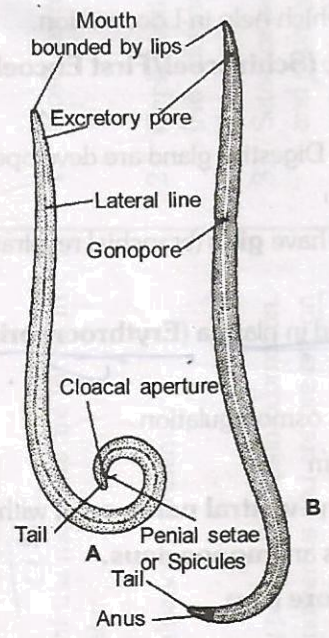
(5) ***Enterobius*** - Pin worm or seat worm (in large intestine)

(6) ***Trichuris*** - Whip worm (in intestine)

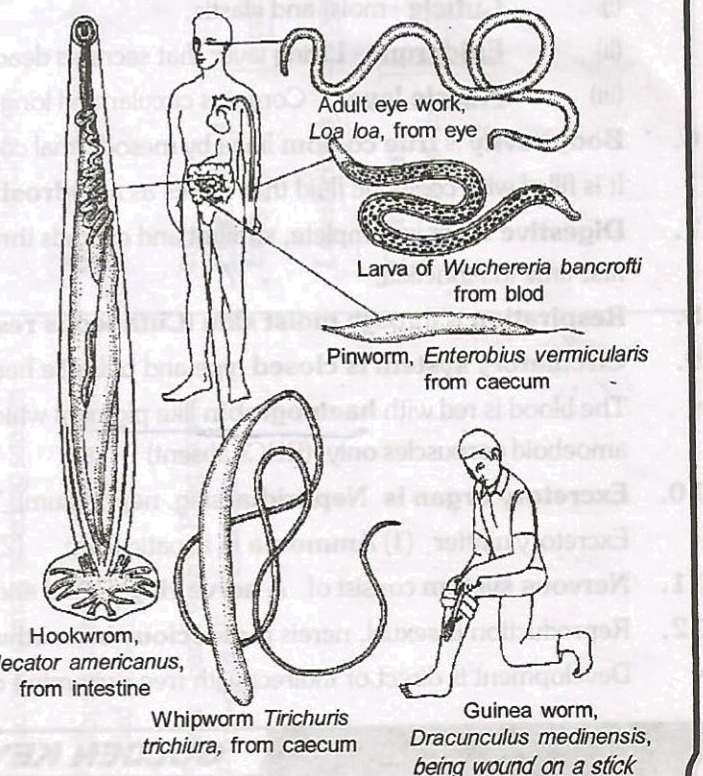
(7) ***Rhabditis*** - Free living nematode

→ Viviparous worm are Trichinella, Wuchereria

SOME ROUNDWORMS THAT PRARASITIZE MAN



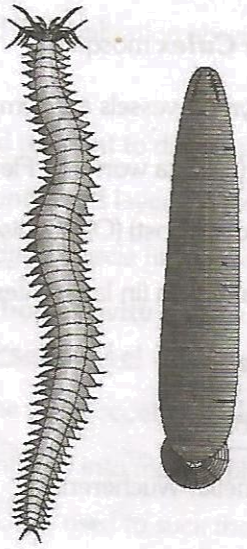
Ascaris : (A) Male, (B) Female



PHYLUM - ANNELIDA

1. Free living found in moist soil, fresh water or sea but few are parasitic.
2. Body is soft elongated, cylindrical and divided into **segments** or **metameres** by ring like grooves called Annuli.
3. They are bilaterally symmetric, 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 organ in few annelids. (eg : ***Nereis***)



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

4. They have **Chitinous Setae** and lateral muscular appendages called **Parapodia** for locomotion.
5. **Body wall** consist of
   (i) **Cuticle** - moist and elastic.
   (ii) **Epidermis** - Living layer that secretes dead cuticle outside.
   (iii) **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 gland 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 remain dissolved in plasma **(Erythrocruorin)**. It has amoeboid corpuscles only. (RBCs absent)

10. **Excretory organ is Nephridia** (sing. nephridium). They also helps in osmoregulation.
    Excretory matter (1) **Ammonia** in aquatic form (2) **Urea** in land form
11. **Nervous system** consist 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.

"**Annelida**" is classified into 3 classes on the basis of presence or absence and position of setae

Polychaeta	**Oligochaeta**	**Hirudinea**
1. Most of the members are found in sea water.	1. Mostly terrestrial, but some are aquatic.	1. Includes Aquatic and terrestrial Leeches which are ectoparasite and sanguivorous.
2. Cephalisation is present.	2. Cephalisation absent (No distinct head).	2. Cephalisation absent.
3. Mainly parapodia helps in locomotion. Setae numerous and are present on parapodia.	3. Setae for locomotion. Number of setae is limited and situated in body wall, (Parapodia & sucker are absent).	3. Parapodia and setae are absent. Suckers at both the ends.
4. Clitellum absent.	4. Clitellum is present permanently for cocoon formation.	4. Clitellum (9-11 segments) developed only in breeding season.
5. Animals unisexual and gonads are formed only during breeding season.	5. Bisexual or hermaphrodite, external and cross fertilisation.	5. Bisexual. Fertilization is internal.
6. Development is indirect. Larval stage is called Trochophore.	6. Development is direct (No larva).	6. Development is direct. (No larva). – Number of segments in leeches are fixed ie. 33 segments. – Anticoagulant Hirudin present in the saliva. – Circulation with haemocoelomic system. – Coelom is divided in many tubes having coelomic fluid and haemoglobin. A special mesodermal tissue Botryoidal tissue made up of adipose tissue is present for **fat strorage** and **excretion.**
e.g. ***Nereis*** - Sand worm/Ring worm ***Aphrodite*** - Sea mouse	e.g. ***Pheretima***] ***Eutyphaeus***] North Indian earthworm ***Lumbricus*** - European earthworm ***Dravida***] ***Megascolex***] South Indian earth worm.	e.g. ***Hirudinaria*** - Fresh water leech ***Bonellia*** - Marine leech- male is ill developed and lives permanently in the uterus of female. ***Pontobdella*** - Skate sucker. ***Hirudo*** - Medicinal leech (highly modified)

PHYLUM - ARTHROPODA

1. Arthropoda is **the biggest phylum** of animalia which includes insects, over two-third 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 **Bilateral symmetric**, **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**

   (i) They have **jointed appendages** for different functions hence name arthro - jointed, poda - foot/appendages.

   (ii) The body of Arthropods is covered by **Chitinous exoskeleton.**
7. **Body cavity** around viscera contain 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). **Trachea 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 hoemocoel 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 animal and **Uric acid** in land animal
13. **Nervous system** comprises of a **nerve ring** and a **double**, **solid and ventral nerve cord** bearing ganglia.
14. Head is distinct [High digree 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. Dovelopment may be **direct** or **indiret.**
18. Animals of **Arthropoda** are most **successful invaders of terrestrial** enviornment among invertebrates due to presence of (i) **Cuticle** (ii) **Appendages** (iii) **Wings**

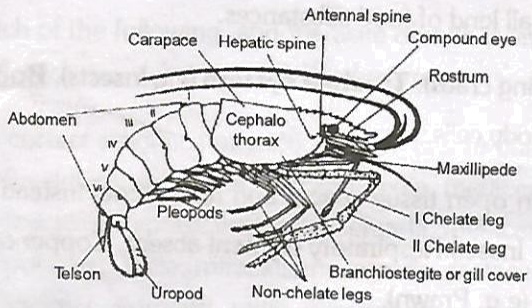
Examples :-

- Economically important insect - **Apis** (Honey bee), ***Bombyx*** (Silk worm), ***Laccifer*** (Lac insect)
- Vectors - ***Anopheles***, ***Culex*** and ***Aedes*** (mosquitoes)
- Gregarious pest - ***Locusta*** (Locust)
- Living Fossil - ***Limulus*** (King crab)
- Others - Butterfly, Scorpion, Prawn, Spider, ***Cyclops***, Centripede, Millipede, ***Peripatus*** etc.

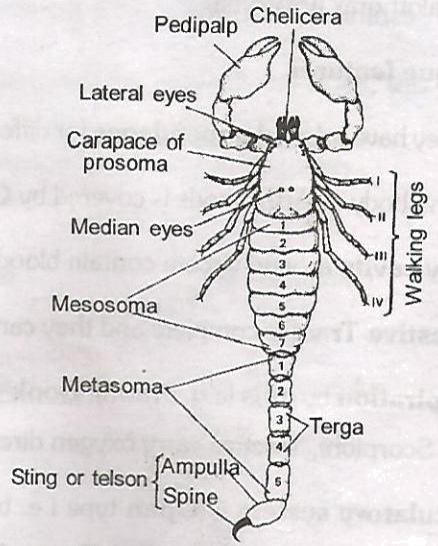
FEW ARTHROPODS

Locust

Butterfly



Palaemon (Prawn)



Palamnaeus (Scorpian)

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

→ Muscles are stripped/striated/voluntary (first time devepoled in Arthropods)

→ Due to presence of joints, muscles are separate or arranged in bundles in them.

Z:\NODE02\2016-17\TARGET\BIO\ENG\MODE_5\01 ANIMAL KINGDOM\02 ARTHROPODA-E.P65

ARTHROPODA (7 CLASSES)

Merostomata
- Includes primitive aquatic arthropods.
- Respiration - Book gills
- Excretion - Coxal gland
- Development-includes larva

e.g. ***Limulus***-King crab or Horse shoe crab (living fossils)

Arachnida (Octapoda)
- Cephalothorax-bears 1 pair of Chelicerae & 1 pair of Pedipalpis for feeding & 4 pairs of walking legs.
- Antennae absent.
- Respiration -Trachea or **book lungs.**
- Excretion - Coxal gland or Malpighian Tubules or both
- Development- Direct

e.g. : ***Palamnaeus*** - Scorpion viviparous and last segment modified into poison sting.
: ***Lycosa/Agelena*** (Spider)
: ***Ticks*** and ***Mites.***

Crustacea
- Exoskeleton harden by impregnation of ca salt. (Chitin + $CaCO_3$) Carapace
- Body has two division cephalothorax and abdomen
- Antennae -Two pairs
- Each segment bears a pair of biramous (forked) appendages modified for swiming, feeding. (5 pairs)
- Respiration- body surface or gills
- Respiratory pigment is Haemocyanin
- Excretion- Green glands
- Development includes - Nauplius, Zoea larva etc.

e.g. : ***Palaemon*** - prawn
: ***Cancer*** - Crab
: ***Eupagurus***-Hermit crab
: ***Daphnia***-Water flea
: ***Cyclops*** - Husband of 100 wives only one eye, No heart
: ***Astacus*** - Cray fish

Diplopoda
- Worm like body with head, thorax and abdomen.
- Each abdominal segment with 2 pairs of legs and pioson claws absent.
- Excretion - Malpighian tubules.

e.g. ***Julus*** - Millipede
Thousand leggers

Chilopoda
- Each segment with one pair of legs
- Body worm like and divisible into head and trunk
- Excretion - Malpighian tubules.

e.g. ***Scolopendra*** - Centipede (Poison - Claws present)
Hundred leggers

Insecta (Hexapoda) (75%)
- Body - Head, thorax, abdoman
- Head - 1pair of antennae, compound eyes and mouth parts present.
- Thorax - 3 pair of legs & one or two pairs of wings.
- Abdomen - lack appendage.
- Respiration-Trachael, system.
- Excretion - Malpighian tubules.

Sub-class

Pterygota (Winged insects)
e.g. ***Bombyx*** - Silkworm
Apis - Honey bee
Mosquitoes
Calotermes - Termite (Social)
Tacharida lacca/ Laccifer lacca - Lac insect
Periplaneta - Cockroach
Musca nebulo (Indian house fly) (without mandible)
Locusta - Locust (gregareous pest)

Apterygota (Wingless insects)
e.g. ***Lepisma*** - Silver fish
Pediculus - louse
Cimax - Bed bug
Xenopsylla cheopsis - Rat bug
Transmit pasteurella or yersina pestis (Plague).

