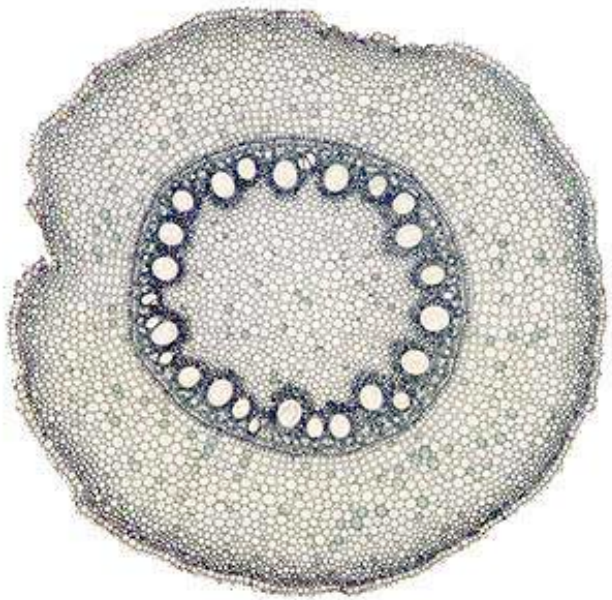
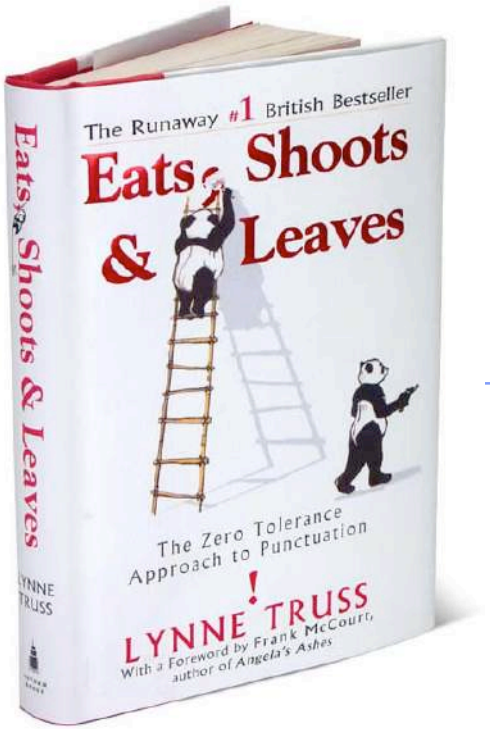


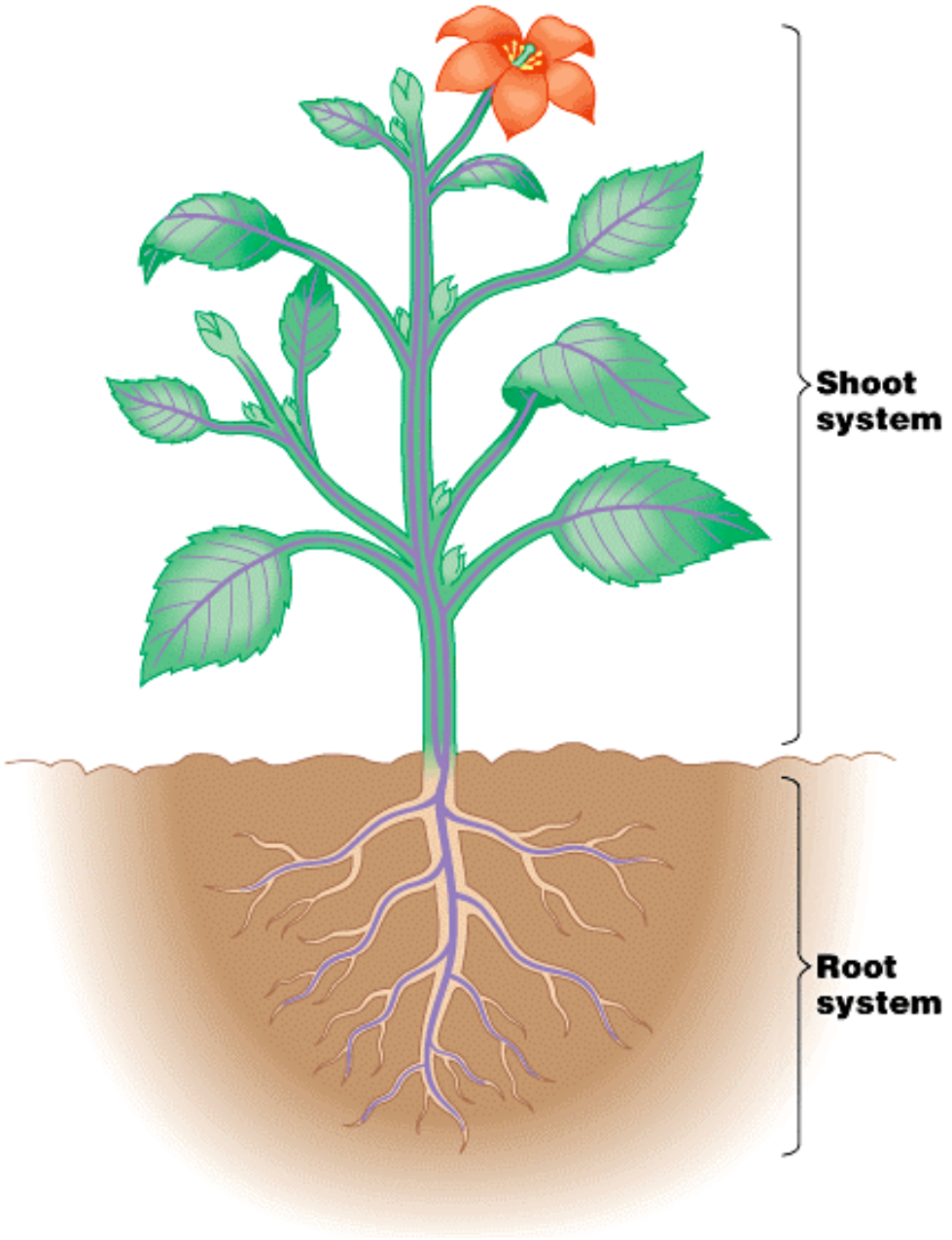
# Chapter 35.

## Plant Anatomy



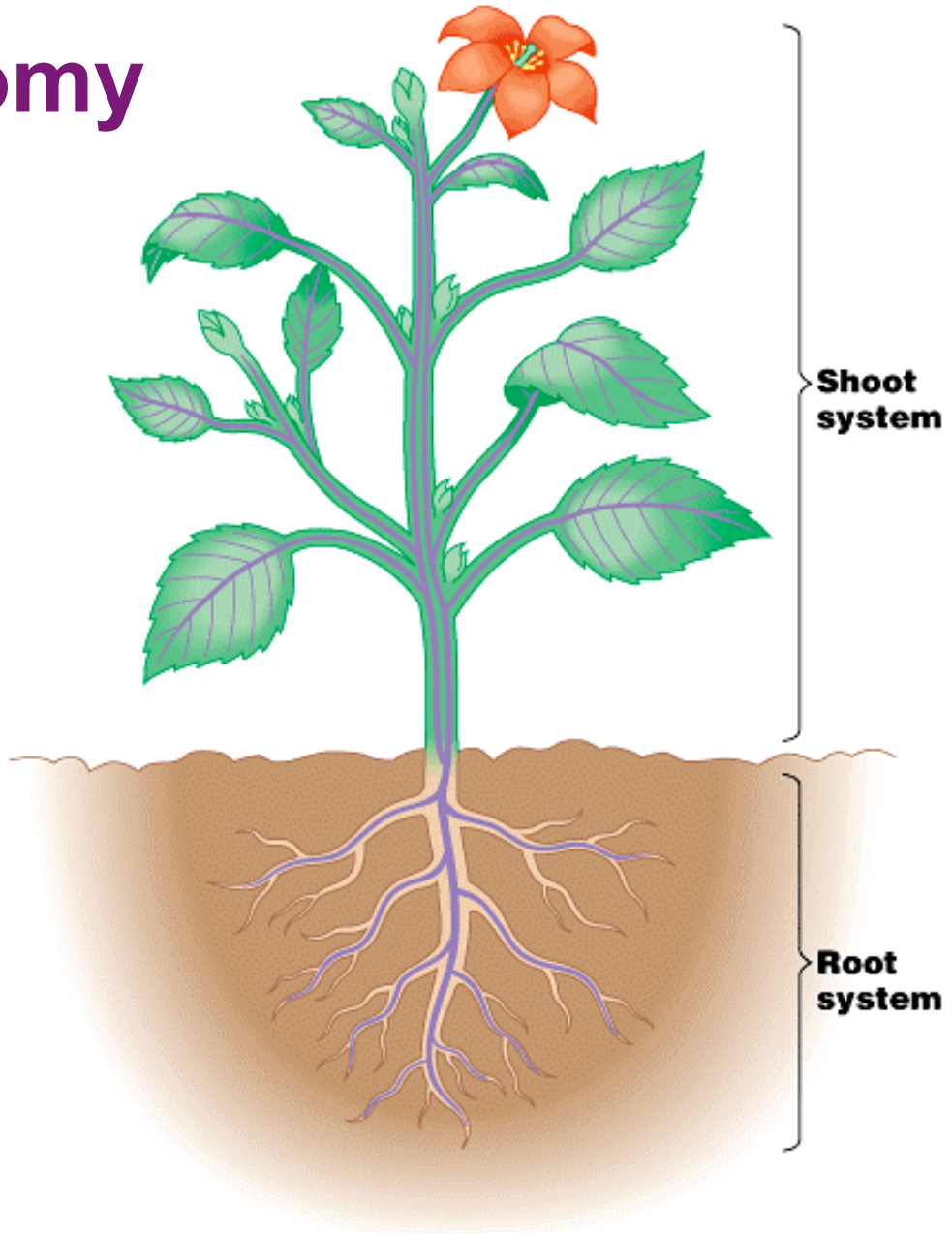

# Basic anatomy

- root
- shoot (stem)
- leaves



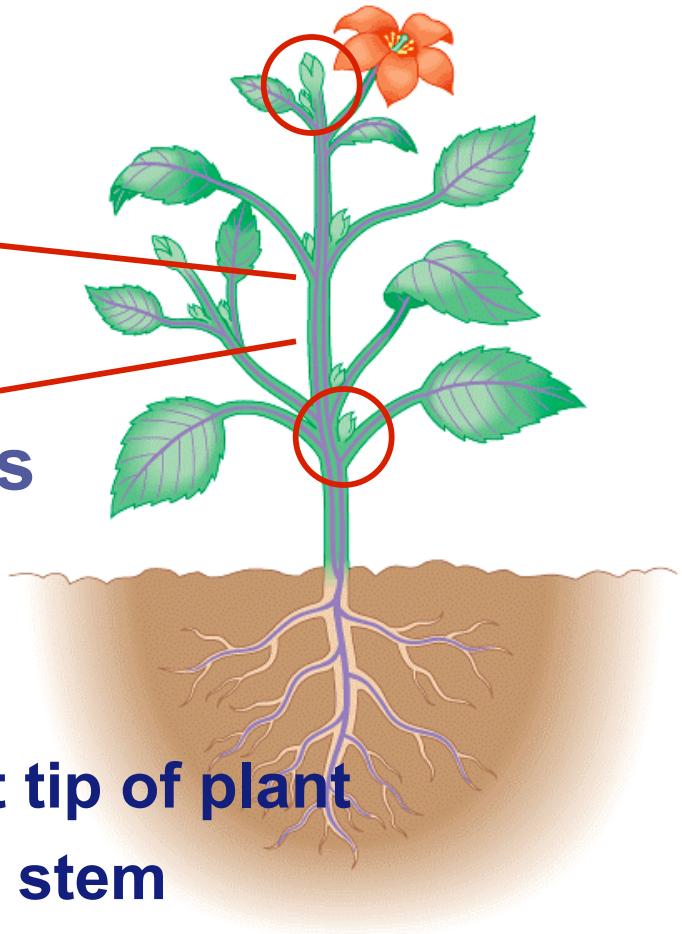
# Expanded anatomy

- root
  - root tip
  - root hairs
- shoot (stem)
  - nodes
  - internodes
  - apical buds
  - axillary buds
  - flowers
- leaves
  - veins



