Cells and Ecosystems
Plants

Junior Science

All living things share the characteristics described in MRS C GREN

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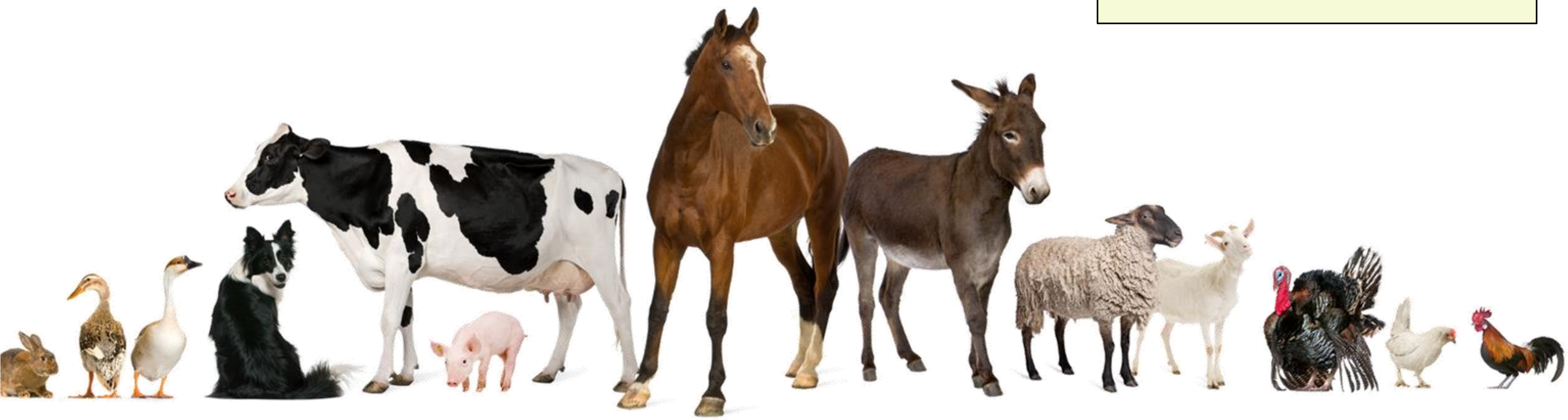
Biology is the study of living things

A **living object** is an object that carries out life functions

A **non-living object** is an object that has not been alive

A **dead object** is an object that was once alive

All living organisms are composed of one or more cells. A cell is a small, living unit that contains all the chemicals and molecules that help support an organism's life.



Classifying objects as living or non-living

How would we know if a **car** or **cow** is living? They both move and need “feeding” to keep them going. So why is only the cow living? We use the acronym MRS C GREN to remind us living objects show **ALL** of the life processes, not just some, and are made up of **CELLS.**

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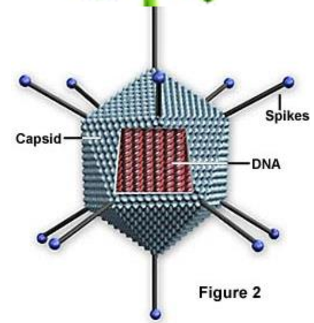
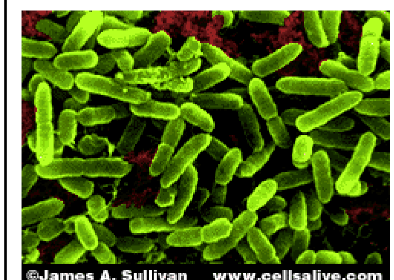
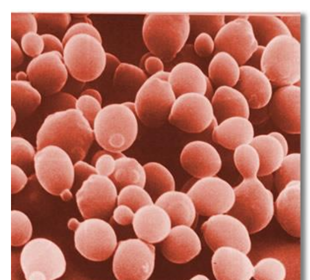
All living things share the characteristics described in MRS C GREN

