# LIVING WORLD

## Contents to be covered in this topic

- DEFINITION AND CHARACTERS OF LIVING ORGANISMS
- DIVERSITY IN LIVING WORLD
- BINOMIAL NOMENCLATURE
- FIVE KINDOMS OF LIFE AND THEIR SILENT FEATURES

# DEFINITION AND CHARACTERS OF LIVING ORGANISMS

## ❑ Introduction

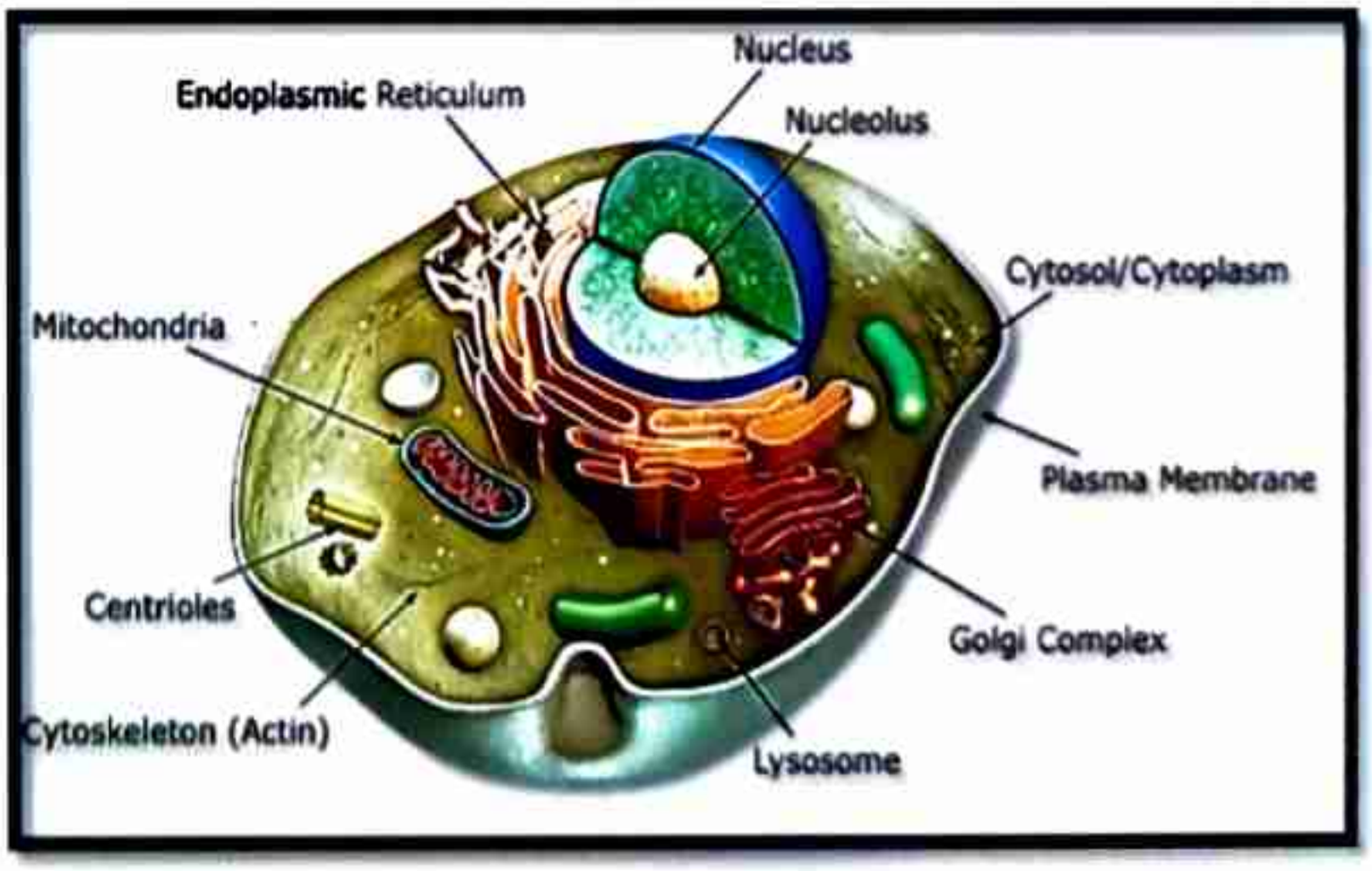
- World is full of **living and non-living things.** But **biology** deals with the **living beings** and their functions. There is a **great diversity of living beings.** Man could **recognize** that living organisms are related to each other.
- Various **forms of living organisms** are found in different types of habitats in the world like **ocean, air, fresh water, forests, cold mountains, deserts, hot water springs etc.**
- Makes us to **differentiate between the living and the non-living organisms**

## ❑ Definition of Life

The definition of life is that **living organism** should maintain homeostatis. As they are **composed of cells, structurally organized,** have the **capacity for growth, undergo metabolism, reproduction, adapt to their environment,** and respond to stimuli and continual change preceding death.

**Some characteristics of 'living organisms' are -**

1. **Cellular structure**
2. **Nutrition**
3. **Respiration**
4. **Movement**
5. **Excretion**
6. **Growth**
7. **Reproduction**
8. **Life cycle**



## ❖ CELLULAR STRUCTURE

living organisms are composed of characteristic types of **structural unit** called cells

## ❖ NUTRITION

Nutrition is the process by which organisms obtain **energy and raw materials** from nutrients such as proteins, carbohydrates and fats

## ❖ RESPIRATION

**Respiration** is the **release of energy** from food substances in all living cells.

Respiration is a **metabolic process** common to all living things The living animal respire continuously and it is an energy releasing process

## ❖ MOVEMENT

All living things move. Living being moves from **one place to another**

## ❖ EXCRETION

All living **things excrete.** Excretion is defined as the **removal of toxic materials, the waste products of metabolism** and substances in excess from the body of an organism.

## ❖ GROWTH

Growth in a living being takes place due to **internal processes, i.e.** cell division. Growth is an important characteristic feature of living beings.

## ❖ REPRODUCTION

Reproduction is an **important process for continuing the lineage of a species.**

**Unicellular organisms** like **bacteria, unicellular algae or Amoeba**, reproduction is synonymous with growth, i.e., increase in number of cells. Yeast and Hydra by budding. Fungi reproduce by asexual spores

❖ **SENSITIVITY**

All living things **are able to sense and respond to stimuli** around them such as light, temperature, water, gravity and chemical substances.

❖ **METABOLISM**

Metabolism can be defined as the **chemical process occurring within a living organism** in order for maintaining life .There are two type of **metabolism ,Anabolism and Catabolism**

❖ **LIFE CYCLE**

Every living being has definite life cycle of birth, growth and reproduction, ageing and death.

## DIVERSITY IN LIVING WORLD

It is known that more than 5 million living species exists on earth out of these approximately 1.5 million species are known and are described. Every year several new living species are reported by the scientists in the world and are added to the list. For convenience, depending upon their occurrence and physical forms they are classified. Their diversified sources like **deserts, oceans, forests and cold zones etc.**

# BINOMIAL NOMENCLATURE


- It is universally accepted that **plants and animals around use are known various local names for convenience,**
- It is also agreed that they should be known by **titles** uniform through out so that there is **no confusion** about their identity
- Scientists have finalize the procedure to assign their names **ICBN (International Code for Botanical Nomenclature)** and **ICZN (International Code for Zoological Nomenclature)** were entrusted to name the plants and animals respectively.
- The scientific name's the scientist **Assigned** has two components i.e. **Generic name** and specific epithet.
- Examples: ***Saraka indica*** (Ashok); Here, **Saraka** is **generic name;** and **indica** is **specific epithet**.

**Rules of Nomenclature:**

1. Each scientific name has **two parts**. The **first word** represents **genus** and the **second** represents the **specific epithet.**
2. The words of the name should be **separately underlined** when handwritten and should be in italics when printed.
3. The generic name should start with a capital letter and specific epithet should start with a small letter.
4. The names should be either Latin or Latinized.
5. Name of the author appears at the end of the scientific name in an abbreviated form

e.g. ***Saraca indica*** Linn. It indicates that this species is first described by Linnaeus.

It is the arrangement of organisms in specific group or categories based on certain characters. These categories are called **taxa**.

**Taxonomy:** It is the science of **identification, nomenclature and classification of organisms based on external and internal structure** with cell structure, development process and ecological information.

**Systematics:**

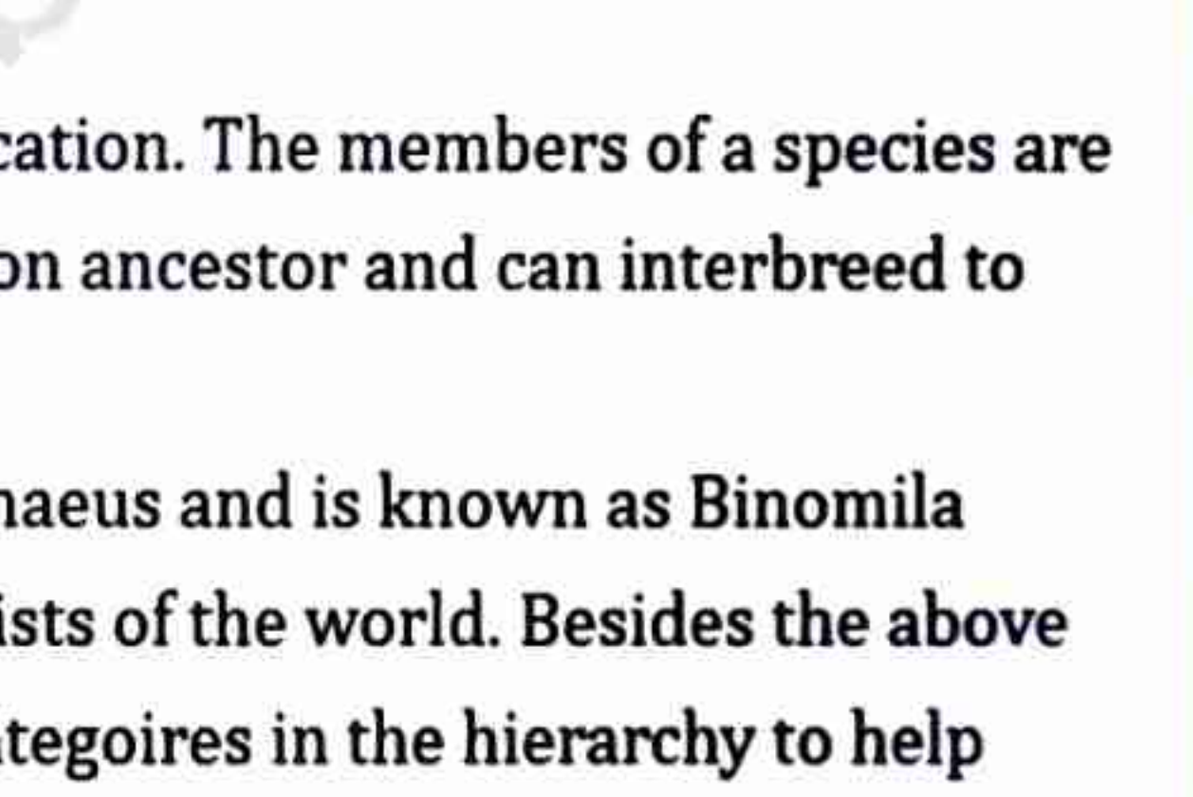
It is the study of organisms with reference to identification, nomenclature. classification and evolutionary relationship. The descending order of **taxa used in classification are -** Kingdom, Phylum or Division, Class, Order, Family, Genus and Species

1. **Kingdom:** Kingdom comprises of various phyla of animals and various divisions of plants
2. **Phylum/Division:** Phylum in animals and Division in plants includes related classes
3. **Class:** Several related orders are induced in a class.
4. **Order:** The order includes several related families.
5. **Family:** Family is a group of related families.
6. **Genus:** Genus is a group of related species which have co-related characters.
7. **Species:** It is the basic unit in classification. The members of a species are closely related, derived from a common ancestor and can interbreed to produce fertile offsprings.

This system was finalized by Carolus Linnaeus and is known as Binomila nomenclature. It is followed by all biologists of the world. Besides the above categories taxonomists developed sub-categoires in the hierarchy to help more precise placement of various taxa.

## FIVE KINDOMS OF LIFE

Five kingdoms of life and their salient features are as follows, namely Monera, Protista, Fungi, Animalia, Plantae, and Viruses.



## ➢ Silent features :

**(1) Monera:** The monerans are the simplest form of the entire living organisms. They are extremely small. These **organisms are prokaryotic.** The organisms are simple unicellular and microscopic. Examples: **Bacteria, mycoplasma, blue green algae, etc.**

**(2) Protista:**

A kingdom or large grouping that comprises mostly single-celled organisms such as the protozoa, simple algae and fungi, slime moulds, and the bacteria. They are now **divided into thirty phyla**, and some have both plant and animal characteristics.

**This group consists of many types of unicellular eukaryotic organisms:**

- They have a **defined nucleus** and **membrane bound organelles.**
- **Locomotion** occurs with the help of hair like structures called **cilia** e.g. Paramecium
- Few protests **synthesize their own food** i.e. they are autotrophic, while others show heterotrophic mode of nutrition

**(3) Fungi:**

Fungi are **simple eukaryotic, lacking chlorophyll** with salient features such as:

- Cell wall is present. It is made up of tough complex sugar called **chitin.**
- They are non-photosynthetic. Their mode of **nutrition is heterotrophic.** Most of them are saprophytes.
- Most fungi are **multicellular** (exceptionally yeast is unicellular fungus).
- The body of multicellular filamentous fungus is called **mycelium,** which is composed of several thread like structures called **hyphae.**
- Few fungi live in **symbiotic relationship** with **blue green algae** as Lichens. Examples: Mucor, Aspergillus, Penicillium, Rhizopus. etc.

**(4) Animalia:**

This group consists of all multicellular eukaryotes which do not posses cell wall. Their salient features are:

- These are heterotrophic they do not prepare their own food.
- They are multicellular eukaryotes.

- They show very limited growth which **stops after maturity**
- Kingdom animalia is further classified into **Vertebrates and Invertebrates**

**(5) Plantae:**

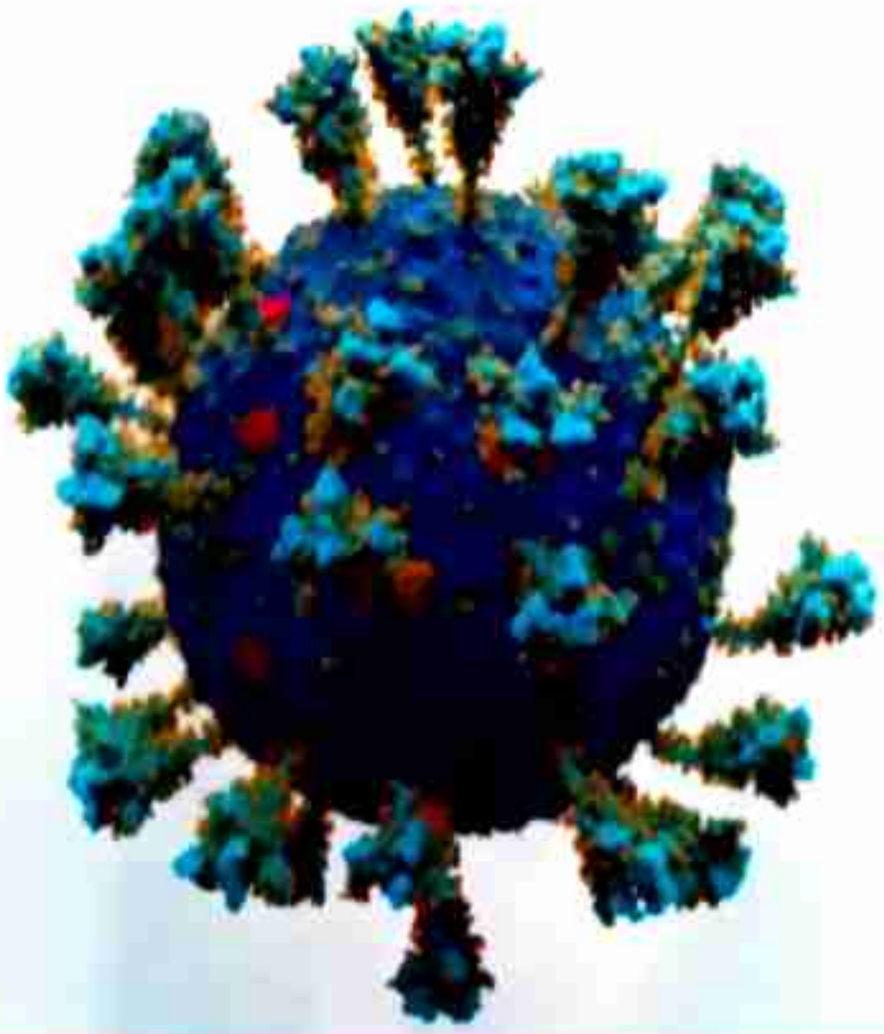
- This group consists of **multicellular Eukaryotic organisms**
- They are **autotrophic i.e.** they prepare their own food in presence of sunlight
- **Chlorophyll, water and carbon dioxide** by photosynthesis.
- They posses **cell wall made up of cellulose**
- Kingdom planate are further classified into Thallophyta, Bryophytes, Pteridophyta, Gymnosperm and Angiosperm.

