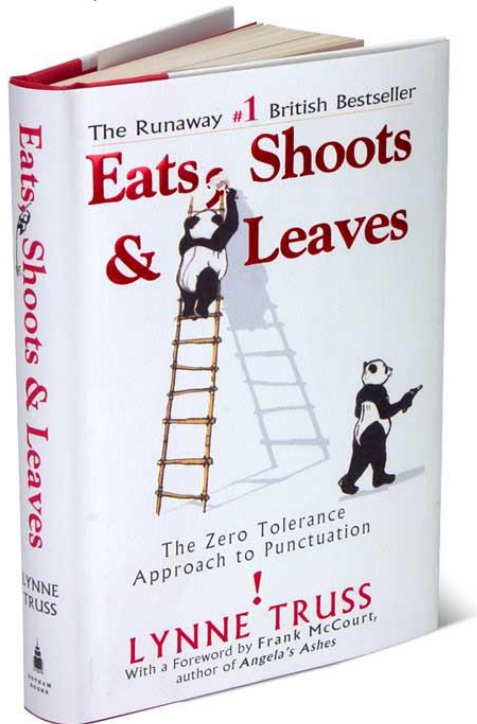
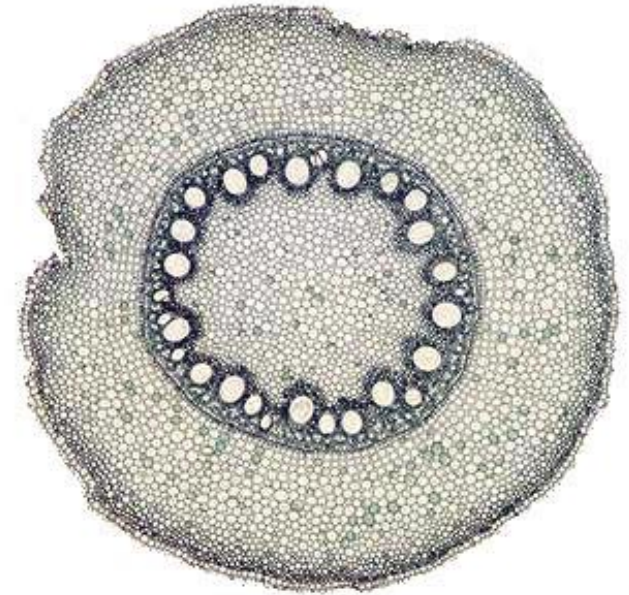
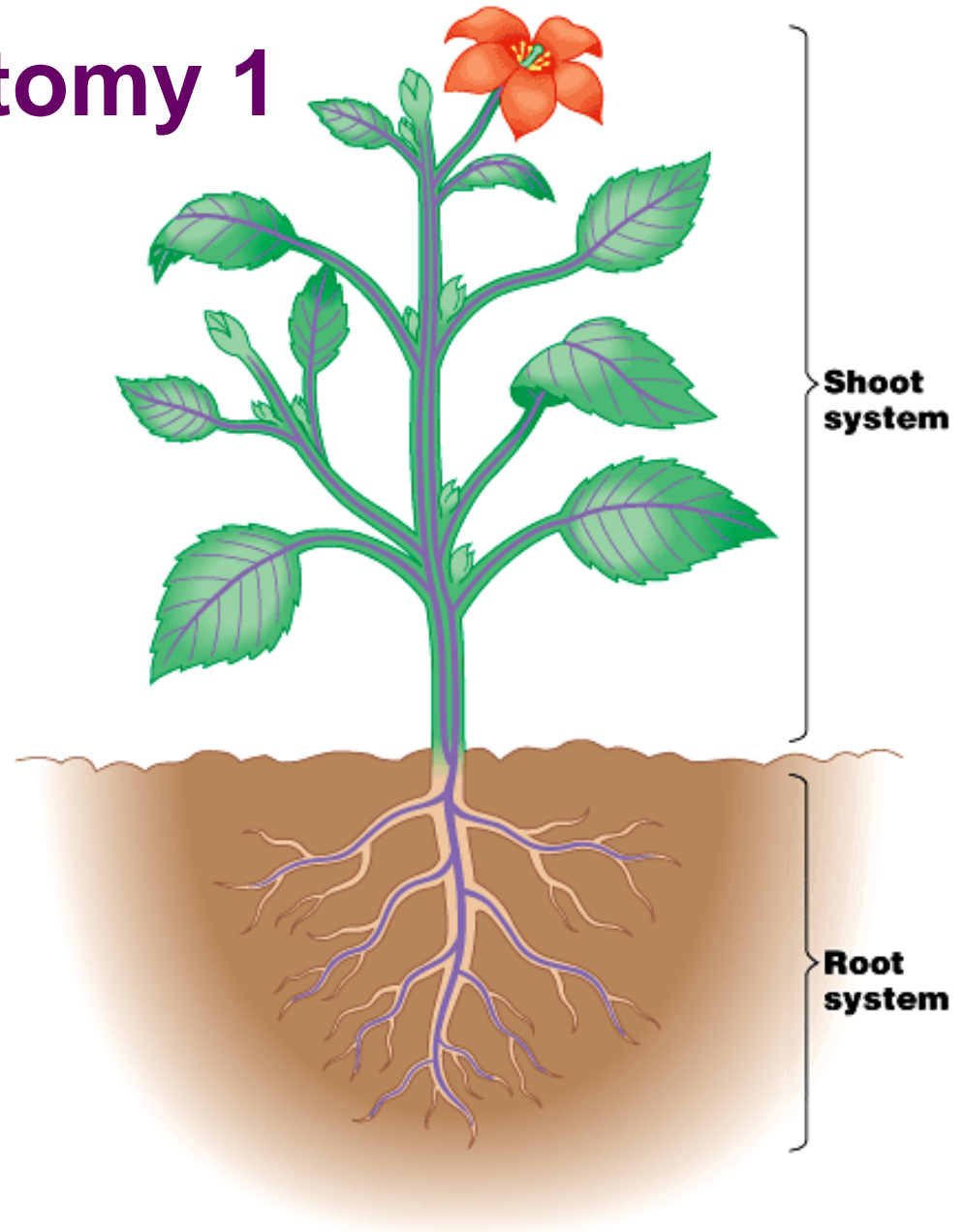


# Plant Anatomy



# Basic plant anatomy 1

- **root**
  - ◆ root tip
  - ◆ root hairs



# Roots

- **Roots anchor plant in soil, absorb minerals & water, & store food**

- ◆ **fibrous roots (1)**

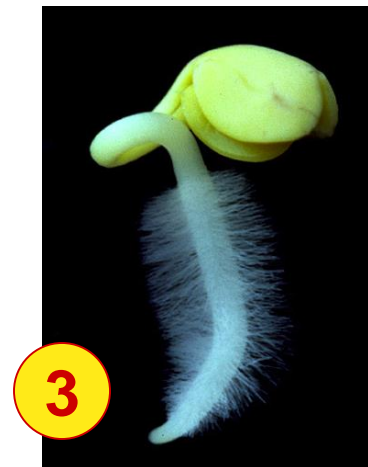
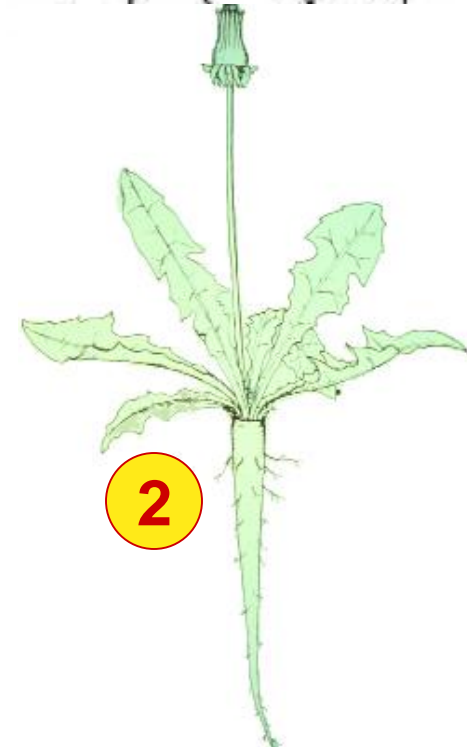
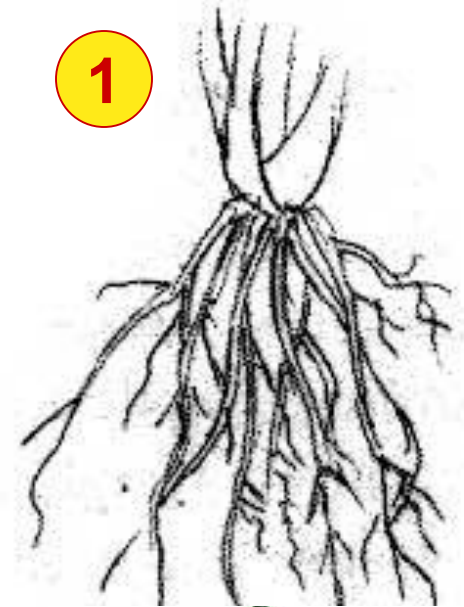
- mat of thin roots that spread out
- monocots

- ◆ **tap roots (2)**

- 1 large vertical root
- also produces many small lateral, or branch roots
- dicots

