Study unit 8

Thanks for your involvement in making this group an interactive one. If you are yet to participate, Please do.

As it has been mentioned in my welcome address that all the tutorials will be based on what the Lecturer has designed. Even though, I tried (and will try in subsequent ones) to simplify the module for the purpose of your understanding, I would like to say that IT IS NOT EXHAUSTIVE IN ITSELF. Hence, onus lies on you to study and study to ensure maximum achievement. To this effect, only highlight excerpt are presented here. This also will cut across all tutorials that I would be pasting on myunisa.

The three basic organs in plant is root stem and leaves. These organs form the shoot system and the root system. The shoot system includes the leaves and stem.

Both the root and the shoot systems are dependent on each other.

Roots

The root anchor the plant in the soil serves as storage organ for carbohydrate and it also absorb water and nutrients from the soil. **Eudicots** have tap root system this system consists of one main vertical root and lateral root branching from it. Tap root develops from the embryonic root. They are well adapted to soil where the water is deep in the ground.

In **most monocots**, the embryonic root dies early and does not form tap root. However, short roots emerge from the stem. These are called adventitious root. Each of these root grow its own lateral root. Therefore, the whole adventitious roots and their lateral roots are referred to fibrous system

Stem

A stem is an organ that raises or separates leaves, exposing them to the sunlight. They also raise flowers for the agents of pollination to access the flowers easily and it also enhances seed and pollen dispersals. Each stem has an alternating node and the space between the two nodes is called the internode. The upper angle between the leaf and stem is the axil. The bud that grows there is called the axillary bud. Axillary bud can form a lateral shoot. The apical bud is located at the tip end of the stem. The apical bud is responsible for most of the growth in plant.

The proximity of axillary bud to the apical bud is partly responsible for its dormancy. This is called the apical dominance when the axillary bud becomes dormant due to its proximity to the apical bud

Leaves

The leaf is usually the main photosynthesis organ in plants. The leaf varies but general consists of flat blade and the stalk also called the petiole. The petiole joins the leaf blade to the stem at the node. Monocots do not have petiole instead they have sheath that envelops the stem. The vein of the leaf in monocots is different from the eudicots. In monocots the vein is parallel while in eudicots the vein is net

Characteristics	Parenchyma	Collenchyma	sclerenchyma
Cell wall	Thin primary cell wall	Unevenly thick primary cell wall	The cell wall with large amount of lignin
Cell organelles	Central vacuole and protoplast	Living protoplast	Dead at maturity. Empty lumen
Function	Variety of metabolic functions synthesising and storing	Provide flexible support with restraining growth	Provide support, rigid especially when they are dead

Vascular tissue transport materials 1) between the root and the shoot system. The vascular tissue is in two parts: xylem and phloem

Xylem conducts water and dissolved mineral upward from the roots to the shoots

Phloem: transport sugar and products of photosynthesis from where they are made to where they are needed; the roots and growth region of the plant

The vascular tissue of the stem or root is collectively called the **stele**.

The root stele is solid central vascular cylinder of xylem and phloem but that of the leaves and stem are in separate strands of xylem and phloem.

Ground tissue system: this is composed of the pith and the cortex. It consists of cells of diverse functions such as photosynthesis, storage and support

Cell types

1. Parenchyma cells: these are cells with primary walls that are relatively thin and flexible. Most of them lack secondary walls. They have large vacuoles. They perform the function of synthesising and storage various organic products. They facilitate wound repair in plants.
2. Collenchymas cells: these cells are grouped in strands. It support the young part of the plant shoot. They are not rigid cells, hence they elongate. They are living cells which are flexible but are thicker than parenchyma cells.
3. Sclerenchyma cells: they are supporting cells but are not as flexible as the collenchymas cells. They contain large amount of lignin which contributes to their rigidity. At maturity, collenchyma does not elongate. There are 2 types of sclerenchyma cells

   A) sclerids: these are irregular box shaped. They have thick ligninfied secondary walls. It made up the walls of the hard nuts.

   B) Fibres: they are usually in strands. They are long slender and tapper. Example of such sclerenchyma cells are found in hemp fibre and flax fibres
4. Xylem cells: the xylem cells consists of two types of water conducting cells

a. Tracheid: these are long thin cells with tapper ends
b. Vessel elements:

At maturity, the living components of tracheids and vessel element disintegrate; it becomes thickened and forms a non living conduit through which water flows.

