

Plant Anatomy Lab 11 – Leaves II

This exercise continues our look at the anatomy of plant leaves. Previously, we looked at typical dicot and monocot leaves. This time, we will consider leaves of gymnosperms and some examples of structural adaptations to environmental conditions. As before, when you look at the vascular bundles within a leaf, think about where (which side) you find the xylem and phloem and how this matches up with the positioning of the xylem and phloem in the young stem where the leaf was attached. You should be able to tell “which way is up” for a leaf section based on this consideration.

Hand sectioning of leaves

Most of the cells you will look at have fairly thin walls (with the exception of some of the cells associated with vascular bundles). This means that your sections must be thin and clean. Try the two-blade method again with the pine needles. There are various ways of doing this and you are free to experiment. One method involves inserting a thin sheet in between the two blades before cutting the leaf. The pine needles are narrow and so you should be able to make many sections quickly once you get the blades held correctly. The cycad leaf may be rigid enough for you to just shave off a thin section without using the two-blade method. Be patient and keep trying, eventually you will get a good section. **Thick sections will not show you what you need to see and even worse; they will tend to lie on the microscope slide with the epidermis up instead of on its side.**

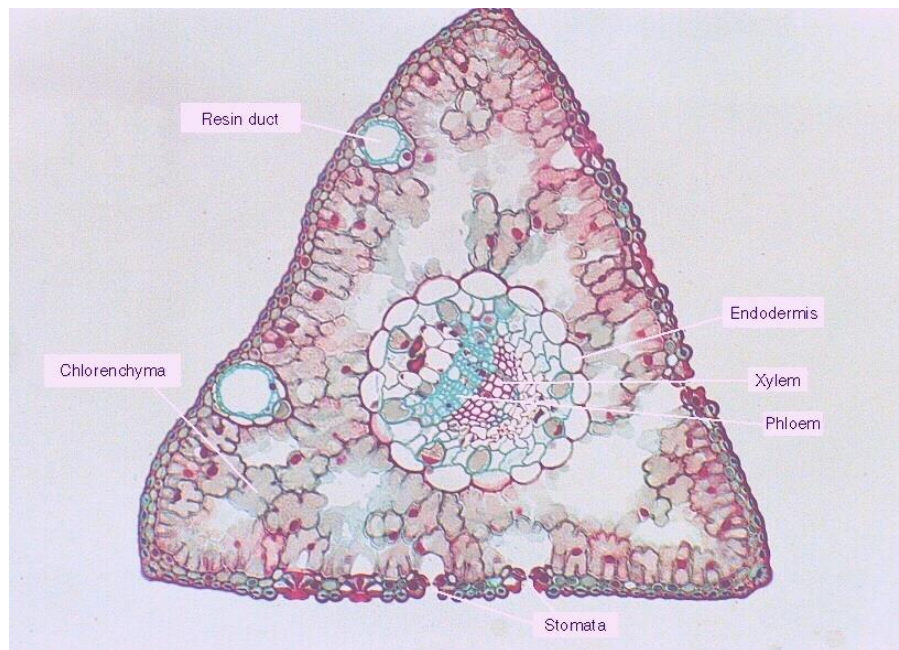
Stain with toluidine blue, but only for 15 to 30 seconds. You just want to lightly stain the epidermis, the vascular tissue, and the walls of exposed cells. If the section is too dark, it will be hard to see chloroplasts in the mesophyll cells.

Gymnosperm leaves

Obtain a couple of needles (foliage leaves) from the *Pinus halepensis* (Aleppo pine) shoot and make transverse sections through the needles.

- Notice the guard cells near the epidermis. Unlike the guard cells of the typical dicots we have looked at, these are sunken below the surface. Sometimes the passage above the guard cells is partly filled with wax. For part of the year, this wax may help prevent water loss from the leaves.
- Observe the chlorophyll containing cells in the mesophyll. Typically in conifers they have ridges or infoldings in their walls.
- Notice the endodermis layer that surrounds the vascular tissue. These are relatively thick walled cells, but generally lack a casparian band thickening.
- Find the xylem and phloem tissue within the vascular bundle. These tissues may also contain undifferentiated parenchyma cells.

- Lastly, notice the occurrence of resin ducts both in the phloem and the cortex. If your section is especially thin, you may see the thin-walled cells that surround the ducts and provide the resin. You may have noticed how this resin makes it difficult to obtain a clean section!



