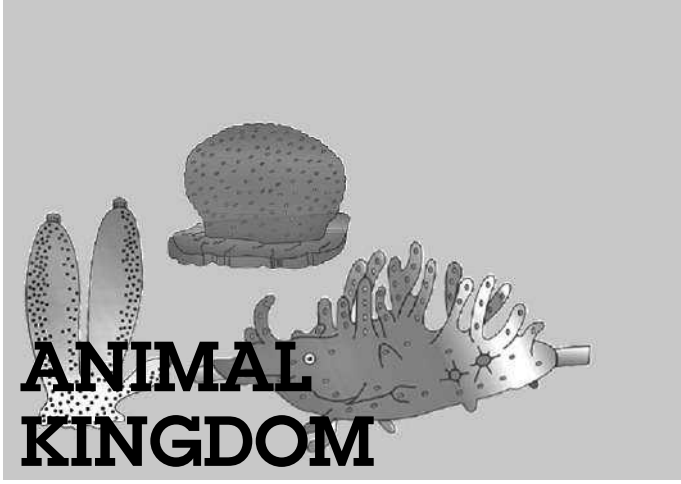
CHAPTER

4 ANIMAL KINGDOM



Chapter Objectives

➢ *Basis of Classification, Classification of animals upto phyla level (non-chordates) and class level (chordates)*

TOPIC-1
Basis of Classification

Quick Review

TIPS and TRICKS...

- *Basis of Classification should be learnt upto phyla level for non-chordates and, Class level for chordates by the help of flowchart and examples.*
- *Learn to write the biological names with correct spellings according to the rules of binomial nomenclature.*
- *Students should learn the differences point wise and in a tabular form along with examples for better understanding and retention.*
- *Always use biological/technical terms rather than common names. Use correct spelling of biological terms.*
- *Practice writing all definitions emphasizing on operative terms.*

❖ **Basis of Classification**

- Animals are classified on the basis of following fundamental features :
  - **Levels of Organisation**
    1. All members of Kingdom Animalia are multicellular, but all of them do not exhibit the same pattern of organisation of cells.
    2. In some animals like sponges, the cells are arranged as loose cell aggregates, but they do not form tissues. This type of body organisation is called as **cellular level of organisation.** In this type of organisation, some division of labour (activities) occur among the cells.
    3. In coelenterates, the cells are arranged in more complex manner. Here, the cells performing the same function are arranged into tissues. This type of level of organisation is called **tissue level of organisation.**
    4. In organ level of organisation, tissues are grouped together to form organs, each specialised for a particular function. **Organ level organisation** is exhibited by members of Platyhelminthes.
    5. In higher animals like Annelids, Arthropods, Molluscs, Echinoderms and Chordates, organs have associated to form functional systems. Each system is associated with a specific physiological function. This pattern of level of organisation is called **organ system level of organisation.**
    6. Organ systems in different groups of animals exhibit various patterns of complexities.
  - The digestive system in Platyhelminthes has only a single opening to the outside of the body which serves as both mouth and anus. This type of digestive system is called **incomplete**. In contrast to this, complete digestive system has two openings, mouth and anus.
  - In animals, circulatory system is of two types – **open circulatory system** and **closed circulatory system**. In **open circulatory system**, blood is pumped out of the heart and the cells and tissues are directly bathed in it whereas in **closed circulatory system**, blood is circulated through a series of vessels of varying diameters (arteries, veins and capillaries).
  - **Symmetry**
    1. In some animals like sponges, any plane that passes through the centre does not divide them into equal halves. Such type of animals are called **asymmetrical**.

2. In some animals like coelenterates, ctenophores and echinoderms, any plane passing through the central axis of the body divides the organism into two identical halves. Such animals are said to have radial **symmetry**.
3. In animals like annelids, arthropods, etc., body can be divided into identical left and right halves in only one plane. Such organisms are said to have **bilateral symmetry**.

❖ **Diploblastic and Triploblastic Organisation**
- In some animals like coelentrates, cells are arranged in two embryonic layers – an external ectoderm and an internal endoderm. Such animals are called **diploblastic animals**. These animals also have an undifferentiated layer, called mesoglea, in between the ectoderm and the endoderm.
- In contrast to above, the developing embryo of the members belonging from phylum platyhelminthes to phylum chordata has a third germinal layer in between the ectoderm and endoderm. This additional layer is called mesoderm and the animals having such characteristics are called **triploblastic animals**.

❖ **Coelom**
- The body cavity lined by mesoderm is called coeloem. Animals which possess coelom are called **coelomates**. Annelids, molluscs, arthropods, echinoderms, hemichordates and chordates are the examples of coelomates.
- In some animals, mesoderm is present in the form of pouches in between the ectoderm and endoderm. Because of this mesoderm does not line the body cavity. This type of body cavity is called **pseudocoelom** and the animals possessing this type of coeloem are called pseudocoelomates. Aschelminthes are pseudocoelomates.
- The animals belonging to phylum platyhelminthes do not have body cavity. Such type of animals are called **acoelomates**.

❖ **Segmentation**
- In some animals, the body is externally and internally divided into segments with a serial repetition of at least some organs. For example, in earthworm, the body shows metameric segmentation and the phenomenon is known as **metamerism**.

❖ **Notochord**
- It is a rod-like structure formed during embryonic development in some animals. Notochord is derived from the mesoderm and located on the dorsal side. Animals possessing notochord are called **chordates** and the animals which lack notochord are called **non-chordates**.

Multiple Choice Questions **(1 mark each)**

Q. 1. In some animal groups, the body is found divided into compartments with at least some organs/ organ repeated. This characteristic feature is named
(i) Segmentation
(ii) Metamerism
(iii) Metagenesis
(iv) Metamorphosis
[NCERT Exemplar, Q. 1, Page 14]

Ans. Correct option : (ii)
Explanation : Segments in such animals are called metameres and this phenomenon is called metamersim.

Q. 2. Body cavity is the cavity present between body wall and gut wall. In some animals, the body cavity is not lined by mesoderm. Such animals are called
(i) Acoelomate
(ii) Pseudocoelomate
(iii) Coelomate
(iv) Haemocoelomate
[NCERT Exemplar, Q. 12, Page 16]

Ans. Correct option : (ii)
Explanation : Body cavity is not lined by mesoderm. Such animals are called Pseudocoelomate.

Short Answer Type Questions **(3 marks each)**

Q. 1. Differentiate between :
(i) Open circulatory system and closed circulatory system
(ii) Oviparous and viviparous characteristics of animals
(iii) Direct development and indirect development
[NCERT Exemplar, Q. 1, Page 18]

Ans. (i) Differences between open circulatory system and closed circulatory system :

Open circulatory system	Closed circulatory system
(i) In this, the blood is pumped by the heart into the blood vessels that open into blood spaces called sinuses.	In this type of circulation, the blood is pumped by the heart into closed blood vessels.
(ii) Blood is in direct contact with tissue cells.	Blood does not come in direct contact with tissue cells.

