

Section 21.3 & 21.4 Roots, Stems, and Leaves

I. Roots

- Roots are plant organs that **anchor** a plant, usually **absorb** water and dissolved minerals, and contain **vascular tissues**.
- All roots are **not alike**; some are **short or long, thick or thin**.
- The type of root can vary based on factors such as **soil type, moisture, and temperature**.

- There are two types of roots.
 1. **Taproots** - **single, thick structures** with smaller branching roots, which accumulate and store food.
Ex: **carrots and beets (most dicots)**
 2. **Fibrous** roots - have **many small branching roots** that grow from a central point. Ex: **grasses (most monocots)**

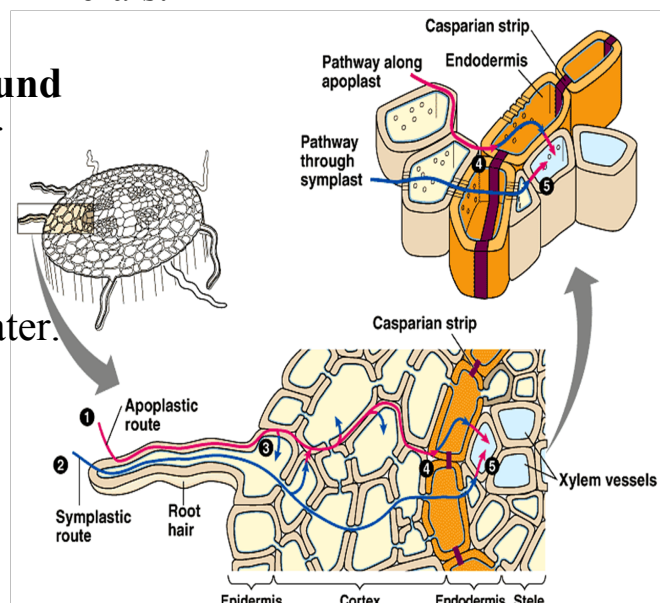


- Other types of roots include *prop* roots [corn on left] and *aerial* roots [orchids on right].

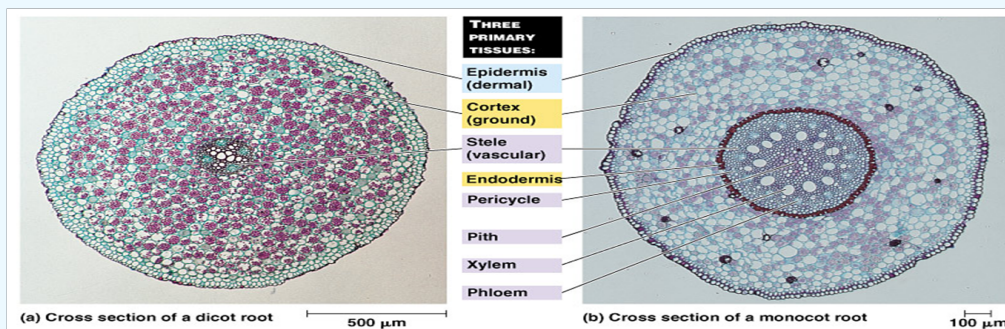


A. The structure of roots

- Epidermal* cells = are in the epidermis, the **outermost layer** of the root.
- Root hairs* = **increase the surface area** of a root; absorbs water, oxygen, and dissolved minerals.
- Cortex* = **inward from the epidermis**; the cortex is **ground tissue**, and helps move water and dissolved minerals into the vascular tissue; made up of **parenchyma cells** that sometimes store food and water.

