Lesson-7
Shoot System

Summary
•Shoot system is an aerial and erect part of plant body which grows upwards. It is usually above the soil and develops from plumule of the embryo. It consists of stem, branches, leaves, flowers, fruits and seeds. •Stem is aerial, upright, positively phototropic part of plant and bears nodes, internodes leaves and buds.

Stem
•The stem may be:- •(i) **Aerial** (erect, rigid, strong and upright as in herbs, shrubs and trees). •(ii) **Sub-aerial** (weak, unable to stay upright and trail on ground as creepers or climb up as climbers) •(iii) **Underground** (buried in soil and produces aerial branches under favourable conditions only).

Types of stem and Modifications

Underground	Subaerial	Aerial
Rhizome (Ginger)	Runner (Grass,oxalis)	Tendrils (Grapewine)
Corm (Saffron)	Stolon (Mint,Jasmine)	Thorns (Citrus)
Bulb (Onion)	Offset (Water hyacinth)	Phylloclade (Opuntia)
Tuber (Potato)	Sucker (Chrysanthemum)	Cladode (Asparagus)

- Shoot apex is the terminal, dome shaped part of shoot, formed of meristem called apical shoot meristem responsible for the development and differentiation of primary permanent tissue and mainly causes growth in length. It is divided into two regions - Tunica and Corpus

Morphological Difference in Stem and Root.

Stem	Root
1. Develops from **plumule**. 2. Young stem is **green** because of chlorophyll. 3. Divided into nodes and internodes. 4. Bears leaves, vegetative and floral buds. 5. No cap present at the apex 6. Positively phototropic and negatively geotropic.	**1.** Develops from **radicle** 2. **Non green** because chlorophyll is absent. 3. Not divided into nodes and internodes. 4. Absent. 5. Root cap is present at the apex. 6. Negatively phototropic but positively geotropic.

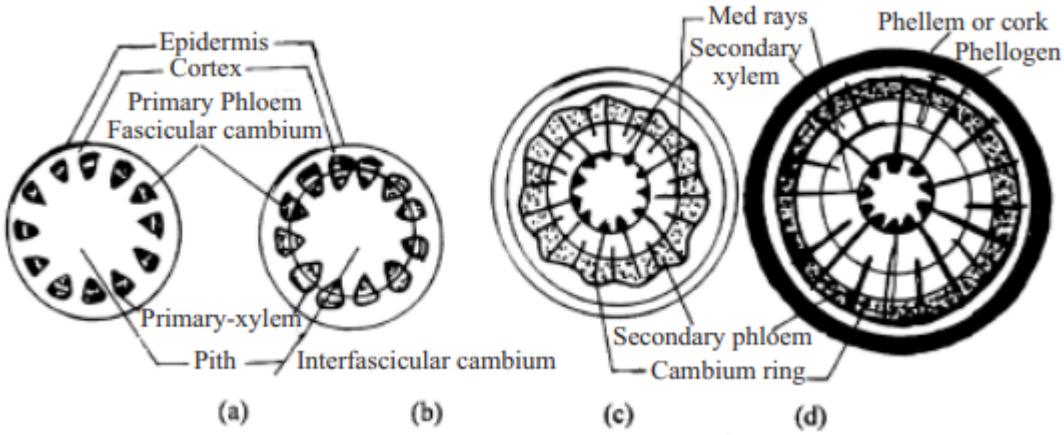
- Dicot and monocot stems are different anatomically.
- Stem undergoes modifications for various special functions like food storage, perennation, protection, climbing, photosynthesis and vegetative propagation.

Differences between monocot stem and dicot stem

Characters	*Dicot stem*	*Monocot stem*
1. Epidermal hairs	Present	Absent
2. Hypodermis	Collenchymatous	Sclerenchymatous
3. Ground tissue	Differentiated into cortex, Undifferentiated endodermis, pericycle, pith and medullary rays	
4. Vascular bundles	(i) Number not very large (ii) Uniform in size (iii) arranged in a ring (iv) open (v) bundle sheath absent (vi) xylem vessels arranged (vii) water cavity absent	(i) Numerous (ii) smaller near periphery, bigger in the centre (iii) scattered (iv) closed (v) bundle sheath present (vi) xylem vessels arranged in a radial row in shape of letter "Y" (vii) water cavity present
5.Secondary growth	Present	Mostly absent

Secondary growth in stem

- It occurs only in dicot stem a little away from the shoot apex and helps the plant to (a) grow in girth (thickness) and (b) makes it very strong to stand upright for many years.
- Growth in thickness in dicot stem becomes possible due to the formation of new tissues entirely by the activity of two lateral meristems - (i) Vascular cambium and (ii) Cork cambium. These tissues thus formed are known as **secondary tissues** and growth in girth is referred as secondary growth.



