Introduction

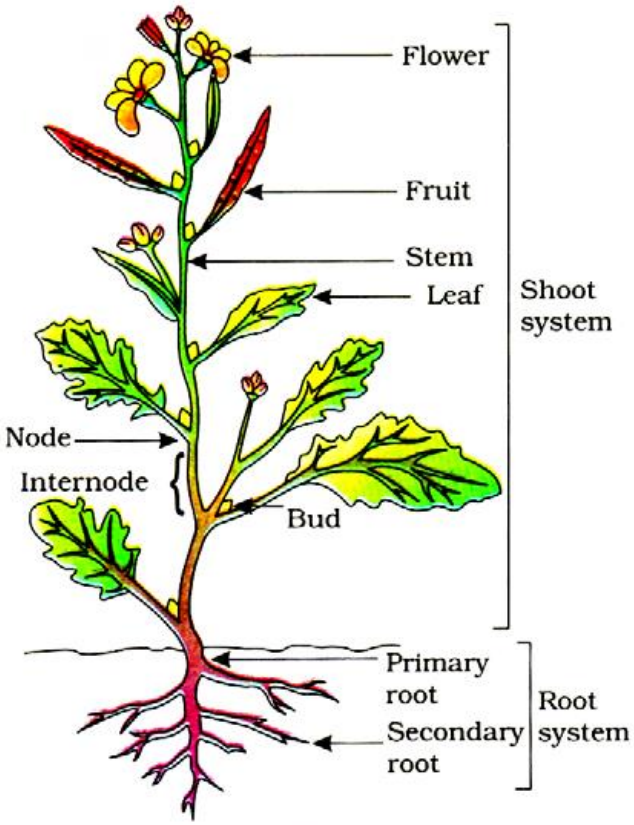
Morphology: (Morphe = form + logos = study). It deals with the **study of forms and features** of different plant organs like roots, stems, leaves, flowers, seeds, fruits etc.

The body of a typical angiospermic plant is differentiated into :

- an underground root system
- an aerial shoot system.

The shoot system consists of stem (including branches), leaves, flowers and fruits.

The roots, stems and leaves are vegetative parts, while flowers constitute the reproductive part. [1]



Parts of a flowering plant

2. CLASSIFICATION OF PLANTS

Depending upon their life span, plants are classified as:

- **Annuals**: Complete their life cycle in one year or single growing season or few weeks to a few months. They pass the unfavourable period in the form of seeds eg. Mustard, Pea.
- **Biennials**: Complete their life cycle in two years-growing, vegetative and storing food in the first year, flowering and fruiting in the second year. They die off after producing flowers and fruits eg. Radish, turnip, carrot are biennial in colder areas. They become annual in warmer places.
- **Perennials**: Survives for several years. These plants usually bears flowers and fruits every year and do not die after producing flowers. eg. Mango, Banana, Guava.[1]

3. PARTS OF A FLOWERING PLANT

The plant body of an angiosperm or a flowering plant primarily consists of an axis, which is dierentiated into:

- Root system
- Shoot system[2]

① THE ROOT SYSTEM

A. Definition Root: The root is a non-green, non-photosynthetic cylindrical, descending part of the plant that develops from the radicle of seed.[2]

B. TYPES OF ROOT SYSTEM

- Taproot System
- Fibrous Root System
- Adventitious Root System[2]

B.1. TAP ROOT SYSTEM

Characteristic feature of most of the dicot plants. It develops from the radicle of the embryo of a seed. The first root is formed by the elongation of radicle and is called primary root. The primary root that persists throughout the life of the plant is termed as taproot. It grows continuously and produces lateral roots that are called as secondary roots. The secondary roots are further branched into tertiary roots and finer rootlets. The taproot and its branches together constitute a taproot system.[2]

(a) Deep Feeder Root System or Racemose Taproot System

The taproot of perennial plants penetrates in the deeper layers of the soil, e.g.,

(b) Surface Feeder Root System or Cymose Taproot System The taproot of some annual plants does not penetrate much and the secondary roots spread horizontally near the soil surface only.[2]

B. 2. FIBROUS ROOT SYSTEM

Roots that consist a bunch of root fibres originating from the base of the stem constitute fibrous root system. In monocotyledonous plants, the primary root is short lived and replaced by many roots. Here, the primary root that originates from the radicle is short lived, as it terminates into the root fibres.[2]

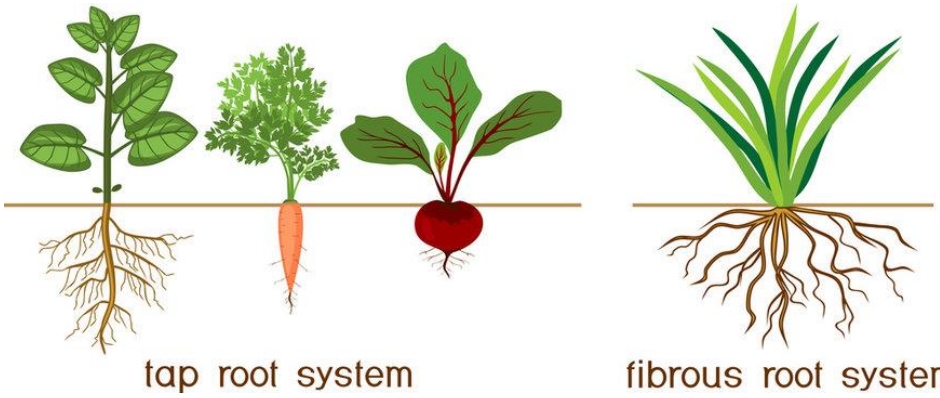


Fig. type of root.

https://t3.ftcdn.net/jpg/02/22/41/34/360_F_222413490_ruyKSSChPY6DbBP4RmRuGynq8KUiKXS1.jpg

B. 3. ADVENTITIOUS ROOT SYSTEM

Roots that develop from any part of the plant other than the radicle. Adventitious roots may develop from the nodes or internodes of the stems. These arise from branches (banyan) or from the leaves several plants creeping on the ground, produce roots from nodes as in wood sorrel grass, etc. These arise from branch cuttings of rose, sugarcane, tapioca, when put into the soil. Mostly adventitious roots do not penetrate deep into the soil. Hence, they are surface feeders. Adventitious roots are characteristic feature of monocot plants.[2]

C. MODIFICATIONS OF ROOT

Modifications can be defined as morphological changes (shape, form, or structure) in an organ to perform certain special functions, other than or in addition to the normal functions. The roots of some plants are modified to perform specialized functions.

C.1. MODIFICATIONS OF TAPROOT

C.1. 1. Fleshy taproot

The taproots of some plants become swollen and fleshy due to the storage of food. Hypocotyl may also join the taproot in storing food. The secondary and tertiary roots remain thin and fibrous. Depending upon the shape, fl eshy taproots are of the following types:

(i) Conical (Cone-shaped)

The primary root is broad at the base and tapers gradually towards apex like a cone. Many thin, threads like secondary roots arise all along the conical root, e.g., Carrot .

(ii) Fusiform (spindle shaped)

The primary root is spindle shaped. It is almost uniformly thick except at the base and apex where it tapers. The basal part of the root is derived from hypocotyl.The root also bears a reduced discoid stem and radicle leaves (leaves arising from roots or appear to arise from roots. Radish.

(iii) Napiform (pitcher-shaped)

Globular or top-shaped and tapers abruptly towards the apex. Bears a reduced discoid stem and radicle leaves.

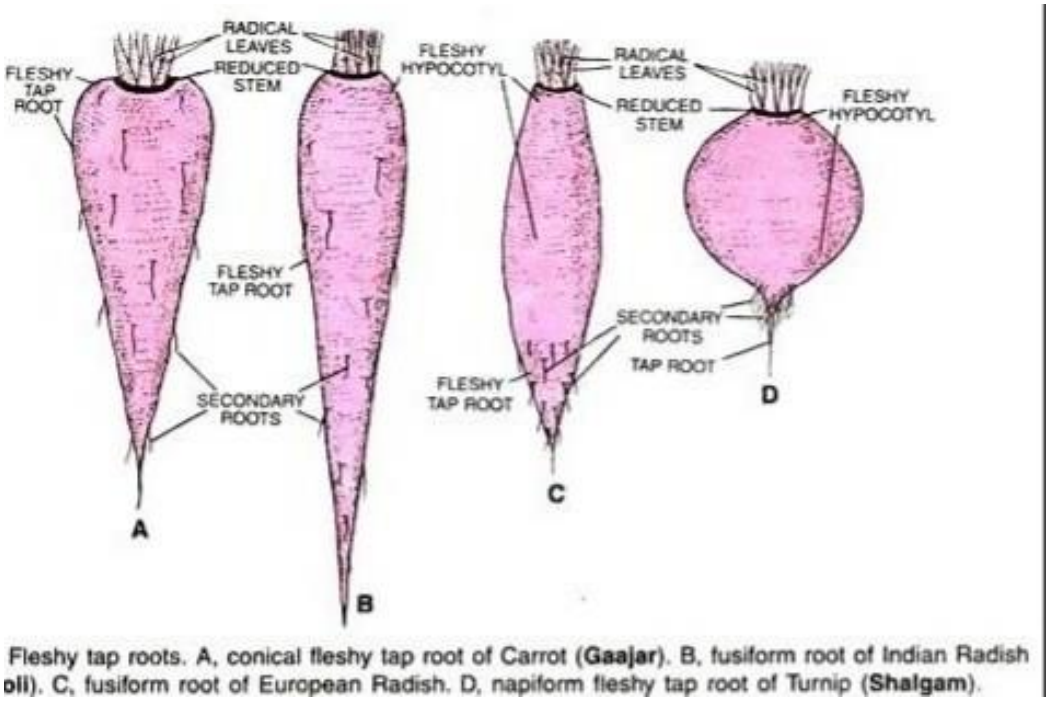


Fig. type of fleshy taproot. https://search-static.byjusweb.com/question-images/toppr_ext/questions/1071218_883784_ans_3e943732ce3e45f99267bd24c3a20730.jpg

C.1. 2. Pneumatophores or Respiratory Roots

These are aerial roots or aerophores found in mangrove plants (plants growing in swamps near the seashores), The underground secondary and tertiary roots of the plants come out of swamp for exchange of gases. They bear small pores called lenticels or pneumatothodes near their tips. The remaining surface of pneumatophores is covered with cork and the proximal submerged part bears many short absorbing roots.

