

PLANTS:



- *Structure and Growth*

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First some basics...

There are 2 main divisions in the Plant Kingdom:



- Gymnosperms-






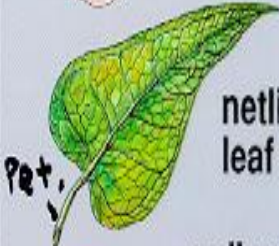


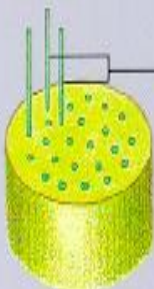

- Less common, more “ancient”, no flowers.
- Bear “naked seeds” not enclosed by special chambers.
- Pines, Junipers, ginkgo trees..



- Angiosperms-

- More common, more recently evolved, bear flowers
- Bear seeds inside a protective “ovary”.
- We will focus on this division in this course.
- Angiosperms themselves have 2 divisions : Monocot and Dicot.

(Angiosperms) Monocot vs Dicot:

| MONOCOTS | DICOTS |
|---|---|
|  <p>one cotyledon</p> |  <p>two cotyledons</p> |
|  <p>floral parts in threes</p> |  <p>floral parts in fours or fives</p> |
|  <p>parallel leaf veins</p> |  <p>netlike leaf veins</p> |
|  <p>pollen grain has one pore or furrow</p> |  <p>pollen grain has three pores or furrows</p> |
|  <p>vascular bundles throughout stem's ground tissue</p> |  <p>stem's vascular bundles arranged in a ring</p> |

Monocot-

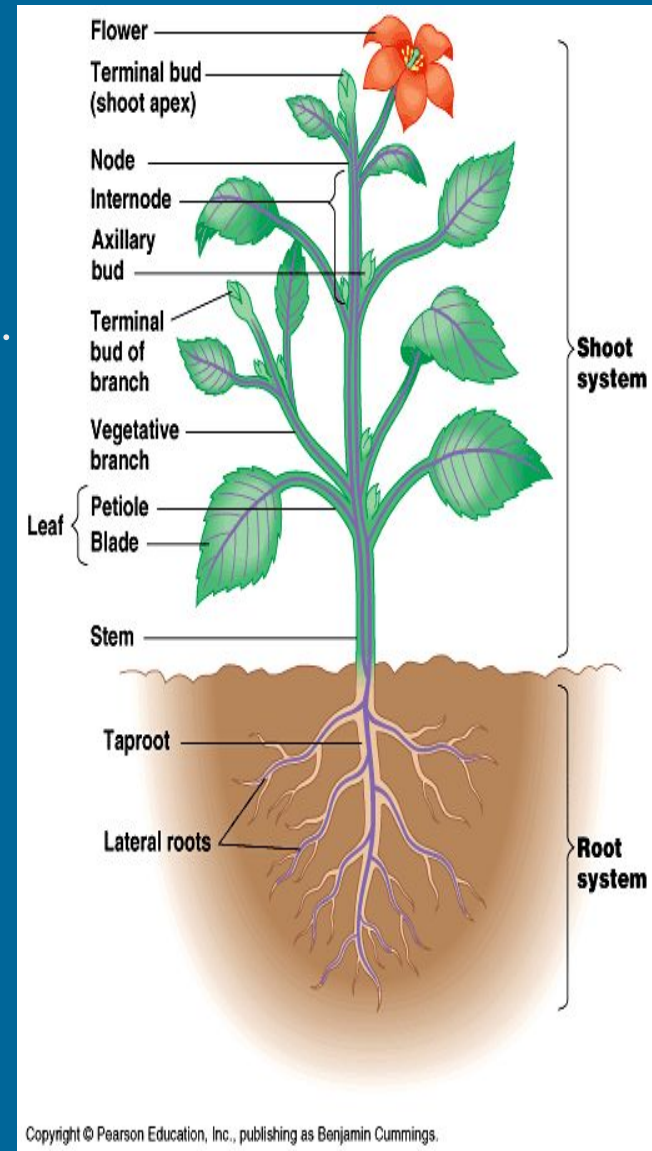
- Stands for “monocotyledonous”
- Fibrous root
- Leaves with parallel venation
- Seeds have just one cotyledon
- Stem bundles are “complex”

