Basic Body Plan, Modular Growth, Diversity of Forms in Plants

Prof. Dr. V. D. Devarkar

Department of Botany,

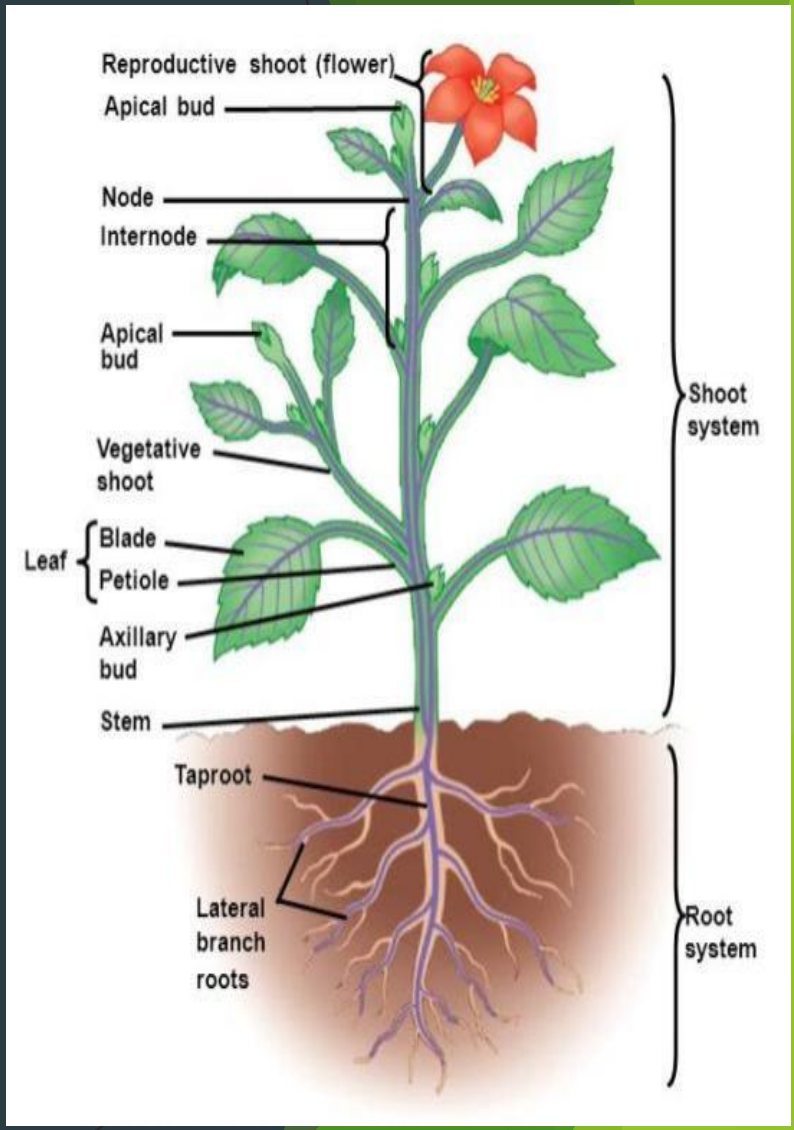
Shri Chhatrapati Shivaji College, Omerga

Basic Body Plan

- The plant body consists of a number of organs, i.e., root, stem, leaf and flower. The flower consists of sepals, petals, stamens, carpels and sometimes also sterile members.
- Each organ is made up of a number of tissues. Each tissue consists of many cells of one kind.
- The complex multicellular body of the seed plant is a result of evolutionary specialization of long duration.
- This specialization has given rise to the establishment of morphological and physiological differences between the various parts of the plant body and also caused the development of the concept of plant organs.

Fundamental Parts

- The axis, consists of two parts—that portion which is normally aerial is known as the stem, and the portion which is subterranean is called the root.
- **Leaves :** The strands of vascular tissue pass through the leaves. The leaves are characteristic of the stem and do not occur on the root. The leaves are found to be arranged on the stem in a definite manner, and bear an intimate structural relation to the skeleton of the axis.
- **Emergences :** In the appendages of the second rank only the outermost layers of stem, the cortex and the epidermis, are usually present which are known as emergences.
- **Hairs :** The appendages of the third rank are hairs. These are projections of the outermost layer of the cells.



