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Investigating the affect of different coloured light on the rate of photosynthesis.

In this piece of coursework I will be investigating the affect of different coloured light on the rate of photosynthesis.

Theory-:

Green plants make their own food by a process called photosynthesis. Photosynthesis occurs only in the presence of. Photosynthesis takes place mainly in leaves and depends on an important green pigment called chlorophyll, which is found in chloroplasts. To obtain the most sunlight as possible, leaves have a large surface area and the more sunlight the plant receives, the better it can photosynthesize. Chloroplasts are found in palisade cells in large numbers and to allow as much light to get in as possible, the cells are arranged like a fence. This helps the energy entering the surface of the leaf to travel a long way through the palisade cells.

Photosynthesis can be defined as the production of simple sugars from carbon dioxide and water causing the release of sugar and oxygen. Plants use the suns energy to join together water and carbon molecules to make the glucose, which is sent around the plant to provide food. Cells in the root or stem can use the glucose to make energy, if the plant does not need to use all the glucose immediately then it is stored which is difficult because glucose is hard to store in water. Plants solve this problem by joining hundreds of glucose molecules together to make starch. Starch does not dissolve in water very well so it makes a better food store. The chemical equation for photosynthesis can be expressed as:

$$\textbf{6CO + 6H O + light} \xrightarrow{\text{Chlorophyll}} \textbf{C H O + 6O}$$

Carbon dioxide +water + energy →Glucose + oxygen

The fact that all plants need light in order to photosynthesise has been proven many times in experiments, and so it is possible to say that without light, the plant would die. The reason that light intensity does affect the rate of photosynthesis is because as light, and therefore energy, falls on the 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. There are many factors, which affect the rate of photosynthesis, including light intensity, temperature and carbon dioxide concentration. The maximum rate of photosynthesis will be constrained by a limiting factor. This factor will prevent the rate of photosynthesis from rising above a certain level, even if the other conditions needed for photosynthesis are improved. It will therefore be necessary to control these factors throughout the experiment so as not to let them affect the integrity of my investigation into the effect of light intensity.

Key Factors: <u>CO_2</u> is vital in photosynthesis because the plant takes in CO_2 from the air and joins with water molecules to make glucose. The CO_2 comes in through the stomata pores on the surface of the leaf and only 0.03 % of the air around is CO_2 so it's pretty scarce.

Prediction-:

I predict that the light filters coloured green, yellow and orange will produce the least amount of bubbles because the light will be transmitted. Whereas placing red, clear/white and blue light filters in front of the elodea will result in the greatest amount of bubbles because the light is absorbed. Certain colours of light can limit the rate of photosynthesis depending on how well it is absorbed into the plants chlorophyll to photosynthesize. Also the wavelength can change the rate of photosynthesis. If the lamp supplying heat for the plant were placed twice as far away, I predict that there would be half as many bubbles. Also if it were moved twice as far closer then there would be twice as many bubbles. This is backed up with knowledge and scientific understanding. This means that to keep my investigation fair, I will have to keep the distance from the lamp to the elodea the same throughout.

Equipment-:

For my experiment I chose as accurate equipment as possible to give myself the most accurate results. The equipment I used was-:

*2 clamps

*Stopwatch

*Lamp

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*Elodea

*Boiling tube

*Sodium hydrogen carbonate powder

*Light filters- red, green, yellow, orange, clear/white

*Forceps

Method-:

The boiling tube was filled with water and the elodea placed in. Next I used to clamp to keep the boiling tube in place. I placed a thermometer into the boiling tube to measure the temperature to keep the experiment fair. I held a light filter with forceps in front of the lamp to make the light going onto the pondweed a different colour. For each coloured light filter I counted the amount of bubbles produced, in a minute. It was important to keep the experiment the same each time to ensure it was fair test for example: The lamp stayed the same distance from the beaker, we used the same plant each time and the plastic sheets were all the same size. The experiment was repeated three times and the results were averaged to ensure they were regular and as expected. Below is a demonstration of how I will set up the apparatus. Results were recorded each time and patterns observed.

The variables for this experiment include:

* Size of the pondweed.

*Amount of water.

*Distance of lamp.

* Size of the boiling tube.

* Transparency of the light filters.

*Time spent counting.

Changing either of the variables would have had effects on the end results; we kept ours all the same each time to ensure a fair test.

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Results-:

These are results are secondary results. This is because in our experiment, the elodea was not producing any bubbles. This may be because the elodea had died, or because it was just too small.

This is a table showing one person's results after doing the experiment.

Colour of filter	Temp C	Number of bubbles	Average
	25	30, 35, 41	35
	25	1, 3, 2	2

The next results table below is of a class result.

	Clear/white	Green	Red	Yellow	Blue	Orange
Group 1	188	4	236	200	8	228
Group 2	390	-	384	-	122	210
Group 3	102	6	24	12	30	-
Group 4	-	12	210	-	-	-
Average	226.66	7.33	213.5	106	53.33	219

The wavelength for each of the light filters.

Blue- 450nm

Green- 520nm

Yellow- 570nm

Orange- 640nm

Red- 700nm

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As predicted, the results conclude that using sheets with colours near the red and blue end of the spectrum produce a higher amount of bubbles than those near green. Thereby proving that photosynthesis is increased with certain colours of light.

Conclusion/Evaluation-

In observation of the results, I have seen how the rate of photosynthesis in the elodea has been affected by the various factors. In reference to the prediction, I was correct in that the red, clear/white coloured filters produced the highest rate of photosynthesis, whereas the sheets, which were green and yellow, resulted in the least bubbles. Which I did not predict was that the orange filter would also make the elodea produce a lot of bubbles. You can also get this evidence from my graph. I feel that we had taken enough measurements to be sure of a fair test as the experiment was repeated several times so. Each plastic coloured filter we used had the same time, and variables as the others so we obtained precise results for every test. We did not find anything, which stood out too much from the pattern except that the red filter, when used resulted more bubbles generally than the blue 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 converts it into energy to photosynthesize. 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 photosynthesize 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 photosynthesize as well. In this experiment we have covered the main colours of the visible spectrum and they are sufficient to produce the results that we are looking for.

If I were to repeat the experiment then there are a number of ways I could improve it. For example to get around the problem of the heat from the lamp producing extra bubbles then a broad glass panel could be positioned in the middle to avert any heat reaching the Elodea. To advance the accurateness of counting the bubbles, you I could only count the ones, which are a certain size, and only the ones coming from the very end of the Elodea. If there were plenty of people counting the bubbles and the results averaged then that would be a more accurate way of obtaining the information required. To extend the investigation I could alter certain variables for example the kind of plant that I'm using to count the bubbles from. I could try a complete species of plant and see if the results are comparable for every type. I could also use dissimilar chemicals in the water each time to see which chemicals result in the maximum rate of photosynthesis.

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