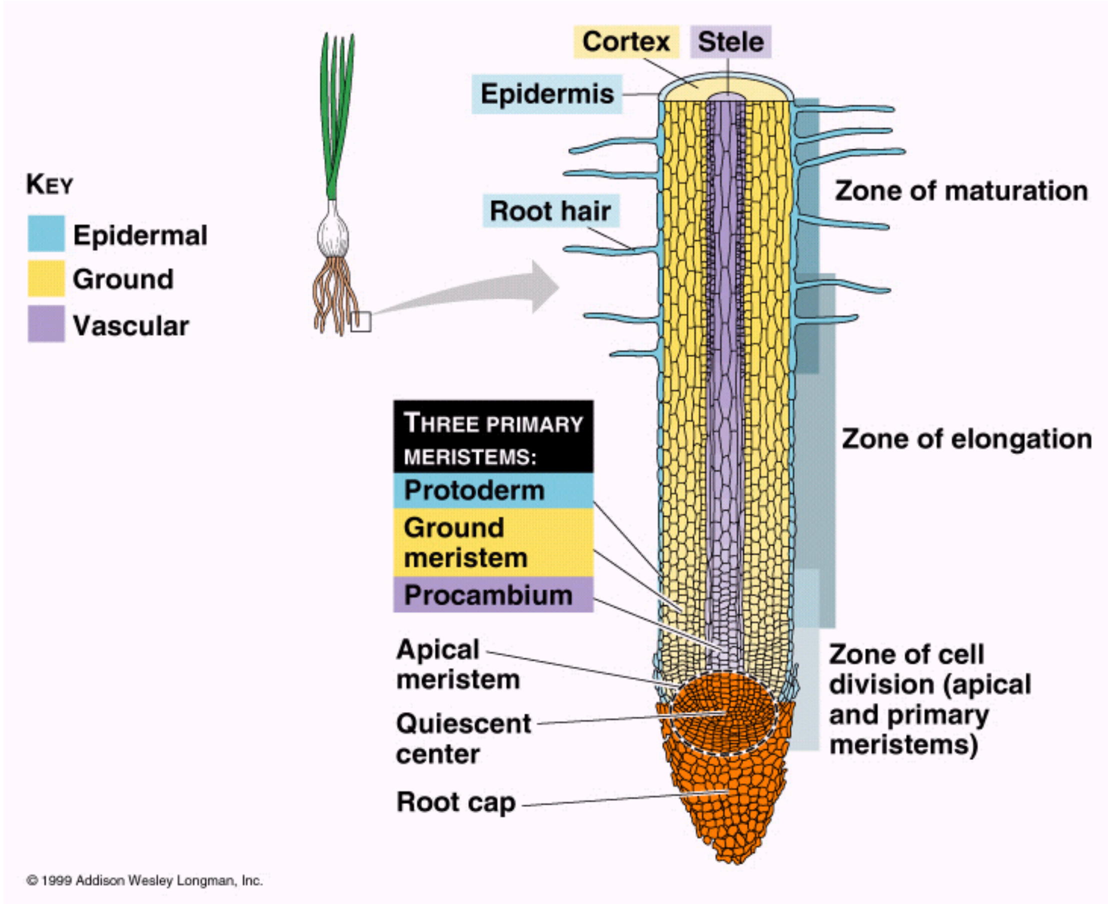
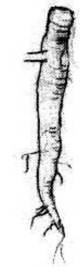
Roots

Roots are used to anchor the plant in the soil, to absorb minerals and water, conduct minerals and water and store food.