# Shoots

- Shoots consist of stems, leaves & buds
- Stems
  - nodes = points at which leaves are attached
  - internodes = stem segments between nodes
- Buds
  - growth of shoot
    - terminal or apical bud = at tip of plant
    - axillary bud = in nodes on stem



# Modified shoots

stolons (strawberries)

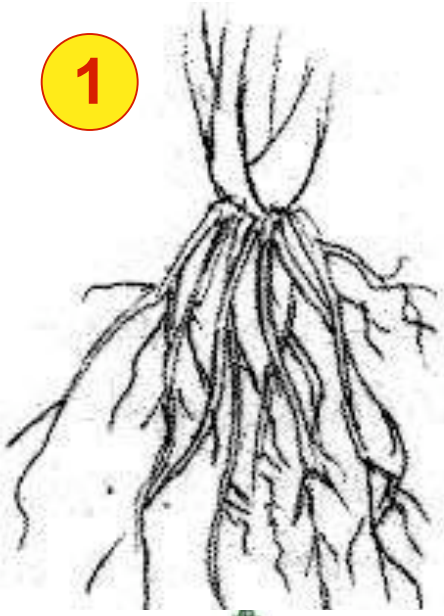
rhizome (ginger)

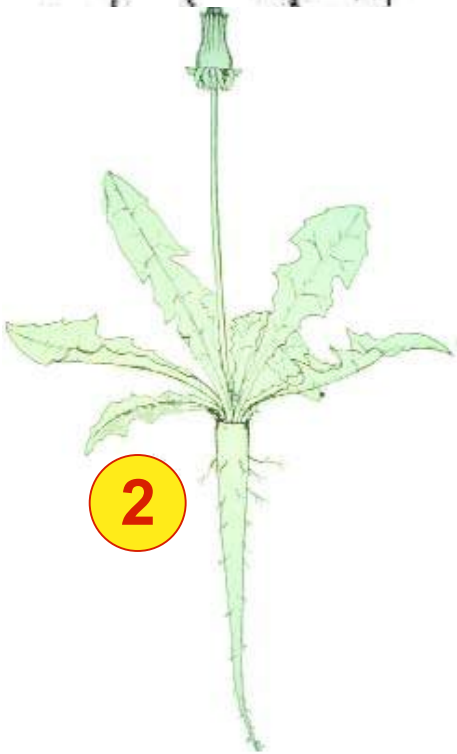
tuber (potato)

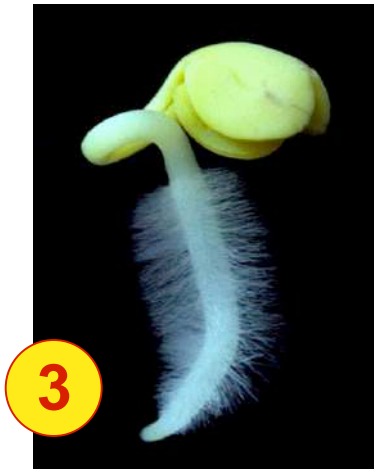
bulb (onion)

# Roots

- Roots anchor plant in soil, absorb minerals & water, & store food
  - fibrous roots (1)
    - mat of thin roots that spread out
    - monocots
  - tap roots (2)
    - 1 large vertical root
    - also produces many small lateral, or branch roots
    - dicots
  - root hairs (3)
    - increase absorptive surface area

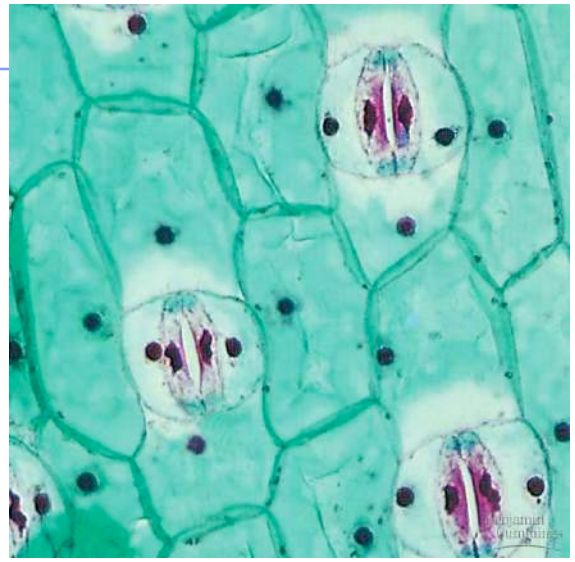


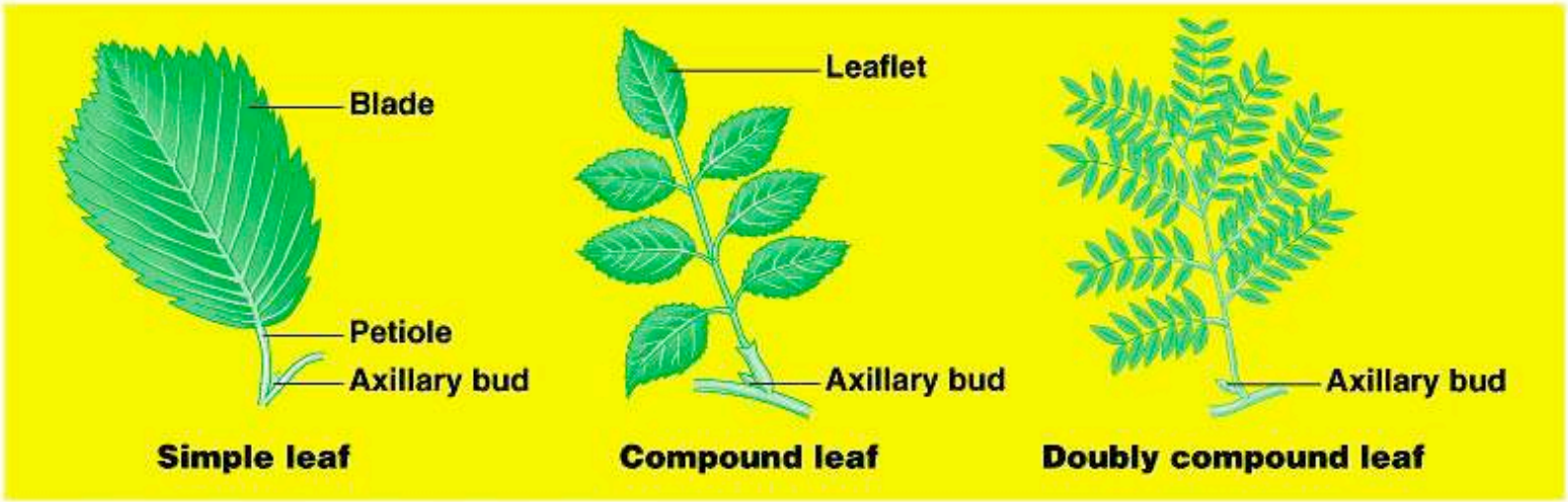



# Leaves

- Function of leaves?
  - photosynthesis
    - energy production
    - CHO production
  - gas exchange
  - transpiration



simple vs. compound



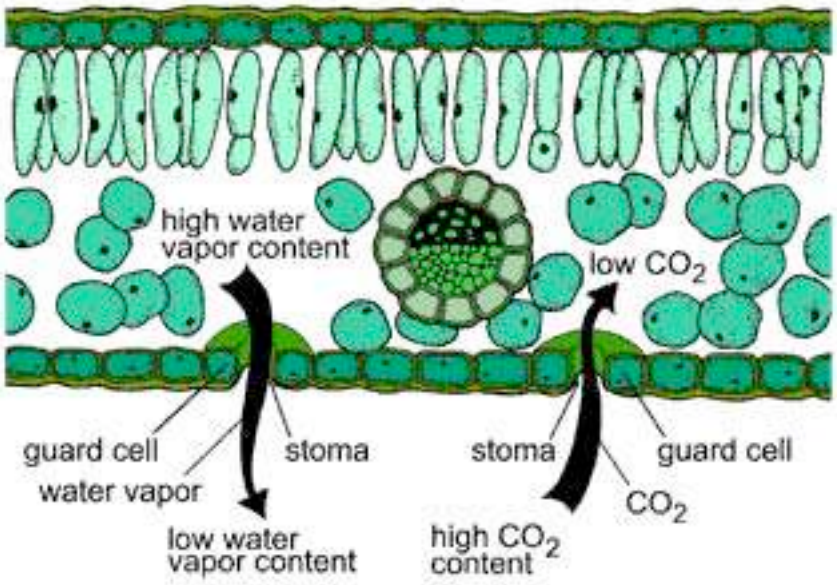
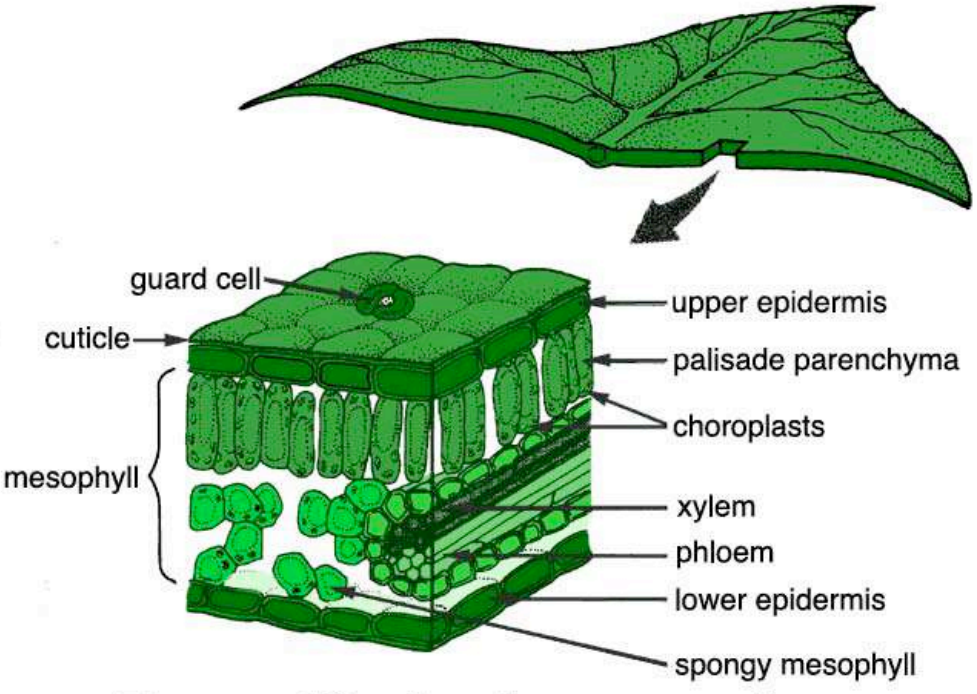
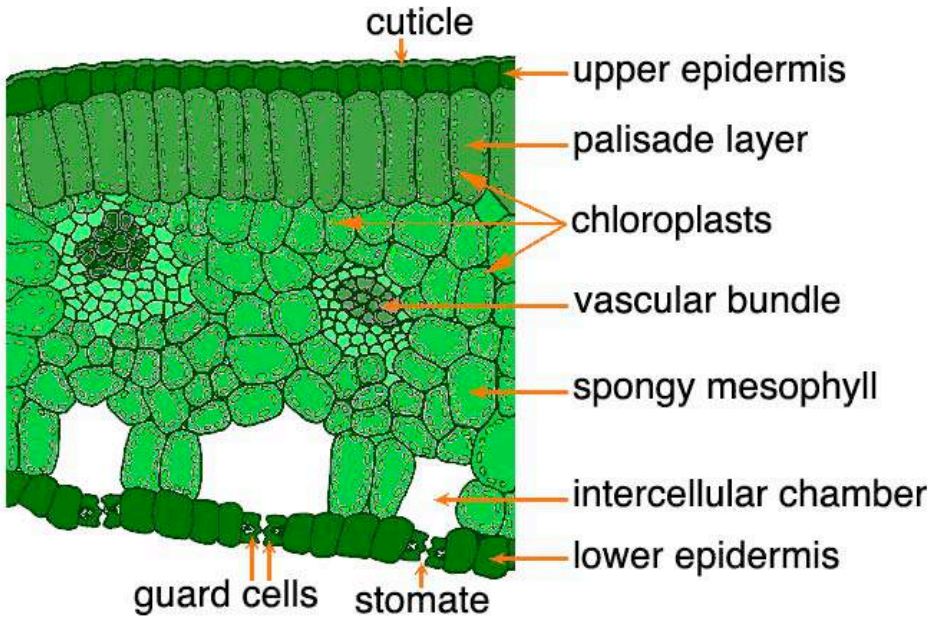


