

Biology 12.3

Plant Physiology

Physiology

1. The activities of the plant
2. Photosynthesis: production of glucose
3. Metabolism: making and breaking molecules
4. Growth

Nutrient requirements

1. Water
2. Minerals
3. Oxygen
4. Carbon dioxide
5. Most plants can manufacture their own food (photosynthesis)

The role of water

1. Photosynthesis: $6\text{CO}_2 + 6\text{H}_2\text{O} > \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
2. Turgor: water pressure inside each plant cell determines stiffness and rigidity (vs wilting)
3. Hydrolysis: metabolic process of breaking molecules (glycolysis)
4. Translocation: nutrients and minerals moved through the plant when dissolved in water
5. Leaf arrangement on plants direct rain, etc. toward the roots
6. The root tips absorb water
7. Soil texture determines the availability of water
 - a. The size of the particles (gravel, sand, silt, clay) determines soil texture
 - b. Loam: is a mixture of sand, silt, clay. Ideal loam is 40% sand, 40% silt, 20% clay
 - c. Humus: dead organic material
 - d. Topsoil: loam + humus + living organisms (10%)
 - e. Pore spaces: the space available in the soil for water and air
8. Water absorption
 - a. Roots hairs absorb water
 - b. Osmosis: water flows in the direction of the greater solute concentration
 - c. Water diffuses through epidermis, cortex and endodermis to vascular bundle
 - d. Root pressure results from increase in water in xylem and pushes water upward
9. Translocation of water
 - a. Root pressure is inadequate to push water very far in plants
 - b. Capillarity: water will travel upward in very thin tubes
 - c. Transpiration: water evaporates from the leaves of trees. An oak tree loses 300 gallons of water on a hot day
 - d. Cohesion: water molecules stick together
 - e. As water evaporates a vacuum action takes place drawing water upward in the plant (e.g., drinking from a straw)

Turgidity

1. The pressure of water inside plant cells is called turgor pressure
2. The solute concentration and water availability affect turgor

Nastic Movement

1. Plant movement such opening and closing of flowers
2. Caused by the loss or gain of turgor pressure
3. The sunflower plant follows the sun from east to west

The role of minerals in plants

1. Used to manufacture substances and aid in metabolism
2. Most plants manufacture their own food (photosynthesis)
3. Nitrogen: In the form of NO_3 or NH_4 used for proteins, nucleic acids
4. Phosphorus: used for ATP, nucleic acids
5. Potassium: cell membranes
6. S, Ca, Mg, Fe (CHOPKINSCaFe)
7. Fertilizers: add minerals to soil (10-10-10 : N,P,K)
8. Mulch: natural method of supplying soil with nutrients from dead remains
9. Absorption of minerals
 - a. Minerals must be dissolved in water
 - b. Active transport: moves dissolved minerals into cells against concentration gradient
 - c. plasmolysis occurs when solute concentration greater in the soil

Insectivorous plants

1. obtain N and minerals by catching and digesting insects with enzymes
2. Venus's fly trap: 3 triggers hairs inside trap
3. Sundew: Hundreds of tentacles with sticky, sweet fluid
4. Butterwort: Sticky, sweet fluid and curling leaf
5. Pitcher plants: hollow leaves with sweet fluid at bottom of pitcher and hairs that prevent backing up
6. Bladderwort: Bladder opening with trigger hairs snaps shut

Hydroponics

1. Growing plants in water/mineral solutions
2. Requires air being bubbled in water (like aquarium)

Plant Hormones

1. Auxins are plant hormones that cause growth
2. Produced in the meristemic region (growth regions of plants)
3. Experiments on oat coleoptiles
4. Remove tip: no growth
5. Replace tip: growth
6. Auxin induces growth (auxin diffused into agar)
7. Auxin on one side of cut tip causes uneven growth
8. Farmers spray auxin on plants to prolong ripening fruit
9. Gibberellins
 - a. discovered by Japanese studying a fungus disease in rice, "foolish seedling disease"
 - b. fungus produced chemical that caused rapid sprouting
 - c. the chemical called gibberellin. Many kinds have been found in plants

Tropisms

1. Directional plant growth
2. Phototropism: Auxins concentrate on shaded side of plants, increasing growth on one side and bending plants toward light (positive phototropism)
3. Geotropism: roots grow toward gravity and stems away from gravity
4. Thigmotropism: plant growth toward or away from touching surfaces
5. Chemotropism: growth toward or away from chemicals

The role of light

1. Intensity, duration, and direction of light affects growth
2. Photoperiodism: the growth of plant affected by duration of light

Dormancy in plants

1. A period of time when plants become inactive waiting for better conditions
2. *Annuals* die in winter and rely on seeds to perpetuate species.
 - a. Removing the flowers as they fade prolongs the blooming cycle
3. Perennials grow for more than two years. Many lose vigor after 3 to 4 years. They may be divided to produce new plants, or they may be grown from seeds or cuttings.
4. Deciduous plants, including trees, shrubs and herbaceous perennials, are those that lose all of their leaves for part of the year.
 - a. Deciduous means falling off at maturity or tending to fall off (deriving from the Latin word *decidere*, to fall off)