



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*), **Protocista** (*eukaryotic, unicellular*), and **Fungi** (*eukaryotic, 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 which contribute towards the biodiversity on planet earth. We shall now learn the classification of plants and animals.



Notes

Plants are multicellular, eukaryotic, photosynthetic autotrophs having cellulosic cell walls. 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. Seed not enclosed in ovary.
- (b) Angiospermae : seeds enclosed in ovary wall; are divided into :
 - (i) Dicotyledon : embryo with two cotyledons.
 - (ii) Monocotyledon : 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. They mainly grow in damp, shady places.

- They are embryophytes that do not have vascular tissues (neither xylem nor phloem).
- No true leaves and roots.
- Sex organs 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 stems – Mosses (*Fanaria*) Fig. 3.1(b)
3. Flat thalloid – Hornworts or *Anthoceros*

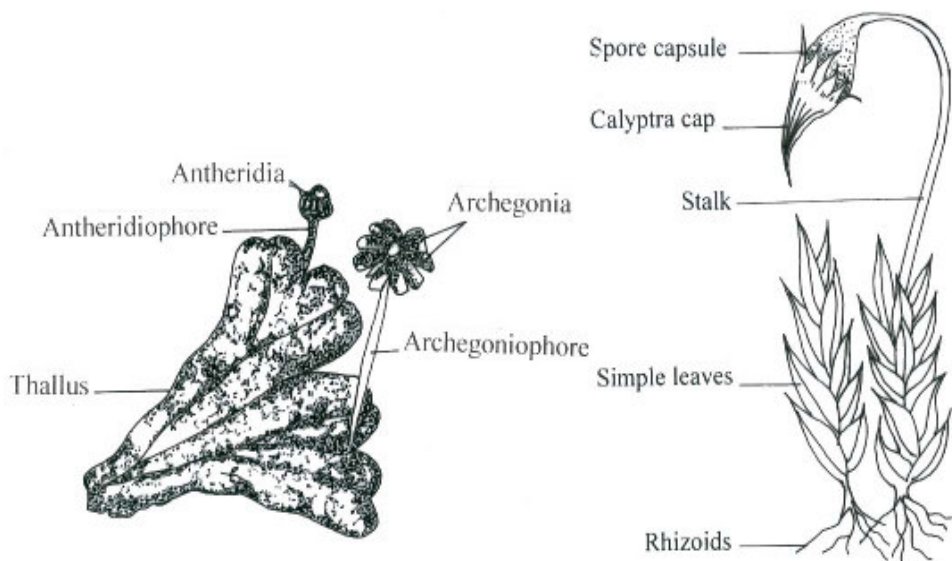


Fig 3.1(a) Liverworts (*Marchantia*)

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



Notes

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 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, unicellular in liverworts and hornworts and multicellular in mosses. Rhizoids act as anchorage and also help in absorption of water 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. Sporogenous tissue in the sporophyte undergoes meiosis to produce haploid spores. The spores germinate to give rise to a gametophyte again.

Gametophyte (Undergoes Mitosis): Gamete producing phase of plants

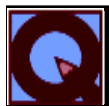
Sporophyte (Undergoes Meiosis): Spore producing phase of plants

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

Comparison of gametophytic and sporophytic phase

Gametophytic phase	Sporophytic phase
1. Haploid phase	Diploid phase
2. Has sex organs	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

- The bryophytes are pioneers of vegetation, i.e. they are the first ones to grow on various habitats like rock, lava, sand, water etc and act as soil binders.
- The mosses hold water better than the soil thus improve the microhabitat for seeds of other plants to grow.
- They are the source of food for fish and birds and for nesting materials for birds.



INTEXT QUESTIONS 3.1

1. Mention one unique feature of bryophytes.
.....
2. Define alternation of generation.
.....
3. Name the male and female sex organs of bryophytes.
.....
4. List the condition suitable for the growth of bryophytes.
.....



3.3 PTERIDOPHYTA (PTERIDOPHYTES)

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

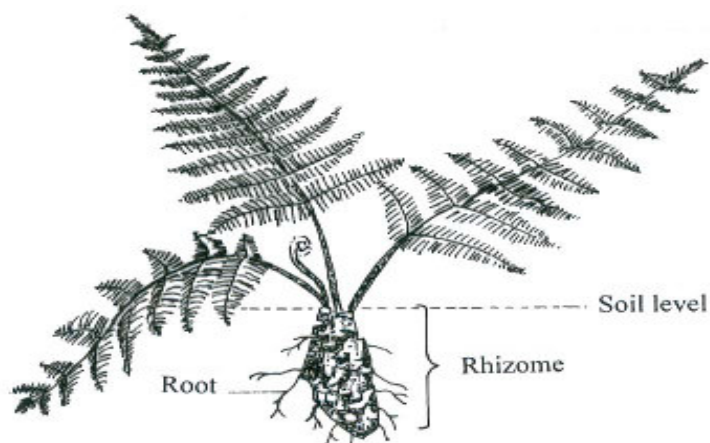


Fig. 3.2 A garden fern plants

1. Ferns are lower vascular plants. They contain vascular tissue. Vascular tissue is made up of xylem and phloem which helps in conduction of water and nutrients to all parts of the plant body. Pteridophytes are usually found in damp, shady places or in gardens, on the hills where temperature is low.
2. The main plant body represents a sporophytic (diploid) generation and has roots which penetrate the soil and absorb water.
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 (remanta).
4. The young leaves show characteristic tightly coiled structure (see Fig. 3.2a). The axis of the leaves is called **rachis** and leaflets on both sides of rachis are called **pinnae**. The division of pinnae are known as pinnules.
5. On the under surface of the leaves, develop spore producing bodies called **Sporangia**. The sporogenous tissue in the sporangia undergoes meiosis to produce haploid spores.
6. The spores germinate into an independent small thallus like body, the gametophyte called **prothallus**. The prothallus bears antheridia and archegonia which produce male gametes and female gametes. The gametes fuse and zygote develops into a diploid sporophyte.
7. The young embryo absorbs nutrients 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 two 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.
.....
3. Why do you classify Pteridophytes under Tracheophyta?
.....
4. Name the male and female reproductive organs in Pteridophytes?
.....
5. Write the name of gametophyte of fern.
.....

