Photosynthesis - Science Coursework

Task:

To experiment with different variables that effect photosynthesis using a computer simulation, and take measurements accordingly.

Prediction:

I predict that firstly the increased temperature will generate more oxygen, however this will only apply to a certain degree, probably around 35°C to 40°C in my opinion, where I think the equation will be at its optimum heat capacity.

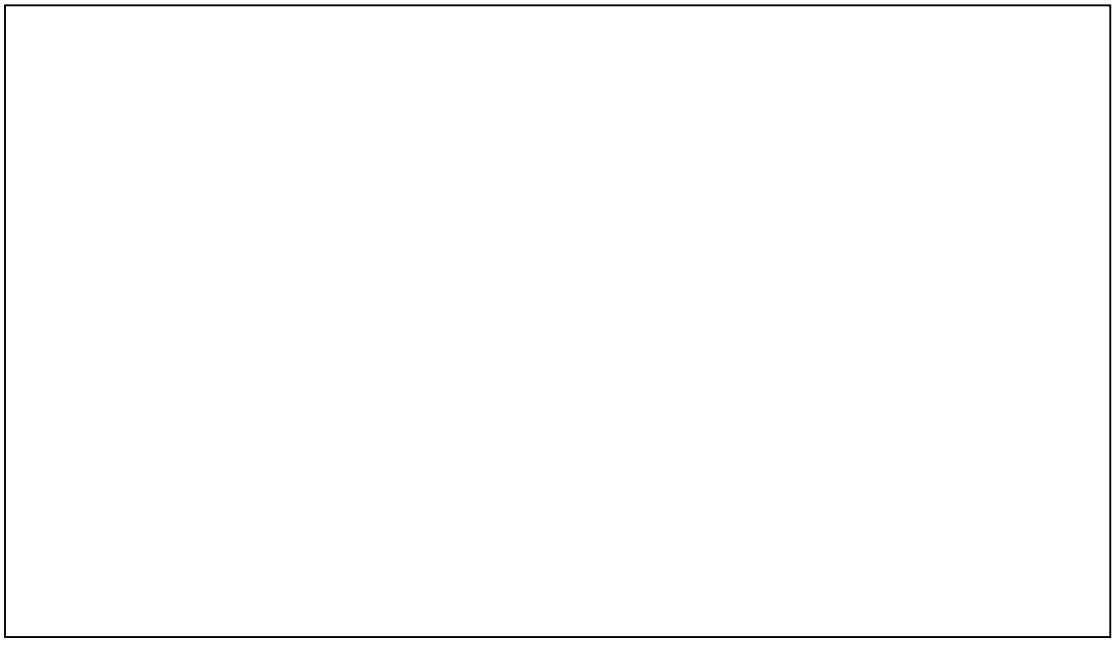
And for the additional experiment, I think that an increased in Carbon dioxide levels will again produce greater amounts of Oxygen. Lastly, a higher light intensity, in my opinion will produce increased levels of Oxygen because as the formula states sunlight is essential for the reaction to take place, therefore it is likely the greater this is the more Oxygen is produced.

Method:

We first decided to find out how the temperature affects the rate of photosynthesis. Using the computer simulation, we tested from 0°C to 50°C, at 5°C intervals. All other variables were set at one certain measure. Take for instance Light Intensity, which was arbitrary at 50 throughout and NaHCO3, which was at 2%. We then let each individual test run for 10 minutes, and then taken the oxygen level produced, measured in mm.

As a secondary experiment we tested for the effect of light intensity to the rate of photosynthesis. Again we fixed the amount of NaHCO3 to 2% and left the temperature at 20°C for the duration of the experiment. For a second time, we took readings of the amount of Oxygen given out over 10 minutes.

Apparatus:



Analysis:

Results:

See overleaf for the table of results and the graphs from these tables.

Conclusion – See attached graphs, reference Gr. 1 and Gr. 2:

Looking at the first experiments results and Gr. 1, I conclude that temperature effects photosynthesis, indeed my results clearly show a steady increase of Oxygen produced from 5°C to 20°C and then a steady decline to 0°C at 40°C of temperature. As aforementioned in my prediction, I guessed that temperature would reach an optimum, however I thought this would be in excess of 10°C above my final results. The concept of temperature effecting photosynthesis can be explained by the fact that Photosynthesis takes place within cells, in organelles called chloroplast that contain the chlorophylls and other chemicals, especially enzymes, necessary for the various reactions; these enzymes work quicker with increased energy which can be in heat and light form hence a higher temperature gives these enzymes more energy to speed up the chemical reactions. The optimum temperature can be explained by the fact that temperatures exceeding 20°C harmed or destroyed the enzymes, which subsequently could not effect the reaction.

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

To explain Experiment 2, notice the pattern of the heat rise in Gr. 2, this shows that light affected the rate at which the above reaction takes place throughout each rise in light intensity, as I predicted. This is explainable because light is absorbed by the pigments in the chroplasts, raising their electrons to higher energy levels. The energy is then transferred to a special form of chlorophyll A, called a reaction centre. Light energy is first trapped by photosystem II, and the energized electrons are boosted to an electron receptor. They are replaced in photosystem II by electrons from water molecules, and oxygen is released. The energized electrons are passed along an electron transport chain to photosystem I, and energy-rich adenosine triphosphate, or ATP, is generated in the process. Light energy absorbed by photosystem I is then passed to its reaction centre, and energized electrons are boosted to its electron acceptor. They are passed by means of another transport chain to energize the coenzyme nicotinamide adenine dinucleotide phosphate, or NADP, resulting in its reduction to $NADPH_2$. The electrons lost by photosystem I are replaced by those passed along the electron transport chain from photosystem II. The light reaction ends with the energy yield stored in the ATP and $NADPH_2$.

There was one anomaly in this experiment evident by the graph this was almost certainly due to a miss-recording and we did not have time to redo the experiment, however I predict that the oxygen given off would total approximately 55 mm.

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