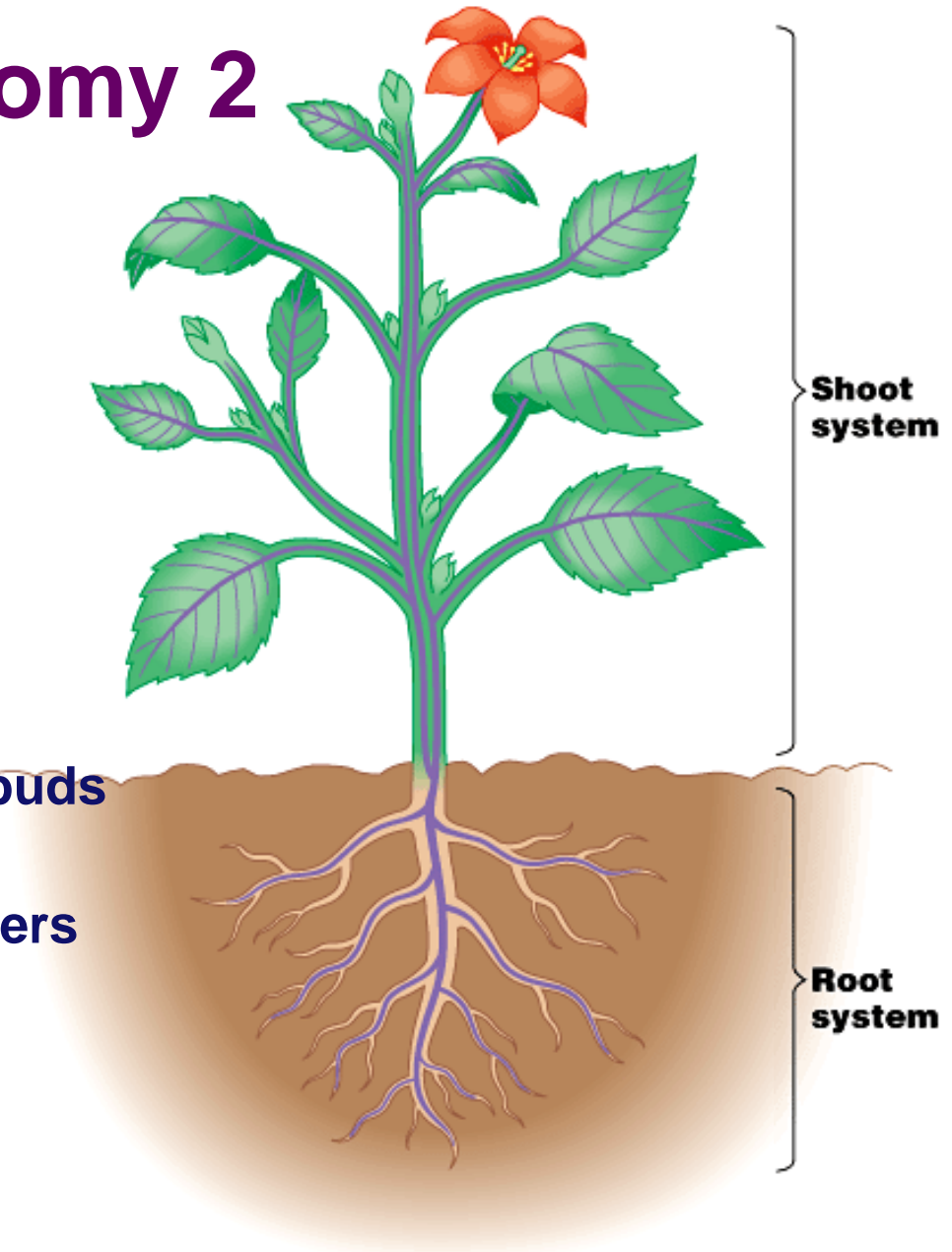
- ◆ **root hairs (3)**

- increase absorptive surface area



# Basic plant anatomy 2

- root
  - ◆ root tip
  - ◆ root hairs
- shoot (stem)
  - ◆ nodes
    - internodes
  - ◆ buds
    - terminal or apical buds
    - axillary buds
    - flower buds & flowers



# Modified shoots

stolons (strawberries)



rhizome (ginger)



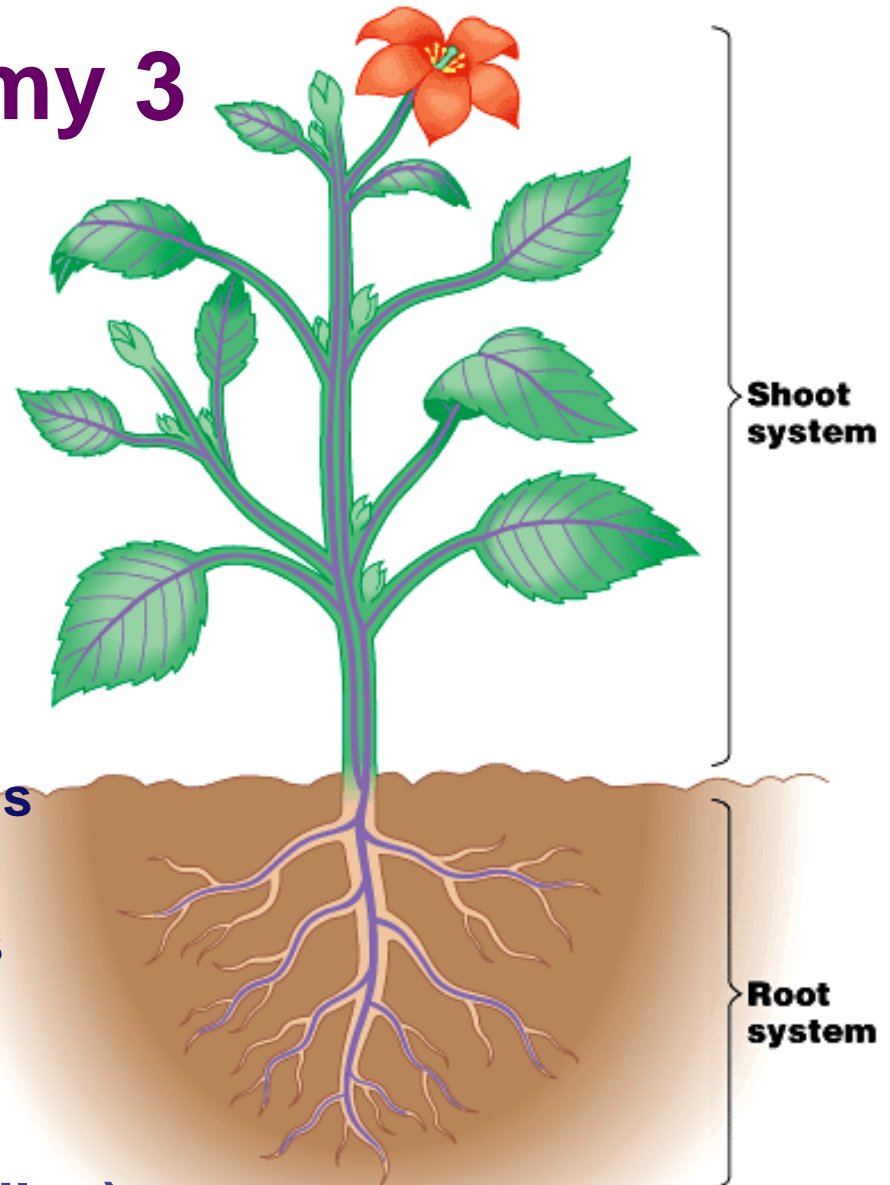
tuber (potato)



bulb (onion)

# Basic plant anatomy 3

- **root**
  - ◆ root tip
  - ◆ root hairs
- **shoot (stem)**
  - ◆ nodes
    - internodes
  - ◆ buds
    - terminal or apical buds
    - axillary buds
    - flower buds & flowers
- **leaves**
  - ◆ mesophyll tissue
  - ◆ veins (vascular bundles)



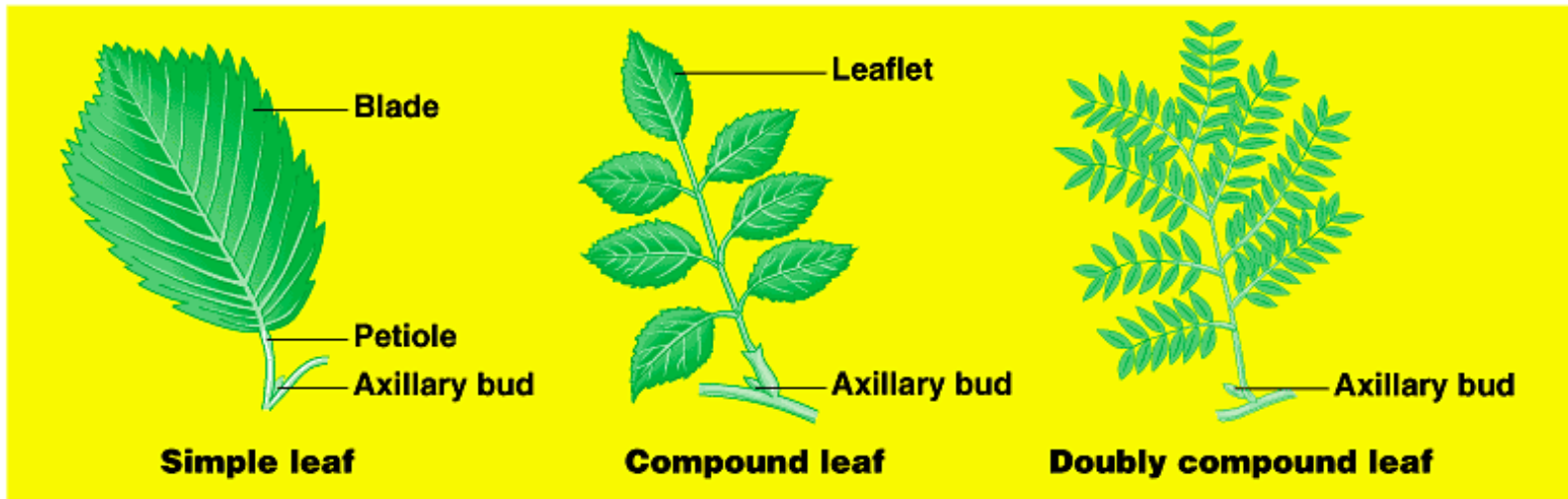
# Leaves

## ■ Function of leaves

- ◆ photosynthesis
  - energy production
  - CHO production
- ◆ gas exchange
- ◆ transpiration



