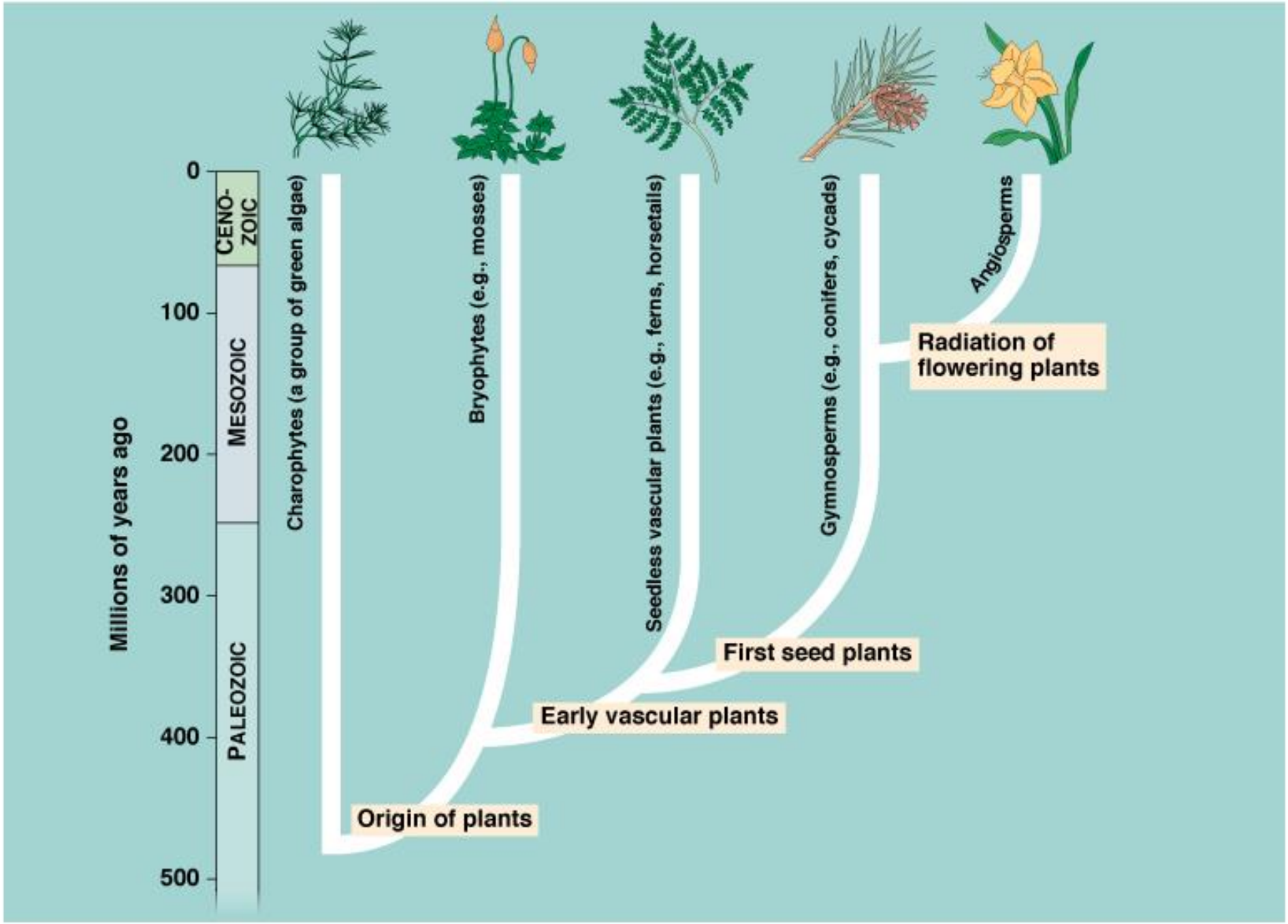
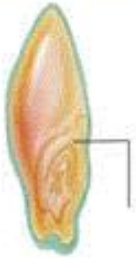
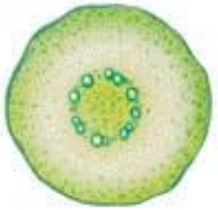
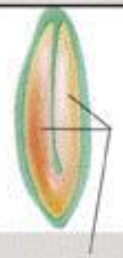
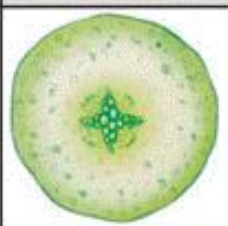
Kingdom Plantae



Monocot vs Dicot Summary

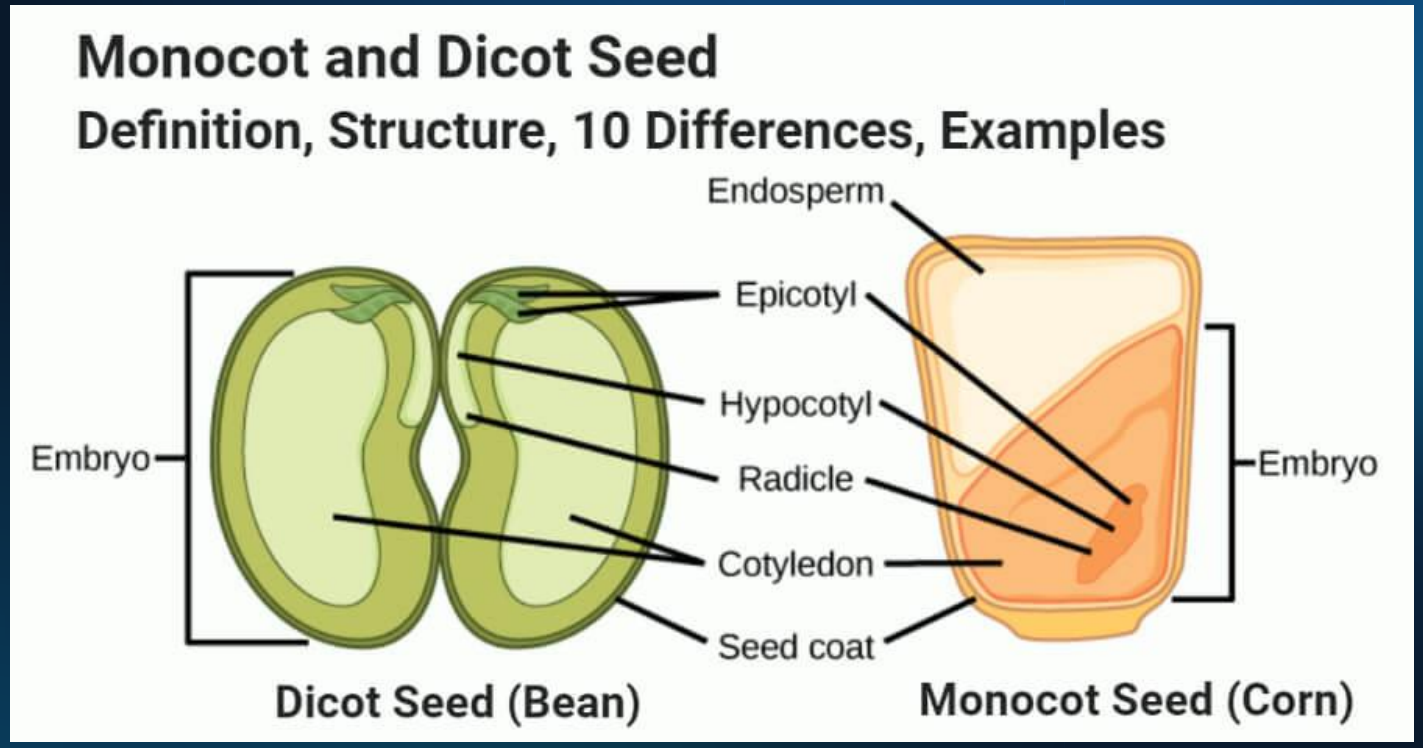
	Seed	Root	Stem	Leaf	Flower
Mono-cots					
		root xylem and phloem in a ring	vascular bundles scattered in stem	leaf veins form a parallel pattern	flower parts in threes and multiples of three
Eudi-cots					
		root phloem between arms of xylem	vascular bundles in a distinct ring	leaf veins form a net pattern	flower parts in fours or fives and their multiples

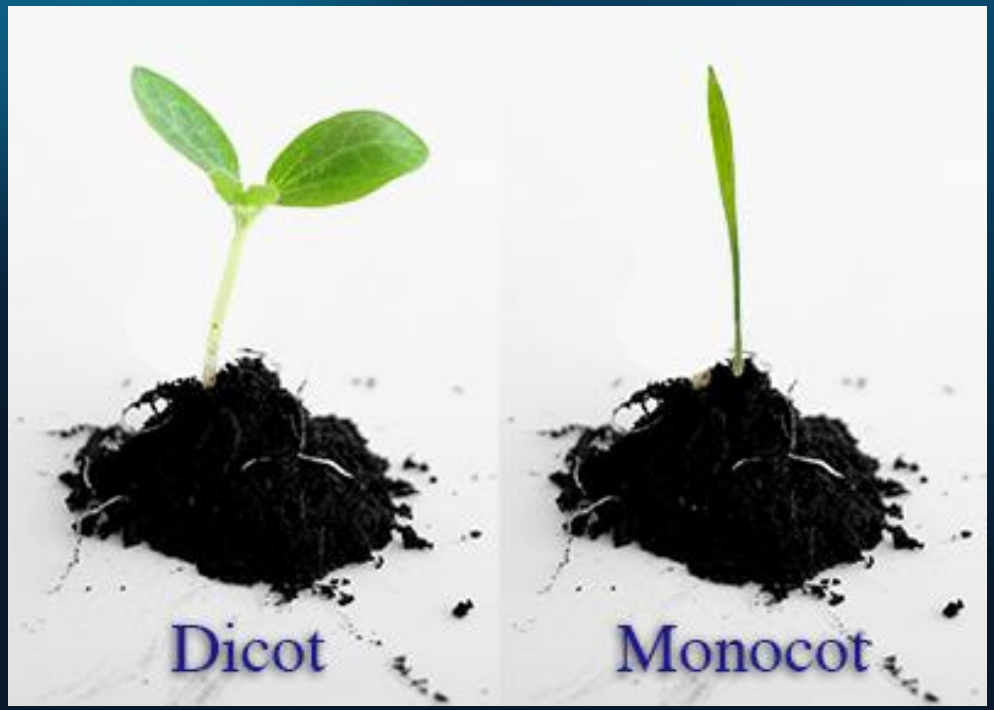
Monocot examples: lilies, daffodils, wheat, banana, rice, onion

Dicot examples: daisies, mint, pea, mango, tamarind

Monocots and dicots are types of angiosperm (flowering plant)

Monocot vs Dicot Summary



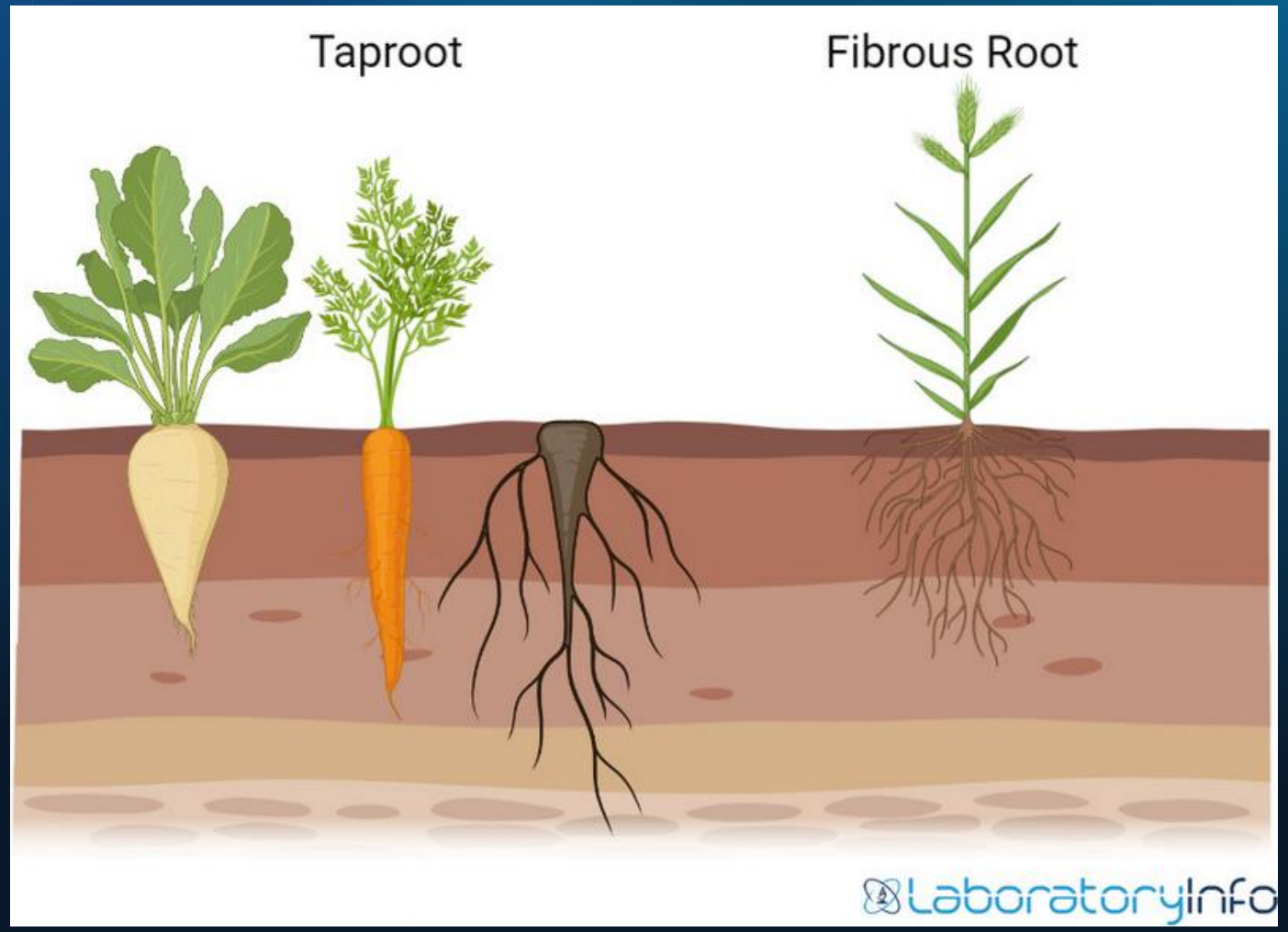


Roots, Stems, and Leaves (Chapter 23)

Roots (23-3)