Onychophora
e.g. ***Peripatus*** - (Walking worm) Connecting link between Annelida & Arthropoda. (Living fossils)

Excretion - Nephridia

Useful Insects

Honey bee (*Apis*) - Honey, Wax
Silk worm (*Bombyx*) - Silk
Lac insect (*Tacharida lacca/Laccifer*) - Lac
Coccineal bug (*Dictylopius*) - Red/Tanin colour
Blister beetle/Spanish fly (*Lytta*) - Cantheridine oil
Red Ants - Formic acid
Dragon flies - Larvivorous (Mosquitoes)

Harmful insects (vector for disease)

Anopheles - Malaria
Culex - Elephantiasis
Aedes - Dengue/Yellow fever
Tse-Tse fly - African sleeping sickness
Sand fly - Kala-azar
House fly - Cholera, Diarrhoea, Dysentry, Gangrene, Intestinal fever.
Bed-bug - Relapsing fever/Typhus
Louse - Trench fever
Tabanus - Surra
Tick - Rockey mountain fever.

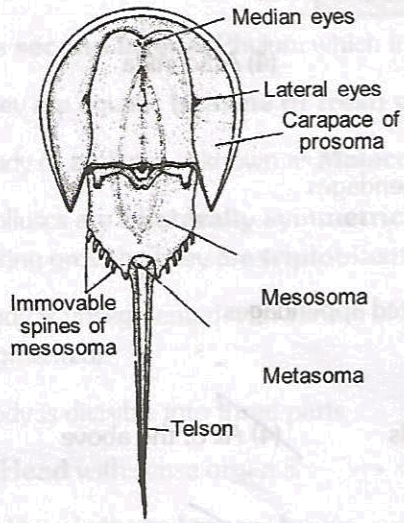
Golden Key Points

Development in insects

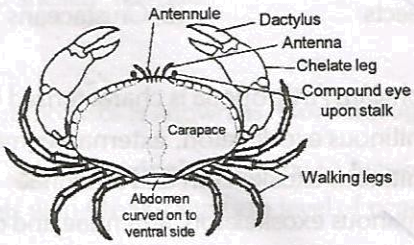
1. **Ametabolous development** (insects without metamorphosis) e.g. Silver fish, young one resemble with adult in all aspects. Three stage of lift history - (1) egg (2) young (3) adult (imago)
2. **Paurometabolous development** (with gradual metamorphosis) e.g. Grass hopper, Cockroaches, Termites etc. young and adult differ in structure but habitat is same, young without wings and grow gradully wings. Three stages (1) egg (2) nymph (young) (3) adult.
3. **Hemimetabolous development** - (Incomplete meta morphosis) Young one differ from adult in structure as well as mode of life. Life history (1) egg (2) naiad (yong) (3) adult . Changes are more than gradual change and less than complete metarorphosis. Hence "incomplete metamorphosis". e.g. Dragonflies and may flies.
4. **Holometabolous development** - (Complete meta morphosis) Young one is differs from adult in form, structure and mode of life. Life history (1) egg (2) Larva (3) Pupa (4) Adult e.g. Butter flies, Moths, House flies, Mosquitose, Beetles, bees, Wasp, Ants.

Larva

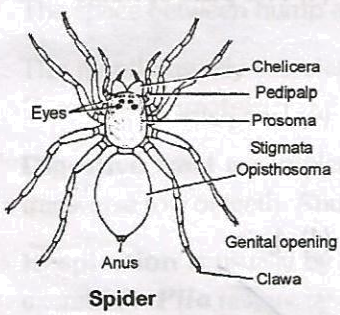
Catterpillar - Silkworm and Butterfly
Pupa of Butterfly - **chrysalis.**
Grub - Honey bee
Maggot - House fly
Wriggler - Mosquito
Pupa of mosquito - **tumbler.**
Zoea or **Megalopa** - Crab
Nauplius - Prawn



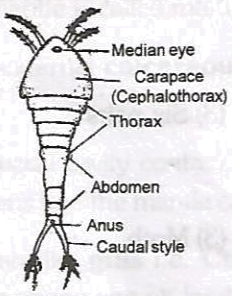
Limulus



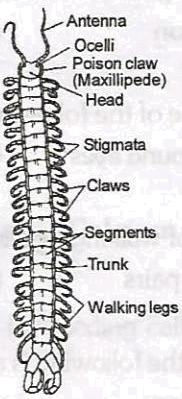
Crab (genus Cancer)



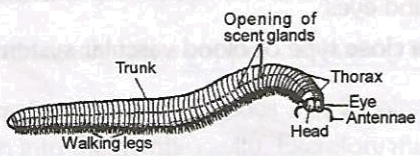
Spider



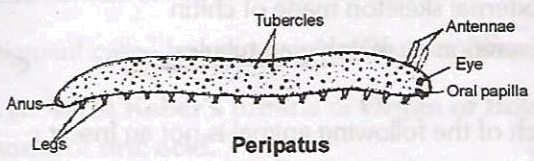
Cyclops



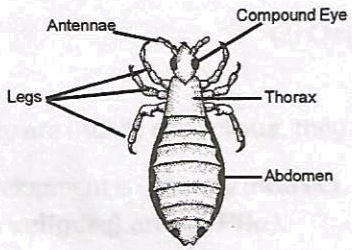
A Centipede (dorsal view)



Millipede

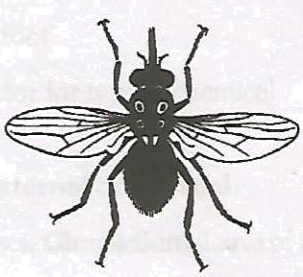


Peripatus



Pediculus (Human head louse)

Bed bug, vector of typhus, relapsing fevers



Tsetse fly (Diptera), vector of African sleeping sickness

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 ***(Neopilina*** is exceptionally segmented).
5. Body is divisible into three parts :

   (i) **Head** with sense organ like Eyes and sensory Tentacles.

   (ii) Dorsal **visceral mass/ hump** containing all visceral organs of body.

   (iii) 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 Concheolin protein**.

7. **Digestive tract** is complete. Buccal cavity contain a file-like rasping organ for feeding called **Radula**, with transverse row of teeth. Anus opens into the mantle cavity.
8. **Respiration** is usually by feather like **gills** i.e. **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)

- **Coelom** is greatly **reduced**. Space 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 of **kidneys** known as **Keber's organs** or **Organ of Bojanus**, which open into the mantle cavity. Excretory matter is **ammonia** or **uric acid.**
11. **Nervous system** comprises three 3 or 4 pairs of **ganglia.**
12. Senses organ includes
    (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 very common larva of Molluscs, **Glochidium** (Larva of ***Unio***) and **Veliger (**Larva of ***Pila).***

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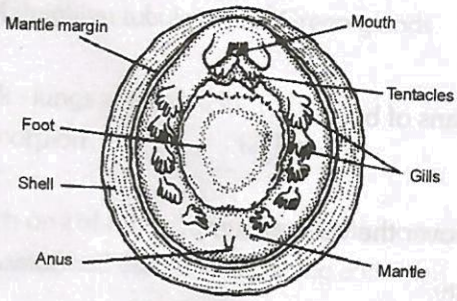
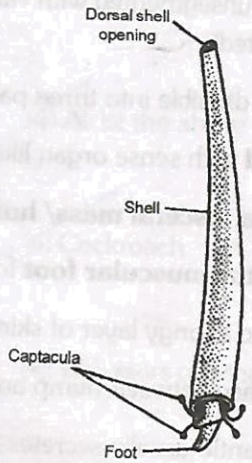
EXTRA POINTS :

- Precious pearl of the size of tennis - ball is made by a giant mollusc - **Tridecna**
- **"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.**

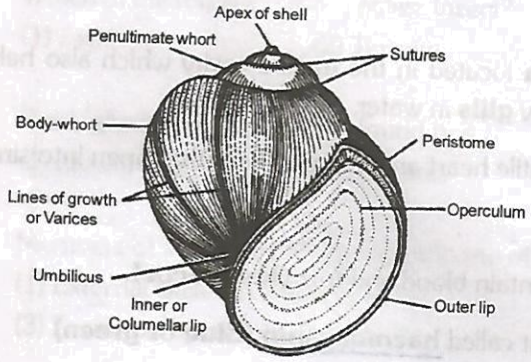
FEW MOLLUSCS



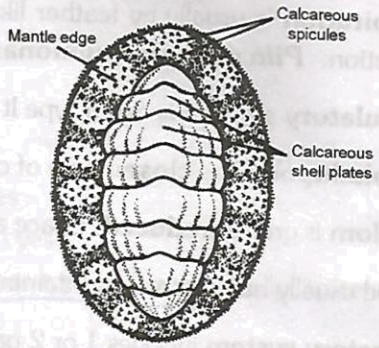
MONOPLACOPHORA
(NEOPILINA)



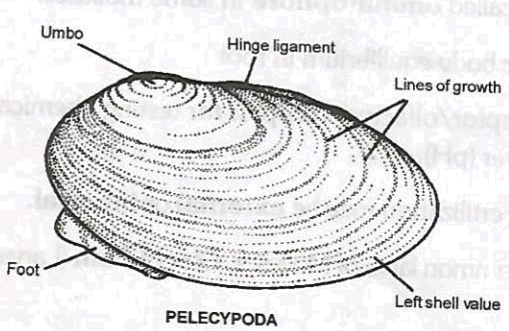
SCAPHOPODA
(DENTALIUM)



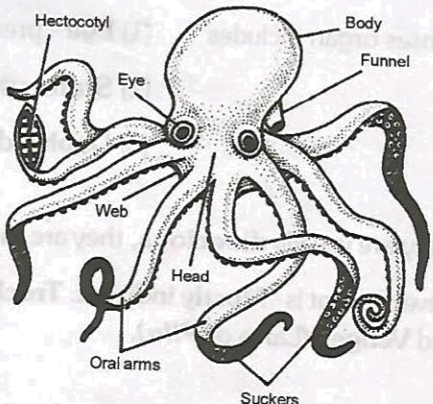
GASTROPODA
(PILA)



POLYPLACOPHORA
(CHITON)



PELECYPODA
(UNIO)



CEPHALOPODA
(OCTOPUS)

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CLASSIFICATION : MOLLUSCA (6 CLASSES)

Monoplacophora	Polyplacophora	Scaphopoda	Gastropoda	Pelecypoda or Bivalvia	Cephalopoda
– Marine, common character of Annelida and Mollusca. – Only segmented mollusc and with nephridia. – Shell - Dome-shaped with mantle. e.g. – ***Neopilina*** – Living fossils – Connecting link between Annelida and Mollusca	– Exclusively marine – Shell - Consists of 8 dorsal plates. (Multivalved) e.g. ***Chaetopleura(Chiton)*** - The coat of mail shell (Sea-mica)	– Exclusively marine – Shell - Tubular, open at both end. e.g. ***Dentalium*** - Tusk - shell. (Respire by mantle)	– Marine / fresh water/ moist soil. – Shell - Spirally coiled (Univalved) e.g. ***Pila*** (Apple-snail) ***Doris*** - Sea lemon ***Aplysia*** - Sea hare ***Turbinella***- Shankh ***Planorbis*** -Land snail ***Lymnea*** - Land snail	– Marine / fresh water. – Shell - Consist of two valves movably hinged dorsally (Bivalved) e.g. ***Unio***- (fresh water mussel) ***Teredo***- Ship worm. ***Pinctada*** - Pearl oysters.	– Exclusively marine – Shell -Internal (Sepia) or external (*Nautilus*) or absent (*Octopus*) – Vertebrate like eyes. – Exhalant siphon – Closed blood circulation. – Discharge Ink from ink glands for defence – Larva absent e.g. ***Octopus*** - Devil fish (8 arms) ***Sepia***-Cuttle fish (10 arms) ***Loligo*** - Squid (Radula absent) ***Architeuthis*** -Giant squid (Largest invertebrate) **Nautilus** (Tiger shell)

PHYLUM - ECHINODERMATA

1. All are **Marine.** Generally live at **bottom** and slow moving.

- Body shape is **star like**, **cylindrical**, **melon-like or disc-like**.

