Biology-Photoshynthesis

Introduction:

Photosynthesis is a very important process in nature. It is the production of energy in the form of glucose involving water from the soil, carbon dioxide from the air and light energy. It takes place in all green plants, which use the green chlorophyll, held in chloroplasts in the leaves, to trap light. The main site of photosynthesis is the palisade cells in the leaf of a plant. It is these cells that contain the green chloroplasts and are very well adapted to their task. They are near the upper side of the leaf where they can obtain the maximum amount of light, they are packed very closely together and as already mentioned contain green chloroplasts clustered towards the upper side too.
Plants photosynthesise to produce food chemicals that are needed to allow them to grow. The main reaction is to produce oxygen and glucose to be changed into energy during respiration. Glucose is stored in the form of starch which is insoluble and does not affect the osmosis taking place in the plant. As plants respire both day and night this starch is often used up during the night when photosynthesis cannot take place. The uses of glucose within the plant are for active transpiration, cell division, the production of protein and the production of cellulose. However many other things can also be produced with the addition of special mineral salts.
In photosynthesis the raw materials are carbon dioxide and water. They react to form the products of the reaction-oxygen and starch (glucose that has been stored). The reactions need energy and this comes from light. The green chloroplasts allow light to be used as energy and therefore both of these things are like helpers in the reaction. Glucose is formed firstly then turned into starch to be stored up for when it is needed.
Although photosynthesis is a complicated process it can be summed up in this equation:

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

carbon dioxide water glucose oxygen

It is important to the reaction that certain factors are present when it is occurring. We know that these are carbon dioxide, water, light and chlorophyll. Without these the reaction will not take place at all, but some of them also determine how quickly the reaction takes place. Water, carbon dioxide and light, along with temperature, all have a particular effect on the rate of photosynthesis. In terms of carbon dioxide the levels in the atmosphere do not really alter very much, but if gardeners wish to increase the rate of photosynthesis then sometimes carbon dioxide is pumped into greenhouses. Up to a certain point as temperature goes up so does the rate of reaction. After it reaches a certain point though the enzymes involved in the reaction become denatured and stop working properly. A drop in the amount of water present may cause photosynthesis to occur at only half the normal rate. The reason for this is the stomata are being closed.

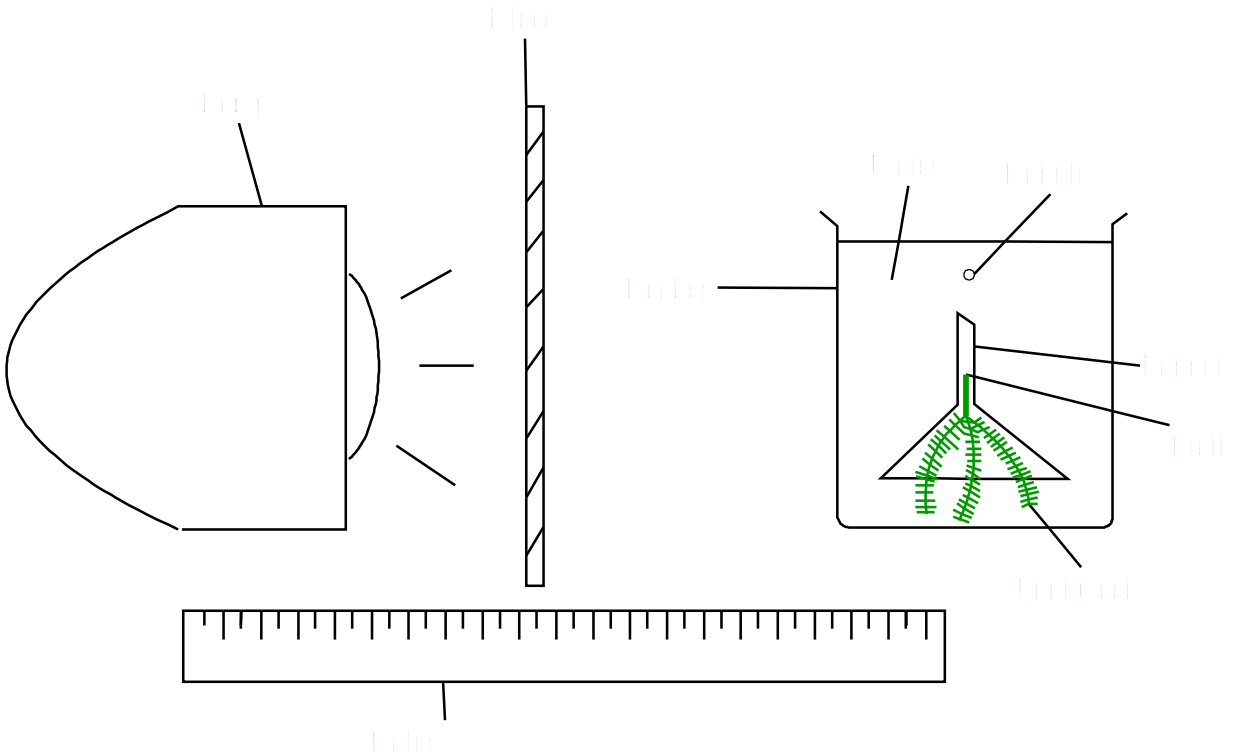
The final factor which contributes is light. I decided to investigate this factor as it seems the most practical.