Types of Roots

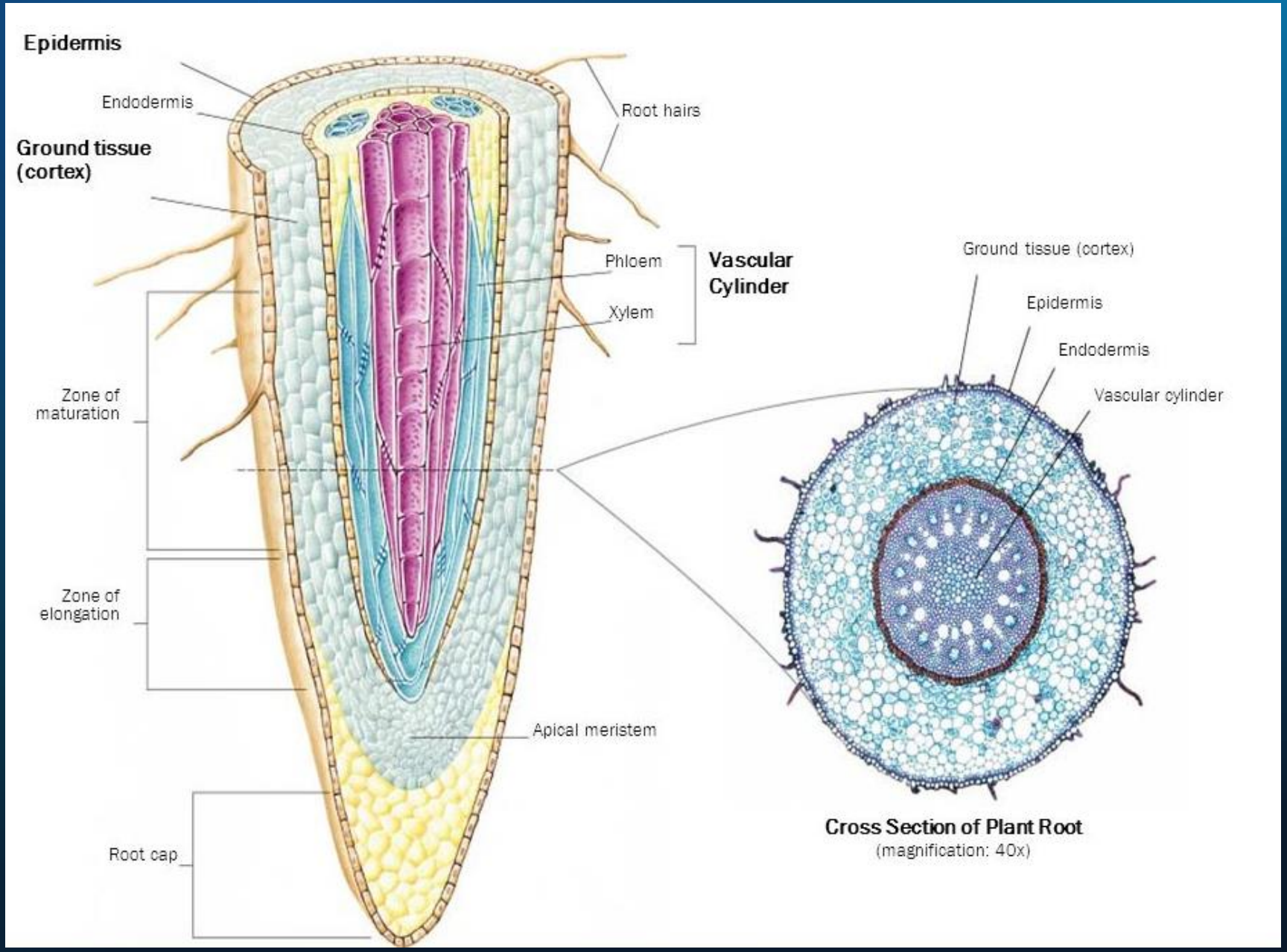
- **Taproot:** primary root grows long and thick while the secondary roots remain small
- **Fibrous roots:** no single root grows longer than the rest; secondary roots grow and branch



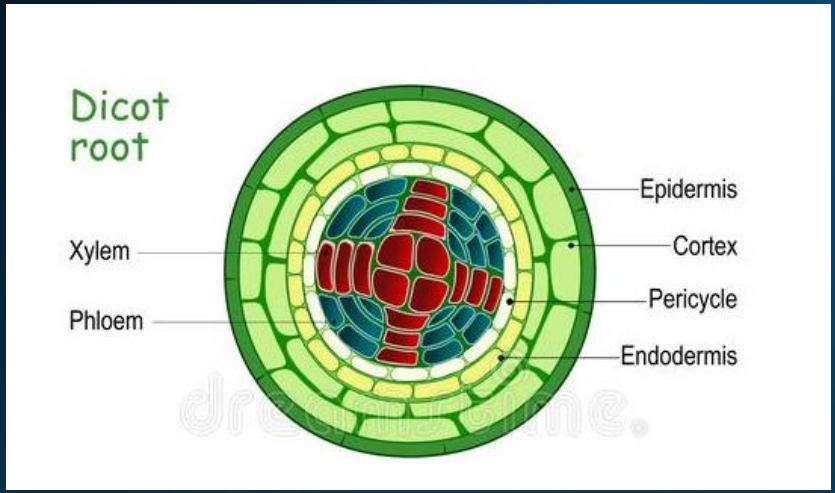
Root Anatomy

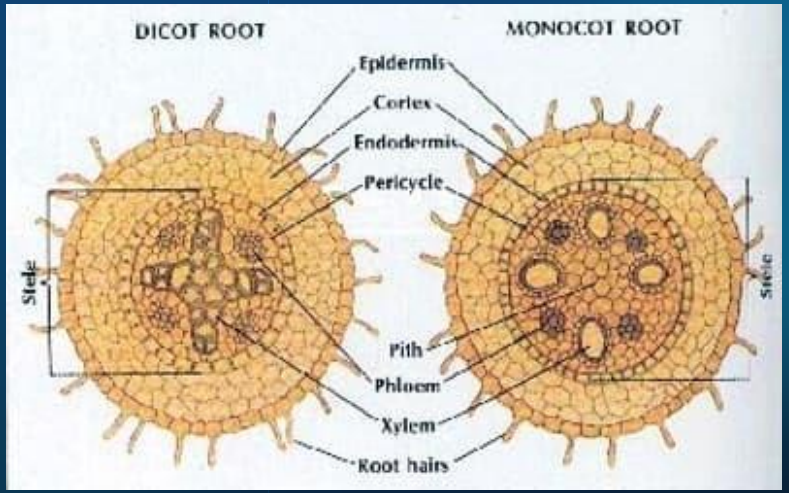
Parts to know: epidermis, root hairs, endodermis, Casparian strip (see tb pg 497), vascular cylinder

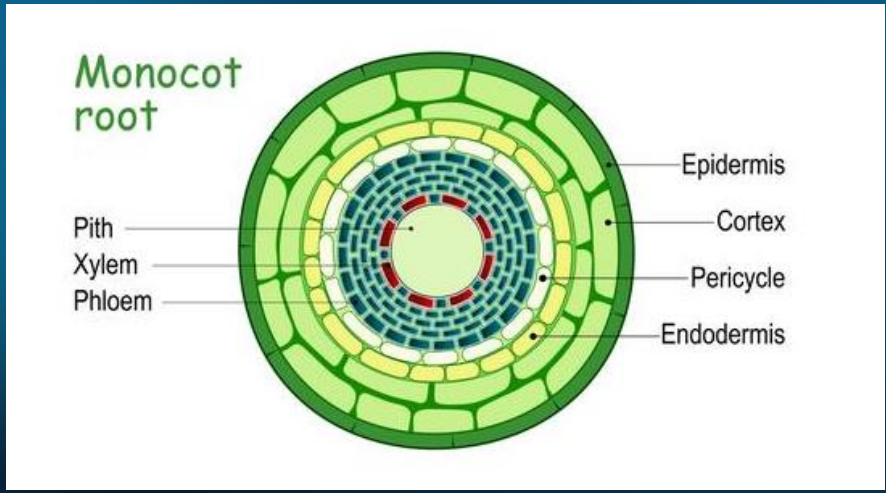
Should also know that the vascular cylinder is made of xylem and phloem, though you will not be asked to label them



Monocot vs Dicot Roots





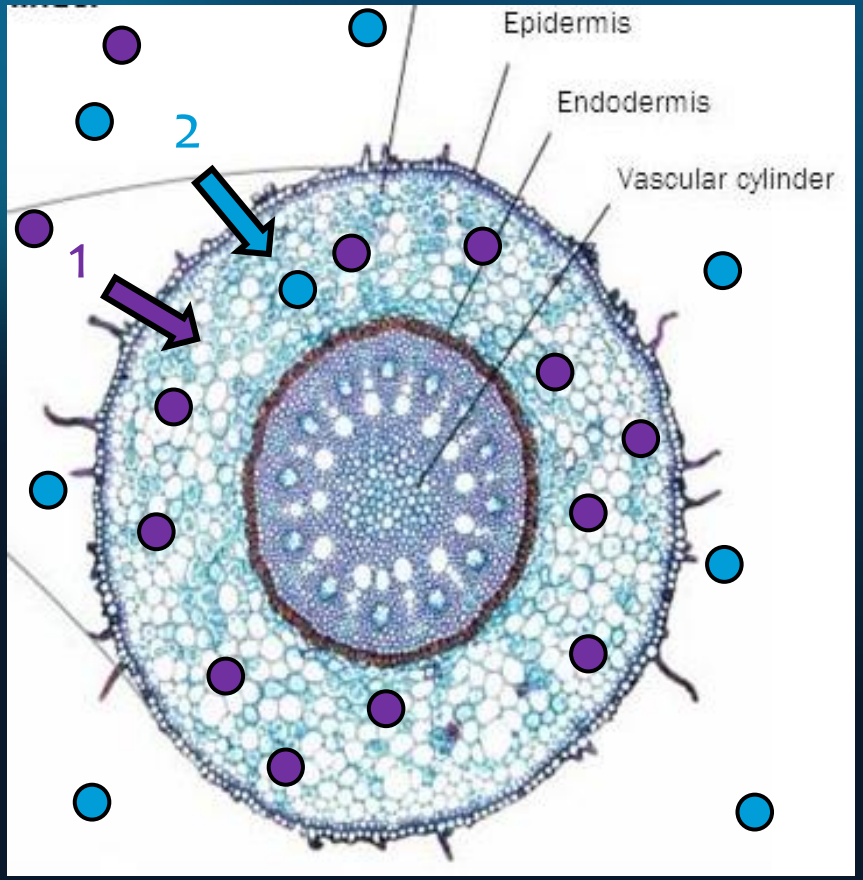


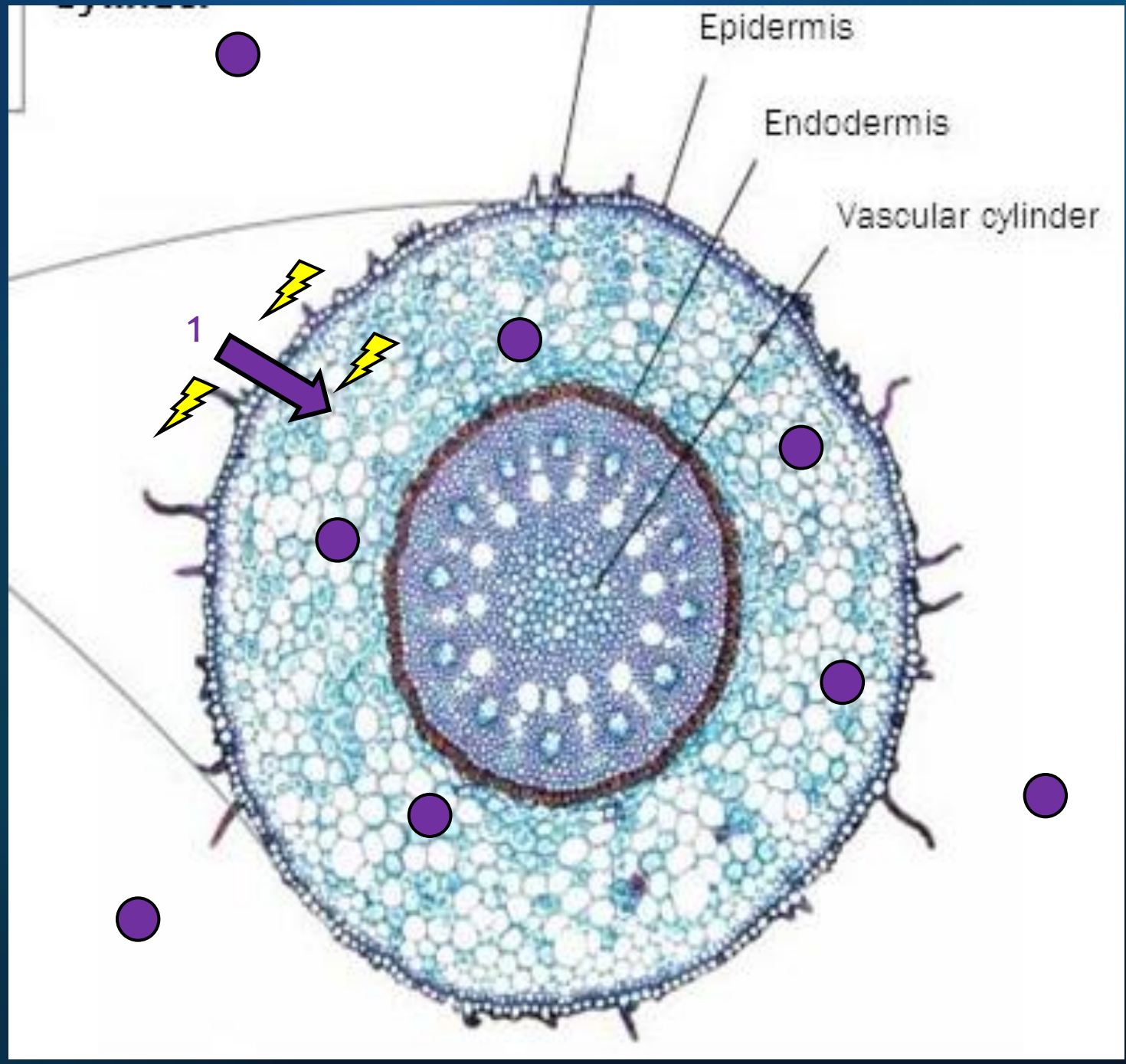
Dicot root: central column of xylem with ‘arms’, surrounded by phloem

