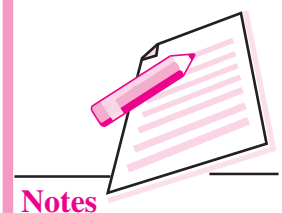


3

KINGDOMS PLANTAE AND ANIMALIA

In the previous lessons you have learnt about the basic aspects of classifying organisms and about the three lower kingdoms: **Monera** (*prokaryotic, unicellular rarely multicellular and filamentous*), **Protoctista** (*eukaryotic, unicellular*), and **Fungi** (*eukaryotic, uni- or multicellular, and heterotrophic*). In this lesson, you will study about the remaining two kingdoms, **Plantae** (*eukaryotic, multicellular and autotrophic*) and **Animalia** (*eukaryotic, multicellular and heterotrophic*).

OBJECTIVES

After completing this lesson you will be able to

- *give the basis of inclusion of certain organisms in Kingdom Plantae;*
- *classify Kingdom Plantae upto divisions;*
- *give the typical characteristics of Algae, Bryophyta, Pteridophyta and Spermatophyta;*
- *classify the division Spermatophyta upto classes- Gymnospermae and Angiospermae;*
- *give the typical features of dicot families such as Malvaceae and Fabaceae;*
- *give the typical features of the monocot families such as Liliaceae and Poaceae;*
- *justify the inclusion of certain organisms in Kingdom Animalia;*
- *classify Kingdom Animalia upto Phyla;*
- *give the characteristics of various animal phyla with examples;*
- *classify Arthropoda and Chordata upto classes with examples;*
- *classify Mammalia upto major orders with examples.*

3.1 MAIN DIVISIONS OF KINGDOM PLANTAE (PLANTS)

Both plant and animal kingdoms include a wide variety of organisms which contribute towards the biodiversity on the planet earth. We shall now learn the classification of plants and animals.

Plants are multicellular, eukaryotic, photosynthetic autotrophs rarely heterotrophs having cellulosic cellwalls. All are embryophytes.

Plantae are classified as follows :

Kingdom Plantae (Embryophyta) is classified into the following divisions:

1. **Bryophyta :** Amphibians of plant kingdom, non-vascular.
2. **Pteridophyta :** True root, stem and leaves, vascular tissue present.
3. **Spermatophyta :** Seed producing, vascular tissues present.

Spermatophyta are further divided into:

(a) Gymnospermae : naked seeded plants. Seeds not enclosed in an ovary.

(b) Angiospermae : seeds enclosed in the ovary wall; are divided into :

(i) Dicotyledons : embryo with two cotyledons.

(ii) Monocotyledons : Single cotyledon in the embryo.

3.2 BRYOPHYTA (BRYOPHYTES)

Bryophytes are amphibians of plant kingdom as they complete their life cycle in both water and on land. These mainly grow in damp, shady places, especially in the hills.

- They are embryophytes that do not have vascular tissues (neither xylem nor phloem), where multicellular sporophytes are always borne on the gametophytes.
- No true leaves and roots, as their independent plant body is gametophytic (haploid).
- Sex organs are jacketed as they are always surrounded by one or several layers of sterile cells.

There are three main types of bryophytes

1. Flat, ribbon-like – Liverworts (*Marchantia*) Fig. 3.1(a)
2. Small, leafy plant body – Mosses (*Funaria*) Fig. 3.1(b)
3. Flat, thalloid plant body bearing a horn-like sporophyte – Hornworts or *Anthoceros*

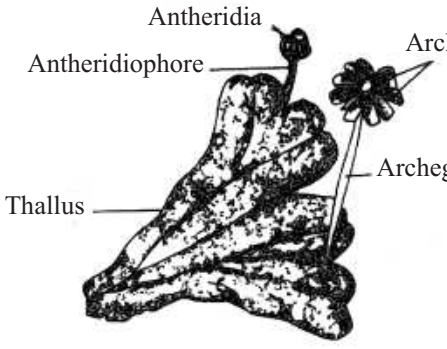


Fig 3.1(a) Liverworts (*Marchantia*)

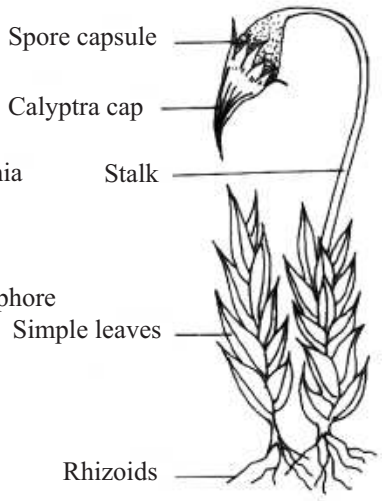


Fig 3.1(b) Moss plant (*Funaria*)

In all types of bryophytes, the main plant body is **gametophyte**, larger and more persistent and photosynthetically active which bears the sex organs. In mosses, the gametophytic plant body is a leafy stem called '**gametophore**' but in liverworts and hornworts the plant body is usually a thallus, that is ribbon-like or heart-shaped and bilaterally symmetrical. The body is without roots, stems and leaves. The plants are anchored to soil by rhizoids, which are unicellular in liverworts and hornworts and multicellullar in mosses. Rhizoids help in anchorage and also in absorption of water and minerals from the substratum. The male sex organs are **antheridia** and female sex organs are **archegonia**. The gametes are produced in the sex organs. Male and female gametes fuse to give rise to a zygote which develops into a **sporophyte**. Sporophyte remains attached to gametophyte and depends on it for food and minerals. The sporogenous tissue in the sporophyte undergoes meiosis to produce haploid spores. The spores, on dispersal, germinate to give rise to a gametophyte again.

Gametophyte (Undergoes Mitosis): Gamete producing phase of plants

Sporophyte (Undergoes Meiosis): Spore producing phase of plants

In all three types of bryophytes, the life cycle shows **Alternation of generations**.

Comparison of gametophytic and sporophytic phases of Bryophytes

Gametophytic phase	Sporophytic phase
1. Haploid phase, generally autotrophic	Diploid phase, heterotrophic or partially autotrophic
2. Has multicellular sex organs called antheridia and archegonia bearing sterile jacket surrounding the gametes	Has spore-producing structure
3. Produces gametes	Produces spores
4. Gametes are produced by mitosis	Spores are produced by meiosis
5. Dominant phase occupies most of the life period	Short-lived phase which remains attached to the gametophyte

- The bryophytes are pioneers of vegetation, i.e. they are the first ones to grow on various habitats like rock, lava, sand, water and act as soil binders.
- The mosses hold water better than the soil thus improve the microhabitat for seeds of other plants to grow.
- These are the sources of food for fish and birds and their dried plant body is used as nesting materials by birds.

INTEXT QUESTIONS 3.1

1. Mention one unique feature of bryophytes.

   .....

2. Define alternation of generations.

   .....

3. Name the male and female sex organs of bryophytes.

   .....

4. List the habitat most suitable for the growth of bryophytes.

3.3 PTERIDOPHYTA (PTERIDOPHYTES)

A fern plant is a pteridophyte. (Fig. 3.2)

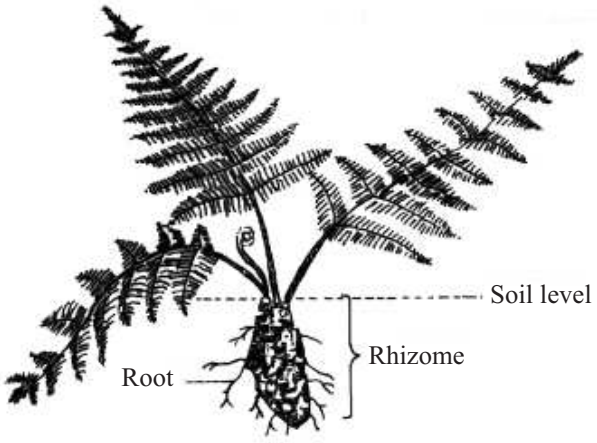


Fig. 3.2 A garden fern plant

1. Ferns are lower vascular plants. They contain vascular tissue. Which is made up of xylem and phloem and helps in conduction of water and nutrients to all parts of the plant body. Pteridophytes are usually found in damp, shady places or in the gardens, and on the hills where temperature is low.
2. The main plant body represents a sporophytic (diploid) generation and has roots which penetrate the soil to absorb water, and minerals.
3. The leaves (**fronds**) of sporophyte grow on thick, horizontal underground stem or **rhizome** which bears adventitious roots. The young leaves and the base of **fronds** are covered by dry brown scales (ramenta).
4. The young leaves and leaflets are characteristically circinately coiled structures (see Fig. 3.2*a*). The axis of the leaves is called **rachis** and leaflets on both sides of rachis are called **pinnae**. The divisions of pinnae are known as pinnules.
5. On the under surface of the leaves, develop spore-producing bodies called **Sporangia** in groups, called **sori** (singular - **sorus**) which may or may not be covered by multicellular structure called **indusium**. The sporogenous tissue in the sporangia undergoes meiosis to produce haploid spores.
6. The spores on dispersal germinate into an independent, small thallus–like body, the gametophyte, called **prothallus**. The prothallus bears antheridia and archegonia which produce male and female gametes respectively. The gametes fuse and the zygote develops into a diploid sporophyte.
7. The young embryo absorbs nutrients and water from the gametophyte until its roots and leaves are formed. The gametophyte then dies.
8. Gametophyte grows independent of sporophyte, and it lives for a short period of time but a new sporophyte is temporarily dependent upon a tiny gametophyte.