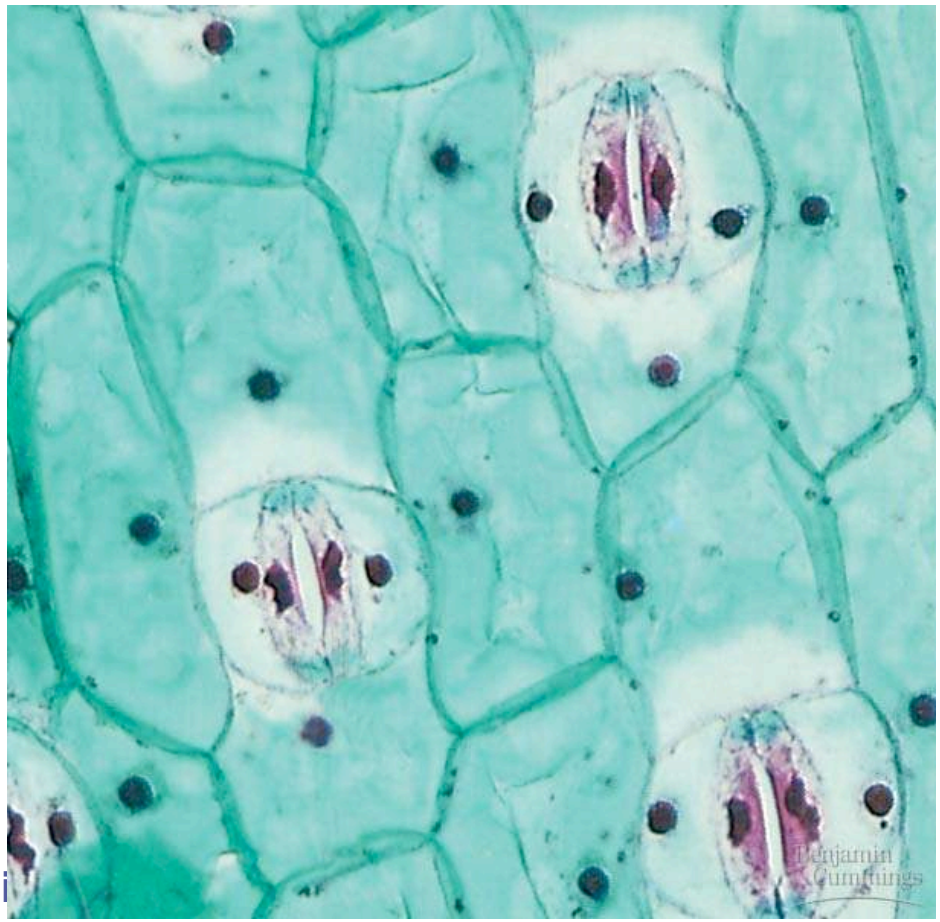

**Figure 25.** Stomata open to allow carbon dioxide ($CO_2$) to enter a leaf and water vapor to leave.

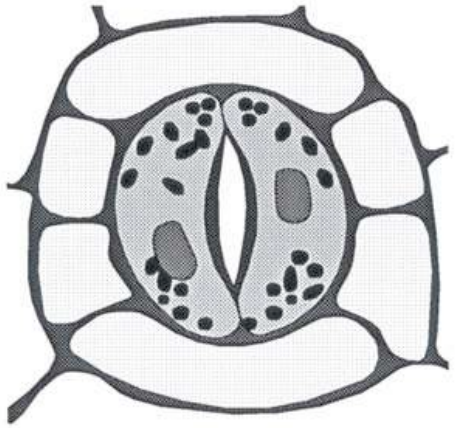


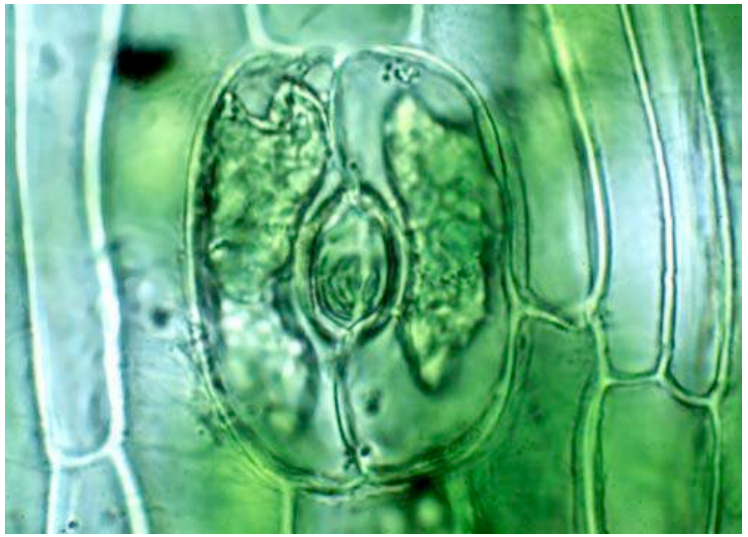



# Stomates

## Function of stomates?

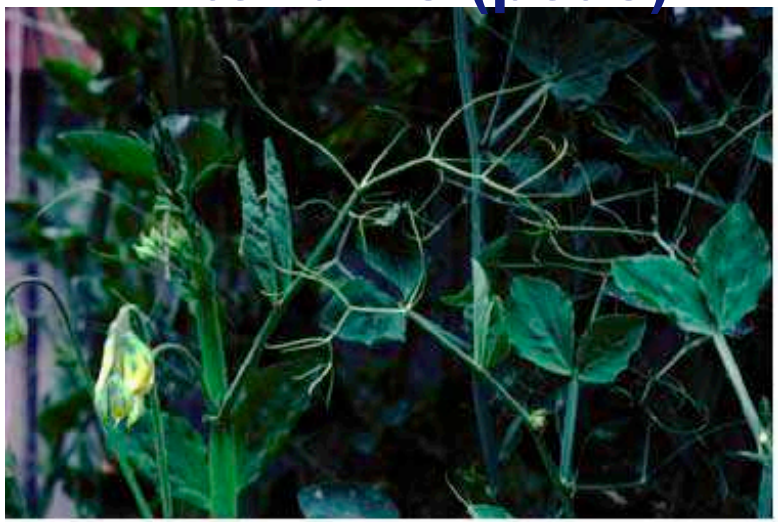






# Modified leaves

tendrils (peas)



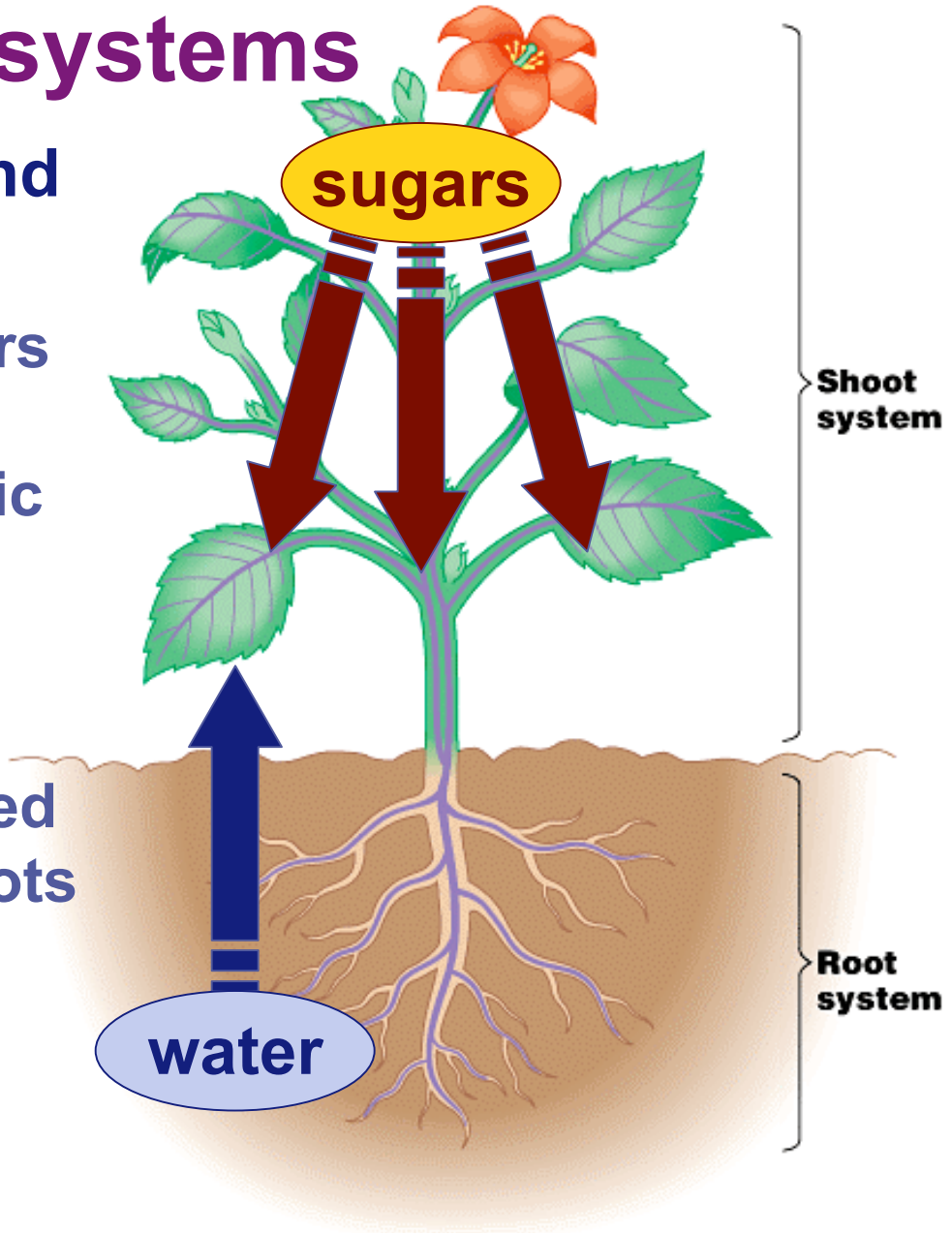
spines (cacti)

succulent leaves

colored leaves (poinsetta)

# Interdependent systems

- **Both systems depend on the other**
  - roots receive sugars & other nutrients from photosynthetic parts
  - shoot system depends on water & minerals absorbed from the soil by roots



# Putting it all together

- Obtaining raw materials
  - sunlight
    - leaves = solar collectors
  - $CO_2$
    - stomates = gas exchange
  - $H_2O$
    - uptake from roots
  - nutrients
    - uptake from roots

