BOTANY LAB ASSIGNMENT #3
Roots and Leaves

ROOTS

When a seed germinates the root starts to grow. It can play a role in:

- Anchoring the plant to the soil.
- Water and mineral absorption.
- Carbohydrate storage.
- Stem support.
- Oxygen uptake.

Root tip

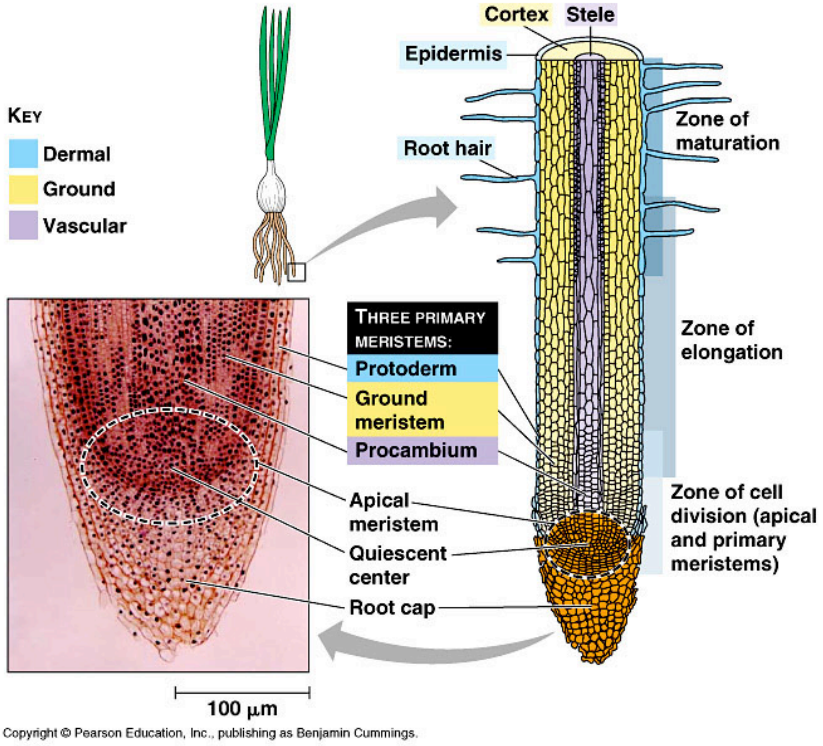
Examine a prepared slide of a root tip. Identify the following structures:

(1) **Root cap** - thimble-shaped tip of the root which protects the apical meristem as the root pushes its way through the soil.

(2) **Zone of Cell Division** - where mitosis is on-going. In this region the cells appear smaller in size because they are continuously dividing.

(3) **Zone of Elongation** - the cells produced in the zone of cell division elongate to push the root deeper into the soil.

(4) **Zone of Maturation** - the cells differentiate into their special cell types. The **stele** with its **Xylem** and **Phloem** will be visible. Root hairs will start to grow out of the epidermis.



With the permission of:

INTERNAL STRUCTURE OF ROOTS

Herbaceous Dicot Root

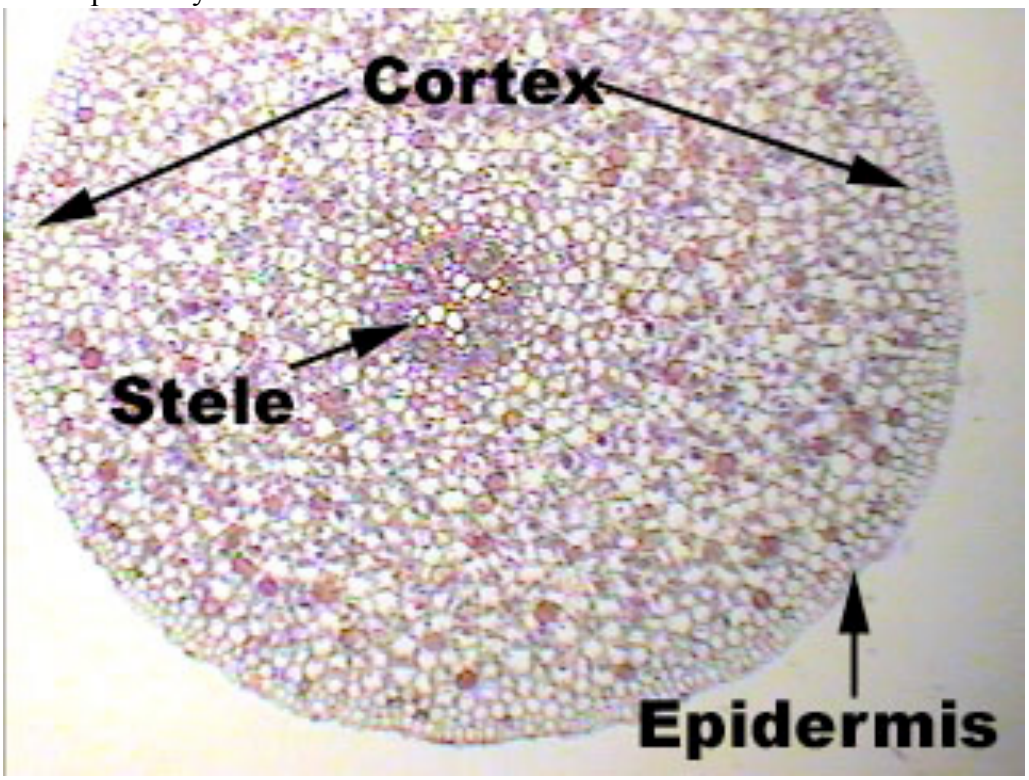
Examine the slide labeled ***Ranunculus*** root X.S. on your microscope. All the tissue you are looking at, are primary tissues (they have developed from the apical meristem).