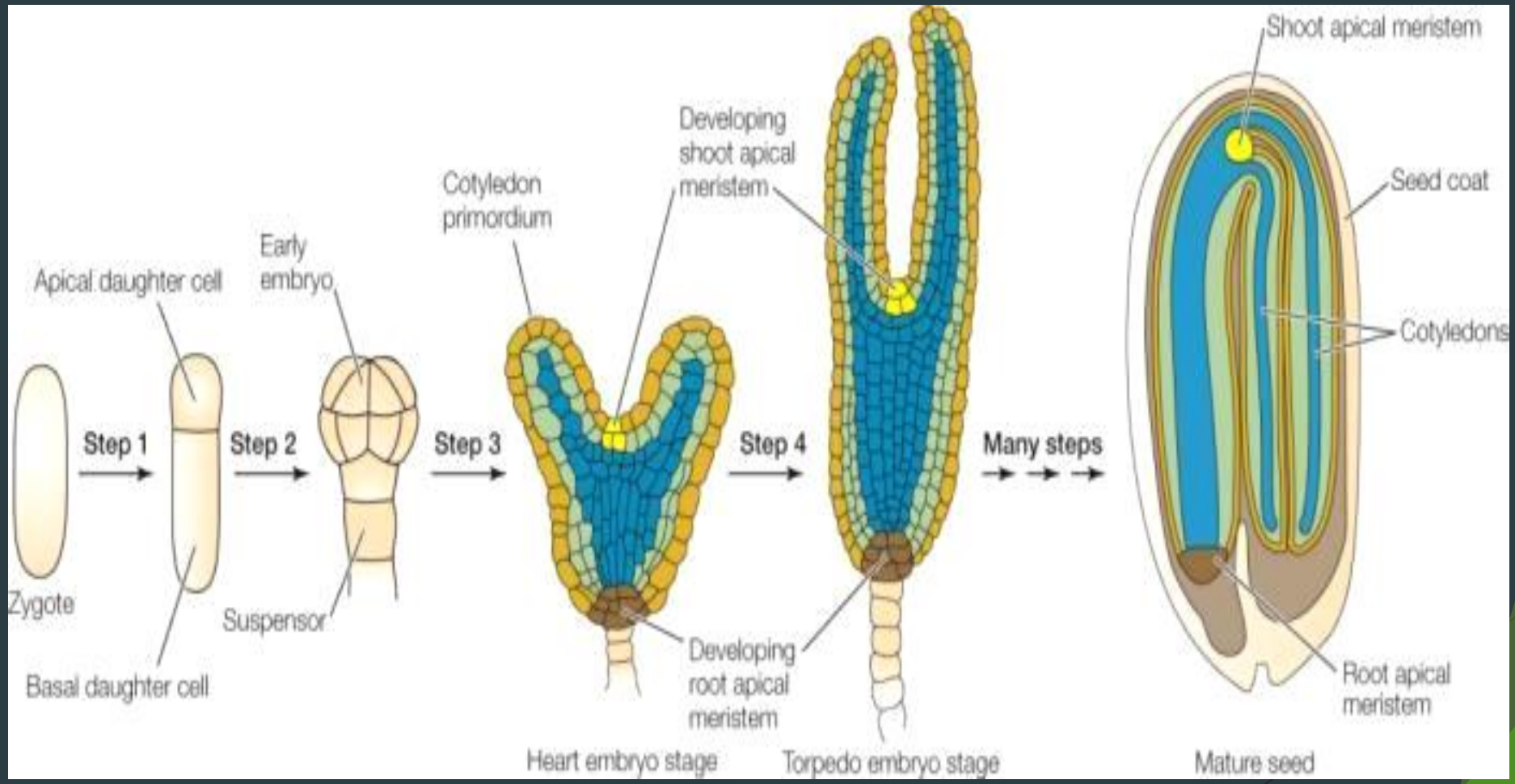
Development of the Plant Body

- A vascular plant begins its existence as a morphologically simple unicellular zygote (2n). The zygote develops into the embryo and thereafter into the mature sporophyte.
- The development of the sporophyte involves division and differentiation of cells, and an organization of cells into the tissues and tissue systems.
- The embryo of the seed plant possesses relatively a simple structure as compared with the mature sporophyte.
- The embryo bears a limited number of parts - generally only an axis bearing one or more cotyledons. The cells and tissues of this structure are less differentiated.
- After the germination of the seed, during the development of shoot and root, the new apical meristems appear which cause a repetitive branching of these organs.

Primary and Secondary Growth

- The first-formed plant body is known as the primary plant body, since it is built up by means of first or primary growth.
- The tissues of this first-formed body are known as primary tissues; for example the first-formed xylem is called primary xylem.
- In most vascular cryptogams and monocotyledons, the entire life cycle of the sporophyte is completed in a primary plant body.