2. The adult Echinoderms are **radially symmetrical** but larvae are **bilaterally symmetrical.**

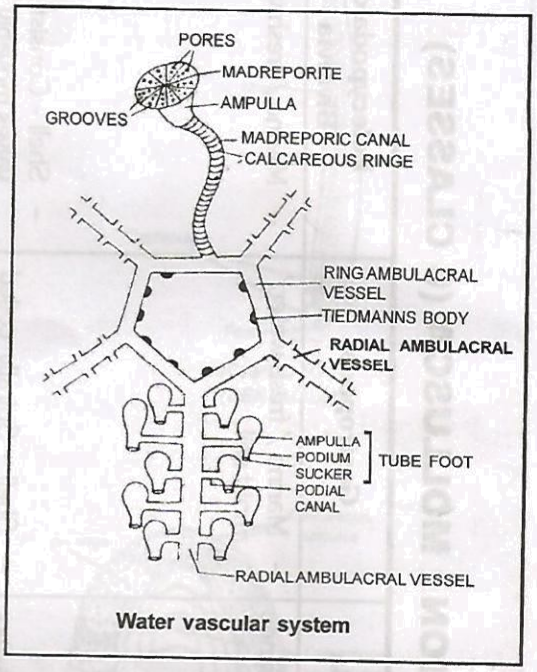
3. They are **triploblastic** and **coelomate** animals with **organ - system level** of organisation. Echinoderms have true **Coelom**

- They do not have distinct **head.**

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

- Minute pincer like structure **pedicellariae** comes out through skin. They keep body surface clear of debris.

5. The most distinctive feature of echinoderm 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, Structures like – Tube feet, radial canals, tiedmann body and stone canal are also found in water vascular system.



Water vascular 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 throug 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**.

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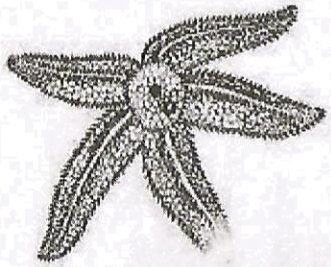
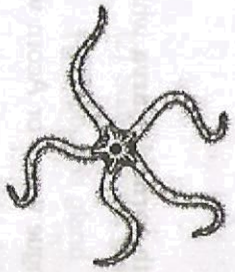
ECHINODERMATA : DIVIDED INTO FIVE CLASSES.

Asteroidea	Ophiuroidea	Echinoidea	Holothuroidea	Crinoidea
• Body - Flat and star like with five thick and short arms. • Larva - Bipinnaria/Brachiolaria. **e.g.** ***Asterias*** - starfish  STAR FISH	• Body - Flat and star like with thin, long, jointed and easily breakable arms. • Larva : Ophiopluteus. **e.g.** ***Ophiura*** - Brittle star ***Ophiothrix*** - Brittle star  BRITTLE STAR	• Body - Globular/disc like and without arms. • Mouth - with **Aristotle's lantern** i.e. Masticating apparatus with 5 teeth. • Larva : Echinopluteus. **e.g.** : ***Echinus***-sea urchin  SEA URCHIN	• Body - Long, cylindrical and cucumber like without arms. • Respiration through cloacal tree. • Larva - Auricularia **e.g.** ***Cucumaria*** (Sea cucumber) ***Holothuria*** (Sea cucumber) ***Synapta***  SEA CUCUMBER	• Body - Plant like fixed with branched arms. • Without spine and pedicellariae • Larva : Doliolaria **e.g.** ***Antedon*** - (Sea lilly)  SEA LILY

PHYLUM – HEMICHORDATA

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

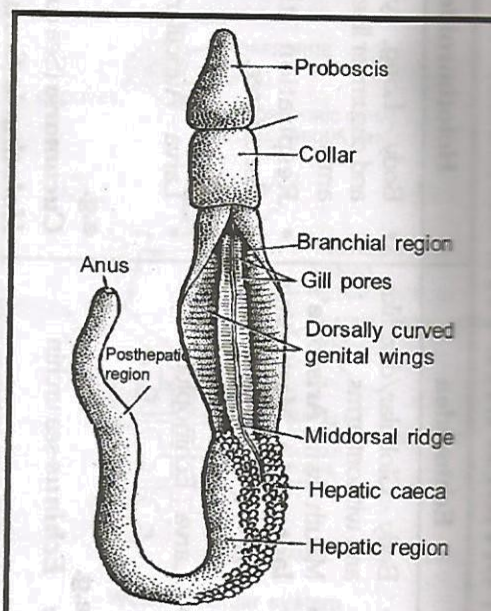
1. Hemichordata was earlier considered as a sub-phylum of chordata. But now it is placed as a **separate phyl** under **non-chordata.**
2. This phylum consists of a small group of **worm like** marine animals with organ system level of organisati
3. They are **bilateral symmetrical, triploblastic** and **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. Mostly **ciliary feeders**, digestive tract is complete.
6. A notochord like structure is found in their **buccal cavity**, that is called "**Buccal diverticulum**" or "**Stomochord**" (outgrowth of buccal cavity) but **true notochord** is **absent**.
7. Respiration takes place through **gill.**
8. Circulatory system is **open type**. Blood is colourless with amoeboid corpuscles. Respiratory pigment **vanadium** is present in some cases. **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 echinoderm in their developmental stages.



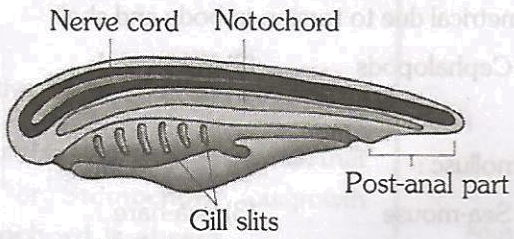
Balanoglossus :
External features in dorsal view

eg. **: *Balanoglossus***:-Tongue worm or Acorn worm

: *Saccoglossus*

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.
- According to taxonomists, **90 - 95% animals are non-chordates** of the total animals present on earth, and rest of the **3 - 5% animals are chordates.**
- In chordates, species with maximum living animals belongs to **Pisces group** and with minimum living species belongs to **Amphibia group**.



Chordata characteristics

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 to body.
- In - **Protochordata** group , notochord is present through out the life 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 organ is **lung.**

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 in position.	Heart is dorsal or lateral in position. (if present).
5.	A post-anal part (tail) is present.	Tail if present is pre anal part (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

→ Phylum **chordata** is divided into **two groups** on the basis of **cranium**, **vertebral column** and **paired appendages** :-

[A] Acraniata or **Protochordata** **[B] Craniata** or **Euchordata**

Phylum Chorodata

- **Group : Acraniata** or **Protochordata** (Lower Chordates)
  - Subphylum : **Urochordata**
  - Subphylum : **Cephalochordata**
- **Group : Craniata** or **Euchordata** (Higher Chordates)
  - Subphylum **Vertebrata**
    - Division : **Agnatha** (Jaw less)
      1. **Ostracodermi**
      2. **Cyclostomata**
    - Division **Gnathostomata** (Jaw present)
      - Superclass **Pisces**
        3. **Placodermi**
        4. **Chondrichthyes**
        5. **Osteichthyes**
      - Superclass **Tetrapoda**
        6. **Amphibia**
        7. **Reptilia**
        8. **Aves**
        9. **Mammalia**

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Group : Acraniata or Protochordata

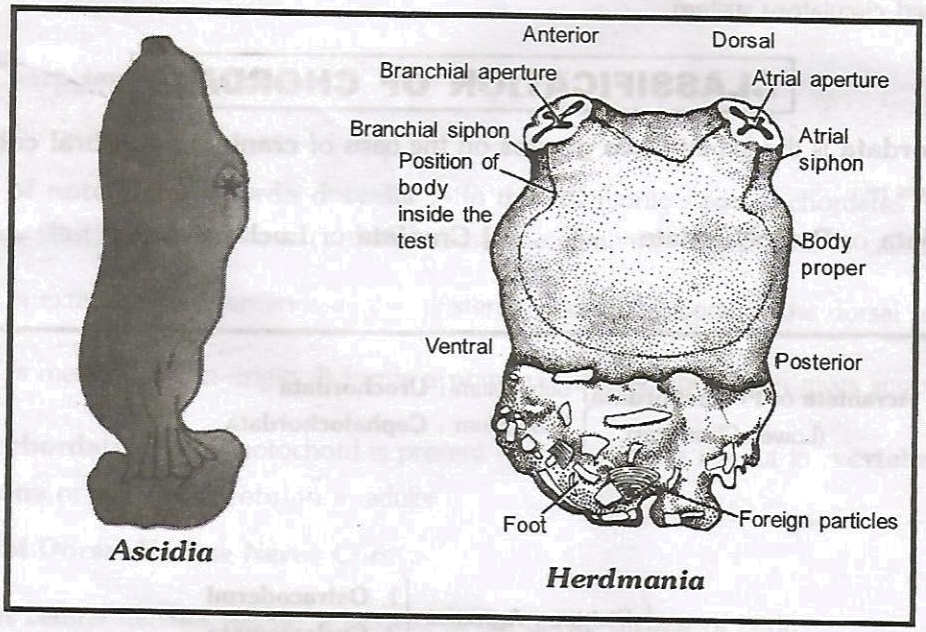
- Protochordates are exclusively **marine**.
- **Pharyngial gill clefts** are found throughout the life for respiration.
- **Notochord** persists throughout the life, but **skull**, **brain** and **vertebral column** is **absent** in them.
- Notochord is not replaced by vertebral column, hence they are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

Subphylum – 1–**Urochordata**

Subphylum – 2–**Cephalochordata**

SUB-PHYLUM - UROCHORDATA OR TUNICATA

- All the members of this subphylum are 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.
- They are **ciliary feeder**.
- All chordate characters are found in larva. Only one chordate character is found in adults i.e. **pharyngeal gill clefts.**

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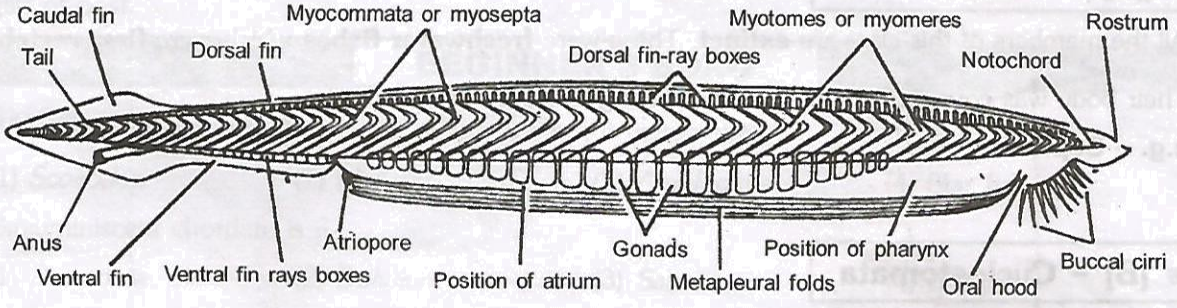
- Blood vascular system is **open type,** heart is situated at **ventral** surface of body.
- Excretion is by **supra neural gland/pyloric gland** and **nephrocytes**.
- Most of the animals are bisexual.
- Fertilisation is **external** and mostly cross-fertilisation.
- A free swimming larval stage is found in this group, just like tadpole of Frog, it is also called **tadpole larva.**
- All the members of this subphylum show **"Retrogressive metamorphosis"**. During this metamorphosis, a well developed free swimming larva is changed into less developed adult.

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

e.g. :

- ***Herdmania*** - Sea - potato or sea - squirts.
- ***Ascidia***
- ***Doliolum*** - Barrel shaped.
- ***Salpa***
- ***Pyrosoma*** - Biolumniscence is found. (Strongest light among marine organism)

SUB-PHYLUM - CEPHALOCHORDATA



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

- They all are found in shallow **sea water.**
- Both larva and adult are free swimming forms.
- Animals form burrows in sand and are nocturnal.
- Body is laterally compressed like fish, and is segmented.
- Notochord and nerve cord remain extended from anterier to tail region. Notochord persists throughout life.
- Alimentary canal is **complete.** Buccal opening is covered by oral hood and this collectively termed as **"Wheel organ"** or **"Ciliated organ of Muller"**. This organ helps in the ingestion of food by producing circular currents in water (Ciliary feeder).
- Blood vascular system is **closed type** and respiratory pigment **absent**.
- For excretion **protonephridia** are present in the form of **flame cells** or **solenocytes**. **Hatschecks nepheridium** (single) is present which helps in excretion.
- Fundamental chordate characters remain throughout life. Larva and adult both show chordate characters. Therefore, they are considered as **first complete chordate animals or typical chordates.**
- These are **unisexual** animals.