The gametophytic and sporophytic phases alternate as in bryophytes

INTEXT QUESTIONS 3.2

1. Name the dominant generation of pteridophytes.

   .....

2. The stage of pteridophytes which produces spores for continuing rest of the life cycle is.

   .....

3. Why do you classify pteridophytes under Trachaeophyta?

   .....

4. Name the male and female reproductive organs in pteridophytes?

   .....

5. Write the name of gametophyte of fern.

   .....

3.4 GYMSOSPERMAE (GYMNOS; NAKED, SPERMA; SEED)

Together with flowering plants Angiosperms, the Gymnosperms form the group Spermatophyta (sperma; seed, phyte; plant) i.e. seed-producing plants.

The gymnospermae bear naked ovules on flat scale leaves called ovuliferous scales which are not enclosed in carpels (ovary). The ovuliferous scales are arranged in cones.

Characteristics of Gymnosperms

1. The adult plant (sporophyte) is a tall, woody, perennial tree or shrub mostly evergreen. The stem is usually branched, but rarely unbranched as in, ***Cycas***.
2. Leaves may be simple (as in ***Pinus***) (Fig. 3.3a) or compound (as in ***Cycas*** Fig. 3.3b).
3. Leaves may be dimorphic or of one kind only. Foliage leaves are large green simple or pinnately compound, needle-like and grow on dwarf shoot as in, *Pinus,* or directly borne on the main trunk as in ***Cycas.*** Scale leaves are brown and simple.
4. Vascular bundles in stem are arranged in a ring and show secondary growth.
5 Gymnosperms bear cones which are usually unisexual (either male or female, Fig. 3.3c), rarely bisexual as in *Gnetum*.
6. Pollen grains are haploid produced in microsporangia of the male cones. In *Pinus*, each pollen grain has two large sacs, called wings to help in the dispersal by wind. Pollen grains produce two male gametes.
7. Ovules are not enclosed in ovary as in Angiosperms, but are borne naked on leafy megasporophylls of female cone, so the term gynmosperms or 'naked seeds' for this group. Ovules are produced side by side, inside which female gamete or egg is produced. The male gamete fuses with female gamete in the ovule. The fertilised ovule then develops into a seed (winged in case of *Pinus*).

Some common Gymnosperms are

Pine (*Pinus*), Redwood (*Sequoia*), Juniper (*Juniperus*), Cedar (*Cedrus*) and sagopalm (Cycas). Many gymnosperms yield timber, resins, turpentine, and several other products like the dry fruit chilgoza. Sago (sabutdana) is obtained from old stems of **Cycas**.

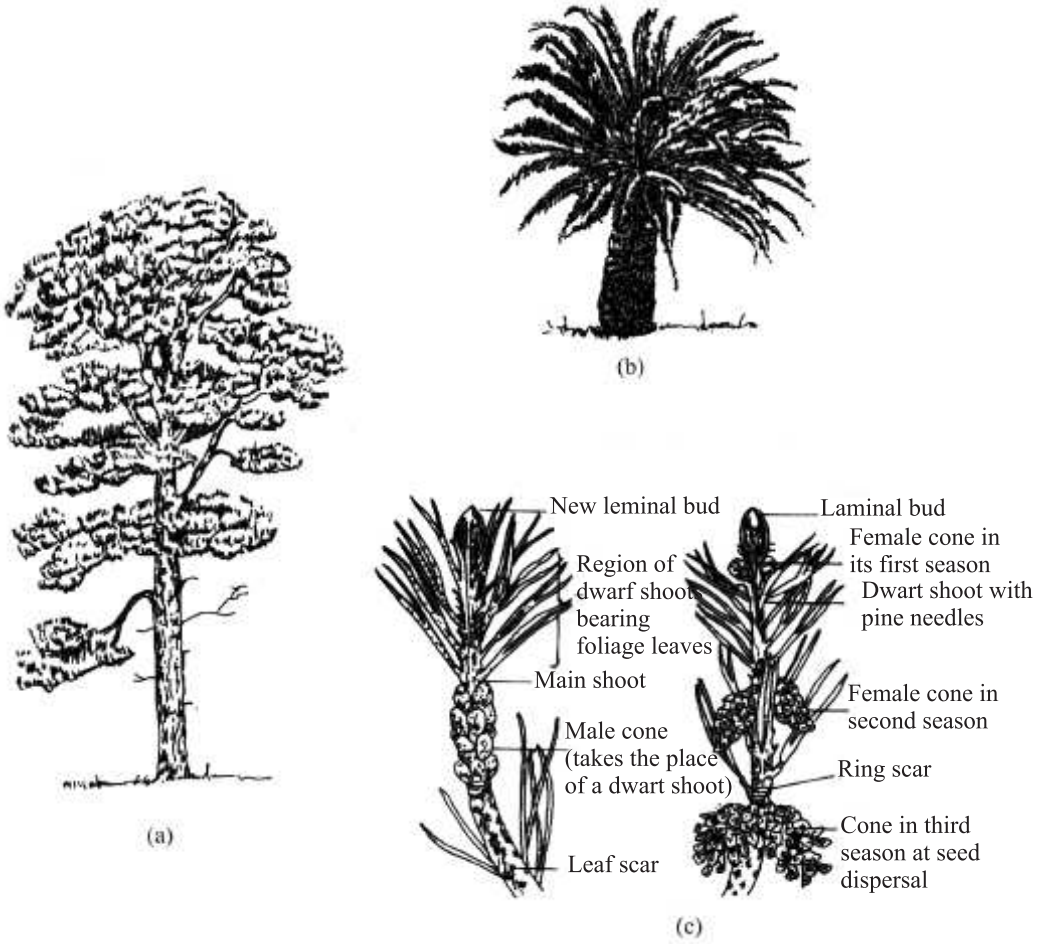


Fig. 3.3 Some examples of phylum Gymnosperm ae (a) *Pinus* tree (b) *Cycas* tree (c) tree with male and female cone

INTEXT QUESTIONS 3.3

1. What does the term gymnosperm mean?

   .....

2. Give any two common examples of gymnosperms.

   .....

3. List two commercial products of gymnosperms.

   .....

3.5 ANGIOSPERMAE

3.5.1 Angiosperms

A typical flowering plant

Our most familiar plants like pea, mango, coconut, wheat and rice come under the group called **Angiosperms**. Their seeds are always enclosed in the fruit. Which is a mature, fertilized ovary.

Look at an angiosperm plant in Fig. 3.4.

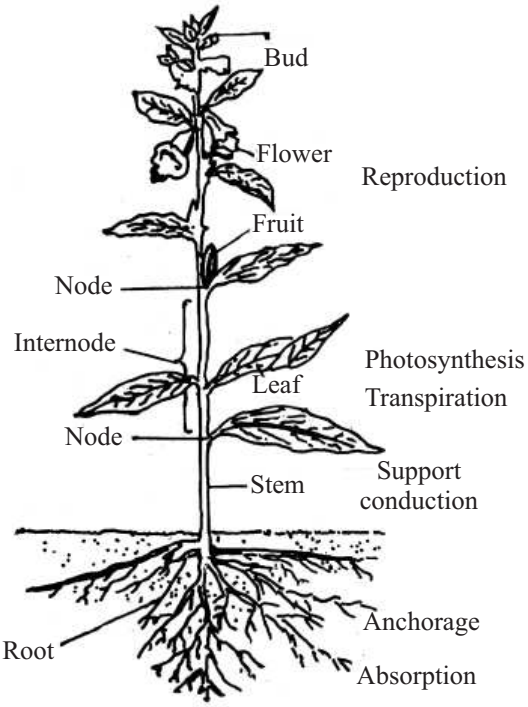


Fig. 3.4 The parts of an angiosperm our plant

The angiosperms are divided into two groups or classes:

1. Dicotyledons.
2. Monocotyledons.

Look at Fig 3.5 to study the differences between the two groups.

Angiosperms bear seeds enclosed in the fruits.

Dicot plants have two cotyledons in seeds whereas **Monocots** have only one cotyledon within the seeds.

Differences between angiosperms and gymnosperms

Gymnosperms	Angiosperms
1. Seeds naked as not enclosed in ovary.	Seeds enclosed in fruit (a mature, fertilized ovary).
2. Independent plants are sporophytes which bear cones where spores develop, that in turn give rise to gametophytes which in turn bear gametes.	Independent plants are sporophytes which bear flowers where reproductive spores develop, which produce gametophytes that in turn, bear gametes.
3. Xylem has mainly tracheids usually absent.	Xylem has both vessels as well as tracheids.

