Chapter 6 Anatomy of Flowering Plants

The Tissue System

Plants are made up of cells, which are grouped into tissues that perform specific functions. These tissues are further organized into organs with specialized roles. Each organ within a plant has its own unique internal structure.

Tissues are categorized based on where they are located in the plant body. There are two main types of plant tissues:

Meristematic Tissue:

- Apical Meristem: Located at the tips of roots and shoots, this tissue produces primary tissues like dermal, vascular, and ground tissues.
- Intercalary Meristem: Found in grasses, it is situated between mature tissues.
- Lateral Meristem: Responsible for generating secondary tissues like cambium.

Permanent Tissue:

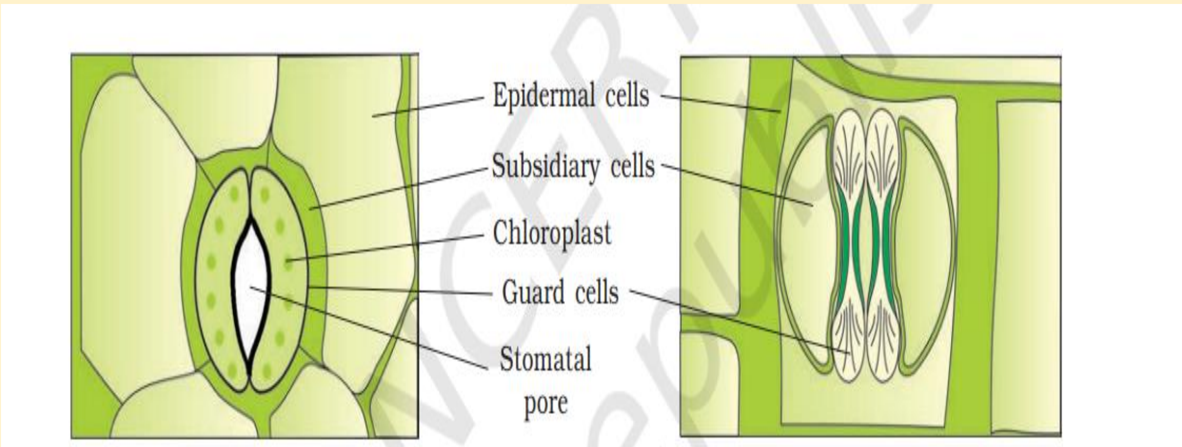
- Simple Tissue: Comprises a single cell type with a consistent structure and function.
- Complex Tissue: Made up of multiple cell types that work together in coordination.

There are three types of tissue systems based on their structure and location. These are:

Epidermal Tissue System

The epidermal tissue system is like the plant's outer coat, covering its entire body. It's made up of different parts like epidermal cells, stomata, and little hair-like structures called trichomes. Picture it as the skin of the plant. This outer layer, called the epidermis, is made of closely packed cells forming a protective barrier. Epidermal cells are usually thin and filled with a big bubble-like vacuole.

They're covered by a waxy layer called the cuticle, which helps keep water inside, kind of like how our skin keeps moisture in. Stomata are tiny holes in the leaf's skin, allowing plants to breathe and release excess water. Each stoma has two guard cells that control its opening and closing. In grasses, these cells look a bit different, more like dumbbells. Surrounding the guard cells, there are some other special cells called subsidiary cells.



Together, they form the stomatal apparatus. The epidermis also has tiny hairs: root hairs in the soil and stem hairs, called trichomes, above the ground. These hairs help with absorbing water and minerals from the soil and reduce water loss through transpiration. They're like the plant's fuzzy coat, protecting it from drying out.

