An Investigation To Show How Light Intensity Effects The Rate Of Photosynthesis Using The Plant Elodea.

Background Information;

In order for the results to show an effect on the changing light intensity I need to know the variables. The other variables will be controlled and become constant so the only factor I will be testing will be light intensity. I will try to do the experiments in the same conditions each time but these will vary. To control this slight variation in room temperature and other factors I will have a range, and use method so stop these hard to control factors from effecting the outcome.

The products of photosynthesis that I will be using as the outcome and taking results will be the release in oxygen, this will be shown by bubbles released the pond weed will be covered in water as this is it natural environment.

Variables;

Carbon dioxide Concentration *– the water will be taken from a sterile source of distilled water. If this was a factor I was changing I could add a solution containing a source of carbon dioxide to the water changing the ratio each time to see the effect.*

Wavelength *– this would be testing the wavelength of different coloured light. This could be used to see which is the most efficient and which is not. This would be done by shining a light with a colour filter again seeing the effect on rate of production of oxygen.*

Water level *– the Elodea is a pond weed it lives under water, because of this the planet will be totally covered submerged too keep with normal environment conditions. This would not be a very good variable to change unless you had a plant that was above ground level and then submerged or a submerged plant and give it less water.*

Light intensity *- this will be kept constant if it was not the variable, but as it is it will be changed to see how the effect on producing oxygen, showing by bubbles in the water, the rate of photosynthesis in the plant.*

Temperature *- the higher the temperature the plant up to around 40 °C the faster the rate of photosynthesis, this was shown in the pre-test which we carried out. If the temperature increases above this the plant will start to die, as the enzymes in it will denature changing shape and not working. This will be explained and controlled carefully to insure this does not happen and make anomalous results.*

Equations;

6CO + 6H☐0 >>>>>>>> C☐ H☐☐0☐ + 6O☐

Raw materials *Products*

Outline Plan;

- *The variable I will be changing is "Light intensity on Elodea."*
- *I will find the distance and temperature best suited for the plant in a pre -test.*
- *I prepare the equipment setting out in the same way and using the same. Checking that everything is in place and that we keep to the plan so every test is the same.*
- *Making use the test tube that the Elodea is kept in a beaker so it will not roll around and be a safety hazard.*
- *Take results moving the length and repeating evaluate data collect any more data if there is any anomalous and needs checking out.*
- *Pack up equipment.*
- *Analysis and the resulting data conclusion including graphs.*
- *Evaluating data - showing strengths and weaknesses of the plan and data collected also detailed explanations for the results collected and fault with the plan which made have been made.*

Plan;

To calculate the data, collected, estimating which light intensity will be the best for conditions of photosynthesis. Proving this with the use of graphs and averages making my results more creditable. I will be doing the experiment that will not be able to be finished in one day, it will be done over a period of time. This may effect the data collected as weather and other factors come into play, but I hope that this change will be so slight it will not change the general direction that the experiment is following.

- *Step one – collect Elodea and place in test tube, attached to a paperclip to be weighed down.*
- *Step two – cut the top of the plant to make a clean break and to let the bubbles of oxygen bubble out of the hole.*
- *Step three - set up the beaker and get the water to the working temperature, making sure all the equipment and table of results ar e correct.*
- *Step four - make sure the lamp is away from any water and there is no spillages.*
- *Step five- switch on the lamp.*
- *Step six- results to be collected being put in the table.*
- *Step seven - make sure the results are not anomalies or look out of place, repeat steps before until all data is collected.*
- *Step eight- look at the data for anomalies again, if there are any repeat length, and discard odd data.*
- *Step Nine - pack up equipment putting it back into the right place making sure that the equipment is in good condition still and cleaned up.*

Remember: Glass can shatter, and that the temperature of the water is very important as it can effect the enzymes effecting the out come by killing the plant off.

Pre-test 1;

We set the experiment as if it was the true experiment but only took the reading for at the extremes, this would identify the range between. This would help me decide if the temperatures which were crucial to the rest of the experiment running smoothly. I needed to know if I could use a set temperature or have a range of constant temperatures. That could lead to errors so a set value was found this was changed accordingly to the reaction of the plant to the temperature.

This was the equipment set up to find the temperature values;

Temperature that photosynthesis is best yield		
Temperate ℃	Number of Bubbles Produced (Oxygen)	Total of Bubbles of Oxygen
15	none	0
25	continuous	160
35	uncountable	---
45	uncountable	---
55	none	0

<u>Pre-test 2;</u>

We set the experiment up using the temperature reading before hand so we would not waste time in finding that the plant would not photosynthesis, using a random temperature, reading for at the extremes this would identify the range. This would give me the range I need so in the final experiment all the results should give data.

