Jonathan Lam
Mrs. McTague
H. Bio. per. 3
5 / 5 / 15

Photosynthesis Study Guide

- **State and explain the two things that all living organisms need (from food).**
    a. energy
    b. basic building blocks (monomers and macromolecules)

- **Explain the key differences between producers (autotrophs) and consumers (heterotrophs).**
    a. producers create their own food, mostly from photosynthesis (some from chemosynthesis)
        i. Create food for all the organisms
        ii. Can convert light energy to usable chemical energy
        iii. Can create organic molecules from inorganic molecules
        iv. Chemo- and photo- autotrophs
            1. Chemoautotrophs get energy from oxidizing minerals--- for bacteria deep in ocean, ground, or extreme environments
            2. Photoautotrophs are like the ones we talked about, using light energy to create chemical energy
    b. consumers are dependent on producers and other producers for food
        i. Cannot live or exist without autotrophs

- **Explain the difference between photoautotrophs and chemoautotrophs. Provide examples of organisms that are photoautotrophs and chemoautotrophs, and compare the diversity of these two groups.**
    a. Photoautotrophs: do photosynthesis from water and CO2. Gain energy from light
        i. Plants, Algae, Protists and some Bacteria
    b. Chemoautotrophs: Oxidize mineral substances then use the energy made with CO2 and water to make sugars
        i. Archae Bacteria
    c. Explain: Differ in how they obtain the energy to make sugars energy. Chemoautotrophs use minerals. Photoautotrophs use light.
    d. Explain: More diverse and large amount of photoautotrophs.

- **State and explain the mathematical relationships between the wavelength, frequency, and energy of electromagnetic radiation. (The electromagnetic spectrum ranges from radiowaves to cosmic waves and includes light.)**
    a. Low to high energy:
        i. Radio waves (extremely low power, huge wavelengths, no damage)
        ii. Microwaves
        iii. Infrared waves
        iv. Visible light
            1. Red to violet (note red next to infra**red** and violet next to ultra**violet**)
        v. Ultraviolet rays
        vi. X-rays
        vii. Gamma rays (extremely harmful, will disintegrate, from nuclear bombs and supernovas)
    b. The higher the frequency, the higher the energy, and the shorter the wavelength

- **State and explain what a photon is.**
    a. It is a bundle of energy- the higher the energy of a light wave, the more the energy in the photon

