STEM

- The system which grows aerially in a plant is called **shoot system.**
- It develops from the **plumule of embryo**
- The axis of the shoot system is called the **'stem'.**

Characteristics of Stem:

- Grows positively phototropic and negatively geotropic
- Growth of stem is maintained by apical bud.
- Stem is divisible into nodes and internodes.
- Leaves are developed on the stem at nodes.
- The upper angle between the leaf and stem is called **axil.**
- The **axillary buds** developed in the axis **produce branches.**
- Young stems are green and woody stems are brown in colour

Functions of stem:

- Stem helps in exposing the foliage to sunlight for efficient photosynthesis.
- Stem conducts water and mineral salts absorbed by roots to the leaves.
- It conducts the synthesized food materials from the leaves to other storage organs of the plant.

Modification of Stem:

• When a permanent change occurs in the structure of stems to perform new functions suitable for the environment, it is called **stem modification.**

Aerial Stem Modifications:

Tendrils:

- Some weak stemmed plants produce wiry, coiled, sensitive and delicate organs useful for climbing and are called **tendrils.**
- The tendrils coil around the support and help the plant in climbing.
- In **Passiflora,** the **axillary bud** develops into a tendril.
- In **Cissus quadrangularis** and **Vitis vinifera** the **terminal buds** develop into tendril.

Thorns:

- These are hard, woody, pointed structures meant for protection.
- They are provided with vascular tissues.
- In **Bougainvillea** and **Duranta axillary buds** develop into thorns and help in climbing.
- In **Duranta** thorns bear **leaves and flowers.**
- In **Carissa carundus,** the **terminal bud** produces pair of thorns.
- In **Punica granatum** the thorns bear **leaves and branches.**

Eg: Bougainvillea, Duranta, Carissa, Punica

Hooks:

- These are woody, curved and sensitive structures.
- In Hugonia axillary buds of opposite leaves develop into Hooks.
- In **Artabotrys** the **apical bud** is modified into an inflorescence and the **peduncle** is modified into a **Hook.**
  Eg: Artabotrys, Hugonia

Phylloclade:

- The plants growing in drought areas and deserts show many adaptations to control the rate of transpiration.
- Leaves are modified into scale leaves (or) spines.
- Leaf like stems are called **phylloclades.** They help in Photosynthesis.
- In **Opuntia** all the leaves of axillary bud modify into a group of spines.
- Some spines are small and appear as hairs. They are called **barbs.**
- The group of **barbs** and spines present at every node is known as **areole.**
  Eg: **Opuntia, Cocoloba, Casuarina.**

Cladophyll or Cladode:

- Short, green cylindrical or flattened branches of limited growth develop from the node of the stem or branch in the axil of a **scale leaf.**
- Such a branch is known as the **cladophyll.**
- It is variation of phylloclade.
- In **Asparagus** the cladophylls are green and cylindrical and are produced in the axils of scale leaves.
- In **Ruscus** the green, flat leaf like organs (branches) are the cladophylls. They bear male or.female flowers fr6m a point (representing a node) half way up on their surface in the axil of another scale leaf.
  Eg: Asparagus, Ruscus. <u>Tuberous stems:</u>
- The aerial stems which store food materials and become tuberous are called **tuberous stems.**
- In **Bulbophyllum,** an **epiphyte,** generally one internode of the stem stores food and water and becomes tuberous.
- It appears as a bulb like structureand is called **pseudobulb.**
  Eg: Brassica oleracea var gangyloides (Knol Khol), Bulbophyllum.

Bulbils:

- In some plant species the vegetative and floral buds are modified into condensed branches.
- They store food materials.
- These modified buds are called bulbils.
- At maturity the bulbils develop into new plants by producing adventitious roots when they get separated from plants.
- They participate in vegetative propagation.
  - In **Dioscorea bulbifera** bulbils develop from axils of leaves.
  - In **Agave americaria** and **Globba bulbifera** they develop in the axil of bracts on the inflorescence.
- In **Oxalis** a group of bulbils arise from the ground level at the apex of tuberous root.

Eg: Dioscorea bulbifera, Agave americana, Globba, Oxalis

Sub aerial stem modifications:

- In some weak stemmed plants the stem remains partly aerial and partly underground. These stems are called sub aerial stems.
- These are specialised for vegetative propagation.

