

Does the Intensity of Light Affect the Rate of Photosynthesis?

Introduction:

To make their own food plants photosynthesise. To do this they need carbon dioxide, sunlight, and water. Carbon dioxide and water react together to form glucose and oxygen. This reaction requires energy (in the form of sunlight). The sunlight is used by the chlorophyll in the leaves to make the reaction happen. Carbon dioxide, temperature and the amount of time exposed to sunlight all affect the rate of photosynthesis, but does the light intensity?

Plan:

Obtain some pondweed and cut off a small section underwater. Put this in a test tube of water and put the test tube in a clamp. Position a lamp at varying distances from the tube. Count how many bubbles of oxygen are given off within two minutes as a result of photosynthesis. Repeat this three times for each position of the lamp and then move the lamp back by ten centimetres. The apparatus will be set up as shown below:

Prediction:

I think the intensity of sunlight will affect the rate of photosynthesis. If the length of time a plant is exposed to sunlight affects photosynthesis I think it would be logical if the same applied to light intensity. I think that the nearer the light is to the plant, the more photosynthesis will occur, so more bubbles of oxygen will be given off. I think this will be relative – if the lamp is at 10cm there will be twice as many bubbles as if the lamp was at 20cm.

The key variable is light intensity, adjusted by moving the lamp. We will then discover the effects of this.

The same type of plant will be used each time as different plants may have different rates of photosynthesis. I will also use the same quantity of plant as more plant matter will do more photosynthesis.

I will keep check of the temperature of the water by using a thermometer. The temperature needs to be controlled as the enzymes work differently at different temperatures – affecting photosynthesis rates.

The quantity of water needs to remain the same because water is needed for photosynthesis. Therefore if there is more water available to the plant, more photosynthesis will happen.

Preliminary Experiment:

When I did this I discovered that the position of the light affects the temperature. The best way we found to deal with this was to put a piece of glass in between the light and the test tube. This means that the temperature doesn't change.

Results:

Light Distance cm	Number of Bubbles			Average count
	test 1	test 2	test 3	
10	10	10	9	9.667
20	6	5	6	5.667
30	3	4	3	3.333
40	2	2	2	2.000
50	1	1	1	1.000

Conclusion:

The experiment went well and there were no anomalies within the results, so I assume the results are reliable.

As the lamp was brought closer to the plant, the rate at which oxygen was given off increased - however, not at a steady rate. The difference between the bubble quantity at 10 and 20cm was 4 bubbles (on average) and between 50 and 40cm this was only 1. This is probably due to the pool of light created by the lamp and the background light. At a closer distance the pool of light would be completely on the tube and there would be very little background light interference. At the further distances the pool of light would be spread over a larger area so the plant would receive a smaller quantity of light of a lower intensity. And also there would be background light interference.

The experiment shows that the intensity of light *does* affect the rate of photosynthesis. In the photosynthesis reaction sunlight splits water into oxygen and hydrogen, the hydrogen and carbon dioxide are then used by chlorophyll to make glucose. Oxygen is not needed for this so it is released. Therefore the more sunlight there is the more photosynthesis can take place and so the more bubbles of oxygen will be given off.

The error bars I have drawn on the scatter diagram are very short, showing a small range and therefore that the results were very accurate and reliable.

Improvements:

Counting bubbles was not a very accurate method of collecting results as it would have been very easy to have miscounted. Possible more accurate experiments are shown below:

The first diagram shows a measuring cylinder over the plant. This would collect and measure the amount of oxygen given off.

The gas syringe is similar to the other experiment, but the oxygen would be used to move a glass tube inside another glass tube with markings on. You would then be able to take a measurement from the marks on the outside tube.

