Aakash + BYJU'S NOTES

Morphology of Flowering Plants

Key Takeaway

1. **Morphology**
2. **Root system**
   - Types of roots
   - Functions of roots
   - Tap root modifications
3. **Shoot system**
   - Functions
   - Modifications
4. **Leaves**
   - Parts of a typical leaf
   - Types of leaves
   - Arrangement of leaves
   - Modifications
5. **Flower**
   - Arrangement
   - Classification

6 Ovary

Fruit 7

8 Seeds

Floral formula symbols 9

10 Floral diagram

Floral families 11

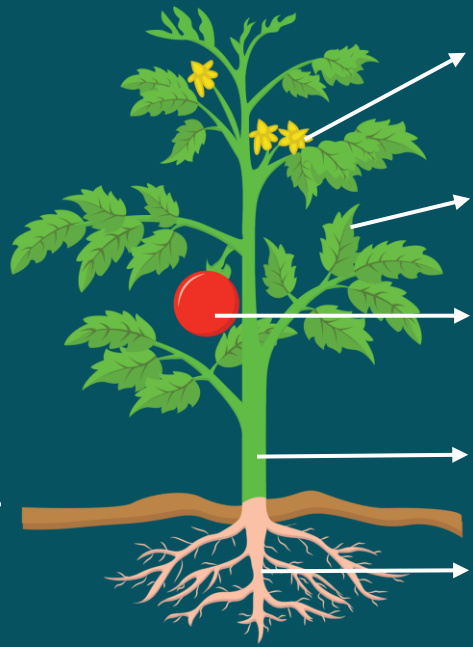
- Fabaceae
- Solanaceae
- Liliaceae
- Brassicaceae

Summary

Morphology

- **Morphology:** Study of external form and structure.
- **Phytomorphology:** Study of the form and structure of **plants**.
- **Root** develops from the **radicle**.

Morphology



Shoot system

Root system

Flower helps in reproduction

Leaf performs photosynthesis

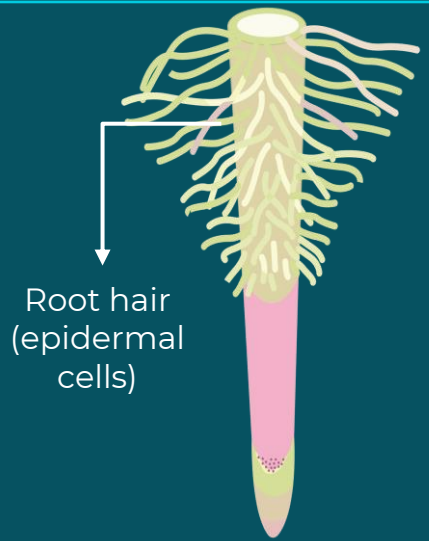
Fruit protects the seeds

Stem supports the plant

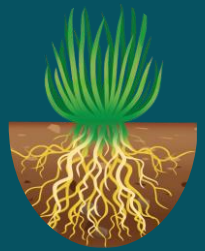
Root absorbs water and minerals from soil

Root System

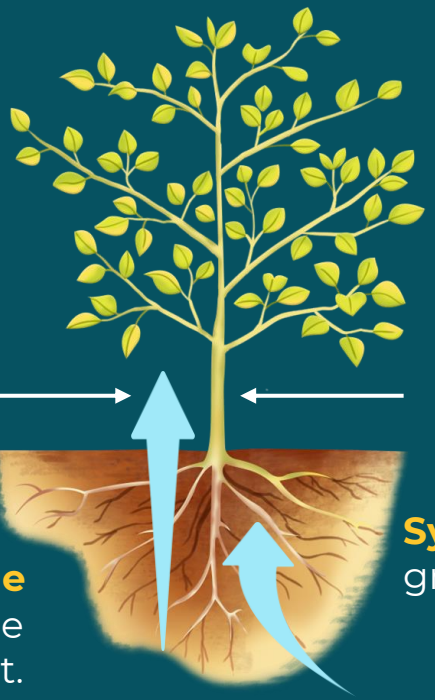
Root is a non-green, underground portion of the plant that primarily helps in mineral and water absorption, as well as provides anchorage to the plant.

Root	Zone/ region of	Description
	Maturation	Cells in this zone are fully differentiated performing specific functions. Roots hairs are present for absorption.
	Elongation	Cells undergo growth and elongation.
	Meristematic activity	Cells undergo continuous cell division.
	Root cap	Root cap protects meristematic tissue.

Types of Roots

Tap root	Fibrous root	Adventitious root
Direct elongation of radicle.	Arises from stem base.	Arises from parts other than radicle like stem, node, leaves, etc.
Primary, secondary and tertiary roots are present; bears lateral roots.	Primary root is short-lived; roots are of similar in size & highly branched.	Can be nodal roots, stem roots, crown roots, junction roots.
Present in dicots such as mustard.	Present in monocots such as wheat.	Present in both monocots (*Monstera*) & dicots (Banyan).
		

Functions of Roots



Support
Water is drawn up the plant by roots. This column of water supports the plant.

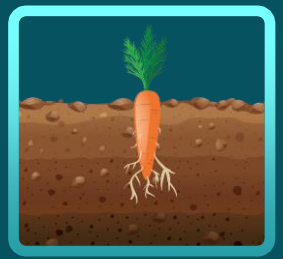
Anchorage
The roots anchor the plant in the compost.

Absorption
Roots take up water containing minerals.

Synthesis of PGRs (plant growth regulators)

Tap Root Modifications

Storage of food

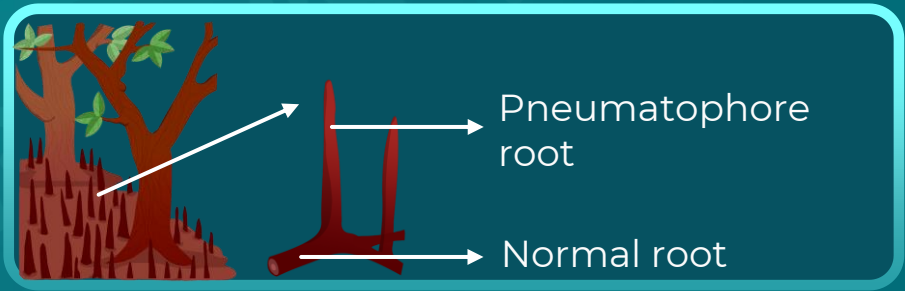
Conical root	Fusiform root	Napiform root	Tuberous root
Conical in shape, i.e. they are widest at the top and taper towards the bottom.	Spindle shaped, i.e. they are widest in the middle and taper towards the top and bottom.	Top like, i.e. they are swollen at the top and taper abruptly at the bottom.	Thickened tap root with no definite shape.
			
Carrot	**Radish**	**Turnip**	**4' O clock plant**

Tap Root Modifications

For respiration

- The aerial roots specialized for gaseous exchange in plants are called **pneumatophores or respiratory roots**.
- They develop in **mangrove plants**, i.e., plants growing in **saline marshes**.
- These roots **grow vertically upward** and are **negatively geotropic**.
- Air enters these roots through minute breathing **pores** called **pneumathodes**, present on the **surface** of **vertical roots**.
- Example., ***Rhizophora***.

Rhizophora



Adventitious Root Modifications

For storage of food

Sweet potato

They get swollen and store food

For the support

Maize

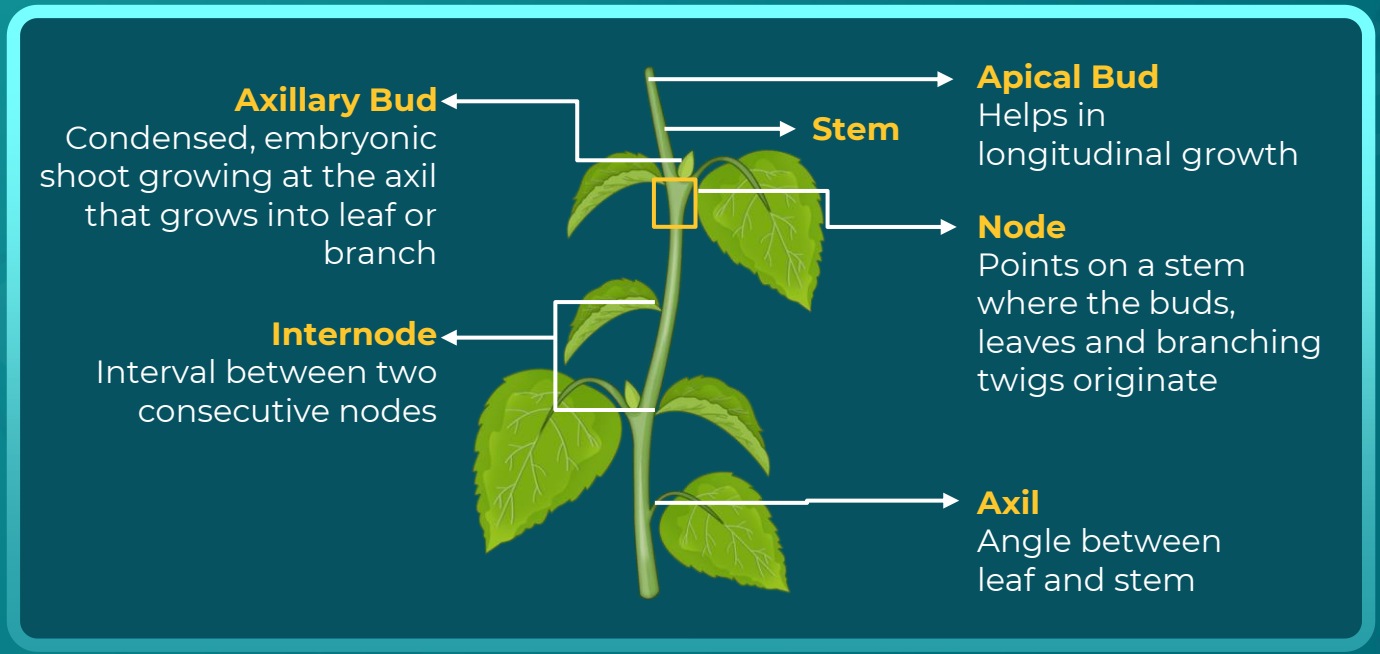
- **Stilt roots**
  - Roots arise **obliquely** from lower nodes of the stem.
  - Examples: Sugarcane, maize.

Banyan tree

- **Prop roots**
  - They are **thick, pillar-like** roots.
  - The roots arise from branches of the plant and grow downward towards soil.
  - Example: Banyan tree.

Shoot System

- **Stem** is the ascending part of the plant that develops from plumule of the seed.
- It is positively phototropic, negatively geotropic & hydrotropic.



Functions of Shoot System

Buds help the plant to **grow**

Vegetative propagation through stem
Eg., Rose

Stem also **stores** food

Supports aerial parts like fruit, flower, leaves

Conduction of water, food and minerals

Modifications of Shoot

Underground stem modifications

- Underground stems of potato, ginger, turmeric, zaminkand and *Colocasia* are modified to store food in them.
- They help in riding over conditions unfavourable for growth.
- E.g. - **Rhizome, tuber, corm, bulb**.

Sub-aerial stem modifications

Runner

- Grows parallel or horizontal to ground & bears buds, scale leaves (reduced & modified).

Stolon

- It grows like an arch and then touches the ground, gives rise to new shoots and roots.