**simple vs. compound**



# Modified leaves

tendrils (peas)



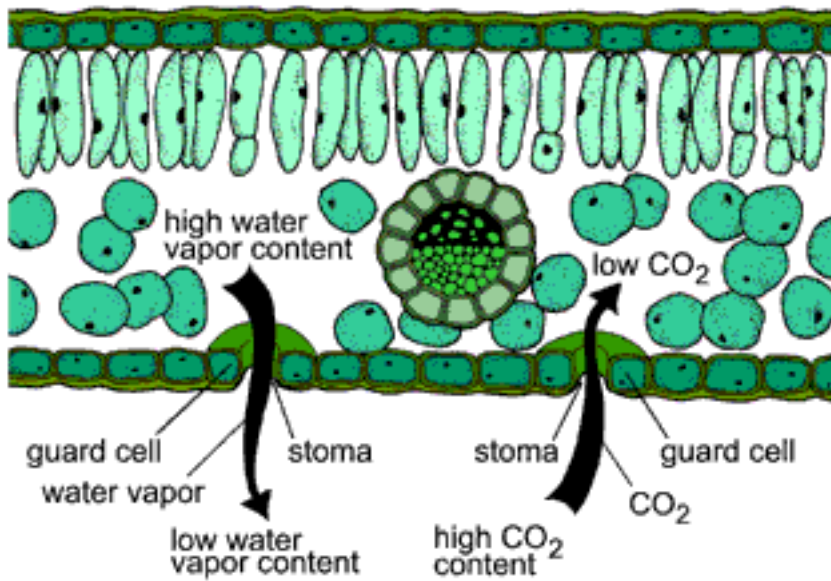
spines (cacti)



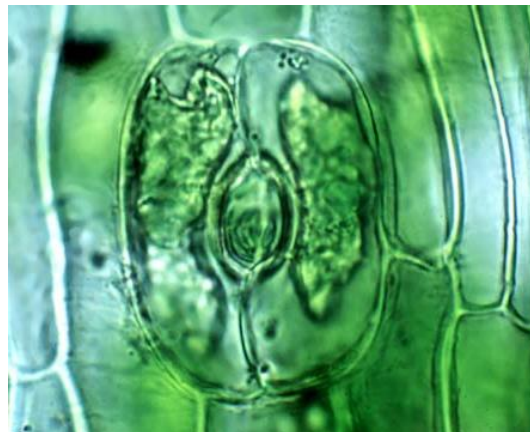
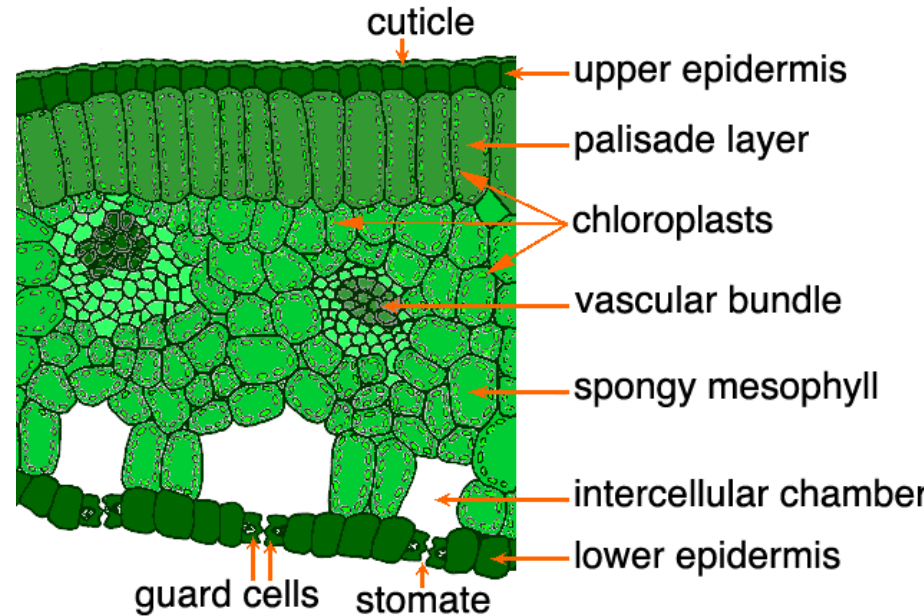
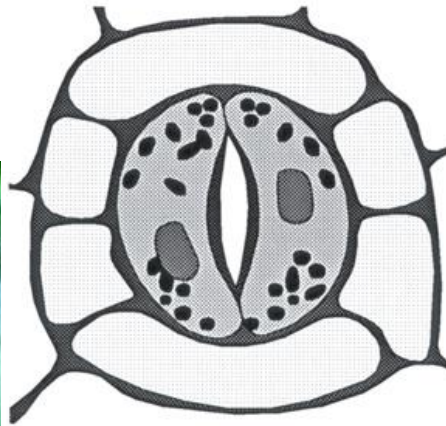
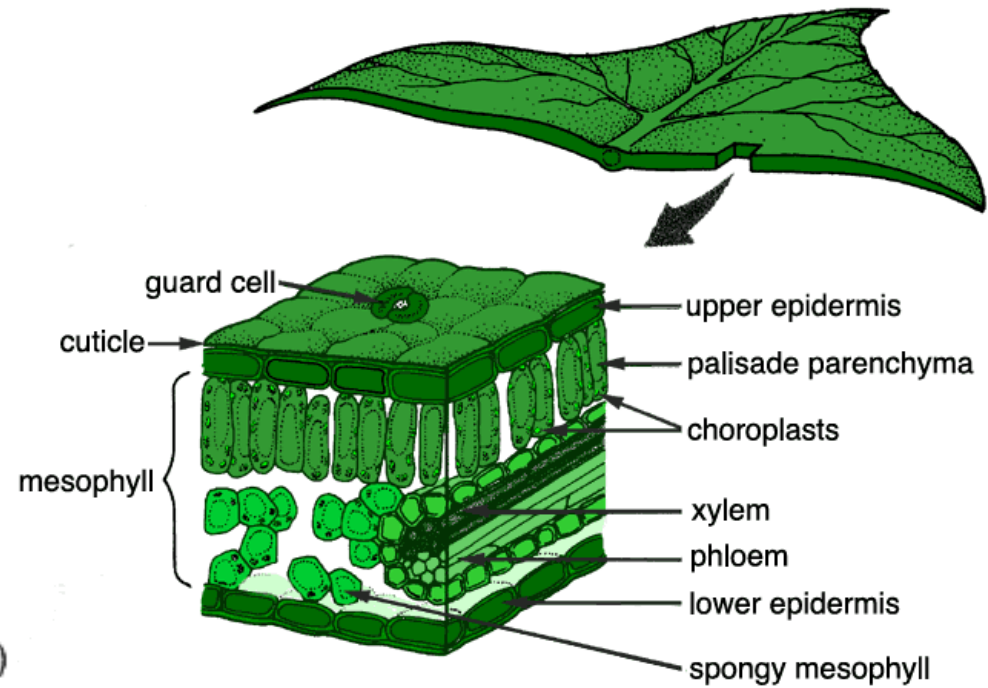
AP Biology succulent leaves

colored leaves (poinsetta)



