

## **Biology 12.2**

### **Plant Anatomy: roots, stems, leaves**

#### **Woody Plants**

1. have relatively hard and soft parts
2. woody parts are harder and stronger parts due to thick cell walls
3. trunks and branches of trees are woody
4. woody parts grow every year
5. softer parts such as leaves and flowers are called herbaceous parts

#### **Herbaceous Plants**

1. all parts have only soft parts, no woody parts
2. softer and weaker parts due to thinner cell walls
3. replaced every year

#### **Growth of plants**

1. Annual plants
2. most herbaceous plant
3. sprout, grow, flower, and produce seeds in one growing season
4. Biennial plant  
sprout and grow in one season, then flower and seed in the next season

#### **Plant organs**

1. Vegetative organs
  - a. include roots, stem and leaves
  - b. these organs are vegetables
  - c. examples include spinach, carrots, asparagus
2. Reproductive organs
  - a. include flowers, fruits and seeds
  - b. these organs are made of same basic tissues as vegetables
  - c. examples include peas, corn, eggplant, tomatoes, apples, cherries

#### **Plant tissues**

1. Meristemic tissue
  - a. growth tissue
  - b. capable of mitosis
  - c. small, thin-walled cells
  - d. undifferentiated cells: can develop into any kind of cell
  - e. found in root tips, stem tips, buds, and other growth areas of plants
2. Vascular tissues
  - a. Non-growth tissues
  - b. differentiated tissues: already developed into vascular cells
  - c. xylem
    - i. long, thick-walled cells form hollow tubes in plants
    - ii. transports water through plant, usually upward from the roots
    - iii. mature cells die and leave the tubes
  - d. phloem
    - i. thinner cell walls

- ii. transports water and dissolved nutrients (sugars) through the plant, usually downward from the leaves
  - iii. mature cells still alive
- 3. Structural
  - a. Non-growth tissues
  - b. differentiated into functional and structural cells
  - c. photosynthesis, food storage, and protection

## Roots

1. Purpose
  - a. anchor
  - b. absorb
  - c. transport
  - d. store food
2. Location of roots
  - a. Underground: typical of most roots
  - b. Aerial: such as 1) Orchid roots seeking water in cracks of bark and 2) ivy roots attaching to objects
  - c. Aquatic: usually dangle in water
  - d. Interstitial: roots penetrating into tissues of another plant such as mistletoe roots
  - e. Surface: seen on the surface of the ground
3. Root systems
  - a. Taproot system
    - i. primarily a single root with small hair-like roots on it
    - ii. develops from the primary root
    - iii. usually long and relatively thin
    - iv. some are thick like carrots or beets
  - b. Fibrous system:
    - i. consists of many secondary roots and lacks a taproot
    - ii. Root systems for many plants are greater in surface area than the leaves
4. Primary tissues of roots
  - a. epidermis: one cell thick, absorbs, includes root hairs
  - b. cortex: storage
  - c. endodermis: selection of materials to be absorbed
  - d. vascular cylinder: central area of root
5. Growth stages
  - a. 1. primary root: if dominant => taproot
  - b. 2. secondary roots: if dominant => fibrous root system
  - c. 3. area must be greater than that of the leaves: 1 ft 8 yr old alfalfa plant 9 meters long; or 10 ft corn - 500 ft of roots
6. Primary root growth
  - a. growth primarily takes place near the root tip
  - b. root cap: tough, dead cells
  - c. meristemic region: mitosis
  - d. elongation region: vacuoles
  - e. maturation region: differentiation
7. Secondary root growth
  - a. involves increase in size
  - b. usually woody plants
  - c. vascular cambium produces secondary xylem
  - d. the outer cortex and epidermis

- e. cracks filled in by cork cells: prevents direct water and mineral absorption
- 8. Modified roots
  - a. storage roots: thick and fleshy
  - b. adventitious roots: grow from stem, petiole or leaf
    - i. prop roots
    - ii. climbing roots
    - iii. aerial roots
    - iv. aquatic roots

### Stems

1. herbaceous and woody
2. manufacture, support and display leaves
3. conduct nutrients to and from leaves
4. types
  - a. erect
  - b. climbing
  - c. prostrate
5. Buds
  - a. apical bud: protects meristemic tissue at the end of the stem
  - b. axillary bud: along the side of the stem
  - c. dormant buds: form during nongrowth phase in winter
  - d. bud scales protect tiny leaves
  - e. bud scale scars form when bud scales fall off for spring growth
  - f. bud scale scars form once a year (can determine age of stem)
  - g. leaf scars form when leaves fall off deciduous trees in the fall
6. Modified stems
  - a. Rhizomes: thick, fleshy, horizontal, underground stem
  - b. Stolons: more slender than rhizomes
  - c. Bulbs: a collection of underground storage leaves (e.g. onion)
  - d. Tubers: storage stems, e.g. potato
7. Corms: thick, underground stems covered with underground leaves (e.g. crocus plant)

### Leaves

1. absorb energy from sunlight
2. photosynthesis
3. most have broad surfaces
4. Leaf Mosaics: arrangement of leaves on stems
  - a. Spiral mosaic: leaves spiral down the stem
  - b. Alternate mosaic: leaves alternate on opposite sides of stem
  - c. Opposite mosaic: leaves directly opposite each other on the stem
  - d. Whorled mosaic: three or more leaves grow around stem at same point
5. Leaf structure
  - a. petiole: holds the leaf blade on the stem
  - b. blade
6. venation
  - a. Parallel venation
  - b. Netted venation:
    - i. pinnate (branched from midrib vein)
    - ii. palmate (branched from end of petiole)
7. simple leaf shapes: one blade (fig 10B-6)
  - a. linear
  - b. cordate: heart shaped

- c. deltoid: triangular
  - d. lobed
  - e. circular
8. compound leaves
- a. compound leaf: blade is divided into leaflets
  - b. pinnately compound: leaflets divided from the midrib
  - c. bipinnately compound: leaflets divided from the first set of leaflets
  - d. palmately compound: leaflets attached to single point at end of petiole
9. Leaf anatomy
- a. cuticle: waxy covering of leaf
  - b. epidermis: one cell thick covering of leaf
  - c. stomata: openings on the underside of the leaf for gas exchange
  - d. guard cell: open and close the stomata
  - e. mesophyll: "middle tissue"; photosynthesis takes place
10. Leaf colors
- a. chlorophyll: green
  - b. carotenes: yellow, orange (e.g., carrots, pumpkins, corn)
  - c. anthocyanins: red, blue, violet (e.g., grapes, roses, cherries, beets)
  - d. fall colors due to loss of chlorophyll when photosynthesis stops. The other pigments can be seen.
  - e. the brown coloring in leaves is due to tannic acid formed by chemical breakdown of plant cell.
11. Leaf modifications
- a. tendrils: part of the plant that wraps around structures to support plant
  - b. spines: hard, sharp leaves (e.g., cacti needles, holly leaves)
  - c. succulent leaves: thick leaves usually store water (e.g., aloe)
  - d. aquatic: extra air space to help float on water
  - e. bracts: colored leaves (e.g., poinsettia, dogwoods, caladiums)