

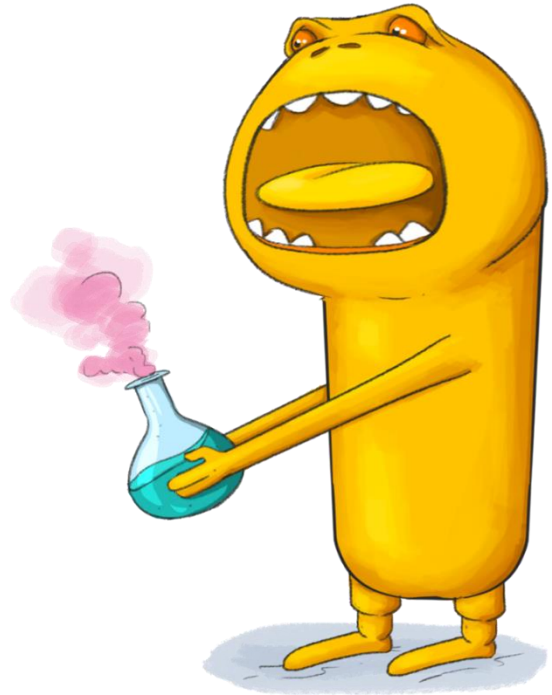


PHOTOSYNTHESIS

JUST SCIENCE

Emma Harrage





In this booklet you will learn about photosynthesis. Photosynthesis is the process by which plants make their food – its also the process in wich the sun's light energy is turned into chemical energy so every living organism on the planet can survive. Photosynthesis is linked to respiration. Photosynthesis makes the food which is used in respiration to make the energy...

Life would be simpler if we could just get our energy from the sun...but then no doughnuts...oh no!

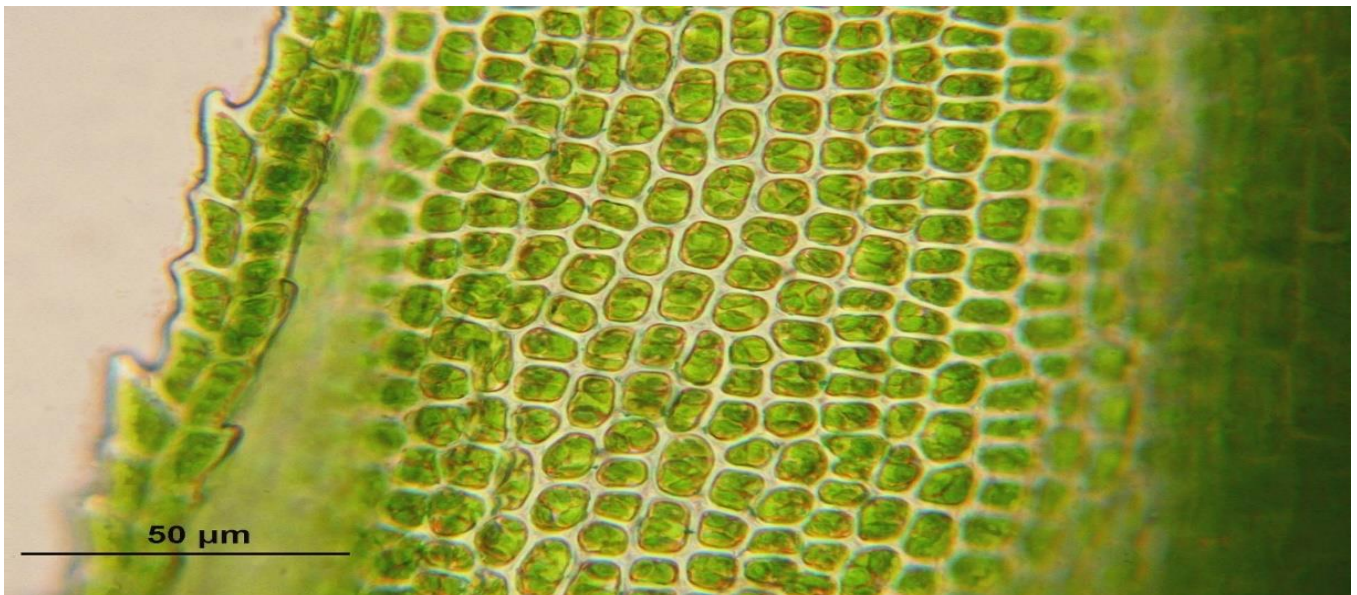


A Very Brief Summary Of Photosynthesis

Plants make their own food in their leaves. They do not get food from the soil or from water. The leaves can make food for the plant because they are green.

The green chemical in a leaf is called CHLOROPHYLL. Plants make food in a process called PHOTOSYNTHESIS. Photosynthesis can take place slowly or quickly. It depends on the temperature, access to water, light and carbon dioxide. Photosynthesis takes place more quickly when it is warm. Plants grow faster when more carbon dioxide is available.

