Do different coloured wavelengths of light affect the rate of photosynthesis in Canadian Pond Weed?

Aim;

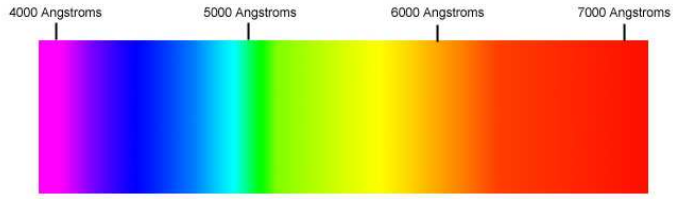
For the aim of this experiment I am trying to discover if different coloured wavelengths of light affect the speed of photosynthesis in Canadian pond weed either speeding up the rate of photosynthesis or prolonging its effects, or even in some places stopping it take place completely.

Prediction;

I predict that the different wavelengths of coloured light will affect the rate of photosynthesis, for example I believe that when there is a green filter on the light there will be a very slow rate of photosynthesis, almost no reaction at all because pond weed is green and so this shows me that pond weed does not absorb green light it refracts it yet absorbs all the other coloured wavelengths. I also believe that photosynthesis will not occur very fast with a similar colour to green such as yellow as these are next to each other in the colour spectrum. I believe that photosynthesis will react much faster with colours at the end of the spectrum such as red and blue as they are the two extremes of the colour spectrum, infrared and ultra violet. As these two coloured wavelengths are the furthest away from the green wavelength I believe they will increase the rate of photosynthesis in the pondweed. The light wavelength diagram shown below emphasises that infrared and ultra violet are the two coloured wavelengths of light furthest away from the green coloured wavelength. I also believe that another aspect which will affect the results I achieve will be the temperature at which the experiment takes place.

As the reaction photosynthesis uses enzymes to take place temperature is a key aspect in the experiment. Enzymes are only active at certain temperatures. If the temperature at which the experiment is to low say 20oC than the reaction will be slowed down as the enzymes will be inactive. Also if the temperature is too high for example it is over 40oC the reaction time will also be slowed down as the enzymes will be inactive. Enzymes are most active at around body temperature, 37oC and so temperature plays a key role. Another reason why temperature will play a key role in the experiment is due to the collision theory. As when particles are warmer they carry more energy and so collide more often causing more reactions to take place over a smaller period of time. As I have no means to control the temperature at which the experiment will be taking place I predict that my results will be inaccurate. With secondary

colours I believe that the rate of photosynthesis will decrease due to the fact that secondary coloured wavelengths of light are closer to the green wavelength than infrared and ultraviolet wavelengths.



Light Wavelengths Spectrum

Fair Testing;

These are things I am going to keep the same;

- The amount of sodium carbonate (1 spatula full)
- The amount of water (500ml)
- The same sized piece of pond weed (6cm)
- The same amount of light (1 Lamp)
- The same amount of timed intervals (Every 30sec for 3min)
- The temperature of the water (Room Temperature 23oC)

The thing that I changed was;

- The colour of the filter (4 filters Red, Blue, Green, Clear)

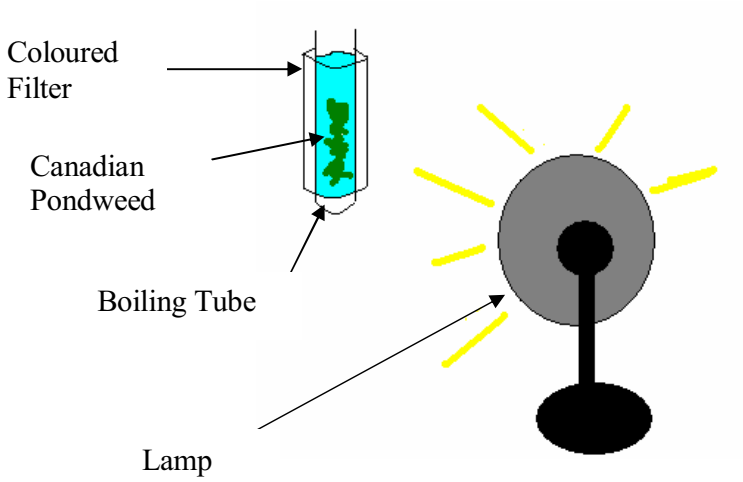
Something's had to remain the same such as the amount of light and the amount of sodium carbonate otherwise the results would be very inconsistent and it would have been a very unfair test.

The variables I chose to alter were the CO2 levels the wavelengths of filter and the amount of time the experiment lasted for. I chose to have one spatula full of sodium carbonate because it sped up the reaction time of photosynthesis but it was a very easy amount to put into the test tube without miscalculating the amount. I chose to have the four different coloured wavelengths of filter Red, Blue, Green and yellow because Red and Blue are at different ends of the spectrum and yellow and green are in the middle so I have a good overall variety of all the colours in the spectrum. When I was choosing the time variable I choose to take a measurement of oxygen produced every thirty seconds for three minutes in the form of bubbles produced by the pond weed. I chose this time variable because it gave me six sets of results per filter. I chose not to use a variable for the temperature the experiment took place at because it was to difficult to keep the experiment at a steady temperature.