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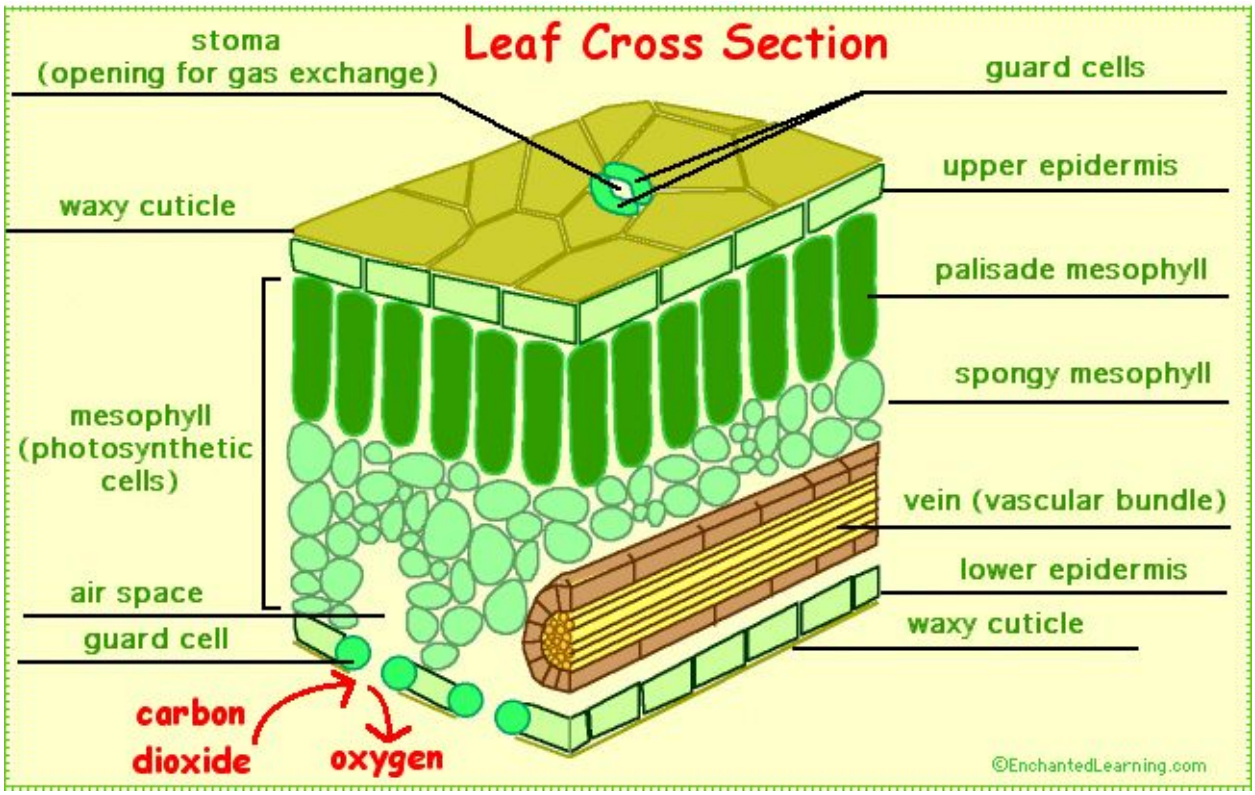
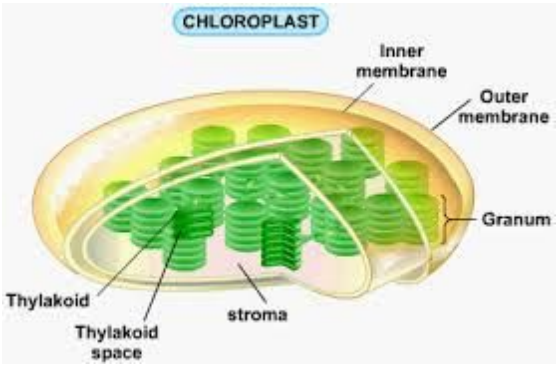
- **Label a diagram of a cross-section of a leaf**
- 

- **State and explain the differences in location, structure, and function between the epidermal and mesophyll layers of cells in a leaf.**
    a. Epidermal cells secrete a cuticle (have many Golgi?) and have no chloroplasts
    b. Mesophyll layers have chloroplasts
        i. Palisades cells
            1. Close together
            2. Long and towards top of cell
            3. Many chloroplasts
        ii. Spongy cells
            1. Loosely packed (air spaces)
            2. Irregularly shaped
            3. Fewer chloroplasts (but still some nonetheless- do little photosynthesis from leftover light from top and reflected light from bottom)

- **Explain the structure and function of guard cells and stomata. Explain how the guard cells function by explaining about how water balance and osmosis causes the guard cells to open and close the stomata.**
    a. Guard cells are two long cells around the stomata
    b. They open by filling up with water, making them bulkier and rounder, creating a space into the spongy layer
    c. Let carbon dioxide in and oxygen out
    d. Sometimes close to conserve water- can cause photorespiration in C3 plants

e. Stimulated by blue light at dawn- complex chain reactions involving ions and pumps to get water in

- **Label a diagram of a chloroplast.**
- 

- **State and explain the structure of a chloroplast. What are thylakoid sacs, thylakoid membranes, thylakoid spaces (lumen), stroma, etc?**
    a. Outer membrane: originally a vacuole membrane
    b. Inner membrane: originally bacteria membrane
    c. Thylakoids: sac
        i. Thylakoids membrane: where light reactions take place
        ii. Thylakoids lumen: space inside thylakoids where protons build up
    d. Grana: stack of thylakoids
    e. Interlamella: extension of thylakoids connecting grana
    f. Stroma: fluid in chloroplast in which Calvin cycle takes place