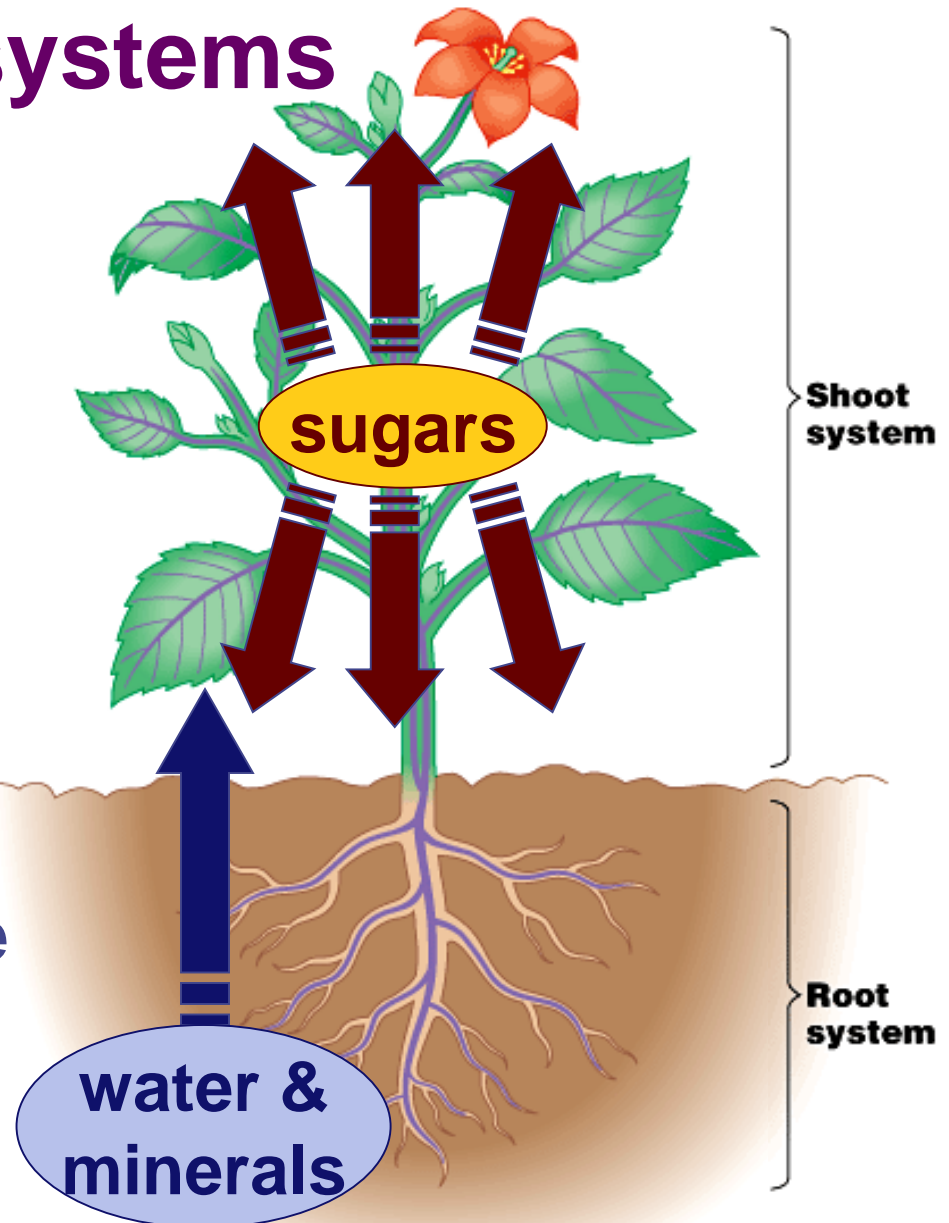


**Figure 25.** Stomata open to allow carbon dioxide ( $\text{CO}_2$ ) to enter a leaf and water vapor to leave.



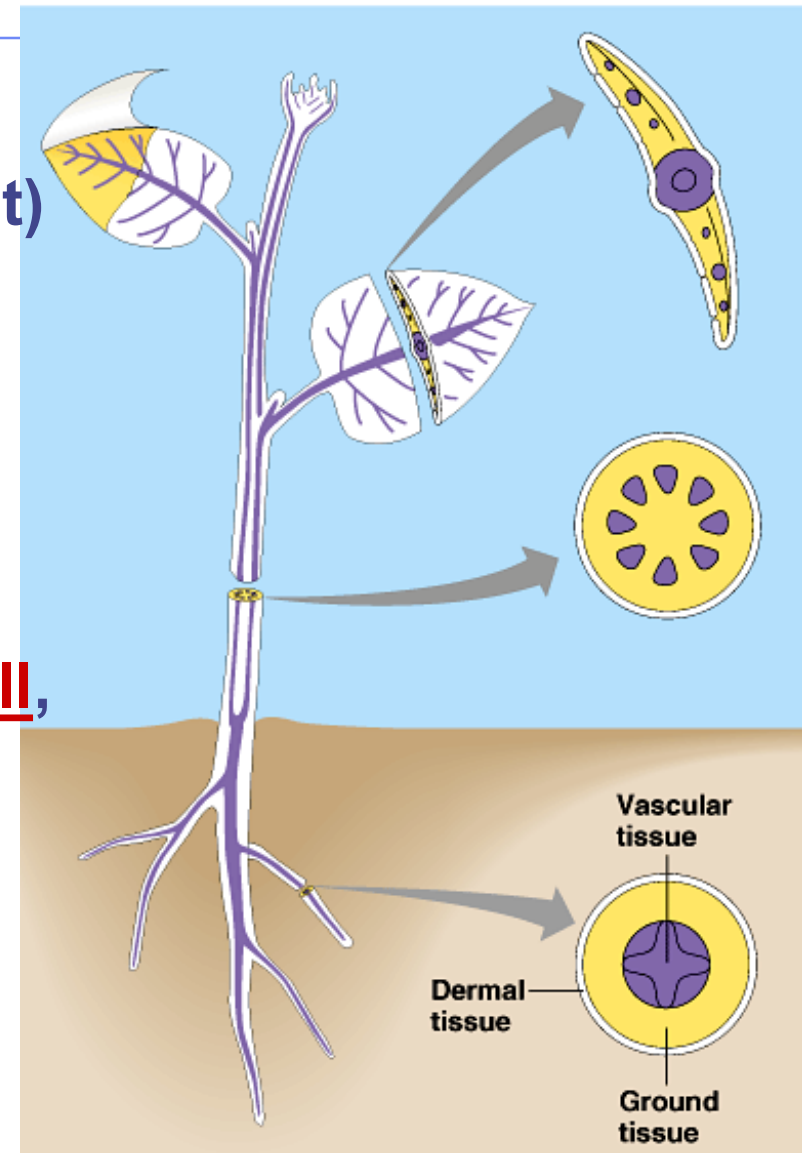
# Interdependent systems

- Both systems depend on the other
  - ◆ **roots** depend on sugars produced by **photosynthetic leaves**
  - ◆ **shoots** depend on water & minerals absorbed from the soil by **roots**



# Plant TISSUES

- **Dermal**
  - ◆ **epidermis** (“skin” of plant)
  - ◆ single layer of tightly packed cells that covers & protects plant
- **Ground**
  - ◆ bulk of plant tissue
  - ◆ photosynthetic **mesophyll**, storage
- **Vascular**
  - ◆ transport system in shoots & roots
  - ◆ **xylem** & **phloem**



# Plant CELL types in plant tissues

## ■ Parenchyma

- ◆ “typical” plant cells = least specialized
- ◆ photosynthetic cells, storage cells
- ◆ tissue of leaves, stem, fruit, storage roots

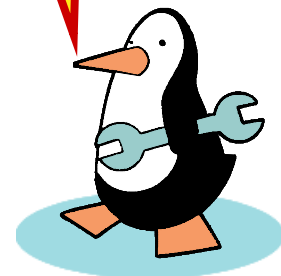
## ■ Collenchyma

- ◆ unevenly thickened primary walls
- ◆ support

## ■ Sclerenchyma

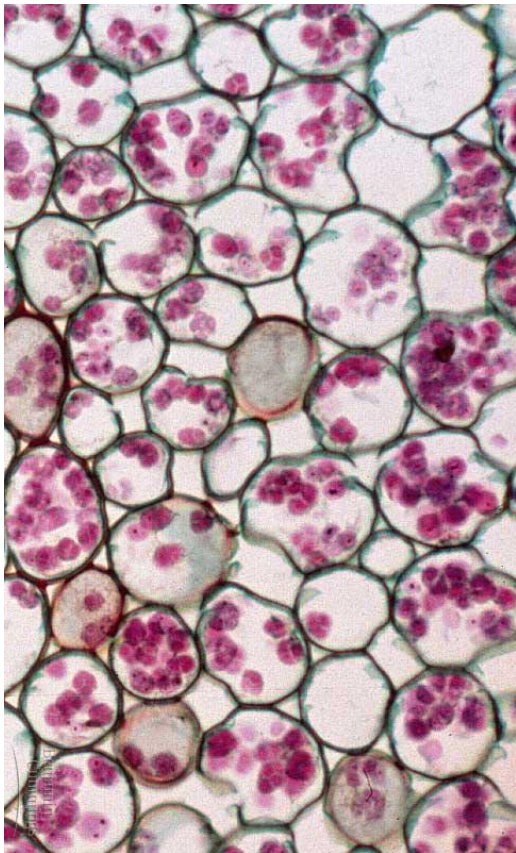
- ◆ very thick, “woody” secondary walls
- ◆ support
- ◆ rigid cells that can’t elongate
- ◆ dead at functional maturity

If I'd only had triplets!



# Parenchyma

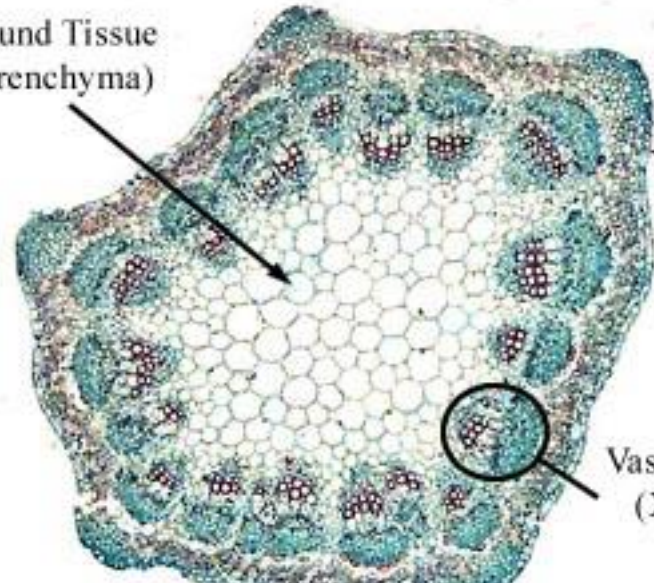
- Parenchyma cells are unspecialized, thin, flexible & carry out many metabolic functions
  - ◆ all other cell types in plants develop from parenchyma



Stem cross-section showing tissue systems.

