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Plant Form

Chapter 35

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Meristems

- Meristematic tissues are clumps of small cells with dense cytoplasm and proportionately large nuclei.
  - Elongation of roots and shoots takes place by repeated cell divisions and subsequent elongation by the apical meristem.
  - In some species, lateral meristems produce an increase in girth.

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Meristems

- Apical meristems
  - located at tip of stems and roots
    - Plant tissues that result from primary growth are called primary tissues.
      - make up primary plant body
    - root apical meristem protected by root cap

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Apical Meristems

- Give rise to three types of primary meristems
  - protoderm - forms epidermis
  - procambium - forms primary vascular tissue
  - ground meristem - differentiates into ground tissue
    - intercalary meristems may arise in stem internodes

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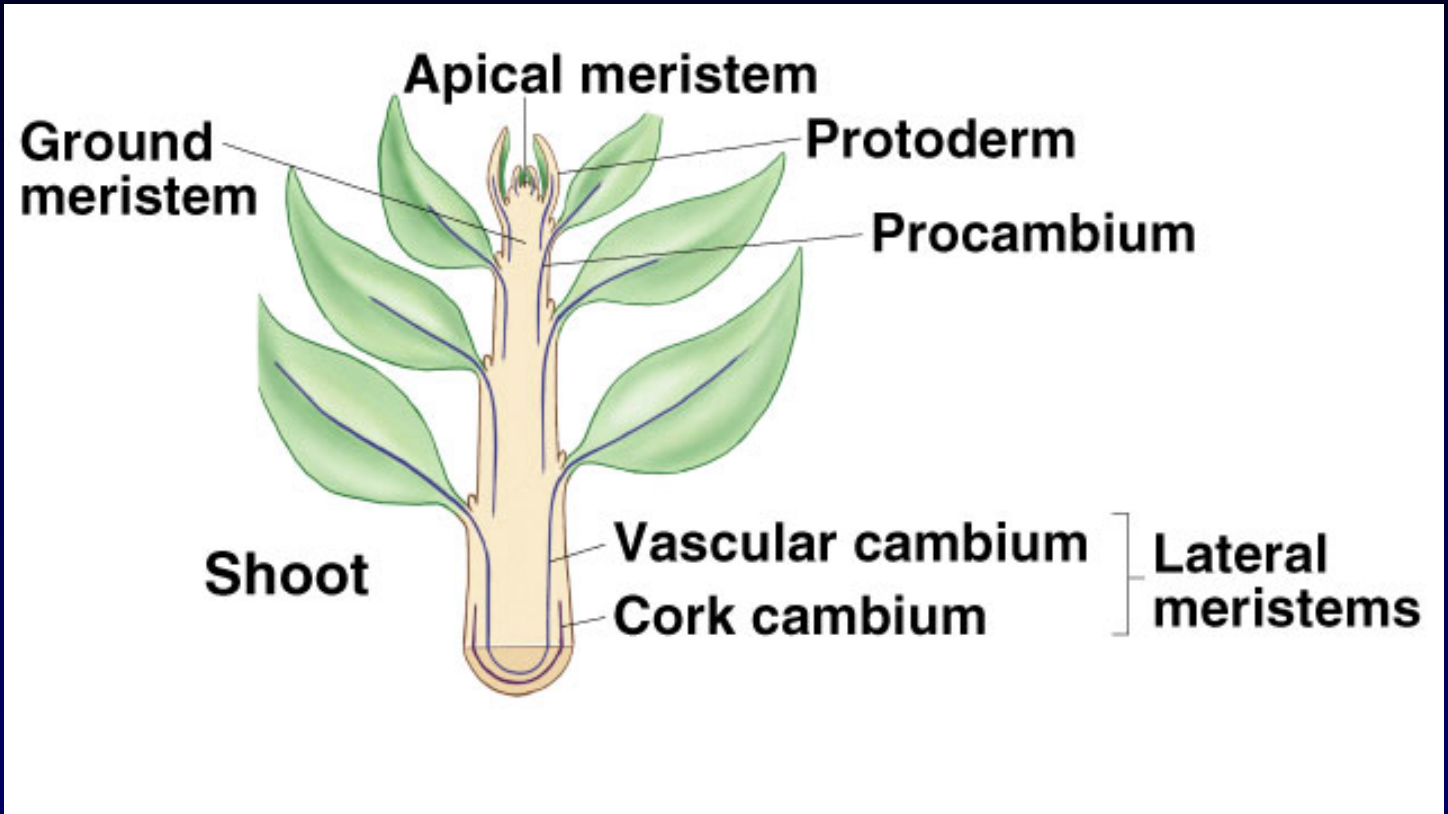

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Lateral Meristems

- Most trees, shrubs, and some herbs have active lateral meristems.
  - increases girth in nonwoody plants - secondary growth
- Woody stems
  - cork cambium
    - produces cork cells
  - vascular cambium
    - produces secondary vascular tissue

