



Morphology of Plants



→ Root



→ Stem

→ Leaf

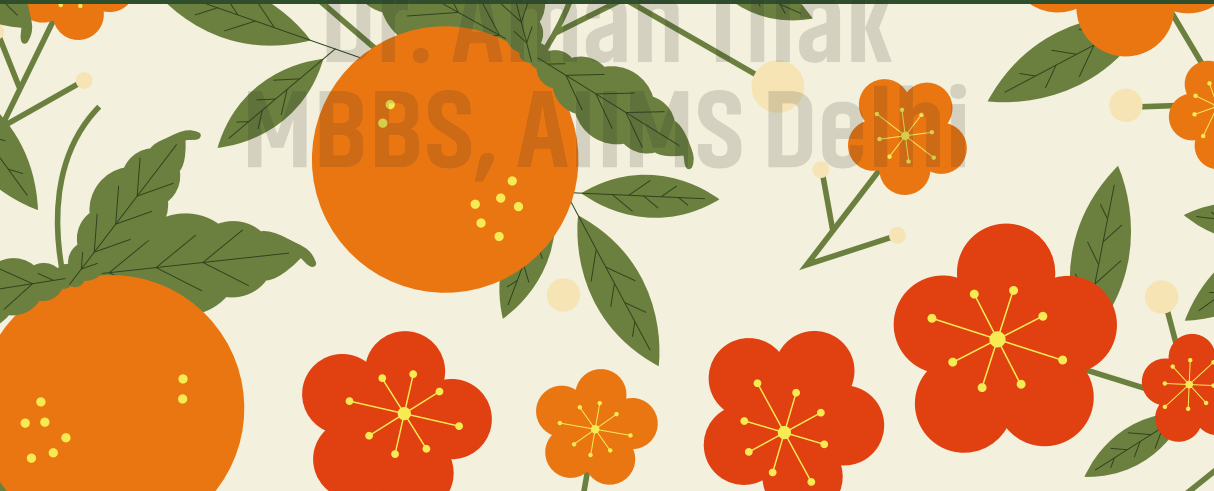
→ Inflorescence

→ Flower

→ Fruit - Seed

→ Families

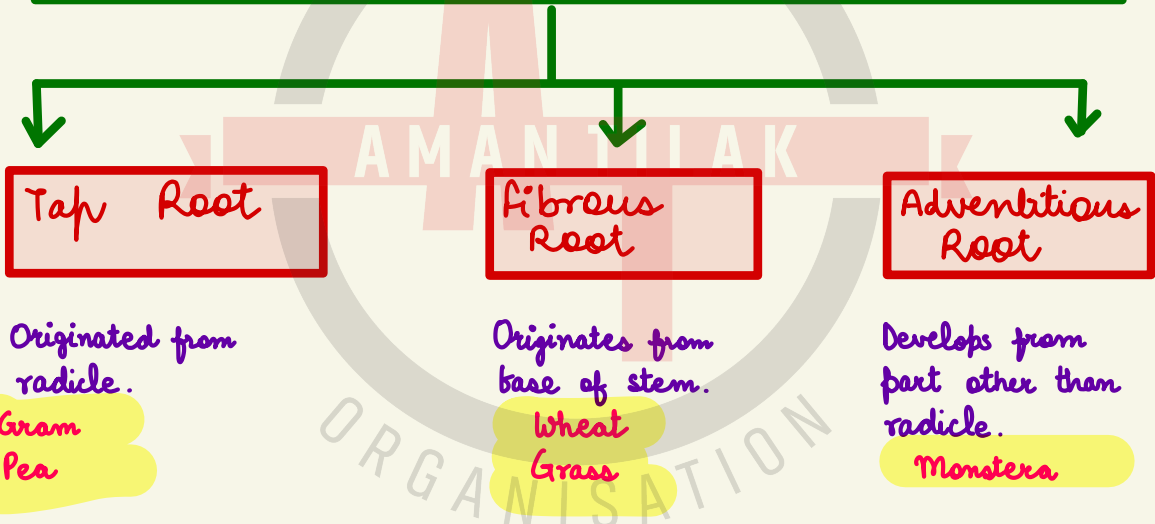
2-3 Q/s



Root

- Underground part of plant
- Develops from radicle

Various types of Root



Functions of Root

- Absorption of water and mineral from soil.
- Anchorage of plant body.
- Store reserve material.
- Synthesis of PGRs (Plant Growth Regulators)

Regions of Root

- 1. Root Cap** : Root covered at apex by thimble-like structure which protects the tip.
- 2. Region of Meristematic activity** : Cells of this region have capability to divide.
 - Cells are small, thin-walled with dense protoplasm.
- 3. Region of elongation** : Cells are elongated & enlarged.
- 4. Region of Maturation** : Region differentiated into mature cells.

