

Exercise Questions

1. What is meant by modification of root? What type of modification of root is found in the:

- (a) Banyan tree (b) Turnip (c) Mangrove trees**

Solution:

In order to carry out some secondary functions or a specific adaptation, roots modify their structures – which can be their size, shape, or even normal functioning. This is referred to as the modification of roots.

- a) In banyan trees, roots develop from the branches, and they go deep down the earth to render mechanical assistance for the tree. This kind of modification is known as prop root.
- b) In turnips, roots are modified to store food, and this type of modification is called a fleshy taproot.
- c) In mangrove trees, the roots are modified into a pneumatic structure to provide oxygen to the tree. This type of modification is called respiratory roots or pneumatophores.

2. Justify the following statements on the basis of external features:

- (i) Underground parts of a plant are not always roots.**
- (ii) The flower is a modified shoot.**

Solution:

- i) In a few plants like ginger, stems remain underground for vegetative reproduction and storage of food. Similarly, stems in potatoes remain underground, which are modified stems. Potato tuber indicates the presence of nodes (buds and scale leaves here) and internodes. The presence of an apical bud at the tip of the potato tuber affirms it to be a stem. Hence, these examples show that underground parts are not always roots.
- ii) Apical meristems give rise to floral meristems, and the axis of the stem gets condensed while internodes lie nearer to each other. Because of this, floral appendages rise in place of stems. This justifies that the flower is a modified shoot.

3. How is a pinnately compound leaf different from a palmately compound leaf?

Solution:

The differences are as follows:

Pinnately compound leaf	Palmately compound leaf
Many numbers of leaflets are present on a common axis	Several leaflets are attached to a common point.
Leaflets are attached to a common axis	Leaflets are attached to a common point

called the rachis	on the leaf stalk.
Leaflet-bearing axis is the continuation of the petiole	Leaflet-bearing axis is very short.
Ex: Neem leaves	Ex: Cotton leaves

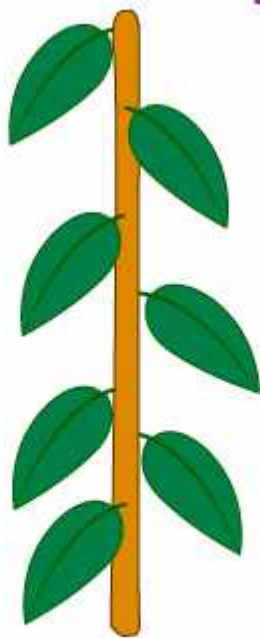
4. Explain with suitable examples the different types of phyllotaxy.

Solution:

The pattern of leaf arrangement on the stem or branch is called phyllotaxy. For example, in China rose, mustard and sunflower plants, a single leaf arises at each node alternately.

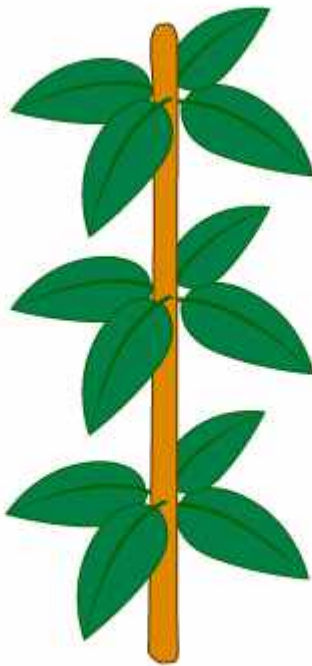
Phyllotaxy is of three types, namely:

- Alternate – the emergence of a single leaf at each node in an alternate manner. Example – Hibiscus



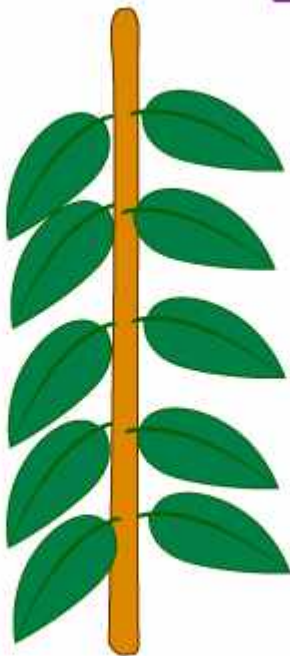
Alternate arrangement

- Whorled – whorl is formed when two or more leaves emerge at a node. Example – Alstonia



