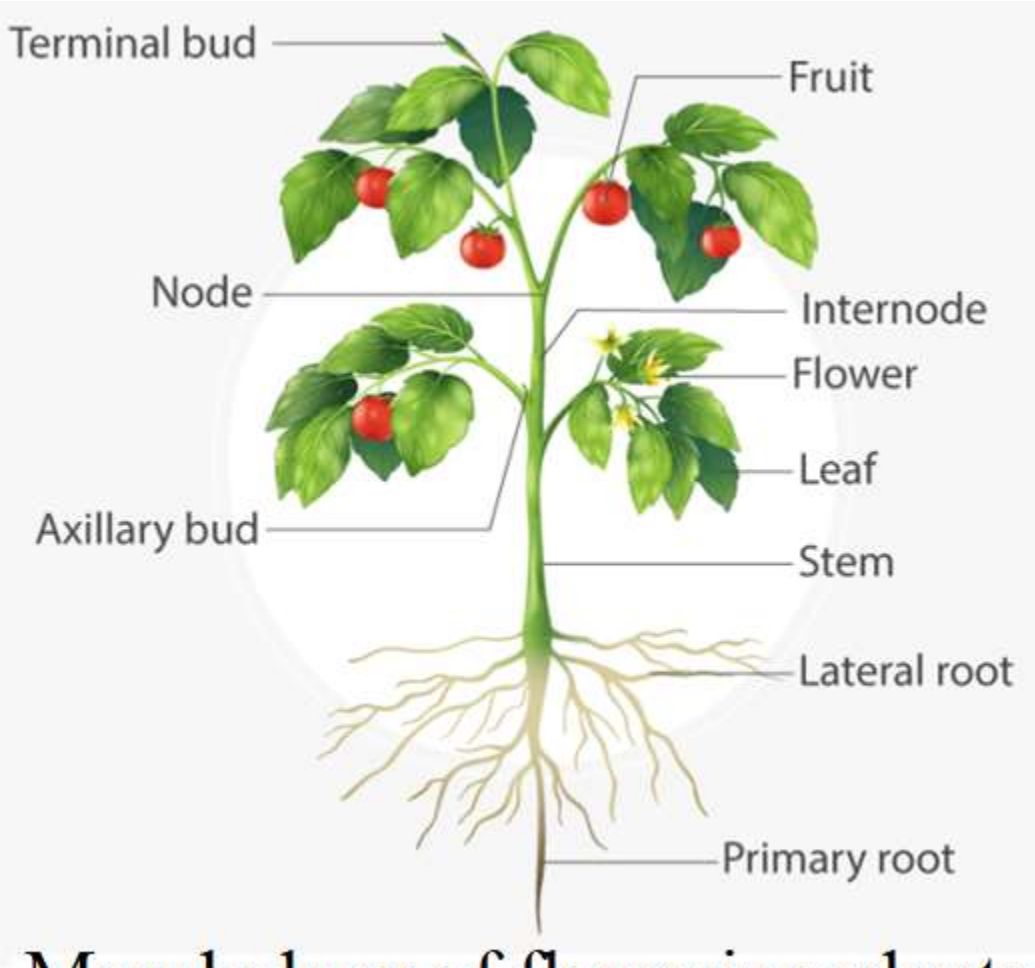
BIOLOGY

MORPHOLOGY OF FLOWERING PLANTS

Morphology

Morphology is the branch of biological science that deals with the study of form, size, colour, structure and relative position of various parts of organisms.



Morphology of flowering plants

Morphology Flowering Plants

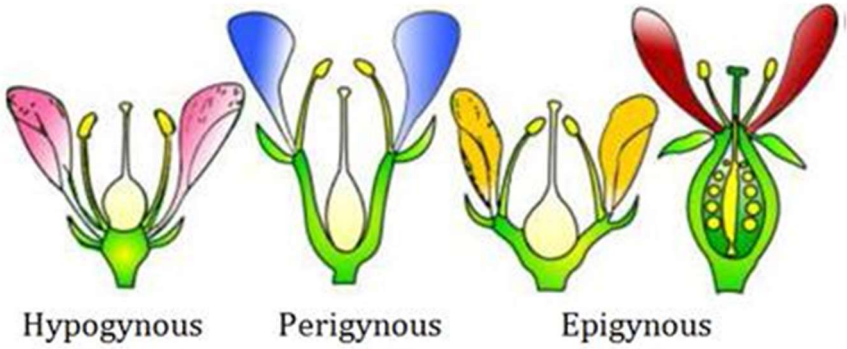
The plant body consists of a main axis, which may be branched or unbranched bearing lateral appendages.

The flower

1. Flower is the reproductive part of angiospermic plants for sexual means of reproduction.
2. A typical flower has four whorls arranged on a swollen end of stalk or pedicel called thalamus. They are Calyx, Corolla, Androecium and Gynoecium.

3. When a flower has both androecium and gynoecium, the flower is called bisexual and flower having either androecium or gynoecium only is called unisexual.
4. When flower can be divided into two equal radial halves in any radii passing through center the symmetry of flower is called actinomorphic (radial symmetry) as in Mustard, Datura, and Chili.
5. When flower can be divided into two similar parts only in one vertical plane it is zygomorphic as in Pea, Gulmohar, Cassia etc.
6. When Floral appendages are in multiple of 3, 4 or 5 they are called trimerous, tetramerous and pentamerous respectively. Flower with bracts are called bracteates and without it ebracteate.

Based on the position of ovary with respect to other floral part on thalamus, flowers are of following types:



- **Hypogynous flower:** Ovary occupies the highest position. The ovary in such case is called superior. E.g., Mustard, brinjal and china rose.
- **Perigynous flowers:** If the gynoecium is situated at the center and other parts are on the rim at same height. Ovary is called half-inferior.
- **Epigynous flowers:** The margin of thalamus grows to completely cover the ovary. Ovary is said to be inferior.

Calyx

Calyx is the outermost whorl of the flower; its members are called sepals. They are generally green and leafy; protect the flower in bud stage. It may be gamosepalous (sepals united) or polysepalous (sepals free).

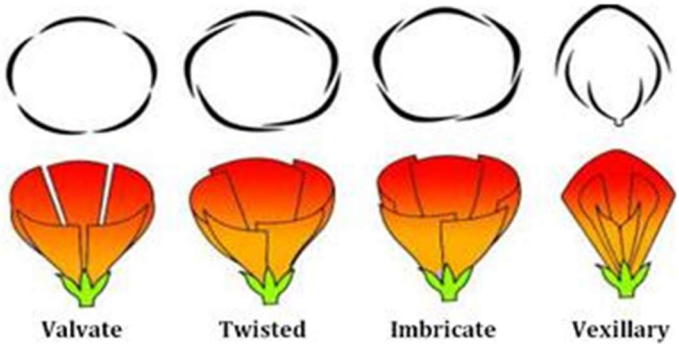
Corolla

consists of petals, brightly colored to attract the insects for pollination. They may be gamopetalous or polypetalous.

- The mode of arrangement of sepals or petals in floral bud with respect to the other

members of same whorl is called aestivation. In valvate, the whorls of sepals or petals touch each other as in Calotropis. In Twisted aestivation, the whorls overlap each other as in China rose.

- In Imbricate aestivation, margin overlap each other but not in particular fashion as in Gulmohur.
- In pea and bean flowers, there are five petals- the largest (standard) overlaps the two lateral petals (wings) which in turn overlap two smallest anterior petals (keel). This type of aestivation is known as vexillary or papilionaceous.