Some of the epidermal cells of this region form thread-like root hairs which absorb water & minerals from soil.

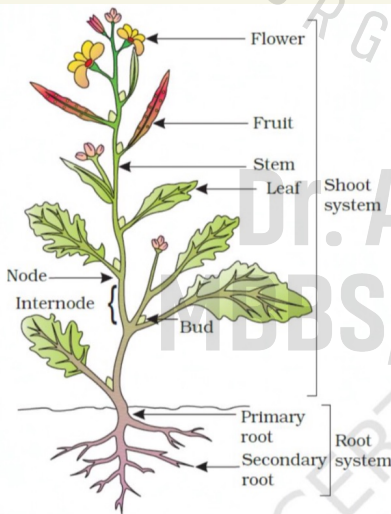


Figure 5.1 Parts of a flowering plant

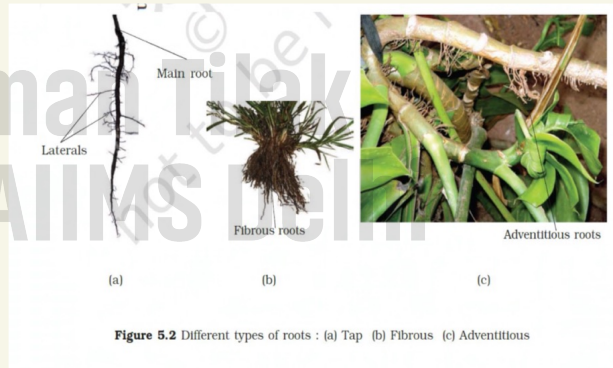


Figure 5.2 Different types of roots : (a) Tap (b) Fibrous (c) Adventitious

Modifications of Root

Modified to store food, support and respiration.

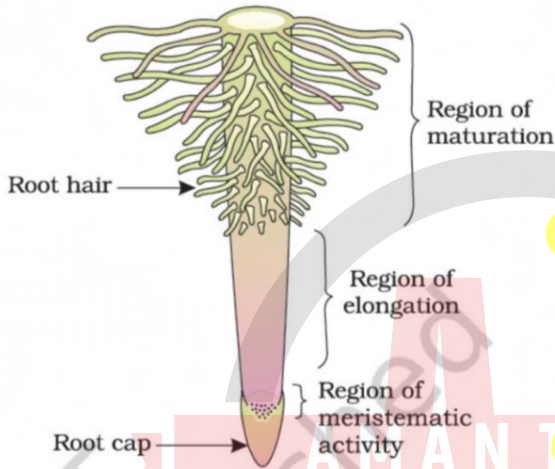


Figure 5.3 The regions of the root-tip

1. For support

Prop roots in Banyan
Stilt roots in Maize
Sugarcane

2. For Respiration

Pneumatophores in Rhizophora

3. For food storage

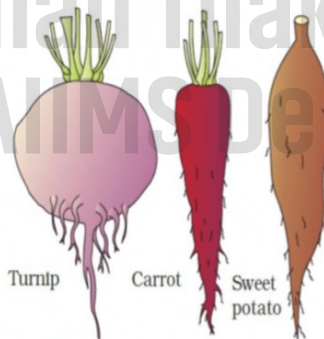
Fusiform (Radish)
Napiform (Turnip)
Conical (Carrot)



Figure 5.4 Modification of root for support: Banyan tree



Asparagus



(a)



(b)

Figure 5.5 Modification of root for: (a) storage (b) respiration: pneumatophore in Rhizophora

STEM

- Aerial part of plant : Develops from plumule.
- Bears nodes , internodes
- Bud present ; Axillary OR Terminal
- main function to spread branches , bear leaves , fruits.

Modifications of Stem

- For food storage , support , protection , assimilation of food and vegetative propagation.