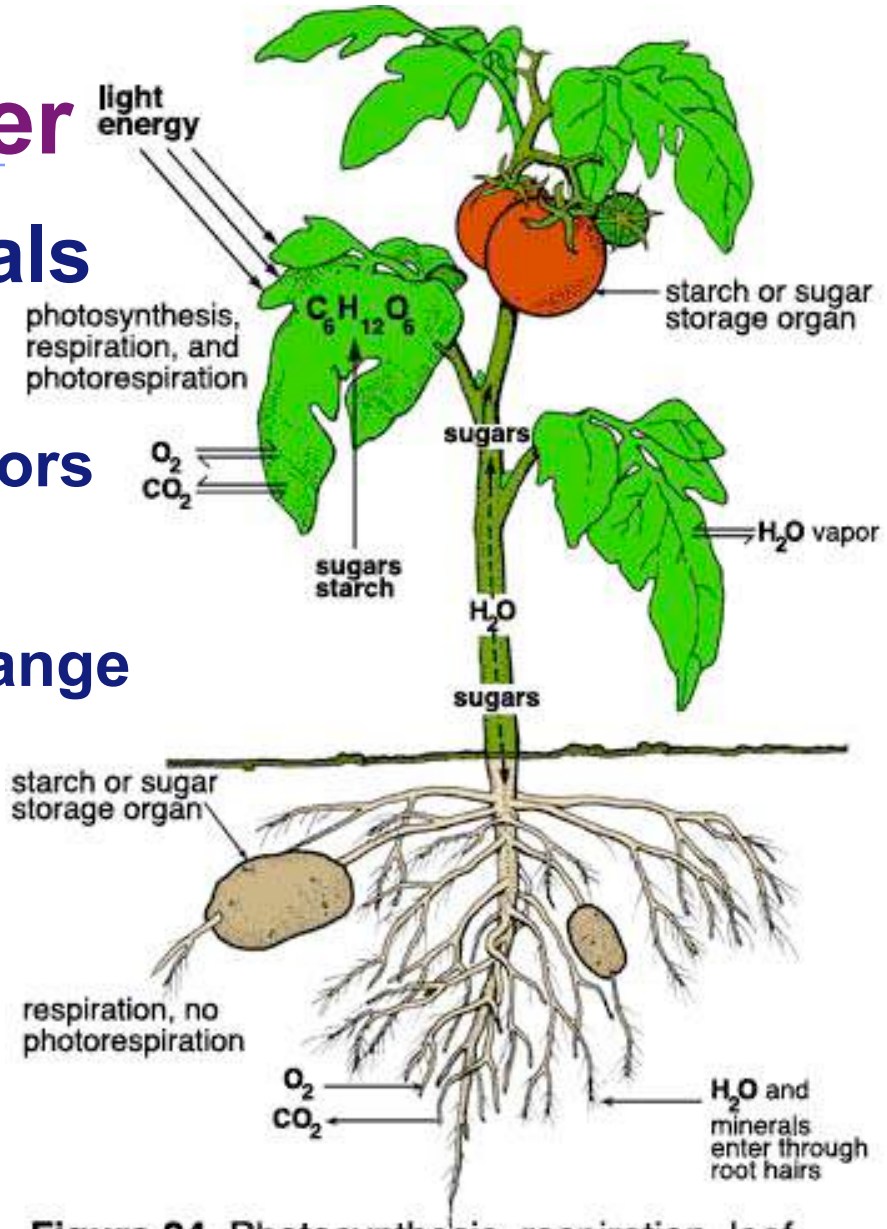
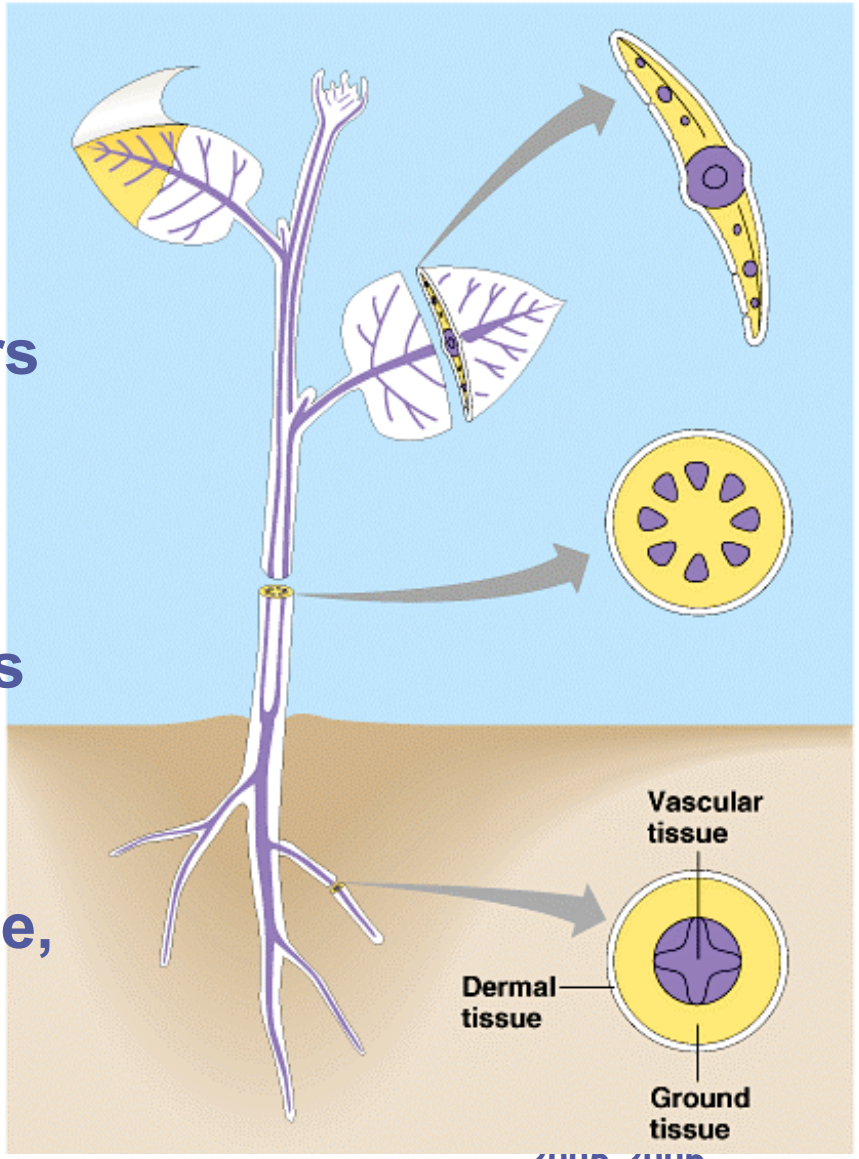


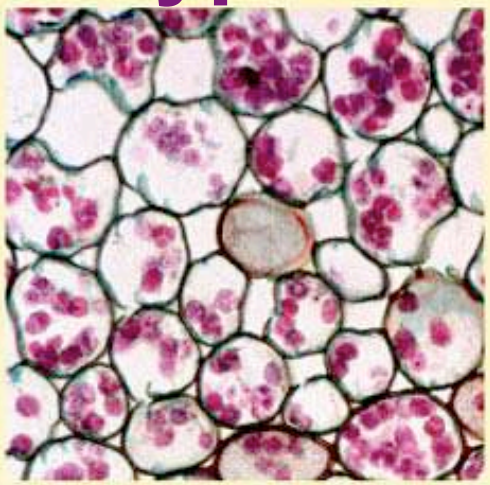

**Figure 24.** Photosynthesis, respiration, leaf water exchange, and translocation of sugar (photosynthate) in a plant.

# Plant tissues

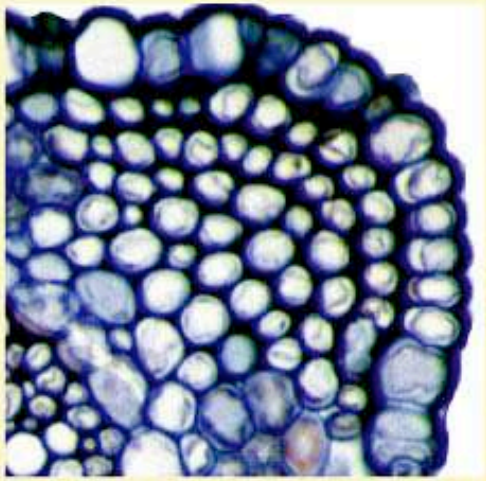
- **Dermal**
  - "skin" of plant
  - single layer of tightly packed cells that covers & protects plant
- **Vascular**
  - transport materials between roots & shoots
  - xylem & phloem
- **Ground**
  - everything else: storage, photosynthetic
  - bulk of plant tissue



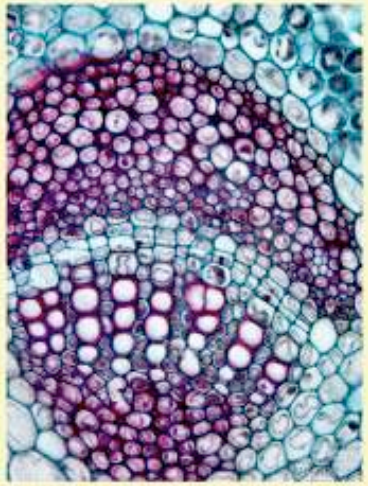
# Plant cell types in tissues



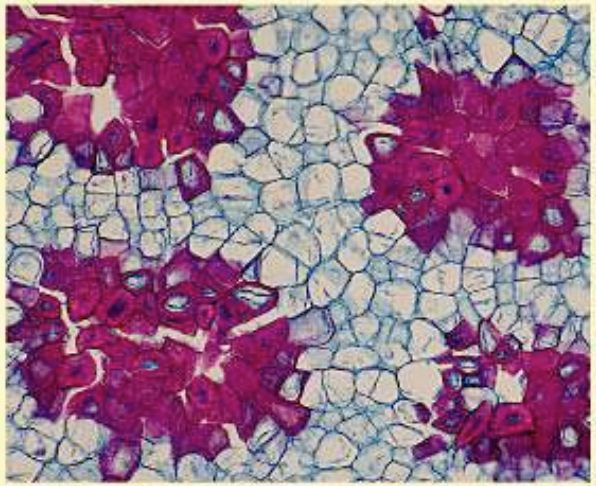
(a) Parenchyma cells



(b) Collenchyma cells



(c) Sclerenchyma cells: Fiber cells



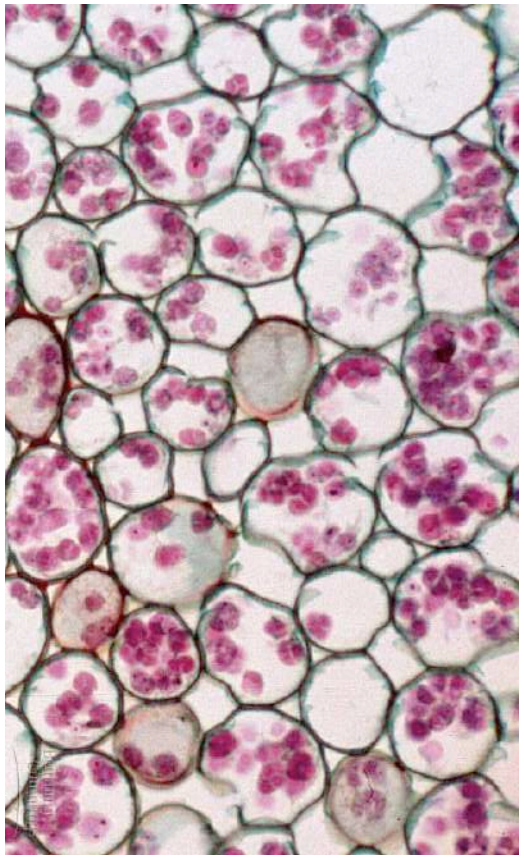

Sclerenchyma cells: Sclereids

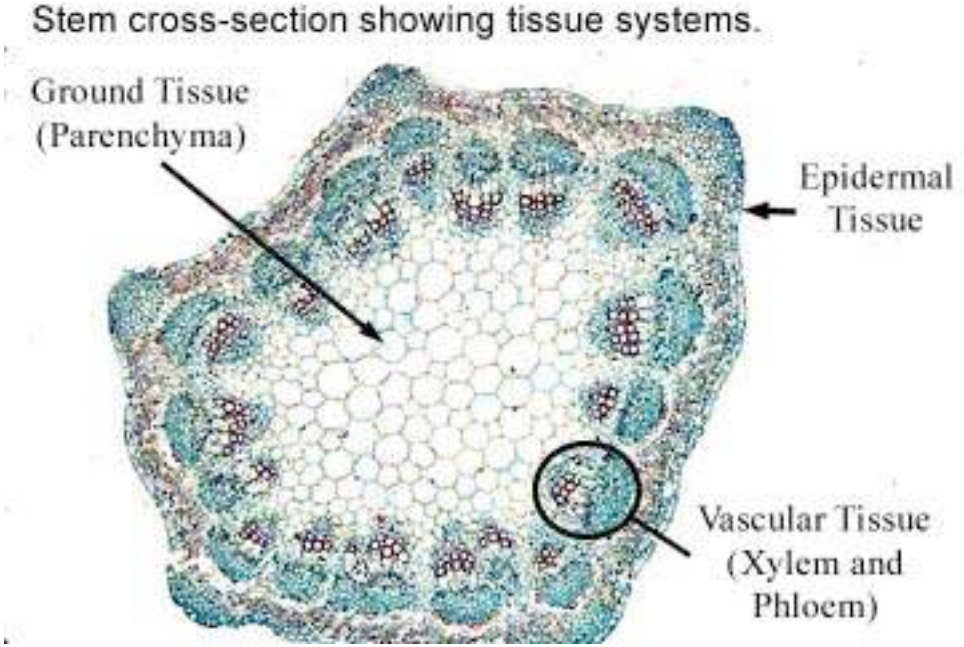
# Plant cell types in tissues


- **Parenchyma**
  - "typical" plant cells = least specialized
  - photosynthetic cells, storage cells
  - tissue of leaves, stem, fruit, storage roots
- **Collenchyma**
  - unevenly thickened primary walls = support
- **Sclerenchyma**
  - very thick, "woody" secondary walls = support
  - rigid cells that can't elongate
  - dead at functional maturity

