

## Biology Coursework:

### Photosynthesis And Factors Affecting It

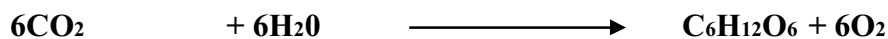
Niall O'Connor

#### Introduction:

Green plants make their own food by the process of Photosynthesis. Four things are needed for photosynthesis to occur in the cells of green plants, light from the Sun, carbon dioxide which diffuses from the air, water from the soil and chlorophyll from the leaves of the plant. Photosynthesis produces glucose, which is used for biomass and energy and oxygen, which is released into the atmosphere.

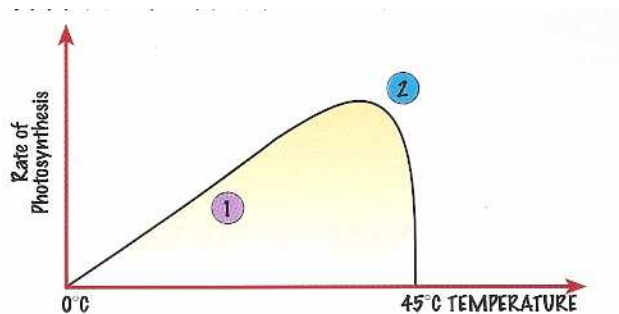
#### The Word & Symbol Equation For Photosynthesis:

Carbon Dioxide + Water  $\longrightarrow$  Glucose + Oxygen



#### Scientific Knowledge:

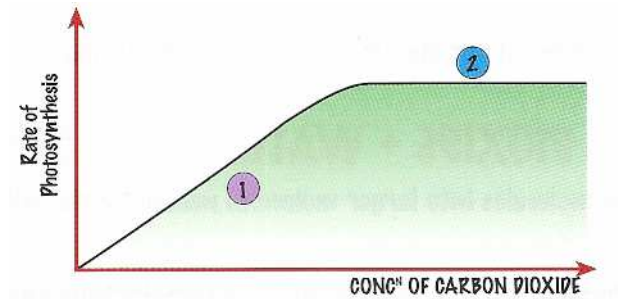
##### Effect of Temperature:



(Graph from Lonsdale science revision guide)

Temperature can be a limiting factor upon photosynthesis as the rate of photosynthesis rises as the temperature rises. However once the temperature reaches 45 C, the enzymes controlling the photosynthesis become denatured and so photosynthesis is stopped.

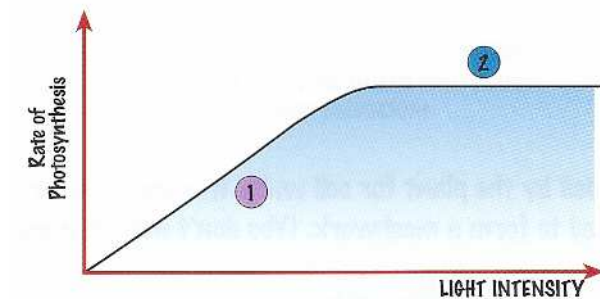
### Effect Of Carbon Dioxide Concentration:



(Graph from Lonsdale revision guide)

The rate of photosynthesis will rise as the carbon dioxide concentration increases, up until a certain point where the concentration of carbon dioxide will no longer be a limiting factor.

### Effect of Light Intensity:



(Graph from Lonsdale revision guide)

The rate of photosynthesis will rise as the light intensity increases, however once a certain point is reached light intensity will no longer be a limiting factor.

### Other Factors That May Affect Photosynthesis:

- Quantity of bicarbonate soda
- Volume of water in the beaker
- Wattage of light bulb
- Sample of pondweed/waterweed

Nitrates, phosphates and potassium are the three main minerals needed by plants. If a plant doesn't get these from the soil, it shows a deficiency symptom. Nitrates provide nitrogen, which is needed for photosynthesis and respiration. Phosphates provide phosphorus needed for photosynthesis and respiration. Potassium helps enzymes (Biological Agents) to work properly. These enzymes are needed for photosynthesis and respiration.