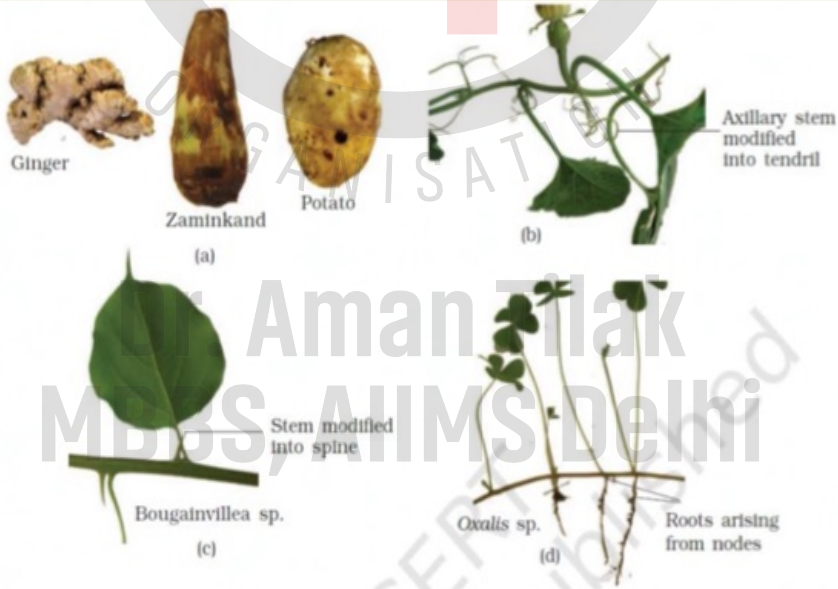


Figure 5.6 Modifications of stem for: (a) storage (b) support (c) protection (d) spread and vegetative propagation

Food storage

Tuber : Potato
Corm : Colocassia

Rhizome : Ginger
Bulb : Onion

Support

Stem tendrils of Watermelon, Grapevine, Cucumber.

For protection

Axillary buds of stems of citrus, Bougainvillea get modified to pointed thorns (protection from animals)

For food Assimilation

Flat stems of Opuntia and cylindrical stem of Euphorbia contain chlorophyll and perform photosynthesis.

For Vegetative Propagn

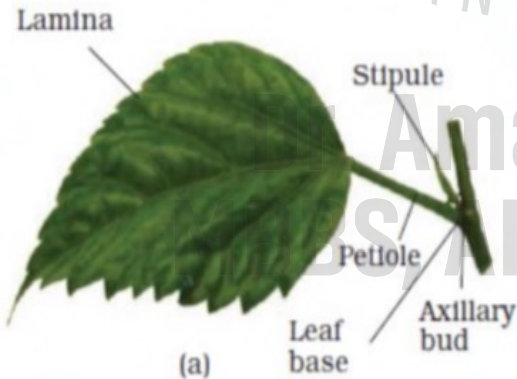
Runner : Grasses (spread to new niches)
Offset : Pistia, Eichhornia (Aquatic Runner) (tuft of roots and rosette of leaves)

- **Sucker** : Pineapple Chrysanthemum Banana
(A slender branch grows vertically for sometime and then touches ground to form new plant)
- **Stolon** : Mint Jasmine
(A branch growing horizontal to soil surface beneath, then arches vertically upward to form new plant)

Leaf

- Developed from shoot apical meristem, flat green structure.
- Manufacture food
- Has -
 - 1) Leaf Base
 - 2) Petiole
 - 3) Lamina

- : Leaf attached to stem by this.
- : Holds the leaf
- : Green expanded part of leaf.



Types of Leaf

• Simple Leaf

When leaf is entire or when incisions; they do not touch midrib

• Compound Leaf

When incisions of lamina reach up to midrib breaking into no. of leaflets.

Bud present in axil of leaf in both simple & compound leaf but not in axil of leaflets.



Figure 5.9 Different types of phyllotaxy :
(a) Alternate (b) Opposite
(c) Whorled

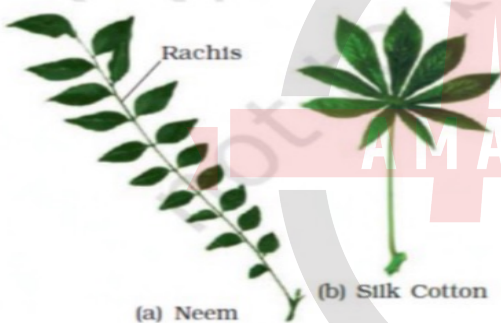


Figure 5.8 Compound leaves :
(a) pinnately compound leaf
(b) palmately compound leaf



Figure 5.7 Structure of a leaf :
(a) Parts of a leaf
(b) Reticulate venation
(c) Parallel venation

- Pinnately compound leaf** : No of leaflets present in a common axis - Rachis. (represents midrib)
- Palmately compound leaf** : Leaflets attached to a common point. (at top of petiole)

Phyllotaxy

Arrangement of leaves on stem of branch.

- Alternate** : single leaf arises from each node
China Rose Sunflower.

2) Opposite : pair of leaves at each node and lie opposite to each other.
Calotropis
Guava

3) Whorled : More than 2 leaves arise at node & form whorl.
Alstonia

Modifications of leaf

Leaves modified to perform functions other than photosynthesis.

