

Al-Mustaqbal University

College of Science

General biology-Botany

Professions Theoretical Lecture 6

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Plant tissue : Root

In plants, the **root tissue system** is responsible for anchoring the plant to the soil, absorbing water and nutrients, and storing food. The root contains various specialized tissues that contribute to its functions. Here's a detailed look at the different plant tissues found in the root:

**1. Epidermis**

* **Structure**: The outermost layer of cells, forming the protective covering of the root.
* **Function**: The epidermis absorbs water and minerals from the soil. It often features **root hairs**, which are extensions of epidermal cells that increase surface area for absorption.

**2. Cortex**

* **Structure**: Located beneath the epidermis, the cortex consists primarily of parenchyma cells.
* **Function**: It stores starch and other nutrients. The cortex also allows water and dissolved minerals to move from the epidermis to the vascular tissue. It plays a key role in the transport and storage of substances within the root.

**3. Endodermis**

* **Structure**: The innermost layer of the cortex, characterized by tightly packed cells.
* **Function**: The endodermis regulates the flow of water and dissolved substances into the vascular tissue. It contains the **Casparian strip**, a waterproof barrier that forces water to pass through the cell membranes, ensuring selective absorption of nutrients.

**4. Pericycle**

* **Structure**: A layer of cells found just inside the endodermis.
* **Function**: The pericycle plays a crucial role in the formation of lateral roots. It is also involved in secondary growth in some plants, contributing to the thickening of the root.

**5. Vascular Tissue**

* The vascular tissue in the root is responsible for transporting water, minerals, and nutrients.
* **Xylem**: Located at the center of the root, xylem transports water and dissolved minerals from the root to the rest of the plant. It can form a star-shaped structure in dicots or a ring in monocots.
* **Phloem**: Situated next to the xylem, phloem carries sugars and other organic compounds from the leaves to other parts of the plant.

**6. Cambium**

* **Structure**: A layer of meristematic cells between the xylem and phloem.
* **Function**: The cambium is responsible for the growth of vascular tissues, producing new xylem and phloem cells. In some roots, it also contributes to the thickening of the root over time.

**7. Root Cap**

* **Structure**: A mass of cells at the tip of the root.
* **Function**: The root cap protects the growing tip of the root as it pushes through the soil. It also secretes mucilage, a slippery substance that helps the root move through the soil and reduces friction.

**Root functions**

Roots serve several essential functions that are critical to the overall health and growth of a plant. Here are the primary functions of root tissues:

### 1. ****Anchorage****:

* **Function**: Roots anchor the plant to the soil, providing stability and preventing it from being displaced by wind or water. This physical support is crucial for the plant’s upright growth.

### 2. ****Water and Mineral Absorption****:

* **Function**: Roots are responsible for absorbing water and essential minerals from the soil. This is done primarily through the **root hairs** in the epidermis, which increase the surface area available for absorption.

### 3. ****Storage of Nutrients****:

* **Function**: Roots store starch, sugars, and other nutrients that can be used by the plant during periods of dormancy or in times of low resource availability. For example, carrots, beets, and sweet potatoes store energy in their roots.

### 4. ****Transport of Water, Nutrients, and Hormones****:

* **Function**: Roots act as a conduit, transporting water, minerals, and nutrients from the soil to the rest of the plant. This is facilitated by the vascular tissue, mainly the **xylem**, which carries water and minerals upward, and the **phloem**, which transports organic compounds like sugars.

### 5. ****Hormonal Regulation****:

* **Function**: Roots produce and transport plant hormones such as **auxins**, which play a key role in growth, root development, and responses to environmental stimuli. They also contribute to **gibberellins** and other growth regulators, influencing the overall growth of the plant.

### 6. ****Production of New Roots****:

* **Function**: The **pericycle** within the root is responsible for the formation of new lateral roots, contributing to root system growth and increasing the root’s surface area for water and nutrient absorption.

### 7. ****Support for the Plant’s Growth****:

* **Function**: Roots provide a foundation for the plant, helping it maintain upright posture as it grows. This physical support is particularly important in larger plants and trees.

### 8. ****Soil Erosion Prevention****:

* **Function**: Roots help prevent soil erosion by binding the soil particles together. This is particularly important in areas where vegetation is crucial to maintaining soil structure.

### 9. ****Symbiotic Relationships****:

* **Function**: In some plants, roots establish symbiotic relationships with microorganisms such as **mycorrhizal fungi** and **nitrogen-fixing bacteria**. These partnerships help the plant absorb nutrients more efficiently, particularly in nutrient-poor soils.