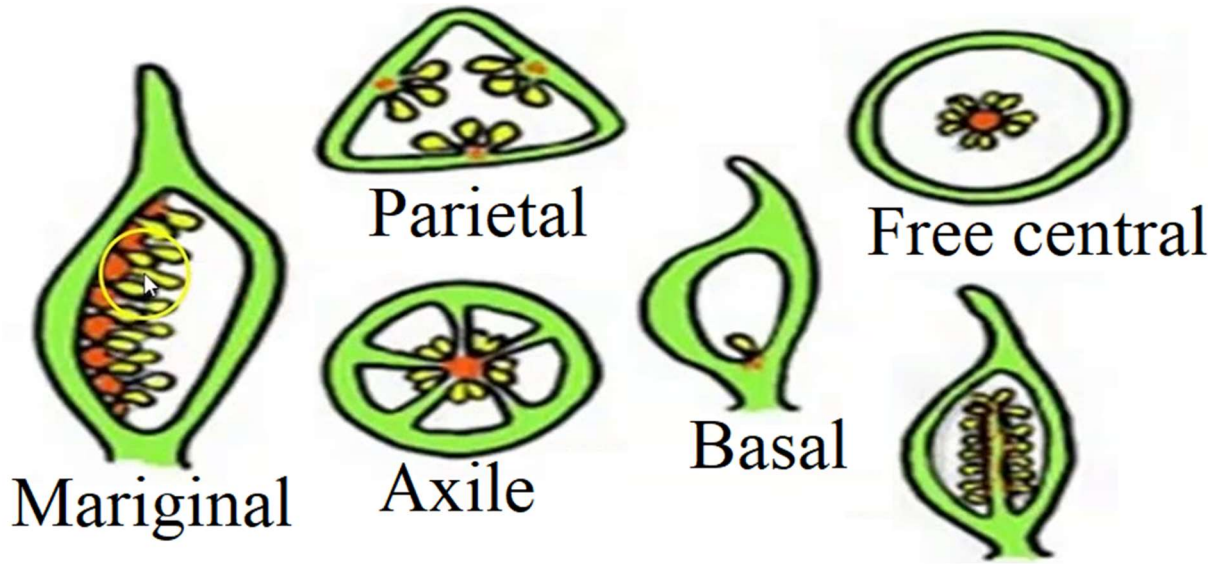


The Androecium

- Androecium represent the male reproductive parts of flower, consists of stamens. Each stamen consists of filament and anther. Pollen grains are produced in pollen sac. Sterile stamen is called Stemenode.
- When stamens are attached with petals it is called epipetalous (Brinjal). Stamen may be free (polyandrous) or may be united in one bundle (monoadelphous), two bundles (diadelphous), more than two (polyadelphous).

Placentation

The arrangement of ovules within the ovary is called placentation.



The Gynoecium

- Female reproductive part of flower consists of one or more carpels. Each carpel is made up of stigma style and ovary.
- When more than one carpel is present, it may be free (apocarpous) as in lotus and rose or fused together (syncarpous) as in mustard and tomato.
- After fertilization, ovules change into seeds and ovary mature into fruits.

Flowers can either be:

- Complete
- Incomplete

A complete flower is the one that consists of sepals, petals, stamens and pistil. On the contrary, an incomplete flower is the one that lacks one or more of these structures.

A complete flower consists of two different parts

- Vegetative Part
- Reproductive Part

Vegetative Parts of a Flower

Petals: This is a bright-colored part that attracts bees, insects, and birds. Color of petals varies from plant to plant; some are bright while some are pale colored. Thus, petals help us to differentiate one flower from another.

Sepals: Sepal is the green-colored part beneath the petals to protect rising buds. Some flowers have fused petals-sepals while a few have separated petals-sepals.

Reproductive Parts of a Flower

Stamen: This is the male reproductive organ and is also known as Androecium. It consists of two parts namely: anther and filaments. the anther is a yellowish, sac-like structure, involved in producing and storing the pollens the filament is a slender, threadlike object, which functions by supporting the anther.

Pistil: This is the innermost part and the female reproductive organ of a flower which comprises three parts -stigma, style and ovary. This is collectively known as the pistil.

1. **Stigma:** It is the topmost part or receptive tip of carpels in the gynoecium of a flower.
2. **Style:** It is the long tube-like slender stalk that connects stigma and the ovary.
3. **Ovary:** It is the ductless reproductive gland that holds a lot of ovules. It is the part of the plant where the seed formation takes place.

Carpels: The carpel is the fourth whorl of the flower present in the center. The carpels contain the pistil, the female reproductive part of the flower. It comprises the ovary, style, and stigma. The egg or the ovule is present in the ovary. After fertilization, sometimes the ovary turns into the fruit to keep the seed. At the top of the ovary is a vertical structure called style that supports the stigma. The dispersed pollens stick to the stigma and travel down to the ovary through the style.

Functions Of Flower

1. Gametophytes develop in the flowers.
2. The flowers can produce diaspores without fertilization.
3. After fertilization, the ovary of the flower develops into a fruit containing a seed.
4. The most important function of flowers is reproduction. They help in the union of male and female gametes.
5. Flowers provide nectar to certain birds and insects, which in turn help in the transfer of pollen from one flower to the other.
6. Flowers may promote selfing, i.e., the union of sperms and eggs from the same flower, or cross-fertilization, i.e., the union of sperms and eggs from different flowers.

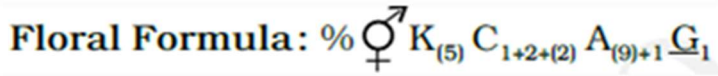
Semi -Technical description of a typical flowering plant

The plant is described beginning with its habit, vegetative characters – roots, stem and leaves and then floral characters inflorescence and flower parts.

The floral formula is represented by some symbols. In the floral formula, Br stands for bracteate K stands for calyx, C for corolla, P for perianth, A for androecium and G for Gynoecium. Fusion is indicated by enclosing the figure within bracket and adhesion by a line drawn above the symbols of the floral parts.

Family Fabaceae

This family was earlier known as Papilionoideae. Herbs, shrubs or tree root with root nodules. Pinnately compound leaves with reticulate venation.



Economic importance

Plants belonging to this family are sources of pulses like Gram, Arhar, Bean. Pea etc. and edible oils like groundnut, soybean, etc.

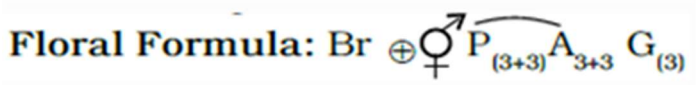
Family Solanaceae

Plant body herbs or shrubs, rarely small trees, commonly known as potato family. Leaves simple or pinnately compound. Reticulate venation.

Many of them are source of food (potato, tomato, Brinjal etc.), spices (Chilli) etc.

Family Liliaceae

- Commonly known as Lily family. Monocots, perennial herbs. Leaves alternate with parallel venation.
- Underground bulbs, corms or rhizomes.
- Flower bisexual, actinomorphic, sepals and petals are absent, having perianth.



It includes ornamental plants (Tulip), Medicine (aloe) and vegetable (colchicine).