Dicot-

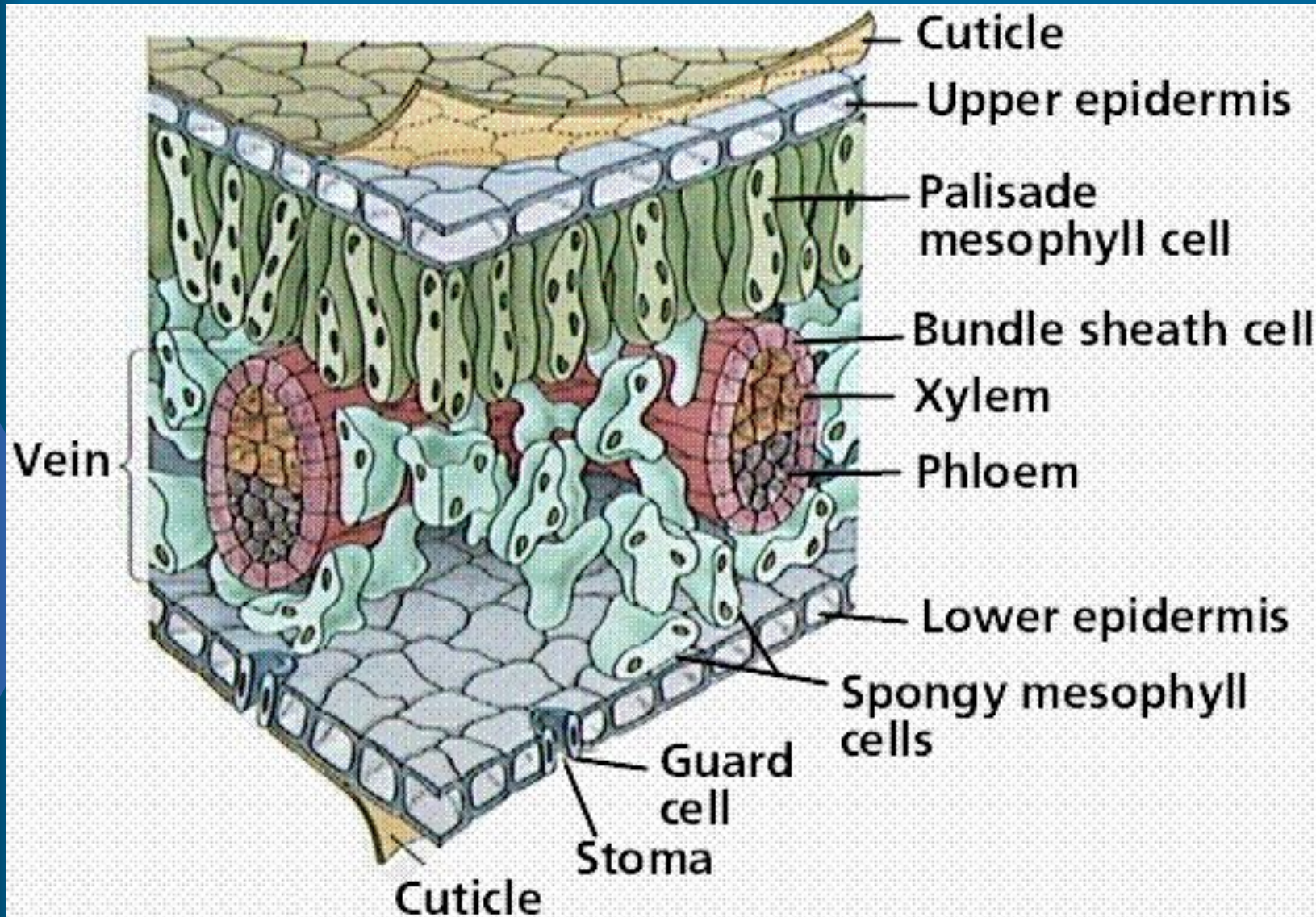
- Stands for “dicotyledonous”
- Taproots (less fibrous)
- Leaves with branching veins
- Seeds with 2 cotyledons
- Stem bundles in the shape of a ring.

Angiosperm structure

- Two basic Systems:
- 1. Root System- anchor, absorb, store
- fibrous: mat of thin roots (monocots)
- taproot: one large, vertical root (dicots)
- Both types have many “root hairs” which provides lots of surface area for absorption.
- 2. Shoot System (Stems & Leaves)
- STEMS:
- nodes: leaf attachment
- internodes: stem segments
- axillary bud: dormant, vegetative potential
- terminal bud: apex of young shoot
- apical dominance: inhibits axillary buds
- Modified stems: stolons, rhizomes, bulbs.
- LEAVES:
- main photosynthetic organ
- Blades joined to node by “petiole”.