Root Tip Regions



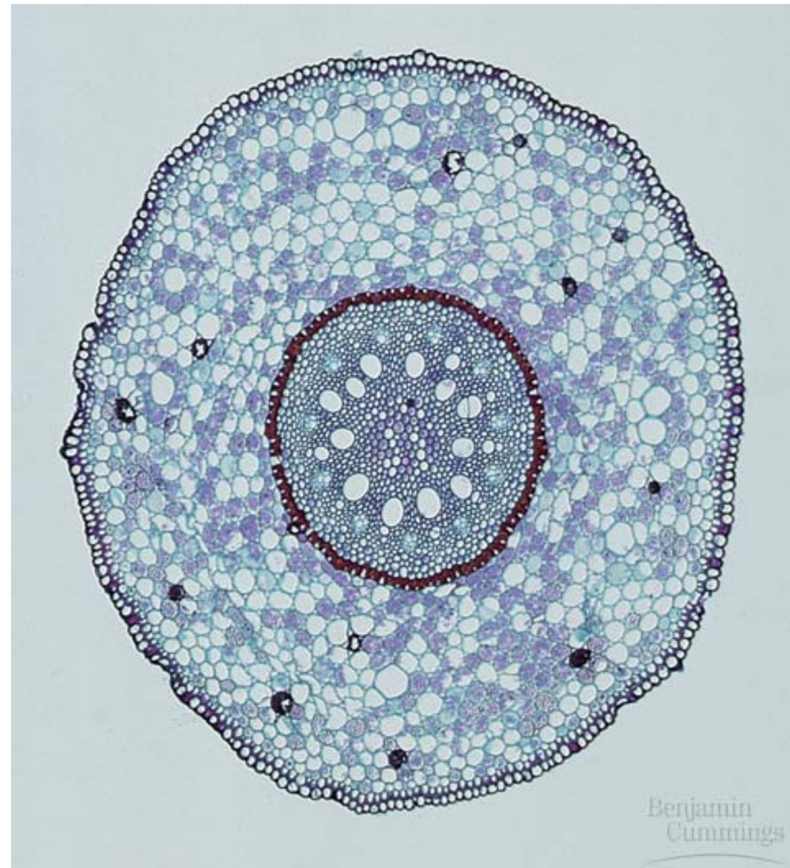
Regions	Function
Root Cap	Protect the apical meristem Perception of Gravity
Apical Meristem	Cell Division Production of new cells
Elongation	Pushes meristem and root cap through ground
Maturation	Development of protoderm, procambium, ground tissue

Monocot Root

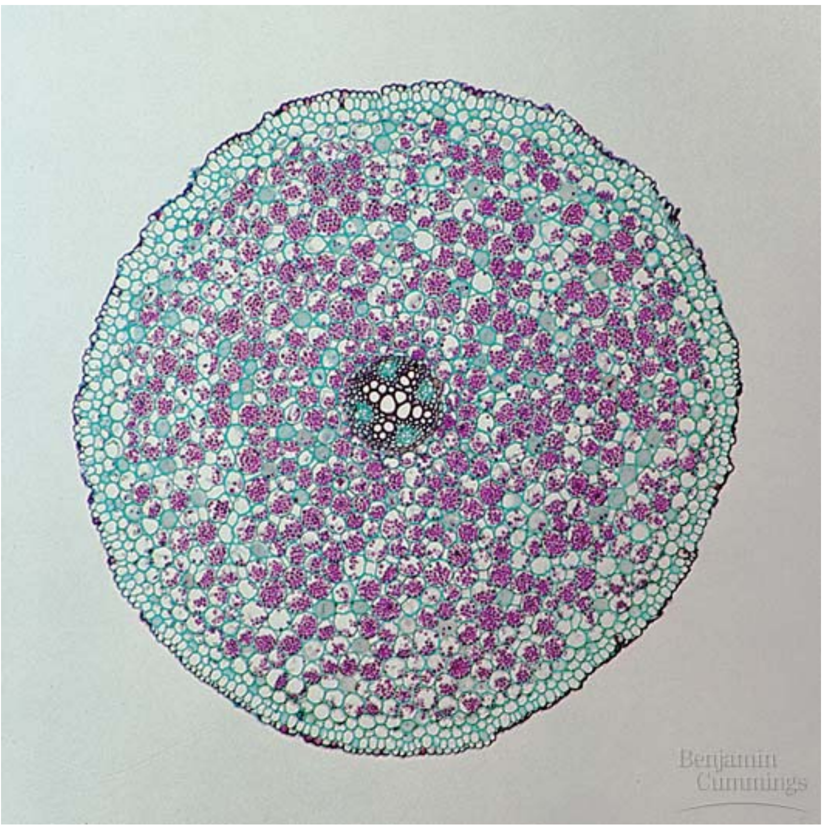
Tissue	Origin	Function
Epidermis	Protoderm	Produce root hairs, protection, absorption
Stele	Procambium	Xylem: water movement Phloem: food movement Pericycle: lateral roots
Cortex	Ground Meristem	Cortex: storage Endodermis: regulation of movement Passage Cells: lateral movement of water

Monocot Root

The three primary meristems give rise to the three primary tissues of roots. (protoderm, procambium, and the ground meristem). You will be beld responsible for the following tissues: Epidermis, Stele, Xylem, Phloem, Pericycle, Cortex, Endodermis, and Passage Cells. You also need to know their functions.



Dicot Root



A dicot root differs from a monocot root because it usually lacks a pith. The three primary meristems give rise to the three primary tissues of roots. (protoderm, procambium, and the ground meristem). You will be beld responsible for the following tissues: Epidermis, Stele, Xylem, Phloem, Pericycle, Cortex, Endodermis, and Passage Cells. You also need to know their functions.