# Parenchyma

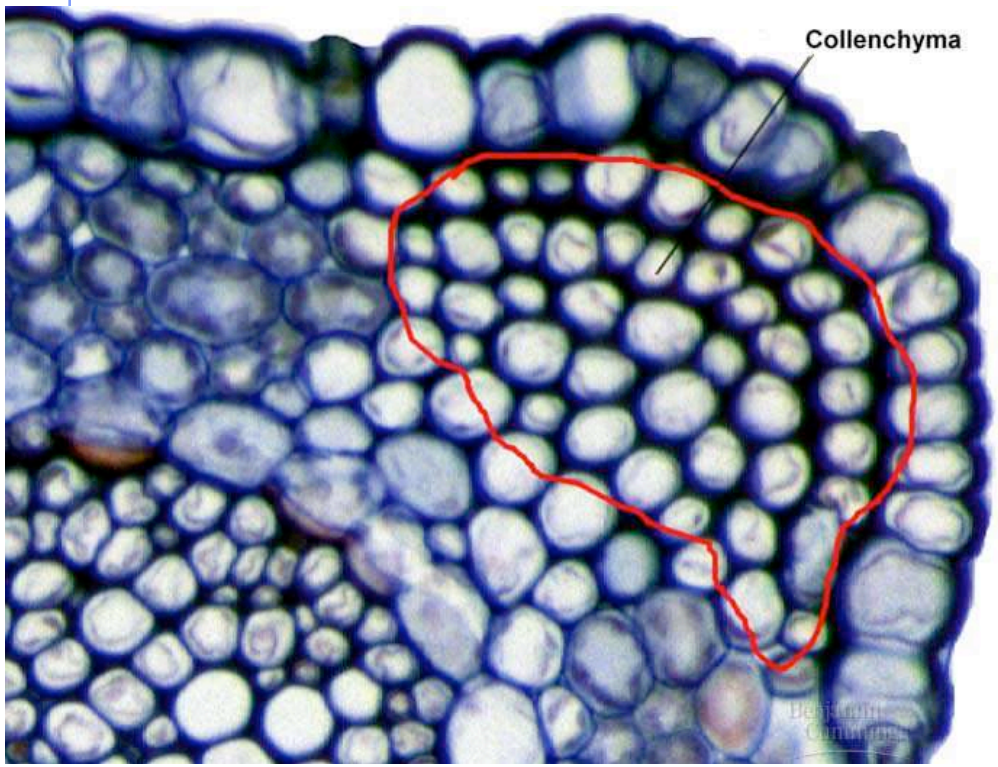
- **Parenchyma cells are relatively unspecialized, thin, flexible & carry out many metabolic functions**
  - **all types of cells develop from parenchyma**

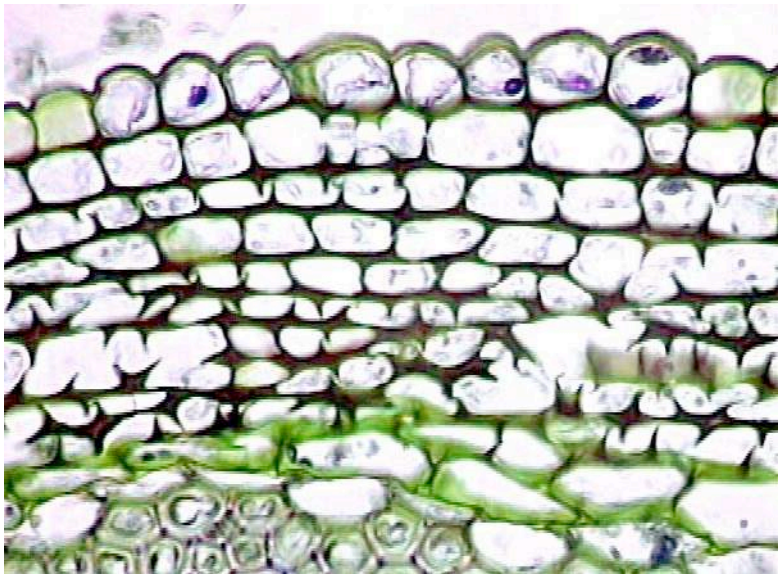




# Collenchyma

- Collenchyma cells have thicker primary walls & provide support
  - help support without restraining growth
  - remain alive in maturity



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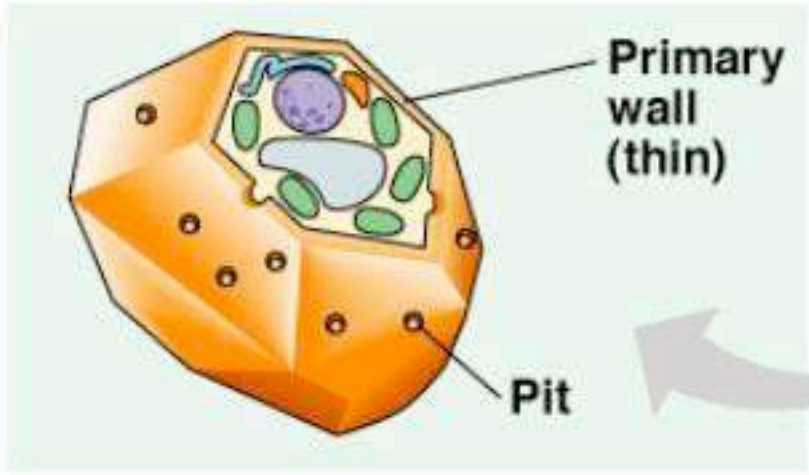
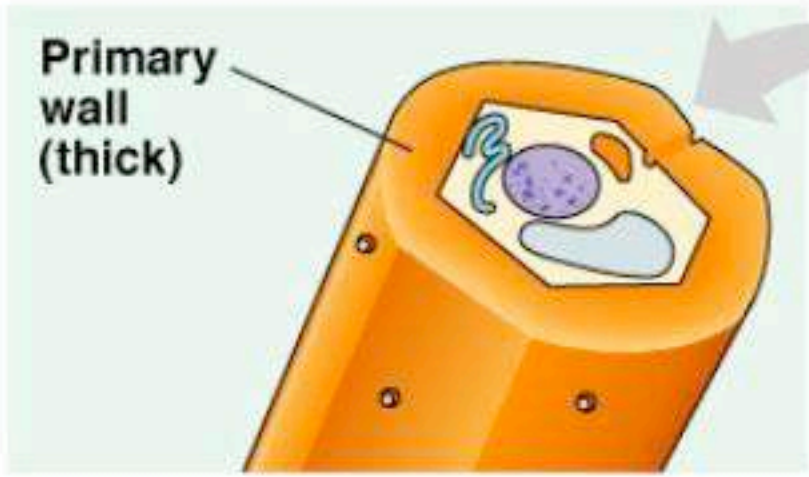
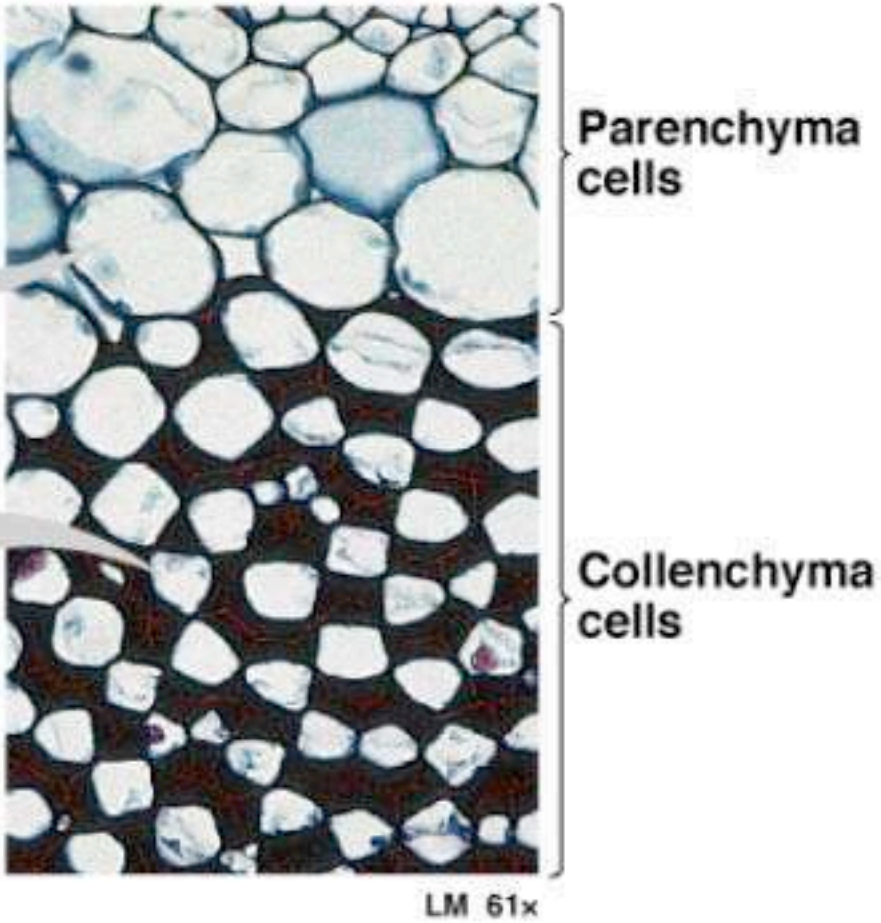