- **Label a detailed diagram of the thylakoid membrane with its embedded photosystems, electron transport chains, solute pumps for H+, ATP synthase, etc.**

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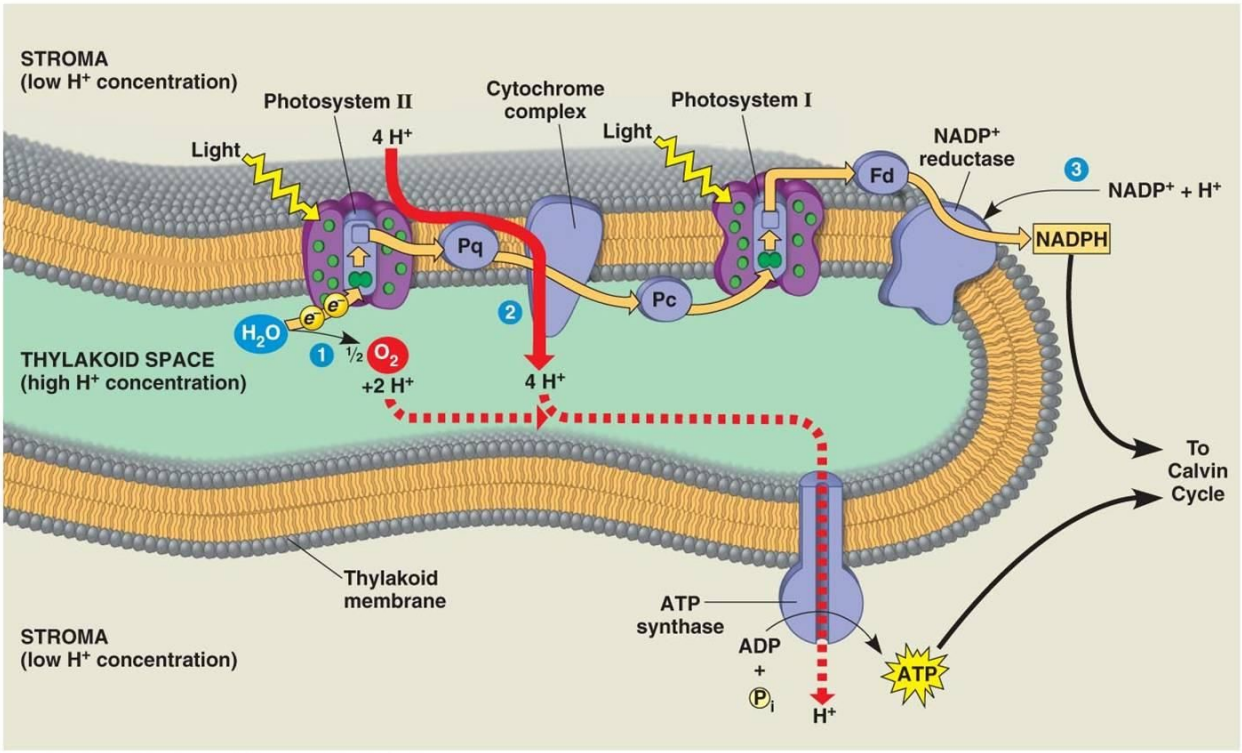
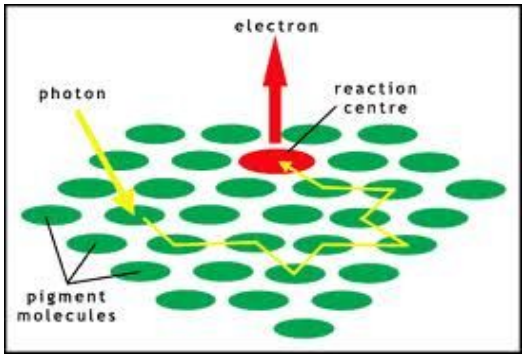