Ground Tissue  
(Parenchyma)

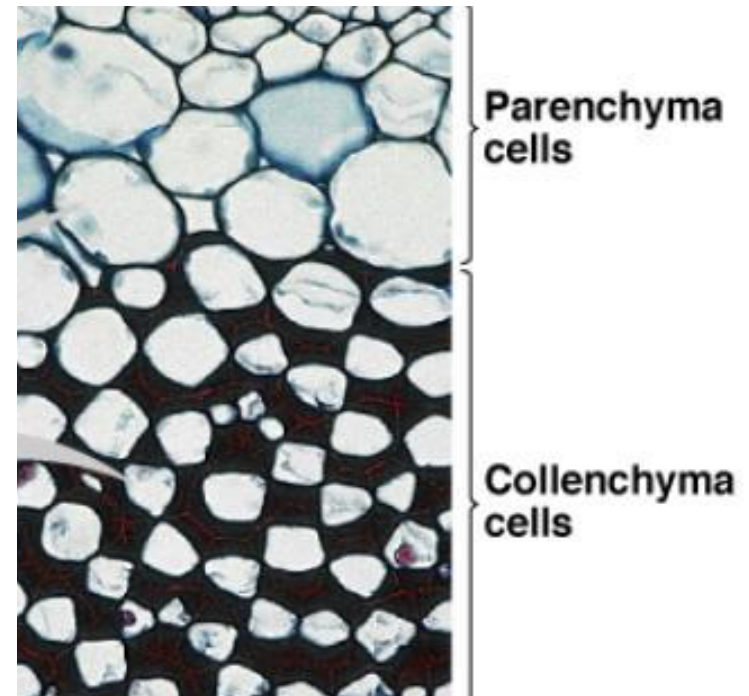
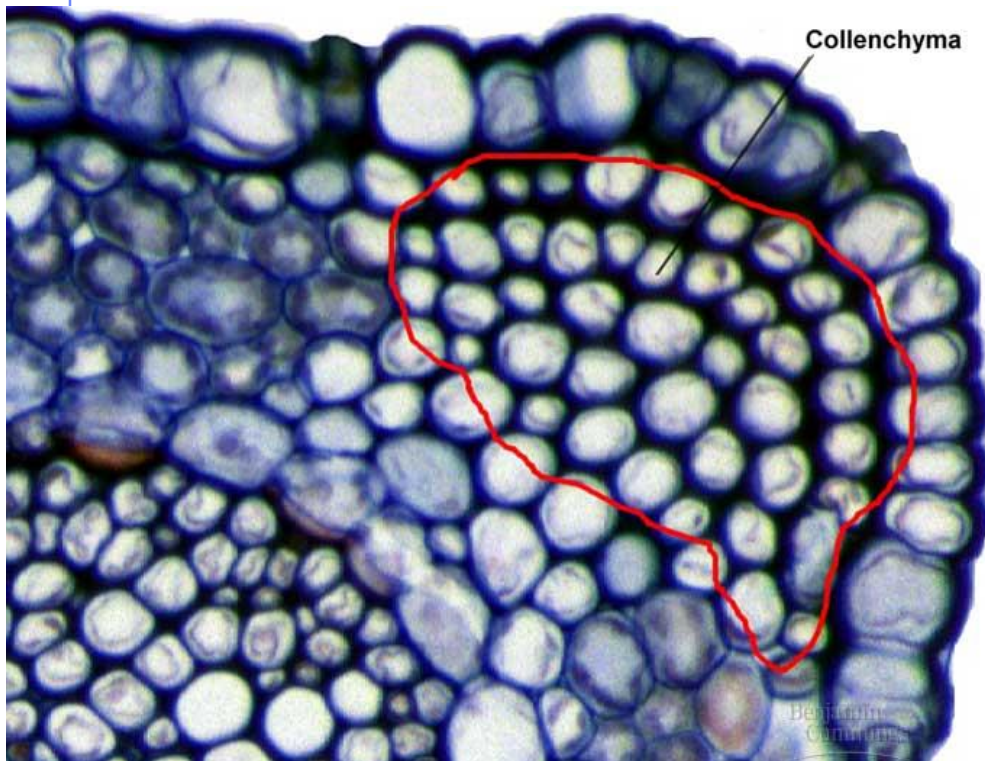
Epidermal  
Tissue



Vascular Tissue  
(Xylem and  
Phloem)

# Collenchyma

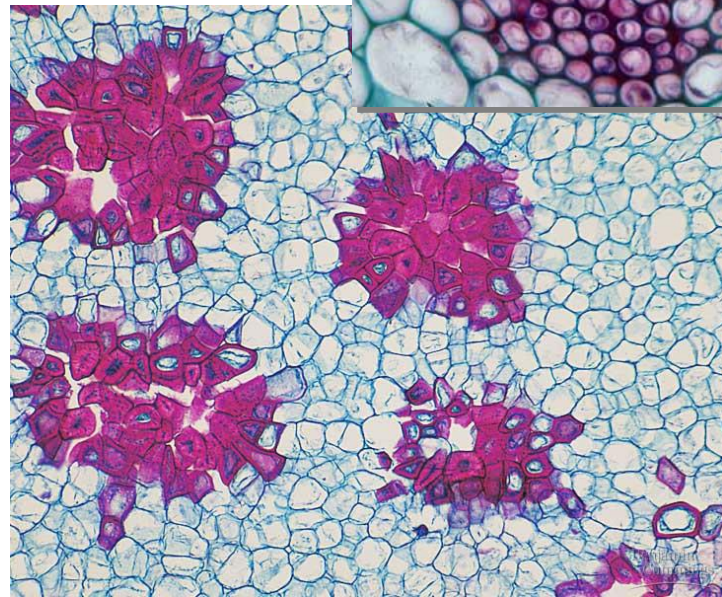
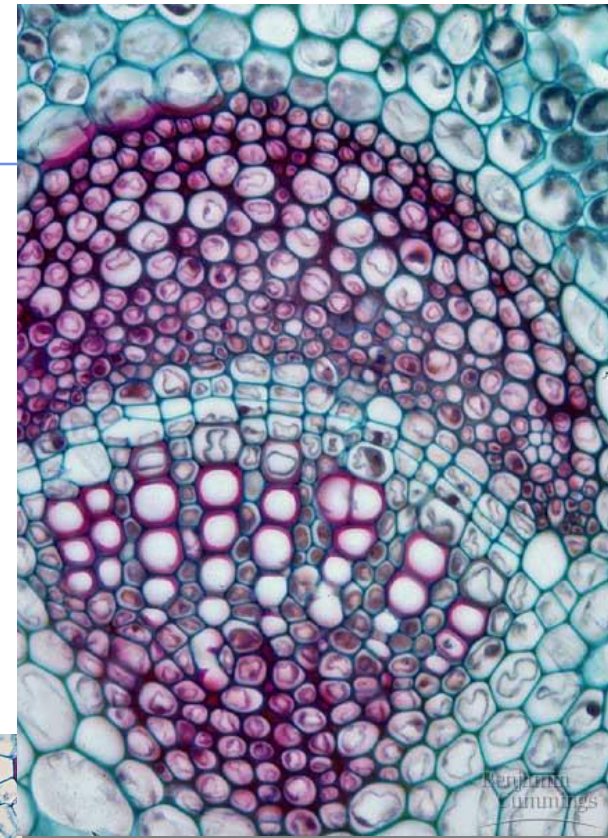
- Collenchyma cells have thicker primary walls & provide support
  - ◆ help support without restraining growth
  - ◆ remain alive in maturity



the strings in celery stalks are collenchyma

# Sclerenchyma

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

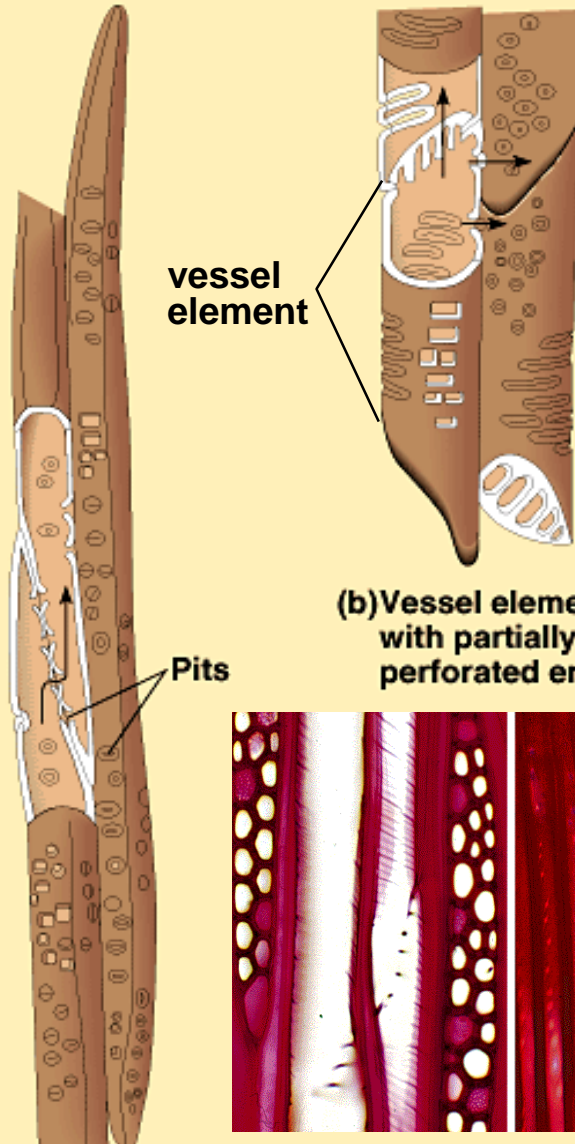


# Vascular tissue

## vessel elements

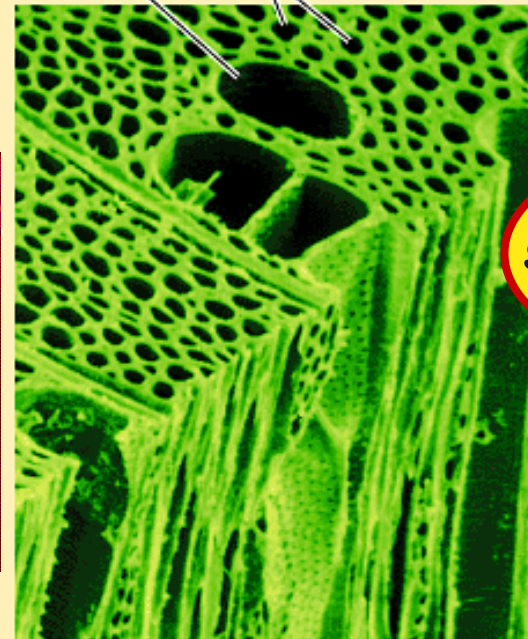
### ■ Xylem

- ◆ move water & minerals up from roots
- ◆ dead cells at functional maturity
  - only cell walls remain
  - need empty pipes to efficiently move H<sub>2</sub>O
  - transpirational pull



(b) Vessel elements with partially perforated end walls

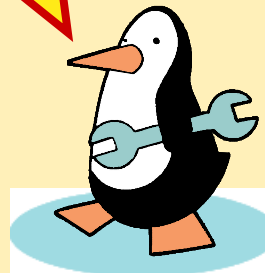
Vessel Tracheids 100 μm



(c) Tracheids and vessels (colorized SEM)

dead cells

Aaaah...  
Structure-Function  
again!