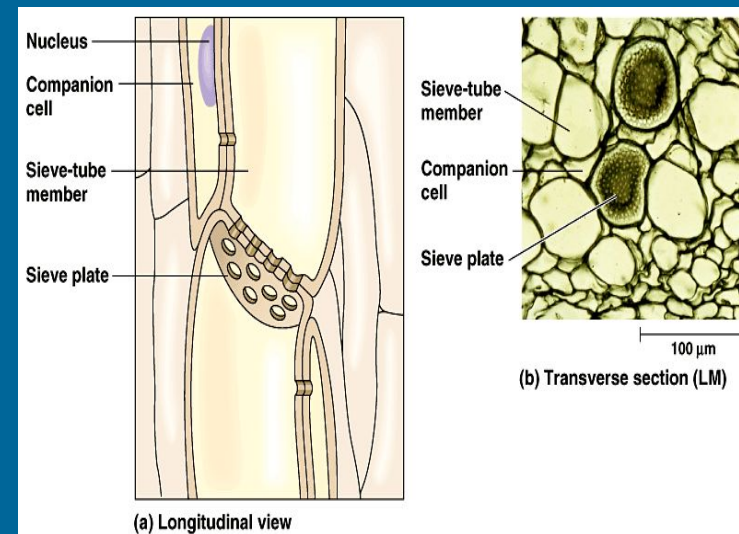
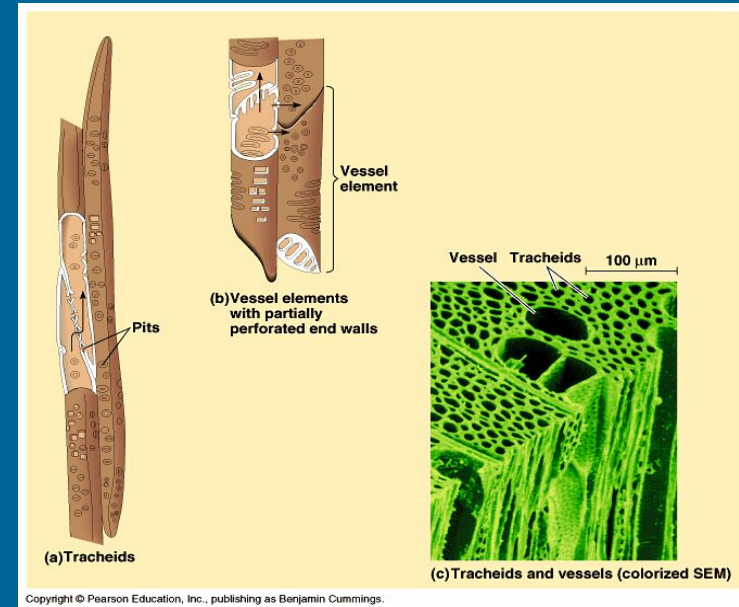


And since we're talkin' leaves.....



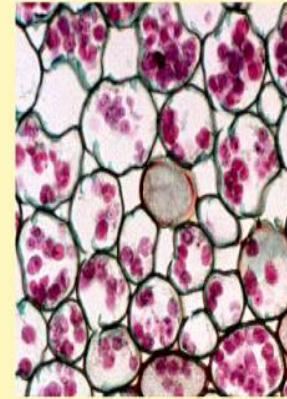
Plant Organ Systems

- **Dermal** (epidermis): single layer of cells for protection
cuticle is part of epidermis
- **Vascular** (material transport)
 - xylem**: water and dissolved minerals
roots to shoots
tracheids & vessel elements: xylem elongated cells dead at maturity
 - phloem**: food from leaves to roots and fruits
sieve-tube members: phloem tubes alive at maturity capped by sieve plates;
companion cells (nonconducting) connected by plasmodesmata
- **Ground** (photosynthesis, storage, support): pith and cortex

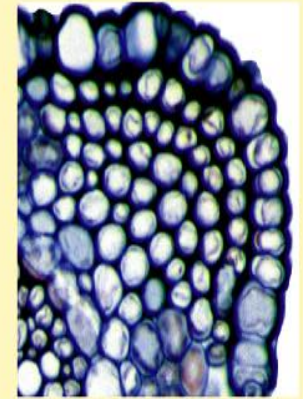


Plant Tissue Cell Types

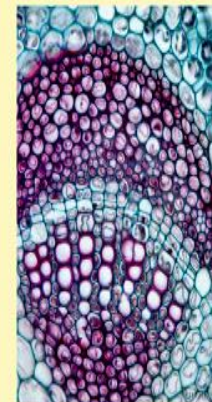
- **Parenchyma:**
 - walls thin and flexible
 - no secondary walls
 - large central vacuole
 - main workhorse for photosynthesis
- **Collenchyma:**
 - unevenly thick primary walls
 - used for plant support
- **Sclerenchyma:**
 - support element strengthened by secondary cell walls with lignin
 - Dead at functional maturity
 - xylem cells are mostly sclerenchyma
 - Also include support cells such as...
 - fibers (long, slender tapered)
 - and sclereids (shorter, irregular)



