Investigating a factor affecting the rate of photosynthesis

Introduction

Photosynthesis is the process necessary for plants as this is how they obtain their food. The rate of photosynthesis is affected by these factors: concentration of carbon dioxide, light intensity and temperature. If one of these factors increase, the rate of photosynthesis will increase but only to a certain point. The rate of photosynthesis could still increase but not because of an increase in that same factor. Another factor has to increase for the rate to increase. The factor that restricts the other two factors from increasing the rate of photosynthesis is called the limiting factor. To do this experiment, I am changing the factor of light intensity. Doing this, I would not need to change the concentration of $NaHCO_3$. It would stay at 1.00%. Our teacher showed us that a range of 15°C to 30°C would be suitable to use. I decided to use 25ºC. This stayed the same throughout the experiment.

For glucose to be made in photosynthesis, water is split into hydrogen and oxygen molecules by the energy absorbed from the sun. The hydrogen then has to combine with the carbon dioxide to produce glucose. If this was left on its own, the hydrogen would eventually combine with the carbon dioxide but it would take a long time. That is why a catalyst is needed to quicken the process.

Enzymes are the catalyst used for the anabolic reaction. Enzymes work by colliding with the hydrogen and carbon dioxide. It is shaped to only accept hydrogen and carbon dioxide molecules. A rise in temperature provides more heat energy, which the enzymes absorb to work faster. They work faster by colliding more frequently. Because of that, it produces more glucose quickly. As with all enzymes, it has an optimum temperature and after that, the enzymes denature. It cannot act as a catalyst anymore and the rate decreases.

Prediction

I believe that as the temperature rises, the rate of photosynthesis will also increase. That is until the plant reaches its optimum temperature and then the rate of photosynthesis will decrease.

Apparatus

We did not use any apparatus because we did the experiment on the computer, over the network. However, on the computer we did use:

Photosynthometer
Elodea
Beaker of water
Lamp

Thermometer

Method

The program had cut a piece of elodea and put it in a beaker of water, with the cut end kept up by anchoring it with a paperclip. We changed the independent variable (light intensity) by moving the lamp different distances away from the beaker. We recorded the distances and the results they produced. A thermometer was used to measure the temperature of the water.

We measured the dependent variable (air) by using a photosynthometer, with a tubing of 1mm diameter, to measure the volume of air given off by the elodea. The tubing of the photosynthometer had to be fixed inside the beaker otherwise an air bubble would form in the tubing, presenting unfair results. We measured the volume of air by pulling the syringe back and measured how much more the air bubble has increased in length using the rule on the tubing.

We needed at least five different variables to be able to obtain a suitable conclusion from the results. We also needed to get two sets of the results to show any anomalous results and for averages.

Results

A table to show the results of the length of an air bubble containing oxygen produced at varying light intensity distances away from the beaker.

Light Intensity	Length from tube (cm)	Length of bubble 1st reading (mm)	2nd reading (mm)	Average (mm)
10	98	4	3	3.5
30	67	9	9	9
50	53	16	15	15.5
70	44	22	24	23
90	37	29	28	28.5

Two graphs were constructed to show the rate of photosynthesis more clearer.

Conclusion

I found that the closer the lamp was to the Elodea, the volume of oxygen was at its highest. Because the temperature from the lamp was getting higher, the enzymes were absorbing more heat energy. Therefore, they were moving faster and were reacting quicker during these temperatures.

The light intensity went up as far as 90°C. If it had gone any further, the curve on the graph and my results would have equalled out because after the enzymes reach their optimum temperature, they become denatured. Their shape is changed and they can

no longer perform their function, which is in this case, combining hydrogen and carbon dioxide.
The rise in the rate of photosynthesis until the light intensity peak that afterwards fell, supported my hypothesis.

I am satisfied with the range of the results we covered but I do believe that the temperatures we measured could be more chosen with more reason instead of randomly picked in a given range. I would have also liked to have made more measurements to find the optimum temperature of the plant. There was enough evidence to draw a suitable conclusion.