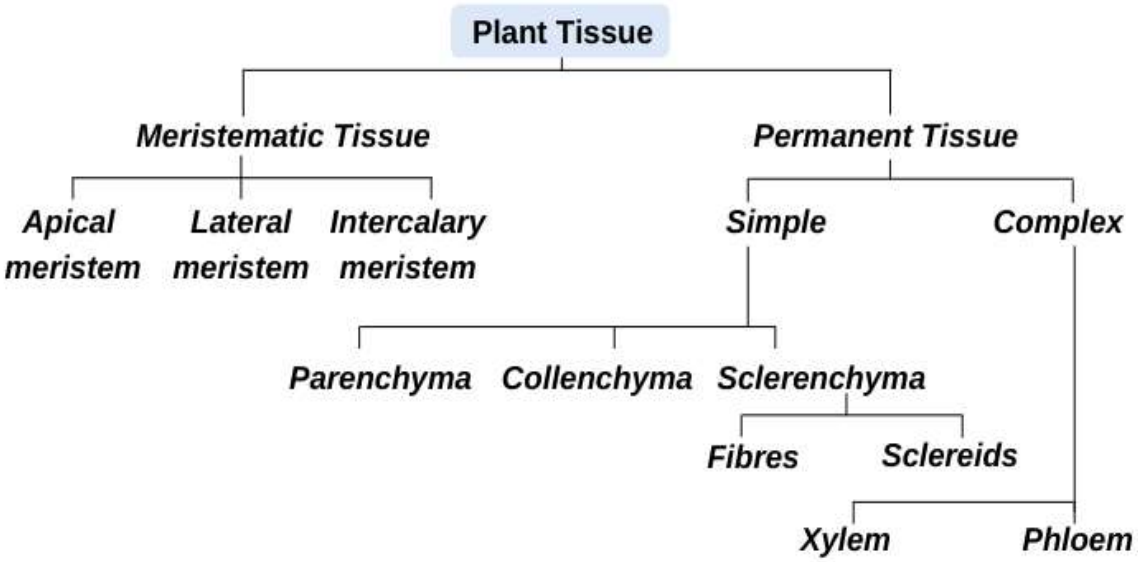
lecture 3

Plant Tissues

Plant tissues are groups of cells that work together to perform specific functions within a plant. They are essential for the growth, development, and survival of plants.

The plant tissues are broadly classified into two types namely:

1. Meristematic tissues
2. Permanent tissues



Sometimes cells of permanent tissue lose their vitality after maturation and become dead cells. Also, some permanent tissue cells remain alive after maturation and can, when appropriate conditions are available, regain their ability to divide and transform into meristematic cells permanently or temporarily. Such cells are called potential meristematic, as such cells can lose their differentiation, as is the case when the intervascular cambium and the cork cambium are formed, where the permanent cells transform back into meristematic cells.

Differentiation, Dedifferentiation, and Redifferentiation in Plant Cells

Differentiation

is the process by which a cell becomes specialized to perform a particular function. This involves the expression of specific genes that code for proteins necessary for the cell's specialized role. For example, a meristematic cell might differentiate into a xylem cell, capable of transporting water and minerals.

Dedifferentiation

Refers to a cellular process in which a differentiated cell loses its special form or function.

It is reverse process. It is when a mature, specialized cell reverts to a less specialized state, often regaining the ability to divide. This can occur under certain conditions, such as injury or stress. For instance, a mature phloem cell might dedifferentiate to form callus tissue, which can then regenerate new plant parts.

Redifferentiation

Is the subsequent process where a dedifferentiated cell re-specializes into a different cell type. This allows the plant to regenerate lost or damaged tissues. For example, a callus cell might redifferentiate into a xylem or phloem cell, restoring the plant's vascular system.

In essence:

- **Differentiation** creates specialized cells.
- **Dedifferentiation** allows cells to become less specialized.
- **Redifferentiation** allows dedifferentiated cells to become specialized again, often for repair or regeneration.