**Notes****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 not enclosed in carpels (ovary). The ovuliferous scales are arranged in cones.

Characteristics of Gymnosperms

1. The adult plant (sporophyte) is 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 pinnately compound, needle-like and grow on dwarf shoot as in *Pinus* and not on the main trunk as in a *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).
6. Pollen grains are haploid produced in microsporangia of male cone. Each pollen grain has two large sacs to help in the dispersal. 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 gymnosperms or 'naked seeds' for this group. Ovules are produced side by side, inside which female gamete or egg is produced. Male gamete fuses with female gamete in the ovule. The fertilised ovule then develops into a seed (winged in case of *pinus*).



Notes

Some common Gymnosperms are

Pine (*Pinus*), Red Wood (*Sequoia*), Juniper (*Juniperus*), Cedar (*Cedrus*). Many gymnosperms yield timber, resins, turpentine, and many other products like the dry fruit chilgoza.

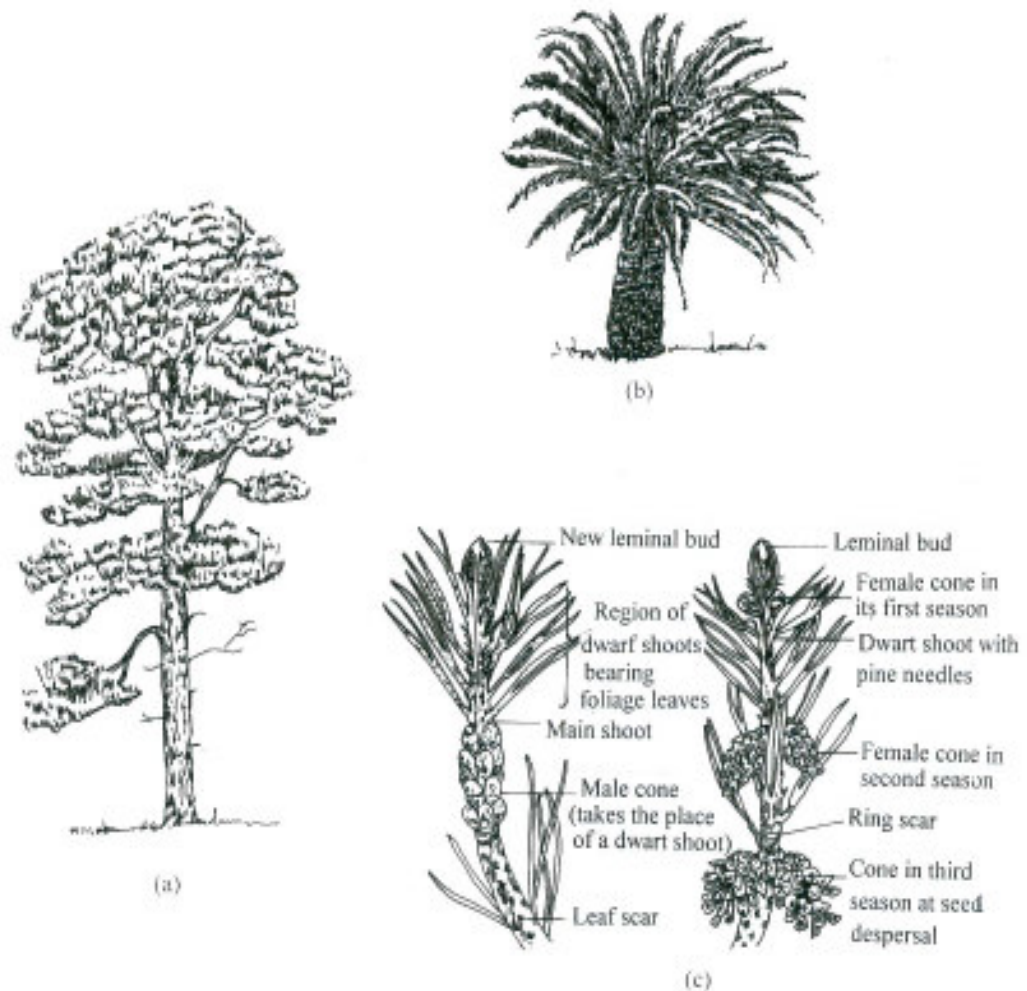


Fig. 3.3 Some examples of phylum gymnosperm (a) *Pinus* tree (b) cypress tree (c) tree with male and female cone



INTEXT QUESTIONS 3.3

1. What does the term gymnosperms mean?
.....
2. Name 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. A fruit is a mature ovary.

Look at an angiosperm plant in Fig. 3.4.

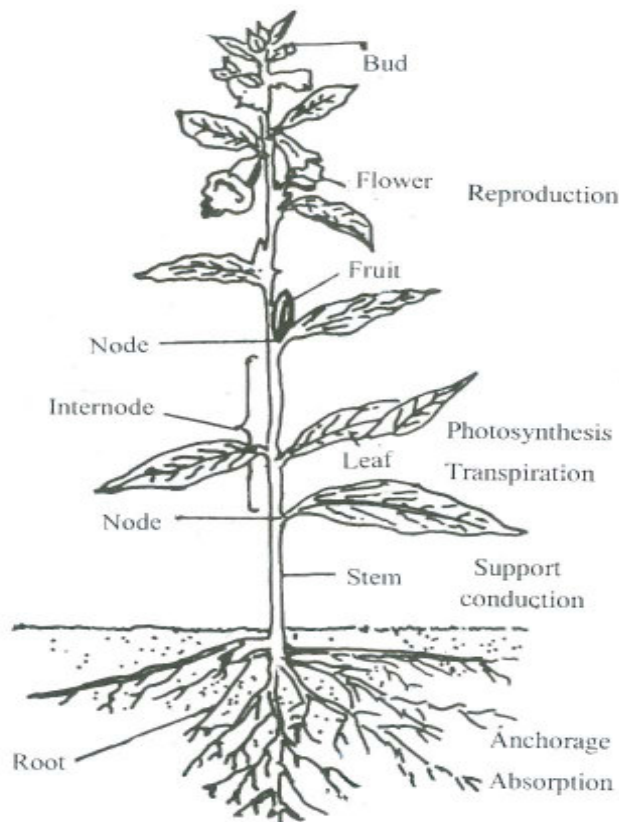


Fig. 3.4 The parts of an angiosperm plant

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 fruits.

