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Rates of photosynthesis

For this experiment we will be finding out how light affects the rate of photosynthesis. To do this we will fill a beaker with water and add some Canadian pondweed. Then we will place a funnel over the pondweed to prevent any gas escaping, then place a measuring cylinder over the funnel to measuring the amount of water displaced by the gas. This will determine the rate at which the plant photosynthesises. We will change the intensity of the light to see if this affects the experiment.
Before we started the experiment we carried out a computer simulation of the experiment. We set the program to a certain amount of light the plant received and recorded the results, the temperature was set for 20 degrees and the amount of calcium chloride was set for 3%. These are the results for the light experiment that was done by computer simulation: -

Light experiment

Light distance (m)	0	10	20	30	40	50	60	70	80	90
Volume of oxygen (mm2)	0	8	16	25	33	42	50	58	67	75

Safety

As this experiment isn't very dangerous there is no need to take heavy precautions, but we should always: -

- Wear goggles
- Put bags and coats out of the way so it isn't a hazard to other pupils
- Keep the experiment away from the side of the bench in case someone may knock the experiment over
- During this experiment we shall be using water and electricity from the lamp, do not touch the socket with wet hands in case of an electrical shock.

Apparatus

- Beaker
- Water
- Pondweed
- Funnel
- Measuring cylinder
- Stop watch
- Lamp
- Meter ruler
- Plasticine
- Sodium hydrogen carbonate
- Electronic balance

Diagram

Fair Test

So the experiment is a fair test I will make sure that I: -

- Time the experiment so that each test will receive the same amount of in the light
- Use the same apparatus
- Do the experiment 3 times so I can obtain an average to make it more accurate
- Keep the temperature of the water the same
- Keep the amount of sodium hydrogen carbonate in the water the same

Method

- Fill a beaker of water along with the pondweed
- Place a funnel over the top of the pondweed and secure the funnel with plasticine, the plasticine will create a small gap between the funnel and the beaker this will let the water circulate.
- The water has to cover to top of the funnel
- Fill a measuring cylinder up with water
- Place your thumb over the top of the measuring cylinder (so not to let any water escape) the cover the top of the funnel with the measuring cylinder. This will measure the amount of displaced water
- Add 2.5 grams of sodium hydrogen carbonate to the water in the beaker
- Place a meter ruler by the beaker
- Put the bench lamp at the end of the meter ruler
- Count the oxygen bubbles (and record them) which will enter the measuring cylinder. the bubbles should displaced the water
- Record the amount of displaced water
- Move the bench lamp 20 cm closer to the experiment
- Then record the number of bubbles and the amount of displaced water
- Give each experiment 2 minutes then record the results
- After each experiment you should also record the temperature
- Repeat the above 3 times to work out an average

Hypothesis

The rate of photosynthesis will increase when I bring the light closer, because light is needed by the chlorophyll in the leaves of the pondweed for photosynthesis.

Carbon dioxide + Water $\xrightarrow{\text{Sun light}}$ Glucose + Oxygen

As you can see from the equation if sun light is left out carbon dioxide and water can't be converted into glucose (which is essential for the growth of the plant) and the production of oxygen. As the light get closer to the pondweed more water will be displaced, because of the oxygen given off by photosynthesis. Also the pondweed will by affected by the heat given off by the light, as the water in the beaker gets warmer the enzymes in the plant will work faster as the temperature reaches optimum. But if the plant gets very hot the enzymes could become denatured therefore photosynthesis will stop. I am quite sure that my hypothesis will work out, because from what I have studied from the computer simulation it indicates that my hypothesis could be correct. The graph from the computer simulation shows me that the line for the amount of oxygen produced gets steeper when the amount of light is more intense. This determines that as the light intensity gets higher the more water is displaced, this is because the light is changing carbon dioxide and water into glucose and oxygen by a chemical process. Oxygen is the visible product of the equation, because the oxygen displaces the water. The closer the light the more energy absorbed by the plant, so as the rate of photosynthesis increases the more oxygen is release.