(iii) *e.g.* Arthropods and Molluscs.	*e.g.* Annelids and Chordates.

(ii) Differences between oviparous and viviparous characteristics of animals

Oviparous characteristics of animals	Viviparous characteristics of animals
(i) It is the phenomenon in which animals lay eggs, which develop outside the mother's body.	It is the phenomenon in which development of foetus occurs inside the mother's body and a young one is born.
(ii) *e.g.* Fishes, reptiles, amphibians, birds etc.	*e.g.* Mammals.

(iii) Differences between direct development and indirect development

Direct development	Indirect development
(i) It is a type of development in which there is no intermediate stage in the life cycle of the egg and the adult.	It is a type of development in which the young one passes through one or more intermediate stages before becoming an adult.
(ii) The young one resembles the adult in all aspects except colour and size.	The young ones do not resemble the adults.
(iii) *e.g.* Mammals	*e.g.* Echinoderms and arthropods

TOPIC-2
Classification of Animals

Quick Review

- **Phylum Porifera**
  - Members of this phylum are commonly known as sponges.
  - Most of them are marine and **asymmetrical** animals.
  - They are primitive multicellular animals with cellular level of organisation.
  - Body wall is two layered – outer dermal layer called **pinacoderm** and inner gastral layer called **choanoderm**.
  - Flat cells called **pinacocytes** are present in the pinacoderm and specialised flagellated cells called **collar cells or choanocytes** are present in the choanoderm.
  - They possess a large cavity called **spongocoel,** which opens to outside through a pore called **osculum**. Choanocytes line the spongocoel.
  - They have a water canal system. Water enters through minute pores called **ostia** in the spongocoel and from the spongocoel goes out through the osculum. The canal system helps in gathering of food, respiratory exchange and removal of waste.
  - The body is supported by a skeleton made up of spicules or spongin fibres.
  - Digestion is intracellular.
  - They are hermaphrodite *i.e.*, male and female sex organs are present on the same individual.
  - They reproduce by asexual and sexual reproduction. Asexual reproduction takes place through fragmentation and sexual by formation of gametes. Fertilization is internal.
  - Development is indirect and involves a larval stage which is morphologically distinct from the adult.
  - Examples : *Sycon* (Scypha), *Spongilla* (fresh water sponge) and *Euspongia* (bath sponge).
- **Phylum- Coelenterata (Cnidaria)**
  - They are aquatic, mostly marine, sessile or free-swimming animals.
  - They possess radial symmetry.
  - They exhibit tissue level of organisation.
  - They are diploblastic.
  - They possess special cells called **cnidoblasts** or **cnidocytes** on the tentacles and the body. These cells help in anchorage, defense and capturing of prey.
  - They have a central gastro-vascular cavity with a single opening called **hypostome**. Digestion is extracellular and intracellular.

- ❖ Some of the coelentrates like corals possess a skeleton composed of calcium carbonate.
- ❖ Coelentrates show two basic body forms – polyp and medusa.
  - **Polyp form :** It is the sessile and cylindrical form which is observed in *Hydra* and *Adamsia*.
  - **Medusa form :** It is the umbrella-shaped and free-swimming form which is observed in *Aurelia* or jelly fish.
- ❖ Some coelentrates *e.g.*, *Obelia* exist in both forms. These coelentrates exhibit phenomenon of alternation of generation (metagenesis). Polyp form reproduces asexually to produce medusae and medusa form reproduces sexually to produce polyps.
- ❖ Common examples of coelentrates are *Physalia* (Portuguese man-of-war), *Adamsia* (Sea anemone), *Pennatula* (Sea-pen), *Gorgonia* (Sea-fan) and *Meandrina* (Brain coral).

■ **Phylum – Ctenophora**

- ❖ Members of this phylum are commonly known as **sea walnuts** or **comb jellies**.
- ❖ They are exclusively marine and possess radial symmetry.
- ❖ They are diploblastic organisms with tissue level of organisation.
- ❖ Their body bears eight external rows of ciliated comb plates which help in locomotion.
- ❖ They exhibit the phenomenon of bioluminescence (the property of a living organism to emit light).
- ❖ Digestion is both extracellular and intracellular.
- ❖ They are hermaphrodite. They reproduce only by sexual means. Fertilisation is external and development is indirect.
- ❖ Common examples of ctenophores are *Pleurobrachia* and *Ctenoplana*.

■ **Phylum – Platyhelminthes**

- ❖ The members belonging to this phylum have dorso-ventrally flattened body. Because of this, they are also called as **flatworms**.
- ❖ They possess bilateral symmetry.
- ❖ They are triploblastic and acoelomate animals with organ level of organisation.
- ❖ Most of them are endoparasites. They possess hooks and suckers to attach and absorb digested food from the host.
- ❖ Specialised cells called **flame cells** are present in them. These cells help in osmoregulation and excretion.
- ❖ They are hermaphrodite.
- ❖ Fertilisation is internal and development is through many larval stages.
- ❖ Common examples of flat worms are *Taenia* (Tapeworm) and *Fasciola* (Liver fluke).

■ **Phylum – Aschelminthes**

- ❖ As their body is circular in cross-section, they are also known as roundworms.
- ❖ They are found in variety of habitats. For example, some of them are aquatic, some are terrestrial and some are parasitic in plants and animals.
- ❖ They have organ-system level of body organisation.
- ❖ They possess bilateral symmetry.
- ❖ They are triploblastic and pseudocoelomate animals.
- ❖ They possess complete digestive system with well developed muscular pharynx.
- ❖ They have an excretory tube which removes body wastes from the body cavity through the excretory pore.
- ❖ They are dioecious, *i.e.*, males and females are distinct. Usually females are longer than males.
- ❖ Fertilisation is internal and development may be direct or indirect.
- ❖ Some examples of aschelminthes are *Ascaris* (Round Worm), *Wuchereria* (Filarial worm) and *Ancylostoma* (Hookworm).

■ **Phylum – Annelida**

- ❖ They may be aquatic (marine and freshwater) or terrestrial; free-living, and sometimes parasitic.
- ❖ They have organ-system level of body organisation.
- ❖ They have bilateral symmetry.
- ❖ They are triploblastic and coelomate animals.
- ❖ Their body surface is distinctly marked out into segments or metameres.

- ❖ They possess longitudinal and circular muscles which help in locomotion.
- ❖ Aquatic annelids like *Nereis* possess lateral appendages called **parapodia** which help in swimming.
- ❖ They possess closed circulatory system.
- ❖ Nephridia (sing. nephridium) help in osmoregulation and excretion.
- ❖ Neural system consists of paired ganglia connected by lateral nerves to a double ventral nerve cord.
- ❖ Some of them such as *Nereis* is dioecious, while some such as earthworms and leeches are monoecious.
- ❖ They reproduce by sexual means.
- ❖ Common examples of annelids are *Nereis*, *Pheretima* (Earthworm) and *Hirudinaria* (Blood sucking leech).