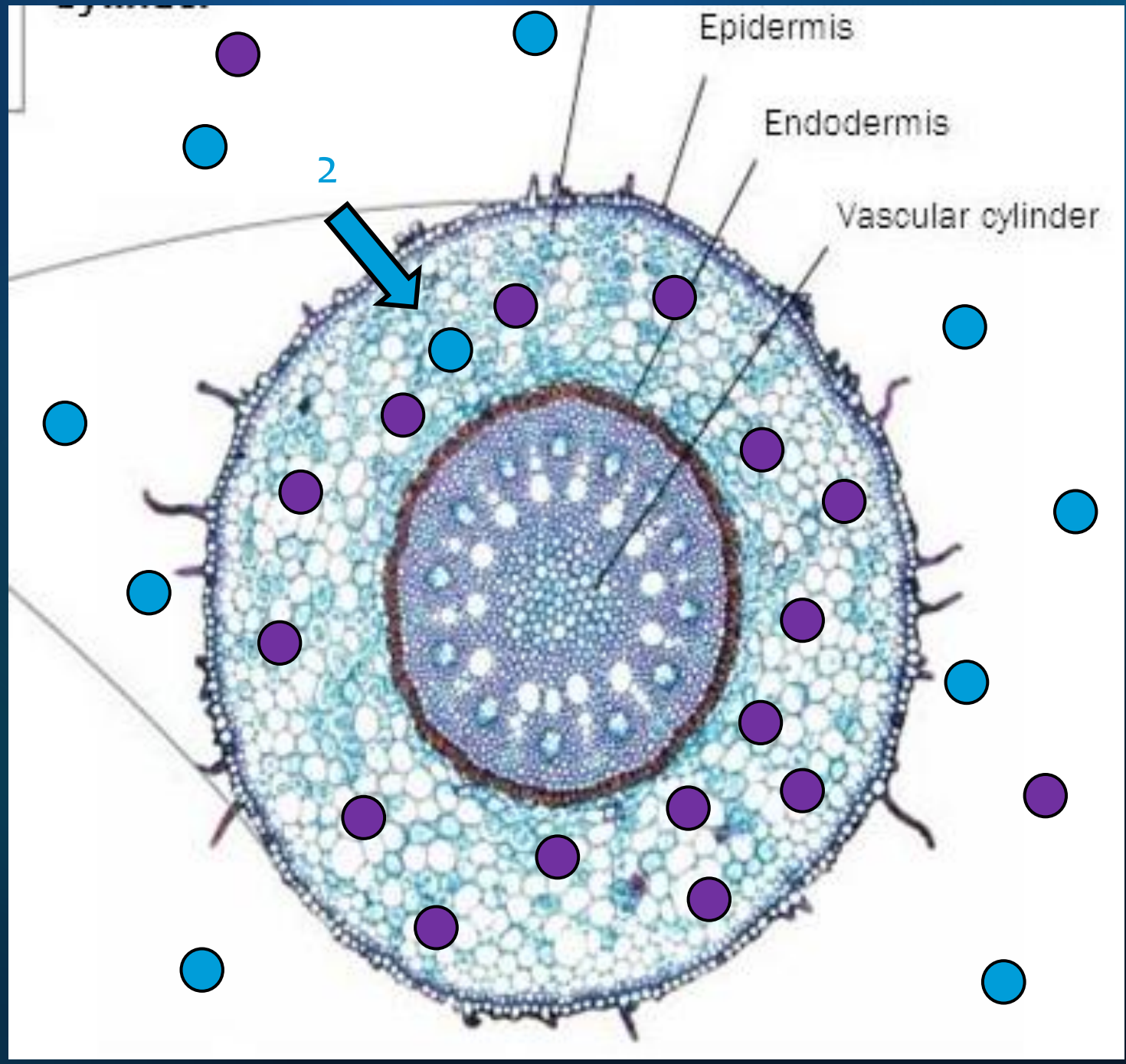
Monocot root: alternating bundles of xylem and phloem in a ring

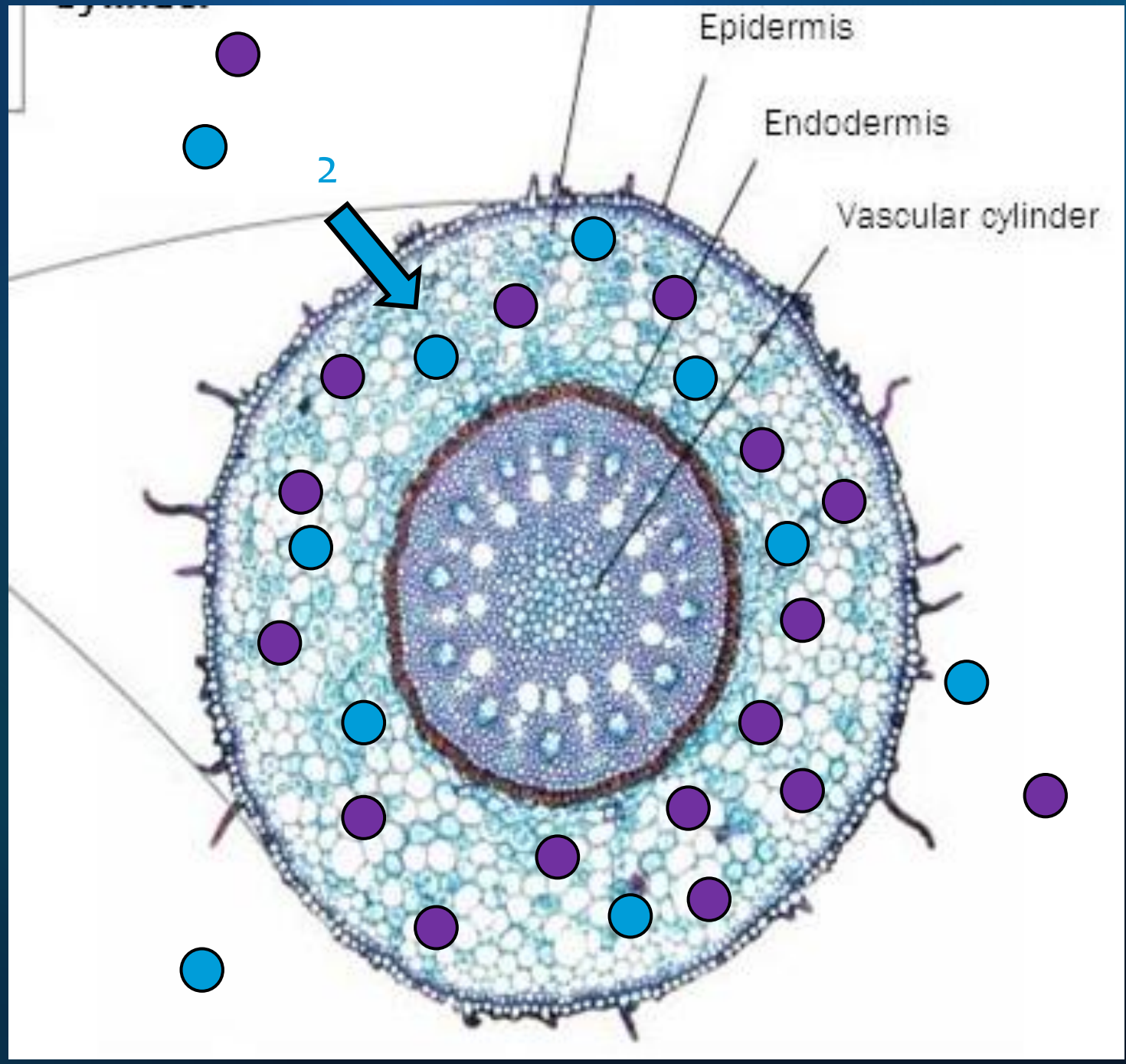
Root Epidermis

- **Epidermis:** outermost layer of cells, has root hairs
- **Root hairs:**
  - Slender projections that penetrate spaces between soil particles
  - Immense combined surface area
  - 1. Active transport of nutrients into root
  - 2. Passive transport (osmosis) of water into root: concentration of solutes inside root is high



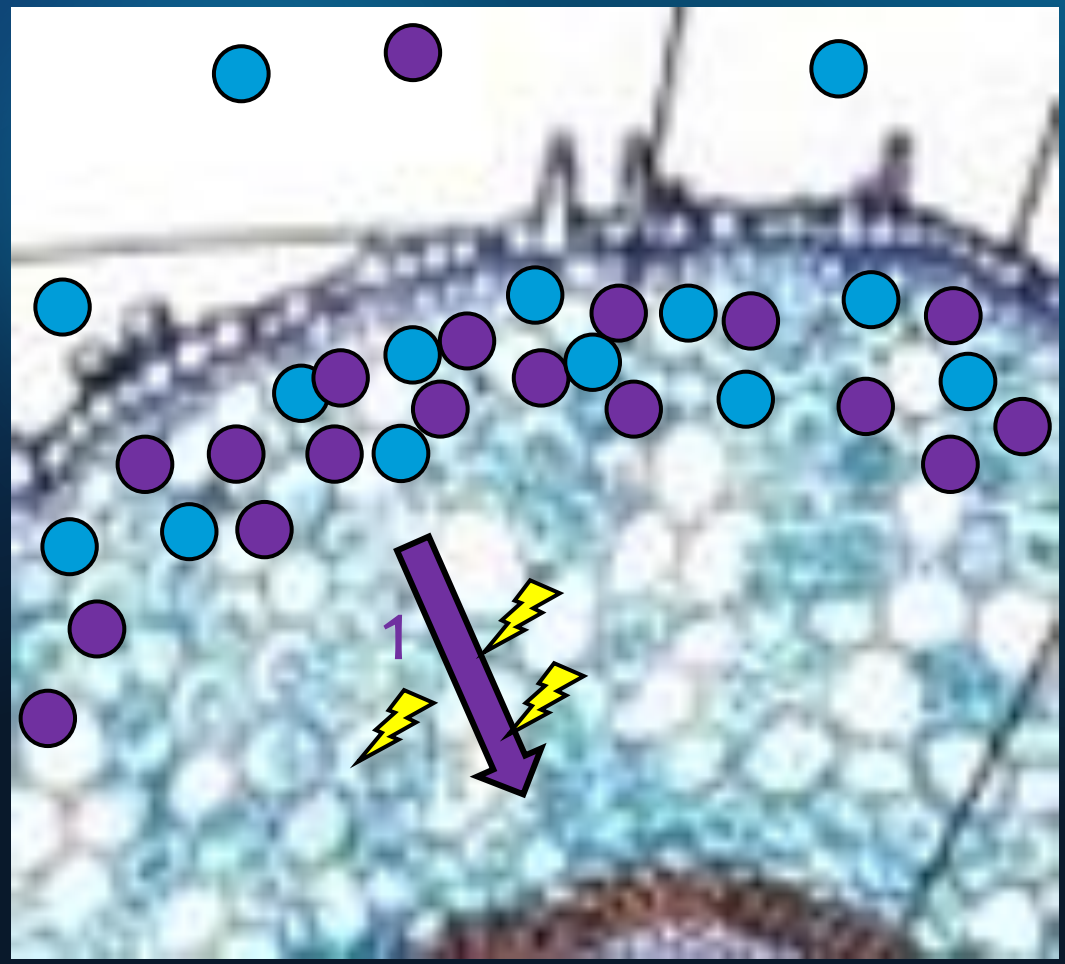

Epidermis
Endodermis
Vascular cylinder
1


Epidermis
Endodermis
Vascular cylinder
2


Epidermis
Endodermis
Vascular cylinder
2

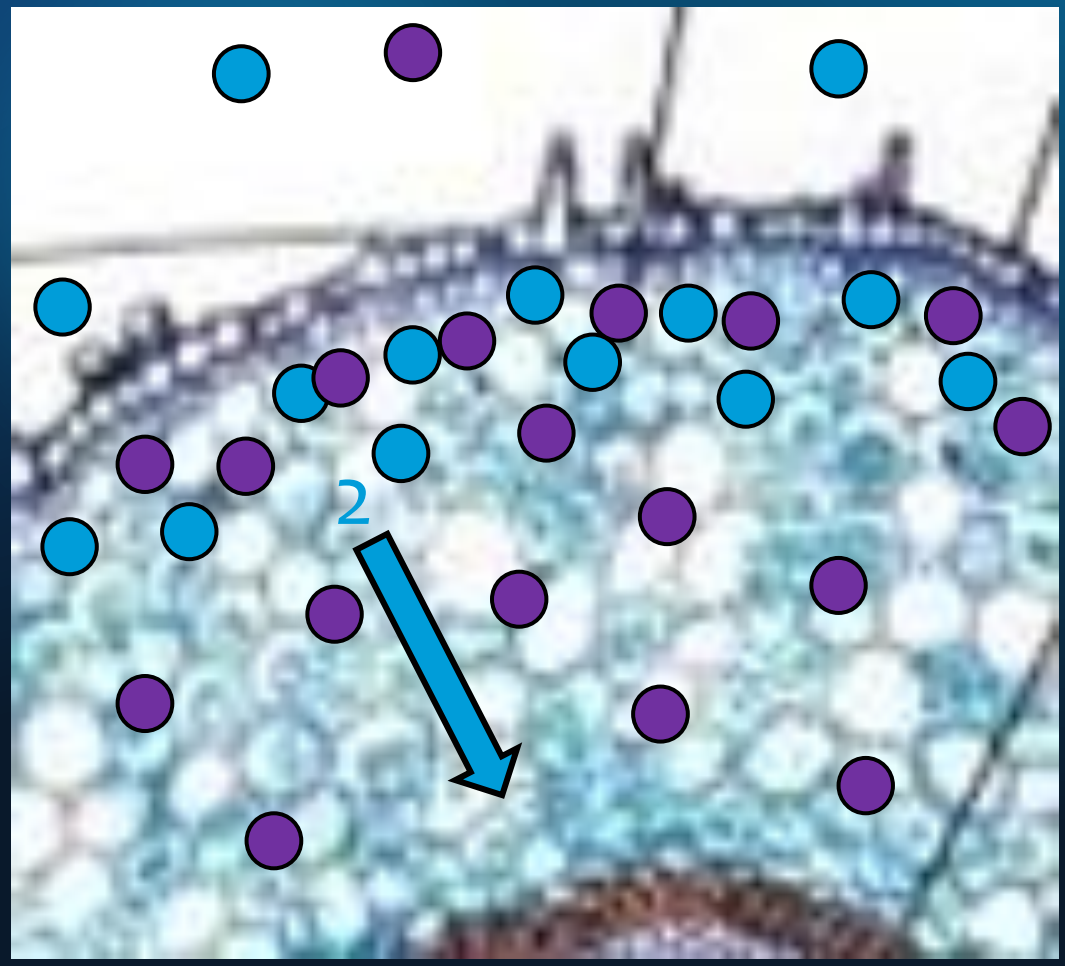
Roots: Moving Inward

Active transport of nutrients towards center of root hair; water follows through osmosis