Whorled arrangement

- Opposite – emergence of a pair of leaves at every node, facing opposite to each other. Example – guava



Opposite arrangement

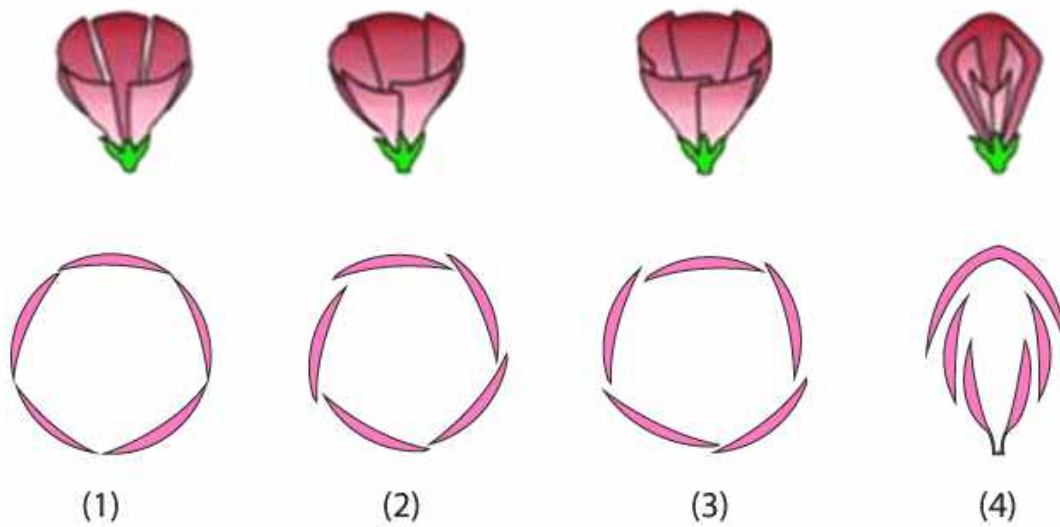
5. Define the following terms:

- (a) aestivation
- (b) placentation
- (c) actinomorphic
- (d) zygomorphic
- (e) superior ovary
- (f) perigynous flower
- (g) epipetalous stamen

Solution:

a) Sepals or petals' arrangement in a floral bud concerning other members of the same whorl is called aestivation. Different types of aestivation are:

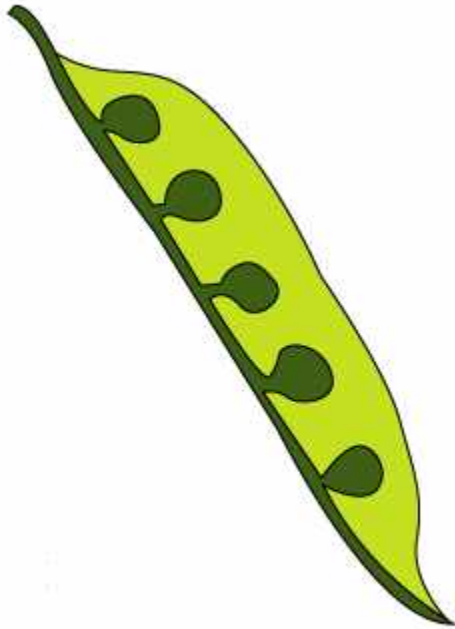
- Twisted – if one margin of the appendage overlaps the adjacent one, it is twisted, either clockwise or anti-clockwise. Example – cotton
- Valvate – In a whorl, when petals or sepals just touch each other at the margin without overlapping, it is valvate. Example – Calotropis
- Imbricate – It is imbricate when petals or sepals overlap each other but not in any definite direction as observed in gulmohar
- Vexillary – The largest petal overlaps the two lateral petals, which in turn overlap the two smallest anterior petals in vexillary aestivation. Example – Bean flower



