Science Coursework

Aim:

My aim is to carry out an experimental investigation that will observe how different heights of light increases or decreases the amount of starch produced in a leaf.

Hypothesis:

I predict that the further away the light is under a leaf the more amount of starch produced to increase. I believe this because the more light the leaf is enabled to the less amount of photosynthesis will take place, I believe this because the light energy will increase causing friction, and this friction will then turn into heat which will destroy any enzymes in the leaf which will slow down the starch production made in the leaf. Before starch the food substance is called glucose which will turn into starch and will be stored in the roots, stems and leaves, loathing the storage system. I also predict that the longer the light shines on the leaf the less starch will be produced because the temperature of the light will begin to transfer into heat and begin to kill the enzymes in the leaf , this will cause the production of starch to fall dramatically.

Dependent Variable:

The amount of starch produced is a dependent variable because it will vary to show that my hypothesis is correct. The amount of starch produced in a leaf because the starch varies due to the light intensity. This will indicate if there is any glucose in the leaf. The amount of starch produced within the leaf will tell me how much glucose is in the leaf is produced in different light intensities.

Independent Variable:

The light intensity is a dependent variable because the light intensity will be shone at different heights. This will help me to understand if the light shone at different heights will produce less starch or more starch. I strongly agree that this will prove my hypothesis

Controlled Variable:

Surface Area of leaf is a controlled variable because the leaf at this precise moment cannot grow in surface area because it is dead therefore it is controlled.
The **room temperature** is a controlled variable because I can control the amount of temperature the plant gets because 24hrs before the experiment the leaf was kept under light for 24hrs and the room in which the experiment was held was not open until around 24hrs.

Preliminary Work

In my preliminary experiment I conducted the same experiment. I had the choice of alternating my experiment, but instead I decided to keep everything the same, this way any mistakes that occurred will be corrected to make my real investigation more

accurate in terms of results and equipment used. In my preliminary I noticed that the colour of leaf took longer to change when I put iodine on it. It came to my conclusion that the amount of iodine I put on the leaf was very small. On the specific day of my preliminary the room temperature was above average, this caused most of the enzymes to die; this made the slowed down the production of starch and caused my results to be anomalous. All these mistakes were corrected and altered in my real investigation.

Equipment List

3 Plants – this is the base of my experimental .The need to repeat my readings are crucial to ensure that I do not have any anomalous results; this will also help me to find an average result and make my results more professional.
Kettle – I will boil the kettle to an appropriate temperature which will kill any productions in the leaf.
3 Beakers – The beakers act as container and the beaker also helps me to measure the amount of water.
9 Test tubes – This will measure the amount of different substances on an accurate scale.
Ethanol – This will remove chlorophyll from the leaf and destroy the waxy layer (cuticle) on the leaf's surface.
Petri dish – This will provide the surface area for the reaction to take place. I t also acts as a store to keep the leaf on.
Cold water
Iodine –This will react with starch to indicate the colour change in the leaf. The iodine will indicate whether there is starch present in the leaf.
Water – The water will be provided from the tap, this water will be boiled in the kettle. This hot water will also be used to sterilise all the apparatus after.
Stands -
3 Lights – to ensure that the lamps don't become over used because this could lead to heat.
Clamp – The clamp will hold the lamp, this will make sure that the light is shone evenly on the leaf.
Forceps – This instrument will be used to pick up and move the leaf from A to B.
Safety Glasses – This protect my eye from any corrosive substances I may come across while doing my experiment.

Plan:

Before I started my experiment all leafs were left untouched.

Step 1: Set up all apparatus needed. Previously the plant was left in a normal room temperature for 24 hours.

Step 2: Boil the water for the appropriate time. Pour 20 cm of water in a beaker, after this remove four leafs at random from a plant (preferably the greenest) then use forceps to hold the leaf and transfer it into the beaker containing 20 cm of hot water..