Apparatus and Diagram;

The apparatus I used for this experiment was;

- 1 Lamp
- 4 Coloured Filters
- 4 Boiling tubes
- 500ml of water per boiling tube
- 1 spatula full of sodium carbonate per boiling tube
- 4 6cm pieces of Canadian pond weed
- A test tube stand
- A spatula
- A Stopwatch



Method;

Firstly we had many practice experiments just to get used to using the pond weed and giving us a chance to discover some variables that we could change for the practical this coursework is based on. One of these experiments was a change of temperature to see if that affected the rate of photosynthesis this was a very difficult experiment as we did no have access to an electronic water bath and so had to control the temperature by using a Bunsen burner which was very challenging so we were not advised to use temperature adjustments in this experiment but to keep the whole experiment at room temperature. We then did a final practice experiment which was going to be the same as the practical this coursework is based on. In this experiment I did encounter some problems but I did overcome them so the method for the final practical is written below.

I collected four samples of pond weed each of six centimetres in length and placed them in a beaker. I then collected four boiling tubes and filled them with water and placed one of the four different coloured filters round each tube. I then collected a lamp and positioned it on the first of the four boiling tubes. I took one of the samples of pondweed and cut of a very small section from one end. I placed it in the water and began the stop watch. While I was timing the experiment my partner was counting the number of bubbles that the pond weed was producing through photosynthesis. We took a reading of bubbles every thirty seconds for three minutes. We then did this for the other three boiling tubes and registered there results in the same way.

Graphs and Tables;

The table below shows the number of bubbles produced every thirty seconds for three minute for each of the different coloured filters.

Number of Seconds	Filter colour Blue	Filter colour Green	Filter colour Clear	Filter colour Red
30	6	0	1	1
60	30	0	6	2
90	59	0	15	2
120	90	0	24	3
150	105	0	24	4
180	120	0	41	5

These results do tie in with my prediction in some ways. As I predicted the blue wavelength increased the rate of photosynthesis greatly as it is close to the Ultraviolet wavelength. My prediction that the green filter would slow or even stop the rate of photosynthesis was also correct as no bubbles were produced in the tree minute time period.
But I was incorrect about my prediction that the red filter would increase the rate of photosynthesis as it was close to the infrared end of the light wavelength spectrum, in fact the red filter produced the second lowest number of oxygen bubbles. Although the bubbles of oxygen were very large which, leads me to believe that ultraviolet waves speed up the rate of photosynthesis and infrared wavelengths increases the output of the reaction. The clear filter also had a very good effect on the rate of photosynthesis which tells me that photosynthesis works very well with all light wavelengths together.

The graph shows the relationship between the four colour filters I tested in this experiment. As you can see from the graph the coloured light wavelength that increased the rate of photosynthesis the greatest was the Blue Filter, which allowed blue and ultraviolet wavelengths of light to pass through. The second highest rate of photosynthesis was through the clear filter. I believe this was down to the fact that all light wavelengths could pass through. The red filter did produce some bubbles as shown in the graph but it didn't increase the rate of photosynthesis as much as I had predicted. Finally as I predicted and as can be seen in the graph the green filter stopped photosynthesis taking place.

Evaluation;

I don't believe that my results are sufficient to support a firm conclusion as I don't believe that I tested enough variables such as enough different coloured filters or secondary coloured filters. Another reason why I believe that I can't support a firm conclusion is that I believe more tests and trials are required and my results lack consistency, as the experiment took place over two lessons and the weather in the classroom was different on both days.

There were three main problems with my method the first of these was that the boiling tube wasn't surrounded by a reflective surface so some of the light was lost and unfiltered light could also get to the pondweed. This affected my results as not only was filtered light passing into the pondweed but also unfiltered light entered which may have sped up or slowed down the rate at which photosynthesis took place. To solve this problem I would surround the experiment with a reflective material such as tin foil which will stop light being lost and unfiltered light coming into contact with the pondweed.

Secondly the temperature was the second problem I faced. With the temperature not being at a constant the results weren't accurate. The temperature also affected the rate of the reaction. I would solve this problem by completing the experiment in a room where the temperature could be kept at a constant thus recording more accurate results.

The third and final problem I encountered was the quality of the filters I used. As the filters weren't a very good quality they may have let through some other wavelengths of light. This would have affected my results as if other wavelengths of light were aloud to pass through rather than just the filtered light it may have sped up or slowed down the rate of the reaction. To solve this problem I would use top of the range filters that only allow through the correct colour wavelength.

There was one anomaly which was the lack of bubbles the red filter produced, although the bubbles were very large the amount of bubbles was disappointing compared to what my teacher said we should expect. This could have been due to several things such as a poor piece of pondweed or a very poor quality filter.

I believe that I could have improved the coursework by spending more time on writing up the coursework and by doing more detailed practical experiments in the lesson time provided.