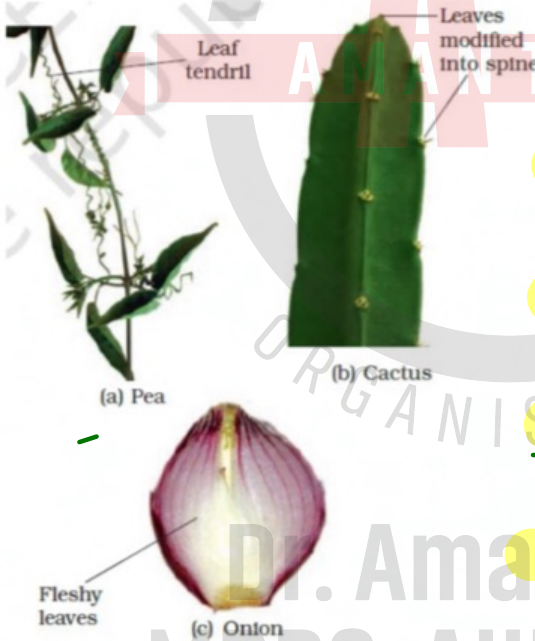


Figure 5.10 Modifications of leaf for :
(a) support: tendril (b) protection: spines (c) storage: fleshy leaves

- **Tendrils**
for climbing in Peas.

- **Spines**
in Cacti

- **Food storage**
Fleshy leaves of Onion

- **Insectivorous plants**
Venus fly trap
Pitcher plant

- **Petiole expands to perform photosynthesis** where leaves are short lived.
Australian acacia

Infloroscence



Figure 5.11 Racemose inflorescence



Figure 5.12 Cymose inflorescence

- Arrangement of flowers on floral axis of stem.
- Flower is a modified shoot.
 - Apical meristem changes to floral meristem.
 - Internodes do not elongate and axis gets condensed.
 - Apex produces different kinds of floral appendages laterally at successive nodes.

1. **Racemose Infloroscence** : Main axis continues to divide
- Flowers borne in acropetal succession.

Radish

2. **Cymose Infloroscence** : Main axis terminates in flower.
- Flowers borne in basipetal order.

Solanum

Flower

- It has 4 different whorls arranged swollen end of stalk or Pedicel called Thalamus OR Receptacle.

The 4 whorls are :

Calyx
Corolla

(Accessory organs)

Androecium
Gynoecium

(Reproductive organs)

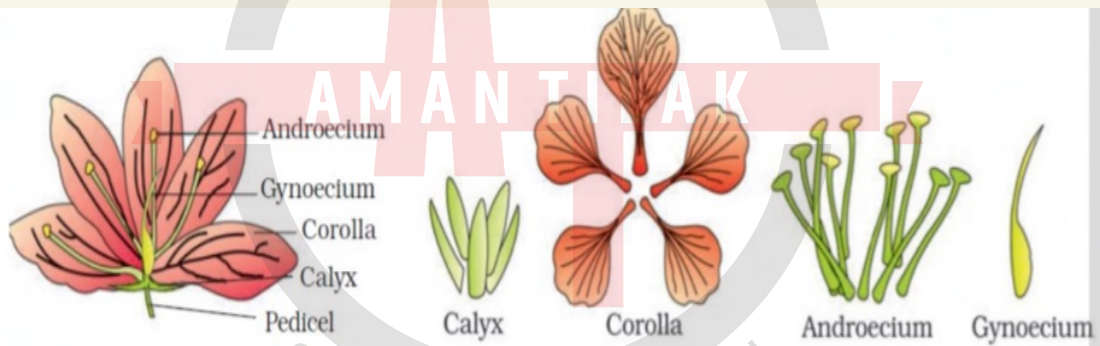


Figure 5.14 Parts of a flower

- Lily : Calyx and Corolla not distinct. (Perianth)

Bisexual flowers : Flower having both androecium and gynoecium.

Unisexual flowers : Flower having either gynoecium or androecium.