Aestivation

b) Arrangement of the ovule within the ovary is known as placentation. They are of the following types:

- Marginal – The placenta forms a ridge through the ventral suture of the ovary. Ovules are borne on the ridge to form two rows. Example – Pea



Marginal placentation

- Axile – placenta is axial, and ovules are attached to it in a multilocular ovary. Example – lemon



Axile placentation

- Parietal – ovules develop on the inner wall of the ovary or on the peripheral. It is single-chambered, but due to the formation of a false septum, it becomes two-chambered. Example- Mustard



Parietal placentation

- Basal – The placenta develops at the base of the ovary, wherein a single ovule is attached to it. Example – Marigold



Basal placentation

- Free central –ovules are borne on the central axis, and septa are absent. Example – Primrose



Free central placentation

- c) Flowers which can be divided into two halves by any vertical plane are known as actinomorphic flowers. Example – Chilli
- d) A flower with bilateral symmetry that can be divided into two halves only in one plane is known as a zygomorphic flower. Example – Gulmohar
- e) In a hypogynous flower, the gynoecium occupies the highest position while other parts remain below it. The ovary in such a flower is known as a superior ovary. Example – Brinjal
- f) A perigynous flower is one in which the gynoecium is situated in the centre, and other parts of the flower are located on the rim of the thalamus. The ovary is half inferior. Example – Rose
- g) Epipetalous stamen – Instead of directly being inserted over the thalamus, it has a stamen which is borne over a petal. Example – Brinjal

6. Differentiate between

(a) Racemose and cymose inflorescence

(b) Fibrous root and adventitious root

(c) Apocarpous and syncarpous ovary

Solution:

The differences are as follows:

(a) Racemose and cymose inflorescence

Racemose inflorescence	Cymose inflorescence
Inflorescence in which young flowers are present at the tip and older flowers are arranged at the base	Inflorescence in which old flowers are present at the tip and young flowers are arranged at the base
Main axis continues to grow and produce flowers laterally.	The main axis has limited growth, which terminates into a flower.

(b) Fibrous root and adventitious root

Fibrous roots	Adventitious roots
The primary root is short-lived and is replaced by a	Roots arise from parts of the

large number of roots in monocotyledons	plants other than the radicle.
Example: Wheat	Example: Banyan tree

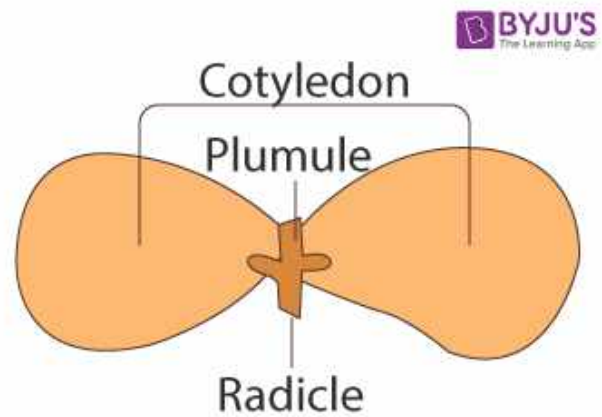
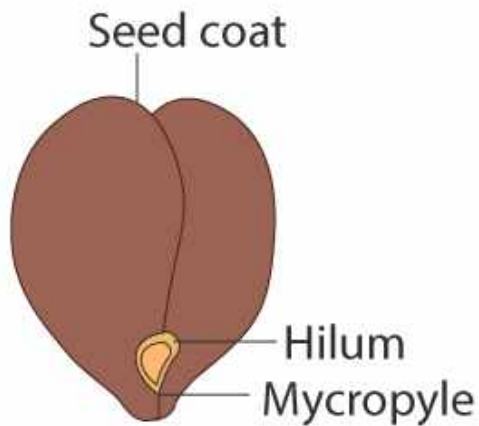
(c) Apocarpous and syncarpous ovary

Apocarpous ovary	Syncarpous ovary
In an apocarpous ovary, two or more carpels are free	In a syncarpous ovary, two or more carpels are fused
Example: Lotus	Example: Mustard

