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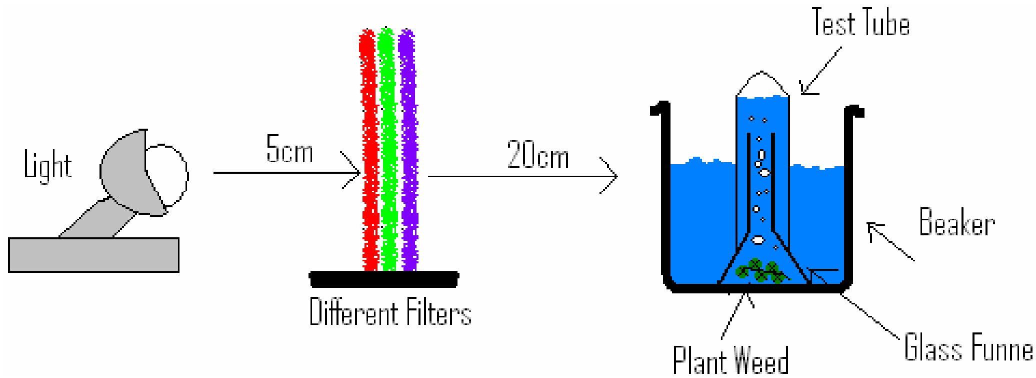
Investigation into the colour of light needed to start a photosynthesis reaction

Diagrams



Method

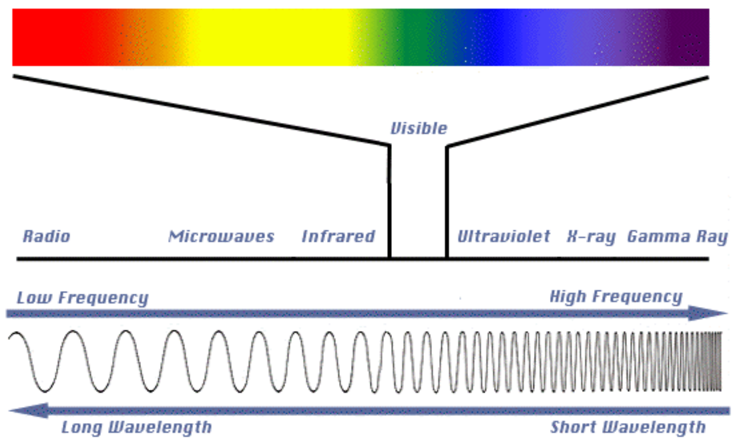
The apparatus for this experiment will be setup as shown in the diagram, for all the experiments the coloured filter will be 5cm away from the white light bulb, which is a 60watt bulb, and the beaker will be 20cm away from the edge of the coloured filter. Just before the experiment takes place we will place the pond weed (which has been in darkness for at least 24 hours to stop it any photosynthesis) into the beaker. I will then place the funnel over the pond weed and place the test-tube into the beaker (like the diagram above) I will then fill the beaker up with cold tap water till it covers the bottom of the test tube (450ml). This is so that we can easily count the oxygen bubbles as they come off the pond weed. Now that the experiment is ready to start, I will turn on the light for one minute, then after the first minute I will count how many oxygen bubbles come from the pond weed in the second minute. I will repeat this stage again once 10 minutes has passed. The preliminary experiment was done to check my prediction of what I think will happen. For this I used red, green and blue filters. The main experiment will be done with more colours if it proves successful - I will repeat the experiment with more colours: red, orange, green, blue and purple filters. I will take three readings for the preliminary experiment and five for the main experiment so that I can take an average for each colour.

Fair Test

- Pond weed is from the same pond.
- Pond weed kept in dark for 24+ hours.
- Pond weed stored in same conditions, darkness, temperature etc…
- Same sized pieces of pond weed (~5cm)
- Same temperatures (fridge, room and water)
- Same room and cold water from the same tap.
- Same light bulb, same strength bulb (60watt)
- Same distance from light to filter, from filter to beaker.
- Same equation (apart from colour of light filter)
  Carbon dioxide + Water → Oxygen + Glucose
  ^
  Light

Prediction

I think that the green filter will not allow the pond weed to start photosynthesis. This is because when white light hits a plant; all colours of light are absorbed, except the green which is reflected. This is why we see the pond weed as been green. On the diagram of the electromagnetic spectrum green light is in the middle, so I expect that the colours either side of green will provide enough energy for the pond weed to start photosynthesis and create oxygen bubbles. As colours either side of green are used as a filter, like orange and blue, I expect more oxygen bubbles to be created and gradually as we spread out to the edge colours (red and violet) I think that more and more bubbles will be created until we get to the edge two colours of the spectrum. Likewise, if we go in from the edge colours into the middle of the spectrum, I expect the amount of oxygen bubbles given off from the pond weed to decrease.