Offset

- Grows laterally, bears rosette of leaves and a tuft of adventitious roots at the node.
- Seen in aquatic plants

Bulb

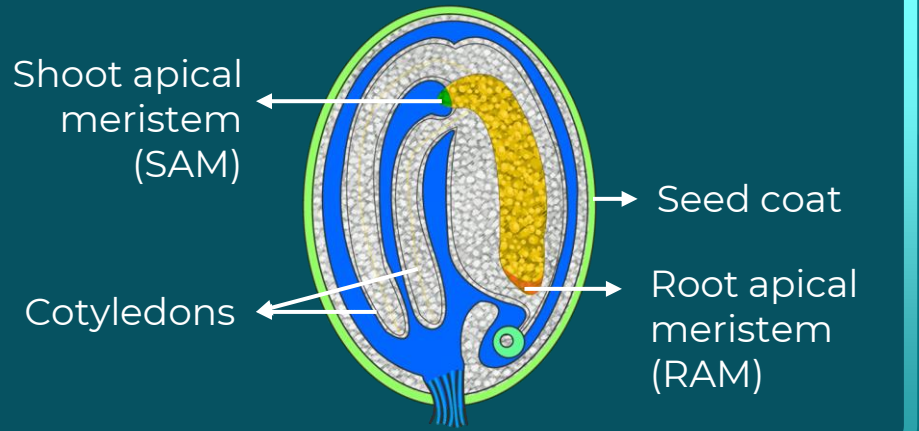
- It comes out upward from the area below soil surface, giving rise to leafy shoots.
- It is known as an underground runner.

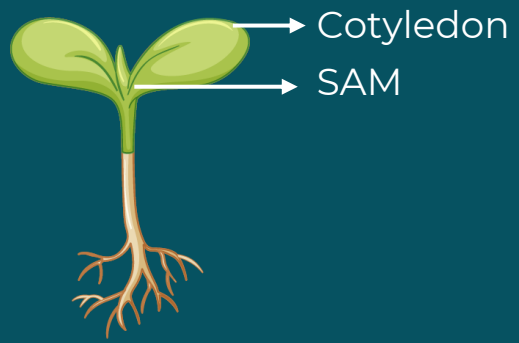
Modification for support & protection

- Some plants develop **slender, spirally coiled** structure from axillary buds which curl around for support. E.g. - gourds, cucumber.
- In other, axillary buds modify into woody, straight and pointed **thorns** which protect from predation and conserve water. E.g. - ***Citrus, Bougainvillea.***

Leaves

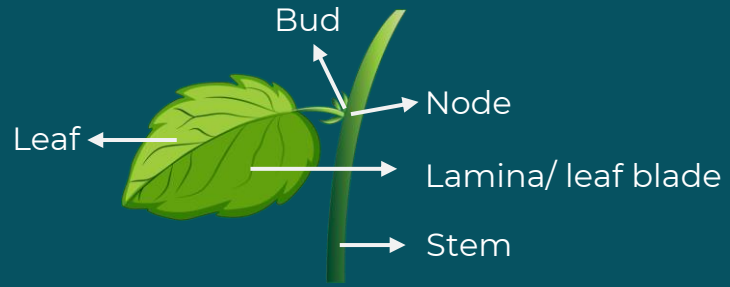
- Seed's embryo has a region known as **SAM (Shoot apical meristems)**.
- Leaves originate from SAM which is located between cotyledons.
- As the shoot grows, the shoot apical meristematic region gets shifted to a position slightly above the region from where the first set of leaves emerge.
- Shoot apex has meristematic cells which are **multipotent stem cells**.





Parts of a Typical Leaf

- Leaf has a flat structure and arises from the nodes of a stem.
- Bud arises from axil, which later develops into leaf, shoot, branch or flower.
- The typical leaf has three main parts: **leaf base, petiole and lamina/leaf blade**.



Structure of leaf

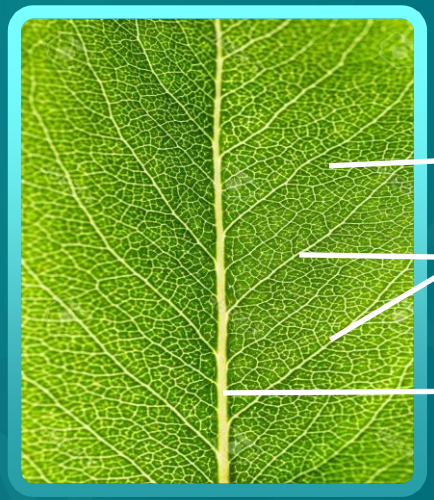
Leaf base

- The leaf is attached to the stem via leaf base.
- Two **lateral leaf-like structures** present on **either side** of the leaf base are known as **stipules**.
- In **monocots** (grasses), **the leaf base extends to form a sheath**.
- **In some** leguminous plants, the leaf base may become swollen.
  - This swollen leaf base is known as the **pulvinus**.

Parts of a Typical Leaf

Petiole

- Petiole helps hold the leaf blade above the level of stem to capture light.
- Long, thin, and flexible petioles help leaf blades flutter in the wind. This brings fresh air to the leaf surface.
- Petioles are often referred to as **stalks**.



Lamina

- Leaf blade, also known as lamina, is the expanded green part of the leaf.
- Leaf lamina is of various shapes. Leaf may have **different margins and apex as well**.

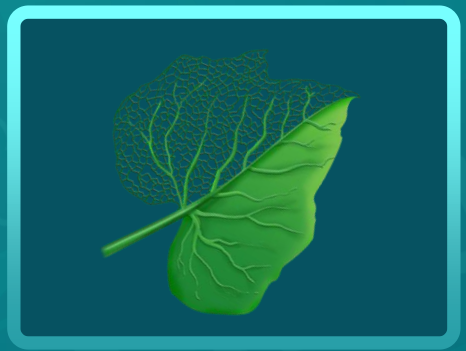
Veins

- Veins provide **rigidity to the leaf blade**. They also act as channels of transport for water, minerals, and food materials.

Parts of a Typical Leaf

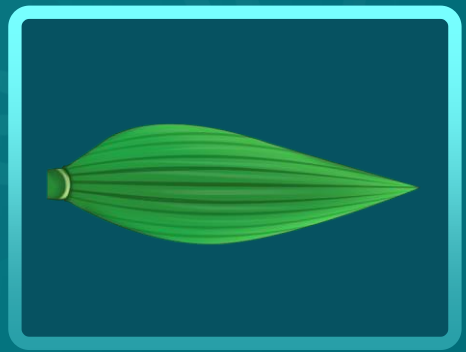
Venation: arrangement of veins and veinlets in the leaf lamina (Based on branching)

Reticulate



- Veinlets form a **network**
- Most **dicots**

Parallel



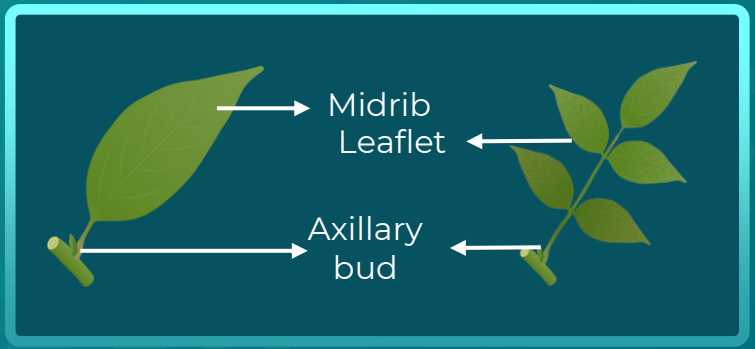
- Veins run **parallel**
- Most **monocots**

Types of Leaves

Types of leaves
(Based on the leaf blade)

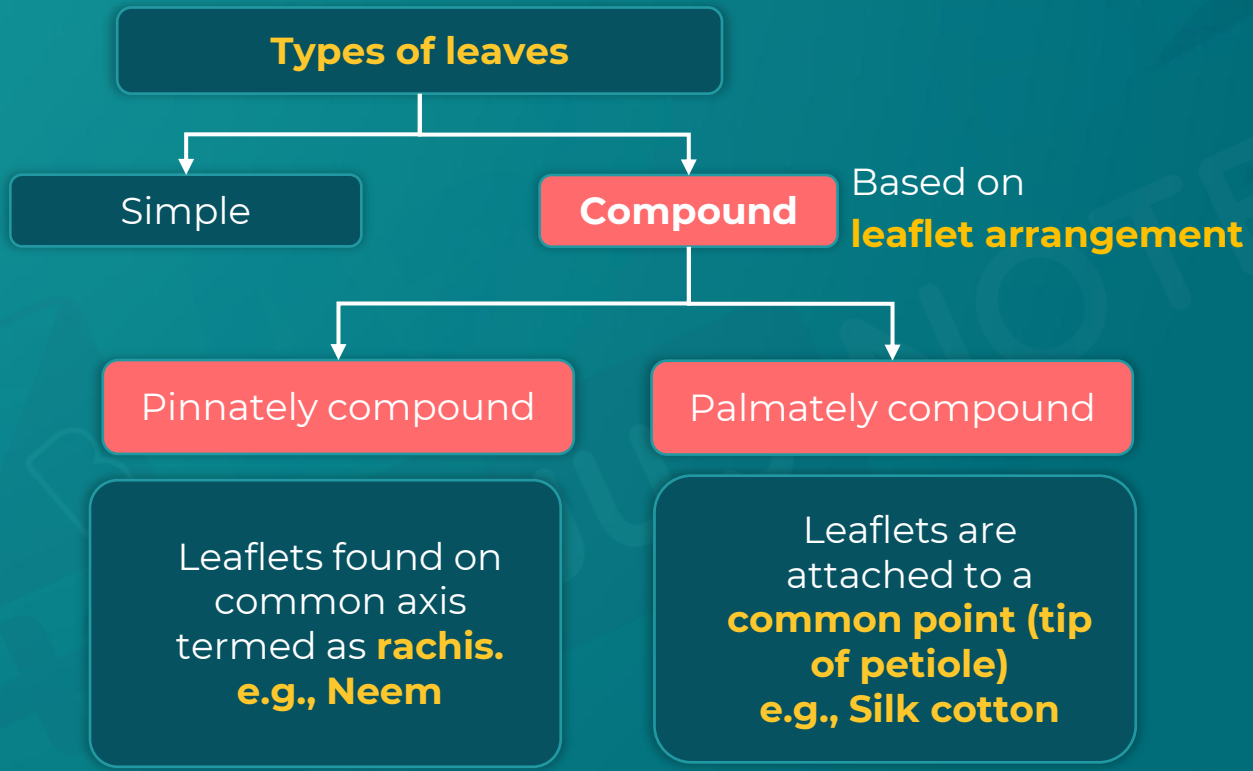
- Simple
- Compound

- **Incisions** of the lamina **do not touch** the midrib in **simple leaf**.
- A bud is present in the axil of petiole in simple leaves. It is known as the axillary or lateral bud.



- Incisions of the lamina reach up to the midrib, breaks into a number of **leaflets**.
- Such a leaf is known as a **compound leaf**.
- Axillary bud is present in the axil of the petiole of compound leaves but absent in the leaflets.

