

**Syllabus :** Flower : Structure of a bisexual flower, functions of various parts.

A brief introduction to complete and incomplete flowers. Essential and non-essential whorls of a bisexual flower; their various parts and functions. Inflorescence and placentation (meaning only). (Charts or actual specimens may be used to help enhance clarity of concepts).

You have already learnt that reproduction is the most important function of any living organism for the survival of the species. In flowering plants this function is performed by the flower. The flower is usually the most beautiful and conspicuous part of a plant.

#### 4.1 STRUCTURE OF A BISEXUAL FLOWER (FIG. 4.1)

*Flower is a specialized shoot in which the leaves are modified into floral structures.*

First of all, there is the **stalk** (pedicel) which supports the flower. Some flowers may be without stalk (sessile). The tip of the flower stalk may be expanded to form a cup-shaped **receptacles** thalamus.

The floral parts are borne on the thalamus in four whorls.

- 1. First whorl** — green **sepals** (collectively called **calyx**).
- 2. Second whorl** — large brightly coloured **petals** (collectively called **corolla**).
- 3. Third whorl** (male parts) ( $\sigma$  = symbol for male) — long thread-like processes somewhat

projecting out and each usually ending in a bilobed tip. These are **stamens** (collectively named **androecium**). Each stamen consists of threadlike **filament** and bilobed **anther**.

- 4. Fourth whorl** (female parts) ( $\text{♀}$  = symbol for female) (centrally located **pistil** that may be formed of a single female unit (carpel) or of several fused carpels (collectively called **gynoecium**). Each carpel consists of a basal **ovary**, a middle **style** and an uppermost **stigma**.

##### 4.1.1 COMPLETE AND INCOMPLETE FLOWERS:

A **complete** (or **perfect**) flower is one which contains all the four floral structures. If one or more sets of floral structures are missing, the flower is called **incomplete** (or **imperfect**).

**Essential** (reproductive) and **non-essential** (non-reproductive) **parts of a flower**. The **essential parts** of a flower are those that are directly concerned with reproduction. These parts consist of the stamens (male parts) and the carpels (female parts).

The **non-essential** (accessory) **parts** are simply the helping parts which either **protect** the reproductive parts of the flower or make the flower **attractive** for pollination. These parts include the sepals and petals. In some cases the petals and sepals are undifferentiated together called **perianth**. When the perianth is non-green it is described as **petaloid**.

When the perianth is green like the sepals, it is described as **sepaloid** perianth.

**Bracts**—When a flower arises in the axil of a leaf-like structure, this structure is known as **bract**. Bracts may be green like ordinary leaves or at times they are coloured. The large and colourful bract of

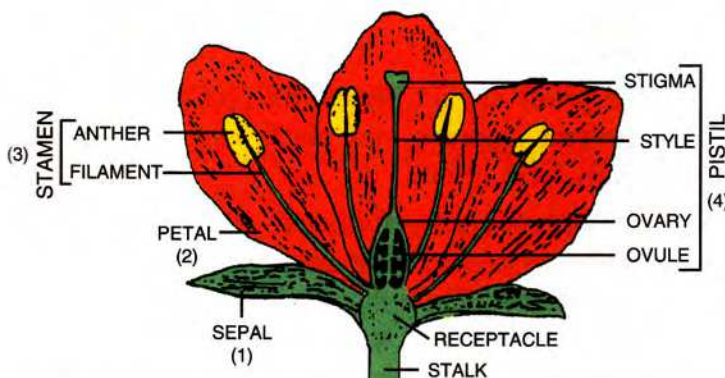


Fig. 4.1 Generalized arrangement of parts of a bisexual flower

Bougainvillea (Fig 4.2) is easily mistaken for petal. The actual flower in this case is small, somewhat cylindrical and attached on the inner side of the bract.