Three main regions can be seen:

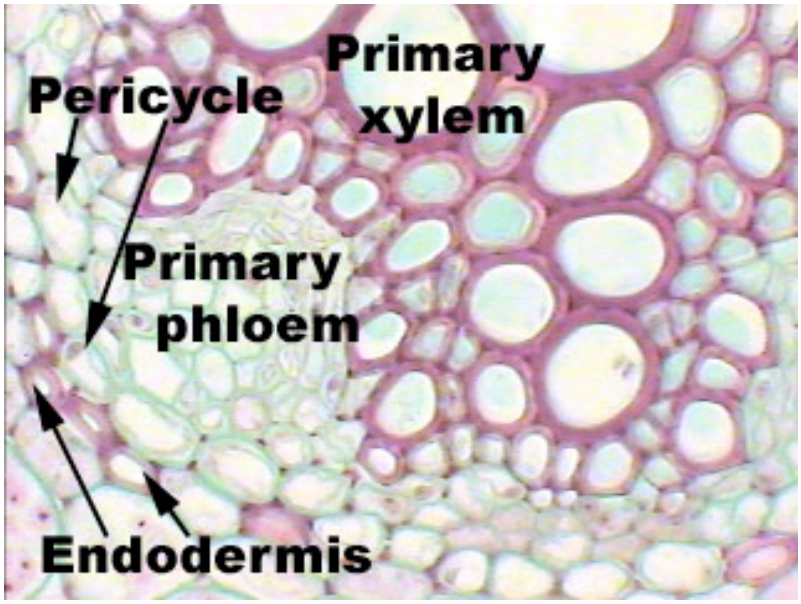
(1) The **stele** - the central vascular cylinder with:
- an outer single layer of cells called the **endodermis.**
- Primary Xylem in the center (star or cross-shaped).
- Primary Phloem - (has smaller cells with no secondary wall).
- Pericycle - a single layer of cells next to the endodermis that gives rise to lateral roots.

(2) The **epidermis** - the outer single layer of cells.

(3) The **cortex -** between the epidermis and the stele. Made up of parenchyma cells.



Cross section of a Herbaceous dicot (***Ranunculus***) root (40X)

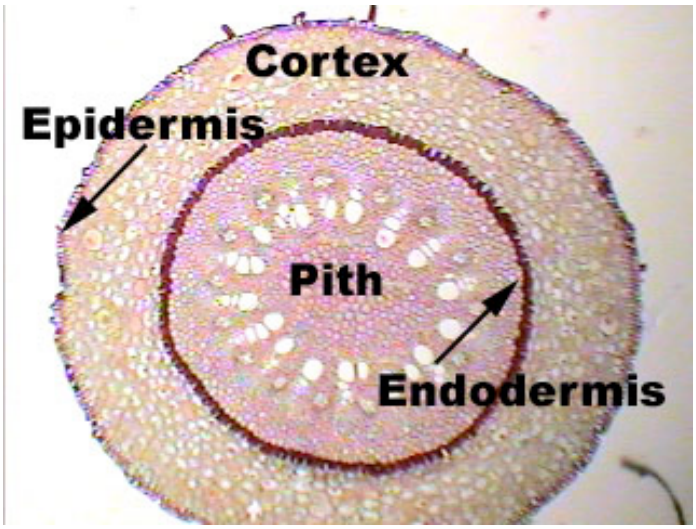


Cross section of a Herbaceous dicot (***Ranunculus***) root stele (400X)

