

# Stems & Leaves Laboratory

## 7

### STATION 1

#### Introduction to the stem

The stem functions as the principal supporting organ in the plant body. The stem also holds and separates the leaves to improve their exposure to light, supports the flowers to aid in pollination and holds up the fruits so that dispersal can take place. Stems also contain **vascular bundles** which conduct materials throughout the plant body. The stem's **buds (terminal buds and axillary buds)** consist of a dome of cells called the **apical meristem** which is surrounded by immature leaves, the **leaf primordia**. As growth occurs, the stem elongates and the leaves unfold. A cell produced by the apical meristem occupies a progressively more basal position as new cells are added. Stems consist of **nodes** and **internodes**. A node is the region on a stem where a leaf (or flower) arises. The region between two successive nodes is the internode.

Stems may be either herbaceous or woody. **Herbaceous** stems remain soft and green and are covered with epidermal tissue; **woody** stems become hardened with secondary xylem formed from secondary growth by a **lateral meristem** and are covered by bark. Lateral meristems give rise to secondary tissues, increasing the girth of a plant. Monocot stems are usually herbaceous and include plants such as lilies, corn, rice and other grasses; eudicot stems may be herbaceous or woody. Examples of herbaceous eudicots include tomatoes, marigolds, alfalfa, pansies and petunias and examples of woody eudicots include pecan trees, oaks and maples.

### Monocot Stems

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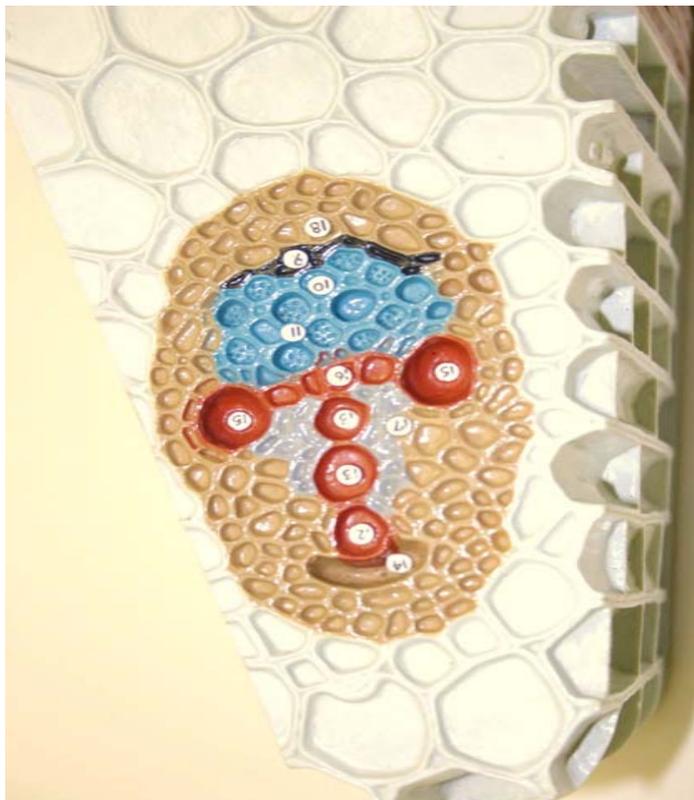
The basic stem structures, called primary tissues, are produced from the apical meristem. The outermost tissue layer is the **epidermis**. Immediately inside are **collenchyma** cells forming the **ground tissue**. The ground tissue in the stem's interior consists primarily of larger, thin-walled **parenchyma** cells. Scattered throughout the parenchyma tissue are **vascular bundles** composed of **xylem** and **phloem**. The **bundle sheath cells** (modified sclerenchyma fibers) surrounding the vascular bundles aid the ground tissue in providing structural support for the stem.

There are two main differences between monocot and eudicot stems. Monocot stems have scattered vascular bundles and they have no cambium. To contrast, eudicot stems have vascular bundles arranged in a ring and can have a cambium that allows for secondary growth (and increases in girth).