■ **Phylum Arthropoda**

- ❖ This is the largest phylum of kingdom Animalia which includes insects.
- ❖ More than two-thirds of all named species on earth are arthropods.
- ❖ They have organ-system level of organisation.
- ❖ They have bilateral symmetry.
- ❖ They are triploblastic, segmented and coelomate animals.
- ❖ Their body is covered by chitinous exoskeleton.
- ❖ The body is divisible into three parts – head, thorax and abdomen.
- ❖ They have jointed appendages.
- ❖ They have gills, book gills, book lungs or tracheal system as respiratory organ.
- ❖ They have open circulatory system.
- ❖ They possess sensory organs like antennae and eyes.
- ❖ They have malpighian tubules as excretory organ.
- ❖ Most of them are dioecious and oviparous.
- ❖ Fertilisation is usually internal. Development may be direct or indirect.
- ❖ Some of the arthropods such as *Apis* (Honey bee), *Bombyx* (Silkworm), *Laccifer* (Lac insect) are economically important insects while some other insects like *Anopheles*, *Culex* and *Aedes* (Mosquitoes) are vectors, and some insects like *Locusta* (Locust) are pest, *Limulus* (King crab) is a living fossil.

■ **Phylum – Mollusca**

- ❖ This is the second largest phylum of Kingdom Animalia.
- ❖ Molluscs are terrestrial or aquatic (marine or freshwater) organisms.
- ❖ They have an organ-system level of organisation.
- ❖ Their body is bilaterally symmetrical.
- ❖ They are triploblastic and coelomate animals.
- ❖ They have soft and unsegmented body covered by a calcareous shell.
- ❖ Their body is differentiated into head, muscular foot and visceral hump. A soft and spongy layer of skin forms a mantle over the visceral hump. The space between the hump and the mantle is called the mantle cavity.
- ❖ The anterior region of the head bears sensory tentacles. The mouth contains a rasping organ for feeding, called radula.
- ❖ In terrestrial forms, respiration takes place through lungs and in aquatic forms respiration takes place through feather-like gills which are present in the mantle cavity.
- ❖ Molluscs are usually dioecious and oviparous with indirect development.
- ❖ Common examples of molluscs are *Pila* (Apple snail), *Pinctada* (Pearl oyster), *Sepia* (Cuttlefish), *Loligo* (Squid), *Octopus* (Devil fish), *Aplysia* (Sea- hare), *Dentalium* (Tusk shell) and *Chaetopleura* (Chiton).

■ **Phylum – Echinodermata**

- ❖ The echinoderms are marine organisms which have an endoskeleton of calcareous ossicles.
- ❖ They have organ-system level of organisation.
- ❖ The echinoderms, in larval stage, are bilaterally symmetrical but adults are radially symmetrical.
- ❖ They are triploblastic and coelomate animals.
- ❖ The digestive system is complete. The mouth is situated on the lower (ventral) side and anus is present on the upper (dorsal) side.
- ❖ Their unique characteristic is presence of water vascular system. This sytem helps in locomotion, capture and

transport of food and respiration.

- ❖ Echinoderms lack excretory system.
- ❖ They reproduce by sexual means. Sexes are separate.
- ❖ Fertilization is usually external and development is indirect with free-swimming larva.
- ❖ Common echinoderms are *Asterias* (Star fish), *Echinus* (Sea urchin), *Antedon* (Sea lily), *Cucumaria* (Sea cucumber) and *Ophiura* (Brittle star).

■ **Phylum – Hemichordata**

- ❖ It was earlier considered as a sub-phylum under phylum Chordata. But now it is considered as a separate phylum under non-chordata.
- ❖ This phylum incorporates worm-like marine animals with organ-system level of organisation.
- ❖ Hemichordates are bilaterally symmetrical, triploblastic and coelomate animals.
- ❖ Their body is cylindrical and differentiated into an anterior proboscis, a collar and a long trunk.
- ❖ They have open circulatory system.
- ❖ They respire through gills.
- ❖ Proboscis gland is their excretory organ.
- ❖ Sexes are separate. Fertilization is external and development is indirect.
- ❖ Common hemichordates are *Balanoglossus* and *Saccoglossus*.

Multiple Choice Questions (1 mark each)

Q. 1. Given below are types of cells present in some animals. Each one is specialized to perform a single specific function except

(i) Choanocytes

(ii) Interstitial cells

(iii) Gastrodermal cells

(iv) Nematocytes

[NCERT Exemplar, Q. 2, Page 14]

Ans. Correct option : (ii)

Explanation : Other cells in the options cannot differentiate. But interstitial cells in testes and ovary can differentiate.

Q. 2. Which one of the following statements is incorrect?

(i) Mesoglea is present in between ectoderm and endoderm in *Obelia*.

(ii) Radial symmetry is found in *Asterias*

(iii) *Fasciola* is a pseudocoelomate animal

(iv) *Taenia* is a triploblastic animal

[NCERT Exemplar, Q. 7, Page 15]

Ans. Correct option : (iii)

Explanation : *Fasciola* is a coelomate animal.

Q. 3. Which one of the following statements is incorrect?

(i) In cockroaches and prawns excretion of waste material occurs through malpighian tubules.

(ii) In ctenophors, locomotion is mediated by comb plates.

(iii) In Fasciola flame cells take part in excretion

(iv) Earthworms are hermaphrodites and yet cross fertilization take place among them.

[NCERT Exemplar, Q. 8, Page 14]

Ans. Correct option : (i)

Explanation : In cockroaches and prawns excretion of water materials occurs through malpighian tubules.

Q. 4. Match the following list of animals with their level of organisation.

Division of Labour	Animal
(i) Organ level	(A) *Pheretima*
(ii) Cellular aggregate level	(B) *Fasciola*
(iii) Tissue level	(C) *Spongilla*
(iv) Organ system level	(D) *Obelia*

Choose the correct match showing division of labour with animal example.

(i) i-B, ii-C, iii-D, and iv-A

(ii) i-B, ii-D, iii-C, and iv-A

(iii) i-B, ii-C, iii-D, and iv-A

(iv) i-A, ii-D, iii-C, and iv-B

[NCERT Exemplar, Q. 11, Page 15]

Ans. Correct option : (iii)

Explanation : Organ level is seen in *Obelia*, Organ system level is seen in *Pheretima* and Cellular aggregate level is seen in *Spongilla*.

