The Creator's Origin of Life - 14

We have followed the flow of energy in the process of photosynthesis from when a pulse of sunlight is absorbed by chlorophyll until it is transformed into a flow of electrons - all moving through a series of specialized and complex biochemicals in the stacks of pancake shaped thylakoids in the chloroplasts.

Some of that energy breaks down water and releases oxygen into the atmosphere. In another part of the chloroplasts a second process, the Calvin cycle, is operating in parallel with the first one. It brings in carbon dioxide and sends out carbohydrate in the form of a sugar. The sugar-making Calvin cycle operates in three phases -

During the carbon fixation phase, each carbon dioxide molecule is attached to a 5-carbon sugar called ribulose biphosphate (RuBP for short). This reaction is calalyzed by RuBP carboxylase (rubisco for short). This is the most abundant protein in chloroplasts, and likely the most abundant protein in the world, although most people have never heard that it exists. This reaction produces a very unstable kind of 6-carbon molecule, which quickly breaks apart to form two molecules 3-phosphoglycerate.

In the reduction phase, each molecule of 3-phosphoglycerate attaches to a phosphate group (which the ATP had lost when using its stored energy) producing 1,3-biphosphoglycerate. Then the NADPH gives two electrons to the 1,3-biphosphoglycerate to generate the output 3-carbon sugar, glyceraldehyde-3 phosphate (G3P). For every six molecules of G3P produced, one exits to be used by the plant, while five molecules of G3P are sent back into the chemical cycle for the last phase.

The RuBP regeneration phase consists of a multi-stage series of reactions in which the energy of three more molecules of ATP are used to rearrange the basic atomic framework of the five recycled molecules of G3P into three molecules of RuBP rubisco, which then are used in phase 1 of the next cycle.

Meanwhile, the 3-carbon sugar is sent out of the chlorplast and enters the vascular tissue of the leaf. The sugar which was made in the chloroplasts of the leaves supplies the plant with all its chemical energy. It also provides the chemical raw material to build both the physical structure of the plant and all the other organic chemicals (biochemicals) in the various kinds of living cells in the plant. About half of the output from the chloroplasts is used up as energy to drive the life processes in the cells.

In most plants carbohydrate is carried away from the leaves in the form of sucrose. After it travels away from the leaves it enters individual plant cells to be synthesized into proteins, lipids, etc. A sizeable proportion of glucose is linked together in chemical chains to produce polysaccharide cellulose which becomes the most common organic molecule in the plant.

Most plants are able to produce more glucose than they can use, so they save it for future use by synthesizing starch. The starch is stored in various locations - some in the chloroplasts and other in the roots (beets, carrots, etc.), tubers (potatoes, taro, etc.), seeds and fruit. World-wide, chloroplasts have been calculated to produce 160 billion tonnes of carbohydrate per year, or about 56 kg (124 lb.) per day per each of the 7.8 billion humans on earth.

"to... everything that has the breath of life in it - I give every green plant for food" - Gen 1:30.