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

Differences between angiosperms and gymnosperms

Gymnosperms	Angiosperms
1. Seeds naked as not enclosed in ovary.	Seeds enclosed in fruit (a mature ovary).
2. Bears cones where spores (gametes) develop.	Bears flowers where reproductive spores (gametes) develop
3. Xylem vessels usually absent.	Xylem has both vessels as well as tracheids.



Notes

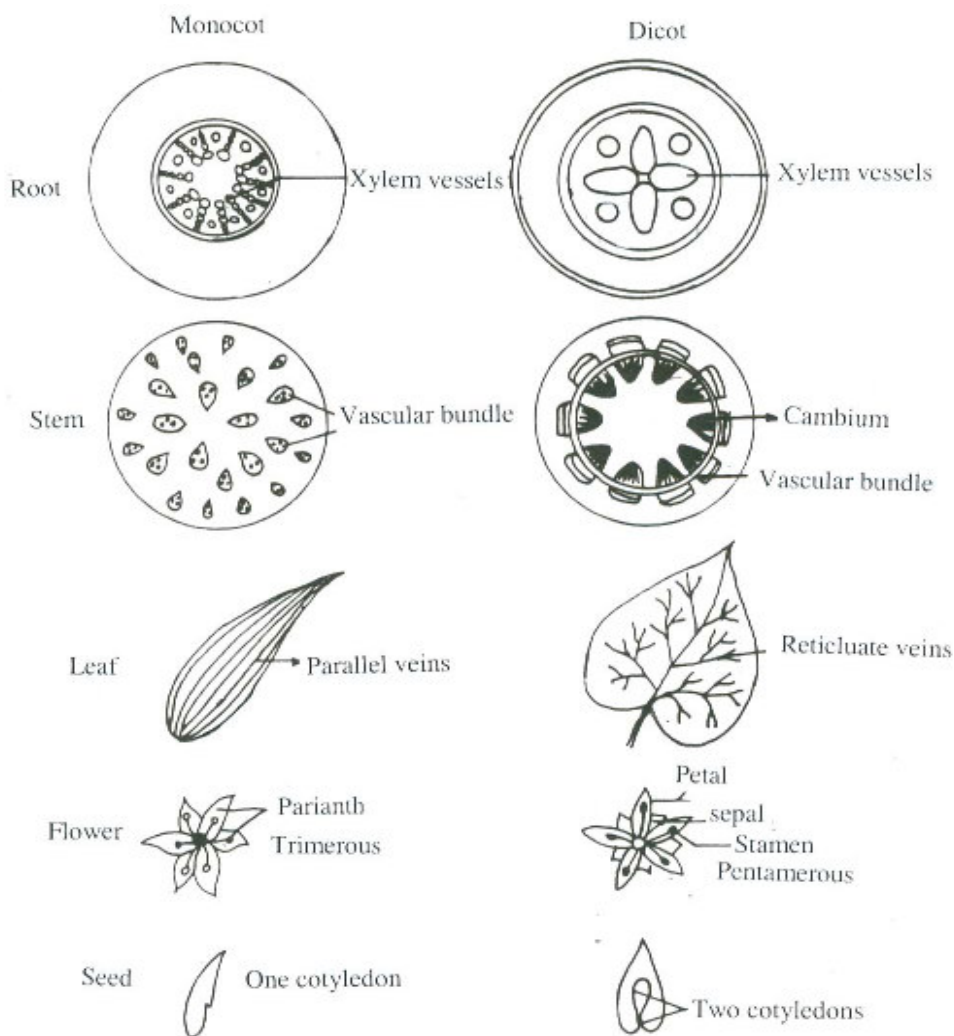


Fig. 3.5 Comparison of Monocots and Dicots

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 so they 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 dicot and two monocot

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



Notes

Fabaceae Family (Papilionaceae) : A dicotyledonous family

The plants are herbs or shrubs. Flowers are zygomorphic (means it can not be cut into two equal halves), bisexual, complete, calyx consists of 5 sepals, jointed. Corolla consists of 5 petals, polypetalous (papilionaceous in shape or butterfly shape). 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 consists of 10 stamens, arranged in two bundles (9+1) that is Diadelphous condition (Fig. 3.6a). Gynoecium is superior, monocarpellary, unilocular with many ovules arranged on a marginal placentia. Fruit is a pod.

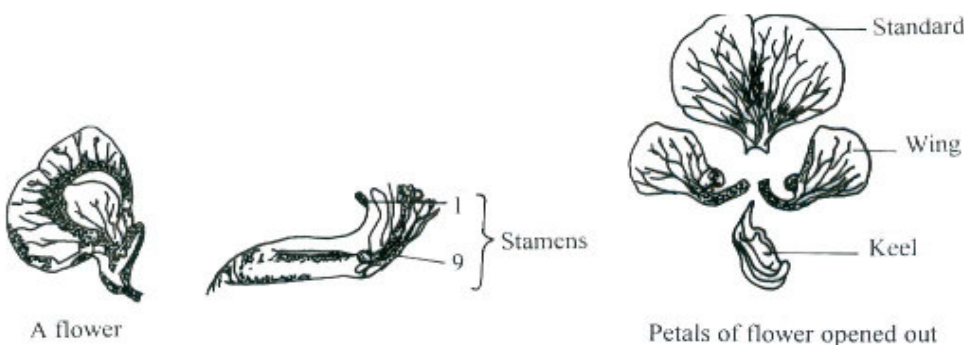


Fig. 3.6a A pea flower

Some examples of useful plants of Fabaceae

Common Name	Botanical Name
Pea (Matar)	<i>Pisum sativum</i>
Pigeon pea (Arhar)	<i>Cajanas cajan</i>
Green Gram (Moong)	<i>Phaseolus aureus</i>
Soya-bean	<i>Glycine max</i>
Lentil (Masoor)	<i>Lens culinaris</i>
Ground nut (Moong-phali)	<i>Arachis hypogea</i>
Chick pea (Chana)	<i>Cicer arietinum</i>

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. Flowers are large and attractive usually solitary axillary (See Fig. 3.6b).