Q. 5. Match the column A with column B and choose the correct option.

Column A	Column B
A. Porifera	(i) Canal system
B. Aschelminthes	(ii) Water-vascular system
C. Annelida	(iii) Muscular Pharynx
D. Arthropoda	(iv)Jointed appendages
E. Echinodermata	(v) Metameres

(i) A-ii, B-iii, C-v, D-iv, E-i
(ii) A-ii, B-v, C-iii, D-iv, E-i
(iii) A-i, B-iii, C-v, D-iv, E-ii
(iv) A-i, B-v, C-iii, D-iv, E-ii

[NCERT Exemplar, Q. 13, Page 16]

Ans. Correct option : (iii)

Explanation : Canal system is present in Porifera, Muscular pharynx is present in Aschelminthes , Matamoras is present in Annelida, Jointed appendages is present in Arthropoda and water vascular system is present in Echinodermata.

Very Short Answer Type Questions (1 & 2 marks each)

Q. 1. Identify the phylum in which adults exhibit radial symmetry and larva exhibit bilateral symmetry.

[NCERT Exemplar, Q. 1, Page 17]

Ans. Phylum Echinodermata

Q. 2. What is the importance of pneumatic bones and air sacs in Aves?

[NCERT Exemplar, Q. 2, Page 17]

Ans. In birds, pneumatic bones or hollow bones filled with air cavities reduce the body weight, which help in flight.
Air sacs serve as reservoirs of air and regulates body temperature.

Q. 3. What is metagenesis? Mention an example which exhibits this phenomenon.

[NCERT Exemplar, Q. 3, Page 17]

Ans. Metagenesis is the phenomenon of alternation of generation shown by cnidarians which exhibit both forms-polyp and medusa. Polyps produce medusae asexually and medusae form the polyps sexually. E.g. *Obelia*.

Q. 4. Which group of chordates possess sucking and circular mouth without jaws?

[NCERT Exemplar, Q. 5, Page 17]

Ans. In Cyclostomata, mouth is circular and jawless

Q. 5. Give one example each for an animal possessing placoid scales and that with cycloid scales.

[NCERT Exemplar, Q. 6, Page 17]

Ans. Placoid scales are characteristic of cartilaginous fishes (e.g., *Scoliodon*).
Cycloid scales are found in bony fishes (e.g., *Catla catla, Exocoetus*).

Q. 6. Mention one example each for animals with chitinous exoskeleton and those covered by a calcareous shell.

[NCERT Exemplar, Q. 8, Page 17]

Ans. Chitinous exoskeleton is the characteristic of arthropoda (*e.g.* Cockroach, termite etc.)
Calcareous shell is present in molluscs (*e.g.* snail and *Pila*)

Q. 7. What is the role of radula in molluscs?

[NCERT Exemplar, Q. 9, Page 17]

Ans. Radula is a rasping organs having rows of horny teeth. It is used in feeding especially for scraping and cutting the food.

Q. 8. Name the animal, which exhibits the phenomenon of bioluminescence. Mention the phylum to which it belongs.

[NCERT Exemplar, Q. 10, Page 17]

Ans. *Ctenoplana* from phylum Ctenophora exhibit the phenomenon of bioluminescence.

Q. 9. Provide appropriate technical term in the space provided.

(i) Blood-filled cavity in arthropods _____.
(ii) Free-floating form of cnidaria _____.
(iii) Stinging organ of jelly fishes _____ _____.
(iv) Lateral appendages in aquatic annelids _____.

[NCERT Exemplar, Q. 14, Page 17]

Ans. (i) Blood filled cavity in arthropods- Haemocoel
(ii) Free-floating form of cnidaria- Medusa
(iii) Stinging organ of jelly fishes- Nematocytes
(iv) Lateral appendages in aquatic annelids- Parapodia

Q. 10. Choose correctly and write in the space provided.

Animal	Excretory Organ/Unit
(i) *Balanoglossus*	(a) Metanephridia
(ii) Leech	(b) Nephridia
(iii) Locust	(c) Flame cells
(iv) Liver fluke	(d) Absent
(v) Sea urchin	(e) Malpighian tubule
(vi) *Pila*	(f) Proboscis gland

[NCERT Exemplar, Q. 13, Page 20]

Ans. (i)-(f), **(ii)**-(b), **(iii)**-(e), **(iv)**-(c), **(v)**-(f), **(vi)**-(a)

Q. 11. Match the following :

(i) Amphibia	(a) Air bladder
(ii) Mammals	(b) Cartilaginous notochord
(iii) Chondrichthyes	(c) Mammary glands
(iv) Osteichthyes	(d) Pneumatic bones
(v) Cyclostomata	(e) Dual habitat
(vi) Aves	(f) Sucking and circular mouth without jaws.

[NCERT Exemplar, Q. 5, Page 18]

Ans. (i)- e, **(ii)**- c, **(iii)**-b, **(iv)**- a, **(v)**-f, **(vi)**- d

Short Answer Type Questions (3 marks each)

Q. 1. Sort out the animals on the basis of their symmetry (radial or bilateral): Coelenterates, ctenophores, annelids, arthropods, and echinoderms.

[NCERT Exemplar, Q. 2, Page 18]

Ans. Radial symmetry : Coelenterates, Ctenophores, Echinoderms

Bilateral symmetry : Annelids and Arthropods

Q. 2. Fill up the blank spaces appropriately:

Phylum/Class	Excretory organ	Circulatory organ	Respiratory organ
Arthropoda			**Lungs/Gills/Tracheal system**
	Nephridia	**Closed**	**Skin/Parapodia**
	Metanephridia	**Open**	
Amphibia		**Closed**	**Lung**

[NCERT Exemplar, Q. 4, Page 18]

Ans.

Phylum/Class	Excretory organ	Circulatory organ	Respiratory organ
Arthropoda	Malpighian tubule	Open	Lungs/Gills/Tracheal system
Annelida	Nephridia	Closed	Skin/Parapodia
Mollusca	Metanephridia	Open	Gills/ Mantle, Pulmonary sac
Amphibia	Kidneys	Closed	Lung

Q. 3. Endoparasites are found inside the host body. Mention the special structure, possessed by these and which enables them to survive in those conditions.

[NCERT Exemplar, Q. 6, Page 9]

Ans. Special characters present in by endoparasites are as follows :

(i) Presence of adhesive organ for attachment to the host. *Fasciola hepatica* possess posterior sucker for the attachment. *Taenia solium* possess hook and suckers for the attachment within the host.

(ii) Presence of thick integument which is resistant to host's digestive enzymes and antitoxin.

(iii) Absence of locomotory organs.

(iv) Lack of digestive organs because digested and semi-digested food of the host is directly absorbed through their body surface.

(v) They are generally hermaphrodite.

TOPIC-3
Chordata

Quick Review

■ **Phylum-Chordata**

❖ Animals belonging to phylum Chordata are fundamentally characterised by the presence of a notochord, a dorsal hollow nerve cord and paired pharyngeal gill slits.