Step 3: Add approximately 5 cm of ethanol in each test tube and place each of the leaves in it. The ethanol will destroy the chlorophyll on the surface area of the leaf.

Step 4: Place each of the test tubes in a beaker filled with boiled water for 2 minutes

Step 5: After the 2 minutes remove each of the plants from the ethanol and thoroughly cleanse the leaf with cold water and forceps. This will prevent the leaf reacting with iodine that is going to be added.

Step 6: Spread each on a Petri dish and add the required amount of iodine needed to change the colour of the leaf.

My range of readings will be ranged from 10-30cm.

Background Theory

We can write the overall reaction of this process as:

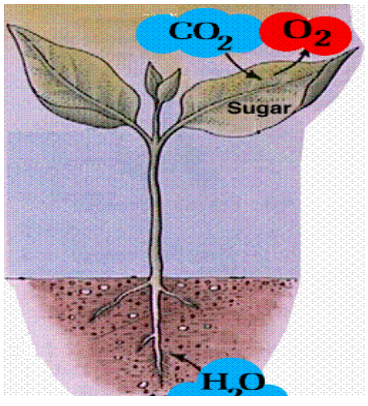
$$6H_2O + 6CO_2 \text{ ----------> } C_6H_{12}O_6 + 6O_2$$

Photosynthesis:

Photosynthesis is the process which produces food for plants. This food is stored in the plant as glucose; this food is then converted into starch. Before this process happens plants need certain criteria for them to produce starch. The most important criteria are light energy from the sun. Chlorophyll is a green photosynthetic pigment found in plants.The chlorophyll absorbs the light energy from the sunlight combining with carbon dioxide and water to produce glucose.The glucose can them be used for various activies to help sustain the plant.The main prurpose is to use the glucose and convert it into starch which can then be used for food purposes.

The things that affect the rate of:
1.The amount of sunlight
2.The amount of carbon dioxide
3.The temperature
4.Texture and condtionof soil
5.The amount if water

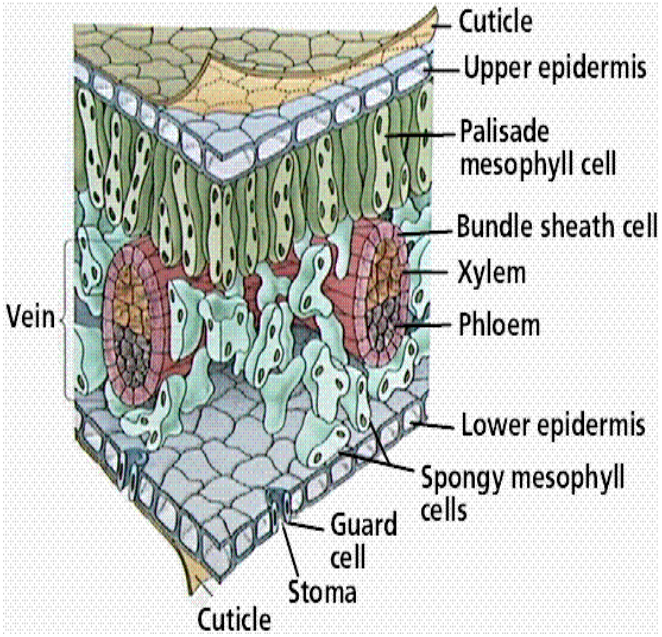
Light is electromagnetic radiation with a wavelength if the intensity increases then the light will relasease more photons.



Leaves and Leaf Structure

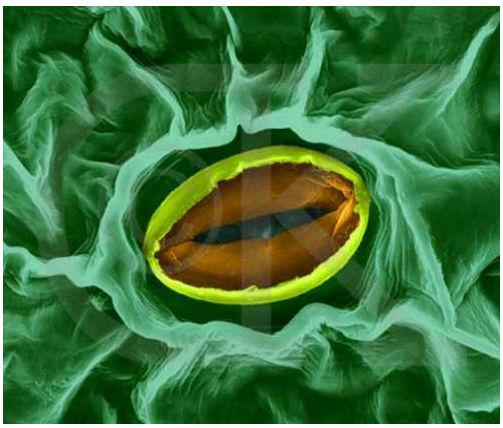
Plants are the only photosynthetic organisms to have leaves (and not all plants have leaves). A leaf may be viewed as a solar collector crammed full of photosynthetic cells.