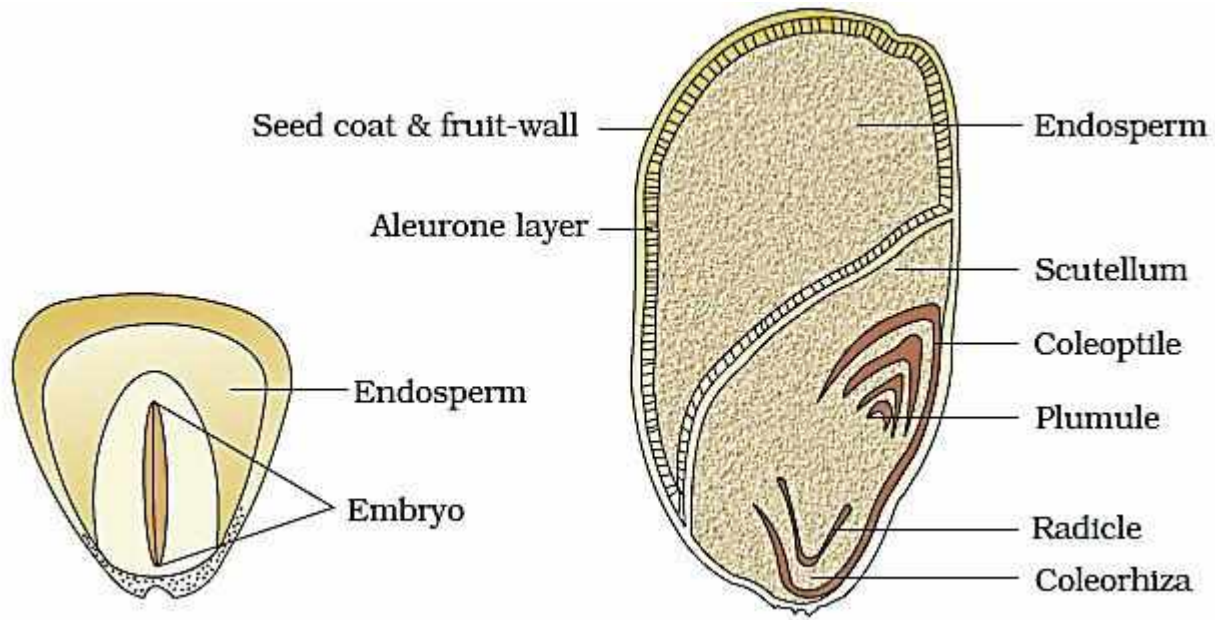
7. Draw the labelled diagram of the following: (i) gram seed (ii) V.S. of maize seed.

Solution:

(i) Gram seed



(ii) V.S. of maize seed



8. Describe modifications of the stem with suitable examples.

Solution:

Modifications of stem:

Food storage:

Underground stems of potato, ginger, and turmeric are modified to store food in them. They act as organs of perennation to tide over conditions unfavourable for growth.

Tendrils:





Tendrils

Tendrils are slender and spirally coiled and develop from axillary buds. These stem tendrils help plants climb, such as in gourds (cucumber, pumpkins, watermelon) and grapevines.

Thorns:

Stems of auxiliary buds get modified into woody, straight and pointed thorns. Thorns protect plants from animals. Several plants of dry regions alter their stems into either fleshy cylindrical structures or flattened. Ex: citrus plants. They possess chlorophyll and perform photosynthesis.