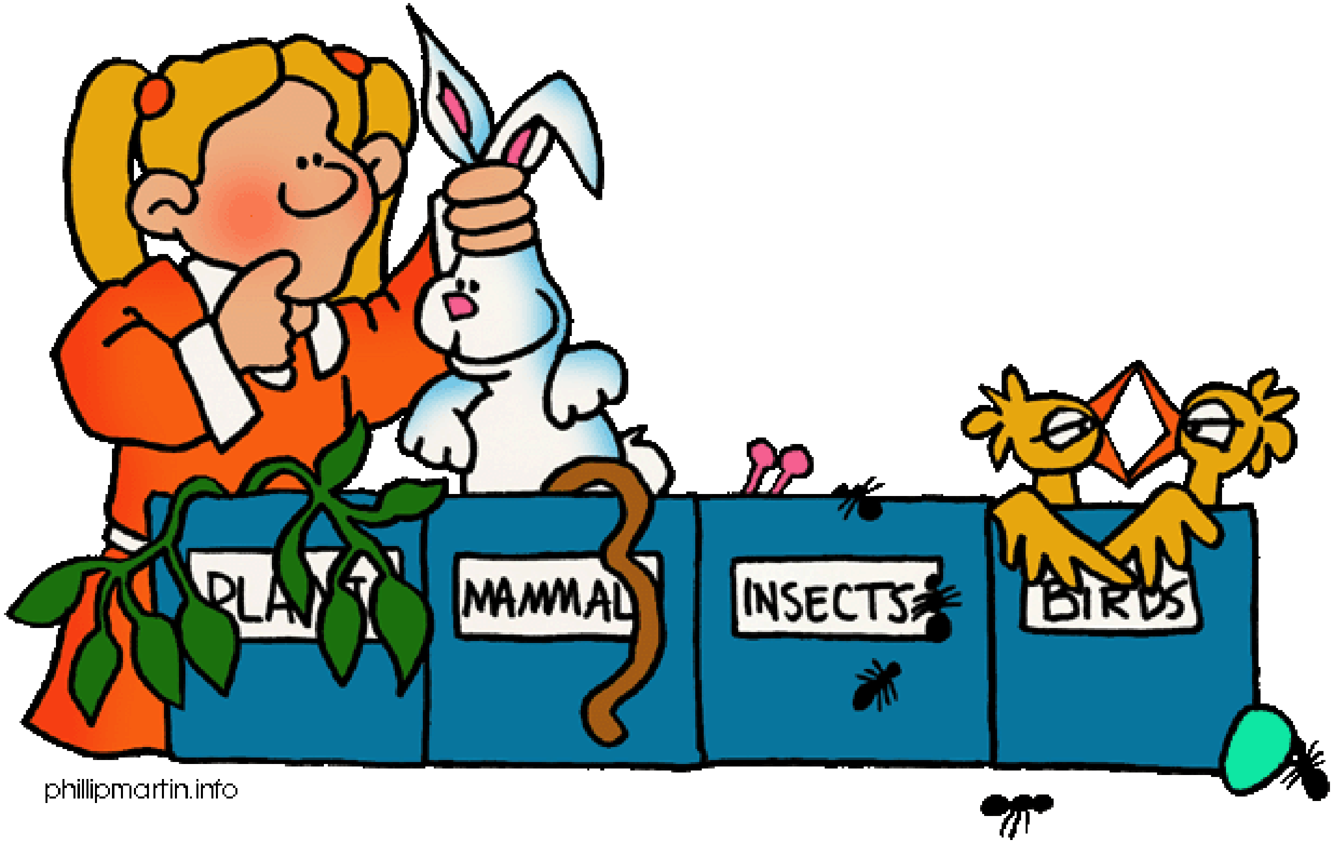
Life function	Gives us the ability to….
Movement	Move through space
Respiration	Obtain energy through reactions in cells
Sensitivity	Respond to the outside environment
Cells	Smallest unit of life – makes up the bodies of bigger organisms
Growth	Increase in size
Reproduction	Create more living things
Excretion	Dispose of waste chemicals
Nutrition	Extract useful chemicals from the environment

Which is Living and which is not? Use MRS C GREN

fire 	fish 	virus 	algae 
jellyfish 	coral 	mould 	bacteria 
amoeba 	crystals 	yeast 	fungus 

