

# MORPHOLOGY OF FLOWERING PLANTS

- Morphology is the study of external features
- Flowering plants are otherwise called as *angiosperms*. Which means enveloped seeded plants.
- They are the plants with fruits and flowers.
- Wolffia is the smallest angiosperm.
- Eucalyptus is the tallest angiosperm.

## The Root

### Functions:

- anchorage- fixes the plants in soil
- absorb water and minerals
- storage in some plants
- respiration, photosynthesis in some plants

### Root system

Root system can be classified in to tap root system, fibrous root system, and adventitious root system.

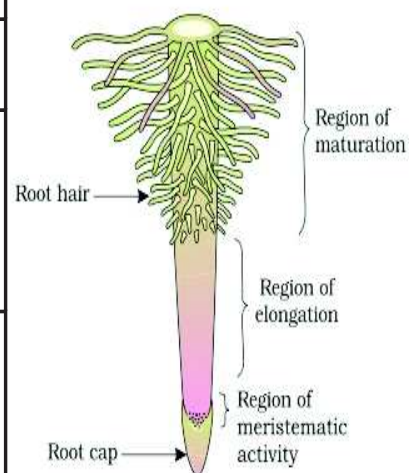
1. **Tap root system**:-It composed of a primary root and its lateral branches. Primary root is the elongation of radicle. It is a characteristic feature of dicotyledons.

2. **Fibrous root system**:- here the growth of radicle is stopped and from the base of the stem numerous fiber like roots are arised. It is a characteristic feature of monocotyledons.

3. **adventitious root system**:- if a root is arised from any part of the plant body other than radicle is called adventitious root. eg. Grass, banyan tree

### Regions of root

Sl. No	Regions	Position	features
	Root cap	At the tip of root	It protects the tender region of root
1	Region of meristematic activity	Just above root cap	Here we can see the meristem. Divide continuously. Cell are small with dense protoplasm
2	Region of elongation	Above meristematic region	Here the cell growth and elongation occur. This region is responsible for increase of root length.
3	Region of maturation	Above elongation region	Here cells are differentiated. Root hairs are arised from here



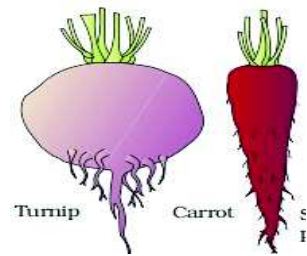
### Root Modification

Modifications are the changes in shape and structure to perform certain functions.

We can see this modifications in hanging roots of a banyan tree and in the roots of sweet potato.

### Tap root modifications

Modification Name	Example	Function
Conical root	Carrot	storage
Napiform root	Beet root, turnip	storage
Fusiform root	Radish	storage



### Adventitious root modifications

Modification Name	Example	Function	Features
Tuberous root	Sweet potato	storage	From each node roots are arised. They store food.
Prop root	Banyan tree	Mechanical support	From the branches hanging roots are arised. It Support the branches
Stilt root	Maize, sugar cane	Mechanical support	From the lower nodes roots arise. They support the plant
Respiratory root [pneumatophore]	Rhizophora	respiration	Negatively geotropic roots arise from some marshy plants with many pores . These pores help in gaseous exchange

### THE STEM

The stem is developed from plumule of the embryo. The stem posses nodes and internodes. Nodes are regions from where the leaves are arised. While internodes are the region between two adjacent nodes.

The stem can be classified into underground stem, sub aerial stem and aerial stem

- ◆ an underground stem grow under the soil. Eg. Ginger
- ◆ sub aerial stems grow like creepers. They are week stems. Eg. Oxalis
- ◆ aerial stems are upright stems.

### Underground stem modifications

Eg. *Ginegr* , *turmeric*, *colacassia*, *zaminkand* in all these root store food. Because of this storage they are swollen

### Subaerial stem modifications

Example	structure
Pistia, Eichornia	Thick and stout internode. group of leaves arise from each node
Mint, jasmine	Lower branch grow vertically for some time then it bends to soil and again grow vertically.
Pine apple, banana, Chrysanthemum (ജമന്തി)	Lateral branch arise from the underground part of main stem and nd it grow horizontally. Then come out and produce leaves.