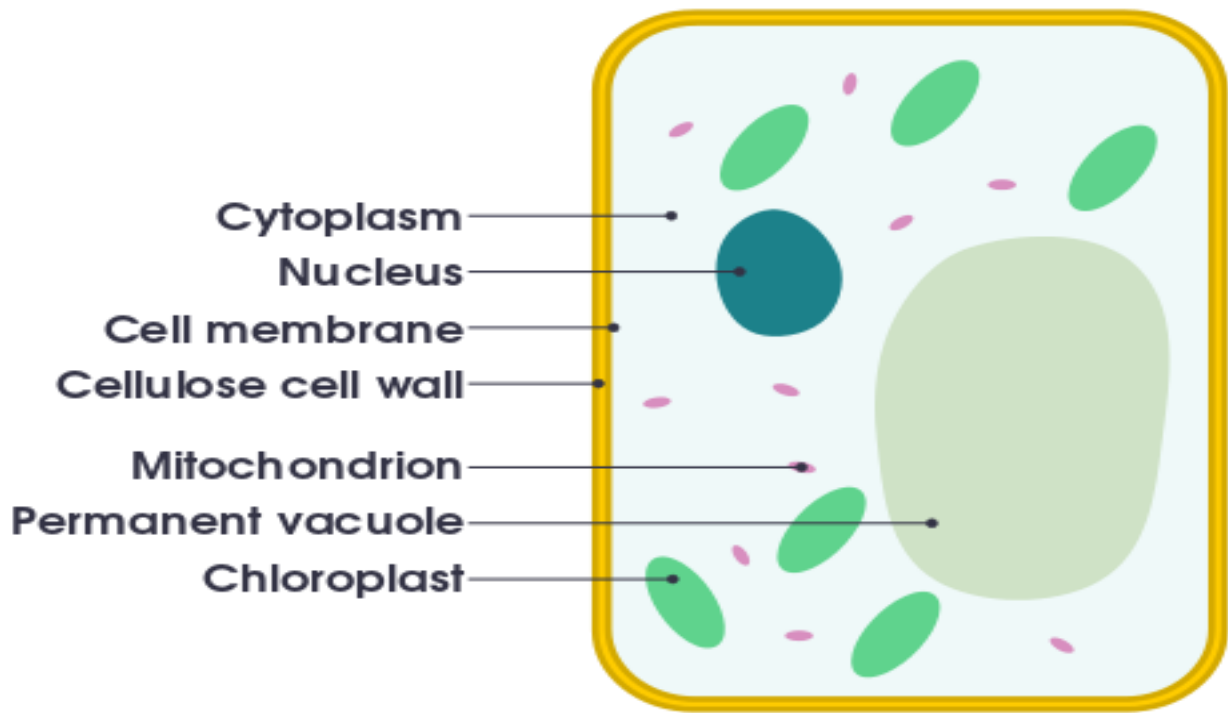
This is a photo of plant cells. Plant cells are green which is why plants are green.



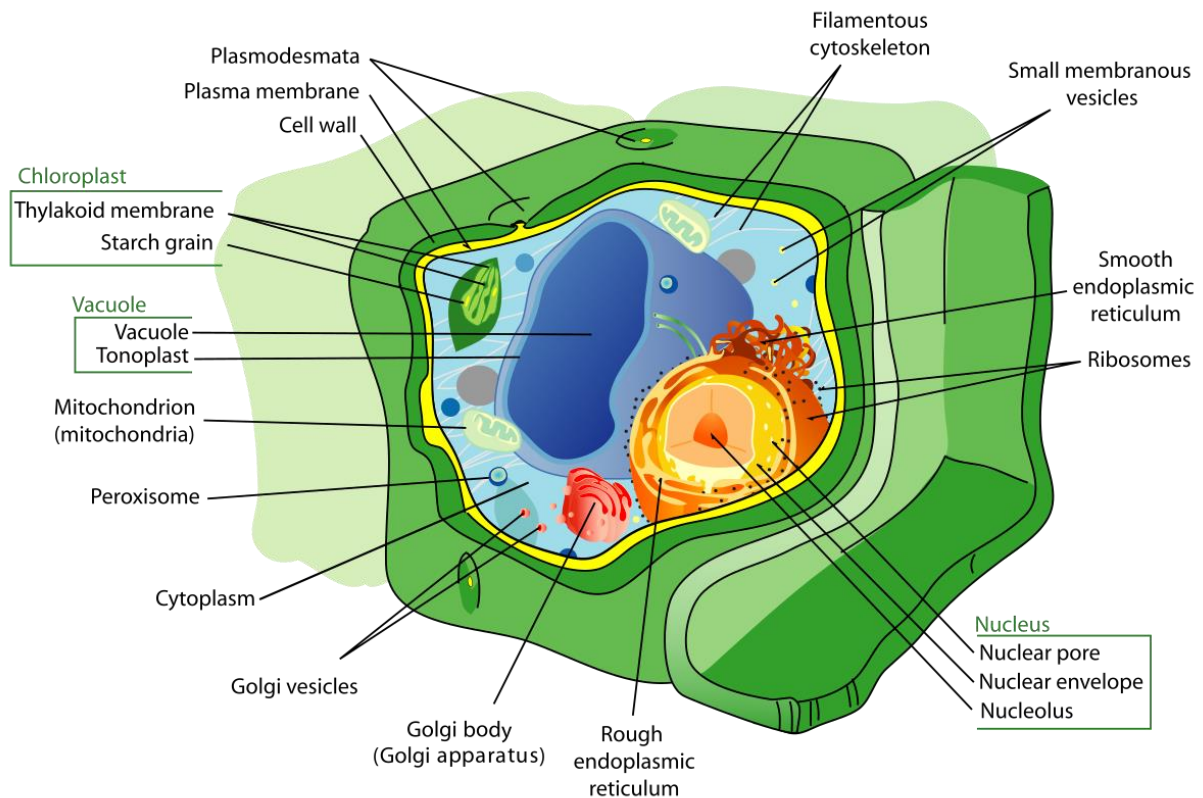
Because of the increase in carbon dioxide in the atmosphere because we are burning fossil fuels, trees are actually growing faster....

Now we just need to stop cutting them down....