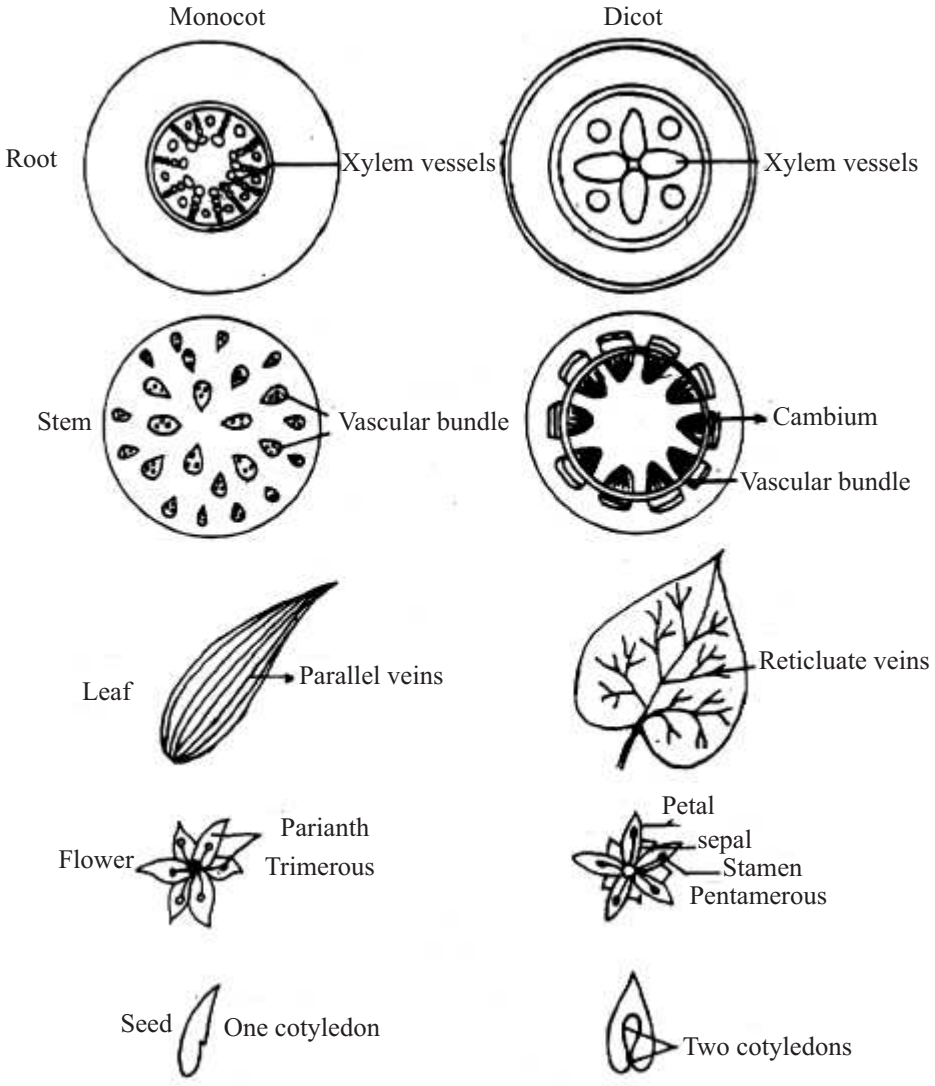


Fig. 3.5 Comparison of Monocots and Dicots

3.5.2 Some families of Angiosperms

Angiosperms include the most diverse and widespread members of the Kingdom Plantae.

Flowers offer a large number of characters which are constant and as such these are used for grouping of angiosperms into different families.

Within each family are included plants which show similarities in organization of various parts of the flower.

We shall study only four families: Two of dicots and two of the monocots

1. Fabaceae – Pea family : includes all the pulses
2. Malvaceae – China rose family
3. Liliaceae – Lily family
4. Poaceae – Grass family : includes cereals

Fabaceae Family (Papilionaceae) : A dicotyledonous family

The plants are herbs or shrubs and rarely trees. Flowers are zygomorphic (means a flower can be cut into two equal halves only through one radius), bisexual, complete, calyx consists of 5 sepals, jointed. Corolla comprise of 5 petals, polypetalous (papilionaceous in shape or butterfly shaped). There is a large petal called standard', two smaller ones called as 'wings and two interior small ones, more or less jointed forming the 'keel'. Androecium gas 10 stamens, arranged in two whorls (9+1) that is diadelphous condition (Fig. 3.6a). Gynoecium is superior, monocarpellary, unilocular with many ovules arranged on a marginal placenta. Fruit is

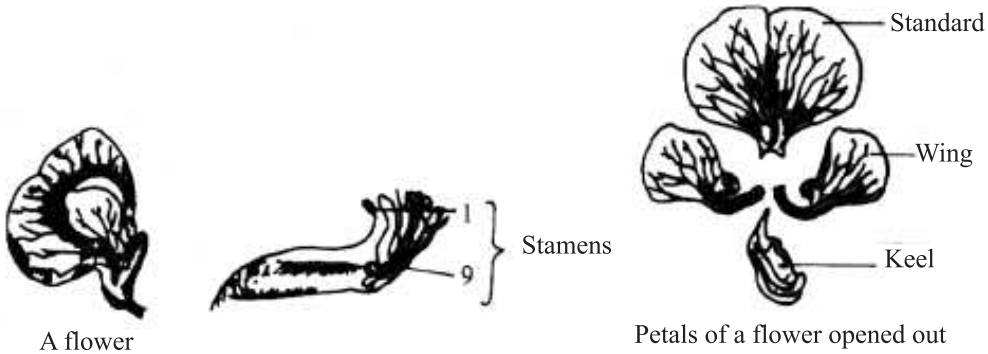


Fig. 3.6a A pea flower

Some examples of useful plants of Fabaceac

Common Names	Botanical Name
Pea (Matar)	*Pisum sativum*
Pigeon pea (Arhar)	*Cajanas cajan*
Green gram (Moong)	*Phaseolus aureus*
Soyabean	*Glycine max*
Lentil (Masoor)	*Lens culinaris*
Groundnut (Moong-phali)	*Arachis hypogea*
Chickpea (Chana)	*Cicer arietinum*

2. Malvaceae

The plants may be herbs, shrubs or trees.

Hibiscus rosa-sinensis (china-rose/shoe flower, vernacular; gurhal) is one of the best examples of this family. The flowers are large and attractive usually solitary axillary (See Fig. 3.6b).

Flowers are pentamerous (all whorls have members that are five or multiples of five), and actinomorphic (means that it can be divided into two equal halves through any radius). Epicalyx is present as an additional whorl of bracteole just below the calyx. Calyx has five sepals that may be free or joined at the base. Corolla has five petals usually free. Androecium consists of indefinite numbers of monadelphous stamens. The lower parts or filaments join together to formtion staminal tube. Gynoceium consists of 5 carpels, syncarpous, and ovary is superior, pentalocular, having axile placenta. Fruit is a capsule.

Cotton, Bhindi, and hollyhock are other examples of members of this family.

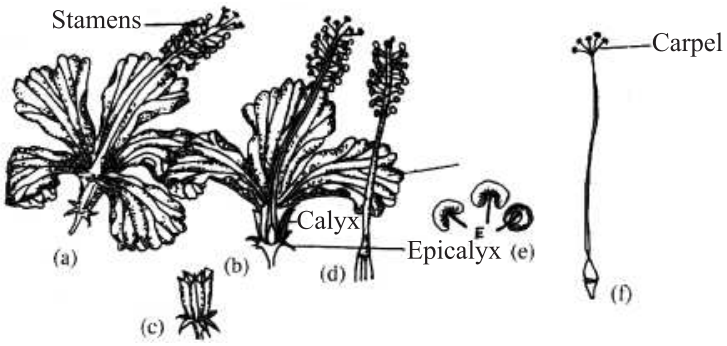


Fig. 3.6b A Chinarose flower

Liliaceae- A monocot family (Lily family)

The plants are mostly perennial herbs. The stem is a rhizome or bulb-like. Leaves may be fleshy, cauline (arising from the underground stem)

Flowers are bisexual, actinomorphic, mostly trimerous (all the whorls have either three units or multiples of three) and hypogynous. Perianth is large, petaloid (corolla-like) usually six, arranged in two whorls of three each, free or united.

Stamens usually six (3+3) in two whorls situated opposite to the perianth lobes. Carpels three, syncarpous, ovary superior, axile placentation. Fruit usually a capsule.

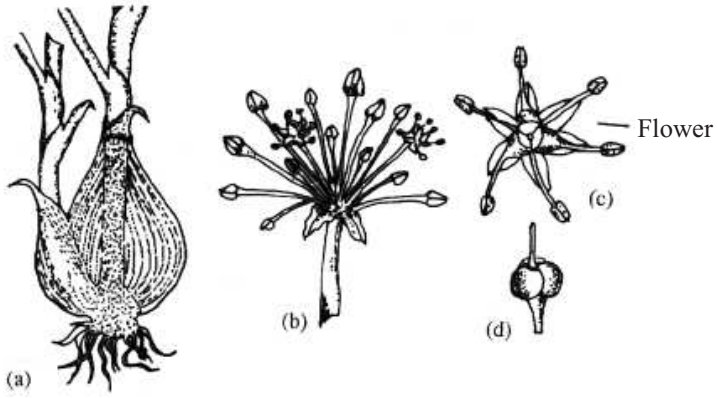


Fig. 3.6c An onion plant.

