BIOLOGY COURSEWORK: PHOTOSYNTHESIS

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INTRODUCTION

Photosynthesis is the name of the process that plants go through to make food (glucose). Photosynthesis takes place in the chloroplasts of the leaf. Within the chloroplast is a green chemical called chlorophyll, this is exactly where the process of photosynthesis takes place. This chemical is utilized to catch light energy from the sun, this is vital in photosynthesis.

(Taken from the BBC GCSE Bitesize website)

As evident from the equation above, light energy is imperative in the process of photosynthesis. Thus, we can say that if light energy was removed from the equation the plant would eventually die. Therefore we can see that light is a limiting factor. If a plant has plenty of Carbon Dioxide and water, but not enough light, the plant will not photosynthesise properly. So if we increase the light intensity the plant would unmistakably photosynthesise better.

Carbon Dioxide is also an important factor in the process of photosynthesis. Consequently if there is not enough Carbon Dioxide the plant cannot photosynthesis properly. If there is additional Carbon Dioxide present the plant would photosynthesise much better.

Another very important limiting factor is temperature. If the weather is too cold the enzymes would be to cold to function properly, therefore causing photosynthesis to be very slow or at a standstill. Unlike the other limiting factors if the plant is exposed to any temperature above the optimum level it causes the rate of reaction in photosynthesis to slow down and stop. If this happens the high temperature severs the enzymes. This usually happens at 20 degrees. *(www.encarta.com)*.

We can see the effect of these limiting factors more clearly in graphs.

Light Intensity Carbon Dioxide Concentration Temperature

As shown in the light intensity and the Carbon Dioxide concentration graphs, as light and Carbon Dioxide increase so does the rate of photosynthesis. The rates are then stable until the limiting factor is removed. However for the temperature graph, if the temperature goes over the optimum level (20 degrees) the plant enzymes begin to break down. This causes the rate of reaction to slow down and eventually stop.

In the diagram below we can see the elements that a plant needs, and when all these elements are present, the output element is oxygen. Therefore we can see that light is an important factor in the process of photosynthesis.

(Taken from the Key Science Biology book).

For a plant to photosynthesise effectively, the leaf needs to be a successful technique for absorbing light energy. The diagram below shows how the leaf is structured to absorb light energy.

This inevitably shows that light energy is vital in the process of photosynthesis. We can see this from the structure of the leaf, as the leaf has a large surface area to trap the most amount of light energy. If light were not that important to the plant there would be no need for the plant to have leaves with large surface areas. *(Taken from the Key Science Biology Book).*

PREDICTION

I predict that as the light intensity is decreased the rate of photosynthesis will also decrease (at a proportional rate).
This is because if light intensity is increased a plant photosynthesises better, so it is obvious if the light intensity is decreased the rate of photosynthesis is slower.

AIM

My aim is to investigate the effect of light intensity on the rate of photosynthesis.

APPARATUS

Test tube

Test tube rack

Stop clock

Metre Stick

Ruler

30 cubit cm of water

Measuring Cylinder

Pondweed (Elodea)

Paperclip

Lamp

Sticky tape

DIAGRAM

EQUATION

(Taken from the BBC GCSE Bitesize website)

VARIABLES

The variable I will be scrutinizing is light intensity. This will be achieved by reducing or increasing the distance of a light source from the plant. This then either increases of decreases the light intensity.

FIXED VARIABLES

The same lamp and light bulb will be used through out the experiment. This is because higher voltage bulbs would increase the light intensity and lower voltage bulbs would decrease the light intensity. Also I will close the blights do that outside light will not interfere with the results of my experiment. Light wavelength (colour) must also be kept the same, as different colours of the spectrum are either absorbed or reflected by the pigments in the plant. The pigment named chlorophyll absorbs blue and red light, but tends to reflect yellow and green light. *(Taken from www.shu.ac.uk)*. As a result the same colour light bulb will be used and the bulb colour is white.

Carbon Dioxide should be kept the same. As this is quite difficult to achieve, I believe that I cannot control this factor very well.

As water is necessary for the process of photosynthesis, I will keep the level of water the same in all my experiments. This will be another fixed variable, as increasing or decreasing the level of water, either increases of decreases the rate of reaction in photosynthesis.

Temperature increases the rate of reaction, if it is increased. As I am only doing the experiment for a short period of time the temperature doesn't affect the plant that much.

Owing to the leaf structures of different species of plant the photosynthetic rate is different in each species. Plants from the same species may have slightly

different rates of photosynthesis. This is because the level of chlorophyll may be slightly different causing different amounts of light absorption. I can only control this by using the same plant through out the whole experiment or using plants that are roughly the same size. This will enable me to achieve accurate results.

SAFETY

Keep all water away from sockets. Mop up any spills immediately. Do not use lamp or socket with wet hands. Do not touch bulb while the lamp is on.

PLANNED METHOD

Setup lamp and metre stick as shown in the diagram on page 8. Paperclip the end of the plant, this stops it from floating up in the test tube. Put the plant in a test tube, and put water in the test tube. Place test tube in a test tube rack and place 10cm away from the lamp. Start the stop clock and after one minute start counting the oxygen bubbles given off from the plant in the test tube. Count the bubbles for 3 minutes, and record your results. (It is a good idea to be at eye level with the plant as this will enable you to see the bubbles more clearly)

Place the plant at 20cm and leave for one minute (Do not switch of lamp in this interval). Then count the oxygen bubbles for three minutes, and record your results. Repeat for 30cm, 40cm, and 50cm.