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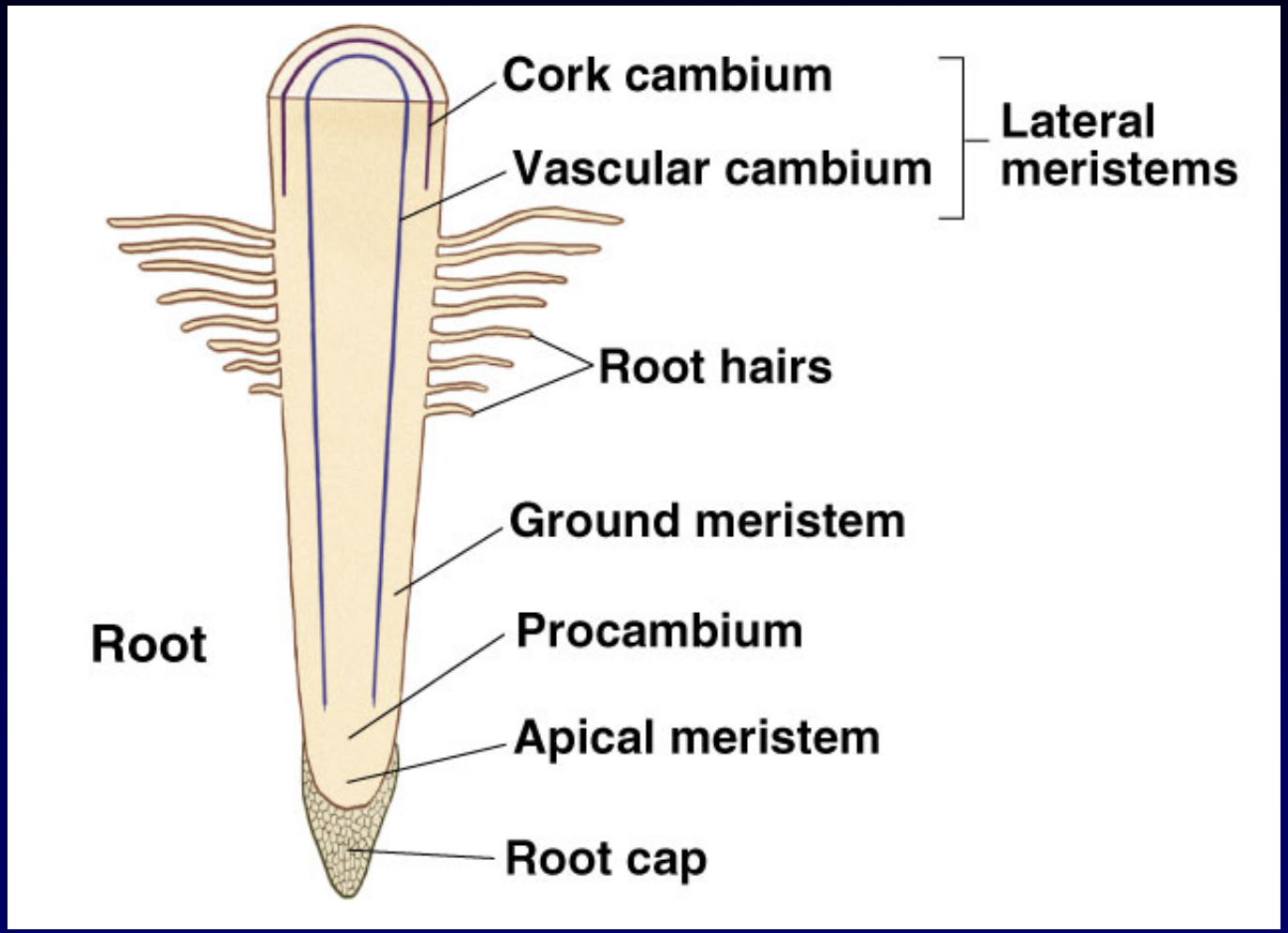

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Organization of the Plant Body

- Vascular plant consists of:
  - root system - anchors plant and penetrates soil to absorb water and ions
  - shoot system
    - stems – framework for positioning leaves
    - leaves - principle sites of photosynthesis
      - vegetative shoot - internode, node leaf and axillary buds

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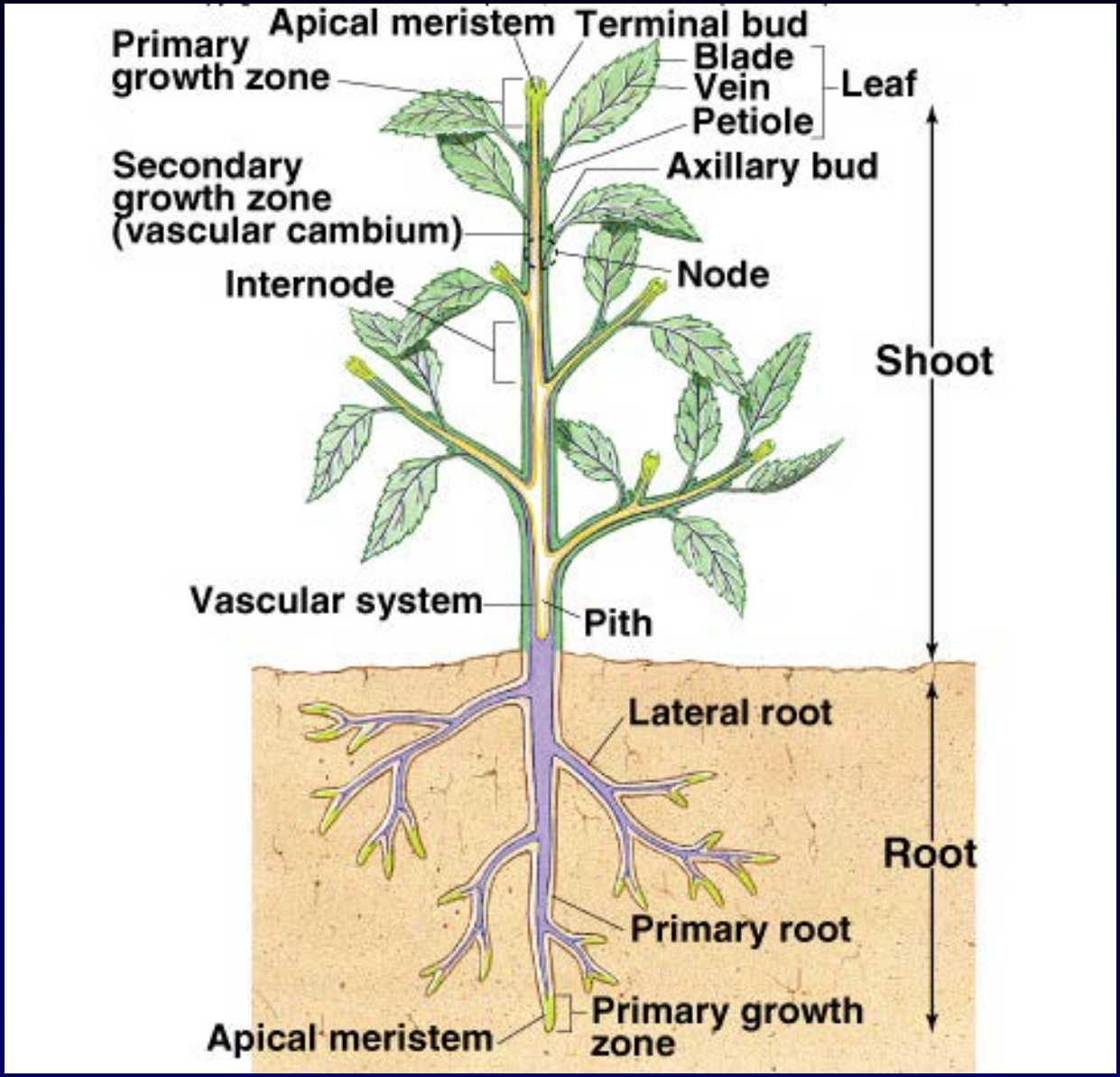
Plant Body Diagram