This was the equipment set up to find the distance values;

Photosynthesis to occur and rate of oxygen

bubbles evaluated		
Distance (cm)	Able to count oxygen bubbles (yes / no)	Able to photosynthesis clearly
20	no	yes
40	yes	yes
60	yes	yes
80	yes	yes
100	yes	yes
120	yes	yes

The range I have chose seems to give me enough variance between the two extremes for distance from the lamp.

Note: a beaker will be used to hold the test tube when the exp eriment will take place, this will not obstruct any light given from the lamp.

<u>Measurements and Observations;</u>

I will be measuring using my own ability to count the bubbles, to record my results with this they will be put in a table so all the data can b e grouped and calculations take place. Any odd results or anomalies will be taken again, being corrected in order to keep all the data consistent.

Here is a table of variables and the value they will be;

Variables	Values
CO□ concentration	Not changed, kept constant with the use of serial distilled water
Light Intensity	Varies, as it is the value testing. The same Watt bulb was used 100 w. The range will be between 40 cm to 120cm. Beaker used to stop any light from being obstructed.
Wave length	This will be kept constant by using normal light. (not filters present)
Length of plant (Elodea)	The length of the plant will be fixed at 5 cm length and cut with a knife. This cut end will be held up right for the oxygen bubbles to be released by.
Water levels	This was kept constant at 30 cm².
Temperature	The temperature was kept constant at 25℃.

Equipment;

The equipment needed for this experiment is;

- *Lamp of 100 wattage - to insure there is the same light being produced.*
- *Beaker - for the light to not be obstructed and to hold the test tube safely during the experiment (filled with water at 25°C, as insulation).*
- *Thermometer – to make sure water is at required value, in both test tube and beaker.*
- *Test tube rack - to hold the test tube while experiment is being set up and to place after each experiment to make sure no distance merges with the other distance.*
- *Meter ruler- so measurements are accurate the distance taken from the edge of the beaker which test tube is placed in (measu red from the light bulb).*
- *Knife – this is to cut the Elodea to 5 cm in length each time (using same piece of Elodea for final experiment.)*
- *Cutting board - this was used so the work surface was not damaged in cutting the plant.*

Readings and number of rea dings;

I will be taking around three result for each lengths of the wire however if there is an anomalies the whole lengths for that go will be redone to make sure the readings are correct. The suspected anomalies are going to be any data that goes to far from the other collected data and may change the figure when rounding later in the analysis. The data will be collected to 2 decimal places as the reading on the voltage meter and ammeter will only go that far with in a sensible boundary. This means howev er it might have some influence on the results, a more accurate way is needed with more figures and the digital output longer.

Prediction;

The resistance of wire should depend on the variable chosen to control but the length. When electrons travel through the wire they will collide with particles slowing the electron down. When they collide they use energy up and the voltage increases, as more energy is required to make the electrons move. This should means the longer the piece of wire the more collisions that will that place during the circuit. When the wire is short but thick in diameter the electrons will travel through using up less energy and colliding less, as they all travel through the distance and get through quicker. This means if you have a long thin, wire the resistance is high as they have more distance to travel so more opportunities for the electrons to collide. The diameter is then proportional to the length with resistance. This shows that wire does have a variance and is dependant on the wire chosen. As the diameter is the same the distance shall only matter. I predict if the electrons collide once in ten centimetres they should roughly collide twice every twenty centimetres. This should give me a straight line when drawing a graph. The gra dient of this line will be determined by the amount if resistance intentionally of the wire, and will stay constant al the way through giving a straight line of best fit.

Obtaining Evidence;

To see if the data I collected had any patterns or similarities I put in a data so it would be easily processed and easy to note down the values while doing the experiment. Here is the data collected;

Results;

Lengths of Constanton wire in cm to 1 d.p. The range of the readings 10cm to 90cm.	Voltage Output in Volts to 2d.p. (V)				Average Voltage in volts to d.p (V)
10	0.07	0.04	0.04	0.04	0.04
20	0.09	0.09	0.09	0.09	0.09
30	0.13	0.14	0.13	0.14	0.14
40	0.18	0.19	0.18	0.19	0.19
50	0.24	0.23	0.23	0.23	0.23
60	0.27	0.29	0.27	0.27	0.28
70	0.31	0.36	0.32	0.32	0.32
80	0.37	0.38	0.37	0.36	0.37
90	0.4	0.43	0.41	0.41	0.42

With the data collected it can now be processed the average is the process that rounds of the figures so they are closer, and more accurate. The resistance is worked out so a graph can be drawn this helps me see if the data has a relationship (straight or cured line) and to see if any anomalies are present or figures that do not quite fit the others when a best fit line goes throughout them. The best -fit line is there not joining all the points unless they have a certain relationship followed through out the whole data, is there is no relationship the graph will not have a best fit line but will join up the points, only on a line graph.