Dicot Root

Tissue	**Origin**	**Function**
Epidermis	Protoderm	Produce root hairs, protection, absorption
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Cortex	Ground Meristem	Cortex: storage Endodermis: regulation of movement Passage Cells: lateral movement of water

Carrot

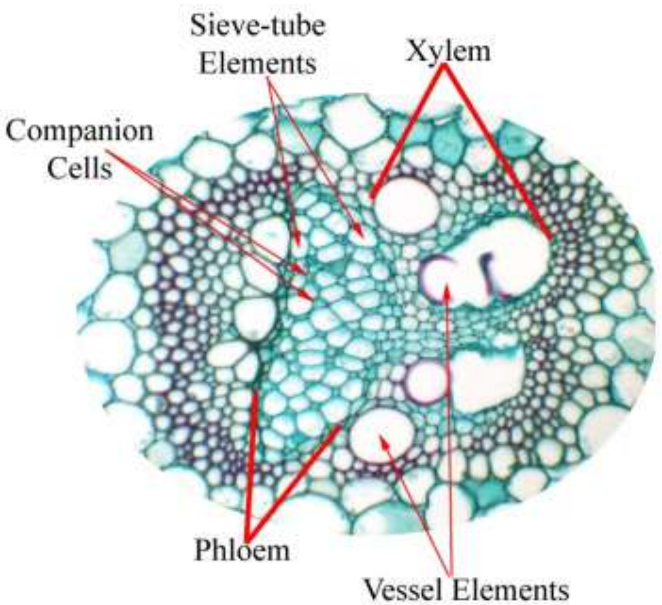
A carrot is a modified taproot. Look at a longitudinal and cross section of a carrot (Daucus) root and be able to identigy the following structures: Cortex, stele, pericycle and lateral roots. The cortex and stele are separated by a white line called pericycle. Small white lines can be seen going from the pericycle to the outside. These are the lateral roots.

Root Hairs

As the root of a young seedling grows, it penetrates the soil. Epidermal cells produce root They absorb water and dissolved minerals from the soil. The small size and larger number of hairs enormously increase the absorptive surface of the root and bring it in contact with a large volume of soil. For optimum growth, the soil should be loosely packed in order to allow for gas exchange. Observe the living radish seedlings (Rhaphanus) under a dissecting scope. The white strings along the roots are the root hairs.

Vascular Bundles

Vascular tissue running the length of a stem composed of primary tissue is called a vascular bundle. Vascular bundles are made up of xylem (usually seen in red) which face the pith and phloem (usually seen in green) which faces the cortex. Be able to recognize the difference between the two tissues.

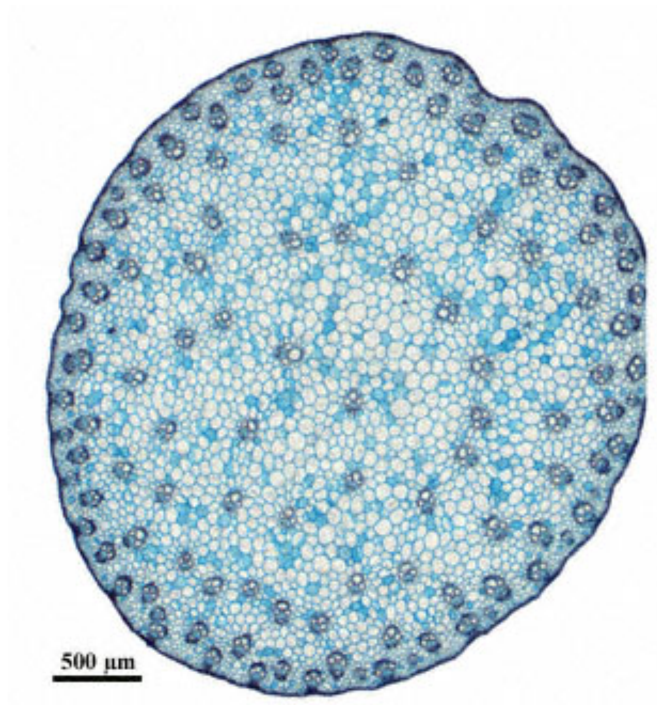


Herbaceous Dicot Stem (*Ranunculus*)

In stems of herbaceous plants, there is usually only primary tissue. Identify the following structures: vascular bundles, pith, epidermis, fibers, phloem, and xylem. Notice that the vascular tissue is found in vascular bundles arranged in a ring. usually seen in red) Inside the ring is a collection of ground tissue called the pith. The fibers stain red and they are found on the outer tips of the vascular bundles. The fibers add support.