C.1. 3. Nodulated taproots

In some plants, secondary, tertiary and even primary roots bear many small irregular swellings called root nodules or tubercles. The root nodules contain millions of minute nitrogen fixing bacteria of the genus Rhizobium. These bacteria pick up free atmospheric nitrogen and convert it into nitrogenous organic compounds. This phenomenon is called **nitrogen fixation.**

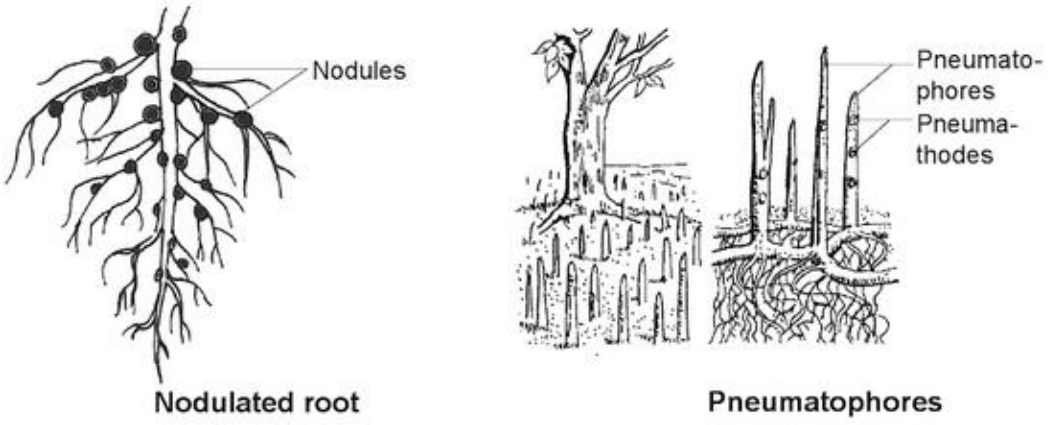


Fig. Modifications of Root

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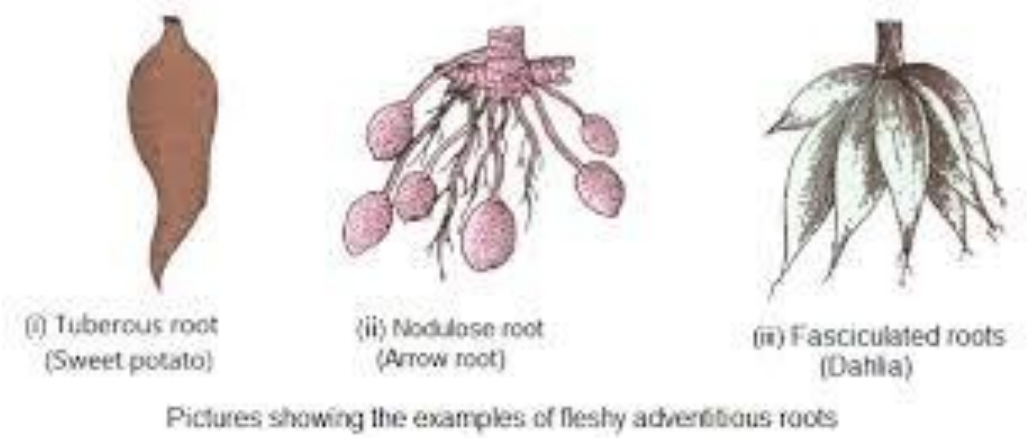
C.2. MODIFICATIONS OF ADVENTITIOUS ROOT

C.2.1. Storage adventitious roots: In some plants, adventitious roots become thick and fleshy due to the storage of food.

- **Tuberous root** These roots are swollen without any definite shape. Tuberous roots are produced singly and not in clusters. Example: Ipomoea batatas.
- **Fasciculated root** These roots are in cluster from the base of the stem
- **Nodulose root** In this type of roots swelling occurs only near the tips. Example: Maranta (arrow root) Curcuma amada (mango ginger), Curcuma longa (turmeric)
- **Moniliform or Beaded root** These roots swell at frequent intervals giving them a beaded appearance. Example: Vitis, Portulaca, Momordica, Basella (Indian spinach).

5. Annulated root These roots have a series of ring- like swelling on their surface at regular intervals. Example: Psychotria (Ipecac)[3]



Pictures showing the examples of fleshy adventitious roots

Fig. List any three names of root modifications found in plants https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQicksxC1W9lhhHWaGUQjRuFZl1UKzu_Rh9gg&usqp=CAU

C.2.2. Roots Modified for Additional Support

(i) Prop or Pillar Roots

these roots are aerial and hygroscopic. As the roots reach the soil, they become thick and pillar-like and start absorbing water and minerals. In old plants, the main trunk may die, but the crown of the tree is supported and nourished by the prop roots.

Fig. **Prop or Pillar Roots** https://qph.cf2.quoracdn.net/main-qimg-5de3a03cb76e6e667b065de961070e69

(ii) Stilt Root or Brace Roots

These are short and thick supporting roots which develop obliquely from the basal nodes of the stem. These roots penetrate down into the soil and give support to the plant, e.g., maize

Fig. Stilt roots https://search-static.byjusweb.com/question images/toppr_ext/questions/656724_417316_ans_c6cc01f08f514af7b2ed35a62c96d227.PNG

(iii) Clinging or Climbing Roots

These are non-absorptive adventitious roots found in some climbers. These may arise from the nodes, or from internodes and both, These roots either enter into crevices or cracks of the support or stick firmly to the support by secreting a cementing gummy substance. These help the climbers to climb up the support.

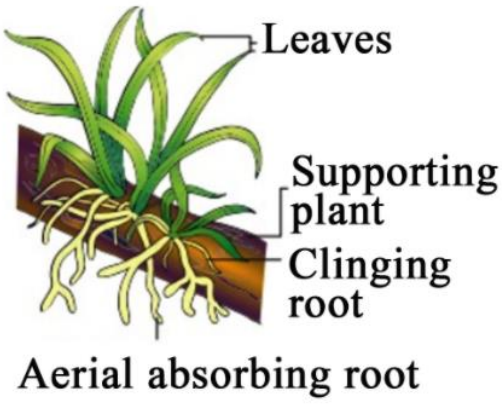


Fig. Clinging or Climbing Roots https://dcx0p3on5z8dw.cloudfront.net/Aakash/s3fs-public/inline-images/20_0.png?MBXoJqDARs8B9G8eVKDqXvdocuk7kbkP

C.2.3. ROOTS MODIFIED FOR VITAL FUNCTIONS

(i) Assimilatory or Photosynthetic Roots

These are green roots, which are capable of photosynthesis. In some submerged roots are highly branched and green in colour to perform photosynthesis

(ii) Haustorial or Parasitic Roots

These roots occur in parasitic plants that are achlorophyllous. It absorb nourishment by establishing contact with the vascular tissue of the host plant. Hence, also called as sucking roots or suckers. And obtains both water and food from the host.

Fig. Haustorial or Parasitic Roots https://bygl.osu.edu/sites/default/files/inline-images/Haustoria%201%20-%20JB.jpg

(iii) Hygroscopic or Epiphytic Roots

These are adventitious roots found in some Orchids. Orchids grow as epiphytes upon the trunks or branches of the trees. The epiphytes develop aerial roots which hang freely in the air. Roots of orchids are whitish in colour and are covered with a specialized spongy tissue called velamen. Velamen helps the roots in absorbing atmospheric moisture.

Fig. Epiphyte orchids (Orchidaceae) https://biomesecosystem.weebly.com/vegetation4.html

(iv) Floating Roots or Root Floats

These are inflated buoyant roots, spongy in texture due to abundant aerenchyma, arising at the nodes of some aquatic plants like .These roots grow out of water and keep the plant afl oat. These also help in gaseous exchange for respiration.

Fig. Floating Roots or Root Floats

https://dustinsfishtanks.com/cdn/shop/products/WM_RedRootFloater_05_42aa0785-7ccf-4682-bd5d-903e4d129898_1024x1024@2x.jpg?v=1667415390

(v) Reproductive Roots

Some fleshy adventitious roots develop adventitious buds. These buds can grow into new plants under favourable conditions. Such roots are called reproductive roots. Sweet potato, etc.

Fig. Sweet potato

https://media.prod.bunnings.com.au/api/public/content/c2434d09c04a4426842b96945cd3899b?v=865cff7b&t=w1100dpr1

D. FUNCTIONS OF ROOTS

Roots perform two types of functions — primary And secondary.

- **D.1. Primary or Main Functions (Performed by all**

The roots)

- **Anchorage:** The roots fix the plant in the soil firmly and support the aerial shoot system.
- **Absorption:** The roots absorb water and mineral from the soil.
- **Translocation:** The absorbed water and minerals are translocated to the stem through the xylem of the root.
- Synthesis of plant growth regulators
- **Prevention of soil erosion:** Roots hold the soil particles firmly and prevent the soil from erosion.

- **B. Secondary or Accessary Functions:** The secondary functions are specialized functions and are performed only by those roots which are modified accordingly:

- **Storage of food:** Some roots store food and become fl eshy, e.g., carrot, radish, sweet potato, etc.
- **Additional support:** Some roots like prop roots and stilt roots provide additional support to the plant, e.g., , (Maize), etc.
- **Climbing:** Some weak stemmed plants climb up a support with the help of clinging roots.
- **Nitrogen fi xation:** The roots of some leguminous plants contain nitrogen-fixing bacteria in their nodules. These bacteria fix free atmospheric nitrogen. Thus, enrich the soil by adding nitrogen compounds.
- **Breathing:** Respiratory roots or pneumatophores of mangrove plants have lenticels that help in exchange of gases.
- **Moisture absorption and retention:** Hygroscopic roots of some orchids absorb moisture directly from the air.
- **Absorption of food:** In parasitic plants, spine-like adventitious roots penetrate the host and obtain food and water from the latter.
- **Assimilation:** The green roots of , water chestnut, carry out photosynthesis.
- **Floating:** The roots of some aquatic plants store air and function as floats.

- **Balancing:** Cluster of adventitious roots arising in free floating aquatic plants (e.g., etc.) helps in balancing the plants over water, surface.
- **Reproduction.** The roots of some plants have adventitious buds (e.g., sweet potato) which help in reproduction.

② Morphology of the Stem

The Stem is the main structural axes of vascular plants, it supports leaves, fl owers and fruits. It develops from the seed plumule.

A. BUDS

A bud is a compacted underdeveloped shoot having a growing point, surrounded by closely placed immature leaves. As the bud grows, the internodes become longer and the leaves spread out, resulting in the formation of a young shoot.

