

**PLANT PHYSIOLOGY Lecture 19 - Mineral Nutrition**

- I. Review of water potential**
  - A. Water potential ( $\Psi$ ) = pressure potential ( $\Psi_p$ ) + osmotic potential ( $\Psi_s$ )**
    - 1. Water potential - a measure used to predict the direction of water flow (from high to low)
      - a) Pressure potential - turgor pressure (associated with cell growth & expansion)
      - b) Osmotic potential - can be used to regulate turgor - regulates plant water movement
- II. Water and mineral absorption by roots**
  - A. Absorption of water by roots**
    - 1. Driven by transpiration - negative pressure in xylem draws water in through free space - water must move through living cells of endodermis
    - 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
- III. Uptake of mineral nutrients: two theories (mass flow and active transport)**
  - A. Mass Flow - probably PASSIVE**
    - 1. Movement of ions by "sweeping" effect - major source of nutrients
    - 1. Minerals may flow with water into root by "facilitated" diffusion
  - B. Active uptake of minerals**
    - 1. Energy-requiring transport of ions into cells of the cortex (mostly minerals in relatively low abundance in soil solution - potassium, nitrate, 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
- IV. Availability of nutrients**
  - A. Soil - a net negative charge**
  - B. Soil environment - pH, texture, organic matter, moisture, etc.**
- V. Xylem transport**
  - A. Mechanism of xylem transport (cohesion-adhesion-tension hypothesis)**
    - 1. Tracheids and vessels 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
- VI. Mineral nutrition**
  - A. CHOPKNS CaFe Mg B Mn CuZn Cl Mo**
    - 1. CHO - carbohydrates
    - 2. P - ATPK - 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	