Some examples of useful plants of Liliaceace

Common names	Botanical names
Ghrit kumari	*Aloe barbadensis*
Shatawar or satmuli	*Asparagus racemosus*
Tulip	*Tulipa tulip*
Kalihari	*Gloriosa superba*
Lily	*Lilium candidum*
Onion	*Allium cepa*

Family Poaceae – A monocotyledonous family

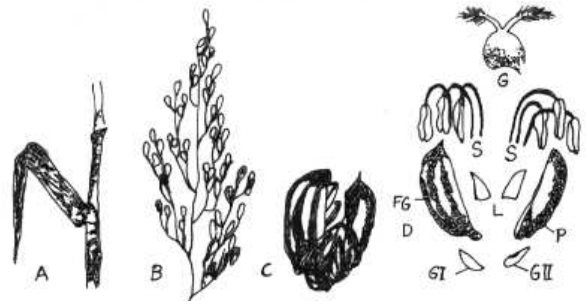
The plants are herbs, rarely woody as in sugarcane. inflorescence, spike of spikelets, For example, wheat. A small spikelet may contain not more than 5 flowers.

Flowers are very small, inconspicuous, with scale-like structures (Fig 3.6d).

Stamens are 3, sometimes 6 as in rice and bamboo, three carpels, syncarpous unilocular, ovary superior bearing a single basal ovule. Fruit is caryopsis (**seed coat and ovary wall inseparably fused**).

Some examples of useful plants of Poaceae

Common Names	Botanical Names
Rice	*Oryza sativa*
Wheat	*Triticum aestivum*
Maize	*Zea mays*
Sugarcane	*Saccharum officinarum*
Sarkanda	*S. spontaneum*
Barley	*Hordeum vulgare*

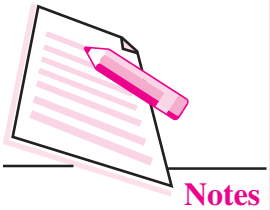


A. Portion of a branch with sheathing leaves and ligules;
B. A panicle of spikelets;
C. 1-flowered spikelet (note the glumes and stamens)
D. Spikelet dissected out
GI. First empty glume;
G II. Second empty glume;
FG. Flowering glume;
P. Palea;
L. Lodicules;
S. Stamens; and
G. Gynoecium.

Fig. 3.6d Rice plant (*Oryza sativa*.)

INTEXT QUESTIONS 3.4

1. Name one dicotyledonous and one monocotyledonous family.
2. Give the number of stamens in
   (a) Papilionaceae .....
   (b) Malvaceae .....
3. Give botanical names of
   (a) Rice .....
   (b) Arhar .....
   (c) Ghrit kumari .....
4. Where do seeds develop in angiosperms?
   .....



Notes

3.6 KINGDOM ANIMALIA

Includes the animals which animalia show a wide variety yet have some common features.

3.6.1 Few general features of kingdom animalia

- These are multicellular eukaryotes
- They have ingestive, heterotrophic nutrition.
- They have the power of locomotion.
- They show increased senstivity through nervous system.

Basis of classification of animals

Organization, symmetry, body cavity, number of embryonic cell layers and presence or absence of notochord are the features used for distinguishing broad categories of animals.

Organization : Bodies of animals are multicellular. although then cells may or may not be organised into tissues and organ systems. Animals such as sponges are aggregates of cells. These are at **cellular level** of organisation. Cnidarians have groups of cells performing specialised functions. They are at **tissue level** of organisation. All other animals have organs and systems for performing body functions. They are at **organ-system** grade.

Symmetry : means *dividing the body into two equal and identical parts*. Sponges are **asymmetrical**. Cnidaria and Echinoderm larvae are radially symmetrical. All other animals are **bilaterally symmetrical or dorsiventral**.

Body Cavity or Coelom : is a cavity between body wall and food canal. It is not present in Acoelomates (a = no, coelom = body cavity) and is present in Eucoelomates (eu = true). Pseudocoelom (pseudo = false) is not a true body cavity. It is found in roundworms.

Embryonic layers : Three layers of cells, ectoderm, mesoderm and endoderm in the embryo (germinal layers) give rise to various parts of the body of the animals. Sponges and Cnidaria do not have mesoderm in their embryos. They have two germinal layers ectoderm and endoderm (diploblastic). Others have three germinal layers (triploblastic).

Notochord : is a solid found in embryonic stage or adults of some animals which are grouped as **phylum Chordata**. All animal groups lacking notochord are termed, **non-chordates**.

Kingdom Animalia
(Multicellular Eukaryotic Heterotrophs)

Sub-Kingdom

	Parazoa	**Eumetazoa**
	(a) No symmetry	(a) Symmetrical
	(b) No tissues (cellular grade of organisation)	(b) Tissue and organ. grade of organisation
	Phylum Porifera	
Organisation and germinal layers	(a) Tissue grade of organisation	(a) Organ system grade of organisation.
	(b) Two embryonic germ layers. (diploblastic)	(b) Three embryonic germ layers (triploblastic)
	Phylum Cnidaria	All other Phyla
Symmetry	Asymmetrical ↓ **Phylum Porifera**	With Radial Symmetry ↓ **Phylum Cnidaria**	Bilateral Symmetry ↓ **All other phyla**
Body Cavity	Aoelomates (No coelom) ↓ **Phyla Porifera, Cnidaria Platyhelminthes**	Pseudocoelomates (False coelom) ↓ **Phylum Aschelminthes**	Eucoelomates (True coelom) ↓ **All other Phyla**
Notochord	Presence or absence of **Notochord**	no notochord **Non-chordata**	Notochord at some stage of life **Chordata**

3.6.2 Major phyla included in Kingdom Animalia

Phylum Porifera (Includes sponges)

Main characters:

- Body with many pores, canals or chambers through which water flows is called the **canal system**.
- large aperture called **osculum** at the upper end.
- Body encloses a large cavity **spongocoel**.
- No organs, movable parts or appendages. Different kinds of cells perform different functions.
- Usually with an internal skeleton of calcareous or siliceous **spicules**, or of **spongin** fibres, or both.
- Reproduction asexual by budding; also sexual.
- Almost all marine.

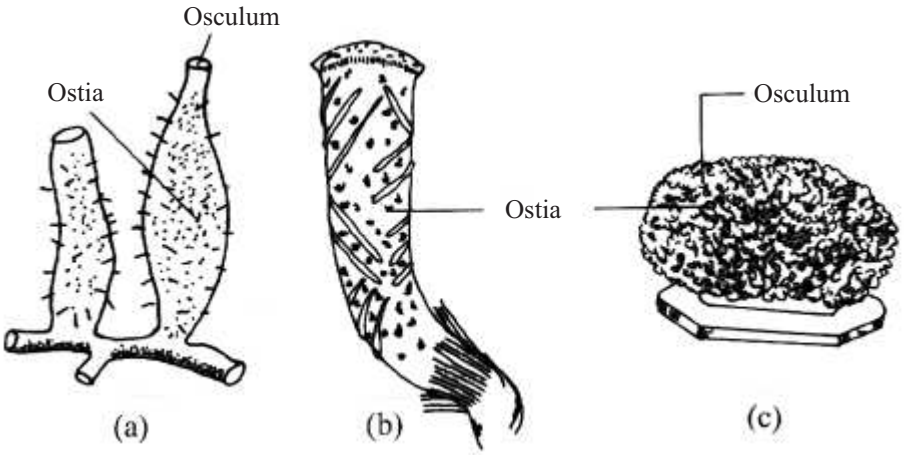


Fig. 3.7 : Phylum Porifera (a) *Sycon;* (b) *Euplectlella;* (c) *Euspongia*

2. Phylum Cnidaria (Includes hydroids, jelly fishes, sea anemone and corals)

Main Characters:

- Body with no head and no segmentation.
- Body wall two layered: external epidermis and inner gastrodermis, jelly-like, non-cellular mesogloea in between.
- Cnidoblasts (stinging cells) present, help to catch prey (carnivorous)
- Skeleton calcareous, horny or none.
- Asexual reproduction by budding in the sessile (polyp) stage, and sexual reproduction in free swimming (medusa) stage.
- Radial symmetry
- All marine, except Hydra (found in fresh water)
- Either fixed like hydra, sea-anemones and corals, or free floating like the jelly fish.

