PLANT NUTRITION & TRANSPORT
Nutrient

- Element essential for metabolic functions of an organism
  - Oxygen (O)
  - Carbon (C)
  - Hydrogen (H)
  - Nitrogen (N)
  - Phosphorus (P)
  - Sulfur (S)
  - Magnesium (Mg)
  - Potassium (K)
Fertilizers

- **N-P-K**
  - Nitrogen (N)
    - Shoot growth (green)
  - Phosphorus (P)
    - Root growth
  - Potassium (K)
    - Reproduction (flowering / fruiting)

28-3-3
Quick Quiz: Which elemental nutrient can a plant obtain without soil?

A) Carbon  
B) Phosphorus  
C) Potassium  
D) Nitrogen
Absorption of Water & Minerals

- Root hairs
  - Movement of water & minerals across epidermis
  - Minerals actively transported to facilitate movement of water
Absorption of Water & Minerals

- **Root vascular cylinder**
  - Water / minerals accumulate in cortex
  - Actively transported across Casparian strip into xylem
Root Vascular Cylinder

- Casparian strip (gold) within all the abutting walls of cells of the endodermis
- Conducting cell of primary phloem
- Conducting cell of primary xylem
- Cells of endodermis
- In root cortex; water molecules pass through and between walls of cells
- Casparian strip (gold) vascular cylinder
- Location of Casparian strip

Exodermis
Root hair
Epidermis
Newly forming vascular cylinder
Cortex

Fig. 30.5, p. 520
Quick Quiz: Where is the vascular cylinder located?

A) In stems
B) Throughout the shoot system
C) Throughout the root system
D) All of the above
Transport of Water Through the Plant

- Transpiration
  - Pressure differentials
    - Evaporation of water through leaves creates low pressure at leaf surface
    - Buildup of water in roots creates high pressure
    - Pressure differential drives movement of water from high to low pressure areas
Transport of Water Through the Plant

- Transpiration
  - Pressure differentials
  - Cohesion-tension theory
    - Cohesion
      - “Like sticks to like”
      - Affinity of water for water
    - Adhesion
      - “Like sticks to unlike”
      - Affinity of water to other surfaces (walls of xylem)
Transport of Water Through the Plant

- Transpiration
  - Requires continuous column of water
  - One-way process
A The driving force of transpiration
Evaporation of water molecules from aboveground plant parts puts water in xylem into a state of tension that extends from roots to leaves. For clarity, tissues inside the vein are not shown.

B Cohesion of water inside xylem tubes
Even though long columns of water that fill narrow xylem tubes are under continuous tension, they resist breaking apart. The collective strength of many hydrogen bonds keeps individual water molecules together.

C Ongoing water uptake at roots
Water molecules lost from the plant are being continually replaced by water molecules taken up from soil. Tissues in the vein not shown.
Regulation of Transpiration & Water Conservation

- **Cuticle**
  - Waxy outer coat

- **Stomata**
  - Pores
  - Regulated through turgor pressure
**Stomata**

- **Structures**
  - Stoma
    - Opening
  - Guard cells
    - \( \uparrow \text{water} \rightarrow \uparrow \text{turgor} \rightarrow \text{open} \)
    - \( \downarrow \text{water} \rightarrow \downarrow \text{turgor} \rightarrow \text{closed} \)
Stomata

a Stoma is open; water has moved in.

b Stoma is closed; water has moved out.
Quick Quiz: Transpiration depends on evaporation of water from which plant organ?

A) Roots
B) Flowers
C) Leaves
D) All of the above
Transport of Organic Compounds

- **Translocation**
  - Transport of carbohydrates (sugars) and other compounds through phloem
  - Source → sink

- **Driving forces**
  - Concentration gradient
  - Water pressure
Quick Quiz: Direction of translocation of food materials in phloem depends on which of the following?

A) Evaporation from leaves
B) Concentration gradients of food materials
C) Carbon dioxide concentrations
D) All of the above