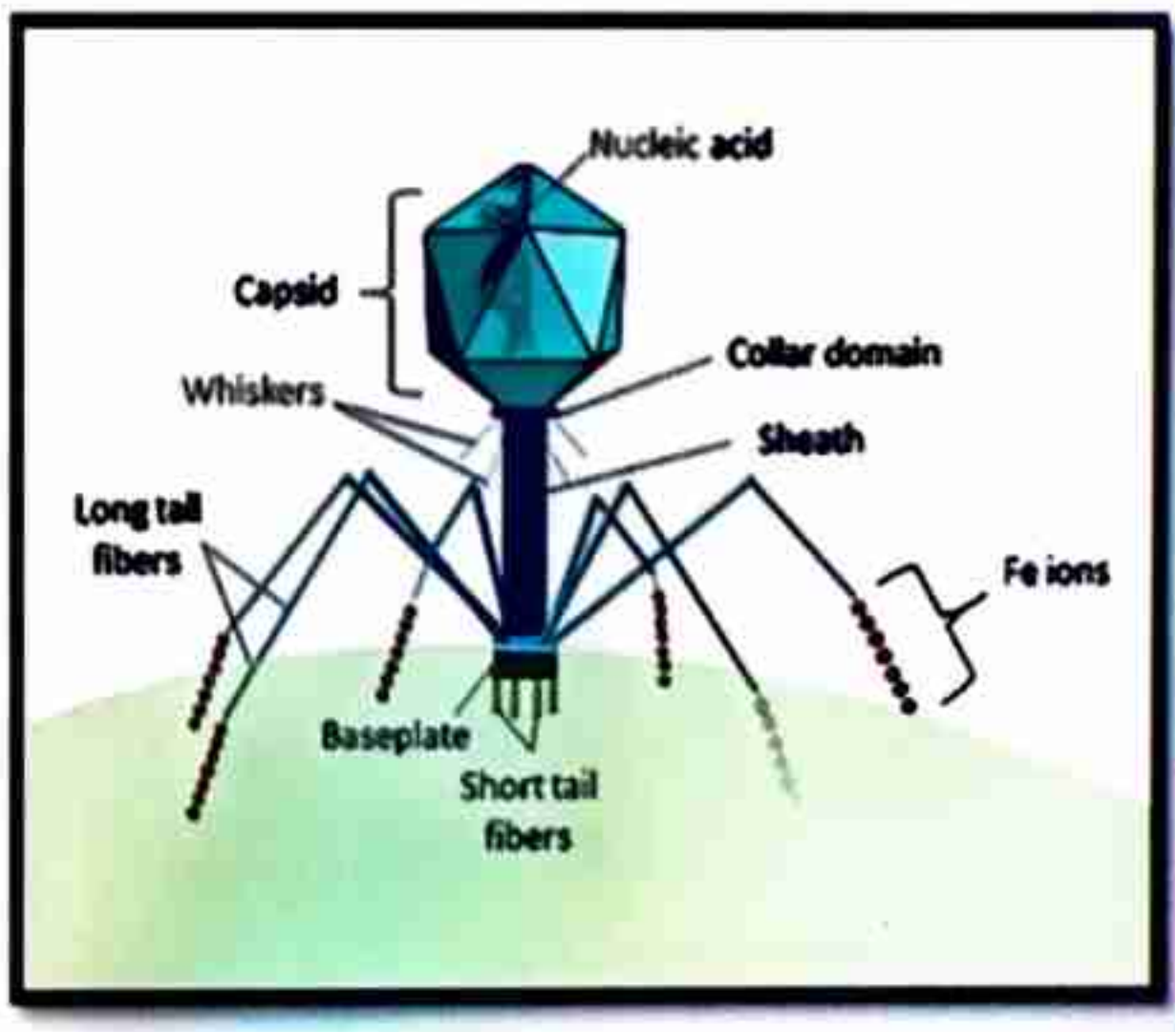
## VIRUSES:

Viruses are **ultra-microscopic, non-cellular living particles,** composed of solely of a nucleic acid **(DNA or RNA)** core, surrounded by a protein envelope called **capsid.** Therefore, they can grow only inside suitable **living cells.** That is why; they are **cultivated in the laboratory** only inside living cells. Viruses **do not increase in size. They can pass through filters, through which bacteria cannot pass.** A virus is called either **'DNA virus' or 'RNA virus'** depending on whether it contains the nucleic acid DNA or RNA. A virus **cannot have both DNA and RNA.**

### ❑ STRUCTURE OF VIRUSES:

**Structure of Viruses:** The viruses, which **infect bacteria, are called 'bacteriophages' or 'phages'.** The bacteriophages were first described Frederick W. Twort and d'Herelle in 1915.





**The functions of structural components of virus are:**

1. **Capsid (Protein Coat):** Protection of nucleic acid from destruction by DNase.
2. **Nucleic Acid Core:** Phage genome carrying genetic information necessary for replication of new phage.
3. **Spiral Protein Sheath:** Retracts, so that nucleic acid can pass from capsid into host cell's cytoplasm.
4. **End Plate and Tail Fibres:** Attachment of phage to specific receptor sites on a susceptible host's cell wall.

# MORPHOLOGY OF FLOWERING PLANTS

## Topics to be covered in this topic

- **DIFFERENT PARTS OF FLOWERING PLANTS**
  - The root
  - The stem
  - The leaf
  - The fruit

# MORPHOLOGY OF DIFFERENT PARTS OF FLOWERING PLANTS

The wide range in the structure of higher plants will never fail to fascinate us. Even though the angiosperms show such a large diversity in external structure or morphology, they are all characterized by presence of roots, stems, leaves, flowers and fruits

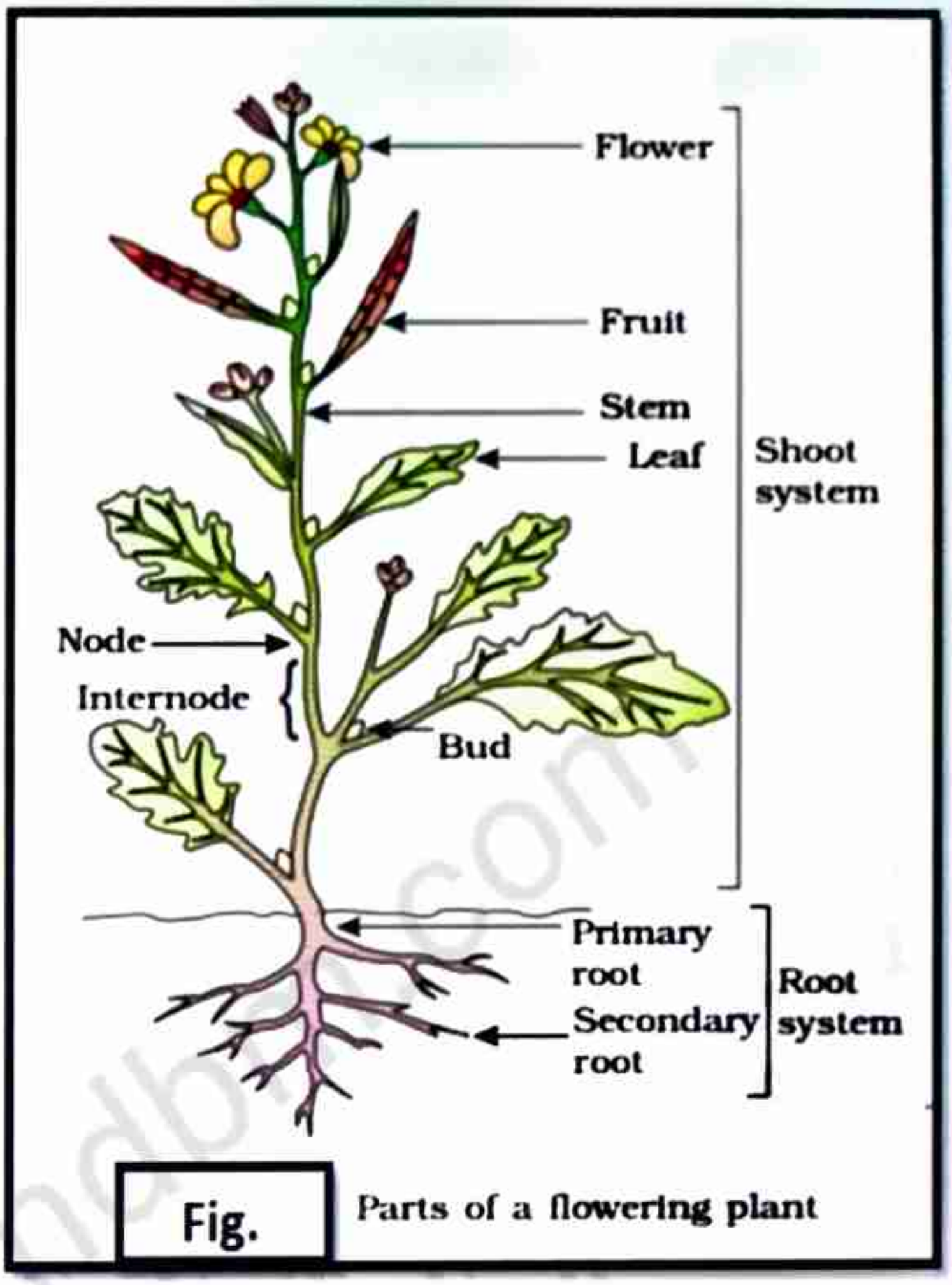
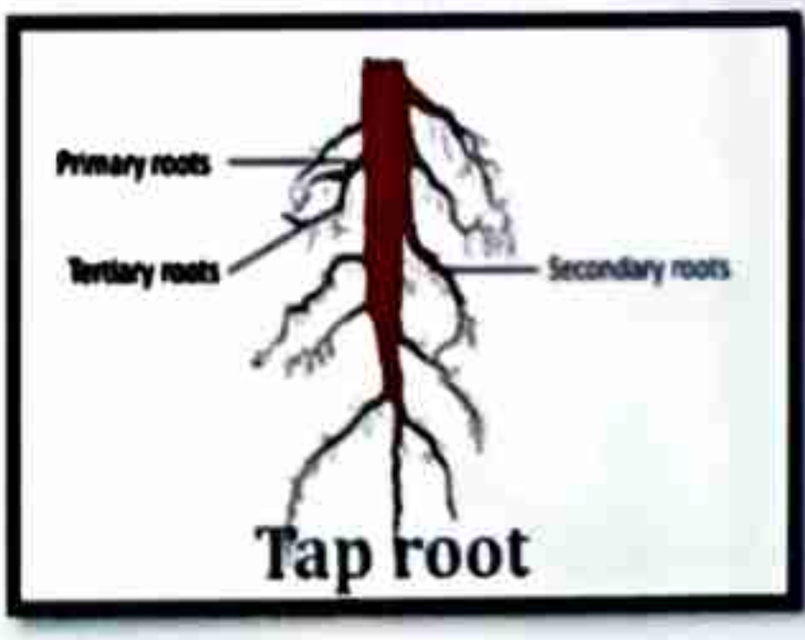



Fig. Parts of a flowering plant

## ❑ THE ROOT

- Root is a **downward growth of the plant** into the soil. It is positively geotropic
- 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 **Primary root system**


Adventitious roots




**Types of Roots:**

**(a) Tap root system**

**(b) Adventitious roots**

**(c) Fibrous root**

**Tap root system :** The primary roots and its branches constitute the tap root

- These roots originate from the base of the stem and constitute the **fibrous root system**
- roots arise from parts of the plant other than the radicle and are called **adventitious roots**


Fibrous roots

## ➢ The main functions of the root system

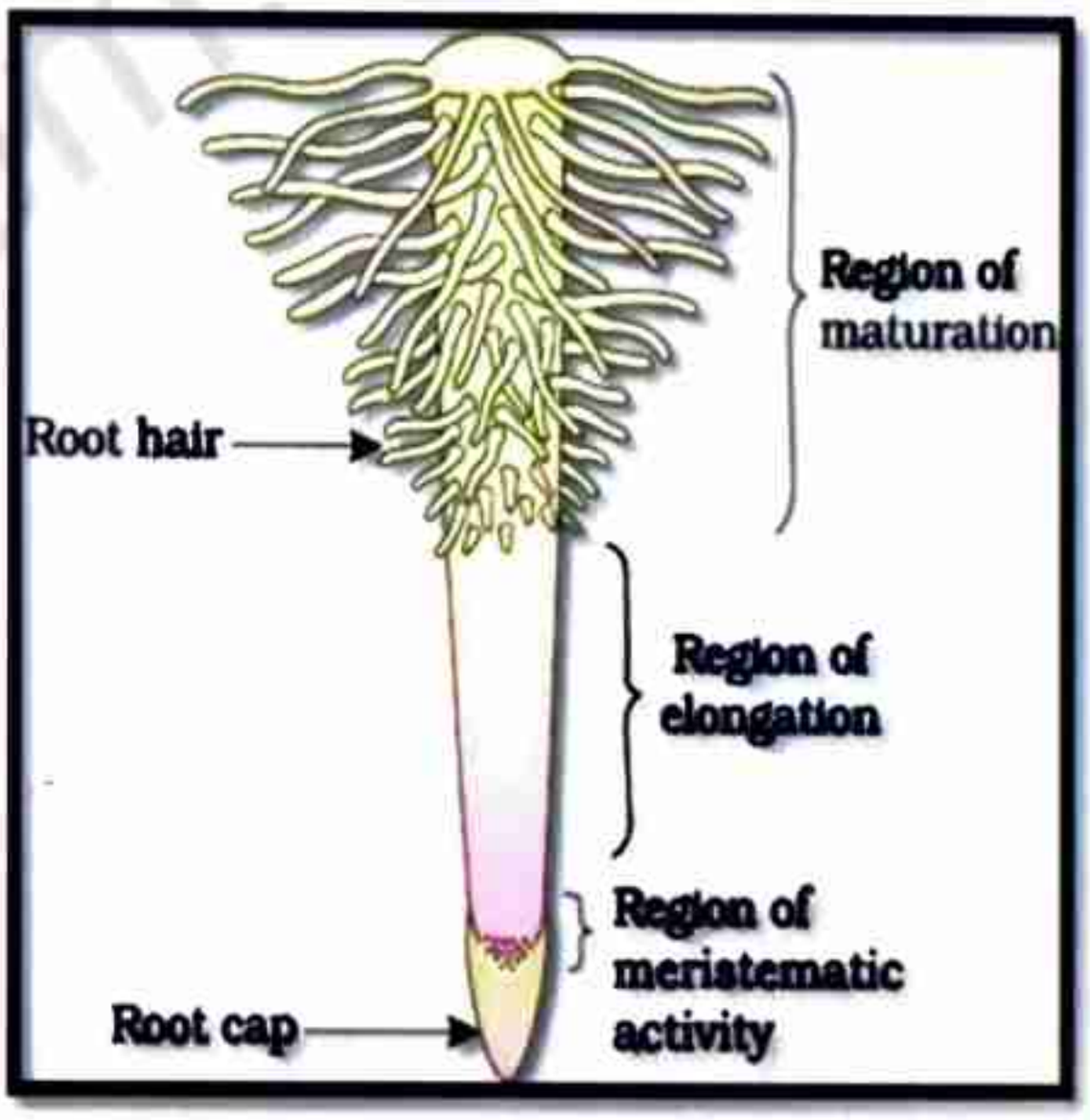
- Roots fix the plant to the soil and give **mechanical support** to the plant body
- **Absorption of water and minerals** from the soil
- **Storing reserve food material** and synthesis of plant growth regulators

## ➢ Various parts of a Root:

A typical underground root exhibits the following parts:

(a) **Root-cap:** The root is covered at the apex by a thimble-like structure called the root cap

(b) **Region of meristematic activity.** producing new cells, The cells of this region are very small, thin-walled and with dense protoplasm. They divide repeatedly.



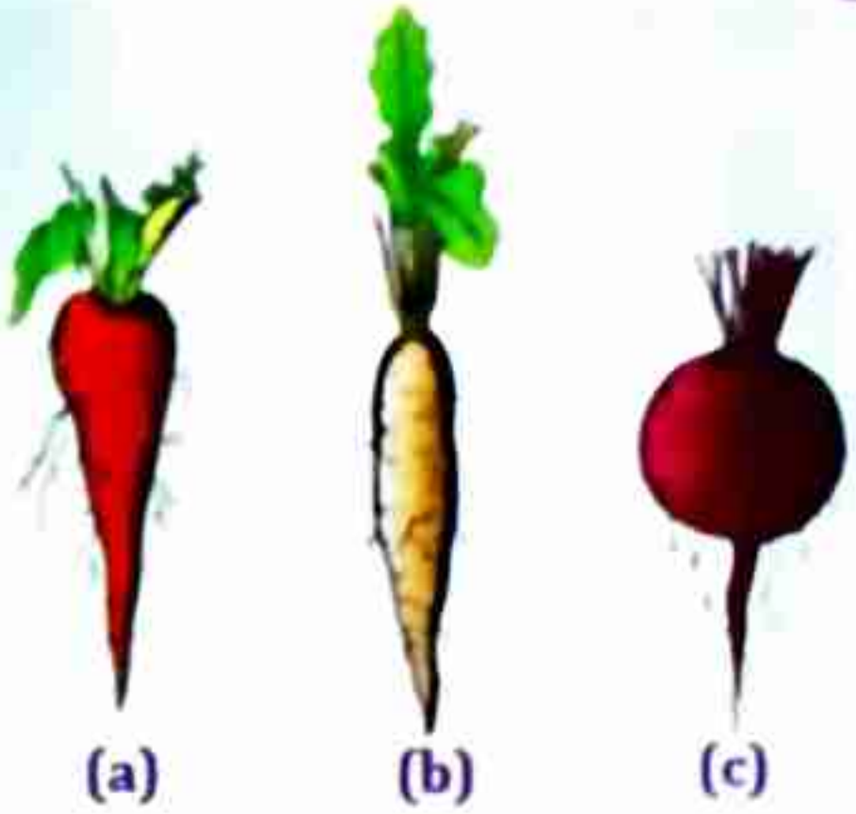

(c) **Region of elongation:** The newly formed cells in the growing region grow further by elongation in this region resulting in the **increase in the length** of the root.

(d) **Region of maturation:** The cells of the elongation zone gradually differentiate and mature. Hence, this zone, proximal to region of elongation

(e) **Root hairs :** From region of maturation 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.

## ➢ Modifications of Root

### 1. Modification of Roots for Storage of Food:


(a) (b) (c)

This type of modification is shown by both the types of roots i.e. tap roots and adventitious roots. These **store carbohydrates**

**Tap roots shows the following three types of modifications:**

**(a) Conical root**

**(b) Fusiform root**

**(c) Napiform root**

**Adventitious root system:** They **store carbohydrates** but do not assume any special shape. This system shows the following types:

- Tuberous roots
- Fasciculated tuberous roots
- Palmated tuberous roots
- Annulated roots

### 2. Modification of Roots for support :

Plant develops special aerial roots to offer additional support to the plant by way of adventitious roots.