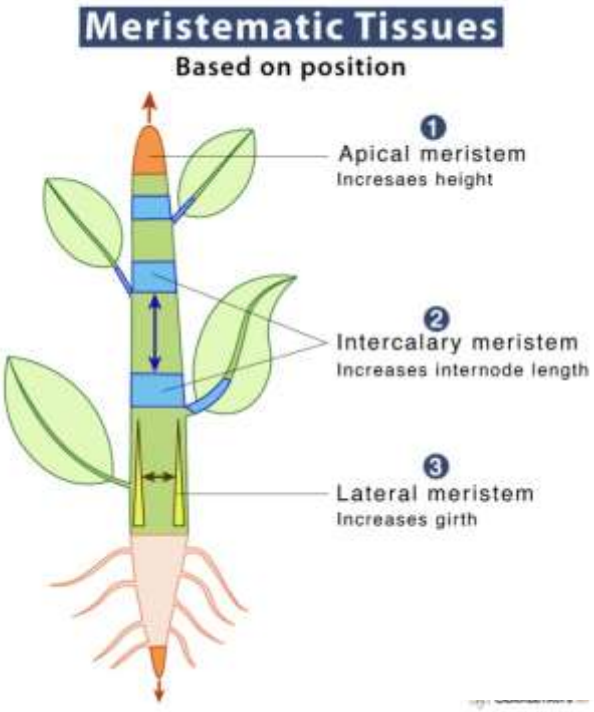
These processes are fundamental to plant growth, development, and wound healing.

Meristematic Tissues

- **Function:** These tissues are responsible for the growth of a plant. They consist of actively dividing cells.
- **Location:** Found in the tips of stems and roots, as well as in the cambium layer of woody plants.

Meristematic tissue is also called growing tissue. Meristems are broadly classified based on the:
(a) Origin and development
(b) Origin of initiating cells
(c) Position in plant body
(d) Function

- **Types according to their position in plants:**
  - **Apical meristem:** Located at the tips of stems and roots, responsible for primary growth (increase in length).
  - **Lateral meristem:** Found in the cambium layer of woody plants, responsible for secondary growth (increase in thickness).
  - **Intercalary meristem:** Located at the bases of leaves and internodes, responsible for the growth of internodes.



In plants, the meristem is found in different zones. Example:

The apex of stem & root, leaf primordia, vascular cambium, cork cambium, etc.,

Characteristic features of meristematic tissue:

- Generally, they are made up of living cells.
- Cells are small, oval, polygonal or round.
- They are thin cell wall made up of cellulose with dense cytoplasm and large nuclei.
- Normally meristematic cells do not have vacuoles, but if it is present, they are very few and small.
- Mitotic cell division happens in plant meristems.
- They do not store food materials because they are metabolically highly active.
- These have no intercellular spaces, cells are closely packed together; and it is called compact tissue.

Functions of Meristematic Tissue:

1. Meristems are actively dividing tissues of the plant.

2. They are responsible for primary (elongation) and secondary (thickness) growth of the plant.

3. All new organs and their growth occur by the division of meristematic tissue.

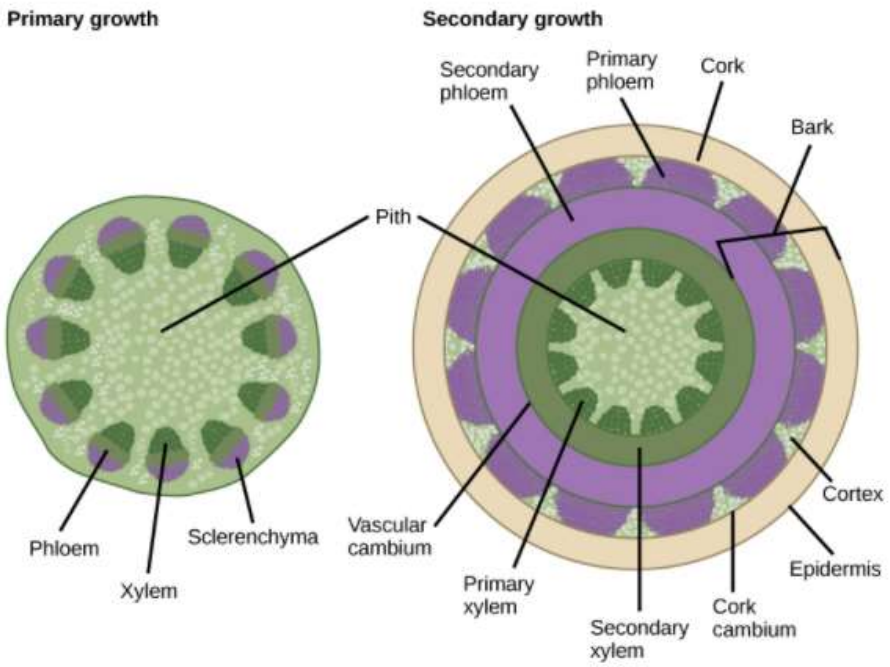
4. Secondary tissues such as, wood, cork are also formed due to activity of meristematic **tissue**

- **Types according to their origin:**
  - Promeristem (primodial meristem)

    These are the earliest and youngest meristem cells of growing organ that originate from the seed embryo.
  - Primary meristem (formed during the primary growth of the plant body).