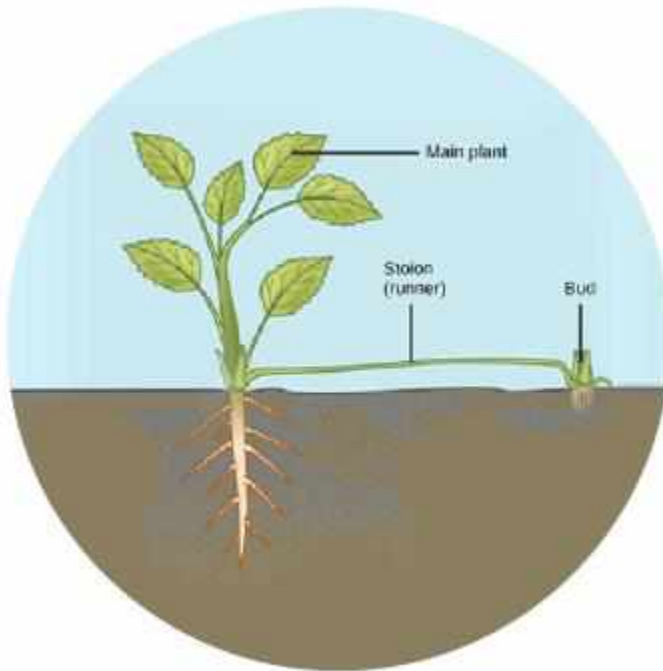


Thorns

Other modifications:

Vegetative reproduction:

Underground stems of some plants such as grass, strawberry, etc. spread to new niches, and when older parts die, new plants are formed. In plants like mint and jasmine, a slender lateral branch arises from the base of the main axis and, after growing aurally for some time, arches downwards to touch the ground.

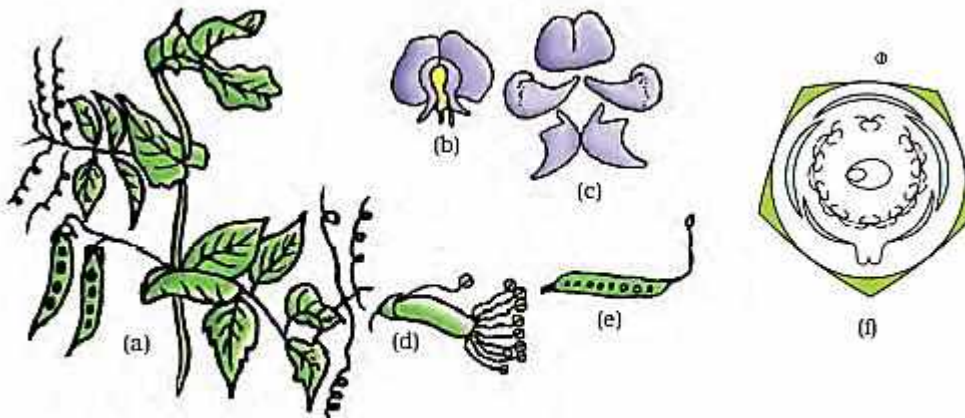


Vegetative reproduction

9. Take one flower from each of the families Fabaceae and Solanaceae and write its semi-technical description. Also, draw their floral diagram after studying them.

Characters of Fabaceae

- They are trees, shrubs herbs having roots with root nodules.
- Stems are erect or climber
- Leaves are alternate, pinnately compound or simple and leaf bases are pulvinate, stipulate with reticulate venation.



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

Inflorescence: racemose

Flower: bisexual, zygomorphic

Calyx: sepals five, gamosepalous; valvate/imbricate aestivation

Corolla: petals five, polypetalous, papilionaceous, consisting of a posterior standard, two lateral wings, two anterior ones forming a keel (enclosing stamens and pistil), vexillary aestivation

Androecium: stamens ten in number, diadelphous, anther dithecous

Gynoecium: ovary superior, monocarpellary, unilocular with many ovules, style single

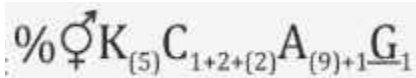
Fruit: legume; seed: one to many, non-endospermic

Economic importance:

Plants of these families are pulses used as fodder and sweet pea.

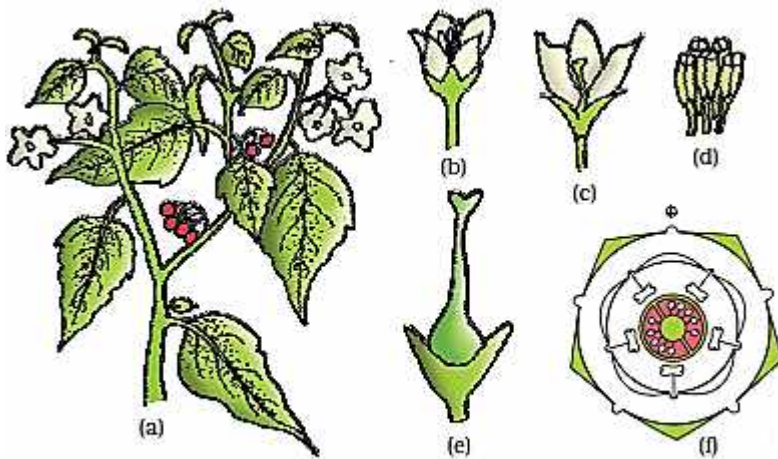
Ex: Peas, trifolium,

Floral diagram:



