

1. Control of levels of LDLs in the bloodstream is the responsibility of LDL receptors on the liver. All cells have LDL receptors and they use them to carry cholesterol (in the LDLs) into cells. In the liver, the amount of LDLs that make it back (after being released as VLDLs) are an indication of how many VLDLs and LDLs the cells used. More LDLs back at the liver indicates less need by cells. If things are working perfectly and the liver is not overloaded, when LDL concentrations rise, the liver will reduce the release of VLDLs.
2. People who do not have functional LDL receptors on the liver have a genetic disease called familial hypercholesterolemia. In this disease, LDL levels rise VERY high and children can die of heart attacks by age 10 if undiagnosed.

Highlights Photosynthesis

1. Photosynthesis is a process in plants and some bacteria that use energy from the light of the sun to synthesize glucose using carbon dioxide and water as starting reagents. It accomplishes this in a multistep process that is divided into two phases, called the light reactions (require light) and the dark reactions (don't require light).
2. Photosynthesis occurs in plants in organelles called chloroplasts. The thylakoid disks of the chloroplast are the sites where the light reactions of photosynthesis and the stroma is the location of the dark reactions.
3. Molecules involved in the capture of light energy are known as the chlorophylls. These molecules contain a porphyrin ring (like hemoglobin) with a magnesium ion at the center (instead of the iron molecule found in hemoglobin).
4. In the light reactions of photosynthesis, 1) electrons are removed from water (producing oxygen); 2) ATP is produced by the process of photophosphorylation as electrons pass through the membrane of the thylakoids; and 3) NADPH is produced from NADP⁺ in the final reduction reaction. NADP⁺ is therefore the terminal electron carrier in photosynthesis, whereas water is the electron source for the process.
5. There are two photosystems (I and II) that act together to produce the reactions of photosynthesis. Photosystem II is involved in the first set of reactions. Here electrons from the first porphyrin ring complex are excited by light. As these electrons are passed to the electron transport chain of the membrane, the ring extracts electrons from water, creating oxygen.
6. Movement of electrons through the electron transport chain in the thylakoid membrane causes protons to be pumped INTO the thylakoid. This creates a proton gradient (higher proton concentration in the thylakoid than the stroma). Protons in the thylakoid move outside through a proton translocating ATP synthase (PTAS) complex (same general structure as the mushroom-like complex with the same function in mitochondrial membranes). As protons move through the PTAS, ATP is generated from ADP (photophosphorylation).
7. Electrons released from photosystem II eventually reach photosystem I where they are excited by sunlight of a different wavelength. These newly excited electrons are passed to ferredoxin and ultimately to NADP⁺, creating NADPH, the final product of the light reactions.
8. Quinones are molecules that help carry electrons in the thylakoid membrane (and mitochondrial membrane too).
9. The dark reactions of photosynthesis are where the glucose is synthesized. Thus, we can think of the light

reactions as the ones where the energy necessary for making glucose is stored up (charging a battery) and the dark reactions as the ones that use energy from the light reactions to store that energy in another form - glucose.

10. The dark reactions of photosynthesis are also known as the Calvin cycle in honor of their discoverer, Melvin Calvin.

11. In the dark reactions, carbon dioxide is removed from the atmosphere in a process called fixation. Carbon dioxide is first covalently attached to ribulose 1,5-bisphosphate (Ru1,5BP) to form a six carbon intermediate that immediately breaks down to form two molecules of 3-phosphoglycerate (3-PG) for each molecule of carbon dioxide combined with Ru1,5BP. This reaction is catalyzed by the enzyme with the acronym RuBisCo.

12. 3-PG is an intermediate in glycolysis and gluconeogenesis. Phosphorylation and reduction of it leads to glyceraldehyde-3-phosphate (G3P).

13. You do NOT need to know the individual reactions of the Calvin cycle, except for the first one I described where carbon dioxide is attached to Ru1,5BP.

14. The pathway described to this point is that taken by plants known as C_3 plants, by virtue of the fact that the first molecule made after fixation of carbon dioxide has three carbons. Another group of plants, known as C_4 plants, fixes carbon dioxide to PEP and forms (surprise!) a four carbon molecule, oxaloacetate.

Ultimately, this four carbon molecule is decarboxylated in another part of the plant, releasing carbon dioxide once again. This newly released carbon dioxide enters the Calvin cycle (same reactions here as C_3 plants).

This unique delivery system allows C_4 plants to efficiently deliver CO_2 to where it is used and allows them to avoid water loss. It may also allow them to be more efficient in that the rubisco reaction is occurring in the plant at a location where the oxygen concentration is lower than it is where the rubisco reaction occurs in C_3 plants.

15. Rubisco is a relatively inefficient enzyme. When it encounters molecular oxygen instead of CO_2 , it catalyzes a reaction that ultimately breaks ribulose 1,5 bisphosphate into 3-PG and glyoxylate. Thus, the glyoxylate cycle in plants makes a lot of sense.