Experiment to find out whether or not the intensity of light affects the rate of photosynthesis

Photosynthesis

What is photosynthesis?
Photosynthesis is the process that plants use to produce food.
What does a plant need to perform the process of photosynthesis?
A plant will need: **Light**, as the energy source that can make photosynthesis happen,
Carbon Dioxide, and
Water.
Also the plant will need suitable conditions, for example, the optimum temperature and pH value of the soil.
The plant will also need Chlorophyll (a green pigment), but the plant creates this itself and the substance is already present in the plants' chloroplasts.
What does the process of photosynthesis make?
Photosynthesis makes 2 substances: **Glucose** and **Oxygen**. **Glucose** is used by the plant to make the basis of many other molecules. **Oxygen** is considered a waste product of the plant, however, plants need oxygen to respire, so, during the night, when there is not an adequate amount of light to photosynthesise reasonably, the plant will be respiring using the oxygen to create food and energy.
Where does the process of photosynthesis take place?
Photosynthesis takes place in the chloroplasts of the plant, which are mainly in the palisade cells of the leaves.
What happens to the products of photosynthesis?
Some of the **Oxygen** is used in the plants respiration,

however, most is released by the leaves through stomata.

Water + Carbon Dioxide $\Longrightarrow$ Glucose + Oxygen

$6H_2O + 6CO_2$ ====> $C_6H_{12}O_6$ +$6O_2$

(====> Stands for 'light energy')

Some of the **Glucose** is immediately used to yield energy. Some is converted to starch as a store of energy and materials, for growth, survival over winter, etc..
Some is converted to fats, as an energy store and to build cell membranes.
Some is combined with nitrates to produce protein for growth, enzymes etc..
Some is converted to cellulose to build cell walls.

What factors might influence the rate of photosynthesis?

- The content of water in the soil, as water is needed for photosynthesis,
- The intensity of the light, as light is needed as the energy source for photosynthesis,
- The Carbon Dioxide content in the air, as Carbon Dioxide is needed for photosynthesis,
- The Oxygen content in the air, as oxygen is needed for the plant to respire which would keep the plant alive,
- The colour of the light, as the plants which we used are green, which means that they either reflect or emit green light and cannot use green light in photosynthesis.

<u>What am I investigating?</u>

I am investigating to find out whether or not the intensity of light affects the rate of photosynthesis. I predict that, the more intense the light, the more the plant will photosynthesise, i.e. I predict that, if you double the intensity of light, then the rate at which the plant photosynthesises at will double, and if you half the intensity of the light, than the rate that the plant photosynthesises at will half as well. However the plant will only photosynthesise if it has enough water and Carbon Dioxide as well as the light (the energy source). I think that this will happen because the plant needs the light and the CO_2 and H_2O to photosynthesise and if the quantities of these are increased then the plants rate of photosynthesis should increase.

Method

I am going to conduct an experiment in which I will put pond weed in the bottom of a glass beaker and shine a light onto it. I will count how many bubbles of Oxygen the plant produces in a set time. I will move the plant further away from the lamp in 10cm stages and see how that effects the rate at which the Oxygen is produced.
To perform the experiment I will need: a lamp, to shine onto the plant, a stop-watch, to count how much time has passed, a metre ruler, to measure the distance from the lamp to the plant, a plant, in this experiment I am using a pond weed called *Cabumba,* and a beaker, for the plant to sit in.
Instructions
1. **Fill the beaker with water,** for the Cabumba to go in,
2. **Weight some Cabumba with a paperclip and place it in the beaker,** so that the Cabumba doesn't float on the surface of the water which would make counting bubbles difficult,
3. **Place the lamp 10cm from the beaker,**
4. **Start the stop-watch and count how many bubbles of oxygen are produced in 1 minute,**
5. **Move the beaker 10cm further away from the lamp and repeat the experiment,** repeat the experiment in order to

make certain that there are no anomalous results,

6. Repeat steps 4 and 5 until you are satisfied with the amount of results that you have,

7. Repeat the whole experiment again from step 1.

The experiment would not be fair because there is other light in the room which could affect the rate at which photosynthesis occurs, such as the fluorescent striplights on the ceiling and the light coming in through the windows. I think that I could have made the experiment fairer by blacking out the room completely and making sure that the only light in the room was the lamp which I was using.
The independent variable in this experiment is the intensity of (or distance from) the light. The dependent variable is the amount of bubbles of Oxygen which the plant produced. The controlled variables are the things that we can change but haven't such as the temperature of the water and the pH value of the water, these may affect the rate of photosynthesis.
I plan to take a sufficient range and number of results, in order to make sure there are no anomalous results.

I performed a preliminary experiment where, instead of counting how many bubbles the Cabumba produced, I collected the Oxygen that the plant produced in a test-tube underwater, and tried to measure it and I found out that, without specialised equipment, this was virtually impossible to do, therefore, I have no results for the preliminary experiment.
I think that this preliminary experiment could have worked better if I'd had a device for measuring the amount of Oxygen released.

Over the page is my table of results for the experiment, and underneath it there is a graph to show the results. I took an average of results from 3 repetitions of the experiment.

Distance from lamp	Number of bubbles
20cm	175
40cm	101
60cm	87
80cm	78
100cm	68

The second time I repeated the experiment, I had anomalous results which didn't make sense, I have found out that I was moving the pond weed away from the lamp, but nearer to the window which was letting in the daylight and therefore, my lamp had no effect upon the plant as it was getting sufficient energy from the sun.

There were no real safety aspects to this experiment, apart from the fact that there was mains electricity and water in close vicinity of each other, but we kept these two dangers separated throughout the experiment. We recorded the observations in a systematic way, (i.e. 20cm, 40cm, 60cm, etc..) We took enough results to identify the trend between the distance from the lamp and the number of bubbles - The further away the lamp was from the Cabumba, the less bubbles the Cabumba produced, however, the number of bubbles was not proportional to the distance from the lamp.

My results show that as you move the plant further away from the lamp, the number of bubbles of Oxygen produced in each minute decreases, this agrees with my prediction. You can see this on the graph which I have drawn, and also on my table of results on page 5. I predicted that, the number of bubbles in each minute would decrease as you moved the pond weed further away from the lamp - I was right, but I said that the results would be proportional, in that if you doubled the distance between the beaker and the lamp, then the number of bubbles produced by the Cabumba would half, as you can see from the graph and table, this was not the case and the results were not proportional.

To make sure that my results were fair, I made sure that the distance between the lamp and the beaker of water was exactly 20cm more than the previous measurement. My results in the second run of the experiment could not have been accurate and reliable because the apparatus were set up next to a window, as I explained on page 5. I realised this and repeated the experiment in a blacked out room. To support my results, I investigated the intensity of the light (measured in Lux) at the different measurements to see if it was proportional to my results, over the page is my results table and graph.

Distance	Light	Number of Bubbles
20cm	2500 Lux	175
40cm	600 Lux	101
60cm	280 Lux	87
80cm	140 Lux	78
100cm	115 Lux	68

As you can see from the graph, the light intensity reduces as the light is moved further away from the Cabumba, and so does the number of bubbles per minute. To investigate this further, it would be possible to collect the amount of oxygen in a container as the plant produced it and measure it with some sort of device.

Overall though, I have found out that, the further away Cabumba is from a light source, the less it produces oxygen. This is because it needs the light as an energy source for the process of photosynthesis (see top of page 2), however the number of bubbles will only increase as long as there is enough Carbon Dioxide and water available to the Cabumba, and the Cabumba is not dead.