The raw materials of photosynthesis, water and carbon dioxide, enter the cells of the leaf, and the products of photosynthesis, sugar and oxygen, leave the leaf.



Water enters the root and is transported up to the leaves through specialized plant cells known as xylem . Land plants must guard against drying out and so have evolved specialized structures known as stomata to allow gas to enter and leave the leaf. Carbon dioxide cannot pass through the protective waxy layer covering the leaf (cuticle), but it can enter the leaf through an opening (the stoma; flanked by two guard cells. Likewise, oxygen produced during photosynthesis can only pass out of the leaf through the opened stomata. Unfortunately for the plant, while these gases are moving between the inside and outside of the leaf, a great deal water is also lost. Cottonwood trees, for example, will lose 100 gallons of water per hour during hot desert days.

The loss of water from the stomata will cause the prduction of starch to reducethis is because the water needed for photosynthesis to occur is being lost.



Light Reactions

There are 2 light reactions:

In the Light Dependent Processes (Light Reactions) light strikes chlorophyll a in such a way as to excite electrons to a higher energy state. In a series of reactions the energy

is converted (along an electron transport process) into ATP and NADPH. Water is split in the process, releasing oxygen as a by-product of the reaction. The ATP and NADPH are used to make C-C bonds in the Light Independent Process (Dark Reactions).

In the Light Independent Process, carbon dioxide from the atmosphere (or water for aquatic/marine organisms) is captured and modified by the addition of Hydrogen to form carbohydrates (general formula of carbohydrates is $[CH_2O]_n$). The incorporation of carbon dioxide into organic compounds is known as carbon fixation. The energy for this comes from the first phase of the photosynthetic process.

What is starch?

Starch is a carbohydrate which is insoluble in water; it is used by plants as a way to store excess glucose.

Test for starch:

Starch solution is used to test for elemental iodine. A blue/black color indicates the presence of iodine in starch solution. The details of this reaction are not yet fully known, but it is thought that the iodine fits inside the coils of amylose.[2] A 0.3% w/w solution is the standard concentration for a dilute starch indicator solution. It is made by adding 4 grams of soluble starch to 1 litre of heated water; the solution is cooled before use (starch-iodine complex becomes unstable at temperatures above 35°C). This complex is often used in redox titrations: in presence of an oxidizing agent the solution turns blue, in presence of reducing agent blue color disappears because I_5^- ions break up into iodine and iodide.

Under the microscope, starch grains show a distinctive Maltese cross effect (also known as 'extinction cross' and birefringence) under polarized light.

How do the factors affect starch?

The **concentration of C02** affects the amount of starch produced in the leaf because only 0.03% of the atmosphere contains C02, if there's not enough C02 then the plant can't photosynthesize therefore cannot make starch.

The **temperature** affects the enzymes that control the chemical reactions of photosynthesis, if the temperature is too high it will kill the enzymes vice versa. The temperature of the room was 22 c.
The **light** affects the amount of starch produced because the chlorophyll uses light energy to perform photosynthesis. Nutrients in the leaf such as potassium are important because it helps enzymes in photosynthesis. Magnesium affects the amount of starched produced because **Magnesium** makes chlorophyll because without chlorophyll photosynthesis wouldn't happen, minerals such as phosphates and Nitrates also affect the amount of starch produced.
Using a reasonable amount of **iodine** to react with the starch will cause the leaf to indicate the colour change and show how much starch is present. If I use less than needed than the colour might not change when it's supposed to, this would lead me to

obtaining inaccurate results. The amount of ethanol used will play a major impact, if ethanol removes chlorophyll from a leaf, a smaller amount of ethanol might not be able to eliminate any chlorophyll present in the leaf. This will make my results anomalous and would make my whole investigation wrong. The amount o time the leaf is killed by boiling water. The boiling water is intended to stop any chemical reactions taking place.