    Primary meristem are produced from promeristem, which further divides to form different permanent tissues. Usually, they are found below the promeristem at shoot and root apex.
  - Secondary meristem (formed during the secondary growth).

    Ex: vascular cambium & cork cambium



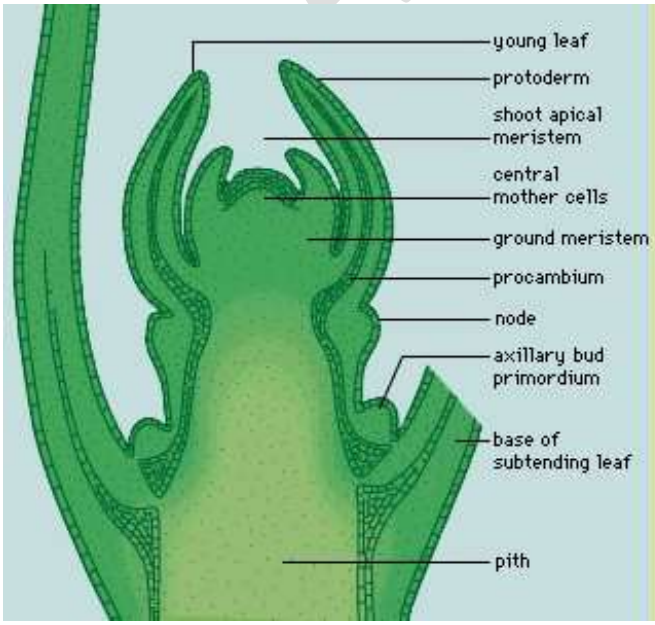
3-According to their function:

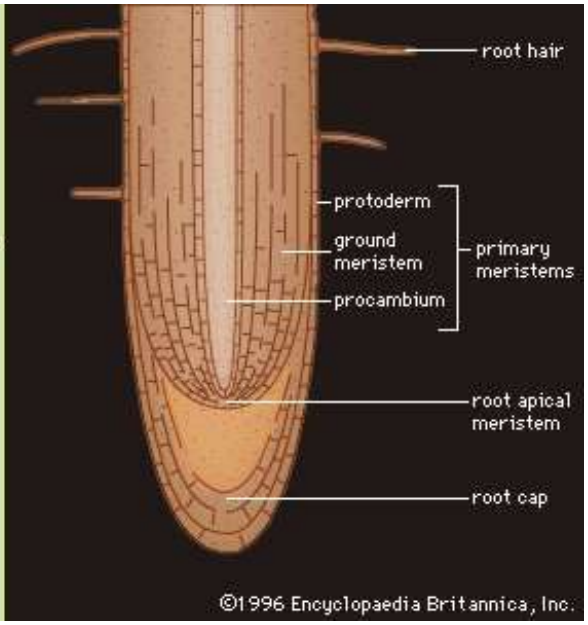
According to Haberlandt, apical meristem is divided into three regions. Based on their function, meristems have been classified into three types, namely:

a) Protoderm meristem

b) Procambium meristem

c) Ground Meristem



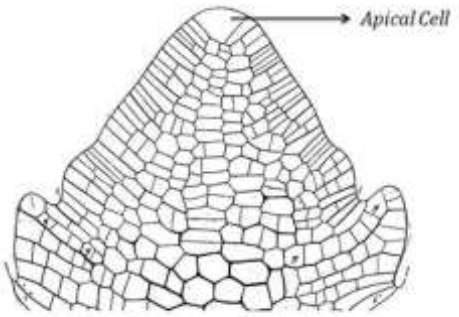


Apical meristem

The shoot apex: The shoot apical meristem is the terminal meristem of the shoot which is the continuing embryonic region of the plant. It continuously gives rise to new cells and tissues from which new organs are formed. It is self determining and autonomous organizing centre of the plant The following are most important theories concerning the shoot apex:

1-**Single apical cell theory**

Presence of a single tetrahedral apical cell in the shoot apex of most vascular and lower plants prompted Nageli (1878) to postulate the apical cell theory. According to this theory a single apical cell is the structural and functional unit of apical meristem and it governs the whole process of growth. Such a single apical cell occurs in algae and majority of bryophytes and pteridophytes. A single apical cell was also believed to be present in seed plants.



