

INVESTIGATING GAS PRODUCTION BY A GREEN PLANT DURING PHOTOSYNTHESIS

INTRODUCTION:

To investigate gas production by a green plant during photosynthesis. Photosynthesis occurs only in the presence of light, it 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 expressed as:

AIM: I am going to investigate how varying light intensity will affect gas production by a green plant during photosynthesis in a plant. To do this I will need to cut a piece of Canadian pondweed and place it into a beaker containing a little bit of sodium hydrogen carbonate. A lamp will be shined onto the pondweed and the amount of bubbles released from the plant will be counted. The lamp will be adjusted to different distances from the plant to try and get different results.

FACTORS WHICH AFFECT THIS REACTION ARE:

- Light Intensity
- Carbon Dioxide
- Water
- Temperature

LIGHT INTENSITY: Pigments in the leaf such as chlorophyll take in light. Chlorophyll absorbs all different coloured types of light, it absorbs blue light, and also easily absorbs red light, and however, chlorophyll does not absorb green light or yellow light effectively. But it tends to reflect them, which decreases the amount of light absorbed, and therefore the rate of photosynthesis. This can be made right by using the same lamp throughout the experiment.

CONCENTRATION: This factor can also affect the rate of reaction and the rate of photosynthesis. If there is too little CO₂, it can become a limiting factor. This factor can be fixed by adding a fixed amount of sodium hydrogen carbonate to the beaker and plant.

WATER: Water is also required in the photosynthesis reaction. When the plants lack water, their stomata closes to prevent further water loss. Closing the stomata cells leads to little carbon dioxide being able to diffuse through into the

leaf. Water is also therefore, linked to the carbon dioxide factor. Water can be kept a constant by keeping the same amount of water in the beaker.

FACTORS WHICH AFFECT THIS REACTION ARE: continued ...

TEMPERATURE: Enzymes are used in the photosynthesis and the respiration of the plant. Therefore, increasing the temperature will increase enzyme reaction and the photosynthetic rate until a certain point is reached when the enzyme denature. The temperature can be kept somewhat a constant by performing the experiment in one session, when the air temperature should not change enough to affect water temperature.

PREDICTION AND SCIENTIFIC KNOWLEDGE:

I predict that as the intensity of the light is increased, as would the rate of photosynthesis at a proportional rate until a certain level is reached, and then the rate of increase will go down.

All plants need light to photosynthesis and this has been proven in many experiments, and so it would be reasonable to say that without light all plants would die. The reason that light intensity does affect the rate of reaction is because as light, and therefore energy, falls on chloroplasts in a leaf, the chlorophyll, which then makes the energy available for chemical reactions in the plant, traps it. Therefore, as the amount of sunlight, or in this case light from a bulb, falls on the plant, more energy is absorbed, so more energy is available for the chemical reactions, and so more photosynthesis takes place in a given time.

Light intensity is inversely proportional to the distance squared because the light energy spreads out as it travels further and further away from its source. Light energy travels along the circumference of an expanding circle. When light energy is released from a point, the energy is dispersed equally along the circumference.

APPARATUS:

- A beaker
- Cold water
- Measuring cylinder
- Canadian Pondweed
- Knife
- White tile
- Stop watch / Clock
- A meter ruler
- Bench lamp
- A beaker containing sodium hydrogen carbonate
- Scalpel
- Scissors

DIAGRAM:

FAIRNESS:

To ensure the experiment is done fairly the following things must be done. The pondweed must be used every time we change the light distance. I will repeat the experiment 5 times for accuracy. There should be only be one variable that I investigate and that is the light intensity. Take the results after every 2 minutes. I also need to use the same lamp when I repeat the experiment so that the intensity of light does not vary.

SAFETY:

To ensure that the experiment goes safely I have to do the following things. I will need to wash my hands after handling the pondweed for hygiene. Also make sure there are no water spillages on the floor on near the lamp, as this can cause an electric shock. When handling the scalpel. Always follow the laboratory rules.

METHOD:

- Collect all the apparatus and set it up.
- Cut a stem of Canadian pondweed.
- Fill the measuring cylinder with water and cut off roughly a few centimetres of the pondweed and place it in the measuring cylinder.
- Set up the lamp, measure with the ruler what distance the lamp will be at in the first experiment and place it there.
- Add the sodium hydrogen carbonate.
- Switch on the lamp and start the stop watch/clock and start counting the bubbles.
- I will count the bubbles for 2 minutes, and then change the distance after the 2 minutes.
- I will repeat the experiment 5 times all at different distances; I will do this to gain accurate results.

RESULT TABLE: Raw Data result table

DISTANCE (cm)	1ST EXPERIMENT (no of bubbles)	2ND REPEATED EXPERIMENT (no of bubbles)	3RD REPEATED EXPERIMENT (no of bubbles)	4TH REPEATED EXPERIMENT (no of bubbles)	5TH REPEATED EXPERIMENT (no of bubbles)
10 cm	99	90	95	97	95
20 cm	71	69	75	79	73
30 cm	60	57	62	56	64
40 cm	50	52	56	55	60
50 cm	49	40	46	48	41

RESULT TABLE: Average table

DISTANCE (cm)	TOTAL FOR 10 min (no of bubbles)	AVERAGE PER 2 minutes (no of bubbles)	AVERAGE PER 1 minute (no of bubbles)
10 cm	476	95.2	47.6
20 cm	367	73.4	36.7
30 cm	298	59.6	29.8
40 cm	224	44.5	22.4
50 cm	274	54.8	27.4

CONCLUSION:

From my results that I have gathered I can say that an increase in light intensity does increase the rate of photosynthesis. I predicted that if the light intensity increases the rate of photosynthesis would increase at a proportional rate until a certain level is reached, and then the rate will go down. Eventually, a level will be reached where as an increase in light intensity will have no further effect on the rate of photosynthesis.

I can see from my results that at the distance of 10 cm in each experiment I have counted roughly the same amount of bubbles all the time and at the distance of 60cm I have counted near enough the same amount of bubbles. This has happened with a slight variation with all the distances.

My results and scientific knowledge support my prediction very well. They prove that the factor of light intensity does affect the rate of photosynthesis. My knowledge of photosynthesis also supports my prediction and conclusion.

EVALUATION:

Overall, I have felt that my experiment did go well, however, I do feel the photosynthesis investigation was probably not performed as accurately as it could have been due to some controllable and uncontrollable conditions. Sometimes the piece of pondweed did not photosynthesise at a steady rate; this could be due to the fact that the pondweed was not cut accurately. Also, the measuring of distances between the measuring cylinder with the pondweed in it and the lamp could have been a bit inaccurate and could have been measured properly this could have been a major negative point to my results. The spreading of sodium hydrogen carbonate in the measuring cylinder could have been inaccurate that's why my results could have varied.

However, I do feel my time keeping was good; I was and tried to be as accurate as possible with this. I could have improved my investigation by cutting the pondweed properly and measuring the distances between the measuring cylinder and the lamp could have been a bit more accurate.

To plot my results for the average graphs I did have to round the numbers up to an integer they may have become less accurate, apart from that I feel I plotted my results as best as I could.