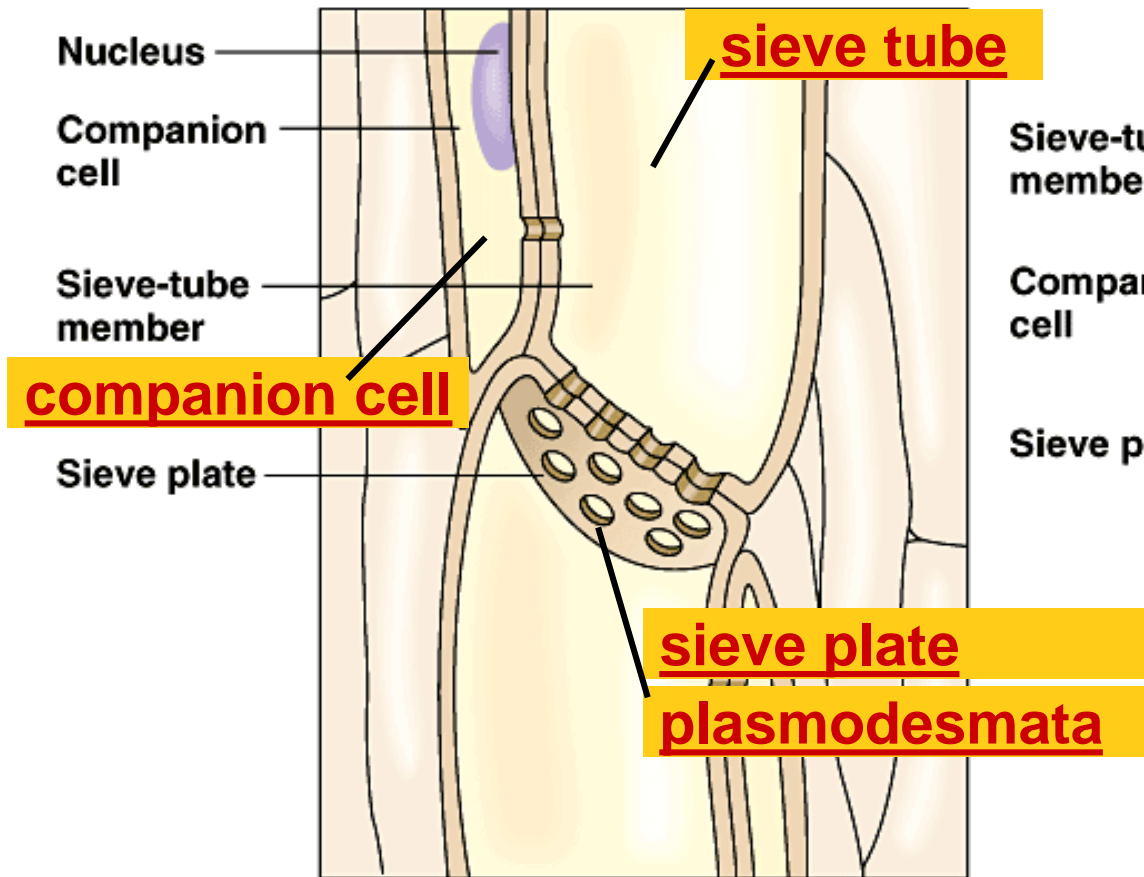


tracheids

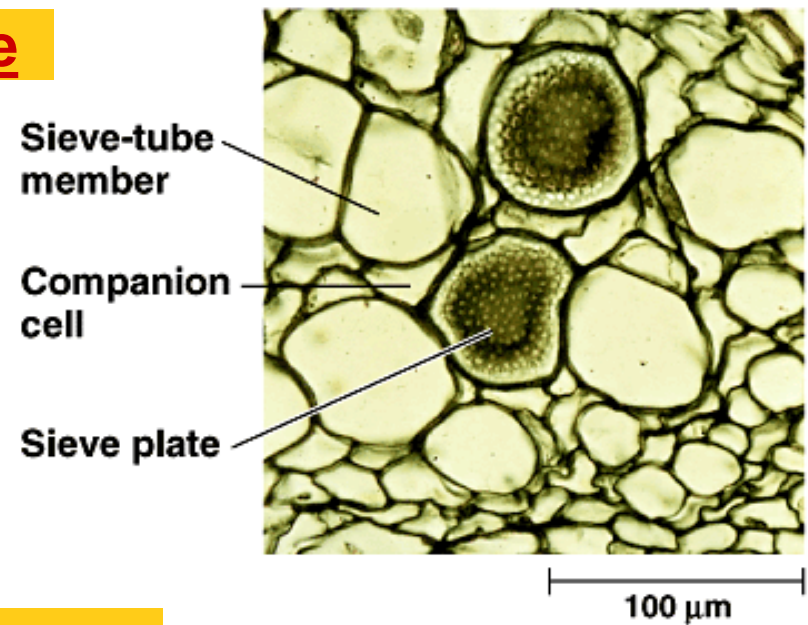


# Phloem: food-conducting cells

- carry sugars & nutrients throughout plant



(a) Longitudinal view

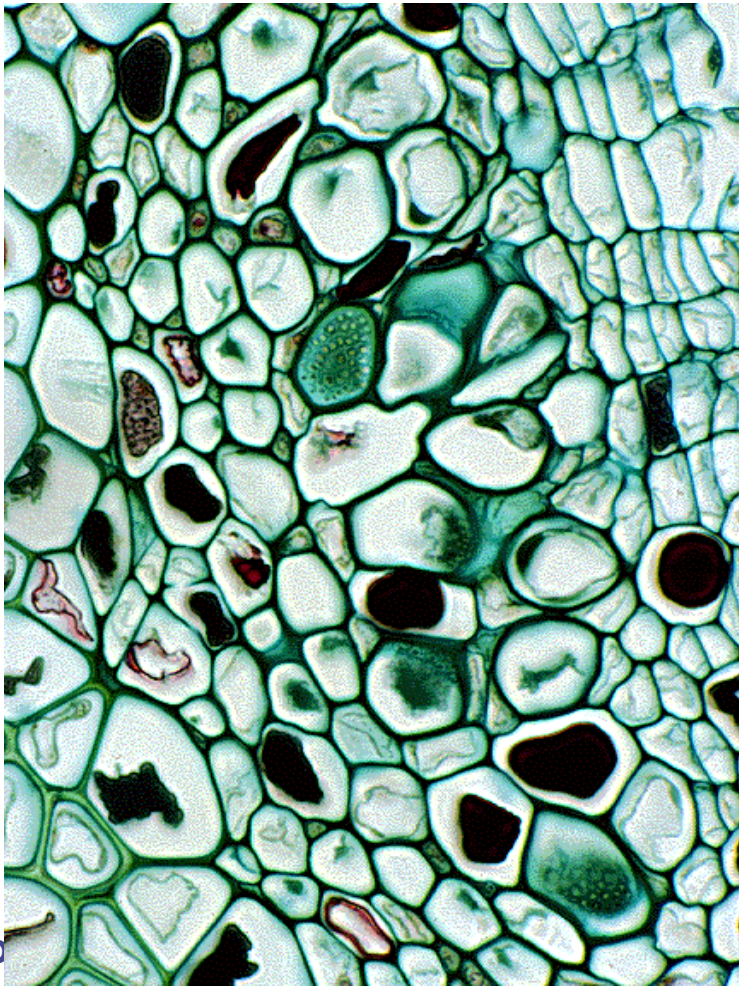


(b) Transverse section (LM)

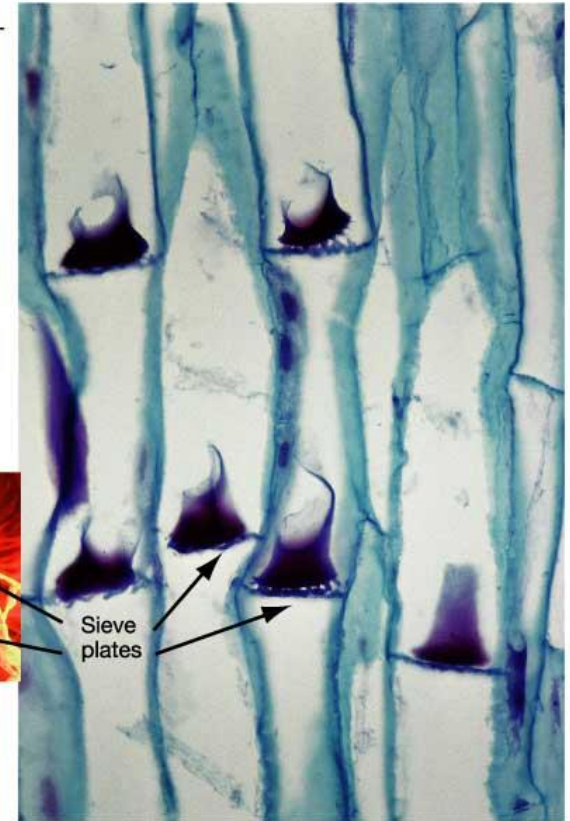
**living cells**

# Phloem: food-conducting cells

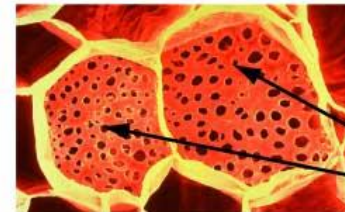
- sieve tube elements & companion cells



LONGITUDINAL SECTION



CROSS-SECTION

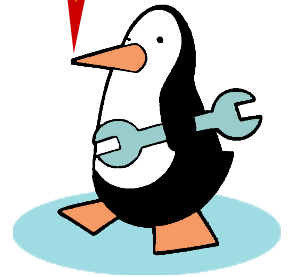


Sieve plates

# Phloem

- **Living cells** at functional maturity
  - ◆ cell membrane, cytoplasm
    - control of diffusion
  - ◆ lose their nucleus, ribosomes & vacuole
    - more room for specialized transport of liquid food (sucrose)
- **Cells**
  - ◆ **sieve tubes**
    - **sieve plates** — end walls — have pores to facilitate flow of fluid between cells
  - ◆ **companion cells**
    - nucleated cells connected to the sieve-tube
    - help sieve tubes