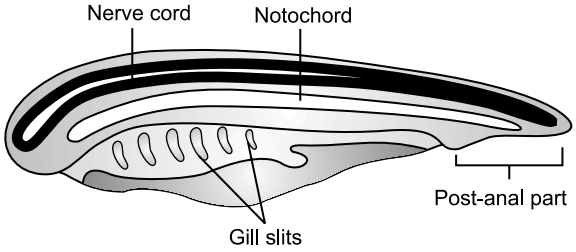


Fig. Chordata characteristics

❖ They are bilaterally symmetrical, triploblastic, coelomate with organ-system level of organisation.

❖ They possess a post anal tail and a closed circulatory system.

Table : Comparison of Chordates and Non-chordates.

S.No.	Chordates	Non-chordates
(i)	Notochord present.	Notochord absent.
(ii)	Central nervous system is dorsal, hollow and single.	Central nervous system is ventral, solid and double.
(iii)	Pharynx perforated by gill slits.	Gill slits are absent.
(iv)	Heart is ventral.	Heart is dorsal (if present).
(v)	A post-anal part (tail) is present.	Post-anal tail is absent.

❖ **Phylum Chordata is divided into three subphyla :**

(i) Urochordata : In urochordates, notochord is present only in larval tail. Their examples are *Ascidia*, *Salpa* and *Doliolum*.

(ii) Cephalochordata : In cephalochordates, notochord extends from head to tail region and is persistent throughout their life. Examples of cephalochordates is *Branchiostoma*.

(iii) Vertebrata : The members of this sub-phylum possess notochord during the embryonic period. In adults, this notochord is replaced by a cartilaginous or bony vertebral column.

- Subphyla Urochordata and Cephalochordata are often referred to as protochordata.
- They have a ventral muscular heart with two, three or four chambers.
- They have kidneys for excretion and osmoregulation.
- They have paired appendages either in the form of fins or in the form of limbs.
- Subphylum vertebrata is divided into two section : Agnatha and Gnathostomata.

Section I. Agnatha (The jawless vertebrates).

Class 1. Cyclostomata

■ **Class – Cyclostomata**

❖ All the members of class Cyclostomata are marine and ectoparasites on some fishes.

❖ They possess an elongated body containing 6-15 pairs of gill slits for respiration.

❖ They have a sucking and circular mouth without jaws.

❖ They lack scales and paired fins.

❖ Their cranium and vertebral column are cartilaginous.

❖ They have closed circulatory system.

❖ They are marine creatures but for spawning they migrate to freshwater. Thereafter, they die within a few days.

❖ Their larvae, after metamorphosis, return to the ocean.

❖ Some common members of class cyclostomata are *Petromyzon* (Lamprey) and *Myxine* (Hagfish).

Section II Gnathostomata (The jawed Vertebrates): Gnathostomata is divided into two super classes : Pisces and Tetrapod.

Super Class I : Pisces (bear fins)

- **Class 1 – Chondrichthyes**
  - They are marine animals.
  - Their body is streamlined and endoskeleton is cartilaginous.
  - Their mouth is located on the ventral side.
  - Notochord is persistent throughout life.
  - Gill slits are separate and not covered by operculum.
  - They contain minute placoid scales. Because of their presence, the skin is tough.
  - Their teeth are modified placoid scales which are backwardly directed. Their jaws are very powerful. These animals are predaceous.
  - They lack air bladder and hence to avoid sinking they have to swim constantly.
  - Their heart is two-chambered (one auricle and one ventricle).
  - Some of cartilaginous fishes *e.g.*, *Torpedo* have electric organs and some of them *e.g.*, *Trygon* possess poison sting.
  - They do not have capacity to regulate their body temperature. Such type of animals are called cold-blooded animals or poikilothermous animals.
  - Sexes are separate. In males, pelvic fins bear claspers.
  - They show internal fertilisation and many of them are viviparous.
  - Some examples of chondrichthyes are *Scoliodon* (Dog fish), *Pristis* (Saw fish) and *Carcharodon* (Great white shark) and *Trygon* (Sting ray).
- **Class 2 – Osteichthyes**
  - This class includes those marine and freshwater fishes which have bony endoskeleton.
  - Their body is streamlined and mouth is terminal.
  - They possess four pairs of gills which are covered by an operculum on each side.
  - Skin is covered with cycloid/ctenoid scales.
  - They possess air bladder which regulates buoyancy.
  - They have two- chambered (one auricle and one ventricle) heart.
  - They are cold-blooded animals.
  - Sexes are separate.
  - Fertilisation is usually external and most of them are oviparous.
  - Development is direct.
  - Common examples of marine bony fishes are *Exocoetus* (Flying fish), *Hippocampus* (Sea horse) while *Labeo* (Rohu), *Catla* (Katla), *Clarias* (Magur) are examples of freshwater bony fishes. Some of them such as *Betta* (Fighting fish), and *Pterophyllum* (Angel fish) are aquarium fishes.

Super class 2. Tetrapoda (bear two pairs of limbs).

- **Class – Amphibia**
  - Amphibians can live in aquatic as well as terrestrial habitats.
  - Their body is differentiated into head and trunk. Some amphibians also possess tail.
  - Their skin is moist and lack scales.
  - They have two pairs of limbs.
  - The eyes have eyelids and tympanum represents the ear.
  - Respiration takes place by gills, lungs and through skin.
  - They possess three-chambered heart. Out of the three chambers, two are auricles and third one is ventricle.
  - They are cold-blooded animals.
  - Sexes are separate. They are oviparous.
  - Fertilisation is external and development is direct or indirect.
  - Some common amphibians are *Bufo* (Toad), *Rana* (Frog), *Hyla* (Tree frog), *Salamandra* (Salamander) and *Ichthyophis* (Limbless amphibia).
- **Class – Reptilia**
  - Members of this class are mostly terrestrial animals and have creeping or crawling mode of locomotion.
  - Their body is covered with dry and cornified skin, epidermal scales or scutes.
  - They lack external ear openings. Tympanum represents ear.
  - Most of them possess two pairs of limbs while some do not have limbs.
  - Except the crocodiles, all reptiles have three-chambered heart.

- ❖ They are cold blooded animals.
- ❖ Sexes are separate.
- ❖ They are oviparous.
- ❖ Fertilisation is internal and development is direct.
- ❖ Some common reptiles are *Chelone* (Turtle), *Testudo* (Tortoise), *Chameleon* (Tree lizard), *Calotes* (Garden lizard), *Crocodilus* (Crocodile), *Alligator* (Alligator), *Hemidactylus* (Wall lizard) and poisonous snakes like *Naja* (Cobra), *Bangarus* (Krait), *Vipera* (Viper).