Types of Leaves



Arrangement of Leaves

- Arrangement of leaves on the stem is called **phyllotaxy**

Phyllotaxy

Alternate

- **Single leaf** arises at each node in **alternate manner**.
- E.g: *Hibiscus*, sunflower, mustard

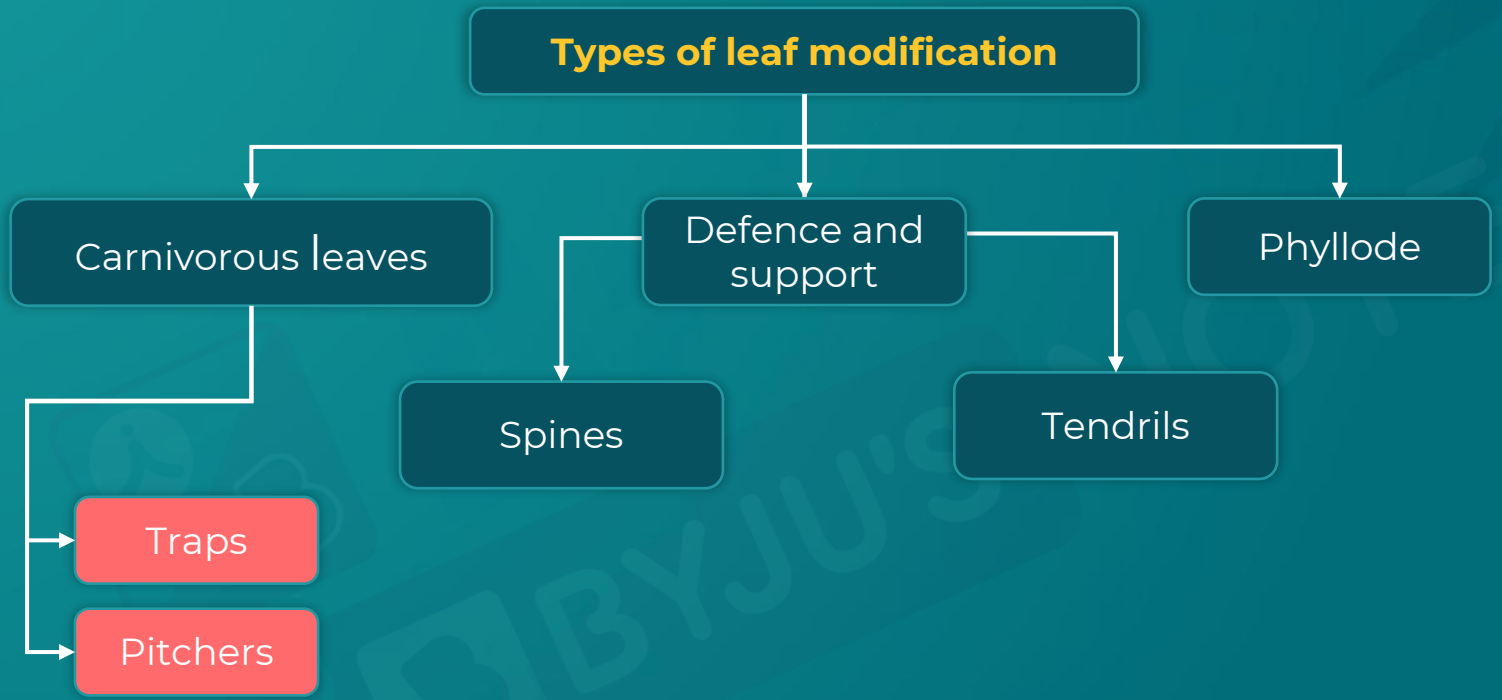
Opposite

- **Pair of leaves arise at each node and lie opposite** to each other.
- E.g. – *Calotropis*

Whorled

- **More than two leaves arise from a single node.**
- E.g: *Alstonia*

Leaf Modification



Leaf Modification

Carnivorous leaves

- Leaf lamina gets modified to trap insects.
- **Insectivorous plants** are photoautotrophic. However, they grow in soil which lacks nitrogen. To fulfil the requirement of nitrogen, they trap insects.
- Examples: Venus flytrap, Pitcher plant (Here, leaf lamina is modified as a pitcher).

Spines

- The leaves are reduced to spines to **minimise water loss**.
- Cacti have **swollen stems**.
- Leaves are modified as spines, they also **provide protection**.

Tendrils

- The leaves are modified as tender coiled structures which provide **support** and **help in climbing**. Example: Pea.
- In some plants, the **axillary bud** converts into tendrils. Example: Cucumber.
- In some plants, the **leaf tip** is modified to tendrils to touch and twine around objects.

Leaf Modification

Storage

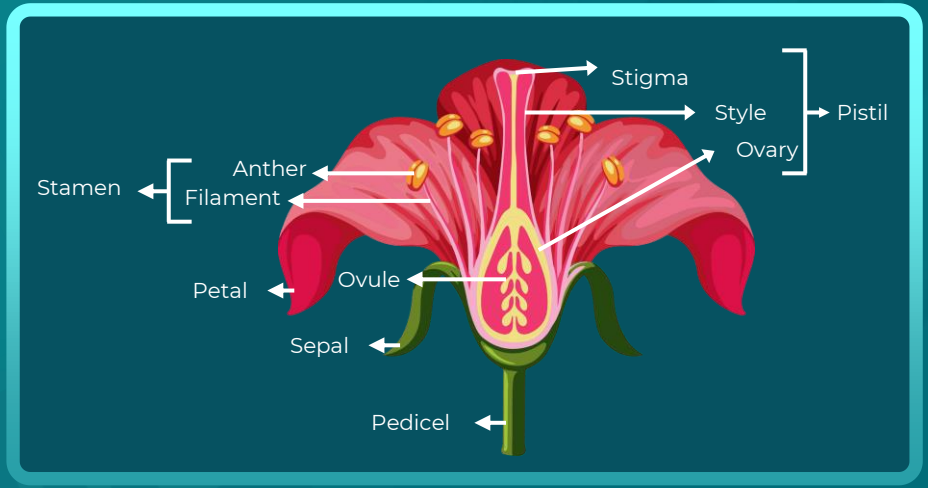
- Some leaves are **modified to store food**.
- Garlic and onion are edible leaves but their outer leaves are dry scale leaves.

Phyllode

- Photosynthetic modified petioles are known as phyllodes. Example: *Acacia*.
- The leaves are short-lived. To **increase photosynthesis**, the leaf petiole expands. It turns green and performs photosynthesis.

Flower

- Flower is a modified shoot.
- Leaf arises from the node.
- The space between two nodes is the **internode**.
- Shoot transforms into a flower, floral appendages develop at nodes.
- As the shoot transforms to flower, the internodes do not elongate. Further, the **axis gets compressed**.
- The floral appendages include calyx (sepals), corolla (petals), stamens (androecium), and carpels (gynoecium).
- **Pedicel** is the **stalk** of a plant that **connects the flower** with the stem of the plant.



Arrangement of Flowers

Inflorescence: arrangement of flowers on the floral axis

Solitary

- It is not a part of the inflorescence.
- **Example**: *Pulsatilla*

Pulsatilla

Racemose

- The main axis continues to grow and has no terminal flower.
- The flowers are borne laterally in an acropetal succession.
- **Example**: Gulmohar

Gulmohar

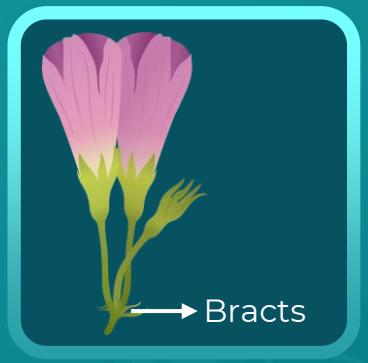
Cymose

- The main axis terminates in a flower. Hence, it is limited in growth.
- The flowers are borne in a basipetal order.
- **Example**: Jasmine

Jasmine

Classification of Flower

- Bracts are **green leaf-like structures**.
- **Function:** They protect the flower.



Tulips - Bracteate

Based on the presence of bracts

Bracteate

- **Bracteate:** Bracts are present at the base of pedicel. **Example**: Tulips
  - Symbol: **Br**

Ebracteate

- **Ebracteate**: In some flowers, bracts are absent. **Example**: Mustard flowers
  - Symbol: **Ebr**

Mustard flower - Ebracteate

- **Spathe**: Bracts that are modified into colourful and bright ones.
- Their function is to **attract pollinators. Example**: *Bougainvillea*

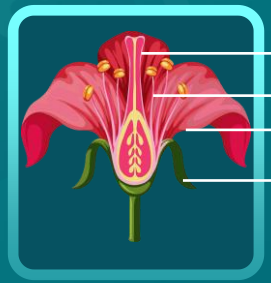
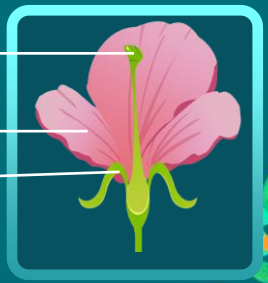
Classification of Flower

- A flower consists of four whorls: calyx, corolla, androecium, and gynoecium.
- Whorl is a term used for the **arrangement of sepals, petals, stamens, or carpels**, which radiate from a common point surrounding the stem or stalk.

Types of whorls

- Non-essential whorls (Accessory whorls)
  - Calyx
  - Corolla
  - They are not directly involved in sexual **reproduction** of plants. These parts may participate in attracting the pollinators.
- Essential whorls
  - Androecium
  - Gynoecium
  - These are **directly involved in sexual reproduction**, i.e., seed formation.

Based on the number of whorls

- Complete
  - 
  - **All 4 whorls present**
- Incomplete
  - 
  - **1 or more whorl absent**

Classification of Flower

Classification of flower based on presence of sexual reproductive organ

Staminate

- Only androecium is present.
- It is found in dioecious plants.
- It is also found in unisexual flower in monoecious plants.
  - **Example:** Male papaya flower.

Pistillate

- Only gynoecium is present.
- It is found in dioecious plants.
  - **Example:** Female *Cucurbit* flower.

Sex-switching plants

- They express sexual differences at different stages of growth.

Staminode

- The stamen present is rudimentary.
- Stamen is sterile, i.e., it does not produce pollen grains.
  - **Example:** *Cassia*

Bisexual

- Both androecium and gynoecium are present in the same flower.
- It is found in monoecious plants.
  - **Example:** *Hibiscus*.

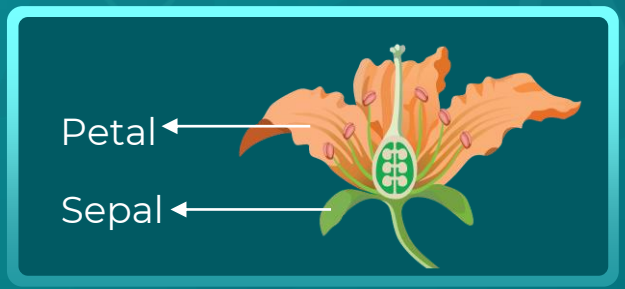
Classification of Flower

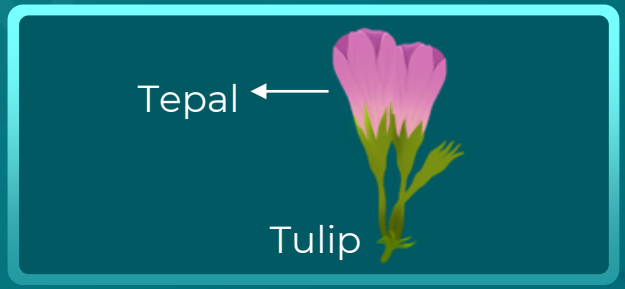
Based on number of appendages

Trimerous	Tetramerous	Pentamerous
3 or multiple of 3 units	4 or multiple of 4 units	5 or multiple of 5 units
• **Example**: Monocot flowers - Lily	• **Example**: Dicot flowers - Primrose	• **Example**: Dicot flowers - *Crassula ovata*

Non-essential Whorls

	Calyx	Corolla	Perianth
Definition	Outermost whorl of flower consisting of green leaf like structures called **sepals**	Whorl of flower consisting of **petals** of various shapes like tubular, bell shaped, funnel-shaped or wheel-shaped enclosing reproductive organs of plant	Petals and sepals together are called **tepals**. They are found in monocots
Function	**Protection** of flower at the **bud** stage	**Attract pollinators**	**Protection** of **flower** and to **attract pollinators**
Symbol	**K**	**C**	**P**





