What is photosynthesis about?

We all know photosynthesis!!! It is the synthesis of organic matter (mainly in the form of glucose) from mineral matter (H_2O, CO_2 and ions), in presence of light:

$$6CO_2 + 6H_2O \xrightarrow{light} C_6H_{12}O_6 + 6O_2$$

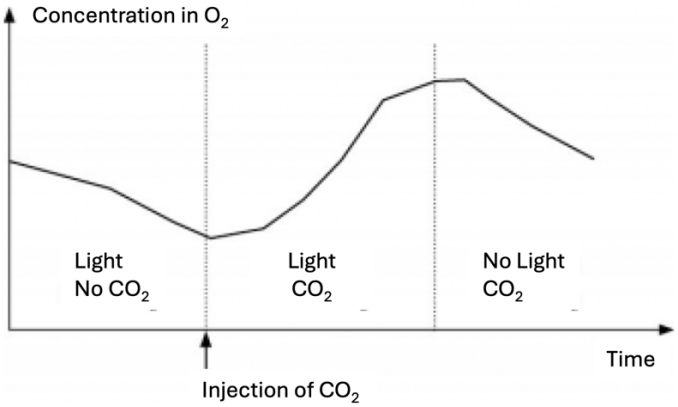
However, this is only the basics… Let's go more in depth.

About light and gases

An experiment has been performed on *Cabomba Carolinania*, which is an aquatic plant loved by aquarists.

The graph below shows the results obtained.

Evolution of concentration in O_2 in the environment of Cabomba carolinania in changing conditions of light and CO_2



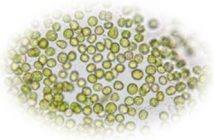
1. **What is/are the independent variable(s)?**
2. **What is/are the dependent variable(s)?**
3. **What conclusions can be drawn from this graph? Relate your answer to the title of this part, and explain your answer through references to the graph.**

About the origin of organic carbon

Using the documents below,

4. **determine the origin of the carbon atoms found in all organic molecules.**
5. **Show that mineral elements are needed to produce organic matter.**

***Document 1:* incorporation of carbon into organic matter**



In 1950, American scientists Benson and Calvin studied the synthesis of organic molecules by the unicellular algae chlorella. To do this, they place a suspension of chlorella algae in the light, and to monitor the synthesis of new molecules, they supply these algae with carbon dioxide in which the chemical element C is labelled. This labeling makes it possible to track the fate of this chemical element, whatever the molecule in which it is incorporated.

	Simple carbohydrates (e.g. glucose)	Complex carbohydrates (e.g. starch)	Proteins	Lipids
Before the experiment starts	-	-	-	-
A few seconds later	+	-	+	-
A few minutes later	++	++	++	+

Document 2: Investigating the needs in minerals

To study the mineral requirements of plants, crops have been grown with different nutrient solutions. The production of organic matter, including lipids and proteins, is described below.

Nutrient solution	Control solution (K, P, N)	Same solution without K	Same solution without P	Same solution without N
Production of organic matter	**Normal production**	**Little or no production**	**Little or no production**	**Little or no production**

About the origin of photosynthetic oxygen

In 1941, American chemists Samuel Ruben and Martin Kamen set up an investigation on the origin of oxygen produced during photosynthesis. They cultivated chlorella in presence of water and hydrogenocarbonate ions (HCO_3^- ions are the source of CO_2 for aquatic plants). ^{18}O isotope was used as radioactive tracer.

Note: ^{18}O is a natural isotope of ^{16}O. In nature 99.8% of oxygen is ^{16}O and 0.2% is ^{18}O.

The results of the experiment are summarized in the following table:

	^{18}O content in:		
	Water	HCO_3^- ions	O_2 produced
Experiment 1	**0.85 %**	**0.40 %**	**0.85 %**
Experiment 2	**0.20 %**	**0.57 %**	**0.20 %**

6. **Deduce from this investigation the origin of oxygen gas produced during photosynthesis.**