Symmetry

• **Actinomorphic** : Radially symmetry
Mustard chilli
Datura

• **Zygomorphic** : Bilateral symmetry
Pea Bean
Gulmohar Cassia

• **Asymmetric** : Irregular
Lanna

Based on position - flower description

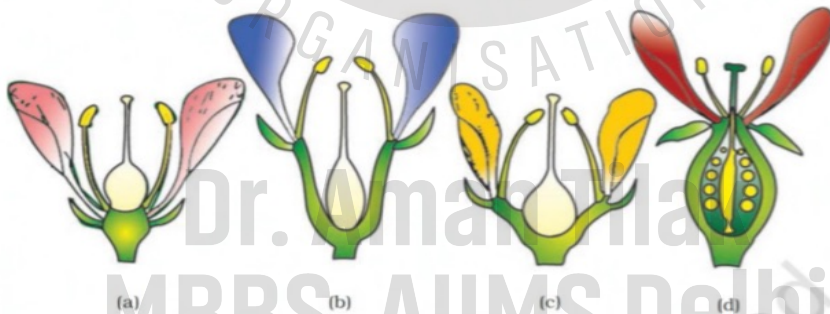


Figure 5.13 Position of floral parts on thalamus : (a) Hypogynous (b) and (c) Perigynous (d) Epigynous

• **Hypogynous flowers** : Gynoecium occupies highest position while other parts situated below it.
Mustard Brinjal
China Rose (superior ovary)

• **Perigynous flower** : Gynoecium and other parts located on rim of thalamus at same level.
 Plum Peach (ovary half inferior)
 Rose

• **Epigynous flower** : Thalamus encloses ovary whole whorl rises above ovary
 Guava (inferior ovary)
 Cucumber
 Ray florets of sunflower

Aestivation

Arrangement of sepals OR petals in floral bud wrt other members of same whorl.



Figure 5.15 Types of aestivation in corolla : (a) Valvate (b) Twisted (c) Imbricate (d) Vexillary

• **Valvate** : sepals or petals touch at margin.
 Calotropis

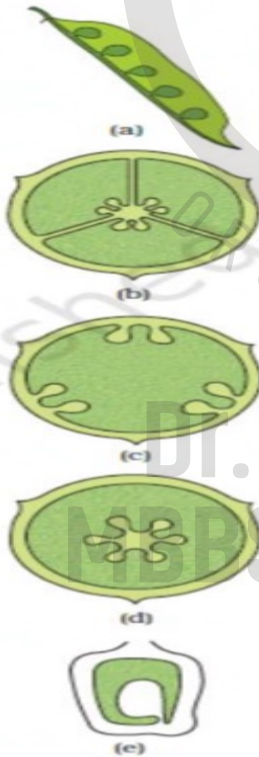
• **Twisted** : one margin overlaps next one
 China Rose

• **Imbricate** : Margin overlaps but not in particular direction
Cassia
Gulmohar

• **Vexillary** : Large petal (standard) overlaps lateral petals (wings) which in turn overlap two smallest anterior petals (keel)
Fabaceae family (Pea, Bean)

Placentation

Arrangement of ovules within ovary.



• **Marginal** : Placenta forms ridge along ventral suture of ovary.
Pea

• **Axile** : Margins of carpels fuse to form central axis
Tomato Lemon

• **Parietal** : Ovules develop on inner wall of ovary (septa: REPLUM)
Mustard Argemone

• **Free Central** : Ovules borne on central axis, lacking septa.
Dianthus Primrose

• **Basal** : Placenta develops at base of ovary.
Sunflower

Figure 5.16 Types of placentation :
(a) Marginal
(b) Axile
(c) Parietal
(d) Free central
(e) Basal

The Fruit

- Ripened or matured ovary after fertilisation
- Parthenocarpic fruits develop without fertilisation.
- Generally consists of Pericarp (fruit wall)
Pericarp may be dry or fleshy.
Differentiated into :
 - 1) Outer epicarp.
 - 2) Middle mesocarp.
 - 3) Inner endocarp.
- Monocarpellary superior ovary developed fruit is 1 seeded.
- Can be said as Drupe in Mango & Coconut.

Edible part of Mango : Mesocarp
Mesocarp of Coconut : fibrous.

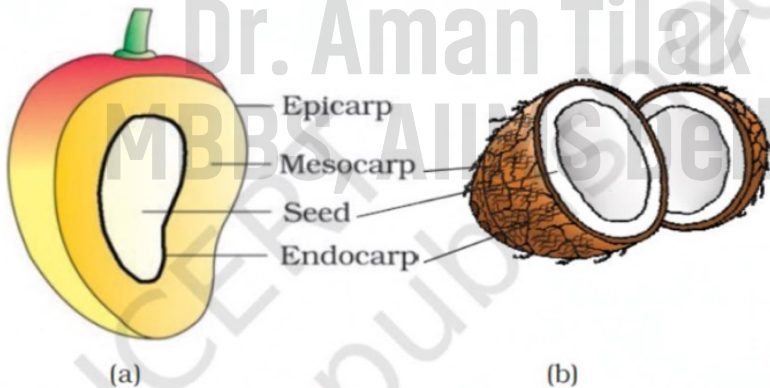


Figure 5.17 Parts of a fruit : (a) Mango (b) Coconut

The Seed

After fertilisation : ovule develops into seed.