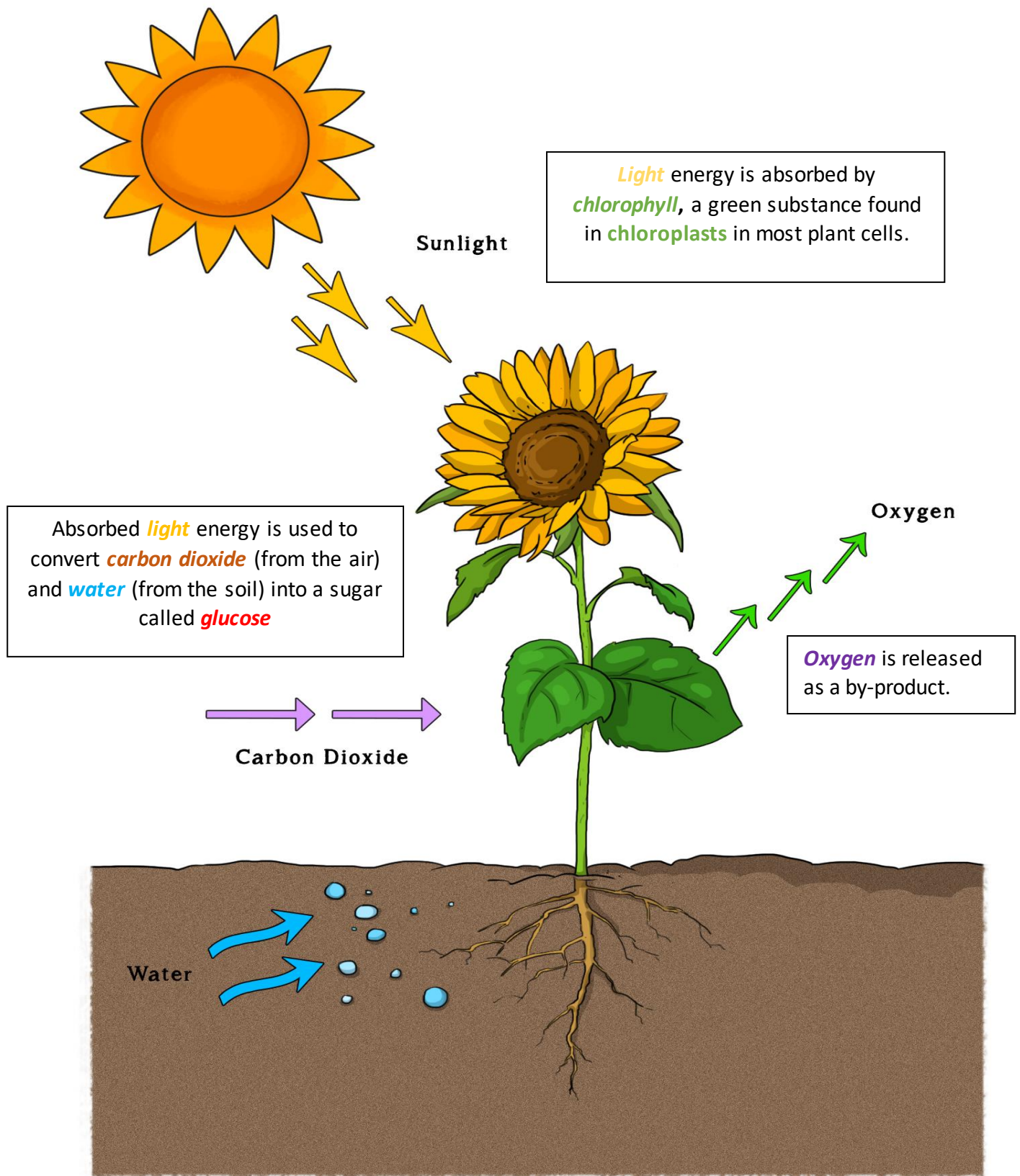
A simple plant cell



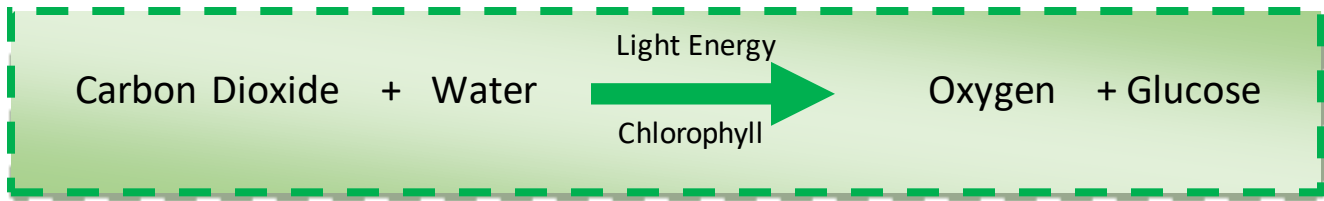
And just for those of you who want to know what a plant cell really looks like here is a very complicated diagram....



Photosynthesis is the chemical change which happens in the leaves of green plants. It is the first step towards making food - not just for plants but for every animal on the planet. Plant cells contain chloroplasts. Chloroplasts contain a chemical called chlorophyll which enables the plant to absorb light energy from the sun.

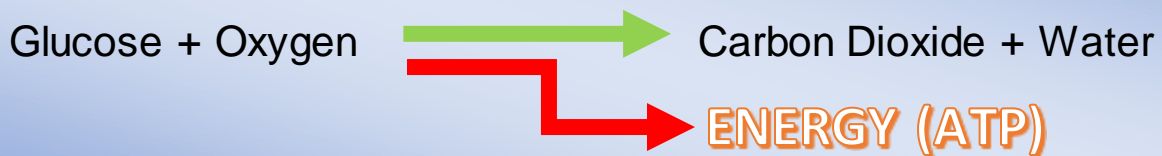


This equation summarises what happens in photosynthesis:



- ✚ Glucose is produced during photosynthesis.
- ✚ Plants make glucose because it is water soluble so it can be transported around the plant.
- ✚ Glucose can also be converted into cellulose which is used in cell walls and fats and proteins which the plant needs.
- ✚ Glucose is soluble in water so it is stored as starch which is insoluble.
- ✚ Plants convert starch back into glucose when it is needed for respiration.

Respiration is when glucose (in the presence of oxygen) is converted into carbon dioxide and water and releases energy.