Primary and Secondary Growth

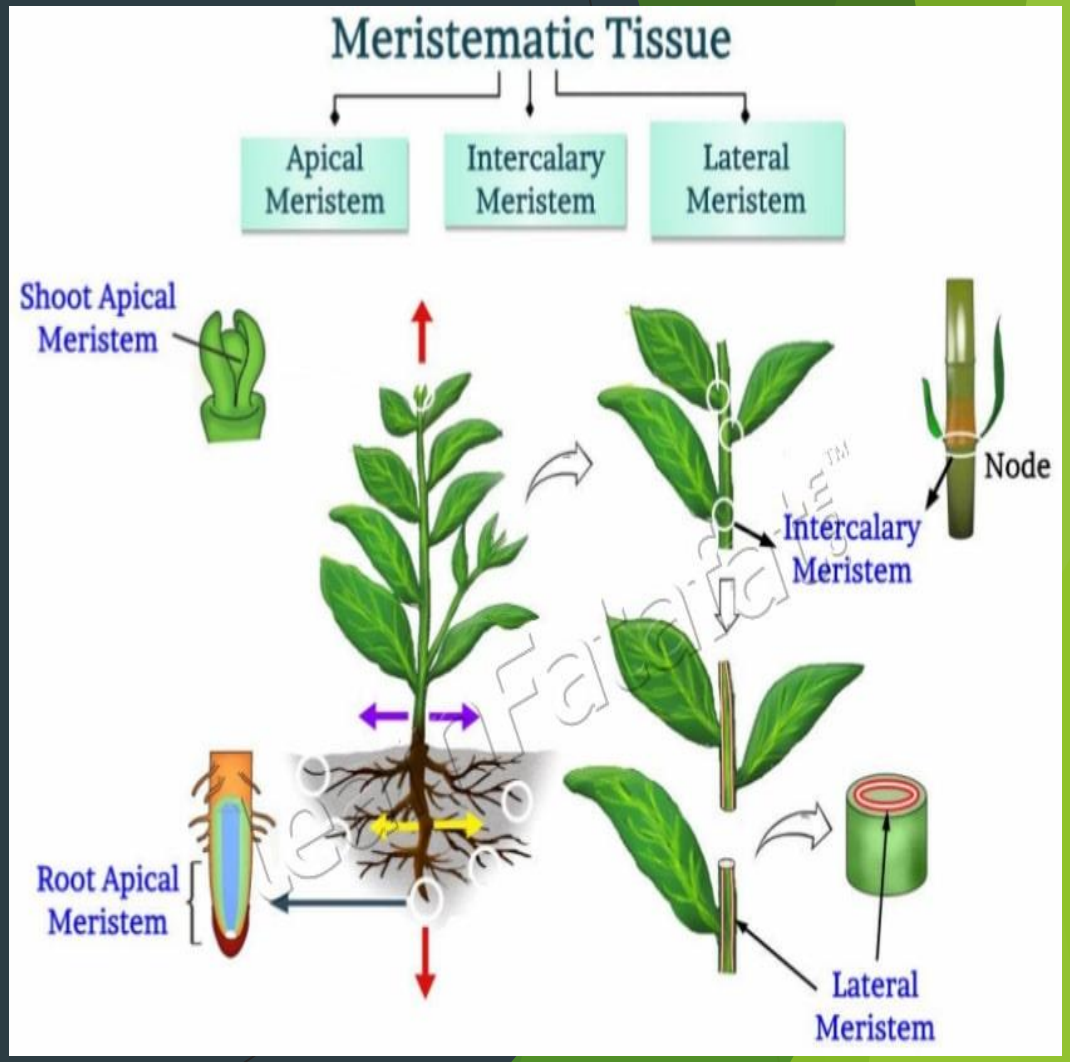


Primary and Secondary Growth

- The primary growth increases the length of the axis, forms the branches and builds up the new or young parts of the plant body.
- The tissues formed as the result of secondary growth are called secondary tissues. Generally the new types of cells are not formed by means of secondary growth.
- A special meristem, the cambium, is concerned with the secondary thickening. The cambium arises between the primary xylem and the primary phloem, and lays down new xylem and phloem adjacent to these.
- In addition, a cork cambium or phellogen commonly develops the peripheral region of the axis and produces a periderm, a secondary tissue system assuming a protective function when the primary epidermal layer is disrupted during the secondary growth in thickness.

