Chapter 10 – Outline

Photosynthesis

Level 1 Items — *AP Students will should be able to:*

1. Identify the basic equation of Photosynthesis.
2. Identify the main reactions of Photosynthesis.
3. Recognize the function, location, requirements and products of the Photosynthesis reactions.
4. Recognize the role of light and pigments in the Photosynthesis process.
5. Recognize the effects and importance of Photorespiration.
6. Recognize various types of Photosynthesis and their importances.
7. Identify the biological and economic importances of Photosynthesis.

Outline — *AP Students will understand:*

A. How Plants Make Food (Autotrophs)
- 1. General Equation for Photosynthesis
- 2. The Splitting of Water
  - a. Model
  - b. Evidence
  - c. Ps as a Redox Process
- 3. The Two Stages of Photosynthesis (an Overview)
  - a. Light Reaction
  - b. Calvin Cycle (Dark Reaction)

B. Light Reaction
- 1. Nature of Light
  - a. Electromagnetic Spectrum
  - b. Visible Light
  - c. Photosynthetic Wavelengths
- 2. Photosynthetic Pigments
  - a. Chlorophyll
    - 1. Structure and Elemental Composition
    - 2. Types
  - b. Accessory
    - 1. Function
    - 2. Examples
      - a. Carotenoids
      - b. Xanthophyll
- 3. Photosystems
  - a. Definition
  - b. Types
    - 1. Photosystem I
    - 2. Photosystem II
- 4. Cyclic Electron Flow – How to make a bunch of ATP
  - a. Pathway
  - b. Function
- 5. Noncyclic or Linear Electron Flow – How to make ATP and NADP
  - a. Function
  - b. Location
  - c. Requirements
  - d. Products
  - e. Pathway
  - f. Chemiosmotic Model

C. How the Calvin Cycle Makes Sugar
- 1. Function
- 2. Location
- 3. Requirements
- 4. Products
- 5. Pathway

D. Photorespiration
- 1. Rubisco
- 2. Importance

E. C4 Plants – a Ps variation
- 1. History
- 2. Anatomy
  - a. Mesophyll Cells
  - b. Bundle Sheath Cells
- 3. Pathway
  - a. PEP Carboxylase
  - b. Calvin Cycle
- 4. Examples
- 5. Growth Characteristics

F. CAM Plants – another Ps variation
- 1. History
- 2. Pathway
  - a. Day
  - b. Night
- 3. Examples
- 4. Growth Characteristics

G. Photosynthesis and Respiration Ratios
- 1. Ps > Rs, growth and reproduction
- 2. Ps = Rs, equilibrium
- 3. Ps < Rs, death by starvation

H. Factors that Affect Photosynthesis
- 1. Light
- 2. CO_2 levels
- 3. Temperature
- 4. Minerals

I. Importances of Photosynthesis
- 1. Food
- 2. Oxygen
- 3. CO_2 Balance
- 4. Plant Products
- 5. Life of Earth

Chapter 10 –Homework

Photosynthesis

1. **Write** the basic equation for Photosynthesis (Ps).

2. Some students define Ps as the process by which plants use light energy as food. **Discuss** if this is a correct statement -would it likely be accepted by an AP Biology Exam Reader?

3. **Contrast** and **compare** an absorption spectra (spectrum) versus an action spectra (spectrum) for Ps.

4. **Discuss** why the narrow area of electromagnetic radiation between 380-750 nm is the best choice to power a process like Ps.

5. **Contrast** and **compare** the function of chlorophyll pigments versus the function of the accessory pigments in Ps.

6. **Explain** the adaptive value of plants having their leaves change color in the fall.

7. **Contrast** and **compare** the tasks or purposes of the Light Reaction and Dark Reaction.

8. During the light reaction the proton gradient across the thylakoid membrane can be as great as 3 pH units. On which side of the membrane (**stroma** or **lumen of the grana**) is the pH the lowest (which way are the H+ moving into)?

9. Photorespiration costs the plant as much as 50% of the carbon fixed in the Calvin Cycle. **Discuss** why this process has not been selected against (or has it?).

10. **Discuss** under what environmental conditions C_4 Ps and CAM Ps are adaptive.

11. In science fiction stories, plants that live on planets far from the sun are often described as having black foliage, while those that live on planets close to the sun are described as having shiny reflective foliage. **Discuss** why these would be good adaptive features.