Pollination

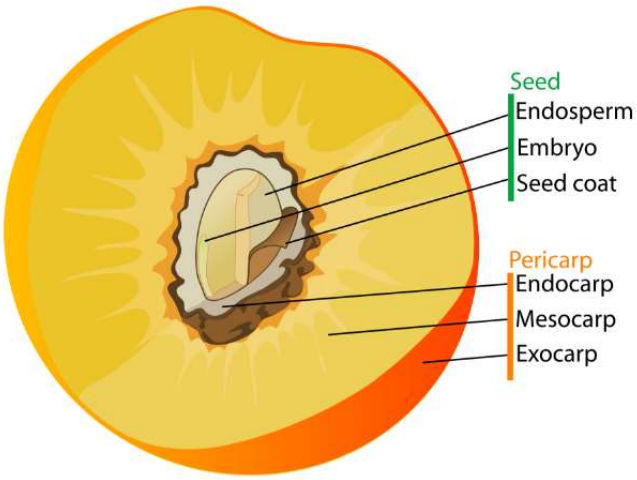
Pollination is the process in which the pollens are transferred from anther to stigma. The process of pollination can occur through a different medium.

The fruit

Mature and ripened ovary developed after fertilisation is fruit. If a fruit is formed without fertilisation of ovary it is called parthenocarpic fruit.

Fruit consists of seeds and pericarp. Thick and fleshy pericarp is three layered called epicarp,

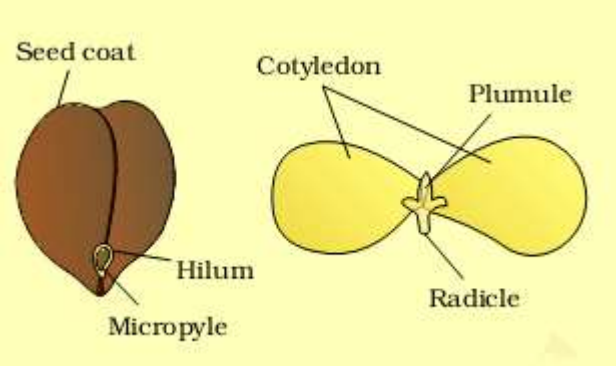
mesocarp



Dicotyledonous Seeds

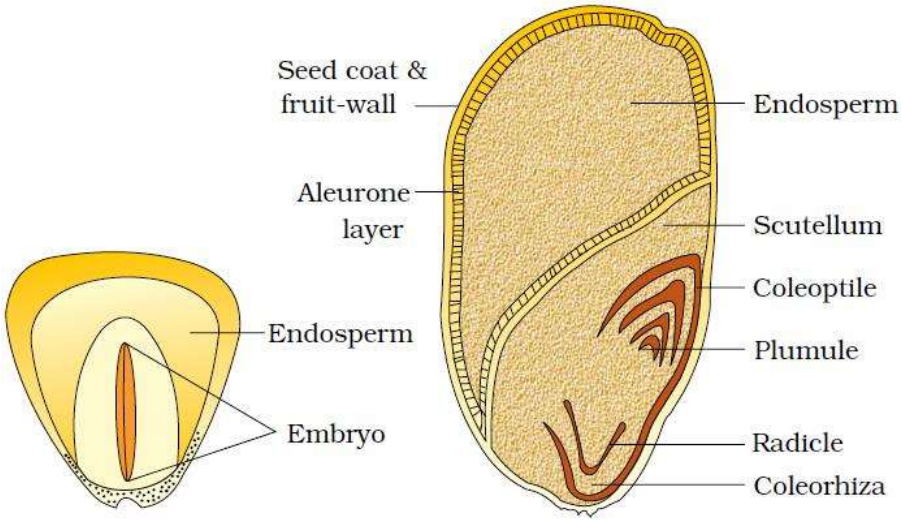
Dicotyledonous Seed is made up of a seed coat and an embryo. Embryo is made up of embryonal axis, radicle and cotyledons.

Seed coat has two layers outer testa and inner tegmen. Hilum is scar through which seed is attached to the ovary. Small pore above the hilum is called micropyle.



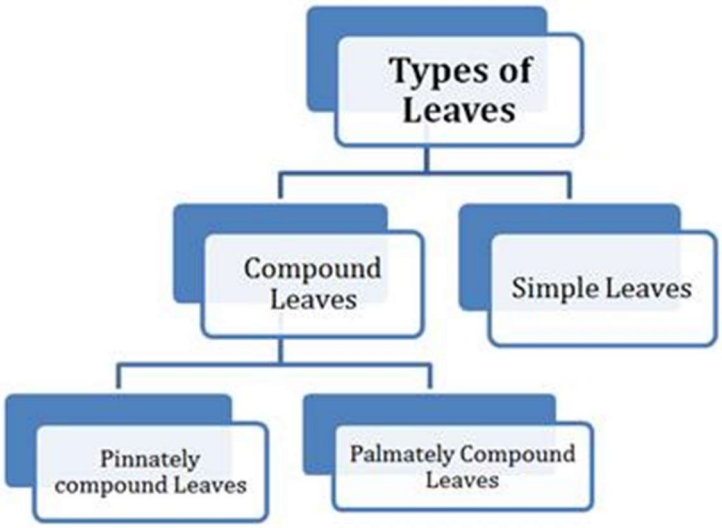
Monocotyledonous seeds

In monocotyledonous seed, outer covering of endosperm separate the embryo by a proteinous layer called aleurone layer. Single cotyledon is called as scutellum having a short axis bearing Plumule and radicle. Plumule and radicle are closed inside sheaths called as coleoptile and coleorhiza respectively.



The Leaf

Leaves originate from shoot apical meristem and are arranged in an acropetal order a typical leaf consists of three parts - Leaf base, Petiole, Lamina. Leaf is attached with stem by Leaf Base which may bear two small leaf like structure called stipule.



Simple Leaves

A leaf having a single or undivided lamina is called Simple leaf. The incisions do not touch the mid rib. Example- Mango, Guava etc.

Compound leaves

When the incision of lamina reach up to the midrib and breaking it into a number of leaflets, it is called Compound leaves.

Pinnately compound leaves: In a Pinnately compound leaves, a number of leaflets are present

on common axis called rachis. Example- Neem.

Palmately compound leaves: In Palmately compound leaves, the leaflets are attached at common point. Example- Silk cotton.

Venation

The arrangement of veins and veinlets in the lamina of leaf.

Types of Venation:

Reticulate Venation: Veinlets form a network as in leaves of dicotyledonous plants (China rose, peepal).

Parallel Venation: Veins are parallel to each other as in leaves of monocotyledonous plants (grass, maize, sugarcane).

The Stem

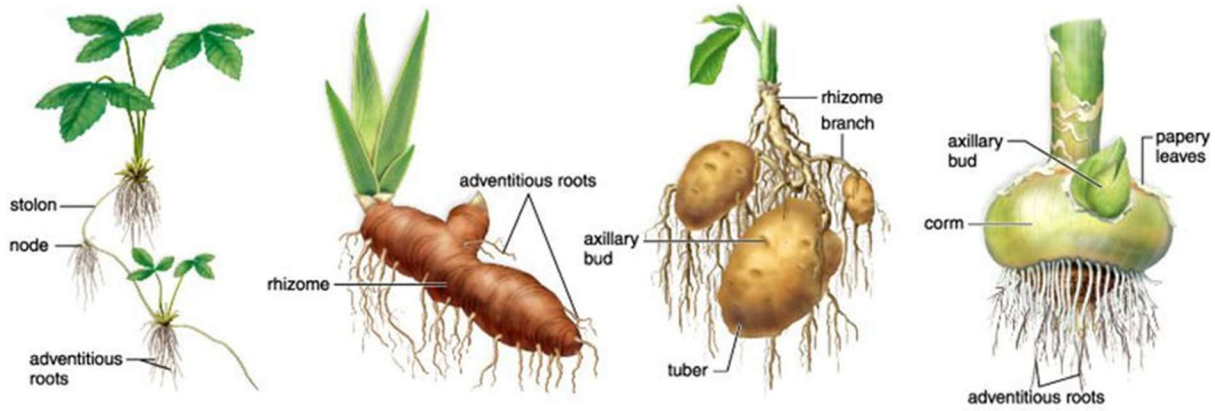
Stem is the aerial part of the plant and develops from plumule of the embryo. It bears nodes and internodes.

