Science course work-photosynthesis

Aim: to investigate the effect of light intensity and the colour of light on the rate of photosynthesis of Elodea, (Canadian pondweed), to do this, I placed a piece of Canadian pondweed in varying light intensities, and observed the amount of oxygen being given off. I used Canadian pondweed because of its unusual quality of giving off bubbles of gas from a cut end, when placed in water.

Apparatus: to do this experiment I will be using the following equipment…

1) 60 –watt bench lamp
2) Canadian pondweed, (well illuminated prior to the practical)
3) Colour filters- red, yellow, green, blue x 1mm thickness
4) 500ml beaker
5) Glass funnel
6) Blue-tack (to hold the glass funnel from the base of the beaker)
7) Stop watch
8) Test tube
9) Top pan balance
10) Spatula
11) Metre ruler
12) Thermometer
13) Clamp stand to hold colour filters in place
14) Sodium hydrogen carbonate
15) Pair of scissors
16) 15cm ruler
17) Glass rod
18) Bucket of water of immersion
19) Detergent (washing up liquid)

Prediction: I predict that as the light intensity increases so does the rate of photosynthesis. The reason is that when the light is increased, the energy absorbed by the chlorophyll increases, which makes the carbon dioxide increase as well. I also predict that as the distance of the light is away from the plant, the weaker the plant is. This is because as the distance doubles the number of bubbles decrease. For example, at 10cm, there will 25 bubbles but at 30cm, there will be 11 bubbles. I hypothesised that if the light intensity increases, the rate of photosynthesis will increase at a proportional rate until a certain level is reached, and the rate of increase will then go down. Eventually,

a level will be reached where an increase in light intensity will have no further effect on the rate of photosynthesis, as there will be another limiting factor, in this case probably temperature. I also predict that blue colour will produced the highest rate of bubbles, and then red, and then followed by any of the other colours

Method: plan of method is cut a stem of Canadian pondweed of about 3cm in length. Fill a test-tube with pond water, and place it in a clamp, and then in a large beaker of cold water. Connect the end of the pondweed to the apparatus. Insert a thermometer into the beaker, and record the temperature at the beginning and end of each experiment, merely as a safety measure against an important rise in temperature, which is not expected. Set up a lamp at a set distance from the plant, making sure that this distance is from the filament of the lamp to the actual pondweed, rather than the edge of the beaker, and assumed the same at any point at any particular distance. When bubbles are, being produced at a steady rate, clear any previous bubbles from the tubing by moving the syringe. Start the stopwatch, and wait for 1 minute. Move the bubbles, which have been collected at the bend in the tubing to the part of the tube with a scale. Find the length of the bubble collected. Repeat for all other readings,

Sciencetific knowledge: Only green plants can make their own food by the process called photosynthesis. Hence, green plants are known as food producers. All other organisms are called food consumers as they depend directly or indirectly on green plants for food.

Importance of Photosynthesis

Photosynthesis is a very important process for the following reasons:

* During photosynthesis, green plants trap the energy from the Sun. This energy is passed on to all other organisms that depend directly or indirectly on green plants for food.

* Photosynthesis replenishes the oxygen that has been used up by all organisms during respiration.

* Photosynthesis purifies the air by removing the carbon dioxide that is given out by all organisms during respiration. Photosynthesis is a process by which plants, some bacteria, and some other substance use the energy from the sunlight to produce sugar, and make their own food. Photosynthesis occurs only in the presence of light, and takes

place in the chloroplasts of green plant cells. Photosynthesis can be defined as the production of simple sugars from carbon dioxide and water causing the release of sugar and oxygen. The chemical equation for photosynthesis can be written as…

Equation: Carbon dioxide + water- glucose + oxygen

$$6H_2O + 6CO_2 \text{ ----------> } C_6H_{12}O_6 + 6O_2$$

If we talk about the necessities of leaves, one could argue that chlorophyll, water, carbon dioxide, oxygen, and light are four factors that are important for leaves.

