Measuring the rate of photosynthesis

Plan

I am going to investigate the factors that affect the rate of photosynthesis, these factors are:

- *CO2*
- *Colour of the light*
- *Temperature*
- *Distance from the lamp to the pondweed*
- *Size of the pondweed*
- *Type of pondweed*

We could measure and observe the way these factors affect the pondweed by looking at:

- *The amount of air bubbles formed per minute*
- *The distance from the lamp to the pondweed*
- *The amount of pondweed*
- *The temperature of the water*
- *How much water is lost*
- *The condition of the pondweed*

I am going to change the different colours of the light by using different pieces of coloured plastic and by doing this I will be observing the amount of air bubbles formed per minute.

Apparatus

- *Lamp*
- *Beaker*
- *Pondweed*
- *Thermometer*
- *Funnel*
- *Test tube*
- *Coloured filters*
- *Stop clock*

Fair test

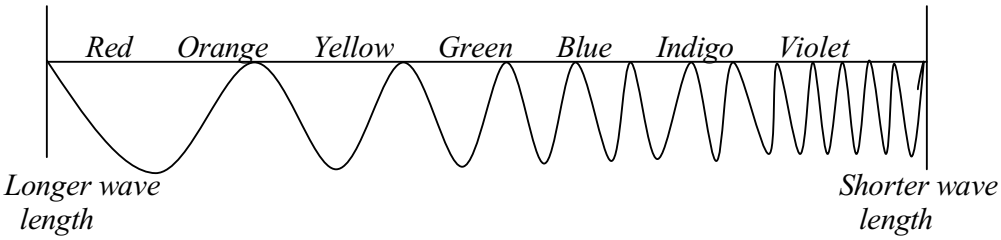
To make this experiment a fair test I am going to keep the following things the same:

- *The type of pondweed*
- *The amount of pondweed*
- *The distance from the lamp to the pondweed*
- *The amount of water*
- *The amount of CO2*
- *The voltage of the lamp*
- The amount of time used for each piece of coloured plastic

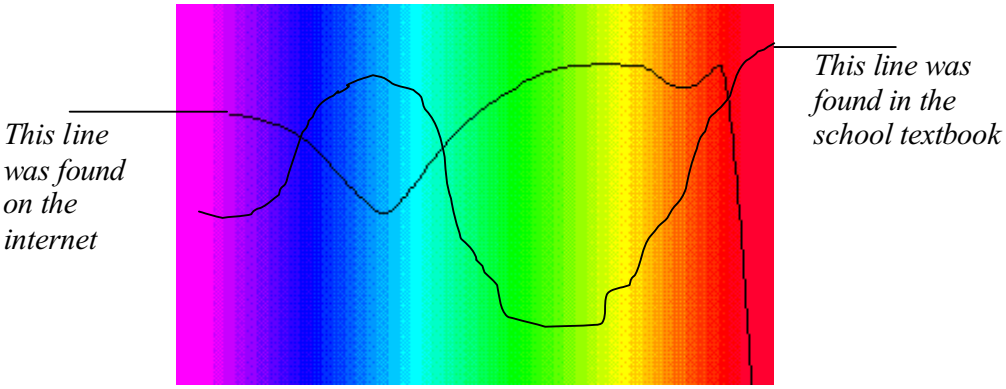
Prediction

I predict that certain coloured lights will affect the amount of bubbles per minute. This is because the pondweed on ly likes certain coloured lights, they prefer colours that have longer wave lengths.

For example:



So pondweed would prefer red, orange or yellow light rather than blue, indigo or violet according to this chart but according to other charts plants prefer the colours red and blue. Pondweed doesn't like the colour green because it is the same colour as chlorophyll, which affects the pondweed from doing photosynthesis. Even though plants don't like green light the chart above shows that more plants absorb green light than violet which also makes my prediction wrong because according to this graph green isn't the worst colour light to use while a plant is going trough photosynthesis.

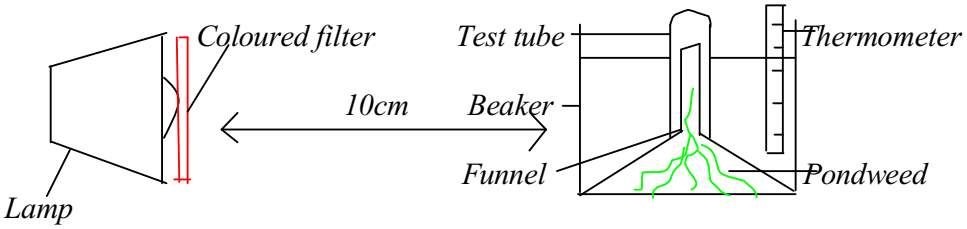


This is a colour spectrum showing the relative amount of light absorbed by each colour.

