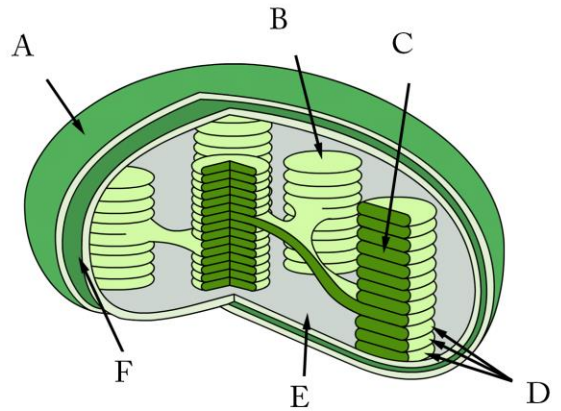


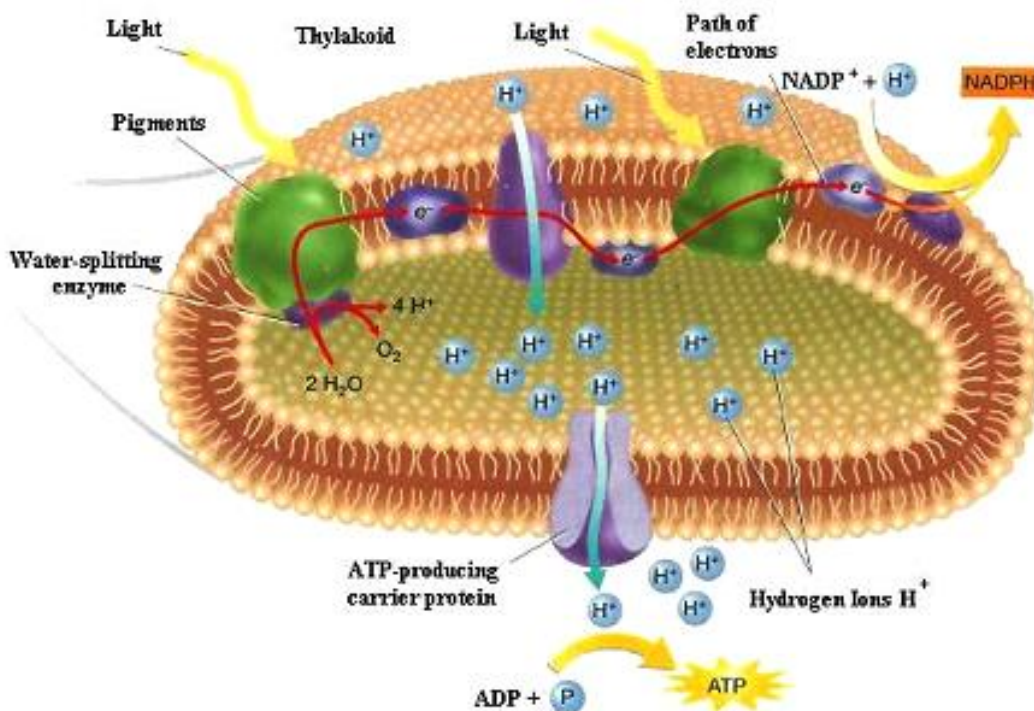
Photosynthesis Review

1. Label the diagram top right.
2. List the 2 raw materials (reactants) of photosynthesis, and describe how the plants obtain each.
3. What are the 2 products of photosynthesis?
4. Describe the structure and function of a stomate?
5. What color is found toward the shorter wavelengths end of the light spectrum?
6. What color is found toward the longer wavelengths end of the light spectrum?
7. What is a pigment?
8. Why is chlorophyll green?
9. According to the action spectrum of photosynthesis, visible light of what wavelengths and color is absorbed the least by plants?
10. Based on your answers to the above question and according to the action spectrum of photosynthesis what color light bulb would be the best to shine on a green plant?
11. What is the structural unit of photosynthesis?
12. What are the 2 general stages of photosynthesis and where in the chloroplast does each take place?
13. Summarize the "Light Dependent Process" (Light Reaction). What is the end result?
14. Summarize the "Light Independent Process" (Carbon Fixation Cycle). What is the end result?
15. A balance of how many carbon atoms must be maintained in the Carbon Fixation Cycle in order for it to continue to cycle?



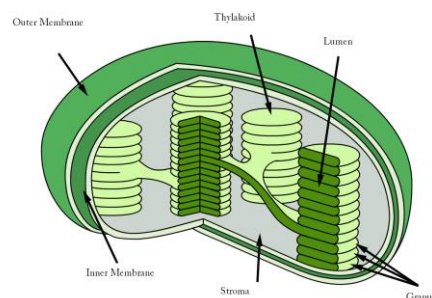
Using the diagram below.

16. What is the entire structure called?
17. Within what large organelle is this entire structure found?
18. Label PSII on the diagram. What happens at there?
19. Label the cytochrome complex on the diagram. What happens at there?
20. Label PSI on the diagram. What happens at there?
21. What is the final electron acceptor along the ETS (in other words where do the electrons end up)?
22. What happens to the hydrogens released when H_2O is split?
23. What happens to the oxygen released when H_2O is split?
24. What happens to the protons that are building up inside the thylakoid?
25. What is ATPsynthase?
26. What three factors contribute to the proton (H^+) gradient across the thylakoid membrane?
27. What are the two energy rich products of this light reaction?