A.1. PROTECTION OF BUDS

- Buds when covered by a series of overlapping and protective bud scales are called **covered or closed buds** or winter buds.
- Buds without protective scales are called **naked buds** found in herbaceous plants.
- The bud scales are often covered with hair or a coating of waxy, oily or resinous matter to prevent desiccation and injuries due to extremes of temperature.

A.2. CLASSIFICATION OF BUDS

On the basis of nature or structure and position.

1. According to the nature or structure, buds are of the following types:

- **Vegetative Buds:** Give rise to leafy shoots.
- **Floral or Flower Buds:** Give rise to flowers or floral shoots.
- **Mixed Buds:** Give rise to both vegetative shoots and flowers.

2. According to the origin and position, the buds are of following type:

- **Terminal or Apical Buds** Occur at the tips of the main stem and its branches.it is help in length-wise increase of stem and its branches
- **Lateral Buds** Present on the stem and branches at various places except apices.
- **Adventitious Buds:** Develop at places other than stem.
- **Foliar or epiphyllous:** Found on leaves.
- **Radical:** Found on roots, e.g., sweet potato
- **Cauline:** Found on the stem and its branches, at places other than nodes and apices.

A.3. MODIFICATIONS OF BUDS

- **Tendrillar Buds:** in some plants are modified into long spring-like threads called tendrils. They help the plant with weak stem in climbing over some support, e.g., gourds (cucumber, pumpkins, watermelon) and grapevines.
- **Bud Thorns** Axillary buds of stems may also get modified into woody, straight and pointed thorns. They protect plants from browsing animals, to reduce. Transpiration and act as organ of defense against grazing, e.g., Citrus,
- **Bulbils and Turions**

Bulbils: These are specialized buds, which become fl eshy due to the storage of food and take part in vegetative reproduction. Bulbils may be axillary (e.g., lily), on the leaf, e.g., hairy Bittercress in place of flower on the floral axis (e.g., Onion,) or base of the swollen roots (e.g.,).

Turions: The fleshy buds found in many aquatic plants perform the function of perennation

B. Functions of the stem

- Stem bears leaves, fl owers and fruits.
- It conducts water and minerals from the roots to the leaves, flowers, and fruits.
- It also transports food, manufactured by the leaves to the roots, fruits and other storage organs of the plant.
- It adds new cells, tissues, and organs, which are required for the continued functioning of the plant.
- A large number of plants store food and water in their underground stems

C. DIFFERENT FORMS OF STEM

- **Aerial or epiterranean stems** it is grow above the soil surface.
- **Sub-aerial or subepiterranean stems The** aerial stems of some plants trail or creep on the ground.
- **Underground or subterranean stems** the stems grow in the soil.

1. **Reduced stems:** The stem is reduced to a small disc above the base of the root. Nodes and internodes are not distinct, and leaves arise crowded together on the stems.

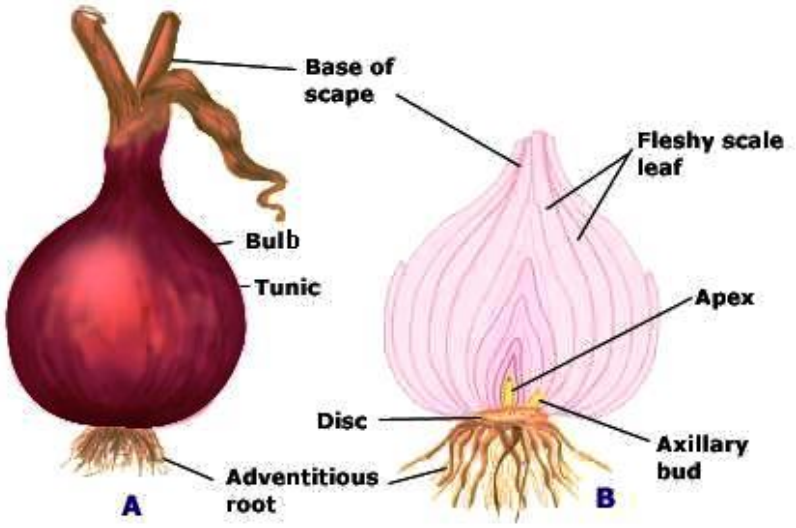


Fig. tunicated bulb. https://files.askiitians.com/cdn1/cms-content/biologymorphology-of-flowering-plantsstem_7.jpg

2. **Erect stems:** These are the most common type of aerial stems. The stems are strong enough to remain erect or upright without any external support. The erect stem is of the following types:

Culm: Erect, unbranched, cylindrical, hollow, nodes visible as rings and swollen. Stems are joined at nodes, e.g., bambino (family Gramineae).

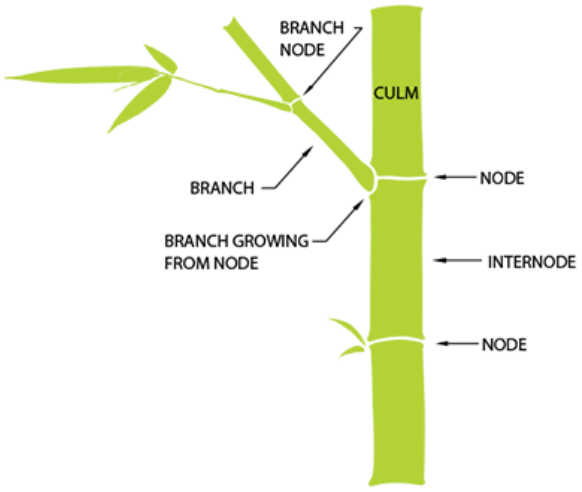


Fig. Bamboo culm. https://bambooauniqueandversatileplant.weebly.com/uploads/1/9/2/3/19234437/9941644_orig.gif

Caudex: Erect, unbranched, cylindrical stem. On the stem, scars of fallen leaves are visible, e.g., coconut date palm.

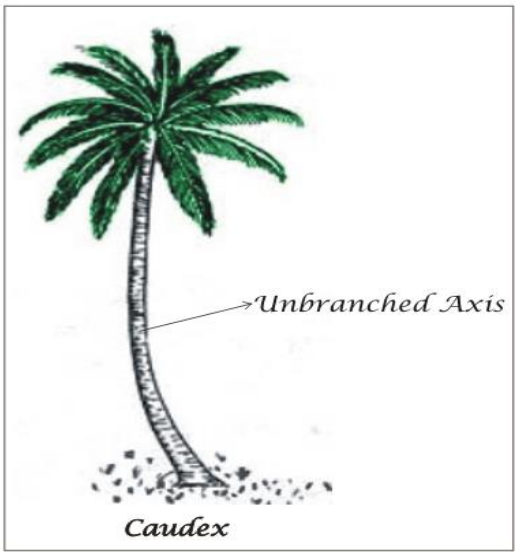


Fig. caudex stem https://cdn.entrance360.com/media/uploads/2019/08/02/concept-1_image-3.jpg

Excurrent: The main stem is thicker than the branches, tapers towards the apical part, branching is acropetal.

Decurrent or deliquescent: The main stem is short, and branching does not follow any definite manner and spread more laterally than vertically. At the stem top, the branches appear like a crown.

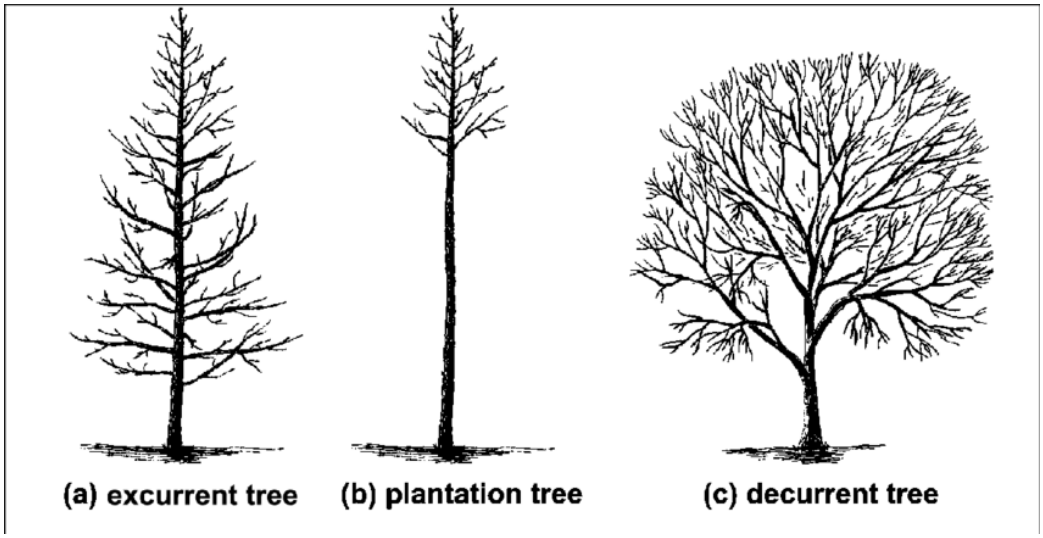


Fig. Different tree forms including (a) excurrent tree with a central trunk, (b) special case of a excurrent tree grown in a plantation and (c) a decurrent tree with spreading form and no central trunk (Harris et al. 2004). https://www.researchgate.net/profile/Ken-James-2/publication/258565809/figure/fig37/AS:669444707721225@1536619464913/Different-tree-forms-including-a-excurrent-tree-with-a-central-trunk-b-special.png

3. **Weak stems:** These are thin, delicate, and slender stems, which cannot stand erect. Therefore, they require support to expose their leaves and reproductive organs. The weak stems may climb up support or grow prostrate on the ground.

A. Upright weak stems: These are weak stemmed plants, which climb up support to expose their foliage and reproductive organs.