Flowers are pentamerous (all whorls are five or multiple of five) actinomorphic. Epicalyx is present as an additional whorl of bractiole just below the calyx. Calyx has five sepals may be free or joint at the base. Corolla has five petals usually free. Androecium consists of indefinite numbers of monodelphous stamens. The lower parts or filaments join together to form staminal tube. Gynoecium consists of 5



Notes

carpels, syncarpous, and ovary is superior penta locular, axile placentation. Fruit is a capsule.

Bhindi, hollyhocks are other examples of this family.

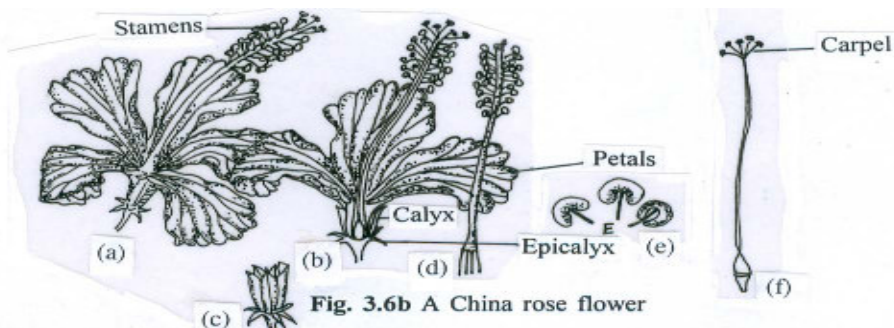


Fig. 3.6b A China rose flower

Liliaceae- A monocot family (Lily family)

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

Flowers are bisexual, actinomorphic, mostly trimerous (all the whorls are 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 perianth. Carpel three, syncarpous ovary, superior, axile placentation. Fruit usually a capsule.

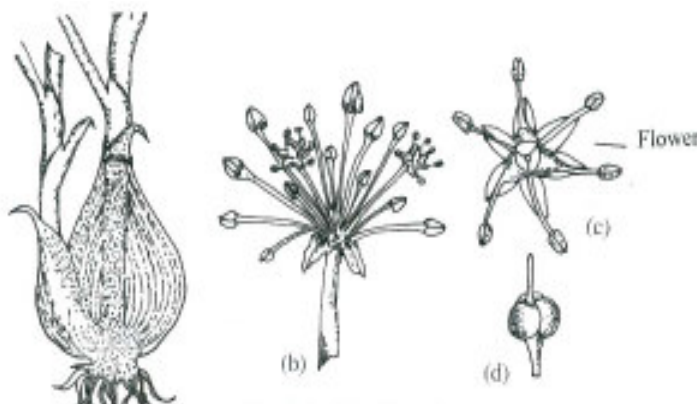


Fig. 3.6c An onion plant.

Some examples of useful plants of Liliaceae

Common name	Botanical name
Ghrit kumari	<i>Aloe vera</i>
Satawar or satmuli	<i>Asparagus racemosus</i>
Tulip	<i>Tulipa tulip</i>
Shakrapushpi	<i>Gloriosa superba</i>
Lily	<i>Lilium candidum</i>
Onion	<i>Allium cepa</i>

Family Poaceae – A monocotyledonous family

The plants are herbs, rarely woody as in bamboo. inflorescence, spike of spikelets, (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, carpels unilocular, ovary superior. Fruit is caryopsis (**seed coat and ovary wall fused**).

Some examples of useful plants of Poaceae

Common Name	Botanical Name
Rice	<i>Oryza sativa</i>
Wheat	<i>Triticum aestivum</i>
Maize	<i>Zea mays</i>
Sugar Cane	<i>Saccharum officinarum</i>
Bamboo	<i>Bambusa sp</i>
Barley	<i>Hordeum vulgare</i>

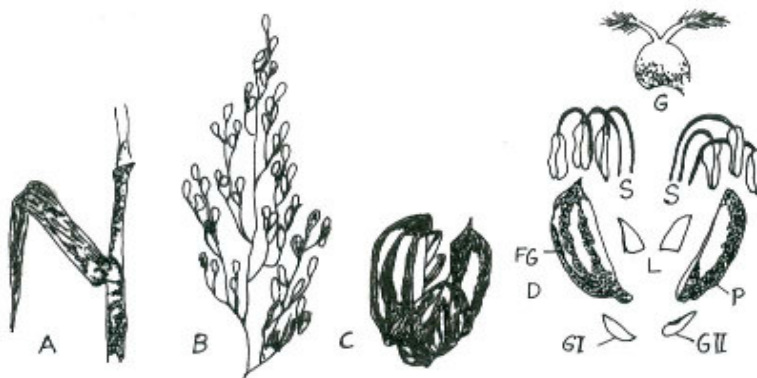
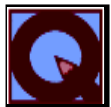


Fig. 3.6d Rice plant (*Oryza sativa*).

**INTEXT QUESTIONS 3.4**

- Name one dicotyledonous and one monocotyledonous family.
- Give the number of stamens in
 - Papilionaceae
 - Malvaceae
- Give botanical name of
 - Rice
 - Arhar
 - Ghrita kumari
- Where do seeds develop in angiosperms?
.....





Notes

3.6 KINGDOM ANIMALAE

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

3.6.1 Few general features of kingdom animalae

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

Basis of classification of animals

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

Organisation : Bodies of animals are multicellular. But cells may or may not be organised into tissues and organ systems. Animals such as sponges are aggregates of cells. They 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 equal and identical parts*. Sponges are **asymmetrical**. Cnidaria and Echinoderm larvae are radially symmetrical. All other animals are **bilaterally symmetrical**.