■ **Class – Aves**

- ❖ This class includes all the birds which have ability to fly (except flightless birds like ostrich).
- ❖ They are characterised by the presence of feathers.
- ❖ They possess a beak.
- ❖ Their forelimbs are modified into wings and the hind limbs are modified for walking, swimming or clasping the tree branches.
- ❖ Their skin is dry and lacks glands but at the base of the tail, oil gland is present.
- ❖ They have fully ossified (bony) endoskeleton. The long bones are hollow with air cavities (pneumatic).
- ❖ In birds, there are additional chambers in digestive tract called the crop and gizzard.
- ❖ Heart is four – chambered.
- ❖ They are able to maintain a constant body temperature. Such type of animals are called warm-blooded or homoiothermous animals.
- ❖ They respire through lungs.
- ❖ Sexes are separate and fertilisation is internal.
- ❖ They are oviparous and development is direct.
- ❖ Common members of this class are *Corvus* (Crow), *Columba* (Pigeon), *Psittacula* (Parrot), *Struthio* (Ostrich), *Pavo* (Peacock), *Aptenodytes* (Penguin) and *Neophron* (Vulture).

■ **Class-Mammalia**

- ❖ They are found in a variety of habitats like Polar ice caps, deserts, mountains, forests, grasslands and dark caves. Some of them are also adapted to fly or live in water.
- ❖ They have milk producing mammary glands to nourish their young ones.
- ❖ They possess two pairs of limbs which are adapted for walking, running, climbing, burrowing, swimming or flying.
- ❖ They possess hair on the skin.
- ❖ External ears or pinnae are present.
- ❖ They possess different types of teeth in the jaw.
- ❖ The heart is four-chambered. They are homoiothermous.
- ❖ They respire through lungs.
- ❖ Sexes are separate and fertilisation is internal.
- ❖ They are viviparous with few exceptions and development is direct.
- ❖ Common mammals are *Macropus* (Kangaroo), *Pteropus* (Flying fox), *Camelus* (Camel), *Macaca* (Monkey), *Rattus* (Rat), *Canis* (Dog), *Felis* (Cat), *Elephas* (Elephant), *Equus* (Horse), *Delphinus* (Common dolphin), *Balaenoptera* (Blue whale), *Panthera tigris* (Tiger), *Panthera leo* (Lion). Exceptionally *Ornithorhynchus* (Platypus) is an oviparous mammal.

Salient Features of Different Phyla in the Animal Kingdom

Phylum	Level of Organisation	Symmetry	Coelom	Segmentation	Digestive System	Circulatory System	Respiratory System	Distinctive Features
Porifera	Cellular	Many	Absent	Absent	Absent	Absent	Absent	Body with pores and canals in walls.
Coelenterate (Cnidaria)	Tissue	Radial	Absent	Absent	Incomplete	Absent	Absent	Cnidoblasts present.
Ctenophora	Tissue	Radial	Absent	Absent	Incomplete	Absent	Absent	Comb plates for locomotion.

Platyhelminthes	Organ & Organ system	Bilateral	Absent	Absent	Incomplete	Absent	Absent	Flat body, suckers.
Aschelminthes	Organ system	Bilateral	Pseudocoelomate	Absent	Complete	Absent	Absent	Often worm-shaped elongated
Annelida	Organ system	Bilateral	Coelomate	Present	Complete	Present	Present	Body segmentation like rings.
Arthropoda	Organ system	Bilateral	Coelomate	Present	Complete	Present	Present	Exoskeleton of cuticle, jointed appendages.
Mollusca	Organ system	Bilateral	Coelomate	Absent	Complete	Present	Present	External skeleton shell usually present.
Echinodermata	Organ system	Radial	Coelomate	Absent	Complete	Present	Present	Water vascular system, radial symmetry.
Hemichordata	Organ system	Bilateral	Coelomate	Absent	Complete	Present	Present	Worm-like with proboscis, collar and trunk.
Chordata	Organ system	Bilateral	Coelomate	Present	Complete	Present	Present	Notochord, dorsal hollow nerve cord, gill slits with limbs or fins.

Multiple Choice Questions **(1 mark each)**

Q. 1. Which one of the following sets of animals share a four chambered heart?
(i) Amphibian, Reptiles, Birds
(ii) Crocodiles, Birds, Mammals
(iii) Crocodiles, Lizards, Turtles
(iv) Lizards, Mammals, Birds
[NCERT Exemplar, Q. 3, Page 14]

Ans. Correct option : (ii)
Explanation : Amphibians have two-chambered heart, while most of the reptiles have three-chambered heart. Crocodiles, birds and Mammals have four-chambered heart.

Q. 2. Which of the following pairs of animals has non glandular skin?
(i) Snake and Frog
(ii) Chameleon and Turtle
(iii) Frog and Pigeon
(iv) Crocodile and Tiger
[NCERT Exemplar, Q. 4, Page 14]

Ans. Correct option : (ii)
Explanation : Glandular skin is present in frog, Snake and Crocodile. Mammals too have glandular skin.

Q. 3. Birds and mammals share one of the following characteristics as a common feature.
(i) Pigmented skin
(ii) Alimentary canal with some modification
(iii) Viviparity
(iv) Warm blooded nature
[NCERT Exemplar, Q. 5, Page 14]

Ans. Correct option : (iv)
Explanation : Warm blooded are both mammals and birds.

Q. 4. Which one of the following sets of animals belong to a single taxonomic group?
(i) Cuttlefish, Jellyfish, Silverfish, Dogfish, Starfish
(ii) Bat, Pigeon, Butterfly
(iii) Monkey, Chimpanzee, Man
(iv) Silkworm, Tapeworm, Earthworm
[NCERT Exemplar, Q. 6, Page 14]

Ans. Correct option : (iii)
Explanation : In option '(iii)' all organisms belong to mammalia.

Q. 5. Which one of the following is oviparous?
(i) Platypus
(ii) Flying fox (Bat)
(iii) Elephant
(iv) Whale
[NCERT Exemplar, Q. 9, Page 14]

Ans. Correct option : (i)
Explanation : Platypus and echidna are oviparous mammals.

Q. 6. Which one of the following is not a poisonous snake?
(i) Cobra
(ii) Viper
(iii) Python
(iv) Krait
[NCERT Exemplar, Q. 10, Page 14]

Ans. Correct option : (iii)
Explanation : Except python, all are poisonous snake.

Very Short Answer Type Questions (1 & 2 marks each)

Q. 1. What is the role of feathers?

[NCERT Exemplar, Q. 4, Page 17]

Ans. Importance of feathers in birds are :

(i) They help in flight. They provide passage for air and reduce friction to minimum.

(ii) They helps in maintaining body temperature by heat loss.