B. Sub-aerial or sub-epiterranean stems (prostrate or weak stems):

These weak stems spread on the ground for exposing their leaves and reproductive organs. Types of sub-aerial stems is:

- **Runners** The sub-aerial weak stem and their slender lateral branches grow horizontally along the soil surface. Adventitious roots arise from nodes and nodes bear new a tuft of leaves.
- **Stolon** They are elongated, horizontal or arched runners with long internodes like runners, these are slender axillary branches, which develop adventitious roots on coming in contact with the soil.
- **Sucker** These stems are similar to the stolon but it grows obliquely upwards and gives rise to a new plant
- **Offset:** These are shorter and thicker than the runner and are often seen in aquatic plants

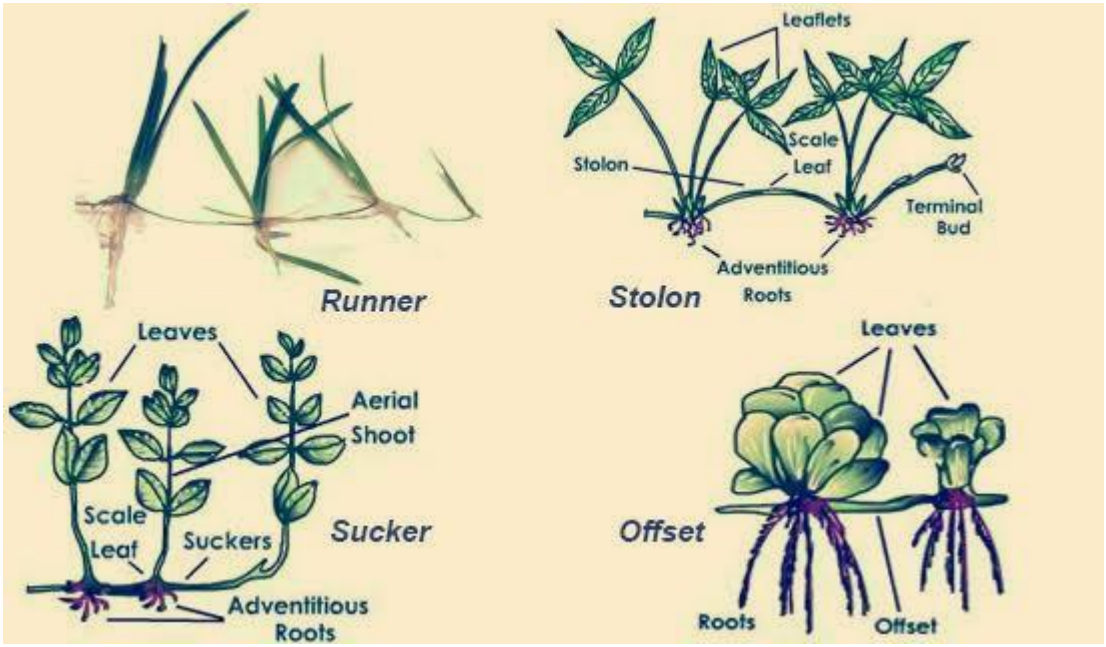


Fig. Types of sub-aerial stems https://www.vedantu.com/question-sets/b4c0d7f3-1f2f-4a78-92ad-6669aab9a0c22383191761798484898.png

4. **UNDERGROUND OR SUB-TERRANEAN STEMS** These stems lie below the soil surface. These are non-green, store food and are adapted for perennation. The underground stem sheds aerial shoots or leaves at intervals during favorable seasons. The aerial shoots wither or die on the approach of unfavorable growth period, but the underground stems tide over this unfavourable period by remaining dormant.

4.1. TYPES OF UNDERGROUND STEMS

1. Stem tuber

Fleshy, swollen, rounded or oblong distal portions of underground axillary or adventitious branches that arise from the underground basal nodes (present on tubers).The tips of these branches become enlarged in the form of tubers, due to the accumulation of surplus food material manufactured by the aerial shoots.

2. Rhizome It is fleshy, horizontally growing, perennial, underground stem which continues to grow for an indefinite period producing new leaves or shoots during favourable conditions. A rhizome bears nodes and internodes. The nodes bear scale leaves that protect axillary buds. It also bears adventitious roots on the nodes and on the lower side.

3. Corm

It is a vertically growing, thick, fleshy usually unbranched spherical or sub-spherical underground stem. It bears several circular nodes with scales, which represent thin sheathing bases of fallen dead leaves. They develop aerial shoots from their buds during favourable period. The aerial shoots manufacture food and store the same in their bases, where new corms are formed.

5. Bulb

An underground spherical structure possesses a reduced discoid stem and several fleshy, sheathing bases (usually called scales), enclosing a terminal bud. The base of the discoid stem bears fibrous adventitious roots. The whole structure takes the shape of a bulb.

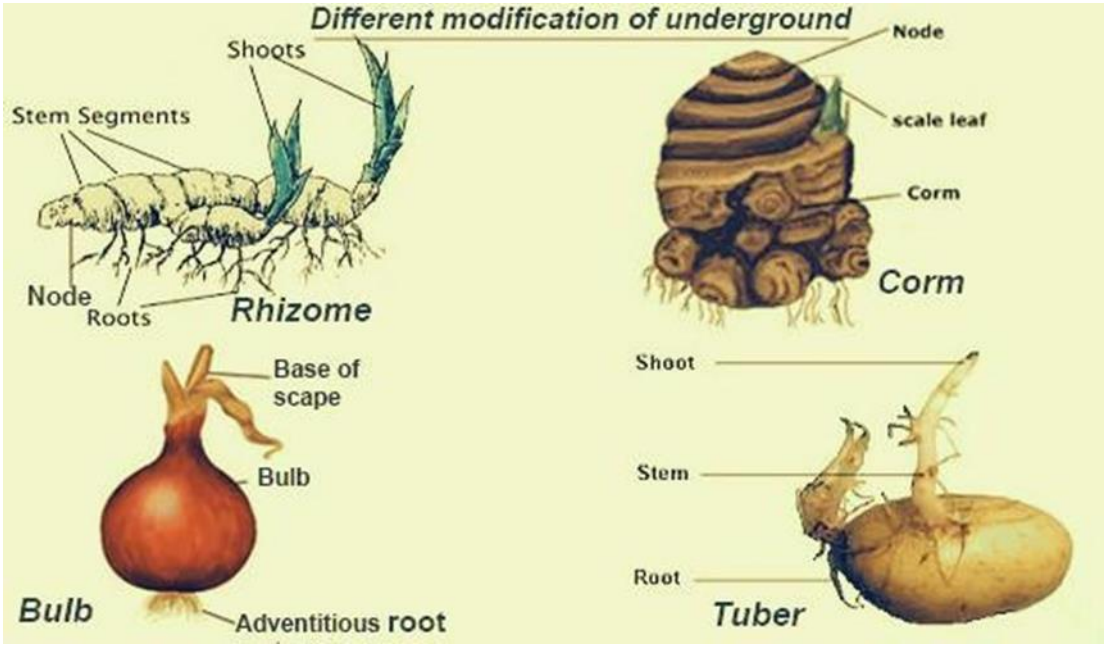


Fig. undergound stems types. https://www.vedantu.com/question-answer/are-the-different-types-of-underground-stem-m-class-11-biology-cbse-5f4cbf7a56e9d4741097efe2

D. MODIFICATIONS OF AERIAL STEMS

In some plants, stems undergo an extreme degree of modifications and depict specific appearances to perform certain special functions besides the normal functions.

D.1. TYPES OF AERIAL STEMS

D.1.1. Stem Tendrils

These are thin, thread-like sensitive, leafless spring-like structures, which coil around a support and help the plant in climbing. Stem tendrils can be branch or unbranched. Branched stem tendrils may bear scale leaves in the region of forking. Stem tendrils are of the following types:

- Axillary bud tendril
- Apical bud tendril

D.1.2. Stem Thorns

These are modified axillary buds, which have lost the capacity for growth. These are stiff, woody, sharp and pointed. Reduce transpiration and prevent browsing by animals.

D.1.3. Phylloclade

These are green flattened or cylindrical stem or branches, which appear leaf like, and have taken over the function of photosynthesis in the absence of normal green leaves. The true leaves are Caducous or reduced to scales or spines to reduce transpiration. Phylloclades are succulent due to storage of water, food and are of unlimited growth.

D.1.4. Cladode : This is a modification of the phylloclade where it contains one or more internodes.

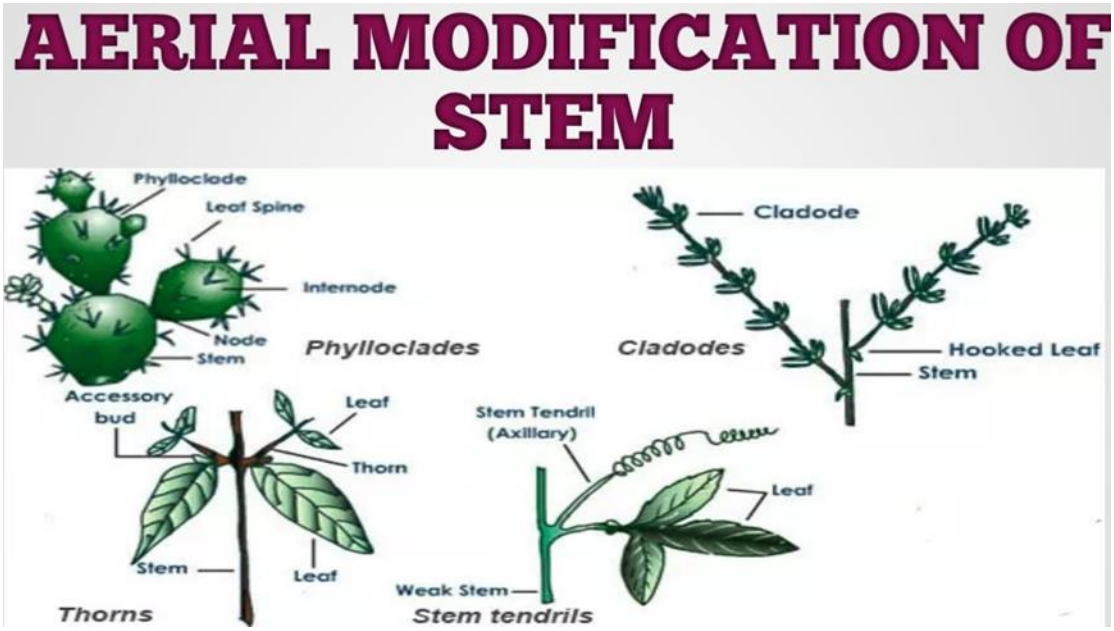


Fig. Aerial Stems. https://www.youtube.com/watch?v=urJaY26WXfE

③ MORPHOLOGY OF LEAF

Leaf is a flattened, lateral outgrowth, which is borne exogenously on the node of a stem or its branches and bears bud in its axil. Typically, it is green in colour due to the presence of chlorophyll and is the chief photosynthetic organ of the plant. All the green leaves of a plant are collectively called foliage.

1. **Parts of a leaf**

1.1. leaf base or hypopodium

It is the lowermost part of the leaf, by which the leaf is joined to the node of the stem or its branch. Usually, it protects a small bud in its axil.

1.2. petiole or mesopodium

It is a cylindrical or sub-cylindrical stalk of the leaf. It raises the lamina above the stem to provide maximum exposure. The leaves with petioles are called petiolate leaves.