## Aerial stem modifications

Modification Name	Example	structure	function	Features
Stem tendril	Cucumber, watermelon, grapevine	Coiled spring like structures	climbiing	Modification of axillary and terminal buds
Thorn	Bougainvillea, citrus	Hard pointed structure	Protection and support	Modification of axillary buds
Phylloclade	Opuntia, euphorbia	Green flattened or cylindrical fleshy	photosynthesis	Since these plants are arid plants their leaves are reduced. So the function of leaf is taken by stem.

## The leaf

A typical leaf consists of three main parts:

- leaf base**----- by which the leaf is attached to stem
- petiole**----- stalk of leaf
- lamina**-----flattened blade like part of leaf



### other parts of leaf

- stipule:-** The leaf base often bear two lateral small leaf like structures called stipules.
  - Pulvinus:---** In some leguminous plants the leaf base may become swollen, which is called the pulvinus.
  - Midrib:---** The middle prominent vein, in lamina ,which is known as the midrib.
- Veins act as channels of transport for water, minerals and food materials.

## Venation

The mode of arrangement of veins on lamina is called venation. There are two types of venation; reticulate and parallel.

- Reticulate:** here the veins form as a network. It is the characteristic feature of dicot leaves
- parallel:** here veins are seen as parallel to leaf margin. It is the characteristic feature of monocot leaves

## Types of leaves

Mainly the leaves can be divided into two; simple and compound

- A] **simple leaf:** a single lamina on a stalk is simple leaf.  
B] **compound leaf:** many lamina/leaflets on single stalk is compound leaf. eg. Curry leaf

### compound leaves are of two types

- pinnately compound leaf:** here the leaflets are arranged lateral sides of a stalk. It looks like a feather.  
eg. curry leaf, neem [नीम]
- Palmately compound leaf:** here leaflets are arranged at the tip of stalk. It looks like palm of hand.

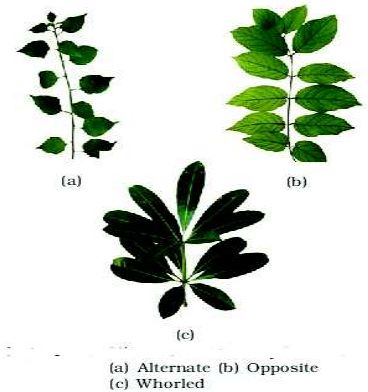
Eg. Silk cotton [ഇലന്ദ്]

\*\*The stalk of a compound leaf is called rachis.

### Phyllotaxy

it is the mode of arrangement of leaves on stem. We can see three types of phyllotaxy

1. alternate: here single leaf arise from a node. Leaves arranged alternately right and left . eg. china rose
2. opposite: two leaves arise from a node. Arrangement is opposite to each other. eg. guava, calotropis [എരിക്ക്]
3. Whorled: more than two leaves arise from node. Arranged around the node. eg. alstonia



### Leaf modifications

Plants	structure	function	Features
Pea	Coiled spring like structures	climbing	Modification name is <b>Tendrils</b>
Cactus	Pointed structure	Protection	Modification name is <b>Spine</b>
Onion, garlic	Fleshy leaves	store food	Modification name is <b>Scale</b>
Australian Acacia	Rachis is flattened and greenish	Photosynthesis	Here leaves are short lived
Pitcher, Venus fly trap	Flask like in pitcher. Leaf bilobed in venus fly trap	Catch insect	Digestive enzymes within it

### Inflorescence

a group of flowers arranged on a common stalk is called inflorescence.

The stalk of inflorescence is called peduncle.

Mainly they are classified into two.