- Fertilisation is **external.**
- Development is **indirect** i.e. larval stage is found.
  e.g. :- Branchiostoma or ***Amphioxus* (Lancelet).**

SUB - PHYLUM - VERTEBRATA

- 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.

Subphylum vertebrata is divided into two divisions :-

(i) Agnatha = Jaw are absent (ii) Gnathostomata = Jaw present

- Group Agnatha is divided into two classes.

[A] **Ostracodermi** [B] **Cyclostomata**

Class [A] – 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*.**

Class [B] – 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.
- These fishes are **ectoparasite** as well as **scavanger**.
- They have elongated body bearing **6-15 pairs** of gills 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.
- Three eyes are found on the head, one median **pineal eye** and two lateral eyes.
- Only one Nostril is present **(Monorhynous).**
- Internal ear contains **one** or **two semicircular canals.** Internal ear works as **statoreceptor** only. (For balancing)
- Animals **unisexual**, fertilization **external**, larval stage absent. Except **Ammocoete** larva is found during development of ***Petromyzon.***

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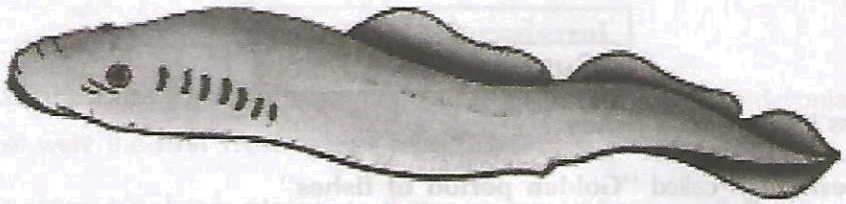
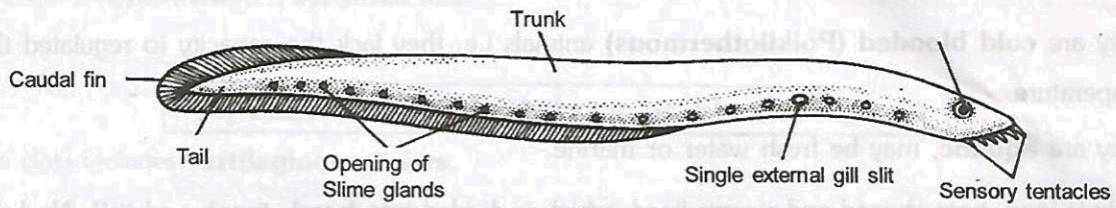


Petromyzon



Myxine

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. It's 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 remain attched with the gills of host.

BEGINNER'S BOX-7

1. Which one of the following is a chordate but not a vertebrate :-

(1) *Scoliodon* (2) *Hag fish* (3) *Amphioxus* (4) Star fish

2. Bioluminiscent chordate is :-

(1) *Pyrosoma* (2) *Doliolum* (3) *Salpa* (4) *Botryllus*

3. "Wheel organ" is found in :-

(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. 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

6. In which one of the following group, brain box is absent :-

(1) Cyclostomata (2) Pisces (3) Amphibia (4) Urochordata

7. Which of the following is the larva of *Petromyzon* ?

(1) Ammocoete (2) Bipinnaria (3) Tadpole (4) Tornaria

8. Circular and suctorial mouth is present in :-

(1) *Labeo* (2) *Petromyzon* (3) *Scoliodon* (4) All the above

9. Jaw less fishes are included in :-

(1) Chondrichthyes (2) Osteichthyes (3) Cyclostomata (4) Lung fishes

10. Notochord is found only in the tail of Larva in -

(1) All chordata (2) Hemichordata (3) Urochordata (4) Cephalochordata

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Super Class – Pisces

- This super class includes **true fishes**.
- **"Devonian period"** is called **"Golden period of fishes"**
- Study of fishes is **Icthyology.**
- They are **cold blooded (Poikilothermous)** animals i.e. they lack the capacity to regulated their body temperature.
- They are **aquatic**, may be fresh water or marine.
- Body is long, boat shaped and stream lined, which is divided into **head, trunk** and **tail.** Neck is absent.
- Body is covered by **dermal scales**. But Cat fish, ***Torpedo*** & ***Wallagonia*** fishes are **scale less.**
- **Paired fins** are present for swimming. e.g. Pectoral and pelvic fins. Along with these unpaired fins are also found on the body e.g. mid dorsal fin and caudal fin.
- External nares are one pair. **(Dirhynous condition)**
- External and middle ears are absent, only internal ear is present which work as statoreceptor. (For balancing)
- Respiration **by gills**, which are **naked** or covered by **operculum**.
- Teeth are Acrodont.
- Heart 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.
- Vertebrae in fishes are **amphicoelous**, in which centrum is concave at both the surfaces.
- 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.
- Fishes are **unisexual.**
- Fertilization is **internal** or **external**.
- Development is **direct i.e.** larval stage is lacking during development.
- Baby fishes are called **Fry or Hatchling**.
- Super class pisces classified into three classes :-

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

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[A] Class - Placodermi

- In this class, **extinct** fishes (Fossil fish) are included, which use to live 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

[B] Class - Chondrichthyes or Elasmobranchi

- This class includes **cartilaginous fishes**.
- They are exclusively marine.
- Endoskeleton is made up of **cartilage.** Notochord is persistant 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 direct 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 **thermoreceptor organ**.
- Liver is **bilobed**
- 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. :-

1. ***Scoliodon*** **:-** Dog fish or common Indian shark - Dog like sense of smell. It is **viviparous**
2. ***Pristis*** **:-** Saw - fish
3. ***Trygon*** **:-** Sting ray - Its dorsal fin has poisonous spines.
4. ***Torpedo*** **:- Electric ray - In this fish** an electric organ is found which is a modified muscle, it can give shock averaging 100–400 volts.
5. ***Carcharodon*** – Great white shark
6. ***Rhincodon*** **:-** Whale shark - It is the **largest true fish.** Its length is 13 - 14 meters.
7. ***Chimaera*** **:-** "Rat fish" or "King of herrings" or Ghost fish. Connecting link between bony & cartilagenous fish. Operculum present and cloaca absent like in bony fishes.

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[C] 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 maybe **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
- Helping respiratory organs **"air bladders"** are present. These air bladders are **hydrostatic** i.e. help in maintaining balance of body and provide Buyoncy.
- 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.
- Liver is **Trilobed**
- Fertilization is **usually external**, **claspers** are absent in male fishes.
- They are mostly **oviparous.**

Examples :-

1. ***Hippocampus*** – **"Sea - horse"** or **"Pregnant male"** : It swims in sea water in its vertical position. A pouch like structure is present at the abdomen of male fishes known as "Brood - pouch" in this pouch male collects the eggs. Secondary vivipary and parental care is found.
2. ***Exocoetus* (Flying fish)** - Its **dorsal fin** is long, it can fly (glide) over 400 metre in sea water with the help of enlarged pectoral fin.
3. ***Labeo* :-** "Rohu"or "Indian carp" (fresh water fish).
4. ***Clarias* :- "Cat fish"** or **Magur** (Fresh water)
5. ***Catla*** – Katla (Fresh water)
6. ***Betta*** – Fighting Fish (Aquarium fish)
7. ***Pterophyllum*** – Angel Fish (Aquarium fish)
8. ***Wallagonia* :-** Lachi (scale less)
9. ***Echeneis*** (Remora) – Suker fish. Shows commensalism with shark and whales. Dorsal fin modified into suker.
10. ***Latimeria or coelacanth*** – **Living fossil** or **oldest living vertebrate** known till now.
11. ***Gambusia*** – Larvivorous fish and is viviparous.

LUNG FISHSES (GROUP - DIPNOI) :-

- Air bladder helps in respiration and can survive out of water.
- These are freshwater bony fishes and have some amphibian like characters.

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- Three chambered heart present.
- External and internal both the nares are present.
- Scales are **Cycloid** type.

e.g. :-

- ***Protopterus*** : African lung fish :- It is living fossil fish.
- ***Lepidosiren*** :- South American lung fish.
- ***Neoceratodus*** :- Australian lung fish.

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 vertebra 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)
- 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*

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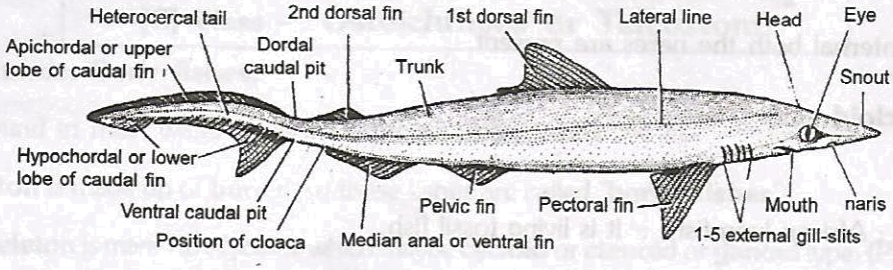
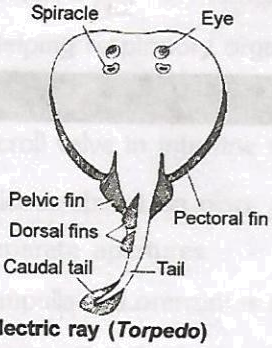
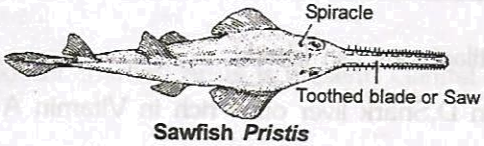


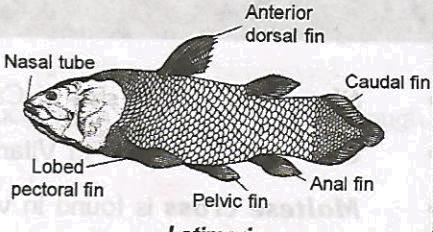
Female Indian dogfish shark (***Scoliodon***)



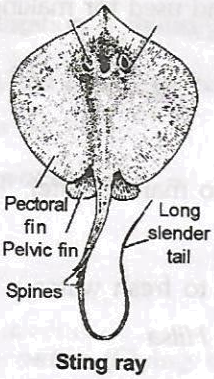
Electric ray (*Torpedo*)



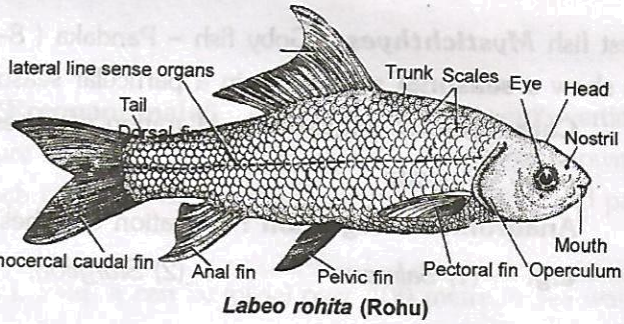
Sawfish *Pristis*



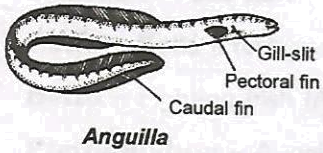
Latimeria



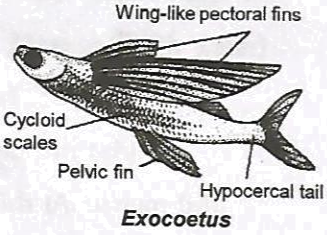
Sting ray
(Trygon)



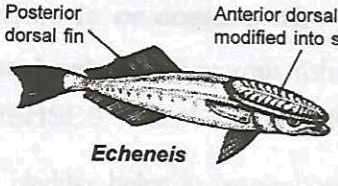
***Labeo rohita* (Rohu)**



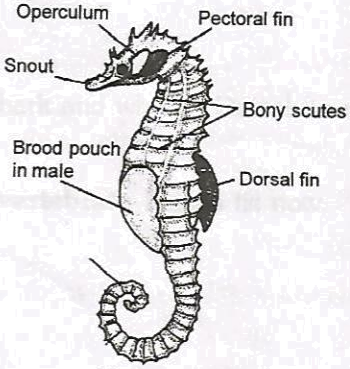
Anguilla



Exocoetus



Echeneis



Hippocampus

Class - Amphibia

Carboniferous period is the golden age of Amphibians

Class amphibia include animals which can live on both the places at ease ***i.e.*** – under water and on the land. (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 evoporation.