Characters of Solanaceae

- Commonly termed as potato family, Solanaceae are mostly herbs, shrubs and rarely small trees
- Stems are herbaceous, rarely woody, aerial; erect, cylindrical, branched, solid or hollow, hairy or glabrous, underground stem in potato.
- Leaves are alternate, simple, rarely pinnately compound, and exstipulate with reticulate venation.



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

Floral Characters

Inflorescence: Solitary, axillary or cymose as in Solanum

Flower: bisexual, actinomorphic

Calyx: sepals five, united, persistent, valvate aestivation

Corolla: petals five, united; valvate aestivation

Androecium: stamens five, epipetalous

Gynoecium: bicarpellary obligately placed, syncarpous; ovary superior, bilocular, the placenta is swollen with many ovules, axile

Fruits: berry or capsule

Seeds: many, endosperms

Economic importance

Plants belonging to this family are used as food, spices, medicines and ornamentals

Floral diagram:



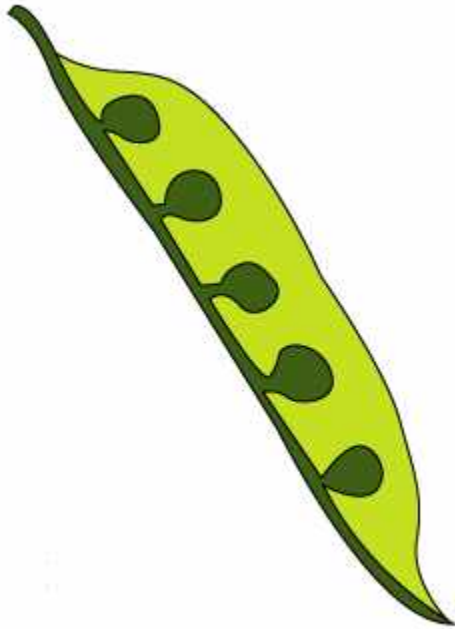
Ex: Brinjal, chilli, ashwagandha, petunia

10. Describe the various types of placentations found in flowering plants.

Solution:

Various types of placentations found in flowering plants are as follows:

- Marginal – The placenta forms a ridge along the ventral suture of the ovary; ovules are borne on the ridge to form two rows. Example – Pea.



Marginal placentation

- Axile – placenta is axial, and ovules are attached to it in a multilocular ovary. Example – lemon.



Axile placentation

- Parietal – ovules develop on the inner wall of the ovary or on the peripheral. It is single-chambered, but due to the formation of a false septum, it becomes two-chambered. Example – Mustard.



Parietal placentation

- Basal – The placenta develops at the base of the ovary, wherein a single ovule is attached to it. Example – Marigold



Basal placentation

- Free central – The ovules are borne on the central axis, and the septa are absent. Example – Primrose



Free central placentation

11. What is a flower? Describe the parts of a typical angiosperm flower.

Solution:

- The reproductive part of an angiosperm is called the flower. It is a modified shoot wherein the shoot apical meristem changes to floral meristem.
- A typical flower has four different kinds of whorls that are organized successively on the swollen end of the pedicel or stalk, known as the receptacle or thalamus. These four parts are classified under accessory organs and reproductive organs. When the calyx and corolla are not distinct, they are called perianth.
- The accessory organs are calyx and corolla; the reproductive organs are androecium and gynoecium

Parts of the flower are as follows:

1. Calyx:

It is the lowermost and outermost whorl of the flower, and they are called sepals. They render support and protection to other floral structures.