1. Racemose
2. cymose

RACEMOSE	Older flowers seen at base and younger flowers towards apex	Acropetal succession	Has indeterminate growth	Eg. crotalaria
CYMOSE	Younger flowers seen at base and older flowers are at apex	Basipetal succession	Has determinate growth	Eg. jasmine

### THE FLOWER

- pedicel----- the stalk of the flower
- thalamus----the swollen end of pedicel
- calyx----- outer whorl of flower. Mostly green in colour
- corolla----- next inner whorl to calyx
- androecium---- inner to corolla. Male reproductive part
- gynoecium-----inner to androecium. Female reproductive part
- actinomorphic---flower which can be cut into two equal halves in any plane
- zygomorphic-----flower which can be cut in to two equal halves in one plane
- assymmetric-----flower which cannot be cut into two equal halves. eg. canna
- trimerous-----flower with appendages three or multiples of three. eg. coconut flower, lilly
- pentamerous----flower with appendages five or multiples of five. eg. pea
- bract-----reduced leaves seen at the base of pedicel

- bracteate-----flowers with bract
- ebracteate-----flowers without bract

### **classification of flowers on the basis of position of ovary**

can be classified into three

- 1.hypogynous
2. perigynous
- 3.epigynous

1.hypogynous:- here the ovary has a superior position than all other parts of flower.  
eg.china rose, brinjal

2. epigynous- here ovary has an inferior position than all other parts of flower.  
eg. guava, cucumber, ray florets in sunflower.

3. perigynous:- here ovary is half inferior. Gynoecium seen at centre and all other parts seen at the rim of thalamus.

eg.rose,plum

### **parts of flower**

**calyx**-it is the outermost whorl. its units are sepals. Generally it is green in colour. In some flowers sepals are fused. Such calyx are gamosepalous. In some flowers sepals are free they are polysepalous.

**Corolla**:- units of corolla are petals. They are brightly coloured. Sometimes they are fused[gamopetalous] sometimes they are free [polypetalous].

**Androecium**: the units of androecium are stamens. They are the male reproductive structures. Each stamen has two parts one stalk, called filament and a box like part called anther at the tip of filament. This anther show pollen sacs inside it. The pollen sacs produce pollen grains.

- ◆ Staminode----- sterile stamen is called staminode
- ◆ epipetalous stamens----stamens attached to petals. eg.brinjal
- ◆ epiphyllous stamens----stamens attached to perianth. eg. Lilly
- ◆ polyandrous----- stamens in free condition
- ◆ monadelphous----many stamens fused to form a single bundle. eg. China rose
- ◆ didaelpous-----stamens fused and form two bundles. eg. Pea
- ◆ polyadelphous----stamens fused and form many bundles—citrus

### **gynoecium**

It is female reproductive part. Units are carpels. Each carpel has three parts. Stigma , style and ovary.

Ovary is the basal swollen portion . On which the style; a long tail like structure seen. At the tip of style stigma seen.

Stigma is the receptive spot. Inside the ovary a tissue seen called placenta; from which the ovules are formed. After fertilisation this ovule form seed. And the ovary form fruit.

Sometimes the ovules are free. Such condition is called apocarpous as in lotus.

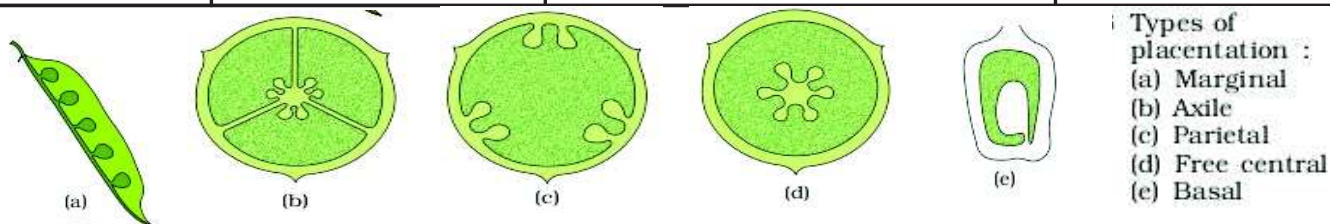
In some flowers the carpels are fused. It is called syncarpous. eg. Tomato.