These are cold blooded or **poikilothermal** animals.

These animals undergo **hibernation** or **aestivation** to prevent themselve 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 moistening the 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. These 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.

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 larvas are **Ammonotellic.**

Skull has two occipital condyles **(dicondylic skull)**.

Vertebrae, in these animals are **procoelus** type, in which centrum is **concave** from anterior side and **convex** from posterior side.

A Tympanum represent the ear. Only one ear ossicle **columella (stapes)** is present in middle ear. External ear absent

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** fertil
- These are **oviparous**, which lay their eggs in water.
- Development is **indirect through larva**

  i.e. **Tadpole larva** - In Frog,

  Axolotal larva - In Salamander

This class is divided into three orders :-

(A) **Gymnophiona** or **Apoda**

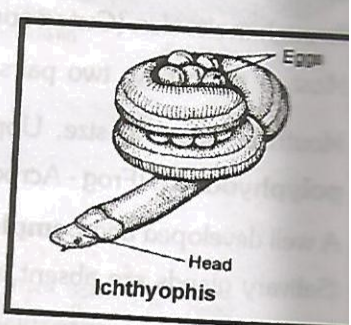
(B) **Caudata** or **Urodela**

(C) **Anura** or **salientia**

[a] Order – Gymnophiona or Apoda

- These are **primitive limbless amphibians** and are their body is **worm** like burrowing in nature.
- Scales present but embeded into skin.

***e.g. :- Ichthyophis* (caecilian) :-** Eyes covered by skin and tympanum absent. (blind or deaf worm)



Ichthyophis

[b] Order – Caudata or Urodela

- Body is distinctly divided into **head, trunk** and **tail (tailed amphibians).**
- Two pairs of equal sized limbs present.
- Usually exhibit neoteny i.e. retention of larval traits even during adult stage.

e.g. :-

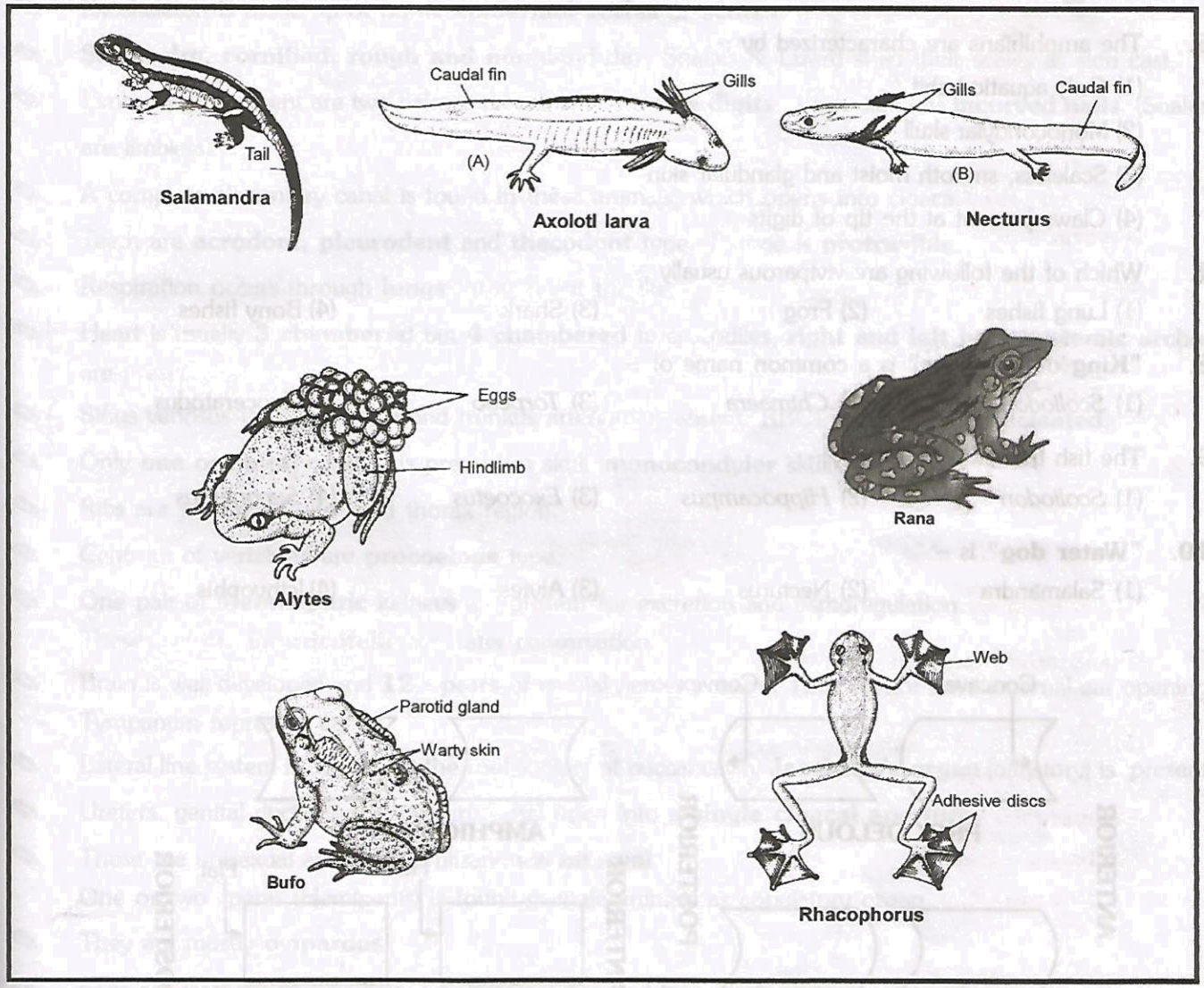
- ***Salamandra* :–** It is **viviparous**. Its larva is called **Axolotl** larva. It sometimes show neoteny. (Longest ge period – 36 months)
- ***Ambystoma*** - Tiger salamander (Axolotl larva)
- ***Necturus*** – Water dog or mud puppy : It shows **permanent neoteny**.
- ***Amphiuma*** - Congo-eel :- Largest RBC is present.

[c] Order – Anura or salientia

- Tail is absent in adult stage like frogs and toads **(Tailless amphibians).**
- Eyes with **lids**, **tear** glands present. (Lower lid movable & upper immovable).
- **Middle ear** and **Tympanic membrane present**.
- These have well developed **vocal sacs** i.e. power of voice.
- Fertilization **external** and development through tadpole larva.

e.g. :-

- ***Rana tigrina*** – Indian bull frog.
- ***Bufo*** – Common toad → Poision glands are found in skin which are modification of parotid salivary gland.
- ***Hyla*** – Tree - frog
- ***Rhacophorus*** – Flying frog
- ***Alytes*** – Midwife toad - Parental care is well developed in them. Male toads carry eggs around their limbs till they hatch.
- ***Pipa*** – Surinam toad - Female carries eggs on its back. Secondary vivipary. (Tongue absent)



BEGINNER'S BOX-8

1. Air bladder is present in :-

(1) Dog fish (2) Flying fish (3) Hag fish (4) Electric fish

2. Ampulla of lorenzini are found in :-

(1) *Scoliodon* (2) *Labeo* (3) *Rattus* (4) *Hippocampus*

3. Which of the following fish is a connecting link between cartilaginous and bony fishes

(1) *Chimaera* (2) *Rhineodon* (3) *Latimaria* (4) Whale

4. Australian lung fish is :-

(1) *Scoliodon* (2) *Lepidosiren* (3) *Protopterus* (4) *Neoceratodus*

5. Amphibians have :-

(1) Incomplete double circulation (2) Complete double circulation

(3) Open circulation (4) Single circulation

6. The amphibians are characterized by :-

(1) Only aquatic habit

(2) Monocondylar skull

(3) Scaleless, smooth moist and glandular skin

(4) Claws present at the tip of digits

7. Which of the following are viviparous usually :-

(1) Lung fishes (2) Frog (3) Sharks (4) Bony fishes

8. **"King of Herrings"** is a common name of :-

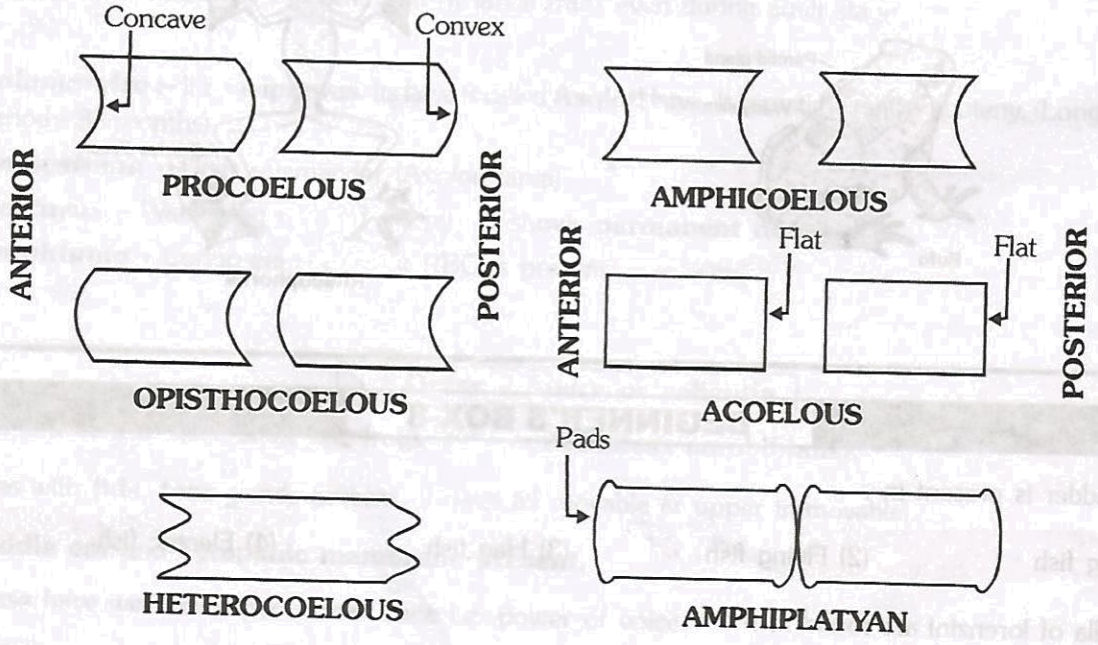
(1) *Scoliodon* (2) *Chimaera* (3) *Torpedo* (4) Neoceratodus

9. The fish that swims vertically :-

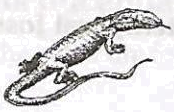
(1) *Scoliodon* (2) *Hippocampus* (3) *Exocoetus* (4) *Syngnathus*

10. **"Water dog"** is –

(1) Salamandra (2) Necturus (3) Alytes (4) Icthyophis



Types of CENTRUM of Vertebrae



REPTILIA

- Class name refer to creeping or crawling mode of Locomotion. (Latin reptum - To creep or Crawl)
- **Mesozoic era** was the Golden age of Reptiles.
- Study of reptiles is known as "**Herpetology**".
- These are **Cold blooded/Poikilothermal animals**.
- Reptiles were the **first successful terrestrial vertebrates** but some are also found in aquatic habitat.
- Body is divided into head, neck, trunk and tail.
- Exoskeleton is made up of horny **epidermal scales** or **scutes**.
- Skin is **dry, cornified, rough and nonglandular,** Snakes & Lizard shed their scales as skin cast.
- Limbs, when present are two pairs and each limb has **five digits**. Each digit has **incurved nails**. (Snakes are limbless)
- A complete alimentary canal is found in these animals, which opens into cloaca.
- Teeth are **acrodont, pleurodent** and **thecodont** type. Tounge is **protrusible**.
- Respiration occurs through **lungs** through out the life.
- Heart is usually **3 chambered** but **4 chambered** in crocodiles, **right and left both systemic arches** are present.
- Sinus venosus is ill developed and trunkus arterious is absent. RBCs are **oval** and **nucleated**.
- Only **one occipital** condyle is present in skull (**monocondyler** skull).
- Ribs are present in neck and thorax region.
- Centrum of vertebrae are **procoelous** type.
- 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 present. They do not have external ear opening. Tympanum represent ear.
- Lateral line system is absent. At the roof/cieling of buccal cavity **Jacobson's organ** (olfactory) is present.
- Ureters, genital ducts and alimentary canal open into a **single cloacal aperture.**
- These are unisexual animals. Fertilization is **internal**.
  One or two penis (Hemipenis) is found in male animals as copulatory organ.
- They are mostly **oviparous**.
- Eggs are leathery and cleidoic, i.e. eggs are covered by a shell made up of $CaCO_3$.
- Development direct i.e. larva stage is absent.
- Parental care is often marked.

