17/07/2004 Bilawal Ajmal Khan 10A

H/W/K Science Investigation

Aim: to investigate the effect of carbon dioxide concentration on the rate of photosynthesis.

Scientific knowledge: The Elodea (*Canadian pondweed*) makes bubbles of oxygen when it photosynthesises. The faster it photosynthesises the faster it makes oxygen. The plant uses dissolved carbon dioxide. This can be made by adding hydrogen carbonate solution to the water.

The factors which can effect how quickly a plant can make food by photosynthesis include the following.

- *Carbon dioxide concentration* - this can be simulated by changing the volume of hydrogen carbonate solution added to the water. At low concentrations of carbon dioxide the rate of photosynthesis is very slow. As you increase the concentration of carbon dioxide the plant can make food faster and faster. There is a limit however. There comes a time when adding more carbon dioxide does not increase the rate of photosynthesis. The plant is making food as fast as it can under the conditions.
- *Light intensity* - this can be altered by either changing the brightness of the bulb or by moving the bulb further and further away from the plant. Plants need light energy in order to make food. The more light they have the faster they can make food. Again there is a limit. Making the light very bright will not make the plant photosynthesise any faster as the plant is making food as it can.
- *Temperature* - this can be done by simply heating the water to different temperatures. When it is cold the plant makes food slowly. This is because the chemical reactions which drive photosynthesis are very slow. As it gets warmer the plant can make food faster and faster. There is a peak temperature however. Above this temperature the plant suffers from too much heat. The delicate proteins in the cells change and become *denatured*. Photosynthesis slows down. If the temperature becomes too hot the plant may die.

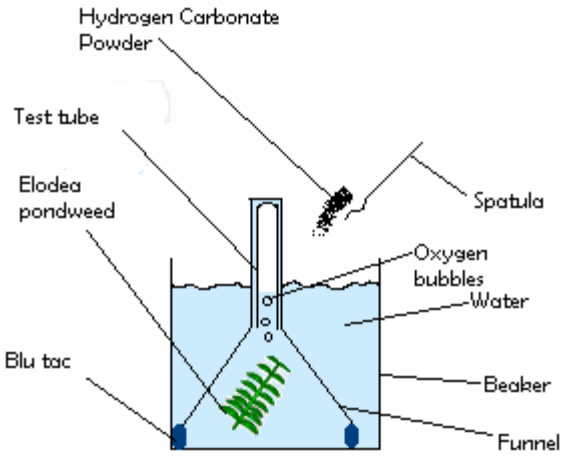
The speed of photosynthesis is controlled by all the factors. The speed at which the plant can make food is limited by the lowest factor. For example, a plant may be in a warm place with lots of carbon dioxide but if it is dark then it cannot make food. Light here is the *limiting factor*. People grow plants in greenhouses to keep the plants warm and help them to grow faster. Some people burn charcoal in greenhouses. As well as warming the air it puts in carbon dioxide to help the plants grow.

Hypothesis: I predict that as the volume of hydrogen carbonate increases so does the number of oxygen bubbles.

Equipment:

- Funnel
- Test tube
- Elodea pondweed
- Blu tac
- Beaker containing water
- Spatula
- Hydrogen carbonate powder

Diagram:



Method:

- Fill beaker with beaker
- Put Elodea plant inside water
- Cover plant with inverted funnel and test tube and stick with blu tac as shown above in diagram
- Count the number of bubbles collected in the test tube for each volume of hydrogen carbonate after 5 minutes
- Repeat experiment by adding Hydrogen Carbonate in volumes of 5, 10, 15 and 20 cm^3 in three different beakers
- Repeat experiment 3 times for each volume of hydrogen carbonate.

Safety rules:

- I will wear goggles throughout the experiment
- Do not make contact with hydrogen carbonate and if this happens wash off with plenty of water immediately
- Normal laboratory rules must be followed at all times

Variables: The variables in this experiment are volume of water, the plant and the hydrogen carbonate powder.

Fair Test: I will keep the volume of water and the plants same throughout the experiment. I will change the volume of hydrogen carbonate. The experiment will be repeated 3 times in different beakers for fair and reliable results. I will justify my hypothesis by looking at similar previous experiments. It is common knowledge that as the concentration of carbon dioxide increases so does the rate of oxygen bubbles produced will also increase. I will also produce reliable accurate results because they will help me make correct conclusions.

I planned the experiment by seeking tuition from various text books like Longman's and Lonsdale revision guide.

Results:

Amount of hydrogen carbonate added in cm^3	Number of bubbles produced [beaker 1]	Number of bubbles produced [beaker 2]	Number of bubbles produced [beaker 3]	Average number of bubbles produced
0	3	0	3	2.0
5	5	10	11	8.7
10	14	9	17	13.3
15	22	16	20	19.3
20	27	21	20	22.7

Conclusion: From the graph I can see that the more hydrogen carbonate I added, the more oxygen bubbles were produced. This means that more carbon dioxide was released and taken up by the plant in photosynthesis. This shows that the more carbon dioxide available to the plant, the faster the rate of photosynthesis. This lead to higher number of oxygen bubbles produced. When the amount of hydrogen carbonate was increased from $15cm^3$ to $20cm^3$ the amount of oxygen bubbles produced started to increase at a slower rate. This indicates that at a stage of photosynthesis no matter how much carbon dioxide is available to the plant the rate of photosynthesis will remain constant. The amount of oxygen bubbles may level out. At this point the limiting factor could be amount of light or temperature.

Evaluation: Generally the results obtained during the experiment were accurate. There was one exception which was anomalous and did not fit into the general trend. The results were also reliable because for each volume of hydrogen carbonate added, three different results were obtained and the average found. This was meant to reduce the level of errors. When the amount of hydrogen carbonate added was $10cm^3$, the amount of oxygen bubbles produced were 13.3. This is an anomalous result because it did not fit into the curve of best fit. This anomalous result could be due to inaccurate readings and measurements. If I was asked to carry out this experiment again, I would rinse my equipment thoroughly before re-using them and have my readings confirmed by someone else before recording them. I think that I have enough evidence to firmly support my

evidence because I took several readings and then the graph I obtained is similar to those found in several science text books. To provide further evidence to support my conclusion I could set up a control test with no hydrogen carbonate added. The results obtained will be compared with the results obtained for the experiment in which hydrogen carbonate is added. I could also redo the whole experiment to see and compare the results I obtained if they are similar.