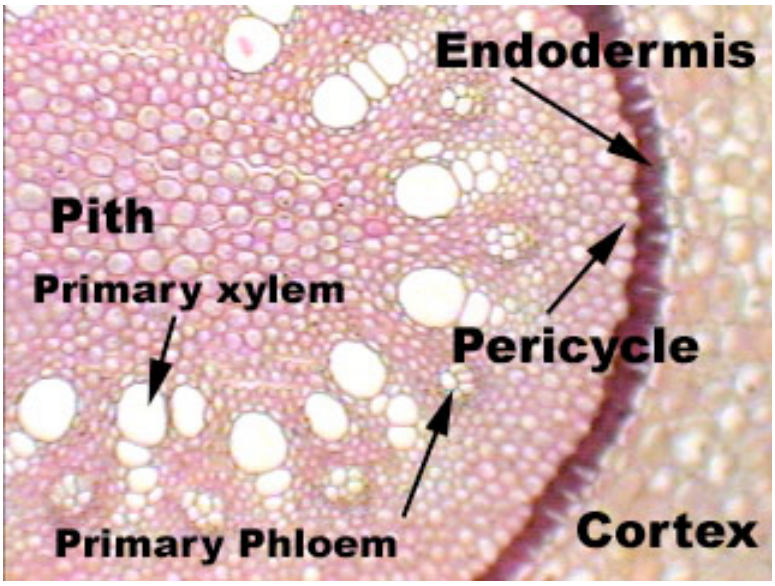
MONOCOT ROOT

Examine a slide of a cross section of a ***Smilax*** (Lily) root on your microscope. Be able to identify the following structures:

(1) The **exodermis** is a layer of lignified cells immediately central to the epidermis.
(2) The **cortex** is the layer of parenchyma cells between the exodermis and the endodermis.
(3) The **endodermis** is the single layer of prominent cells circling the stele.
(4) The **Pericycle** is just inside the endodermis.
(5) The **stele** is everything inside the endodermis.
(6) The **Primary phloem** cells are the less conspicuous cells inside the stele.
(7) The **Primary xylem** cells are more conspicuous.



Cross section of a monocot (***Smilax***) root (40X)

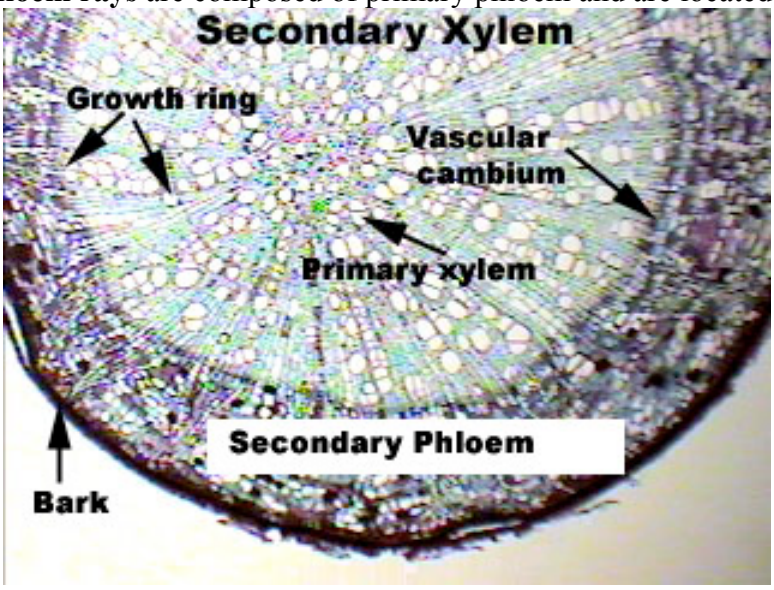


Cross section of a monocot (***Smilax***) root (100X)

WOODY DICOT ROOT

Examine a prepared slide of ***Tilia*** (Basswood) root cross- section on your microscope. Be able to identify the following structures:

(1) **Primary xylem** are the conspicuous cells inside the heartwood.
(2) **Secondary xylem** makes up the obvious **annual growth rings**.
(3) **Vascular cambium** produces both the secondary xylem and the secondary phloem.
(4) **Cortex** is located between the vascular cambium and the bark (it is mostly composed of the secondary and primary phloem).
(5) **Phloem rays** are composed of primary phloem and are located in the cortex.