5. The phloem cells: at maturity, the phloem cells are living cells. In gymnosperm, the phloem cells are long narrow cells. In angiosperms, the phloem tissue consists of chains of cells which are sieve-tube elements. Sieve tube elements lack nucleus, ribosome and distinct vacuole and the cytoskeletal plate has pores which facilitates the flow of fluid from cell to cell along the sieve tube

Meristem

Growth occurs in plant throughout their life time. Generally, growth can be determinate or indeterminate

Growth in plants is indeterminate. This means that there is a continuous growth. The reason for indeterminate growth in plant is that, there is always an undifferentiated tissue called the meristem which continually divides and produces new cells that can elongate

There are two types of meristem

- Apical meristem:
- Lateral meristem:

I. Apical meristem:

This is located at the tip of the roots and shoots and in the axillary buds of the shoot. Apical growth allows for root to extend through the soil. The primary growth is caused by the apical meristem.

The primary growth

A shoot apical meristem is a dome shaped mass of dividing cell at the shoot tip. Elongation is due to lengthening of internodes cells below the shoot tip. Branching is also part of primary growth in shoot of plant. Branches arise from the activation of the buds. The dormancy of the bud depends on its closeness to the active apical bud in some monocots meristematic activity occurs at the base of the stem and leaves. These areas are called the **intercalary meristem**

Tissue organisation in stem

Unlike the lateral roots which has it source deep in the vascular cylinder, the lateral shoot is at the surface of the stem through the axillary buds.

In Eudicots, the vascular tissue is made of vascular bundles arranged in ring form. The xylem is adjacent to the pith and the phloem to the cortex

In most mono cots the vascular bundles are scattered throughout the ground tissue. The ground tissue consists of the parenchyma cells

Tissue organisation in leaves

The epidermis in leaf is usually interrupted by the leaf pores called the stomata. Stomata are organs that allow the gaseous exchange of CO_2 and oxygen between the surrounding air and the photosynthetic cells inside the leaf. The stomata pore is flanked by two guard cells which regulate the opening and closing of the pore. The mesophyl which is found in between the upper and lower epidermal layer is made up of parenchyma cells specialised for photosynthesis

II. Lateral meristem:

This consists of the vascular cambium and the cork cambium

Secondary growth occurs along the circumference of the stem and the roots where there is no more growth in length. This growth adds to the thickness of the plant or organ. This is called secondary growth caused by lateral meristem

In Eudicots: the mesophyl is divided into 1) palisade mesophyl and 2) spongy mesophyl

- Palisade mesophyl: consists of two or more layers of the elongated parenchyma cells on the upper part of the leaf.
- Spongy mesophyl: this is below the palisade. The parenchyma cells at the spongy mesophyl are more loosely packed with a labyrinth of air spaces through which CO_2 and oxygen circulate around the cells and up to the palisade region. The air spaces are larger in the vicinity of the stomata to allow for taking in of CO_2 and the release of oxygen.

Secondary growth occurs through the increase in the Vascular cambium and Cork cambium

Vascular cambium:

The vascular cambium adds layers of vascular tissue called secondary xylem and secondary phloem. Vascular cambium is a cylinder of meristematic cells usually one cell thick. It usually increases in circumference yearly as it adds layer of secondary xylem to its interior and secondary phloem to its exterior. These secondary xylem and phloem cells give additional support to the shoot.

Cork cambium

The epidermis is pushed outwards at the initial stage of secondary growth until it falls off the root and the stem. The epidermis is then replaced by the two tissues produced by the first cork cambium. The first layer of the cork cambium is called the phillodermand the second is cork cell

- **The phillodermis** is a thin layer of parenchyma cell. It forms the interior of the cork cambium
- **The cork cell**: this accumulates at the exterior of the cork cambium. As the cork cell matures, they deposit waxy, hydrophobic materials called **suberin** in their walls and then die. Therefore, the cork cell then serves as a protection against the loss of water, physical damage and pathogens. The cork cells and tissues it produces form a layer of **periderm**.

The periderm is impermeable to water and gases. Therefore, water does not penetrate the root through the periderm but the new and youngest part of the root. Older peristem are sloughed off and peel away.