**(a) Climbing roots**

**(b) Stilt roots**

**(c) Columnar roots**


(a)


(b)


(c)

### 3. Modifications of Roots for Special Functions:

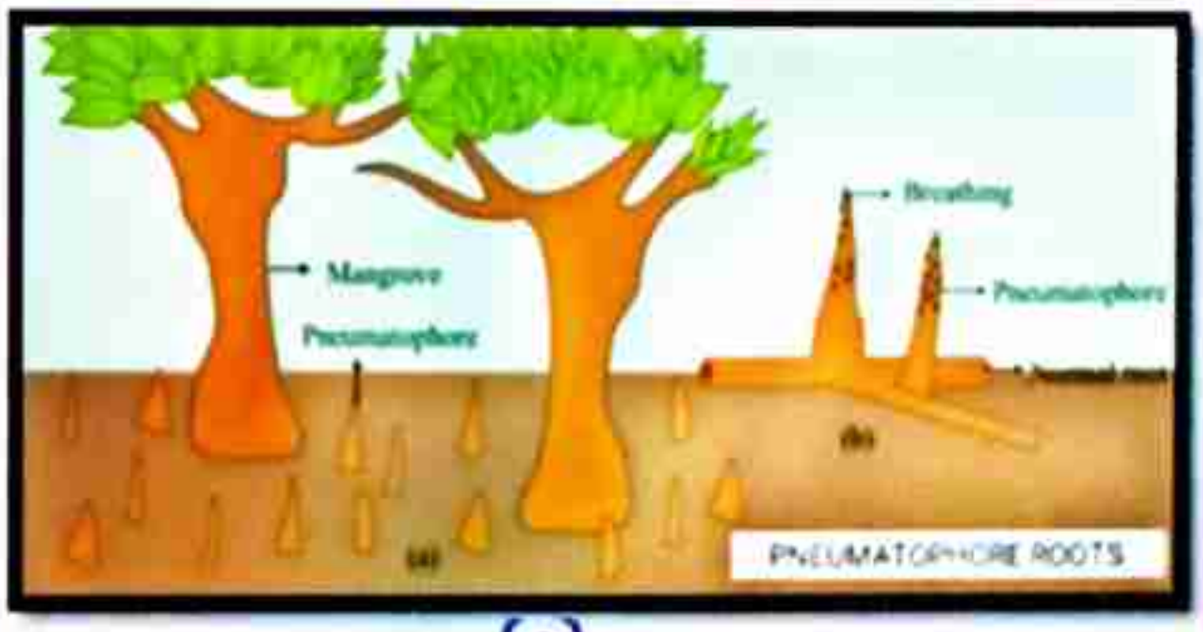
**a) Respiratory roots or pneumatophores (Breathing roots)**

**b) Sucking roots or Haustoria**

**c) Photosynthetic roots**


(b)

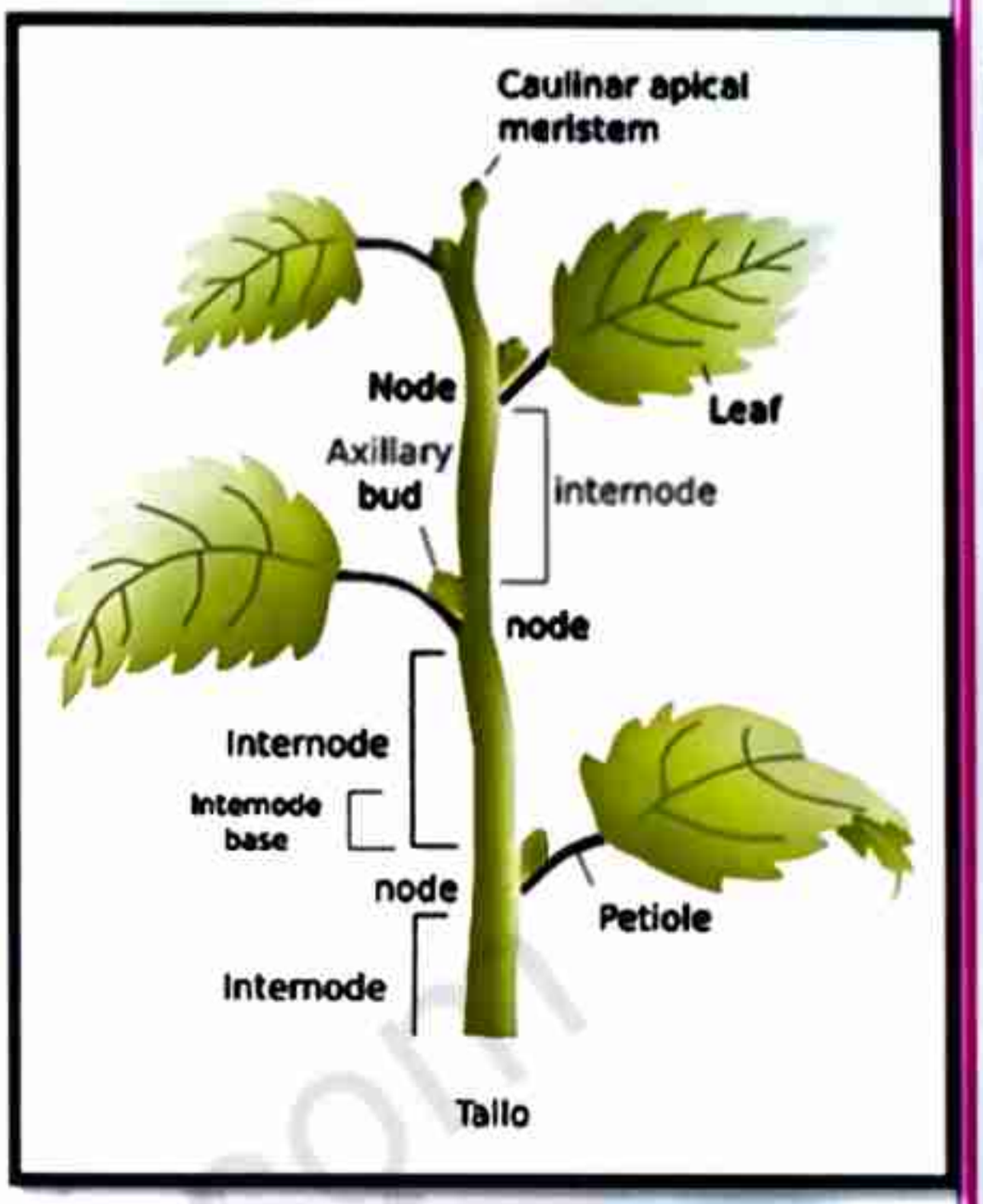
(c)



(a)

## ❑ THE STEM

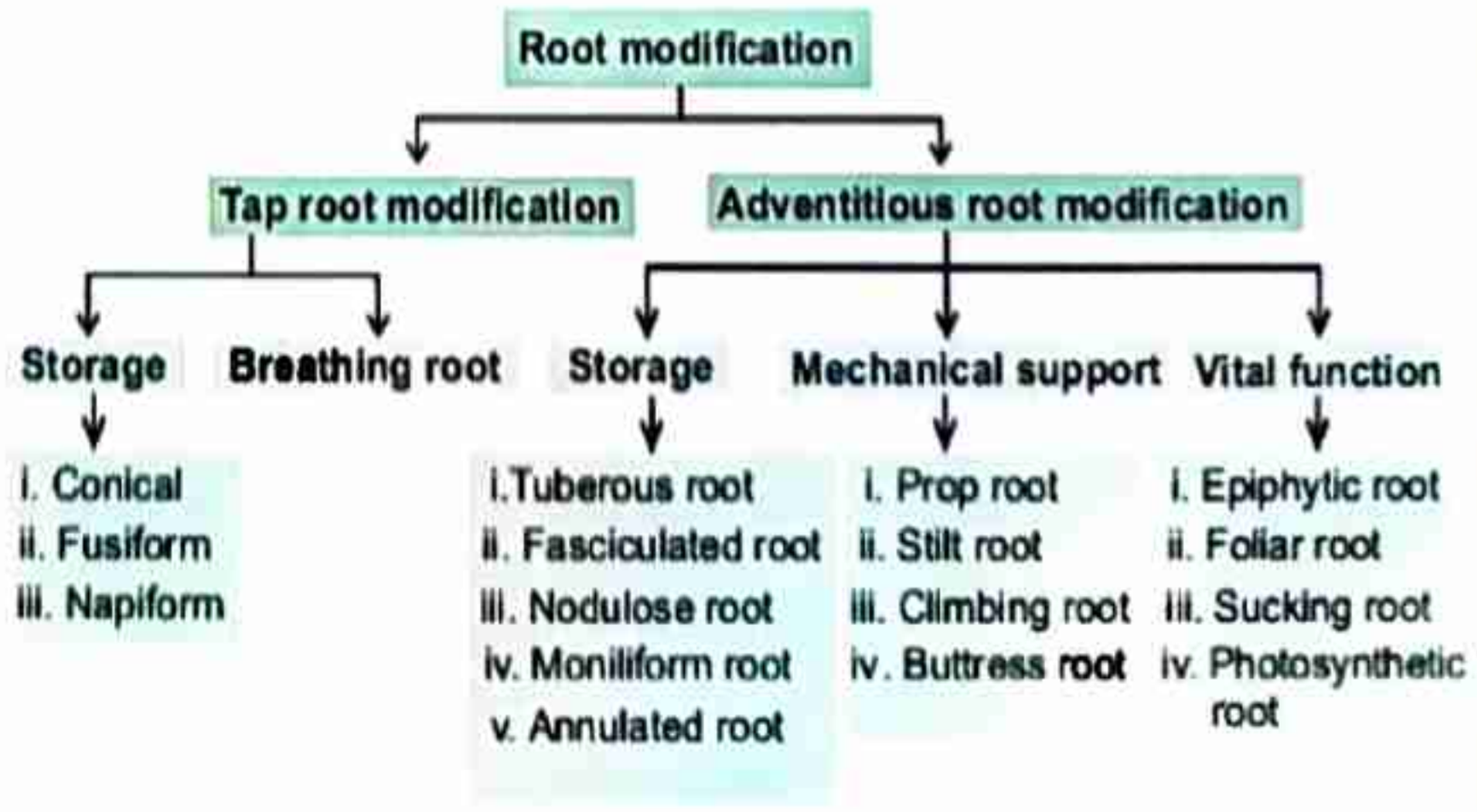
- The stem is the **ascending part of the axis** bearing branches, **leaves, flowers and fruits.**
- It develops from the **plumule of the embryo** of a germinating seed.
- The stem bears **nodes and internodes.**
- The region of the stem where leaves are born are called **nodes**
- Internodes are the **portions between two nodes.**
- The stem bears buds, which may be terminal or axillary.
- Stem is generally green when young and later often become woody and dark brown




➢ **The main function of the stem is**

- Spreading out branches bearing leaves, flowers and fruits
- It conducts water, minerals and photosynthates
- Some stems perform the function of storage of food, support, protection and of vegetative propagation

➢ **Modifications of stem**



## ➢ Modifications of stem

### UNDERGROUND MODIFICATIONS OF STEM

**Rhizome**

- Grow **horizontally under soil**
- **Characterized by the presence of nodes, internodes and scale leaves**
- **Also possess bud in the axil of scale leaves**
- Serve as **storage organs**

**EX-** Ginger, Dioscorea, Turmeric, rhubarb, male fern

**Tuber**

- Characterized by **presence of 'eyes'** from vegetative buds, which grow further and **develop into a new plant**
- Serve as **organs of storage**

**EX-** Potato, Jalap, Aconite, Dioscorea

**Bulb**

- **Food material is stored in fleshy scales**
- **Buds are present in axils** of the scales and few of them develop in spring season at the expense of stored food material in the bulb

**EX-** Garlic, Onion, Squill and Gloriosa

**Corm**

- They **bear bud in the axil of the scale leaves** and these **buds then develop further to form a new plant**

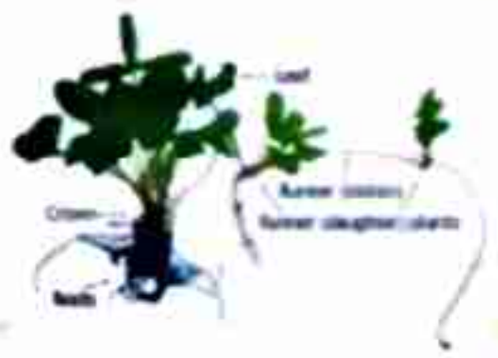
**EX-** Saffron and colchicum

### SUBAERIAL MODIFICATIONS OF STEM

**Runner**

- Have the specialty of **creeping on ground and rooting at nodes**

**EX-** Strawberry and pennywort



**Stolon**

- **Lateral branches arising from base of the stems**, which grow horizontally
- **Characterized by presence of nodes and internodes**

**EX-** Glycyrrhiza, arrow root and jasmine

**Offset**

- Originated from axil of the leaf as short and thick horizontal branches
- Also characterized by the presence of rosette type of leaves and a cluster of roots at their bottom. Offsets are shorter and stouter than runner. EX- Aloe, Valerian and Agave

**Sucker**

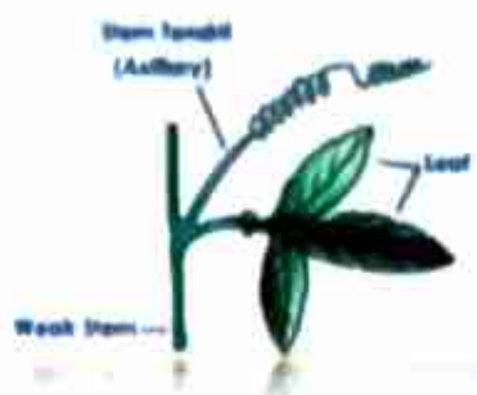
- Lateral branches developed from underground stems
- Suckers grow obliquely upwards and give rise to a shoot, which develop further into new plants.
- They are characterized by the presence of scale leaves

EX- Mentha species, pineapple, banana, etc.

## AERIAL MODIFICATIONS OF STEM

**Stem tendrils**

- Wiry , coiled, produced by weak stem plants called tendrils
- Axillary bud is modified into tendril in graphe-vine




**Thorns**

- Described as strong, straight and hard pointed structures
- Thorns bear flowers, and even fruits

EX- Rose, Ziziphus , Duranta

**Cladodes**

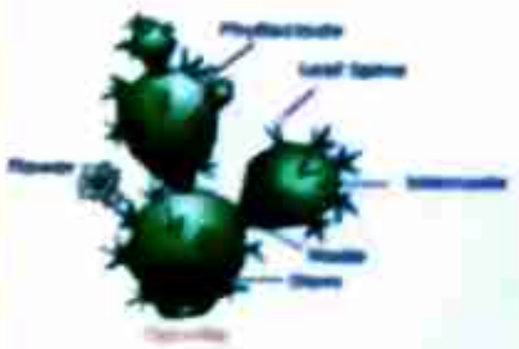
- Some times flat or cylindrical branches arise from node of the stem which are short and green

EX- Asparagus racemosus

**Phyloclades**

- Flat, green branch of stem, containing node and internodes
- Characteristic of xerophytes
- Perform photosynthesis

EX- Phyllocactus latifrons

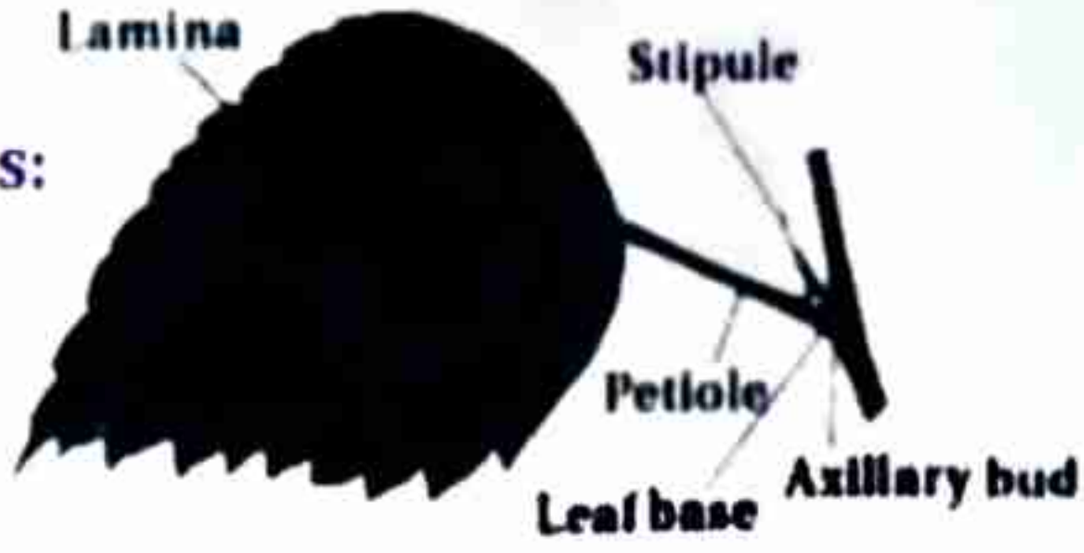


**Bulbils**

- Produced by floral buds
- Bulbil get detached from the original plant and grow independently. EX- Onion

## ❑ THE LEAF

- The leaf is a **lateral, generally 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**