White pine needle in transverse section.

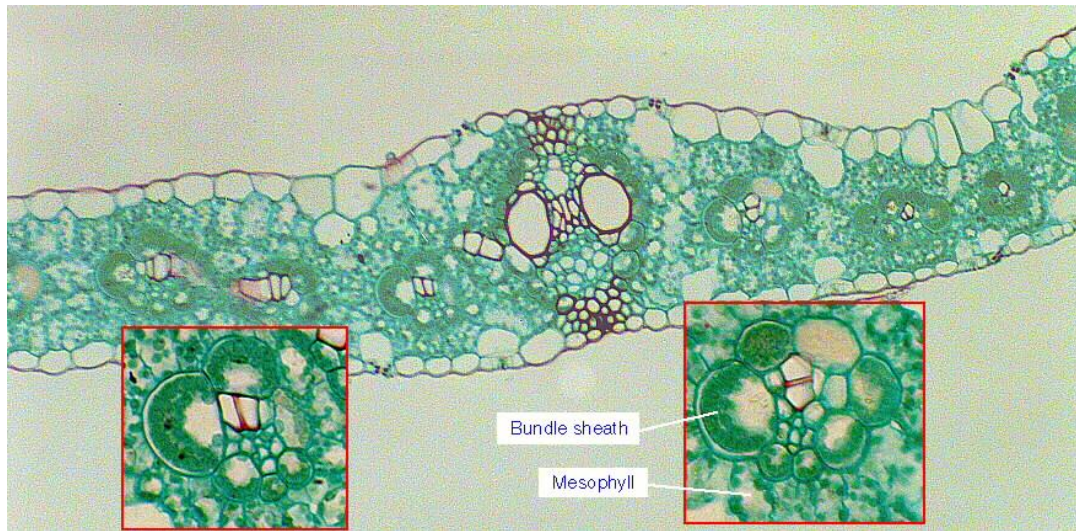
Obtain a leaf of the early vascular plant *Cycas revoluta* (a cycad) and section it as described previously.

- Notice that these leaves have a palisade-like layer of photosynthetic parenchyma. Is this layer located immediately inside the epidermis?
- Find the guard cells and substomatal cavities. Which surface of the leaf are they on?
- Find the vascular tissue. Do these leaves have a main bundle plus other minor bundles? Locate xylem and phloem in the vascular tissue. Can you find the endodermis around the vascular bundle?
- Lastly, notice the unusual laterally oriented cells outside of the vascular bundle that pass out through the leaf mesophyll. These cells may function for transport and are called accessory transfusion cells (or tissue). Do they look like parenchyma or tracheids or both?

Specialized leaf anatomy

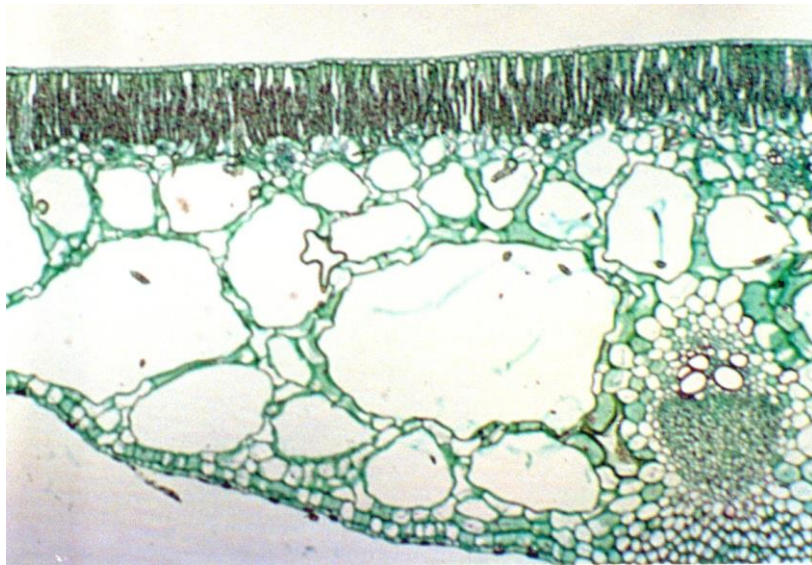
Obtain a prepared slide of *Zea mays* (corn) leaves. Notice the odd epidermal cells called bulliform cells. The main feature of interest, here, is referred to as the Kranz anatomy. Look at the vascular bundles and find the bundle sheath surrounding the xylem and phloem. These bundle sheath cells have chlorophyll and are the site of part of the photosynthetic reactions occurring in C_4 photosynthesis. In this process, CO_2 is fixed in the form of organic acids in the mesophyll cells,

transported to the bundle sheath, and released again as CO_2 where it becomes highly concentrated and enhances the ultimate fixation of carbon into sugars.