Functions of stem:

Exposure of leaves, conduction of water and minerals, translocation of food, exposure of flowers and fruits.

Modification of stems:

- Underground stem of potato, ginger and turmeric are modified to store food. They also act as organ of perennation in unfavorable conditions.
- Stem tendril help plants to climb as in cucumber, pumpkins, and grapes.
- Axillary buds of stem may modify into woody, straight and pointed thorns as in Citrus and Bougainvillea.
- Plants of arid regions modify their stem to flatted (Opuntia), fleshy cylindrical (Euphorbia) having chlorophyll for photosynthesis.



The Root

In plants, root is the non-green (due to absence of chlorophyll), cylindrical and descending part that normally grows downwards into the soil. It does not bear leaves, buds and not distinguished into nodes and inter nodes.

Functions of Roots:

The major functions of roots are as follows:

- Fixation Root provides fixation to the plants with soil.
- Absorption Roots absorb water and minerals from the soil and provide it to all parts of the body.
- Storage Roots of many plants store food for the use of other plant parts and for animals.
- Aeration Plants growing in waterlogged soil or marshy areas have special roots, i.e., pneumatophores for respiration.
- Conduction Roots transport water and minerals in upward direction for the uses of stems and leaves.

The main axis is divided into two parts:

- **Root system:** The underground root system develops from the radicle embryo and helps in fixation of the plant as well as absorption of water and minerals.
- **Shoot system:** The shoot system is the aerial part of the plant, which is found above the root and ground level. The shoot system includes the stem, leaves, bud, flower, fruits and the seeds. Shoot system is one of the important systems of a plant.

Main functions of root system:

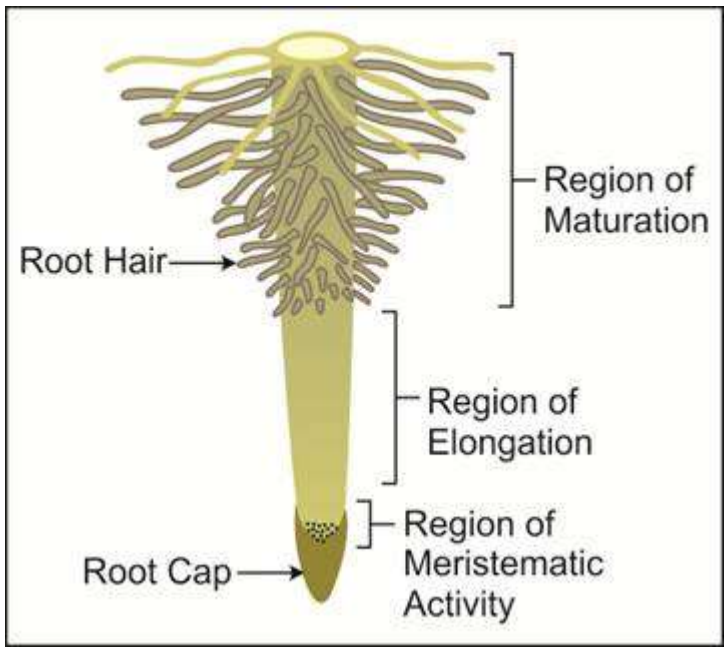
- Absorption of water and minerals from the soil.
- Provides anchorage to plant parts.
- Stores reserve food material and synthesizes plant growth regulators.

Various types of root:

- **Tap root:** Originates from radicle. Dicotyledonous plants e.g., mustard, gram, mango.
- **Fibrous root:** Originates from base of the stem. Monocotyledonous plants e.g., wheat, paddy.
- **Adventitious root:** Originates from parts of the plant other than radicle. Banyan tree (Prop roots) Maize (Stilt roots).

Regions of Roots:

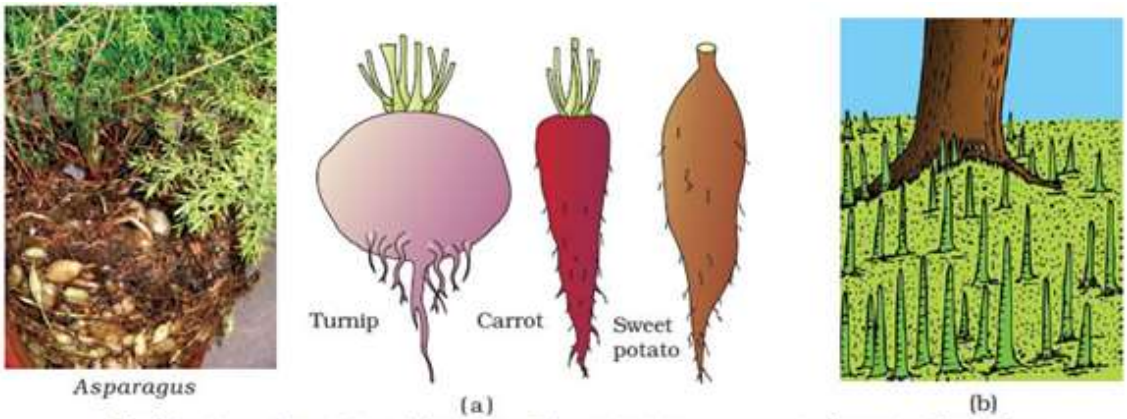
- The apex of root is covered by a thimble like structure called root cap, it protect the tender apex of root while making way through soil.
- Above the root cap is region of meristematic activity having small cells with dense cytoplasm.
- The part above the region of meristematic activity is region of elongation where cells under go elongation and enlargement to increase the length of root.
- Region of maturation contain root hairs that help in absorption of water and minerals.



Modification of roots:

Roots are modified for storage, nitrogen fixation, aeration and support.

- Tap root of carrot, turnip and adventitious root of sweet potato get swollen to store food.
- Prop root of Banyan and Stilt root of maize and sugarcane have supporting root coming out from lower node of stems.
- In Rhizophora, Pneumatophores help to get oxygen for respiration as it grows in swampy areas.



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

Inflorescence

A flower is a significant part of a plant tailored for reproduction. In addition, it is an essential part of the bouquet, decorations, celebrations, garden, rituals, etc. Among different parts of a plant, the flower is the most attractive part due to its beauty and fragrance.

Racemose Inflorescence

In this type of inflorescence, the flowers branch laterally on the floral axis. Here the floral axis keeps on growing and the flowers develop in an acropetal pattern.