Analysis Evidence and Drawing Conclusion;

Lengths of Constanton wire in cm to 1 d.p. The range of the readings 10cm to 90cm.	Ohms resistance in ohms(Ω)
10	0.4
20	0.9
30	1.4
40	1.9
50	2.3
60	2.8
70	3.2
80	3.7
90	4.2

The real value of the wire can be found out the real value for Constan ton is 4.7Ω for a meter if I take 50cm as an example the 4.7 Ω would be divided into 2 as 50cm is half that of a meter. The true result should have been 2.35 Ω the result I found was 0.05 Ω of this point. This could be explained by the rounding of some figure but it is so close I believe my experiment was well executed as it almost gained the true value. This would be the best I could have hoped for using the limited decimal places by the digital read out.

(See graph of result and notice the straight line of best fit showing a define relationship)

Conclusion;

The data I collected make it possible to simulate and work our calculations producing a graph with line of best fit. The data could be used for working out the resistance per meter of wire, and the average of the results that it needed in order to be worked out. With this data I plotted a graph, it was straight and has a best line going almost all trough the points. The prediction estimated that the data would produce a straight line on the graph and would be the same gradient. The data drawn shows this and showed that the prediction was in the right area of view. The prediction did not estimate the gradient of the line this was almost impossible from the initial data collected. The results could curv e if the prediction was not correct and if it did it would be difficult to estimate this, this would only be viewed on a graph so all the data would have to been collected to see the results. The line does not goes exactly go through all the points as some margin of error is always expected, but the are very close to the line. If the true value is worked out for fifty centimetres it is only 0.05Ω out of the value which has been recorded in perfect laboratory conditions and with higher accuracy measuring machines than for two decimal places. The true value of the wire is 4.7Ω for the meter and when 2.35 Ω for fifty centimetres, the value I reached was 2.3Ω. This is very close and could be accounted for rounding of values on the digital output of only two decim al places.

Evaluating Evidence;

The data collected was collected in the same way and with the same instruments. It is very close to the real value and I believe it is a good indication that when the length of the wire is increased the resistance does as well in almost set values for different wires. This would give a straight line on the graph that was produced when the data collected was plotted. The only slight waver in the result when the had be processed was the data for the length 0.7 meters, this is so slight how ever that it is of no worry as it still is clearly next to the line and is following the pattern but with slight irregularity. The length was chosen to be in the middle value of 24 swg so it would not heat up and make the resistance even h igher. This chose the gradient of the line as it was propitiation the resistance and is the mains other factor in the wire that may *have determined what the results would be. The equipment there was no problems with the working order but there was in the l imitation of the two decimal places on the out put screen. The other explanation for this is that the current was changing and be corrected to 0.1 amps, this was done but with the limited display could not see how far away the value was. If it was lower it would give a slightly lower result with no indications through the method suggested or show up until all the result have been sorted and calculations made on the data.*

The other difficulty I can think about would be the movement of the wire and the crocodile clip, if it were not placed exactly on the same length each time the display may flicker and add a value on or way. The data collected was also taken from the digital out put however this out put was changing or flicking from different values. It was taken on my discretion, the result I chose was that which it seemed to stay on the most or the highest value if roughly the same.

Information collected in this experiment could be compared with data of other resistance of wires to see if the resistance or gradient of the line if graphs were drawn, was the same or if it was completely random from metal to metal. This would help decide how resistant the wire becomes and if extended the length and it discontinuation or continued. The other interesting things to continue with the experiment would be the connection of other alloys and their relationship with themselves, and heavier and lighter alloys of the same type. The data collected and compared would then be used to see how effective the alloy is at resist ance and how far this resistance extents till it is all off one metal or the other. This extra work would make sure the length is constant for all wires, also comparing with alloys and their effect on the gradient would be noted on how much the compound ch anges the resistance. This work would make the information gather from this experiment valid and help find out the effect on changing the concentration of metals.

The experiment followed the original prediction and with only a slight waver with length 0.7 meters the true vale was almost completely correct and could only be made clearer of error if more accurate measurement equipment was available.