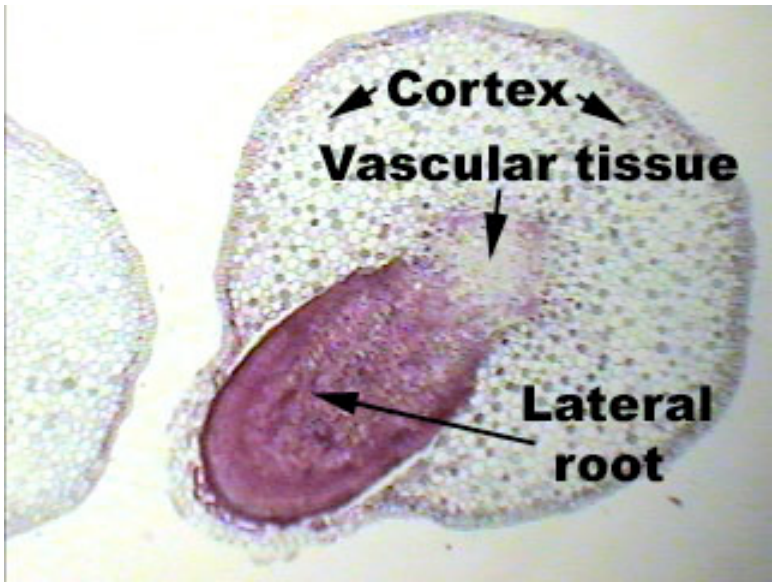


Cross section of a Basswood (***Tilia***) root (40X)

Lateral roots

Examine the slide labeled as ***Salix*** (willow) lateral root development. Be able to identify the following structures:

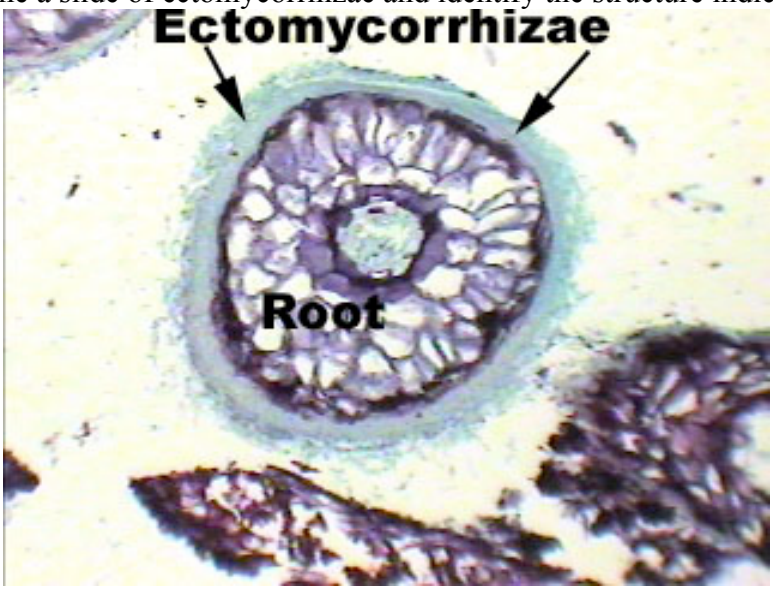
(1) **Lateral root** developing from the pericycle.
(2) **Pericycle.**
(3) **Cortex.**



Cross section of a willow (***Salix***) lateral root (40X)

MYCORRHIZAE - are symbiotic associations of roots and fungi that enhance nutrition. The fungus benefits from a steady supply of sugar from the plant, and the plant benefits because the fungus increases the surface area of the root for an increase in the uptake of water and minerals. Ectomycorrhizae form a dense sheath over the surface of the root.

Examine a slide of ectomycorrhizae and identify the structure indicated below.



Root with ectomycorrhizae

If the fungal component penetrates the root it is called endomycorrhiza. Most endomycorrhizal fungi are zygomycetes. They are found in 80% of all vascular plants, and can be identified by the vesicles in the center of the root cells that stain darkly.