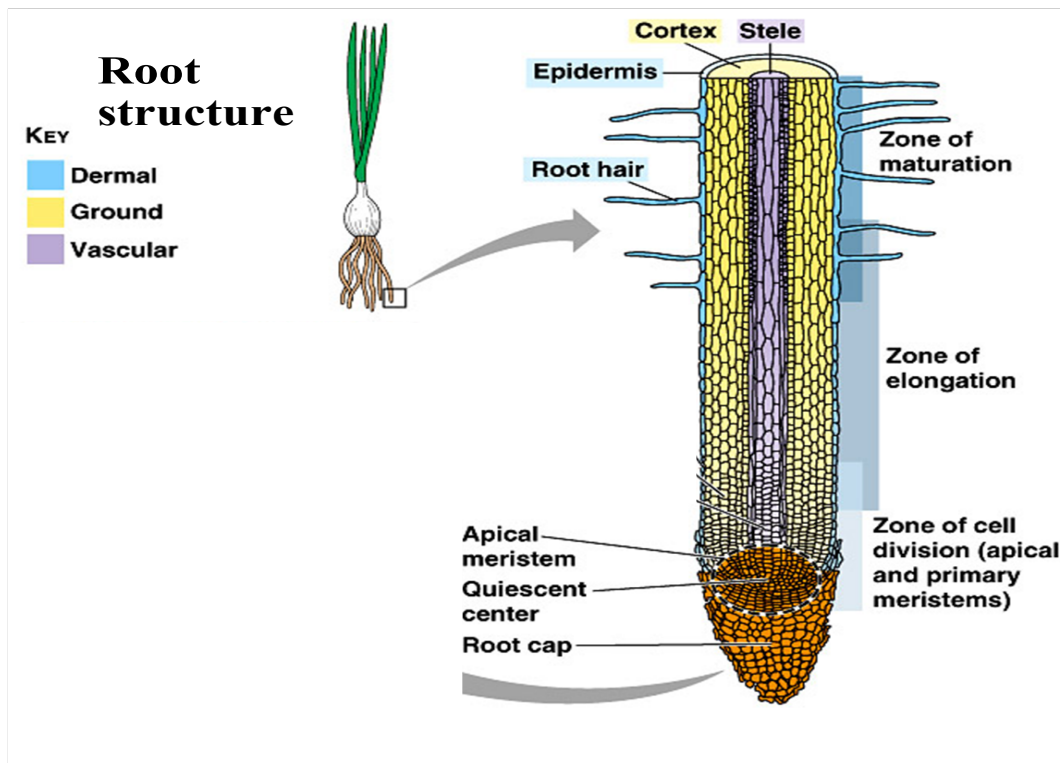


- **Endodermis** = next layer inward from the cortex, **layer of waterproof cells** that form a seal around the roots vascular tissue; **controls** the flow of water and dissolved material into the root.
- **Xylem and phloem** = **center** of root. Arrangement differences in monocots and dicots. In **monocots**, an area called the **pith**, **used for storage**, is the very center of root.



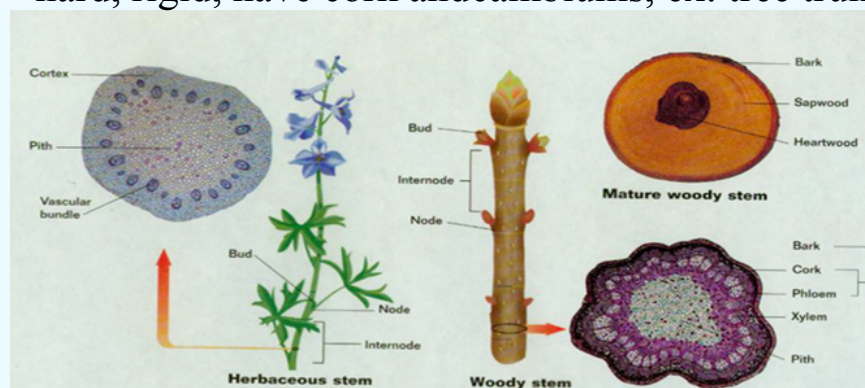
B. Root Growth

- There are two areas of rapidly dividing cells in roots.
 1. **Apical** meristem = within root produces cells that cause a root to **increase** in length, **differentiation** of the cells occurs as they mature.
 2. **Vascular** cambium = develops **between** the xylem and phloem of a **dicot** and contributes to a roots **increase** diameter.
- **Root cap** = protective layer of cells that **covers the tip** of each root.



