Elodea experiment

Aim

To find out if temperature affects the rate of photosynthesis in elodea.

Apparatus

Heat mat, gauze, Bunsen burner, tripod, beaker, thermometer, funnel, goggles, test tube, water, elodea, sodium hydrogen carbonate, lamp, spatula.

Plan

Put the elodea in a beaker full of water the snap the end that is growing off to get rid of any air bubbles. Turn a funnel upside down then place it over the elodea and top up the beaker so that the top of the funnel is covered. Then fill a test tube with water and place thumb over the top, turn the test tube upside down and put in under water then take your thumb off. The water should not escape because it is underwater. Move the top of the test tube across and put over the top of the funnel. Empty some water so that it does not spill. The test tube full of water is there so that you can see the air bubbles produced during photosynthesis. Add a thermometer and record the temperature as your starting temperature. Now count how many bubbles travel up the test tube in 5 minutes, so that you can have a control. Remove the test tube and funnel and add a spatula full of sodium hydrogen carbonate and stir till it is fully dissolved, this provides the elodea with carbon dioxide so reduces the limiting factors. Then place the funnel over the elodea again and top up with water so the top is covered, place the test tube over the funnel as before. Then put the Bunsen burner on the heat mat and attach the Bunsen burner to the gas tap. Place the gauze on the tripod and put both on the heat mat. Position the beaker on the gauze and put on your goggles. Now position the lamp so that it shines directly onto the elodea providing light and reducing the limiting factors once again. Ensure that your hair is tied back if it is long and make sure all clothing that could get in the way is tucked in such as ties. Get a splint and light your Bunsen burner ensuring that it is on a yellow flame by keeping the air hole closed. Now open the air hole and move the Bunsen burner underneath the beaker. Heat the water in the beaker so that it is 5 c higher than the starting temperature;

stir the water so the heat is distributed evenly. When the water and elodea reach the correct temperature begin counting how many air bubbles there are in 5 minutes, keep the water at a constant temperature by moving the Bunsen away and putting it back under the beaker. The bubbles that travel up the test tube are oxygen bubbles; oxygen is created during photosynthesis so the more oxygen bubbles the greater the rate of photosynthesis. Record the result for the amount of bubbles in 5 minutes then increase the temperature of the water again so that it is 10 c higher than the starting temperature, when it reaches this temperature count the number of bubbles and record the result again. Ensure that the bubbles are counted in the same way for all of the readings and repeat these steps for 15 c 20 c 25 c 30 c 35 c above the starting temp and record the results for all of them. With your results divide the number of bubbles in 5 minutes by 5 so that you have the average rate of photosynthesis per minute. Record these results onto a graph with the temperature along the y-axis and the rate of photosynthesis along the x-axis.

<u>Prediction</u>

I predict that the elodea will photosynthesise greatest at around 30 c because this is the optimum temperature for enzymes and I think this will be reflected in the enzymes that do photosynthesis. However I think that at about 50 c the elodea will no long photosynthesise because the heat will denature the enzymes, there for the graphs to show my results will have an "n" shaped curve. I think this will happen because at lower temperatures than 30 c the enzymes will not work as well and so photosynthesise slower, but do not denature. The only limiting factor is temperature because we have constant light supply from the lamp and plenty of carbon dioxide from the sodium hydrogen carbonate. At about 60 c I think the enzymes will be denatured and so will no longer photosynthesise. The shape of the enzymes will be permanently changed and so even if you cool the elodea down it will no longer photosynthesis as efficiently. Photosynthesis works by the enzymes bumping into the particles of water and carbon dioxide and breaking them down into energy, glucose and oxygen. As the heat increases in the plant, the amount of kinetic energy held by the enzyme increases so they bump into the particles more and so can break them up more rapidly. This is why

I think the higher the temperature the greater the rate of photosynthesis. However, when the enzymes reach a certain temperature, then shape will change and so they will no longer be able to break down the particles, this is denaturing.

Starting Temperature (c)	**Temperature Reached (c)**	**Number of bubbles in 5 minutes**	**Number of bubbles per minute.**
23	-	0	0
23	33	14	3
36	46	21	4
48	58	95	19
57	66	92	18
65	75	200	20
75	85	0	0

Diagram

Method

I followed my plan except I decided to go up in tens instead of fives. So I measured the temperature as 10 c above the starting temperature, then 20 30 40 and 50 c above the starting temperature.

Conclusion

The optimum temperature for photosynthesis in elodea is about 75 c. The enzymes denatured somewhere between 75 and 85 c. The optimum temperature for photosynthesis enzymes is a lot higher than the enzymes used for digestion in the human body. I think this is because the enzymes can cope with higher temperatures before they denature. My results are quite reliable but when it got to temperatures such as 66 and 75 c there were a lot of bubbles so it is possible that I may have miss-counted. Also the heat may not have been evenly distributed throughout the water so some parts of the elodea may have been hotter than other areas. Also the temperature fluctuated while I was counting the number of bubbles, sometimes being higher than the temperature I was aiming for, and sometimes being lower. When I was counting the bubbles, they were different sizes that meant that if a large bubble were produced it would contain more carbon dioxide, and would mean more photosynthesis would have been done. I only counted large bubbles as one bubble, and small bubbles also as one bubble, which meant that the actual rate of photosynthesis was not accurately recorded. This would mean that the results are inaccurate and are therefore only be an estimate. The graph reflects the "n" shape that I predicted in my prediction. In my prediction I thought that the optimum temperature would be around 30 c but in fact it was twice as much. If I were to repeat this experiment I would like to be able to heat the water more accurately to ensure that the heat was distributed evenly. I would also try and find a more effective method of counting the bubbles, because at high temperatures it was difficult to count all the bubbles.