Non-essential Whorls

	Calyx		Corolla	
Classification based on free or united appendages	**Polysepalous**	**Gamosepalous**	**Polypetalous**	**Gamopetalous**
Definition	**Sepals** are separated and **free**	**Sepals** are **fused** and united	**Petals** are separated and **free**	**Petals** are **fused** and united
Symbol	K_n (n= number of sepals)	$K_{(n)}$ (n= number of sepals)	C_n (n= number of petals)	$C_{(n)}$ (n= number of petals)
Example	Rose	Tomato	Rose	Tomato

Aestivation

Aestivation : arrangement of sepals and petals with respect to other members of the same whorl

Valvate

Sepals or petals in a whorl touch one other at the margin

Calotropis

Twisted

One margin of the appendage overlaps that of the next one

Cotton, lady's finger

Imbricate

Margins of sepals or petals overlap one another but not in any particular direction

Cassia, gulmohar

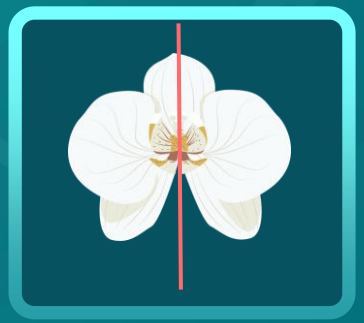
Vexillary

Largest petal (standard) overlaps the two lateral (wings) that overlap the two smallest anterior petals (keel)

Pea plant

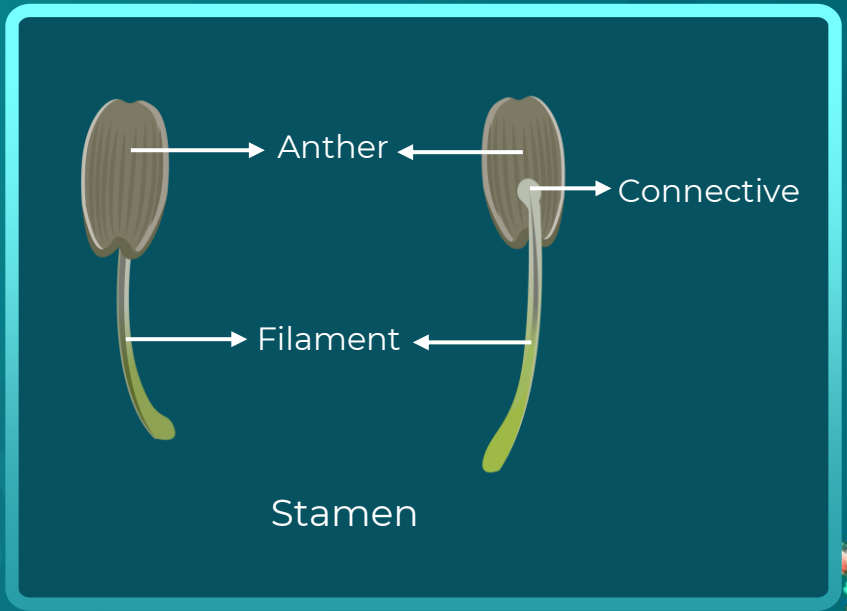
Symmetry in Flowers

Symmetry

- **Actinomorphic (⊕)**
  - Flowers that can be cut in any plane to get equal halves
  - 
  - **Chilli**
- **Zygomorphic (%)**
  - Flowers that can be cut in only one plane to get equal halves
  - 
  - **Gulmohar and bean**
- **Asymmetric ($)**
  - Flowers that can not be divided into equal halves
  - 
  - ***Canna***

Essential Whorls : Androecium

- Stamens are collectively termed as androecium.
- **Function**: It helps in sexual reproduction in plants.
- **Symbol**: It is represented by **A**.
- **Parts of androecium**
  - **Stamen**: It is the male reproductive organ of a flower. It has the following 3 parts:
    - **Filament**: It is the stalk of the stamen.
    - **Anther**: It is the bilobed structure of stamen. It houses pollen grains required for pollination.
    - **Connective**: It is the sterile part that connects anther lobes.



Stamen

Classification of Androecium

Based on fusion of stamen to floral parts

- **Epipetalous**
  - Stamens are attached to petals
  - 
  - **Brinjal**
- **Epiphyllous**
  - Stamens are attached to perianth
  - 
  - **Lily**

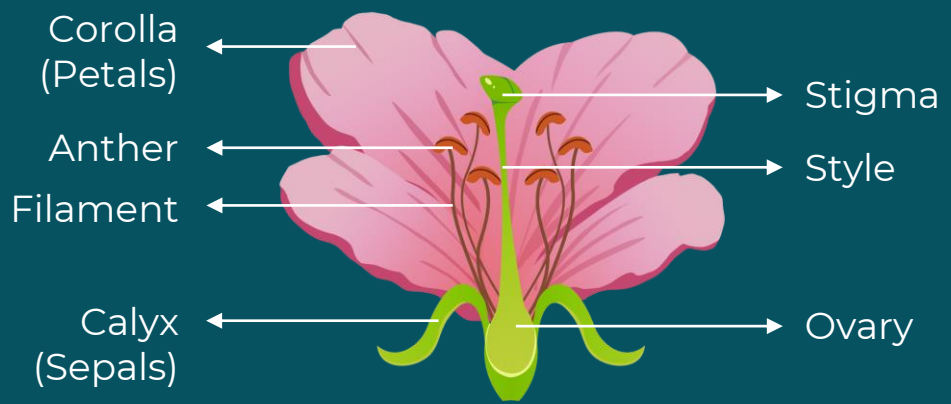
Classification of Androecium

Based on unification of filaments

- Polyandrous (free stamens)
- Adelphous (united stamens)
  - Monadelphous
    - 
    - Filaments of the stamens are fused as single bundle
    - Example- China rose
  - Diadelphous
    - 

    - Filaments of the stamens are in 2 bundles
    - Example- Pea
  - Polyadelphous
    - 
    - Filaments of the stamens are in several bundles
    - Example- *Citrus*

Essential Whorls: Gynoecium

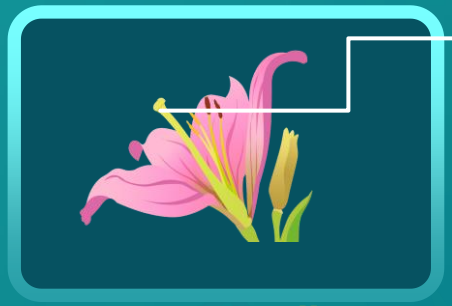


- **Group of pistils** are collectively called gynoecium
- Represented by letter **'G'**
- Pistil or carpel is the **female reproductive organ**
- It has 3 parts -
  - **Stigma** – Receptive surface for pollen grains
  - **Style** - Connects the ovary to the stigma
  - **Ovary** – Enlarged basal part

Classification of Gynoecium

Based on unification of carpels

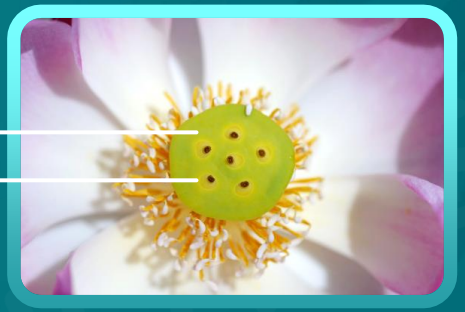
Single Carpel



Monocarpellary

Example: Fabaceae members

Multiple, free carpels



Apocarpous

Examples: Rose, lotus

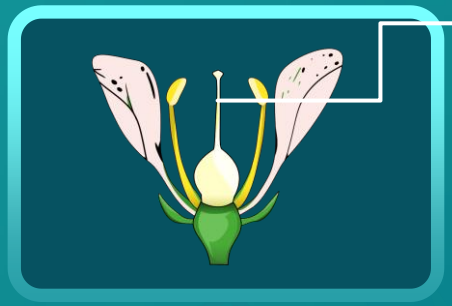
Multiple, fused carpels

Syncarpous

Examples: Mustard, tomato

Classification of Flowers Based on Gynoecium Position

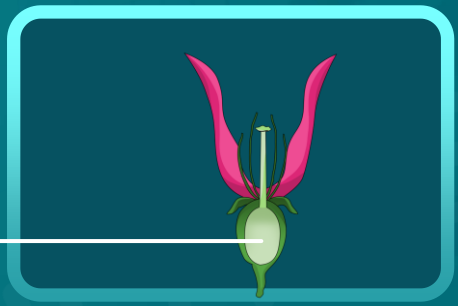
Based on position of ovary



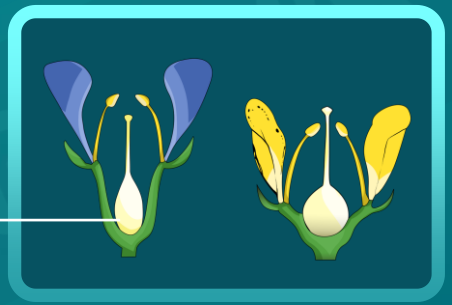
Superior ovary

Hypogynous

Inferior ovary



Epigynous



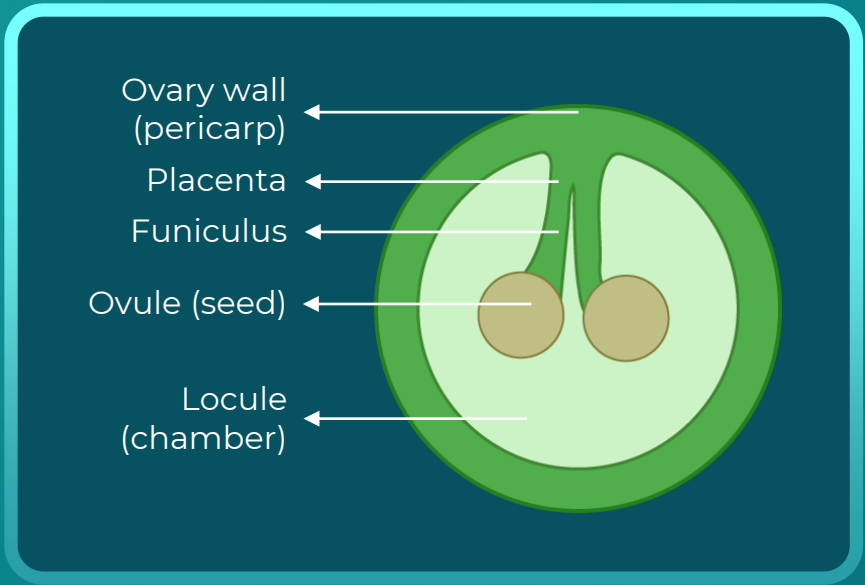
Half inferior ovary

Perigynous

Classification of Flowers Based on Gynoecium Position

	Hypogynous	Perigynous	Epigynous
Position of gynoecium	Highest	Centre	Lowest (Thalamus margin grows upwards enclosing ovary & fused to the ovary)
Position of other whorls	Below gynoecium	At the rim of thalamus at the same level	Above ovary
Ovary position	Superior	Half inferior	Inferior
Symbol	G	-G-	G
Example	*Hibiscus*, mustard flower, brinjal flower	Rose, plum, peach flower	Sunflower, guava flower, cucumber flower

Ovary



Parts of ripened ovary

- Ovary is enlarged basal portion of the the female organ (carpel or pistil) of a flower.
- An ovary has one or more chambers known as **locules**.
- Each ovary bears one or more ovules attached to it which develop into seeds upon fertilisation.
- Ovary wall develops into **pericarp** when ovary ripens.
- Ovules are connected to the ovary by placenta.
- **Funiculus** is a stalk like structure.

