

# The journey of co2 biology essay

[Science](#), [Biology](#)



This essay will explain the uptake and assimilation of carbon dioxide into the plant. This will cover the processes used to make glucose, the light dependant and light independent reactions that are a part of photosynthesis. The glucose then proceeds to the mitochondria where it is the vital ingredient in cell respiration. The individual processes involed in cell respiration will be discussed including glycolysation, the Kreb cycle and the electron transport chain. The processes incolved for the transport of waters and minerals around the plant will be discussed. The carbon dioxide molecule enters the plant from the atmosphere via the stomata. The CO<sub>2</sub> enters the stomata by diffusing down the concentration gradient. The atmosphere having the higher concentration of CO<sub>2</sub>. The stomatal complex shown below is structured to facilitate the intake of CO<sub>2</sub> and to control the loss of water. The central pore where CO<sub>2</sub> enters, also where water is lost, is surrounded by two guard cells. These guard cells stop the flow of water out of the cell ensuring the plant does not loose too much moisture through transpiration. unknown. (Unknown). unknown. Available:

[https://sciencevogel.com/file/view/stomata\\_1.](https://sciencevogel.com/file/view/stomata_1.jpg/33020793/412x279/stomata_1.jpg)

[jpg/33020793/412x279/stomata\\_1.jpg](https://sciencevogel.com/file/view/stomata_1.jpg/33020793/412x279/stomata_1.jpg). Last accessed 17 feb 2013. Once the carbon dioxide molecule has passed through the stomata it then defuses through the cell layers to reach the chloroplasts. The chloroplasts are the organelle in which photosynthesis takes place and the site of the production of metabolic food for the plant. The chloroplasts which are situated in the leaves of the plant absorb photons from sunlight(energy). After the carbon dioxide has diffused through the stomata and the rest of the cell layers it finds an end to its journey in the chloroplast. After light energy and carbon

<https://assignbuster.com/the-journey-of-co2-biology-essay/>

dioxide the next ingredient for photosynthesis to take place is water. The water needed for the processes is transported up the plant from the roots by the xylem. The production of glucose is the reason why photosynthesis occurs. The site at which photosynthesis occurs is the chloroplast and specifically in the green chlorophyll. The chloroplasts are composed in structure of outer membrane, inner membrane, stroma, thylakoid, granum, lamella and inside of the thylakoids resides the lumen. Unknown.

(Unknown). Chloroplast Anatomy. Available: [http://creationwiki.org/pool/images/thumb/b/b6/Chloroplast\\_anatomy.jpg/400px-](http://creationwiki.org/pool/images/thumb/b/b6/Chloroplast_anatomy.jpg/400px-Chloroplast_anatomy.jpg)

[Chloroplast\\_anatomy.jpg](http://creationwiki.org/pool/images/thumb/b/b6/Chloroplast_anatomy.jpg/400px-Chloroplast_anatomy.jpg). Last accessed 17 feb 2013

Photosynthesis uses atmospheric CO<sub>2</sub>, water and photons to create a single molecule of glucose.

The by-product of the reaction is O<sub>2</sub> which is released back into the atmosphere. For the production of glucose by photosynthesis 6 carbon dioxide molecules and 6 water molecules are needed. The energy for the reaction is gain from photons which are absorbed in the thylakoids. The thylakoids are specialised in this role, as can be seen from their structure and how they are stacked in granum. They are situated as to maximize their surface area exposed to the sunlight (photons). Due to the requirement of sunlight (photons) for the light dependant reaction to take place this reaction can only happen when enough sunlight is present. The optimal times for photosynthesis to occur is during the day in the spring and summer seasons. The light dependant reaction takes place on the thylakoid's membrane and creates chemical energy from a conversion of light energy. There are a number of pigments used in the absorption of the light needed for the reaction to take place. Previously mentioned were the chlorophyll, the

chlorophyll are green and absorb red and blue light. Other pigments such as the beta-carotene pigments are grouped into clusters and reside on the membrane of the thylakoid. The other pigments can absorb other colours (frequencies) of light and this light is then sent to the chlorophyll for the reaction. The central part of the chlorophyll molecule is a porphyrin ring. The ring is made up of a central magnesium ion and 4 fused rings of nitrogen and carbon. The chlorophyll molecules are arranged in arrays and are called photosystem 1 and 2. The chlorophyll absorb photons (light energy) and this excites electrons to a higher energy level. The excited electrons from photosystem 1 are transported down an electron chain and added to NADP which in turn forms NADPH. The excited electrons from photosystem 2 are transported down another electron chain to replenish the electrons from photosystem 1. As the electrons travel from photosystem 2 to photosystem 1 they gather hydrogen ions from the stroma into the thylakoid. For photosystem 2 to gain the electrons it had lost back it splits water. Upon the splitting of the water molecules the hydrogen and oxygen molecules then proceed into the thylakoid. The hydrogen concentration inside the thylakoid is now higher than the surrounding areas. Hydrogen diffuses from the thylakoid through ATP synthase thus creating ATP. The light dependent reaction that occurs reduces the amount of carbon dioxide in the atmosphere. Carbon dioxide is an integral role in this reaction. The carbon that the plant assimilates for photosynthesis in the form of carbon dioxide becomes a part of the plant. When the plant dies this can return back to the atmosphere by, for example, the burning of fossil fuels.