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Organization of the Plant Body

- Tissue types
  - ground tissue - parenchyma cells
  - dermal tissue - outer covering
    - epidermis in primary growth plants
      - cuticle
    - bark in secondary growth plants
  - vascular tissue - conduction
    - xylem - water and dissolved materials
    - phloem - carbohydrates

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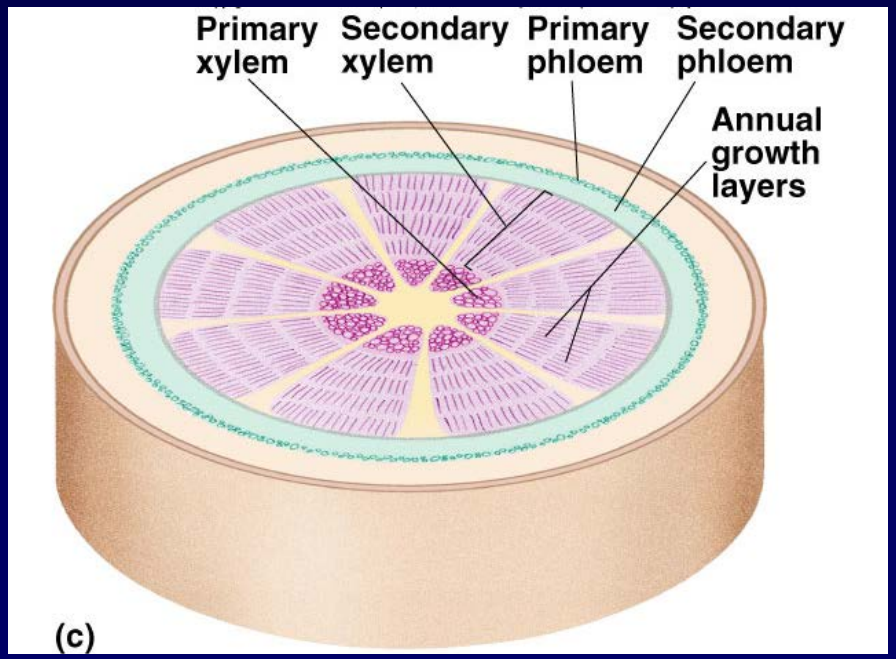
Primary and Secondary Growth

- Primary growth results from cell division at the apical meristem at the plant tip.
- Secondary growth results from cell division at the lateral meristem, increasing the shoot's girth.



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Dermal Tissue

- Epidermal cells originating from the protoderm cover all parts of the primary plant body.
  - guard cells - dumbbell-shaped cells flanking stomata
  - trichomes - hairlike outgrowths
    - regulate microclimate
  - root hairs - tubular extensions of epidermal cells
    - increase root's surface area

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Ground Tissue

- Parenchyma
  - store food and water
- Collenchyma
  - provide support for plant organs
- Sclerenchyma
  - supporting function
  - secondary walls impregnated with lignin
    - fibers and sclerids
    - may be nonliving at maturity

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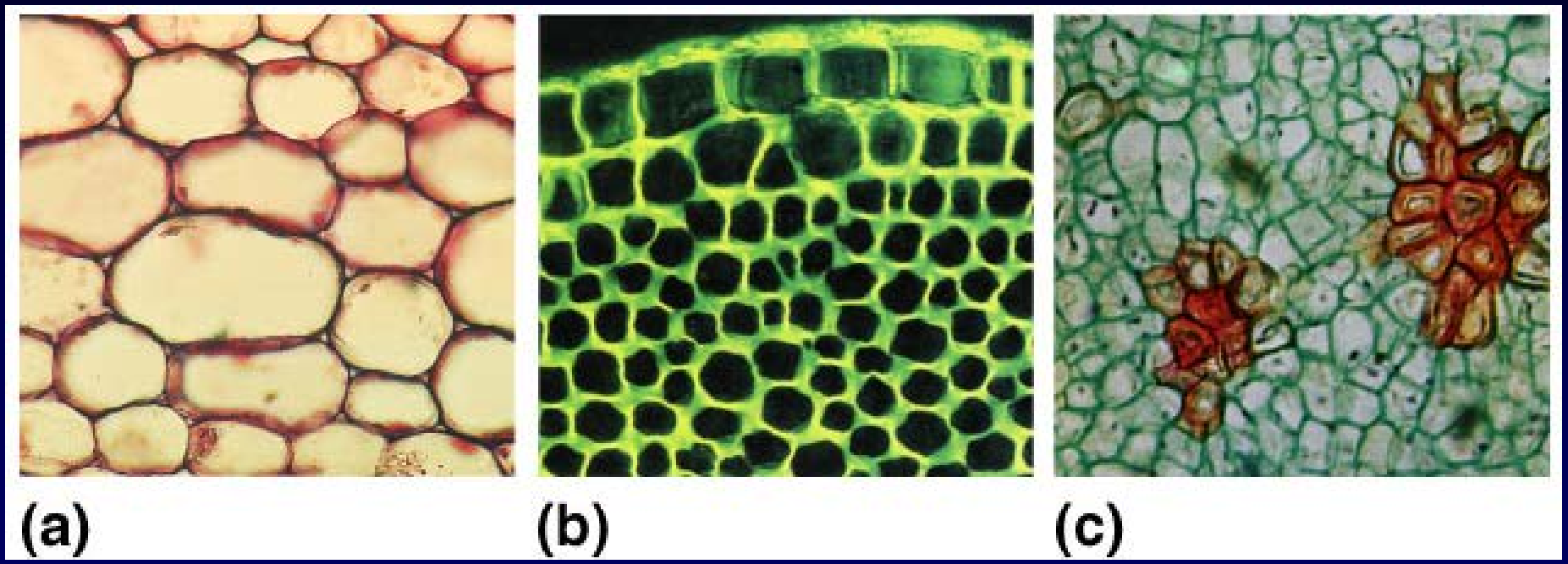
Ground Tissue