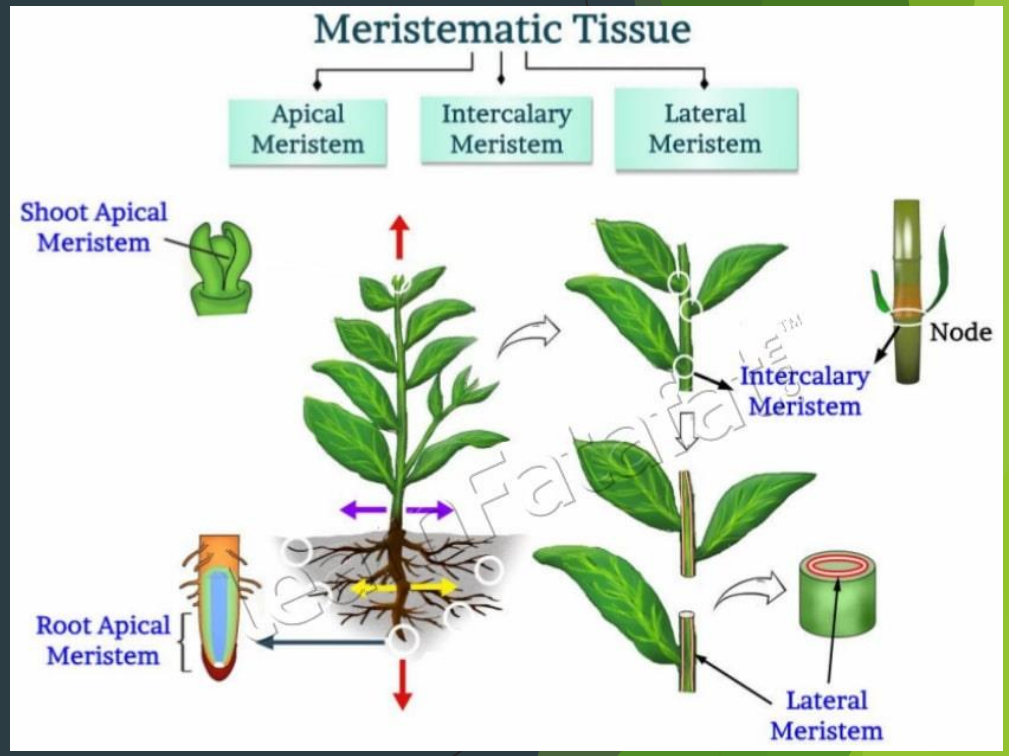
Apical Meristem

- The apical meristem lies at the apex of the stem and the root of vascular plants.
- Due to the activity of these meristems, the organs increase in length.
- The initiation of growth takes place by one or more cells situated at the tip of the organ.
- These cells always maintain their individuality and position and are called ‘apical cells’ or ‘apical initials’.