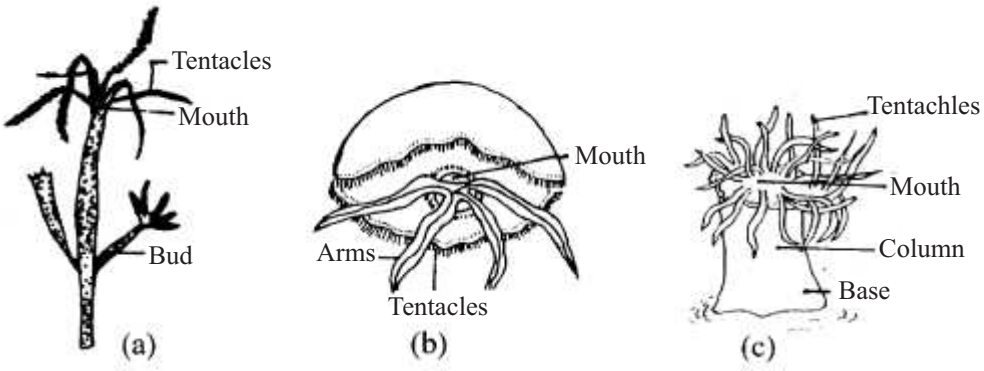


Fig. 3.8 Three common Cnidarians (a) Hydra (b) Jelly fish (c) Sea Anemone

3. Phylum Platyhelminthes (Flat worms)

Main Characters:

- Elongated, soft bodied, dorsoventrally flattened worms, without true segmentation.
- No body cavity

– Suckers or hooks or both for attachment to the body of the host
– Sexes usually united, mostly sexual reproduction, with asexual reproduction in some.
– Alimentary canal has only one opening–the mouth. In some forms (e.g. tapeworms) there is no alimentary canal at all.
– A few are free-living but mostly parasites.

Examples: *Planaria* (free living),
Fasciola (liver-fluke) is a parasite of sheep liver, *Taenia* (tapeworm) is a parasite of the human intestine.

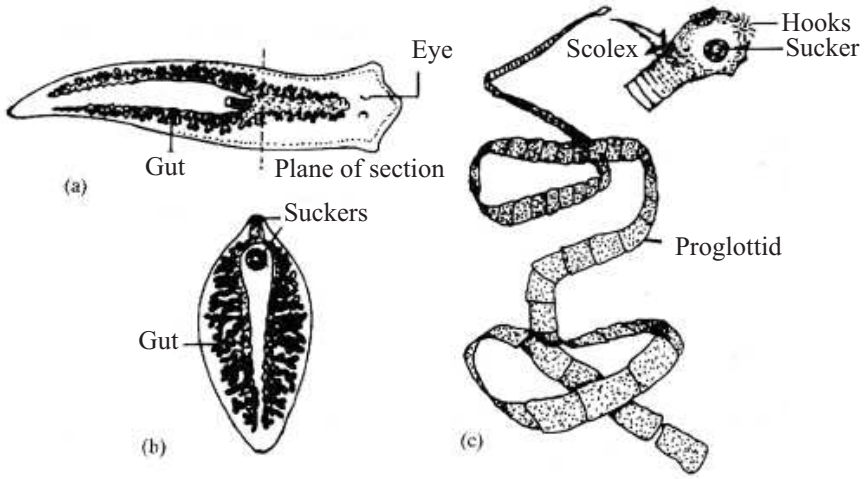


Fig. 3.9 Phylum Platyhelminthes (a) *Planaria* (b) *Fasciola* (c) *Taenia*

3. Phylum Aschehelminthes (Class Nematoda)

(Roundworms, thread worms)

Main characters:

– Elongated cylindrical round body
– Body cavity is a pseudocoelom (false body cavity)
– Alimentary canal opens at the two ends, mouth and anus.
– Sexes separate, males smaller than females (Fig 3.10).
– Mostly parasitic in animals but some live freely in the soil.
– *Ascaris* is a common roundworm, parasitic in the intestine of humans.
– Pinworm and *Wucheria* (Filariaworm) are some other examples.

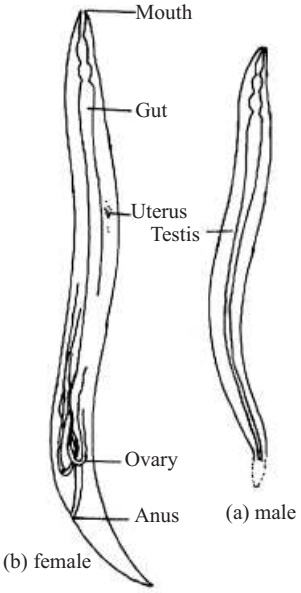


Fig. 3.10 *Ascaris* (a) Female (b) Male

4. Phylum Annelida (Includes earthworms)

Main characters:

– Elongated, segmented, coelomate (true body cavity) worm-like animals.
– Body provided with setae or parapodia for locomotion.

– Well developed digestive system with the alimentary canal open at both the ends.
– Excretory organs called **nephridia**.
– Sexes united (as in earthworm) or separate (as in *Nereis*).
– Regeneration quite frequent.
– Aquatic, some terrestrial animals, some living in tubes and some even parasitic.

Examples: *Nereis*, Earthworms like *Pheretima* (free-living in soil), *Hirudinaria* (leech, a parasitic on cattle, See figure 3.11.

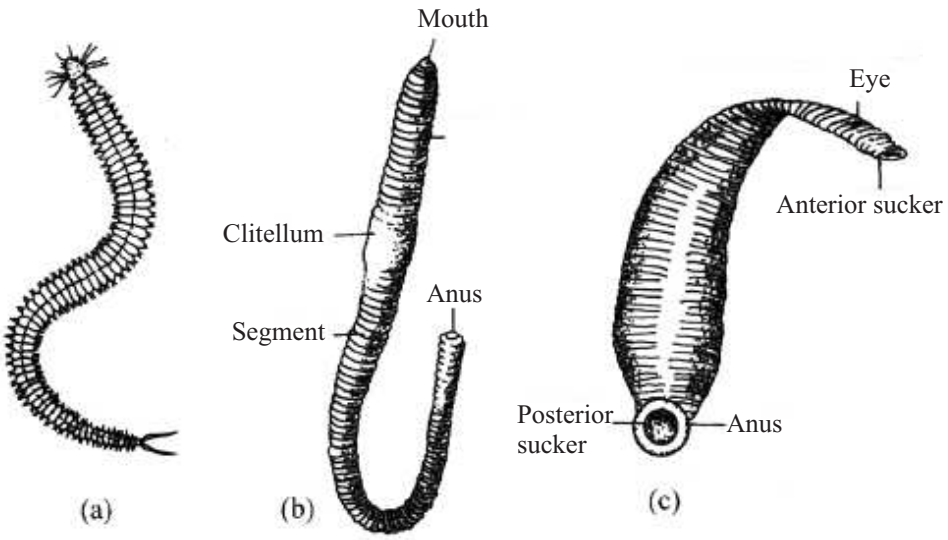


Fig. 3.11 Annelids (a) *Nereis* (b) *Pheretima* (c) *Hirudinaria*

6. Phylum Arthropoda (includes Crab, scorpion, insect, spiders etc.)

Main Characters:

– Segmented body, can be differentiated into head, thorax and abdomen
– Head and thorax often fused to form **cephalothorax**
– Jointed legs for locomotion, one pair each on some or all body segments
– Exoskeleton of chitinous cuticle, shed at intervals (moulting)
– Sexes usually separate.

Arthropods are further divided into classes.

(i) Crustacea (ii) Myriapoda (iii) Insecta (iv) Arachnida

Classification

Phylum Arthropoda

Class 1 Arachnida	Class 2 Crustacea	Class 3 Myriapoda	Class 4 Insecta
(a) Cephalothorax with 2-chelicerae, 3- pedipalpi, and 4 pairs of walking legs	(a) body covered with dorsal covering called carapace	(a) Body with numerous segments	(a) body divisible into head, thorax, and abdomen.

(b) abdomen usually without legs	(b) cephalothorax with 13 pairs of legs in appendages sexes usually separate	(b) each segment bearing 1-2 pairs of legs terrestrial and air-breathing arthropods	(b) thorax 3-segmented with 3 pairs of legs in each segment usually 2 pairs of wings on the last two thoracic segments.
(c) eyes simple	(c) eyes compound	(c) eyes compound	(c) eyes compound
(d) sexes separate	(d) sexes separate	(d) sexes separate	(d) sexes separate
(e) Example scorpion (Fig. 3.12a)	(e) Example Prawn (Fig. 3.12b)	(e) Example (Scolopendra) and Millipede (Fig. 3.12c)	(e) Example: Cockroach (Fig 3.12d)

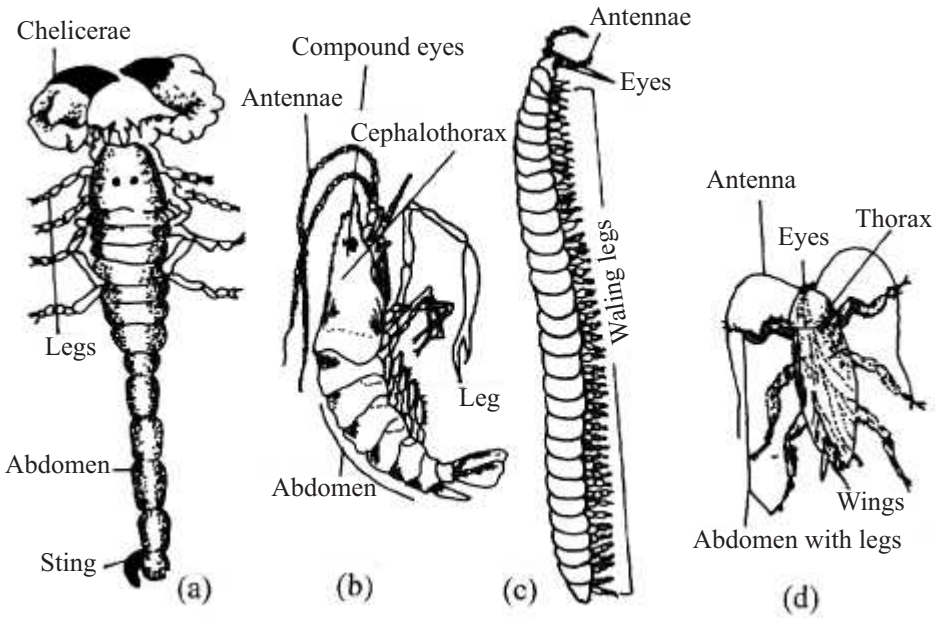


Fig. 3.12 Arthropods (a) Scorpion; (b) Prawn; (c) Millipede; (d) Cockroach

7. Phylum Mollusca (includes squids, snails and oysters)

Mollusca

These animals have a soft, unsegmented body, with a hard, calcareous shell to protect the soft body. They have a muscular foot to help in locomotion and also to act as a weapon in some cases. Examples: snails, slugs, oysters, mussels, clams, squids, and octopuses (Fig. 3.13).