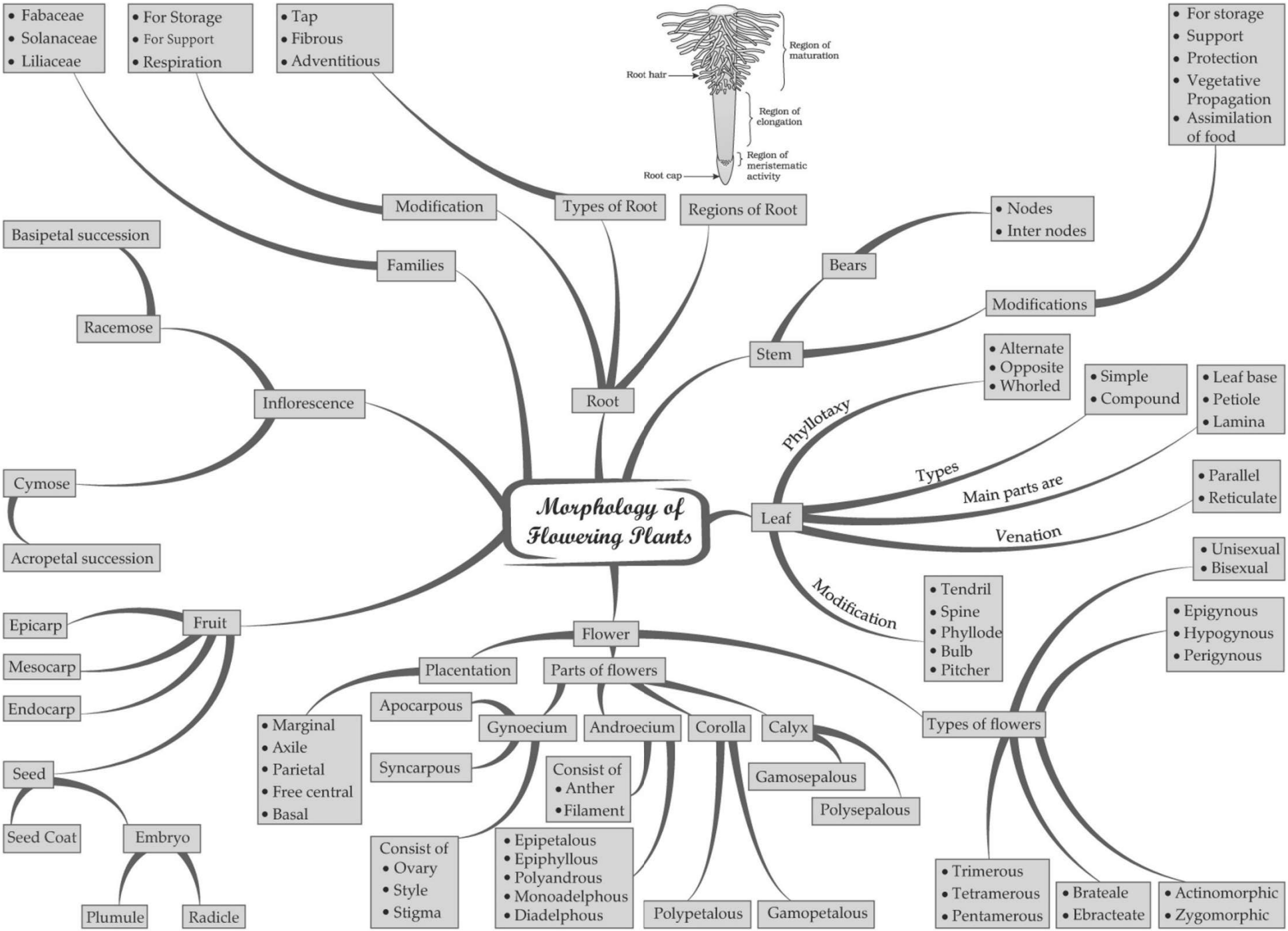
Racemose inflorescence

Cymose Inflorescence

In this type of inflorescence, the flower is the terminating point of each floral axis. In Cymose inflorescence, flowers follow the basipetal pattern of growth.

Cymose inflorescence

CHAPTER : 5 MORPHOLOGY OF FLOWERING PLANTS



Important Questions

➢ Multiple Choice Questions:

Question 1. Which one of the following is not a characteristic of root?

(a) Absence of buds

(b) Presence of chlorophyll

(c) Presence of root cap

(d) Presence of Unicellular hair

Question 2. Roots that grow from any part of the plant body other than the radicle are called

(a) Tap roots

(b) Adventitious roots

(c) Modified roots

(d) Aerial roots

Question 3. The place on stem or branch form where one or more leaves arise is called

(a) Apex

(b) Bud

(c) Internode

(d) Node

Question 4. Which one of the following underground, fleshy structure is a stem?

(a) Carrot

(b) Potato

(c) Turnip

(d) Sweet Potato

Question 5. Phyllode is a modification of

(a) Root

(b) Flower

(c) Petiole

(d) Bud

Question 6. Potato tubers are formed at the tips of

(a) Primary roots

(b) Adventitious roots

(c) Petiole

(d) Stolons

Question 7. Mesocarp and endocarp is the edible part of the fruit of

(a) Apple

(b) Mango

(c) Banana

(d) Litchi

Question 8. Drupe is recognised by

(a) Stomy mesocarp

(b) Fleshy seed coat

(c) Thin seed coat

(d) Stony endocarp

Question 9. What do you eat in coconut?

(a) Mesocarp

(b) Fruit wall

(c) Entire seed

(d) Embryo

Question 10. The positions of shoot apex in monocot embryo is

(a) Lateral

(b) Basal

(c) Sub-terminal

(d) Terminal

Question 11. In which one of the following plants the oil is stored in endosperm

(a) Coconut

(b) Ground nut

(c) Seasame

(d) Soyabean

Question 12. In maize, the flower are

(a) Bisexual

(b) Unisexual but on the same plant

(c) Absent

(d) Unisexual but on different plants

Question 13. Epipetalous is condition of

(a) Aestivation of petal

(b) Placentation

(c) Stamens

(d) Position of ovary

Question 14. A characteristic of angiosperm is

(a) Flower

(b) Root

(c) Seed

(d) All of these

Question 15. An aspect of flower shown in floral formula but not in floral diagram is

(a) Aestivation

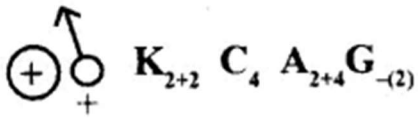
(b) Floral symmestry

(c) Position of ovary

(d) Cohesion of floral parts

➢ Fill In the Blanks:

1. Solanaceae is a large family, commonly called as the '……'
2. Fabaceae family was earlier called ……, a sub family of family …….
3. The following floral formula represents the …… (Family: Brassicaceae)



$$\oplus\ \mathrm{K}_{2+2}\ \mathrm{C}_{4}\ \mathrm{A}_{2+4}\mathrm{G}_{\underline{(2)}}$$

4. In the floral formula, 'K' for ……. 'P' for …….. 'A' for ……
5. The outer covering of endosperm separates the embryo by a layer called …….
6. The embryo consists of one large and shield shaped cotyledon known as ……. and a short axis with a …… and a radicle

➢ True or False:

1. The study of external features of plants is known as external morpholgy and that of internal features as anatomy.
2. The knowledge of external morpholgy of flowering plants is not essential for the study of all

branches of botany.

3. The root is covered at the apex by a thimble-like structure called the not cap
4. A few millimetre above the root cap is the region of meristematic activity.
5. Tap roots of carrot, turnip and adventitious roots of sweet potato, get swollen and store food.
6. The main function of the stem is spreading out branches bearing leaves, flowers and fruits. It conducts water, minerals and photosynthates.

➢ Very Short Question:

1. What do you mean by morphology?
2. What are the hanging roots of a banyan tree called?
3. In which type of plants, the primary root is short-lived and is replaced by a large number of roots?
4. Name one plant which has a fibrous root system.
5. Name one plant which has adventitious roots?
6. What is a root cap?
7. Name the region a few millimetres above the root cap?
8. What is the function of root hairs?
9. Name two plants whose taproots store food.
10. Name one plant whose roots come out of the ground and grow vertically upwards.