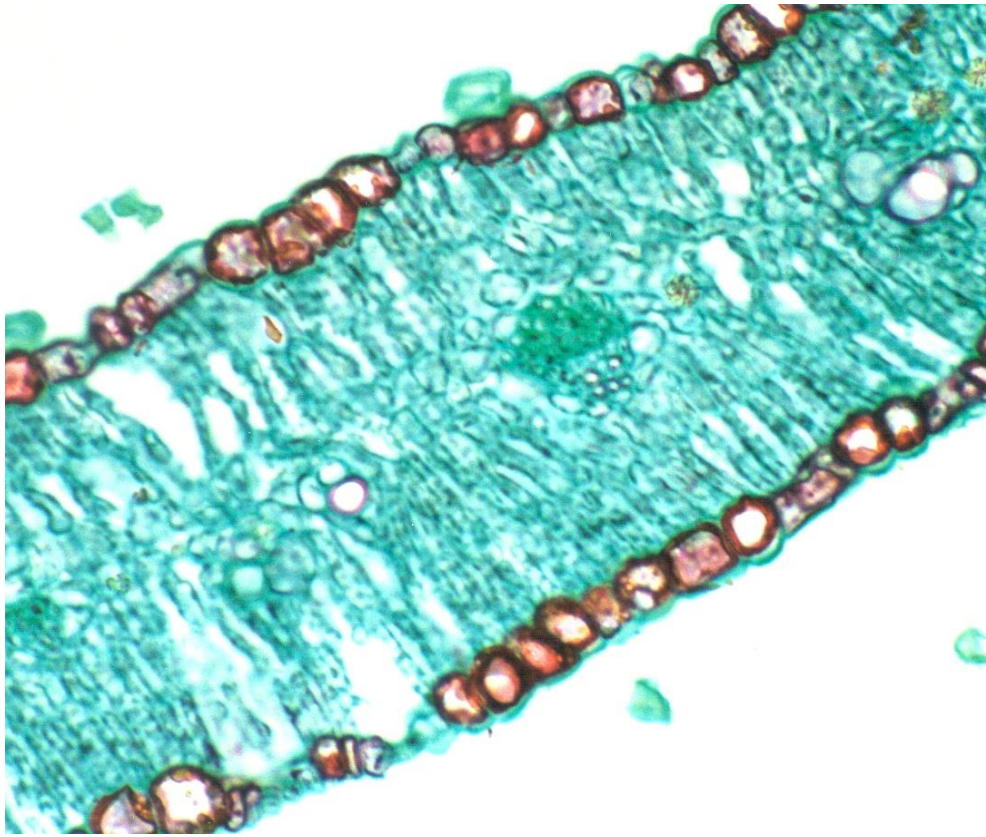


Corn leaf with Kranz anatomy

Obtain a prepared slide of a *Castalia* leaf. This is a hydrophyte or aquatic plant similar to *Potamogeton* and *Vallisneria*. You should readily see the large air spaces that are involved in gas diffusion and perhaps buoyancy for these leaves. Where are the guard cells? For our typical dicot leaves, the guard cells were usually located on the side of the leaf with the spongy mesophyll, not the palisade mesophyll. Observe the vascular bundles. Are they small compared to other leaves we have seen? Do they have both xylem and phloem? Think about all these leaf characteristics with regard to function for a leaf living in an aquatic environment.



Lastly, look at a slide of *Larrea* (creosote bush) leaves. This is a xerophytic plant with xeromorphic leaves that show some adaptation to the desert environment. Find the palisade layer(s). Are there more than one? Where is the spongy mesophyll tissue? Is there a lot of internal air space in these leaves? See if you can find guard cells.



Larrea leaf.