Root with endomycorrhiza

LEAVES

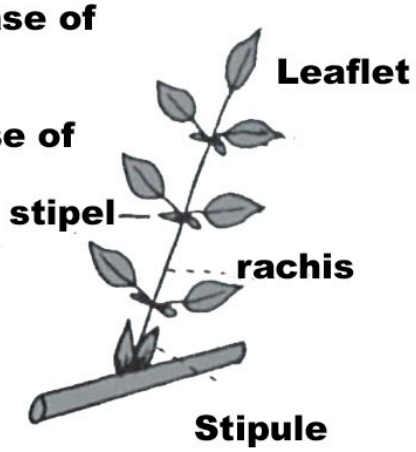
External Structure of Leaves

A leaf consists of three major parts:

(1) **Blade** (lamina) the broad flattened part of a leaf.
(2) **Petiole** (stalk).
(3) **Stipules** leaf-like structures found at the base of the petiole.

A stipule is an appendage at the base of the petiole

A stipel is an appendage at the base of the leaflet



A leaf having a blade, petiole and stipule is said to be a **complete** leaf.
A leaf missing one or more of these structures is said to be an **incomplete** leaf.

Venation

Parallel veins are small and run more or less parellel. Most parallel veined leaves are long and narrow.

Netted venation. The veins connect together to form a net

NET

Fig. 154.

Types of leaves

Leaves can be grouped as follows: (these are only some of the categories)

(1) A **simple** leaf has a single intact blade.

(2) If a leaf is divided up into smaller leaflets it is said to be a **compound** leaf.

Palmately compound leaves have all of the leaflets originating from the same point on the petiole (see the photo below)

Pinnately compound leaves have their leaflets arising from different parts of the petiole (see the photo below).

The way that leaves attach to the stem in relation to the node is important. **Opposite** leaves attach at the same point on the stem (across from each other).

Alternate leaves attach at different points to the stem.

Internal structure of leaves

Leaves are composed of 3 major tissue types.

(1) **Epidermis** layer - both upper and lower.
(2) **Mesophyll** - between the upper and lower epidermis.
(3) **Veins** - groups of xylem and phloem.

Dicot Leaf

Find the slide labeled ***Syringa*** and identify the structures indicated below.

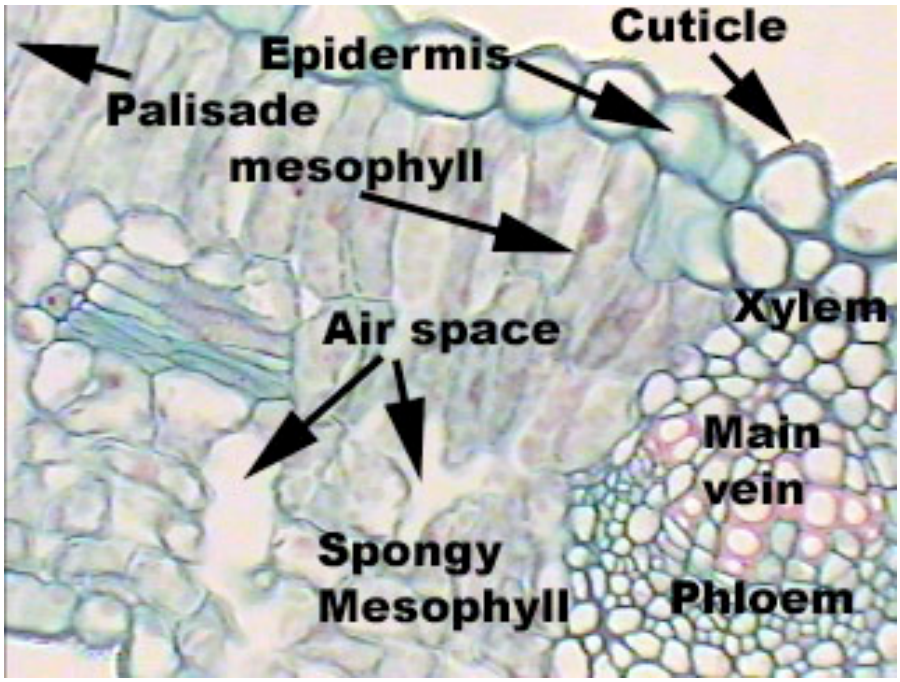
(1) The **Cuticle** is located on the upper epidermis. It protects the plant and slows down water loss from the leaf.

(2) The **Guard Cells** and **Stomata** regulate the passage of gases.