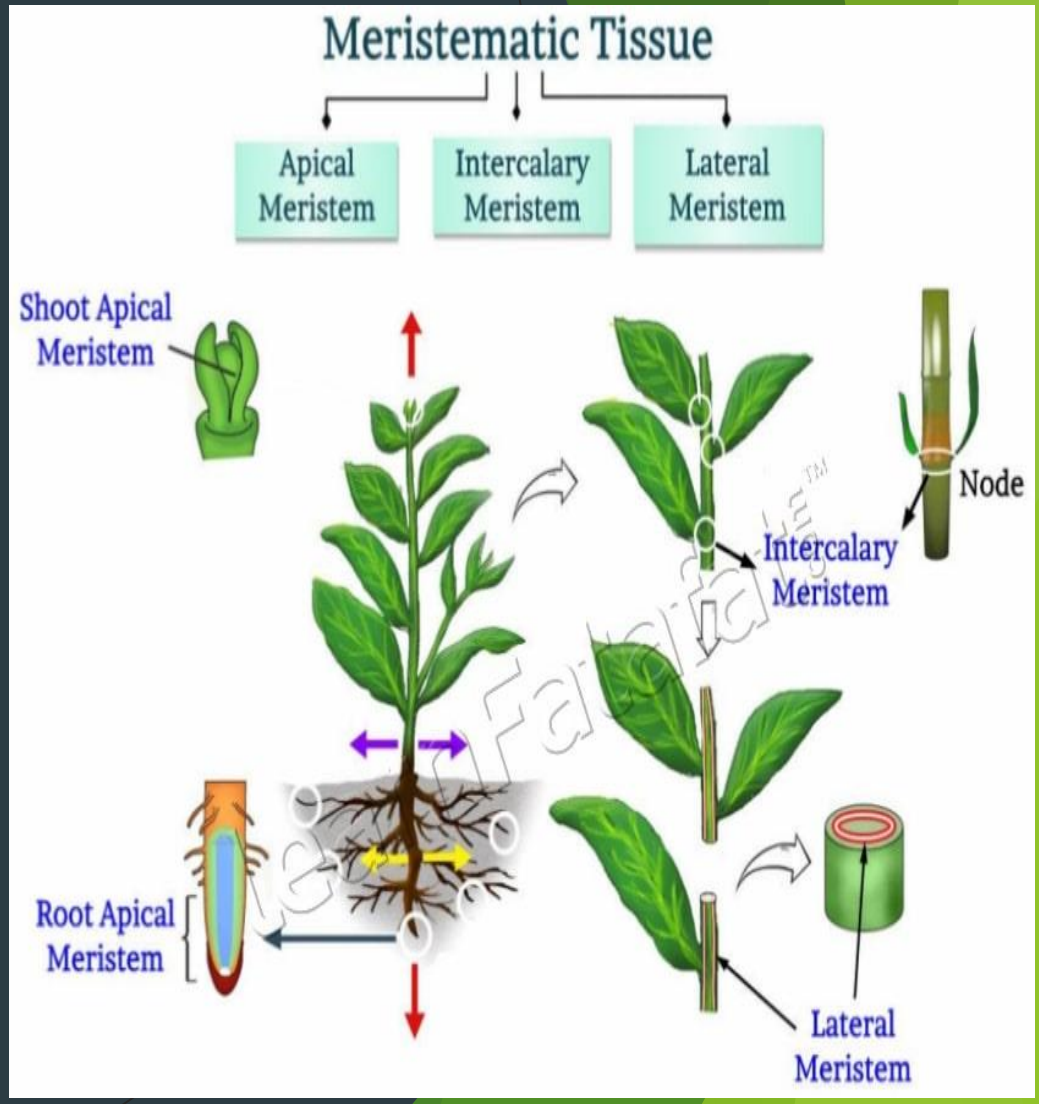
Intercalary Meristems

- The intercalary meristems are merely portions of apical meristems that have become separated from the apex during development by layers of more mature or permanent tissues and left behind as the apical meristem moves on in growth.
- The intercalary meristems are inter-nodal in their position.



Lateral Meristems

- The lateral meristems are composed of such initials which divide mainly in one plane (periclinally) and increase the diameter of an organ.
- They add to the bulk of existing tissues or give rise to new tissues.
- These tissues are responsible for growth in thickness of plant body. The cambium and the cork cambium are the examples of this type.
- The cambium does not fall definitely in either group (primary and secondary).
- It arises from apical meristem of which it is late and specialized stage. However, the accessory cambia are secondary.