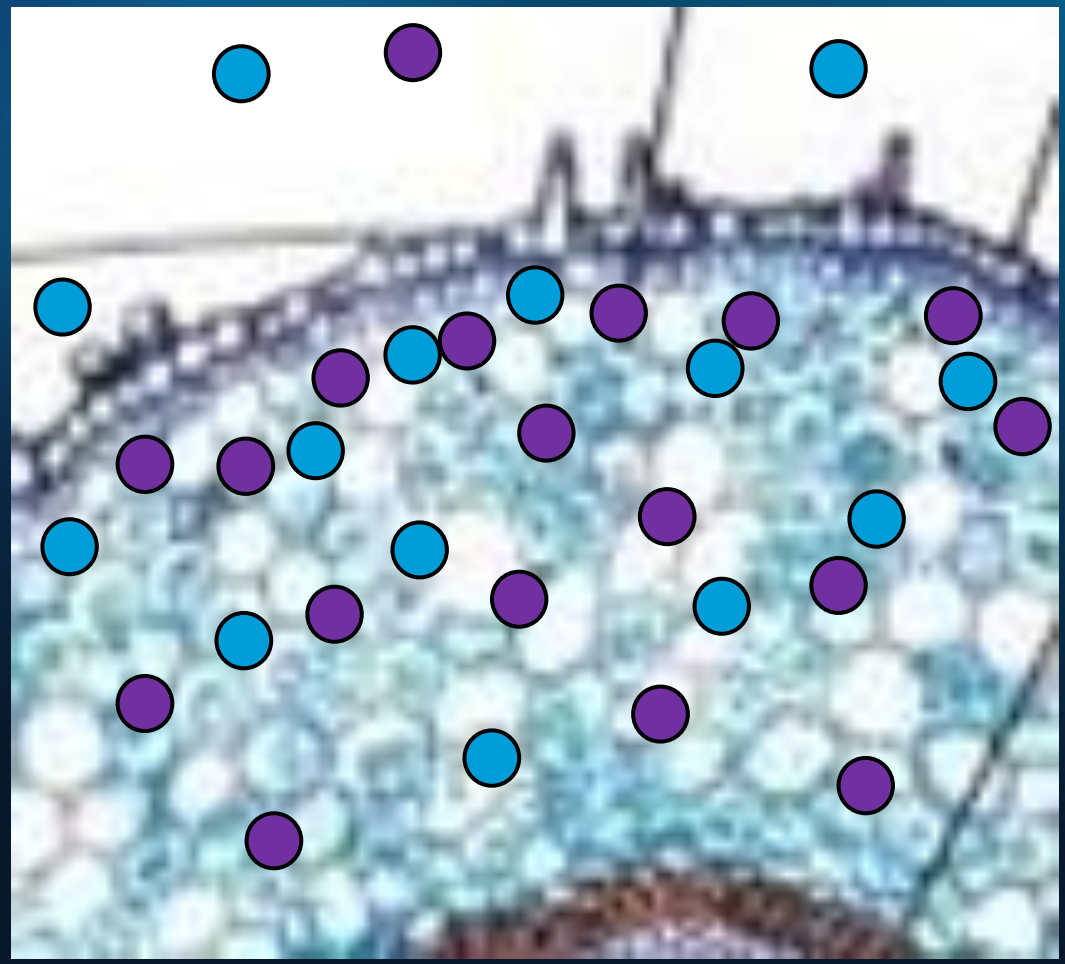
Roots: Moving Inward

Active transport of nutrients towards center of root hair; water follows through osmosis



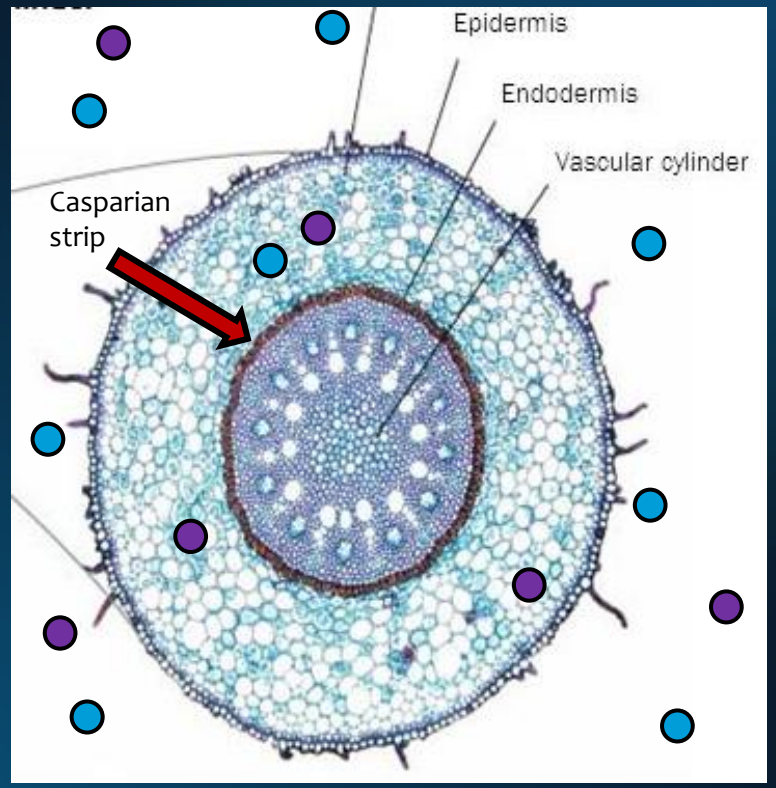
Roots: Moving Inward

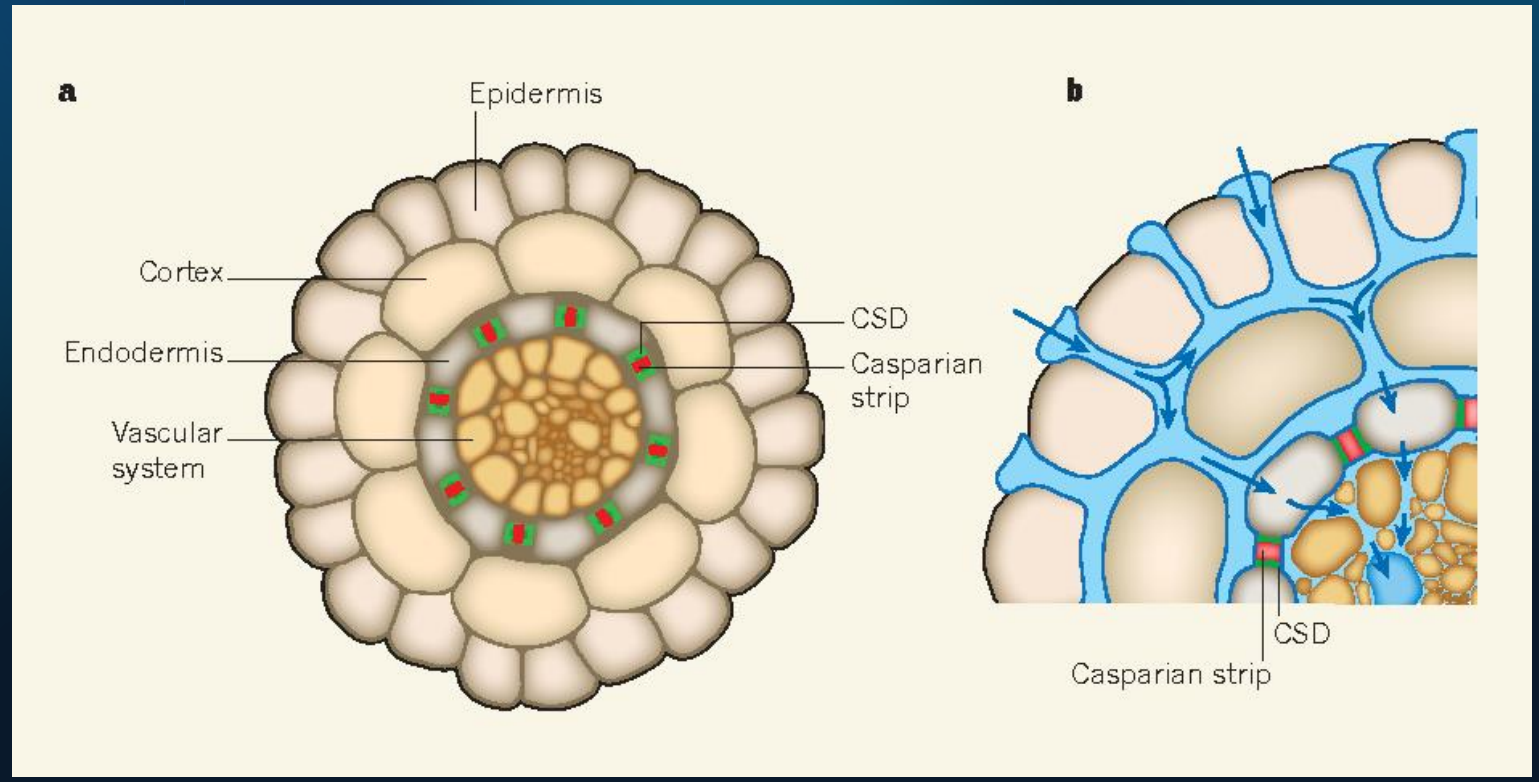
Active transport of nutrients towards center of root hair; water follows through osmosis



Roots: Moving Inward

Casparian strip: impermeable barrier that surrounds vascular cylinder

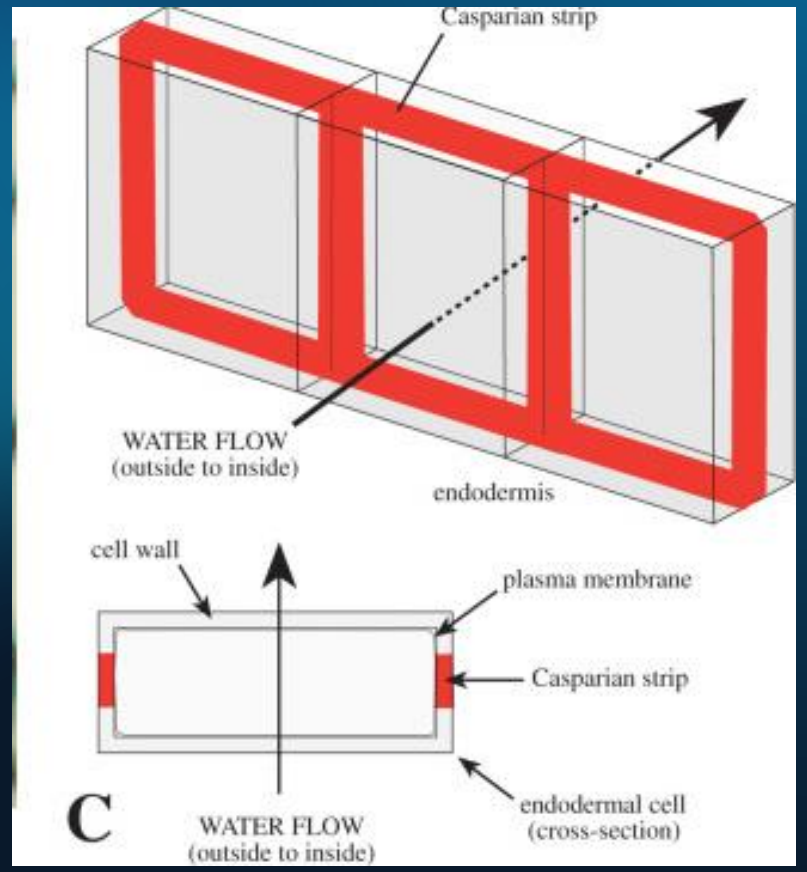




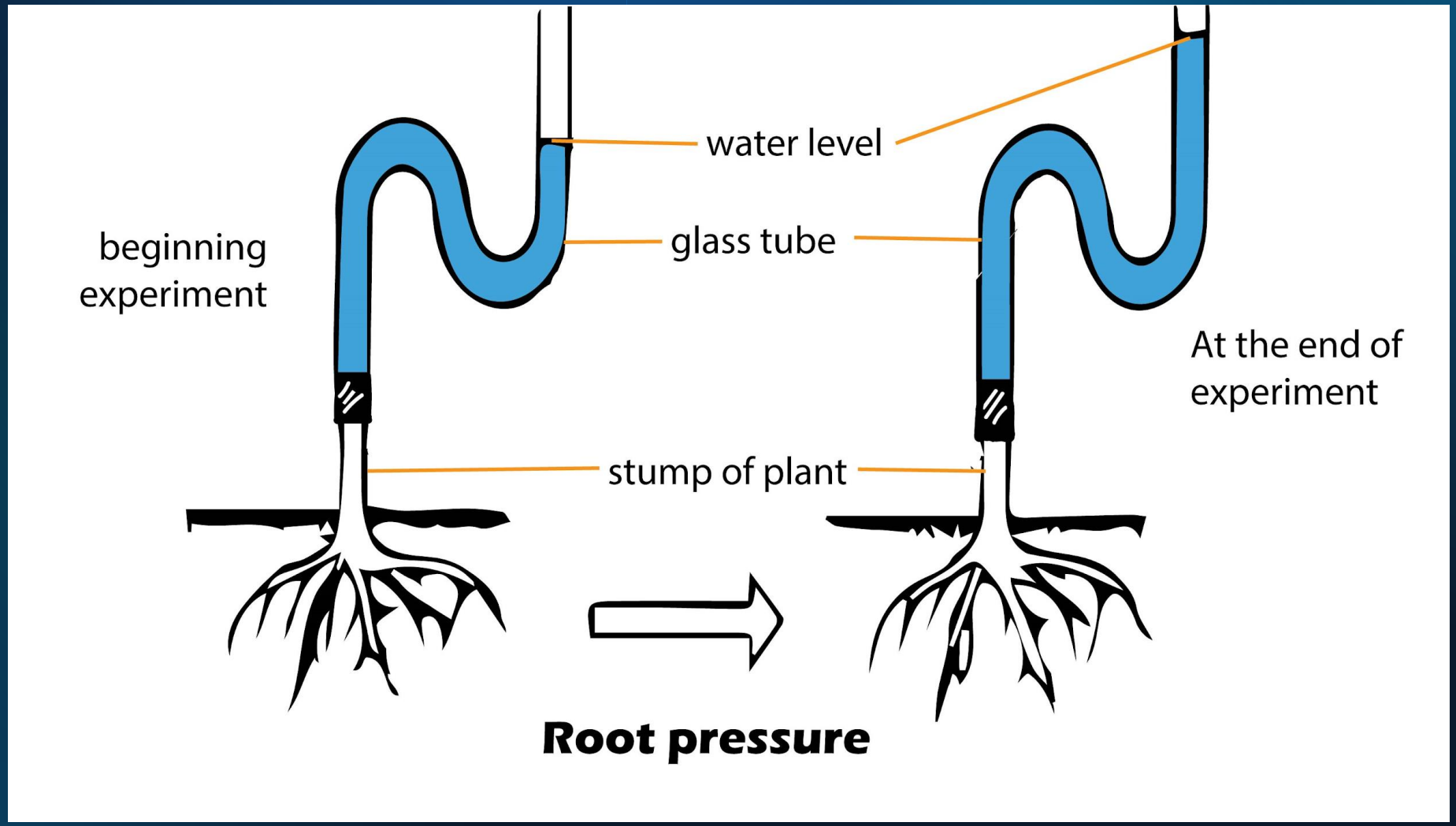
Roots: Moving Inward

Casparian strip: impermeable barrier that surrounds vascular cylinder

- Nutrients actively pumped into vascular cylinder; water follows passively through osmosis
- Water cannot leave vascular cylinder because of the Casparian strip (i.e. it is a one-way trip)