Method

1. *Set up the equipment (as shown in the diagram below) and make sure you have 5 pieces of coloured plastic. The turn on the lamp for 5 minutes so the water is able to warm up. The water needs to be right next to the lamp to enable it to warm up in the space of 5 minutes.*
2. *Then you need to place one piece of coloured plastic in front of the lamp and attach it with cellotape. Make sure the lamp is 10cm away from the po ndweed and record the temperature of the water.*
3. *Turn on the lamp and time 5 minutes on the stopwatch, you need to leave it another 5 minutes so the pondweed can adjust to the new colour of light. When these 5 minutes are up time another minute and record h ow many bubbles you see floating to the top of the test tube. Record this result in a table.*
4. *When the minute is up change the colour plastic and repeat the experiment again. When you have done each colour once you need to repeat them another 2 times this will give you 3 sets of results for each colour and you then need to find the average amount of bubbles per minute.*

Diagram

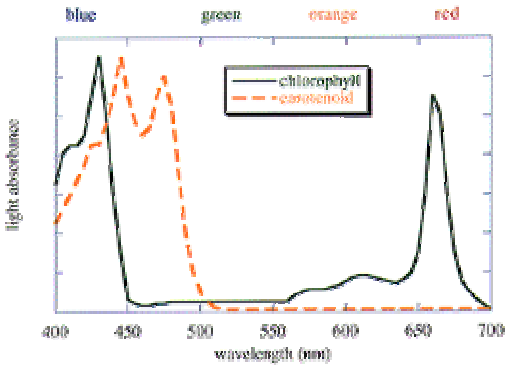


Result table

Colour	*Amount of bubbles (per min)*			*Average*
	1st go	2nd go	3rd go	
Red	68	62	51	60
Blue	33	25	39	32
Green	3	3	3	3
Orange	90	108	111	103
Yellow	117	130	112	120

Conclusion

My prediction was incorrect according to my results because I believed that red and blue would be the mo st intense colour and would produce more air bubbles but according to my results the best colours were yellow and orange because these produced the most air bubbles. I think this had happened because either the plastics are of different thickness or some coloured plastics were letting more light through than they should have been. The colour that stayed the way it was suppose to be was green because that let through very little amount of light according to the amount of air bubbles produced. The experiment needed to be tested at least 3 times each because many of the results varied in a big way, which made you wonder whether our experiment was working. If each piece of plastic had been tested for thickness and length that the results may have been fairer bec ause the plastics wouldn't have been different in any way and we might have got results that followed the colour spectrum and just any pattern.



This diagram shows the amount of chlorophyll and carotenoid produced when different coloured lights are used.

Analysis

From my results I found that the yellow filter was the best to use and my graph proves that my prediction was incorrect because I predicted that the blue and red filters would have the biggest wave lengths but shown by my graph yellow has the biggest wave length followed by orange. My results and prediction were correct in one way because I had said the green filter would have the smallest wavelengths and it did. Green is the shortest wavelength because it is the same colour as chlorophyll and when the plant's going through photosynthesis the chlorophyll will refrain from absorbing the colour. The equation for photosynthesis is:

$$\text{Carbon dioxide + water} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \text{glucose + oxygen}$$

There is no pattern in my results because my graph doesn't follow the colour spectrum diagram and they both produce different curves. I think this is because the different pieces of coloured plastic were different thickness and size, which affected how much light they let through and how well the plant photosynthesised.

Evaluation

The overall experiment was difficult to do because the experiment had to be done over a number of days and it was hard to get the same watt bulb and the exact same filters that we had used the day before which made the experiment unfair because more than one thing was changed. First off all our experiment was not completely fair. We did not attempt to regulate the temperature as well as we could have done which as we know is a limiting factor of photosynthesis. We could have put the test tube into a beaker filled with water of a certain temperature. This would have helped to regulate the temperature so we would have been certain that light was the only limiting factor. Also the size of the pieces of pondweed were not all the same so some people may have achieved different results depending on the size of their pondweed and therefore how much surface area was available for photosynthesis to take place in the palisade cells. The distance may not have been completely accurately measured and we could also have taken each set of results twice to make doubly sure we were getting an accurate picture. In reference to my prediction, I was incorrect in that the red and blue coloured sheets didn't have the highest rate of photosynthesis, whereas the sheets, which were yellow and orange, resulted in the most bubbles. Each plastic coloured sheet 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 yellow plastic sheet, when used resulted in more bubbles than the red sheet. This shows that for our experiment chlorophyll absorbed yellow light more easily than red. 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 yellow and orange parts of the spectrum are held in front of the pondweed it absorbs the light and can photosynthesize better. If plastic sheets are held up which 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, but this did not work as yellow is close to green and it was absorbed the most. 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.