Main Characters.

- Unsegmented soft-bodied animals terrestrial or aquatic,
- Exoskeleton in the form of a shell. When present shell is usually univalved or bivalved; internal shell present in some.
- Sexes separate or united.
- Have a muscular foot for locomotion.

Examples. Apply snail (*Pila*), Freshwater mussel (*Unio*), Cuttlefish (*Sepia*), Slugs, Octopus.

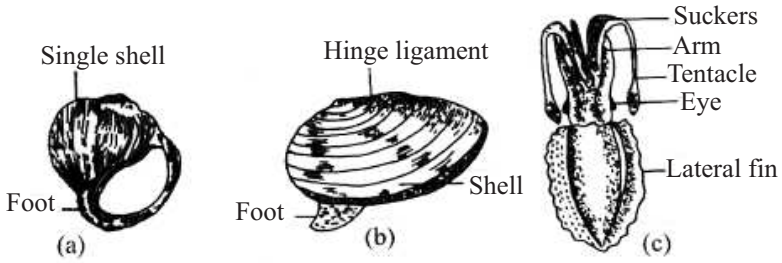


Fig. 3.13 Three molluscs (a) *Pila* (b) *Unio* (c) *Sepia*

8. Phylum Echinodermata (Includes starfishes, brittle stars, sea urchins, sea cucumbers)

Main Characters:

- Marine animals, with unsegmented body.
- Head absent, body surface marked with 5 radiating areas.
- Radial symmetry.
- Endoskeleton of dermal calcareous ossicles with spines.
- Movement by tube feet.
- Sexes usually separate.
- Regeneration of lost parts a peculiarity.
- Adults are radially symmetrical, but the larvae are bilaterally symmetrical.

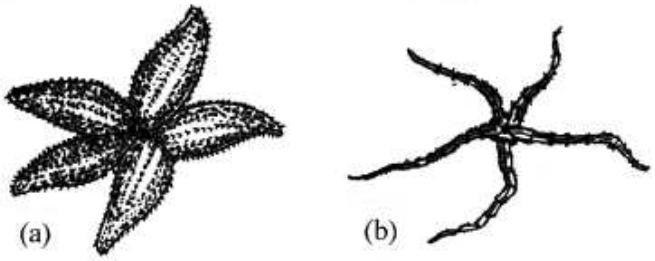


Fig. 3.14 Echinoderms (a) Asterias (b) Ophiara

INTEXT QUESTIONS 3.5

1. Member of which phylum possesses the cnidoblasts?

   .....

2. What do the earthworms possess which help them in locomotion?

   .....

3. Are all the Platyhelminthes parasites?

   .....

4. How many pairs of legs do the following have
   (i) Insects; .....
   (ii) Scorpions; .....

(iii) Spiders .....

5. Name the organs by which the starfish move?

.....

6. Give two examples of the Phylum Arthropoda :

.....

7. Name the phyla which have the following characteristics :
   (i) Tube feet. .....
   (ii) Cnidoblasts .....
   (iii) Chitinous exoskeleton .....
   (iv) Jointed legs .....
   (v) Nephridia .....
   (vi) Flattened body and a gut without anus. .....

3.9 PHYLUM CHORDATA

Main Characters:

– Notochord present at some stage of life, in most cases replaced by backbone.
– Dorsal tubular nerve cord.
– Gill slits present at some stage of life. (larva or adult)
– Body with a head and trunk and two pairs of appendages.

Classification

Phylum Chordata

1. Subphylum Urochordata	2. Subphylum-Cephalochordata	3. Subphylum Vertebrata
(a) Notochord present only in larval stage. (uro-tail)	(a) Notochord and nerve cord remain present throughout the life and extend through entire length of the body.	(a) Notochord replaced by vertebral column (back bone)
(b) Body bag-shaped, covered by a particular tunic or testa in adult stage.	(b) Body elongated and flattened from sides.	(b) Body with well developed head and paired fins or limbs. Cartilaginous or bony endoskeleton
(c) Limbs absent	(c) Limbs or paired fins absent.	(c) paired limbs present (tetrapoda)
(d) Dorsal tubular nerve cord present in the larval forms and reduced in adult.	(d) Dorsal tubular nerve cord present in adults.	(d) Dorsal tubular nerve cord present which is divided into brain and spinal cord.
(e) Example: *Herdmania* (Fig. 3.15a)	(e) Example: *Amphioxus* (Fig 3.15b)	(e) Examples.: All animals with backbone (Fig. 3.15c)

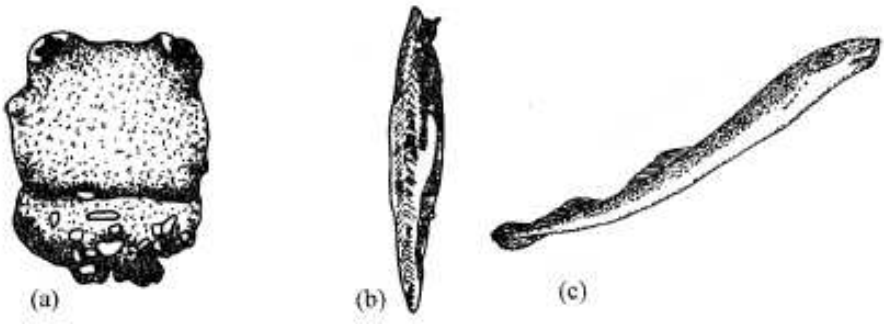


Fig. 3.15 Chordates (a) *Herdmania* (b) *Amphioxus* (c) *Petromyzon*

The subphylum vertebrata has 2 super classes Agnatha (jawless vertebrate) and Gnathostomata (jawed vertebrata)

Super-class Agnatha (A, no ; Gnathos : jaw) (jawless vertebrates)	Super-class Gnathostomata (jawed vertebrates)
Class : Cyclostomata	Class (1): Chondrichthyes
(Cyclo = circular, Stoma = mouth)	Class (2): Osteichthyes
– no jaws	Class (3): Amphibia
– 7 pairs of gill-slits	Class (4): Reptilia
– no paired fins	Class (5): Aves
– eg. Petromyzon (Lamprey) (Fig. 3.15)	Class (6): Mammalia

The two classes of fish include the cartilaginous and bony fish. Fishes are aquatic animals, gill breathing and move with the help of scales.

Class 1. Chondrichthyes

(Gk, Chondro = cartilage; ichtyes = fish)

– mouth ventral
– tail heterocercal
– Skeleton cartilaginous
– Five to seven pairs of gills
– Operculum (gill cover) absent

Example: *Scoliodon* (*dog-fish*) (Fig 3.16a)

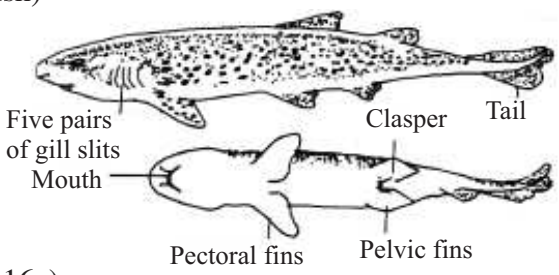


Fig. 3.16a Scoliodon

Class 2. Osteichthyes

(os = bone; ichthyes = fish)

– Mouth terminal
– Tail homocercal
– Skeleton bony
– Four pairs of gills
– Operculum present

Example : *Labeo* (Rohu) (Fig. 3.16b)

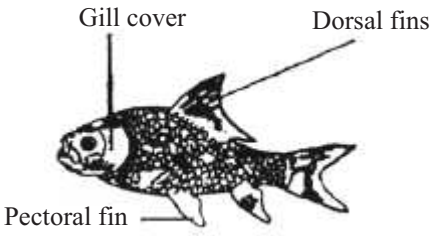


Fig. 3.16b Labeo

INTEXT QUESTIONS 3.6

1. Name the following

   (i) The category of animals possessing backbone.