Roots: Onward and Upward



Roots: Onward and Upward

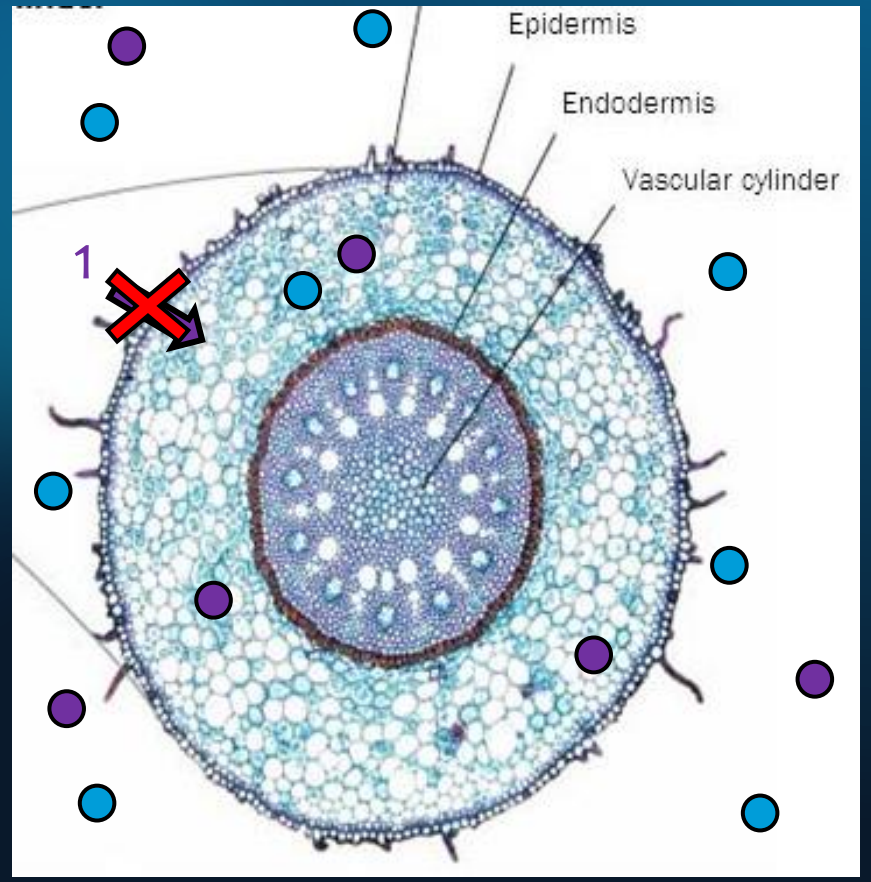
- As more and more water enters (and cannot leave) the vascular cylinder, it is pushed upwards
- **Root pressure:**
  - Caused by continued movement of water into vascular cylinder
  - Water is pushed upwards in the plant
  - Sufficient for moving water in small plants (e.g. strawberries)

101 WAYS TO KILL A PLANT: OVERWATERING

Excessive watering can cause a plant to die of dehydration.

101 WAYS TO KILL A PLANT: OVERWATERING

- Active transport requires ATP and *oxygen* (aerobic cellular respiration)
- Normally, roots take oxygen from small air gaps between soil particles
- Flooded roots → cannot import nutrients → water not absorbed

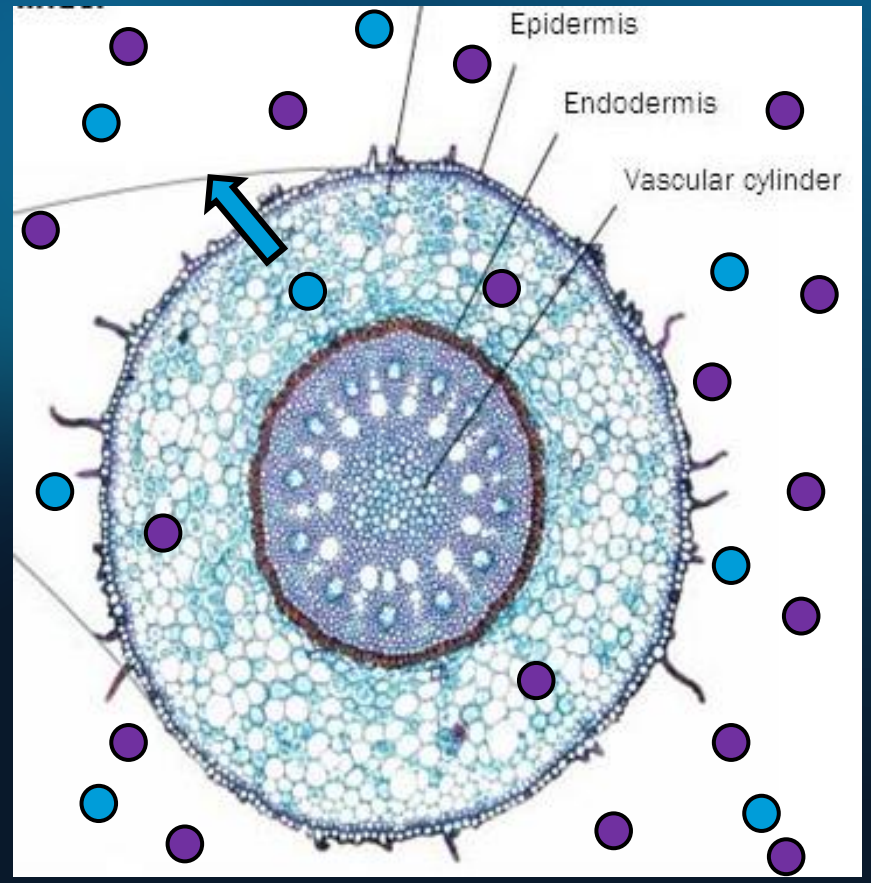


101 WAYS TO KILL A PLANT: OVERFERTILIZING

Excessive use of fertilizer (or too much salt in the soil) can cause a plant to die of dehydration.

101 WAYS TO KILL A PLANT: OVERFERTILIZING

- Passive transport of water into the root requires the concentration of solutes in the root be higher than outside the root.
- If the soil is too saturated with salt or fertilizer, roots can lose water. This is called root burn.



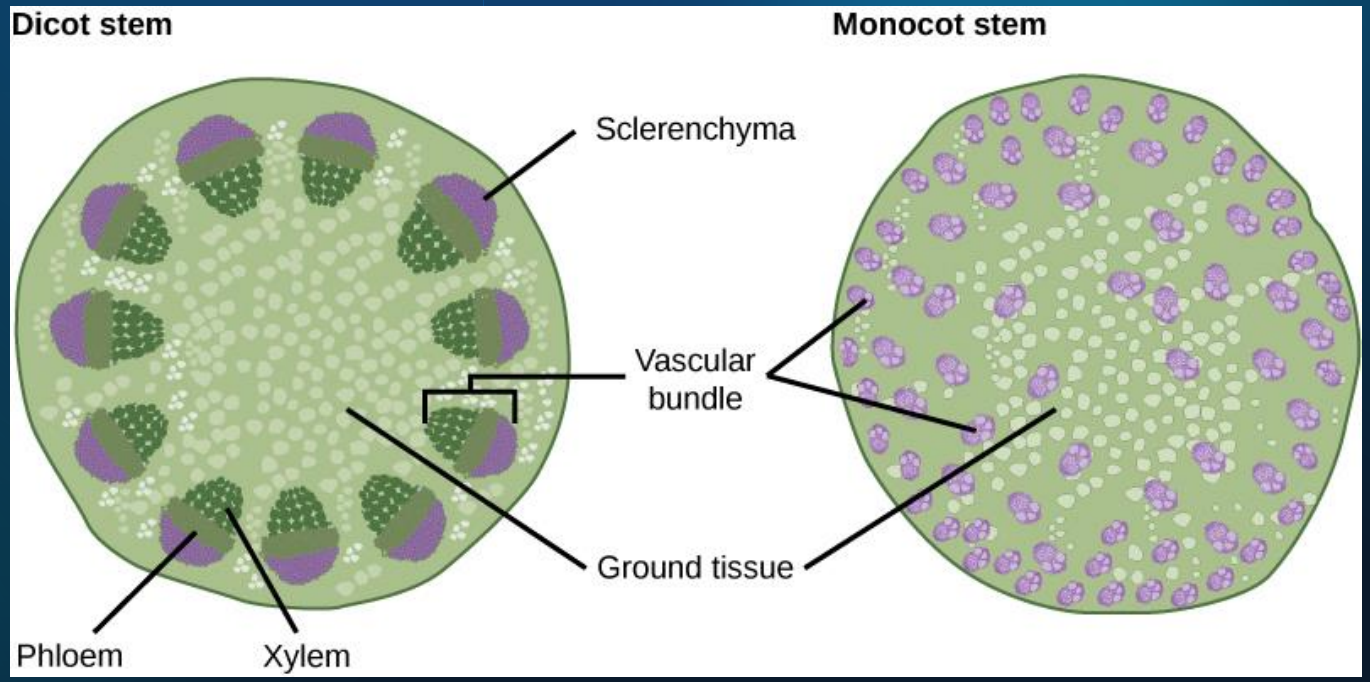
Stems (23-4)

Overview

- Purpose of stems:
  - Hold leaves up in the sunlight
  - Transport substances between the roots and leaves
- Stem components:
  - Parenchyma
  - Vascular tissue (xylem, phloem)
  - Cambium tissue
  - Cork tissue

Monocot vs Dicot Stems

Dicot stem: vascular bundles in distinct ring: phloem exterior and xylem interior



Monocot stem: vascular bundles scattered

Vascular Tissue: Phloem

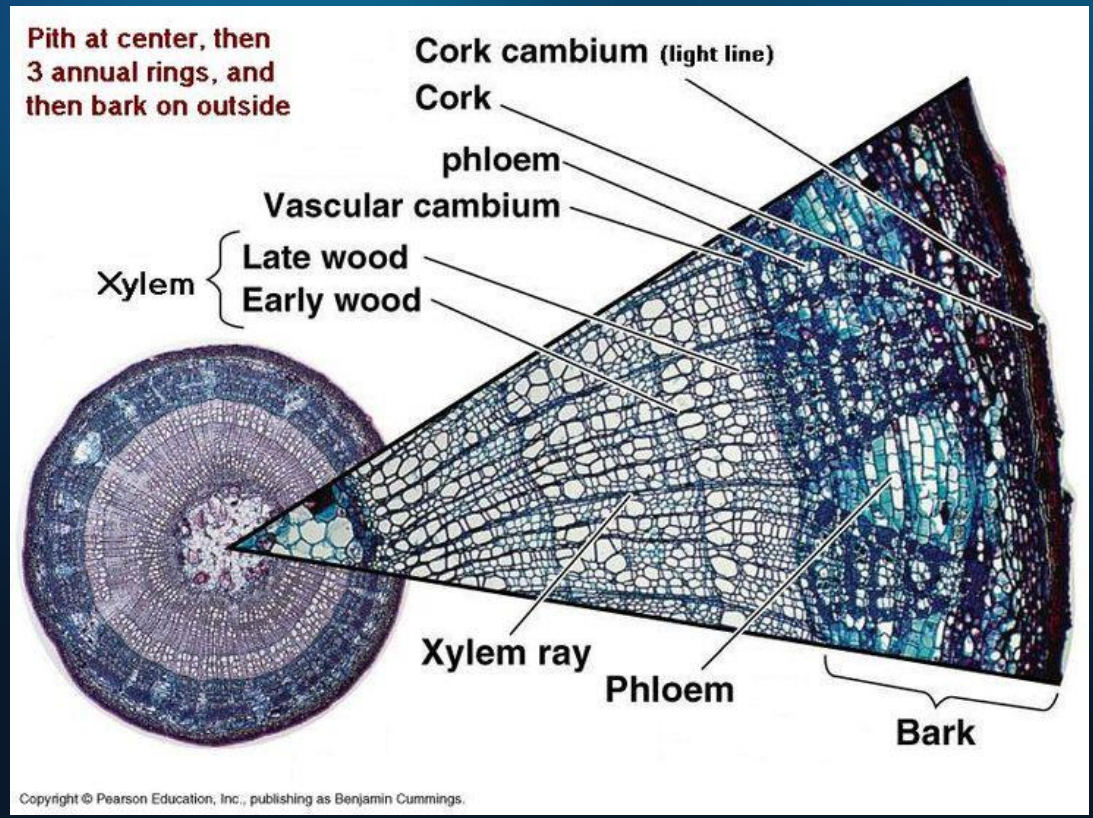
- Stem phloem connected to root phloem
- Carries sugar and other products of photosynthesis from the leaves to other plant parts
- Smaller cells
- In woody dicots, phloem is part of the inner bark

Vascular Tissue: Xylem

- Stem xylem connected to root xylem
- Carries water
- Larger cells
- Makes up the rings of trees: thicker in years when rain is plentiful
- In woody dicots, not all of the xylem is used:
  - Older xylem near center is **heartwood** – dead xylem cells, does not conduct water but provides structural support
  - Younger xylem towards outside is **sapwood** – transports liquids

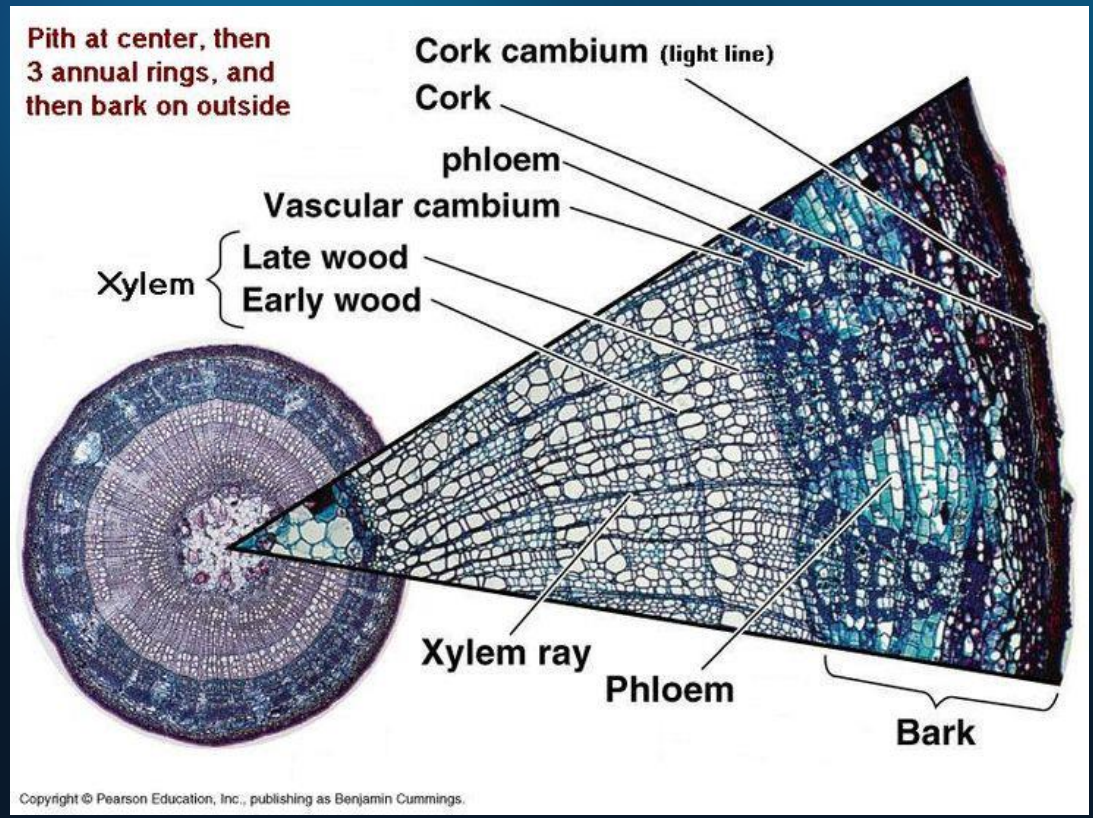
Vascular Cambium

- **Vascular cambium:**
  - Thin layer that separates xylem from phloem
  - Makes more xylem and phloem cells, causing the dicot to increase in width