GOLDEN KEY POINTS

In reptiles, birds and mammals, All the three embryonic membranes **amnion, chorion** and **allantois** 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 these extra embryonic membranes are absent in them.

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

Class - Reptilia

Living reptiles (2 subclasses)

- Anapsida
  - order
    - Chelonia
- Diapsida
  - order
    - Rhyncocephalia
    - Squamata
    - Crocodilia

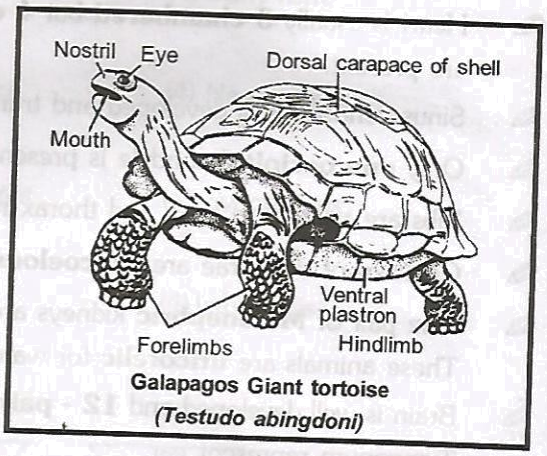
Subclass - Anapsida

- Temporal fossae are absent in the temporal region of the skull i.e. roof of skull is complete.

Order - Chelonia

- They are terrestrial, marine and fresh water animals.
- Whole body is covered by firm bony shell, dorsal plate is called **carapace** and ventral plate called **plastron**.
- Jaws are horny **beak like** and **teeth less.**
- Scales are found on **neck**, **limbs** and **tail**.

  All these three organs can be pushed into the **carapace**.
- Thoracic vertebrae and **ribs** are attached with **carapace**.
- Cloacal aperture is vertical and it helps in respiration (cloacal respiration).
- **Single** copulatory organ is found in male animal.



Galapagos Giant tortoise
(Testudo abingdoni)

e.g. ***Testudo*** – Land tortoise

- ***Trionyx*** – Fresh water Terrapins (Edible)
- ***Chelone*** – Marine Turtles
- ***Kachhuga tactum*** – Roofed tectum.

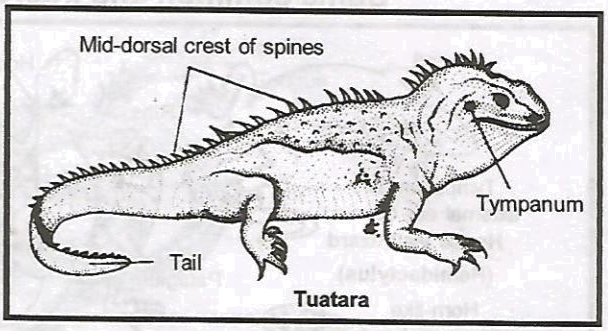
Sub-class - Diapsida

- One pair superior and one pair inferior temporal fossae are found in the temporal region of skull.

Z:\NODE02\2016\17\TARGET\IIO\ENG\MODE-5\01 ANIMAL KINGDOM\04-REPTILES.P65

(a) Order – Rhynchocephalia

- Most of the species of this order are found in the form of fossils. (Extincted)
- Only **Sphenodon punctatum** species is live. It is found in New Zealand only.
- A functional **third eye** or **pineal eye** is found in the head.
- Teeth are **acrodont** type.



e.g. ***Sphenodon punctatum*** – Commonly called Tuatara in local language of **Newzealand. (living fossil)**

(b) Order - Squamata :-

- All the lizards & snakes are included in this order (Largest order).
- Body is covered by epidermal scales.
- Vertebrae are procoelus type.
- Teeth are pleurodont, i.e. teeth are situated at lateral side of jaw bone.
- Copulatory organs are paired (hemipenis).

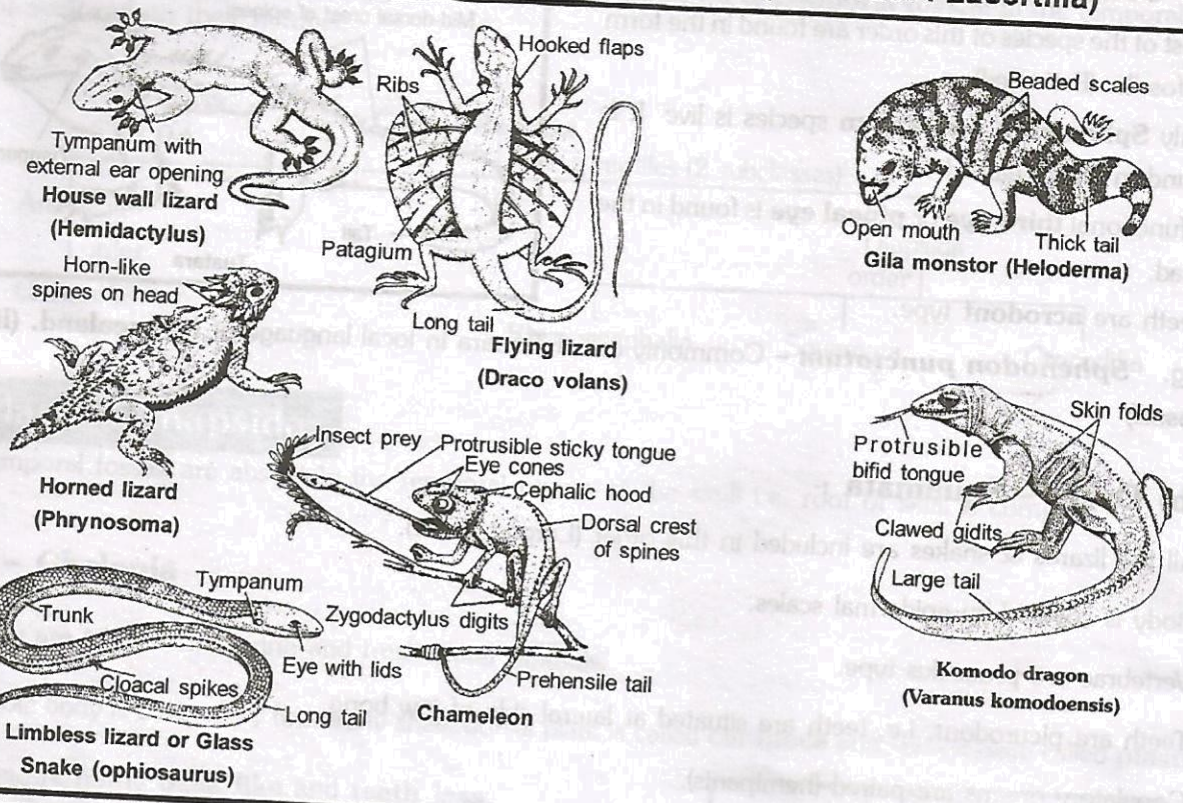
Lizards

- Study of lizards is called **"Saurology"**
- Eyelids are **movable** Lizards have limbs, urinary bladder, tymparum, girdles and nictitating membrane in the eye.
- **Foramen of panizzae** is present in the heart of lizard.

e.g.

1. ***Hemidactylus*** - Common lizard/**wall lizard**. It can shed its own tail at the time of emergency. It is called **autotomy**. Power of regeneration is well marked.
2. ***Calotes*** - **Blood sucker/Garden lizard/Girgit.** It can change its colour according to environment.
3. ***Draco*** - **Flying lizard.** It can glide from one tree to another tree with the help of lateral skin extensions called patagia.
4. ***Chameleon*** - **Tree lizard** (Viviparous)
5. ***Varanus*** - **Goh** or **Monitor lizard.** ***Varanus komodoensis*** –Komodo Dragon is the **Largest living lizard**
6. ***Ophiosaurus*** - It is **limbless lizard**. It is also called **glass - snake**.
7. ***Heloderma*** - **Gila - monster.** It is the **only poisonous lizard**. Its poison glands are modified sublingual salivary glands (Maxico & USA).
8. ***Phrynosoma*** - Horned toad (viviparous)

Some common and interesting lizards (Suborder : Lacertilia)

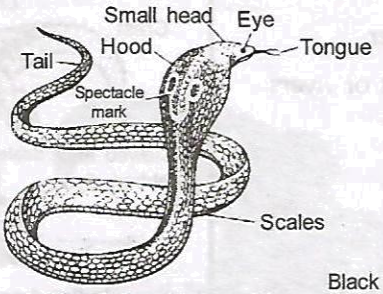


Snakes

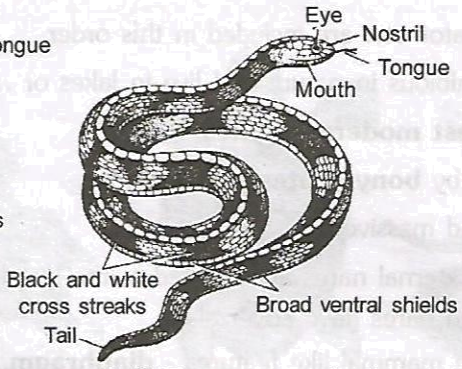
- The study of snakes is called **ophiology** or **serpentology**.
- Girdles and limbs absent **(Limbless)**.
- Eyelids are immovable and nictitating membrane in eyes are absent.
- Urinary bladder **absent.**
- **Tympanum,** middle ear absent.
- Tongue thin, long and **bifid** and sensitive to odour and vibration.
- Left lung is ill developed.

e.g.

