Aim

My aim is to investigate the effect of changing light intensity on the rate of photosynthesis.

Introduction

This is an investigation into how the amount of light provided to a plant can affect the rate of photosynthesis in a plant when it has a constant supply of reactants.

The reactants in this experiment are H_2O(water), CO_2(carbon dioxide) and light. The products are glucose and oxygen.

The glucose is stored in the plant as starch and also used for respiration and growth of the plant. The oxygen is given off into the surroundings, this is what we will be measuring.

The word equation for this process is:

$$6CO_2 + 6H_2O \xrightarrow{\text{sunlight}} C_6H_{12}O_6 + 6O_2$$

There are several factors that affect the rate of photosynthesis-

Temperature- the warmer the surroundings the higher the rate of photosynthesis. This is because this is an enzyme based process. This will happen only if the plant is given an adequate supply of water and carbon dioxide.

But if the temperature becomes to high the structure of the cells unravels and they become denatured.

Carbon Dioxide Concentration-The higher the concentration of carbon dioxide the higher the rate of photosynthesis. There is an upper limit but too much carbon dioxide will have no damaging effects on the plant itself.

Water- The amount of water must not be too high because this can cause the plant to become waterlogged. This stops active transport and the plant cannot get oxygen from the soil.In my investigation this will not affect my results as Elodea is a water based plant.

We can put the results of this investigation into practise by using them in ,for example a commercial greenhouse. If we know the optimum amount of light needed for plants to photosynthesise ,they will grow at the fastest rate possible whilst not damaging the plant.

The factor my investigation is based on is light intensity.

Prediction

I predict that as the light intensity increases the rate of photosynthesis will increase up to a limit. This is because plants need a certain amount of light to photosynthesise and enzymes work best at higher temperatures but too much light can photo-oxidise the photosynthesis cells.

Planning

In my experiment I will be measuring the effect of moving a lamp closet to a 13cm piece of Elodea, hence increasing the light intensity, and the rate of photosynthesis. I will the measure the rate of oxygen evolved to indicate the rate of photosynthesis. The first thing I will do is to close the blinds in the laboratory, so that the only light the plant receives comes from the lamp, meaning that I can be certain that I am controlling the light intensity. I will then fill two beakers with water, one will be placed in front of the other to act as a heat shield. This will prevent the water containing the Elodea from becoming warmer, which would affect the rate of photosynthesis. By putting the heat shield in place, I can be certain that the rate of photosynthesis is only being affected only the light intensity, rather than the temperature. I will put a spatula of sodium bicarbonate in the other beaker to make sure there is enough carbon dioxide in the solution for the Elodea to photosynthesise (sodium bicarbonate forms carbon dioxide when dissolved in water). I will then place the Elodea in the beaker and cover in with a funnel. This funnel will be attached to a delivery tube attached to sealed syringe. The oxygen released from the elodea will be channelled through to the syringe and will force the syringe level up showing us the amount of oxygen released. In my experiment I will at first place the lamp one metre away from the beaker acting as a heat shield and time how long it takes for 5 cm.3 of oxygen to be produced. I will repeat the process at 25 cm intervals, each time moving the lamp closer to the elodea. Once I have recorded the oxygen evolved at 0 cm distance from the heat shield, I will empty out the beaker containing the elodea and refill it with water and a spatula of sodium bicarbonate and put in a new piece of elodea of the same length as before and repeat the experiment two more times.

Results

Experiment number123Mean1003223143273213.12x10-03752362422352384.21x10-03501651591511586.33x10-03256974717114.08x10-002229342835.71 x10-03All times have been rounded to the nearest second.

Analysis

I can see from the graph that as the lamp is moved close to the elodea, the rate of photosynthesis increases. This is because as the lamp moves closes to the elodea, the light intensity increases and so the chloroplast cells in the plant can absorb more energy, giving enough power for a faster reaction. From this I can conclude that my prediction that as the lamp was moved closer to the elodea, the rate of photosynthesis would increase was correct. The reason that the rate of photosynthesis rises when the light is moved closer to the elodea is that the higher light intensity allows for a faster reaction between carbon dioxide and water in the plant.

The line on the graph begins to level off at the end. From this I can conclude that eventually the line would become completely horizontal. This is because even if the plant has enough light to increase its rate of photosynthesis, it will be limited by other factors such as heat and carbon dioxide levels. This is as I predicted.

Evaluation

The procedure that I used was correct. I know this because the variable I controlled (distance of lamp from elodea) and the variable I measured (time taken to evolve 5cm3 of oxygen) was related to my objective, which was to investigate how changing light intensity affects rate of photosynthesis. The results that I collected are also correct because they enabled me to prove that my prediction was correct.

I believe Also although I tried to keep the temperature constant, there may have been small fluctuations due to the number of people in the laboratory. Another flaw was that it was difficult to keep the precise time at which the oxygen level reached 5cm3 because we carried the investigation out in the dark. A further problem is that by decreasing the distance of the lamp from the Elodea, I cannot be certain that the light intensity is being increased proportionately so patterns shown on my graph may be slightly distorted.

To improve my investigation I could have used a light meter to measure light intensity, which would have given me more accurate readings. I also could have weighed the amount of sodium bicarbonate to keep it more constant. Another improvement would have been to have coat the beaker containing the elodea with black card paper all round except the front to negate the effect of other light sources. I also could have performed the investigation at another time when no one else was performing it in the

laboratory. that the results that I acquired were reasonably fair because I used several strategies to ensure that they were unbiased. I lowered the blinds to ensure that my light source (lamp) was the main light source that the elodea received. I also put another beaker in front of the beaker containing the elodea to act as a heat shield, preventing it from warming up which could affect the rate of photosynthesis. I also changed the water after each full cycle, and pout in a new spatula of sodium bicarbonate. This is to prevent build up of chemicals in the water, and to keep the levels of carbon dioxide roughly the same in each cycle. I repeated the cycle three times to negate the effect of anomalous results.
However, there were several flaws in my investigation. There were other light sources in the room as there was other people were performing this investigation as well. Although the effect of this light would be small, compared to that of my lamp, it may have had some effect on my results.

Distance of lamp
100
75
50
25
0

Time taken for 10cm3 of o2 be formed s
658 (100cm), 445(75cm), 314 (50cm), 138 (25cm), 71(0cm)

Time taken for 10cm3 of o2 be formed (s)
658 (100cm), 445(75cm), 314 (50cm), 138 (25cm), 71(0cm)
645, 429, 289, 145, 63
653, 458, 294, 152, 76
652, 444, 299,145,70 (average)
Rate of reaction (s-1) 1.53, 2.25, 3.34, 6.9, 14.29. (10*-3)