- Both photosystems are involved with using light energy to power the synthesis of ATP and NADPH, via the passing of electrons along the thylakoid membrane
- Photosynthesis begins in photosystem II, where photons are absorbed and energy is funneled to the P680 reaction center
- Here, excited high-energy electrons are passed to the primary electron acceptor, which then passes them down an electron transport chain of carriers to photosystem I
    - This chain of cytochrome proteins is much like that found in mitochondrial respiration
- Meanwhile, a similar photon-harvesting process is also exciting electrons in photosystem I, which combine with those from PS II at the P700 reaction center
- P700 passes these electrons on to its primary electron acceptor, which then hand off the electrons to a protein called ferredoxin
- Ferredoxin then passes two electrons to the electron carrier NADP+, reducing it to NADPH at the conclusion of the light reactions
    - This reaction is catalyzed by an enzyme called NADP+ reductase
    - NADP+ + H+ + electrons → NADPH
- P680 gives up electrons early in the process, so they need to be replaced, so an enzyme will split H2O to provide tow new electrons to P680, allowing the reactions to continue
- Splitting of water also results in the generation of O2 gas, which is released
- Lack of water=lack of electrons
- Process also involves chemiosmosis
    - As electrons are moved down the ETC between photosystems, an electrochemical gradient is set up as H+ is pumped across the thylakoid membrane
    - Then, an ATP synthase enzyme can utilize this gradient to form ATP as the H+ flow back across
    - Original energy comes from light, rather than food (photophosphorylation)
    - ETC pumps H+ form the stroma into the thylakoid space, then generates ATP out in the stroma as the H+ move back out there
- Summary of the light reactions:
    - Energy from the sunlight pushes electrons from water, to PSII, to PSI, and then to NADPH, forming ATP on the side
    - Light reactions generate NADPH, ATP, and oxygen gas (when we broke down water at the beginning)
    - ATP and NADPH carry this energy in chemical form to the stroma for the Calvin Cycle – a series of anabolic reactions that are able to make sugars from carbon dioxide
- **<u>The Calvin Cycle</u>**
    - Generates a 3-carbon sugar called glyceraldehyde 3-phosphate (G3P)
    - To form one of these, the cycle must actually be completed three times (one CO2 comes in at a time), which is how it is always diagrammed
    - Three phases:
        - Carbon fixation
        - Reduction
        - Regeneration
    - Carbon fixation