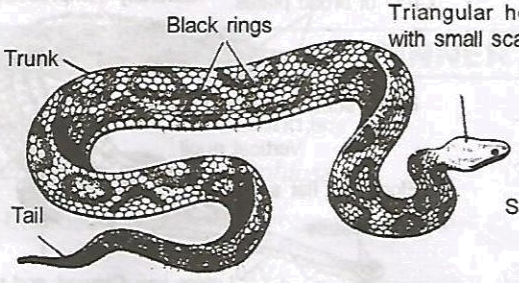
1. ***Python molurus*** - **Ajgar,** the **largest non-poisonous snake** (25 feet). Rudiments of hind limbs are found on the body.
2. ***Ptyas mucosus / Zamenis*** or Rat snake. It is commonly called **Dhaman**. It feeds on rats, so it is also called "Friend of farmers". It is a **non-poisonous** snake.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



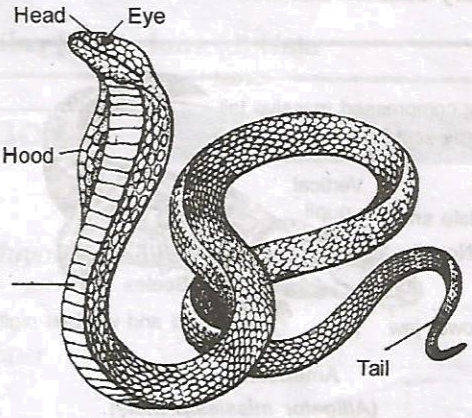
Indian Cobra (*Naja naja*)



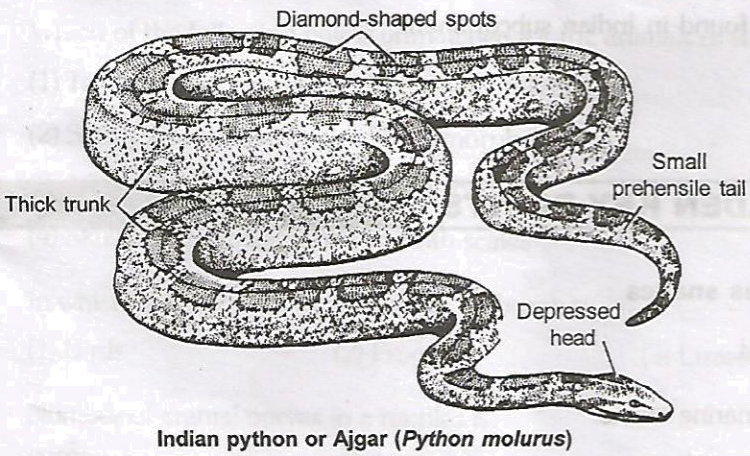
Krait (*Bungarus caeruleus*)



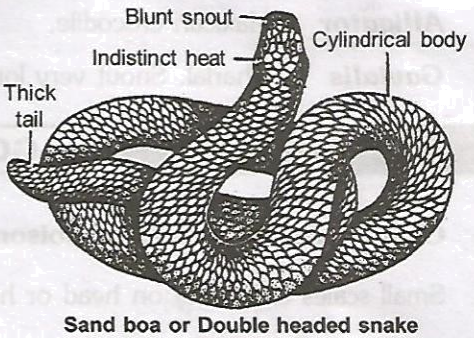
Indian pitless or Russel's (*Vipera russelli*) Viper



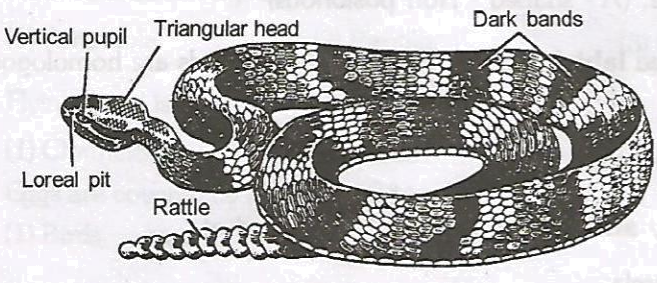
King cobra (*Naja hannah*)



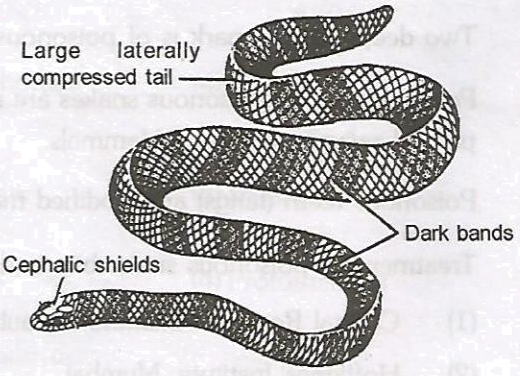
Indian python or Ajgar (*Python molurus*)



Sand boa or Double headed snake (*Eryx johnii*)

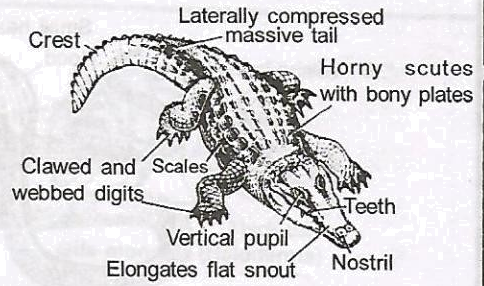


Rattle snake (*Crotalus horridus*)



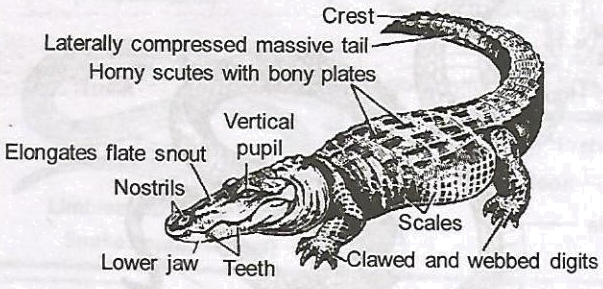
Sea snake (*Hydrophis*)

(c) Order - Crocodilia or Loricata

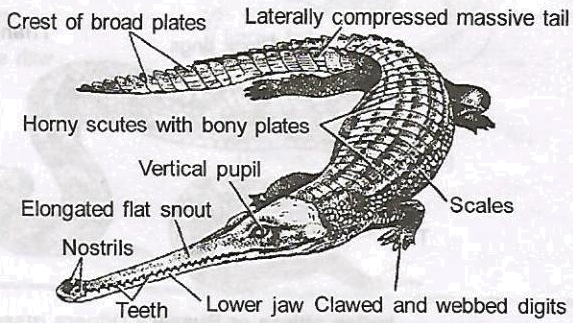


Indian freshwater crocodile
(Crocodylus palustris)

- Crocodiles, alligator etc. are included in this order.
- These are amphibious in nature and live in lakes or rivers.
- These are **largest modern reptiles**.
- Skin is covered by **bony scutes/bony plates.**
- Body is solid and massive.
- Snout is long. External nares are situated at the distal end of snout and nares have cover also.
- They have some mammal like features - **diaphragm**, **thecodont teeth** and **4-chambered heart.**
- Urinary bladder **absent**.



American Alligator
(Alligator mississipiensis)



Gavial or gharial
(Gavialis gangeticus)

e.g.

- ***Crocodilus (Crocodile)*** - It is only found in Indian subcontinent.
- ***Alligator*** - Maxican crocodile.
- ***Gavialis*** - Gharial. Snout very long.

GOLDEN KEY POINTS

Characteristic features of poisonous snakes :-

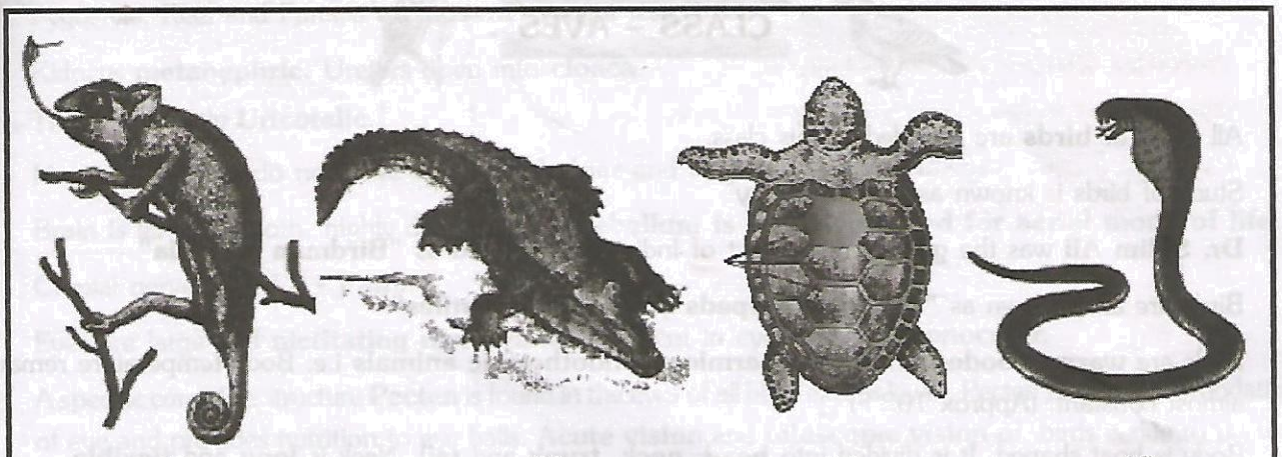
- Small scales are found on head or hood.
- Laterally compressed tail is present in marine snake.
- Ventrally placed scales of the body are broad.

  Two deeper teeth mark is of poisonous snake. (Λ - shaped - Non posionous)
- 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) Hoffkines' Institute, Mumbai.

  Biggest **Serpentorium** is located in India - **Chennai**



(a) (b) (c) (d)

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

BEGINNER'S BOX-9

1. Only poisonous Lizard of the world is:-
(1) *Heloderma* (2) *Ophiosaurus* (3) *Phrynosoma* (4) *Hemidactylus*

2. Which of the following is a non poisonous snake:-
(1) Cobra (2) Eryx (3) Viper (4) Krait

3. Group amniota includes:-
(1) Birds and mammals (2) Birds and reptiles
(3) Mammals and reptiles (4) Reptiles, birds and mammals

4. Which of the following pair is unmatched for the animals of Reptilia class:-
(1) Temperature constant and external fertilisation.
(2) Sexes seperate and lack of Metamorphosis
(3) 12 pairs cranial nerves and skin rough
(4) Skull monocondylic and skin with scales

5. In which of the following tympanum is absent:-
(1) Birds (2) Frog (3) Lizard (4) Snake

6. Number of cranial nerves in a reptiles is:-
(1) 8- pairs (2) 10- pairs (3) 12- pairs (4) 14- pairs

7. Horned toad belongs to:-
(1) Amphibia (2) Reptilia (3) Protochordates (4) Fishes

8. Flying lizard is –
(1) Chameleon (2) Draco (3) Exocetus (4) Varanus

9. Eggs are covered by leathery shell in:-
(1) Birds (2) Amphibians (3) Snakes (4) Prototherians

10. The glass snake is a:-
(1) Limb less amphibian (2) Limbless lizard (3) White snake (4) Limbless fish

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 characterstic 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 makes 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 suppliment respiration.
- Sound producing organ at the junction of trachea and bronchi of birds is called **syrinx**.
- Heart is four **chambered**. Double circulation is found.
- Hepatic portal system is well developed in birds, but renal portal system is ill developed. Sinus venosus is absent. **Only Right aortic arch is** present. R.B.Cs are **nucleated**.
- Endoskeleton is **fully ossified (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**.
- Centrum of the vertebra is **heterocoelous**.
- **Last four caudal vertebrae fuse** to form **pygostyle**. Which helps in wagging of tail.
- Sternum is large. Swollen basal part of sternum is called "**Keel**" This keel offers sites for attachment of **flight muscles**.
- Ribs of birds are **bifid and uncinate processes are present in ribs.**
- Two bones, **clavicle** and **interclavicle** fuse to form **V - shaped bone called furcula** or **Wish bone** or **Merry thought bone**. Which Act as a spring between two pectoral girdles.

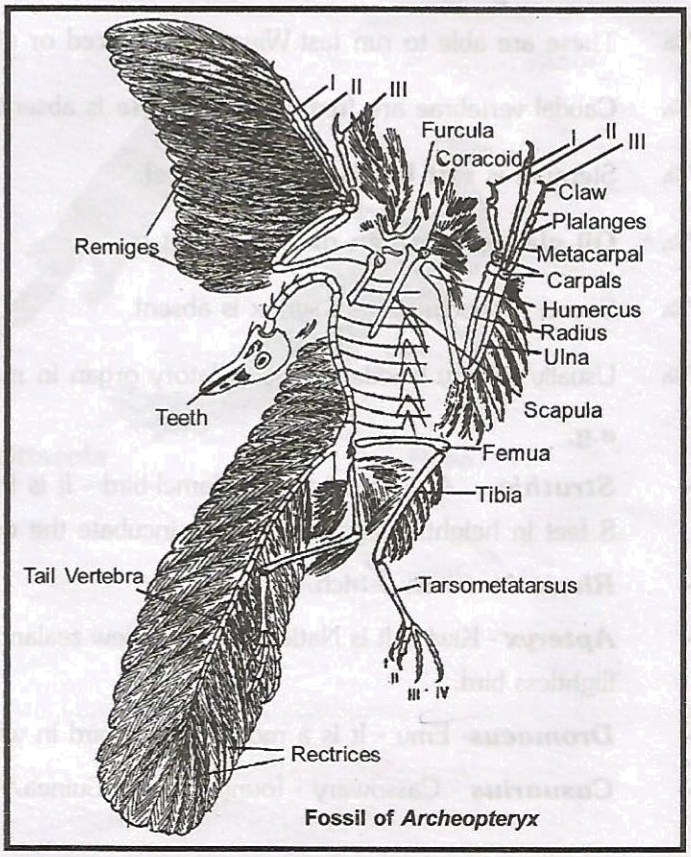
- Pygostyle, Keel and Furcula are **absent** in flight less birds.
- Kidneys **metanephric.** Ureters open into **cloaca**.
  They are mostly **Uricotelic**.
- Most of the birds do not have **urinary bladder** and **copulatory organ.**
- Brain is large, smooth, highly developed. **Cerebellum is well 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's. 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. Copulatory organ absent in males.
- Fertilization is **internal**. They are oviparous and development is direct.
- All the birds form nests. **Parental care** is well marked.