   .....

   (ii) The group of backboned animals but having no jaws.

   .....

   (iii) Any one cartilaginousfish.

   .....

2. State one difference between cartilaginous and bony fishes.

   .....

3. Name one bony fish.

   .....

4. List the three main characters of the phylum Chordata.

   .....

Class 3 : Amphibia (amphi: double or both, "bios" : life referring to life on land as well as in water)

Main characters:

- The animal partly live in water and partly on land.
- Skin smooth or rough, rich in glands.
- Two pairs of limbs; pentadactyl (five-fingered), digits without claws.
- Body with distinct head and trunk, no neck.
- Two nostrils opening into the buccal cavity.
- Tympanum present on surface of body wall.
- Eggs are laid in water.
- In the early stage of life (larvae), they breathe by means of gills, but adults breathe by lungs.
- Heart three-chambered.
- Larval stage tailed and aquatic.

Some are tailed (salamander) and some are tailless (Frog, Toad)

Examples : *Salamandra*, *Proteus* (Fig. 3.17a), *Rana* (Frog, Bufo Toad (Fig. 3.17b) *Ichthyophis* (Fig. 3.17c)

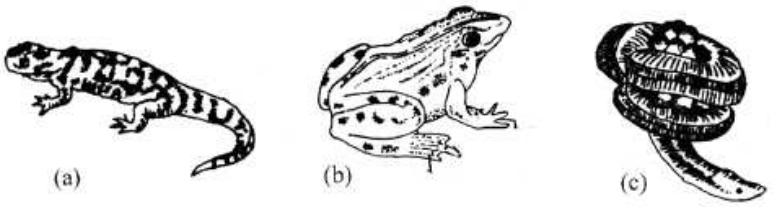


Fig. 3.17 *Amphibian* (a) *Salamandra* (b) Frog (c) *Ichthiophis*

INTEXT QUESTIONS 3.7

1. How many chambers are there in an amphibian heart?

   .....

2. Name one tailless amphibian.

   .....

3. What is the literal meaning of the term "amphibia".?

   .....

Class 4 : Class Reptilia (reptere: to crawl) : are four-legged or legless crawling animals whose body is covered by scales. they lay eggs on land

Characteristic features:

- Terrestrial (live on land), or some are aquatic (live in water).
- Body covered with horny scales.
- Skin is dry.
- Paired pentadactyl limbs (absent in snakes) with clawed digits.
- Tympanum small and depressed (absent in snakes).
- Respiration by lungs.
- Heart three-chambered but with a partially divided ventricle (4- chambered in crocodiles).
- Their eggs have leathery shell.

Examples : Tortoise, turtles, garden lizard (calotes) wall lizard (*Hemidactylus*), cobra (*Naja naja*) and crocodile (*Crocodilus*) and Gharial (*Gravialis*)

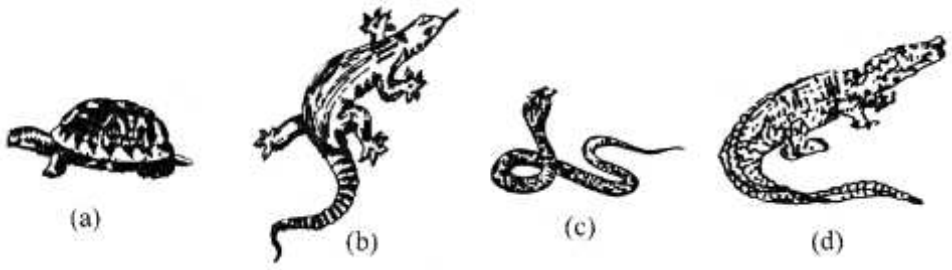


Fig. 3.18 Reptiles (a) Turtle (b) Wall lizard (c) Cobra (d) Crocodile

Class (5) Class : Aves (avis = Bird)

Characteristic features:

- Warm-blooded (homoiothermal, also called endothermal i.e. body temperature remains constant).
- Body covered with feathers, scales are present only on hind-limbs
- Body is divisible into three parts: head, neck and trunk.
- Jaws with horny beak, no teeth.
- Hind-limbs with four digits adapted for perching, walking or swimming
- Bones with air spaces to make the skeleton light (pneumatic bones).
- Forelimbs modified into wings for flight.
- Heart 4-chambered, lungs for respiration connected with air-sacs.
- Voice-box or **syrinx** (present at the junction of trachea and bronchi).
- Only left ovary and oviduct present in the females (economy in body weight.)
- All oviparous (lay eggs), egg with much yolk and calcareous shell.

Example : *Struthio* (Ostrich), *Abteryx* (Kiwi), *Pavo* (Peacock) *Columba*, (Pigeon), Corvus (Crow), etc. (Fig. 3.19).

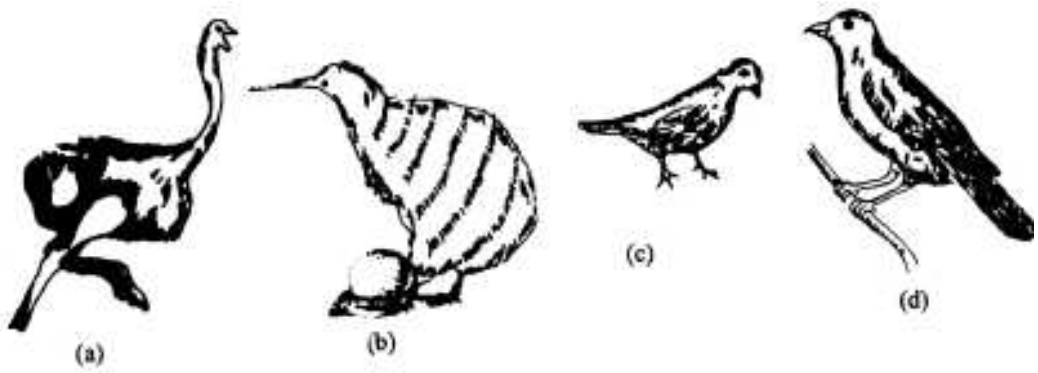


Fig. 3.19 Aves (a) Ostrich (b) Kiwi (c) Pigeon (d) Crow

INTEXT QUESTIONS 3.8

1. Name an aquatic reptile.

   .....

2. How many chambers are there in the heart of a:

   (i) lizard; .....

   (ii) crocodile .....

3. What is the voice box in birds called?

   .....

Class (VI) Mammalia (Mamma : breast)

Characteristic features:

– Body covered with hair.

– Presence of milk (Mammary) glands.

– Sweat and oil glands present in the skin.

– Body divisible into head, neck, trunk and tail; tail absent in some.

– Projecting external ears (pinna) present.

– Digits usually ending in claws, nails or hoofs.

– Dentition thecodont (teeth in sockets of jaw bones) and generally heterodont (four different types).

– Seven neck vertebrae

– Homoiothermal, warm blooded and heart four-chambered.

– Testes are extra-abdominal (not within abdominal cavity) contained in scrotal sacs

– Viviparous, give birth to the young, some primitive mammals are oviparous (lay eggs).

– Foetus is nourished by mother through placenta.

Classification of Class Mammalia

1. Sub-class Prototheria	2. Sub-class Metatheria	3. Sub-class Eutheria
(a) No external ear.	(a) External ear present.	(a) External ear well developed
(b) Teeth found only in young	(b) teeth found in both young and adults	(b) Teeth present in young as well as adults.
(c) Placenta absent	(c) No placenta for nourishment to the embryo	(c) Placenta is present
(d) Mammary glands are devoid of nipples	(d) Mammary glands present	(d) Mammary glands present
(e) Females are oviparous. Example: Duck-bill platypus (Ornithorhynchus) (Fig. 3.20a)	(e) Immature young ones are born. Marsupium (pouch) is present in females Example: Kangaroo (Macropus) (Fig. 3.20b)	(e) Mature young ones are born (For further classification and examples, see below).

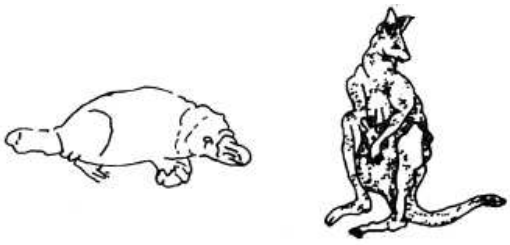


Fig. 3.20 (a) Duck-billed Platypus (b) Kangaroo

Birds and mammals have a constant body temperature. The are termed homoiothermal.

Sub-class Eutheria has been divided into a number of orders. Some important ones are as follows:

Order 1 : Rodentia

- Herbivorous and terrestrial.
- Incisors long, sharp and chisel-shaped.
- Forelimbs shorter than the hindlimbs.

Example: Rat, Squirrel (Fig. 3.21).