Chlorophyll is necessary for leaves, because without chlorophyll, the leaves would die. Carbon dioxide concentration does affect the rate of photosynthesis if there is too little carbon dioxide the it will become a limiting factor, but because the experiment is done in, a short period, it will not be sufficient to cause the carbon dioxide concentration to become the limiting factor. Water availability is also important if there is a lack of water, and then the plants' stomata close to prevent further water loss. This closing of the stomata cells also leads to little carbon dioxide being able to diffuse through. Clearly, in a water plant, like the Canadian pondweed, as long as the plant is fully sunken in water at all times, this will not be a problem. Temperature has an affect on photosynthesis; in fact, the temperature will increase the rate of photosynthesis, because Enzymes are used in the photosynthesis reactions of a plant. However, there will be a point at which the enzymes denature. The temperature will be at room temperature during the experiment because

Independent factors: I will change these factors…

- Colour
- Intensity or the strength of the light
- The distance

Dependent factors:

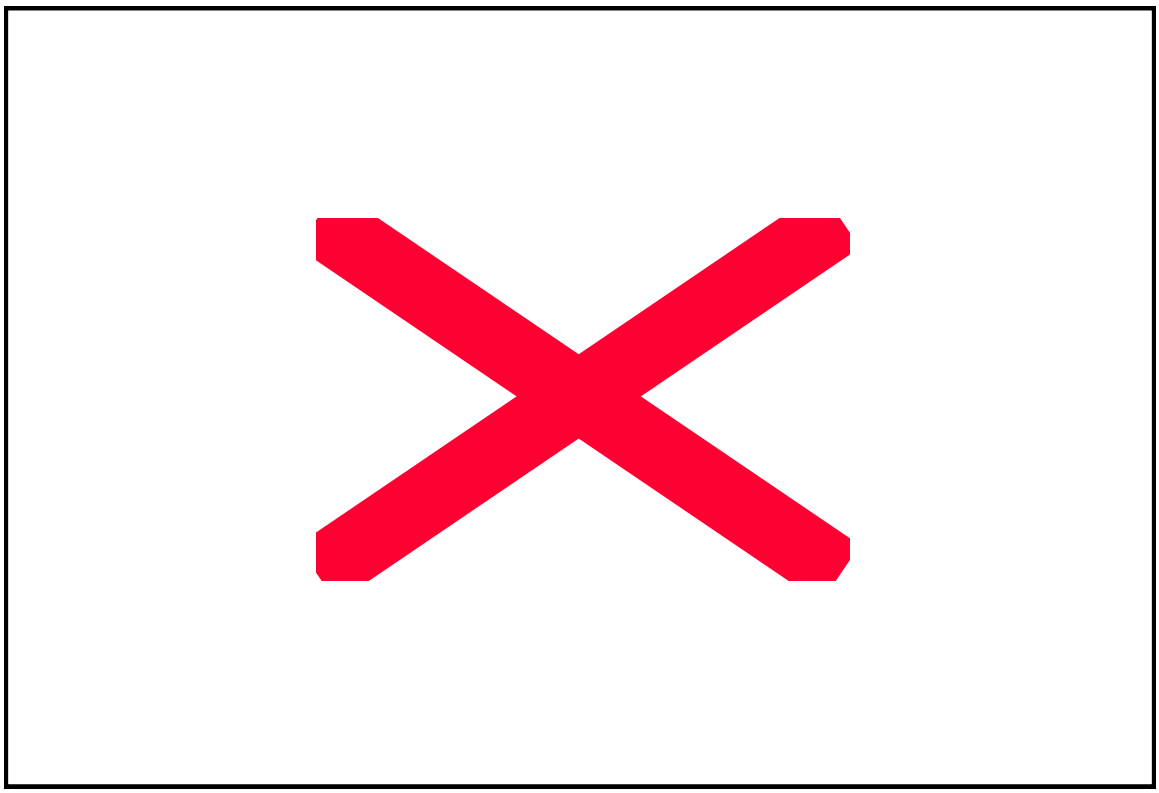
- No. Of oxygen bubbles counted for 5 minutes
- Which will give you the rate of photosynthesis

Input variables - light intensity is to be varied by increasing and decreasing the distance from the light source to the plant

Output variables - volume of oxygen produced (rate of photosynthesis) is to be measured by finding the volume of oxygen produced in a minute, and therefore finding the rate of photosynthesis

Control factors: these factors cannot be changed during the experiment…

- Heat
- Water
- Carbon dioxide
- Plant
- Same amount of chlorophyll
- Light



The action spectrum of photosynthesis is the relation usefulness of different wavelengths of light, and in result, one of the three will happen. Energy is dissolute as heat. The energy may be release immediately as a longer wavelength; Energy may set off a chemical reaction, as in photosynthesis. Light wavelength (colour) - light the pigment (A pigment is any substance that absorbs light) chlorophyll, in the leaf, absorbs energy. Chlorophyll easily absorbs blue light, in the 400-450 nm ranges, and easily absorbs red light, in the 650-700 nm range. However it does not easily absorb green or yellow light, rather it reflects them, decreasing the amount of light absorbed, and therefore the rate of photosynthesis. This can easily be controlled, simply by using the same lamp throughout the experiment.