RESULTS FOR PILOT STUDY

DISTANCE FROM LAMP (CM)	NUMBER OF OXYGEN BUBBLES		
	Experiment 1	Experiment 2	Experiment 3
10	96	99	95
20	74	75	73
30	63	67	59
40	51	53	47
50	22	24	23

DISTANCE FROM LAMP (CM)	NUMBER OF OXYGEN BUBBLES (AVERAGE)
10	96.6
20	74
30	63
40	50.3
50	23

GRAPH

This graph show the results for the pilot study.

GRAPH

This graph show the average result for the pilot study.

OBSERVATION FOR PILOT STUDY

From the results of my pilot study I can see that my results are not that accurate. This may be because I had to change the plant, as I done the experiment over a period of two days. The photosynthesis rate could have been different between both the plants I used.

Another cause may be that the oxygen bubbles coming out of the plant may have dissolved into the water, thus causing me not to see them. I also could have missed some bubbles due to human fault. This has caused me to obtain inaccurate results.

In my final experiment I will try to be more accurate and also to try and use the same plant, so the photosynthesis rate will remain roughly the same.

FINAL METHOD

Set up the lamp and metre stick as shown in the diagram on page 8. Fill a test tube with 30cm^3 of water and place in a test tube rack. Cut 5cm of elodea and attach a paperclip at the bottom of the elodea (this will prevent the plant from floating up when placed in the test tube). Put the elodea in the test tube and align the test tube in the rack to 10cm, against the metre stick.

Turn the lamp on and start the stop clock. Leave the plant to stand for one minute and then restart the stop clock. Count how many bubbles of oxygen are given of the plant in 3 minutes. Record your results.

Then align the test tube in the test tube rack to 20cm, and leave to stand for one minute. After one minute start the stop clock and cont the number of oxygen bubbles given off of the plant in three minutes. Record your results.

Repeat for 30, 40 and 50cm.

(Make sure you do not turn the lamp off during this whole experiment, and do not move the plant away from the light source. Use the same plant through out the whole experiment).

Repeat the whole experiment two more times, to obtain accurate results.

RESULTS

DISTANCE FROM LAMP (CM)	NUMBER OF OXYGEN BUBBLES		
	Experiment 1	Experiment 2	Experiment 3
10	103	100	101
20	85	91	89
30	69	74	67
40	47	52	49
50	31	29	33

DISTANCE FROM LAMP (CM)	NUMBER OF OXYGEN BUBBLES (AVERAGE)
10	101.3
20	88.3
30	70
40	35
50	31

GRAPH

This graph shows the results from my final experiment.

GRAPH

This graph shows the average results for my final experiment.

CONCLUSION

As evident from my results and graph, light does affect the rate of photosynthesis. As the light intensity was decreased the rate of photosynthesis was decreased. This shows that my prediction was valid.

This was because when light is increased, the plant receives a lot more light so it is able to photosynthesise much better. It is roughly the same for all other factors. For example, if the amount of nutrients a plant receives is increased the rate of photosynthesis will increase, until a certain point.

Using my knowledge of the other factors I was able to make an accurate prediction.

EVALUATION

After completing my experiment and contemplating in the results and graphs that I had drawn, I noticed that my final experiment was far more accurate than my pilot study. This shows that after obtaining inaccurate results in the pilot study I took more precautions in my final experiment to obtain accurate results. However, even after taking such precautions I still got a few anomalous results, which did not fit into the trend of the graph. This could be due to a number of reasons such as that maybe I miscounted the bubbles or missed a few due to human error. This mistake can only be rectified with the use of hi-tech equipment that was not available to me.

Even though I used the same plant throughout my whole experiment, I think that my results were not that accurate. This can be from a number of things. Firstly I didn't close the blinds in the laboratory, so there could have been outside light interference, which could have caused the number of bubbles to increase. Secondly, I was relying on the bubbles emerging from the plant to be exactly the same size, which they clearly were not. Thirdly, I could have missed some bubbles due to human error. Also some bubble could have dissolved into the water; thus causing me not to see them. Lastly, as there was no barrier between the lamp and the plant there could have been an interference of temperature. This could have caused me to gain some results that were not that accurate.

Even though some results were not accurate, on the whole the experiment still gave me enough information to make a conclusion. This was because I could clearly see that as the light intensity was decreased the bubbles were emerging slower, and slower. Therefore we can say that as light intensity is decreased the rate of photosynthesis is also decreased.

I also believe that my experiment was quite accurate because when drawing up the graph I could see that the results were in roughly the same range. There were no extreme values that did not fit into the range of my results. There was only one anomalous result on my average graph, if I had time I would have repeated that part of the experiment to obtain a better result.

If I were to repeat the experiment again I would close all blinds to stop outside light from interfering in the collecting of my results. Therefore the plant would rely only upon the lamp for its source of light. I would also put a glass or

plastic barrier between the lamp and the plant to retain some heat from the lamp. This way the temperature would be significantly lessened and then not disturb my results.

On the whole I think my experiment could be made better, but perfect results could not be achieved. This is because of the lack of hi-tech equipment, which was not available to me.

BIBLIOGRAPHY

- BBC GCSE Bitesize website. www.bbc.co.uk/revision

- Letts Revise GCSE Science Study Guide

- Biology Book