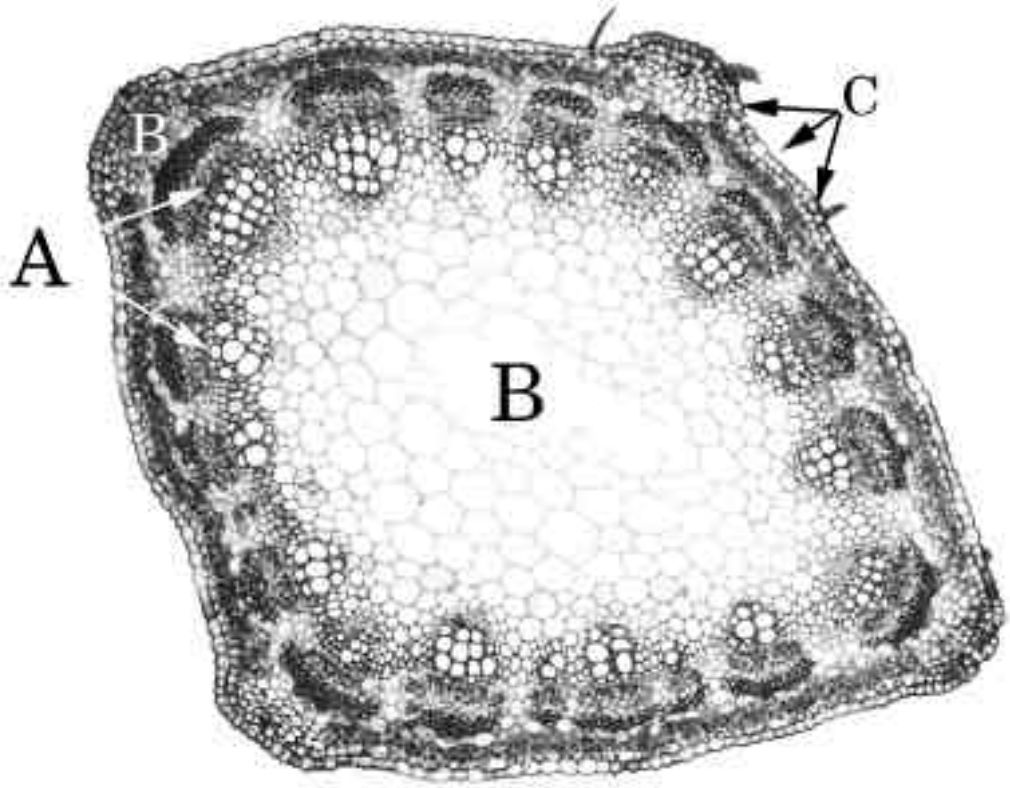
Cells and Tissues of the Plant BodyTissues

Introduction: Plant tissues can be classified into three systems. The **dermal tissue system** includes the epidermis in herbaceous growth and the bark in woody growth. The **vascular tissue system** includes all the tissues that function to move water up and sugars throughout a plant. All the tissue which is surrounded by the dermal tissue and which embeds the vascular tissues is considered the **ground tissue system**.

I. Tissues in Herbaceous Eudicoteledon Stems: Three stems that are often used to study tissues and cell types in introductory botany classes are *Medicago* (Alfalfa), *Coleus*, and *Cucurbita* (squash). Each of these have vascular tissue organized into bundles that are arranged in a circular pattern seen in cross-section. This arrangement divides the ground tissue into two regions, the **pith** laying inside the vascular bundles and the **cortex** positioned outside. As these are herbaceous stems, the dermal tissue in each is made up of an epidermis.

Cross section of *Medicago* Stem:



A = Vascular Tissue System
B = Ground Tissue System
C = Dermal Tissue System

Ia. The Epidermis: The epidermis functions to control the loss of water from the plant. It accomplishes this primarily through the excretion of a waxy layer called the cuticle. Like a sheet of wax paper, the cuticle limits the passage of water. In doing this it also blocks the passage of gasses between the plant and its environment. To keep the tissues from suffocating, the epidermis must have openings. These openings are called stomata (singular = stoma) and include a pair of cells (the guard cells) that can open and close to regulate water loss.

View stomata of prepared slide of cross section of *Medicago*.

View face view of stomata of *Zebrina*.

Trichomes: herbaceous plants often appear hairy. This is due to multicellular structures that project out from and are part of the epidermis.

View a trichome of living section of *Coleus* stem.

Ib. Ground Tissue:

The Cortex: The cortex often includes **collenchyma** tissue. Collenchyma cells have unevenly thickened primary walls. Collenchyma is the tissue peeled from celery. It provides support to plant structures, and, because the cells have no secondary walls, it is elastic.