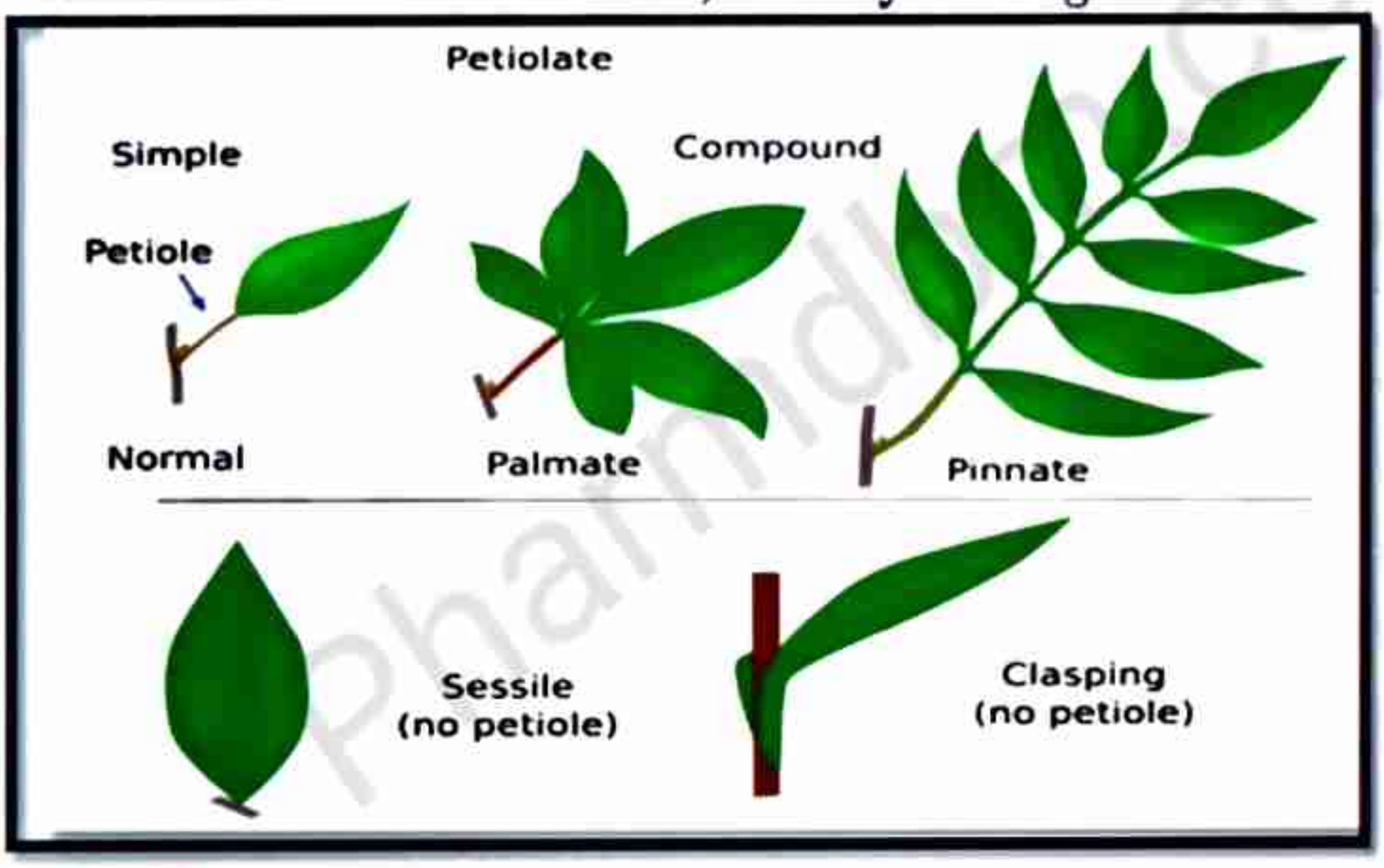



**A typical leaf consists of three main parts:**

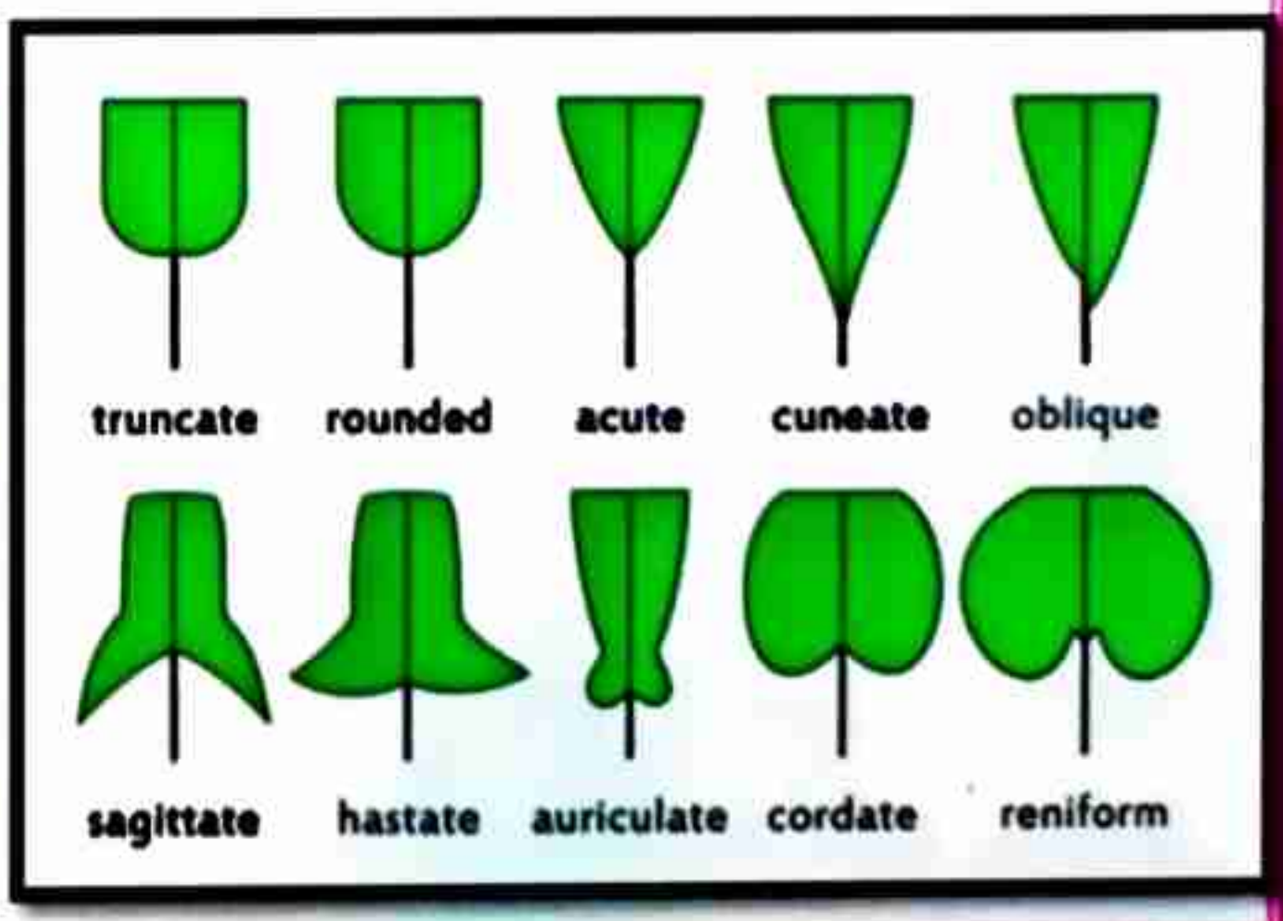
- Leaf base
- Petiole
- Lamina

✓ **Petiole**

The petiole **help to hold the blade** to light. Long thin flexible petioles allow leaf blades to flutter in wind, thereby cooling the leaf




✓ **Leaf base** :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



✓ **Lamina or Leaf-blade:** The **flat expanded part of the leaf** is lamina or leaf-blade (Epipodium). Lamina may be thick as in xerophytic leaves or thin as in hydrophytes or intermediate as in mesophytes.

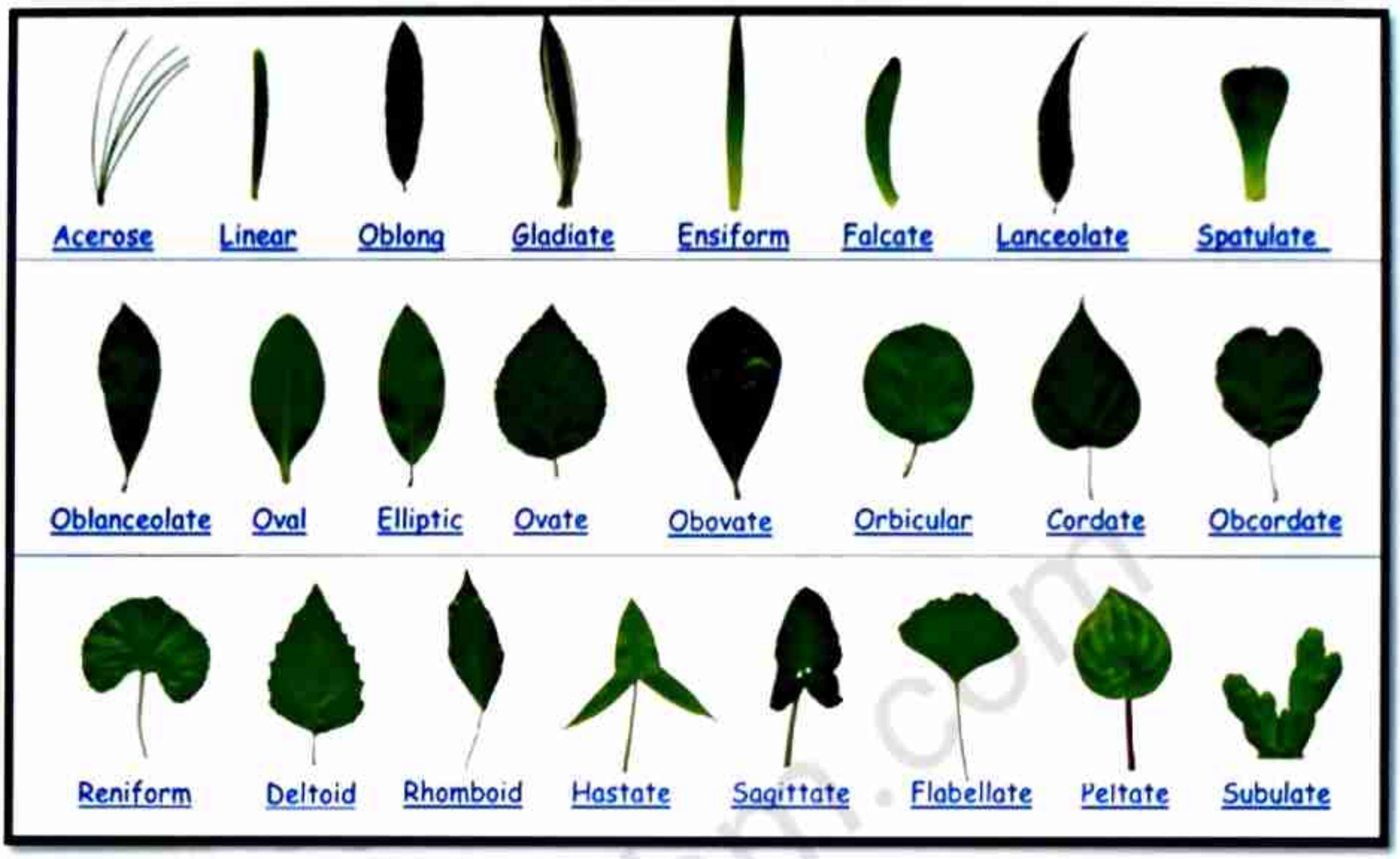


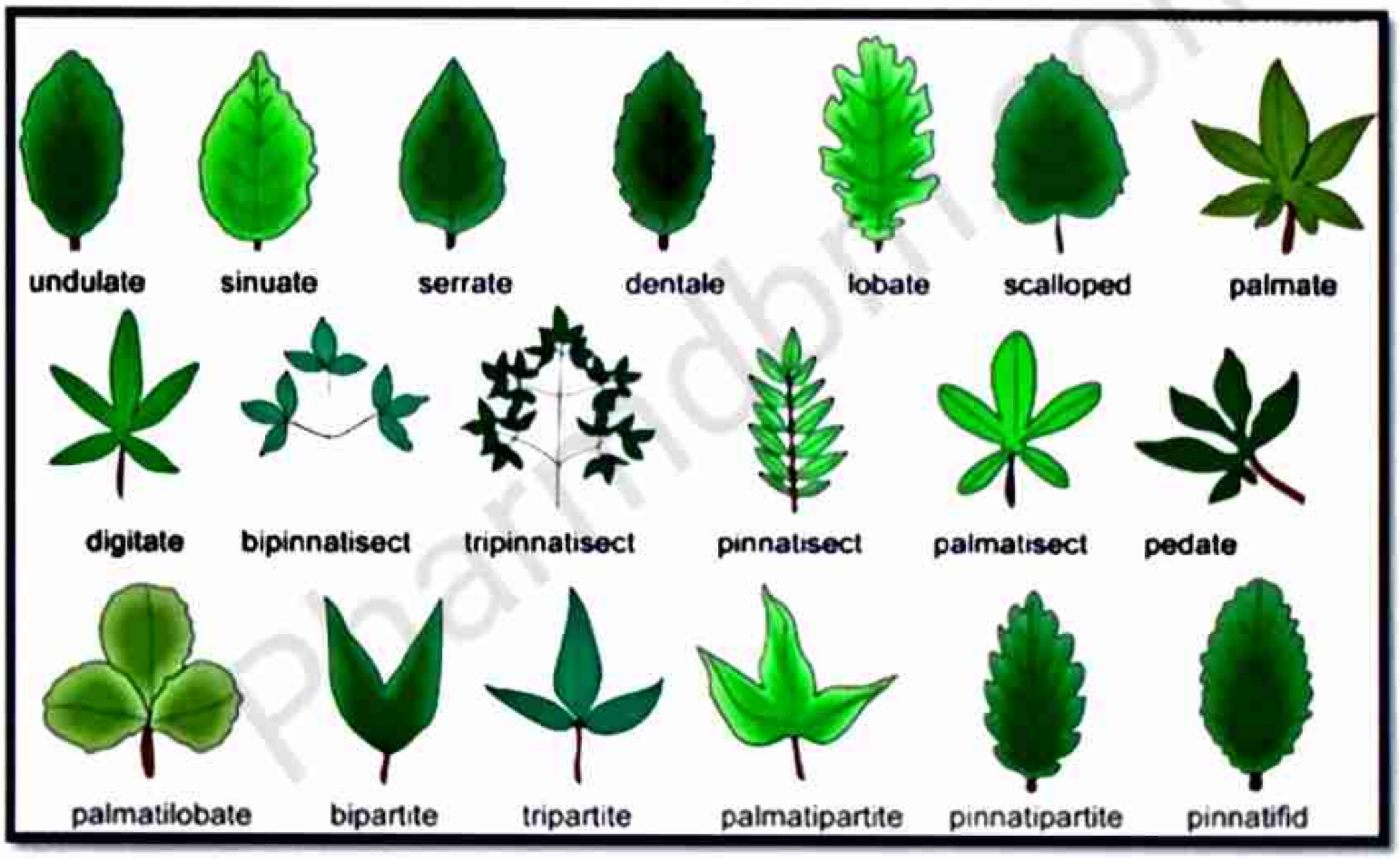

**Fig. Shape of lamina of leaves**

| | |
|---|---|
| **ACICULAR** | Needle like i.e. Pinus |
| **LINEAR** | When it is long narrow and flat i.e. Grasses |
| **OBLONG** | Broad leaves with two parallel margins and abruptly tapering apex i.e. Banana |
| **LANCEOLATE** | Which look like lance or spear-shaped. Examples: Nerium, senna |
| **OVATE** | Egg-shaped or broad base and narrow apex. Examples: China rose, Buchu |
| **OBOVATE** | Broad apex and narrow base. Example: Jangali-badam |
| **OBCORDATE** | Inversely heart-shaped i.e. base is narrow but apex is broad, Example: Oxalis |
| **SPATHULATE** | Like spatula or spoon-shaped as in Calendula and Drosera |
| **CUNEATE** | Wedge-shaped as in Pista |
| **CORDATE** | heart shaped i.e. Betel. |
| **FALCATE** | When leaves are sickle-shaped as in Eucalyptus |

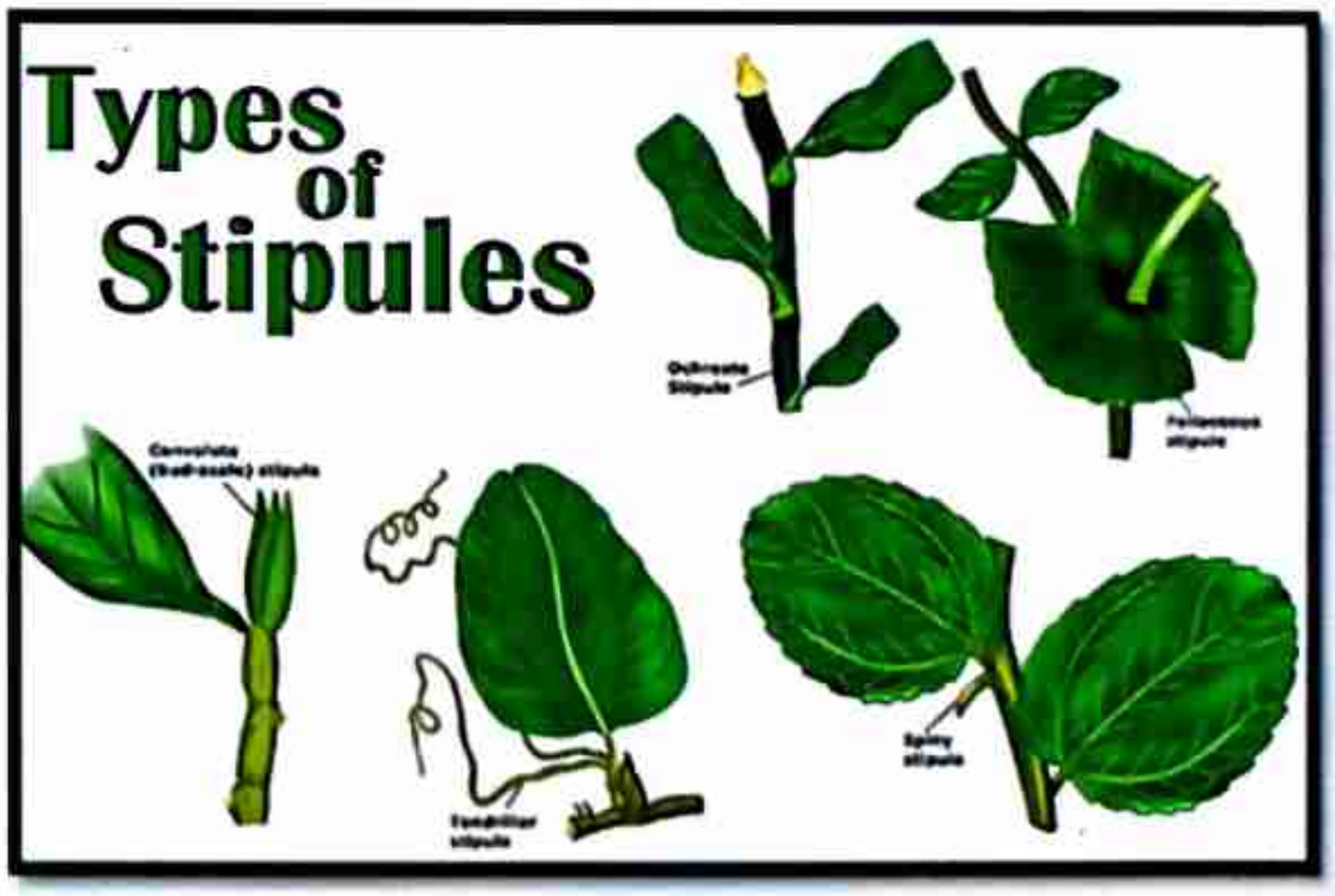
| | |
|---|---|
| **HASTATE** | When the two lobes of sagittate-leaf are directed outwards as in **Ipomoea.** |
| **RENIFORM** | Kidney shaped: Indian pennywort |
| **AURICULATE** | When the leaf has got ear-like projections at the base. |
| **ROTUND (ORBICULAR)** | When the blade is circular or round e.g. **lotus** |
| **ELLIPTICAL OR OVAL** | When the leaves are narrow at the base and apex but broad in the middle such as **guava, vinca, etc.** |
| **PELTATE** | When the lamina is shield-shaped and fixed to the stalk by the center |