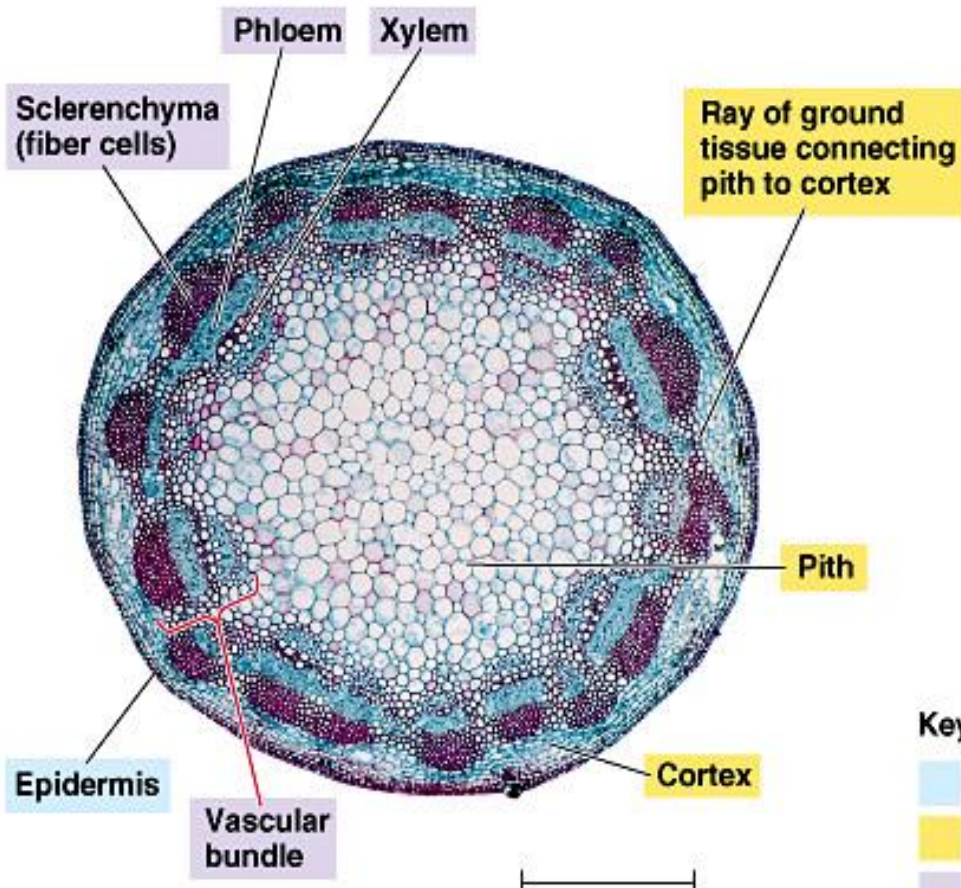
Aaaah...  
Structure-Function  
again!



# Vascular tissue in stems

## dicot

trees & shrubs

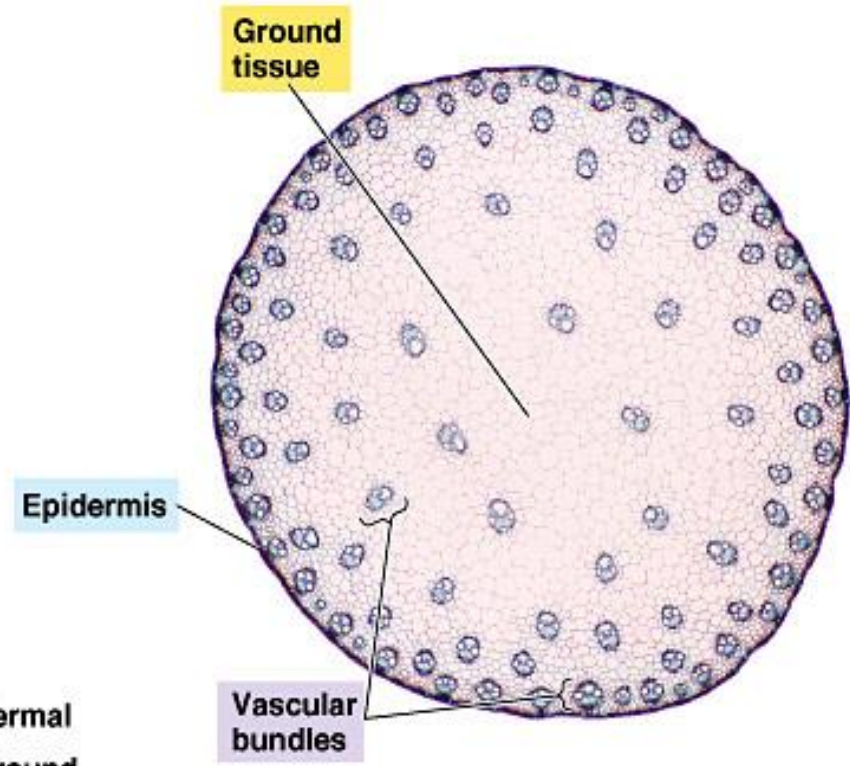


(a) Dicot

collect annual rings

## monocot

grasses & lilies



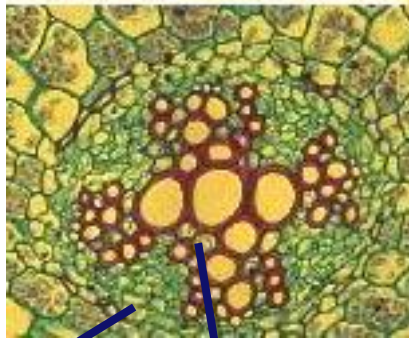
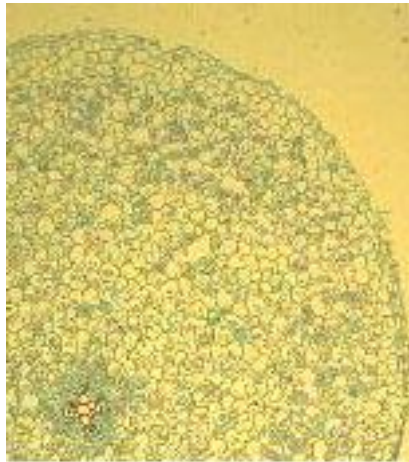
### Key