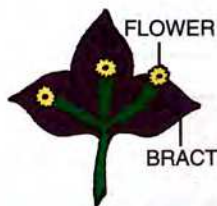


Fig. 4.2 Bougainvillea. Large, coloured bracts bear the flowers

**Nectaries :** Most flowers produce a sweet fragrant liquid called nectar. Groups of nectar-secreting cells, **nectaries** are situated usually at the base of the pistil or on the bases of the petals. The nectar attracts insects like honeybees, for cross pollination. In some cases nectaries are very prominent as in Nasturtium (Fig 4.3)

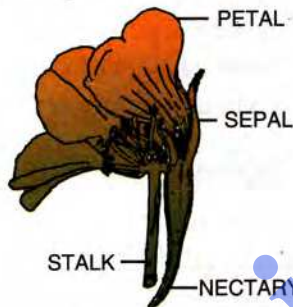


Fig. 4.3 Nasturtium. A flower cut medially to show the nectary containing a clear liquid (the nectar) at the bottom

#### 4.1.2 SEXUALITY IN FLOWERS

**Male, female and bisexual flowers.** The **anthers** of the stamens produce **pollen** which forms the male cells (male gametes). The **ovary** of the carpel bears the **ovule** which encloses the egg cell (female gamete). The stamens and the carpels are the male and female parts of the flower respectively.

- A flower which contains both stamens and carpels is called **bisexual** or **hermaphrodite** or just a **perfect flower**.
- A flower which has only one of these parts, that is, having only the stamens or only the carpels is called **unisexual** or incomplete (**imperfect**) flower, e.g. papaya and palm.
- A unisexual flower which contains only the stamens is called the **male** or **staminate flower**.
- A flower which contains only the carpels is called the **female** or the **pistillate flower**.

**Neuter flower** — A flower in which both male and female reproductive organs are lacking. *Example:* Ray florets of sunflower.

#### 4.2 GENERAL DESCRIPTION OF THE FLORAL PARTS

**(a) Calyx** (sepals). Usually there are five sepals. Sometimes they may be less or in a few cases even more. The sepals may be free **polysepalous** or fused **gamosepalous** (Fig 4.4). Sometimes, as in *Hibiscus* (shoe-flower) there may be a second series of sepals called episepals, collectively called **epicalyx**. When the flower opens the sepals may fall off or persist. Sepals are usually green but in some cases they are brightly coloured (called petaloid) as in Gul Mohur (flame of the forest) where they are red.

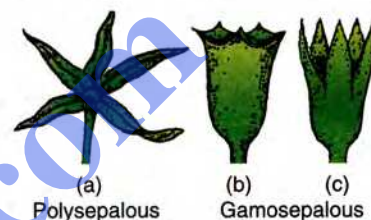


Fig. 4.4 Calyx – free (a) and fused (b and c) types of sepals

The sepals **protect the young flower bud** and when green they also perform **photosynthesis**.

**(b) Corolla** (petals). The petals are generally arranged in a single whorl but sometimes there may be a double whorl (e.g. Poppy) or in a spiral (e.g. Water lily). They may be free **polypetalous** or united **gamopetalous** forming a tube (Fig. 4.5).

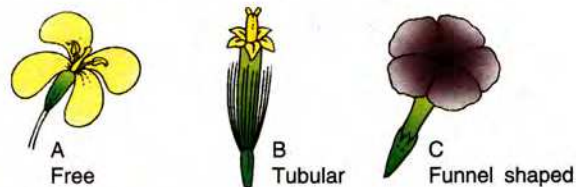


Fig. 4.5 Kinds of corolla. A—Free petals, B—Petals fused in a tubular form C—Petals fused, somewhat funnel shaped

The petals **attract insects** for pollination. They also **protect stamens and pistils** especially when the petals form a tube.

**(c) Androecium** (stamens). The number of stamens in different flowers may vary from a few to a large number. Each stamen consist of: a long **filament** and an **anther** attached to its extremity. The anther is usually two lobed. Each lobe has two **pollen sacs** [four sacs in all (Fig. 4.6A)]. Within the pollen

sacs are contained **pollen grains**. When fully matured the pollen sacs rupture to liberate pollen grains. The pollen grains are generally powdery particles of different shapes and sizes (Fig. 4.6B).

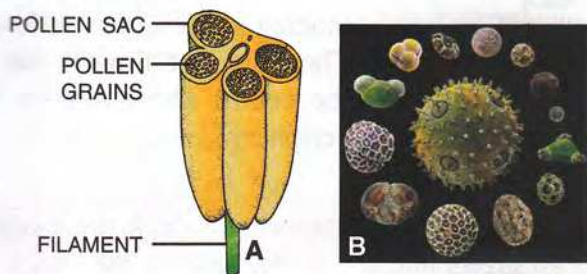


Fig. 4.6 A—Pollen sacs contain pollen grains (diagrammatic). B—Pollen grains from different plants show different shapes and sizes

