

**GCSE Biology Coursework**  
**Photosynthesis and limiting factors**  
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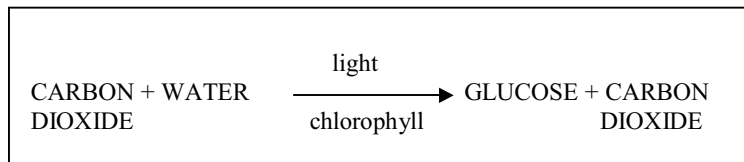
Plan for the experiment, which will evaluate how the rate of photosynthesis in a water plant is affected when the intensity of a light source is varied.

**Aim:**

To investigate how light intensity affects the rate of photosynthesis.

**Background Information:**

Plants need carbon dioxide, water, light and chlorophyll in order to make food; and starch and oxygen are produced, if one of these is missing then starch cannot be produced. Photosynthesis occurs rapidly or slowly, depending on the circumstances and this will determine, how much food is made in a certain period of time. Carbon dioxide and water are the raw materials of photosynthesis and they react to produce starch and oxygen, which are the products. These reactions need energy, which comes from the light and it is the chlorophyll, which enables the plant to use light energy for this process. Glucose is then formed and later turned in to starch.



In order to make a prediction for my experiment I will have to research photosynthesis and its limiting factors. A limiting factor is something that will either slow a process down or if the amount of it is increased the rate of the process will speed up. There are five limiting factors for the rate of photosynthesis, which are: light, carbon dioxide, water, temperature and chlorophyll.

Experiments show that the more carbon dioxide there is in the air the faster the plant photosynthesises. Raising the temperature up to 40 degrees will increase the rate of photosynthesis. However, temperatures beyond this can destroy the enzymes that are needed for the chemical reactions. I will be controlling all of the following variables: levels of oxygen, levels of water and the temperature. I will be investigating light as my uncontrolled variable.

The rate of photosynthesis can be measured in two ways:

- 1) The rate of production of products (eg glucose, starch, oxygen)
- 2) The rate of disappearance of the reactants (eg carbon dioxide, water).

In order for my investigation to be fair I have decided to repeat the experiment three times, and then take an average. This will enable me to get more reliable and varied results. It is also important for me to take correct measurements for my experiment and this, will be achieved by me closely following my method.

### Prediction:

We are able to find out the effect of light on photosynthesis by using a water plant that produces bubbles when a source of light is shone upon it. I think that the brightness of the light will affect the speed of photosynthesis and as a result more bubbles will be produced. I think that the closer the lamp is to the plant, the faster the rate of photosynthesis. This will be because the light coming from the lamp will be more intense which will mean that more bubbles will be given off.

### Equipment list:

- pond weed
- beaker
- paperclip
- metre rule
- lamp
- water
- stopwatch
- straw

### Diagram:



### Method:

- 1) Darken the room and black out the windows
- 2) Set up your equipment by filling the beaker with water and placing the pond weed in the beaker with a paperclip attached to the bottom (this will weigh the plant down).
- 3) Cut the top of the plant off to allow oxygen bubbles to escape.
- 4) Carbonate the water by blowing into the beaker with a straw (this will ensure that there is a good supply of carbon dioxide for the pond weed).
- 5) Place a metre rule on the table to one side of the beaker. Position the beaker at a certain distance away from the lamp and it is this distance that is the variable, which we are measuring.
- 6) Time a minute on the stopwatch and count how many bubbles appear during this time.
- 7) Repeat this three times and then take an average.
- 8) Move the lamp 20cm closer and repeat the experiment.
- 9) Record your results

Throughout the experiment I will be changing the distance of the lamp from the pond weed which will allow me to assess how the light intensity affects the rate of photosynthesis. I will have to ensure that this experiment proves to be a fair test, so we can produce the most accurate results. In order to do this I will have to keep certain things such as: the size of the pond weed, the distances of the lamp from the beaker and the time spent recording and the amount of carbon dioxide which is blown through the straw into the water constant

I have decided to start my experiment with the lamp being placed 100cm away from the beaker with the pond weed. I will then move the lamp 20cm closer and time how many bubbles come off the water plant by using the stop watch. I think that this range of measurements will be sufficient for me to obtain the necessary evidence.

### Risk Assessment:

- 1) Make sure that the surface area you are working on is completely clear to avoid accidents.
- 2) Be careful not to spill any of the water on your surface area.
- 3) Make sure that the water does not make contact with the lamp or electrical socket.

### Results Table:

0	24	32	29	28
20	11	19	18	16
40	8	5	13	9
60	4	8	3	5
80	2	1	1	1
100	0	1	0	0

See graph for results

### Conclusion:

My results clearly show that light intensity increases the rate of photosynthesis and that the closer the lamp to the beaker, the quicker the rate of photosynthesis. The results shown in the table above, all demonstrate this, and proves that my prediction was correct. I believe that my results were accurate and the repetition of all of the stages of my experiment meant that I was able to record reliable evidence.

The graph also helps to determine that there is a steady and constant raise in the number of bubbles given off each minute at each separate distance. This gradual raise in my findings also tell me that only the variable (the light

intensity) changed during the experiment, whereas the carbon dioxide levels, water levels and the size of the pond weed remained equal throughout the experiment which allowed this investigation to be a fair test.

### Evaluation:

I feel that this investigation went successfully and I was able to obtain clear and relevant information that proves that light intensity speeds up the rate of photosynthesis, provided that all other limiting factors are kept constant. My measurements were as reliable as I could have made them and the range of numbers that I used between 0 - 100 cm proved suitable for this investigation.

There are other experiments, which we can do to investigate further the rate of photosynthesis. These include the levels of carbon dioxide, the amount of water and the temperature as each of these can effect the rate and will prevent photosynthesis happening if it is removed. I could also vary the angle of the head of the lamp when shining upon the water plant or the size of the lamp.

However there are some improvements that I could make if I was to repeat this experiment again, which would allow me to support my conclusions further. If I was, to do this for a second time I would extend the range of numbers that I used and try to establish the point at which photosynthesis stops. I could also place another beaker full of water between the lamp and water plant, which would prevent the pond weed heating up and would act as a heat shield. In order to make this investigation even more accurate you could also have two people recording the time and counting the number of bubbles so that no mistakes will occur.

In conclusion I feel that this experiment has successfully proved my initial thoughts and predictions and has enabled me to gain a wider understanding of the properties of photosynthesis and the affect that the light intensity has upon the rate of photosynthesis. This investigation has also given me ideas for other experiments, which could prove alternative aspects of photosynthesis.