- **Label a diagram of a photosystem.**
- 

- **Label and explain a diagram of an overview of photosynthesis.**

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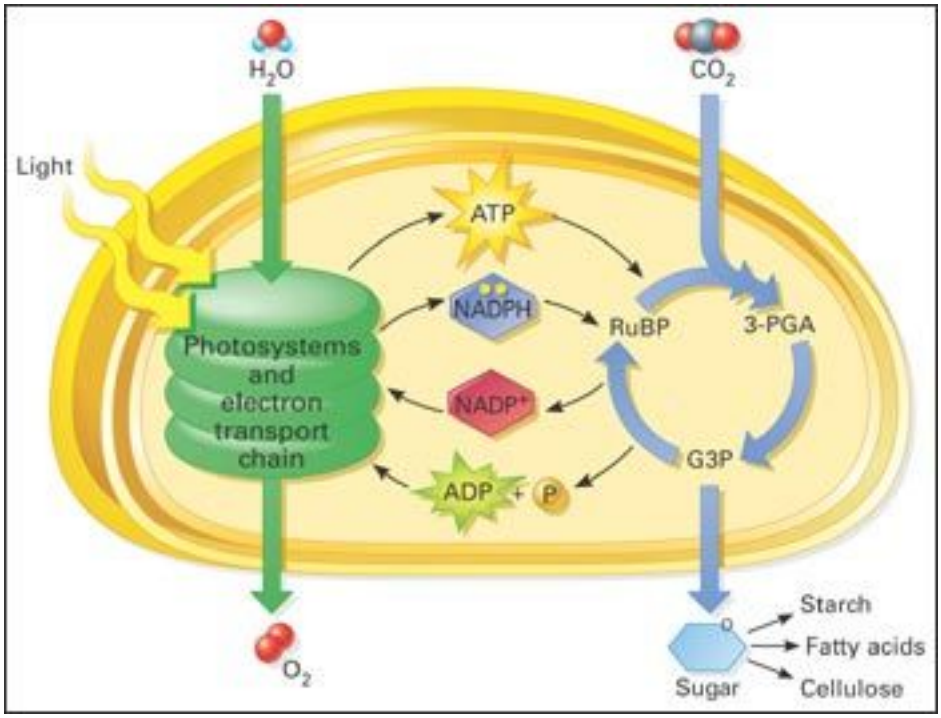
- 

- **Label and explain a diagram showing the steps of the light reactions.**

- **Label and explain a diagram showing the steps of the Calvin cycle.**
- Look at thylakoid membrane