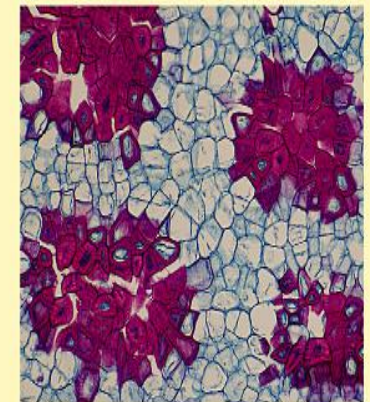
(a) Parenchyma cells



(b) Collenchyma cells



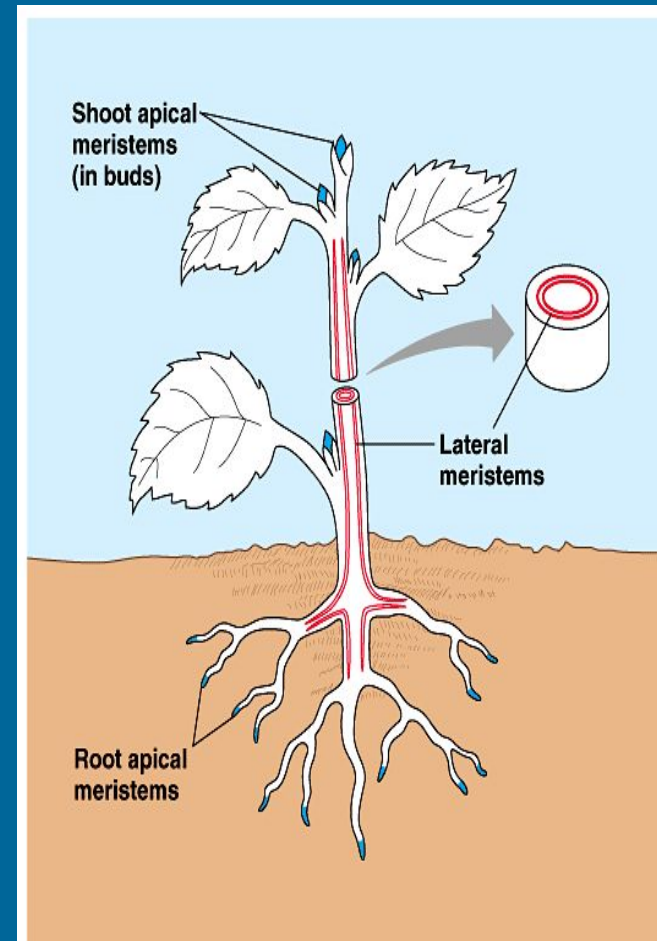
(c) Sclerenchyma cells:
Fiber cells



Sclerenchyma cells: Sclereids
50 μ m

Plant Growth

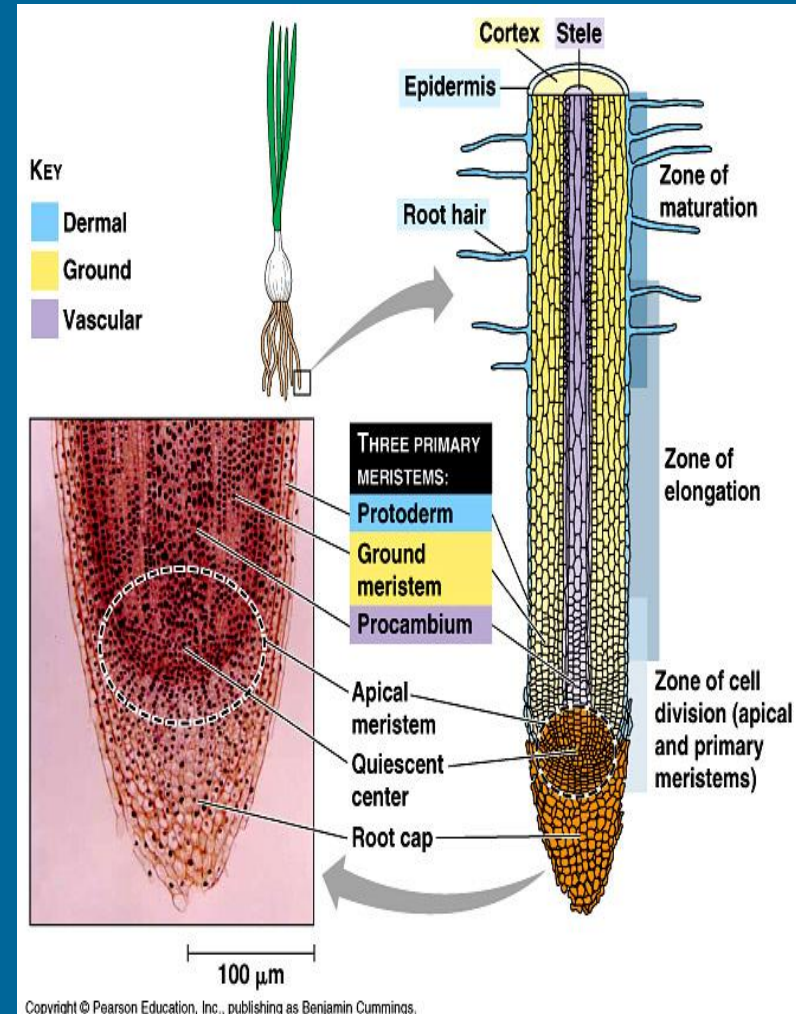
- Life Cycles
- Exhibit “Indeterminate growth”
- *annuals*: 1 year (wildflowers; food crops)
- *biennials*: 2 years (beets; carrots)
- *perennials*: many years (trees; shrubs)
- Meristem
