

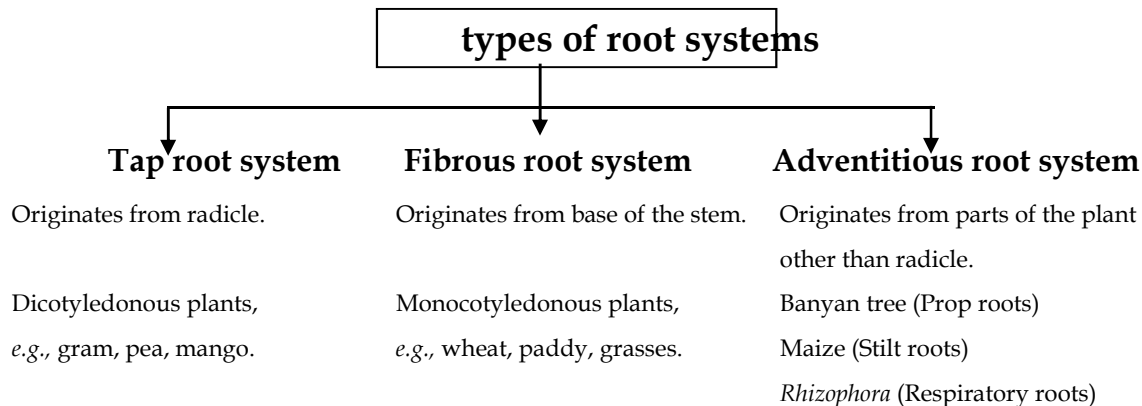
## CHAPTER - 5

### MORPHOLOGY OF FLOWERING PLANTS

**Morphology:** The study of various external features of the organism is known as morphology.

**Adaptation:** Any alteration in the structure or function of an organism or any of its part that results from natural selection and by which the organism becomes better fitted to survive and multiply in its environment.

**The Root:** The root is underground part of the plant and develops from elongation of radicle of the embryo.



**Root Cap:** The root is covered at the apex by the thumble-like structure which protects the tender apical part.

#### Regions of the root:

- 1. Region of meristematic activity:** Cells of this region have the capability to divide.
- 2. Region of elongation:** Cells of this region are elongated and enlarged.
- 3. Region of Maturation:** This region has differentiated and matured cells. Some of the epidermal cells of this region form thread-like root hairs.

#### Modifications of Root:

Roots are modified for support, storage of food, respiration.

- **For support:** Prop roots in banyan tree, stilt roots in maize and sugarcane.
- **For respiration:** pneumatophores in *Rhizophora* (Mangrove).
- **For storage of food:** Fusiform (radish), Napiform (turnip), Conical (carrot).

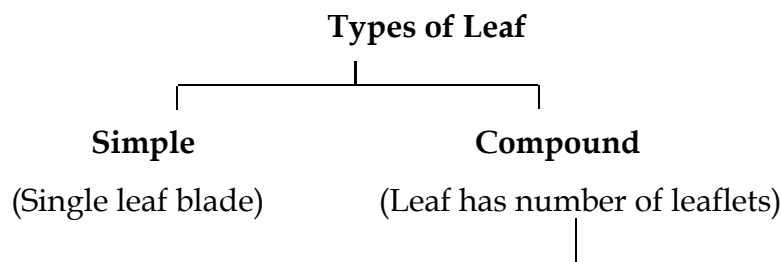
**The Stem:** Stem is the aerial part of the plant and develops from plumule of the embryo. It bears nodes and internodes.

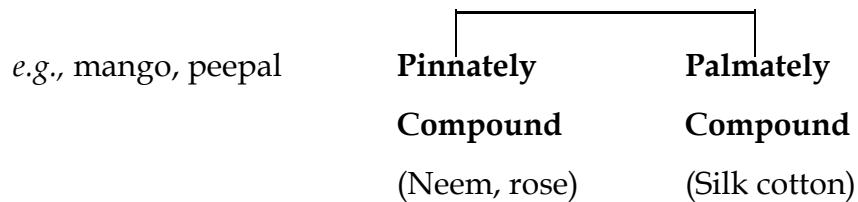
**Modifications of Stem:**

In some plants the stems are modified to perform the function of storage of food, support, protection and vegetative propagation.