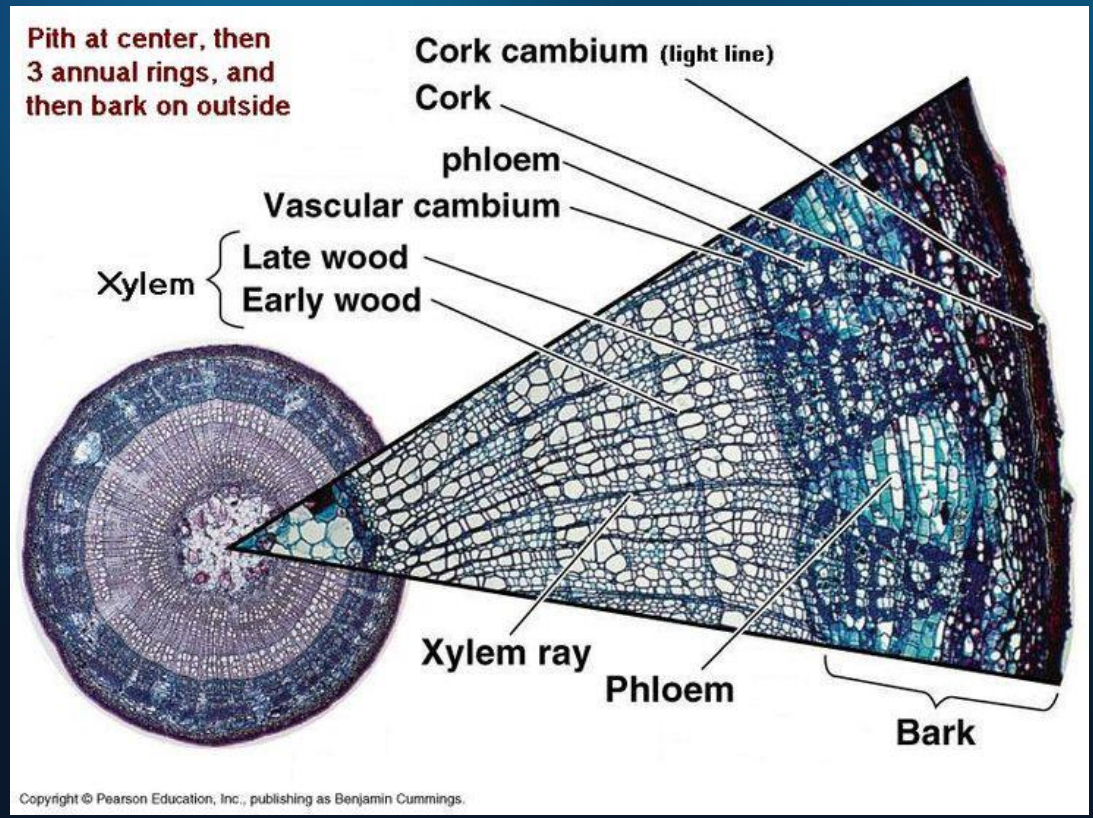
Cork

- **Cork:**
  - Outer bark of trees
  - Have thick cell walls
  - Often contain waterproof substances (oil, fat, wax) to prevent evaporation
  - Outermost cork cells are dead



Cork Growth

- Layer of **cork cambium** between phloem and cork: produces new cork cells

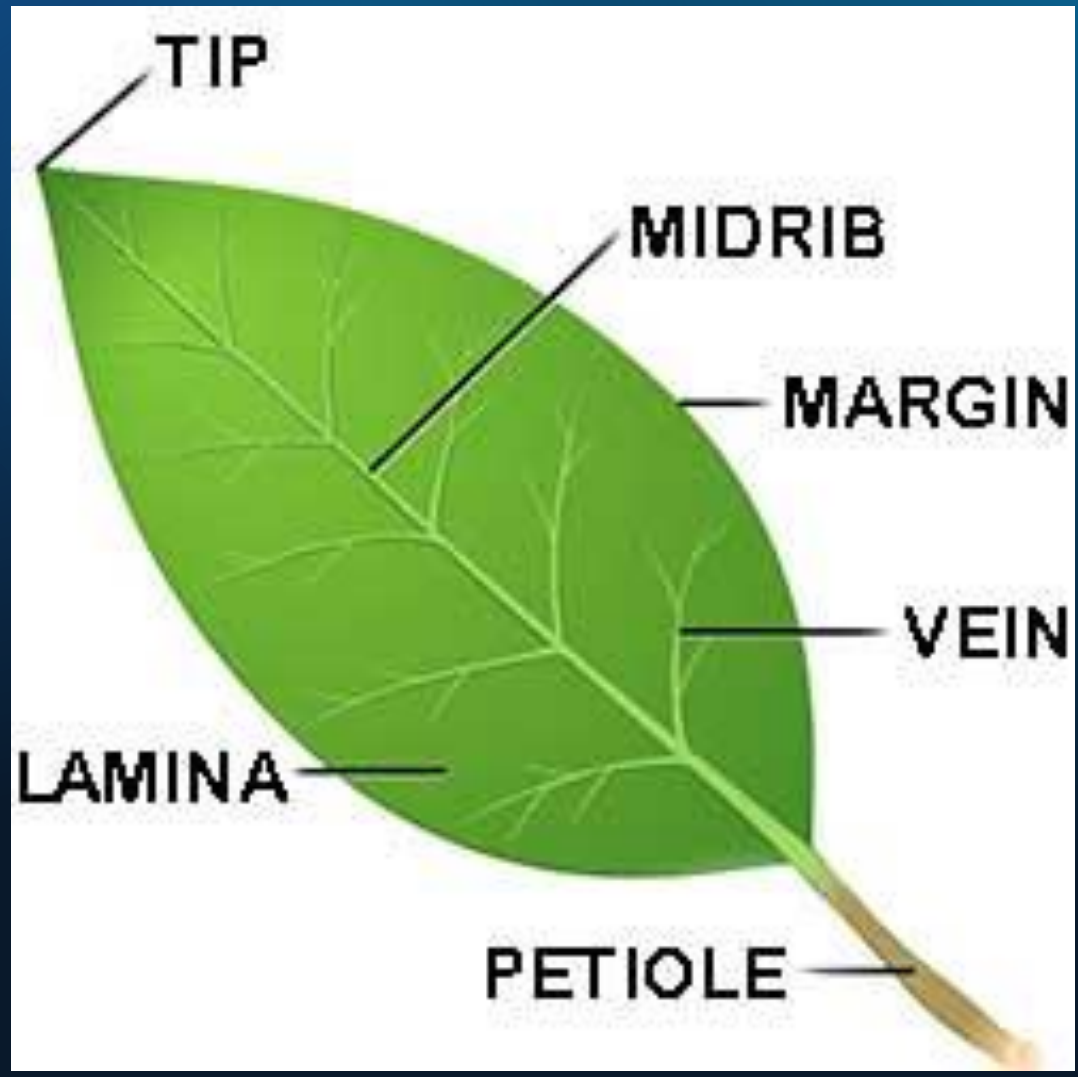


Leaves (23-5)

KUSO
DESIGN

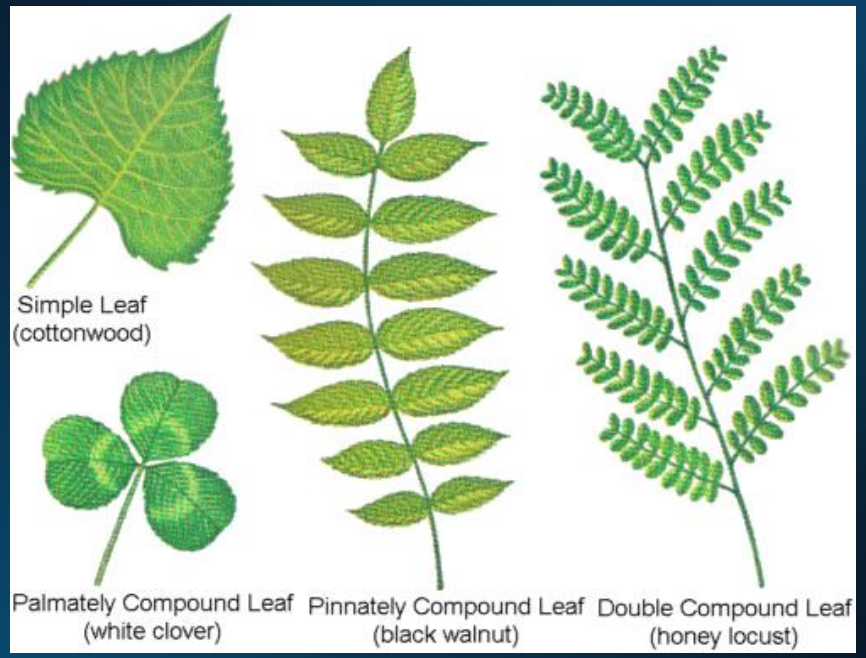
Macroscopic Leaf Structure

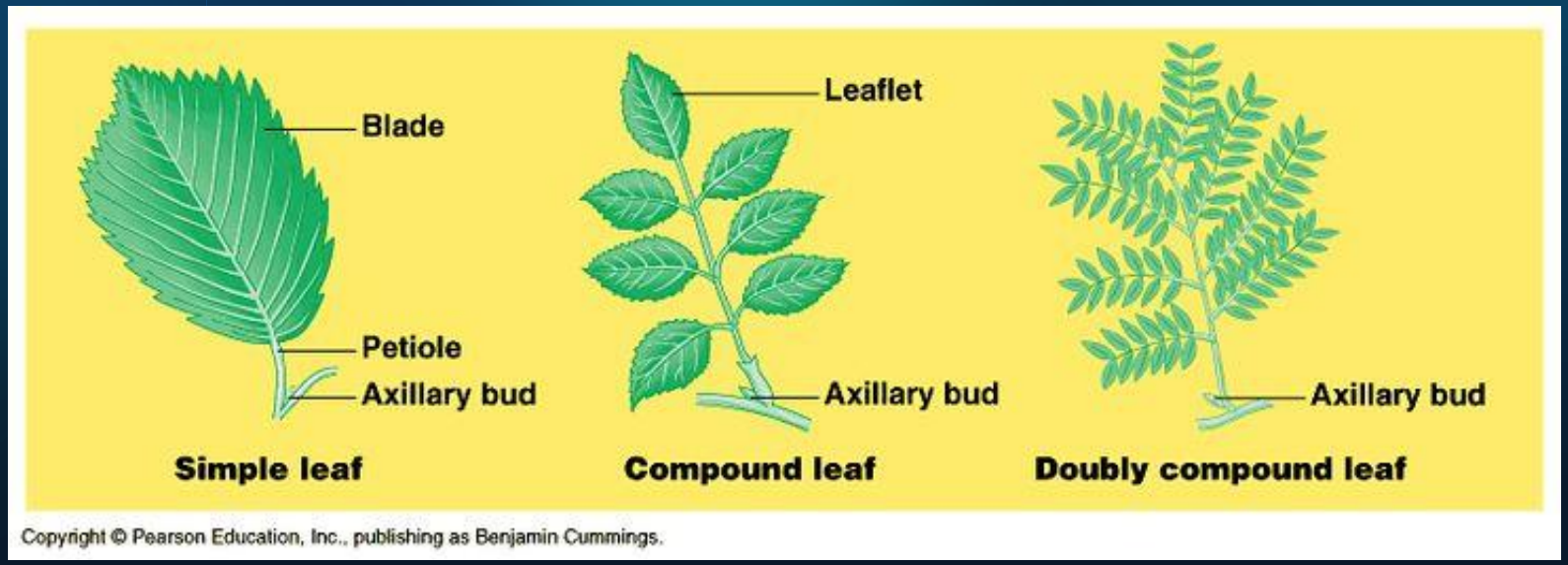
- **Blade:** large thin, flattened section of leaf
- **Petiole:** thin structure attaching blade to stem



Macroscopic Leaf Structure

- **Simple leaf:** a single blade connected directly to the stem
- **Compound leaf:** smaller leaflets connected together

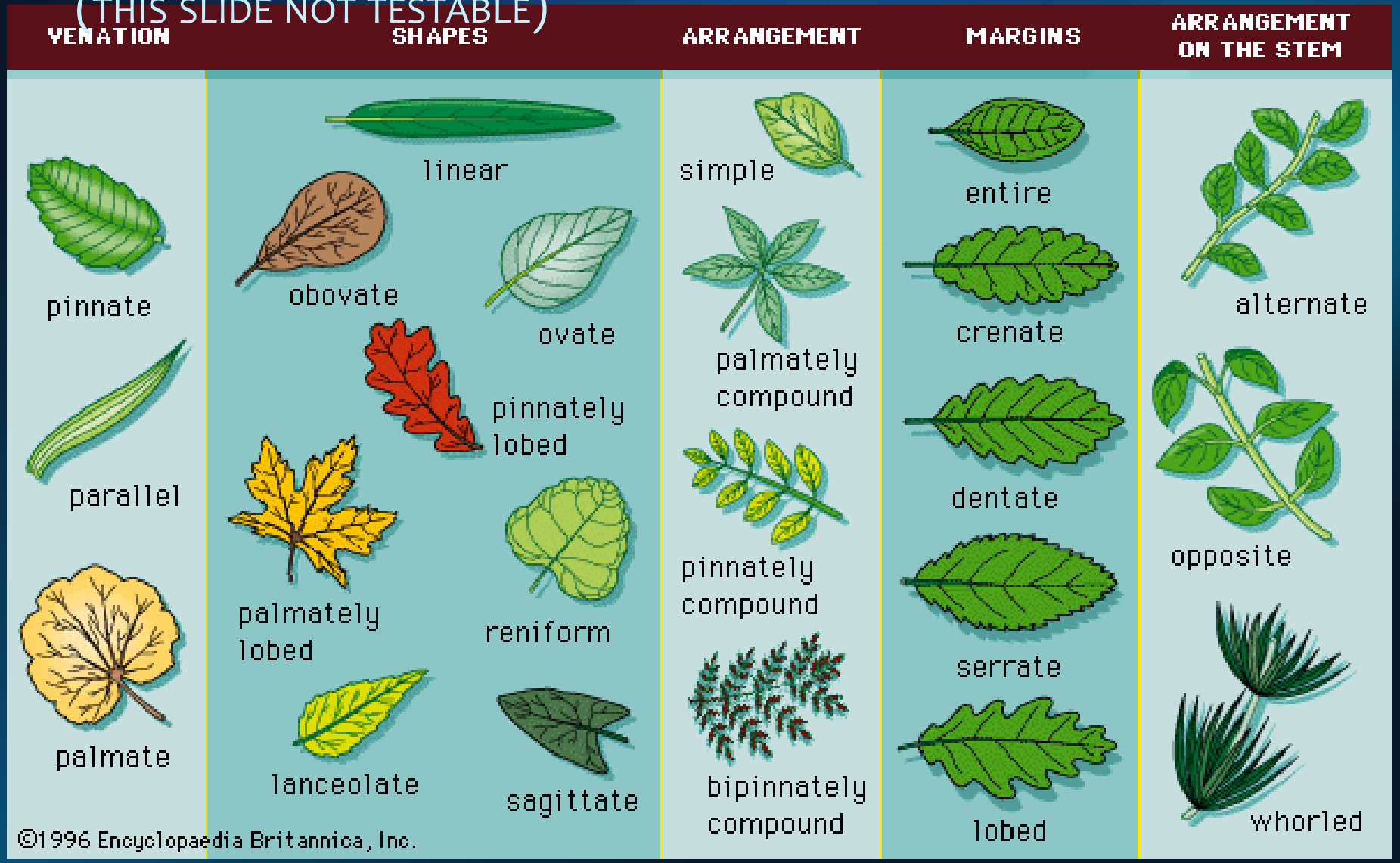




Pro tip: unsure whether you're looking at a leaf or a leaflet? Look for buds. There is a bud wherever the petiole of a leaf connects to the stem of a plant.