- **perpetually embryonic tissues**
- *apical*: tips of roots and buds; primary growth
- *lateral*: cylinders of dividing cells along length of roots and stems; secondary growth (wood)
- There are 3 “primary Meristems”:
- 1. Protoderm- becomes epidermis
- 2. Procambium- becomes vascular tissue
- 3. Ground Meristem- becomes ground tissue



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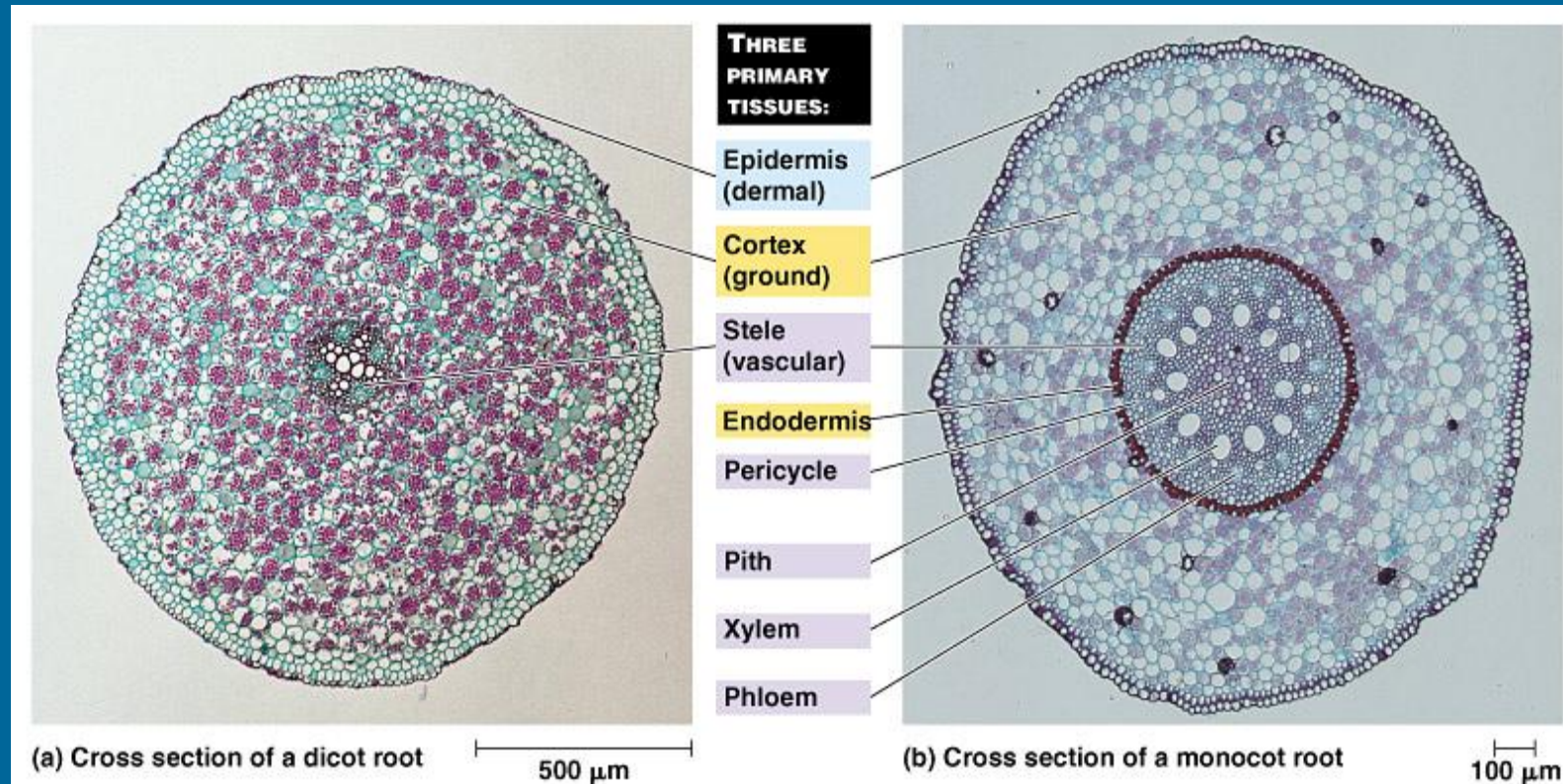
Primary growth