- Made of seed coat and embryo.

Embryo made up of :

A radicle

Embryonal axis

1-2 cotyledons

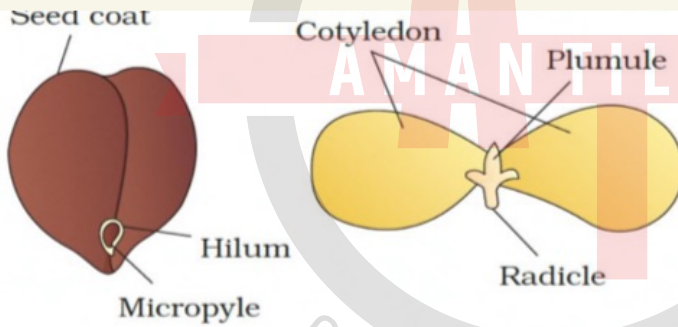


Figure 5.18 Structure of dicotyledonous seed

Dicot seed -

- Seed coat : outer testa
: inner tegmen
- 2 cotyledons - fleshy
- Endospermic seeds -
CASTOR
- Non Endospermic seed -
Bean
Pea
Gram

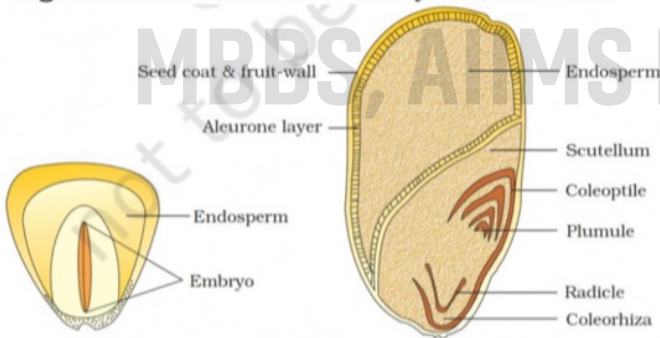


Figure 5.19 Structure of a monocotyledonous seed

Monocot seed -

Generally Endospermic
except ORCHIDS.

- 1 large shield shaped
cotyledon : SCUTELLUM
- Plumule covered by
coleoptile and
radicle Covered by
coleorrhiza.

Families

Symbols :

Br : Bracteate

K : Calyx

C : Corolla

P : Perianth

A : Androecium

G : Gynoecium

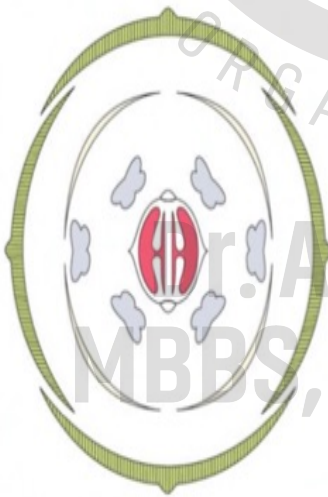
$\underline{G}$: inferior ovary $\overline{G}$: superior ovary

σ : Bisexual

% : Zygomorphic

$\oplus$: Actinomorphic

- Position of mother axis wrt flower is represented by DOT on top of floral diagram.



$\oplus \sigma K_{2+2} C_4 A_{2+4} \overline{G}_{(2)}$

Figure 5.20 Floral diagram with floral formula

(Brassicaceae)

Mustard family :