1.3. Lamina or leaf blade or epipodium.

It is green, expanded portion of the leaf. It is the main site of photosynthesis and helps in exchange of gases. Lamina is interspersed with a number of veins and veinlets. Witches contain vascular tissues

For the transport of water and food. They also provide rigidity to the lamina and keep the latter expanded.

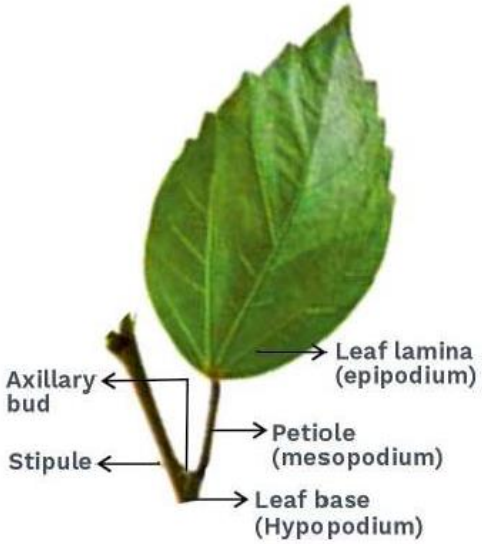
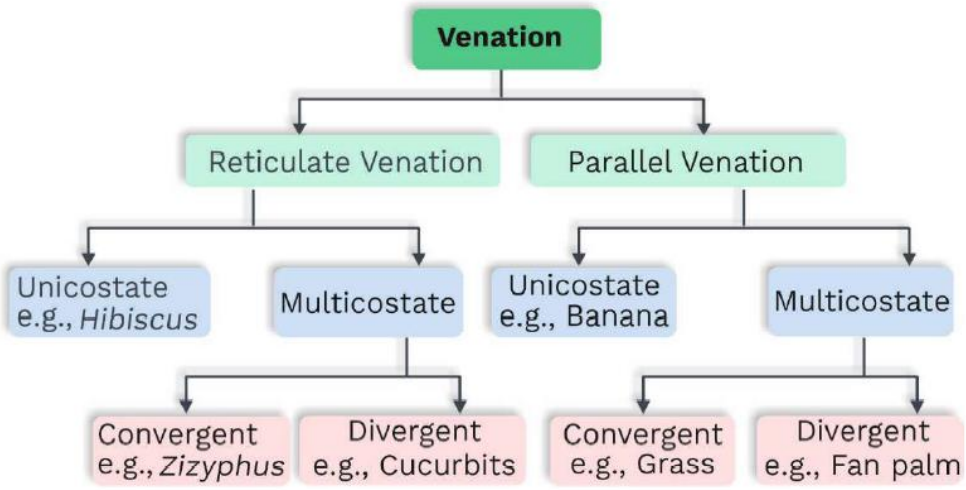


Fig. Parts of a leaf[2]

2. Types of Leaves

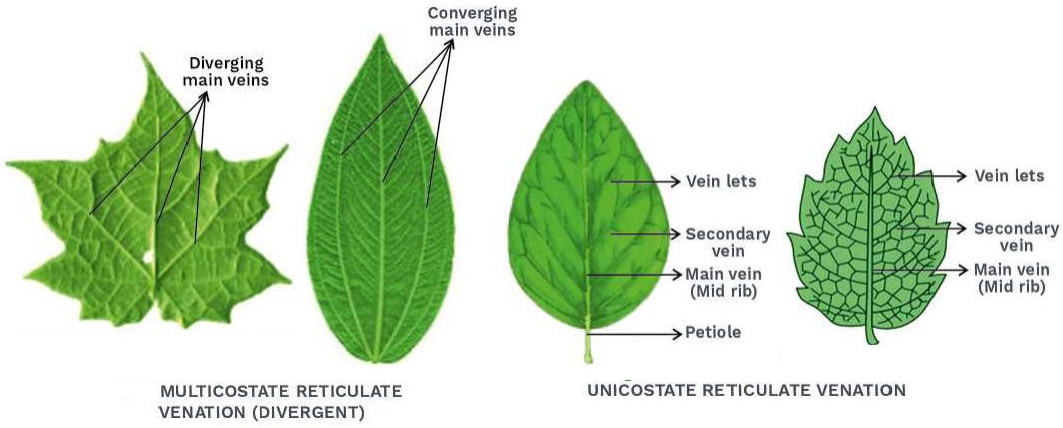
2.1. Venation

The arrangement of veins and veinlets in the lamina of a leaf is called venation. The veins are the conducting channels for water, minerals and organic food. Veins also provide firmness to the lamina and keep it expanded. The lamina has one or more prominent veins termed as midribs, which arise from the petiole. Midrib (prominent/main vein) gives rise to lateral veins that traverse the entire lamina. The veins and veinlets are more prominent on the undersurface of the lamina in dorsiventral leaves.



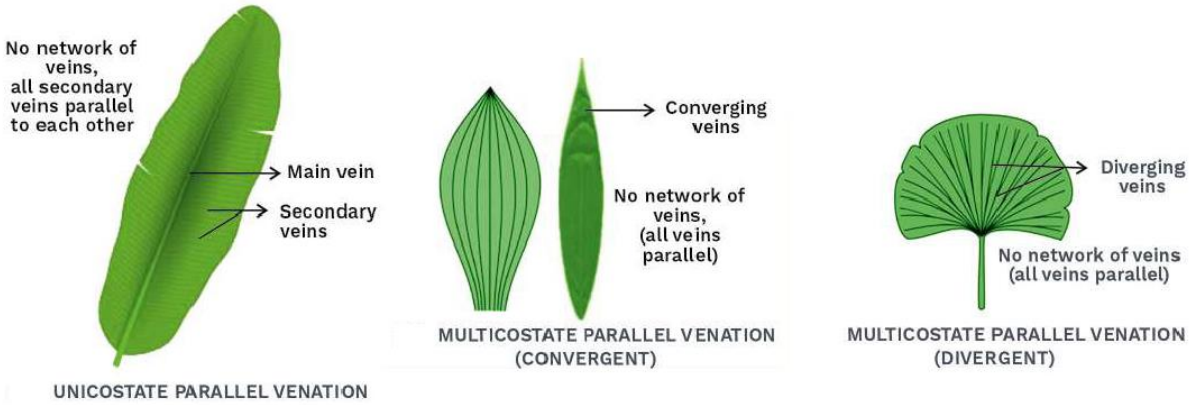
2.1.1. Reticulate Venation

The veins arising from the midrib, branch and re-branch to form a network of veins, this network is reticulate venation. It is a characteristic feature of the leaves of dicot plants.



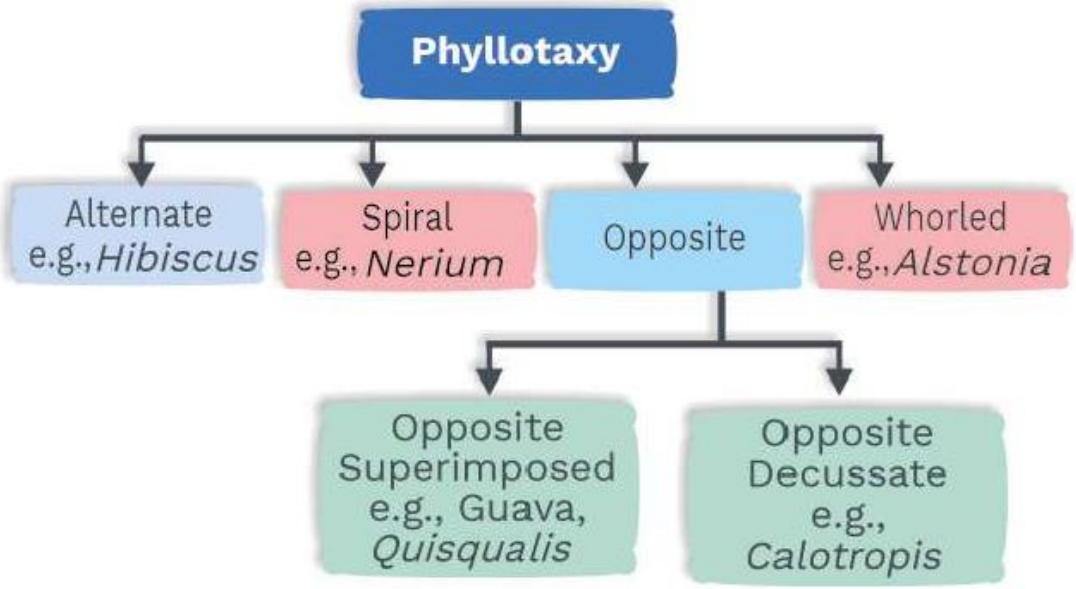
2.1.2. Parallel Venation

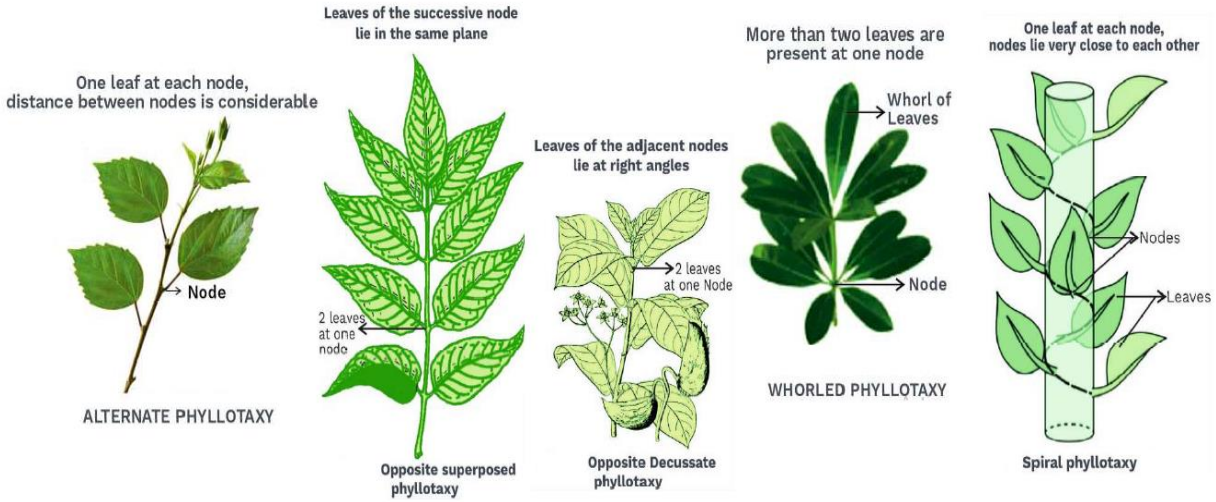
The veins arising from midrib or main veins run parallel to each other towards the margin or the apex of the lamina. The veinlets are inconspicuous and reticulation or network of veinlets is absent. Parallel venation is characteristic of the leaves of monocot plants.