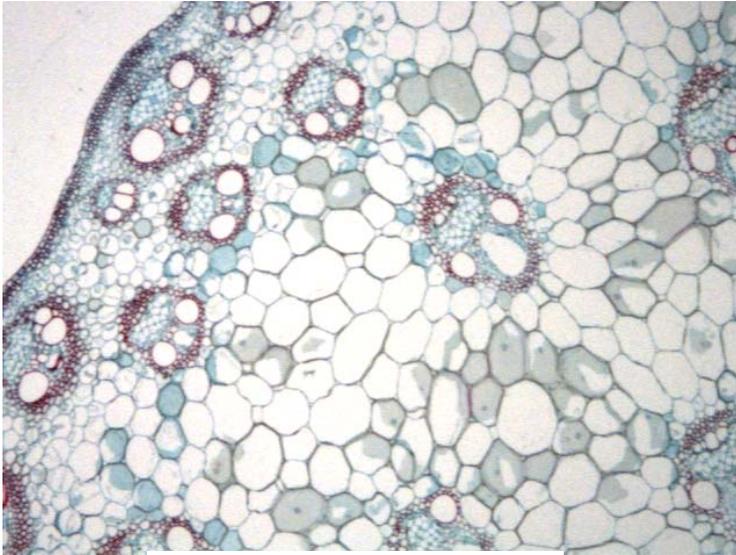
**Examine the monocot stem model.** Be able to identify epidermis, ground tissue parenchyma, vascular bundle, xylem, phloem



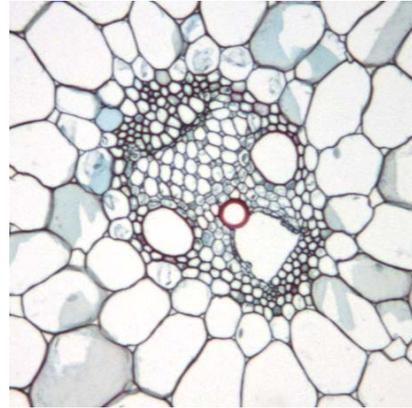
**Monocot Stem models**



**View the prepared slide of a monocot stem and compare with the model. Label the micrographs below: epidermis, ground tissue, vascular bundle, xylem, phloem**



Monocot stem cross section 40x



Monocot stem- vascular bundle 100x

## **Review Questions:**

1. Describe the differences between monocot and herbaceous eudicot stems with respect to vascular bundle arrangement.
2. List the basic functions of stems.
3. Why are the bundle sheath cells important?
4. List two examples of eudicots and monocots.
5. Name the region on a stem where a leaf arises.

# STATION 2

## Eudicot Stems

### Herbaceous Eudicot Stems

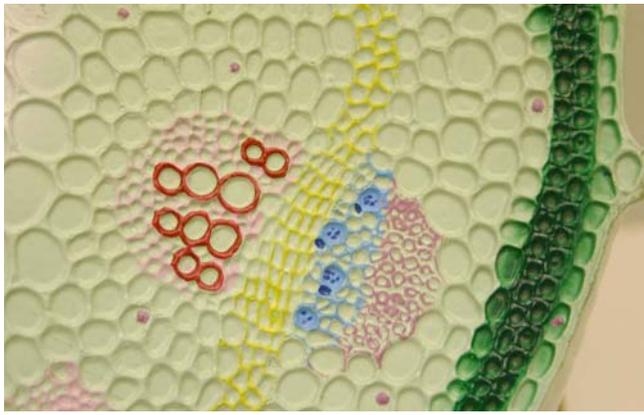
Unlike monocots, eudicots may possess lateral meristems. The **vascular cambium**, one type of lateral meristem, separates the xylem and phloem within the vascular bundles of herbaceous eudicot stems. The vascular cambium gives rise to secondary vascular tissues; secondary xylem develops to the inside of the cambium (towards the center) while secondary phloem develops toward the outside.

In a eudicot stem, the **vascular bundles** are arranged in a ring, surrounding the **pith**. The area between the vascular tissue and the **epidermis** is designated as the **cortex**. Both the cortex and the pith are composed primarily of **parenchyma cells**. As parenchyma cells extend between the vascular bundles, connecting the cortex and pith. Structural support for the stem is provided by **sclerenchyma fibers** within the vascular bundles and **collenchyma cells** within the cortex.