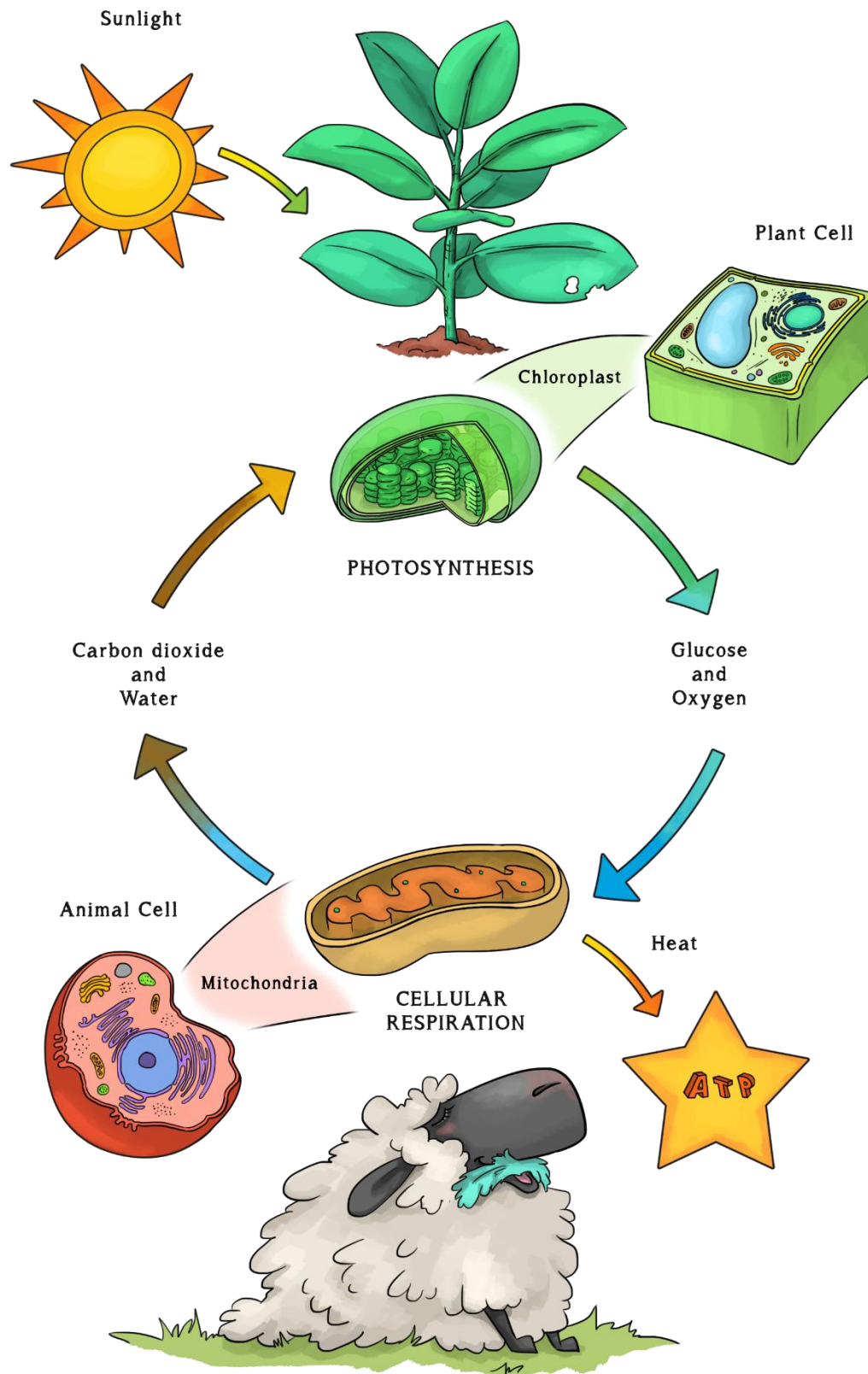


*Plants photosynthesise AND respire.
The oxygen they produce during
photosynthesis is used for respiration.
At night plants only respire.*

Respiration happens in the mitochondria in every cell and makes Adenosine triphosphate (ATP). ATP is a form of chemical energy in cells.



Photosynthesis and Cellular Respiration

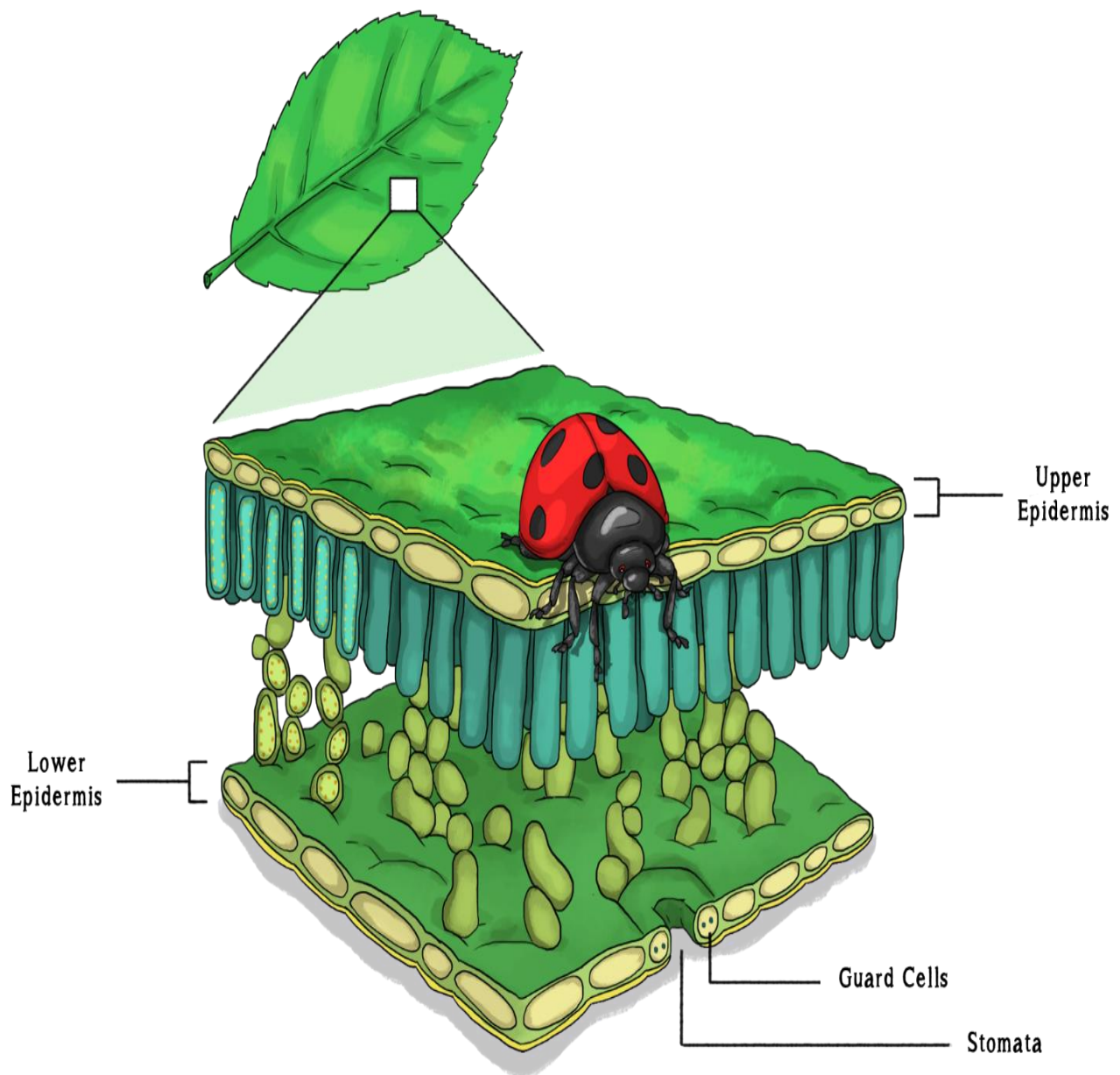


Balanced Equations:



A Plant's leaves have several adaptations to be able to photosynthesise:

Large surface area to absorb light	Contain chlorophyll
Stomata only open at night to reduce water loss	Large network of veins to transport water and sugars



Some Extra stuff you may like to know:

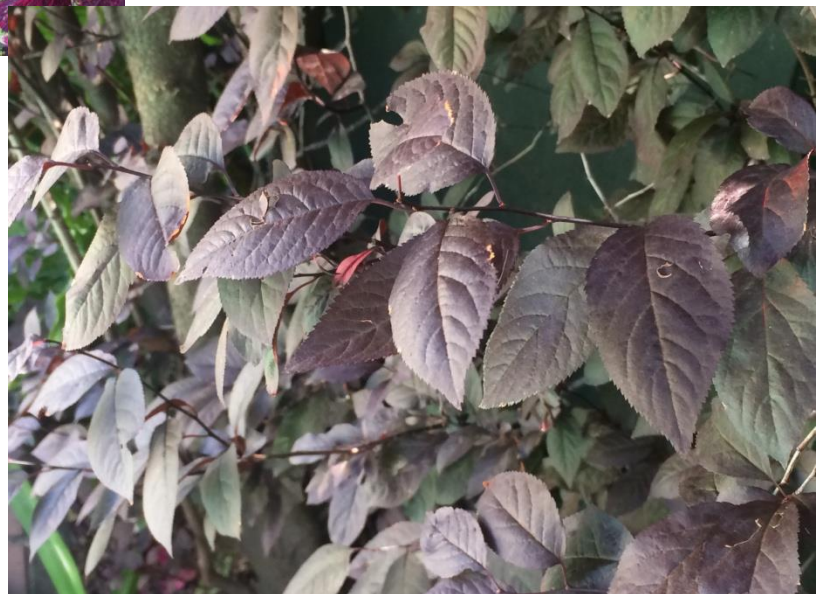


Deciduous Trees/plants lose their leaves in autumn and winter. Before their leaves fall they often change colour. This is because the plant reabsorbs chlorophyll so they do not lose it when the leaves fall off.



A Flame Nettle

An Ornamental Plum



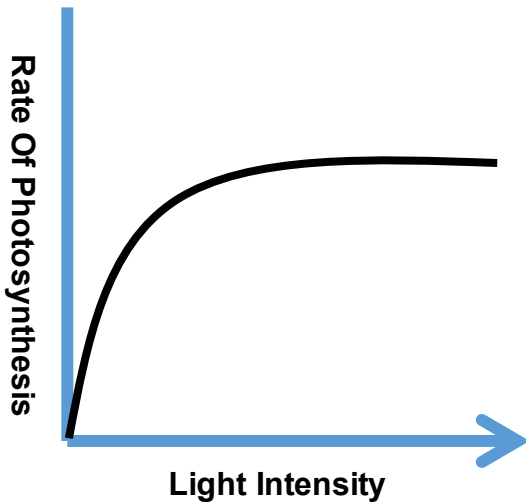
Plants that aren't green still have chlorophyll and photosynthesise. We just can't see the green in them!



Three factors can limit the speed of photosynthesis: light intensity, carbon dioxide concentration and temperature.

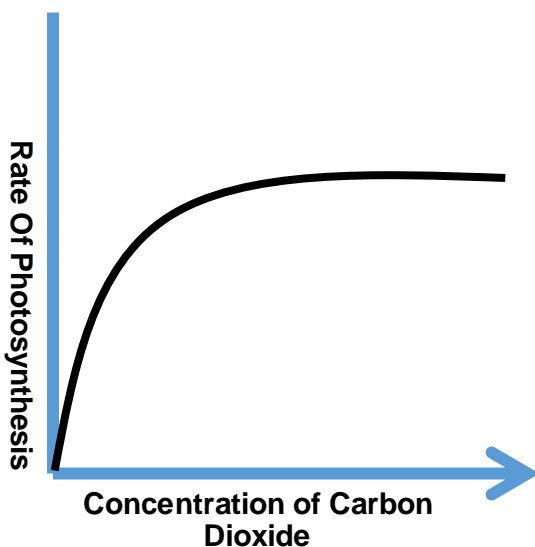
Light intensity

Plants need light for photosynthesis. Without enough light, a plant cannot photosynthesise quickly. Increasing the light intensity will increase the speed of photosynthesis.



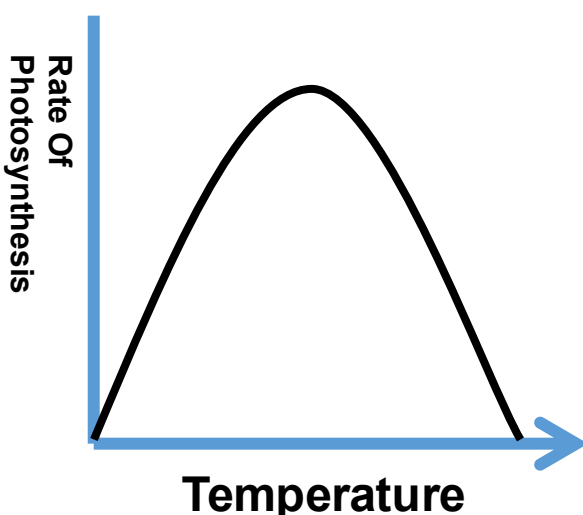
Carbon dioxide concentration

Carbon dioxide is a reactant needed for photosynthesis. If a plant cannot get enough carbon dioxide photosynthesis will be limited. Because the concentration of carbon dioxide is increasing in the atmosphere, researchers have found that trees are growing more quickly.