Results

Preliminary Experiment					
Test No. / Colour	Violet	Green	Red		
1	5	0	3		
2	10	0	4		
3	4	1	7		
Total	19	1	14		
Average	7	1	5		
Main Experiment					
Test No. / Colour	Violet	Blue	Green	Orange	Red
1	2	0	0	2	0
2	3	1	0	1	1
3	6	2	1	2	2
4	6	2	1	3	2
5	7	3	2	2	3
Total	24	8	4	10	8
Average	5	2	1	2	2

Analysis

My graphs show that when the pond weed is in green light, it gave off very few oxygen bubbles; this is because most of the green light hitting it was reflected as I predicted. We can tell this because we see the pond weed as been green in colour. On the graphs we see that there is a higher amount of bubbles given off when other colour filters apart from green are used. Violet light made the pond weed release more oxygen bubbles than any other colour we used. In the preliminary experiment the results were in the shape of a V, which is what I expected, but when the experiment was done in more detail (main experiment) the results started high, dropped to a low (using green light) and then levelled out. I did not expect to see any bubbles coming from the pond weed when I used the green filter. From these results I have found that violet light is the most absorbed by the pond weed and that green light is the lease absorbed and most reflected, unused colour. I think my results support my prediction, apart from the bit where I thought that green light would not allow the pond weed to photosynthesise and create oxygen bubbles.

Evaluation

Overall, I think my experiment went well, but I did notice that sometimes the accuracy was not as good as it should be. This was show by the size of our error bars, which do not give a very clear sign of the exact result. This was due to the fact that I was depending on the oxygen bubbles been the same size, which they visibly wasn't, this experiment wasn't very successful scientifically because there was not enough detail about the oxygen bubbles, the quality of the filters or the energy of the light coming through the filters. I think this error margin shown by the error bars could have been reduced if I had repeated the experiment more and taken an average. There are also a number of smaller inaccuracies which apply to both the preliminary experiment and the main experiment. The distance we measured between the light source and filter, the distance between the light source and the pondweed and the distance between the filter and the pondweed was not measured very accurately, in this case, the measurements weren't taken from the filament of the lamp to the pondweed, only from the end of the light bulb to the edge of the beaker – this makes way for a small percentage of error. Looking at the light bulb we used, combined with the size of the pondweed and beaker, I think the margin of error would be ~3cm. I did not use the measurements as part of my results, but it may have been one of the factors which affected the outcome of my results. The measurements we used more as a guide and layout for the experiment, and to ensure that as much light as possible went through the filter and not around it to the pondweed. But light which came through the windows and light from the ceiling fluorescent lights could have affected our results, although we did try to reduce this by closing the blinds in the lab and turning on the ceiling fluorescent lights the furthest away from the experiment – this again would have increased the margin of error in our overall results. We could have removed the problem of "pollution" from other light sources if we had done the experiment in a dark room. Heat also has an effect on the rate of photosynthesis, so although I said we were doing the experiment in normal room temperature, some heat from the lamp might also have got to the plant and caused fluctuations in our results of photosynthesis. This could have been prevented through out my experiments if I had checked the temperature of the water after each test to make sure it didn't change rather than just at the beginning of the experiment. The level of carbon dioxide in the water could also have affected the rate of photosynthesis by the pondweed; I didn't measure the carbon dioxide levels in the water, as I didn't know the means to. However, I could have added sodium hydrogen carbonate to the water so that there was more carbon dioxide in the water, and I could have seen if different amounts of carbon dioxide in the water affected the rate of photosynthesis. Overall, I think that the concentration of carbon dioxide in the water would have been sufficient for the tests which I did, due to the short space of time they took. Due to the small amounts of oxygen given off during the experiments I didn't think it would be useful to measure the amount of oxygen given off, but I could have measured this with a burette. This would have allowed me to see whether different colours of light affect the amount of oxygen given off by plants. If I were to repeat the experiment, I would use a light meter to ensure that the same amount of light energy is coming through the filter and reaching the plant, with this I could adjust the distance of which the lamp is away from the pondweed. Another point is that I would use more accurate measuring techniques which I said before in this evaluation if I were to repeat this experiment again. One of the things which struck me most was that violet light made the pondweed give off many more oxygen bubbles than any other colour, so a good idea for if the experiment was repeated again would be to use ultra violet energy to see if the trend with violet light continued. I think another improvement to my tests would be an extension on the amount of time each test lasted, because I don't really think I gave the pondweed enough time to "get going" – this was a constraint on me though, because I did not have enough school time to do the experiment as long as I wished. Another idea I would like to try if I repeated the experiment is whether light from different light sources combined with different colours has different effects on the rate of photosynthesis by the pondweed. I could try light from fluorescent or halogen sources along with coloured light filters.