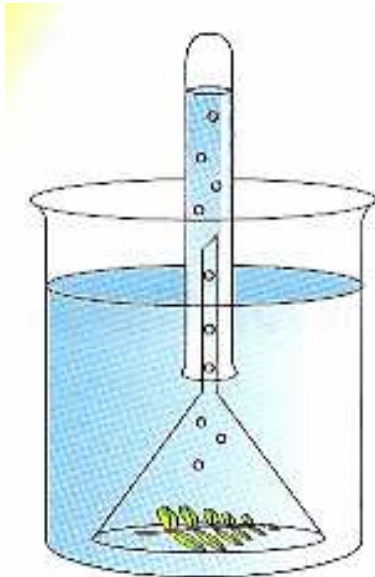
### **Method/Investigation:**

I am going to use pondweed/waterweed, so that the experiment will be able to occur under water, which is important, as the amount of bubbles of water lost to oxygen production will be the focus of the results/experiment. The Amount of water lost in the test tube to oxygen will be measured by counting the amount of bubbles. This will give me my results. Each experiment will last 1mins, as a certain amount of oxygen should have collected in that amount of time. Every reading will be taken over a time of one minute, to ensure fair testing. The experiments will be repeated at least twice, as this will create a fair average. Safety will take major consideration, for example the use of goggles and being aware of the fact that the Bunsen burner can cause injury. All of the factors, which are not being investigated, will be kept constant to ensure fair testing.

### **Chosen Factor:**

I am going to investigate temperature, as it is the only one that would be hard to control as a key variable. For instance my preliminary work that investigated CO<sub>2</sub> concentration

### **Diagram:**



(Picture from Lonsdale Revision Guide)

### **Prediction:**

When it is dark and cold photosynthesis will not occur. There will be limiting factors for instance the CO<sub>2</sub> concentration will limit the amount of

photosynthesis that occurs. The enzymes that work to carry out photosynthesis will work best at around 47°C.

### **Preliminary Experiment:**

#### **Aim:**

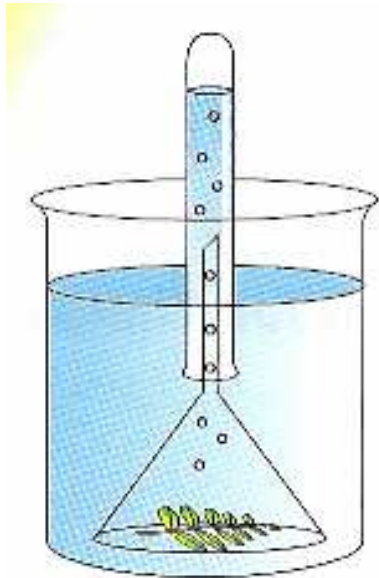
To see how CO<sub>2</sub> concentration (Bicarbonate Soda) affects the amount of bubbles produced in one minute.

#### **Prediction:**

I predict that as the quantity of bicarbonate soda increases, the amount of bubbles produced will also increase.

#### **Obtaining Evidence:**

For my preliminary experiment I am going to investigate CO<sub>2</sub> concentrations effect on photosynthesis. For my main experiment I am going to use pondweed/waterweed, so that the experiment will be able to occur under water, which is important, as the volume of water lost to oxygen production will be the focus of the results/experiment. The Amount of water lost in the test tube to oxygen will be measured by counting the amount of bubbles. This will give me my results. Each experiment will last 1mins, as a certain amount of oxygen should have collected in that amount of time. All of the experiments will last 1mins, to ensure fair testing. The experiments will be repeated at least twice, as this will create a fair average. Safety will take major consideration, for example the use of goggles and being aware of the fact that the Bunsen burner can cause injury. All of the factors, which are not being investigated, will be kept constant to ensure fair testing.



(Picture from Lonsdale Revision Guide)

**Apparatus: (as labeled on diagram)**

- + A stopwatch
- + Varying amounts of Bicarbonate Soda
- + Goggles

**Results:**

Amount of Bicarbonate Soda in Spatulas	Amount of bubbles produced in 1 min
$\frac{1}{4}$	42
$\frac{1}{2}$	53
$\frac{3}{4}$	58
1	64
1 $\frac{1}{4}$	70

**Evaluation of Preliminary:**

(How the experiment could be improved)

Use a measuring cylinder to measure how much volume is lost to oxygen produced instead of counting bubbles as this is more accurate and the results are more reliable.

**Conclusion of Preliminary:**

From my preliminary I can conclude that  $\frac{1}{2}$  of a spatula of Bicarbonate Soda will be added in my main experiment to speed up the reaction. Finally in my real experiment I will repeat my experiment to back up my results.