Table of Results

Experiment 1

Distance of light (m)	Amount of water (ml)	Number of bubbles	Temperature (c)	Time (min)
100	1	140	20	2
80	1	229	20	2
60	1	299	20	2
40	1	400	20	2
20	1	580	20	2
0	1	>600	20	2

Experiment 2

Distance of light (m)	Amount of water (ml)	Number of bubbles	Temperature (c)	Time (min)
100	1	137	20	2
80	1	228	20	2
60	1	260	20	2
40	1	450	20	2
20	1	660	20	2
0	1	>700	21	2

Experiment 3

Distance of light (m)	Amount of water (ml)	Number of bubbles	Temperature (c)	Time (min)
100	1	198	20	2
80	1	250	20	2
60	1	262	20	2
40	1	390	20	2
20	1	612	20	2
0	1	>650	20	2

Average Results

Distance of light (m)	Amount of water (ml)	Number of bubbles	Temperature (c)	Time (min)
100	1	158	20	2
80	1	236	20	2
60	1	274	20	2
40	1	413	20	2
20	1	617	20	2
0	1	>650	20	2

Analysis

My results agree with my hypothesis so I was correct. I can't see a pattern in my graph but the graph shows me that when the length in meters decreases the number of bubbles increases. This means that the higher the light intensity the more oxygen is released from the plant this is due to photosynthesis. Photosynthesis uses carbon dioxide and water then the light will make the plant carry out a chemical process turning the carbon dioxide and water into glucose and oxygen. The oxygen in the equation is released out of the plant and then displaces the water. The computer simulation was probably a lot more accurate than my experiment, this is because there were not factors to affect it like room temperature, sun light and in a physical experiment there would be a small amount of carbon dioxide already present in the water. Towards the end of experiment 2 the water temperature rose 1 degree, which could have been the reason why there were so many bubbles at the end of that experiment. The heat from the lamp would have heated up the water and therefore the heat would pass into the plant. When the plant gets hotter the enzymes in the plant would begin work faster because of the heat. The enzymes would be reaching their optimum temperature.

Evaluation

The experiment overall was successful because nothing went drastically wrong and I have ended up with a good set of results. But I couldn't measure the amount of displaced water because the bubbles where so small that they didn't contain enough volume of oxygen to affect the levels of the water. Another problem was that the bubbles where so small and so fast that they became very hard to count towards the end, all I could do was estimate the results which wouldn't be very accurate. There are a few factors that could have affected this experiment these are

- Light

There is sun light in the room as well as the bench lamp, which could of made the light more intense than I already thought. I think to improve this that we should of conducted the experiment in a bit more darkness but I could see the problem with this, we would not be able to see the bubbles clearly so it may not of been very accurate.

- Temperature

The room temperature could have fluctuated during the lesson and when the bench lamp was very close it would have warmed up the experiment. This would of affect the experiment by building the plant up to its optimum temperature which would of made the plant produced more oxygen. To improve this maybe we could of put the whole experiment in a water bath to keep the experiment at a constant temperature.

- Carbon dioxide

There could have been carbon dioxide already present in the water, which would have given the plant more carbon dioxide; this would have made the plant produce more oxygen. The pondweed may have been already photosynthesising before the experiment, because of the small amount of carbon dioxide already in the water, which would have made our results higher than they should have been.

The amount of water wasn't a problem because the pondweed is used to being situated in a high depth of water or a low depth of water. We could have prevented the changes in temperature by keeping the pondweed in a fridge where it is cold and dark. This would have reduced the chance of the plant photosynthesising to a minimum. The enzymes in the plant would have been in a dormant state. Overall I am happy with the experiment. This experiment is the best way to study rate of photosynthesis I know that it would be quite have to change it much. If I were to do the experiment again I think the main improvement should have been the time. I think that it should have been extended so that our results where more accurate. We could have studied the plant photosynthesising for longer. This would be easy to change and if I were to do the experiment again I would time each light distance for 5 minutes. If I did this maybe the water would displace more so that I could include it more in my evaluation and analysis.