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Vascular Tissue

- Xylem
  - principle water-conducting tissue
    - combination of vessels and tracheids
  - primary xylem derived from procambium
  - secondary xylem formed by vascular cambium
    - wood made of accumulated secondary xylem

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Vascular Tissue

- Phloem
  - principle food-conducting tissue in vascular plants, located toward the outer part of roots and stems
    - carried out through sieve cells and sieve-tube members
      - some sieve areas (pores) have larger pores called sieve plates
      - each sieve-tube member associated with companion cell

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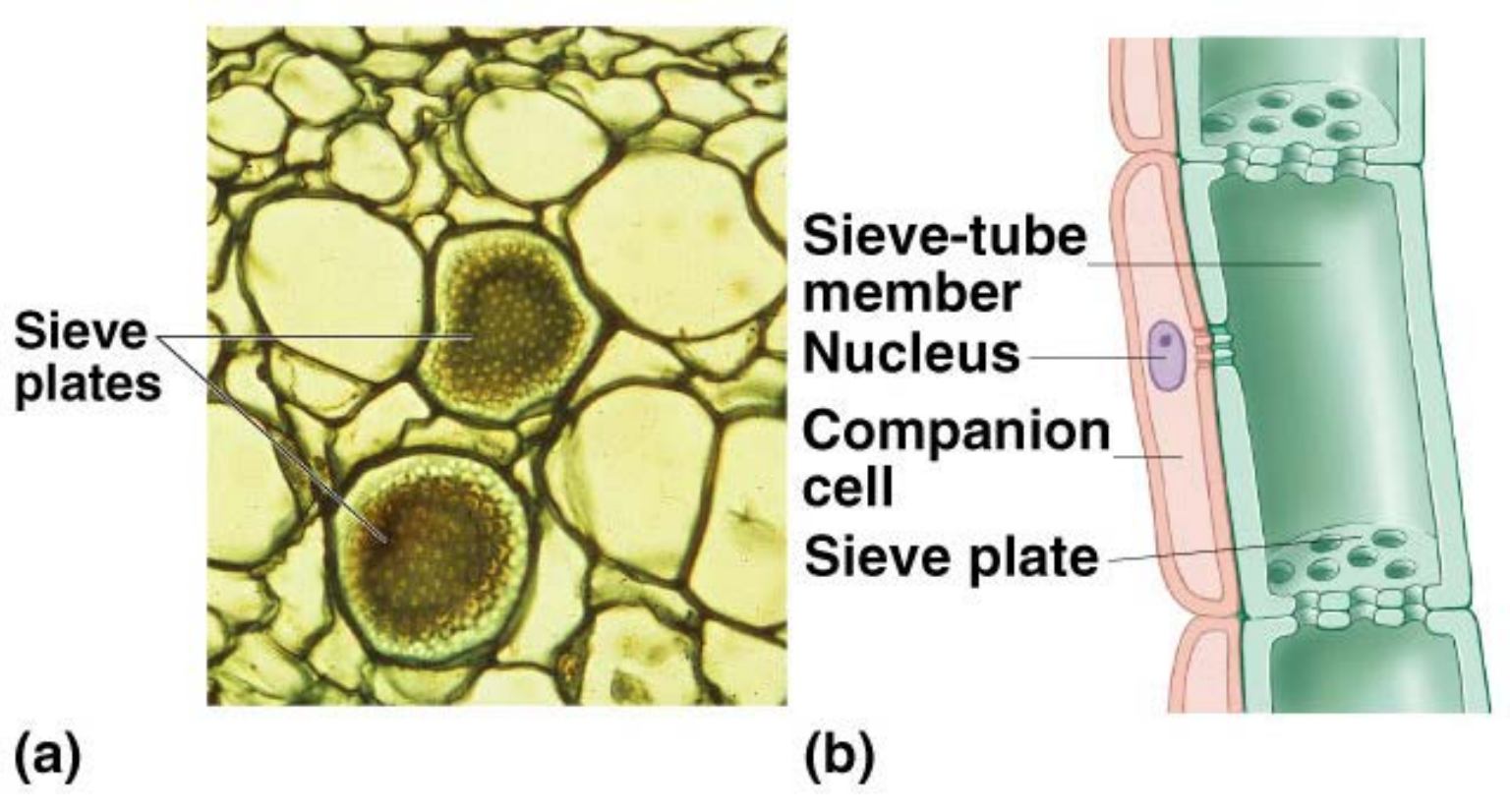
Sieve-Tube Member



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Root Cells Differentiate

- Root structure
  - root cap
    - composed of inner columella cells and lateral root cap cells
    - new root cap produced when existing cap is removed
      - functions in gravity perception

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Root Structure

- Zone of cell division
  - cells divide every 12 to 36 hours toward the edges of the concave dome
    - Apical meristem daughter cells divide into protoderm, procambium, and ground meristem tissues.
- Zone of elongation
  - roots lengthen because cells produced by primary meristems grow longer than wide