In androecium, stamens may be free (polyandrous) as in *Petunia*, or joined in different ways in **single, double** or **several** groups (Fig. 4.7):

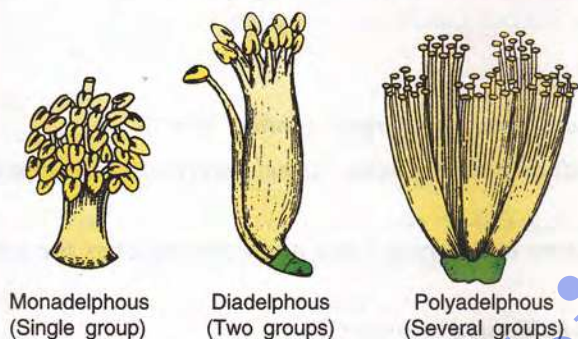


Fig. 4.7 Cohesion (joining) of stamens.

- (i) **Monadelphous** : Stamens are united in one group by their filaments. Only anthers are free. *e.g.*, china rose (staminal tube), cotton.
- (ii) **Diadelphous** : The filaments are united in two bundles. *e.g.* pea (out of ten, nine stamens form a staminal tube while one is free).
- (iii) **Polyadelphous** : The filaments are united in several groups. *e.g.* *Bombax*.

#### How to remember the above three terms ?

- *Mono -*, *Di -* and *Poly -* respectively mean single, two and several.
- *Adelphous* literally means “group of brothers”, here referring to the part from which the anthers grow out in bundles. Thus the bundle of anthers arising from a single part (monadelphous or monodelphous), the bundles from two parts (diadelphous) and from several parts (polyadelphous).

(d) **Gynoecium** (carpels). Gynoecium is also known as **pistil**. It is composed of one or more carpels. Each carpel consists of three parts—stigma, style and ovary.

**Stigma** is the terminal knob-like part, it may be divided into two or more lobes and may assume a feathery appearance. The stigma is covered with hair or with glandular papillae. It serves as the landing place for pollen during pollination.

**Style** is the tubular slender stalk which connects the stigma to the ovary.

**Ovary** is the swollen basal portion composed of one or many carpels. The inner cavity of the ovary may be a single chamber or divided into several chambers (locules) each containing a number of rounded bodies, the **ovules**. The cushion or swollen region in the ovary attaching the ovules to the wall of the ovary is called **placenta**.

#### Sexuality in plants

In most plants the flowers are bisexual. They have both male and female parts.

In many plants the male and female flowers are separate. Such plants are of two types :

- (i) **Monoecious plants** (*mono*: one, *oecium* : house): Male and female flowers grow on the same plant *e.g.* maize, cucumber, pumpkin, etc.
- (ii) **Dioecious plants** (*di* : two): Male flower (staminate) and female flower (pistillate) grow on different plants *e.g.* palm, papaya, etc.



#### PROGRESS CHECK

1. Mention if the following statements are **true** (T) or **false** (F)
  - (i) Flowers can be complete or incomplete. T/F
  - (ii) A flower typically has six floral whorls. T/F
  - (iii) Bracts are usually green, but sometimes large and colourful. T/F
  - (iv) Nasturtium has nectaries. T/F
  - (v) Stamens and carpels are the male and female parts T/F
  - (vi) The prefix “gamo-” is used whenever any of the floral whorls are fused T/F
  - (vii) Stigma may be simple or divided into two or more lobes. T/F
  - (viii) Papaya is monoecious plant. T/F

#### 4.3 INFLORESCENCE AND PLACENTATION

*Inflorescence is the mode of arrangement of flowers on the axis of the plant*

The flowers may be arranged in several different ways in different plants, this manner of arrangement is termed **inflorescence**.



- singly either at the apex of the main stem or at the terminal apex of the lateral branches.



- in the axils of the leaves.



- growing out from the axils of different leaves reaching the same level making a cluster.
- The axis is laterally flattened making a disc as in sunflower. The youngest flowers are in the centre and oldest in the periphery.

**Placentation** is the manner in which the ovules are arranged/attached to the wall of the ovary.

Ovules turn into *seeds* in the mature fruit (transformed *ovary*). Their different arrangements can be seen in fruits such as those of pea, tomato, mango, lotus, etc.