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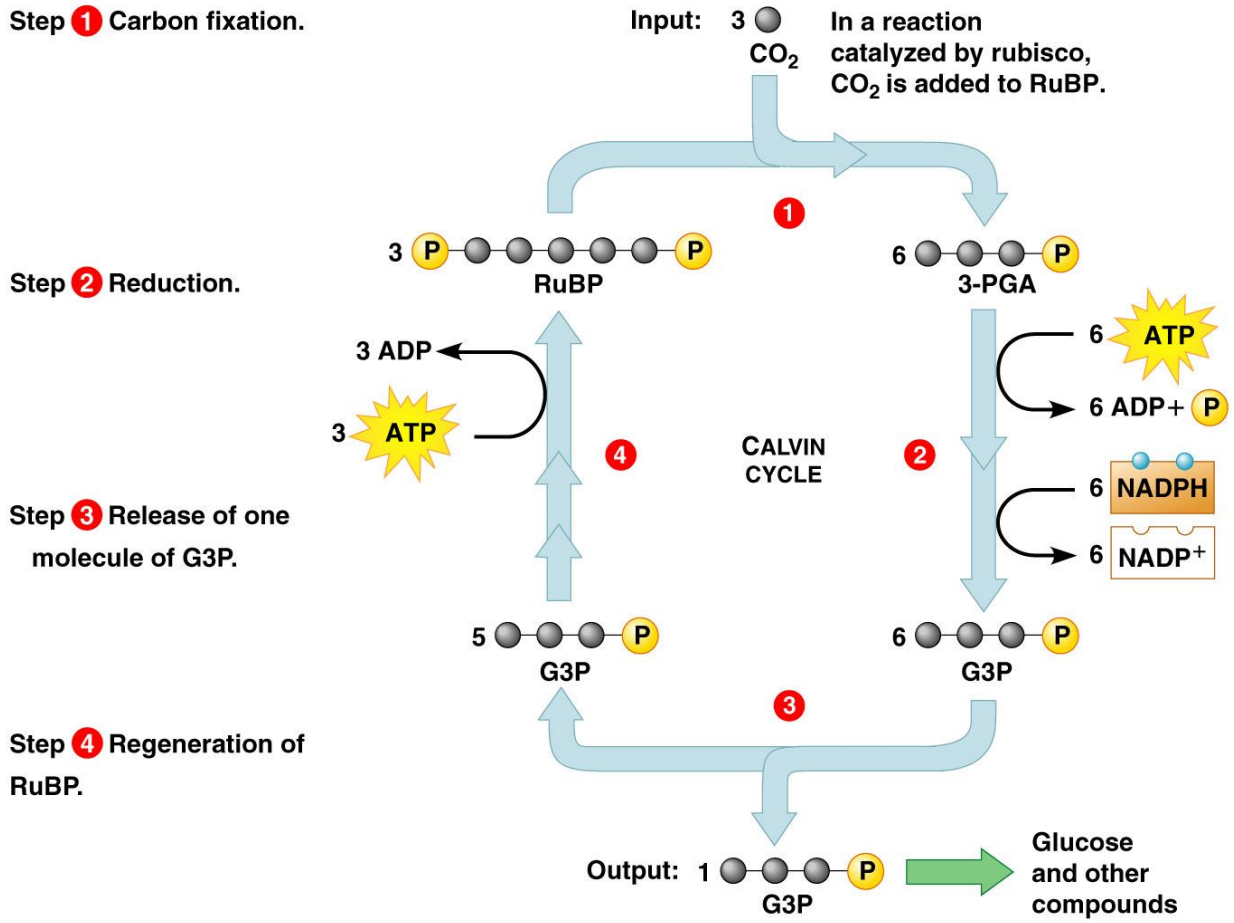

- **Explain the entire process of photosynthesis at both the overview and extremely detailed levels and use appropriate terminology in doing so.**
  a. In a leaf cell (or other photosynthesizing plant cell), in the chloroplast, in the thylakoids membrane, a photon of light strikes the pigments (chlorophyll and carotene) in the photosystem 2.
  b. The pigmented carry the energy to a pair of chlorophyll a molecules in the center of the photosystems.
  c. An electron from the chlorophyll pairs is excited and jumps up to a primary electron acceptor.
  d. A water molecule from the lumen is split by an enzyme into 1/2 O2 and 2 H+ ions, and two electrons. The electrons are taken by the chlorophyll pair, and the O combines with another to become diatomic and diffuses out of the cell (or photorespiration, if stomata are closed too long in C3 plants)
  e. The primary electron acceptor carries the excited electron to the proton pump, which pumps H+ ions inside the lumen. The energy of the electron is depleted
  f. … not done yet

- **Explain the difference between oxidation and reduction reactions. Identify reactions as either oxidation or reduction reactions.**
  a. oxidation = lose electrons
  b. reduction = gain electrons

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- **Explain the effect of environmental conditions on the rate of photosynthesis.**
    a. photosynthesis uses CO_2 and releases O_2
    b. the more the photosynthesis the less the CO_2, and the less the greenhouse gases and global climate change
    c. photosynthesizers are CO_2 sink

- **Explain, as well as compare and contrast, the C4 and CAM adaptations that help plants handle certain environmental conditions.**
    a. C4 do their light reactions in cell usually near the vein and do there calvin cycle in a mesophyll cell called a “bundle-sheath” cell
    b. CAM plants store CO2 at night and do their light reactions in the day.
    c. both store CO_2 first into PEP, a three carbon sugar that becomes OAA, a four carbon sugar, with carbon fixed

- **Explain global warming and the ozone layer (mostly unrelated).**
    a. ozone used to protect Earth from harmful rays
    b. CFCs chlorine can break down O_3 into ClO^- and O_2, and contribute to global warming