**Aim:**

To find out how temperature affects photosynthesis

**Prediction:**

Temperature can be a limiting factor upon photosynthesis as the rate of photosynthesis rises as the temperature rises. However once the temperature reaches 45 C, the enzymes controlling the photosynthesis become denatured and so photosynthesis is stopped.

**Method: (How will I carry out my investigation?)**

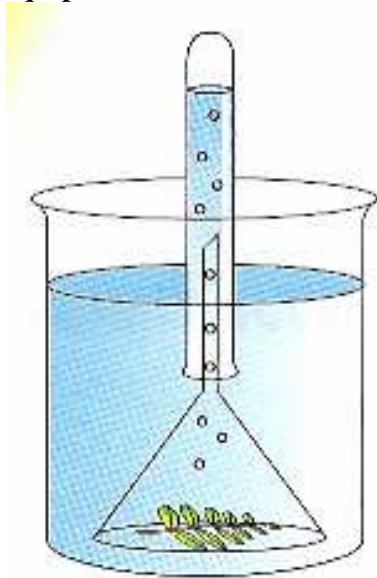
What plant will I use? Why?

I am going to use pondweed as it can carry out the process of photosynthesis under water, this is important as under water the amount of oxygen produced by photosynthesis can be recorded easily.

What results will I measure?

I have decided to count the amount of oxygen bubbles produced by photosynthesis.

What equipment will I need?



- + A stopwatch
- + 1/2 a spatula of Bicarbonate Soda
- + A Bunsen burner
- + Ice
- + Goggles
- + A Thermometer

How will I get my results?

I have decided to count the amount of oxygen bubbles produced by photosynthesis.

What range and number of observations will I take?

I am going to measure my results over a 70° range (10°-80°). I will take observations at an interval of every 10°.

**How long will each experiment take?**

At each interval I will measure the amount of bubbles produced over a 1 min period.

**Will I repeat my experiment?**

Yes I will repeat my experiment to test my first set of results and create a greater average.

**How will I insure that I am working safely?**

Always taking into consideration the fact that I am using a Bunsen burner and wearing protective clothing, such as safety goggles.

**How will I make sure that my investigation is a fair test?**

Using a thermometer to measure the temperature of which I am recording results and repeating my experiment.

### **Results:**

Temperature in °C	Amount of bubbles produced (1 <sup>st</sup> experiment)	Amount of bubbles produced (2 <sup>nd</sup> experiment)
10	2	5
20	5	6
30	9	11
40	21	23
50	105	94
60	10	12
70	6	8
80	5	4

### **Analysis & Consideration of Evidence**

Sunlight plays a much larger role in our world than we may expect: all the food we eat and all the fossil fuel we use is a product of photosynthesis, which is the process that converts energy in sunlight to chemical forms of energy that can be used by biological systems. Many different organisms, ranging from plants to bacteria, carry out photosynthesis. Organisms convert CO<sub>2</sub> (carbon dioxide) to organic material by reducing this gas to carbohydrates in a rather complex set of reactions. Electrons for this reduction reaction ultimately come from water, which is then converted to oxygen and protons. Energy for this process is provided by light, which is absorbed by pigments.

My analysis supports my prediction: When it is dark and cold photosynthesis will not occur. There will be limiting factors for instance the CO<sub>2</sub> concentration will limit the amount of photosynthesis that occurs. The enzymes that work to carry out photosynthesis will work best at around 47°C.

### **Evaluation:**

If we are to look again at how I carried out this experiment (See paragraph headed “How will I carry out my investigation”) it would seem that the evidence I have accumulated is very reliable. It is sufficient enough evidence to support my conclusion but my experiment could have gathered much more reliable evidence by making a few changes.

For example instead of counting the amount of bubbles produced I could have used a measuring cylinder to find the volume of water that was lost to O<sub>2</sub> production. I could have extended the experimentation period from 1 minute to 2 or 5 minutes. Finally I could have checked my experiment more by repeating my experiment more often, 5 times instead of 2.

Temperature can be a limiting factor upon photosynthesis as the rate of photosynthesis rises as the temperature rises. However once the temperature reaches 45 C, the enzymes controlling the photosynthesis become denatured and so photosynthesis is stopped.

The rate of photosynthesis will rise as the carbon dioxide concentration increases, up until a certain point where the concentration of carbon dioxide will no longer be a limiting factor.

The rate of photosynthesis will rise as the light intensity increases, however once a certain point is reached light intensity will no longer be a limiting factor.

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