## ✓ Leaf margins

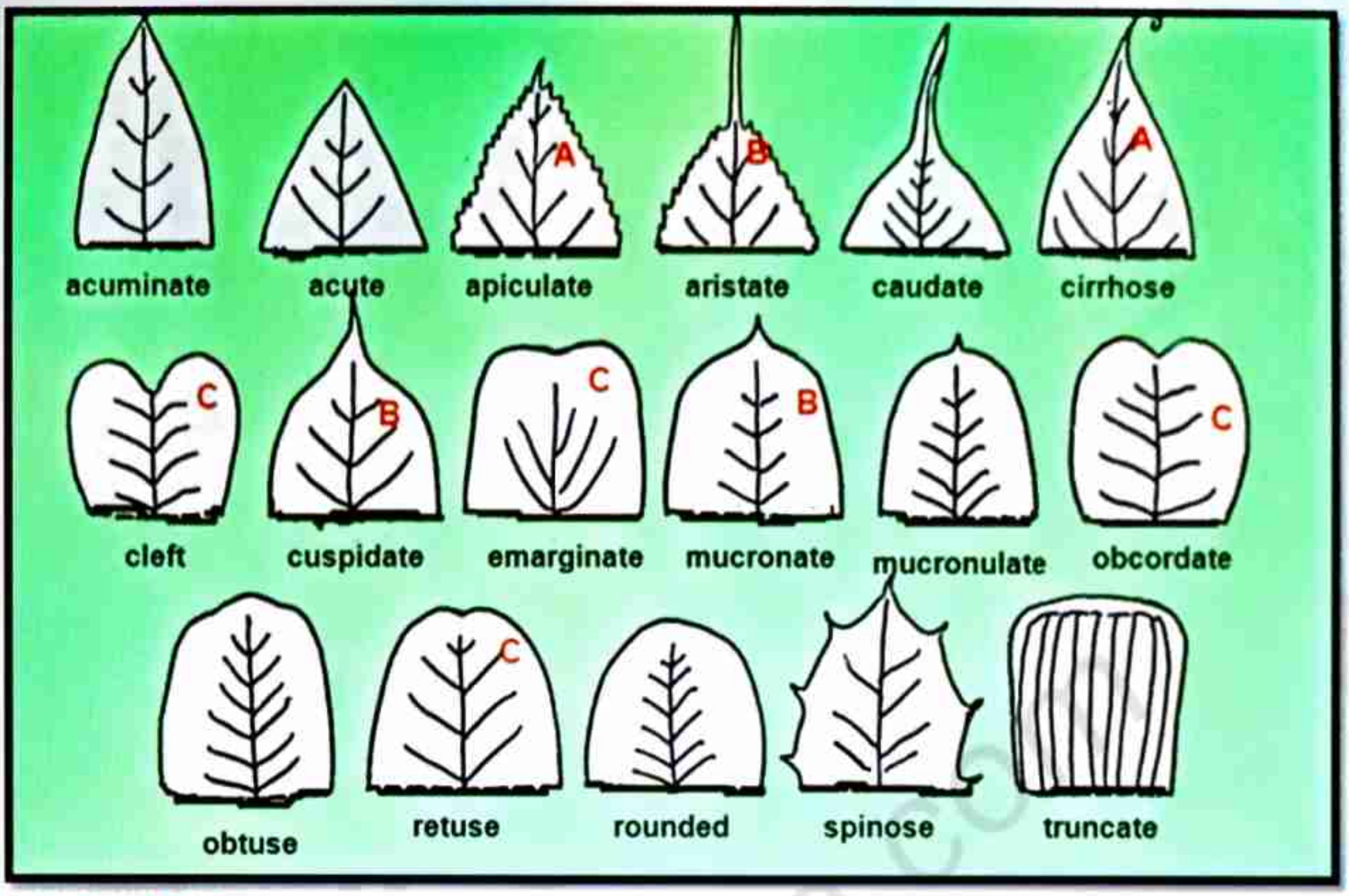
**Leaf margin may be of the following types:**




✓ **Stipules:** The leaf is attached to the stem by the leaf base and may bear two lateral small leaf like structures called stipules



## ✓ Leaf Apices




## ✓ Leaf Surface

| TYPES | DESCRIPTION |
|---|---|
| **Glabrous** | When surface is smooth and free of hair or any outgrowth i.e. Vasaka, Datura. |
| **Rough** | When harsh to touch, Digitalis. |
| **Hairy** | When covered with hairs. |
| **Glutinous** | When covered with sticky substance, Tobacco. |
| **Glaucous** | When covered with waxy coating, Castor |
| **Pubescent** | Covered with straight, short hair i.e. Senna. |

## ✓ Types of Leaves

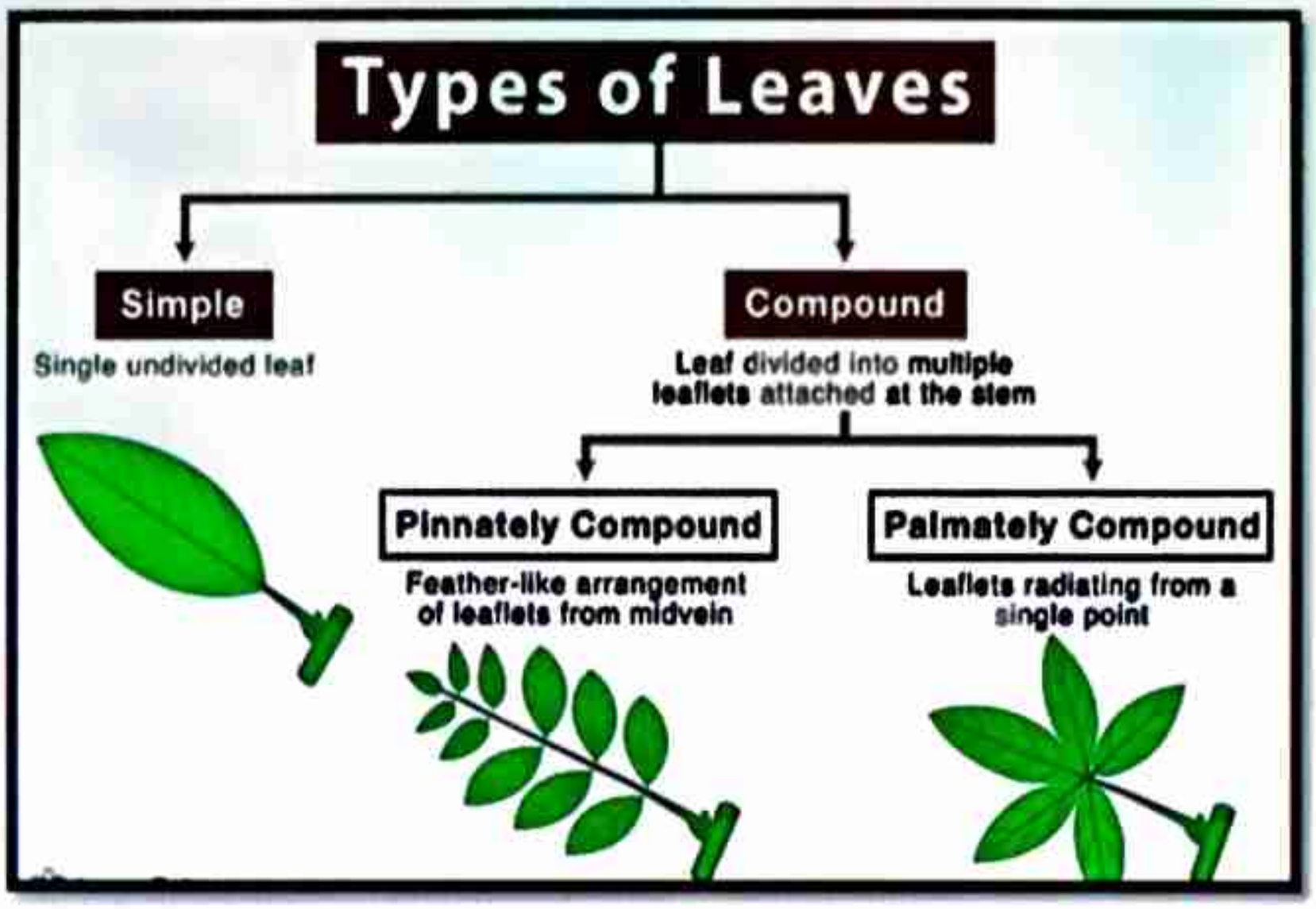
They are classified into two main groups

### 1. Simple leaves

A leaf is said to be **simple,** when its lamina is entire or when incised, the incisions do not touch the midrib.

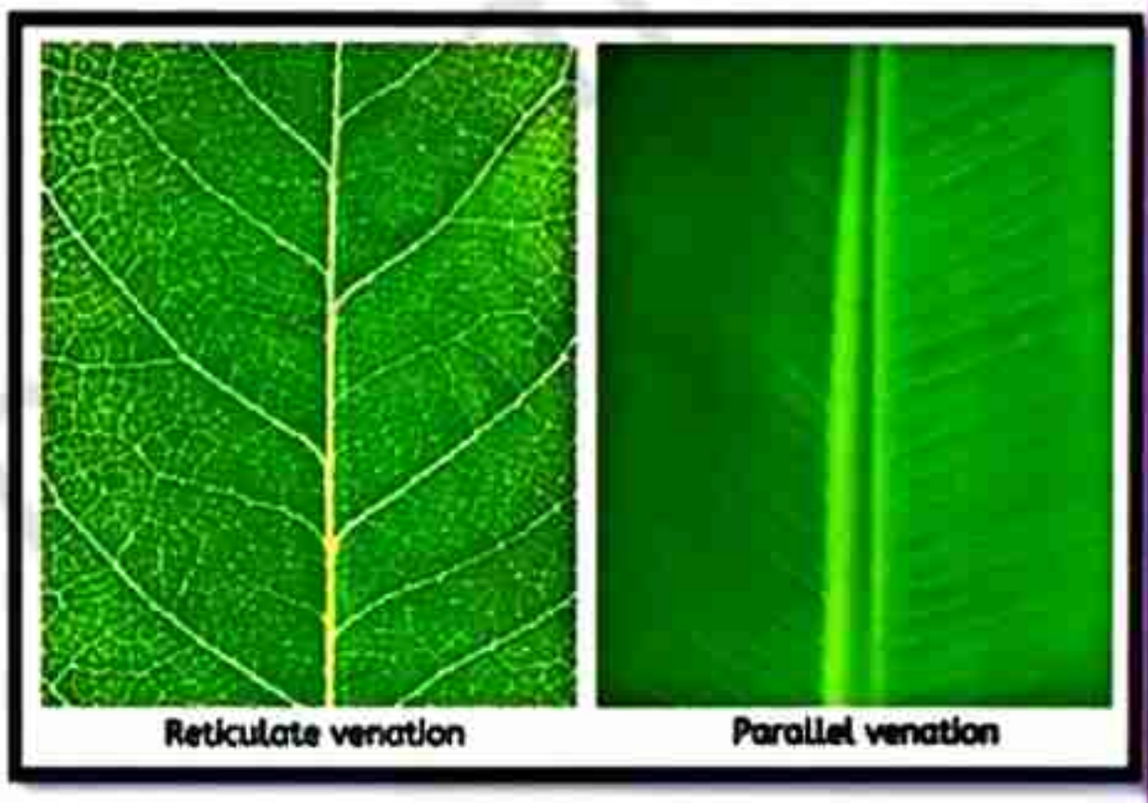
### 2. Compound leaves

When the incisions of the lamina reach up to the midrib breaking it into a number of leaflets, the leaf is called **compound**




## ✓ Venation

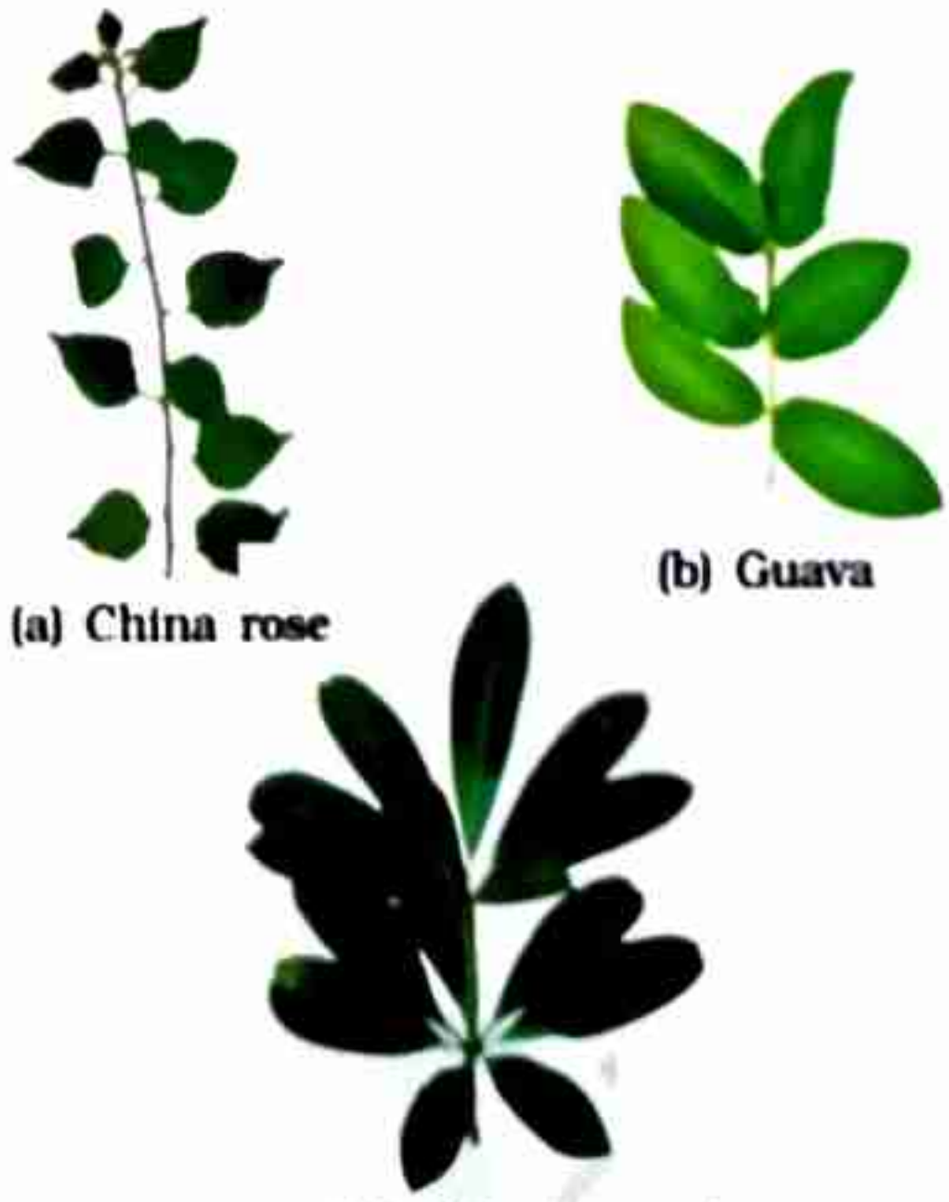
- The arrangement of **veins and the veinlets** in the lamina of leaf is termed as **venation**
- When the **veinlets form a network**, the venation is termed as **reticulate**
- When the veins run parallel to each other within a lamina, the venation is termed as **parallel**




## ✓ Phyllotaxy

Phyllotaxy is the pattern of arrangement of leaves on the stem or branch. This is usually of three types – **alternate, opposite and whorled**

- In **alternate** type of phyllotaxy, a single leaf arises at each node in alternate manner, as in **china rose, mustard and 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**, as in **Alstonia**

**Different types of phyllotaxy :**

(a) Alternate

(b) Opposite

(c) Whorled

## ✓ Modifications of Leaves

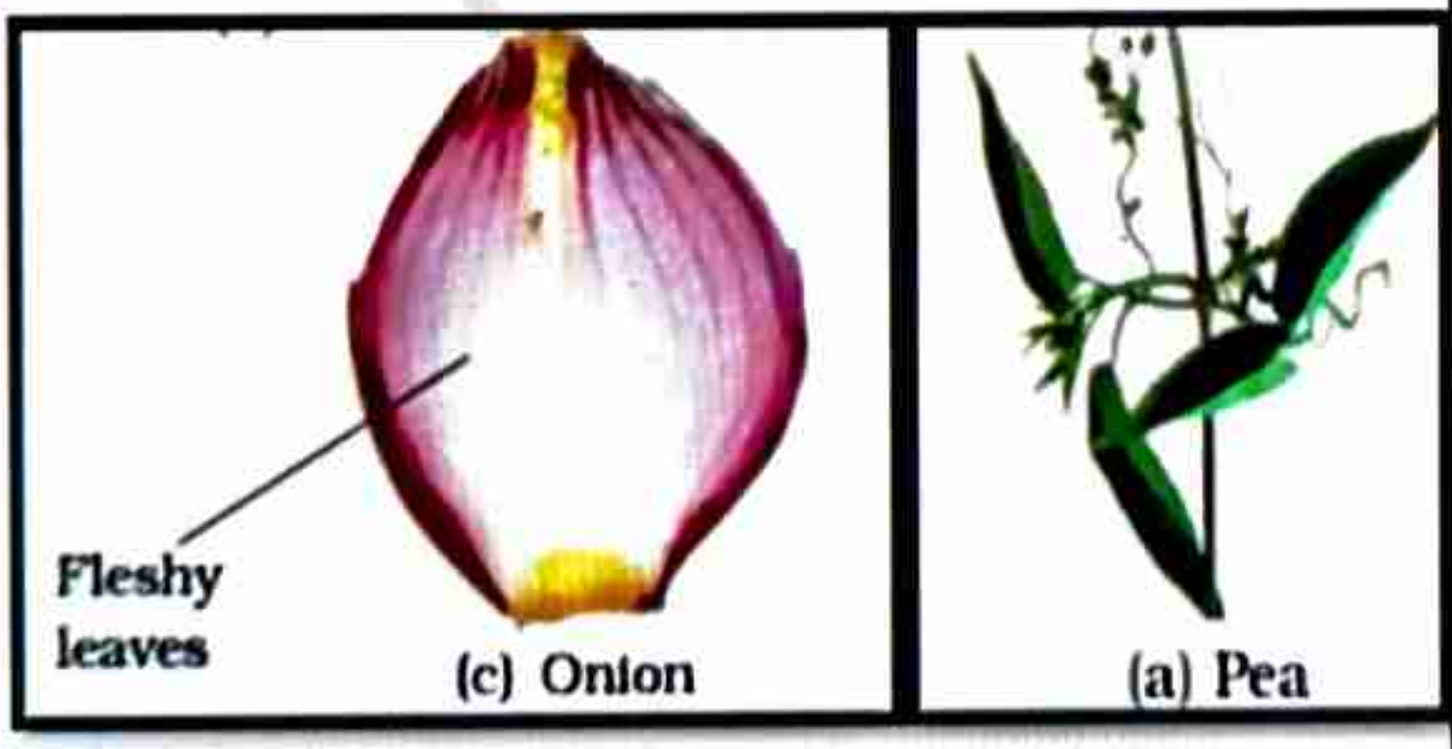
- Leaves are often modified to perform functions other than **photosynthesis.**
- They are converted into tendrils for **climbing**
- spines for **defence** as in cacti
- The fleshy leaves of onion and garlic **store food**
- In some plants such as Australian acacia, the leaves are small and short-lived. The petioles in these plants expand, become green and **synthesise food.**
- Leaves of certain **insectivorous plants** such as pitcher plant, venus-fly trap are also modified leaves.