(3) The mesophyll is divided into two types:

- **Palisade Mesophyll** is located directly under the upper epidermis. It has the greatest concentration of chloroplasts.
- **Spongy Mesophyll** is located directly under the palisade mesophyll, toward the bottom of the leaf.
- both types of mesophyll are composed of parenchyma cells.

(4) The Main Vein is composed of xylem on the top and phloem on the bottom.

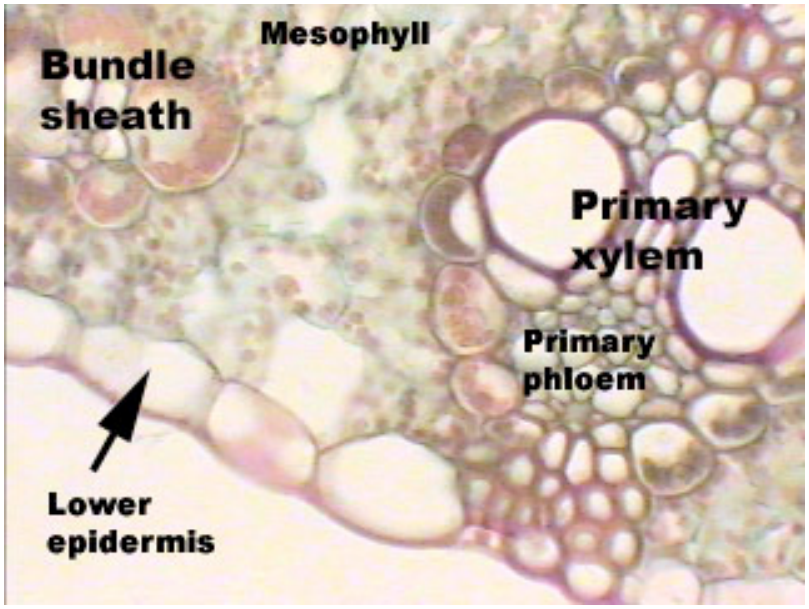


Monocot Leaf

Find the slide labeled ***Zea mays*** leaf X.S. Be able to identify the structures indicated below:

(1) The **Mesophyll** is not found in two types (like the previous Dicot leaf).

(2) The main **vascular bundles** are identical to those seen in the ***Zea mays*** stem (remember that the vessel elements resemble a "face"). These bundles have a pronounced layer of sclerenchyma cells called the **bundle sheath extension.**



Zea Mays leaf

LEAF ADAPTATIONS

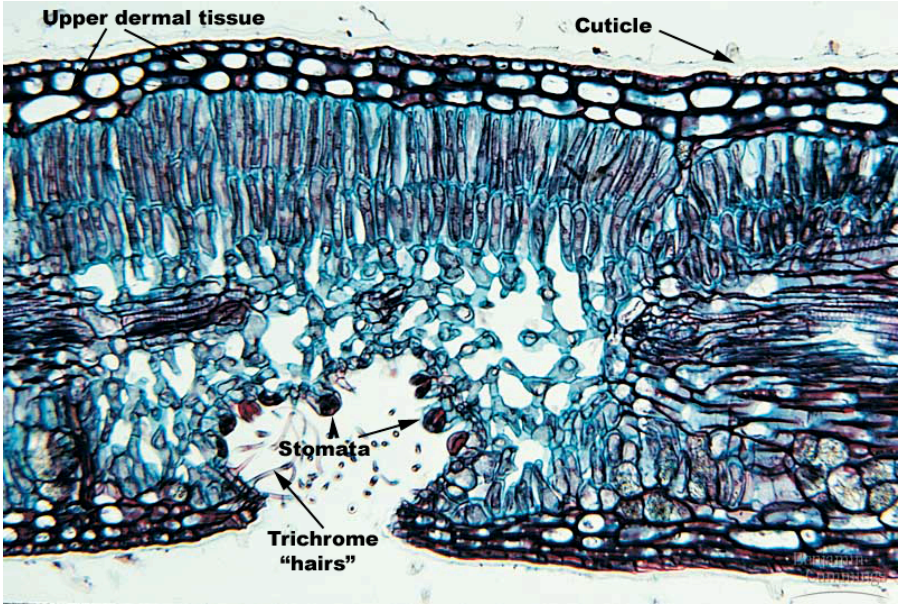
Some leaves have adaptations for surviving in extreme environments:

(1) **Mesophytes** are those plants whose leaves are not adapted to extreme environments (see Syringa leaf above).
(2) **Xerophytes** are those plants adapted to arid environments.
(3) **Hydrophytes** are those plants adapted to grow in water.
(4) **Sclerophytes** are those plants adapted to resist animals, freezing temperatures, and ultraviolet light.