Method

I need to find out how the of presence light and the intensity of it contributes to the rate of photosynthesis. To be able to measure the rate I need some type of visible sign that photosynthesis is actually taking place. I will use a type of plant that grows in water and produces bubbles when photosynthesising. By counting these bubbles I can tell how fast oxygen is being given off and therefore produced from photosynthesis. I will place the pondweed in a beaker containing water and also a bit of sodium hydrogen carbonate-NaHCO3-(0.5%). This is put in as it acts as carbon dioxide. If it wasn't there then another limiting factor may be the cause of the rate changing instead of just light.
By placing the beaker next to a lamp I can alter the light intensity. I will move the lamp further away every time and then count the number of bubbles that are produced within one minute. The weed will be given two minutes each time to adjust to the new level of light intensity. To start with the lamp will be 5cm away from the beaker, then the following distances:

10 cm
15 cm
20 cm
25 cm
30 cm

This diagram shows how I set up the experiment:



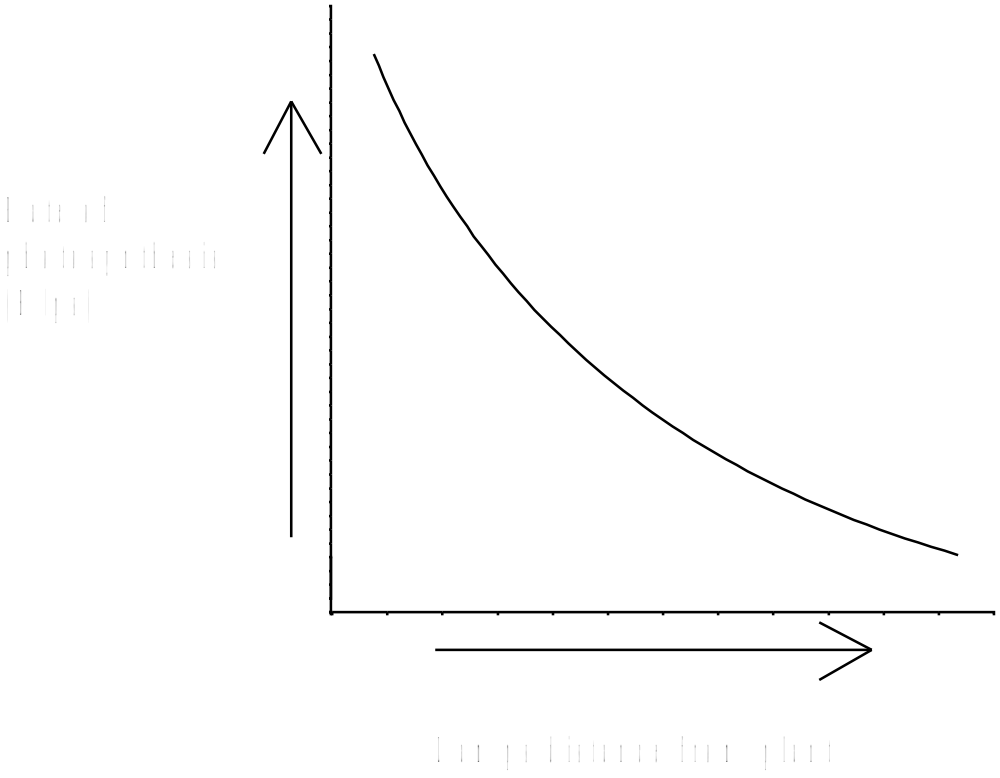
The rate of reaction will be in number of bubbles per minute (b.p.m).