Apical Meristem Organization in Shoot
Apical Cell Theory

2-Histogen theory (Hanstien theory)

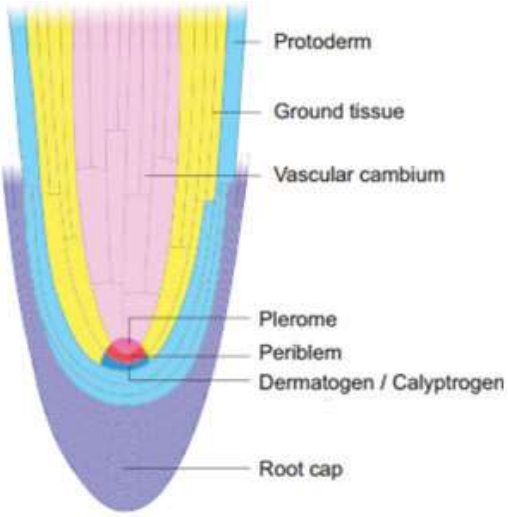
It was proposed by Hanstein (1870). According to this theory, the shoot apical meristem consists of three distinct meristematic zones or layers (or histogens):

(a) **Dermatogen**: Outermost layer and it forms epidermis and epidermal tissue system

(b) **Periblem**: It is the middle layer which gives rise to cortex and endodermis.

(c) **Plerome**: The innermost layer forms pith and stele.

(d) **Clyptrogene**: The inner most layer of root cap.



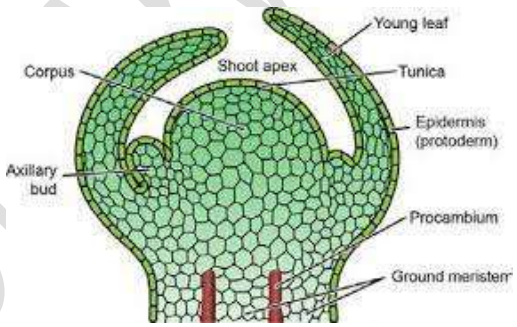
Apical Meristem Organization in Shoot
Histogen Theory

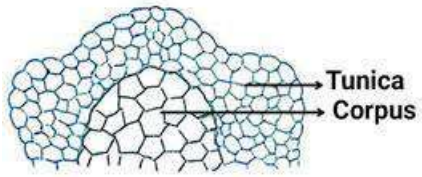
4-Tunica corpus theory (Schmidt theory 1924)

This theory was proposed by Schmidt (1924). According to this theory, the shoot apex consists of two distinct zones.

(a) **Tunica:** It is mostly single layered and forms epidermis. The cells of tunica are smaller than corpus. The tunica shows only anticlinal division and it is responsible for surface growth.

(b) **Corpus:** It represents the central core with larger cells. Corpus shows divisions in all planes and it is responsible for volume growth.





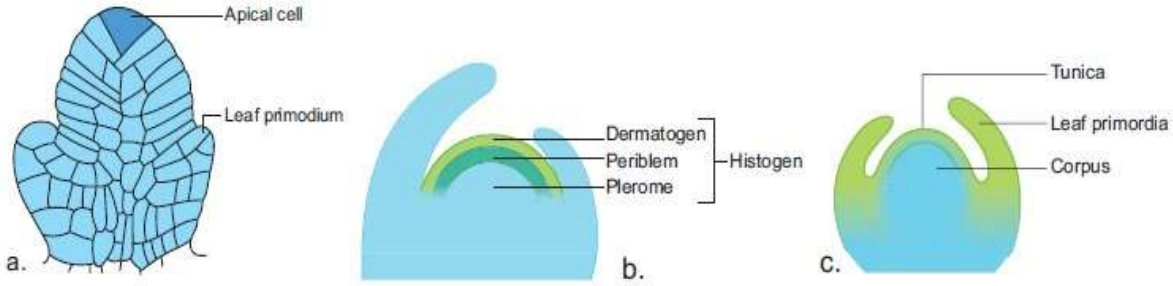


Figure 9.2: Shoot apical meristem a) Apical cell theory, b) Histogen theory, c) Shoot Tunica corpus theory