Photosynthesis Coursework.

Aim:

To investigate the effect of changing light intensity on the rate of photosynthesis.

Background:

Photosynthesis is the manufacture by plants of carbohydrates and oxygen from carbon dioxide and water in the presence of ch lorophyll with sunlight as the energy source. This chemical process occurs in the leaves, with glucose (carbohydrate) being the plants food source and oxygen the “waste” product. Photosynthesis is dependent on favourable temperature and moisture conditions as well as on the atmospheric carbon dioxide concentration. Increased levels of carbon dioxide can increase net photosynthesis in plants. The chlorophyll is used to convert light energy into chemical energy.

Carbon Dioxide + Water + (energy from light) $\rightarrow$ Glucose + oxygen
$6Co_2$ + $6H_20$ + Light energy = (chlorophyll) = $C6H_{12}0_6$ + $6H_20$

The factors that effect the rate of reaction are temperature light and the concentration of carbon dioxide. The temperature is important because if it is too cold, the rate of photosynthesis will be limited because the enzymes will not work properly. Light is essential because it drives the rate of reaction and carbon dioxide must be present to produce the glucose and 0_2

Prediction:

I predict that the more intense the light, t he faster photosynthesis will take place because light is needed for the reaction and there will be more input energy. When the lamp is at its highest wattage it will be giving all the light (energy) that the pondweed will need to photosynthesise at its op timum speed.
I predict that the graph of results will look something like this.

Preliminary Investigation

Aim:

To investigate how much pondweed (elodea) we should use for our full photosynthesis investigation.

Procedure:

We will get different amounts of elodea then we will then count the amount of bubbles produced. This is to decide the appropriate amount of elodea to use.

- We got all the apparatus ready
- Different amounts of pondweed; 1g, 2g, 3g, 4g and 5g – placed in
- Then we put the Elodea under the light and
  Counted the bubbles for 6 minutes

Preliminary Results

Mass of pondweed	No. of bubbles
1g	62
2g	51
3g	42
4g	22
5g	14

Preliminary conclusion:

Our preliminary investigation showed us the lighter the pondweed the more bubbles there are.
We decided to keep the pondweed at 1 gram because it gave us lots of bubbles and we thought it would give us the best results, as to 5 grams, which gave out smaller amount of bubbles. This was probably because the pondweed at the bottom of the flask would block out the light energy and the funnel.

Plan:

We will measure the rate of photosynthesis by counting the number of bubbles the pondweed gives out in a certain amount of time.
To change the light intensity, we will use a different wattage bulb to see if it changes the rate of reaction.

Fair test:

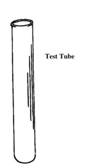
To make sure that this experiment was as accurate as possible we had to make sure that it was a fair test. We did this by keeping all the variables except the light intensity (wattage of lamp) the same. The temperature will be constant because I used the same cold tap water for each test and the $C0_2$ Is constant because the atmosphere is constant. I made sure I didn't breathe into the test tube. I want my results to be as accurate as possible so I am going to repeat each experiment three times and take an average each time I do the experiment. I will also measure and control the other limiting factors, which I hope to keep constant so I can prove they did not change and affect the experiment.

Therefore for a fair test and to obtain accurate results, I will -

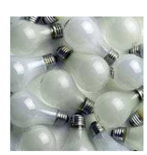
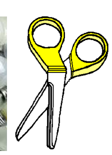
- Do each experiment three times and find an average of the results.
- Use the same tap water with the same amount of pondweed in each.
- Not breathe into the test tubes.
- Only change the wattage of the lightbulb.

Apparatus:

Pondweed (elodea) 1g in each
Test tube
Funnel
500ml beaker
Different wattage light bulbs – 20, 40, 60, 100
Scissors
Scales
Stop clock




Procedure:

To carry out the investigation, you have to:

- Get the apparatus ready
- Take the pondweed, out of the water, dry it out with a paper towel (to make sure no excess water interferes with the readings).
- Weigh it on an electric balance to 1gram; this mass g ives the best results. We counted the most bubbles.
- Cut some of the pondweed if needed to get to 1gram.
- Set up the apparatus as shown in the diagram above.
- Make sure the pondweed is placed at the bottom of the funnel and turn on the light.
- Wait for 3 minutes, to make sure you gather enough results.
- Than start counting the median size bubbles straight away for 6 minutes.
  Repeat the procedure 3 times to make sure you have no anomalous results.

Results:

These are the results of the full photosynthesis in vestigation.

Wattage	Light energy (joules)	Experiment 1 No. of bubbles after 6 minutes	Experiment 2 No. of bubbles after 6 minutes	Experiment 3 No. of bubbles after 6 minutes	No. of bubbles after 6 minutes (average)
No light	0	0	1	1	1
20w	72 00	3	8	5	5
40w	14 400	7	16	14	12
60w	21 600	49	44	50	48
100w	36 000	55	51	61	56

We didn't have an 80-watt light bulb so by plotting a graph we could extrapolate how much an 80-watt light bulb would affect the rate of reaction.