Radish
Turnip

FABACEAE

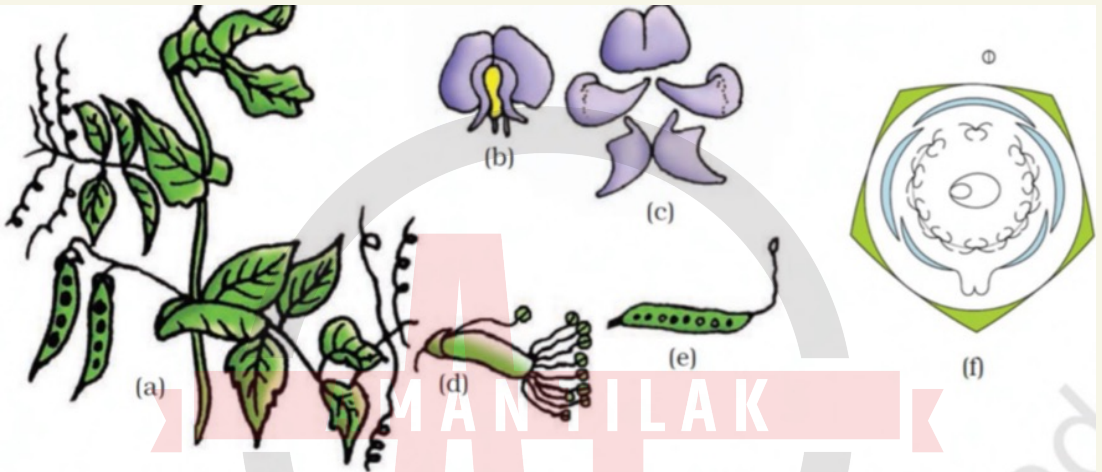


Figure 5.21 *Pisum sativum* (pea) plant : (a) Flowering twig (b) Flower (c) Petals (d) Reproductive parts (e) L.S. carpel (f) Floral diagram

Floral formula : $\frac{\% \text{ } \uparrow}{\text{ } \downarrow} K(5) C_{1+2+(2)} A_{(9)+1} \underline{G}_1$

- Diadelphous condition
- Vexillary aestivation of corolla

Examples :

Pulses (Gram, Moong)
 Oil (Soyabean, Groundnut)
 Dye (Indigo)
 Fibres (Sunhemp)
 Fodder (Sesbania, Trifolium)
 Ornamental (Lupin, Sweet pea)
 Medicine (Muliathu)

SOLANACEAE

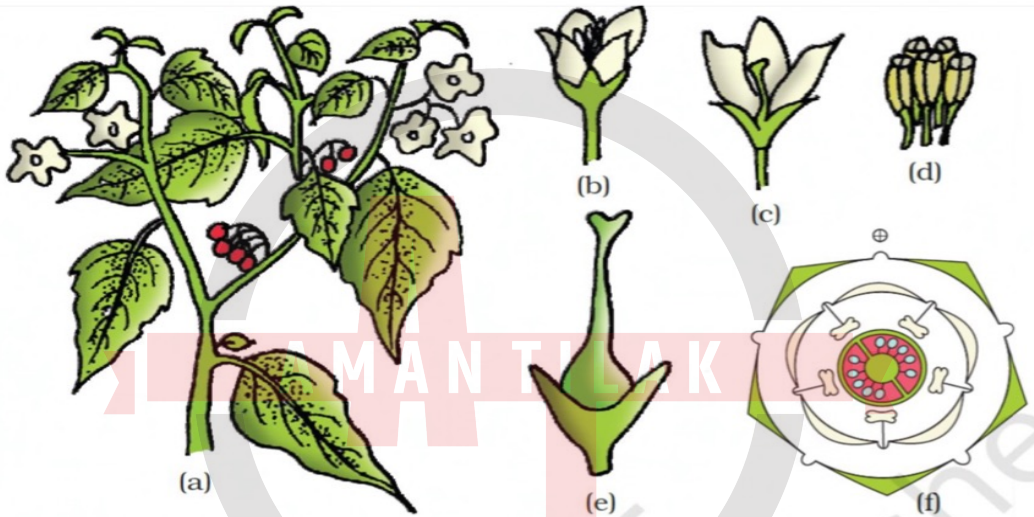


Figure 5.22 *Solanum nigrum* (makoi) plant : (a) Flowering twig (b) Flower (c) L.S. of flower (d) Stamens (e) Carpel (f) Floral diagram

Floral formula : $\oplus \quad \text{♀} \quad K_{(5)} \quad C_{(5)} \quad A_5 \quad \underline{G_{(2)}}$

- cymose inflorescence
- Swollen placenta

Examples :

Food (Tomato, Brinjal, Potato)
 Spice (chilli)
 Medicine (Belladonna, Ashwagandha)
 Fumigatory (Tobacco)
 Ornamentals (Petunia)

