Factors Affecting the Rate of Photosynthesis.

Introduction:

Green plants photosynthesise when it is light. During photosynthesis, a green pigment called chlorophyll absorbs light energy. The energy collected is used by the plant to convert carbon dioxide and water into glucose, and oxygen is given off as a biproduct.

Carbon dioxide + water + light energy $\rightarrow$ glucose + oxygen

Variables:

Variable	Type	Experiment conditions
Light intensity	Independent	This will be changed throughout the experiment.
Carbon dioxide	Controlled	The amount of carbon dioxide in the water containing the plant will be saturated using sodium hydrocarbonate solution.
Temperature	Controlled	The experiment will be done at room temperature, which is close to optimum for photosynthesis. This will not fluctuate extensively throughout the experiment time period.
Water	Controlled	The plant piece used will be In water throughout the experiment time period.
Plant piece	Controlled	The plant piece used will be the same piece throughout and a healthy piece will be chosen.

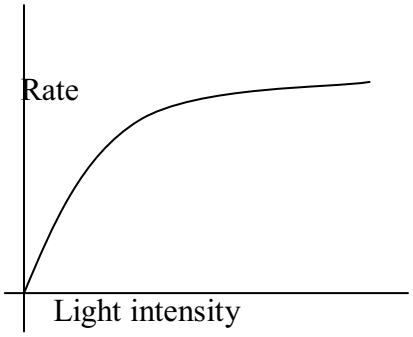
Preliminary Work:

A program called **PSYNTH** was used to give some indication of the results of altering the light intensity. Light intensity was chosen as the factor to investigate, as it is easiest to carry out within the class room and time period set.
The program generated these results with a carbon dioxide concentration of 0.1and at a temp of 25 degrees centigrade (optimum for photosynthesis):

Light Intensity (alv)	Rate (au)
0.0	0.0
5.0	8.1
10.0	15.5
15.0	20.3

20.0	24.0
25.0	26.7
30.0	28.7

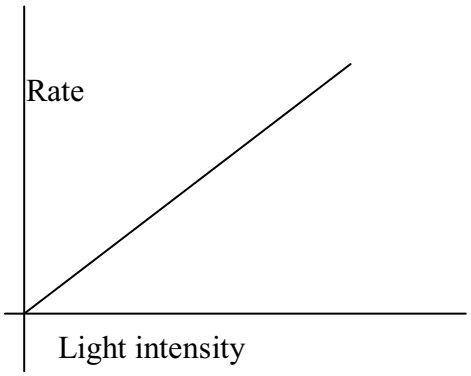
The graph produced looked like this:



From these results, the necessary information can be drawn to make an appropriate prediction.

Prediction:

In photosynthesis the light energy absorbed is used to split the water molecules, absorbed from the ground, into hydrogen and oxygen. The oxygen escapes from the leaf and the hydrogen is added to the carbon dioxide, which has been absorbed through the stomata. Therefor if the light intensity is increased the amount of light energy absorbed by the plant is increased. This means that there is more light energy to split water molecules therefor more water molecules can be split thus increasing the amount of oxygen given off. If the light intensity is doubled then the plant can absorb double the light energy thus doubling the energy for splitting water molecules. This means that doubling the light intensity will double the amount of oxygen given off due to double the amount of split molecules.
Therefor we would expect a graph of this to look like,



This is a straight line through the origin showing that rate and light intensity are proportional. In reality this would continue until a point where another of the mentioned limiting factors, water, carbon dioxide or temperature became limiting as in the preliminary work where carbon dioxide became limiting. As the solution will be saturated with sodium hydrocarbonate the

limitation of the reaction will not occur due to carbon dioxide or any of the above mentioned factors as explained in the variables table.

Apparatus:

Photoelectric cell
Lamp
Beaker
Stop watch
Water
Piece of Elodea
Metre rule
Goggles
Paper clip

Method:

To begin with some water will be put into a beaker and some sodium hydrocarbonate added to saturate the solution with carbon dioxide. A piece of Elodea (a piece that produces suitable rate of bubbling for measurement) will be attached to a paper clip and put in the water so that the shoot is held completely underwater, as shown below.

A lamp will be placed as close to the jar as possible and left for one minute then, for the second minute the number of bubbles produced by the Elodea will be counted and recorded. The lamp will then be moved 5cm further away and the same process repeated. This will be done a further 5 times making a total of seven measurements. This will then be repeated twice to give three measurements for each distance of the lamp. This will help provide an average Afterwards the elodea and the jar will be replaced by a P.E. cell and the same seven measurements taken again except that the voltage out put of the P.E. cell will be recorded instead. This will provide a.l. values to replace the distances of the lamp in the results table.