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Root Structure

- Zone of maturation
  - cells differentiate into specific cell types
    - root surface cells mature into epidermal hairs, each with root hair
    - cortex produced by parenchyma cells
      - inner boundary differentiates into endodermis
        - surrounded by Casparian strips composed of suberin

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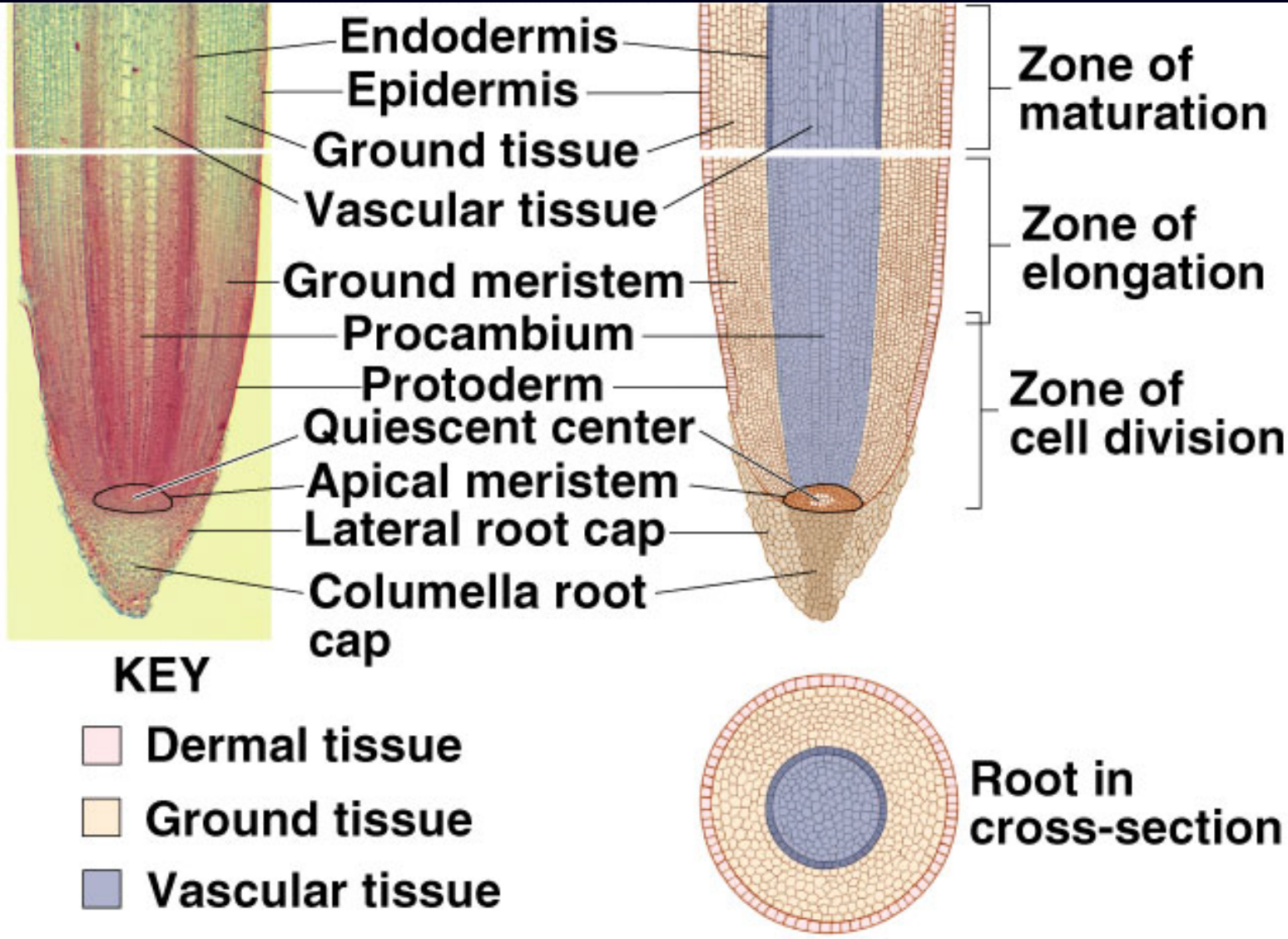
Root Structure



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Modified Roots

- Most plants produce either a taproot system (single large root with smaller branch roots) or a fibrous root system (many smaller roots of smaller diameter).