### **Placentation**

The arrangement of ovules in ovary is known as placentation. Various placentation types are there.

Placentation type	Ovule bearing position		Example
marginal	At the margin of ovary	Here placenta form a ridge along the ventral suture of ovary	pea
axile	Around the central axis	Here placenta is axial	China rose,tomato
parietal	At the periphery	Here ovules form at inner wall ovary	cucumber

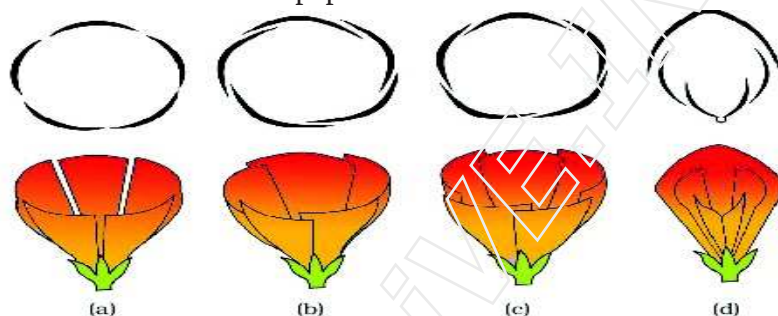
free central	Freely at centre	Ovule seen at centre but no septa here for ovary	dianthus prime rose
basal	At the base of ovary	Single ovule form	sunflower ,marigold



### Aestivation

The mode of arrangement of petals or sepals in flower is called aestivation. The aestivations are.

1. valvate:- here we can see an end to end arrangement of sepal or petals. eg. Calotropis
2. twisted:- here margins of sepals or petals are overlapped. eg. cotton, china rose
3. imbricate: here petals or sepals are overlapped but without any particular order
4. vexillary- the largest petal[standard petal overlaps the lateral petals[wing petal]. The wing petal overlaps two small keel petals. Such corolla are papilionaceous.



Types of aestivation in corolla : (a) Valvate (b) Twisted (c) Imbricate (d) Vexillary

### The fruit

Fruit is a ripened ovary. The fruit develop without fertilisation are called parthenocarpic fruit. The fruit consist of a fruit wall and seeds. The fruit wall is termed as pericarp. The pericarp has three layers in some fruits. The outer epicarp, middle mesocarp, and inner endocarp in mango the epicarp is leathery while mesocarp is fleshy. The endocarp is hard. In coconut epicarp is leathery, mesocarp is fibrous and endocarp is stony. In mango and coconut the fruit is termed as drupe.

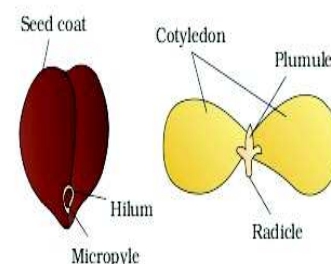
### The seed

the ovules develop into seed after fertilisation. The seed is made up of seed coat and embryo. The embryo consists of embryonal axis and cotyledons.

### Structure of a dicot seed

a dicot seed has two cotyledons. Seed coat has two layers outer testa and inner tegmen.

- ✓ Hilum - is scar which indicates the point of attachment of seed with fruit
- ✓ micropyle - is small opening of seed
- ✓ radicle and plumule - two ends of embryonal axis
- ✓ endosperm - nutritive tissue in seed





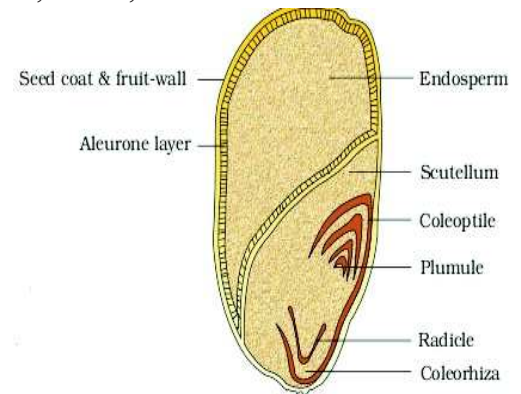
- in some seeds endosperm is absent; such seeds are nonendospermous. While seeds with endosperm is endospermous

### Monocot seed

seeds with one cotyledon are monocot seed. They are seen in grass, wheat, rice etc.

