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*

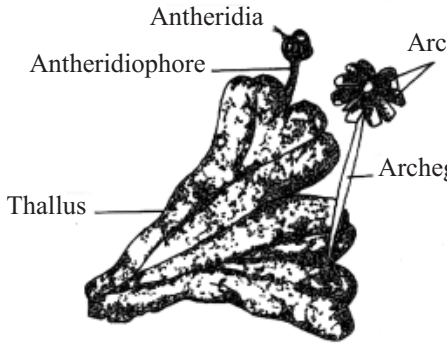


Fig 3.1(a) Liverworts (*Marchantia*)

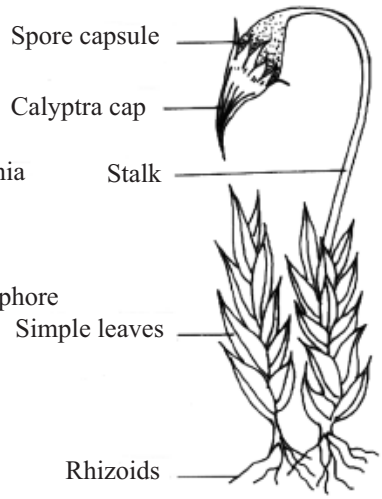


Fig 3.1(b) Moss plant (*Funaria*)

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)

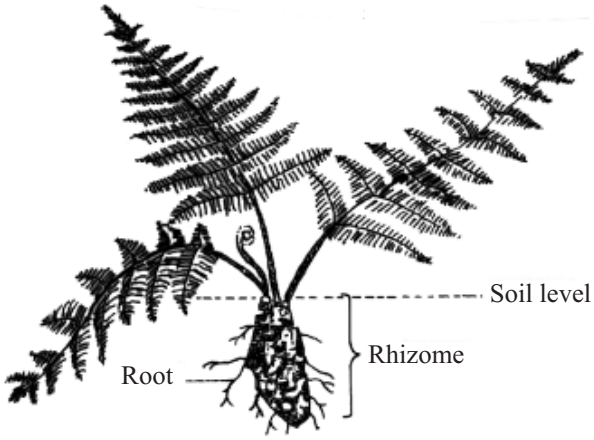


Fig. 3.2 A garden fern plant

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**.