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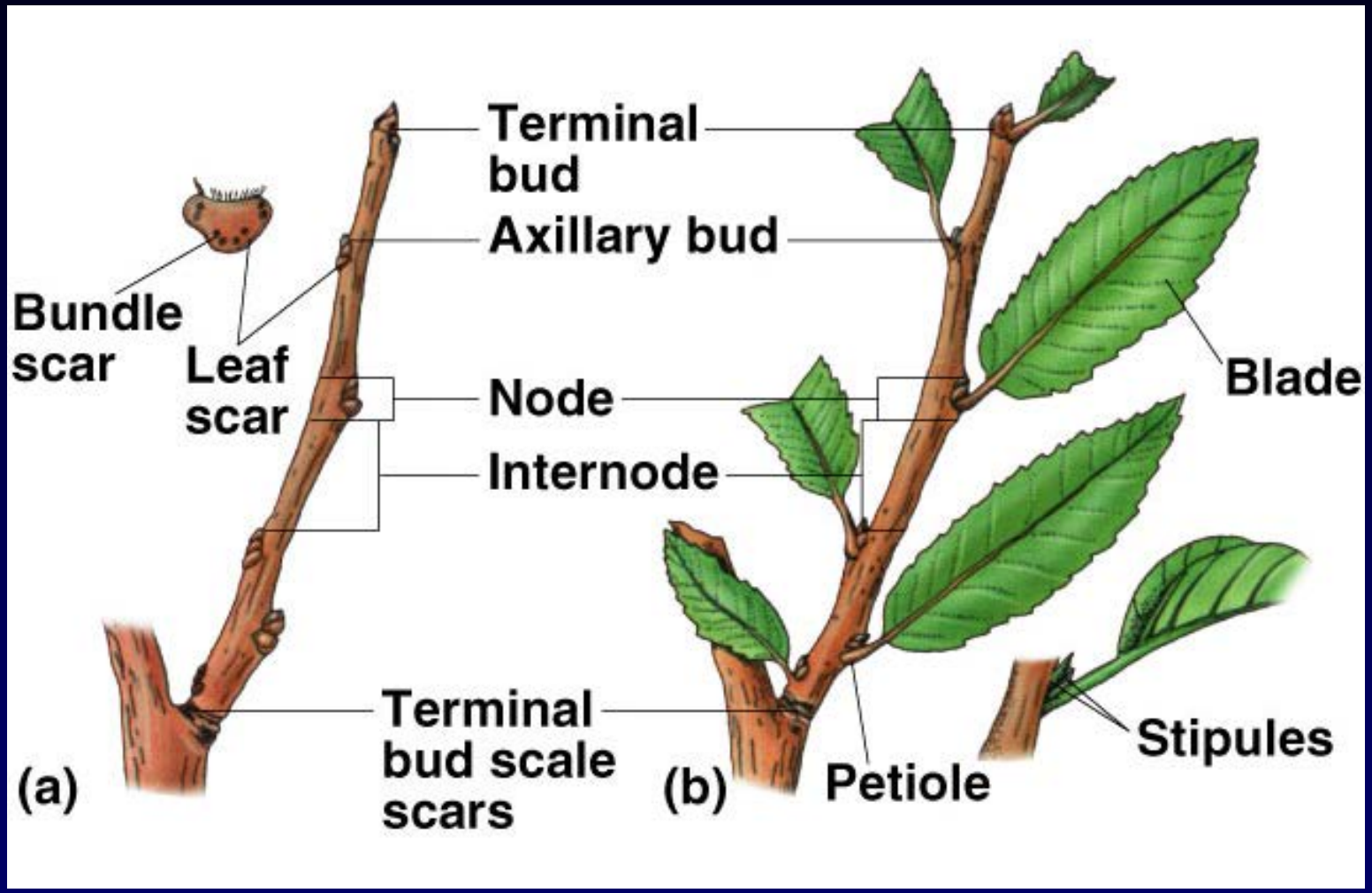
Woody Twig



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External Stem Form

- Leaf
  - blade - flattened portion
  - petiole - stalk
    - sessile - no petiole
    - axil - space between petiole and stem
      - axillary bud
      - terminal bud
  - stipules - appendages at base of leaf
    - stipule scars

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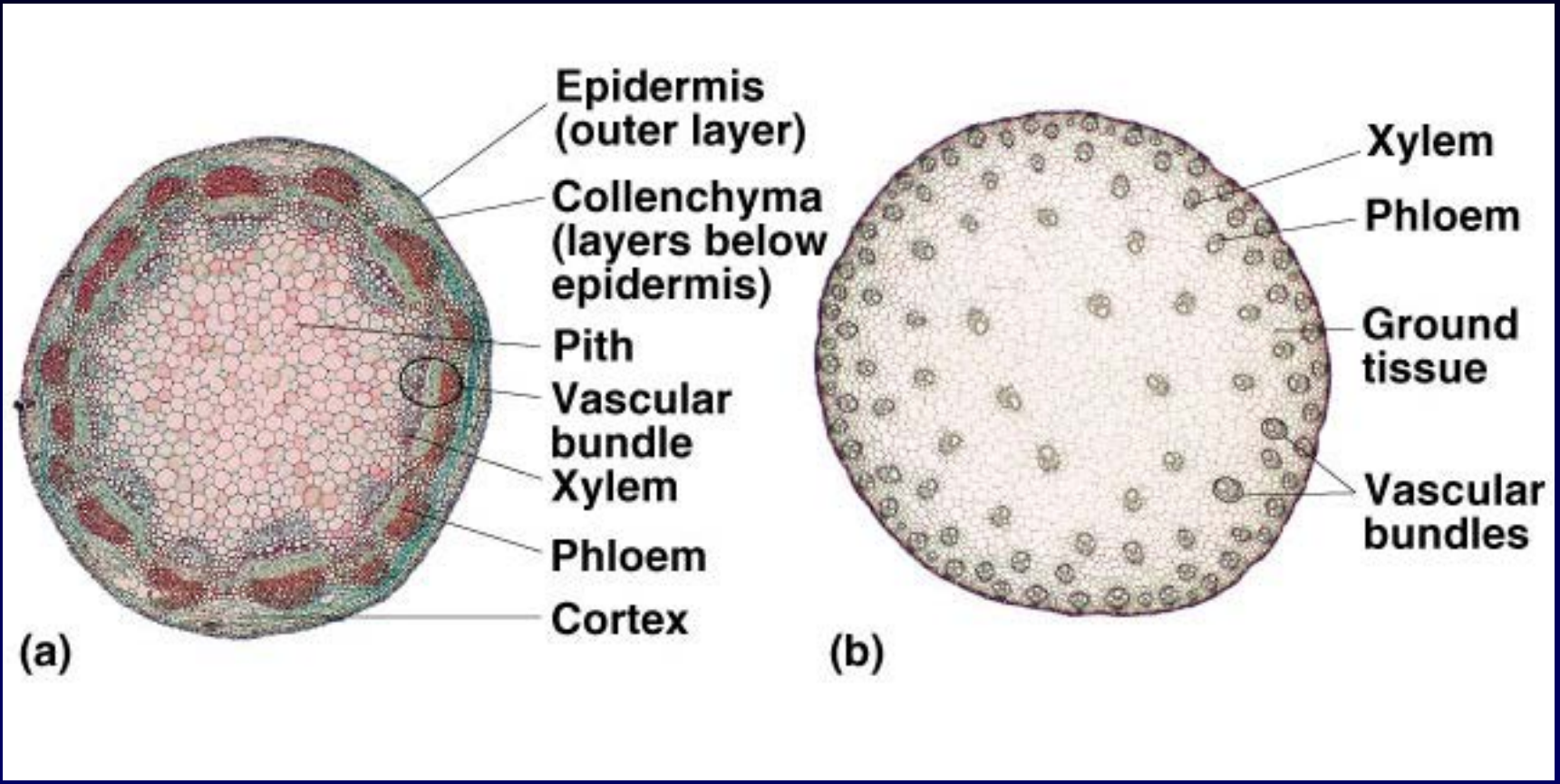
Stems