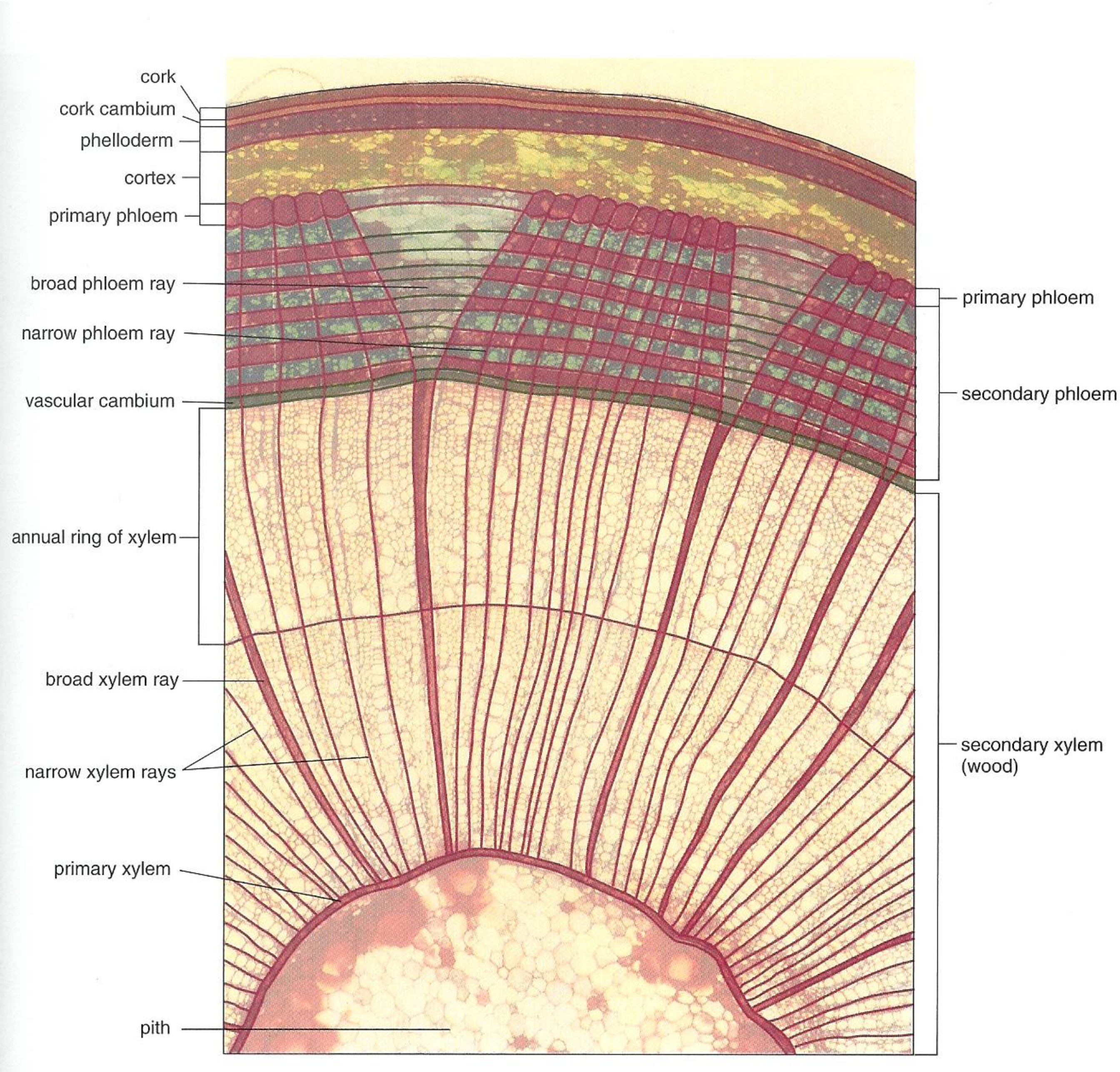
Herbaceous Monocot Stem

The tissue arrangement in monocot stems differ from that of dicots. The vascular bundles are scattered and not found in any set pattern. The xylem is usually found toward the center of the stem and the phloem is usually facing outward within a vascular bundle. Look at the prepared slide of a scross section (CS) of the herbaceous monocot *Zea* (corn). The monocot stem does not have a true pith.



Woody Dicot Stem

Most vascular plants undergo secondary growth, which increases girth (width). Two lateral meristems are responsible for secondary growth: the vascular cambium which produces xylem and pholem: and the cork cambium which produces a tough covering called bark. Secondary growth occurs in all gymnosperms and most dicot species of angiosperms but is rare in monocots. We will observe prepared slides of the tree basswood (*Tilia*) to demonstrate the different tissues moving from the inside to the outside of the stem.



