Investigation-Effect of light intensity on rate of Photosynthesis

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Plan

My task is to investigate how light intensity affects the rate of photosynthesis in pondweed and will do this by measuring the amount of oxygen produced by the pondweed while in a boiling tube full of water. I will investigate h ow the light intensity affects the rate of photosynthesis by measuring the amount of oxygen produced. I will achieve this by counting the number of oxygen bubbles produced.

Photosynthesis is the process by which the energy of sunlight is used by organ isms, especially green plants, to synthesize carbohydrates from carbon dioxide and water. This process can be determined by the equation:

Carbon dioxide + Water $\xrightarrow{\text{chlorophyll}}$ *Glucose + Oxygen*

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

As you can see oxygen is an end product of the process of photosynthesis so it is valid to measure the amount of this given off to measure the rate of photosynthesis.

For the investigation I will need:

- *A desk lamp*
- *A boiling tube*
- *Water*
- *A beaker*
- *Sodium hydrogen carbonate (good source of* CO_2*)*
- *Canadian Pondweed*
- *A metre rule*
- *A stopwatch*
- *A paperclip*

I will set the apparatus up as follows:

Safety

- *I will need to keep the water and electricity (needed to power the desk lamp) as far away from each other as possible to reduce the risk of electric shock.*
- *Also handle beaker with care (due to broken glass hazards).*

Method

1. *Arrange apparatus as shown previously and switch on desk lamp.*
2. *Attach paperclip to the top of the pondweed to weigh it down to the bottom of the test tube, as experiment wouldn't be valid if the pondweed was at the top of the test tube.*
3. *Use metre rule to measure first distance of 100cm. (Distance between desk lamp and the pondweed beaker).*
4. *Time 5 minutes on the stopwatch.*
5. *Count the number of bubbles produced by pondweed.*
6. *Record results for 2 minutes.*
7. *Repeat method with remaining distances. (50cm, 40cm, 30cm, 20cm and 10cm).*

Fair Test

- *We made sure that we switched off all the classroom lights so they didn't affect the light intensity given to the pondweed.*
- *We recorded for 2 minutes to make sure all the remaining bubbles from the previous distance had gone.*
- *We measured accurately by using a stopwatch (for timing 5 minutes for each distance) and a metre rule to measure the distance between the desk lamp and the pondweed beaker.*

Prediction

I am making my prediction based the preliminary experiment I carried out. Here are the results of that preliminary experiment:

Distance pondweed is away from the lamp (cm)	***Number of oxygen bubbles produced***
100	*0*
90	*0*
80	*0*
70	*0*
60	*0*
50	*0*
40	*1*
30	*2*
20	*4*
10	*6*

Due to inactivity between 100cm and 50cm, I have altered the method for the final experiment.

As you can see by the results, the smaller the distance (the higher the light intensity), the more oxygen bubbles are produced. This is because the rate of photosynthesis is higher due to the higher amount of light energy, which is a catalyst (as well as chlorophyll) for the process of photosynthesis.

So for the final experiment I predict the same activity, that the higher the light intensity, the more oxygen bubbles will be produced.

Accuracy

To make this experiment accurate I will measure accurately the distance the pondweed is from the lamp using a metre rule and will measure accurately the time period that the pondweed has been exposed to the light using a stopwatch, and for the same time period of five minutes for each distance. Moreover for the final experiment, I will carry it out three times for each distance and take the average result to get a more accurate set of results.

Results

Distance away from lamp (cm)	***1st attempt***	***2nd attempt***	***3rd attempt***	***Average number of oxygen bubbles produced***
100	*0*	*0*	*0*	*0*
50	*3*	*5*	*4*	*3*
40	*7*	*7*	*6*	*6.6*
30	*11*	*10*	*12*	*11*
20	*16*	*14*	*17*	*15.6*
10	*23*	*24*	*21*	*22.6*

Analysis

As you can see from the graph, there is one very clear trend, that as the distance away from the lamp decreases (light intensity increases), the rate of photosynthesis increases, as shown by the increase in number of oxygen bubbles.

Perhaps a more significant result is that the results are fairly constant, with the exception of the distance between 20cm and 10cm, which increases fairly rapidly. Without this result the graph would've probably been a straight-line graph (with line of best fit) but in my case the result line slowly curves upwards.

Conclusion

I think that from my results I can safely say that my prediction was correct, as the light intensity increases so does the rate of photosynthesis in the pondweed and therefore gives off more oxygen bubbles. This was because light is a major factor in the process of photosynthesis and the process can't be carried out without the plant receiving light. So the more light a plant receives, the more efficient it will be at

carrying out photosynthesis, presuming that the plant has enough carbon dioxide and water and therefore producing more glucose and oxygen.

So because the pondweed was receiving more and more light as the lamp grew closer, it was inevitable that the rate of photosynthesis would increase due to the light being a catalyst for the process of photosynthesis (along with chlorophyll). Also photosynthesis could happen easily because the pondweed was in abundance of sodium hydrogen carbonate in the test tube, which is a good source of carbon dioxide. Therefore it would aid photosynthesis because water and carbon dioxide are the input factors of photosynthesis.

Evaluation

Overall I feel my results were quite accurate as shown by my results graph with the exception of the distance between 20cm and 10cm, although it would have been a straight-line graph (with line of best fit) without that result because the remaining results were fairly constant.

I predicted that as the light intensity increased, so would the amount of oxygen bubbles, and I am pleased that my prediction was correct. For it to be correct we needed to make sure that we measured five minutes for each distance three times then measure two minutes for recording results accurately with the stopwatch. Also we needed to measure accurately the distance from the lamp's light bulb to the pondweed beaker.

This simply wasn't very practical though because the light bulb is at a height and it is difficult to measure accurately the tip of the bulb with the metre rule, which is below the bulb on the desk. This may have been the reason for the rapid increase in the rate of photosynthesis between the distance of 20cm and 10cm, due to possible slight inaccurate measuring. Another possibility for the reason of the slight anomaly of the last distance might have been simply counting incorrectly, as this was quite difficult to do with the fairly large number of oxygen bubbles in the test tube.

I don't think that doing any more readings of the experiment would have made the results any more accurate, as we had already carried out the experiment three times for each distance and at the moment I can't think of any ways to improve the the experiment.

Overall though I am fairly pleased with the outcome of the investigation and I am especially pleased that my prediction was correct.