LILIACEAE

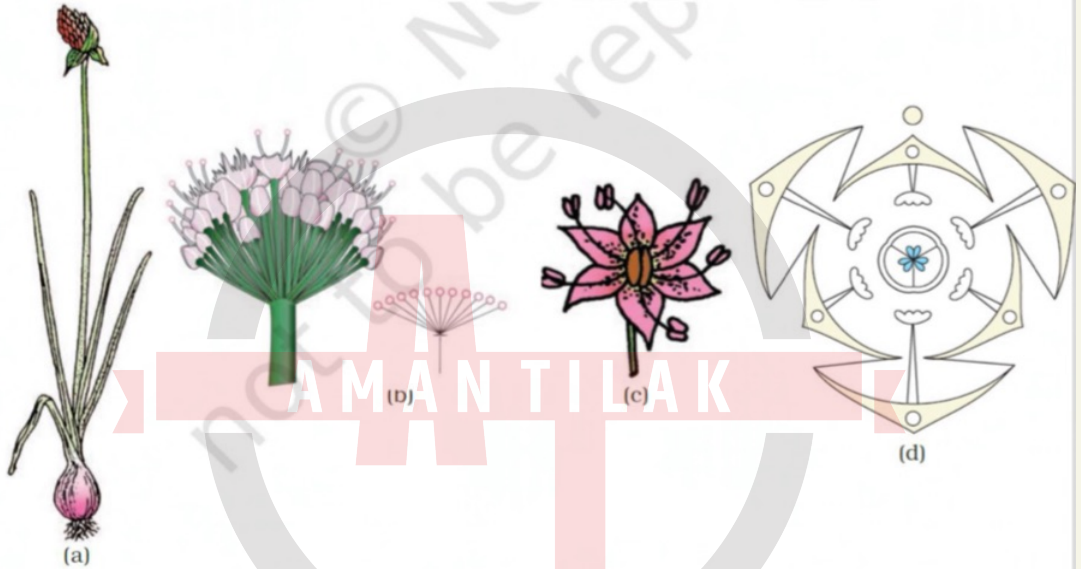


Figure 5.23 *Allium cepa* (onion) plant : (a) Plant (b) Inflorescence (c) Flower (d) Floral diagram

Floral formula : $\oplus \quad \text{♀} \quad P_{(3+3)} \quad A_{3+3} \quad \underline{G}_{(3)}$

Umbellate crystals
Tepals (3+3) united into tube.

Examples :
Ornamentals (Tulip, Gloriosa)
Medicine (Aloe)
Vegetables (Asparagus)
Colchicine

PREVIOUS YRS IMP1

Placentation in which ovules develop on the inner wall of the ovary or in peripheral part, is (NEET-2019)

- A Axile
- B Parietal
- C Free central
- D Basal

The correct answer is 'B'

WHY OPTION 'A' IS WRONG

- Option (1) : When the placenta is axial and ovules are attached to it in a multilocular ovary, the placentation is axile.

How many plants among *Indigofera*, *Sesbania*, *Salvia*, *Allium*, *Aloe*, mustard, groundnut, radish, gram and turnip have stamens with different lengths in their flowers? [NEET(Phase-2)2016]

- A Three
- B Four
- C Five
- D Six

ANSWER AND EXPLANATION

Flower having unequal length of stamens is of two types:

1. Didynamous : *Salvia*-Two short and two long stamens
2. Tetradynamous : Brassicaceae family which involves two short and four long stamens e.g. Mustard, Radish, Turnip

Indigofera, *Sesbania*, Groundnut, Gram belong to Papilionaceae family that shows Monadelphous condition.

Allium and *Aloe* belong to Liliaceae family that shows Epiphyllous condition.

Among china rose, mustard, brinjal, potato, guava, cucumber, onion and tulip, how many plants have superior ovary? (Re-

AIPMT-2015)

A Four

B Five

C Six

D Three

ANSWER AND EXPLANATION

Superior ovary is found in hypogynous flowers such that ovary occupies highest position while other parts are situated below it. e.g. Mustard, China rose, Brinjal.

Also, potato belonging to Solanaceae show superior ovary. Onion and Tulip belonging to Liliaceae show superior ovary. Hence, 6 out of 8 examples given in question show superior ovary. Guava and Cucumber have epigynous flower with inferior ovary.

Among bittergourd, mustard, brinjal, pumpkin, china rose, lupin, cucumber, sunnhemp, gram, guava, bean, chilli, plum, *Petunia*, tomato, rose, *Withania*, potato, onion, Aloe, and Tulip how many plants have hypogynous flower? (NEET-2013)

A Ten

B Fifteen

C Eighteen

D Six

ANSWER AND EXPLANATION

Superior ovary is found in hypogynous flowers such that ovary occupies highest position while other parts are situated below it. e.g. Mustard, China rose, Brinjal (as mentioned on Page 73: class XI NCERT 2018-19).

Also, Potato, Chilli, *Petunia*, Tomato, *Withania* (Ashwagandha) belonging to Solanaceae show superior ovary.

Aloe, Lupin, Onion and Tulip belonging to Liliaceae show superior ovary.

Sunnhemp, Gram and Bean belonging to Fabaceae show superior ovary.

Hence, 15 out of 21 plants mentioned have hypogynous flower with superior ovary.

Guava, Cucumber, Pumpkin and Bittergourd have epigynous flower with inferior ovary.

Rose and Plum have perigynous flower with half inferior ovary.