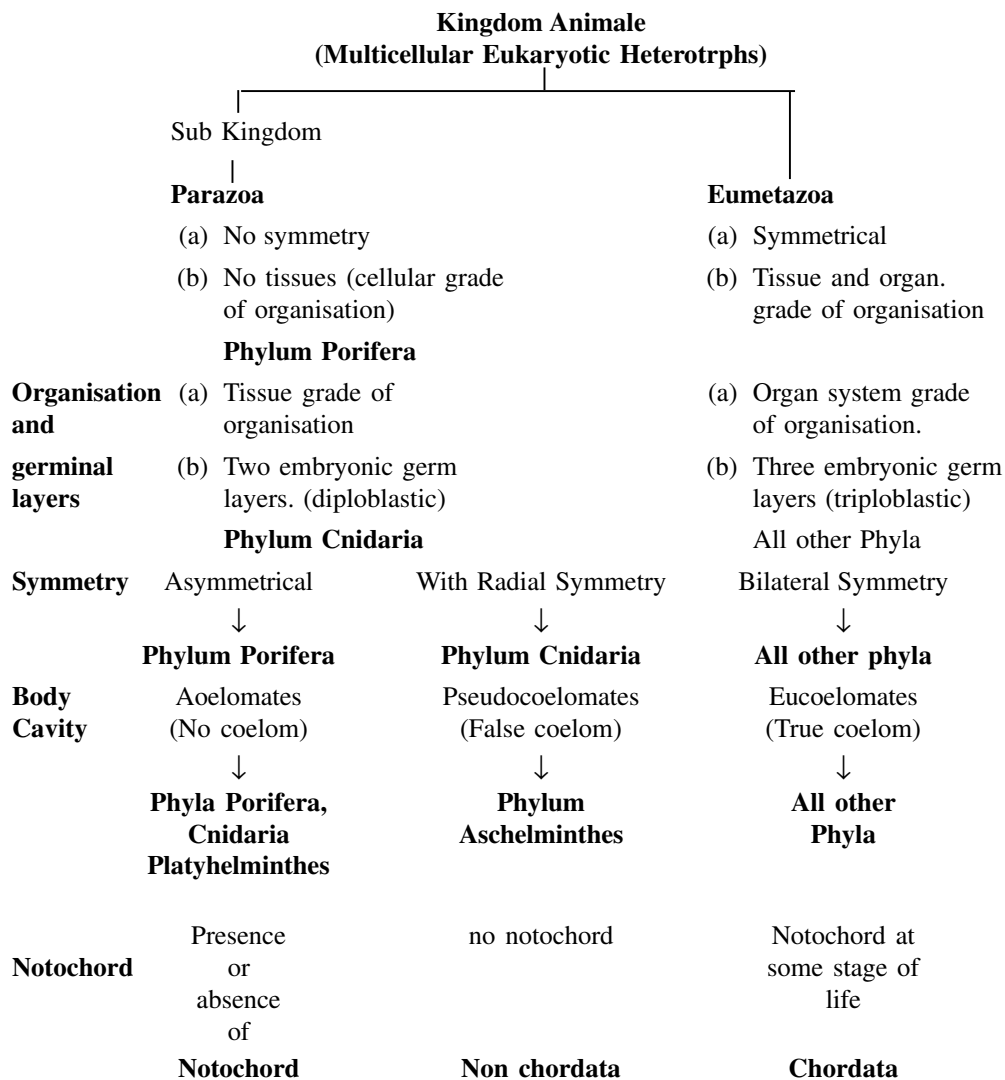
Body Cavity or Coelom : is a cavity between body wall and food canal. It is not present in Acoelomates (a = no, coelom = body cavity) and present in Eucoelomates (eu = true). Pseudocoelom (pseudo = false) is not a true body cavity. It is found in round worms.

Embryonic layers : Three layers of cells, ectoderm, mesoderm and endoderm in the embryo (germinal layers) gives rise to parts of the body of 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 rod found in embryonic stage or adults of some animals which are grouped as **phylum chordata**. All animal groups lacking notochord are termed, **non-chordates**.



Notes



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 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 silicious **spicules**, or of **spongin** fibres, or both.
- Reproduction asexual by budding; also sexual.
- Almost all marine.



Notes

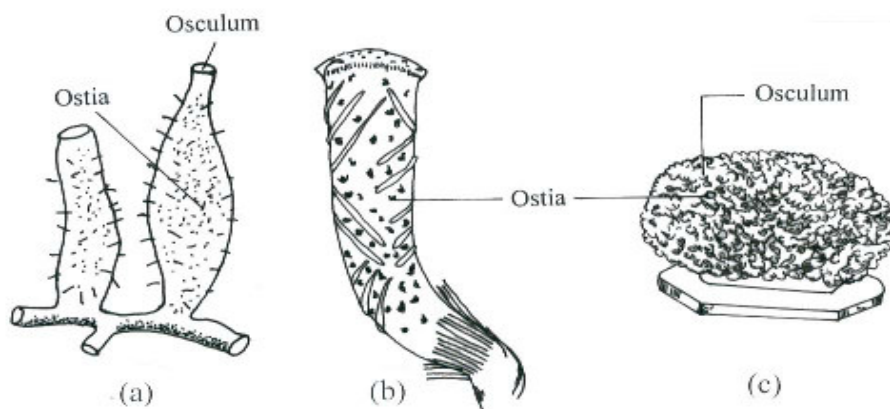


Fig. 3.7 : Phylum Porifera (a) *Sycon*; (b) *Euplectella*; (c) *Euspongia*

2. Phylum Cnidaria (Includes hydroids, jelly fishes, sea anemone, 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, helps 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.

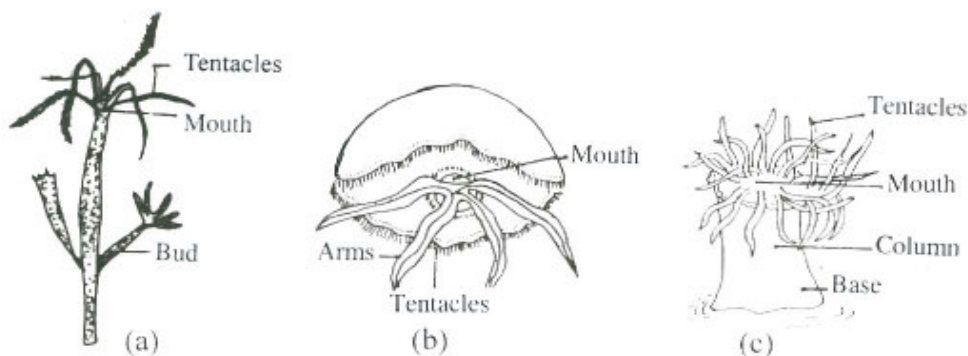


Fig. 3.8 Three common Cnidarians (a) Hydra (b) Jelly fish (c) Sea Anemone

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 human intestine.