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Modified Stems

- Special purpose modifications
  - bulbs
  - corms
  - rhizomes
  - runners and stolons
  - tubers
  - tendrils
  - cladophylls

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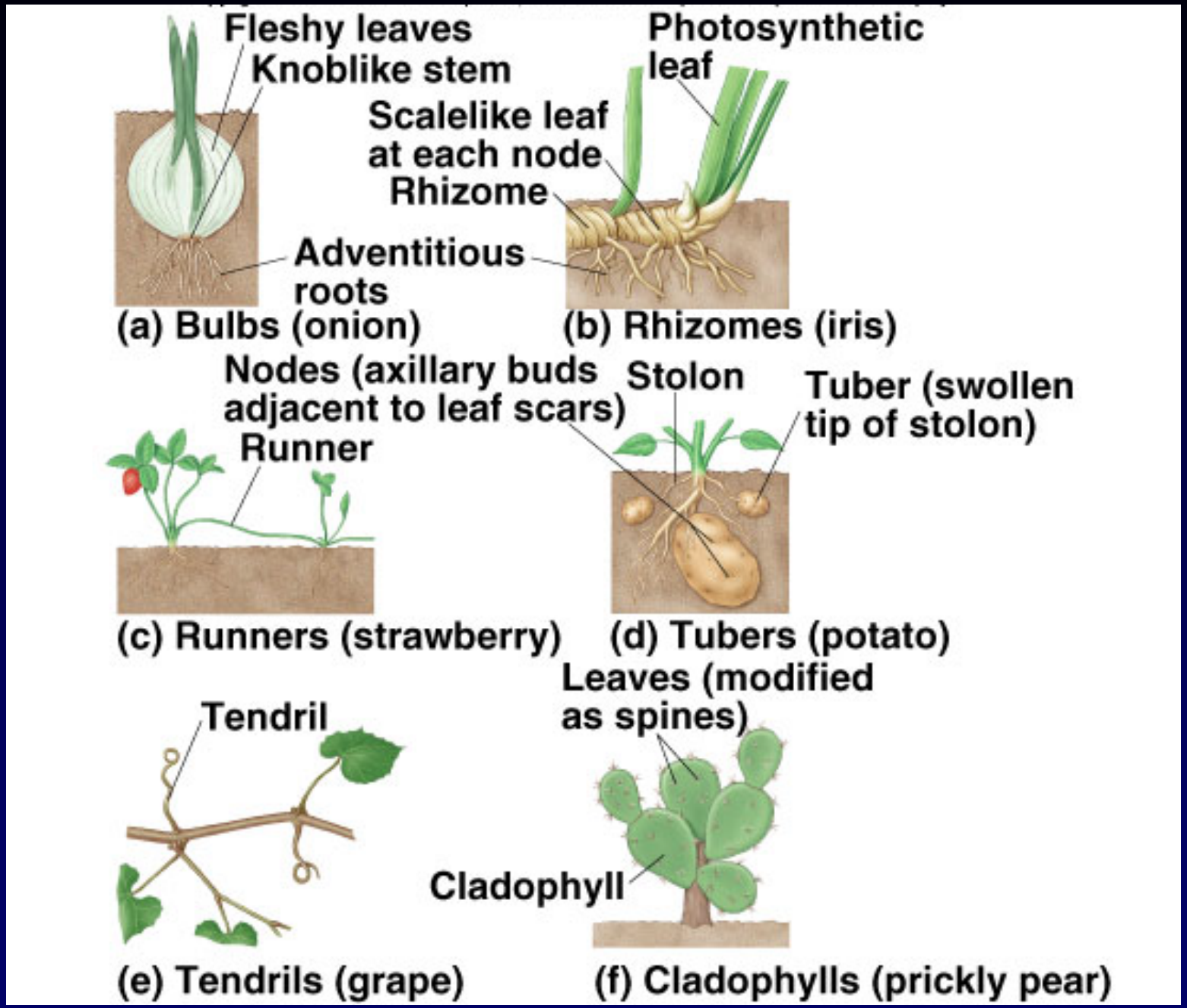

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Leaves

- Leaf external structure
  - microphylls - have one vein that does not leave a gap when it branches from the vascular cylinder of the stem
  - megaphylls - have several veins that leave a gap when they branch from the vascular cylinder of the stem

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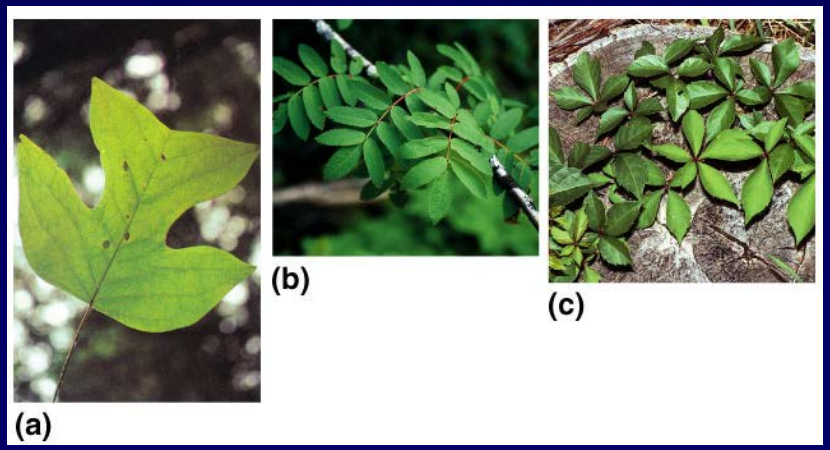
Leaf External Structure