Xerophytes

Examine slides of ***Nerium oleander*** leaf X.S. on your microscope. Be able to recognize the structures indicated below.

This leaf is adapted for arid conditions. The **epidermis** is several layers thick and is covered by a thick cuticle (to reduce water loss). On the bottom of the leaf **stomatal crypts** can be seen. They contain hairlike structures called **trichomes** (they help to maintain a humidified state to decrease water loss through the stomata).



Xerophyte **- *Nerium oleander***

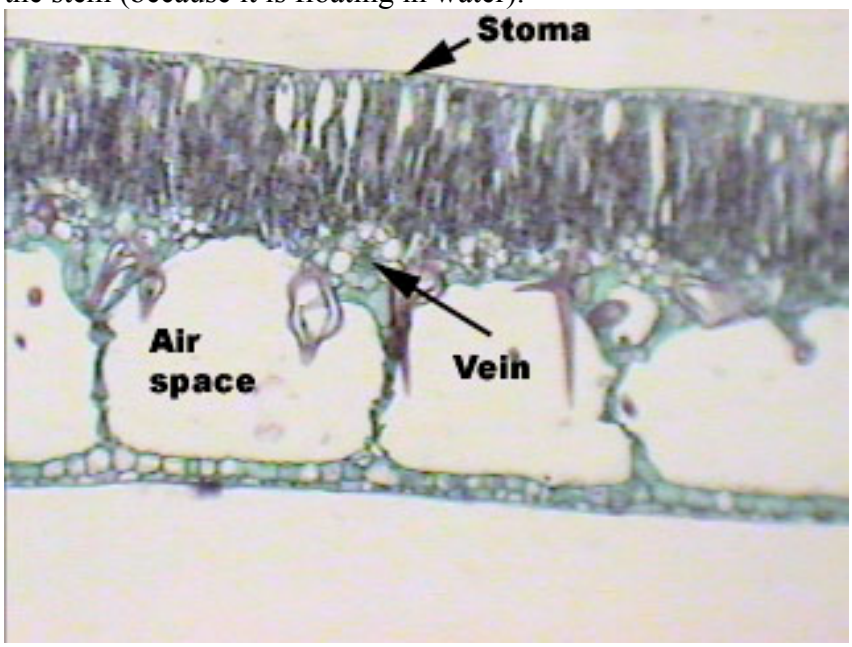
Hydrophytes

Examine the slides of the water lily ***Nymphaea***. Be able to identify the structures indicated below.

(1) Notice that the **stoma** is on the upper surface of the leaf (which is floating in water).

(2) **Air spaces** keep the leaf afloat and forms channels for the passage of air to submerged parts of the plant.

(3) The **xylem** tissue is reduced because the plant does not have to transport water up the stem (because it is floating in water).