Woody Dicot Stem

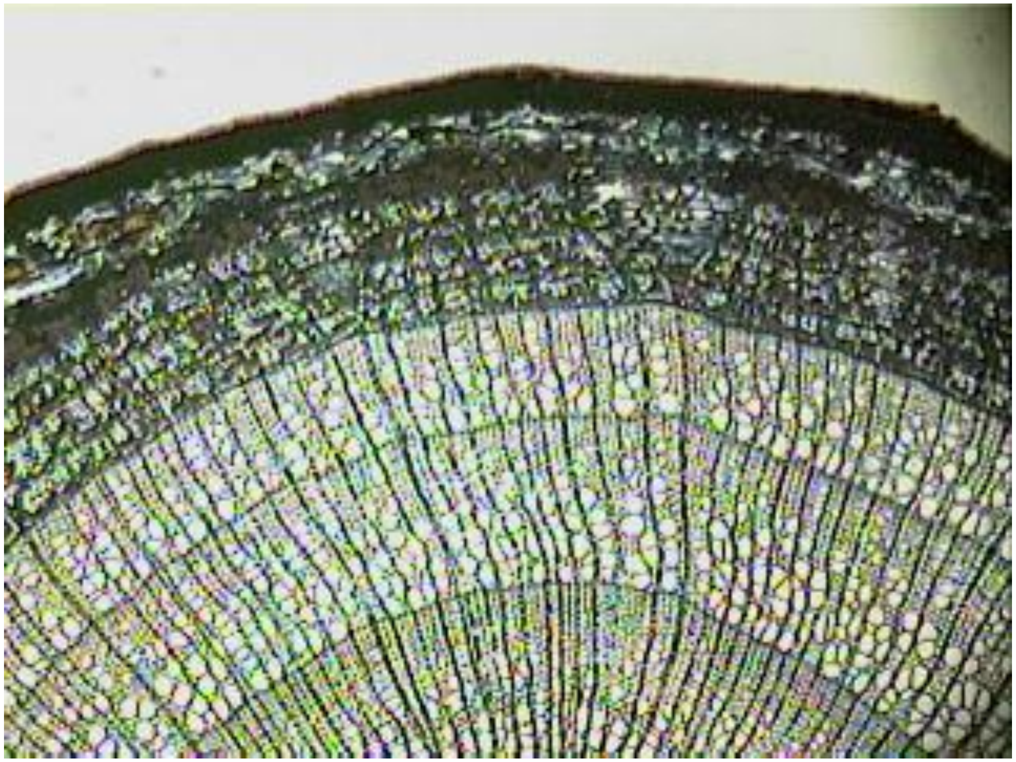
Woody Dicot Stem

Tissue	Function
Pith	Storage
Primary Xylem	Moves water and minerals upward
Secondary Xylem	Moves water and minerals upward
Vascular Cambium	Produces secondary growth
Secondary Phloem	Moves nutrients around the plant
Primary Phloem	Moves nutrients around the plant

Woody Dicot Stem (Continued)

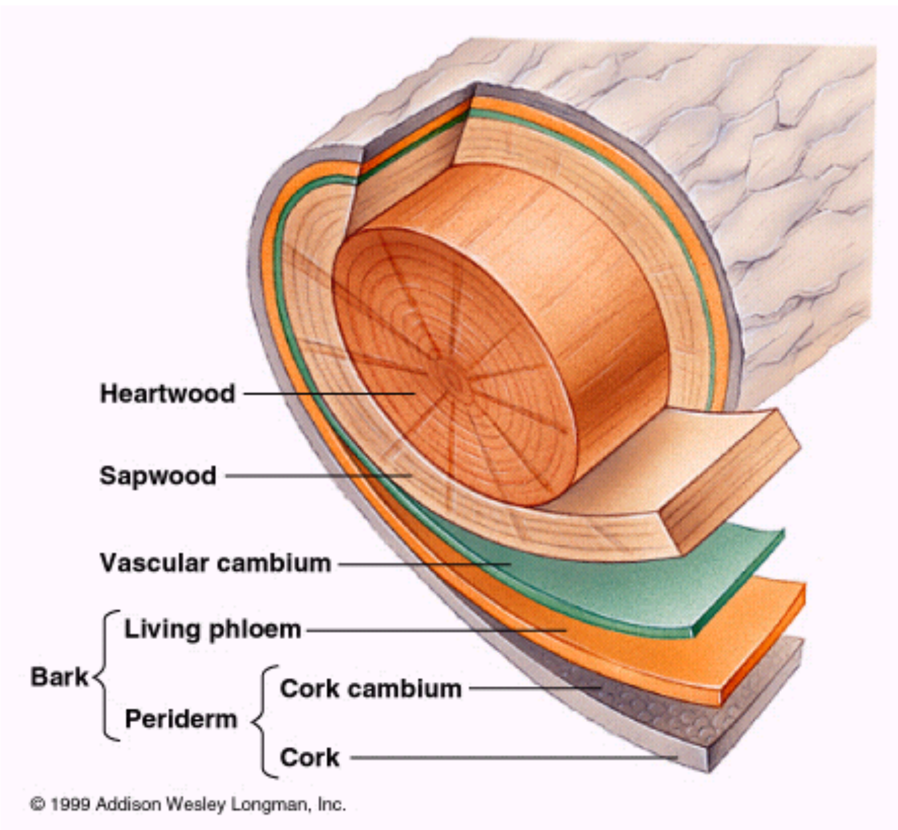
Tissue	Function
Cortex	Storage
Phelloderm	Made of parencyhma cells Unknown function
Cork Cambium	Produces phelloderm and cork cells
Cork Cells	Physical barrier for protection