- **For food storage:** Rhizome (ginger), Tuber (potato), Bulb (onion), Corm (colocasia).
- **For support:** Stem tendrils of watermelon, grapevine, cucumber.
- **For protection:** Axillary buds of stem of citrus, *Bougainvillea* get modified into pointed thorns. They protect the plants from animals.
- **For vegetative propagation:** Underground stems of grass, strawberry, lateral branches of mint and jasmine.
- **For assimilation of food:** Flattened stem of *Opuntia* contains chlorophyll and performs photosynthesis.

**The Leaf:** Develops from shoot apical meristem, flattened, green structure, manufacture the food by photosynthesis. It has bud in axil. A typical leaf has leaf base, petiole and lamina.



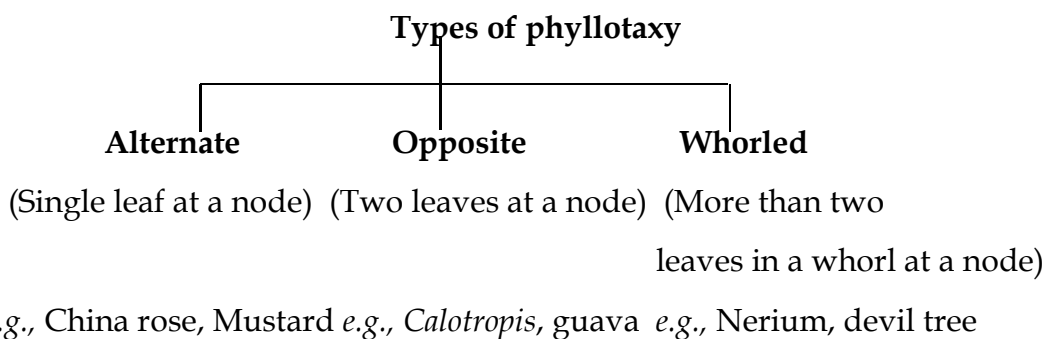


**Venation:** The arrangement of veins and veinlets in the lamina of leaf.

**Types of Venation:**

1. **Reticulate:** Veinlets form a network as in leaves of dicotyledonous plants (China rose, peepul).
2. **Parallel:** Veins are parallel to each other as in leaves of monocotyledonous plants (grass, maize, sugarcane).

**Phyllotaxy :** The pattern of arrangement of leaves on the stem or branch.



**Modifications of Leaves:**

- Tendrils: (Climbing) – Sweet wild pea
- Spines: (Protection) – *Aloe*, *Opuntia*, *Argemone*
- Pitcher: (Nutrition) – *Nepenthes*
- Hook: (Support) – Cat’s nail

**Inflorescence:** The arrangement of flowers on the floral axis.

**Main types of Inflorescence:**

1. **Racemose:** Radish, Mustard, *Amaranthus*.
2. **Cymose:** Cotton, Jasmine, *Calotropis*.
3. **Special type:** *Ficus*, *Salvia*, *Euphorbia*.

**The Flower:** A flower is modified shoot. It is a reproductive unit in angiosperms. Flowers may be unisexual or bisexual, bracteate or ebracteate. Some features of flower are as given below:

Symmetry of flower	On the basis of no. of floral appendages	On the basis of position of calyx, corolla, androecium with respect of ovary
Actinomorphic (radial symmetry)	Trimerous	Hypogynous (superior ovary) E.g., Hibiscus
Zygomorphic (bilateral symmetry)	Tetramerous	Perigynous (half inferior ovary) E.g., Rose
Asymmetric (irregular)	Pentamerous	Epigynous (inferior ovary) E.g., Banana

**Parts of flower:**

- 1. Calyx:** Sepals, green in colour, leaf like whorl.
- 2. Corolla:** Petals, usually brightly coloured to attract insects for pollination.
- 3. Androecium:** Stamens are male organs and produce pollen grains. Stamens may be epipetalous (attach to petals) Ex, Brinjal, Datura or epiphyllous (attach to perianth - tepals are united). Stamens may be monadelphous (united into one bundle) Ex. Hibiscus, cotton, diadelphous (two bundles) Ex. Pea, Bean or polyadelphous (more than two bundles) Ex. Citrus, Castor.
- 4. Gynoecium :** Made up of one or more carpels, female reproductive part, consists of stigma, style and ovary, ovary bears one or more ovules. Carpels may be apocarpous (free) Ex. Vinca or syncarpous (united) Ex. Hibiscus. After fertilization, ovules develop into seeds and ovary into fruit.