II. Stems

- most *above* ground part of a plant that supports leaves and flowers
- have *vascular* tissues
- either: *herbaceous* - green, flexible, carry out photosynthesis, ex: petunias, carnations, or
- *woody* - hard, rigid, have cork and cambiums, ex: tree trunks



- can act as food storage organs as:
 1. **Corm** = short thickened stem surrounded by leafy scales, ex: **gladiolus**
 2. **Tuber** = swollen stem that has buds from which new plants grow, ex: **potato**
 3. **Rhizome** = thick underground stem, ex: **iris**



Rhizomes



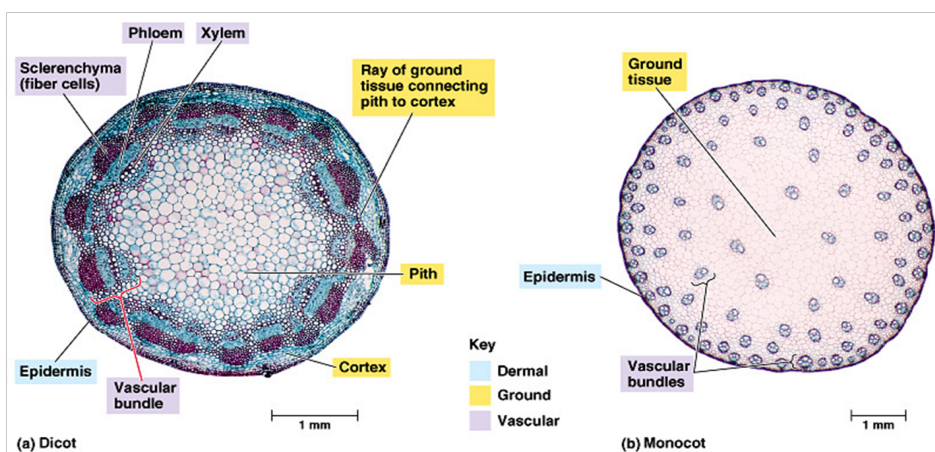
Tuber



Corm

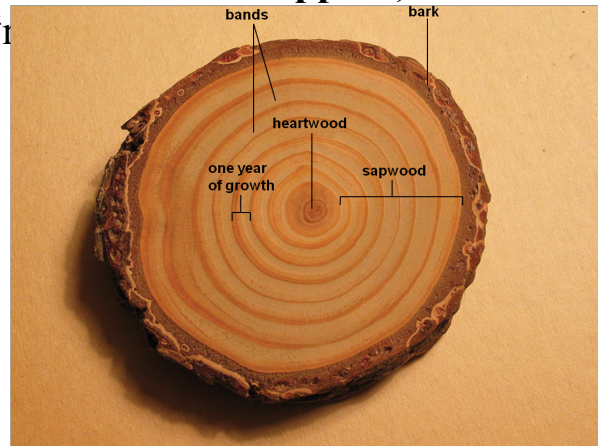
A. Internal Structures

- Vascular tissue inside stems is arranged **differently** than inside roots.
- **Bundles** of vascular tissue with **parenchyma** cells.
- Monocot and dicots **vary on arrangement** of vascular tissue



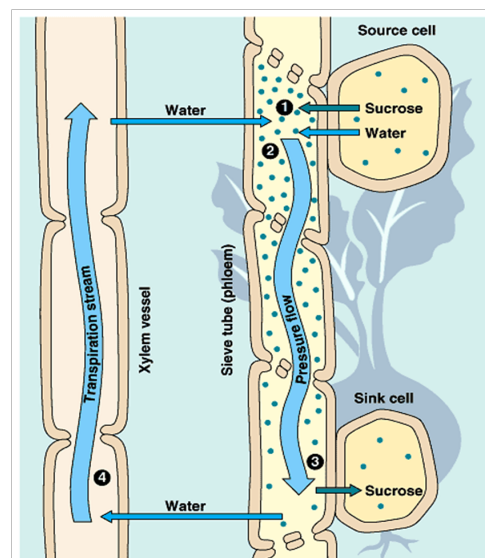
B. Woody Stems

- **Secondary** growth = added **thickness** to stem resulting from **cell division** in vascular cambium.
- **Annual rings** = result of layers of xylem formed each year; called **wood** and contains **sclerenchyma** fibers that add **support**; can estimate **age** of tree by counting “rings”



