Biology Coursework

-

To investigate a factor which may affect the rate of photosynthesis of Canadian pondweed…

Aim:

I plan to investigate whether light intensity affects the rate of photosynthesis of a length of Canadian pondweed, or ELODEA. This plant is suitable because it naturally occurs in water, so placing it in water for a prolonged period of time would not disturb it.
Light intensity is measured in arbitrary units, and is calculated by using the formula

$$\textit{Intensity} = \textit{distance(from lamp)}^{-2}$$

or

$$\textit{Intensity} = 1 \div \textit{distance (from lamp)}^{2}$$

As the distance from the lamp increases, so the intensity decreases – they are INVERSELY PROPORTIONAL.
Photosynthesis is a chemical reaction in plants that converts carbon dioxide and water into glucose and oxygen via a substance called CHLOROPHYLL. This is a green-pigmented chemical that absorbs sunlight and uses the energy to split water, thereby giving off oxygen bubbles.

This is the equation for the reaction:

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

carbon dioxide + water → glucose + oxygen

Hypothesis:

I believe that the more light a plant receives, the more it will photosynthesise in a given time. This is because photosynthesis relies on two main things – light energy and carbon dioxide. To make my experiment as accurate as possible, and to ensure that there is no other limiting factor than light intensity, I shall place in the water some sodium hydrogen carbonate, which will release CO_2. This will mean that the only variable in this experiment will be the light intensity, so making my experiment as accurate and fair as possible.

Apparatus:

- beaker
- small syringe (capacity about 5ml)
- glass funnel
- plant irradiator
- cut length of *elodea*, or Canadian pondweed
- sodium hydrogen carbonate (to provide unlimited CO_2 in order that it is not a "limiting factor")

Method:

I will put a piece of cut pondweed in a beaker of water and place a funnel over the top of it. I will place an inverted syringe, filled with water, on top of the funnel, and use this to measure the volume of gas collected. The apparatus will then be placed at different distances from the irradiator, and I will use each distance to calculate the intensity of the light reaching the set-up. I will leave the apparatus like this for enough time to collect a measurable amount of gas, but so I can fit in as many different experiments as possible – and every 2 minutes I will record the volume of gas collected.

Diagram:

Table of Results:

Distance (cm)	Intensity ($1/d^2$)	Bubble Count	Amended Intensity (intensity x 100,000)
10	0.01	72	1000
20	0.0025	80	250
30	0.001111111	107	111.1111111
40	0.000625	55	62.5
50	0.0004	53	40
60	0.000277778	28	27.77777778
70	0.000204082	23	20.40816327
80	0.00015625	19	15.625
90	0.000123457	14	12.34567901
100	0.0001	7	10

Analysis:

From my results I gather that my hypothesis was correct, although the results are not an accurate display of this fact. There are three results that do not follow the pattern of the others, and I believe this may have been a mistake in recording the data – human error is only marginally more likely, however, than the unending complexities of nature…

I constructed two graphs, one of distance vs. bubble count and the other of intensity (x100,000) vs. bubble count. The graph of intensity turned out to be more difficult to produce but infinitely more helpful than the graph of distance.

In trying to construct the light intensity/bubble count graph, I discovered that it is difficult to use fractions on a graph axis. I then changed them to decimals, and this made a graph that worked. However, it is difficult to read, as all the numbers are within a very small range. So I constructed another graph with essentially the same data, but I multiplied the intensity by 100,000. This made the data easier to analyse.

Conclusion:

In the end I could not measure the volume of gas due to the complexity of trying to water-proof the small end of a syringe with blu-tack… Instead I just counted the number of bubbles. This proved not so accurate, but a lot easier to do.

My hypothesis was proved correct, as the curve shows that there is (sort of…) a positive correlation between light intensity and bubble count.

Evaluation:

The experiment was not a resounding success, but did merely what I set out to do – prove my hypothesis correct, if only slightly.

In order that I could obtain more accurate results, I could have done many things, including:

- found the correct equipment to measure the volume, and done so
- used a light meter to gauge the light intensity
- repeated each distance more times to obtain an accurate average
- used an automated data-logging machine of some kind to count the bubbles, thereby eliminating the factor of human error
- found the rate of the reaction by involving time in my calculations

Overall, my experiment was not astoundingly impressive, but served my purpose very well.