**Gamosepalous** – (Sepals united) Ex. *Hibiscus*

**Polysepalous** – (Sepals free) Ex. Mustard

**Gamopetalous** – (Petals united) Ex. Sunflower

**Polypetalous** – (Petals free) Ex. *Hibiscus*

**Perianth:** If calyx and corolla are not distinguishable, they are called perianth.

**Aestivation:** The mode of arrangement of sepals or petals in floral bud.

**Types of aestivation:**

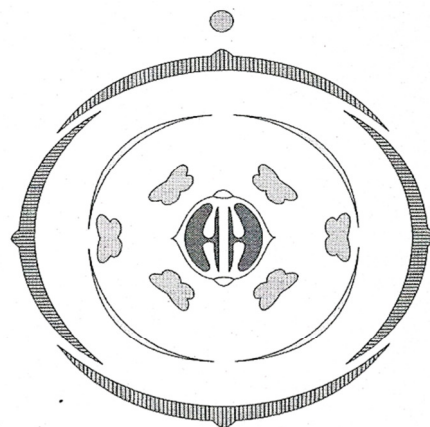
1. **Valvate:** Sepals or petals do not overlap the sepal or petal at margins.  
Ex. Annona, Calotropis.
2. **Twisted:** Sepals or petals overlap the next sepal or petal. Ex. Hibiscus, Cotton.
3. **Imbricate:** The margins of sepals or petals overlap one another but not in any definite direction. Ex. Cassia, Crotalaria.
4. **Vexillary:** The largest petal (standard) overlaps the two lateral petals (wings) which in turn overlap two smallest anterior petals (Keel). Ex. Pea Bean.

**Placentation :** The arrangement of placentae with ovules within the ovary.

**Types of Placentation :**

1. **Marginal:** Placenta forms a ridge along the ventral suture of ovary. Ex. Pea, Bean.
2. **Axile:** Margins of carpels fuse to form central axis. Ex. Citrus, Hibiscus.
3. **Parietal:** Ovules develop on inner wall of ovary. Ex. Cucurbita, Mustard.
4. **Free central:** Ovules borne on central axis, lacking septa. Ex. Dianthus, Primrose.
5. **Basal:** Placenta develop at the base of ovary. Ex. Sunflower, Marigold.

**Floral Diagram**



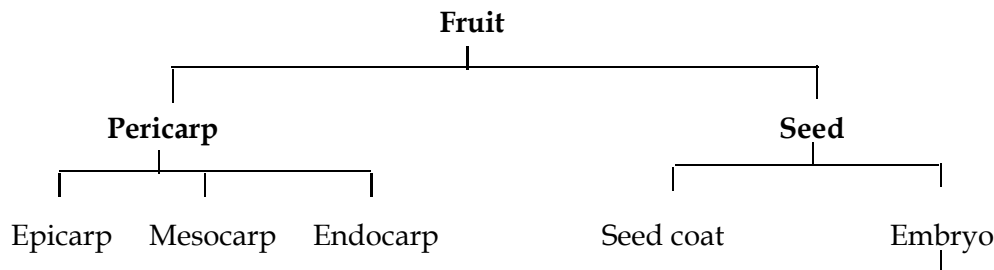
$\oplus \text{♀} K_{2+2} C_4 A_{2+4} \underline{G}_{(2)}$

**Floral formula =**

**Extra symbols and characteristics of flowers used in Botany**

Characteristics of the flower	Symbols	Characteristics of the flower	Symbols
<b>Bracts:</b>		<b>Calyx:</b>	K
Present (Bracteate)	Br	Polysepalous	$K_5$
Absent (Ebracteate)	Ebr	Gamosepalous	$K_{(5)}$
<b>Bracteoles:</b>		<b>Corolla:</b>	C
Present (Bracteolate)	Brl	Polypetalous	$C_5$
Absent (Ebracteolate)	Ebrl	Gamopetalous	$C_{(5)}$
<b>Symmetry of the flower:</b>		<b>Essential whorls:</b>	
Actinomorphic	$\oplus$	<b>Androecium:</b>	A
Zygomorphic	o o	Stamens - free	$A_{10}$
<b>Nature of the flower:</b>		United	
<b>Bisexual :</b>	$\text{♂} \text{♀}$	monadelphous condition	$A_{(10)}$
<b>Unisexual :</b>		diadelphous condition	$A_{(9)+1}$
Male flower	$\text{♂}$	Numerous (infinite)	$A_{\infty}$
Female flower	$\text{♀}$	epipetalous	$C_5 \overbrace{A_5}^{\curvearrowright}$
<b>Non-essential whorls:</b>		<b>Gynoecium:</b>	G
<b>Perianth:</b>	P	Carpels - free (apocarpous)	$G_5$
Tepals - free	$P_3$	united (syncarpous)	$G_{(5)}$
Tepals - united	$P_{(3)}$	<b>Ovary -</b>	
		superior	$\underline{G}$
		inferior	$\overline{G}$

**The fruit:** The mature ripened ovary develops into fruit. The parthenocarpic fruits are formed from ovary without fertilization.