Result table:

Colour	Distance (cm)	Number of bubbles	Average	Temp
White	10	**390** 330, 320	325	15
	20	114, **190**, 132	138	15
	30	46, 41, 49	45	15
	40	18, 19, 16	18	16
	50	10, 9, 12	10	17
Red	10	370, 300, 300	300	15
	20	91, 102, 113	102	15
	30	44, 34, 41	40	16
	40	17, 11, 10	13	17
	50	10, 4, 5	6	18
Yellow	10	159, 142, 139	147	15
	20	34, 38, 31	34	15
	30	16, 4, 9	10	16
	40	8, 7, 1	5	16
	50	2, 7, 4	4	16
Green	10	4, 1, 6	4	15
	20	5, 2, 5	4	15
	30	4, 4, 6	5	15
	40	1, 0, 4	2	16
	50	3, 2, 3	3	16
Blue	10	290, 280, 280	283	15
	20	71, 78, 63	72	15
	30	24, 19, 23	22	16
	40	11, 4, 9	8	17
	50	10, 1, 7	6	17

Conclusion: studying the result, I have seen how the rate of photosynthesis in the plant (elodea) has been affected by the different factors. Therefore, my prediction was correct that the red and the blue filter papers produced the highest rate of photosynthesis, where as the green and yellow produced the least bubbles. Enough measurements were taken to be sure of a fair test as the experiment was repeated several times so each plastic coloured sheet used had the same time and variables as the others so precise results were obtained for every test.
There was a pattern in the result table, except red filter sheet produced more bubbles than the blue filter sheet. The highest average number of bubbles the red produced was 300, where as the blue it was 283, which makes the difference of 17 bubbles being produced by the red filter sheet. This shows that chlorophyll absorbs red light more easily than blue. The Elodea produced more bubbles with sheets at each end of the spectrum because the chlorophyll in the plant absorbs all the colours but transmits green. When the light is absorbed, the plant changes it into energy to photosynthesise. The more light energy it receives the better and faster it can do this so when the sheets near the blue and red parts of the spectrum are held in front of the Elodea it absorbs the light and can photosynthesise better. If plastic sheets are held up which are have a colour near the green part of the spectrum then the light will be transmitted and the plant will not be able to photosynthesise.

In this experiment, the main colours of the visible spectrum were covered and they are sufficient to produce the results that we are looking for.

Evaluation: If the experiment were too repeated, there are several ways of improving it. For example the plant could be weighed to see how heavy it is, because if one plant is heavier then anther, one could argue that the plant have different amount of chlorophyll there the method is an accurate. Same plant could be used through out the experiment, because the plants that were used for the experiment were different, even though they are the same type of plant, they are not identical, just as humans are not identical even though we are all same species.

A thick glass panel could also be used and place it in the middle to prevent any heat reaching the Elodea, because when the heat from the lamp reaches the plant, it will produced more bubbles. To improve the accuracy of counting the bubbles, the ones which are a certain size could only be counted, and

only the ones coming from the very end of the Elodea. To expand the investigation certain variables could be changed, for example the type of plant that was used to count the bubbles. Also because is hard to get stop on count the number of bubbles, the right method would be one where one could find the absolute volume. In addition, an entire species of plant could be tested and see if the results are similar for every type. Different chemicals could be used in the water each time to see which chemicals result in the greatest rate of photosynthesis.

Nevertheless, I think the method is quite accurate, because the result table shows us the number that was used for the green filter were very low, and that makes my prediction accurate as well. On the other hand, the number that was used for the green filter that is shown on the white filter colour is quite high. Over all, the entire result table shows us that there is a pattern in the graph, and that it steadily decreases rapidity. The result does fit the pattern, because it shows the shorter the distance, the more white and red light, and the higher the temperature, the better the photosynthesis, because there were more bubbles for white and red colours. There are no anomalies in this result table because all the points go through their line of best fit, and all go through as they were predicted.