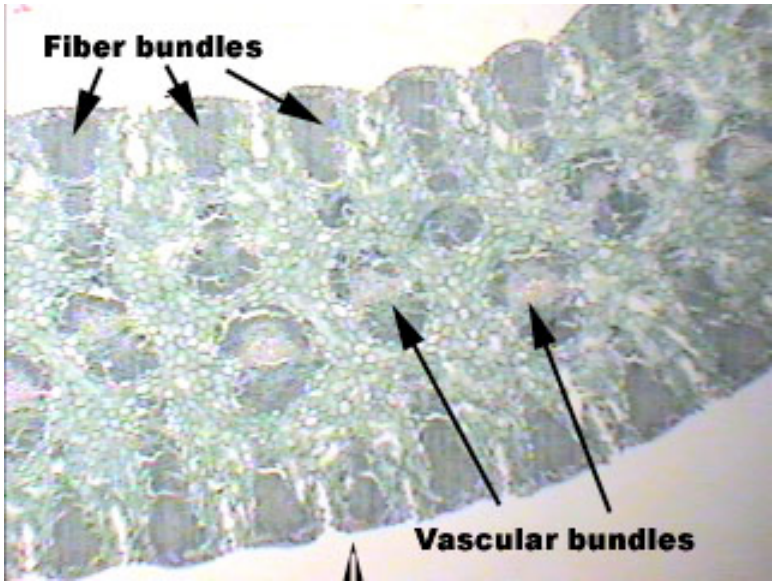


Hydrophyte leaf of the water lily ***Nymphaea***

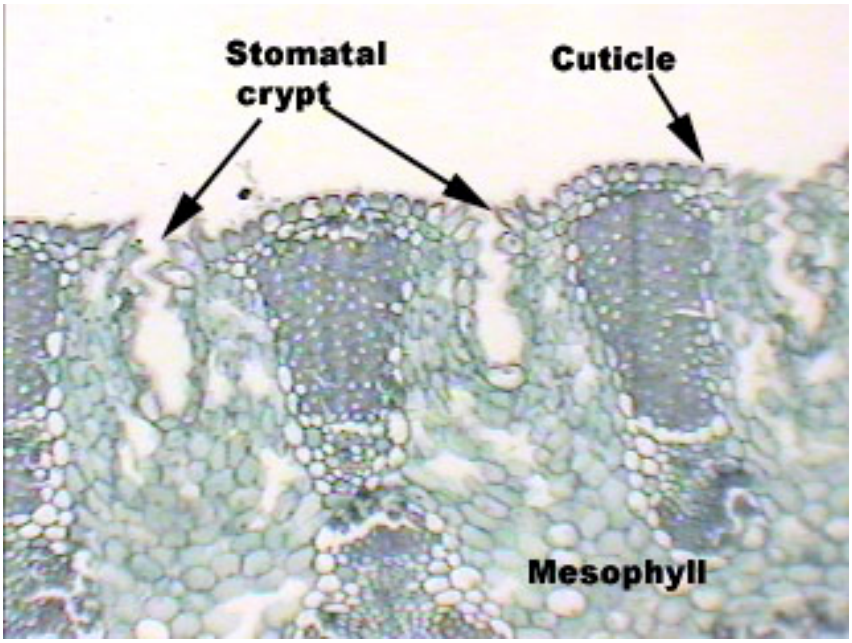
Sclerophyte

Examine a slide of Yucca. Be able to recognize the structures indicated below.

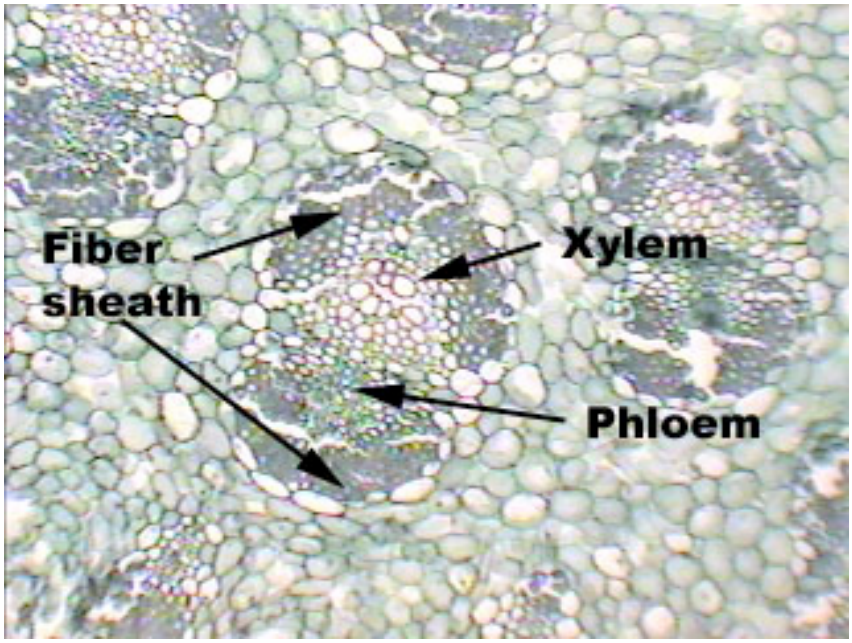
(1) The leaves are tough and fibrous with a thick cuticle (reduces water loss).
(2) Thick **mesophyll** surrounds the vascular bundles
(3) The **stomata** occur in long narrow grooves between the fiber bundles.
(4) The **vascular bundles** have fibrous sheets.



Yucca Leaf cross-section (40X)



Yucca leaf cross-section (100X)



Yucca leaf cross-section (100X)

ABSCISSION ZONE

During the fall the leaves separate from the plant at the **abscission zone**, which is a layer of thin-walled parenchyma cells at the base of the petiole.