

## GENERAL BOTANY Lecture 11 - Respiration &amp; secondary metabolism

- I. Overview**
- A. Photosynthesis (energy & CO<sub>2</sub> fixation) - chloroplasts
  - B. Respiratory & secondary metabolism
    - 1. Glycolysis - cytoplasm
    - 2. Krebs (Citric acid cycle) - mitochondrion
    - 3. Electron transport & oxidative phosphorylation - mitochondrion
- II. Glycolysis [glucose and fructose from Calvin cycle (photosynthesis)]**
- A. Glucose - glucose-6-p - fructose-6-p - fructose 1,6-dp - PGAL (=DHAP) - 1,3-dp-glycerate - 3-p-glycerate - 2-p-glycerate - phosphoenolpyruvate - pyruvate
  - B. Initial step(s) - energy requiring (2 ATP)
  - C. Subsequent steps
    - 1. Two - substrate-level phosphorylations (4 ATP)
    - 2. One - reduction of NAD to NADH (2 NADH)
  - D. Yield - 2 ATP & 2 NADH
  - E. Final product - 2 pyruvates
- III. Alternatives after glycolysis**
- A. Lactic acid - 2 ATP (no NADH) ... intense muscle activity (little O<sub>2</sub> available)
  - B. Ethanol - 2 ATP (no NADH) ... fermentation
  - C. Krebs Cycle - (2 ATP) and oxidative phosphorylation (32 ATP)
- IV. Krebs Cycle - mitochondrial matrix**
- A. [pyruvate - acetyl CoA] - citrate - isocitrate - alpha-ketoglutarate - succinyl CoA - succinate - fumarate - malate - oxaloacetate - w/acetyl CoA - citrate
  - B. Initial step(s) - pyruvate converted to acetyl CoA [CO<sub>2</sub> emission and NADH production] - acetyl CoA combines with oxaloacetate (4 carbon) to form citrate (6 carbon)
  - C. All steps from pyruvate to CO<sub>2</sub>
    - 1. Cycle (two trips) - 2 GTP (2 ATP), 8 NADH, and 2 FADH<sub>2</sub>
  - D. Final product - 6 CO<sub>2</sub>
- V. Electron transport system & oxidative phosphorylation - inner mitochondrial membrane**
- A. Convert NADH & FADH<sub>2</sub> to ATP
    - 1. NADH (glycolysis) = 2 ATP - 4 ATP
    - 2. NADH (Krebs) = 3 ATP - 24 ATP
    - 3. FADH<sub>2</sub> (Krebs) = 2 ATP - 4 ATP
  - B. How is it done? H<sup>+</sup> gradient (opposite of chloroplast)
    - 1. NADH & FADH<sub>2</sub> give up H<sup>+</sup> to outer compartment (High outside)
    - 2. H<sup>+</sup> is then pumped back in and ATP is produced
  - C. Net yield of ATP
    - 1. From oxidative phosphorylation - 32 ATP
    - 2. Substrate level phosphorylation - 4 ATP
    - 3. TOTAL..... 36 ATP
- VI. Secondary metabolism**
- A. From glycolysis & Krebs
    - 1. Fats, glycerol, fatty acids, amino acids, & proteins
      - a) Example: Carbohydrate - (ribose) - nucleic acid
      - b) Example: Amino acid - (glycine) - hemoglobin
      - c) Example: Amino acid - (glutamate) - chlorophyll