Runners:

- In some weak stemmed plants the stems creep on the soil and are rooted at every node.
- When the internode break off, the nodes lead an independent life.
  - These weak stemmed plants are called runners. Eg: Hydrocotylevulgaris, Lippia nodiflora and Oxalis.

Stolons:

- In some plants the long slender branches which arise from the base of the stem grow obliquely downwards.
- - When these branches touch the soil they produce adventitious roots.
- These branches are called stolons.
- The method of raising plants vegetatively by layering depends mainly on stolon principle. Eg: Nerium, Jasminum and Rosa.

Suckers:

- Underground branches grow obliquely upward from the axillary buds of nodes present below the soil.
- These underground branches are called suckers.
- Eg: Chrysanthemum and Mentha

Offsets:

- These are found in free floating water plants like Pistia and Eichhornia.
- In these plants the stem is reduced to a disc like 'structure.
- Many leaves are developed from this stem in rosette manner.
- The axillary buds of these leaves develop into short slender branches of one inter nodal length and grow horizontally above the water.
- These branches are called offsets.
- Each offset bears a cluster of leaves on the upperside and adventitious roots on the lower side.
- Offsets are rarely found in terrestrial plants like Agave americana.
- Eg: Pisitia, Eichhornia.

Underground stem Modifications:

- Stems which grow below the soil are called underground stems.
- They store food materials and become fleshy and bulky.
- They also act as organs of vegetative propagation and perennation.
- These stems grow underground and are protected from herbivorous animals.
- Hence underground stem modifications are also called multipurpose stem modifications.

Rhizome:

- It is underground stem which grows horizontally below the soil with nodes and internodes.
- It is dorsiventrally differentiated
- It produces aerial branches and reproductive organs from the dorsal side and Adventitious roots from the ventral side.
- Scale leaves are present at the nodes.
- The branches developed from the axillary buds not only store food materials but maintain horizontal growth of the rhizome.
- Terminal bud develops and produces aerial branches.
- The underground rhizome remains alive even in drought conditions.

Eg: Zingiber officinalis, Curcuma longa, Musa paradisiaca and Canna indica.

Corm:

- This underground stem grows vertically in the soil at a particular depth.
- It stores food materials that are synthesised in aerial branches and become tuberous. It bears nodgs and internodes. Leaves are reduced to scale leaves.
- The axillary buds of these scale leaves produce daughter corms
- Apical bud is big and produces aerial shoot
- In Amorphophallus corm is kept at a particular depth in the soil by some special adventitious roots called contractile roots (or) pull roots.

Stem Tuber:

- The apices of these underground branches store food materials and become tuberous. These are called **stem tubers.**
- The tuber is covered by brown coloured **periderm.**
- It bears many **eye** like structures. These eyes represent the nodes.
- Each eye possesses a semilunar **leaf scar** and an **axillary bud** in its axil.
- The scar represents the position of scale leaf.
- The **eyes** help in **vegetative propagation.**
- **Stem tubers do not possess roots.**
- In **Potato** the stem tuber stores **starch.**
- The stem tuber of **Helianthus tuberous** stores **inulin. .**
- In **Stachys tubifera** the reserve food is **Stachyose.**

Eg: **Solanum tuberosum (Potatp)Helianthus tuberosus, Stachys tubifera.**

Bulb:

- It is a special type of underground sem. The **stem is reduced** to a **biconvex shaped disc** like structure.
- The disc bears many adventitious roots on its lower side.
- Many leaves develop on the upperside of the disc and grow above the soil.
- The **leaf bases** of scale leaves **store food** and water and become **fleshy.**
- The **axillary buds** produce **daughter bulbs.**
- The terminal bud present at the centre of the bulb develops into an aerial shoot producing inflorescence
- Daughter bulbs help in vegetative propagation.
- **Bulb** is considered as the **only underground stem** which **does not store food.**
- Bulbs are of 2 types

Tunicated bulb:

- In this the fleshy leaf bases of scale leaves overlap one above the other in concentric circles.
- The entire bulb is covered by dry membranous scale leaves called **tunic.**

Eg: **Allium cepa (Onion)**

Scaly Bulb (or) Imbricate bulb (or) naked bulb:

- The scale leaves are fleshy and loosely arranged.
- The whole bulb is not covered by tunic.

Eg: **Lilium candidum.**

- In **Allium sativum** a number of fleshy scale
- leaves called **cloves** are present.
- **Cloves** are **enclosed** in whitish skinny **tunic.**