Photosynthesis Review Key

1. Label the diagram top right.
2. List the 2 raw materials (reactants) of photosynthesis, and describe how the plants obtain each. **Water comes in through the roots and is transported up to the leaves through specialized conductive tissue called xylem. Carbon dioxide enters the leaves through tiny holes or pores (called stomata) found mainly on the underside of leaves.**
3. What are the 2 products of photosynthesis? **Oxygen is given off as a waste product. Sugar is also produced, however one might say that glyceraldehyde 3-phosphate (G₃P) is the true product and sugars like glucose and fructose are later made by the glyceraldehyde 3-phosphate.**
4. Describe the structure and function of a stomate? **Small pore like hole mainly found on the underside of leaves. It can be opened and closed by the plant regulating the amount of CO₂ that can diffuse in and the amount of O₂ that can diffuse out. Specialized cells called guard cells surround the stomate and control when it is opened. When guard cells are full of water (turgid) the stomate is open. When guard cells are full dehydrated (placid) the stomate is closed.**
5. What color is found toward the shorter wavelengths end of the light spectrum? **Ultraviolet or violet light.**
6. What color is found toward the longer wavelengths end of the light spectrum? **Infrared or red light.**
7. What is a pigment? **A pigment is any substance that absorbs light.**
8. Why is chlorophyll green? **It absorbs all colors except green which it reflects. The green reflected light then strikes our eyes and we perceive the color green.**
9. According to the action spectrum of photosynthesis, visible light of what wavelengths and color is absorbed the least by plants? **Light around 525 nm or green light is not absorbed by plants.**
10. Based on your answers to the above question and according to the action spectrum of photosynthesis what color light bulb would be the best to shine on a green plant? **White light has all the colors but a violet/blue light would seem to be the best.**
11. What is the structural unit of photosynthesis? **Chloroplast but more specifically the thylakoid.**
12. What are the 2 general stages of photosynthesis and where in the chloroplast does each take place? **Light reaction in the thylakoid and the Dark reaction in the stroma.**
13. Summarize the "Light Dependent Process" (Light Reaction). What is the end result? **Energy from light is absorbed by a chlorophyll complex at PSII and an electron is pumped down one site along the ETS. To replace the missing electron, PSII steals an electron from water (water is the electron loser) splitting the water into H⁺ ions and O. The oxygen pair up forming O₂ and are given off as waste. The H⁺ ions (called protons) are left to build up inside the thylakoid and help increase the proton gradient across the thylakoid membrane. The electron from the water is passed along the ETS like a hot potato from one electron acceptor to the other. Along its travels down the ETS the "excited" electron is used to pump H⁺ across the membrane into the thylakoid also helping increase the proton gradient. When the electron reaches PSI it is re-energized by another unit (photon) of light. This time the excited electron is used to reduce NADP⁺ turning it into NADPH (here one might say the electron hops into the electron taxi cab called NADPH). The proton gradient gives ATPase the energy to convert ADP into ATP (this is called photophosphorilation). The end result is NADPH and ATP are produced.**
14. Summarize the "Light Independent Process" (Carbon Fixation Cycle). What is the end result? **The 2 products of the light reaction (ATP and NADPH) are now used to drive the carbon fixation cycle. The ATP releases its energy and the NADPH drops off the electrons and protons (H⁺) it picked up from water in the light reaction. The carbon fixation cycle starts as 3 CO₂ molecules enter the stroma and are grabbed by the enzyme RuBisCo and each is added to a 5 carbon chain. Through a series of reactions and shuffling of atoms, 6 molecules of glyceraldehyde 3-phosphate (G₃P) are**



produced. One G₃P is removed and the other 5 G₃P are reshuffled and used to regenerate the cycle. The end result is G₃P which is a 3 carbon chain that can be thought of as a half a sugar. Two turns of the cycle are therefore required to produce 1 sugar molecule.

15. A balance of how many carbon atoms must be maintained in the Carbon Fixation Cycle in order for it to continue to cycle? **15**
Using the diagram below.
16. What is the entire structure called? **Thylakoid**
17. Within what large organelle is this entire structure found? **Chloroplast**
18. Label PSII on the diagram. What happens at there? **Light excites electrons, sending them down the ETS, leaving the PSII hungry for new electrons.**
19. Label the cytochrome complex on the diagram. What happens at there? **As the electrons flow down the ETS, they pump protons into the thylakoid to help build the pressure gradient.**
20. Label PSI on the diagram. What happens at there? **Light again excites electrons, this time giving them the energy boost they require to make it to the end of the ETS.**
21. What is the final electron acceptor along the ETS (in other words where do the electrons end up)? **NADP⁺ which becomes NADPH**
22. What happens to the hydrogens released when H₂O is split? **They help build the pressure gradient.**
23. What happens to the oxygen released when H₂O is split? **They wait for another oxygen, pair up and are released into the atmosphere.**
24. What happens to the protons that are building up inside the thylakoid? **They eventually build so much pressure that they are released through the ATPsynthase converting ADP into ATP.**
25. What is ATPsynthase? **It's an enzyme in the thylakoid membrane that uses the energy of the proton gradient to convert ADP into ATP.**
26. What three factors contribute to the proton (H⁺) gradient across the thylakoid membrane?
 1. **splitting of H₂O at PSII releases two protons H⁺ into the thylakoid.**
 2. **at cytochrome complex protons (H⁺) are pumped into the thylakoid.**
 3. **any protons outside the thylakoid are picked up by the taxi cab (NADPH) and taken away to build G₃P.**
27. What are the two energy rich products of this light reaction? **ATP and NADPH**