**Examine the eudicot stem model.** Be able to identify epidermis, cortex, vascular bundle, xylem, phloem, vascular cambium, pith

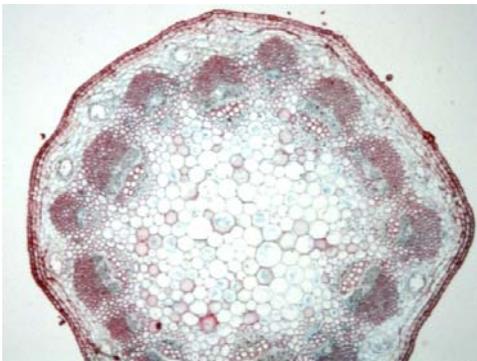


**Herbaceous Eudicot Stem**

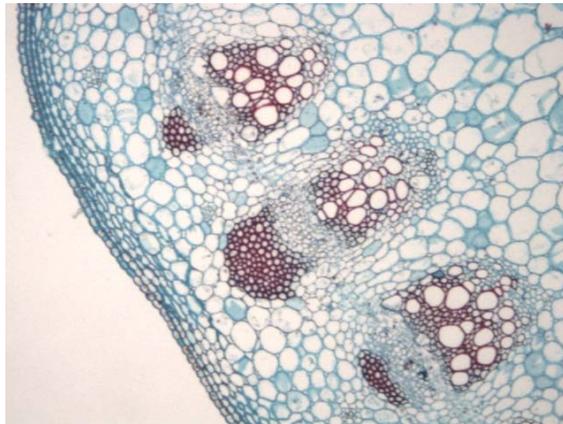


### Enlarged Vascular Bundle

View the prepared slide of a eudicot stem and compare with the model. Label the micrographs below: epidermis, cortex, vascular bundle, xylem, phloem, vascular cambium, pith



Cross Section of a Eudicot Stem 40x



Cross Section of a Eudicot Stem 100x

## Review Questions

1. Which cell type comprises the cortex and pith? What are the functions of these tissues?
2. What does the vascular cambium produce – are these tissues produced to the outside of the cambium or to the inside?
3. BE SURE to compare and contrast the cross sections of stems and roots from last week; pay special attention to the monocot root and eudicot stem slides!!!

# STATION 3A

## Leaf Structure & Function

### Leaf Structure & Function

**Leaves** are the primary photosynthetic organs of plants. Most leaves are broad and flat to provide a large surface area for absorption of sunlight and gas exchange. Leaves vary with respect to arrangement on the stem, venation pattern, and anatomy.

Leaf parts include a blade, petiole, and veins. A leaf **blade** is a flattened structure with a prominent upper and lower side. A **petiole** is the stalk of a leaf that attaches the blade to the stem. **Veins** contain the vascular tissue in the blade of the leaf. Veins provide water to the leaves, carry sugars to the roots, and offer support to the blade. The largest vein in a leaf is called the **midrib**.

Monocot leaves typically have long, slender blades and lack a petiole. The veins of monocot leaves tend to run side by side without intersecting in a pattern termed **parallel venation**. On the other hand, eudicot leaves usually do have a petiole and come in a variety of shapes. The veins of eudicot leaves form a branching network referred to as **netted venation**. If the major veins branch from a central point the netted venation is said to be **palmate**. A **pinnate venation** pattern is one in which the major veins branch off along the length of the midrib.

**Observe the laminated leaf specimens and label the illustrations below:** blade, petiole, veins, midrib



**Parallel Venation**  
(monocots)



**Palmate Venation**  
(eudicots)



**Pinnate Venation**  
(eudicots)

Leaves may be either simple or compound. **Simple** leaves have a single blade while compound leaves have several **leaflets** that share a common petiole. There is one **axillary bud** at the stems' node at the base of the petiole of each leaf regardless of whether it is simple or compound. The extension of the petiole between leaflets is called the **rachis**. There are two basic types of compound leaves, pinnately and palmately compound leaves. If all the leaflets branch from a central point, the leaf is **palmately compound**. If the leaflets branch from the rachis, the leaf is **pinnately compound**.



