

Based on Mader, Sylvia S. 1996. *Biology* - 5th Ed. WCB

and

Cox, G.W. 1997. *Conservation Biology* - 2nd ed. WCB

and

Levine, J.S. and K.R. Miller. 1994. *Biology: Discovering Life*. D.C. Heath

Plants

Reading: Chapters 30, 32 in Levine and Miller

I. Plants

A. Basic Needs

1. Sunlight

- a) Trees grow to it
- b) Algae may swim to it
- c) Need for support

2. Water

- a) Need for roots

3. Reproduction

- a) Special structures
- b) Plants can't move

(1) Replacement of water as a means for mixing gametes

B. Evolution – movement onto land

1. Must solve 3 problems (5 in book)

- a) Support
- b) Water to leaves
 - (1) A lot of work to raise gallons of water to the top of a tall tree
- c) Replacing water as a medium for sperm to swim in

2. Solutions

- a) Roots
- b) Vascular tissue
- c) Pollen

C. Parts of a plant:

1. Three main parts:

- a) Roots – obtain water, nutrients, anchor plant
- b) Stems – hold up plant, transfer water, nutrients, sap
- c) Leaves – photosynthetic center

2. 3 tissues

- a) dermal tissue - protection
- b) vascular tissue – moving materials
- c) ground tissue – support, photosynthesis

3. Meristems

- a) Apical meristem
 - (1) **at the tips of roots**
 - (2) **increase in length**
- b) lateral meristem
 - (1) **circles stems and roots**
 - (2) **increase in girth**
- c) differentiation – transformation of one of the divided meristem cells into a specialized cell

4. Cell types:

- a) Epidermal cells
 - (1) **Guard cells**
- b) Parenchyma cells – ground tissue
- c) Xylem – transports water, minerals up
 - (1) **Comprised of tracheids or vessel elements**
 - (2) **Transport water**
 - (3) **Dead when functional**
- d) Phloem – transports sap – both ways
 - (1) **Sieve-tube members – no nucleus**
 - (2) **Companion cells**

5. Roots

- a) Primary roots
- b) Secondary roots
- c) epidermis
 - (1) **Root hairs**
- d) Cortex
- e) Endodermis
 - (1) **Casparian strip**

D. Water movement**1. 3 forces:**

- a) root pressure
- b) capillary action
- c) transpiration
 - (1) **transpiration is made effective by:**
 - (a) tension - “pull” from leaves
 - (b) cohesion – water molecules stick together
 - (c) adhesion – water sticks to walls of xylem

2. Ultimately powered by the sun**3. 100 liters/day = 4 liters/hr = 4 kg/hr = 10 pounds / hr up 300 feet.****E. Sap movement****1. Pressure/flow hypothesis**

- a) Sugars produced in leaves
- b) Sugars pumped into phloem
- c) Water follows by osmosis
- d) Roots remove sugar, cause gradient which draws sugar and water to roots
- e) Water usually moves in the opposite direction of sap

- F. Water uptake by roots**
 - 1. **Active transport of mineral ions into roots**
 - 2. **Water follows due to osmotic pressure**
 - 3. **Endodermis and Casparian strip regulate water flow – water must move through cells**
 - 4. **High salt levels in soil can pull water out of the root hairs**
 - a) Halophytes tolerate higher salt concentrations

- G. Tree stems**
 - 1. **Two layers of meristem tissue**
 - a) Vascular cambium produces new xylem to inside, phloem to outside
 - b) Cork cambium forms new cork (bark) to outside
 - 2. **Annual rings – xylem produced more rapidly in spring**

II. Plant Growth

- A. Seeds**
 - 1. **Three parts**
 - a) Embryo
 - b) Stored food
 - c) Seed coat
 - 2. **Monocots:**
 - a) One cotyledon
 - b) Food stored in endosperm
 - c) Grasses (corn, rice, wheat, etc)
 - 3. **Dicots:**
 - a) Two cotyledons
 - b) Food stored in cotyledons
 - c) Woody plants

- B. Dormancy**
 - 1. **Period of inactivity by the seed**
 - 2. **Allows bad growing seasons to be bypassed**
 - 3. **May last days to 12,000 years**
 - 4. **Many seeds need drought, damage to seed coat, or freezing temperatures before germination**

III. Plant nutrients – Table 32.2 page 643**A. Materials needed for photosynthesis****1. Water - source of hydrogen**

- a) taken in through roots
- b) aided by mycorrhizae
- c) transported up trunk via xylem
- d) lost through stomata - transpiration
- e) Stomata open due to turgor pressure
- f) Turgor pressure requires water
- g) No water - stomata close, reduces water loss

2. CO₂ - source of carbon

- a) Taken in at stomata
- b) Stomata open only when water available
- c) Taken in at night by desert plants

3. Nitrogen - needed for amino acids

- a) Taken in as NO₃⁻ dissolved in H₂O
- b) Nitrogen fixed by bacteria in soil
- c) Nitrogen present in animal wastes, fertilizers
- d) *Rhizobium* in nodules of legumes also fix N₂
- e) In short supply for bog plants --> carnivory

4. Phosphorous - used in ATP, DNA, cell membranes

- a) Taken in with water as PO₄
- b) uptake enhanced by mycorrhizae
- c) "mined" from decaying organisms

5. Magnesium - used in chlorophyll

- a) taken up with water

B. Sources of minerals**1. Fertilizers**

- a) N-P-K ratios --> nitrogen - phosphorous - potassium
- b) Elements removed from soil most quickly
- c) = 5% nitrogen, 10% phosphorous, 5% potassium
- d) Test soil to determine proper ratio

2. Mineral availability - affected by soil

- a) Property of pH - acids leach minerals from soils
- b) Under acid conditions soil releases aluminum and iron rather than calcium, magnesium and potassium
- c) Aluminum and iron may be toxic to the plant
- d) Plants can use energy to concentrate minerals far above levels found in the soil

3. Epiphytes - getting by without soil

- a) Some have roots, get water from atmosphere or rain
- b) Bromeliads
- c) Some send haustoria into plant for water or sugars or both

C. Agriculture

1. Human recreation of natural systems
2. Only cycles if wastes returned to soil
3. Otherwise --> mining soil

1. Practices:**a) preparing soil**

- (1) **slash-and-burn**
- (2) **machinery**
- (3) **soil erosion**
- (4) **use of fossil fuels**
- (5) **soil compaction**

b) monoculture

- (1) **efficiency**
- (2) **susceptibility to disease, pests**

c) fertilizers

- (1) **replace lost nutrients**
- (2) **expense**
- (3) **eutrophication**

d) pesticides

- (1) **attempt to deal with pest problems caused by monoculture**