➢ Short Questions:

1. What are the functions of the root system?
2. Write a note on different types of root systems.
3. Write a short note on the stem.
4. What are the main functions of the stem?
5. Describe the main parts of a leaf.
6. What are the functions of petiole and lamina?
7. What do you mean by venation?
8. Explain the two types of compound leaves.

➢ Long Questions:

1. Write a note on the regions of the root.
2. Write a note of different types of leaves and phyllotaxy.

3. Write in details about a flower.

Assertion Reason Question-

1. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

   (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

   (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

   (c) If Assertion is true but Reason is false.

   (d) If both Assertion and Reason are false.

   Assertion: Apical meristem of root is subterminal.

   Reason: At the terminal end of root, root cap is present.

2. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

   (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

   (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

   (c) If Assertion is true but Reason is false.

   (d) If both Assertion and Reason are false.

   Assertion: Fibrous root stem.

   Reason: Fibrous root system is found in dicots only.

Case Study Based Question-

1. In majority of the dicotyledonous plants, the direct elongation of the radicle leads to the formation of primary root which grows inside the soil. It bears lateral roots of several orders that are referred to as secondary, tertiary, etc. roots. The primary roots and its branches constitute the tap root system, as seen in the mustard plant. In monocotyledonous plants, the primary root is short lived and is replaced by a large number of roots. These roots originate from the base of the stem and constitute the fibrous root system, as seen in the wheat plant. In some plants, like grass, Monstera and the banyan tree, roots arise from parts of the plant other than the radicle and are called adventitious roots. The main functions of the root system are absorption of water and minerals from the soil, providing a proper anchorage to the plant parts, storing reserve food material and synthesis of plant growth regulators.

   The root is covered at the apex by a thimble-like structure called the root cap. It protects the tender apex of the root as it makes its way through the soil. A few millimetres above the root cap is the region of meristematic activity. The cells of this region are very small, thin-walled and with dense protoplasm. They divide repeatedly. The cells proximal to this region undergo rapid elongation and enlargement and are responsible for the growth of the root in length. This region

is called the region of elongation. The cells of the elongation zone gradually differentiate and mature. Hence, this zone, proximal to region of elongation, is called the region of maturation. From this region some of the epidermal cells form very fine and delicate, thread-like structures called root hairs. These root hairs absorb water and minerals from the soil.

Roots in some plants change their shape and structure and become modified to perform functions other than absorption and conduction of water and minerals. They are modified for support, storage of food and respiration. Tap roots of carrot, turnip and adventitious roots of sweet potato, get swollen and store food. In some plants such as Rhizophora growing in swampy areas, many roots come out of the ground and grow vertically upwards. Such roots, called pneumatophores, help to get oxygen for respiration.

1.) Identify incorrect statement

Statement 1 – The root is covered at the apex by a thimble-like structure called the root cap.

Statement 2 – Elongation of the radicle leads to the formation of primary root.

Statement 3 – Pneumatophores are roots come out of the ground and grow vertically upwards

Statement 4 – Root hairs absorb water and minerals from the soil.

a.) Only 1

b.) Only 3

c.) Both 2 & 3

d.) None of the above

2.) Which of the following is feature of primary roots

a.) Short lived.

b.) Originate from the base of the stem

c.) Constitute the fibrous root system.

d). All of the above.

3.) What is the function of roots?

4.) What are adventitious roots?

5.) Explain root modification and give any two example of root modification?

6.) What is pneumatophores?

2. The leaf is a lateral, flattened structure borne on the stem. It develops at the node and bears a bud in its axil. The axillary bud later develops into a branch. Leaves originate from shoot apical meristems and are arranged in an acropetal order. They are the most important vegetative organs for photosynthesis.

A typical leaf consists of three main parts: leaf base, petiole and lamina. The leaf is attached to the stem by the leaf base and may bear two lateral small leaf like structures called stipules. In monocotyledons, the leaf base expands into a sheath covering the stem partially or wholly. In some leguminous plants the leaf base may become swollen, which is called the pulvinus. The petiole help hold the blade to light. Long thin flexible petioles allow leaf blades to flutter in wind, thereby cooling the leaf and bringing fresh air to leaf surface. The lamina or the leaf blade is the green expanded part of the leaf with veins and veinlets. There is, usually, a middle prominent vein, which is known as the midrib. Veins provide rigidity to the leaf blade and act as channels of transport for water, minerals and food materials. The shape, margin, apex, surface and extent of incision of lamina varies in different leaves.

The arrangement of veins and the veinlets in the lamina of leaf is termed as venation. When the veinlets form a network, the venation is termed as reticulate. When the veins run parallel to each other within a lamina, the venation is termed as parallel. Leaves of dicotyledonous plants generally possess reticulate venation, while parallel venation is the characteristic of most monocotyledons.

A leaf is said to be simple, when its lamina is entire or when incised, the incisions do not touch the midrib. When the incisions of the lamina reach up to the midrib breaking it into a number of leaflets, the leaf is called compound. The compound leaves may be of two types. In a pinnately compound leaf a number of leaflets are present on a common axis, the rachis, which represents the midrib of the leaf as in neem. In palmately compound leaves, the leaflets are attached at a common point, i.e., at the tip of petiole, as in silk cotton.

Phyllotaxy is the pattern of arrangement of leaves on the stem or branch. If is of three types – alternate, opposite and whorled. In alternate type of phyllotaxy, a single leaf arises at each node in alternate manner, e.g. China rose, sun flower plants. In opposite type, a pair of leaves arise at each node and lie opposite to each other as in Calotropis and guava plants. If more than two leaves arise at a node and form a whorl, it is called whorled, e.g. Alstonia.

1.) The arrangement of veins and the veinlets in the lamina of leaf is termed as

a.) Phyllotaxy

b.) Venation

c.) Reticulate venation

d.) Parallel venation

2.) The leaf attached to the stem by the leaf base and may bear two lateral small leaf like structures termed as

a.) Petiole

b.) Lamina

c.) Stipules

d.) Pulvinus

3.) Explain different parts of typical leaf.

4.) Explain types of venation with suitable examples.

5.) Explain different types of phyllotaxy with suitable examples.

✓ Answer Key-

➢ Multiple Choice Answers:

1. (b) Presence of chlorophyll
2. (b) Adventitious roots.
3. (d) Node
4. (b) Potato
5. (c) Petiole
6. (d) Stolons
7. (c) Banana
8. (d) Stony endocarp
9. (c) Entire seed
10. (a) Lateral
11. (a) Coconut
12. (b) Unisexual but on the same plant
13. (c) Stamens
14. (d) All of these
15. (c) Position of ovary

➢ Fill In the Blanks:

1. Potato family
2. Papilonoideae, Leguminosae
3. mustard plant
4. calyx, perianth, androecium
5. aleurone layer
6. scutellum, Plumule

➢ True or False:

1. True
2. False

3. True
4. True
5. True
6. True

➢ Very Short Answers:

1. Answer: Morphology refers to external structures.
2. Answer: Prop roots
3. Answer: Monocotyledonous
4. Answer: Wheat plant
5. Answer: Banyan
6. Answer: The root is covered at the apex by a thimble-like structure called the root cap.
7. Answer: Region of meristematic activity.
8. Answer: To absorb water and minerals from the soil.
9. Answer: Carrot and turnip
10. Answer: Rhizophora.

➢ Short Answer:

1. Answer: The main functions of the root system are as follows:

   (a) Absorption of water and minerals from the soil.

   (b) To provide a proper anchorage to the plant parts.

   (c) To store reserved food material

   (d) Synthesis of plant growth regulators.

2. Answer: (a) In most of the dicotyledonous plants, the direct elongation of the radicle leads to the formation of primary roots which grows inside the soil. The primary roots and their branches constitute the taproot system. For example-mustard plant.