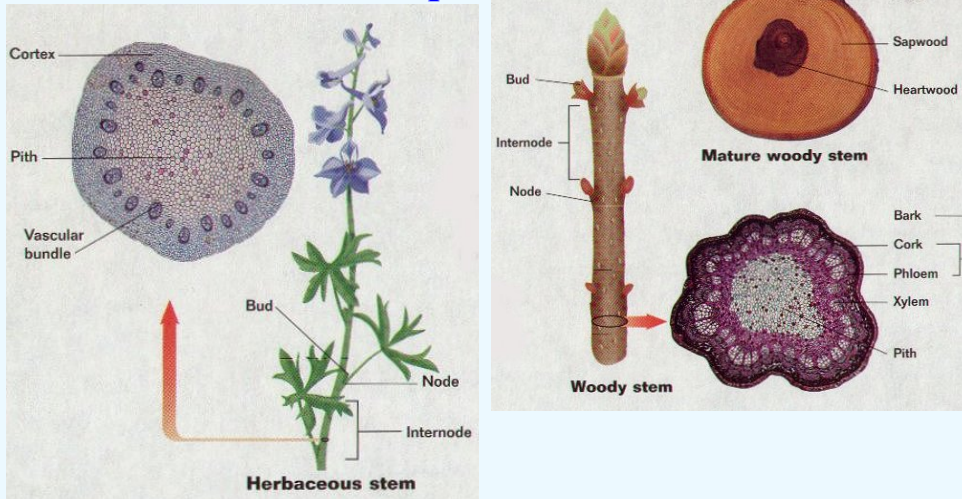
C. Stems Transport Materials

- **Transports** water, sugars, and other compounds
- **Xylem** moves water and dissolved materials from roots to leaves
- **Phloem** carries dissolved sugars from photosynthetic tissues in the leaves to other parts of plants
- **Sink** = any portion of plant that **stores sugars**
- **Translocation** = act of **moving sugars** in the phloem to other parts of plant



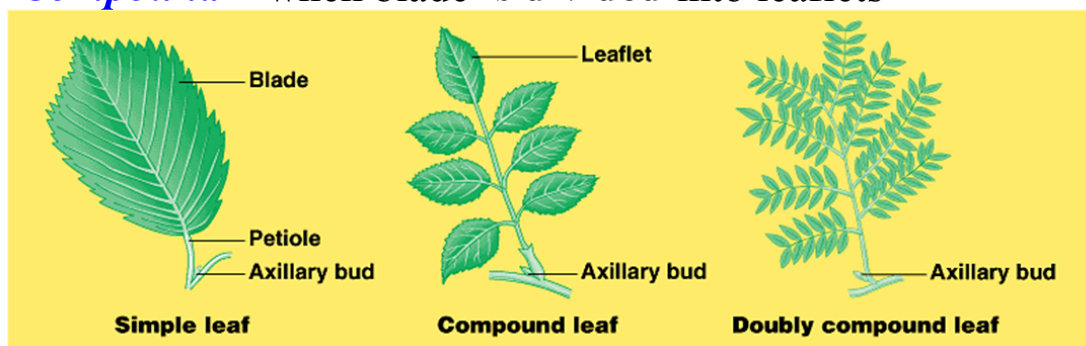
D. Growth of Stem

- **Primary growth** lengthens stem, due to production of cells in apical meristem at **tip of stem**.
- **Nodes** = meristems located at **intervals along stem** where branches and leaves **develop**