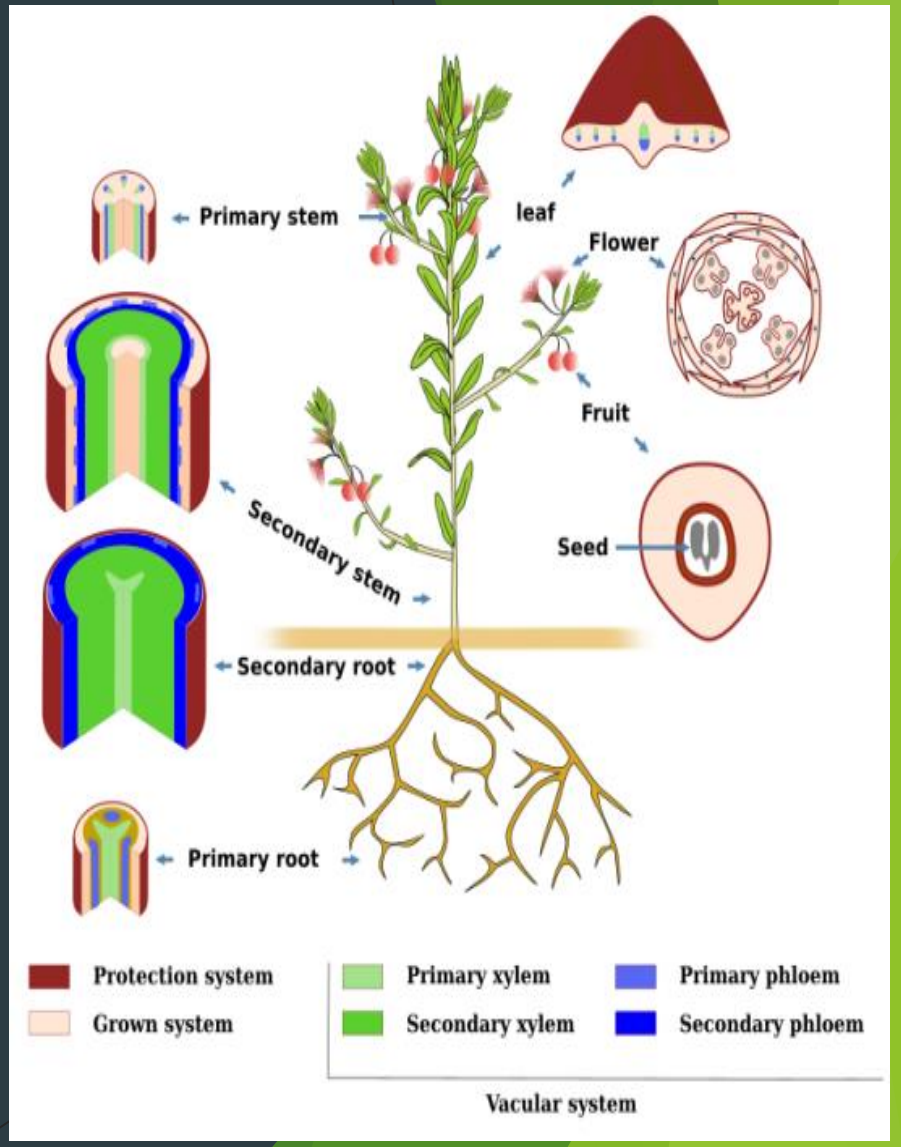


Internal Organisation of Vascular Plant

- The cells or the morphologic units of the plant body. In the plant body the cells are of several kinds and their combinations into tissues are such that different parts of the same organ may differ from one another.
- The larger units of tissues may show topographic continuity or physiologic similarity, or both together.
- As pointed out by Sachs (1875), the plant body of a vascular plant is composed of three systems of tissues (1) The dermal, (2) The vascular and (3) The fundamental or ground system.

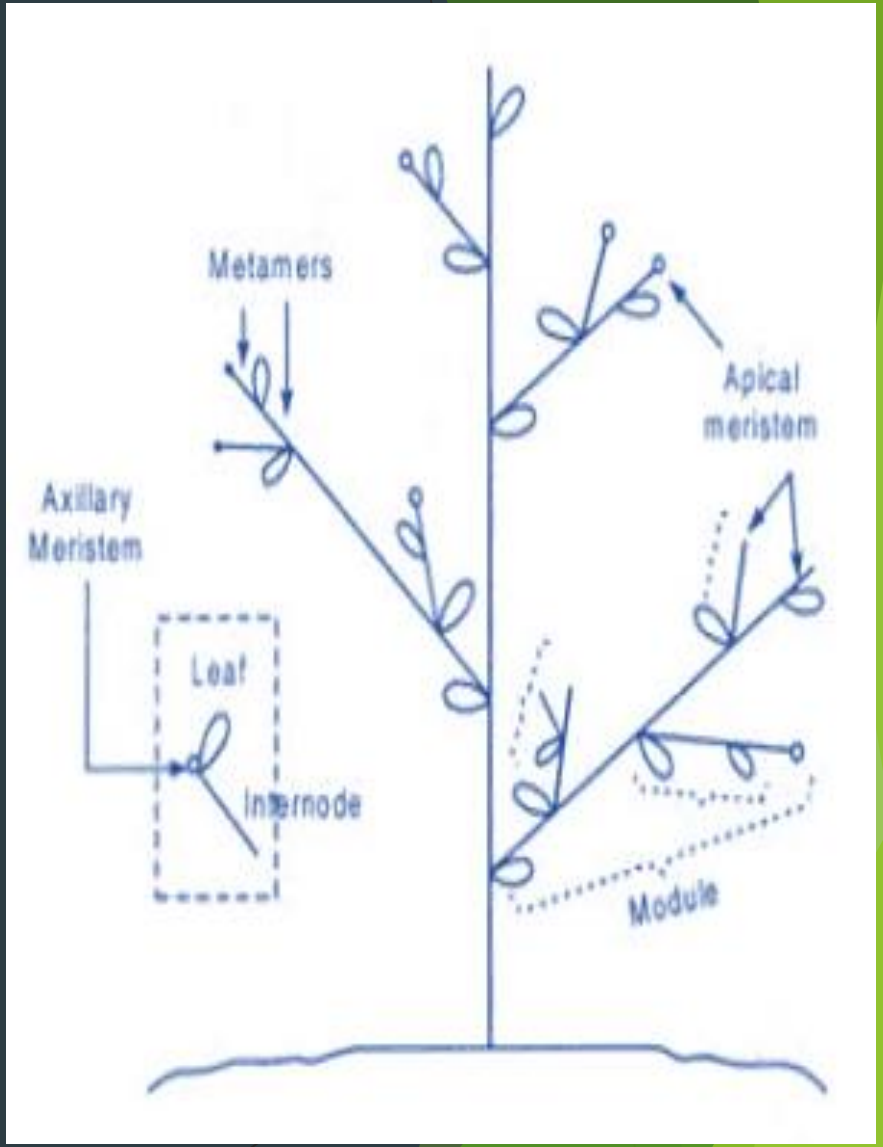
Internal Organisation of Vascular Plant

- The three vegetative organs, i.e., stem, root and leaf, are distinguished by the relative distribution of the vascular and ground tissues.
- The vascular system of the stem is found between the epidermis and the centre of the axis. In such type of arrangement the cortex (ground tissue) is found between the epidermis and the vascular region and the pith in the centre of the stem



