3 October: 1^{o} Tissues II; roots

Partial review of last week's lecture. Note, however: 1) the new/expanded information for collenchyma and sclerenchyma, below (reviewed briefly in today's lecture), and; 2) It is highly unlikely that I will ask explicit questions about parenchyma and collenchyma, but you'll encounter these terms in texts/online so I include them in the course them for your edification.

Recall that plant structure is organized at 3 levels:

ORGANS —built from→ TISSUES —built from→ CELLS

I. Organs (for now):

1) Leaves
2) Roots
3) Stems

II. Tissues: (only 1° tissues have been discussed so far; remember - 2° tissue is wood and bark)

1) epidermis (includes: trichomes, stomata, cuticle)
2) vascular tissue (xylem, phloem)
3) ground tissue

III. Cells: Three types, defined by cell wall thickness. Here is a brief overview of each, and where they are found in leaves.

1) Parenchyma – cells with thin primary walls.

- Ubiquitous, and by far, the most common cell type in plant 1° tissues
- Highly diverse in form and function (we'll study many in labs throughout the semester)
- Examples in leaves (from last lecture): palisade parenchyma, spongy parenchyma, epidermis, phloem, xylem (as we will learn, xylem can also exist as sclerenchyma cells when it develops a 2° cell wall (in wood) – we'll get to that next week when we explore 2° tissues!)

2) Collenchyma – cells with thickened primary cell walls.

- Relatively rare - a low percentage of plant calls are collenchyma.
- Used to provide structural support in leaves and herbaceous stems – mostly absent in roots!
- "Plastic": Can be deformed and maintain a new shape. Critical for leaves and the tips of herbaceous stems that must change shape as they grow
- Examples in leaves: small bundles that provide support in herbaceous leaves/stems.

3) Sclerenchyma – thick secondary cell wall (and of course, the primary cell wall remains present)

A) Conducting sclerenchyma: xylem. We will discuss in great detail in a later lab and lecture!!

B) Non-conducting sclerenchyma

1) Fibers – long and elastic

- Elastic: Can be deformed, but they return to their original shape
- Present in tissues where growth is completed, and used to maintain "final shape" of tissue/organ but provide flexible support for organs/tissues to bend in the wind etc.
- Examples in leaves: sclerophylls such as *Yucca*.

2) Sclereids – cuboidal and brittle (do not bend)

- Resist deformation – used at protective tissue to resist any deformation – like a "helmet"
- Not in leaves – examples include walnut 'shells', pits of stone fruits (cherry, peaches, etc).
- Present in fruit of pears (the "gritty" texture when one bites into a pear) and visible under microscope (we'll see these in lab when we examine fruits).

ROOTS

The basics:
Root: organ (typically underground) that anchors the plant in place, and absorbs water and nutrients.
In plants, there are two types of root systems, plants with a taproot and plants with fibrous roots:
Radicle: the embryonic root in a seed plant
Taproot: A large central root derived from the radicle, from which other roots branch off (**lateral roots**).
Fibrous roots: A mass of similar sized roots, each arising directly from the stem, none derived from radicle. Fibrous roots are found in ferns, monocots, and some dicots. All other plants have taproots (mosses have no true roots – we'll get to them in a few weeks!).
Adventitious root: Root arising from non-root tissue (stem, leaf, node).

We'll explore additional and interesting concepts about root structure and function in lab next week. It is possible that a portion of the material covered in lab will appear on the next Midterm.

Monocots vs. dicots:
Before we proceed with our examination of roots, we should take this opportunity to establish a few of the many differences between two large groups of plants: monocotyledons ('monocots') vs. dicotyledons ('dicots'). All species of flowering plants fall into one of two groups: monocotyledons ('monocots') vs. dicotyledons ('dicots'). So far this semester, we have discussed leaves and roots, so here is a list of how leaf and root structures vary in these two groups of plants (we'll expand this list as the semester progresses):

Monocotyledons ('monocots', ~60,000 spp.)	**Dicotyledons ('dicots'; ~200,000 spp.)**
One seed leaf (seed leaf = "cotyledon")	Two seed leaves (seed leaf = "cotyledon")
Leaf venation: parallel	Leaf venation: not parallel (pinnate, palmate, etc.)
Leaf shape: long and "strap-like" (e.g., corn, most orchids)	Leaf shape: variable but not long and "strap-like" (e.g., *Quercus* spp., *Ceanothus* spp., all the species we have and will press in lab)
Root system: fibrous roots (typically)	Root system: taproot with lateral roots (typically)

Specialized roots
Storage roots – store starch for future use. (Ex: carrot, radish, sweet potato).

Aerial roots – Roots above the ground, typically adventitious. Many types. Example emphasized was orchids. Most orchids are **epiphytic** because they grow on other plants (epi, "on" + phyte "plant"), the host is usually a tree. Orchid roots have a **velamen** – white sheath for sequestering H_2O and protecting roots.

Prop roots (aka stilt roots) – type of aerial root used for structural support. Grow downwards from stem tissue, when they contact ground they conduct water up into the plant. [Ex: corn (*Zea mays*), banyan (*Ficus benghalensis*)]. Common in tropical trees b/c tropical soil is often shallow.

Buttress roots – Plate-like roots that provide support. As with prop roots, common in tropical trees that grow in shallow soil. *(FYI: some classify buttress roots as types of prop roots…you need not dintinguish).*

Pneumatophores – semi-hollow root projections that protrude upwards from roots and enhance access to O_2. Common in trees that grow in submerged soils where O_2 levels are low [mangroves, bald cypress swamps (*Taxodium distichum*). *Remind me…why do the roots require O_2?* Interestingly, recent research indicated that the "knees" (pneumatophores) of bald cypress trees do not increase O_2 delivery to roots. What then, is their purpose? That is unknown for the time-being., but alternative hypotheses focus on increasing structural stability in the muddy/swampy soils in which they are found.