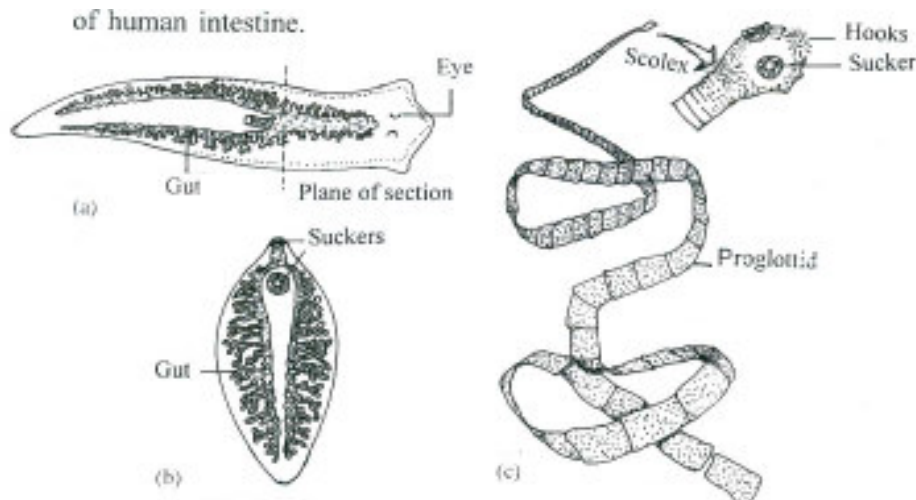


Fig. 3.9 Phylum Platyhelminthes (a) Planaria (b) Fasciola (c) Taenia

3. Phylum Aschehelminthes (Class nematoda)

(Round worms, 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 are smaller than females. (Fig 3.10)
- Mostly parasitic in animals but some live freely in the soil.
- Ascaris is a common round worm, parasitic in the intestine of humans.
- Pin worm and *wuchereria* (Filaria worm) are some other examples.

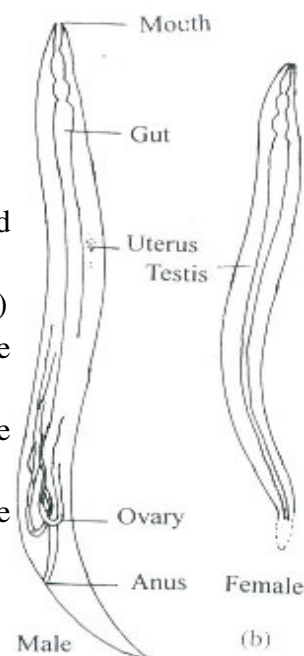


Fig. 3.10 Ascaris
(a) Female (b) Male

4. Phylum Annelida (Includes earthworms)

Main characters:

- Elongated, segmented, coelomate (true body cavity) worm-like animals.



Notes



Notes

- Body provided with setae or parapodia for locomotion.
- Well developed digestive system with the alimentary canal open at both 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) (parasitic on cattle). See figure 3.11.

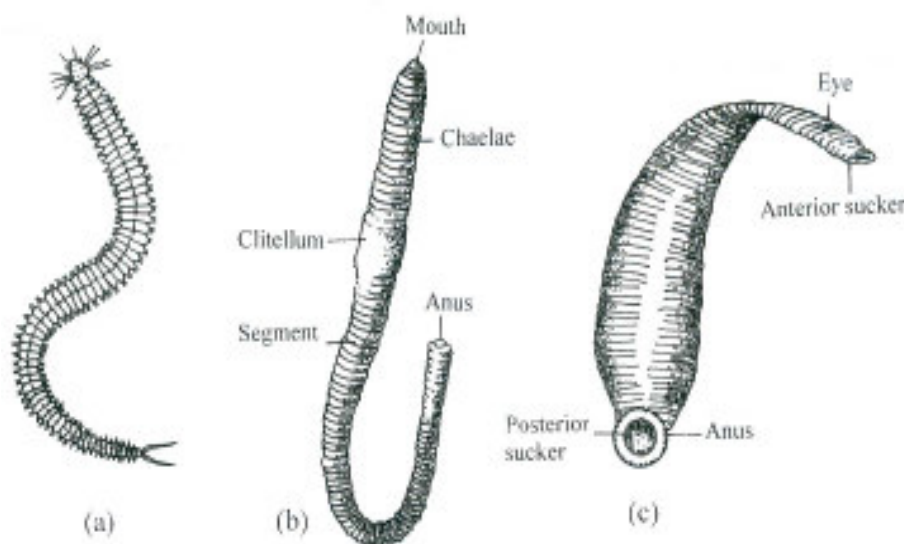


Fig. 3.11 Annelids (a) *Nereis* (b) *Pheretima* (c) *Hirudinaria*

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, 2- 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.



Notes

(b) abdomen usually without legs	(b) cephalothorax with 13 pairs of legs or appendages sexes usually separate	(b) each segment bearing 1-2 pairs of legs terrestrial and air-breathing arthropods	(b) thorax 3-segmented with 3 pair of 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)

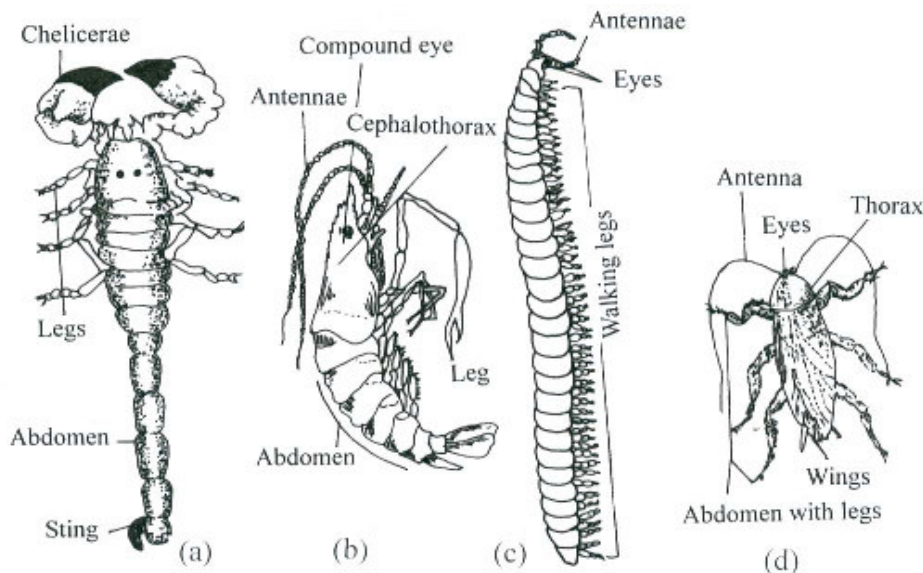


Fig. 3.12 Arthropods (a) Scorpion; (b) Prawn; (c) Millipede; (d) Cockroach

7. Phylum mollusca (includes conch, snails etc.)

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 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 in some.
- Sexes separate or united.
- Have a muscular foot for locomotion.