- Dermal
- Ground
- Vascular

1 mm

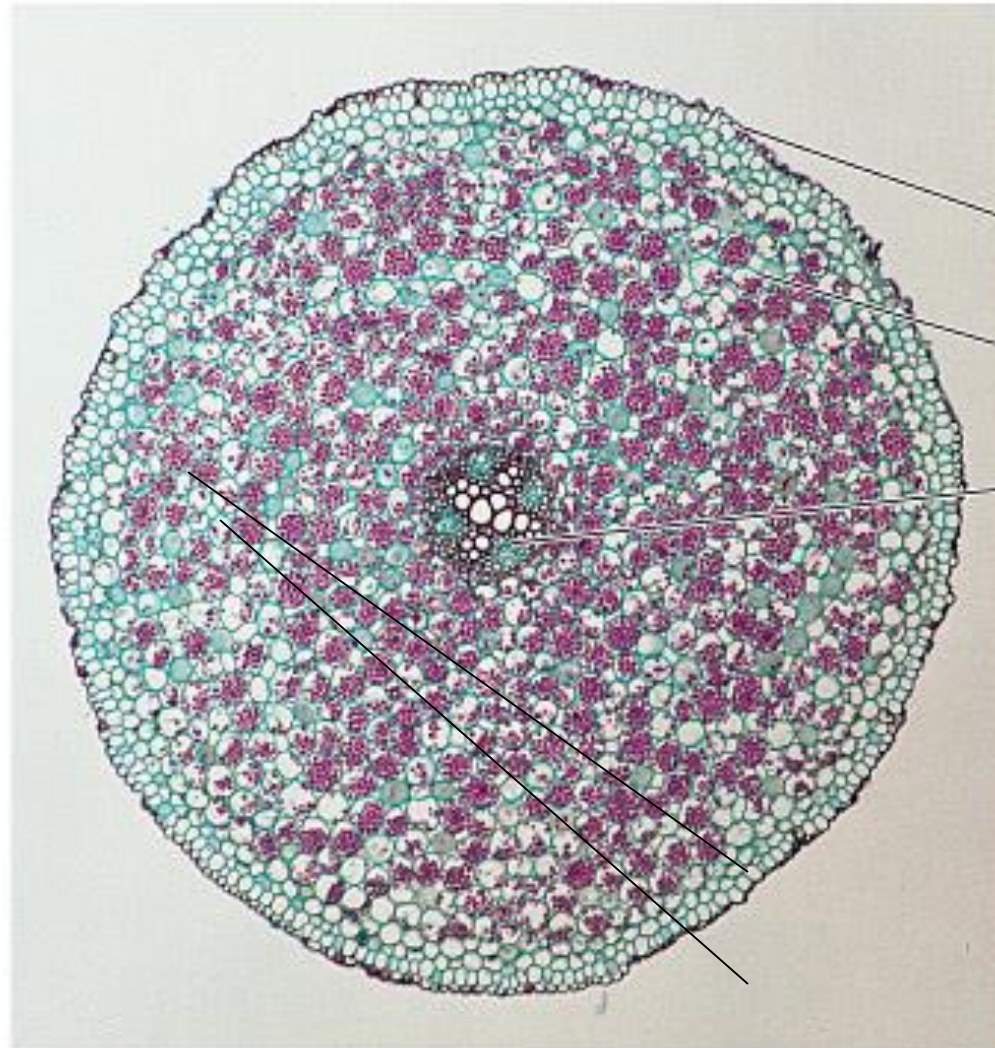
(b) Monocot

# Vascular tissue in roots: dicot



phloem

xylem

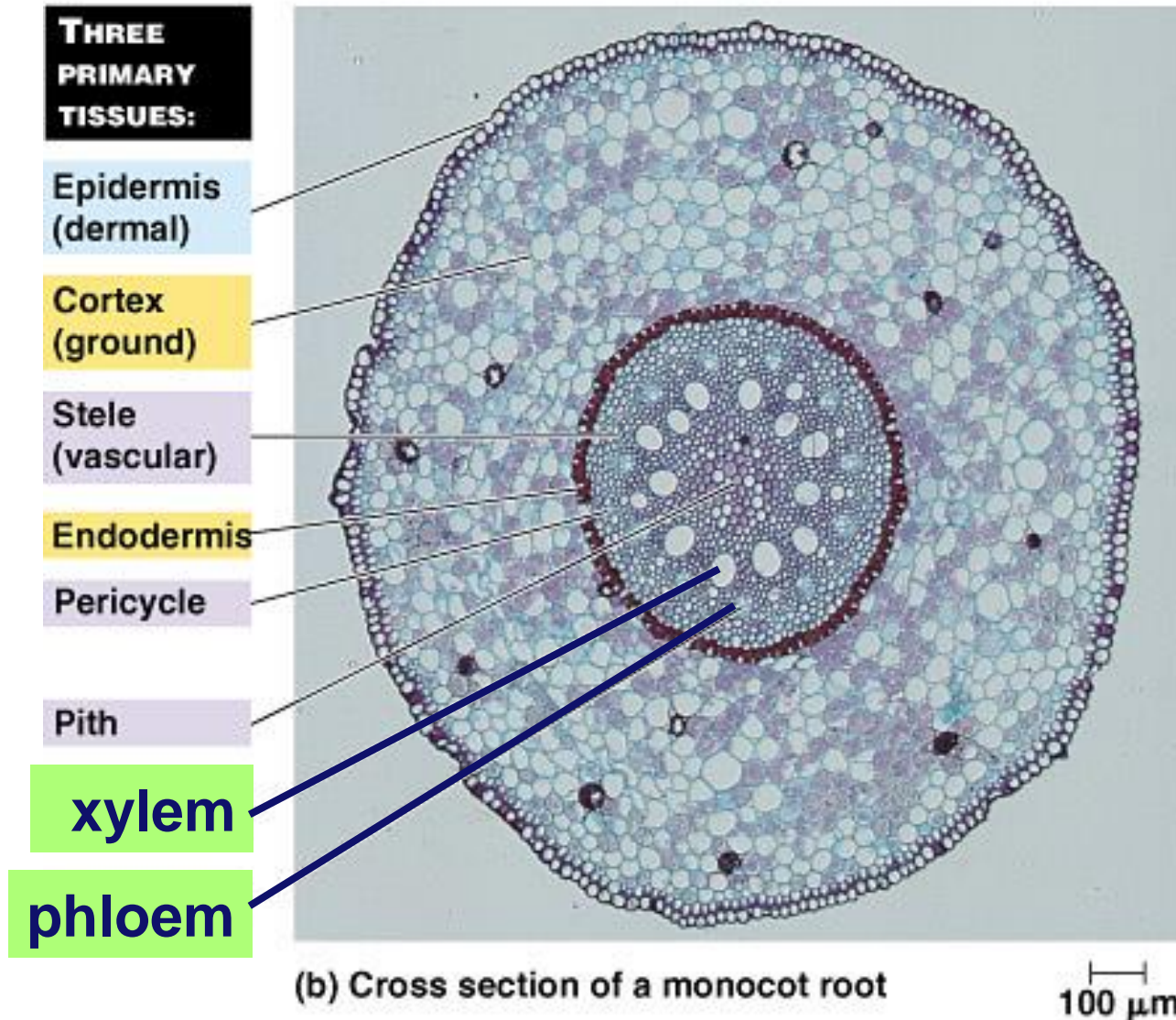


- THREE PRIMARY TISSUES:**
- Epidermis (dermal)
  - Cortex (ground)
  - Stele (vascular)
  - Endodermis
  - Pericycle
  - Pith
  - Xylem
  - Phloem

(a) Cross section of a dicot root

500  $\mu\text{m}$

# Vascular tissue in roots: monocot



**You too can be a  
Flaming Carrot if...  
You Ask Questions!**



A decorative graphic consisting of a horizontal blue line at the top, a vertical blue line on the left, and another horizontal blue line at the bottom. Small circles are placed at the intersections of these lines: one at the top-left, one at the bottom-right, and one at the bottom-right end of the bottom horizontal line.

# **Ghosts of Lectures Past (storage)**



# Putting it all together

## ■ Obtaining raw materials

### ◆ sunlight

- **leaves** = solar collectors

### ◆ CO<sub>2</sub>

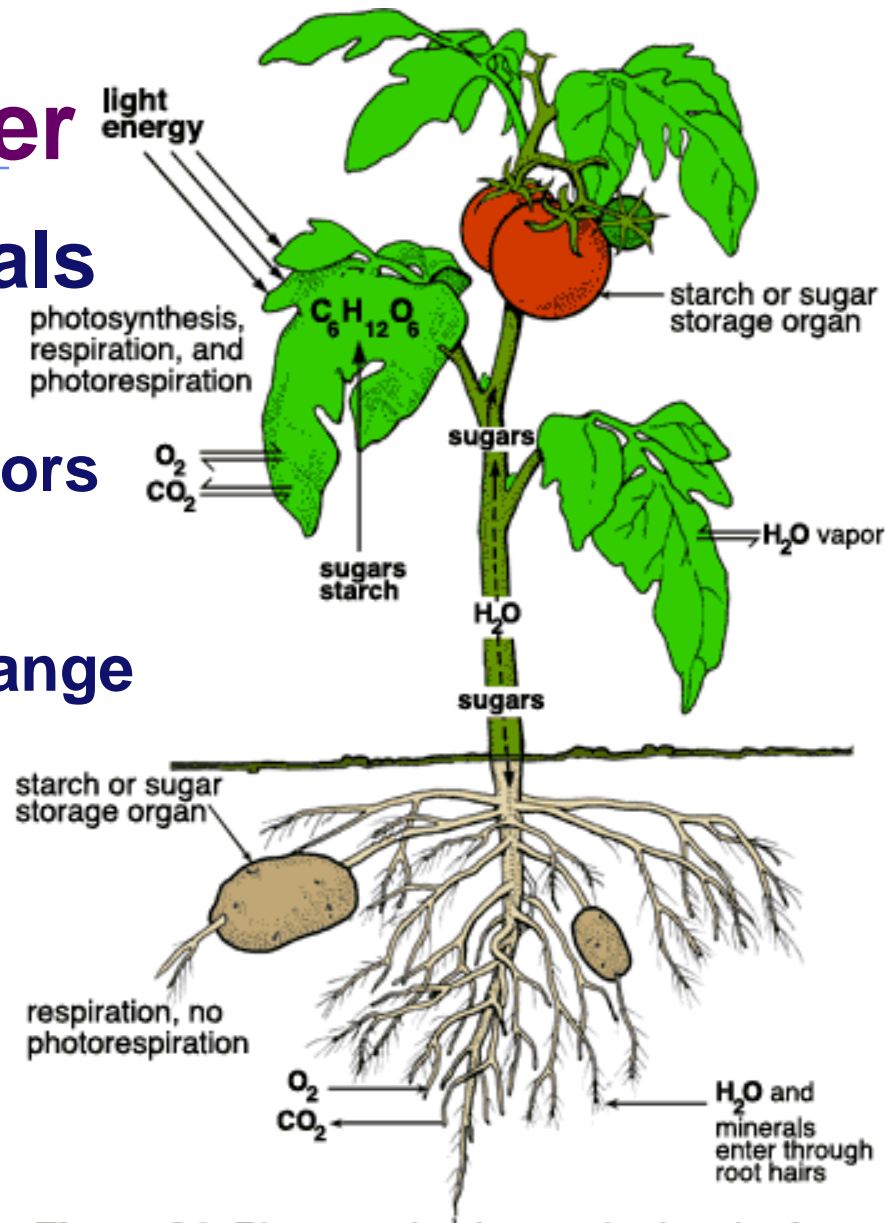
- **stomates** = gas exchange

### ◆ H<sub>2</sub>O

- uptake from **roots**

### ◆ nutrients

- uptake from **roots**



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

**Phloem**

**sieve plate**

**sieve  
tubes**