   (b) In monocotyledonous plants the primary root is short-lived and is replaced by a large number of roots. Their roots originate from the base of the stem and constitute the fibrous root system. For example wheat plant.

   (c) In some plants, roots arise from parts of the plant other than the radicle. Such roots are called adventitious roots. For example grass, banyan tree etc.

3. Answer: The stem is the ascending part of the axis bearing branches leaves, flowers and fruits. It develops from the plumule of the embryo of a germinating seed. The stem bears nodes and internodes. The region of the stem where leaves are born is called nodes while

the portion between two nodes is called an internode. The stem is generally green when young and later becomes woody and dark brown.

4. Answer: The main functions of stem are as follows:

   (a) Spreading out branches bearing leaves, flowers and fruits.

   (b) To conduct water, minerals and photosynthates.

   (c) Some stems perform the function of storage of food, support, protection and vegetative propagation.

5. Answer: The leaf consists of three main parts-leaf base, petiole and lamina.

   (a) Leaf base: The leaf is attached to the stem by the leaf base.

   (b) Petiole: The petiole help hold the blade to light.

   (c) Lamina: It is the green expanded part of the leaf with veins and veinlets.

6. Answer: Functions of petiole:

   (a) The petiole helps hold the blade to light.

   (b) It allows leaf blades to flutter in wind, thereby cooling the leaf and bringing fresh air to the leaf surface.

   Functions of Lamina

   (a) The veins of the lamina provide rigidity to the leaf blade

   (b) It acts as channels of transport for water, minerals and food materials.

7. Answer: The arrangement of veins and the veinlets in the lamina of the leaf is termed venation. The veinlets in the form of a network are termed reticulate and when the veins run parallel to each other within a lamina, the venation is termed as parallel. Dicotyledonous plants generally possess reticulate venation while monocotyledonous generally possess parallel venation.

8. Answer: The two types of compound leaves are:

   (a) Pinnately compound leaf: In which a number of leaflets are present on a common axis, the rachis, which represents the midrib of the leaf as in neem.

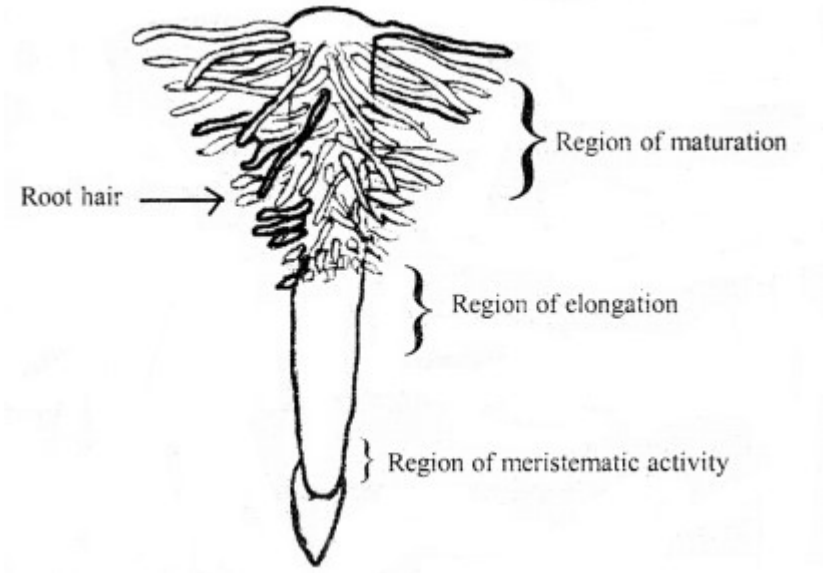
   (b) Palmately compound leaves: The leaflets are attached at a common point, i.e., at the tip of the petiole, as in silk cotton.

➢ Long Answer:

1. Answer: At the apex, the root is covered by a thimble-like structure called the root cap. The root cap protects the tender apex of the root as it penetrates the soil. A few millimetres above the root cap is the region of meristematic activity. The cells present in this region are very small, thin-walled and with dense protoplasm.

   The cells proximal to this region undergo rapid elongation and enlargement and are also

responsible for the growth of the root in length. This region is called the region of elongation. The cells of this region gradually differentiate and mature. This zone proximal to the region of elongation is called the region of maturation. Some epidermal cells, from this region, form very fine and delicate, thread-like structures called root hairs. The functions of these root hairs are to absorb water and minerals from the soil.



The regions of the root-tip

2. Answer: When the lamina of the leaf is entire or incised and the incisions do not touch the midrib, the leaf is said to be simple. A leaf is said to be compound when the incisions of the lamina reach up. to the midrib breaking it into a number of leaflets. In both simple and compound leaves a bud is present in the axil of the petiole. However, a bud is not present in the axil of leaflets of the compound leaf.

   There are two types of compound leaves:

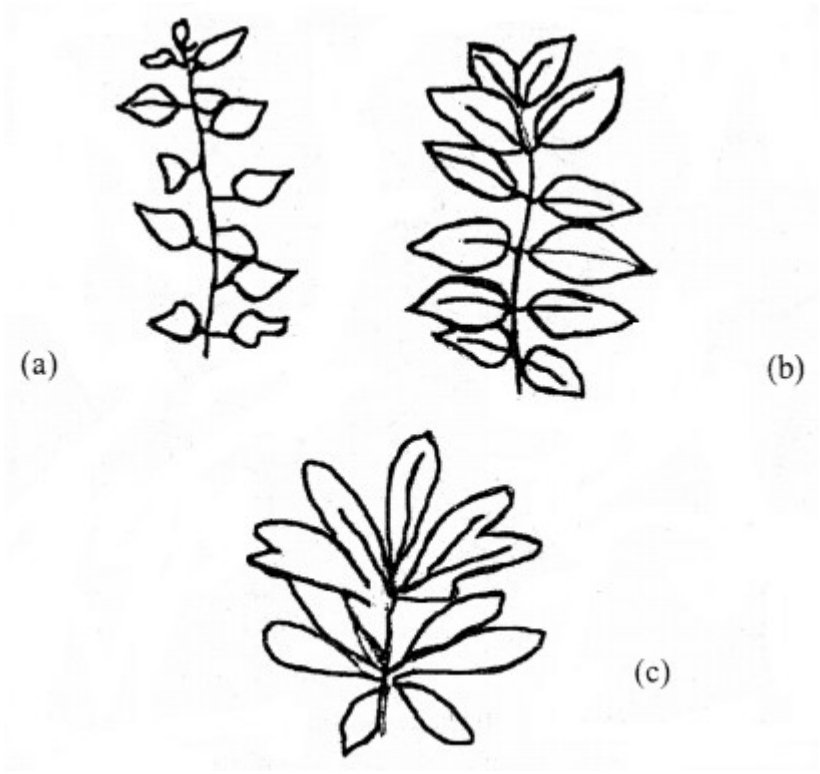
   (a) Pinnately compound leaf

   (b) Palmately compound leaf

   In a pinnately compound leaf, a number of leaflets are present on a common axis, the rachis, which represents the midrib of the leaf. However in palmately compound leaves, the leaflets are attached at a common point,

   i. e, the tip of the petiole.

   Phyllotaxy refers to the pattern of arrangement of leaves on the stem or branch. Phyllotaxy is of three types alternate, opposite and whorled. A single leaf that arises at each node in an alternate manner is called alternate phyllotaxy, for example, as in china rose. When a pair of leaves arise at each node and lie opposite to each other it is called opposite phyllotaxy, for example in calotropis. If more than two leaves arise at a node and form a whorl it is called whorled phyllotaxy, as in Alstonia.