Notes

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

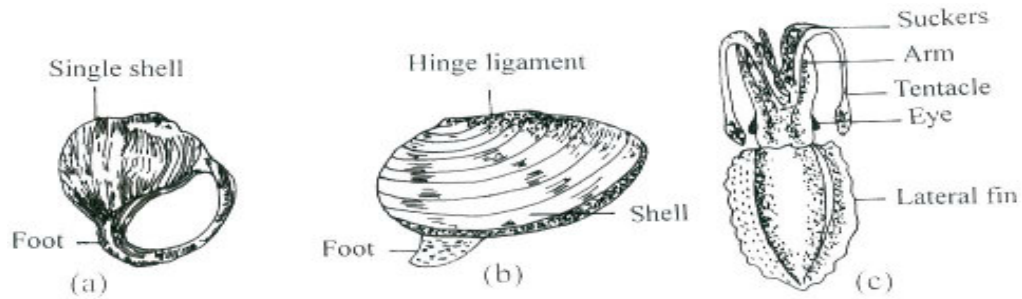


Fig. 3.13 Three molluscs (a) *Pila* (b) *Unio* (c) *Sepia*

8. Phylum Echinodermata (Includes star fishes, 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.

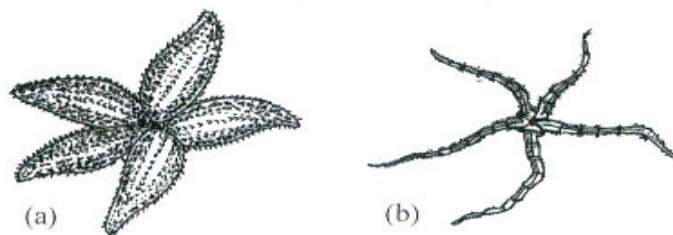


Fig. 3.14 Echinoderms (a) *Asterias* (b) *Ophiura*



INTEXT QUESTIONS 3.5

1. Member of which phylum possess 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;



Notes

(iii) Spiders

5. Name the organs by which the starfish move?

.....

6. Give two examples of 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. (larval 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: <i>Herdmania</i> (Fig. 3.15a)	(e) Example: <i>Amphioxus</i> (Fig. 3.15b)	(e) Examples.: All animals with backbone (Fig. 3.15c)



Notes

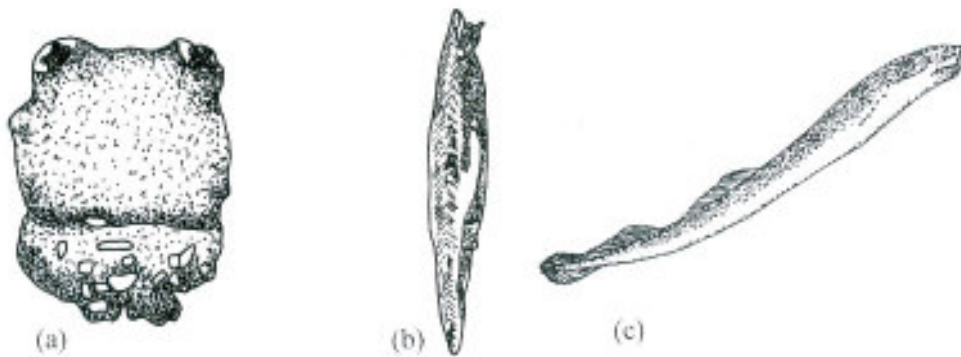


Fig. 3.15 Chordates (a) *Herdmania* (b) *Amphioxus* (c) *Petromyzon*

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

- Super-class Agnatha (A, no ; Gnathos : jaw)
(jawed vertebrates)
Class : Cyclostomata
(Cyclo = circular, Stoma = mouth)
– no jaws
– 7 pairs of gill-slits
– no paired fins
– eg. *Petromyzon* (Lamprey) (Fig. 3.15)

- Super-class Gnathostomata
(jawed vertebrates)
Class (1): chondrichthyes
Class (2): Osteichthyes
Class (3): Amphibia
Class (4): Reptilia
Class (5): Aves
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)

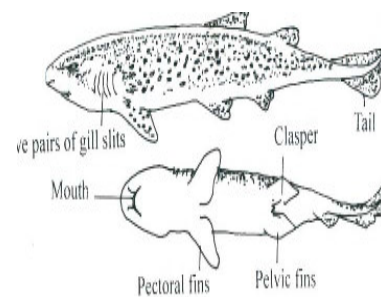


Fig. 3.16a *Scoliodon*

Class 2. Osteichthyes

(os = bone; ichtayes = fish)

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

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

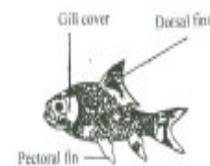
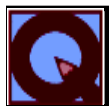


Fig. 3.16b *Labeo*

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 cartilaginous fish.
.....
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:

- 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 buccal cavity.
- Tympanum present on surface of body wall.
- Eggs are laid in water.
- In 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 (salamandre) and some other are tailless (Frog, Toad)

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



Notes

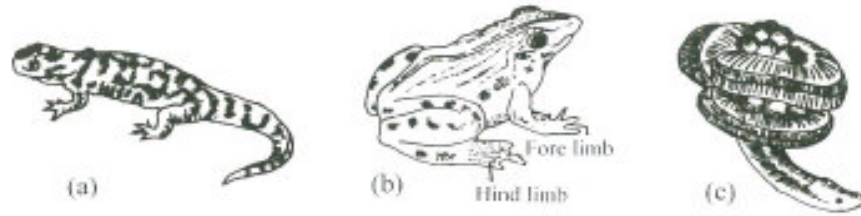


Fig. 3.17 Amphibian (a) Salamandra (b) Frog (c) Ichthyophis



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 into 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 partilly divided ventricle (4- chambered in crocodiles).
- Their eggs have leathery shell.