(a-d) T. S. Dicot Stem- Various stages in secondary growth (Diagrammatic)

Wood

- Wood is the secondary xylem produced by the activity of vascular cambium in dicot stem.
- Sap Wood and Heart Wood Outer part of wood which is functional and consists of recently formed secondary xylem having some living cells is called sap wood. As the plant ages in the

central part of stem, the inner cells of sap wood that become non-functional and dark in colour constitute, heart wood.

Leaf

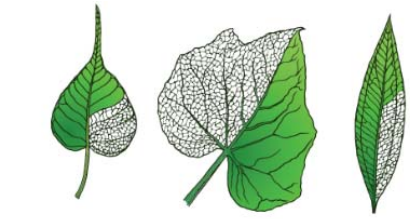
- **Leaf** is a flattened and expanded lateral appendage of stem or branch developing from its node.
- It is the seat of very important physiological processes like photosynthesis, transpiration and respiration. There are two types of leaves Simple and Compound.

Structure of Leaf

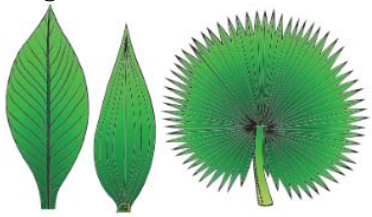
- A typical leaf has three parts: (i) Leaf base (ii) Petiole and (iii) Lamina or leaf blade cells.

Venation in leaves

- Arrangement of veins and veinlets in the lamina is known as Venation. It is of two types:-
- ***Reticulate venation*** -veins forming a network e.g. dicots
- ***Parallel venation*** -veins arranged in parallel rows e.g. monocots



(a) *Ficus* (b) *Cucurbita* (c) *Cinnamomum*



(a) Canna (b) Bamboo (c) Borassus

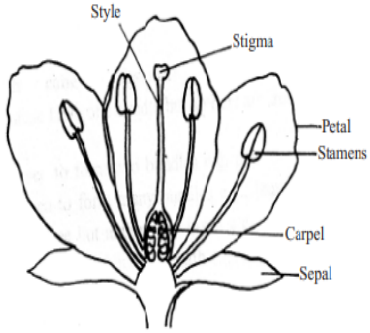
- **Reticulate venation** **Parallel venation**

- **Phyllotaxy**: It is the arrangement of leaves on stem or branch. The orientation and arrangement of leaves is such that they get appropriate amount of sunlight for photosynthesis. It is of three types. 1. Alternate 2. Opposite 3. Whorled
- Leaves are modified into tendrils, spines, phyllode, pitcher or bladder to perform special functions.
- **Internal structure of leaf shows three main tissues** - epidermis with stomata, mesophyll differentiated into spongy and palisade tissue in dicot leaf but only spongy tissue in monocot leaf and vascular system.
- In dicot leaves, each stomatal apparatus consists of kidney shaped guard cells surrounding a pore. In monocot leaves stoma is surrounded by two dumbbell shaped guard

FLOWER

A flower is a modified shoot because it has

i. nodes very close to one another and
ii. Floral leaves arranged in successive whorls.



- A typical flower has accessory whorls i.e., calyx and corolla and reproductive or essential whorls i.e., androecium (male) and gynoecium (female)
- Flowers may be bisexual, unisexual or neuter; actinomorphic zygomorphic; hypogynous, perigynous or epigynous.
- Variations occur in floral parts.
- Placentation is the manner in which placenta bearing ovules are distributed in the ovary .It is of many types.

Types of inflorescence

- There are two major types of inflorescence (i) Racemose. The main axis does not end in a -flower but continues to grow. (ii) Cymose. The main axis ends in a flower and the growth is limited.
- Hypanthodium, verticillaster and cyathium are special types of inflorescence.

Fruit

- Fruit is a ripened ovary that develops after fertilization
- Ovules develop into seeds and the ovary wall matures into fruit wall called the pericarp which may be thin or differentiated into epicarp, mesocarp and endocarp.
- Fruits may be true or false and categorized into simple, aggregate or composite types.
- A fruit that develops without fertilization is called parthenocarpic fruit. It is seedless or has non-viable seeds e.g, banana, and grapes

Test Yourself

- 1. What are the differences between aerial stem and underground stem. Explain with example.
- 2. Write about the modifications of sub aerial parts of stems. Mention their functions also.
- 3. What is Phyllotaxy? Give examples of alternate, opposite and whorld Phyllotaxy.