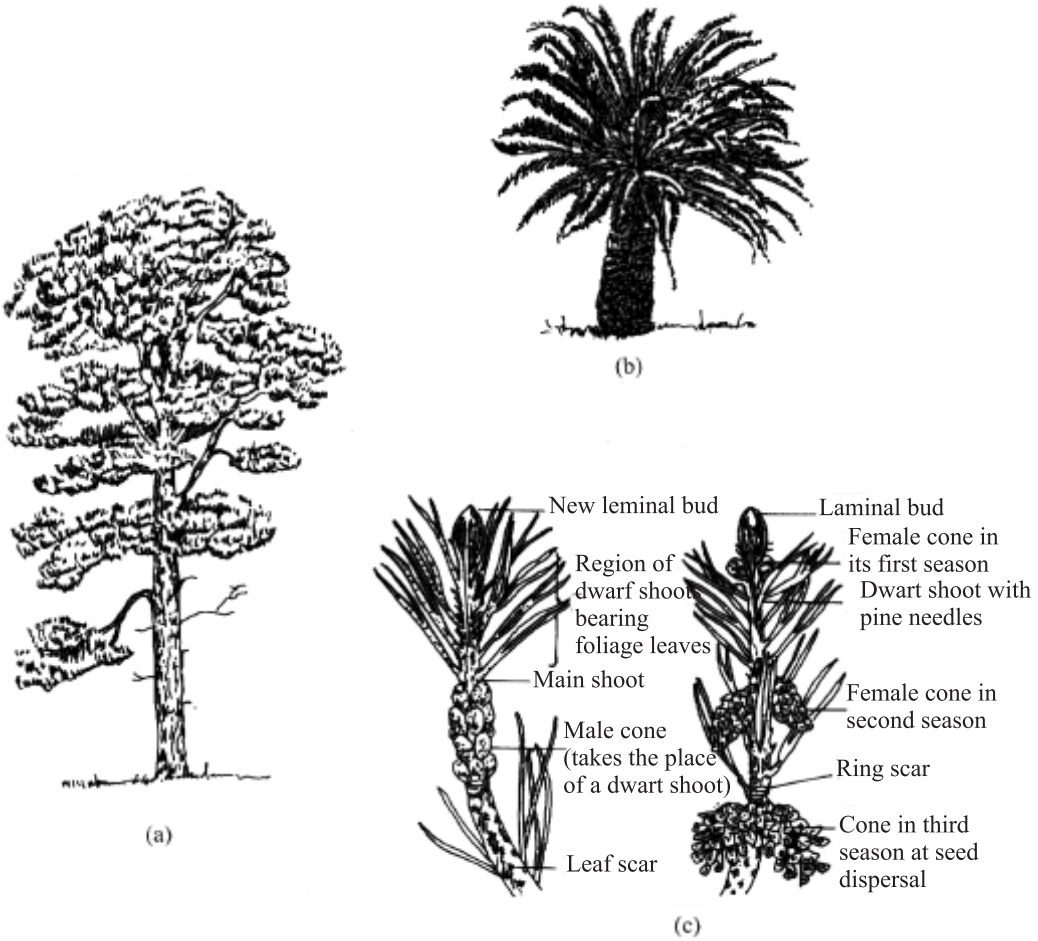


Fig. 3.3 Some examples of phylum Gymnosperm ae (a) *Pinus* tree (b) *Cycas* tree (c) tree with male and female cone

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.

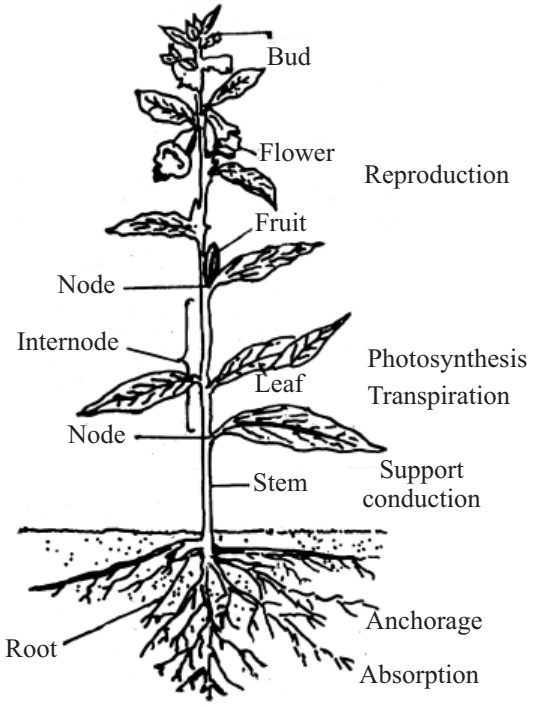


Fig. 3.4 The parts of an angiosperm our plant

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.