Classification of Ovary

Based on arrangement of ovules

Placentation is the method by which the placenta is distributed inside the ovary of the plants.

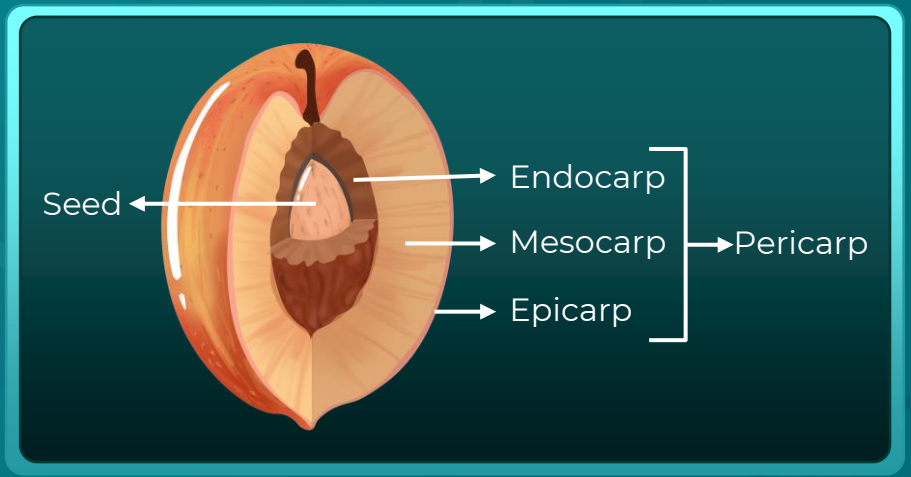
Types	Placentation	Examples
Axile	Ovules attached to axial placenta in a multilocular ovary	Orange, tomato
Marginal	Ovules attached to ridge-like placenta	Pea
Parietal	Ovules develop on inner wall of ovary	Cantaloupe
Free-central	Ovules are borne on the central axis with no septa	Primrose, *Dianthus*
Basal	Placenta develop at the base of the ovary and single ovule is attached	Marigold, sunflower

Fruit

The fruit is a **ripened ovary,** while the **ovule develops into seeds post-fertilization**. The fruit wall or **pericarp is differentiated** into three layers.

Parts of fruit

- **Epicarp-** Outermost layer
- **Mesocarp-** Middle layer
- **Endocarp-** Innermost layer



Types of Fruit

True fruits

- **Develop** from **mature ovary after fertilization**
- Usually the **mesocarp is the edible portion**
- **Examples-** Mango, peas.

False fruits

- **Develop from parts of flower other than the ovary**
- **Example-** Apple and pear thalamus or the receptacle develops into the fleshy, edible portion

Parthenocarpic fruits

- **Formed without fertilisation**
- **Seedless fruits** are formed
- Parthenocarpy can be **natural or induced**
- Can be induced using growth factors
- **Example-** Grapes, banana

Simple Fruits

Development of simple fruits

From monocarpellary ovary

Develops from a single ovary containing **one carpel**.
E.g. - Mango and coconut (fruit is called drupe).

From multicarpellary ovary

Develops from a single ovary containing **multiple fused carpels**.

Types of simple fruits

Fleshy

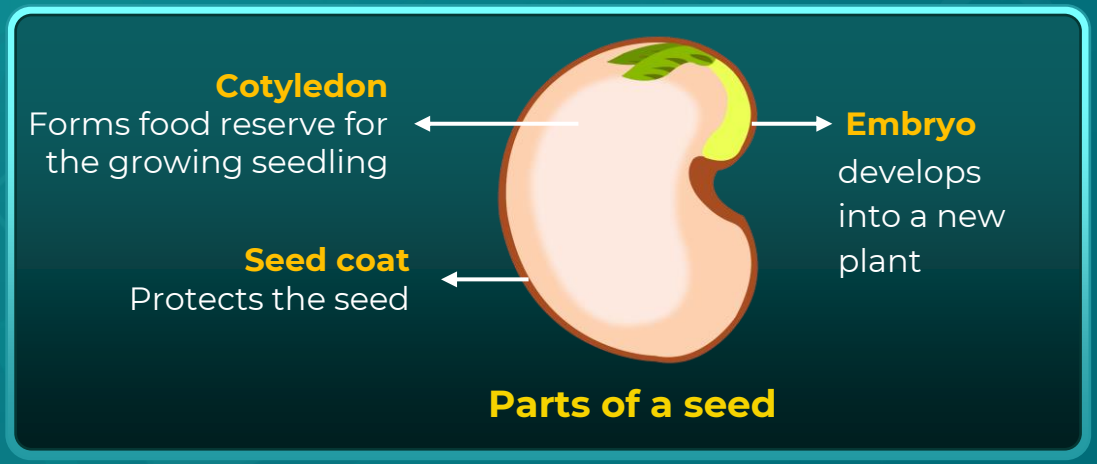
Pericarp is differentiated into epicarp, mesocarp and endocarp.

Dry

Pericarp is not differentiated into 3 layers.

Seeds

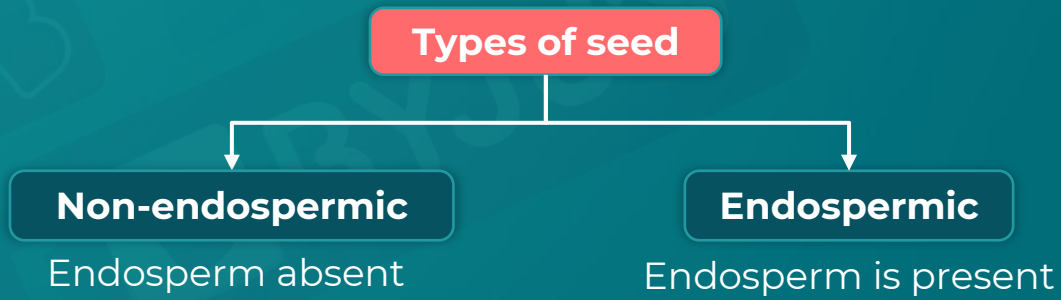
- **Seed** develops from **fertilised ovule**.
- It is found inside the fruit.
- **Seed dispersal** is the mechanism by which plant seeds are transported to new sites for germination.



Parts of a seed

Endosperm

- **Endosperm** is a **nutritive tissue** stored in the seed for the nourishment of growing embryo.
- Endosperm is formed by the **fusion of one male gamete and the polar nuclei** found in the embryo sac of the ovule.
- It is generally **triploid**.
- The endosperm **may or may not be fully consumed** during the embryo development.



Endosperm

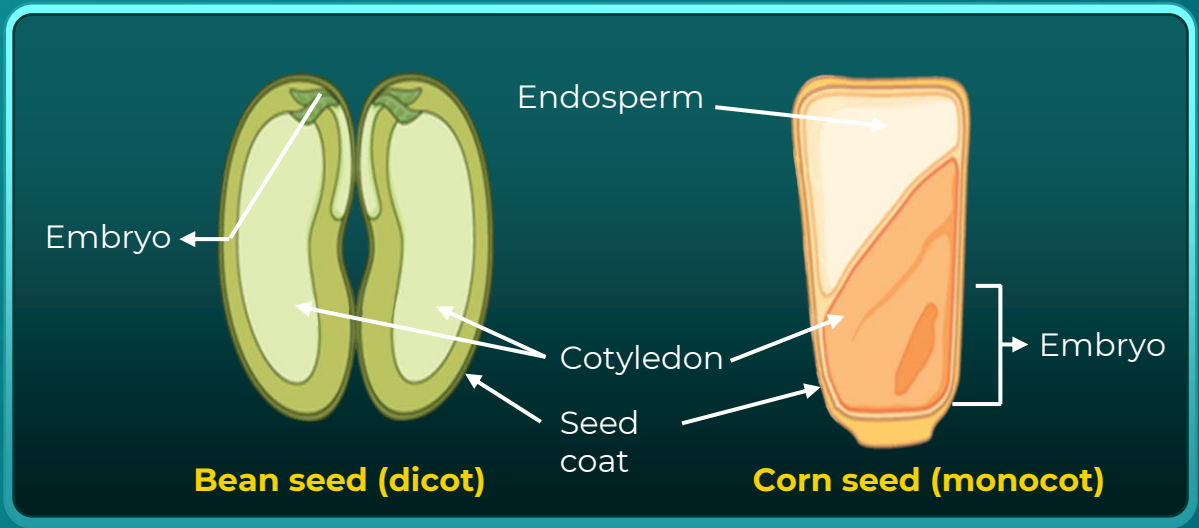
Types of seed

Dicotyledonous

Seeds which have a two cotyledons

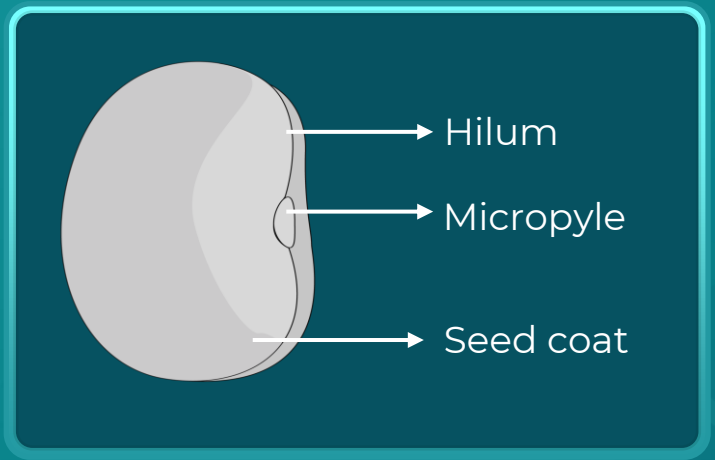
Monocotyledonous

Seeds which have a single cotyledon



Dicot Seed

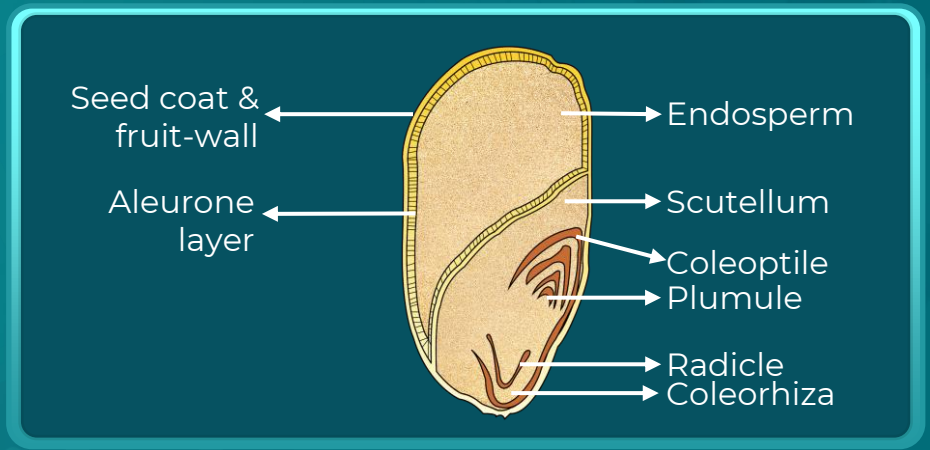
- The dicot seed has **two cotyledons**.
- The seed is bilayered, **outer layer is testa** and the **inner** is **tegmen**.



- **Hilum** - Scar on the seed, which marks the **point of attachment** of the funicle.
  - **Funicle** is a stalk that connects the seed with the placenta.
- **Micropyle** - Pore from which **water enters** the seed.
  - It is a small opening that is formed through which the pollen tube enters the ovary for fertilization.