Obtaining Evidence:

1

Measurement (cm)	Colour (Ph Scale)
10	Black
20	light purple
30	Green

2

Measurement (cm)	Colour (Ph Scale)
10	Black
20	Black/Green
30	Green

3

Measurement (cm)	Colour (Ph Scale)
10	Black
20	Black/Green
30	Dark Green

Average

Measurement (cm)	Colour (Ph Scale)
10	Black
20	Black/Green
30	Green

Analysis

At the measurement of 10 cm the colour of the ph was black for all of my 3 reading. I believe it was black because no starch was produced. The light caused the energy to change into heat which killed the enzymes. The light is so close to the leaf that 100% of the lights energy will travel directly to the leaf. When the light is absorbed the chlorophyll will not be able to synthesise water and carbon dioxide because the cells will not be able to coup with the heat causing them to be damaged.

At the measurement of 20 cm the colour of the ph was black/green for readings 2and 3 because the height of the lamp had been increased causing some of the light energy to slow down because the distance the light had to travel is longer causing particles in the air to collide with the light making the light slow down in speed. For readings 1 the measurement was 20 seconds this result varied from all the other readings under the same measurement. I believe this happened because the lamp was used for the first time meaning it was not over used which could of lead to heat causing it go black/green instead of it going light purple. I also believe this because in my preliminary I had the same problem occurring.

At the measurement of 30 cm, readings 1 and 2 produced a ph that made the iodine change to green. I believe this happened because the lamp was cooled for a longer interval between 1 and 2 .This made the lamp more refreshed and more reliable

Evaluation:

My results are reliable simply because I have had experience from my preliminary experiment therefore any mistakes that I had made in my preliminary could be corrected therefore would of given me accurate results. There were some anomalous because of mistakes made. I used didn't let my lamp cool down which made my lamp hot when used for a long duration.

Before pouring the water onto leaf I believe that I left the water to long before pouring it onto the leaf. My timing skills were poor due to me forgetting to start the timer. There are many things I could of done to improve my reliability of results I could of timed how long the plant was kept under the light because my plants were not kept under light for exactly 24hrs I came into the room about 22hrs10mins therefore my plant did not get the maximum amount of time therefore my results could of improved There was less C02 because there were only plants in the room and they were taking in all the C02 so as time went on less C02 was in the atmosphere this would slow down the rate of photosynthesis produced. I could of took more leafs from various plants in different whether climates such as rain, heat to see whether the light or climate affected the amount of starch produced.

I could have used cold water and warm water to help me identify whether the light affected the starch production to see whether this method would kill the leaf as the hot water did. . I never weighed my leafs before and after the experiment, I should of done this because if a small fragment of starch was gained or lost I wouldn't not be able to tell whether it contains starch because the ph would of not been as accurate. I could of used different types of light such as sun, torch. The lamp could have of been over used, this could of caused a dimmer light to be emitted.

I could have tested for the oxygen produced by relighting a glowing splint. I would have been able to do this if I done my experiment in a more controlled area. could of heated the flame for a very quick duration than cool it down to ensure that all starch produced was broken down

I was not accessed to some of the equipment I needed due to a lack of resources that were provided to me. I believe that if my mistakes were corrected I would have met my hypothesis more accurately.

Conclusion:

Overall I believe that my results were unprofessional because I didn't have enough time to prepare. I was also not provided with accurate instruments which would help me to record more professional results. One thing I am happy with is that my results reflect my hypothesis

Bibliography:

Miss Chahal (Class teacher)
www.wikipedia.org
Gcp Book
Partner (Anwar)