Name_____ Mailbox #_____

PHOTOSYNTHESIS OVERVIEW

Light-Dependent Reactions

1. What are the raw materials (the reactants) for the light dependent reactions?
2. Where do the light-dependent reactions take place?
3. What are the byproducts of the light-dependent reactions?
4. Where do the byproducts of the light-dependent reactions go after they are produced?
5. What energy-poor "shuttle" molecules are required by the light-dependent reactions?
6. When sunlight excites the electrons in the chlorophyll molecules of Photosystem II, what is the potential energy of those electrons used for?
7. Where to "used/spent" electrons from Photosystem II go to get "re-energized"? What is the source of the energy that re-energizes them?
8. The newly excited electrons produced in Photosystem I are ultimately picked up by what energy-poor "shuttle" molecule? What new energy-rich molecule is formed as a result? Where does this energy-rich molecule go next?
9. What is the purpose of creating a hydrogen ion concentration gradient between the thylakoid space and the stroma? (Low H+ concentration in the stroma, high H+ concentration in the thylakoid space)…?
10. What is the source of the replacement electrons for those that are lost by chlorophyll P680 in Photosystem II?
11. What is the source of the replacement electrons for those that are lost by chlorophyll P700 in Photosystem I?
12. How, specifically, is ATP produced during the light-dependent reactions? Where does it go from here? Is it produced in the stroma or the thylakoid space?

Calvin Cycle

1. Where does the Calvin Cycle take place?
2. What is required to initiate the first step of the Calvin Cycle? How, as in the Citric Acid Cycle of cell respiration, is this a "chicken or the egg" sort of problem?
3. What is it called when carbon is brought into plants from the atmosphere and ultimately used to create G3P (glyceraldehyde 3-phosphate) through the Calvin Cycle?
4. Why is rubisco likely the most abundant protein on Earth?
5. What are the byproducts of the Calvin Cycle (please include ALL byproducts, not just those that would be part of the chemical equation for photosynthesis)?
6. Where do the ADP, detached phosphate functional groups, and $NADP^+$ go after being produced by the Calvin Cycle?
7. The energy input of ATP and NADPH into the Calvin Cycle is used to create what energy-rich intermediate molecule? (Hint: It's *not* glucose…)
8. Why is sugar (glucose) not the direct byproduct of the Calvin Cycle? What else is G3P good for besides as a raw material for sugar production?

Follow-Up Questions

1. The purpose of cell respiration in a mitochondrion is to convert the chemical energy of sugar into the chemical energy of ATP (from a directly unusable form to a directly usable one). The purpose of photosynthesis is to convert light energy into chemical energy (in the form of directly *unusable* sugar). If a plant can manufacture ATP during the light reactions of photosynthesis (which it can), what good does it do the plant to convert this directly-usable form of chemical energy back into an unusable form (in the form of glucose), especially since it could just use the ATP directly (which it could)? In other words, plants turn light energy into ATP, then ATP into sugar…then use their mitochondrion to covert the sugar *back into ATP*…. Why do they bother with the Calvin Cycle at all when they could skip it entirely and then have no need for mitochondria? (Hint: There are two correct answers to this question…).
2. What is a C_3 plant and why do we call them this?
3. What is "photorespiration", what causes it, and what problems does it create for a plant?
4. What is a C_4 plant and why do we call them this? What is the major difference between how a C_3 plant and a C_4 plant fix carbon? What is the reason for the difference?
5. What is a CAM plant? How is a CAM plant different from a C_4 plant? How are they similar?
6. *Why* do some plants (C_4 and CAM plants) require special adaptations in order to fix carbon?