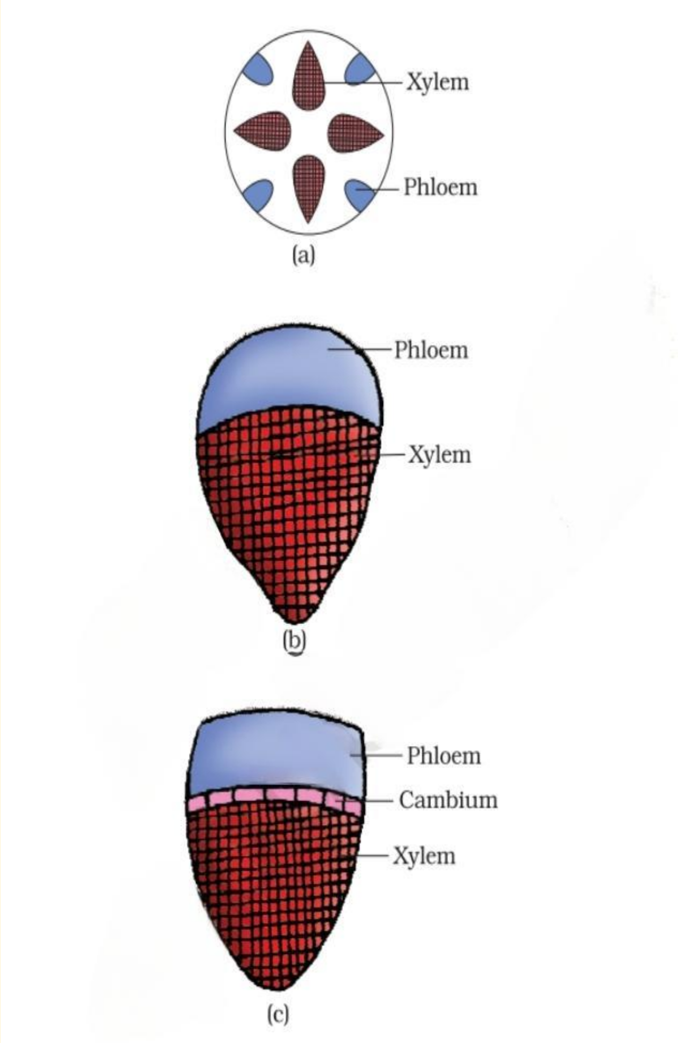
The Ground Tissue System

The ground tissue is like the body of a plant, supporting and filling it out. It's made up of different types of simple tissues, like parenchyma, collenchyma, and sclerenchyma. These tissues are the building blocks, helping the plant grow and stay strong. You can find them in various parts of the plant, except for the skin (epidermis) and the plumbing (vascular bundles).

In the stems and roots, you'll see parenchyma cells in the cortex, pericycle, pith, and medullary rays. These cells are like the flexible, versatile workers, adapting to different tasks. In leaves, the ground tissue is called mesophyll, where you'll find thin-walled cells full of chloroplasts, the plant's green energy factories. Think of it as the plant's flesh, providing support, storage, and energy production.

The Vascular Tissue System

The vascular system in plants is like their circulatory system, transporting nutrients, water, and sugars throughout the plant. It's made up of two complex tissues: the phloem and the xylem. Together, these tissues form vascular bundles, which are like the plant's blood vessels. In dicotyledonous stems, there's a layer of tissue called cambium between the phloem and xylem. This cambium can produce secondary tissues, like more xylem and phloem, making these bundles "open" because they can grow wider.



But in monocotyledons, there's no cambium present, so they can't produce secondary tissues. These bundles are called "closed." When you look inside a vascular bundle, you might see different arrangements. In radial bundles, the xylem and phloem alternate along different radii, like in roots. But in conjoint bundles, they're grouped together along the same radius.

Anatomy of Dicotyledonous and Monocotyledonous Plants

Dicotyledonous and monocotyledonous plants differ in their anatomical structures. Dicots have two cotyledons, reticulate venation, and a taproot system with vascular bundles arranged in a ring. Monocots, on the other hand, have one cotyledon, parallel venation, and a fibrous root system with scattered vascular bundles. Let's explore the tissue organization of roots, stems, and leaves in more detail.

Dicotyledonous Root:

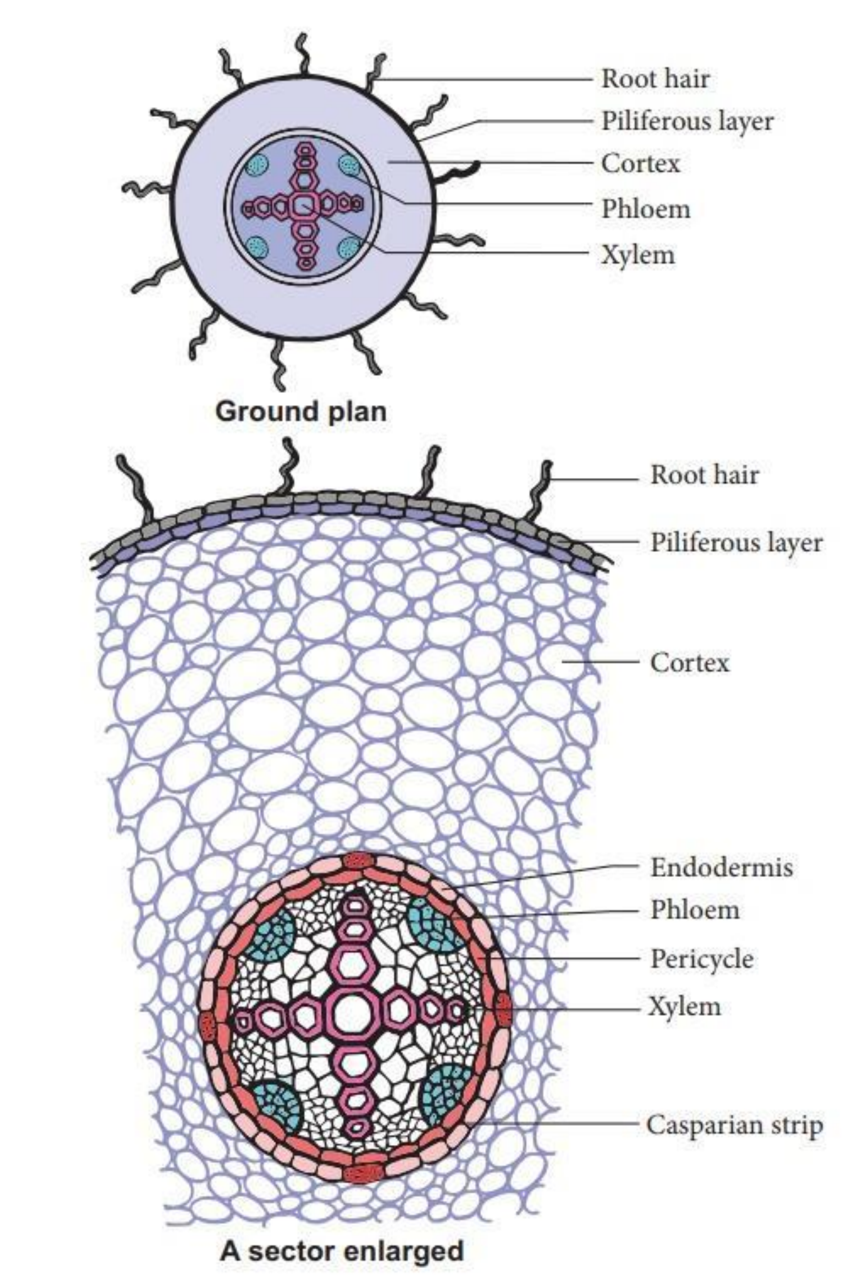
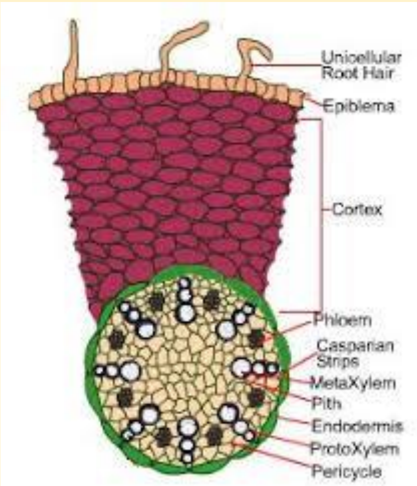


Figure 12.2 Transverse section of Dicot root

- Epiblema: The outermost layer of the root with unicellular root hairs.

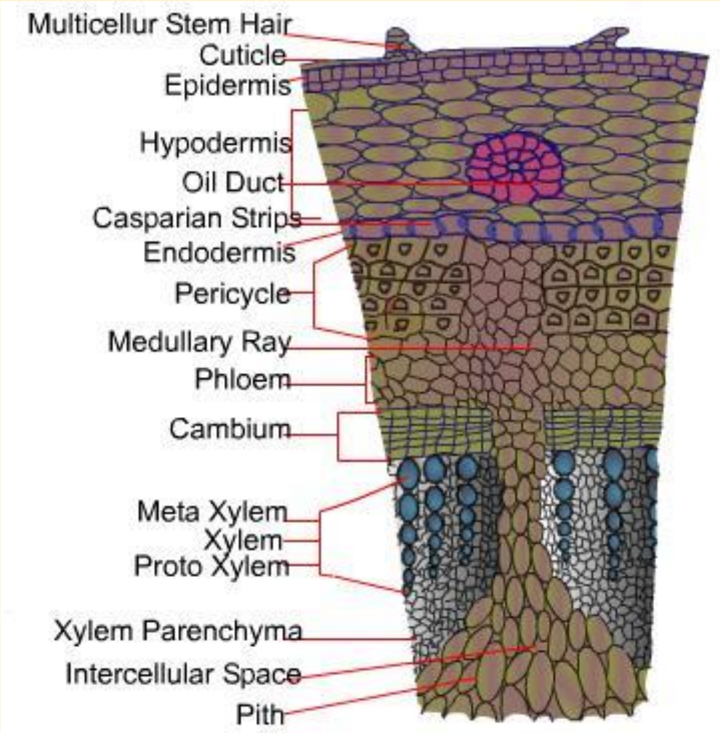
- Cortex: Consists of thin-walled parenchyma cells.
- Endodermis: Barrel-shaped cells with casparian strips, lacking intercellular spaces.
- Pericycle: Contains thick-walled parenchymatous cells, initiates lateral roots and vascular cambium.
- Pith: Small or inconspicuous.
- Conjunctive Tissue: Parenchymatous cells between xylem and phloem.
- Stele: Inner tissues including pericycle, vascular bundles, and pith.