Monocot Seed

- It has **one cotyledon** called **scutellum** and a **short embryonal axis**.
- Short embryonal axis has a plumule and a radicle.
- **Seed coat** is **membranous** and fused with the fruit wall.
- **Endosperm** is **bulky** and stores food.



- **Aleurone layer** is the **outer proteinaceous covering** of the endosperm.
- **Plumule** is enclosed in a sheath called - **Coleoptile**.
- **Radicle** is enclosed in a sheath called - **Coleorhiza**.

Floral Formula Symbols

Representation of the structure of a flower using numbers, letters and various other symbols

Symbol	Description
Br	Bracteate
Ebr	Ebracteate (no bract)
⊕	Actinomorphic flower
%	Zygomorphic flower
♂	Staminate flower (male flower)
♀	Pistillate flower (female flower)
⚥	Bisexual flower

Symbol	Description
A	Androecium
A_n	Stamens free n = number of stamens
$A_{(n)}$	Stamens fused indicated by brackets n = number of stamens
C A	Epipetalous condition
P A	Epiphyllous condition

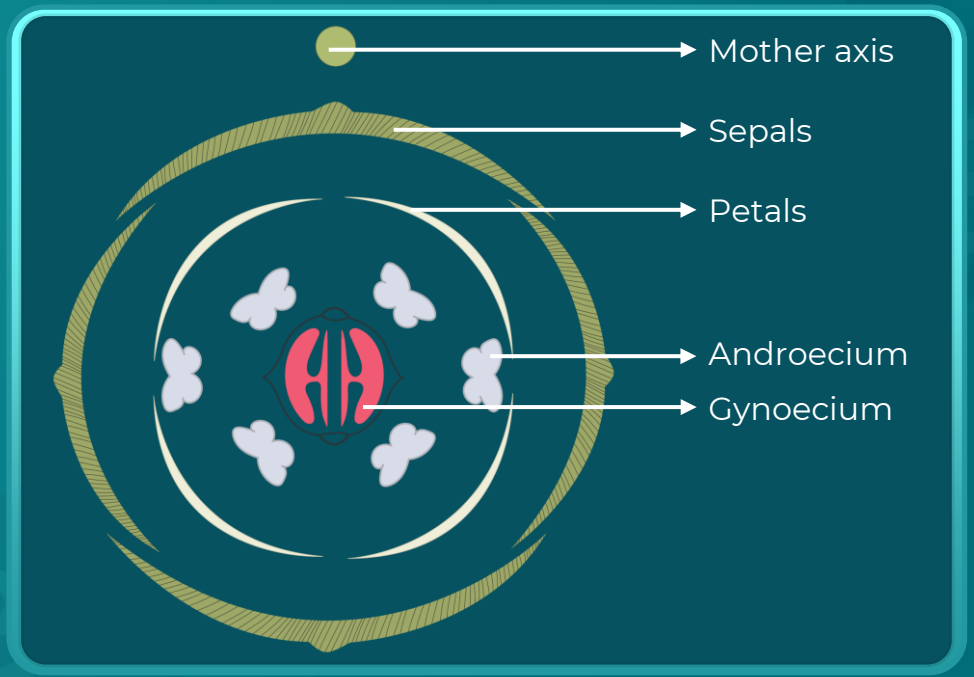
Floral Formula Symbols

Symbol	Description
K	Calyx
K_n	Polysepalous calyx n = number of sepals
$K_{(n)}$	Gamosepalous calyx (Fusion indicated by brackets) n = number of sepals
C	Corolla
C_n	Polypetalous corolla n = number of petals
$C_{(n)}$	Gamopetalous corolla (Fusion indicated by brackets) n = number of petals
P	Perianth

Symbol	Description
G	Gynoecium
G_n	n = number of carpels
$G_{(n)}$	Fused carpels indicated by brackets (Syncarpous condition) n = number of sepals
$\underline{G}$	Superior ovary
G	Inferior ovary

Floral Diagram

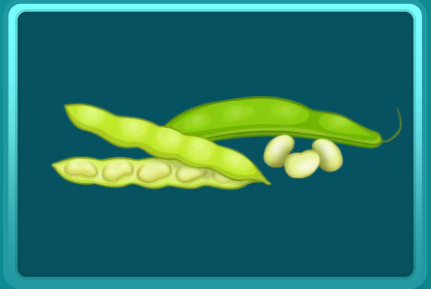
- **Floral diagram** is the diagrammatic representation of a flower or a bud.
- A floral diagram illustrates the arrangement, position, structure, aestivation, connotation and adnation of the floral components. It has a circular outline.
- It was first introduced in the 19th century by the scientist named **August Wilhelm Eichler**.



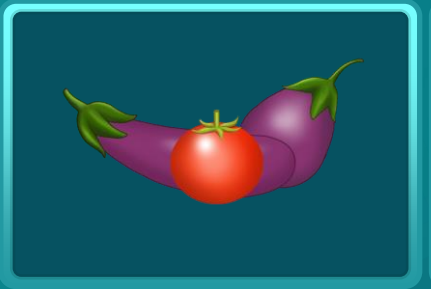
$\oplus \; \male \; K_{2+2} \; C_4 \; A_{2+4} \; \underline{G}_{(2)}$

Floral Families

Four floral families



Fabaceae

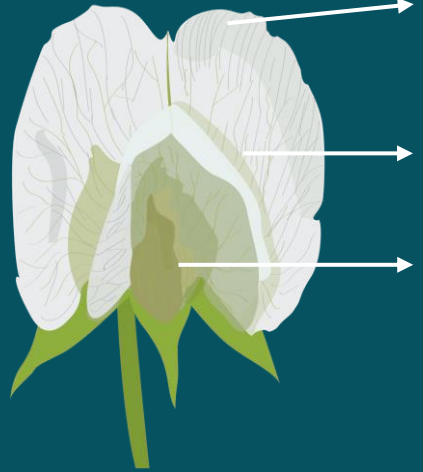


Solanaceae

Liliaceae

Brassicaceae

Fabaceae



Standard petal or banner
Outermost and the largest petal of the flower

Wing or alae
Two lateral petals

Keels or carinae
Two innermost and smallest petals

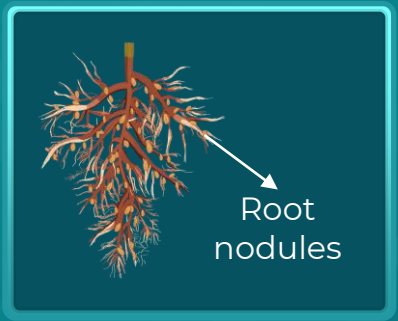
- The **fabaceae or leguminosae, commonly known as pea, bean or legume family** are a large and economically important family of flowering plants.
- It includes trees, shrubs, perennial or annual herbaceous plants which can be easily recognised by fruits (legume).
- **It includes a variety of pulses such as chickpea, garden pea and important agricultural and food plants such as soya bean, beans, alfalfa, peanut etc.**

Fabaceae: Vegetative Characteristics

Habit

- Herbs
- Shrubs
- Trees
- Vines

Root system



- Tap root system with root nodules
- *Rhizobium* - nitrogen fixing bacteria - present in the root nodules.

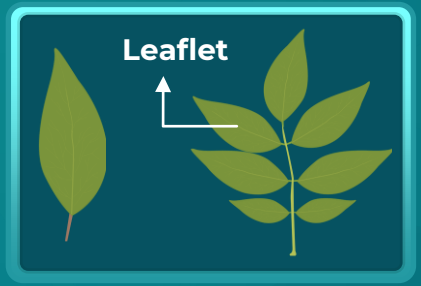
Shoot system

- Erect stem
- Weak stem, needs support to climb

Fabaceae: Vegetative Characteristics

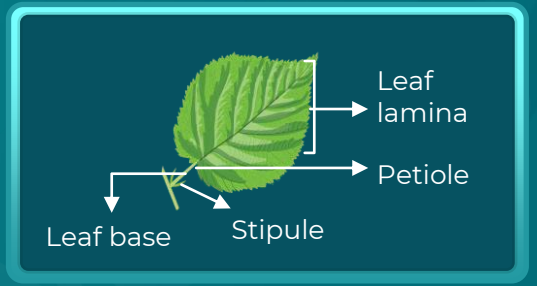
Leaf arrangement

Alternate (phyllotaxy)

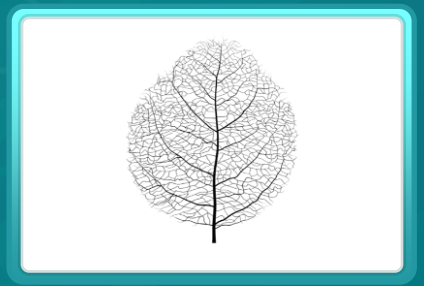


Simple leaf (rare)

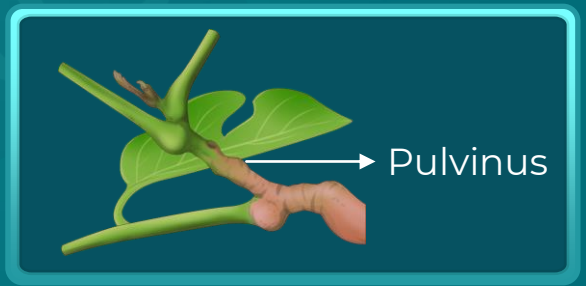
Compound leaf



Stipulate



Reticulate venation



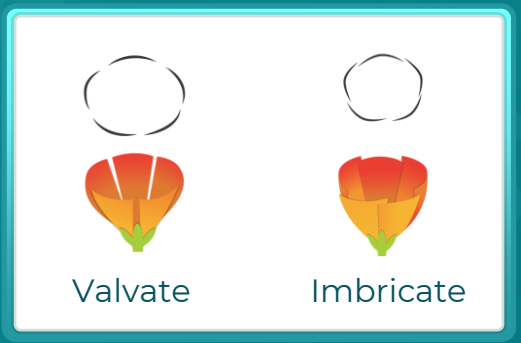
Swollen leaf base

Fabaceae: Floral Characteristics

- Inflorescence: **Racemose**
- Sexuality: **Bisexual or Hermaphrodite** (♀)
- Symmetry: **Zygomorphic**
  Bilaterally symmetrical (%)