Age of a Woody Dicot



The age of a dicot can be determined by counting the number of rings. The rings are made up of dead cells called xylem. The type of year (rainfall amounts) can be determined by the width of the ring.

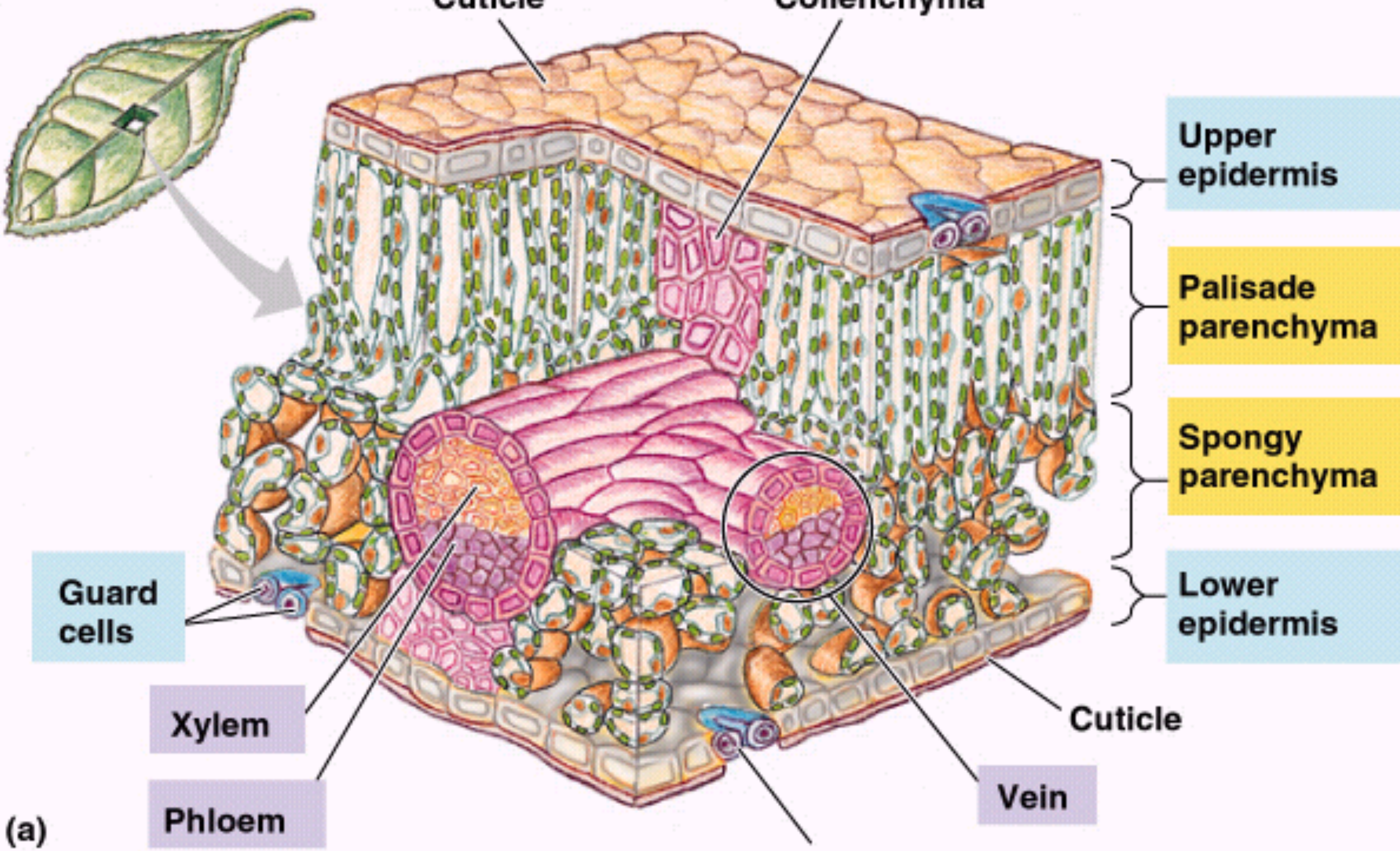
Tissues of a Tree Trunk



By examining a cross section of a mature tree, many important regions can be seen by the unaided eye. Sapwood and heartwood are made up of secondary xylem. Sapwood is younger and function for water movement. Heartwood is older, darker wood that no longer functions for water movement and is used for support.

Spiral Xylem Vessels

Conifers have xylem that consist primarily of tracheids; no fibers or vessel elements. The wood tends to be soft and is often called soft woods. The woods of woody dicots possess vessels elements and tend to be hard and are called hard