

PHYSIOLOGY

I. **Physical Processes** - processes that do not involve chemical changes (ie. forming or breaking of bonds).

A. **Diffusion** - net movement of ions or molecules from a region of higher concentration to a region of lower concentration; results from random thermal motion of particles.

1. **Solvents & Solutes**

B. **Osmosis** - movement of water across a differentially permeable membrane from a region of low solute concentration to a region of higher solute concentration.

1. **Turgor** - positive hydrostatic pressure that develops within plant cells due to osmotic water entry.

C. **Absorption** - taking in of water & minerals by plants; most often due to osmotic pressure.

1. **Passive Absorption** - due to uneven osmotic pressure; can be performed by dead cells.

2. **Active Absorption** - movement against gradient; performed by living cells.

3. **Factors Affecting Absorption**

a. **Hygroscopic Water** - unavailable soil moisture due to colloid particles holding water too tightly for roots to get to it; permanent wilting percentage.

b. Water holding capacity of soil - **field capacity** is the water content after gravitational water has been removed (ie. hygroscopic & capillary water content).

c. Solute concentration of soil - affects osmosis.

d. Cold temperature - causes less absorption.

e. **Saturated Soil** - contains too much water which forces out the oxygen.

f. Transpiration rate

D. **Imbibition** - process by which a porous material absorbs a liquid and swells as a result of the adherence of the liquid to the internal surfaces of the material; cellulose is colloidal & imbibes water.

E. **Plasmolysis** - shrinkage of cytoplasm away from the cell wall due to excess water loss when a cell is placed in a solution containing a higher solute concentration than that of the cell.

F. **Guttation** - secretion of droplets of water from tips & margins of leaves when **root pressure** exceeds transpiration rate.

G. **Translocation** - long distance transport of water & organic material through plant.

1. **Transport thru Xylem**

a. **Cohesion-Tension Theory** - as water is lost from transpiration in the leaves it "pulls" water from the xylem, which through cohesive force (tension) pulls more water up the xylem tissue from the root system.

(1) **Evidence** - root pressure not sufficient to push water up tall trees; not all plants bleed when trunk is cut; when xylem is cut water pulls away (upward) from cut.

b. **Root Pressure Theory** - water is pushed upward by positive pressure in root system; a higher concentration of solutes in root than soil causes the pressure.

2. **Transport thru Phloem** - less is known.

a. **Pressure Flow Model** (Karl Munch) - see Figure 11.6 on page 200. a.k.a Ernst Munch & Mass Flow Model.

H. **Transpiration** - evaporation of water from surfaces of plant; occurs mainly by evaporation of water from mesophyll within leaves & diffusion through stomates.

1. **Environmental Factors**

a. **Relative humidity** - high humidity less diffusion.

b. **Temperature** - warm leaves evaporate more water; warm air holds more vapor.

c. **Wind velocity** - dual effect: dry air increases transpiration, high wind velocity cools leaf & decreases transpiration.

d. **Light intensity** - stomates open in bright light.

e. **Soil conditions** - temperature; solute concentration (affects water uptake); oxygen in soil.

2. Morphological Factors

- a. Deep roots that can reach water table; extensive fibrous roots system.
- b. Water storage organs.
- c. Thick cuticle or cell walls.
- d. Sunken stomates or restricted to lower surface; stomates that close.
- e. Ability to reduce transpiring surface; vestigial leaves.

II. Plant Nutrition

A. Autotrophic

1. Photosynthetic
2. Chemosynthetic

B. Heterotrophic

1. Parasitic
2. Saprophytic
3. Holophytic (Holozoic) - eg. slime molds.

III. Metabolic Processes - processes involving chemical changes (ie. breaking or forming of bonds).

A. Intermediary Metabolism

1. Mineral Contents of Plants

- a. **Macronutrients** - required in large amounts.

C (carbon) P (phosphorus)
H (hydrogen) K (potassium)
O (oxygen) Ca (calcium)
N (nitrogen) Mg (magnesium) S (sulfur)

- b. **Micronutrients** - required in lesser amounts.

Fe (iron) Zn (zinc)
B (boron) Mo (molybdenum)
Mn (manganese) Cu (copper)

B. Photosynthesis

C. Chemosynthesis

D. Assimilation

E. Digestion

F. Respiration