2. Corolla:

Corolla is composed of petals which are brightly coloured to attract insects for pollination. Located inner to the sepals and outside the stamens.

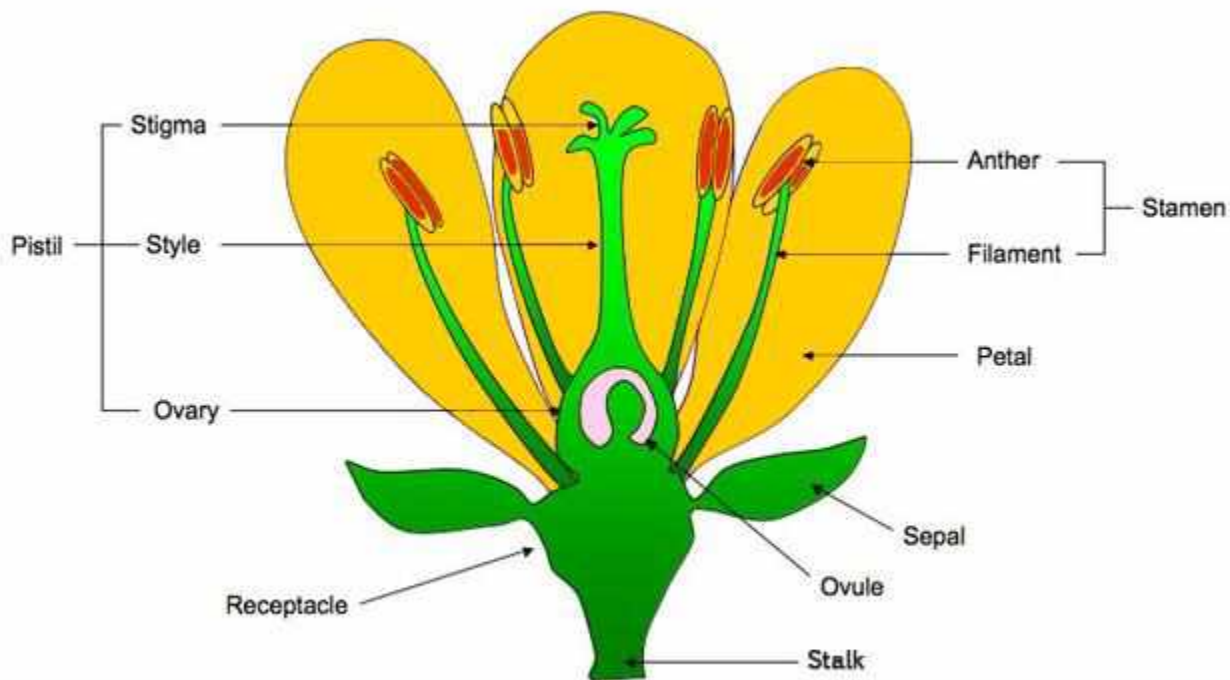
3. Androecium:

Androecium consists of stamens which represent male reproductive organs of a stalk, filament and an anther.

Anthers are bilobed, where each lobe has two chambers, the pollen sacs where pollen grains are produced. The stamens may be united with other members, namely petals or amongst themselves.

4. Gynoecium:

The gynoecium is the female reproductive part of a flower which is made of one or more carpels, which in turn is composed of three parts – stigma, ovary, and style. The ovary is found at the base, enlarged bearing the style, which is an elongated tube. The ovary is connected to the stigma through the style, the tip of which bears the stigma where pollen grains are received. Each of the ovaries bears one or more ovules attached to the placenta.



Parts of a flower

12. How do the various leaf modifications help plants?

Solution:

Leaves fundamentally perform photosynthesis. But in some plants, leaves are modified to carry out different functionalities, as mentioned below:

Tendrils: Tendrils help with climbing as in peas.

Spines: Thorns are modified leaves that protect plants from animals, serving as an organ of defence.

Pitcher: Leaves of this plant are modified into pitcher-like structures containing digestive juices aiding in trapping and digesting insects.

Synthesis of food: Fleshy leaves of garlic and onion store some food. These are modified leaves. Phyllodes emerging from the petioles of leaves synthesize food. Phyllodes are flattened, green structures that replace the short-lived leaves.

