BASIC PLANT TISSUE TYPES

Parenchyma:

- Most common type of cell and tissue.
- Thin primary walls.
- Typically alive at maturity.
- Many subtypes, including cells involved in photosynthesis; secretion of nectar, fragrances, resins, and oils; short- and long-distance transport.
- Slides: ragweed pith, nucleate cells, sclerenchyma, chlorenchyma, air chambers, tannin

Collenchyma:

- Produced in shoot tips, young petioles, along vascular bundles.
- Unevenly thickened primary walls, usually thicker in corners.
- Typically alive at maturity.
- Provide plastic support (can be deformed by pressure or tension and retain new shape). Stretchy.
- In stems, parenchyma tends to expand but collenchyma holds it in, like an inner tube.
- Slide: angelica stem

Sclerenchyma:

- Primary walls plus secondary walls.
- Most dead at maturity.
- Provide elastic support (can be deformed but return to original size and shape).
- Begin life as parenchyma. Grow to final shape and size. Then secondary wall laid down. Wall becomes impregnated with lignin; waterproof.
- Slide: grass cross-section showing fibers and vessels

Sclerenchyma is divided into categories, mechanical and conducting.

Mechanical sclerenchyma:

Sclerids -- short, more or less cuboidal.
Form hard, impenetrable surfaces, like shells & pits.

Fibers -- long and flexible. Allows wood to be both strong and flexible.

Conducting sclerenchyma:

Tracheids -- Long and narrow with tapered ends. No perforations.
Vessel elements -- Short and wide with perpendicular end walls.

More to come on tracheids, fibers, and vessel elements....

INTERNAL ORGANIZATION OF STEMS

Apical Meristems: Apical meristems (shoot, root) generate the herbaceous plant parts. The meristems have tiny cells dominated by the nucleus; they divide rapidly, and elongate/differentiate past the meristem into the following types of tissues. Secondary (woody) growth occurs by the cambium – we'll discuss later.
Slide: apical meristem

Epidermis: Outermost surface of herbaceous stem.
Interface between plant and environment.
Regulate interchange of material between plant and surroundings.
Slides: guard cells, thick cuticle, thicker cuticle

Cutin on epidermis prevents water loss (air almost always drier than cells).
Barrier against invasion by bacteria, fungi, and small insects.

Totally impermeable epidermis wouldn't work. Need gas exchange.
Stomata (singular is stoma) are pores surrounded by guard cells that regulate the openness of the pore.

Cortex: contains photosynthetic parenchyma cells, sometimes collenchyma. Sometimes specialized cells that secrete resin, latex, etc. In dicots, cortex is between epidermis and a ring of vascular tissue. (In monocots, they are intermixed.)
Slides (under stems): dicot stem, monocot stem, collapsible cortex

Vascular tissues (More on these later):
Xylem conducts water and minerals. Dead. Flow is from roots to leaves.
Phloem distributes sugars and minerals. Alive. Flow can be either up or down.

Pith:
Parenchyma located in center of most shoots and some roots; surrounded by vascular bundles.

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TYPES OF XYLEM

XYLEM: Contains two types of conducting cells, both made of sclerenchyma.
Both can be called by the name "tracheary elements".

Tracheids evolved about 420 mya. In all vascular plants.
Vessel elements more recent (about 100 mya). Almost exclusively in angiosperms.
(Tracheids in angiosperms are restricted mostly to fine veins of leaves.)

Water moves through tracheids via pit-pairs. No secondary wall in those areas, but primary walls do exist, giving some friction to water passage. Tracheids ~ 1 mm long.

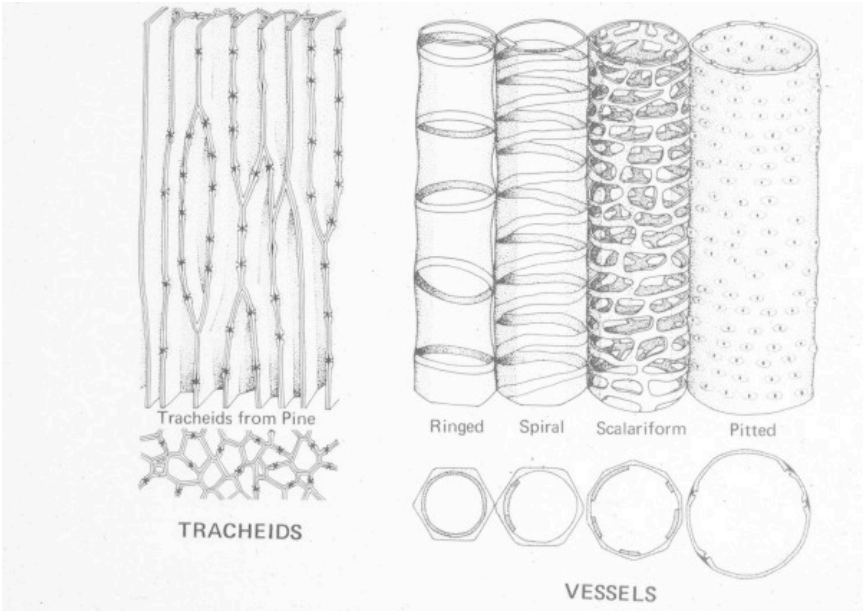
Vessels brand new invention! Like tracheids, individual cells produce both primary and secondary walls before dying. But then, a large hole is digested through the entire end wall of the element. Vessel elements are stacked on top of each other like a series of hollow tubes. (stack called vessel). Much less friction.

Each vessel element ~ 0.1 mm long, but vessels themselves 10 cm-3 m long!

Remember that tracheary elements have secondary walls laid down, that don't cover the entire primary wall. There are several patterns in which these thickenings are arranged:

- Annular thickenings: like rings around tube. Not very strong but allows lots of water to move through. Fine in wet environments. Water provides turgor.
- Helical thickening: Secondary wall spiral-like.
- Scalariform thickening: secondary wall covers most surface of primary wall. Stronger.
- Pitted secondary wall: Virtually all the primary wall is covered by the secondary wall.
- Very strong. Water leaves and enters cell slowly. Better in dry conditions.

This picture shows how tracheids are long and thin compared to vessel elements. The various types of secondary thickening can occur in either type of element.



Slides (look under xylem): annular walls, perf plate face, scalariform walls, CBP pine, CBP dicot, CBP pine xs.