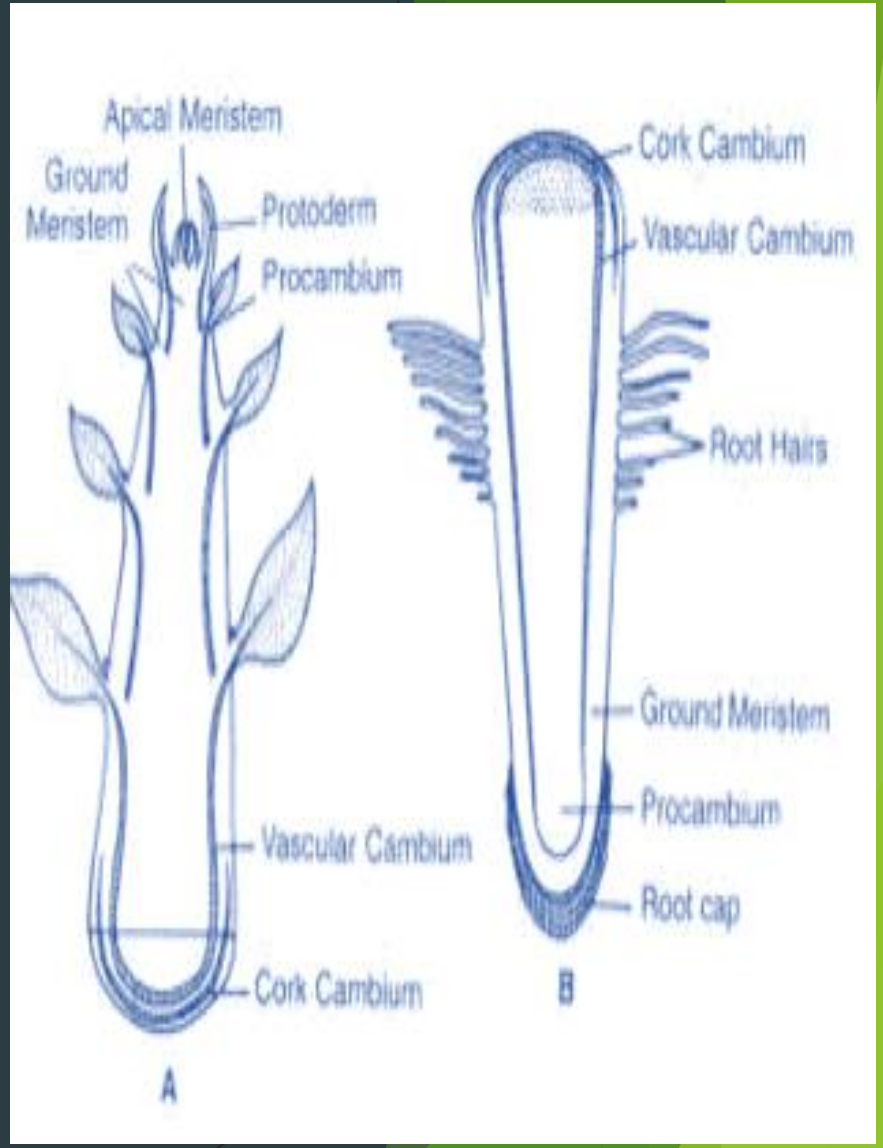
Modular Growth of Plant

- Module is a product of an apical meristem; while metamers are serially homologous repeated units along an axis and are generally sub-units of modules.
- A vegetative metamer consists of a leaf, the segment of stem subtending it and its axillary meristem



Types of Modularity

- According to comparative morphology the modular growth occurs through the retention of the same few types of structures, e.g., branches and flowers in plants.
- In contrast to developmental genetic modules, the modular subunits comprising an organism are similar to each other, i.e., serially homologous and loosely analogous to individuals in population.