Macroscopic Leaf Structure

(THIS SLIDE NOT TESTABLE)



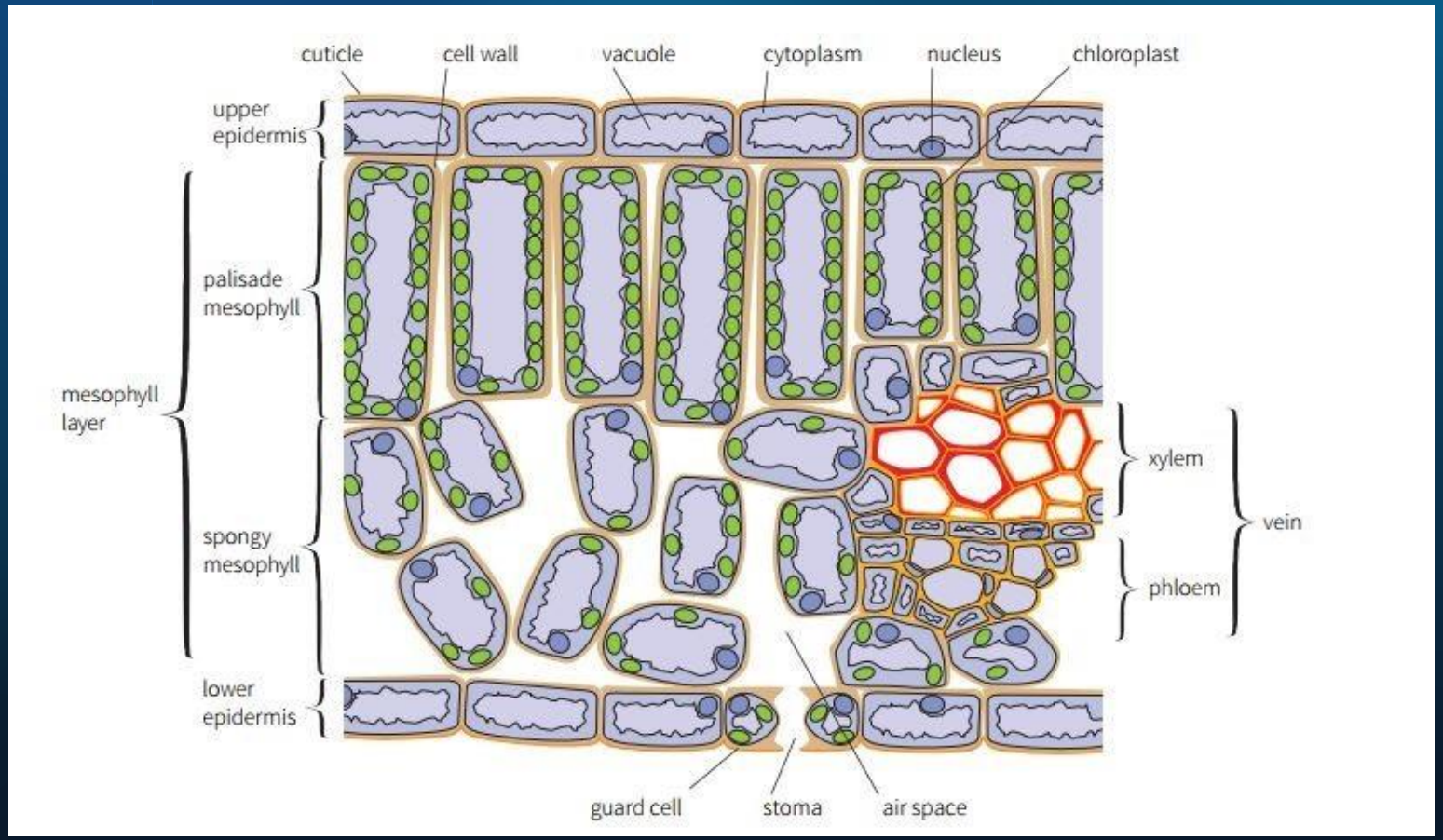
Leaves come in all shapes and sizes.

Microscopic Leaf Structure

Cuticle: waterproof waxy layer

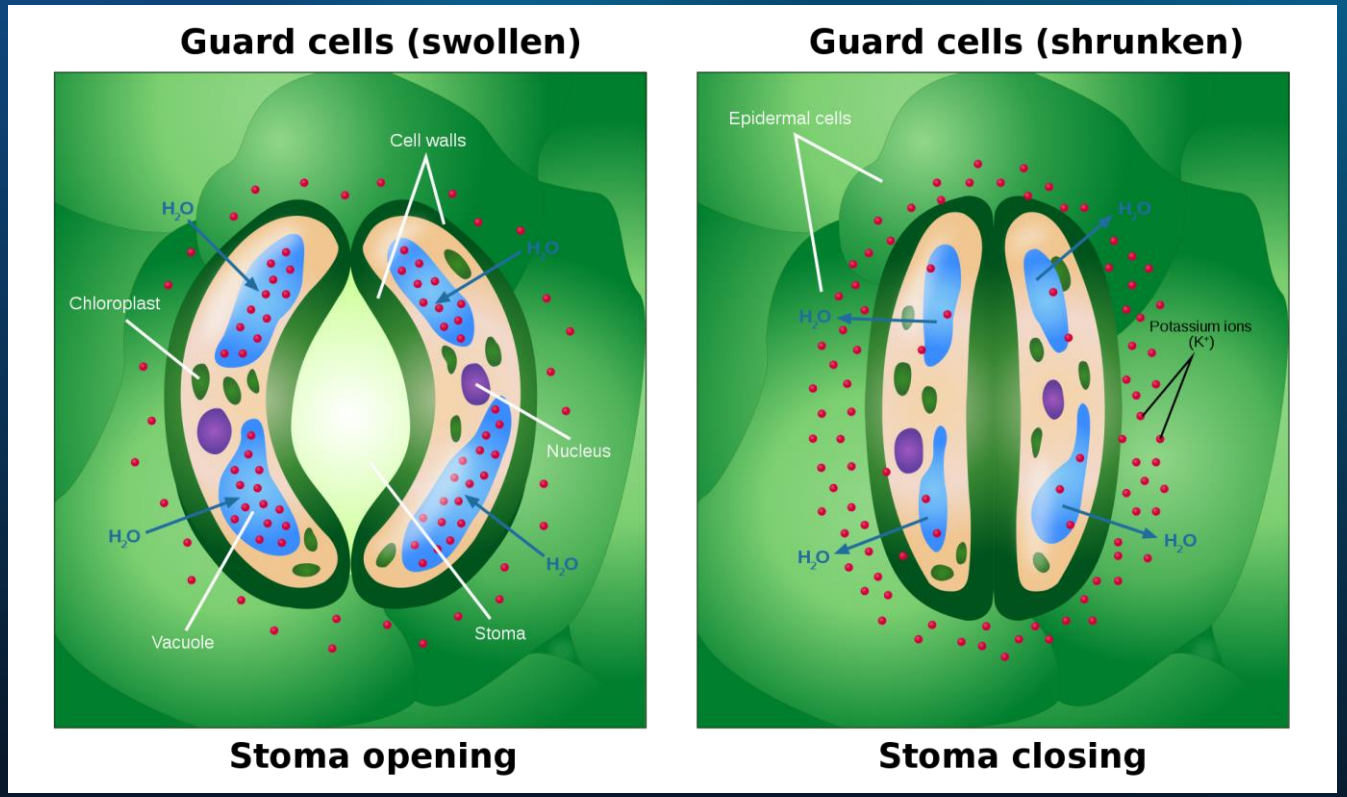
Epidermis: outer layer of cells, lack chloroplasts

Stoma (pl. stomata): small openings that can open and close for gas exchange



Microscopic Leaf Structure

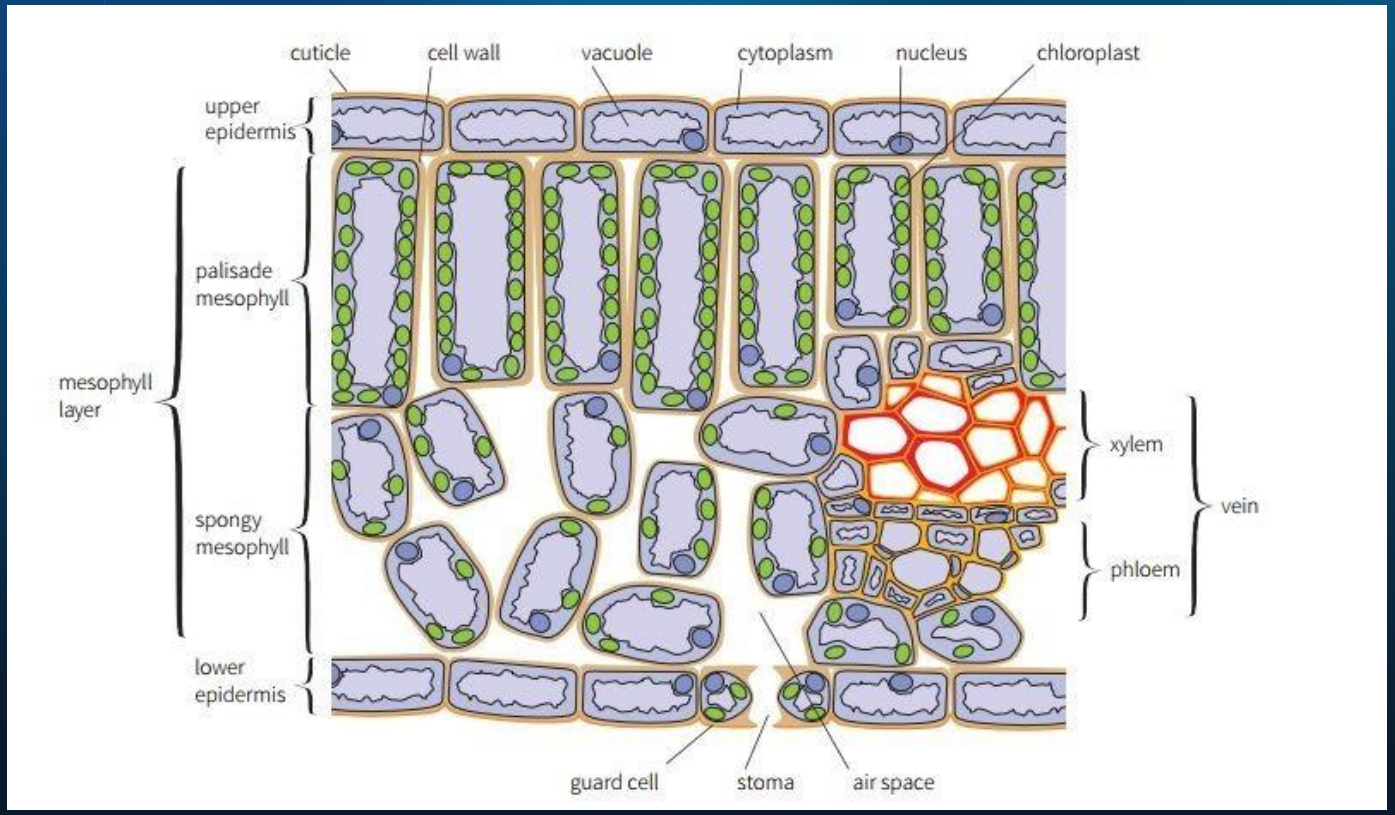
- Each stoma is made of two guard cells which respond to changes in water pressure.
- High water → guard cells swell and stoma opens
- Low water → guard cells 'deflate' and stoma closes



Microscopic Leaf Structure

Mesophyll cells:

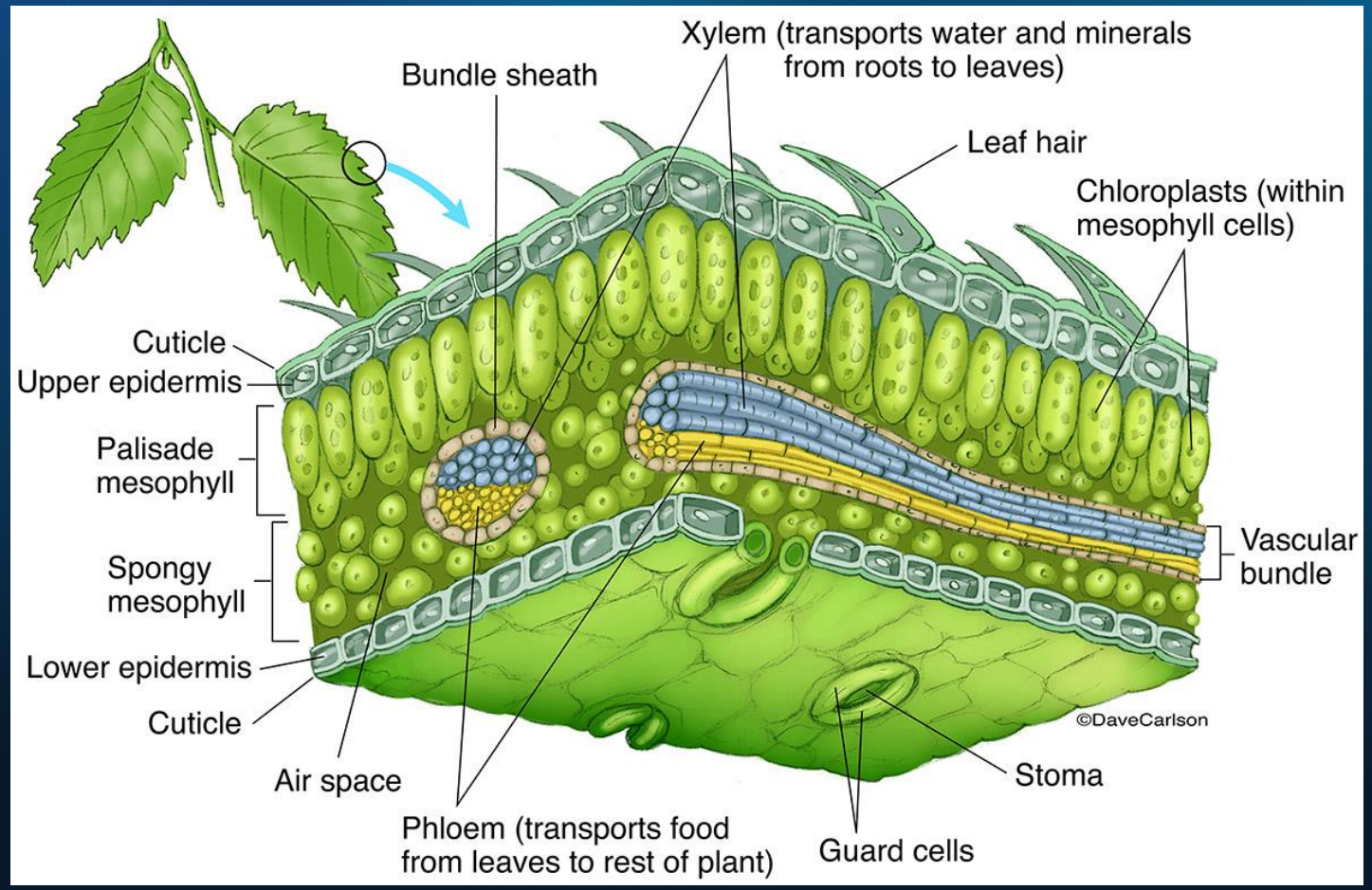
- Contain chloroplasts and perform photosynthesis
- Have direct access to air and water



