

## An Investigation To Show How the Amount Of Sodium Hydrogen Carbonate Affects The Rate Of Photosynthesis In Pond Weeds.

### Investigation Outline:

An experiment was planned and carried out where the concentration of carbon dioxide available to a water plant was changed by varying the concentration of NaHCO<sub>3</sub> in the water. However all the other factors that may have affected the rate of photosynthesis were carefully monitored and controlled. E.g. light intensity and temperature.

### Hypothesis:

I predict that when the concentration of sodium hydrogen carbonate increase the rate of photosynthesis in the plant will also increase or 'speed up'.

### Results:

Concentration of NaHCO <sub>3</sub> (mol/dm <sup>3</sup> )	Volume of O <sub>2</sub> produced in 240 minutes cm <sup>3</sup>	Volume of O <sub>2</sub> produced in 240 minutes cm <sup>3</sup>
0	1.8	2.1
0.1	6.2	6.9
0.2	11.8	11.1
0.3	17.9	18.2
0.4	23.7	22.9
0.5	24.4	23.9

### Calculations to show average oxygen production in 60 minutes (cm<sup>3</sup>):

$$(1.8 + 2.1) / 2 = 1.95 / 2 = 0.975$$

$$(6.2 + 6.9) / 2 = 6.55 / 2 = 3.275$$

$$(11.8 + 11.1) / 2 = 11.45 / 2 = 5.725$$

$$(17.9 + 18.2) / 2 = 36.1 / 2 = 18.05$$

$$(23.7 + 22.9) / 2 = 23.3 / 2 = 11.65$$

$$(24.4 + 23.9) / 2 = 24.15 / 2 = 12.075$$

I firstly divided the sum of the first and second column to get the average then I divided by two to get the average for sixty minutes not two hundred and forty.

### Average rate of oxygen produced in 60 minutes:

Concentration of NaHCO <sub>3</sub>	Average rate of O <sub>2</sub>
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(mol/dm <sup>3</sup> )	produced in 60minutes (cm <sup>3</sup> )
0	0.5
0.1	1.6
0.2	2.9
0.3	4.5
0.4	5.8
0.5	6

### Conclusion

Having studied these results I can see that when the concentration of the sodium hydrogen carbonate increased so did the volume of oxygen production in 60 minutes. I predicted this would be the case therefore proving my hypothesis to be correct. I have also noticed a trend for example when the concentration of sodium hydrogen carbonate was 0.2 mol/dm<sup>3</sup> the volume of oxygen produced was 2.9cm<sup>3</sup> and when the concentration was doubled to 0.4mol/dm<sup>3</sup> the volume of oxygen produced also doubled to 5.8cm<sup>3</sup> and this is what's known as the doubling affect. However this trend does not continue throughout the results. When the concentration of sodium hydrogen carbonate was 0.5 mol/dm<sup>3</sup> the oxygen production only increased by 0.2cm<sup>3</sup> from the previous concentration. Whereas the other concentrations were significantly increased compared to there predecessors. This leads me to believe that the rate of oxygen will no longer increase as the concentration of NaHCO<sub>3</sub> is increased I believe this is because the NaHCO<sub>3</sub> is no longer a limiting factor of the reaction.

These results are what I expected as they do agree with my hypothesis. The increase in rate of photosynthesis because the more sodium hydrogen carbonate that was present meant there was more carbon dioxide readily available to the plant so it could reduce the carbon dioxide by the hydrogen that is present in the enzymes inside the chloroplast of the plants leaves and therefore speeding the rate of photosynthesis up and therefore leading to a greater rate of oxygen production in a given time.

However in part (b) of the graph its seems to start to level out because there is only one result that shows this I am not able to state whether this could be due to anomalies (if this proves to be the case we would have to carry out another experiment with a greater range of results) or that the graph is beginning to level off due to 'limiting factors'.

There are many types of limiting factors however I believe that water is not the limiting factor in this case as it is a water plant and has adapted to living in such conditions. However light or temperature could be acting as a limiting factor in the rate of photosynthesis. These limit the reaction because when a factor is missing the process involved is unable to operate fast enough and the overall production of glucose takes longer to produce the glucose. If light is the limiting factor to the pondweed then fewer water molecules will be split into their separate elements of hydrogen and oxygen which means that fewer carbon molecules will be able to be reduced by hydrogen molecules therefore the rate of photosynthesis will limited. However different light intensities could change this problem. For example if the plant has mostly green light shining on it most will be reflect causing the same problem as I have stated above. However if blue light was to be shone on it, the chlorophyll would absorb more of the light causing the water molecules to be spilt into their elements (oxygen and hydrogen) then the carbon

molecules will also be able to be reduced by the hydrogen molecules and so increasing the rate of photosynthesis.

Another limiting factor of this reaction could be the temperature. If this is so this could mean the plants enzymes are unable to work at their optimum temperature and therefore working at a slower rate that causes the rate of reaction to decrease which will end up in a lower production of glucose molecules.

### Evaluation:

Overall, I believe this experiment to be a fairly accurate and successful one as my result support my prediction. However if I were to do this experiment again I would try to keep the temperature at a constant because I am still unsure of the limiting factor in this experiment. To do this I could place the experiment in a water bath of a constant temperature. If I was to do this I would be sure of which limiting factor affected this experiment. Also I could try out various sizes of pond weed as larger pieces would have a larger surface area and a greater number of palisade cells available to the light and this would have an effect on the rate of photosynthesis.