**Placenta** : Tissue that attaches the ovule to the wall of the ovary.

### POINTS TO REMEMBER

- *Flower is a reproductive organ.*
- *Essential parts of a flower include the stamens (male parts) and the carpels (female parts).*
- *Sepals protect the bud, petals attract insects, stamens produce pollen grains, carpel receives pollen and its ovary becomes the fruit containing seeds (ovules).*
- *Essential parts of a flower are the reproductive parts (stamens and carpels) and non-essential ones the non-reproductive parts (petals and sepals).*
- *Nectaries are common in most brightly coloured (insect-pollinated) flowers.*
- *Sepals may be brightly coloured, these are then said to be petaloid.*
- *The pollen grains are fine powdery particles of different shapes.*
- *The manner of arrangement of flowers on the plant is termed inflorescence.*

### REVIEW QUESTIONS

#### A. MULTIPLE CHOICE TYPE

1. Bougainvillea flower is an **example** of
  - (a) incomplete flower
  - (b) having a large nectary
  - (c) water pollination
  - (d) large colourful bracts
2. A flower is said to be complete when :
  - (a) It has the corolla and calyx
  - (b) It has the corolla and gynoecium
  - (c) It has the androecium and gynoecium
  - (d) It has all the four whorls.
3. The part of the flower that gives rise to the fruit is
  - (a) Sepals
  - (b) Petals
  - (c) Ovary
  - (d) Stamens
4. The part of the flower that gives rise to the seed is
  - (a) Ovary
  - (b) Placenta
  - (c) Ovule
  - (d) Pollen grain
5. The essential whorls of a flower are the
  - (a) Calyx and corolla
  - (b) Stamen and ovary
  - (c) Calyx and epicalyx
  - (d) Androecium and gynoecium

## B. VERY SHORT ANSWER TYPE

1. Match the parts in Column A with the flowers or parts of flower in Column B.

### Column A

- (a) Polyadelphous
- (b) Pollen grains
- (c) Free petals
- (d) Non-essential
- (e) Sweet fragrant fluid

### Column B

- (i) Polypetalous
- (ii) Calyx, corolla
- (iii) Nectar
- (iv) Bombax
- (v) Pollen sac

## C. SHORT ANSWER TYPE

1. Explain the following terms :
- (a) Incomplete flower
  - (b) Staminate flower
  - (c) Pistillate flower
  - (d) Bisexual flower
2. Distinguish between the following pairs :
- (a) Flower and inflorescence,
  - (b) Petals and petaloid sepals.
3. Where are the following structures/parts located and what are their functions ?
- (a) Placenta
  - (b) Thalamus
  - (c) Anther
  - (d) Stigma
4. Why are the following described as stated :
- (a) The androecium of pea flower is **didelphous**
  - (b) Ray florets of sunflower as **neuters**
  - (c) Salvia sepals as **petaloid**
  - (d) China rose stamens as **epipetaloid**

## D. LONG ANSWER TYPE

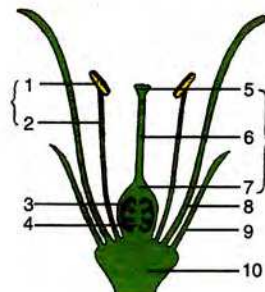
1. Name the different types of androecium found in flowers .
2. Name the type of androecium found in
- (a) China rose
  - (b) Bombax
  - (c) Pea

## E. STRUCTURED/APPLICATION/SKILL TYPE

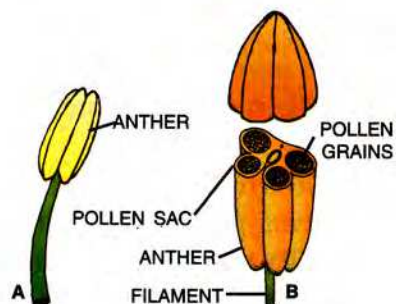
1. There is a flower in which you use the following terms : Standard, wings and keel.
- (a) Name the flower

- (b) What part of the flower do the names given above refer to ?

2. The figure given alongside represents generalised arrangement of the different parts of a bisexual flower. Name the parts numbered 1-10.



3. Given below are two figures (A & B) of a certain part of a flower. Study the figures carefully and answer the following questions:
- (a) Which major organ of a flower does the figure A represent ? What is the collective term for this organ ?
  - (b) Are the contents of the pollen sacs in B male or female ?
  - (c) Can you state how the contents of the pollen sacs would come out ?



4. What are bracts ? State their function.
5. Explain the terms Monodelphous, Didelphous and Polydelphous. In each case name a flower possessing such an androecium.