**Modifications of leaf for :**

**(a) support: tendril**

**(b) protection: spines**

**(c) storage: fleshy leaves**




## ✓ The inflorescence

**A flower is a modified shoot wherein the shoot apical meristem changes to floral meristem.**

**Internodes do not elongate** and the **axis gets condensed.** The **apex produces different kinds of floral appendages** laterally at successive nodes instead of leaves.

The arrangement of flowers on the floral axis is termed as **inflorescence**

**Two major types of inflorescences are defined –**

- **Racemose and cymose**
- In racemose type of inflorescences the main axis continues to grow, the flowers are borne laterally in an acropetal succession
- In cymose type of inflorescence the main axis terminates in a flower, hence is limited in growth

**Fig. Cymose inflorescence**

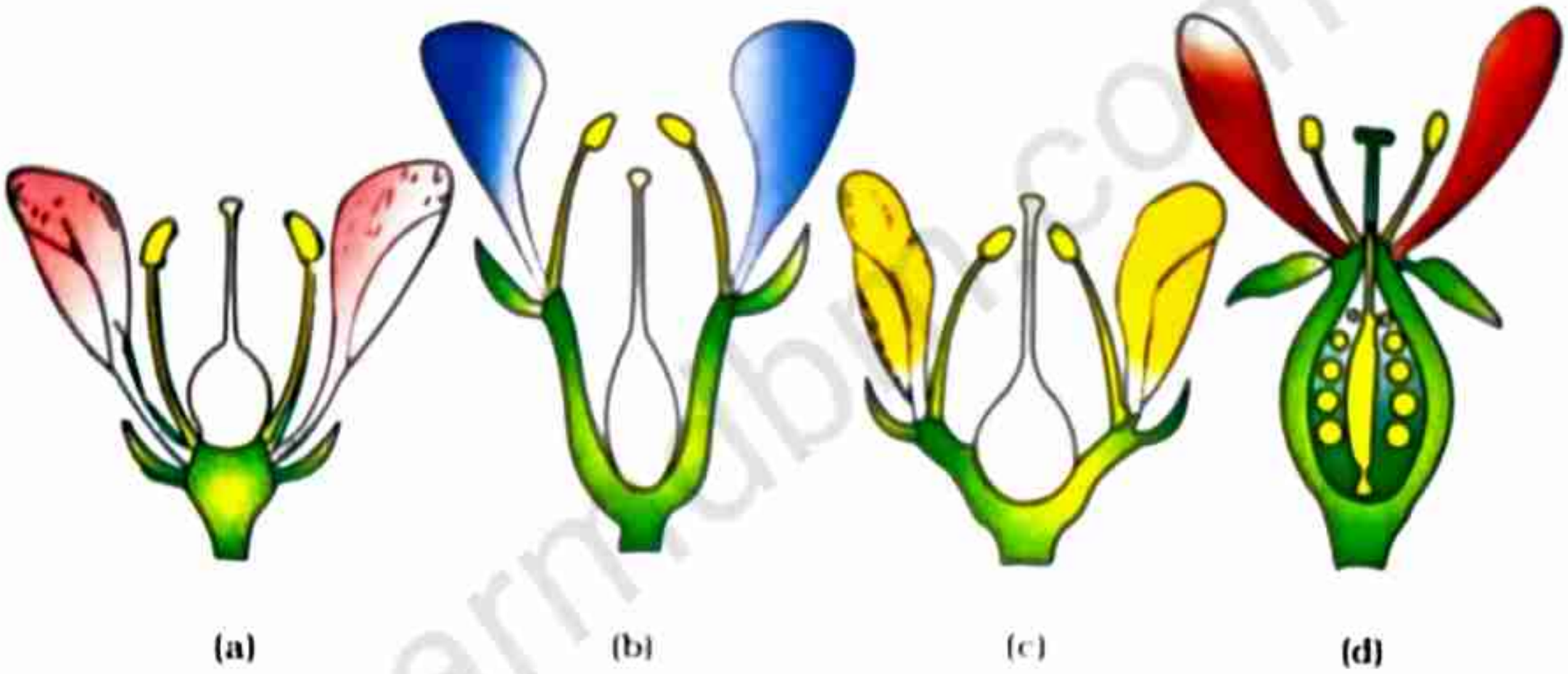
**Fig. Racemose inflorescence**

## ❑ THE FLOWER

- The flower is the **reproductive unit** in the angiosperms.
- It is meant for **sexual reproduction.** A typical flower has four different kinds of whorls arranged successively on the swollen end of the stalk or pedicel, called thalamus or receptacle.
- These are calyx, corolla, androecium and gynoecium.
- **Calyx and corolla are accessory organs, while androecium and gynoecium are reproductive organs.**
- In symmetry, the flower may be **actinomorphic (radial symmetry)** or **zygomorphic (bilateral symmetry).**

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

- In the **hypogynous flower** the **gynoecium occupies the highest position** while the other parts are situated below it. **The ovary** in such flowers is said to be superior, **e.g., mustard, china rose and brinjal.**
- If **gynoecium is situated in the centre** and other parts of the flower are located on the rim of the thalamus almost at the same level, it is called **perigynous.** The ovary here is said to be half inferior, e.g. plum, rose, peach.
- **In epigynous flowers**, the **margin of thalamus grows** upward enclosing the ovary completely and getting fused with it

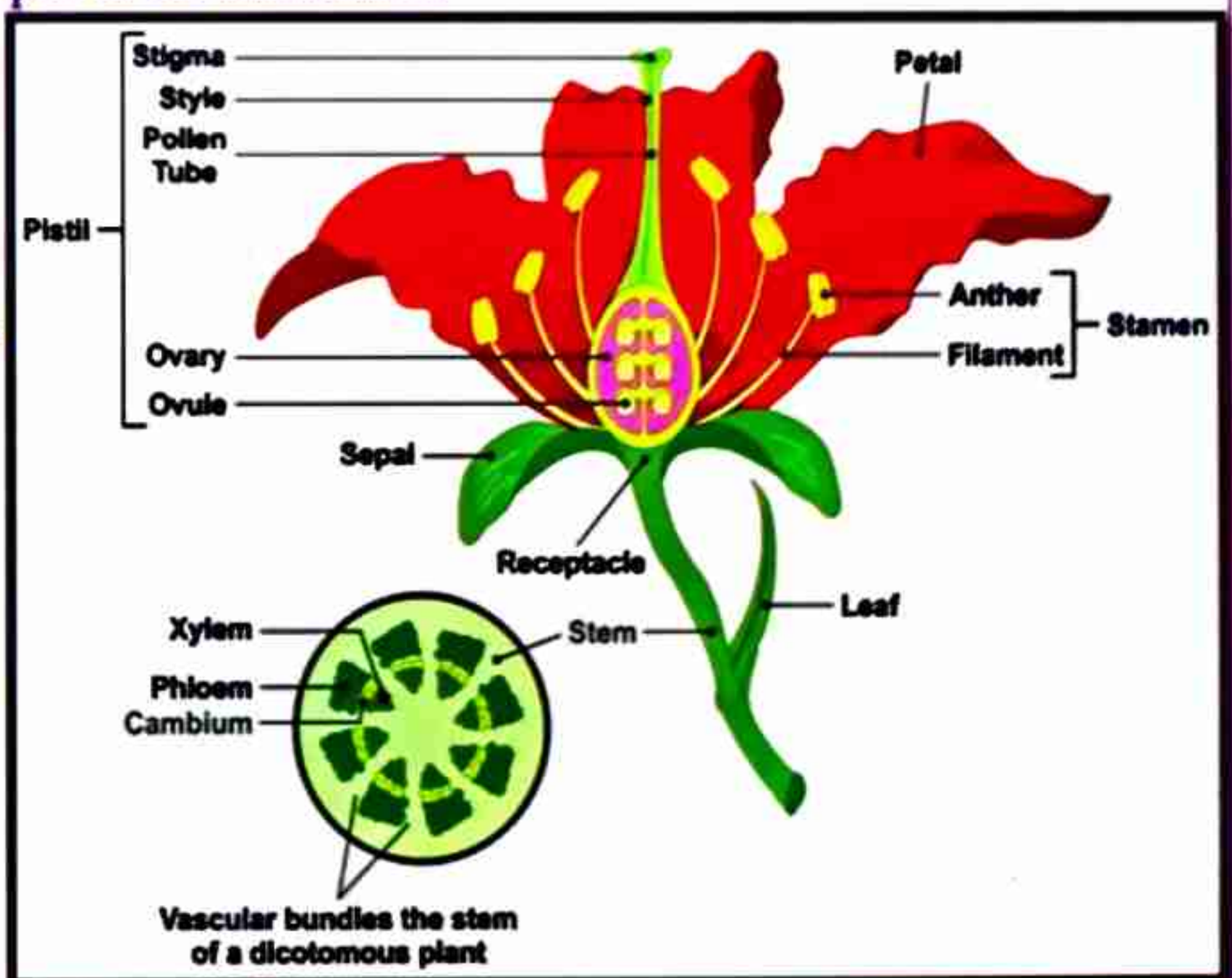


(a) (b) (c) (d)

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

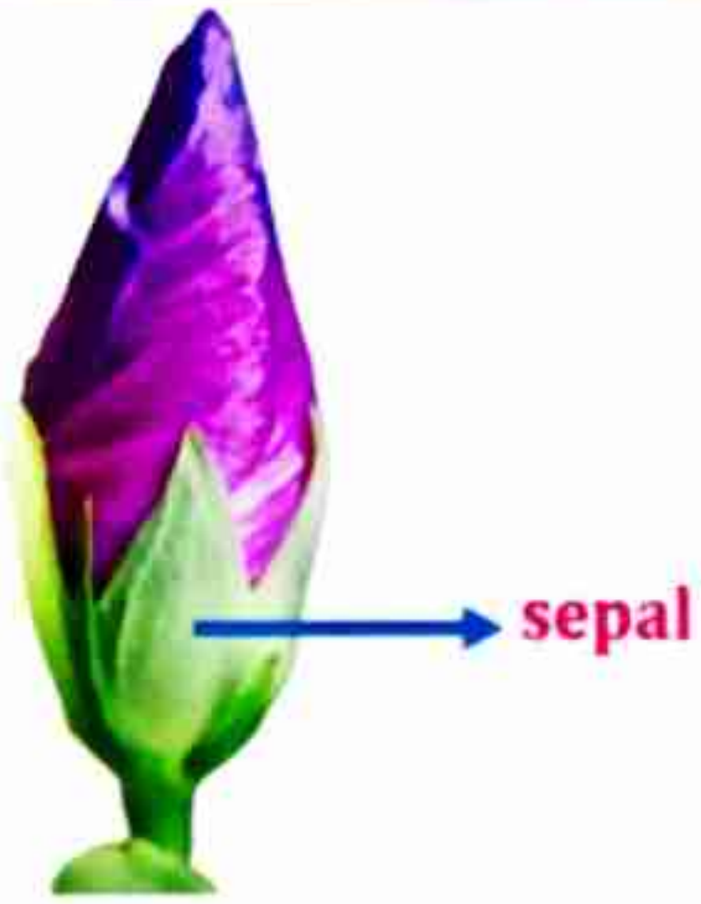
## ➢ Parts of a Flower

Each flower normally has four floral whorls, viz., **calyx, corolla, androecium and gynoecium**



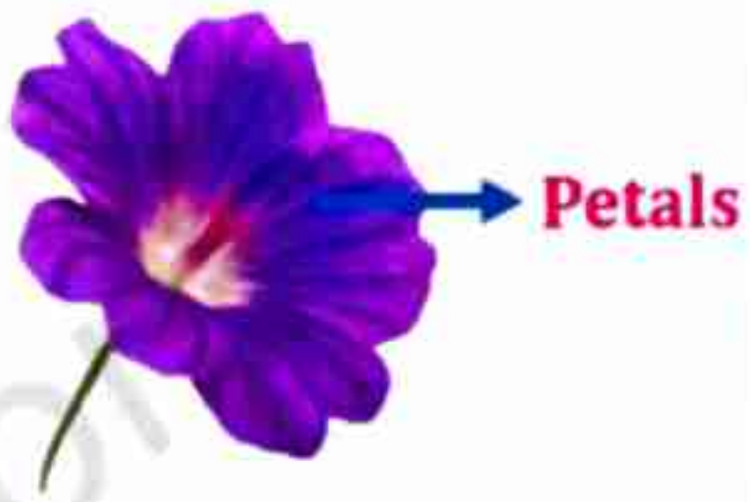
## ✓ Calyx

The calyx is the **outermost whorl of the flower** and the members are called **sepals.** Generally, **sepals are green**, leaf like and protect the flower in the bud stage

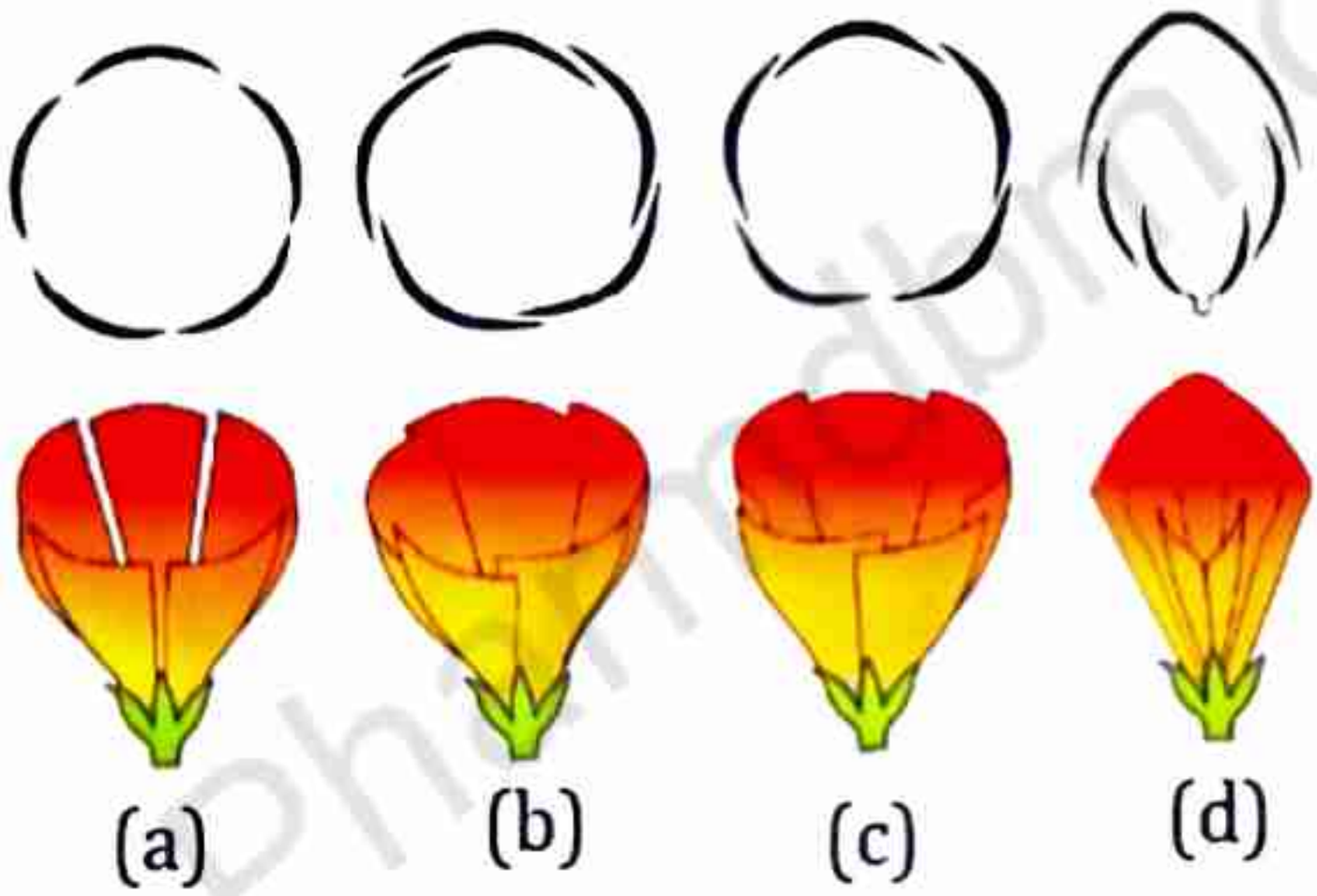



## ✓ Corolla

Corolla is composed of **petals.** Petals are usually brightly coloured to attract insects for pollination.

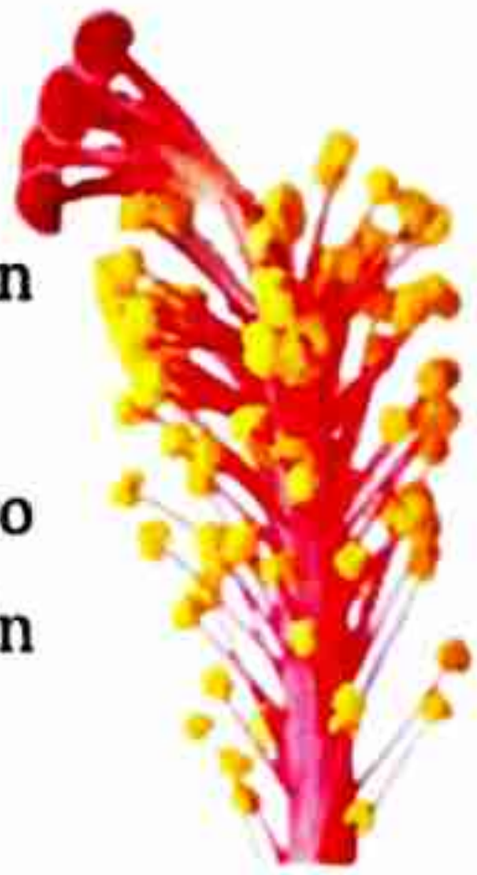



**Aestivation:** The **mode of arrangement of sepals or petals** in floral bud with respect to the other members of the same whorl is known as aestivation.

