GENERAL BIOLOGY Lecture 24 - Plants: Absorption & Transport

I. Water and mineral absorption by roots
A. Absorption of water by roots
   1. Driven by transpiration - negative pressure in xylem draws water in through roots
   2. Root pressure (driving force when transpiration is low - high humidity)
      a) Solutes (sugars) built up in roots cause an osmotic drive of water from
         surrounding media solution to inner root (i.e., water moves from higher
         potential to lower potential)
      b) Xylem transport driven by positive pressure - source for guttation

II. Uptake of mineral nutrients
A. Passive uptake of minerals (mineral ions move freely into free space of cortex)
   1. Movement of ions by the "sweeping effect"
      a) Ions can cross the endodermal cell membranes passively by being "swept" into
         the stele with water

B. Active uptake of minerals
   1. Energy-requiring transport of ions into cells of the cortex (mostly minerals in low
      abundance in soil solution - nitrate, potassium, sulfate, phosphate, etc.)
   2. Movement into xylem is blocked by special barrier (Casparian strip of an endodermis) -
      promotes active transport
      a) Endodermis (with Casparian strip) requires that molecules pass through a
         plasma membrane to enter (or leave) the vascular cylinder

III. Xylem & phloem transport
A. Mechanism of xylem transport (cohesion-adhesion-tension hypothesis)
   1. Xylem is usually dead, empty cells
   2. Transport by bulk flow - driven by transpiration
      a) Transpiration causes "suction" and negative pressure on water in xylem
   3. Important characteristics of water
      a) Cohesion - attraction of water molecules to each other
      b) Adhesion - attraction of water to other molecules (like cell walls)
      c) Tension - ability of water to withstand negative pressure

B. Mechanism of phloem transport (pressure-flow hypothesis)
   1. Source is high pressure; sink is low pressure
   2. "Source-sink" directionality (photosynthesis is source; meristem is sink)
      a) Sugar (photosynthate) is actively transported into phloem at a source
      b) Water moves into sieve tube by osmosis
      c) Water uptake pushes phloem sap (photosynthate) towards sink
      d) Sap (photosynthate) is unloaded at sink;
      e) Water returns to xylem

IV. Mineral nutrition
A. CHOPKNs CaFe Mg B Mn CuZn Cl Mo
   1. CHO - carbohydrates
   2. P - ATP K - enzymes & stomates N - proteins
      S - amino acids Ca - membranes Fe - ETS & photosynthesis
      Mg - chloro. B - CHO breakdown Mn, Cu, Zn - enzymes
      Cl - OEC Mo - enzymes