woods. Xylem vessels in woody dicots are spiral in shape. These special cells are used for carrying water and minerals upward in the stem. Be able to recognize a spiral xylem vessel from the melon plant *Cucurbita*.



Cuticle
Collenchyma
Upper epidermis
Palisade parenchyma
Spongy parenchyma
Lower epidermis
Guard cells
Xylem
Phloem
Cuticle
Vein
Stoma

(a)

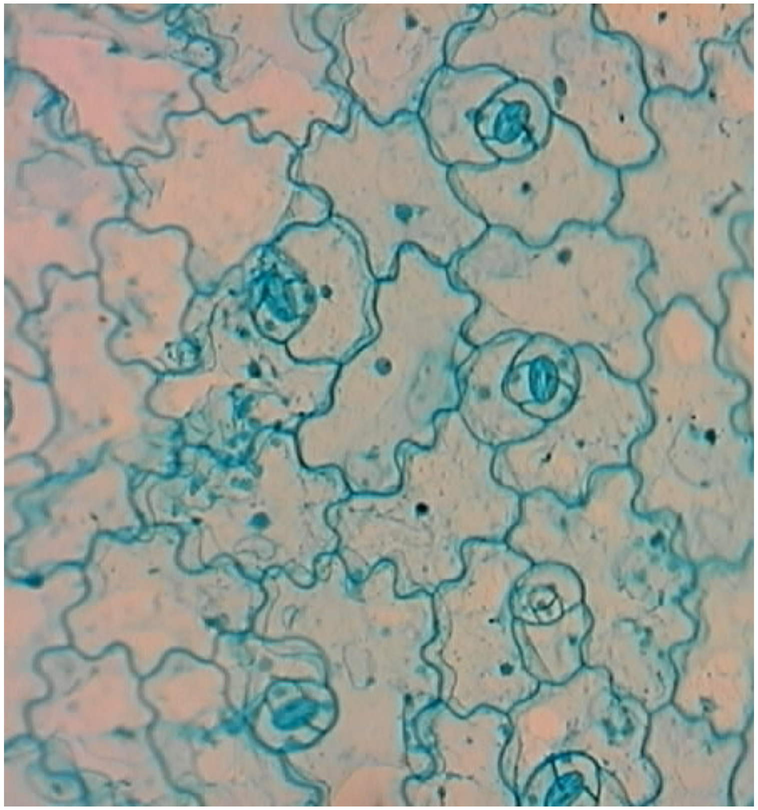
The Leaf

Leaves are the photosynthetic organs of the plant. Leaves act as solar panels that capture sunlight and convert solar energy into chemical energy in the form of sugars using carbons dioxide and water. The structure of a leaf can actually be divided into three major regions: the epidermis, the mesophyll, and the veins (vascular bundles). Observe the cross section (CS) of a leaf. You will be held responsible for the following regions, structures and functions.

