

GENERAL BOTANY Lecture 10 - Photosynthesis (Part II)

IV. (Continued from last time) Dark reactions

- A. Major purpose - use energy from light reactions to fix CO<sub>2</sub> into organic molecules
- B. Reagents of dark reactions
  1. ATP and NADPH
  2. CO<sub>2</sub>
  3. Ribulose biphosphate
  4. Enzymes (especially RUBISCO - Ribulose biphosphate carboxylase / oxygenase)
- C. Why fix CO<sub>2</sub>?
  1. Store and use chemical energy in the form of organic compounds
- D. Steps of CO<sub>2</sub> fixation:
  1. CO<sub>2</sub> and H<sub>2</sub>O (1 carbon) are added to ribulose biphosphate (5 carbons) to form two molecules of 3-phosphoglyceric acid (3-PGA) (total of 6 carbons)
  2. Catalysis of this reaction by RUBISCO
  3. 3-PGA is reduced to 3-PGAL with the help of NADPH and ATP
  4. 3-PGAL is converted to either fructose diphosphate or, eventually ribulose biphosphate
  5. Fructose diphosphate goes to other aspects of metabolism and ribulose biphosphate goes back to the original cycle of CO<sub>2</sub> fixation.
  
- E. Overall reaction of photosynthesis
$$12\text{H}_2\text{O} + 6\text{CO}_2 \xrightarrow{\text{light}} 6\text{O}_2 + \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O}$$
- F. Other types of CO<sub>2</sub> fixation - under hot conditions (to prevent O<sub>2</sub> competition)
  1. C4 plants - fix CO<sub>2</sub> by combining it with PEP to form OAA (PEP carboxylase)
  2. OAA (Malate after reduction) from mesophyll releases CO<sub>2</sub> to bundle sheath where RUBISCO carries on its usual process)
  3. Recyclization occurs when Malate is converted to pyruvate and, subsequently PEP for another round of CO<sub>2</sub> fixation.
- G. Now what happens?
  1. We have carbohydrate - a principle form of organic energy
    - a) Respiration will harvest energy and convert it to the universal currency - ATP