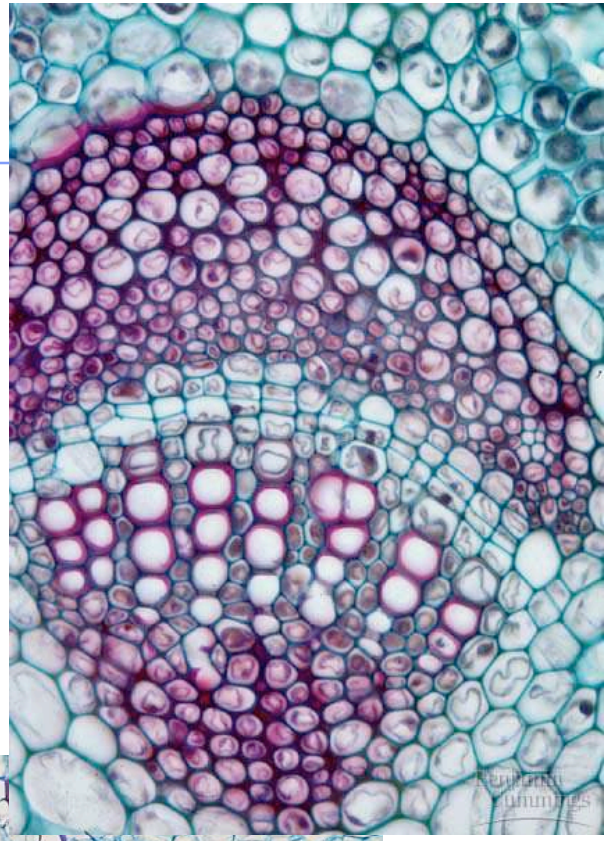



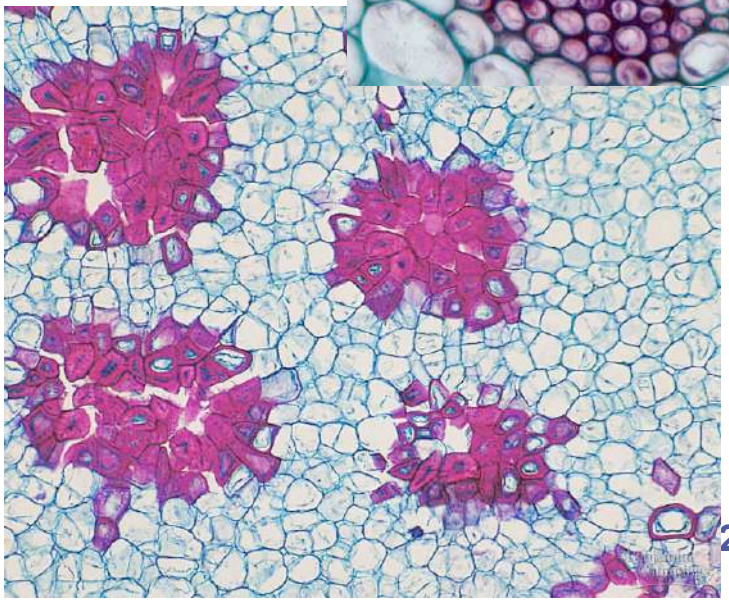




**the strings in celery stalks are collenchyma**

# Sclerenchyma

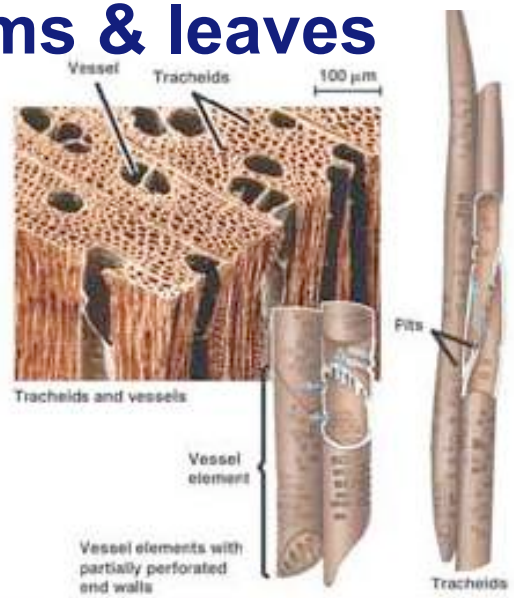
- Thick, rigid cell wall
  - lignin (wood)
  - cannot elongate
  - mostly dead at maturity
- Support cells
  - xylem vessels
  - tracheids
  - fibers
    - rope fibers
  - sclereids
    - nutshells
    - seed coats
    - grittiness in pears

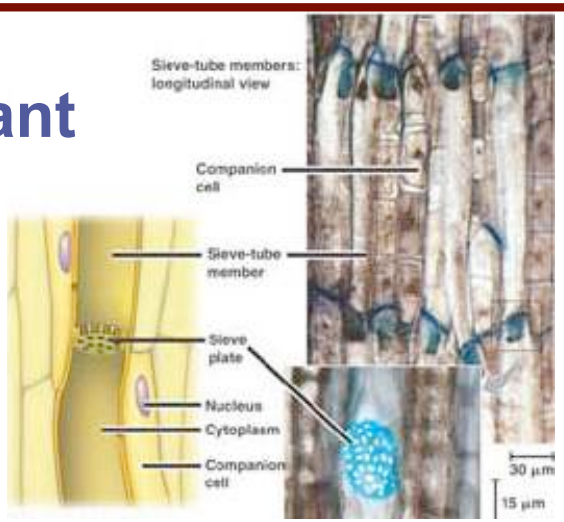




# Vascular tissue

- Transports materials in roots, stems & leaves
- Xylem
  - carry water & minerals up from roots
  - tube-shaped dead cells
    - only their walls provide a system of microscopic water pipes
- Phloem
  - carry nutrients throughout plant
    - sugars (sucrose), amino acids…
  - tube-shaped living cells



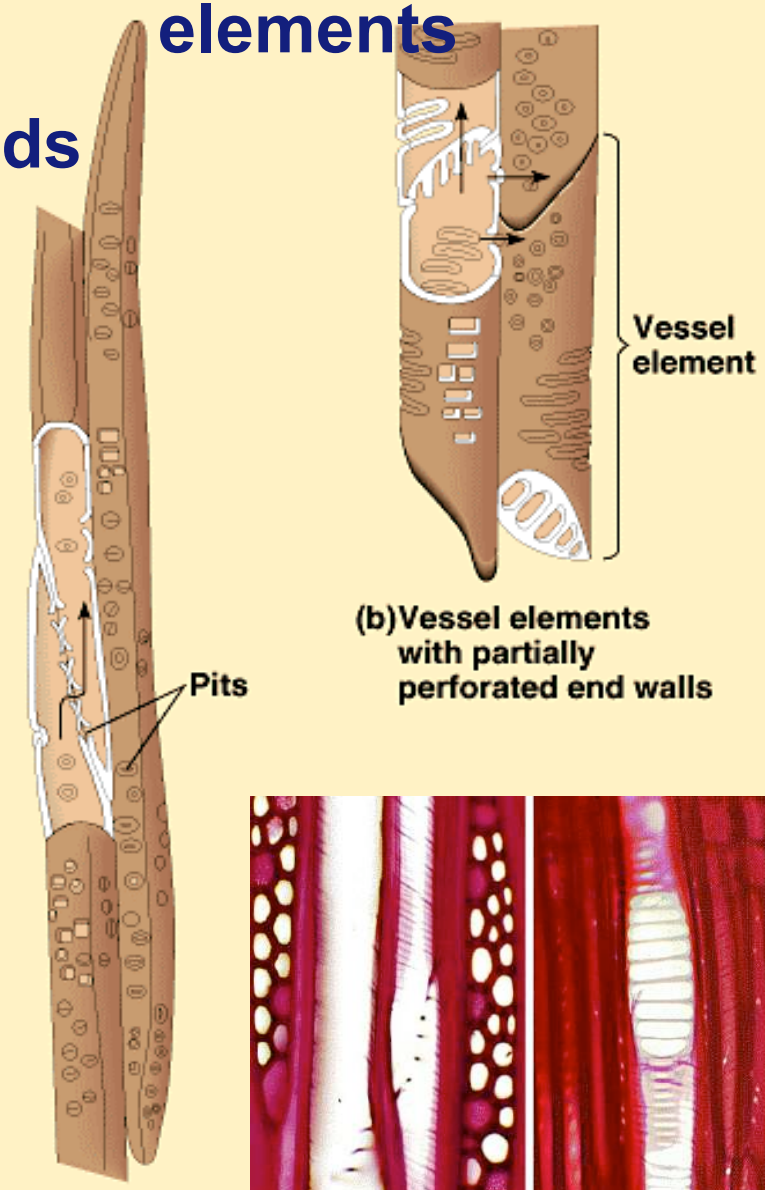
# Xylem

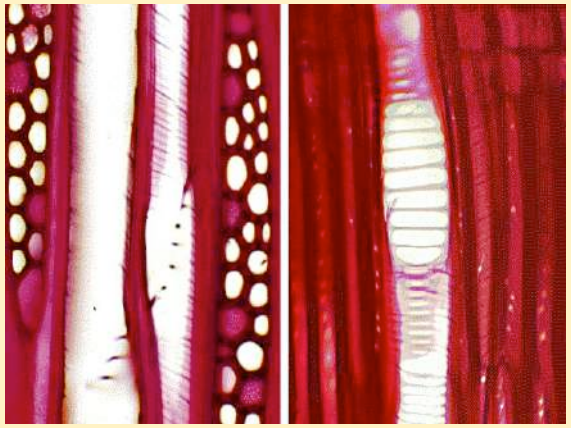
**dead cells →**

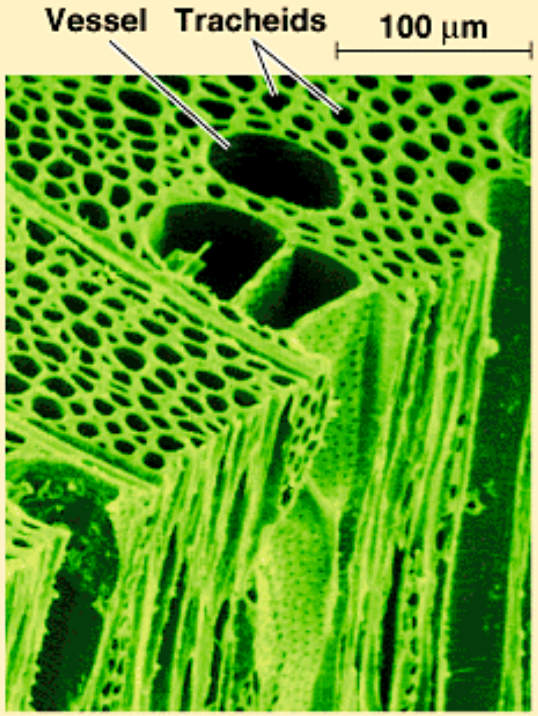
**water-conducting cells of xylem**

**vessel elements**

**tracheids**

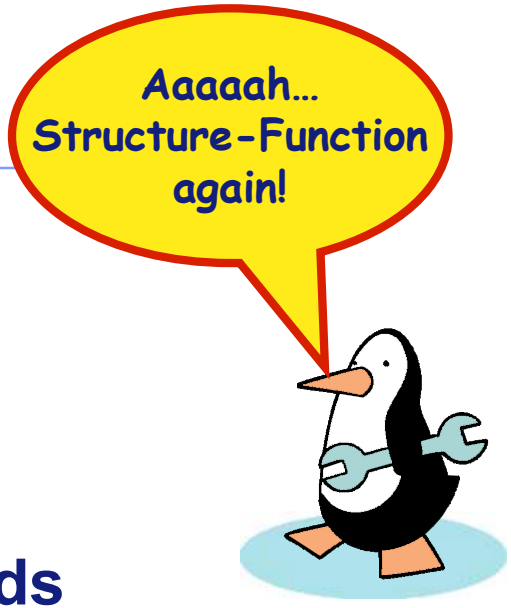





(c)Tracheids and vessels (colorized SEM)

