How does Light Intensity Affect the Rate of Photosynthesis?

Plan:

We are going to find out whether light intensity affects the rate of photosynthesis. Photosynthesis is the process where plants make their food. To make food by photosynthesis, plants need light (and chlorophyll to absorb it) carbon dioxide and water. Glucose is produced as the plant's food from this process and oxygen is given off as a waste product. The equation for photosynthesis is: $6CO_2 + 6H_2O \dashrightarrow C_6H_{12}O_6 + 6O_2$. The amount of light, carbon dioxide and water will affect the rate at which photosynthesis occurs. They affect the rate because if for example there is lots of carbon dioxide but a small amount of light, lots of the carbon dioxide would be wasted because the amount of light and carbon dioxide has to be equal for a reaction to take place.

The purpose of this investigation is to find out whether the amount of light available to the pondweed will affect the rate of photosynthesis.

Aim:

We will change the distance that the light is from the plant and we will measure the volume of gas (oxygen) given off from the pondweed.

Prediction:

I predict that when there is more light intensity given to the pondweed, more oxygen will be given off up to a point. I predict this because the pondweed will photosynthesize more quickly at because it will have enough carbon dioxide and water to keep up with the amount of light that there is, but when the light intensity keeps increasing, there will not be enough carbon dioxide and water as there is sunlight. When there is less light intensity, photosynthesis will happen at a slower rate because gradually there will not be enough sunlight as there is carbon dioxide and water.

Variables:

To do the experiment we will keep the same piece of pondweed because different pieces of pondweed will

photosynthesize at different rates. We will keep the rate of carbon dioxide the same by just using one limited amount of sodium hydrogen carbonate in the beaker. The water will have to be the same volume and temperature so that the resources of carbon dioxide and water will stay the same and so that the enzymes cannot be denatured if the water is too hot or cold. To do this we will use a measuring cylinder and thermometer. We will keep the increments of length that the beaker is away from the lamp the same by using a ruler. We will also use the same lamp, because if we use a lamp with a stronger bulb, photosynthesis will be affected. The time of the experiment will be measured with a stopwatch.

Apparatus:

Method:

To find out whether light intensity affects the rate of photosynthesis, we will fill 350ml of a 700ml beaker with water that is 30*C, which is the average room temperature. This is so that the enzymes in the pondweed will not be denatured. We will then get a piece of pondweed and add a paperclip to one end to weigh it down. We will the fill up a test tube with water and place it in the beaker so that it is over the pondweed. Then we will place a lamp right up to the beaker and turn it on. For two minutes we will measure the volume of gas that is being given off from the pondweed. (We will actually not use a test tube to measure the volume of gas that

is given off; instead we will just count the oxygen bubbles that we can see being given off from the pondweed. We are changing this because we do not have the proper resources to carry out the experiment accurately if we are measuring volume of gas.) Every two minutes up to 12 minutes we will move the lamp away from the beaker in increments of 5cm each time by using a ruler. Every time that we move the lamp we will count the bubbles for two minutes and we will ensure that there is carbon dioxide so that the pondweed can photosynthesise by adding sodium hydrogen carbonate to the water to provide the carbon dioxide. After we have taken down all of the results, we will see if the pondweed has photosynthesised more quickly if there is a higher light intensity.

Results Table:

Light Intensity (Cm)	Number of Bubbles Counted (every 2mns)		
	Experiment 1	Experiment 2	Experiment 3
0	28	25	31
5	16	19	14
10	10	11	9
15	7	9	8
20	2	4	1
25	0	0	1

Analysis:

We found out that as the light intensity decreased, the rate of photosynthesis, or the number of bubbles, will slow down. All of the results concluded that when the lamp is further away from the beaker, less bubbles are produced from the pondweed. The graph shows a curve in the points, so we can see that the rate of photosynthesis falls quite quickly at first but when the light intensity is at 20cm away from the pondweed it starts to slow down and level out at a steadier rate. These results tell us that photosynthesis needs quite a lot of light (energy) to happen quickly. We can also tell from this that the carbon dioxide and water need to be at the same level as the light/energy, because otherwise for example, if there is lots of carbon dioxide and not much sunlight, there would be lots of carbon dioxide that has to be wasted because there wouldn't be enough sunlight to react with the excess carbon

dioxide. We can now see that for a plant to photosynthesise quickly it needs to have enough carbon dioxide, water and sunlight because if it only has enough of one or two of those factors, those factors will still have to be reduced to react with the factor that is the lowest. From this experiment I can see that my prediction is correct because I predicted that the rate of photosynthesis would be quicker with a higher light intensity then slow down after a while because there would not be enough light as there was carbon dioxide and water, and I found that this was the case and I explained why above.

Evaluation:

Throughout the experiment we were trying to make sure that everything was accurate. To do this we made sure that we stuck to all of the variables that we had set at the start of the experiment and kept all of the times and amounts that we had prepared the same. The repeat readings that we recorded were all reasonably similar to the first experiment that we did. The biggest difference in the amount of bubbles counted was six bubbles and that was between the second (25) and third (31) experiment when the lamp was 0cm away from the beaker. The only other noticeable difference was when the lamp was 5cm away from the beaker also between the second (19) and third (14) experiment and that difference was five bubbles. So those were the only anomalies that were found. These anomalies could have been caused because the temperature may have changed in the water or the rates of the water, carbon dioxide or water could have changed. All of these things would be beyond our control. I think that the results and the quantity of them were good because they did show quite a wide variety, and they all seemed to be relatively similar. I think that we can give a good conclusion to what we are trying to find out by using them because of these factors.

I think that the method that we used was suitable for the investigation; this was even though the first method wasn't suitable because we did not have the proper resources available to be able to measure the volume of gas, so we just had to count the bubbles that we could see being given off from the pondweed. I think that this was just as good as measuring the volume of gas because it was quicker and also more accurate because it was going to definite results because the bubbles were visible, whereas the gas wouldn't have been. All of the equipment was reliable enough but maybe we could

have checked that all of the lamps had the same strength bulb and make sure that all of the bulbs that we used had all been used for the same amount of time or that they were all new. All of the variables that we planned to use were all fine and none were tricky to use. The hardest variable to control was the temperature of the water during the whole experiment because the water would change temperature from its starting temperature. The strength of the lamp was also a difficult variable to control because we didn't know that all of the other lamps that were in use had the same strength bulb.

We could improve the experiment by also using the first method of measuring the volume of gas given off from the pondweed as well as counting bubbles to see the difference in results between the two methods. We could also make sure that the water was always the same temperature by running tap water and leaving it in a room for a while until it reached the room's temperature, we can then keep the temperature of the room the same so that the temperature of the water which can be used in the experiment will stay the same. Some other evidence that we could use to justify the conclusion could maybe be to add more results just to conform the accuracy of all the results. Another thing that we could do is to do the experiment again using different size of pondweed to find out if the size of the pondweed affects rate of photosynthesis. We could also compare our results to other people's to make sure that they have roughly the same pattern of results.