Modularity in Plants

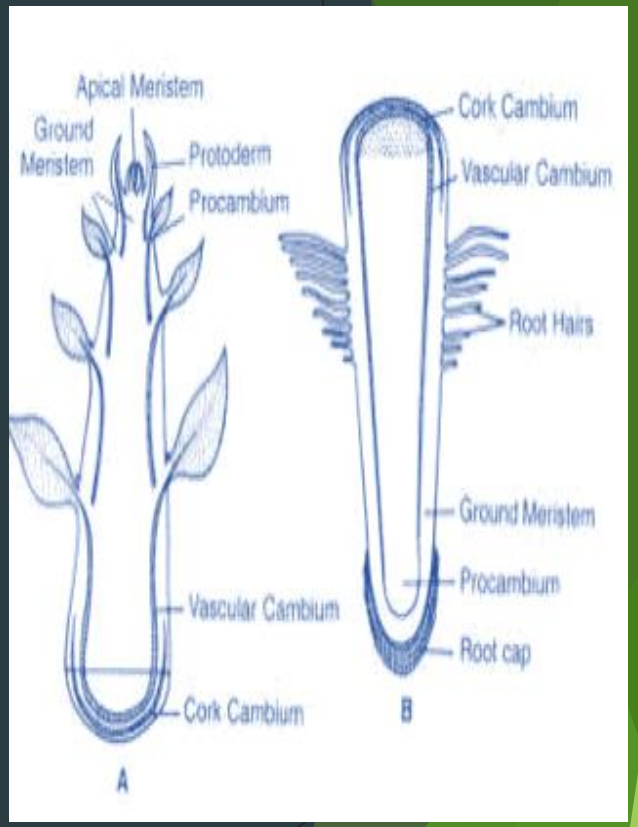
- In plants, module is the product of apical meristem, e.g., branches, cones or flowers.
- Vegetative modules produce new meristem that may give rise to additional vegetative or reproductive modules, creating a modular hierarchy.
- Usually modules themselves are composed of repeated units or metamers. For example, a typical vegetative metamer consists of a node and an internode, a leaf and an axillary meristem.

Shoot System Modules

- Metamers unite to form module. Modules divide due to outgrowths of axillary buds or adventitious buds. When the axillary bud grows continually without undergoing rest period is called sylleptic sub-module while the axillary bud that undergoes some dormancy period is called proleptic sub-module.
- The activity of module is directly related with that of apical meristem. After getting a stimulus, the axillary bud activates and module branches.
- New modules may arise some time playing an important role in regeneration, e.g., in Eucalyptus, after fire new modules grow out rapidly from hidden buds produced by modification of the base of stem.
- Any module or sub-module terminates in a flower or inflorescence depending upon the portion or orientation of metamers in shoot apex

Root System Modules

- Primary and lateral roots are modules of root system. Lateral roots are well developed in herbs. Various types of roots, such as respiratory roots, storage roots, etc., are types of modules.



Diversity of Plant Forms : Habitat

- Habitat is the natural living place or locality of plant, i.e.,
  - Aquatic,
  - Terrestrial,
  - Marshy, etc.

  whether cultivated as an ornamental plant, a food crop or occurs in a wild state.

Diversity of Plant Forms : Habit

- **Herb -** Plant with no persistent parts above ground, as distinct from shrubs and trees, e.g., *Ranunculus* of Ranunculaceae, *Mentha* of Fabaceae.
- **Shrub -** Perennial woody plant, typically with several stems arising from or near the ground, e.g., *Capparis* of Capparidaceae, *Thuja*.
- **Tree -** A perennial woody plant with a single trunk, e.g., *Melia* of Meliaceae, Mango of Anacardiaceae.

Diversity of Plant Forms : Habit

- **Annual -** Plant that completes its life-cycle, from seed germination to seed production, followed by death within a single season, e.g., *Brassica*.
- **Biennial -** Plant that continues its growth from year to year. In herbaceous perennials serial parts die away in autumn, replaced by new shoots in the following year from underground structures, e.g., Delphinium,
- Perennials, permanent woody stems above ground from starting point for each New Year's growth, a characteristic that enables some of them to reach a large size, e.g., shrubs and trees.
- **Parasite -** Plant living in or on another plant (its host) from which it obtains food, e.g., *Cuscuta* of Convolvulaceae.

Diversity of Plant Forms : Habit

- **Epiphyte -** Plant attached to another plant, not growing parasitically upon it but merely using it for support, e.g., *Vanda* (an orchid) of Orchidaceae.
- **Mesophyte -** Plant growing under average conditions of water supply.
- **Hydrophyte -** Plant whose habitat is water or very wet places, e.g., *Ranunculus aquatilis* of Ranunculaceae; *Neptunia oleracea* of Mimosaceae.
- **Xerophyte -** Plant of dry habitat able to endure conditions of prolonged drought, e.g., *Capparis decidua* of Capparidaceae.
- **Saprophyte -** Plant which obtains organic matter in solution from dead and decaying tissues of plants (or animals), e.g., *Monotropa*.

THANK YOU!