Temperature

Temperature is also a limiting factor. If the temperature is too cold or too hot, then plants cannot photosynthesise quickly.



The availability of water is also a limiting factor. Any one of these factors could limit the rate of photosynthesis.



A Summary Of Photosynthesis

Plants make their own food in their leaves.
The green chemical in a leaf is called
CHLOROPHYLL. Chlorophyll absorbs sunlight.
Plants make food in a process called
PHOTOSYNTHESIS.



Limiting Factors:

Carbon Dioxide concentration

Light intensity

Temperature

Access to water



Check your understanding:

	True/False
Chlorophyll is green	
A plant needs water	
All green parts of a plant can photosynthesise	
Plants get food from the soil	
Glucose is a product of photosynthesis	
Oxygen is needed for photosynthesis	
Chloroplasts contain chlorophyll	
The speed of photosynthesis is dependent on the type of minerals in the soil	
Plants get food from the sun	
Plants use some of the oxygen they produce for respiration	

A little harder:



This is a variegated leaf. Gardeners like to plant these kinds of plants in their gardens for variety. Explain how these kinds of plants may be disadvantaged over other garden plants.



A squirrel drops an acorn.



The acorn begins to grow.



50 years later it has grown into a 12m high oak tree with a mass of approximately 400KG.

Explain, as scientifically as you can, how the tree has increased in mass and height.

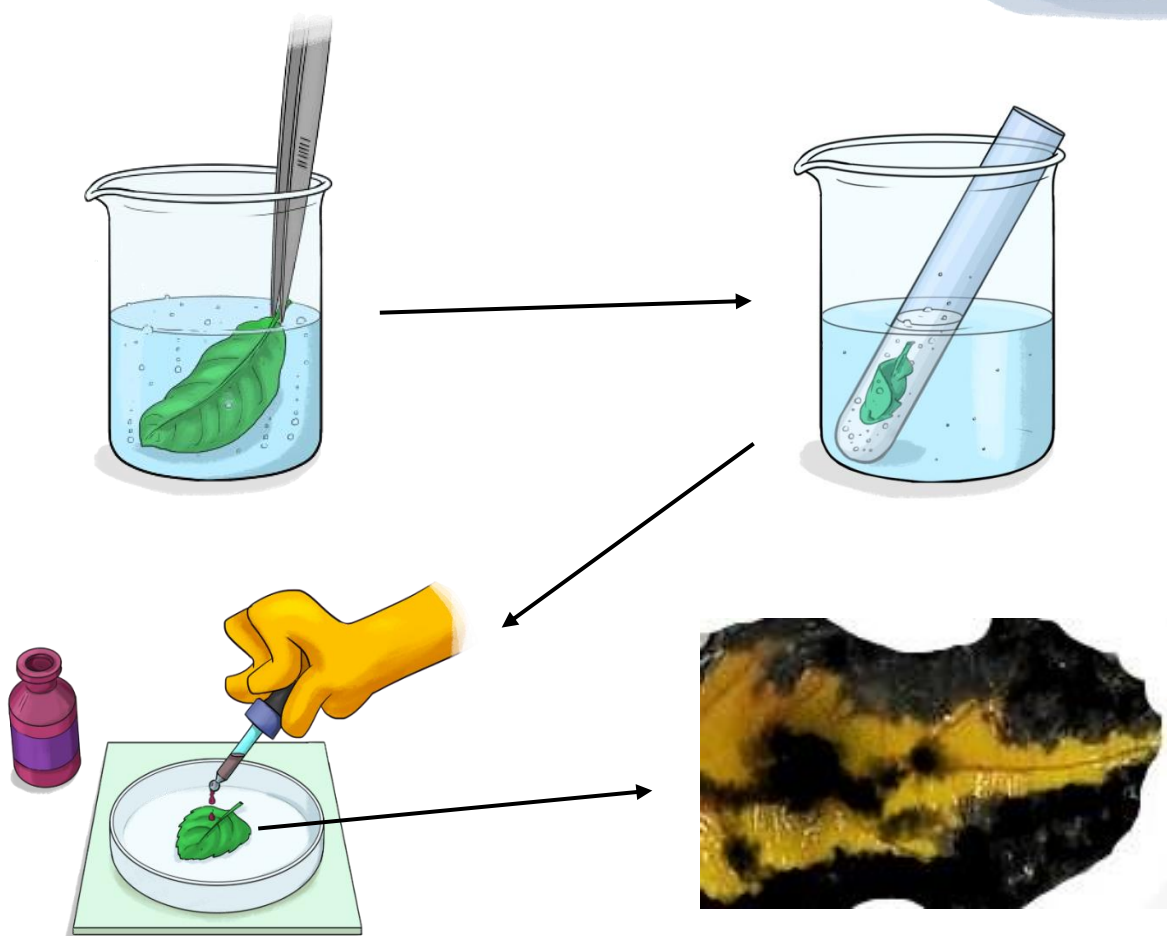
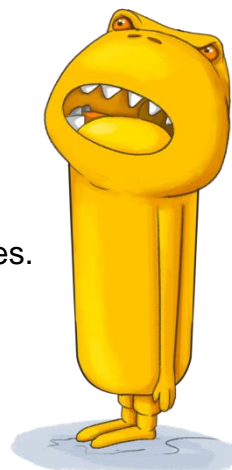


Photosynthesis Practical Investigations:

The standard practical investigation is: **Testing a Leaf for Starch**. A leaf needs to be partially covered with tin foil, or a plant needs to be stored in a dark cupboard for at least 24 hours before the practical.

Method:

1. Place a leaf in a beaker with water and boil for 5 minutes.
2. Remove the leaf, place the leaf in a test tube and cover with ethanol.
3. ***Turn off the Bunsen burners. Ethanol is highly flammable***
4. Place the test tube back into the beaker and allow it to boil for 5 minutes.
5. Remove the leaf from the ethanol and place on a white tile.
6. Cover the leaf with iodine.
7. Observe the colour changes.