Class Aves is divided into 2 subclasses :-
(a) Archaeornithes **(b) Neornithes**

(a) Subclass - Archaeornithes

- It includes extinct birds or toothed birds of Jurassic period.
- Wings are ill developed, i.e. capacity of flying was very less.
- Bones were non-pneumatic.
- **Pygostyle** and keel were **absent**.
- There were present 3 - 3 clawed digits of forelimb at the free edges of wings.
- **Teeth** were present in the jaws of skull.
- They are considered as the **connecting links** between **reptiles** and **birds**.

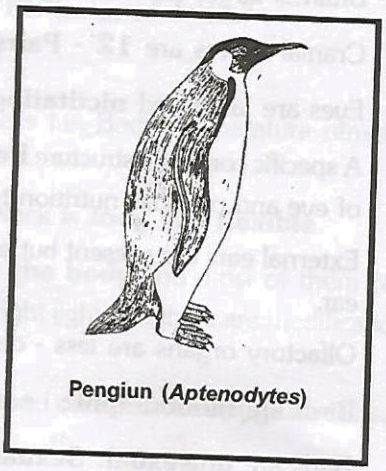
e.g. : ***Archaeopteryx*** **- Lizard bird**. (Extinct in Cretaceous period) Its fossil was discovered by Andreas Wagner in 1861 from Bavaria (Germany).



Fossil of *Archeopteryx*

(b) Sub class – Neornithes

- This subclass includes mostly live animals and **extinct** animals of post jurassic period.
- Wings are well developed which are used in flying (except some birds)
- Bones are pneumatic.
- **Pygostyle** and **Keel** present.
- Digits of forelimbs are fused and claws absent.
- They have **toothless beak.**



Pengiun (*Aptenodytes*)

This subclass is classified under three superorders :-

(i) Super order - Impennae

- It includes **aquatic and marine birds.**
- **forelimbs** are modified into **flippers** for swimming.
- **Sternum** without **keel.**

e.g.

- **Aptenodytes** – Penguin, also called "**sea bird of Antarctica**"

(ii) Super order - Palaeognathae or Ratitae

- It includes large and massive birds, which are flightless in nature.
- These are able to run fast.Wings are reduced or absent.
- Caudal vertebrae are free and **pygostyle** is absent.
- Sternum is **raft like** which lacks **Keel**.
- **Oil glands** or **preen glands** absent.
- Sound producing organ syrinx is absent.
- Usually urinary bladder and copulatory organ in males present.

e.g.

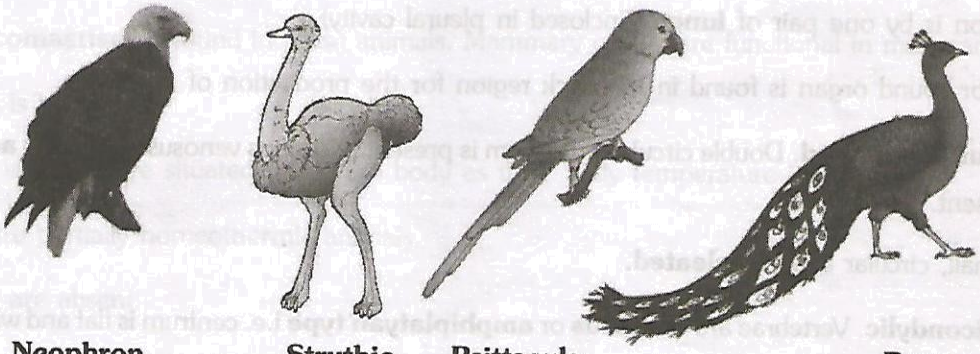
- ***Struthio*** - African ostrich or Camel-bird - It is the **largest living bird** of modern period. It is almost 8 feet in height. Polygamous, male incubate the eggs (Largest eggs).
- ***Rhea***- American ostrich.
- ***Apteryx*** - Kiwi - It is National bird of New zealand. It has hair like feathers all over its body. It is smallest flightless bird.
- ***Dromaeus***- Emu - It is a monogamous bird in which only males look after their young ones and eggs.
- ***Casuarius*** - Cassowary - found in New Guinea/Australia.

(iii) Super order - Neognathae or Carinatae

- It includes small sized **flight birds** of modern era. Wings are well developed
- **Pygostyle** is present
- **Keel** in sternum is highly developed.
- Oil glands or preen glands are found.
- Sound producing **syrinx** is present.
- Urinary bladder and copulatory organ absent.

e.g.

- ***Pavo - cristatus*** - Peacock - It is the national bird of India.
- ***Psittacula*** - Indian parrot. (Upper jaw movable)
- ***Columba livia*** - Blue rock pigeon - Its crop glands secrete pigeon milk
- ***Neophron*** - Vulture (Scavenger bird)
- ***Passer domesticus*** - Sparrow - It shows commensalism with man.
- ***Corvus splendens*** - Crow
- ***Diomedea*** - ***Albatross*** - Marine bird with **largest wings** in flying birds.
- ***Helena*** - Humming bird or sunbird. It is the smallest flying bird. It is found in cuba. It can fly in forward and backward both the directions.It can fly like helicoptor. Its size is about 3 to 4 cm.
- ***Micropodus*** - Pitohui/pathua - It is the only one poisonous bird, which is found in New guinea.
- ***Swift spine tailed*** - Fastest flying bird, it is found in **Japan**.



Neophron **Struthio** **Psittacula** **Pavo**

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.**
- The most unique mammalian characterstic is the presence of milk producing glands **(mammary glands)** by which the young ones are nourished.
- A horizontal, **diaphragm** is present in between thorax and abdomen of all the members without any exception. Diaphragm helps in **respiration, defaecation, micturition** and **parturition**.
- The skin of mammals is unique in possessing **hair.**
- Skin of mammals is thick and glandular. So many types of glands are present in the skin as **sweat glands**, **sebaceous glands** and **mammary glands**. (Mostly modified sweat gland)
- Two pairs of limbs are present in trunk. Limbs are **pentadactyl** which help in swimming, walking, running etc. **Hind limbs** are **absent** in some aquatic mammals.
- Alimentary canal is **complete.** Anus and urinogenital apertures are separate. Cloaca is absent
- Teeth are **Thecodont** (embeded in boy 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**. Vertebrae are **acoelous** or **amphiplatyan type** i.e. centrum is flat and with cartilaginous pads at both the sides.
- Neck is having **7 cervical vertebrae except** : **Bradypus/Sloth** has **9 or 10** cervical vertebrae and **Sea - cow/Manatee** has **6** cervical vertebrae.
- Ribs are **bifid**. (Bicephalic)
- 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)
- Mid brain consists of 4 solid optic lobes collectively known as **corpora quadrigemina**.
- Cranial nerves are 12 - **pairs**
- External ear is present in the form of **ear pinna.**
- **Malleus**, **Incus** and **stapes** are the three ear ossicles in middle ear.
- Mammals are **unisexual** animals. Testes of males are situated outside the abdominal cavity in the **scrotal sacs**. A distinct penis is present in males for copulation.
- Fertilization is **internal** and it takes place in **fallopian tubes**.
- Embryo is attached with the uterus of mother by placenta in higher mammals, so these animals are also called **placental** animals.
- Mostly mammals are **viviparous**, which give birth to their young ones. Some mammals are **oviparous** [Prototherians].
- Parental care is well marked in mammals. Mother feeds the child by milk secreted by her mammary glands and looks after her child.
- Livings mammals are classified into following 3 groups :-

(i) Prototherians or Monotremes

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

e.g. : *Ornithorhynchus* (Duck billed platypus) :- Poison glands are present in the claws of **male platypus**. It is oviparous mammal.

- **Echidna/Tachyglossus (spiny ant-eater).**

(iii) Metatherians or Marsupials

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

e.g.

- ***Macropus*** – Kangaroo – Found in Australia only. Saltatorial locomotion.
- ***Didelphys*** – Opossum – It has Shortest gestation period (12–13 days).

(iii) Eutherians

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

Ex. of Eutherians

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

(2) **Camelus (Camel)**

(3) **Macaca (Monkey)**

(4) **Rattus (Rat)**

(5) **Canis (Dog)**

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

(7) **Panthera leo = Lion**

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

(9) **Zalopus = Sea lion**

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

(10) **Delphinus = Common dolphin**

(11) ***Balaenoptera musculus*** - Blue whale – Found in **Antarctic ocean**. A Horny sheet called **Baleen** plate (for filtration) is found in upper jaw instead of teeth. Milk is squirted down to the throat of baby by the muscle contraction of mother. **Retea mirabile** is found in thoracic region which helps in **respiration** in under water.

(12) ***Orcinus*** - Killer whale.

(13) ***Physeter*** - Sperm whale – From its stomach **Ambergris** is secreted which is used in making perfumes.

Order of fish like marine mammals is called **Cetacea** in which whale, dolphin are included. They have no hind limb, Hair, Ear Pinna.

7. Which of the following group of animals have monocondylar skull:-
(1) Amphibia & mammals (2) Reptilia & mammals
(3) Aves & mammals (4) Reptilia & aves

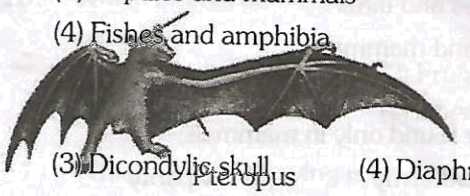
8. *Archaeopteryx* shows the characters of:-
(1) Reptiles and birds (2) Reptiles and mammals
(3) Birds and mammals (4) Fishes and amphibia

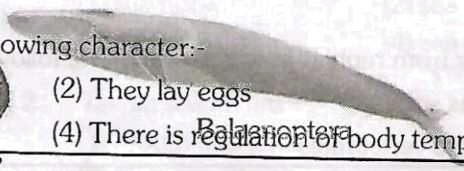
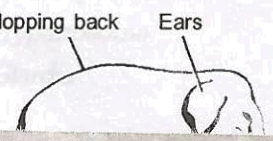
9. Character found only in mammals:-
(1) Homeothermy (2) Viviparity (3) Dicondylic skull (4) Diaphragm

10. Birds differ from reptiles in which one of the following character:-
(1) Skin has scales (2) They lay eggs
(3) There are vertebrates (4) There is regulation of body temperature

(14) ***Elephas*** - Indian elephant
(15) ***Loxodonta***- African elephant, it is the **largest living land animal.**
(16) **Horse = Equus[Odd toed animals]**
(17) **Rhinoceros = Single horn Genda.** It is found in kaziranga national park, assam.
(18) **Hippopotamus = River horse.**





Ornithorhynchus Macropus Pteropus Balaenoptera

Slopping back Ears Long mane Small head Fibrous horn

ANSWER KEY

BEGINNER'S BOX-1

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

BEGINNER'S BOX-2

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

BEGINNER'S BOX-10

1. has poison glands:-
(1) Male platypus (2) Female lizard (3) Male rabbit (4) Male rat

BEGINNER'S BOX-3

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

BEGINNER'S BOX-4

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

2. External ear pinna is found in:-
(4) Fishes

BEGINNER'S BOX-5

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

3. Respiratory organs of whale are:-

BEGINNER'S BOX-6

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

4.

BEGINNER'S BOX-7

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

morphism absent (2) Bisexual and sexual dimorphism absent
(3) Unisexual and sexual dimorphism present (4) Bisexual and sexual dimorphism present

BEGINNER'S BOX-8

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

5. rs in the eyes of:-
(4) Mammals

BEGINNER'S BOX-9

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

6. Furculum, synsacrum and pygostyle are characteristic of :-

BEGINNER'S BOX-10

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