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Biology Coursework
Investigating factors which affect the rate of photosynthesis in a pond plant

An Experiment Investigating the Factors Affecting Photosynthesis in Canadian Pondweed

The experiment I am going to investigate involves exploring the effect certain limiting factors have on the rate of photosynthesis in Canadian pondweed. The formula for photosynthesis is as follows:

$6CO_2 + 6H_2O = 6O_2 + C_6H_{12}O_6$

Photosynthesis is the process in which green plants make use of the energy in sunlight to manufacture carbohydrates from carbon dioxide and water in the presence of chlorophyll. Water is absorbed by the roots and carried to the leaves by xylem tubes, and carbon dioxide is obtained from the air through the stomata and diffuses into the cells containing chlorophyll. Chlorophyll is a green pigment that is capable of converting sunlight energy into a latent form, stored in the plants food.

Preliminary Work

I am going to do this preliminary work so that I can find the boundaries for my experiment by finding the conditions needed for my experiment to work. There are three main limiting factors that could affect the rate of photosynthesis in my pondweed. These are:

CO_2 levels - to adjust the amount of CO_2 in the water I am using for my experiment I can add bicarbonate of soda. This will dissolve in the water and increase the amount of CO_2 available for the plant to use during photosynthesis.

Light levels - these can be changed by the distance or strength of the light used during this experiment. This experiment should be conducted in the dark so that any other lights (other than the light I am using) will not affect my experiment.

Temperature - the heat of the water I am using during my experiment can have an affect on the rate of photosynthesis. The water must not be too cold, as the pondweed will not be able to photosynthesise at a measurable rate. It must also not be too hot, as this will kill the plant.

A Table of my Preliminary Work Results

Preliminary Work Results

Distance from Light (cm)	30 seconds Oxygen Levels (No. of Bubbles)	60 seconds Oxygen Levels	120 seconds Oxygen Levels
0	87tion hypothesis.	180	310
5	82	168	305
10	75	153	254
15	54	114	210
20	41	93	178

Fair Testing

I have decided to investigate light as my limiting factor affecting photosynthesis and therefore I must keep the other variables constant. I will do this by:

CO_2 levels - adding ½ gram of bicarbonate of soda to each experiment before I begin so that each experiment has an equal amount of CO_2 in it. However, the same water cannot be used for each experiment because if the pondweed has not used up the entire ½ gram of bicarbonate of soda during the first experiment, and I add another ½ gram on top of the original amount, one experiment will have had higher CO_2 levels than another, making the experiment unfair.

Temperature levels - I will place a thermometer in the beaker of my experiment and add hot/cold water when appropriate if the temperature changes.

Each of my experiments will be 60 seconds long to get decent measurable results, and the light source I am using during will be moved in 5-centimeter intervals after every experiment. The light source must also remain at a constant intensity. Every piece of pondweed I use will be exactly the same length to make this a fair test. The light wavelength (colour) of my light source must also remain constant, as the chlorophyll in the leaves absorbs light. Blue and red light is easily absorbed by the chlorophyll, but yellow and green light is reflected away from the chlorophyll, which decreases the amount of light absorbed, and therefore the rate of photosynthesis. Using the same light source throughout the experiment can control this, as well as maintaining the light intensity. I have decided that I will keep the temperature of my experiment at 20°C throughout, because this is approximately room temperature and therefore it will make it easier to maintain the temperature if the surroundings are at a similar temperature. I must also be careful in case the heat from the light I am using in the experiment heats up the water. I can counteract the effect of this by adding cold water.

Apparatus

- Beaker
- Test tube
- Filter funnel
- Ruler
- Pondweed
- Water
- Light
- Stopwatch
- Pen and pencil
- Electronic scales

Method

1) Set up apparatus

2) Measure amount of bicarbonate of soda to use.

3) Add bicarbonate of soda to water.

4) Start stopwatch.