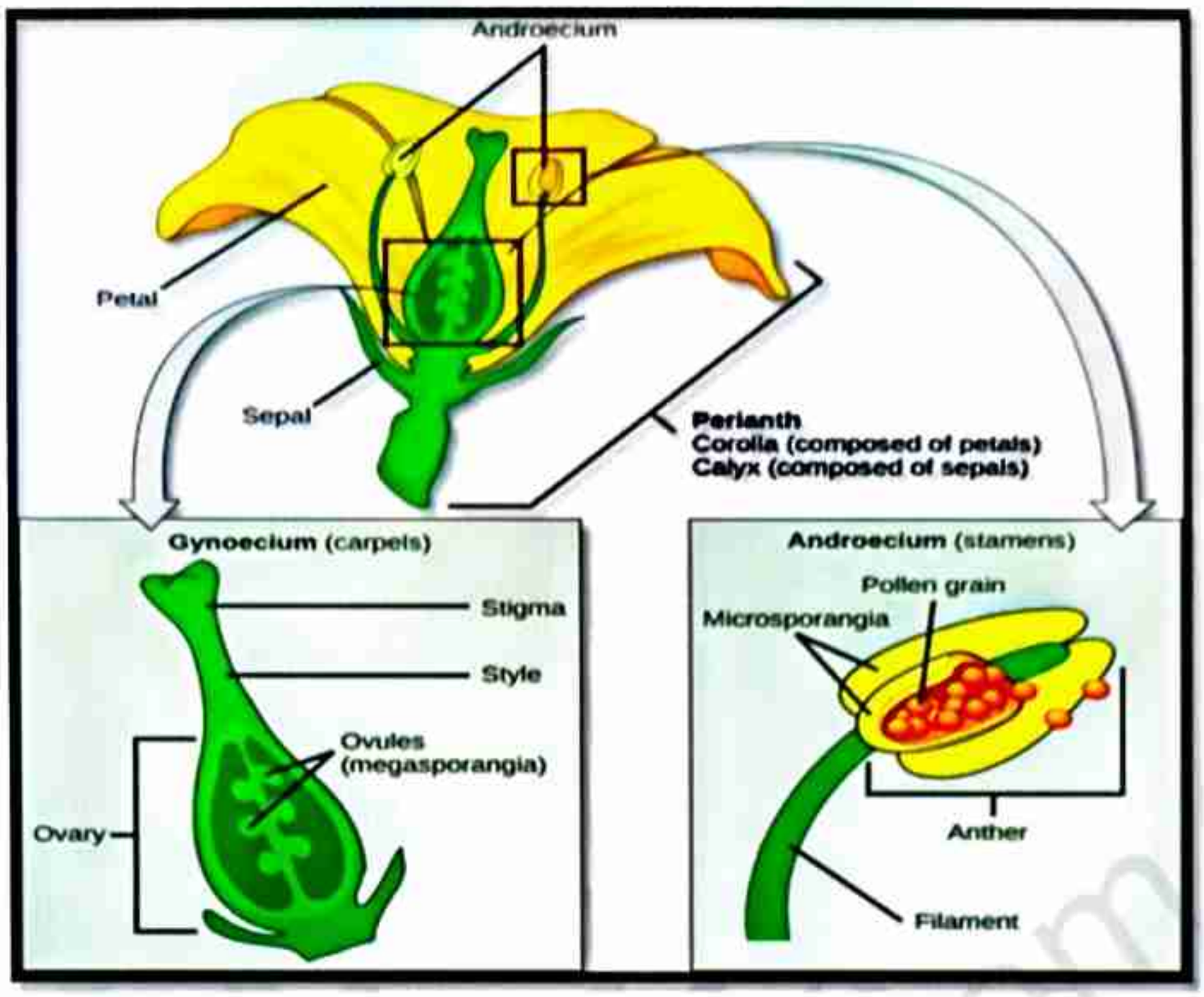



**Types of aestivation in corolla** : (a) Valvate (b) Twisted (c) Imbricate (d) Vexillary

## ✓ Androecium



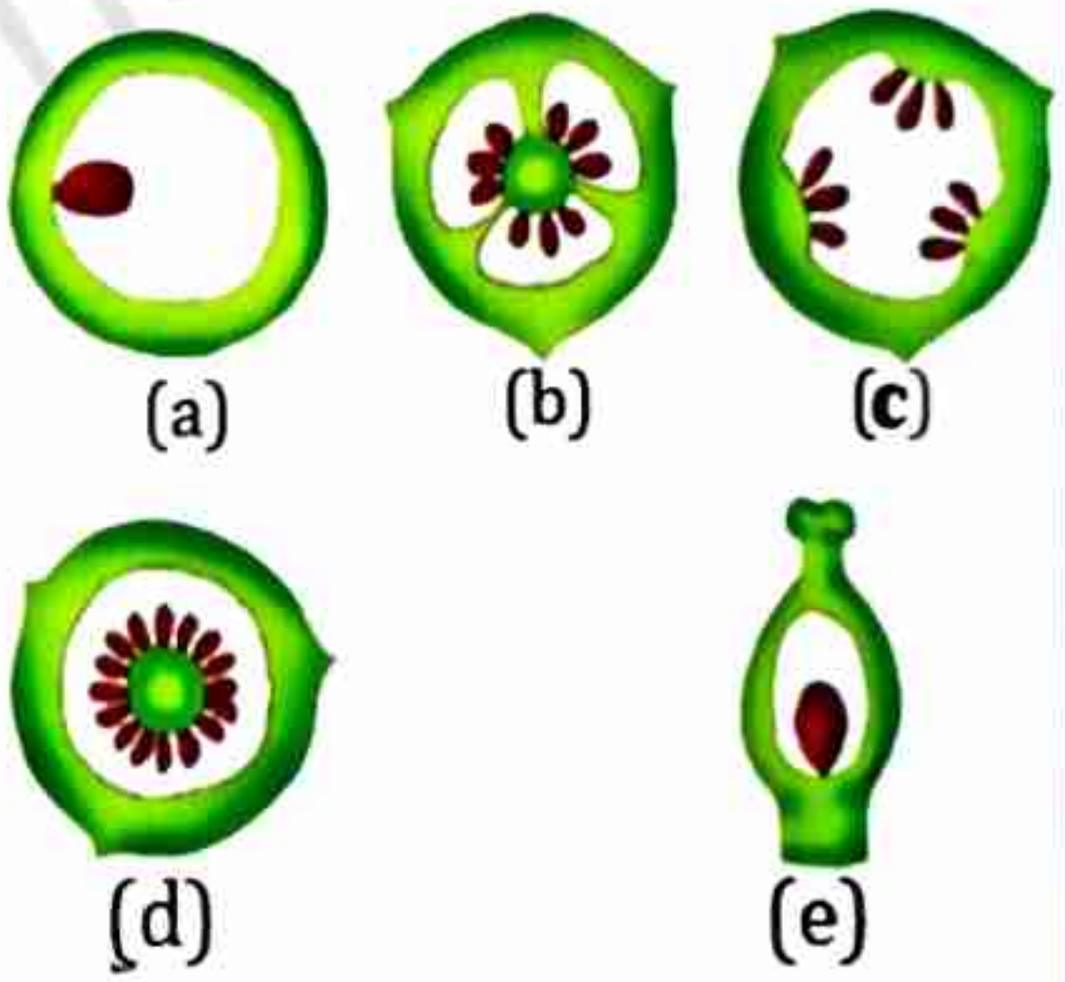
- **Androecium** is composed of **stamens**
- Each stamen which represents the male reproductive organ consists of a stalk or a filament and an anther
- Each **anther is usually bilobed** and each lobe has two chambers, the pollen-sacs. The pollen grains are produced in **pollen-sacs**
- A sterile stamen is called **staminode**




## ✓ Gynoecium

- Gynoecium is the **female reproductive part of the flower** and is made up of one or more carpels
- A carpel consists of three parts namely **stigma, style and ovary**

**Placentation:** The arrangement of ovules within the ovary is known as placentation. The placentation are of different types namely, **marginal, axile, parietal, basal, central and free central**




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

## ❑ THE FRUIT

- The fruit is a **characteristic feature of the flowering plants**
- It is a mature or ripened ovary, **developed after fertilization**
- If a fruit is formed without fertilization of the ovary, it is called a **parthenocarpy fruit**

- The fruit consists of a **wall or pericarp and seeds**. The **pericarp may be dry or fleshy**
- When **pericarp is thick and fleshy**, it is **differentiated into the outer epicarp,** the middle **mesocarp** and the inner **endocarp.**

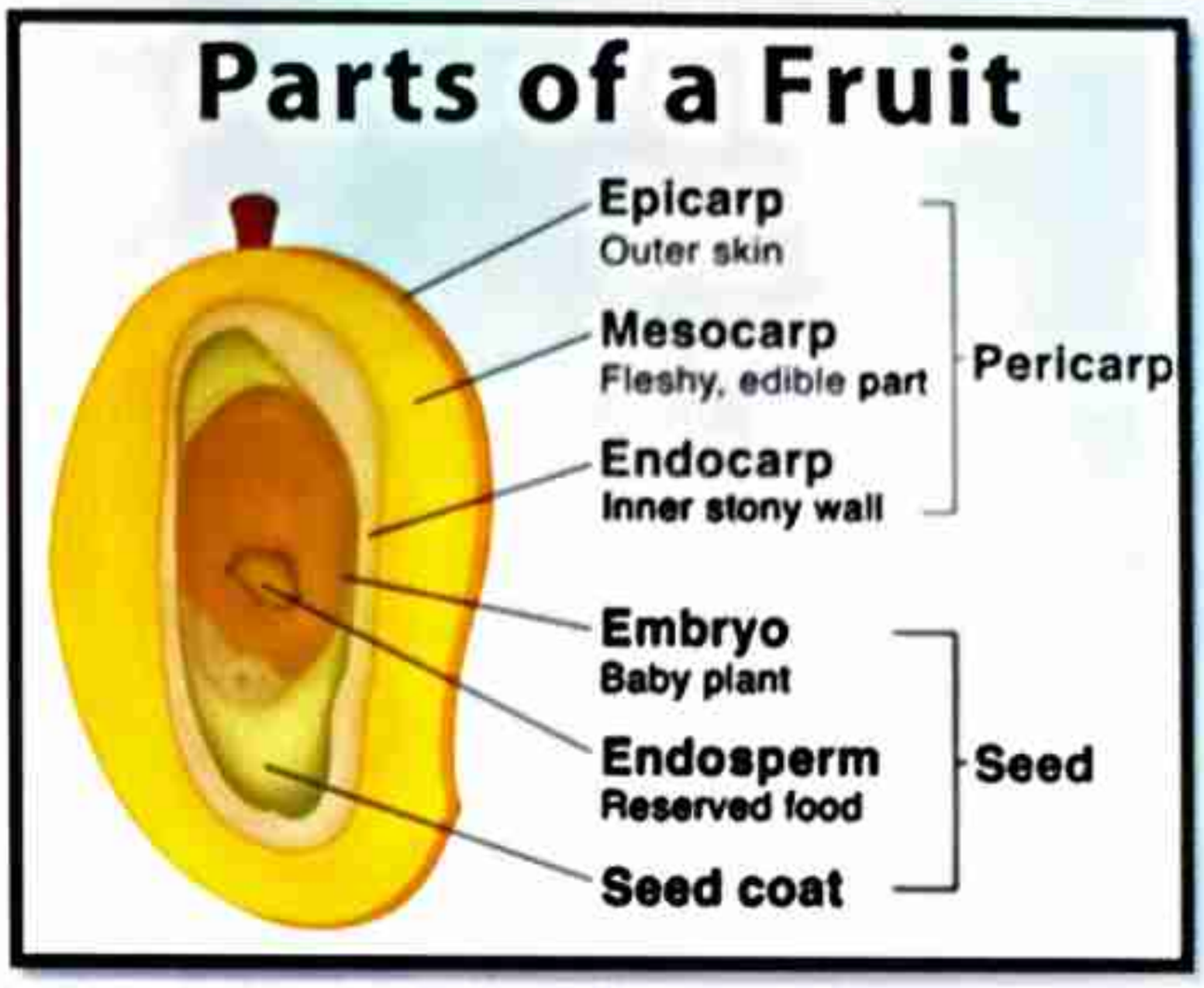



**Fig. Parts of a fruit** : (a) Mango (b) Coconut

## ❑ THE SEED

The ovules after fertilization, **develop into seeds.** A seed is made up of a **seed coat and an embryo**. The **embryo is made up of a radicle**, an embryonal axis and one (as in wheat, maize) or two cotyledons (as in gram and pea)

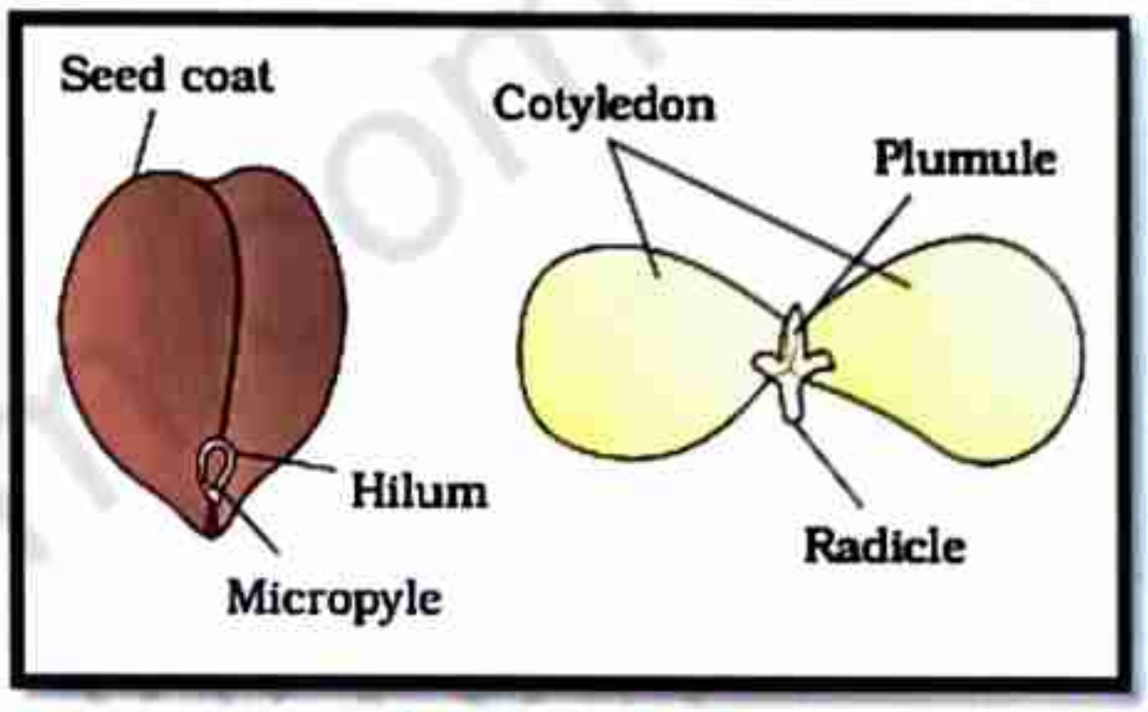



**Fig. Structure of dicotyledonous seed**

**Structure of a Dicotyledonous Seed**

- The outermost covering of a seed is the **seed coat.** The seed coat has two layers, the **outer testa** and the **inner tegmen**
- The **hilum is a scar on the seed coat** through which the developing seeds were attached to the fruit.
- Above the hilum is a small pore called the micropyle.
- Within the seed coat is the embryo, consisting of an **embryonal axis** and two cotyledons.
- At the two ends of the embryonal axis are present the **radicle** and the **plumule**
- In some seeds such as castor the endosperm formed as a result of double fertilization

## Structure of Monocotyledonous Seed

- Generally, monocotyledonous seeds are endospermic but some as in orchids are **non-endospermic**
- In the seeds of cereals such as maize the seed coat is membranous and generally fused with the fruit wall.

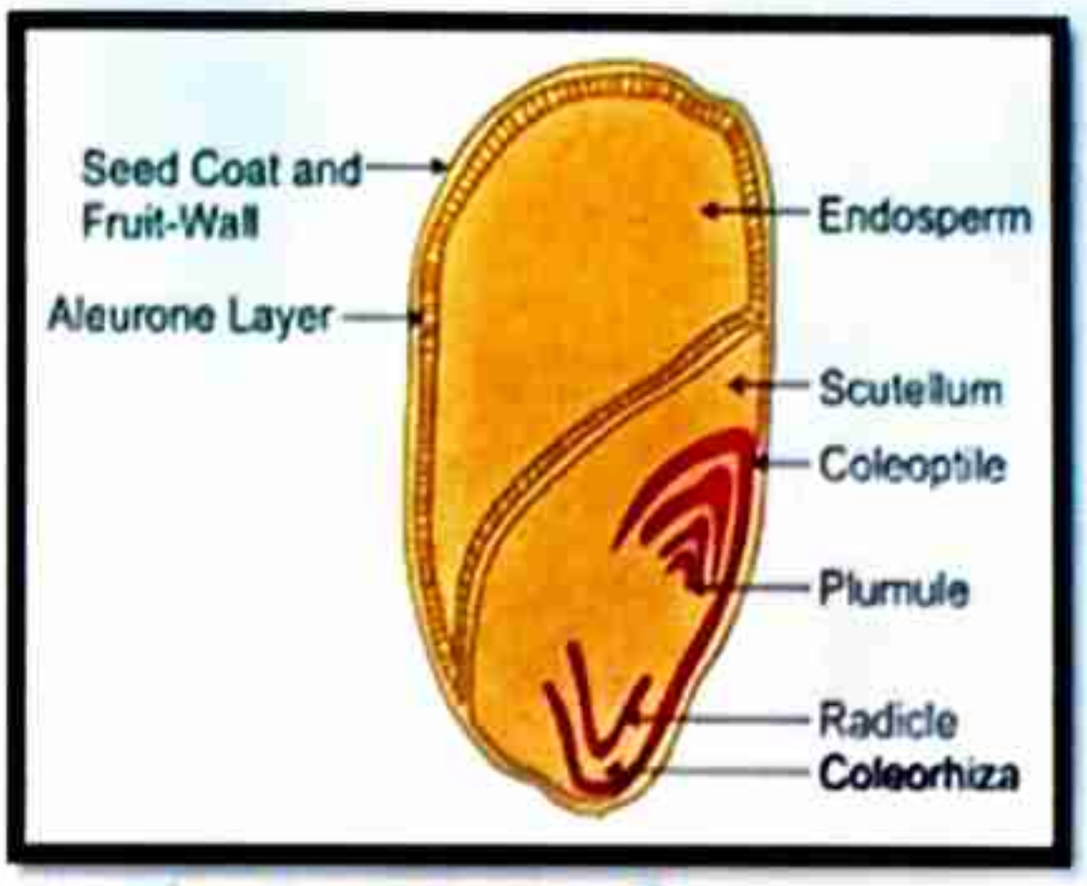



**Fig. Structure of a monocotyledonous see**

- The endosperm is **bulky and stores food**
- The outer covering of endosperm separates the embryo by a proteinous layer called **aleurone layer.**

## ➢ Functions of Seeds

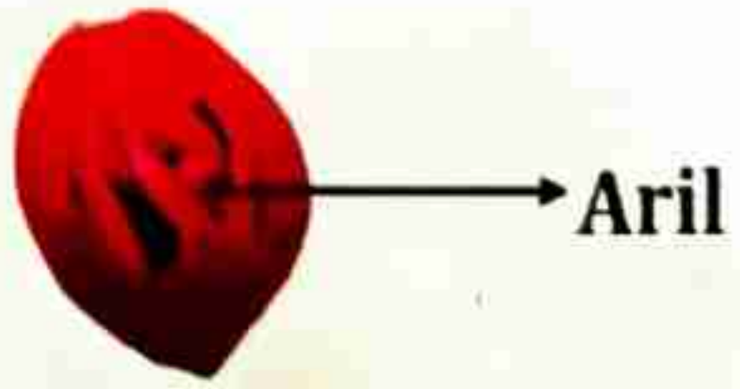
**Seed performs the following functions:**

1. Most important function of the seeds is **reproduction** i.e. it germinates into new plant
2. Seeds are meant for the **spread of the species**
3. Species and varieties do not come to an end by successive formation of seeds by plant.