We also worked out how much light energy was being given out. We did this using the formula:
1 watt = 1 joule of energy per second
40 watts = 40 joules per second

To work out how much energy was spent it total, we times the number of watts by 60 to get one minute and then we multiplied it by 6 to work out the energy for 6 minutes.

100w x 60= 6000 = 1 min
x 6 = 36 000 joules (6 mins)

60w x 60 = 3 600 = 1 min
x 6 = 21 600 joules (6 mins)

40w x 60 = 2 400 = 1 min
x 6 = 14 400 joules (6 mins)
20w x 60 =1 200 = 1 min
X 6 =7 200 joules (6 mins)

This shows us the energy transferred from the bulb into the plant.

Conclusion:

The pattern of my graph is different to my prediction; it is not proportional because when it gets past 40 watts, the amount of bubbles goes up dramatically and then goes back to the same speed at 80 watts.
This tells me that between 40 watts and 60 watts is the optimum light intensity for the elodea, the chloro phyll is absorbing the maximum amount of light that it can which is no more than 60 watts.

Light affects the rate of photosynthesis because it is needed for plants to make glucose and oxygen.
Plants respire all the time but they photosynthesis during the day because light becomes available but if there is no natural light, artificial light can be used. The brighter and warmer it is, the faster photosynthesis occurs because the light is like a catalyst, assuming there is enough carbon dioxide because those are the three variables.

Plants, unlike animals, do not get food by eating other organisms. They make their own food, usually in the form of glucose, from the inorganic compounds carbon dioxide and water. Carbon dioxide is taken in through the leaves, and water is taken in mainly through the roots. Sunlight acts as the energy needed to run the reaction that yields glucose as the product the plant needs and oxygen as a waste product that is released into the environment.

In green plants and algae, the pigme nt molecules that initially absorb the light energy are chlorophyll, with accessory pigments such as carotenoids, phycobilin, or phycoerythrin. Some halobacteria use other primary photosynthetic pigments than chlorophyll, notably bacteriorhodopsin. It may be noted that the typical colors of photosynthetic organisms (green, brown, golden, or red) result from the light that is *not* absorbed by the pigment molecules, but instead is reflected before meeting the eye.

The typical overall chemical reaction of pho tosynthesis is:

$$6H_2O + 6CO_2 + light \rightarrow C_6H_{12}O_6 \text{ (glucose)} + 6O_2$$

This is carbon dioxide plus water plus light (energy) yields oxygen plus sugar. In animals, this is exactly reversed in the process of respiration (which plants also use, to release the energy stored in photosynthesis): oxygen plus sugar yields carbon dioxide plus water plus energy. However, it is important to note that this chemical equation is highly simplified; in reality photosynthesis employs a very complex mechanism for the adsorbption and conversion of light into chemical energy, using chemical pathways with many important intermediates. Photosynthesis has two distinct stages, called the light reaction and carbon fixation.

Evaluation:

Although I am happy with my experiment I know that it was not as accurate as it could have been. This is because when we were counting the bubbles we were relying on them all being the same size, which they were not.

My graph came out slightly different to what I had expected, the points were a lot steeper than I had first anticipated but they look slightly similar.

The graphs do not show any anomalous results, but our results table does show an odd result on one occasion when we counted the number of bubbles using a 40watts bulb. On the first attempt we counted 7 bubbles but the other two had 14 and 16 bubbles. This could have been due to lack of attention on counting the bubbles.

To improve the accuracy of counting the bubbles, we could have used a better container other than the beaker such as using test tubes to see more accurately. Measuring the light intensity could have been more accurate if we measured the distance between the light and beaker with more precision. Also breathing into the test tubes would have affected the experiment as you are letting out carbon dioxide. If we rep eated the coursework then we would make sure to either not breathe by the pondweed or to wear masks. Also I could use a thermometer to check that the temperature of the water in each beaker is the same.

At 80w we expect the results to be half way between 6 0w at 100w as that would be the likeliest thing to occur.

Making sure there were no other factors affecting the rate of photosynthesis is very difficult, but if we were to make sure carbon dioxide was not interfering with the experiment, it would be a lot more accurate.

To confirm that my conclusion is correct, I could repeat the experiment one more time to see if the results were similar. To continue the experiment I could use the other factors that affect the rate of photosynthesis instead of intensity of light.

I would find a way to set up the experiment so I would keep the same light intensity (I would use a 40w bulb) and alter the temperature, by using water at different temperatures with the same amount of elodea.

References:

I've used various source s to collect my information, such as:

- Mary James, The Essentials of Edexcel, Science: Single & Double Award B, Volume 1 Modules 7-12, Lonsdale revision guides
- http://www.bbc.co.uk/schools/gcsebitesize
- www.Google.com