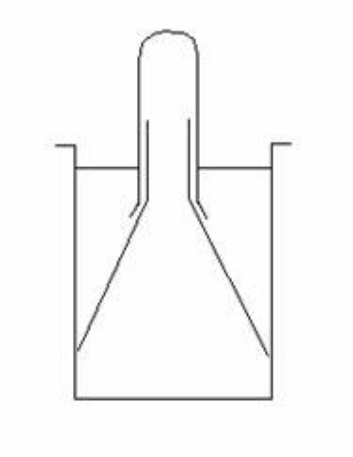
5) Count the number of bubbles that the pondweed gives off in 60 seconds.

6) Record results.

7) Move light source 5cm after every experiment.

8) Repeat each section of the experiment 3 times.

Diagram of Experiment



Hypothesis

I predict that as the distance of the light from the plant decreases (the light comes nearer to the pondweed), the rate of photosynthesis in the plant will increase. This is because the more light there is for the plant to use, the more photosynthesis it can do. The more photosynthesis it can do, the more oxygen will be produced, resulting in more bubbles been given off by the plant. I also predict that the rate at which these bubbles are given off will increase because more bubbles will be produced in the same amount of time when the light source is nearer (a higher rate of photosynthesis will occur).

A Table of my Results

Results of my Experiment

Distance from Light (cm)	Experiment One (60 secs) Oxygen Levels (No. of Bubbles)	Experiment Two (60 secs) Oxygen Levels (No. of Bubbles)	Experiment Three (60 secs) Oxygen Levels (No. of Bubbles)
0	66	60	50
5	52	46	43
10	44	33	36
15	40	29	29
20	24	26	

Why did Experiment One gain higher results than Ex. Two, and Ex, Two more than Ex. Three?

A Table of my Average Results

My Average Results

Distance from Light (cm)	Oxygen Levels (No. of Bubbles)
0	59
5	47
10	38
15	29
20	24

A Table of my Average Results in the form of $^1/_d{}^2$

Reciprocal of Average Distance	Result of Calculation
$^1/_0{}^2$	0
$^1/_5{}^2$	0.04
$^1/_{10}{}^2$	0.01
$^1/_{15}{}^2$	0.003
$^1/_{20}{}^2$is.	0.0025

Analysis of Results

My results appear to be accurate, and follow in accordance to my prediction.

I feel that I conducted my experiment accurately and efficiently, and relatively fairly, given the conditions I had to work in. I do not appear to have any anomalous results. My results were accurate, but if I were to do this again I would collect a wider range of results to create more detailed and accurate graphs. This would also help me find out the point at which light ceases to be a limiting factor. To do this I would have to increase the light intensity of my light source, because my light source was placed at a 0cm mark and yet it still did not make light a limiting factor. To make this test fairer I could have conducted it in a room with no windows, so that there was not even a possibility that extra light could have affected my experiment. I would also have made sure that all the water I used in my experiment had an equal concentration of carbon dioxide in it because, although I added an equal amount of bicarbonate of soda to each experiment, there is no guarantee that each beaker of water had an equal amount of carbon dioxide dissolved in it at the beginning of the experiment. To counteract this I would….

To gain more accurate results I would decrease the rate of photosynthesis by adding less bicarbonate of soda. This is because when the light source was at its closest to the plant, it became very difficult to accurately measure the number of bubbles being given off by the plant. Slowing the process down would decrease the chance of human error and therefore the accuracy of my results.

It is likely that the bubbles that the pondweed gave off were not pure oxygen. If I were to do this experiment again I would test this with an oxygen probe. If I were to take this experiment further, I could experiment with fluorescent lights and halogen lights (Ultra Violet??), to see whether or not this affected the rate of photosynthesis in a different way to, for example, red or yellow light. I would also like to investigate what effect the pH level of the water can have on the rate of photosynthesis. The pH level affects enzymes in plants; therefore it should also affect the rate of photosynthesis.