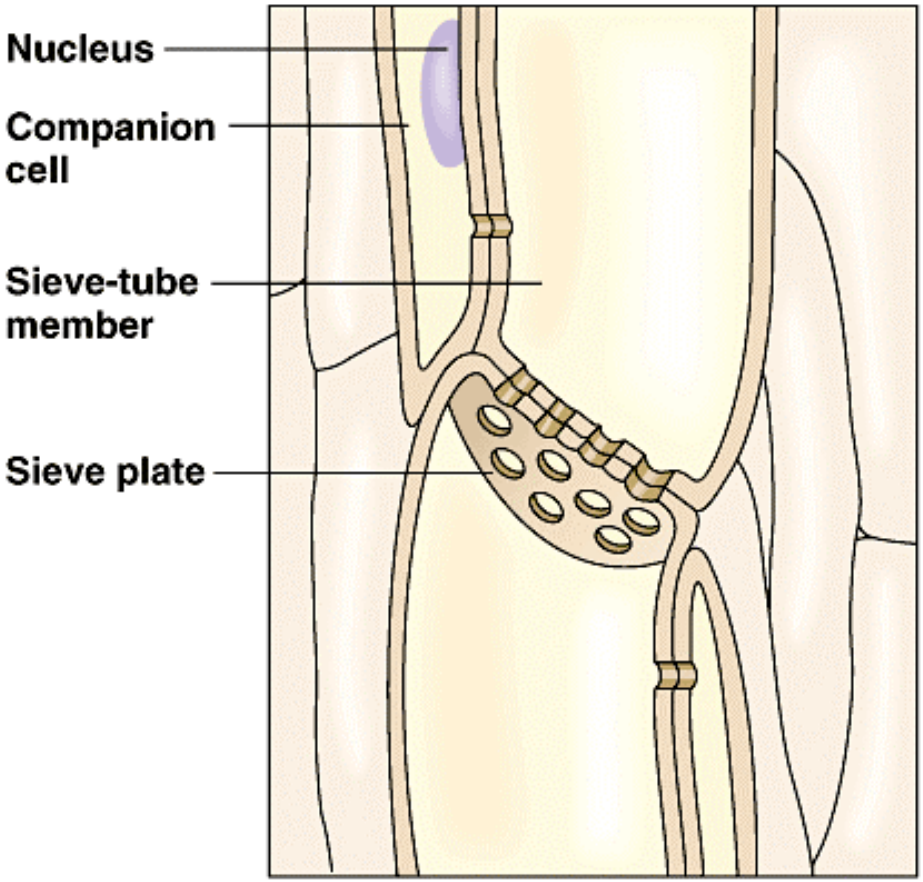
# Xylem



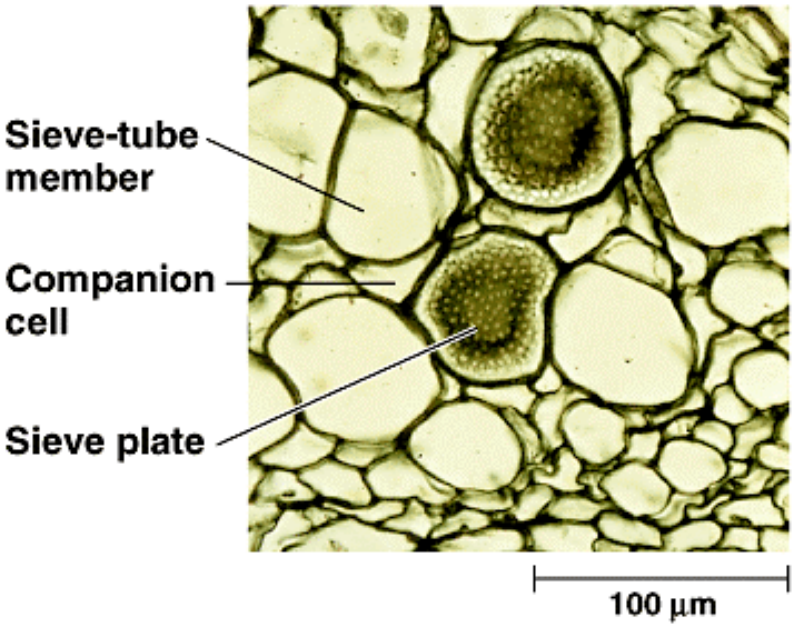

- Dead at functional maturity
- Cell elongated into tubes
  - tracheids
    - long, thin cells with tapered ends
    - walls reinforced with lignin = support
    - thinner pits in end walls allows water flow
  - vessel elements
    - wider, shorter, thinner walled & less tapered
    - perforated ends walls allows free water flow

# Phloem: food-conducting cells

- sieve tube elements & companion cells



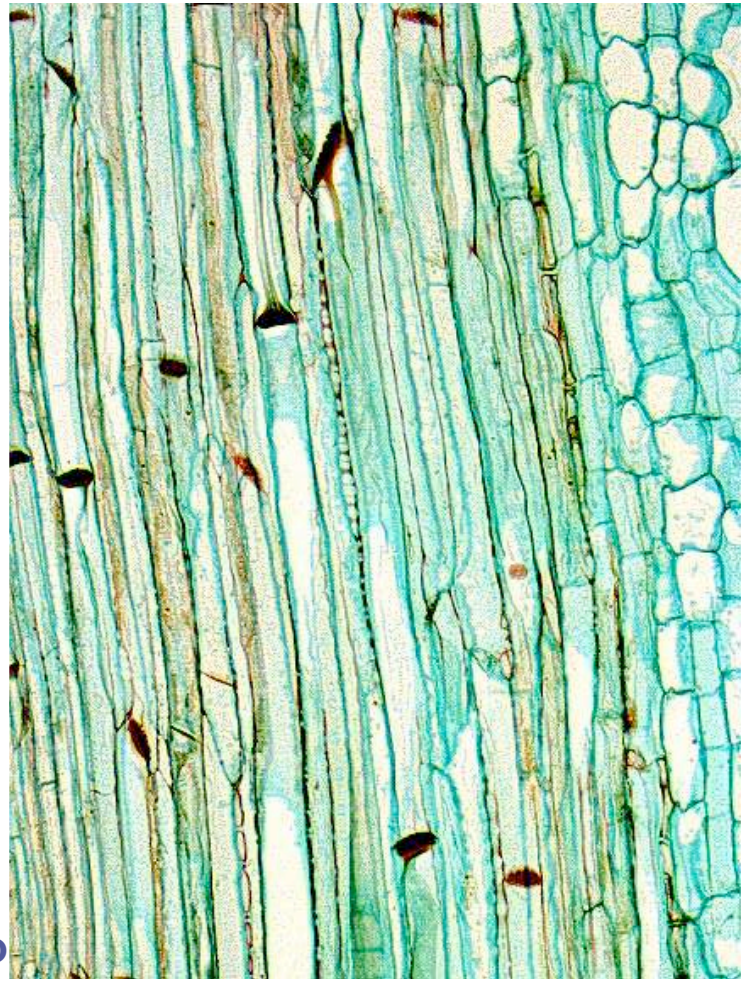

(a) Longitudinal view

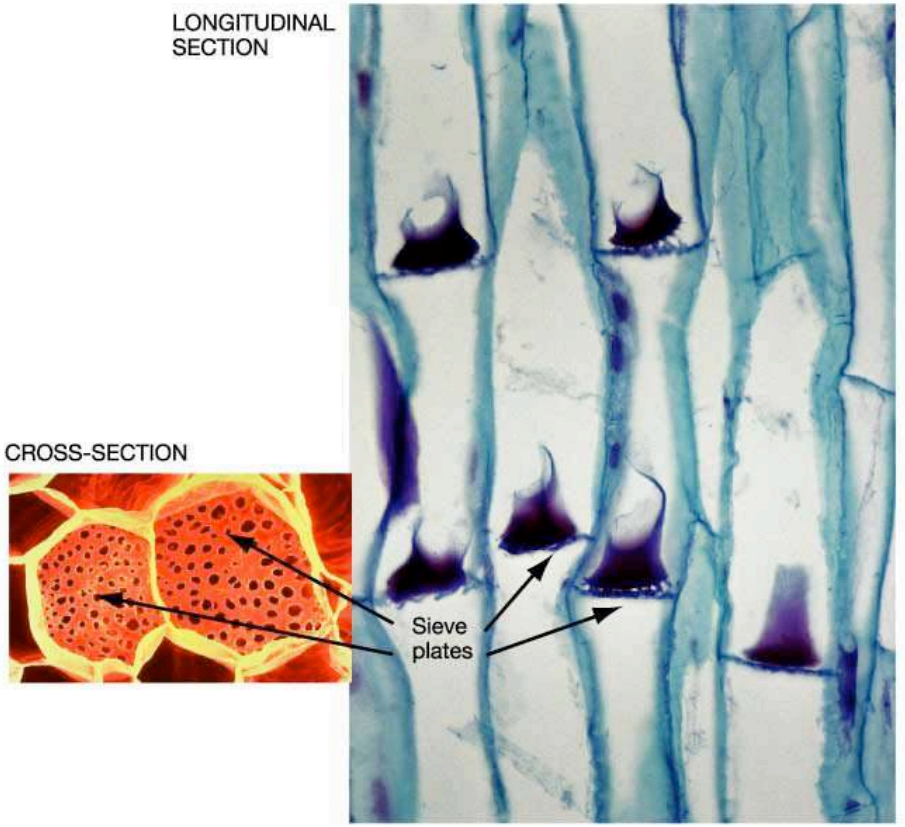



(b) Transverse section (LM)

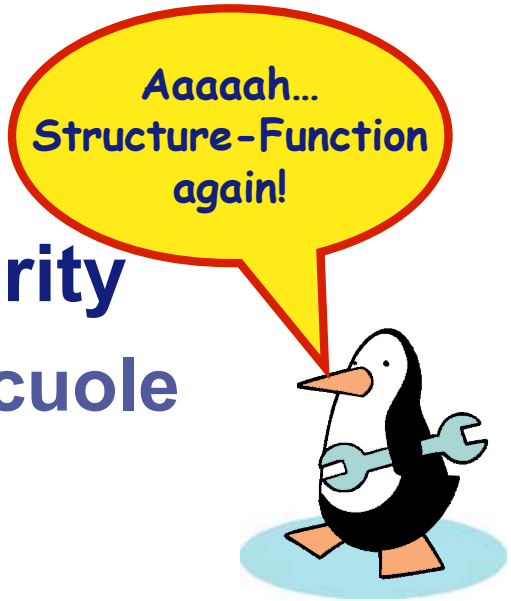
# Phloem: food-conducting cells

- sieve tube elements & companion cells



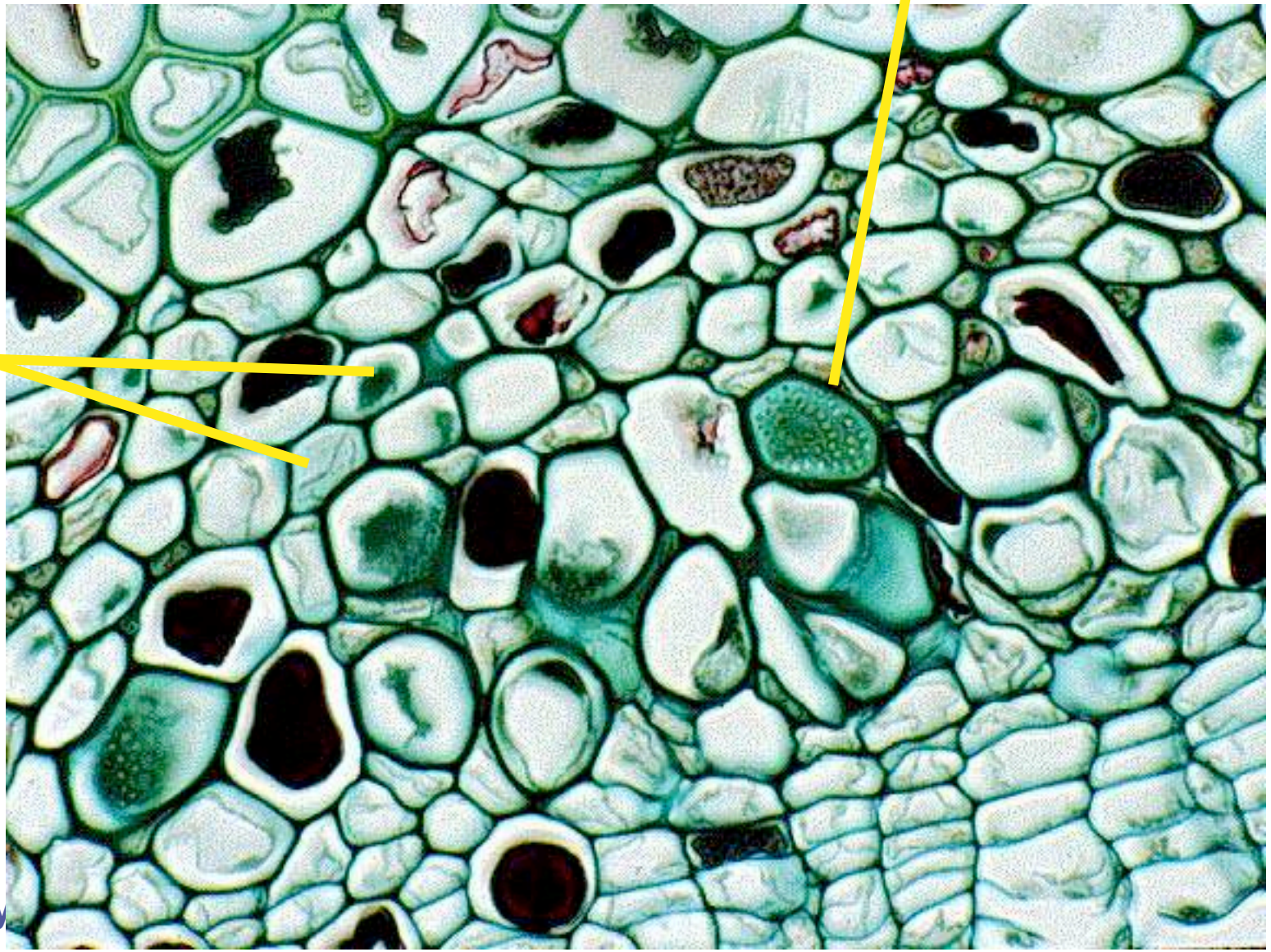


# Phloem




- Living cells at functional maturity
  - lack nucleus, ribosomes & vacuole
    - more room: specialized for liquid food (sucrose) transport
- Cells
  - sieve tubes
    - end walls, sieve plates, have pores to facilitate flow of fluid between cells
  - companion cells
    - nucleated cells connected to the sieve-tube
    - help sieve tubes