View of collenchyma in the cortex of *Coleus* stem.

The Pith: In *Coleus*, this region is composed entirely of parenchyma tissue consisting of **parenchyma cells**.

Ic. Vascular Tissue: Vascular tissue includes **xylem** and **phloem** both of which are complex tissues: that is they each consist of more than one cell type.

Xylem is a tissue with tracheary elements. Tracheary elements have secondary walls and are dead at maturity. Water moves through them by mass flow. There are two types of tracheary elements, tracheids and vessel members. Vessel members have perforation plates and tracheids do not. A perforation plate is simply an area of the cell wall where the wall material has been completely removed. Water can flow from vessel member to vessel member through these perforation plates. With tracheids, water moves from tracheid to tracheid only through pits. These pits are areas of the cell wall where the secondary wall is is lacking but which still has a primary wall

through which water must move.In *Medicago*, *Cucurbita*, and *Coleus* vessel members are the only tracheary element found in the xylem. In *Medicago* and *Coleus* stems, **xylem** occurs in the innermost area of each vascular bundle (facing the pith).

View xylem in cross section of a prepared slide of *Medicago.*

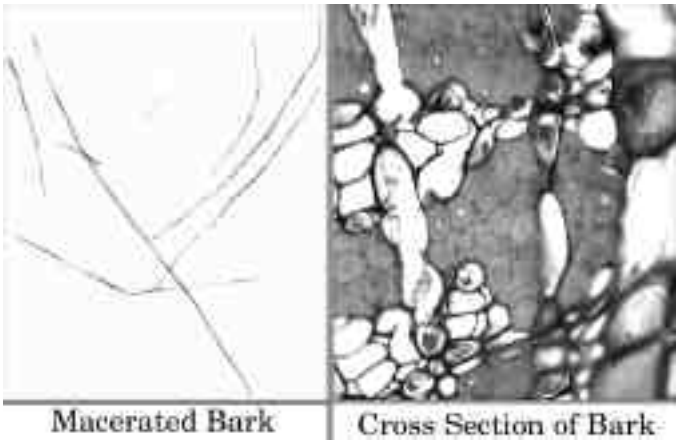
Phloem is a tissue with of sieve elements. There are two types of sieve elements, sieve cells and sieve-tube members. Both are alive at maturity and lack secondary walls. In sieve-tube members all of the sieve areas are located along distinct areas of the wall termed sieve-plates. In *Medicago*, *Cucurbita,* and *Coleus* sieve-tube members are the only sieve elements found in the phloem. Sieve-tube members are found in the phloem of flowering plants, and sieve cells in the phloem of gymnosperms..

Phloem in cross section of *Medicago*.

II. Sclerenchyma

Fibers: These cells are found in all three tissue systems. They have secondary walls and function to support and protect the plant. Cotton, hemp and flax are all examples of plant fibers.

Two views of fibers of basswood (*Tilia*) bark



Cross section of fibers of *Tilia* bark.

Macerated *Tilia* bark - view of fibers.

Sclereids. Sclereids are cells with thick secondary walls that are not elongated like fibers. They function to provide support and protection to plant tissues.

Stone Cells are found int he tissue of pear fruit. They provide the gritty texture of the flesh near the core.

Branched sclereids pervade the ground tissue of many plants including the mesophyll of water lily.

III, Specific Cell Types in the Vascular Tissues of *Cucurbita*

The *Cucurbita* stem is different from *Medicago* or *Coleus* in that it has two concentric rings of vascular bundles surrounding a pith with a huge hollow (intercellular space). Further, the vascular bundles have phloem both to the outside as well as the inside of the xylem. The cells in thevascular tissues are easy to see and, hence, it is frequently used in introductory courses.

The Xylem:

Cross Section: The xylem tissue is made up of vessel members and parenchyma cells.

Longitudinal Section:

The metaxylem vessels include a complete cylinder of pitted secondary wall. These vessels differentiated after the young stem stopped elongating.

Protoxylem vessels have incomplete secondary walls. The secondary walls consist of either hoops or spirals. **Protoxylem** differentiates while elongation is occurring. The incomplete secondary walls inside the primary walls function to prevent the vessel from collapsing and yet allows it to be stretched without ripping.