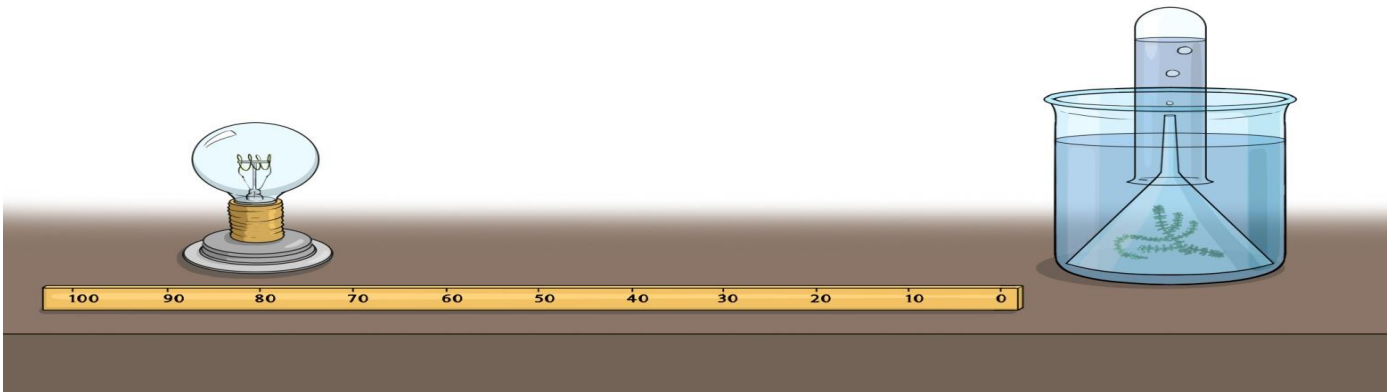


The leaf will turn black because the plant has been photosynthesising. Iodine is a test for starch. Remember: Plants store glucose as starch because glucose is soluble in water.



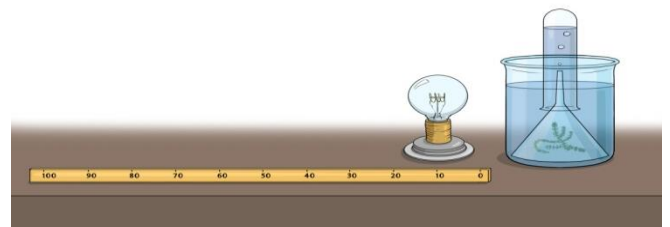
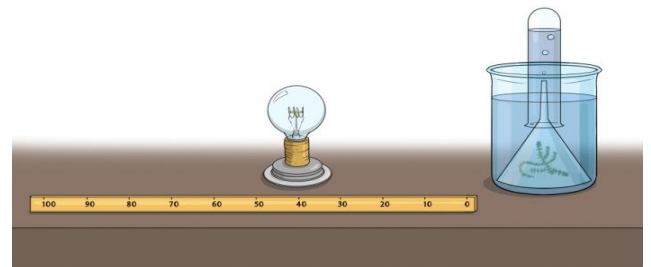
Light Intensity

Aim: To investigate the effect of light intensity on photosynthesis.



Set up your apparatus as above

- 1 Position the light 80cm from the pondweed and allow 2 minutes for the pondweed to adjust.
- 2 Count the number of bubbles released over a one-minute period.
- 3 Move the lamp 20cms closer and repeat steps 1 and 2.
- 4 Continue at further intervals of 20 cm up to 0cm.
- 5 Record your results a table and use these to plot a graph.



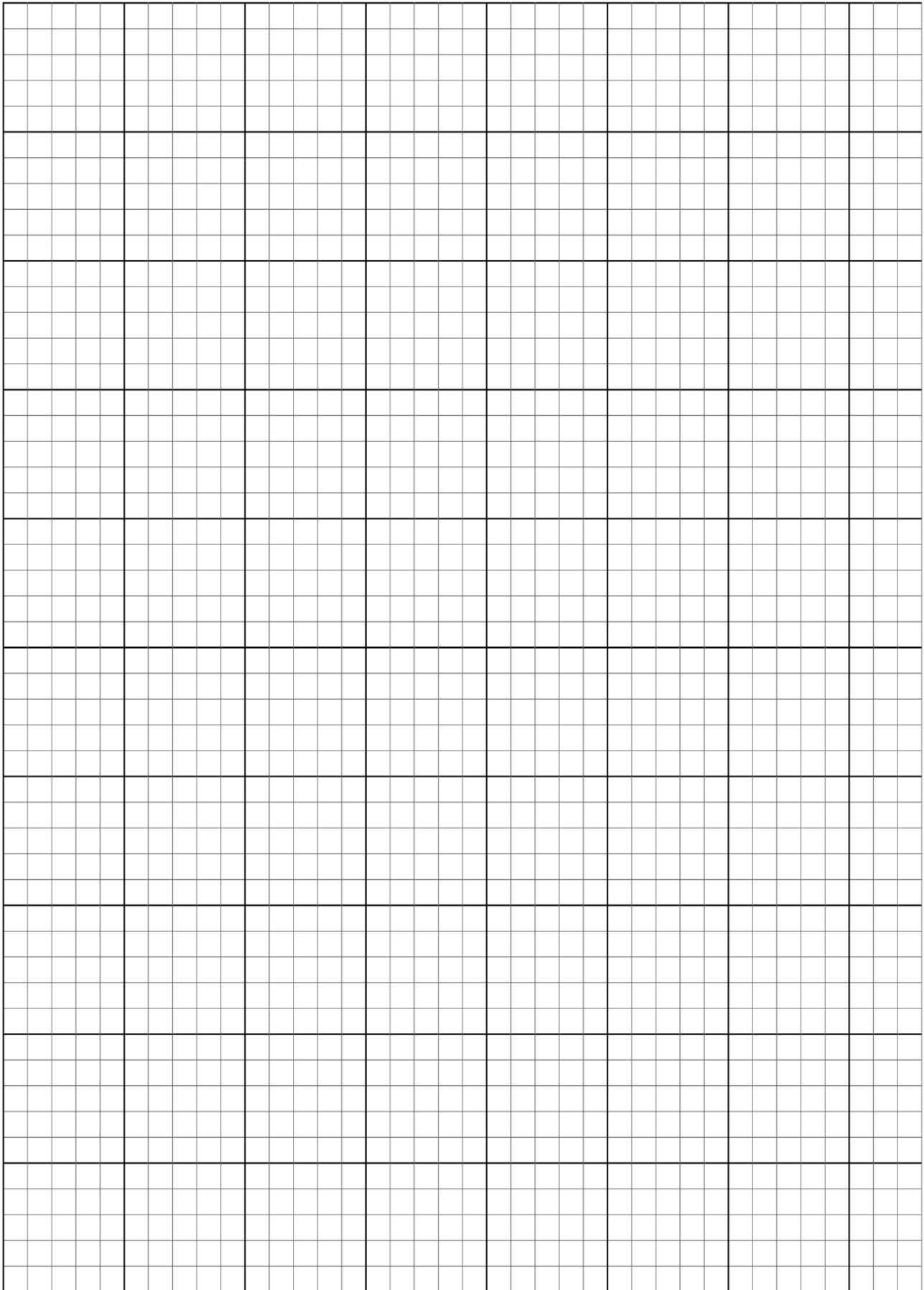
Results:

Title:

Distance From Lamp (cm)	Number of bubbles per minute
70	
50	
30	
10	



Use the graph paper below to draw a graph.



Conclusion:

Identify the variables:

Independent:

Dependant:

Controls:

Evaluation:

How would you make sure that this experiment was a fair test?

Suggest 3 ways that you could improve this experiment.

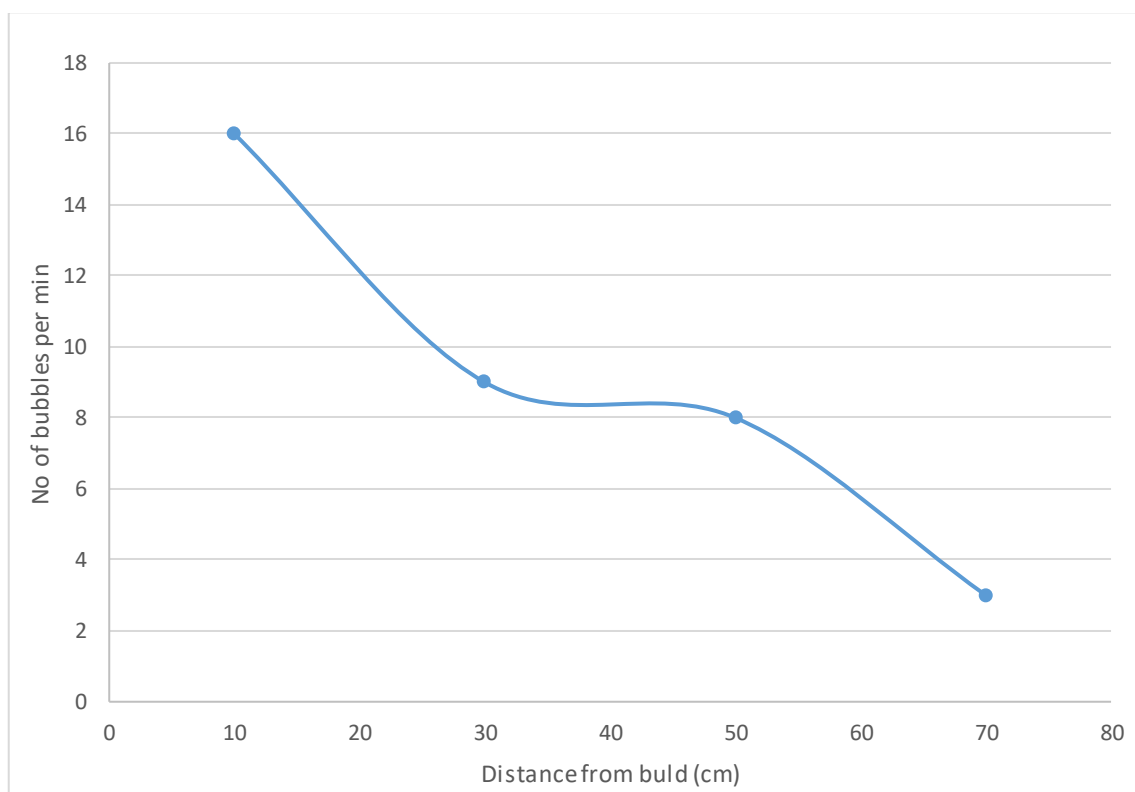
How did/could you make your experiment:

Accurate	
Precise	
Reliable	



If you did not do the experiment here is some actual data you can use:

Distance From Lamp (cm)	Number of bubbles per minute
70	3
50	8
30	9
10	16



Conclusion: More oxygen bubbles are produced when the light is closer to the beaker. So a greater light intensity gives a greater rate of photosynthesis.

- **Independent variable** - the light intensity (how close the light is).
- **Dependant variable** - the number of oxygen bubbles given off (the rate of photosynthesis).
- **Controlled variables** – species of pondweed, the size of the pondweed, the volume of water used, temperature of the water, pH of the water, the amount of time bubbles were counted for, the amount of time the plant was given to adjust to new light position.

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Evaluation:

Fair test: only change one factor and keep all the others the same – so you only change the position of the lamp

Three improvements: use a gas syringe to collect the oxygen and measure volume. Use a blue lamp instead of a white lamp – blue light increases vegetative growth. Use a sodium hydrogencarbonate solution instead of water to increase the availability of carbon dioxide. If you are using tap water, leave the water to stand overnight to remove the chlorine as chlorine will reduce the rate of photosynthesis.

Accurate Your measurements are **accurate** if they are close to their true value.

Precise Your measurements are **precise** if they are similar when completed again.

Reliable Your experiment is **reliable** if you get precise measurements when it is repeated.
Your DATA is **reliable** if others get precise measurements when they repeat it.



Just Science

Photosynthesis

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<http://www.loopy-lou.com/>

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