Q. 2. Write one example each of the following in the space provided.

(i) Cold blooded animal _____

(ii) Warm blooded animal _____

(iii) Animal possessing dry and cornified skin _____

(iv) Dioecious animal _____

[NCERT Exemplar, Q. 11, Page 17]

Ans. (i) Cold blooded animal-*Rana* (frog)

(ii) Warm blooded animal- *Corvus* (Crow)

(iii) Animal possessing dry and cornified skin-*Crocodilus* (Crocodile)

(iv) Dioecious animal- *Ascaris* (roundworm)

Q. 3. Give an example of the following:

(i) Round worm

(ii) Fish possessing poison sting

(iii) A limbless reptile/ amphibian

(iv) An oviparous mammal

[NCERT Exemplar, Q. 13, Page 17]

Ans. (i) Roundworm- *Ascaris*

(ii) Fish possessing poison sting- *Trygon*

(iii) A limbless reptile/amphibian- *Ichthyophis*

(iv) An oviparous mammal- Duck billed platypus.

Short Answer Type Questions (3 marks each)

Q. 1. There has been an increase in the number of chambers in heart during evolution of vertebrates. Give the names of the class of vertebrates having two, three or four-chambered heart.

[NCERT Exemplar, Q. 3, Page 18]

Ans. Two chambered heart : Pisces
Three chambered heart : Amphibian, Reptile
Four chambered heart : Aves, Mammalia

Q. 2. Match the following and write correct choice in space provided:

Animal	Characteristics
(i) *Pila*	**(a) Jointed appendages**
(ii) Cockroach	**(b) Perching**
(iii) *Asterias*	**(c) Water vascular system**
(iv) *Torpedo*	**(d) Electric organ**
(v) Parrot	**(e) Presence of shell**
(vi) Dog fish	**(f) Placoid scales**

[NCERT Exemplar, Q. 7, Page 19]

Ans. (i)-(e), **(ii)**-(a), **(iii)**-(c), **(iv)**-(d), **(v)**-(b), **(vi)**-(f)

Q. 3. Differentiate between :

(i) Open and closed circulatory system

(ii) Oviparity and viviparity

(iii) Direct and indirect development

(iv) Aceolomate and pseudo coelomate

(v) Notochord and nerve cord

(vi) Polyp and medusa

[NCERT Exemplar, Q. 8, Page 19]

Ans. (i) Differences between open circulatory system and closed circulatory system : Refer to Topic 1/ SAQ/ Q.2. (i)

(ii) Differences between oviparous and viviparous characteristics of animals : Refer to Topic 1/ SAQ/ Q. 2. (ii)

(iii) Differences between direct development and development : Refer to Topic 1/ SAQ/ Q. 2. (iii)

(iv) Differences between Acoelomate and Pseudo coelomate :

Acoelomate	Pseudo coelomate
(i) Animals which do not have coelom are called as acoelomates.	Animals which have body cavity called pseudocoleom, derived from the blastocoel of embryo.
(ii) E.g. Sponges, Cnidarians, Ctenophores and flatworms	E.g. Round worms

(v) Differences between Notochord and Nerve cord :

Notochord	Nerve cord
(i) Notochord is the skeletal rod that lies lengthwise between the central nervous system and the alimentary canal or the gut.	Nerve cord is a bundle of nerve fibers with chains of ganglia, generally running ventrally.
(ii) It is found in vertebrates.	It occurs in invertebrates.
(iii) In vertebrates, it forms the axial skeleton.	It forms a major part of nervous system.

(vi) Differences between Polyp and Medusa :

Polyp	Medusa
(i) Polyp is sessile and cylindrical form in *Aurelia*.	Medusa is umbrella shaped and swimming form in *Aurelia*.
(ii) Polyp produces medusa asexually.	Medusa form polyps sexually.

Q. 4. Give the characteristic features of the following citing one example of each

(i) Chondrichthyes and Osteichthyes

(ii) Urochordata and Cephalochordata

[NCERT Exemplar, Q. 9, Page 19]

Ans. (i) Characteristic features of Chondricthyes are :

- These are marine animals with a streamlined design for swimming.
- They have cartilaginous endoskeleton.
- They have heterocercal caudal fin.
- They have gill slits and are without operculum, except *Chimaeras*.
- Skin is tough with placoid scale that are dermal in origin.
- Jaws are well developed. Mouth is located ventrally. Development of the movable jaw allow these animals to eat larger prey and become top predators.
- Teeth are modified placoid scales which are backwardly directed.
- They lack air bladder. Thus, they have to swim constantly to avoid sinking.
- They are cold blooded animals (Poikilotherms). Cold blooded animals lack the capacity to regulate the body temperature.
- **Examples:** *Scoliodon* (Dog fish), *Pristis* (Saw fish), *Trygon* (Sting ray), *Torpedo* (Electric ray), etc.

Characteristics features of Osteichthyes :

- Bony fishes are found in both habitats: marine and freshwater. They have a developed heavy skeleton made completely of bone. A backbone surrounds the spinal cord and the brain is fully encased in a protective skull.
- They have homocercal caudal fin.
- Mouth is terminal.
- They have four pairs of gills covered by an operculum on each side.
- Skin is covered with cycloid, ctenoid and ganoid scales.
- They have air bladder which regulates buoyancy.
- Their swim bladder is a gas-filled sac that allows the animal to float at any depth in the water (sharks must move through the water to avoid sinking).
- The body is covered with a layer of mucous to facilitate gliding through the water and to protect from parasites.
- Gills extract dissolved oxygen from the water around them.
- **Examples :**

  Marine fishes : *Exocoetus* (flying fish), *Hippocampus* (sea horse), *Sardine*, Mackeral, Tuna, *Echeneis* (sucker fish), etc.

  Fresh water fishes : *Labeo* (Rohu), *Catla* (Katla), *Clarias* (Magur), *Anguilla, Mystus*, etc.

(ii) Characteristic features of Urochordata :

- Notochord is present only in larval tail.
- Body is covered by test made up of tunicin
- They show retrogressive metamorphosis.
- **Examples :** *Ascidia, Salpa, Doliolum, Herdmania* (Sea squirt), *Ciona, Botryllus* (colonial Urochordata), *Pyrosomaetc*.

Characteristic features of Cephalochordata :

- Notochord extends from head to tail region and is persistent throughout the life
- They are exclusively marine.
- They are fish-like.
- **Coelom :** They have no definite coelom.
- Sexes are separate and fertilisation is external.
- **Examples :** Branchiostoma *(Amphioxus or Lancelet)*

Q. 5. Mention two similarities between

(i) Aves and mammals

(ii) A frog and crocodile

(iii) A turtle and pila

[NCERT Exemplar, Q. 10, Page 19]

Ans. (i) Similarities between Aves and Mammals : They both have four-chambered heart and are warm blooded animals.

(ii) Similarities between frog and crocodile : They both are poikilotherms (cold-blooded animals). Frog and Crocodile are oviparous.

(iii) Similarities between turtle and Pila : Both are aquatic animals. Their body is covered with dry and cornified skin. In turtle, the epidermal covering is known as scales while in case of *Pila*, it is known as calcareous shell.

Long Answer Type Questions

(5 marks each)

Q. 1. Give three major differences between chordates and non-chordates and draw a schematic sketch of a chordate showing those features.