Calyx

- Pentamerous, Gamosepalous $K_{(5)}$
- **Imbricate or valvate** aestivation



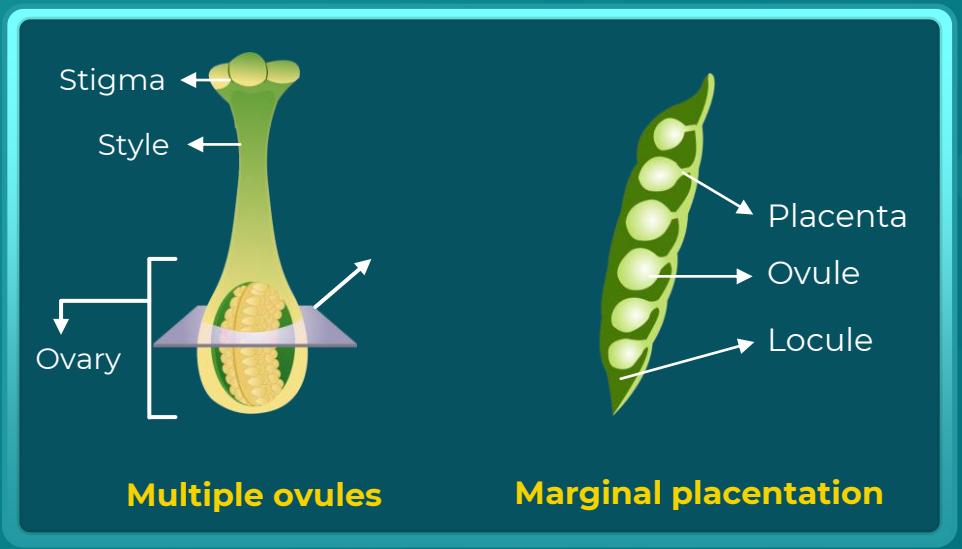
Corolla

- Pentamerous, Polypetalous C_5
- **Vexillary** aestivation

Fabaceae: Reproductive Characteristics

Gynoecium

- Single carpel, multiple ovules
- Marginal placentation
- Unilocular ovary



Androecium

- Diadelphous arrangement
- Dithecous anther, 2 lobes

Fabaceae: Floral Diagram & Formula

Floral formula

Bisexual

5 Petals, papilionaceous corolla

$\% \, ♀♂ \, K_{(5)} \, C_{1+2+(2)} \, A_{(9)+1} \, \underline{G}_{1}$

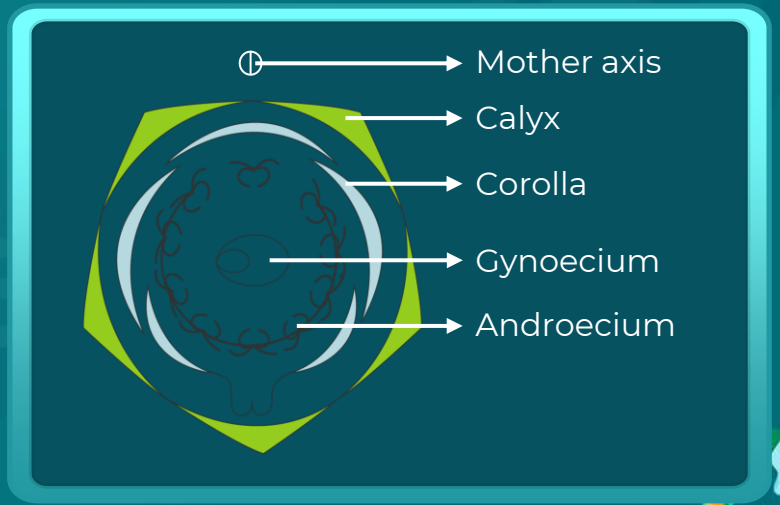
One carpel, Superior ovary

5 sepals, Gamosepalous

Zygomorphic

10 stamens, diadelphous

Floral diagram



Fabaceae: Economic Importance

Food

Pulses

Oils

Groundnut oil

Soybean oil

Timber and fibres

Shisham

Hemp

Medicine

Butterfly pea

Dye

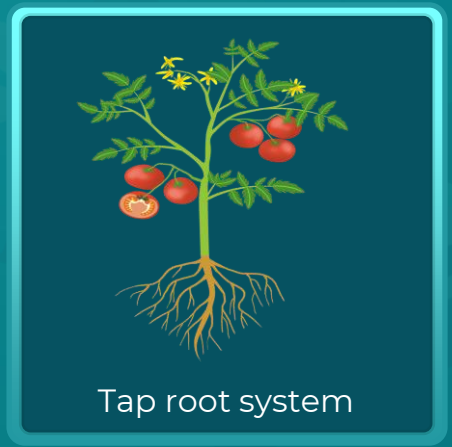
Indigo

Solanaceae: Vegetative Characteristics

Habit

- Herbs
- Shrubs
- Trees (rare)

Root system



Tap root system

Shoot system

- Aerial, erect stem, herbaceous and rarely woody, branched, hairy/ non-hairy (glabrous)

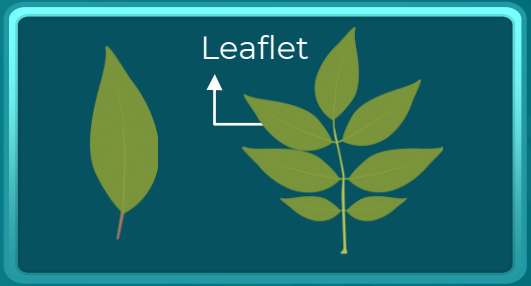
Glabrous non-hairy stem

Hairy stem

Solanaceae: Vegetative Characteristics

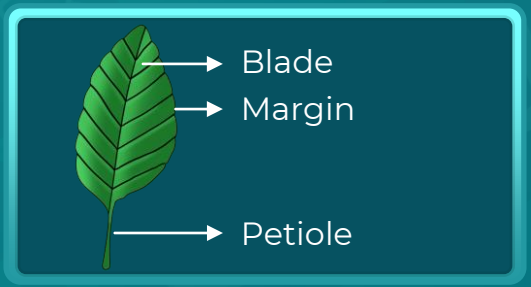
Leaf arrangement

Alternate (phyllotaxy)

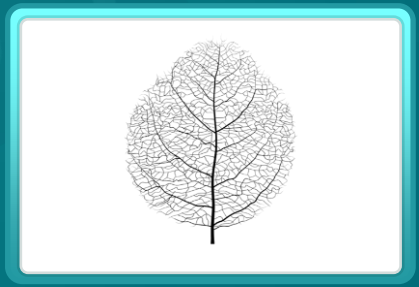


Simple leaf

Compound leaf (rare)



Exstipulate (no stipule)



Reticulate venation

Solanaceae: Floral Characteristics

- Inflorescence: **Solitary, axillary or cymose**
- Sexuality: **Bisexual or hermaphrodite** (♂)
- Symmetry: **Actinomorphic** - radially symmetrical (⊕)

Calyx

- Pentamerous, Gamosepalous $K_{(5)}$
- **Persistent** calyx and **valvate** aestivation

Valvate

Persistent calyx

Corolla

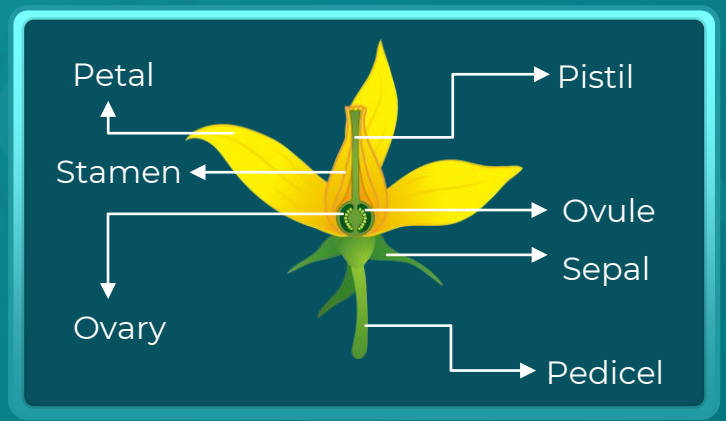
- Pentamerous, Gamopetalous $C_{(5)}$
- **Valvate** aestivation

Valvate

Solanaceae: Reproductive Characteristics

Gynoecium

- **Hypogynous-** Superior ovary
- Bicarpellary, Syncarpous- $G_{(2)}$.
- Bilocular ovary
- **Swollen placenta, axile**

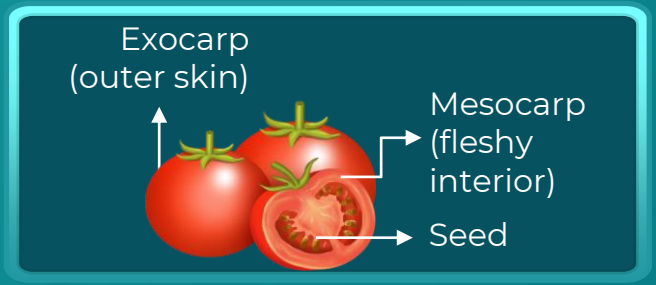


Androecium

- Five stamens - A_5
- **Epipetalous** - Filaments of stamen attached to petals

Solanaceae: Reproductive Characteristics

Fruits



Berry (All or most of pericarp is fleshy)
E.g: Tomato

Dehiscent capsule

Seeds

- Multiple seeds
- Dicotyledonous
- Endospermic
- Axile placentation

Multiple seeds

Axile placentation

Solanaceae: Floral Diagram & Formula

Floral formula

Bisexual

5 petals, Gamopetalous

$\oplus \; ♂ \; K_{(5)} \; C_{(5)} \; A_5 \; \underline{G}_{(2)}$

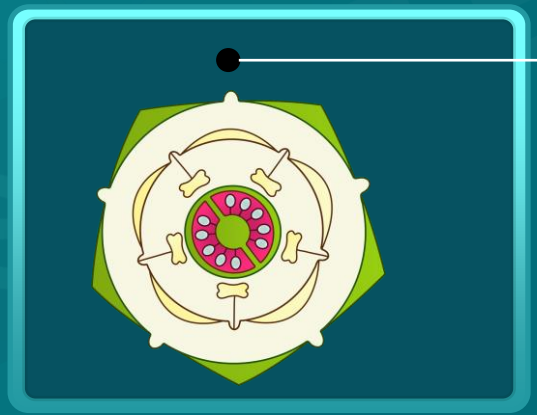
Bicarpellary, Syncarpous, Superior ovary

5 sepals, Gamosepalous

Actinomorphic

5 stamens, epipetalous

Floral diagram



Solanaceae: Economic Importance

Food

Tomato

Brinjal

Potato

Spices

Chillies

Medicine

Ashwagandha

Belladonna

Fumigatory

Tobacco

Ornamentals

Petunia

Liliaceae: Vegetative Characteristics

- The lily family
- Consists of monocots

Habit

Perennial herbs

- Tulips, onions, lilies, etc belong to this family.

Root system

Fibrous root

Shoot system

Corm

Colchicum

Bulb

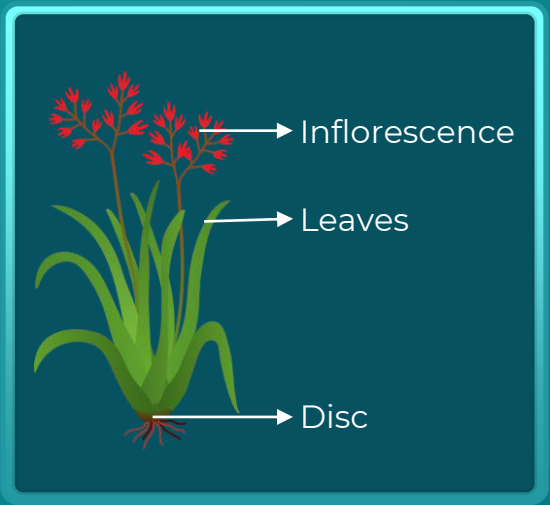
Onion

Rhizome

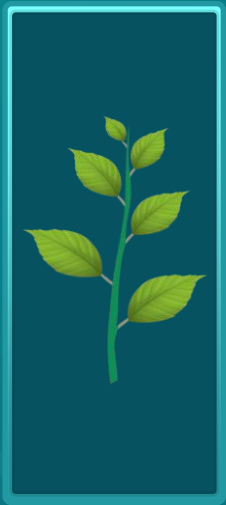
Gloriosa

Liliaceae: Vegetative Characteristics

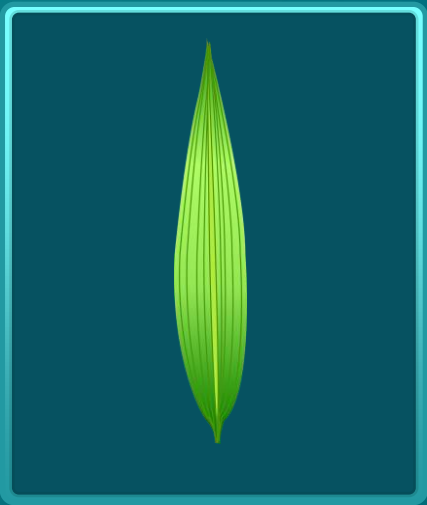
Leaf arrangement



Basal leaf- leaves arise from the base of the stem



Alternate
(phyllotaxy)