VARIABLES AND CONSTANTS

The factor that will be changed is light intensity. This is the only factor that will be changed. The factors that will be kept constant are the amount of water the weed is put in, carbon dioxide levels, lamp that is used and temperature. This means that out of all the possible factors we have chosen only one to monitor.

PREDICTION

I predict that as the light intensity is increased the rate of photosynthesis will also increase. However at a certain point the light will reach a point where the rate will not increase any more. The chloroplasts will no longer be able to absorb any light so the rate will stay at its optimum level or even decrease. At this point light is no longer limiting.
The graph of results will probably look something like this:



Results

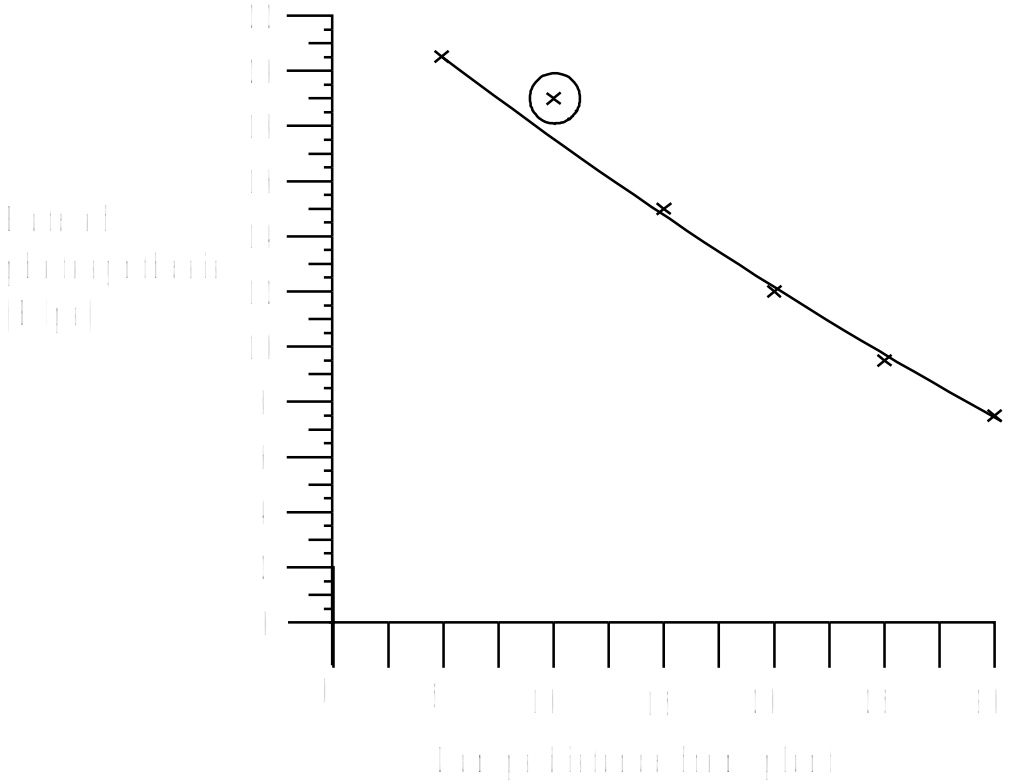
I performed the experiment twice and took an average of the 2 experiments to produce more accurate and fair results. I put the results into a table:

Distance From Lamp cm	Exp 1 (B/ps)	Exp 2 (B/ps)
5	21	20
10	19	19
15	16	14
20	12	12
25	10	9
30	8	7

This table shows the average of the results taken from the 2 experiments:

Distance From Lamp (cm)	Average (B/ps)
5	20.5
10	19
15	15
20	12
25	9.5
30	7.5

I put my results into a graph. This is a graph of the averages:



Conclusion

As you can see my results have turned out quite similarly to how I expected. I have circled a result that seemed to stray away from the line making it not as smooth, this result seems anomalous. This shows that it can't have been 100% reliable. It does prove however that as light intensity is increased the rate of photosynthesis is increased also. This is because the more light there is available the more light the chloroplasts can absorb. They use this light in the reaction as energy; therefore the more energy there is available the faster the reaction can take place.