**Simple leaf**

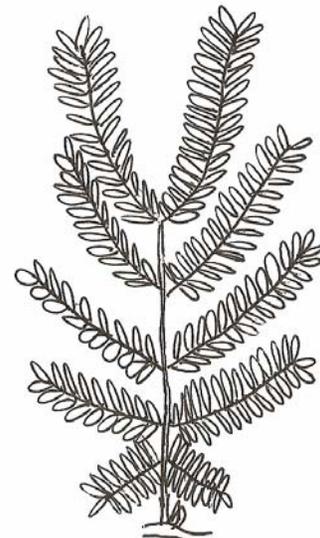
**Observe the laminated leaf specimens and label the compound leaves below: axillary bud, petiole, leaflet, rachis**



**Palmately Compound**



**Pinnately Compound**



**Double Pinnately Compound**

## Review Questions

1. You find a plant that has leaves with parallel venation. Considering what you know, what type of root system would you expect this plant to have? Also, how many petals would you expect to find on the flowers?
2. What structure do you look for at the base of the petiole to help determine if a leaf is simple or compound?
3. What two vascular tissues are located within the vein? What does each transport?
4. What is the primary function of the leaf?

## STATION 3B

### Eudicot Leaf anatomy

Leaves consist of photosynthetic tissue sandwiched between an upper and lower epidermis. The **upper epidermis** is covered by a waxy **cuticle** that prevents water loss from the leaf blade. The **lower epidermis** also has a cuticle along with openings called **stomata** (**stoma**, singular) through which gas exchange occurs. Cells on either side of the stoma, **guard cells**, have chloroplasts and regulate the opening and closing of the stomata.

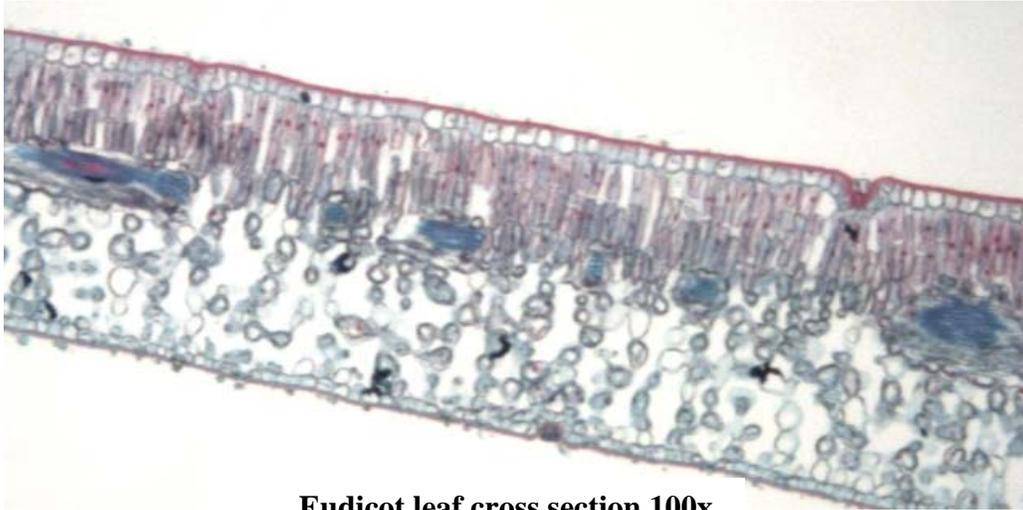
The photosynthetic tissue of the leaf is the **mesophyll**. In eudicots, the mesophyll is divided into two layers. The **palisade layer** just below the upper epidermis consists of tightly packed, cylindrical cells. Underneath the palisade layer, the **spongy layer** consists of loosely arranged, circular cells and **air spaces** that allow for distribution of gases.

The **veins** of a leaf are extensions of the vascular bundles in stems, with protective **bundle sheath cells** surrounding the vascular tissue. (The bundle sheath may extend out towards the epidermis along the midrib region.) **Xylem** is located on the upper side of the vein and **phloem** is located on the lower side.

**Examine both the eudicot leaf model and prepared slide. Compare with the illustration below.** Be able to identify cuticle, epidermis (lower & upper), palisade mesophyll, spongy mesophyll, guard cells, stomata, vein, xylem, phloem, bundle sheath cells, air spaces



**Eudicot Leaf**



**Eudicot leaf cross section 100x**

## **Review Questions**

1. Give the function for each of the following:

cuticle

stoma

guard cells

2. Explain how leaf structure directly correlates to its function? (e.g. Why are most blades flat? Why do epidermal cells lack chloroplasts? What purpose are the air spaces in the spongy mesophyll?, etc)

3. Leaf epidermal cells are covered with a waxy cuticle. Explain why root epidermal cells lack such a cuticle.