Plants (8%)

I. General Plant Information
   a. Autotrophs
   b. Photosynthetic
   c. Algae
      i. ≠ Plants
      ii. = Protist

II. Plant Structure
   a. Roots
      i. Function
         1. Absorb H₂O and minerals
      ii. Structure
         1. Epidermis: Outermost layer (skin)
         2. Cortex: Thick 2nd layer
         3. Endodermis: Thin 3rd layer
         4. Stele: Innermost Vascular tissue
iii. Zones

1. Root Cap: Protection for the root
2. Apical Meristem: Area with most cell division and growth
3. Zone of Elongation: Cells continue to grow
4. Zone of Maturation: Cells gain identity and distinct role
5. Root Hair: Help anchor the root in the soil and give a greater surface area for absorbing H₂O and nutrients

iv. Root Systems

1. Tap Root System
   a. Purpose: Storage
   b. 1 big main root
   c. i.e.
      i. Carrots

2. Fibrous Root System
   a. Purpose: Anchoring
   b. Extensive branching
   c. i.e.
      i. Grass
      ii. Dandelions
v. H2O Transport/Absorption
   1. Casparian Strip
      a. Waxy material around endodermal cells
      b. Does not allow H2O to pass as easily
      c. Forces H2O to go through the plasma membrane
      d. Benefits
         i. Creates selectively permeable wall for roots
            1. Lets in only certain minerals
         ii. Prevents water loss
         iii. Creates pressure
         iv. Guttation
            1. Pushing or squeezing H2O up to the leaves
            2. In low plants
               a. i.e. strawberry plant
b. Stems
   i. Main purpose is to transport
      1. H₂O and nutrients from the roots to the leaves
      2. Glucose to the roots from the leaves
   ii. Transport Pathways
      1. Xylem
         a. Transport of H₂O and Minerals
         b. Made of dead cells
            i. Tracheid Cells (Gymnosperms)
               1. Line up next to each other to form a hollow tube for H₂O to run down
            ii. Vessel Element Cells (Angiosperms)
      c. Transpiration Pull Model
         i. Properties of H₂O
            1. Polar
               a. Hydrogen Bonds between H₂O molecules
                  i. Cohesion
         ii. Process
            1. H₂O is released by the leaf
            2. H₂O is replenished in the leaf by the xylem
            3. Cohesion enables multiple H₂O molecules to travel together
         iii. Transpiration
            1. Loss of H₂O from the leaf
               a. H₂O evaporation
               b. H₂O use in Photosynthesis
2. Phloem
   a. Transport of Glucose
      i. Made in Photosynthetic cells
   b. Made of living cells
      i. Sieve Tube element cells
         1. Are hollowed out
         2. Each have a companion cell
            a. Support Sieve Tube element cells
         3. Sieve Tubes
   c. Glucose
      i. “Source”: Site of production
      ii. “Sink”: Site of storage or usage
   d. Pressure Flow/ Mass Flow Model
      i. Sugar from leaf enters Phloem
      ii. H₂O from xylem enters Phloem to balance out concentration of solutes
         1. Creates high Osmotic pressure
      iii. Sugar H₂O flows from a high pressure environment to a low pressure environment
         1. To bottom/roots
      iv. In return, root cells push H₂O up the xylem
iii. Primary Growth
   1. Plant grows taller in Apical Meristems

iv. Secondary Growth
   1. Plant grows in width
      a. Wider
   2. Roots and Shoots increase in diameter
   3. Cross-section of a Stem undergoing secondary growth
      a. Primary Xylem: Center
      b. Vascular Cambium: Layer of secondary growth
      c. Primary Phloem: Outside Vascular Cambium
      d. Secondary Xylem: Dead cells (wood)
      e. Secondary Phloem: Replace Primary Phloem
      f. Cork Cambium: Becomes outer cell layer that protects the full tree (bark)

v. Vascular Plants (Tracheophytes)
   1. Xylem
   2. Phloem

vi. Non-Vascular Plants
   1. No Xylem
   2. No Phloem
   3. Can not transport nutrients as easily
   4. Lower to the ground
vii. Leaves

viii. Photosynthesis

1. Stomates
   a. Allow CO₂ and O₂ to exit and enter the leaf
   b. Regulated by 2 Guard Cells
      i. High Turgor Pressure: Filled with H₂O
         1. Open

2. Mesophyll Cells
   a. Spongy and Palisade
      i. Contain Chloroplasts