**The reaction for the light dependant production of glucose.**

$6\text{CO}_2 + 6\text{H}_2\text{O} (+ \text{light energy}) = \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$  Energy obtained from the light reaction is stored in the form of adenosine triphosphate(ATP). The ATP molecule is made from the neucleotide adenine which has then been bonded to a sugar. The neucleotide and sugar is then bonded to the three phosphate groups which reflects the triphosphate in the name. Within the chloroplast there is another reaction that takes place. This is the light independent reaction. The light independent reaction also reacts  $\text{CO}_2$  to form sugar. The light independent uses the ATP which was formed within the light dependant reaction as its source of energy. The light independent reaction involves a cycle called the Calvin cycle to create glucose. The purpose of the Calvin cycle is Carbon Fixation, Converting  $\text{CO}_2$  into a form the cell can use. The Calvin cycle is orchestrated in the stroma of the chloroplast. In phase one of the cycle carbon dioxide is reacted with an enzyme called rubisco(ribulose-1, 5-bisphosphate carboxylase). Rubisco bonds carbon dioxide to ribulose biphosphate to form 2 molecules of phosphoglycerate. In phase 2 of the cycle ATP and NADPH are used to convert the phosphoglycerate molecules into glyceraldehyde 3-phosphate(G3P). The ATP is broken down into ADP(Adenosine Diphosphate) and the third phosphate molecule is used in the production of glyceraldehyde 3-phosphate. Along with the phosphate from the ATP molecule the high energy electron from the NADPH is also transferred to complete the molecule of glyceraldehyde 3-phosphate. The two left over products are ADP and  $\text{NADP}^+$  which can be recycled in further light dependant reactions for from ATP and NADPH again. In phase 3 of the cycle two molecules of G3P will leave the cycle to be made into organic

molecules such as glucose. The remaining 10 G3P molecules then proceed onto phase 4. Phase 4 breaks the G3P molecules down with rubisco and then completes the cycle back to phase 1. The glucose which is produced from the carbon dioxide molecules then is used in the mitochondria in cell respiration. Unknown. (Unknown). Cell Respiration. Available: [http://www.phschool.com/science/biology\\_place/biocoach/cellresp/intro.html](http://www.phschool.com/science/biology_place/biocoach/cellresp/intro.html). Last accessed 17 feb 2013. The product of cellular respiration is ATP. ATP being the "currency" from any action that requires energy. The 3 processes involved in cellular respiration are Glycolysis, the Krebs cycle and the electron transport chain. Glycolysis is the breaking down of glucose into smaller molecules called pyruvic acids. Glycolysis requires 2 ATP molecules to fuel the reaction with the end product being the original 2 molecules and 2 extra ATP. The other products of this process are as mentioned earlier 2 pyruvic molecules and 2 NADH molecules. Glycolysis happens within the cytoplasm. The Krebs cycle happens within the mitochondria membrane. The Krebs cycle takes the pyruvic acids created in glycolysis and makes more ATP and other forms of energy. The pyruvic acid molecules are oxidised (bonded with oxygen) so one of the carbon molecules from the pyruvic acid is turned into carbon dioxide. The oxidation reaction leaves a two-carbon compound called Acetyl Coenzyme A (ac-CoA). NAD<sup>+</sup> is also involved in the process. The NAD<sup>+</sup> bonds with a hydrogen atom to produce more NADH. The ac-CoA is bonded with another molecule called oxaloacetic acid to form citric acid. The citric acid is then further oxidised and the cycle starts all over again. The main reason of the Krebs cycle is to make NADH and FADH<sub>2</sub> for the electron transport chain. The electrons from the NADH and FADH<sub>2</sub> act as a pump in

the channel proteins in the inner membrane of the mitochondria. The proteins swap the electrons from NADH and FADH<sub>2</sub> for protons from a hydrogen atom. The protons are passed to the outside of the membrane. Once on the out of the membrane the protons will go down the concentration gradient back into the membrane. To do so they pass through another protein called ATP synthase. The ATP synthase bonds ADP with another phosphate group to form ATP. The xylem and phloem transport nutrients around the plant. Xylem for water and phloem for sugars. The xylem are specialised in their role within the plant due to the make-up of their tissues. The xylem consist of elongated hollow cells to aid in the flow of water to every part of the plant. The cells contained within the xylem are tracheids, parenchyma , vessel members and fibres. Another transport vessel used to transport other molecules like glucose and starch are the phloem. In contrast to the xylem the phloem is made up of living tissue(xylem are dead cells). The phloem are made up of companion cells, albuminous cells and supportive cells such as fibres and sclereids. When biological molecules, such as glucose, reach the cell membrane within the plant some can passively diffuse across the membrane. Other molecules are too large to cross the membrane by diffusion and are " actively transported" across the membranes at the cost of ATP at the carrier protein. Minerals are actively transported into the epidermal cells. The minerals proceed through the plasmodesma. The minerals come from the cells of the prticycle and parenchyma into the xylem where they enter the water. The water proceeds through a pressure differential known as the transpiration pull. This is due to the plant losing water through the stoma and releasing it back into the water

cycle. The pressure differential draws the water containing the minerals up the xylem where it can be distributed to different cells. From the carbon dioxide molecule being present in the atmosphere travelling through the stomatal pores on the leaf it undergoes extreme changes to be used and assimilated by the plant. The carbon dioxide is first used in the production of glucose and cellular energy currency ATP. The glucose then passes down to the mitochondria by firstly being broken down in the cytoplasm. The mitochondria then produces ATP by various reactions. One of the by-products of these reactions is the very molecule that set it all in motion, carbon dioxide. The CO<sub>2</sub> has a long journey to make it back to the atmosphere but along that journey it can sustain life.