

Explain how the light-dependant reactions provide the means to drive the light-independent reactions.

Photosynthesis is the process by which living organisms, particularly plants, capture solar energy and use it to convert carbon dioxide and water into simple sugars. The process is dependant on pigments particularly chlorophyll. When a photon of light hits a chlorophyll molecule it causes some of its electrons to gain energy. If the electrons gain enough energy they leave the chlorophyll molecule. This loss of electrons oxidises the chlorophyll and the electrons are used to reduce some other molecule. The electrons from the chlorophyll have to be replaced. The replacements are provided by water, which breaks down to release hydrogen ions and hydroxide ions. The hydroxide ions can then produce oxygen and electrons. These electrons are used to reduce the chlorophyll. Oxygen is lost as a waste product of photosynthesis. The breakdown of water is known as photolysis. The electrons leaving the chlorophyll molecule are passed along a chain of electron carriers with each member of the chain at a lower energy level. As the electron moves down the chain, energy is released which is used to produce ATP from ADP and P. Eventually the electrons are used to convert NADP to reduced NADP. The products ATP and reduced NADP are used to fuel the reactions of the light-independent stage of photosynthesis.

(a) Name the carbon dioxide acceptor in the light-independent reactions and show how it is recycled.

Carbon dioxide enters the stroma down a diffusion gradient. It then reacts with ribulose biphosphate (RuBP) a 5 carbon sugar. A highly unstable 6 carbon compound is formed which immediately splits to give 2 molecules of glycerate -3-phosphate (G3P) a 3 carbon organic acid. To convert the acid to sugar it requires a reduction reaction. The reducing power comes from the reduced NADP formed in the light-dependant reactions, ATP provides the energy. G3P is reduced to give glyceraldehyde -3-phosphate, a 3 carbon sugar. Some of the sugars formed are drawn off and used by the plant and the rest are involved in a series of reactions to regenerate RuBP.

(b) 5/6 of the products of the light-independent reactions are recycled as the carbon acceptor, discuss what happens to the remaining products.

The glucose formed can be used by the cells or converted to starch for storage. The sugars can be fed into biochemical pathways to produce amino acids and lipids.