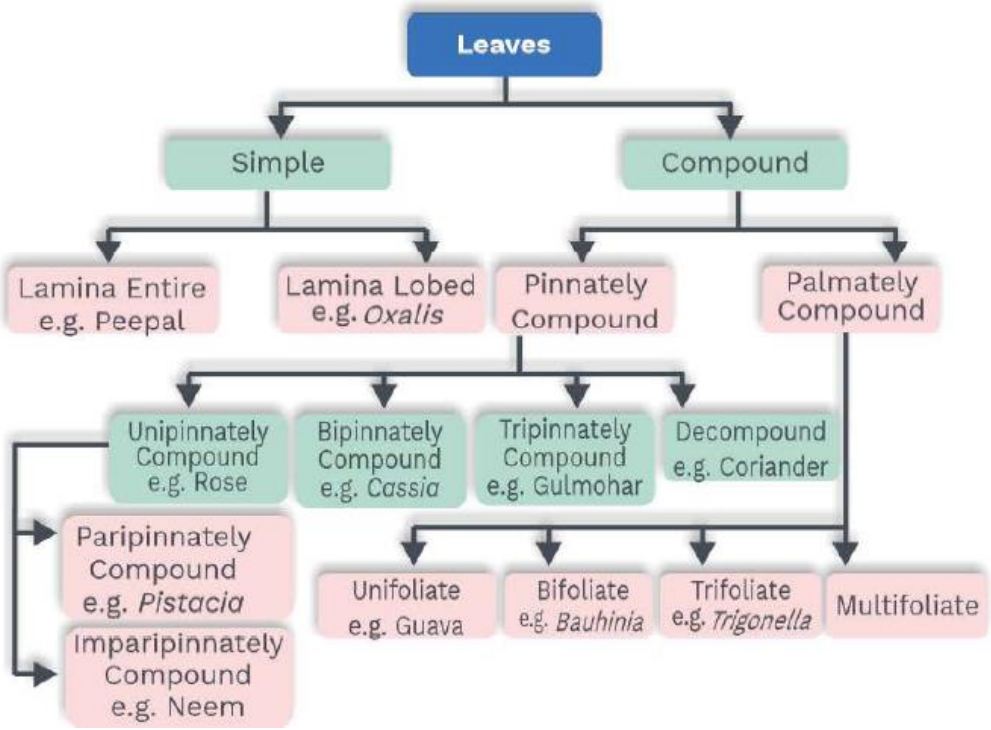
2.2. Phyllotaxy

Phyllotaxy is the arrangement or distribution of leaves on the stem or its branches so that they may receive maximum sunlight to perform photosynthesis.



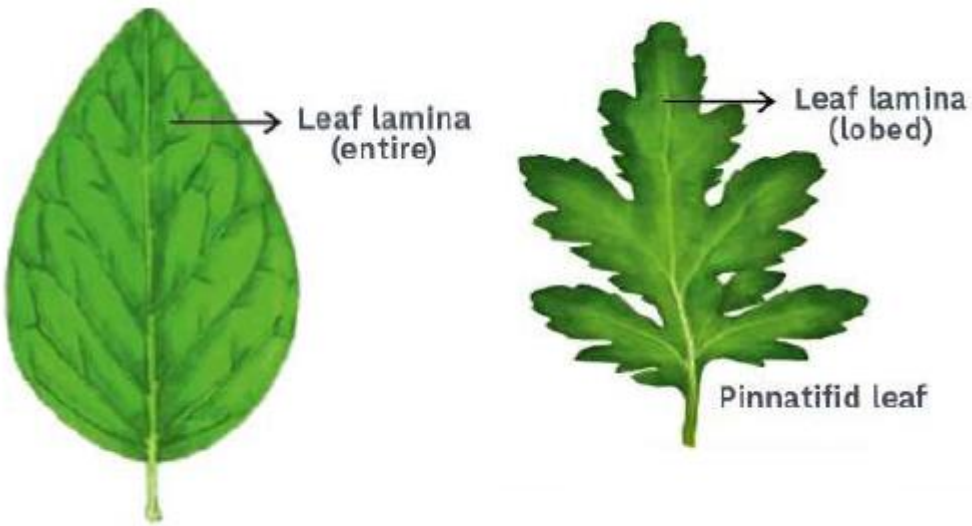


2.3. Simple and Compound leaves



2.3.1. Simple leaf

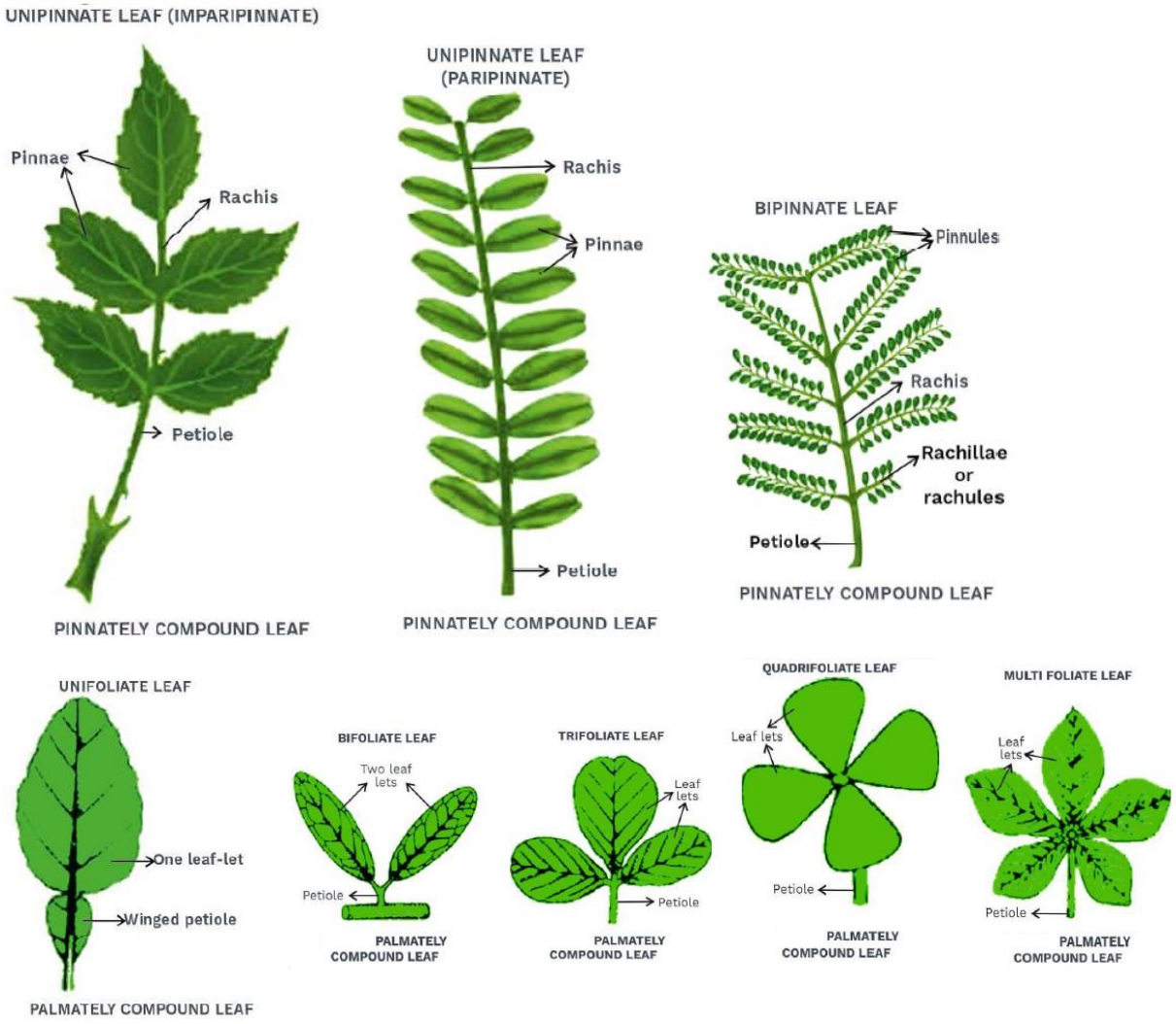
The simple leaf has single or undivided lamina. The lamina of a simple leaf may have incisions, but the incisions do not reach the midrib and the lamina does not divide into separate lobes



SIMPLE LEAVES

2.3.2. Compound Leaf

Compound leaf has its lamina completely divided into distinct segments called leaflets or pinnae. In such leaves, the leaflets are distinct, free from one another and articulated (joined) to the rachis (a derivative of the midrib) or the tip of the petiole. The leaflets or pinnae resemble leaf in having base, stalk and blade.



3. MODIFICATION OF LEAVES

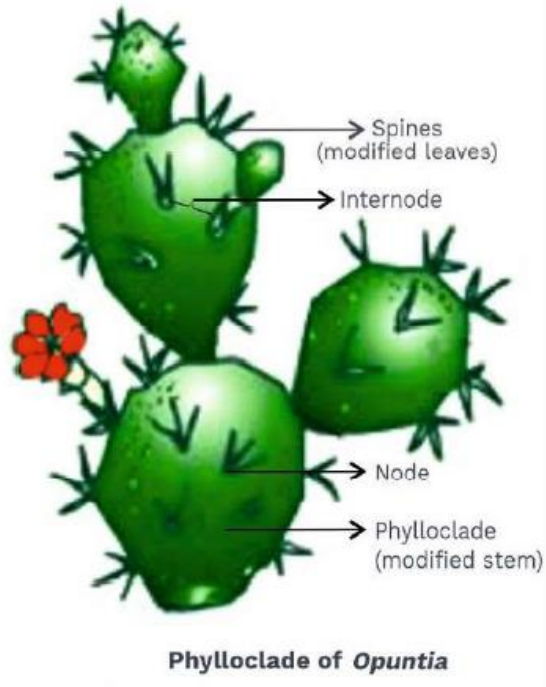
The modifications of leaves help to perform special functions.