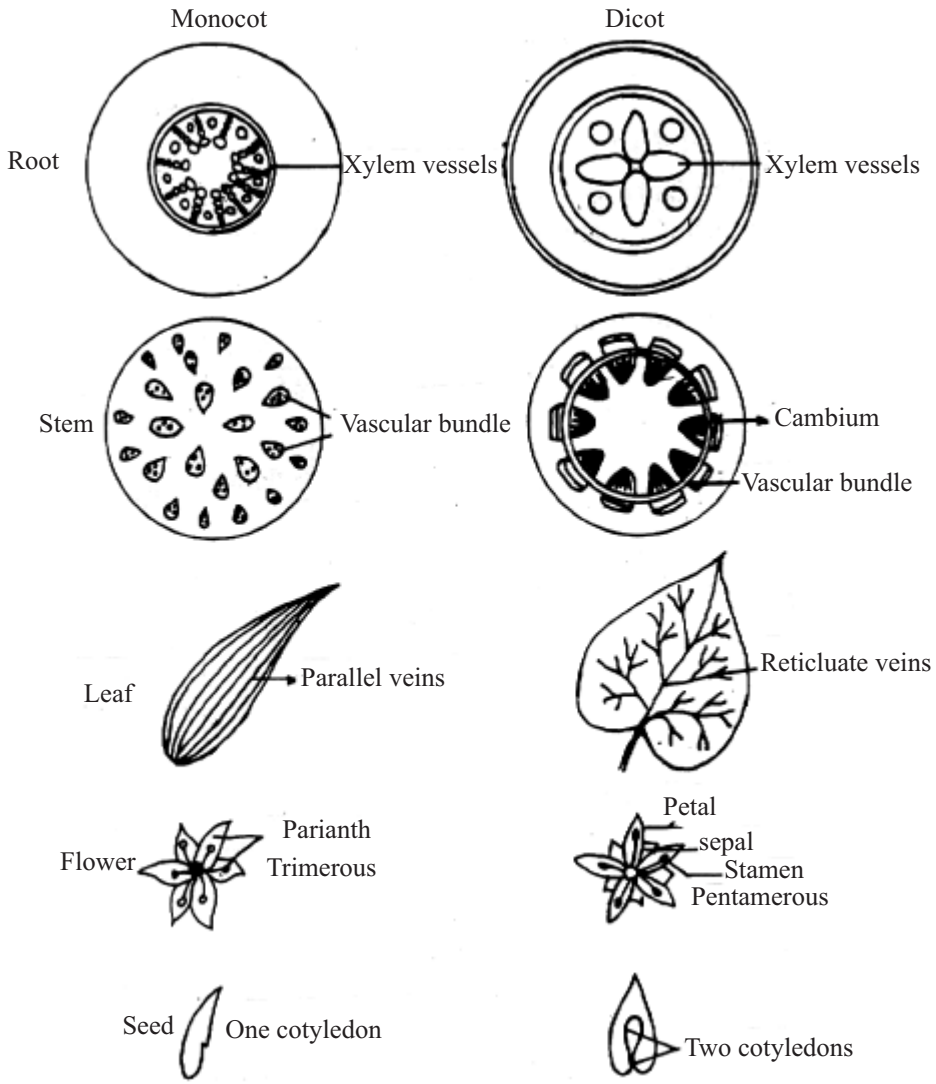


Fig. 3.5 Comparison of Monocots and Dicots

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

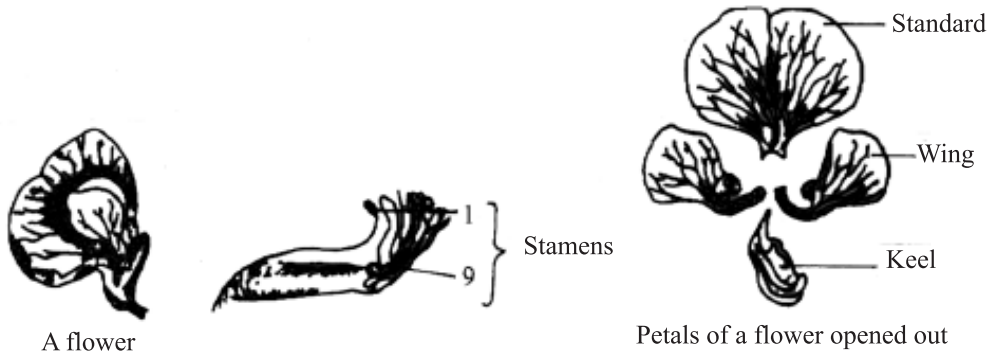


Fig. 3.6a A pea flower

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.

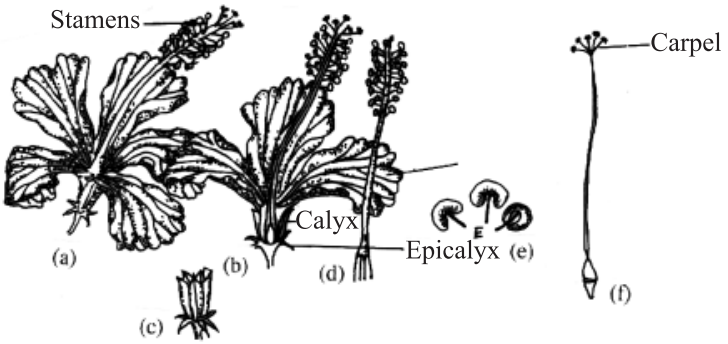


Fig. 3.6b A Chinarose flower

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.

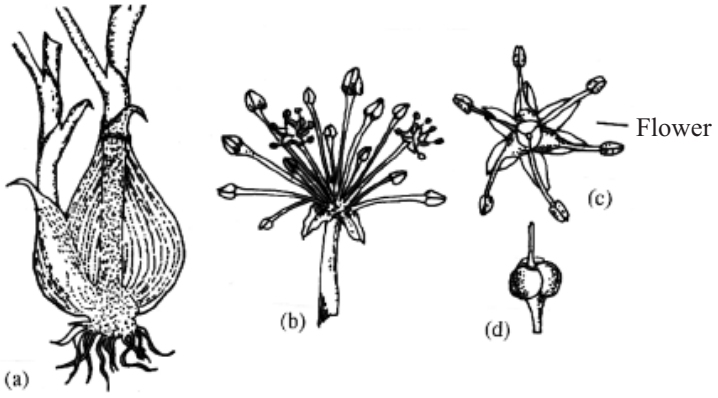


Fig. 3.6c An onion plant.

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

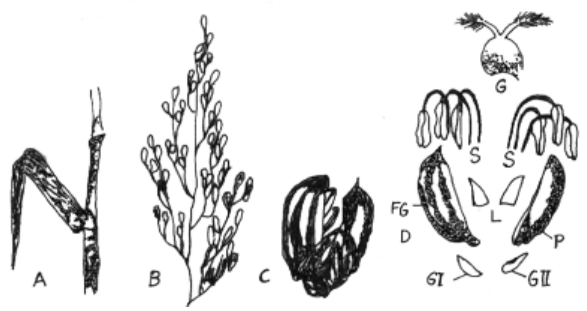
The plants are herbs, rarely woody as in sugarcane. inflorescence, spike of spikelets, For example, wheat. A small spikelet may contain not more than 5 flowers.

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?
   .....