Monocotyledonous Root:



- Similar anatomy to dicot root with epidermis, cortex, endodermis, pericycle, vascular bundles, and pith.
- More than six xylem bundles (polyarch) compared to dicot root.
- Large and well-developed pith.
- Does not undergo secondary growth.

Dicotyledonous Stem:



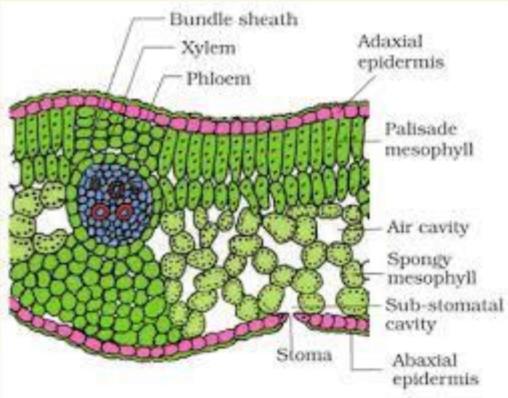
- Epidermis: Protective outer layer with trichomes and stomata.
- Cortex: Hypodermis, middle parenchymatous cells, and endodermis (starch sheath).
- Pericycle: Semi-lunar patches of sclerenchyma.
- Medullary Ray: Radially placed parenchymatous cells between vascular bundles.
- Vascular Bundles: Arranged in a ring with conjoint, open bundles and endarch protoxylem.
- Pith: Central portion with parenchymatous cells providing structural support and storage.

Monocotyledonous Stem:

- Sclerenchymatous Hypodermis: Provides mechanical strength beneath the epidermis.

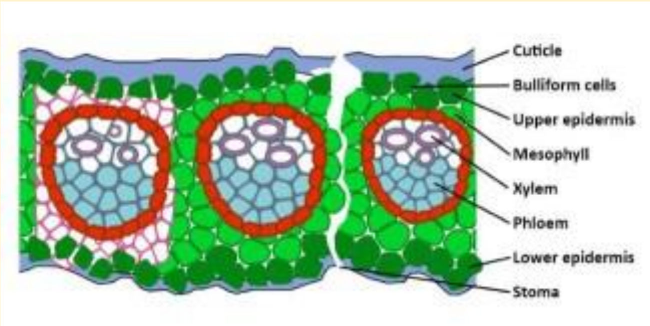
- Numerous Vascular Bundles: Scattered throughout the stem, each surrounded by a sclerenchymatous bundle sheath.
- Conjoint and Closed Vascular Bundles: Smaller peripheral bundles compared to centrally located ones.
- Absence of Phloem Parenchyma: Water-containing cavities within the vascular bundles.

Dorsiventral (Dicotyledonous) Leaf:



- Epidermis: Covers both upper (adaxial) and lower (abaxial) surfaces with a small cuticle, more stomata on the abaxial surface.
- Mesophyll: Chloroplast-containing parenchyma cells between upper and lower epidermis, consisting of palisade parenchyma (adaxially placed) and spongy parenchyma (below palisade cells).
- Vascular System: Vascular bundles surrounded by thick-walled bundle sheath cells, visible in veins and midrib.
- Vein Thickness: Varying thickness in reticulate venation of dicot leaves.

Isobilateral (Monocotyledonous) Leaf:



- Similar anatomy to dorsiventral leaf but with stomata on both epidermal surfaces.
- Undifferentiated Mesophyll: No differentiation into palisade and spongy parenchyma.
- Parallel Venation: Veins run parallel in monocot leaves.
- Bulliform Cells in Grasses: Adaxial epidermal cells along veins modify into large, empty bulliform cells, responding to water availability by altering leaf surface exposure.

Secondary Growth

Secondary growth, a process characterized by the widening or thickening of plant stems or roots, contrasts with primary growth, which occurs at the tips. This lateral expansion, typical in dicots and gymnosperms, leads to the formation of woody tissues. Key to secondary growth are two lateral meristems: the vascular cambium and cork cambium.

The vascular cambium generates secondary xylem inward and secondary phloem outward, enhancing mechanical support and facilitating water and nutrient transport. Meanwhile, the cork cambium produces cork cells to replace the epidermis, forming protective bark. The annual rings seen in tree cross-sections reveal growth patterns influenced by environmental conditions. Secondary growth is vital for creating robust and enduring plant structures.