3.1. Leaf tendrils

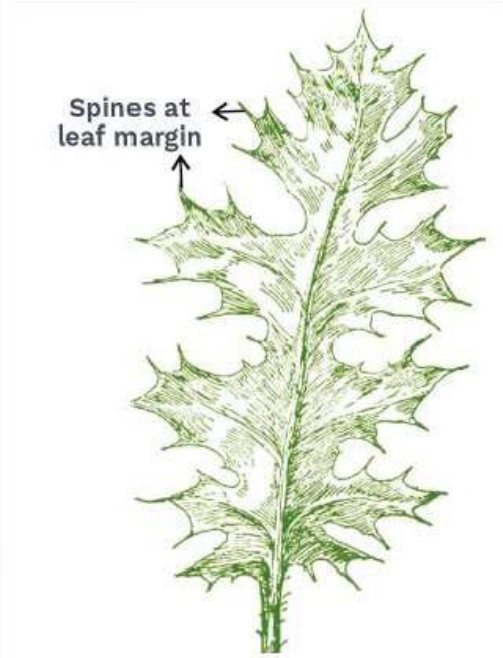
In some weak stemmed plants, the leaves or their parts are modified into sensitive, spring-like Slender, coiled structures called tendrils. Leaf tendrils help the plant to climb up a support to expose its foliage to sunlight. Leaf tendrils are usually unbranched and devoid of scales.

3.2. Leaf spines

In some plants, leaves or their parts are modified into sharp pointed structures called spines. They protect the plant from grazing animals and Excessive transpiration.



Phylloclade of *Opuntia*



3.3. Phyllodes or Phyllodia

The petiole of Australian Acacia and the part of rachis become flattened, taking the shape and functions of the leaf. In such plants, the normal leaves develop in seedling stage and soon fallow (leaves are ephemeral). The fl attened petioles which carry out the functions of the lamina are called phyllodes. They also help in reducing transpiration because they are vertically placed and have fewer stomata.

3.4. Leaf pitcher

In some insectivorous plants, the leaf or lamina is modified into a pitcher-like structure. These leaf pitchers are meant for catching and digesting the insects,In pitcher plants, the leaf apex gives rise to a coloured lid for attracting the insects.

3.5. Storage or Fleshy leaves:

They are fleshy scale leaves which store water and food materials e.g., Onion, garlic etc.

FIGURE: AUSTRALIAN ACACIA (PHYLLODE)

4. FUNCTIONS OF LEAVES

Leaves perform primary and secondary functions.

5.1. Primary or Main Functions

- The most important function of leaves is the synthesis of organic food through photosynthesis.
- Stomata on leaves help in the exchange of gases that are necessary for photosynthesis and respiration.
- Leaves are the main site of loss of water called transpiration. Transpiration provides necessary force for the ascent of sap and keeps the temperature of plants, a bit low in summer.

- Leaves protect the axillary and terminal buds from mechanical injury and desiccation.

5.2. Secondary or Accessory Functions

- The leaves or their parts be modified into tendrils to help the weak stemmed plant climb up a support, to expose the foliage to sunlight and air.
- The leaves store water to resist drought. In addition, the onion leaf bases store food.
- Leaf spines reduce transpiration and provide protection from grazing animals.
- Leaves or leaf segments of insectivorous plants are modified into a trap mechanism for catching and digesting small insects.
- Some leaves of plants help in vegetative multiplication.

④ FLOWER

A flower is a highly modified shoot, which performs the function of sexual reproduction. It has a highly condensed axis called thalamus or torus. Shoot bears flowers only when the plant has grown vegetatively.

1. PARTS OF FLOWER

Flower of the whorls are as known as:

- Sepals
- Petals
- Stamens
- Carpels

- **Non-Essential Floral Parts:** Sepals and Petals do not participate in Fruit and Seed formation.
- **Essential Floral Parts:** Stamens and Carpels participate in Fruit and Seed formation.

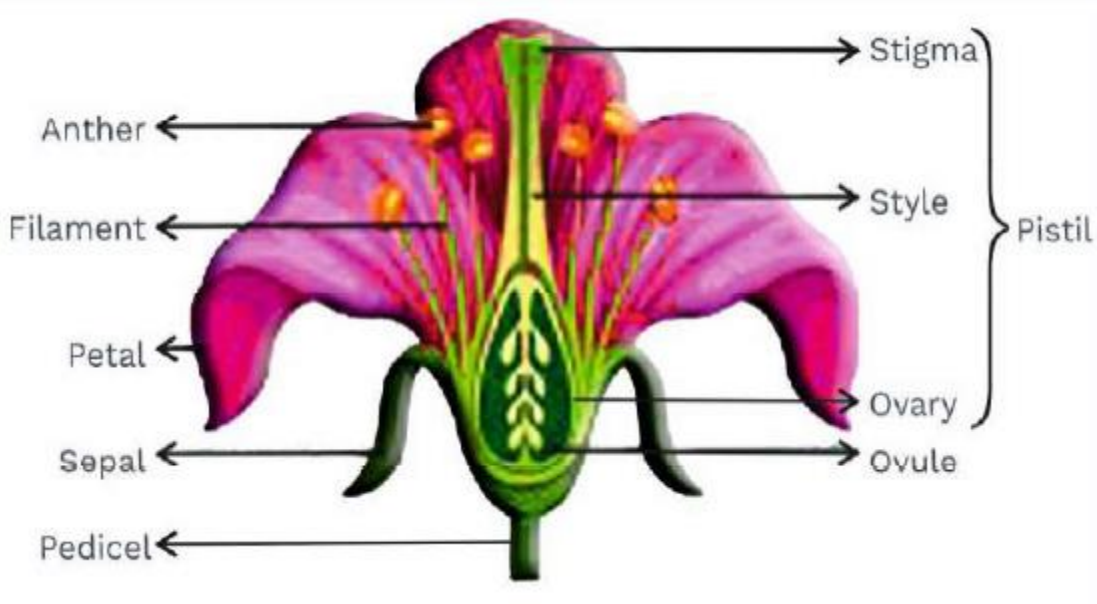
A. Parts of Stamen

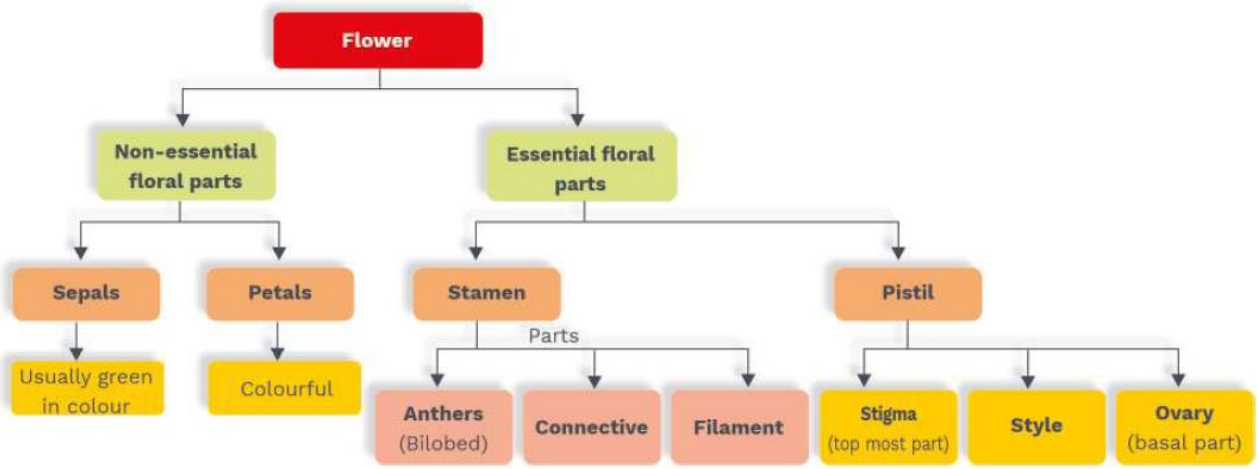
- **Broad Terminal Anther:** It contains tiny structures named pollen grains or microspores.
- **Filament:** Stalk-like structure that holds the anthers and supplies water and nutrients to the developing microspores.

B. Parts of a Carpel

- Receptive tip or Stigma

- A stalk-like Style
- A basal swollen part, Ovary
- The ovary contains one or more oval structures called ovules.





2. MEROSITY IN FLOWERS

There is some basic number of floral appendages in the floral whorls of a flower. This phenomenon is called **merosity.**

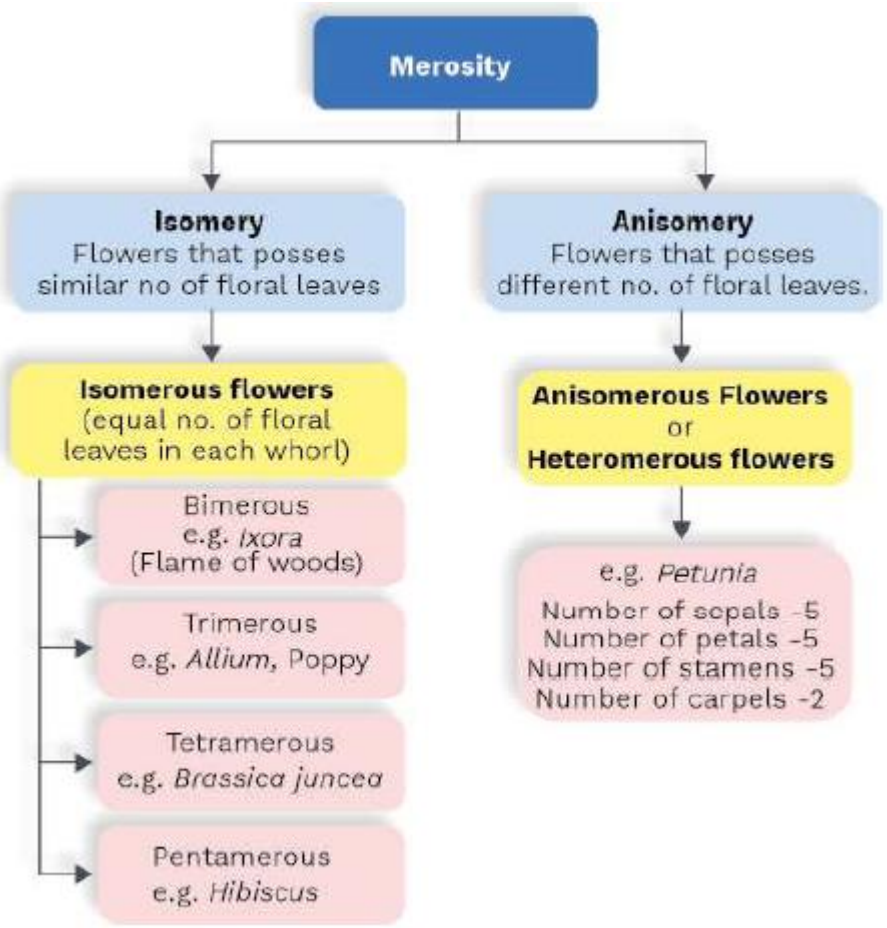
Isomery: When the number of floral leaves in each whorl is same, the phenomenon is called isomery.

