Investigating the rate of photosynthesis in pondweed

Possible variables and preliminary work

Variable	High	Explained	Low
Light intensity	9 mm^3/min of O_2	I found that changing the light intensity was good as it gave good results.	7.5 mm^3/min of O_2
CO_2 concentration	10 mm^3/min of O_2	I found that concentration gave a good range of results and it would also be interesting to investigate this one.	5.8 mm^3/min of O_2
Temperature	8.3 mm^3/min of O_2	Temperature gave a small range of results and is unreliable as the temperature would always be changing.	8.4 mm^3/min of O_2
Volume of water	8.6 mm^3/min of O_2	The volume of water did not give a good range of results.	7.9 mm^3/min of O_2

Chosen Variable

My chosen variable is concentration of CO_2 because it gave me a good range of results and it is a main factor of photosynthesis.

Fair Testing

To keep this a fair test I will change only my chosen variable and keep all other variables the same.

Safety

To ensure safety I will bare these things in mind and check that everything is safe before and during the experiment. I will be careful of water and electricity, lamp becoming hot, handling glass and sodium hydrogen carbonate.

Apparatus

- Photosynthometer
- Clamp
- Sodium hydrogen carbonate
- Lamp

- Pond weed
- Beaker
- Water

Diagram

Procedure

We will set up the apparatus as shown in the diagram above. We will put the lamp 20mm away from the beaker. We will add 0.5g of sodium hydrogen carbonate to a beaker of water. We will then time it for 1min and after that pull the syringe up until there is a bubble in the photosynthometer. We will then record the results in a table. After that we will pull the bubble through until there is no more air in the tube. We will then change the water and repeat the experiment with 1g, 1.5g, 2g and 2.5g. We will repeat this 3 times for each.

Prediction

I predict that as the amount of $NaHCO^2$ increases there will also be an increase in the amount of Oxygen (O^2) given off. This is because when the $NaHCO^2$ is added, the amount of Carbon Dioxide (CO^2) increases. Therefore the pondweed will respire more quickly than before the $NaHCO^2$ was added, taking in more CO^2 and giving off more O^2.

Scientific Theory

Photosynthesis is the combination of organic compounds from carbon dioxide and water (with the release of oxygen) using light absorbed by chlorophyll.
Here is the formula for photosynthesis:

Carbon Dioxide + Water $\xrightarrow{\text{Sunlight}}$ **Energy + Oxygen**
$6CO^2$ H^2O **$C_6H_{12}O_6$ $6O^2$**

In this experiment the $NaHCO^2$ increases the amount of carbon dioxide in the solution. Therefore more carbon dioxide molecules diffuse into the plant than before the $NaHCO^2$ was added. The CO^2 molecules pass through the plant's pores, letting the plant photosynthesise at a higher rate. I expect the graph to look like this.

1. This part shows that as the CO^2 increases so does the rate of photosynthesis.
2. This part shows that it tails off. This is caused by limiting factors. There are 4 things needed for photosynthesis to occur. They are light, chlorophyll, water and CO^2. At any given time one other of the above factors will become the limiting factor that keeps photosynthesis at that rate. If the CO^2 increases then it will cause the photosynthesis will increase until a point. At this point either the temperature of light intensity needs to be increased for the level to rise any further.

Results

Amount of $NaHCO^2$(g)	Amount of O^2 given off from photosynthesis(cm^3) 1		2		3	Average		
0	8	6.283	7	5.497	7	5.497	7.33	5.759
0.5	11	8.639	11	8.639	9	7.068	10.33	8.115
1	11	8.639	10	7.853	12	9.424	11	8.639
1.5	12	9.424	11	8.639	13	10.210	12	9.424
2	11	8.639	13	10.210	12	9.424	12	9.424
2.5	12	9.424	12	9.424	12	9.424	12	9.424

Conclusion

From my graph I can see that it turned out as I predicted. As in my prediction it shows that the rate of photosynthesis increase as the CO^2 increases. This proves that it is needed for Photosynthesis. The graph also shows it beginning to curve to a straight line. This means that limiting factors prevented the rate of photosynthesis increasing.

There are 4 things that are needed for photosynthesis to occur. They are water light, carbon dioxide and chlorophyll. The carbon dioxide is being increased so one of the other factors eventually prevents the rate of photosynthesis increasing as there is not enough of it to allow more photosynthesis to occur. Either temperature or light intensity are wrong and there for the one which it is has become the limiting factor. The levels of each need to match.

Evaluation

I feel that overall the experiment went well. The results I obtained were of good quality and a suitable conclusion could be drawn to match them. I noticed an anomaly in my results at 0.5g so it didn't change the line of best fit. Overall the results obtained were of good quality. The procedure was a good one although there are some things that could be changed. The bulb was probably heating the water slightly therefore not keeping all the variables the same this could be improved by having the bulb further away from the beaker. The results however were not changed greatly by this and therefore were suitable to support the conclusion.

To provide additional evidence experiments on the other factors of light and heat could be investigated. These would show a similar graph shape proving again that these limiting factors stop the rate of photosynthesis increasing any further. This would be done by setting up this same experiment but keeping the sodium hydrogen carbonate level the same and moving the light nearer or closer to the beaker to measure light intensity would be one. The other would be to change the temperature of the water for each result. However if the temperature was increased too much it would be found that it would destroy the chlorophyll enzymes preventing photosynthesis occurring further.