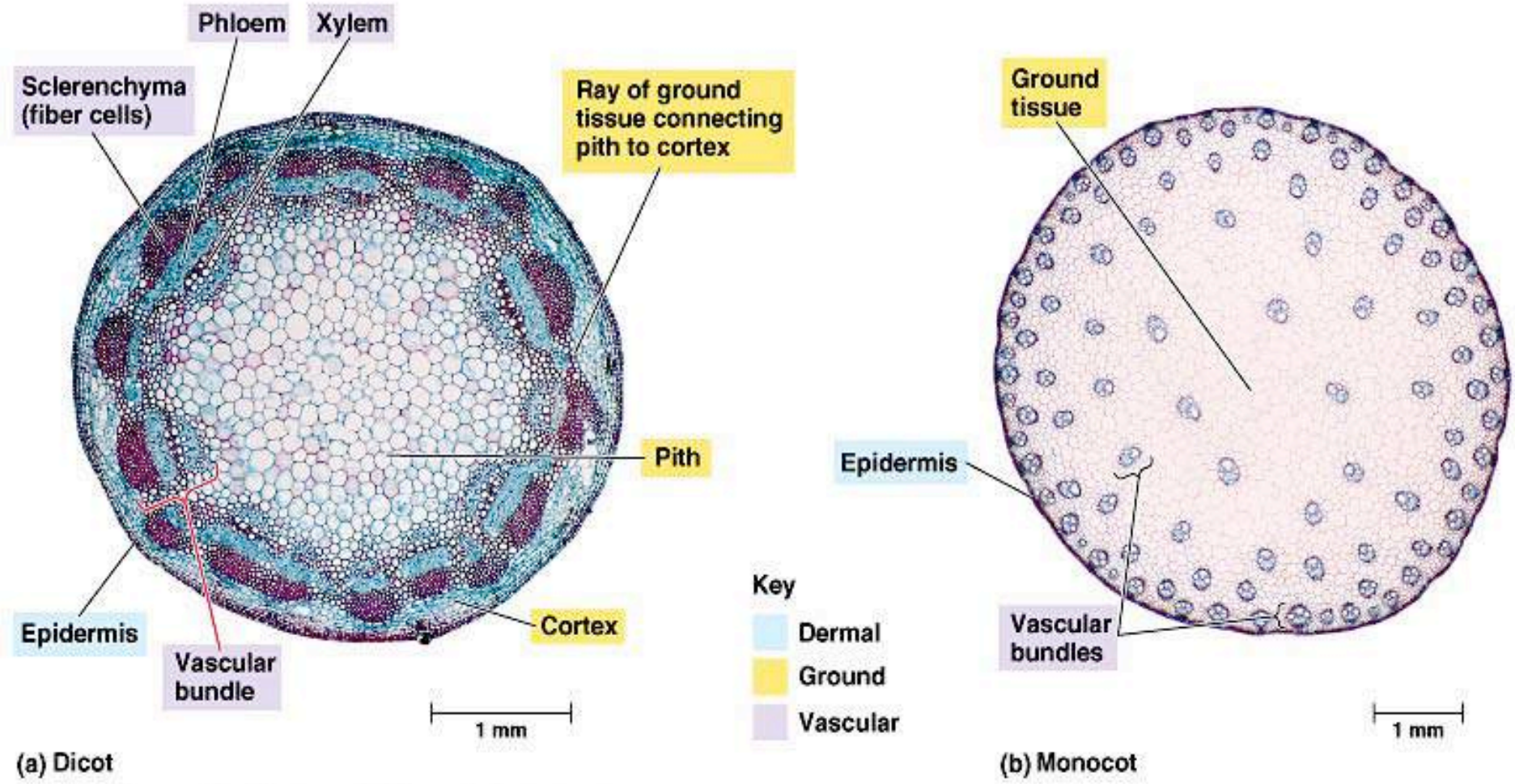
# Phloem



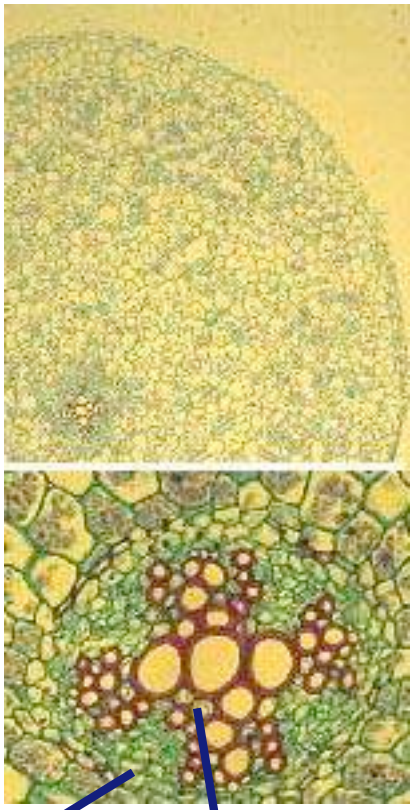
# Vascular tissue in herbaceous stems

## dicot
### trees & shrubs

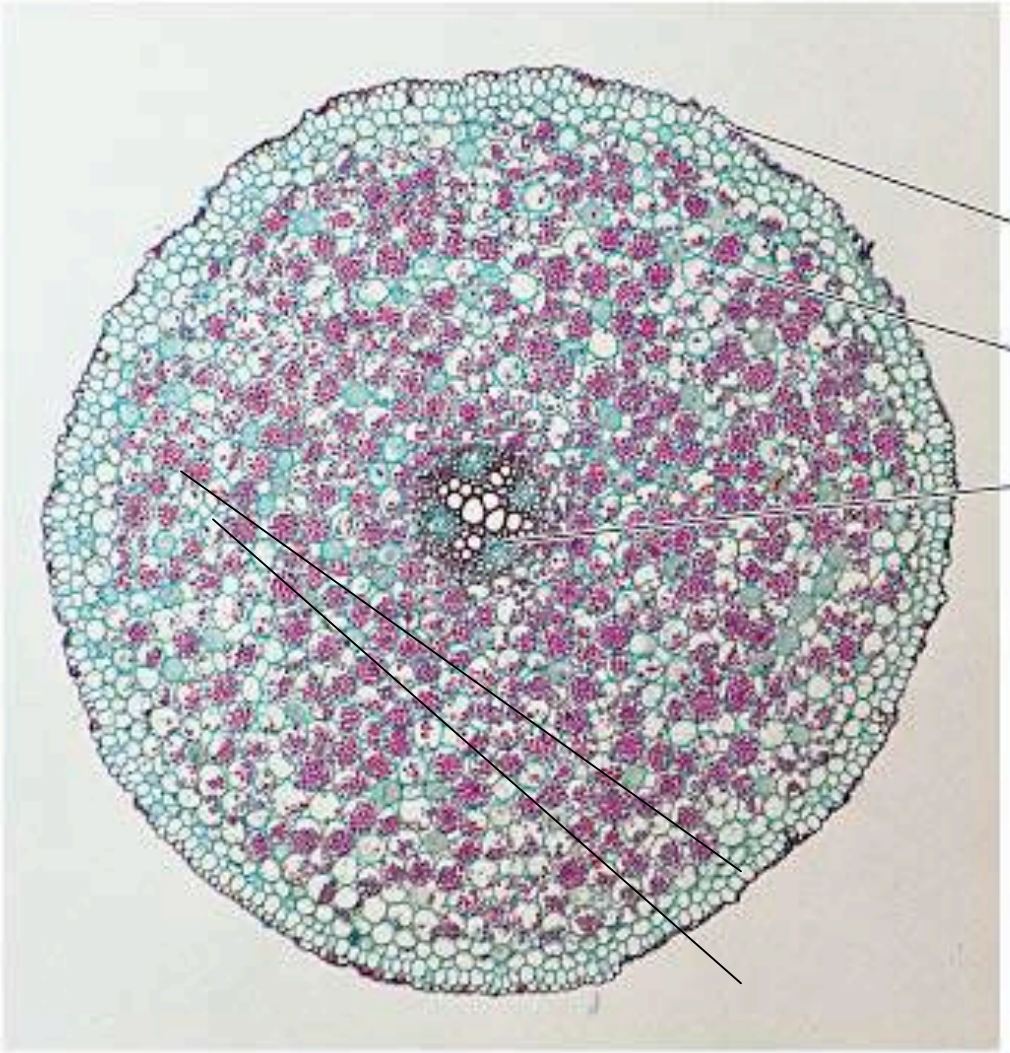
## monocot
### grasses & lilies



# Root structure: dicot

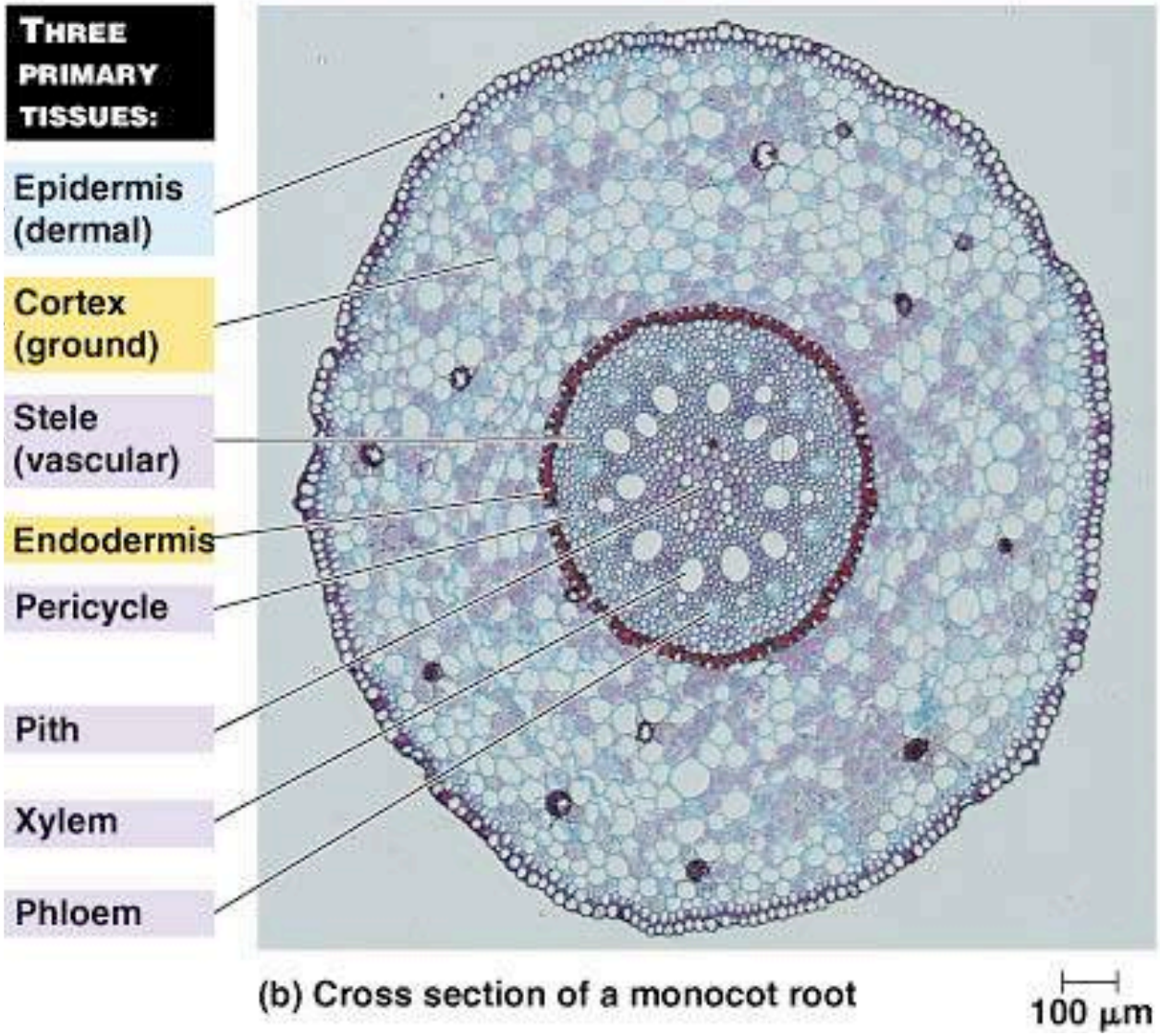


phloem xylem




(a) Cross section of a dicot root

# Root structure: monocot




(b) Cross section of a monocot root

# Any Questions??