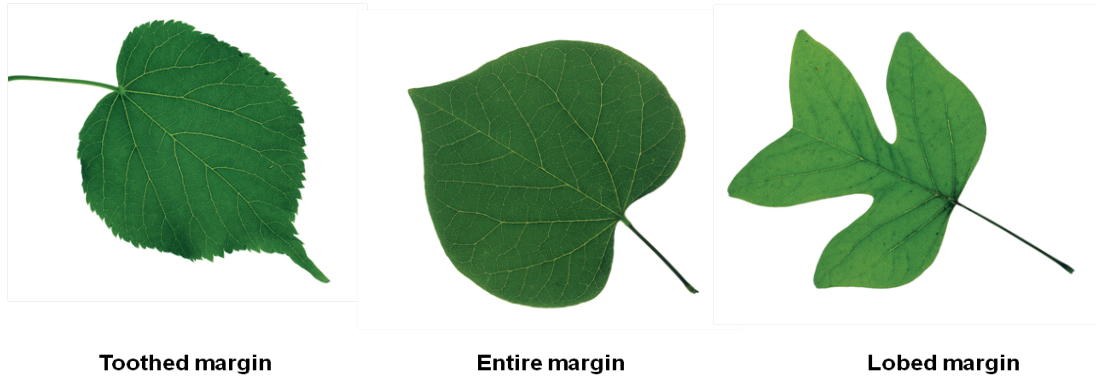


III. Leaves

- Primary function is **photosynthesis**
- **Blade** = flat, broad, green **surface** of leaf
- **Petiole** = in most plants a stalk that joins the **leaf blade to the stem**
- Leaf arrangements include
 1. **Simple** = **one blade, not divided** Ex: maple
 2. **Compound** = when blade **is divided** into leaflets



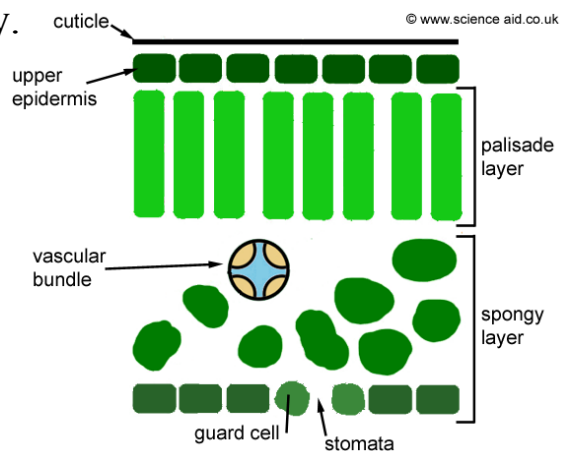
- **Leaf margins** may be toothed, entire, or lobed.



A. Leaf Structure

• **Mesophyll** = between epidermal layers, photosynthetic tissue in two layers, including:

1. **Palisade** = *column shaped* cells, just under upper epidermis
2. **Spongy** = *loosely, irregular* shaped cells, allows **gasses** to flow in and out of leaf easily.

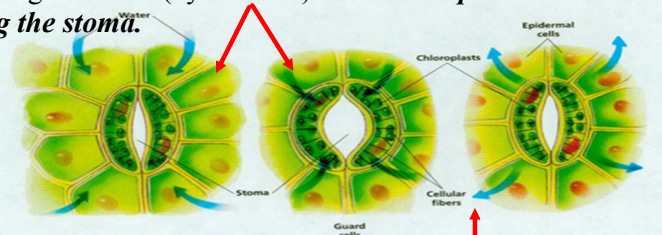


B. Transpiration

= **loss** of water through a plant; plants lose up to **90%** of water through transpiration

- **Stomata** = opening within the lower epidermis for gas exchange (CO₂, H₂O, and O₂).
- **Guard cells** = regulate the opening and closing of stoma, regulating transpiration

Thus, when there is **more water available in surrounding cells** than the guard cells, water enters the guard cells (by osmosis). The **water pressure causes them to bow out, opening the stomā.**



When there is **less water in the surrounding cells**, water leaves the guard cells, the **water pressure is released** and the cells come together, **closing the stoma.**

C. Leaf Modifications

- **Venation** varies in monocots and dicots
- Types of leaves for differ functions include:
 1. **spines** - protection, water loss
 2. **needles** - extreme temperature
 3. **succulents** - storage
 4. **entrapment** - capture insects, small animals