Embryonal axis (Plumule + Radicle)	Cotyledons (Store food)

## **The Seed**

The ovules after fertilization develop into the seeds.

A seed is made up of seed coat and an embryo.

An embryo is made up of an embryonic axis having plumule and radicle with one or two cotyledons (One cotyledon Example - Maize, Two cotyledon Example - Pea).

### **Family : Fabaceae**

Ovary superior, monocarpellary, unilocular with many ovules, style is single-marginal placentation.

Character: Majority of plants belonging to this family are pulses.

E.g.: Pulses like Bengal gram, green gram, horse gram, etc.

### **Family: Solanaceae**

Ovary superior, bicarpellary, syncarpous, bilocular, placenta swollen with many ovules-axile placentation.

Character: Persistent calyx

E.g., Tomato, Chilli, Brinjal, etc. of potato family

### **Family: Liliaceae**

Parallel venation. Ovary superior, tricarpellary syncarpous, trilocular with many ovules-axile placentation.

Character: stem underground (Bulb/ Corms/Rhizomes)

E.g., Tulip, Gloriosa, Aloe, Asparagus, etc.

**Note: For Diagrams and Figures see the NCERT Standard XI Biology Text Book**

## SUMMARY :

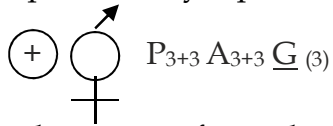
Flowering plants exhibit enormous variation in shape, size, structure, mode of nutrition, life span, habit and habitat. They have well developed root and shoot systems. Root system is either tap root or fibrous. Generally, dicotyledonous plants have tap roots while monocotyledonous plants have fibrous roots. The roots in some plants get modified for storage of food, mechanical support and respiration. The shoot system is differentiated into stem, leaves, flowers and fruits. The morphological features of stems like the presence of nodes and internodes, multicellular hair and positively phototropic nature help to differentiate the stems from roots. Stems also get modified to perform diverse functions such as storage of food, vegetative propagation and protection under different conditions. Leaf is a lateral outgrowth of stem developed exogeneously at the node. These are green in colour to perform the function of photosynthesis. Leaves exhibit marked variations in their shape, size, margin, apex and extent of incisions of leaf blade (lamina). Like other parts of plants, the leaves also get modified into other structures such as tendrils, spines for climbing and protection respectively. The flower is a modified shoot, meant for sexual reproduction. The flowers are arranged in different types of inflorescences. They exhibit enormous variation in structure, symmetry, position of ovary in relation to other parts, arrangement of petals, sepals, ovules etc. After fertilisation, the ovary is converted into fruits and ovules into seeds. Seeds either may be monocotyledonous or dicotyledonous. They vary in shape, size and period of viability. The floral characteristics form the basis of classification and identification of flowering plants. This can be illustrated through semi-technical descriptions of families. Hence, a flowering plant is described in a definite sequence by using scientific terms. The floral features are represented in the summarised form as floral diagrams and floral formula.



## EXERCISE QUESTIONS

### Very Short Answer Questions (1 mark each)

1. Which part of opuntia is modified to form spines?
2. Name one plant in which leaf is pinnately compound.
3. In mangroves, pneumatophores are the modified adventitious roots. How are these roots helpful to the plant?
4. Which part of mango fruit is edible?
5. Why do various plants have different type of phyllotaxy?
6. State the main function of leaf tendril.
7. Which plant family represent the following floral formula :



8. The endosperm is formed as a result of double fertilization (triple fusion). What is its function?
9. Which type of venation do you observe in dicot leaf?
10. In pea flower, the aestivation in corolla is known as vexillary. Give reason.

### **Exercises – Answers**

1. In *Opuntia* leaves are modified into spines.
2. Neem, Rose, Acacia.
3. Pneumatophores in mangroves help in respiration.
4. The edible part in mango fruit is mesocarp.
5. For proper exposure of leaves to get sunlight.
6. The leaf tendrils help the plant for climbing.
7. Liliaceae
8. Endosperm stores the food.
9. Reticulate venation.
10. In peas, there are five petals. The largest one (standard) overlaps the two lateral petals (wings) which in turn overlap the two smallest anterior petals ( keel ).