Microscopic Leaf Structure

Vascular tissue:

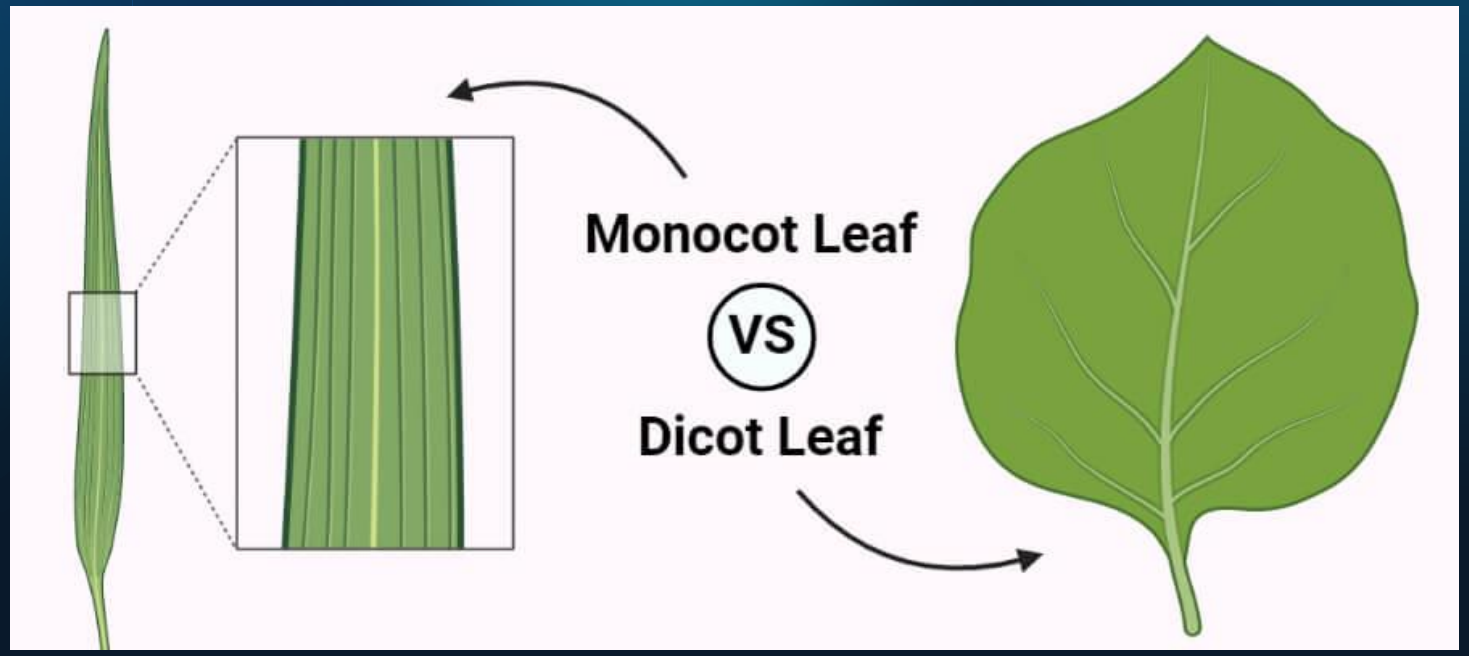
- Xylem and phloem are bundled in veins
- Xylem brings water/nutrients to the leaf; phloem carries sugars away



Microscopic Leaf Structure

Vascular tissue:

- Veins run through the petiole and connect to the stem vascular tissue
- Veins run parallel in monocots, branch in dicots

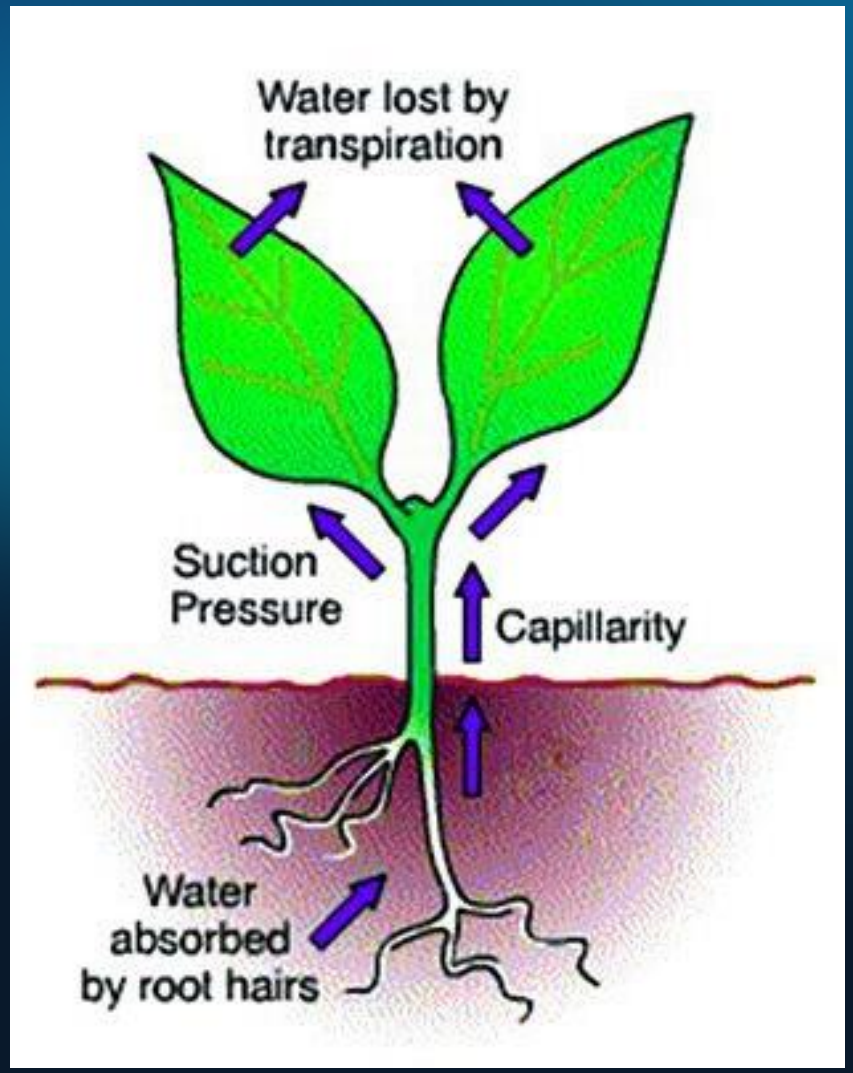


Transport in Plants (23-6)

Summary

Plants move water (and nutrients) upwards from the roots to the leaves through the following mechanisms:

- Root Pressure
- Capillary Action
- Transpiration Pull

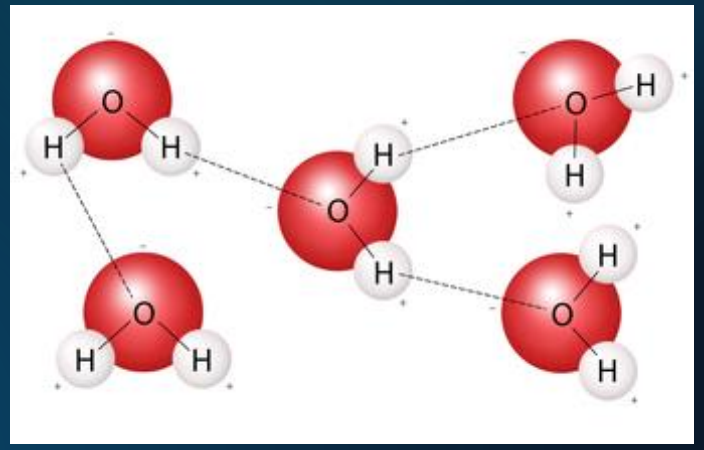


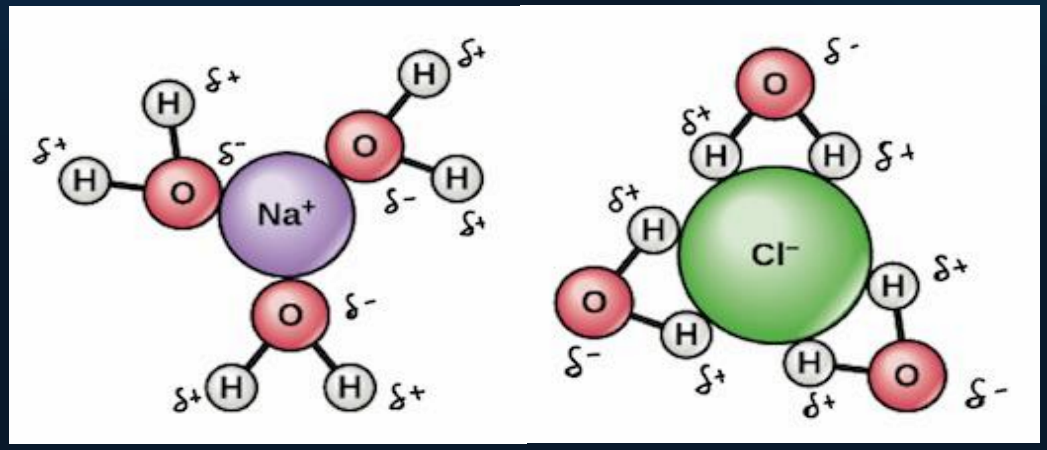
Root Pressure

- *Discussed previously in Root section (23-5)*
- *Tl;dr: roots are continuously intaking water. This forces water up the plant through the vascular system.*

Capillary Action

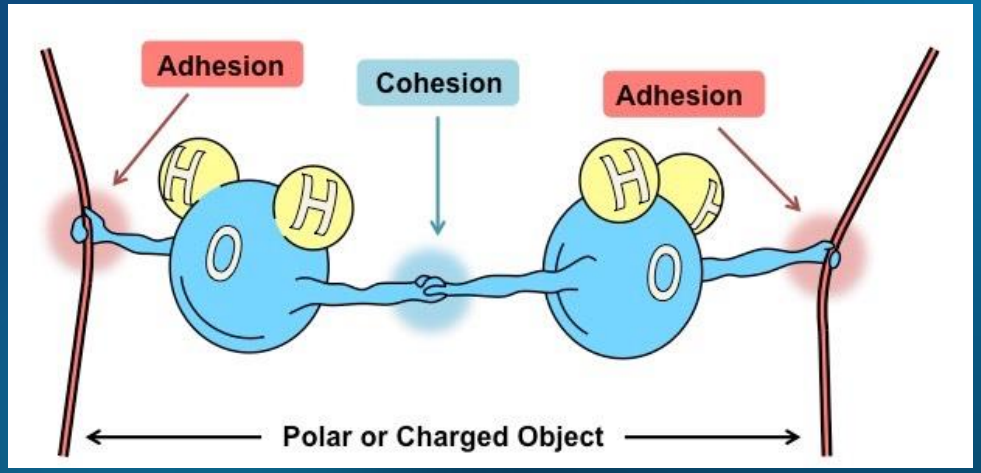
- *Discussed previously in Biochemistry unit. Summary below and next slide.*
- Water experiences strong cohesion (sticks to itself) and adhesion (sticks to other things)

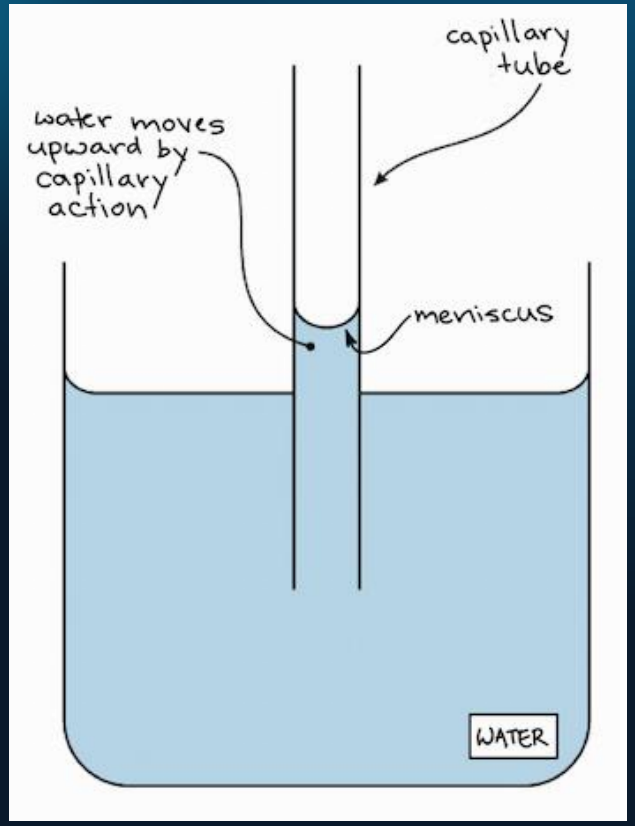




Capillary Action

- Capillary action: water is automatically drawn up narrow tubes through cohesive and adhesive forces, without energy expenditure
- Xylem is made of tubes; capillary action helps draw water upwards





Transpiration Pull

1. Water evaporates constantly from mesophyll cells
2. Evaporated water is replaced through osmosis from neighbouring mesophyll cells
3. ‘Lost’ water is replaced through osmosis from neighbouring xylem
4. Adhesion and cohesion pull water molecules from stems and roots

Transpiration Pull

- Very strong process: large tree can move 1800 liters of water from ground to atmosphere in a day!