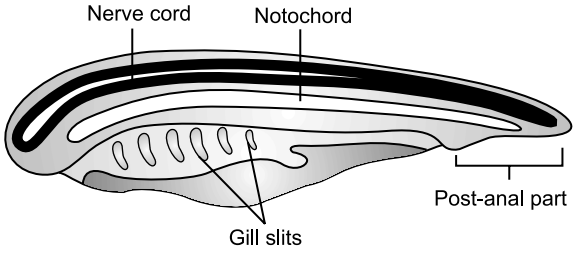
[NCERT Exemplar, Q. 1, Page 20]

Ans. Differences between Chordates and Non-chordates :

Chordates	Non-chordates
Notochord is found at some stage in the life cycle of a chordate.	Notochord is not present in any stage.
Pharyngeal gill slits are present.	Pharyngeal gill slits are absent.

Post anal tail is present.	Post anal tail is absent
Chordates have ventral heart.	They have dorsal heart. (If present).

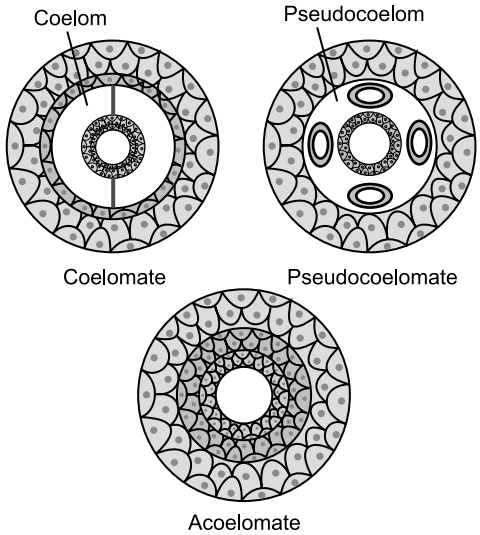
Schematic sketch illustrating important characters of chordates is shown below :



Q. 2. What is the relationship between germinal layers and the formation of body cavity in case of coelomate, acoelomates and pseudocoelomates?

[NCERT Exemplar, Q. 2, Page 20]

Ans. There are three germinal layers : the outer ectoderm, the middle mesoderm and the inner endoderm. The body cavity that is lined by mesoderm is called coelom. Coelom separates the muscles of gut and body wall. Animals possessing coelom are called coleomates. They have body cavity completely surrounded by mesoderm. Coelom is lined by peritoneal layer and is filled with coelomic fluid. *Examples,* Annelids to chordates. In some animals, the body cavity is partially surrounded by mesoderm. Such animals are called psuedocoleomate. Mesoderm is present in scattered pouches between ectoderm and endoderm. *Example,* Aschelminthes. The animals in which there is complete absence of body cavity are called acoelomate. In this, the space between body wall and digestive cavity is filled with matrix (parenchyma). *Examples,* Poriferans to Platyhelminthes.



Q. 3. Comment upon the habitats and external features of animals belonging to class amphibia and reptilia.

[NCERT Exemplar, Q. 3, Page 20]

Ans. Characteristic feature of animals belonging to Class Amphibia :

(i) Amphibians have aquatic larval life and terrestrial adult life.

(ii) Amphibians are the first tetrapods to invade the land. The juvenile phase of the life cycle is dependent on water, where gas exchange occurs through gills. The adult phase is less dependent on water and gas exchange occurs through lungs.

(iii) Body is divisible into head and trunk.

(iv) Skin is moist without scales.

(v) Two pairs of limbs are used for locomotion except for caecilians.

(vi) They are Poikilotherms (cold blooded animals).

(vii) Respiration is by gills (in larva), lungs and skin (in adults).

(viii) Amphibians have a three-chambered heart (2 auricles+ 1 ventricle).

(ix) Fertilisation is external. However in *Salamander* and *Ichthyopis* fertilization is internal.

(x) They are mostly oviparous, except for *Salamandra salamandra*, which is viviparous.

(xi) Development is indirect.

(xii) Examples : *Bufo* (Toad), *Rana* (Frog), *Hyla* (Tree frog), *Salamandra* (Salamander), *Ichthyophis* (Limbless amphibia), *Ambystoma* (Tiger salamander), *Rhacophorus* (Flying frog), *Necturus* (Mud puppy), *Amphiuma* (Congo eel), *Salamandra*, *Siren* (Mud eel), *Ambystoma, Triturus* (newt), *Uraeotyphlus, Ichythyopis* (Blind worm) etc.

Characteristic feature of animals belonging to Class Reptilia :

(i) They are mostly terrestrial.

(ii) They have creeping and crawling mode of locomotion.

(iii) Body is covered by dry and cornified skin, and epidermal scales or scutes.

(iv) They are poikilotherms (cold blooded animals).

(v) Reptiles have more efficient lungs than amphibians.

(vi) Most reptiles, like amphibians, have three-chambered heart, except for crocodiles and alligators, which have four chambered heart.

(vii) Most reptiles reproduce by laying eggs on dry land. Some snakes give live birth to well-developed young.

(viii) All reptiles have internal fertilization.

(ix) They are oviparous. The amniotic egg is encased in a water-tight, leathery shell covering.

(x) Development is direct.

(xi) Examples : *Chelone* (Turtle), *Testudo* (Tortoise), *Chameleon* (Tree lizard), *Calotes* (Garden lizard), *Crocodilus* (Crocodile), *Alligator*, etc.

Q. 4. Mammals are most adapted among the vertebrates. Elaborate.

[NCERT Exemplar, Q. 4, Page 20]

Ans. Mammals are most adapted among the vertebrates. This statement can be justified by following features :

(i) They are found in variety of habitats i.e. polar ice caps, deserts, mountains, grassland etc.

(ii) They are homoiotherms (warm blooded animals).

(iii) They have 2 pairs of limbs adapted for walking, running, climbing, burrowing, swimming or flying.

(iv) All mammals have hair.

(v) They have different types of teeth in jaw-Heterodont, thecodont, diphyodont. Fish, amphibians, and reptiles have teeth that are all similar.

(vi) Mammals walk more efficiently than reptiles because their legs are positioned further under their body.

(vii) Respiration is by lungs. More efficient breathing results from the diaphragm muscle.

(viii) Mammals have a four chambered heart. Renal portal system is absent.

(ix) Mammals have well-developed sense organs and a large brain with a large cerebrum.

(x) Fertilisation is internal.

(xi) These animals have mammary glands (milk producing glands) to nourish young ones.

(xii) They are viviparous (except for *Echidna* and *Platypus*). *Echidna* and *Platypus* are egg laying mammals.

(xiii) Development is direct.

(xiv) Examples : *Ornithorhynchus* (Platypus), *Macropus* (Kangaroo), *Pteropus* (flying fox), *Camelus* (Camel), *Macaca* (Monkey), *Rattus* (Rat), *Canis* (dog), *Felis* (Cat), etc.