- Simple leaves - undivided blades
- Compound leaf - blade divided into leaflets
  - pinnately compound - leaflets arranged in pairs along common axis
  - palmately compound - leaflets radiate out from common point



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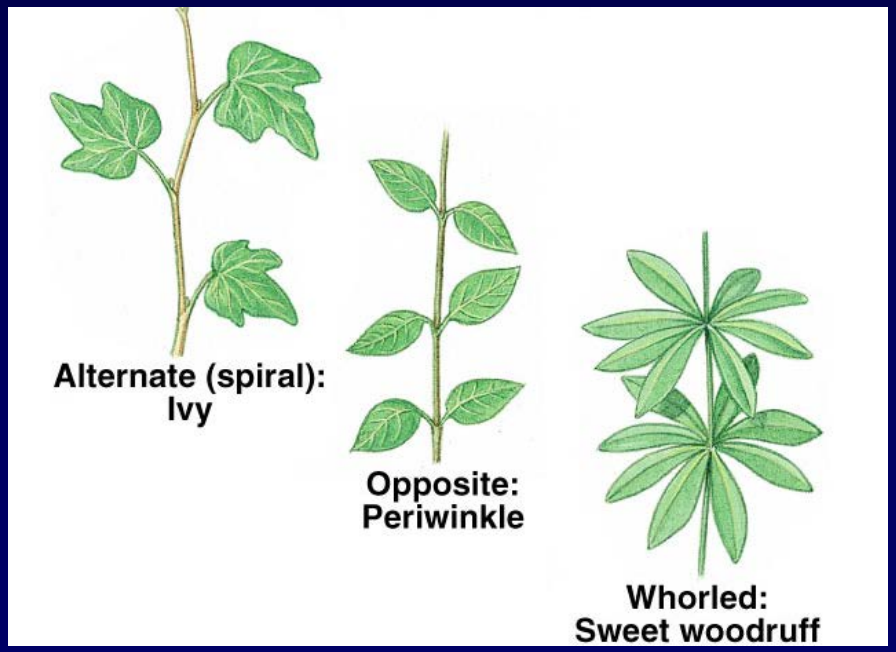
Leaf External Structure

- Leaf arrangement
  - alternate - one leaf per node
  - opposite - two leaves per node
  - whorl - circle of leaves at same level



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Leaf Internal Structure

- Epidermis has waxy cuticle and may have tricomes
  - lower epidermis contains stomata flanked by guard cells
- Mesophyll - tissue between upper and lower epidermis
  - Dicots have rows of cholenchyma cells constituting the palisade mesophyll.
    - spongy mesophyll between palisade mesophyll and lower epidermis
  - monocot mesophyll not differentiated

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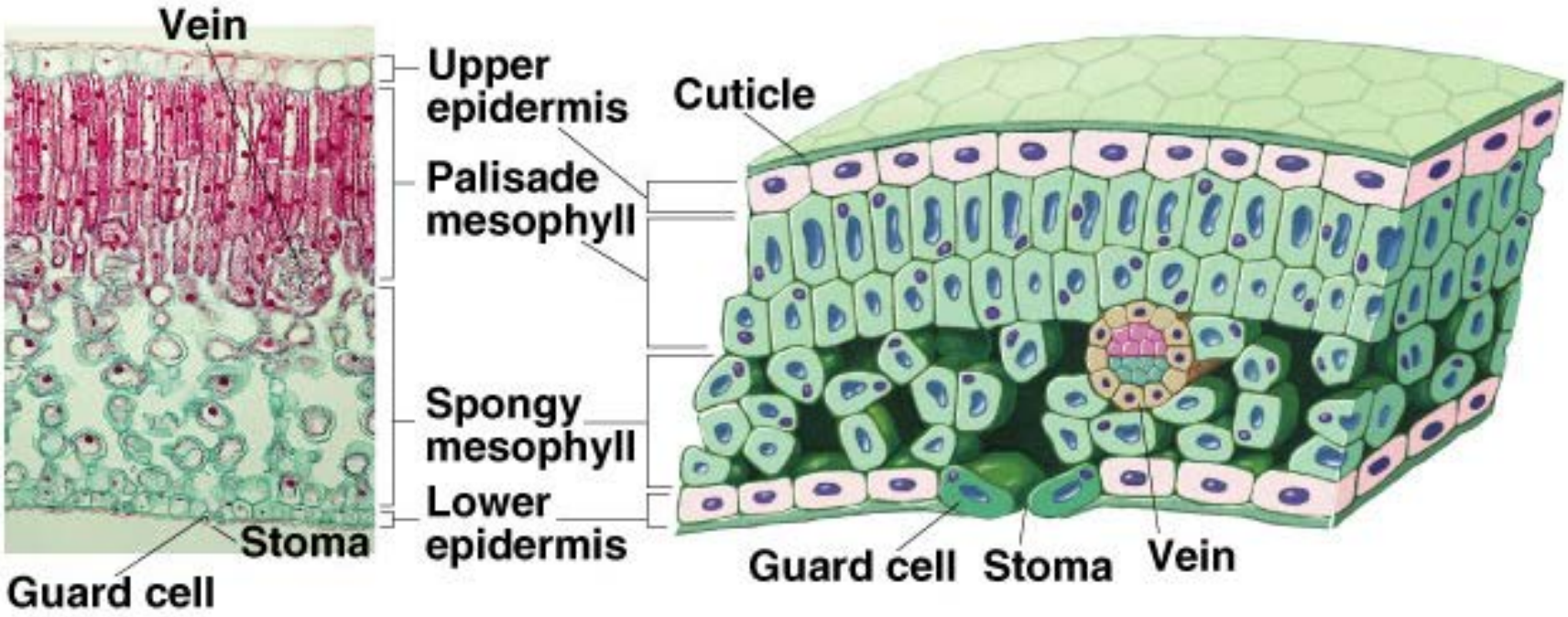
Leaf Cross Section



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Modified Leaves

- Modifications
  - floral leaves (bracts)
  - spines
  - reproductive leaves
  - window leaves
  - shade leaves
  - insectivorous leaves