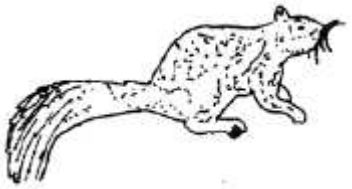


Fig. 3.21 Squirrel

Order 2 : Cheiroptera:

- These are flying mammals.
- Fore-limbs adapted for flight.
- Skin folded i.e. patagium works as wing.
- Hind-limbs thin and short.
- Nocturnal (active at night).
- Bats have poor eyesight. They avoid colliding against objects by **echolocation** in which the bat emits supersonic waves which are reflected back from the objects and the bat can perceive the reflected waves to determine the position of the object. The method is very similar to radar.

Example- Bat (Fig. 3.22)

Fig. 3.22 Bat

Order 3. Carnivora

- Flesh-eating mammals.
- Large pointed and sharp canines to tear the flesh.
- Fingers with sharp claws.

Example: Lion, Tiger, Cat, Dog (Fig. 3.23).

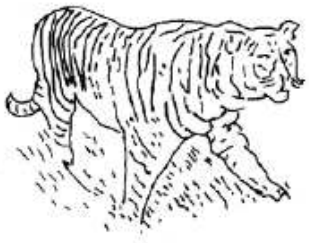


Fig. 3.23 Tiger

Order 4. Primates

- Highly developed brain.
- Eyes are set forward in the head to provide binocular (depth-perception) vision

– The neck is mobile.
– Limbs have five digits with flat nails.
– The thumb of the hand and the greater toe of the feet are opposable (for grasping)
– Two thoracic mammae (breasts) present.

Example: Monkey, Apes, Man (Fig. 3.24).

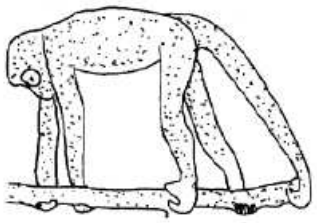


Fig. 3.24 Monkey

Order 5. Cetacea

– Aquatic.
– Fore-limbs are changed into paddles.
– No neck.
– Fish-like shape but respiration by lungs.

Example: whale (Fig. 3.25)

Fig. 3.25 Whale

Order 6. Proboscidea

– Large, herbivorous, terrestrial.
– Fusion of upper lip and nose to form a long mobile trunk.
– Only one pair of incisors in upper jaw which form huge tusks in males.

Example: Elephant (Fig. 3.26).

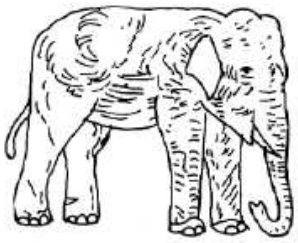


Fig. 3.26 Elephant

Order 7. Ungulata

– Hoofed mammals.
– Herbivorous.
– Usually domesticated by man.
– Mammae are abdominal with teats.

Example: Deer, Cows, Sheep (Fig. 3.27)

Fig. 3.27 Deer

INTEXT QUESTIONS 3.9

1. Match the items in Column I with those in Column II

Column I	Column II
(i) Humans	(a) Carnivora
(ii) Platypus	(b) Ungulata
(iii) Tiger	(c) Primates
(iv) Whale	(d) Prototheria
(v) Horse	(e) Metatheria
(vi) Kangaroo	(f) Cetacea

2. Name the Group of Mammals which includes
   (i) Egg-laying mammals .....
   (ii) Pouched mammals .....
   (iii) Flesh-eating mammals .....
   (iv) Aquatic mammals .....
   (v) Flying mammals .....
3. For which characteristic feature are certain animals placed in class mammalia?
   .....
4. Name a mammal which has marsupium.
   .....
5. Which group of chordates possesses hair?
   .....

WHAT YOU HAVE LEARNT

- Animals are multicellular eukaryotes with heterotrophic nutrition, locomotion and sensitivity through nervous system.
- They may be at cellular grade of organisation (Phylum Porifera), tissue grade (Phylum Cnidaria) or organ grade of organisation (other animal phyla).
- Their body may be asymmetrical (Porifera), radially symmetrical (Cnidaria), or bilaterally symmetrical (other animal phyla).
- Kingdom Animalia is divided into two groups: Non-chordates and Chordates.
- Non-chordates are included in three sub phyla Urochordata, Cephalo-chordata and Vertebrata. Vertebrata has super classes-Agnatha (Jawless) and Gnathostomata (possessing jaws).
- Gnathostomata includes six classes – Chondrichthyes (cartilaginous fishes), Osteichthyes (bony fishes), Amphibia (frog), Reptilia (lizard) Aves (birds) and Mammalia (rat)
- Porifera are characterised by ostia, osculum, spongocoel and canal system.
- Cnidaria have cnidoblasts (stinging cells), coelenteron and the polyp and medusoid forms.
- Platyhelminthes (flat worms) include some free-living but mostly parasites like tapeworm and liver fluke.
- Class Nematoda of phylum Aschelminthes includes roundworms.
- Annelida (Earthworms) show metameric segmentation and have nephridia.
- Arthropods have jointed appendages and chitinous cuticle as their exoskeleton.
- Mollusca includes soft-bodied animals covered by a calcareous shell.

- Echinodermata includes spiny-skinned, marine animals which have tube feet for locomotion.
- Chordates have (i) a notochord (ii) a dorsal hollow nerve cord and (iii) gill slits at some stage of the life.
- Amphibians live on land as well as in water. Their limbs have no claws.
- Reptiles have horny scales covering the body. They are mostly terrestrial.
- Class Aves includes birds–the flying vertebrates with forelimbs modified into wings.
- Mammals possess hair and mammary glands which secrete milk to feed the young ones.
- Kingdom Plantae is classified into two divisions i.e. Bryophyta and Trachaeophyta.
- Bryophytes are amphibians of plant kingdom and are non-vascular.
- Main plant body of Bryophytes is a gametophyte; sporophyte remains attached to gametophyte.
- The main plant body of Pteridophytes is a sporophyte.
- All groups of Plantae show alternation of generations
- Gymnosperms and Angiosperms are seed-producing plants.
- In Gymnosperms seeds are naked, whereas in Angiosperms seeds are enclosed in ovary.
- Main difference between dicotyledonous and monocotyledonous plants is number of cotyledons in the embryo.
- Brassicaceae and Fabaceae are dicot families, whereas Poaceae and Liliacea, are monocot families.

TERMINAL EXERCISES

1. List the main groups of Kingdom Plantae.
2. Give the two main types of Bryophytes.
3. Differentiate between gametophyte and sporophyte.
4. Define alternation of generations.
5. Why are Pteridophytes grouped under Trachaeophyta?
6. Differentiate between Angiosperms and Gymnosperms.
7. Give three main differences between dicot and monocot plants.
8. Name three families of Angiosperms giving one character of each family.
9. Define an animal.
10. With examples name (i) the three kinds of symmetry and (ii) the three grades of organisation met within the Kingdom Animalia.

11. Explain the term triploblastic.
12. Name the major non-chordate phyla. Give one characteristic feature and one example of each.
13. Give one major difference between
    (i) Cyclostomes and other fishes
    (ii) Chondrichthyes and Osteichthyes, Cite examples.
14. Why are frogs included in the class Amphibia?
15. Give two characteristic features of reptiles. Cite examples of five reptiles
16. Give three features of birds which adapt them to aerial life and give two examples of flightless birds.
17. Give three features of mammals and one difference between Prototheria, Metatheria and Eutheria.
18. Name any five orders of Mammalia, Give one characteristic feature and one example of each.

ANSWERS TO INTEXT QUESTIONS

3.1 1. They complete their life cycle in water and land.

2. Alternation of gametophytic phase with sporophytic phase.

3. Antheridia and Archegonia

4. Cool and humid place.

3.2 1. Sporophytic 2. Sporophyte 3. They have vascular tissues

4. Antheridia and Archegonia 5. Prothallus

3.3 1. Naked seeds 2. *Cycas* and *Pinus* 3. Timber, resins

3.4 1. Fabaceae, Poaceae. 2. 10, infinite

3. (i) *Oryza sativa* (ii) *Cajanus cajan* (iii) *Aloe barbadumins*

4. In the Ovary after fertilization

3.5 1. Cnidaria 2. Cetae 3. No

4. (i) 3 (ii) 4 (iii) 3

5. Tube feet 6. Prawn, Millipede or any other

7. (i) Echinodermata (ii) Cnidaria

(iii) Arthropoda (iv) Arthropoda

(v) Annelida (vi) Platyhelminthes

3.6 1. (i) Vertebrata (ii) Agnatha (iii) Scoliodon

2. Endoskeleton bony in bony fishes and cartilaginous in cartilaginous fishes

or

5 to 7 pairs of gills in cartilaginous fishes and 4 pairs in bony fishes.

3. *Labeo, Catla.*

4. 1. notochrod at some stage of life

2. dorsal tubular nerve cord

3. gill slits at some stage of life.

3.7 1. Three 2. Ichthyophis

3. Can live both, in water and on land.

3.8 1. Turtle, seasnake 2. Three and four

3. Syrinx

3.9 1. (i) and c (ii) and d (iii) and a (iv) and f

(v) and b (vi) and e

2. (i) Prototheria (ii) Metatheria (iii) Carnivora

(iv) Cetacea (v) Cheiroptera

3. Mammary or milk glands 4. Kangaroo

5. Mammalia