## ➢ Uses of Seeds

1. **Due to high protein and fixed oil contents seeds are the essential part of the food**
2. **Cotton seeds are used as source of cotton fibres**
3. **Guar seeds, Isapgol, psyllum are used for the isolation of mucilage**

## ➢ Special structure of seed

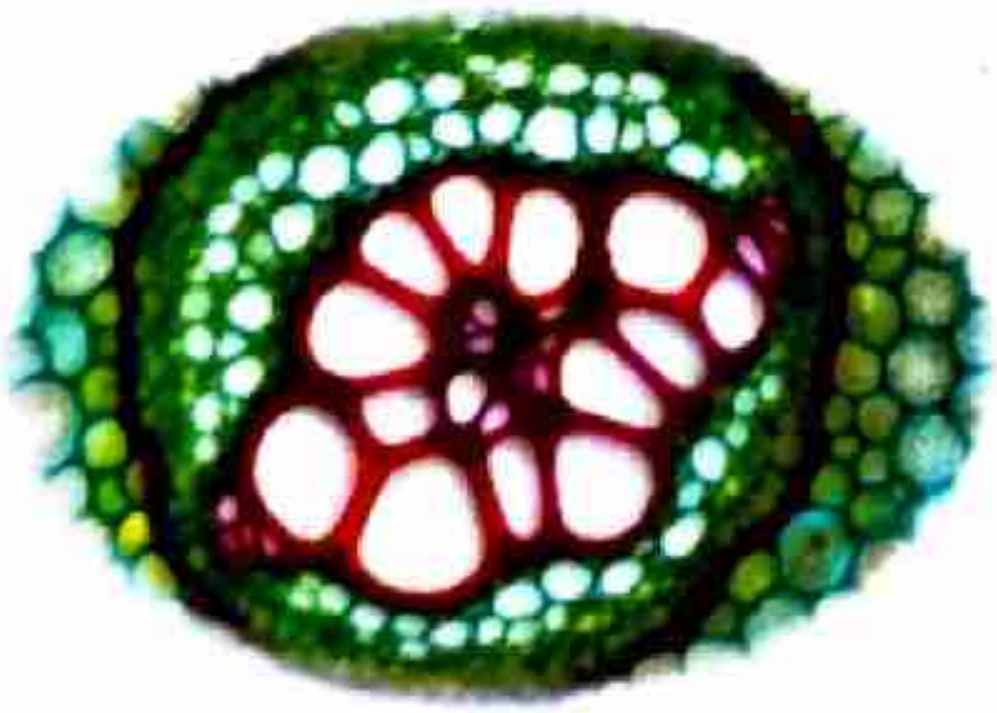
| TERMS | DEFINITION | |
|---|---|---|
| Aril | Succulent growth from Hilum covering the whole seed. E.g. Nutmeg |   |

| TERMS | DEFINITION | |
|---|---|---|
| Arista (awn) | **Stiff bristle like appendages** with many flowering glumes. E.g. Strophanthus |  Arista |
| Caruncle | It is **warty outer growth from micropyle** E.g. Castor, Croton, Viola |  Caruncle |
| Strophiole | **Enlarged funicle** E.g. Datura and Colchicum seed |  |
| Hair | **Gossypium and calotropins** are example of outer growth of hair |  Hairs |
| Arillode | Outer growth of **origin from micropyle** and covering the seed. E.g. Cardamom |  Arillode |

# GENERAL ANATOMY OF ROOT, STEM, LEAF OF MONOCOT AND DICOTYLEDONS

## Contents to be covered in this topic

- INTRODUCTION
- HISTOLOGICAL DETAILS OF DICOLYLEDONNS AND MONOCOLYLEDONNS ROOTS
- HISTOLOGICAL DETAILS OF DICOT AND MONOCOT STEMS
- HISTOLOGY OF TRANSVERSE SECTION OF LEAVES



# GENERAL ANATOMY OF ROOT, STEM, LEAF OF MONOCOT AND DICOTYLEDONS

## ❑ Introduction

### ➢ Histology of Root, Stem and Leaf

Histology or **microscopical characters** of plant **are the** most important characters to prove their **identity it varies from species to species** of the same family. **Examples:** ***cinnamon cassia*** **and** ***cinnamon zeylanicum***

## (a) General histological details of dicolyledonns (Dicot) and Monocolyledonns (Monocot) roots are as under:

| DICOT - ROOT | MONOCOT – ROOT |
|---|---|
| **EPIBLEMA:** It is made up of **thin walled, single called layer,** most of the epiblema cells extend outwards to form unicellular root hairs. This is layer is used **for absorption of water and solutes** dissolved in water. **Root hairs do not have cuticle** | **EPHIBLEMA:** It is **single called outermost layer having many root hairs** |
| **CORTEX:** This is also made of **thin walled rounded cells** constituting many layers. Cortex cells contain **lencoplants** and **reserves starch grains.** Since **epiblema is short-lived outer cells of cortex** form exodermis. | **CORTEX:** Few layers, **internal to epiblema** made up of rounded or oval shape with plenty of intercellular spaces |
| **ENDODERMIS:** It consists of **dumb-bell shaped cell** and is made of **only one layer** and **no intercellular spaces**. This is **innermost layer of cortex** and occurs as a ring around stele | **ENDODERMIS: Innermost layer of cortex** consisting of thick-walled cells. **Barrel- shaped cells**, passage cells are frequently present. |

| | |
|---|---|
| **PERICYCLE:** This is **single layered, lying internal to endodermis**, forming circular layer. Cells are thin walled and very small in size | **PERICYCLE: Internal to endodermis** consisting of thin walled, single cells. |
| **CONJUNCTIVE PARENCHYMATOUS TISSUE:** It is the parenchymatous tissue in between xylem and phloem. | **CONJUCTIVE TISSUE:** Similar to dicot root |
| **PITH:** It consists of very small in the cortex of the root and gets destroyed. | **PITH:** Present in the centre well developed and containing parenchymatons cells |
| **VASCULAR BUNDLES (VB): Vascular bundles** are arranged in ring. Protoxylem **lies away from centre** so that development of wood in possible number of V.B. may be 2 to 6. Phloem part consists of usual sieve-tubes, companion cells and phloem parenchyma, xylem consisting of protoxylem which lies towards periphery and metaxylem towards centre. | Xylem and phloem forms equal number of separate bundles, in a ring radially arranged. Many number of vascular bundles are present xylem and phloem, **similar to dicot root** |

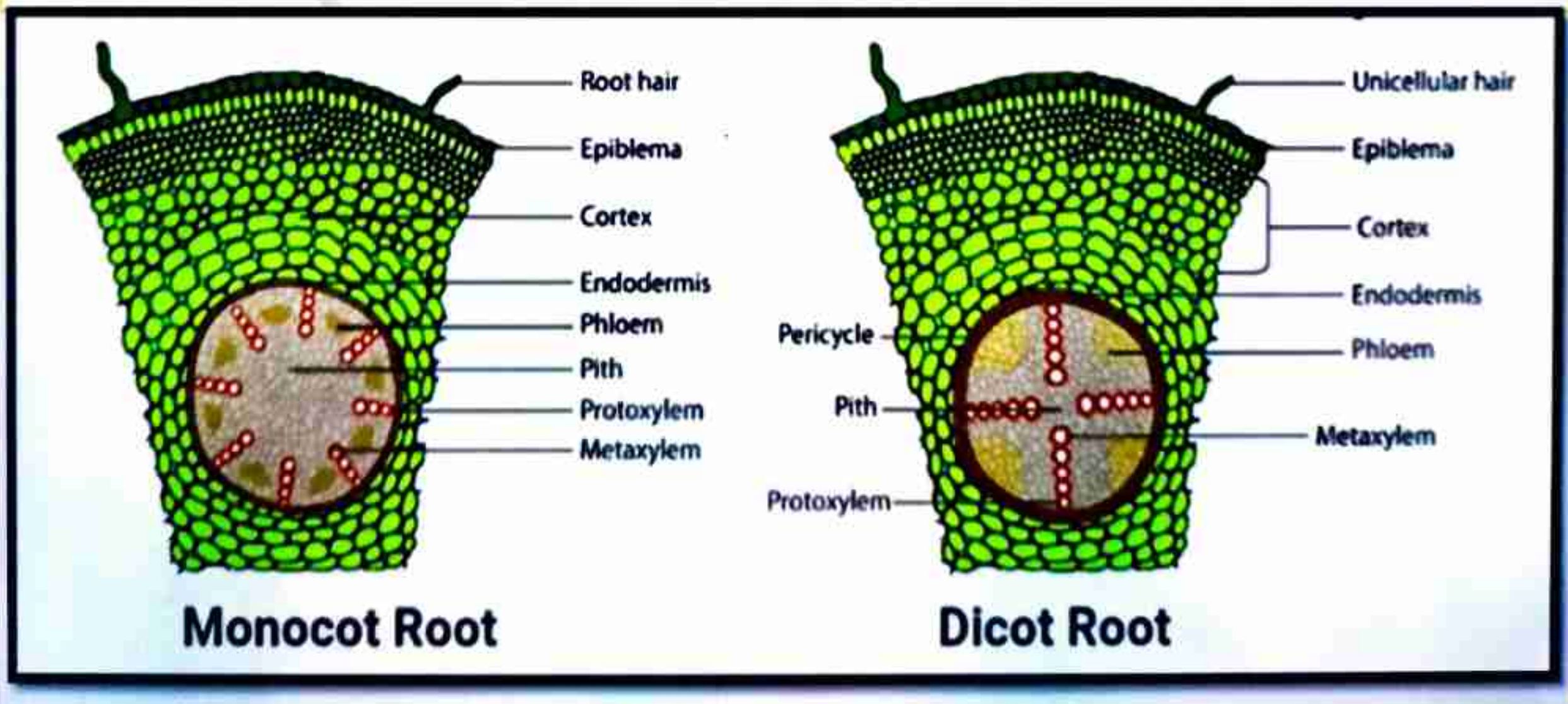



**Fig. Histology of root**

## (b) General Histological details of Dicot and Monocot Stems

| DICOT - STEM | MONOCOT – STEM |
|---|---|
| **EPIDERMIS** - Is the **outermost protective layer** of the stem Covered with a **thin layer of cuticle,** it may **bear trichomes** and a few **stomata.** The cells arranged in multiple layers between epidermis and pericycle constitute the cortex. It consists of three sub-zones. | Is the **outermost protective layer** of the stem |
| **HYPODERMIS:** consists of a few layers of **collenchymatous cells** just below the epidermis, which provide **mechanical strength** to the young stem | The monocot stem has a sclerenchymatous hypodermis, |
| **CORTEX:** Parenchymatous few layered | Parenchymatous up to the centre. |
| **ENDODERMIS:** The innermost layer of the cortex is called the endodermis. The cells of the endodermis are rich in starch grains and the layer is also referred to as the starch sheath. | **Not marked** |
| **PERICYCLE:** present on the inner side of the endodermis and above the phloem in the form of semi-lunar patches of sclerenchyma. | Without differentiation into different tissues |

| | |
|---|---|
| **MEDULLARY RAYS**: In between the vascular bundles there are a few layers of **radially placed parenchymatous cells**, which constitute medullary rays. | Not marked out |
| **PITH:** A large number of rounded, **parenchymatous cells with large intercellular spaces** which occupy the central portion of the stem constitute the pith | **Pith** is **absent** |
| **VASCULAR BUNDLES** : A large number of **vascular bundles are arranged** in a **ring** ; the 'ring' arrangement of vascular bundles is a characteristic of dicot stem. Each vascular bundle is **conjoint, open, and with endarch protoxylem** | **VASCULAR BUNDLES :** Vascular bundles are **conjoint and closed.** Peripheral vascular bundles are generally smaller than the centrally located ones. **The phloem parenchyma is absent,** and water-containing cavities are present within the vascular bundles. |

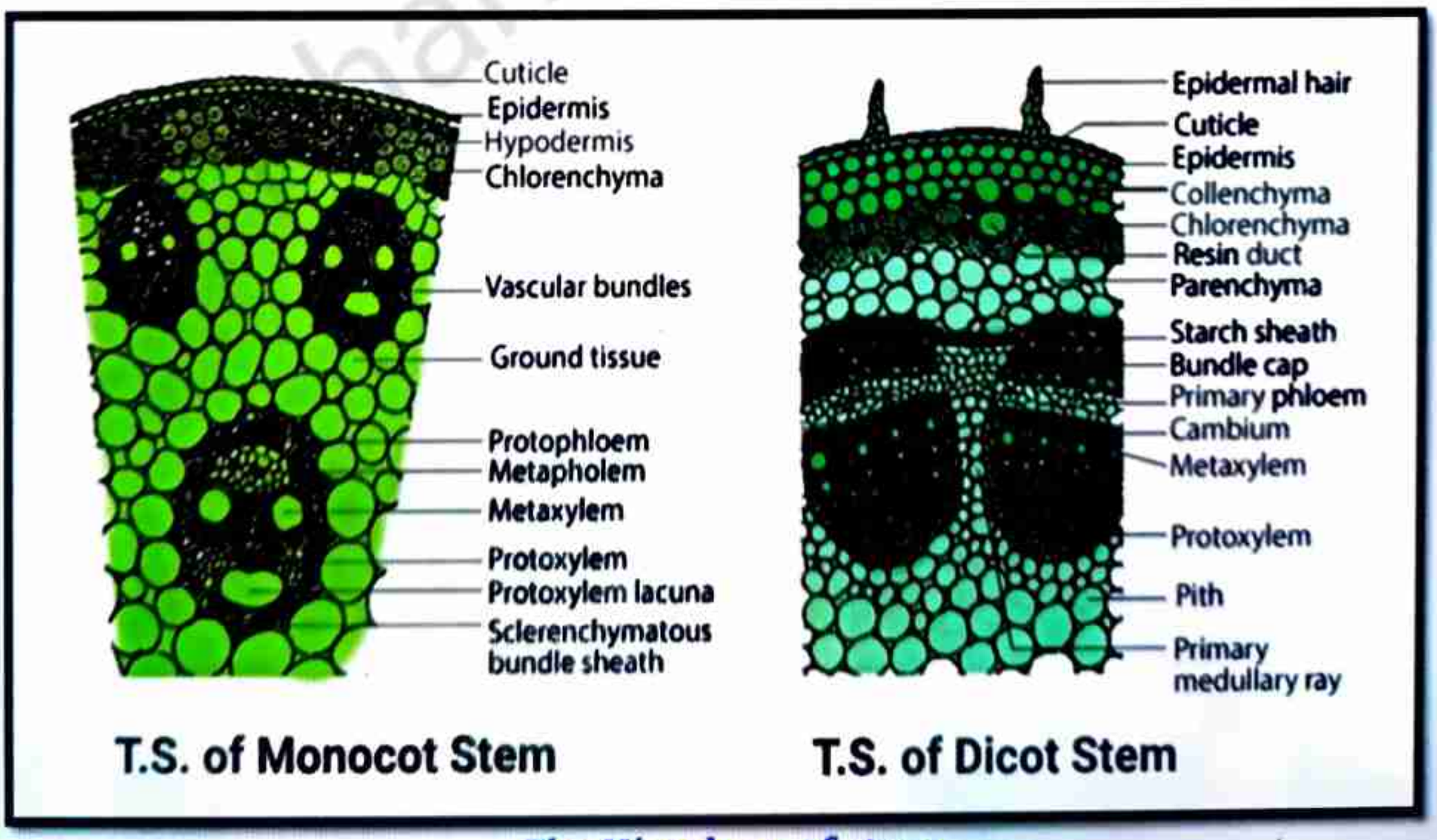



**Fig. Histology of stem**

## (c) Histology of Transverse Section of Leaves

| DORSIVENTRAL LEAF | ISOBILATERAL LEAF |
|---|---|
| Epidermis is present on both surfaces covered by cuticle. Stomata are also present | Epidermis present on both the surface is covered with cuticle and contains equal number of stomata on both sides |
| Spongy parenchyma is made of rounded or oval to irregular cells and placed towards lower epidermis. Many intercellular spaces and chloroplast are present | Mesophyll contains only spongy parenchyma containing chloroplasts of no palisade cells. |
| Number of vascular bundles decreases from base towards the apex. Vascular bundles distributes water and mineral matter and collect prepared food material. Vascular bundle consists of xylem and phloem lying towards upper and lower epidermis respectively. Xylem is made up of vessels, tracheids wood fibres and wood parenchyma. Phloem is constituted of usual contents like sieve-tubes companion cells. Phloem carries food material from leaf blade to the growing parts of the plant as well as to the storage organs. | Vascular bundle is covered by thin and compact layer of parenchyma known as border parenchyma or bundle sheath. Xylem lies-towards upper epidermis while phloem-towards lower epidermis. Xylem consists of vessels, tracheids wood fibres and wood parenchyma. Phloem consists of sieve-tubes, companion cells and phloem parenchyma, xylem carries water and food material of different parts of leaf blade |