Exstipulate
(no stipule)

Parallel venation

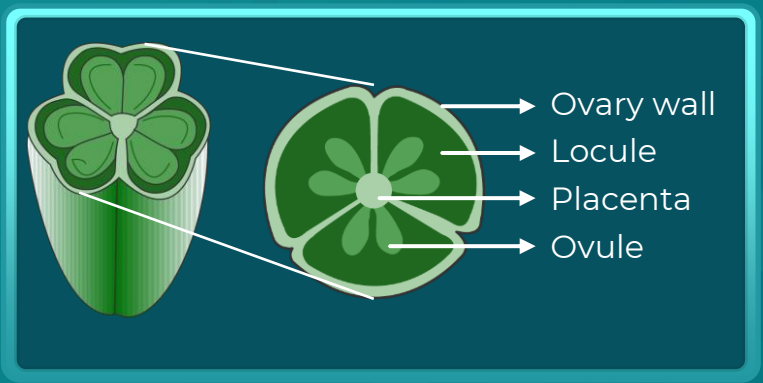
Liliaceae: Floral Characteristics

- Inflorescence: **Solitary, cymose umbellate clusters**.
- Sexuality: **Bisexual or hermaphrodite** (☿)
- Symmetry: **Actinomorphic** - radially symmetrical
- **Perianth** made of **tepals** (no distinct petals and sepals)
  - Aestivation: **Valvate**

Liliaceae: Reproductive Characteristics

Gynoecium

- **Tricarpellary** and **Syncarpous-** $\underline{G}_{(3)}$
- **Trilocular** ovary, **multiple ovules**
- **Axile** placentation



Ovary

Androecium

- Six stamens arranged in group of three- A_{3+3}
- **Epiphyllous**.

Epiphyllous condition

Liliaceae: Reproductive Characteristics

Fruits

- Capsule

- Berry (rarely)

Seeds

- Multiple seeds present
- Monocotyledonous
- Endospermic

Liliaceae: Floral Diagram & Formula

Floral formula

Actinomorphic

Perianth, 2 groups of 3 tepals each

$$Br \oplus \ \varphi \ P_{(3+3)} \ A_{3+3} \ \underline{G}_{(3)}$$

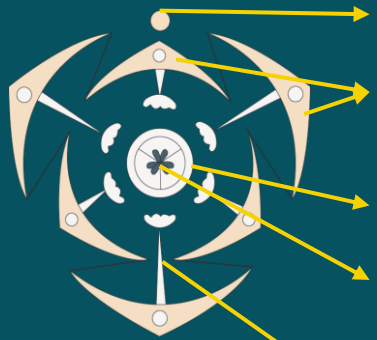
Tricarpellary, syncarpous, superior ovary

Bracteate

Bisexual

6 stamens, 2 whorls

Floral diagram



Mother axis

6 tepals arranged in 2 whorls of 3 each (fused)

Tricarpellary and trilocular gynoecium

Axile placentation

Stamen attached to tepals (Epiphyllous condition)

Liliaceae: Economic Importance

Ornamentals

Tulips

Gloriosa

Medicine

Aloe

Vegetable

Asparagus

Colchicine

Colchicum autumnale

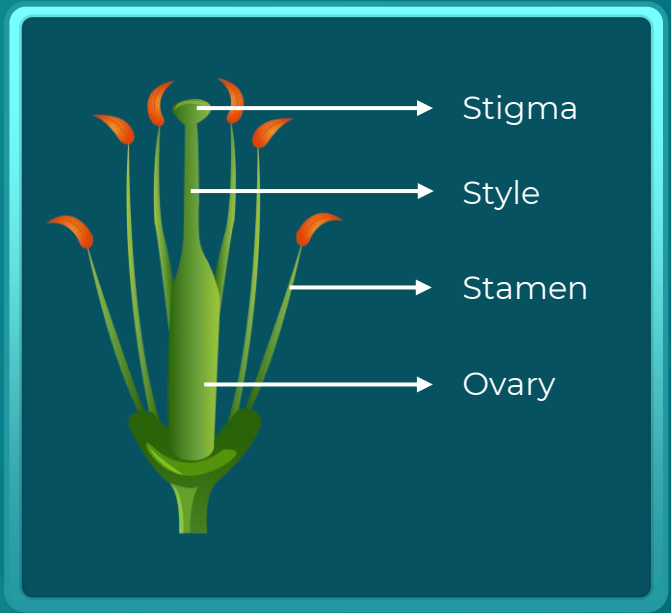
Brassicaceae

- The mustard family
- **Tetradynamous** condition is its unique feature
  - Flower has six stamens that are arranged into two groups.
  - One group has two short stamens.
  - Other group has four long stamens.
- **Bicarpellary, syncarpous, superior ovary**

- Floral formula for Family **Brassicaceae** -

  Ebr. ⊕ or% ⚥ K_{2+2} C_4 A_{2+4} $\underline{G}_{(2)}$
- **Bisexual or Hermaphrodite** (⚥)
- **Actinomorphic**- Radially symmetrical
- Polysepalous (4 sepals)
- Polypetalous (4 petals)

Brassicaceae



Tetradynamous condition

Summary

Root modifications

Tap root

Storage

- Conical roots (Carrot)
- Fusiform roots (Radish)
- Napiform roots (Turnip)
- Tuberous roots (4 o'clock plant)

Respiration

- Pneumatophores (*Rhizophora*)

Adventitious root

Storage

- Sweet potato

Support

- Prop roots (Banyan tree)
- Stilt roots (Maize, sugarcane)

Summary

Venation
(Based on branching)

- Reticulate
- Parallel

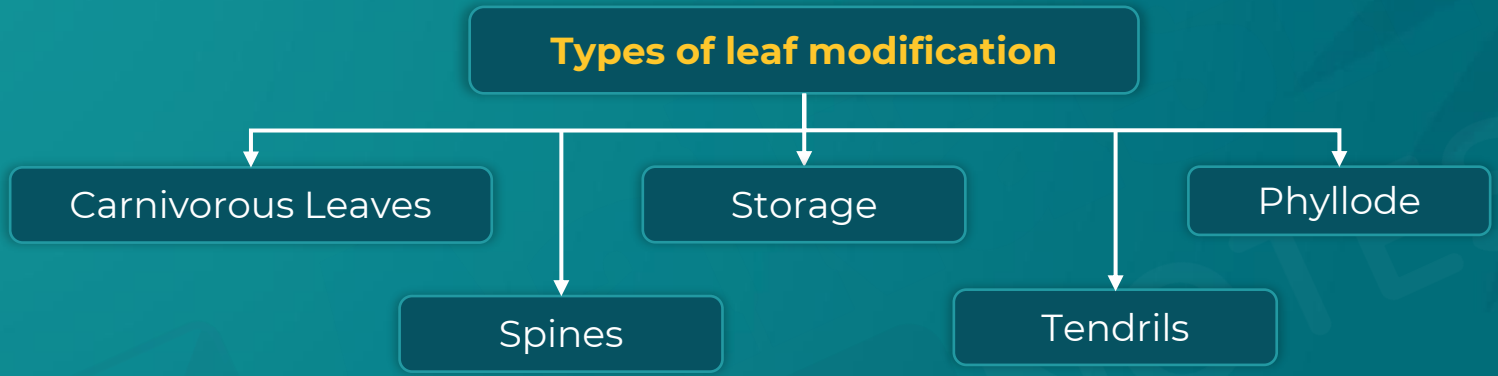
Types of leaves
(Based on the leaf blade)

- Simple
- Compound

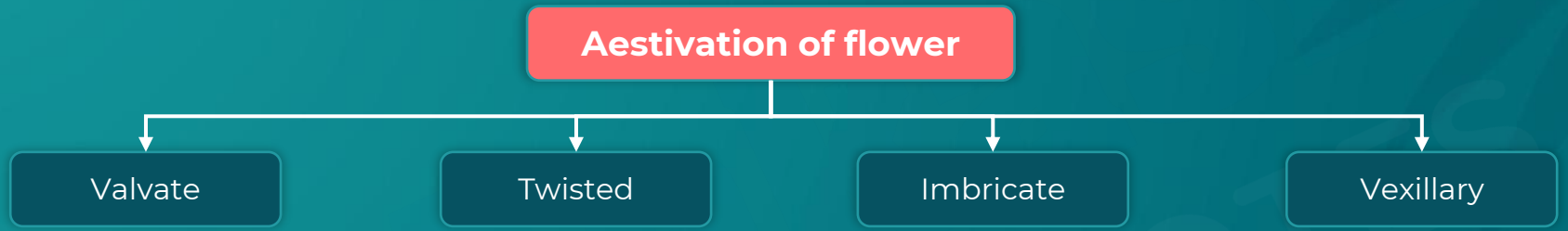
Phyllotaxy

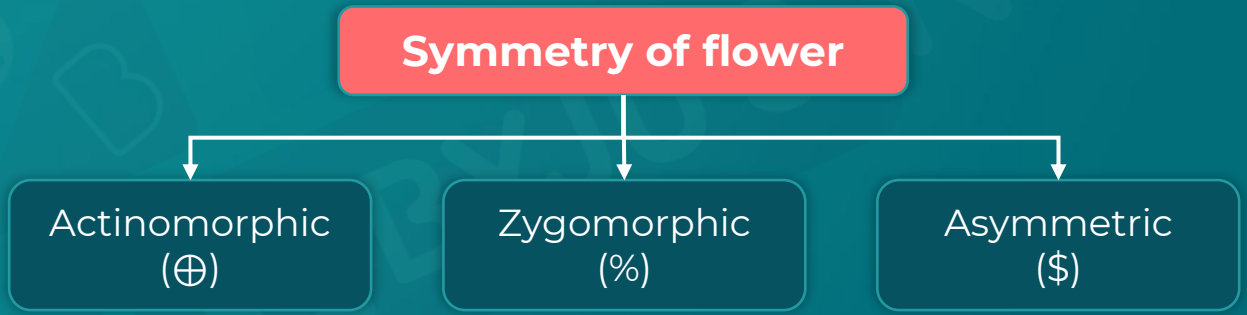
- Alternate
- Opposite
- Whorled

Summary



Summary





Summary

Classification of ovary based on arrangement of ovules

Types	Placentation	Examples
Axile	 Ovules attached to multilocular ovary	Orange, tomato
Marginal	 Ovules attached to ridge-like placenta	Pea
Parietal	 Ovules develop on inner wall of ovary	Cantaloupe
Free-central	 Ovules are borne on the central axis with no septa	Primrose, *Dianthus*
Basal	 Ovules develop at the base of the ovary	Marigold, sunflower

Summary

Dicot seed	Monocot seed
The seed coat is distinct from the fruit wall	The seed coat is completely fused with the pericarp
There are two cotyledons in the seed	There is a single cotyledon in the seed
Endosperm is absent in most of them but present in a few of them	Endosperm is present in most of them and absent in a few of them
There is no protective sheath for radicle and plumule	The radicle is protected by coleorhiza and the plumule is protected by coleoptile

Summary

Floral formula

Representation of the structure of a flower using numbers, letters and various other symbols.

$$\oplus\ \male\ K_{2+2}\ C_{4}\ A_{2+4}\ \underline{G}_{(2)}$$

Floral diagram

Floral diagram is the diagrammatic representation of a flower or a bud.