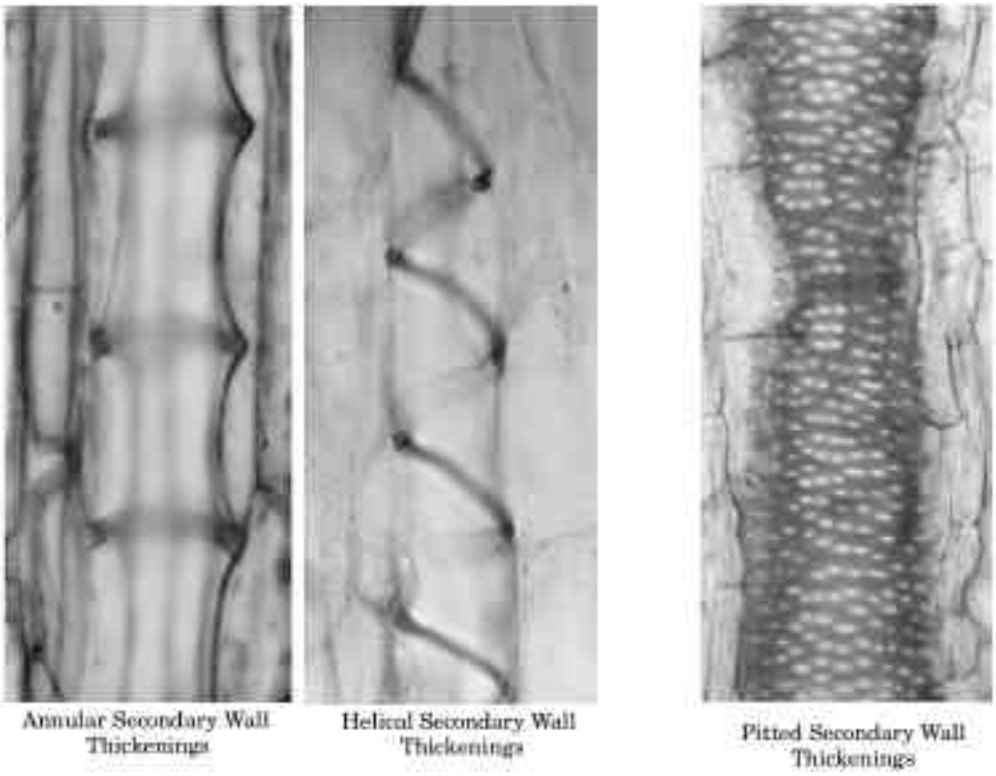
The Phloem:

Cross Section**:** The phloem includes **sieve-tube members, companion cells** and **phloem parenchyma cells. Sieve-tube members have sieve plates.** Companion cells are smaller cells with the dense cytoplasm.

Longitudinal Section**:** In longitudinal section, the sieve tube are arranged one on the other to form a continuous **sieve tube**.
Sieve plates are at the junctures of these cells. The spacial relationship of the companion cells to the sieve-tube members can also be discerned in this section.