- Roots:
- root cap~ protection of meristem
- zone of cell division~ primary (apical) meristem
- zone of elongation~ cells elongate; pushes root tip
- zone of maturation~ differentiation of cells (formation of 3 tissue systems)



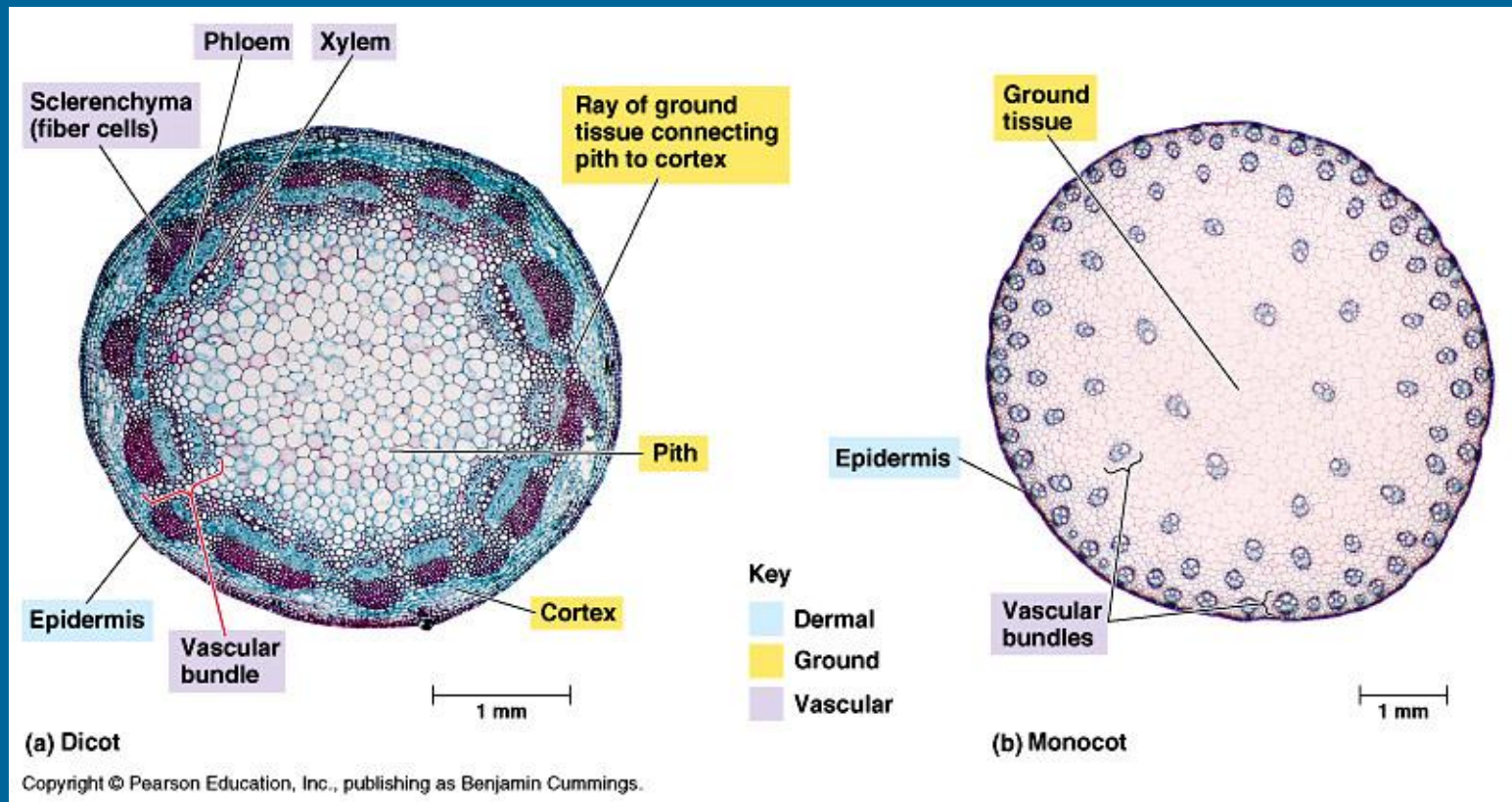
Primary Tissues of Roots

- *Stele*~ the vascular bundle where both xylem and phloem develop
- *Pith*~ central core of stele in monocot; parenchyma cells