#### parts of monocot seed

<b>scutellum</b>	Single plate like cotyledon
<b>Aleurone layer</b>	Outer protein covering of endosperm
<b>coleoptile</b>	Sheath above plumule
<b>coleorhiza</b>	Sheath above radicle



#### Floral diagram and Floral formula

in floral formula various symbols are used. They are

<b>Br</b>	Bracteate
<b>K</b>	Calyx
<b>C</b>	corolla
<b>A</b>	Androecium
<b>G</b>	Gynoecium

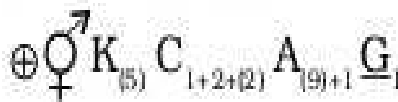
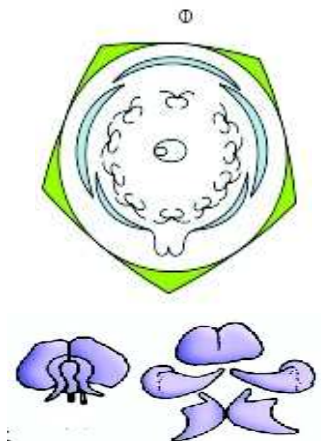
<b>P</b>	Perianth
	actinomorphic
<b>%</b>	Zygomorphic
<b>G</b>	hypogynous
	Female flower

Some important families are discussed here; like fabaceae, solanaceae, liliaceae

### FABACEAE

#### Floral characters

- Flower: - bisexual, zygomorphic  
 Calyx: - 5 sepals, gamosepalous, imbricate aestivation  
 Corolla: - 5 petals, polypetalous, vexillary aestivation, papilionaceous corolla [butterfly like]  
 Androecium: - 10 stamens, diadelphous, dithecous anther  
 Gynoecium: - 1 carpel, ovary superior



#### Economic importance

Sources of pulses (*grams, soyabeen, mung* etc)  
 Edible oil (*soyabeen and groundnut*)  
 Ornamentals ( *lupine, Sweet pea*)

medicine (*muliathi*)  
 dye (*indigofera*)  
 fibers (*sunhemp*)

## SOLANACEAE

Commonly called as potato family

### Floral characters

- Flower: - bisexual, actinomorphic  
Calyx: - 5 sepals, gamosepalous, valvate aestivation  
Corolla: - 5 petals, gamopetalous, valvate aestivation,  
Androecium: - 5 stamens, epipetalous  
Gynoecium: - 5 carpel, syncarpous, ovary superior



### Economic importance

Sources of food (*tomato, brinjal, potato* etc)  
medicine (*belladonna, aswagandha*)  
Ornamentals (*petunia*)

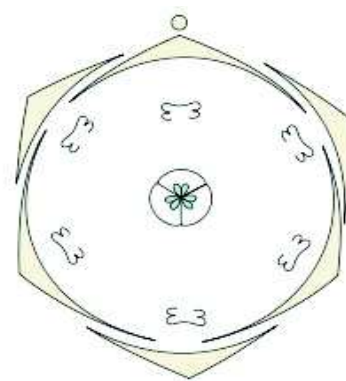
spice (*chilli*)  
dye (*indigofera*)  
fumigatory (*tobacco*)

## LILIACEAE

Commonly called as lilly family

### Floral characters

- Flower: - bisexual, actinomorphic  
Perianth: - 6 tepals, gamophyllous, valvate aestivation  
Androecium: - 6 stamens, epiphyllous  
Gynoecium: - 3 carpels, syncarpous, ovary superior



### Economic importance

Vegetable (*asparagus, onion, garlic*)  
Ornamentals (*gloriosa, tulip*)

medicine (*aloe vera*)  
Colchicine (*Colchicum autumnale*)

*Floral diagram of mustard [family-brassicaceae]>>>>*