Examples : Tortoise, turtles, garden lizard (calotes) wall lizard (*Hemidactylas*), cobra (Naga naja) and crocodile (Crocodylus) Gharial (Gravialis)

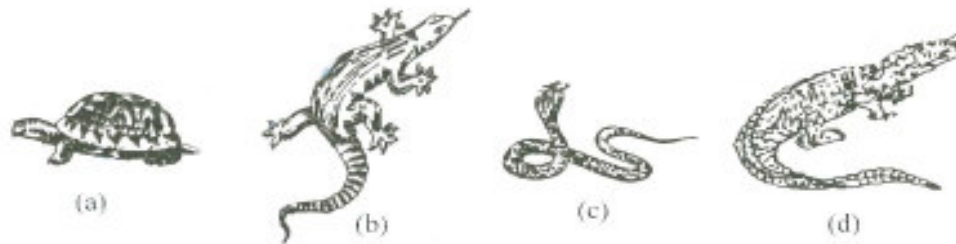


Fig. 3.18 Reptile (a) Turtle (b) Wall lizard (c) cobra (d) crocodile



Notes

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).
- Fore limbs 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).

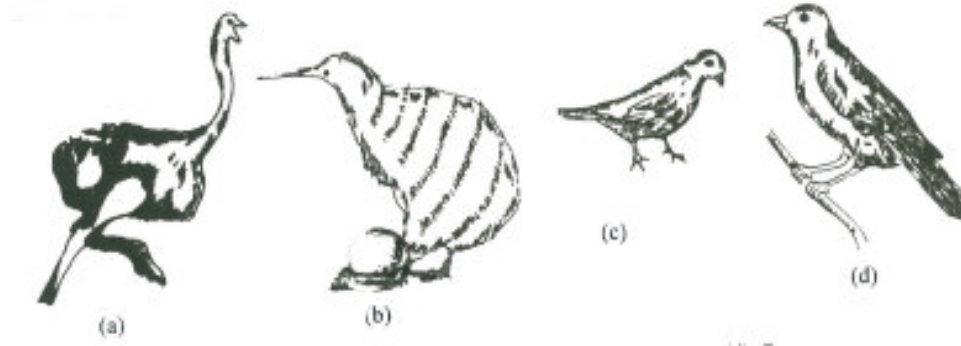


Fig. 3.19 Aves (a) Ostrich (b) Kiwi (c) Pigeon (d) Crow

**INTEXT QUESTIONS 3.8**

1. Name an aquatic reptile.

.....

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

(i) lizard;

(ii) crocodile

3. What is the voice box in birds called?

.....



Notes

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
- Homoeothermic, warm blooded and heart four chambered.
- Testis 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 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).



Notes

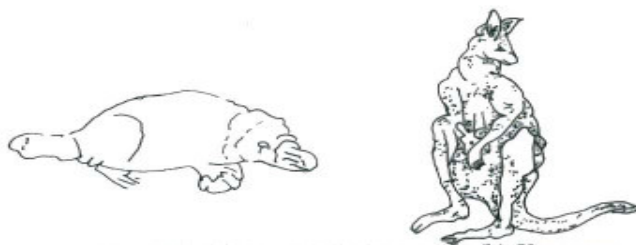


Fig. 3.20 (a) Duck-billed platypus (b) Kangaroo

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

Sub class Eutheria has been divided into 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 hind limbs.

Example: Rat, Squirrel (Fig. 3.21)



Fig. 3.21 Squirrel

Order 2 : Chiroptera:

- These are flying mammals.
- Fore-limbs adapted for flight.
- Skin fold 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



Notes

- 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)

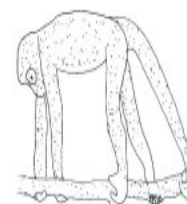


Fig. 3.24 Monkey

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

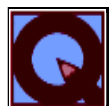
Order 7. Ungulata

- 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



Notes

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 etc), Reptilia (lizard, etc.) Aves (birds) Mammalia (rat etc.)
- 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 Nematode of phylum Aschelminthes include round worms.
- Annelida (Earthworms etc.) 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.

**Notes**

- 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 life.
- Amphibians live on land as well as in water. Their limbs have no claws.
- Reptila have horny scales covering the body. They are mostly terrestrial.
- Class Aves includes birds-the flying vertebrates with fore limbs 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 plants and are non vascular.
- Main plant body of Bryophytes is a gametophyte; sporophyte remains attached to gametophyte.
- Main plant body of Pteridophytes is a sporophyte.
- Both 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.
- Brassicaceae and Fabaceae are dicot families, whereas Poaceae is a monocot family.

**TERMINAL QUESTIONS**

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.



Notes

11. Explain the term triploblastic.
12. Name the major nonchordate 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.



ANSWER TO INTEXT QUESTIONS

- 3.1**
1. They complete their life cycle in water and land.
 2. Alternation of gametophytic phase with sporophytic.
 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, 6
 3. (i) *Oryza sativa* (ii) *Cajanus cajan* (iii) *Aloe vera*
 4. Ovary
- 3.5**
1. Cnidaria
 2. Cetae
 3. No
 4. (i) 3 (ii) 4
 5. Tube feet
 6. Prawn, Nillipede or any other
 7. (i) Echinodermata (ii) Cnidaria
(iii) Arthropoda (iv) Arthropoda
(v) Annelida (vi) Platyhelminthes



Notes

- 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 fish and 4 pairs in bony fishes.
3. *Labeo, Catla*.
4. 1. notochord at some stage of life
2. dorsal tubular nerve cord
3. gills slits at some stage of life.
- 3.7** 1. Three 2. Ichthyophis
3. Can live in both, in water and on land.
- 3.8** 1. Turtle, sea snake 2. Chelonia 3. Three and four
4. 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) chiroptera
3. Mammary or milk glands 4. Kangaroo
5. Mammalia