- *Cortex*~ region of the root between the stele and epidermis (innermost layer: *endodermis*)
- *Lateral roots*~ arise from *pericycle* (outermost layer of stele); just inside endodermis, cells that may become meristematic



Primary Tissues of Stems

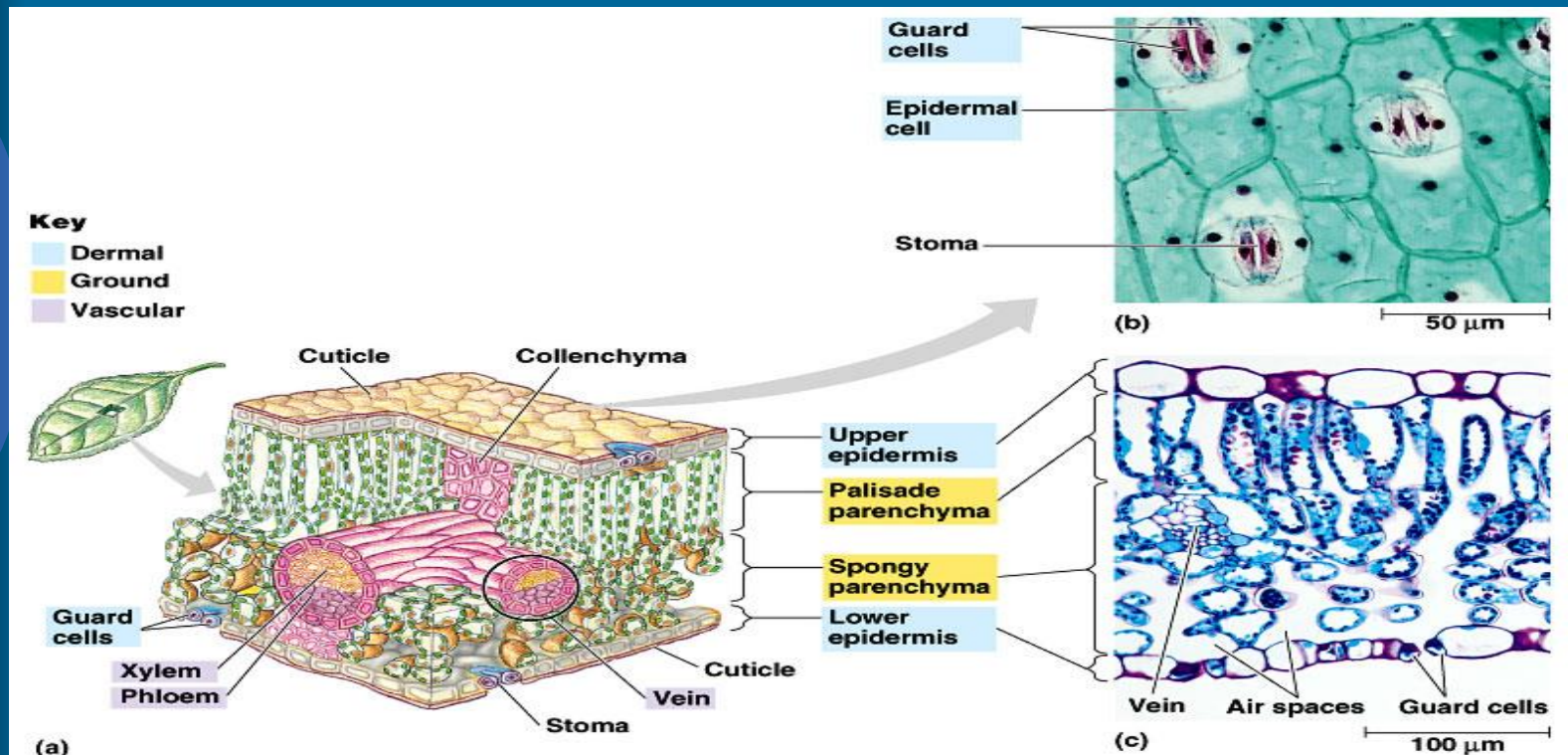
- Vascular bundles (xylem and phloem)
- Surrounded by ground tissue (xylem faces pith and phloem faces cortex)
- Mostly parenchyma; some collenchyma and sclerenchyma for support