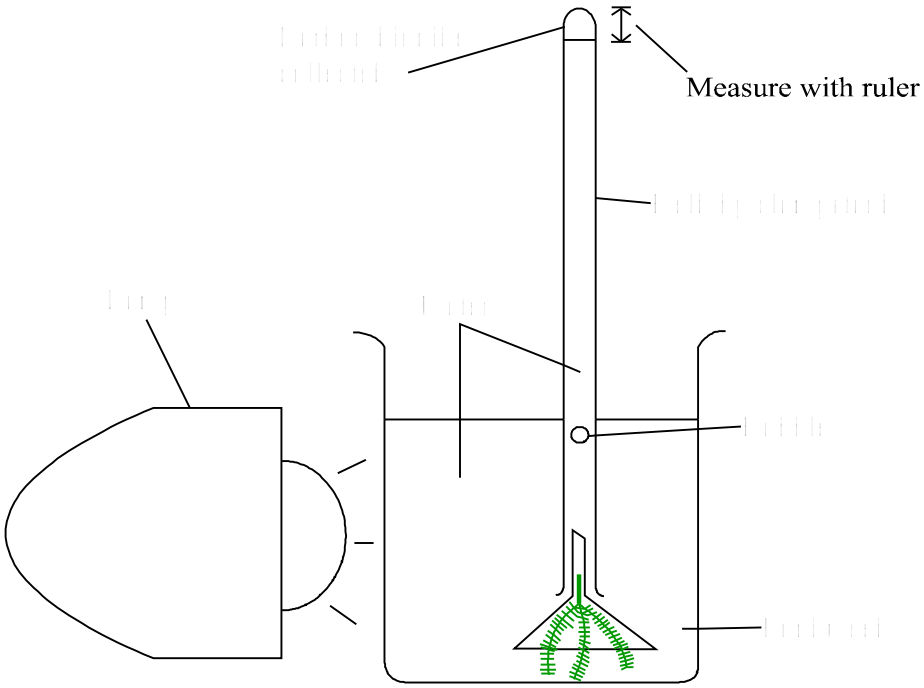
Evaluation

On the graph there wasn't a point where the rate started to level off. I assumed that this would happen, as the chloroplasts would not be able to absorb any more light energy. However this did not happen so it may be that we did not take the pondweed close enough to the light so it would reach a point where the rate could no longer increase. If I wanted to experiment with this further I could've used a more powerful light source. There was one result that seemed anomalous when put into the graph. I circled this and didn't bother to try and put the line of best fit through it as it was clearly anomalous the rest of the results and would just change the shape of my graph making it less accurate.

This anomalous result, among others, can be explained by many things. My experiment was not fair for many reasons. I tried to control the temperature a bit by putting a sheet of glass in front of the beaker to stop

the heat from the lamp warming up the water, but I didn't regulate the room temperature. Temperature is a factor affecting photosynthesis, and as I didn't take all the results on the same day, the temperature could've been different during the different experiments. I could have put the test tube into a beaker filled with water of a certain temperature. This would have helped to regulate the temperature so I would have been certain that light was the only limiting factor. Also the size of the pieces of pondweed were not all the same so some people may have achieved different results depending on the size of their pondweed and therefore how much surface area was available for photosynthesis to take place in the palisade cells. The distance may not have been completely accurately measured.

I think that another way we could have gone about doing this experiment would be to set up an experiment similar to this, but where the carbon dioxide produced is collected in a test tube. The experiment would be set up as shown:



This would help to give me a greater idea of how much carbon dioxide is being produced and therefore how fast photosynthesis is occuring. As the carbon dioxide is produced it will travel up the tube and collect in a bubble at the top. By measuring the bubble every minute we would easily be able to work out the rate of the reaction in the pondweed.
I think that overall my evidence is very reliable and that my results show what I thought they would. It could have been more accurate than it is but I think I achieved what I set out to do which was prove that as light intensity is increased photosynthesis speeds up.