Depending upon the similar basic number of floral leaves, a flower is described as:

- **Bimerous:** Floral are leaves two or in multiple of two in each whorl,
- **Trimerous:** Floral leaves are three or in multiples of three.
- **Tetramerous:** Floral leaves are four or in multiple of four.

- **Pentamerous:** Floral leaves are five or in multiple of five.

Heteromery: When the number of floral leaves vary in different whorls of a flower, the number of carpels may be fewer than the number of other floral leaves. This phenomenon is called heteromery.



3. COMPLETE AND INCOMPLETE FLOWERS

- **Complete flower** having all the four types of floral organs
- **The flower incomplete** is the absence of any one or more of the floral organs.

4. Unisexual flower

A unisexual flower bears only one of the two essential floral organs. It would be male or staminate (if only stamens are present) and female or pistillate (if only carpels are present).

5. Bisexual flower

The flower that is contains both the essential organs, i.e., stamens and carpel (stamens and pistil).

6. Neuter Flower

Both the essential organs are absent in neuter flowers.

7. Monoecious Plants and Dioecious Plants

A. Monoecious Plants: Both the types of unisexual flowers (Staminate and Pistillate) are present on the same plant, e.g.,maize.

B. Dioecious Plants: When a plant bears only one type of unisexual flowers, it is termed as dioecious,

C. Polygamous Plants: Some plants possess more than one type of flower. In mango and cashew nut plants, intersexual, staminate (male) and neuter flowers occur together. Such plants are called polygamous.

8. FLORAL SYMMETRY

The arrangement of the floral organs around the thalamus of the flower is known as floral symmetry. The shoot (axis) on which the flower is borne is called mother axis.

The side of flowers towards mother axis is called the posterior side and the side away from it is called anterior side. In terminal flowers, a distinction into anterior and posterior sides is not found.

9. Regular and Irregular Flowers:

- A flower is said to be regular when its floral parts of each series of a flower are similar in size, shape, colour and origin.
- A flower is described as irregular when it shows any irregularity in any type of its floral organs whether in shape, size, colour or origin.

⑤ SEED

A true seed is a mature ovule that contains an embryo or miniature plant, stored food material and protective coverings. In most of the plants, the embryo ceases to grow immediately and lies dormant for one or more seasons, within the seed. Seed dormancy in most of the plants remains till they receive adequate sunlight, temperature, water and air. This phenomenon of seed dormancy has given several advantages for survival to the seed plants. Thus, the seed represents a stage between the beginning and end of plant growth.

1. STRUCTURE OF SEED

1.1. Dicotyledonous seed

The Parts of gram seed is:

- Seed Coat

- Cotyledons
- Embryonic axis

A. **Seed Coat:** The gram seed coat has two integuments surrounding the ovule. Seed coat is protective in nature.
    - **Testa:** It is the outer seed coat and is leathery, thick and brown in colour.
    - **Tegmen:** It is the inner coat that is thin, white, and often inseparable from the testa
    - **Hilum:** It is a scar on the seed coat through which the developing seeds are attached to the fruit.
    - **Micropyle:** It is the opening in the integuments and is visible in gram seed. Water is absorbed through the micropyle during the germination of seed.

B. Cotyledons

When the seed coats are removed, the large embryo becomes visible. The bulk of it consists of a pair of fleshy structures called cotyledons in dicot seeds. In gram seed, the cotyledons store food (carbohydrates and proteins) and provide nourishment to the developing embryonal axis. They lack endosperm. Such seeds are also found in many other plants such as groundnut, pea, mustard etc.

C. Embryonic axis

The cotyledons are attached laterally to the embryonal axis. Embryonic axis has two parts – the radicle or the embryonic root and the plumule or the shoot tip. The radicle

is outside the cotyledons and points towards micropyle. The plumule is seen only after separating the two cotyledons. The plumule or the shoot tip is enclosed within the first pair of small, folded true leaves. The region of the embryonal axis between the radicle and the point of attachment of the cotyledons is called hypocotyl (below the cotyledons), whereas the portion between the plumule and cotyledons is termed epicotyl (above the cotyledons). In the gram seed, epicotyl elongates rapidly when the seed germinates.

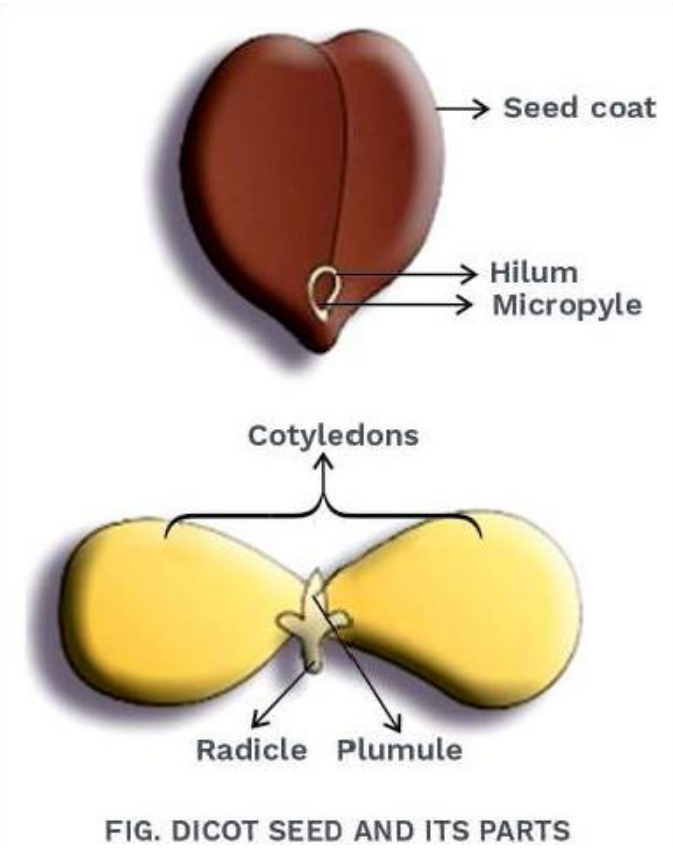


FIG. DICOT SEED AND ITS PARTS

1.2. Monocotyledonous seed

The internal structure of the grain in longitudinal section shows the following parts:

- **Pericarp:** On the outer side, a single covering called pericarp and testa are found. Inner to pericarp, the grain is divided into two unequal portions: Endosperm and Embryo.
- **Endosperm:** The upper half of the grain is made up of massive endosperm. The bulk of endosperm is laden with starch, but its outer layer next to the grain coat contains abundant protein. It is called aleurone layer. Proteins present in this layer help in the synthesis of some enzymes, needed for germination of the grain.
- **Embryo:** The lower half of the grain is occupied by the embryo. Maize embryo has a single cotyledon attached laterally to the embryonal axis. This cotyledon is called scutellum. The scutellum has a secretory epidermis, found in close contact with the endosperm. The epithelium helps the scutellum in absorbing the food material stored in the endosperm.
- **Embryonic Axis:** The portion of the embryonal axis below the cotyledon is the radicle. It is covered by a protective sheath called radicle sheath or coleorhiza.

The upper end of the embryonal axis is the plumule surrounded by a protective sheath called plumule sheath or coleoptile.

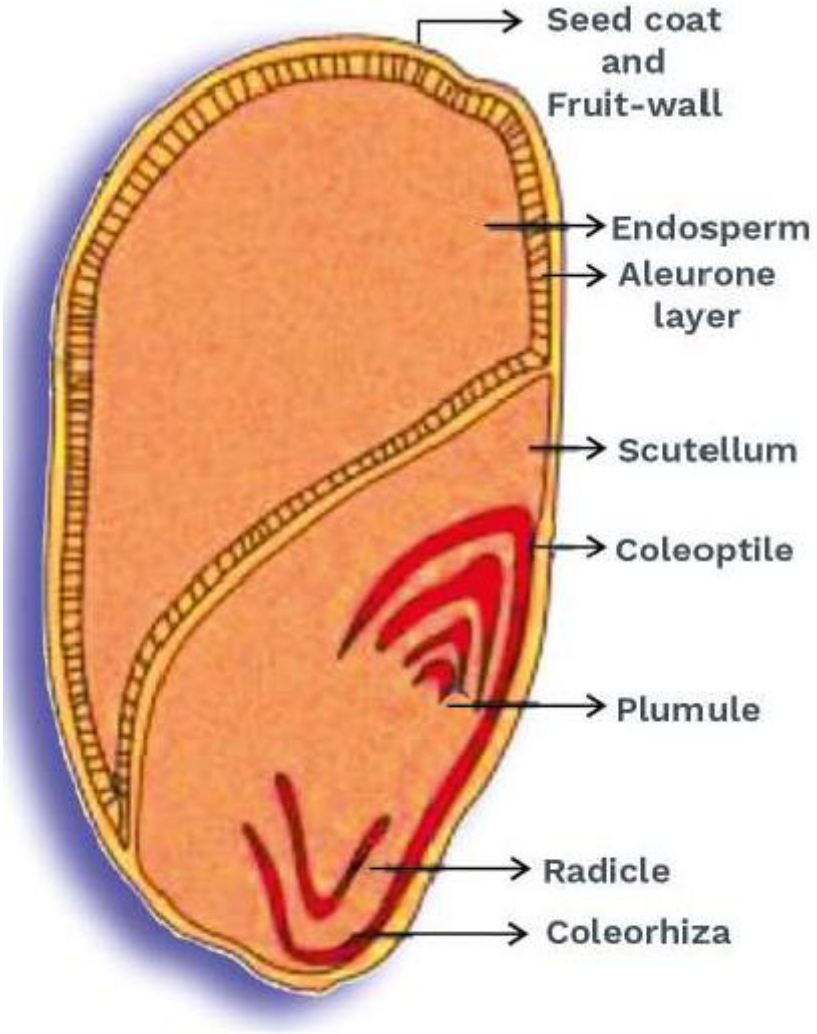


FIG. INTERNAL STRUCTURE OF MONOCOT SEED

2. TYPES OF SEEDS

- **Endospermic Seeds:** Seeds that contain endosperm at maturity are called endospermic or albuminous seeds. Mostly monocot seeds are endospermic, except a few.
- **Non-endospermic Seeds:** Seeds that do not contain endosperm at maturity are called nonendospermic or ex-albuminous seeds. Mostly dicot seeds are non-endospermic, except a few.