Cucurbita: Longitudinal Sections of Vascular Tissue

Vessels in the Xylem

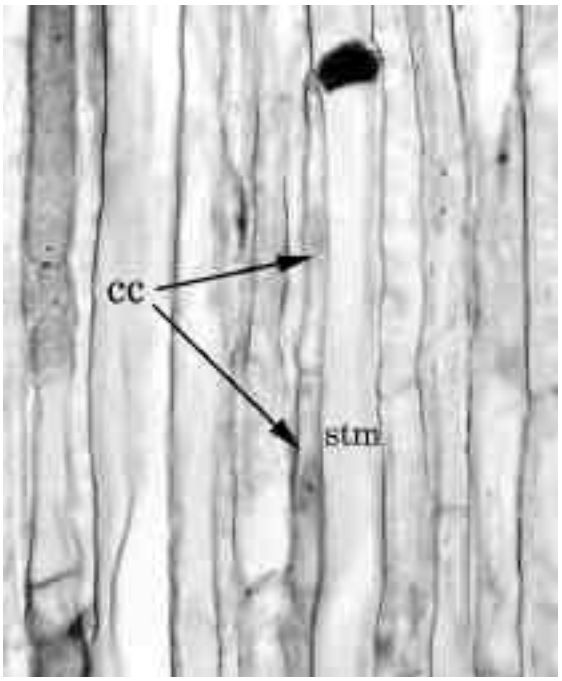


Annular Secondary Wall Thickenings

Helical Secondary Wall Thickenings

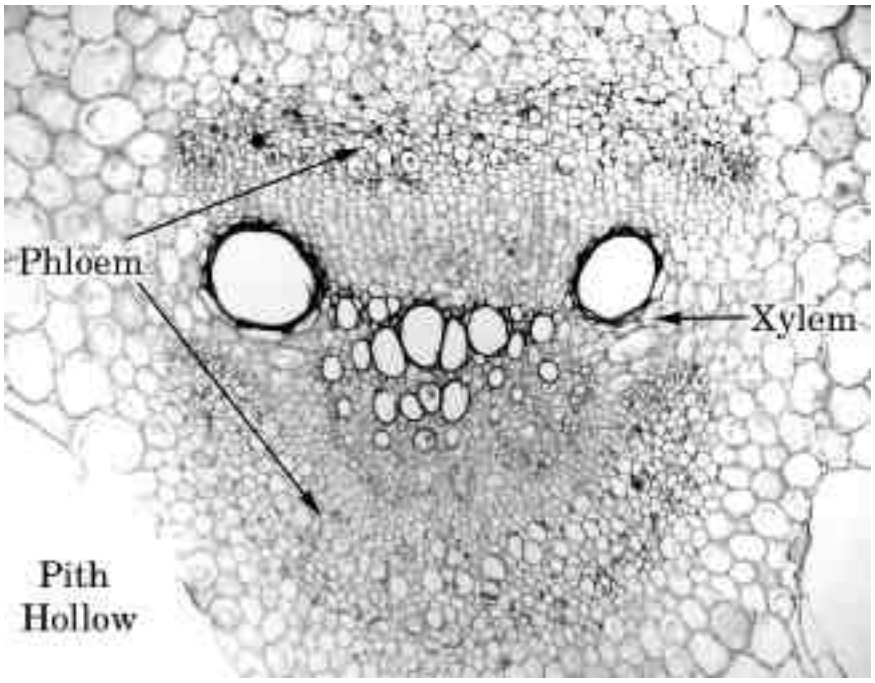
Pitted Secondary Wall Thickenings

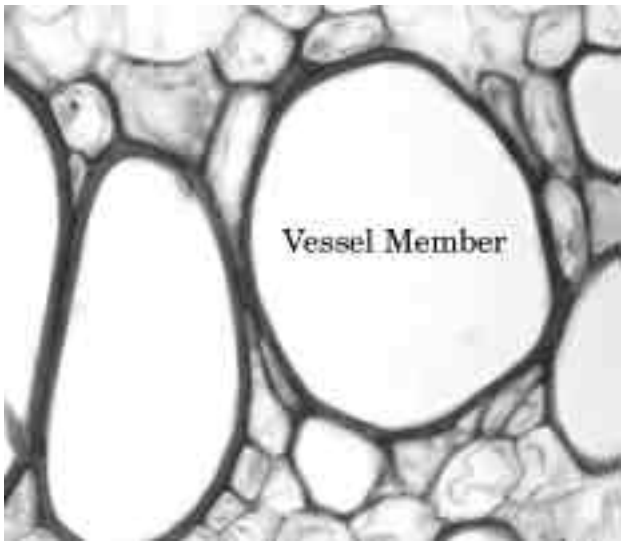
Phloem Tissue



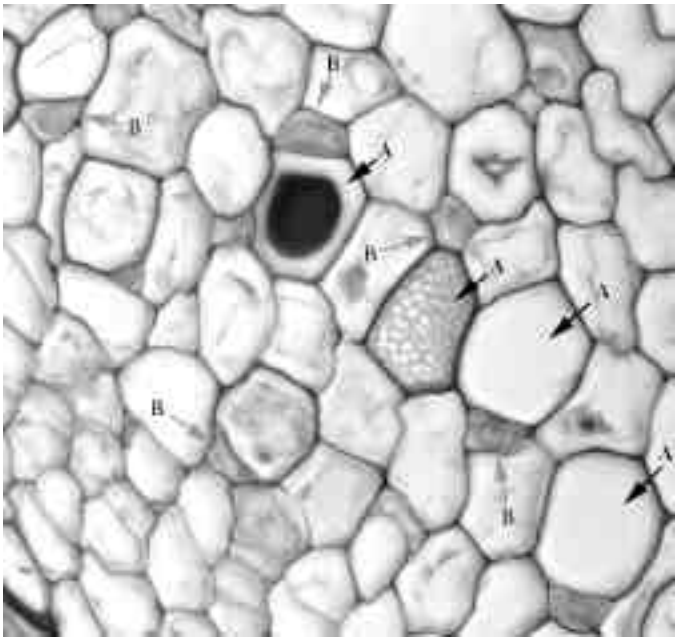
cc = companion cells
stm = sieve tube member

Cucurbita: Cross Sections of Vascular Tissue





Xylem



Phloem

A = sieve tube members

B = Companion cells