108C Discussion Problems: Week 1 – Photosynthetic Light Reactions

Answer each question descriptively with complete sentences where appropriate.

1a. A single photon of wavelength 480nm is absorbed by chlorophyll *b* in a light-harvesting complex. What chemical feature(s) of chlorophyll and other chromophores allow them to absorb visible light? How is the energy of the photon maintained within the chromophore?

1b. The energy from a photon absorbed by a chromophore results in excitation of the “special pair” of chlorophyll in the reaction center greater than 99% of the time. How is this energy transferred from the LHCs to the reaction center? Does any mass get transported during this process? What accounts for the incredible efficiency with which this process occurs?

1c. The energy absorbed in the LHC from a photon at 480nm is used to energize an electron in the special pair from +1.0V to -1.0V. What percentage of the original photon's energy was used to energize this electron? What happened to the remainder of the energy? How does that energy loss aid in photosystem function?

2a. Once an electron has been excited within the special pair, it is able to undergo electron transport. How is unidirectional electron transport energetically favorable? What must occur in the special pair of chlorophyll before another electron transport event is possible?

2b. Green plants have two distinct electron transport chains. What class(es) of molecules transport electrons from photosystem II? What class(es) of molecules transport electrons from photosystem I? How is the free energy of each electron transport chain harnessed for the benefit of the cell?

2c. In green plants, what is the primary electron donor for light-driven electron transport? What is the ultimate electron acceptor? How many photons of light are required to transport one electron from the primary electron donor to the ultimate electron acceptor?

2d. The thylakoid membrane is elaborate and forms two distinct structures. What are these structures? How and why are photosystems I and II distributed between these two structures?

2e. The photosystem reaction centers can only energize one electron at a time, yet many steps in the electron transport pathway require obligate multiple-electron transfers. What are these steps and how are the electron carriers able to convert between multiple- and single-electron transport events?