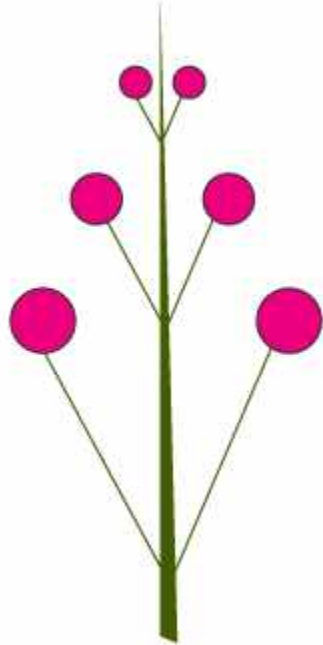
13. Define the term inflorescence. Explain the basis for the different types of inflorescence in flowering plants.

Solution:

Inflorescence is the arrangement of flowers on the floral axis.

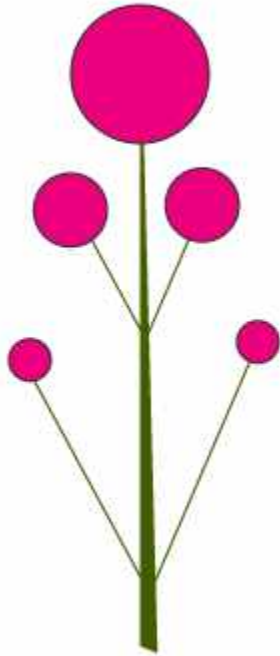
There are two major types of inflorescence depending upon whether the apex is converted into a flower or continues to grow. They are as follows:

Racemose: A type of inflorescence in which the flowers are borne laterally in acropetal succession, i.e., newer flowers are near the apex while older flowers are at the base. The main axis continues to grow.



Cymose: A type of inflorescence in which the main axis terminates in a flower and has limited growth. Flowers are borne in a basipetal order where younger flowers are near the base, and older flowers are at the apex.





14. Write the floral formula of an actinomorphic, bisexual, hypogynous flower with five united sepals, five free petals, five free stamens and two united carpels with superior ovary and axile placentation.

Solution:

The floral formula is as follows:



\oplus Indicates that the flower is actinomorphic

$\text{♀} \text{♂}$
Indicates a bisexual flower

$K_{(5)}$ indicates that the calyx contains five united sepals

C_5 represents that corolla consists of five free petals

A_5 represents that androecium consists of five free stamens

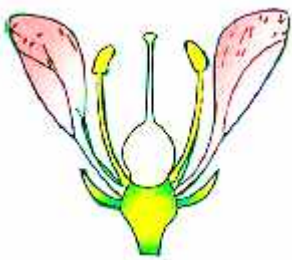
$\underline{G}_{(2)}$ represents that the gynoecium consists of a superior ovary, with two united carpels along with axile placentation.

15. Describe the arrangement of floral members in relation to their insertion on the thalamus.

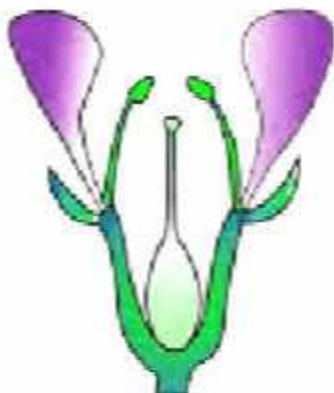
Solution:

The arrangement of floral members in relation to their insertion on the thalamus are of three types:

Hypogynous flowers are the ones in which the gynoecium occupies the highest position while the other parts are situated below it. The ovary is said to be superior. Example – Brinjal.



Perigynous flowers are the ones in which gynoecium stays in the centre and other parts of the flower are located on the rim of the thalamus, almost at the same level. The ovary is said to be half inferior. Example – Rose.



Epigynous flowers are the ones in which the margin of the thalamus grows upwards, enfolding the ovary. Here the ovary gets fused with the thalamus, and other parts of the flower arise above the ovary. Hence ovary is said to be inferior. Example – Flowers of guava

