

## Photosynthesis Concept Questions

1. Explain why almost all organisms depend on photosynthesis to satisfy their energy needs. (Photosynthesis produces glucose which is used by most cells as energy.)
2. Photosynthesis can be thought of as a process that converts energy. What are the three energy conversions? (Solar energy is converted to the chemical energy of the electrons; chemical energy of electrons is converted to ATP; the energy in ATP is converted to the chemical energy in glucose.)
3. What is the relationship between the processes of photosynthesis and cellular respiration? (The two are the reverse of one another.)
4. Identify where each of the reactants in photosynthesis comes from and where the products are produced. (For terrestrial plants, water is acquired from the soil via the roots and  $\text{CO}_2$  is taken from the atmosphere through the stomata.  $\text{O}_2$  is released when water is split in the light reactions and glucose is made from the G3P produced from the Calvin cycle.)
5. In the fall, what causes the leaves to become brightly colored? (As the sun becomes lower in the sky, less blue light reaches plants so they produce less chlorophyll as it absorbs predominantly blue light. The disappearance of chlorophyll allows other pigments to be seen and the leaves change color.)
6. Where *exactly* would you find chlorophyll and the ETC? (Chlorophyll molecules are embedded in the thylakoid membrane. The ETC is also in the thylakoid membrane, between the two photosystems.)
7. Summarize the events of the light reactions. (Students should understand that light energy is trapped and harvested by chlorophyll molecules. High energy electrons are stripped from chlorophyll molecules and passed through an electron transport system to make ATP. The electrons are then re-energized by light and used to reduce  $\text{NADP}^+$  to NADPH.)
8. What molecule is analogous to the NADH used in cellular respiration? (NADPH)
9. What is the purpose of the electron transport chain in photosynthesis? (It makes ATP.)
10. How do the electrons accepted by the ETC become high energy? (The energy comes from absorbing a photon.)
11. As electrons from the photosystems are used to reduce  $\text{CO}_2$ , how is it that they never “run out”? (Photosystem II gets replacement electrons from water while photosystem I gets them from photosystem II via the electron transport system.)
12. Why is the ATP produced in the chloroplasts not available to the plant cell for cell work? (It is inside the chloroplasts and used in the Calvin cycle.)
13. Why does the primary electron acceptor have to be so close to the reaction center chlorophyll? (These two must be close together so that electrons are captured before they lose their energy.)
14. When plants photosynthesize, they always make more glucose than they require for energy. Explain. (Some is needed for growth and some is stored times when light is unavailable.)
15. Explain how the products of the light reaction are used to reduce  $\text{CO}_2$  in the Calvin cycle to form PGAL and describe the fate of this PGAL. (ATP provides the energy and NADPH provides the electrons to reduce  $\text{CO}_2$ . The Calvin cycle product, G3P (PGAL) is used to make glucose from which the plant can make polysaccharides and other molecules.)
16. What is the function of the Calvin cycle? (The Calvin cycle fixes atmospheric carbon dioxide into organic carbon in the form of G3P (PGAL))
17. What is the immediate energy source for the Calvin cycle? (The energy needed to perform the reduction in the Calvin cycle is provided by ATP produced in the light reactions.)
18. If you could catch all the G3P (PGAL) a green plant produces and remove it, what would happen to the plant? (The cells of the plant would have no fuel for cellular respiration and would be unable to produce the energy needed for cell work. It would also be unable to synthesis cellulose.)
19. If you illuminate a solution of chlorophyll, carbon dioxide, and water in a beaker, will the mixture produce sugar? Explain. (No it will not. The production of glucose requires ATP and NADPH from the light reactions and the enzymes of the Calvin cycle.)
20. Both the light reactions and the Calvin Cycle stop when there is no light. Which specific reaction

stops first? Which stops next? Continue answering the question "Which stops next?" until you have explained why both pathways have stopped. (In the absence of light, electrons would stop moving through the electron transport system, so no ATP would be made. Without a source of electrons,  $\text{NADP}^+$  would not be reduced to NADPH. Without NADPH or ATP the Calvin cycle would stop so no G3P (PGAL) would be made.)