

Lab -5- The Root

The root is the principal underground organ of the plant body and functions primarily in anchorage and absorption. The roots of many plants are also specially modified as food storage structures. Roots also contain meristematic tissues (apical meristems) for the production of new cells and vascular tissues for the transport of materials through the plant body.

You should be familiar with the following terms associated with the root system:

Primary Root. The first root of a plant that develops from the radicle of the embryo.

Secondary Root. Any of the branches of the primary root.

Taproot System. A root system that consists of an enlarged primary root that is noticeably larger than the secondary roots is termed a taproot system. Carrots, beets, turnips, etc. are all good examples of plants that produce a taproot system.

Fibrous Root System. A root system in which the primary root and its branches are approximately equal in size.

Adventitious Roots. Any roots that arise from parts of the plant other than the radicle of the embryo are termed adventitious roots.

Herbaceous Monocot Roots

The basic structure of herbaceous monocot roots is very similar to that of herbaceous dicot roots. In cross section, you should be able to identify the epidermis, cortex, endodermis, and the vascular cylinder. Notice that the arrangement of tissues in the vascular cylinder differs between monocot and dicot roots.

Herbaceous Dicot Roots

The roots of most dicots are composed of several different kinds of simple and complex tissues and exhibit a very characteristic structure when viewed in cross section. You should be able to identify (and be familiar with the functions of) the following parts of the root.

Root Tissues

Basic Differentiation Regions of the Root

Apical Meristem. The root apical meristem is located at root tips. It produces new root cap cells below, and above, it produces cells that contribute to protoderm, ground meristem of the cortex, and procambium, the three primary meristems that initiate tissues.

Root Cap. The function of the root cap is to protect the apical meristem and to aid the developing root as it penetrates the soil as the root elongates. It is composed of parenchyma cells whose walls, along the surfaces of the root cap, are

mucilaginous to provide easier passage through soil particles. As cells are sloughed off, more cells are produced by the apical meristem.

Elongation Region. Back of the apical meristem is the region where most elongation of the root takes place.

Maturation Region. In primary growth, the epidermal cell walls of the mature root become cutinized or suberized with wax-like substances. With secondary growth, the cork cambium replaces epidermis and cortex with root bark tissues, cork and phelloderm.

Non-vascular Tissue Systems

Epidermis. The epidermis is the outermost tissue of the root. It is usually a single layer. In the root elongation zone are root hairs , lateral protrusions of epidermal cells, which are active in water and mineral nutrient uptake.

Cortex. Basically, cortex tissue is made up of parenchyma cells. In conifers and dicots with secondary growth, the cortex is shed. Monocots, without secondary growth, retain their cortex and many develop sclerenchyma tissue. Food, mostly as starch, is stored in the cortical cells in amyloplasts Proplastids may develop into chloroplasts in cortical cells if the root is exposed to light.

Endodermis. The innermost layer of cortex that encircles the vascular tissue is called the endodermis. Along the radial and transverse walls of endodermal cells is a suberin-rich fatty layer called the **casparian strip** . It blocks absorbed soil water from passing between the cells to the xylem; thus, water and mineral nutrients must pass through the selectively permeable membranes of endodermis cells instead, an effective filtering system .

Vascular Tissue System

Pericycle. The central cylinder of vascular tissue is surrounded by thin-walled parenchyma tissue called pericycle . The pericycle is the site where vascular cambium and lateral roots originate. As a lateral root penetrates through the cortex, its apical meristem and its derivative tissue systems become organized. Adventitious roots, which develop from stems, are initiated in parenchyma near differentiating vascular tissue.

Xylem. If no xylem is formed in the center of the root, parenchyma tissue develops there. Primary xylem arms radiate from the center and vary in number. The dicot types include diarch (2 arms), triarch (3 arms), or tetrarch (4 arms), and the monocot type is polyarch (many arms).

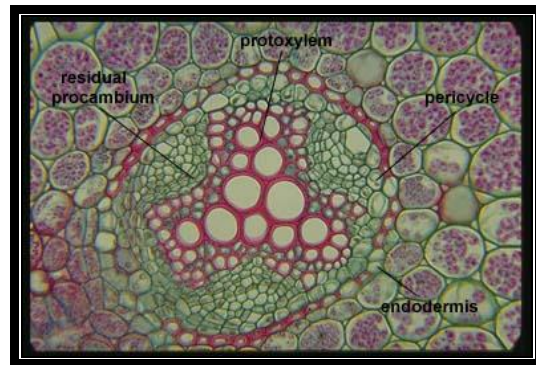
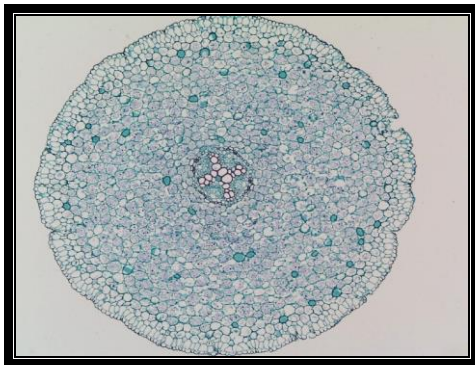
Phloem. Procambium cells , between the radiating arms of primary xylem, produce primary phloem outward and xylem tissue inward. In secondary growth, the vascular cambium , which originates from the pericycle, extends completely around the tips of the xylem arms and inside the primary phloem poles. It produces secondary xylem inward and secondary phloem outward.

Practical parts:

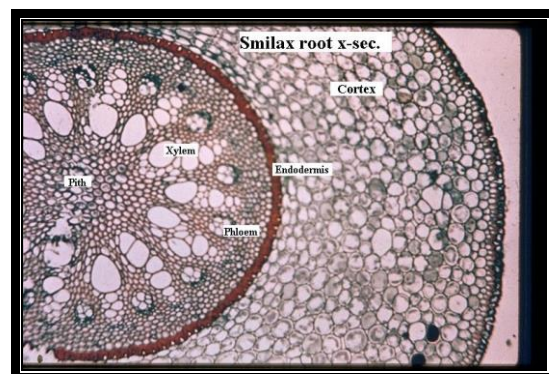
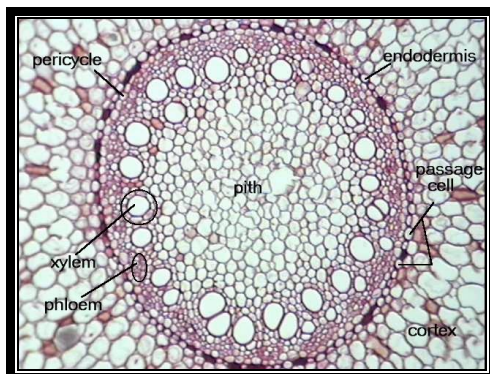
1. Examine the permanent slide of Onion root (L. S. Allium cepa root tip) or Corn (Zea mays) root and draw few cells under high power ,showing the meristematic tissue.



- 2- Examine and draw the permanent slide of Ranunculus root (dicot). Notice that the arrangement of tissues in the vascular cylinder



- 1- Examine and draw the permanent slide of Smilax root or Zea mays (Monocot). Notice that the arrangement of tissues in the vascular cylinder



- 2- Compare between dicot and monocot root in :
 - a- Number of xylem arch.

- b- Present the pith .
- c- Present of casparian strip