In summary, the roots play a vital role in a plant's survival, growth, and reproduction by anchoring the plant, facilitating the absorption of water and nutrients, storing energy, and contributing to overall plant health.

**Plant dicot**

In dicot plants (short for dicotyledons), plant tissues are organized in specific ways to support their growth and function. The tissues in dicots can be categorized into three main tissue systems: dermal, ground, and vascular tissue. These tissues work together to provide the plant with protection, support, and the ability to transport water, nutrients, and sugars.

### 1. ****Dermal Tissue****

* **Epidermis**: The outermost layer of cells that acts as the plant's protective barrier. The epidermis contains **stomata** (pores) for gas exchange and **trichomes** (hair-like structures) for protection and water retention.
* **Periderm**: In woody dicots, as the plant matures, the epidermis is replaced by periderm, which includes **cork** cells and provides additional protection, especially in stems and roots.

### 2. ****Ground Tissue****

Ground tissue is responsible for the storage of nutrients, support, and photosynthesis in dicot plants. It is made up of three types of cells:

* **Parenchyma**: The most common ground tissue. Parenchyma cells are thin-walled, and they are primarily involved in photosynthesis (in the leaves) and storage of starch (in roots).
* **Collenchyma**: These cells provide flexible support, especially in the growing parts of the plant, like the stems and petioles. They have unevenly thickened cell walls.
* **Sclerenchyma**: Sclerenchyma cells are thick-walled and lignified, providing rigid support in mature parts of the plant. They are found in the xylem and some parts of the stem.

### 3. ****Vascular Tissue****

### The vascular tissue is responsible for the transport of water, minerals, and sugars. It consists of two major components:

* **Xylem**: The tissue that conducts water and dissolved minerals from the roots to other parts of the plant. In dicots, the xylem consists of **vessel elements** and **tracheids** that are specialized for water conduction.
* **Phloem**: The tissue responsible for transporting sugars and other organic nutrients produced in the leaves to the rest of the plant. The phloem includes **sieve tube elements**, **companion cells**, and **phloem fibers**.

In dicot plants, xylem and phloem are arranged in **vascular bundles**, which are typically arranged in a circle in the stem. The arrangement and pattern of vascular bundles help differentiate dicots from monocots.

### 4. ****Meristematic Tissue****

Meristematic tissues are regions of active cell division that allow for growth. There are two types of meristems in dicots:

* **Apical Meristem**: Found at the tips of the roots and shoots, it is responsible for primary growth, which increases the length of the plant.
* **Lateral Meristem**: Includes the **vascular cambium** and **cork cambium**, which contribute to secondary growth (growth in thickness) by producing new vascular tissue and protective cork layers.

### Features of Dicot Tissues:

* **Leaf Venation**: Dicot plants typically have a net-like or reticulate venation pattern in their leaves, as opposed to the parallel venation seen in monocots.
* **Vascular Bundles**: In the stems of dicots, vascular bundles are arranged in a ring, which is characteristic of dicots and differs from the scattered arrangement seen in monocots.
* **Root Structure**: In dicot roots, the vascular tissue is arranged in a central pattern, with xylem in the center and phloem surrounding it, often in a star shape.

### Example Dicot Plants:

* Sunflowers (Helianthus)
* Roses (Rosa)
* Oak trees (Quercus)
* Beans (Phaseolus)

In summary, the plant tissue in dicots is well-organized into dermal, ground, and vascular tissues, each specialized to help the plant grow, protect itself, and transport essential nutrients. This tissue structure supports the plant's ability to adapt, thrive, and reproduce in various environments.

### Characteristics of Dicot Plants:

1. **Cotyledons**: Dicots have **two cotyledons** in the seed. These cotyledons are the first leaves that appear during seed germination and store nutrients that help the young plant grow.
2. **Leaf Venation**: The leaves of dicots typically have **reticulate or net-like venation**, where the veins form a branching pattern, as opposed to the parallel venation found in monocots.
3. **Vascular Tissue**: In dicots, the vascular bundles (containing xylem and phloem) are typically arranged in a **circle or a ring** in the stem, while in monocots, vascular bundles are scattered throughout the stem.
4. **Root Development**: Dicot plants usually form a **taproot** system, where the main root grows thicker and deeper with smaller lateral roots branching off. In contrast, monocots generally develop a fibrous root system.
5. **Flower Parts**: Dicots typically have flower parts (petals, sepals, stamens) in multiples of **four or five**. This is in contrast to monocots, which generally have flower parts in multiples of three.
6. **Secondary Growth**: Many dicots (especially woody dicots) undergo **secondary growth**, which allows them to grow in girth. This is facilitated by the vascular cambium, which produces new xylem and phloem tissue, contributing to the thickness of stems and roots.