The Leaf

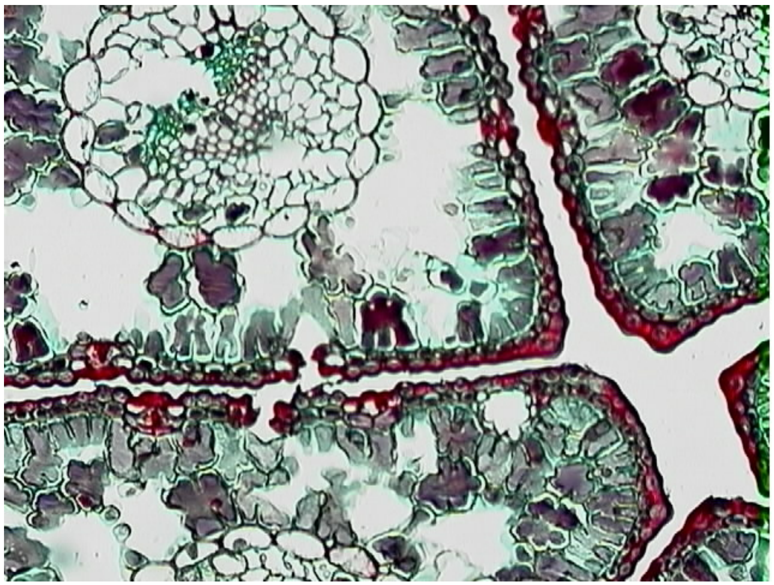
Region	Structure	Function
Epidermis	Cuticle	Prevents water loss
	Epidermal Cells	Protective layer
	Guard Cells and Stomates	Gas Exchange
Mesophyll	Pallisade Layer	Photosynthesis
	Spongy Layer	Photosynthesis and gas exchange
Veins	Vascular Bundles	Transport

The Lower Epidermis



Look at the prepared slide of the lower epidermis (*Sedum* – CS) Be able to recognize the following structures: Guard cells, stomates, lower epidermal cells. The epidermal cells will look like puzzle pieces. The guard cells are regulated by turgor pressure. When they are full, the stomates are open. When they are empty, the stomates are closed.

Pine Needles



Pine trees have adaptations for living in arid conditions. In arid regions, one of the largest problems faced by plants is water loss through the stomates. Pine needles have their stomates recessed (sunken) within the surface of the leaf. Observe a cross section (CS) of a pine needle and be able tecognize the following structures: guard cells and stomata.

Minerals and Plant Nutrition

Plants need certain nutrients to do well. Know the following symptoms and their causes.

Chlorosis – lack of N or K

Deep Green or Purple Pigmentation – lack of P or N

Stunted Growth – lack of P or N

Necrosis – Lack of K

Pitcher Plants

Pitcher plants are found in damp, boggy soils in northeast Florida, which are deficient in nitrates and phosphates. They capture their prey by having their funnel shaped leaves covered with nectar glands and down curved teeth. Once the insect lands, they move down to a slick area with no foothold. The insect falls into the fluid at the bottom where it is absorbed.

Venus Flytrap

Venus Flytraps are found in damp, boggy soils in the Carolinas, which are deficient in nitrate. They capture their prey by using their modified leaves that contain two lobes. Each lobe has an outer area that contains teeth. Each lobe has trigger hairs that signal the leaves to close on their prey (flies or larger insects – smaller insects can escape).

Sundew

Sundews are found in acid, boggy soils, along roadside ditches, which are deficient in nitrates. They capture their prey by having modified leaves that contain stalked glands or tentacles which contain highly viscid mucus. They catch only small or very weak prey. Flies and ants can escape.

Gibberellins

Gibberellic Acid effects germination. Observe the seeds that were treated with the hormone and compare them to the control seeds. Gibberellic acids promote seed germination and plants treated with it will grow quicker. This hormone could be used to speed up growth in agricultural plants.

Gibberellins

Gibberellic Acid effects growth rate. Observe the plants that were treated with the hormone and compare them to the control plants. Gibberellic acids promote stem elongation and plants treated with it will grow longer. This hormone is used to produce flower shoots but can cause problems if the stems grow too quickly.

Phototropism

Some researchers believe it is the tip of the plant. Observe the plant that was placed next to a light. Auxin is the hormone that is thought to be responsible for the plant bending toward the light. It is the stem that is actually "bending". The plant actually doesn't bend. The cells away from the light are affected more by auxin and elongate faster which "bends" the plant toward the light.

Gravitropism

Shoots display a negative gravitropism. Observe the plant that was placed on its side. Plants may tell up from down by the settling of Statoliths (plastids with heavy starch grains). Auxin is the hormone that is though to be responsible for the plant "bending" upward. The stem actually doesn't bend. The cells on the bottom of the plant are more affected than the upper cells and elongate faster which "bends" the plant upward.

Rapid Leaf Movement

Rapid leaf movement occurs in *pulvini* which are specialized cells at the base of a plant leaf or leaflet that facilitates growth-independent movement. Pulvinar movement is caused by changes in turgor pressure which results in a sudden change of turgor pressure in the cells of the pulvinus. A small number of species use this as a form of presumptive defense mechanism to protect the plant from predators.