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

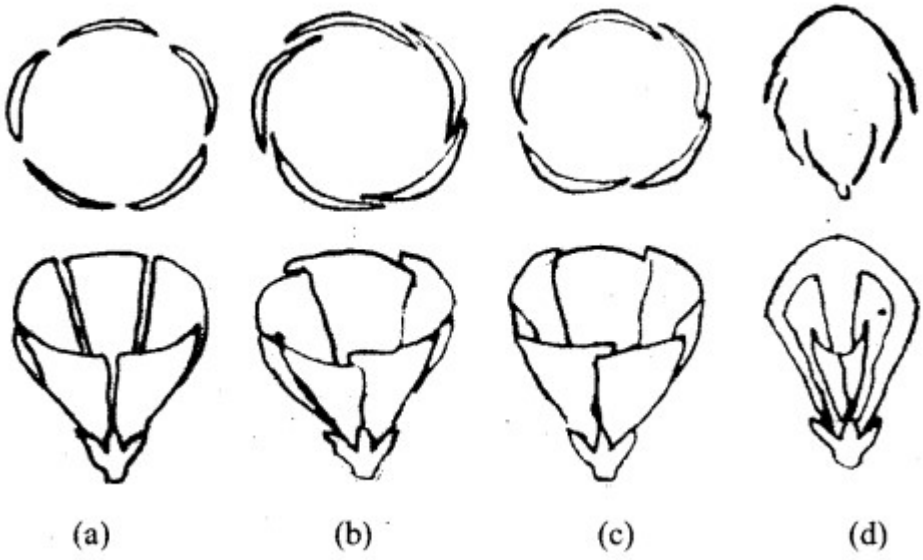
3. Answer: A flower is a reproductive unit in the angiosperms. It is meant for sexual reproduction. Four different kinds of whorls are found in a flower. These are arranged successively on the swollen end of the stalk or pedicel, called the thalamus or receptacle.

   These are calyx, corolla, androecium and gynoecium.

   (a) Calyx: It is the outermost whorl of the flower and its members are called sepals. Mostly the sepals are green in colour, leaf-like and protect the flower in the bud stage. The calyx may be gamosepalous (in which sepals are united or polysepalous (in which sepals are free).

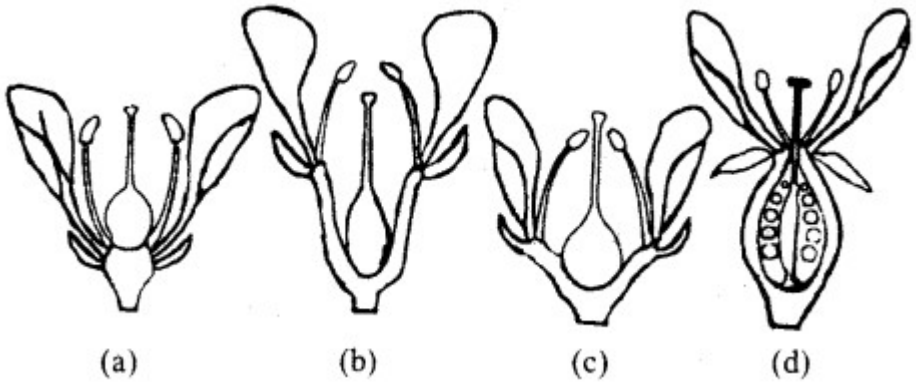
   (b) Corolla: It is composed of petals that are usually brightly coloured to attract insects for pollination. The shape of the corolla may be tubular, bell-shaped, funnel-shaped or wheel-shaped.

   (c) Aestivation: The pattern of arrangement of sepals or petals in the floral bud with respect to the other members of the same whorl is known as aestivation. The main types of aestivation are valvate, twisted, imbricate and vexillary.



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

(d) Androecium: It is composed of stamens which are male reproductive organs of a flower. Each stamen consists of a stalk or a filament and an anther. Each anther is usually bilobed. There are two chambers (pollen sacs) in each lobe. The pollen grains are produced in pollen sacs.



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

(e) Gynoecium: It is the female reproductive part of the flower. It is made up of one or more carpels. A carpel consists of three parts ovary, stigma and style. The stigma is at the tip of the style and is the receptive surface for pollen grains. The ovary is an enlarged basal part. The style connects the ovary to the stigma. Each ovary bears one or more ovules attached to a flattened, cushion-like placenta.

A flower may be trimerous tetramerous or pentamerous when the floral appendages are in multiples of 3, 4 and 5 respectively.

The flowers are described as hypogynous perigynous and epigynous based on the position of calyx, corolla and androecium in respect of the ovary on the thalamus.

Assertion Reason Answer-

1. (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

   Explanation: Root cap is the terminal part of root.

2. (c) If Assertion is true but Reason is false.

   Explanation: A number of thin, thread-like branched roots develop from the base of the stem in fibrous root system. The roots are of nearly equal size. They form a bunch which helps in holding the soil firmly. It provides good anchorage to the plant, helps in proper absorption of water and minerals. This root system is found in many monocots. Examples of plants having fibrous root system are wheat and barley.

Case Study Answer-

1. **Answer:**

   1.) d

   2.) d

   3.) Roots perform the following functions:

   - Roots absorb water and nutrients from the soil.
   - They anchor the plant firmly.
   - They help in storing food and nutrients.
   - Roots transport water and minerals to the plant.

   4.) The roots developed from different parts of the plant other than radicle are called as the adventitious roots.

   5.) Root modification – Roots in some plants change their shape and structure and become modified to perform functions other than absorption and conduction of water and minerals. They are modified for support, storage of food and respiration.

   Examples,

   - Tap roots of carrot.
   - Adventitious roots of sweet potato, get swollen and store food.

   6.) Pneumatophores – In some plants many roots come out of the ground and grow vertically upwards. Such roots, called pneumatophores, help to get oxygen for respiration.

2. **Answer:**

   1.) b

   2.) c

   3.) A typical leaf consists of three main parts: leaf base, petiole and lamina.

   - Leaf base – The leaf is attached to the stem by the leaf base and may bear two lateral small leaf like structures called stipules. In monocot, the leaf base expands into a

sheath covering the stem partially or wholly. In some leguminous plants the leaf base may become swollen, which is called the pulvinus.

- Petiole – The petiole help hold the blade to light. Long thin flexible petioles allow leaf blades to flutter in wind, thereby cooling the leaf and bringing fresh air to leaf surface.
- Lamina – The lamina or the leaf blade is the green expanded part of the leaf with veins and veinlets. There is, usually, a middle prominent vein, which is known as the midrib. Veins provide rigidity to the leaf blade and act as channels of transport for water, minerals and food materials.

4.) Venation is the arrangement of veins and the veinlets in the lamina of leaf is termed as venation.

- Reticulate venation – When the veinlets form a network, the venation is termed as reticulate. Leaves of dicotyledonous plants generally possess reticulate venation.
- Parallel venation – When the veins run parallel to each other within a lamina, the venation is termed as parallel, while parallel venation is the characteristic of most monocotyledons.

5.) The pattern in which the leaves are arranged on the stem is known as phyllotaxy. These are of three types:

- Alternate Phyllotaxy- The leaf arises from each node in an alternate manner. For eg. China rose, sunflower.
- Opposite Phyllotaxy- The leaves arising at each node lie opposite to each other. For eg., Calotropis
- Whorled Phyllotaxy– More than two leaves arise at each node and form a whorl. For eg., Alstonia