Primary Tissues of Leaves

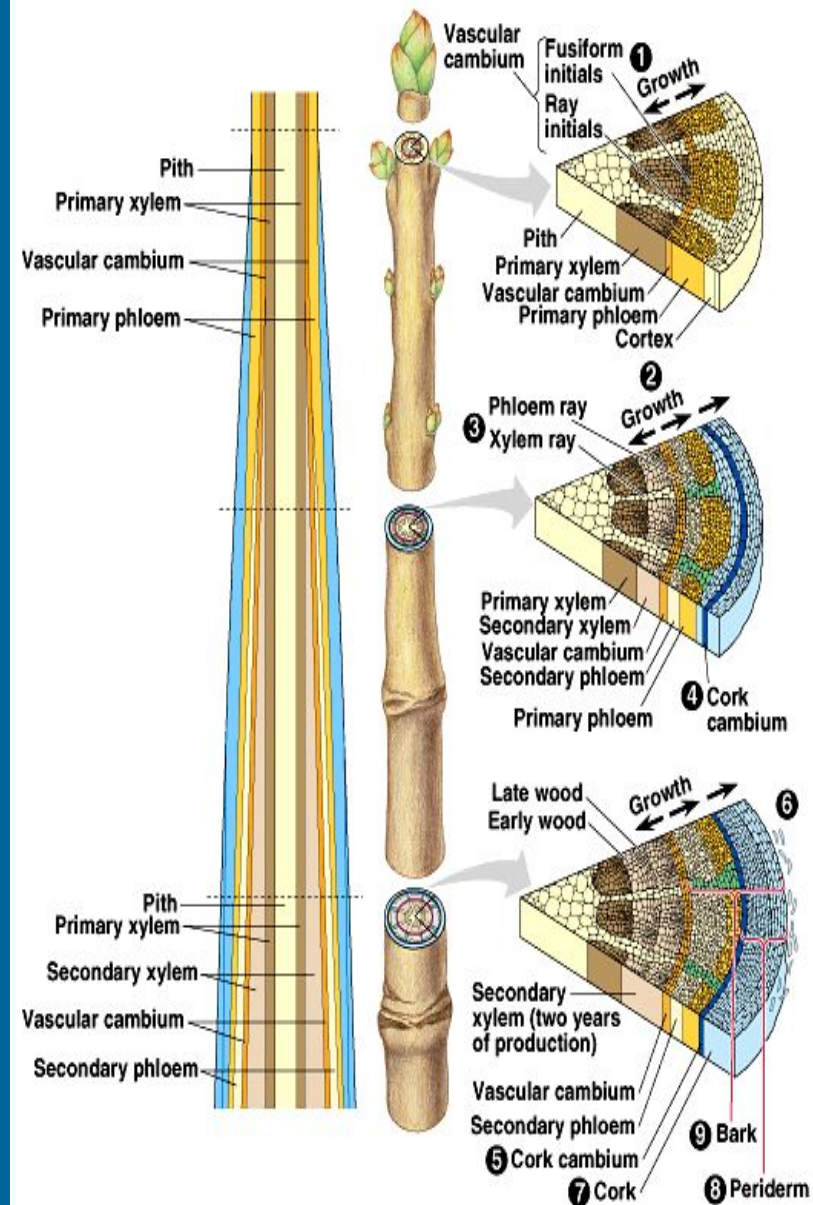
- Epidermis/cuticle (protection; prevents desiccation)
- *Stomata* (tiny pores for gas exchange and transpiration)/*guard cells*
- *Mesophyll*: ground tissue between upper and lower epidermis (parenchyma with chloroplasts); palisade (most photosynthesis) and spongy (gas circulation)

Campbell Activity



Secondary Growth

- Two lateral meristems
- *1. vascular cambium* ~ produces secondary xylem (wood) and secondary phloem (diameter increase; annual growth rings)
- *2. cork cambium* ~ produces thick covering that replaces the epidermis; produces cork cells;
 - cork plus cork cambium make up the *periderm*;
 - *lenticels* (split regions of periderm) allow for gas exchange;
 - *bark* ~ all tissues external to vascular cambium (phloem plus periderm)



Summary of primary & secondary growth in a woody stem