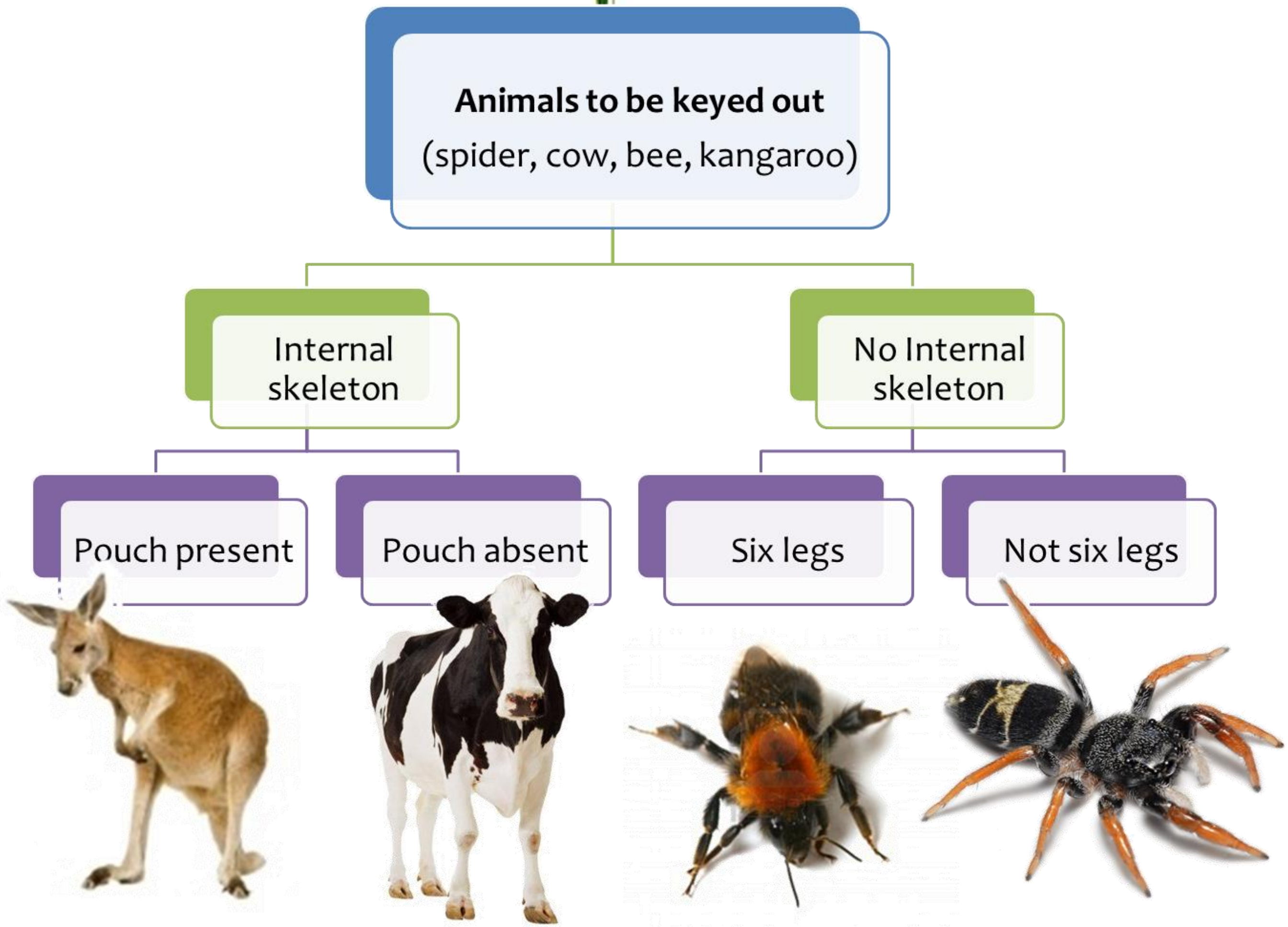
Living things are classified into groups based on similarities / features

Biologists classify all living things into overall groups, called **Kingdoms**. The members of each kingdom are alike in key ways, such as the nature of their cells, their body features or the way they obtain energy. Classification keys can be used to identify living things (and other objects) in each group.



What is a dichotomous identification key?

The Dichotomous keys are used as tools to help identify unknown organisms using careful observations and matching those observations in an organised manner against choices given at each step. Each two choices are known as a **couplet**. **Dichotomous** means branched.



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Using a simple dichotomous identification key.

Rules for Using Dichotomous Keys:

1.Read both choices in a couplet (pair) carefully.

2.When reading a couplet, make sure you understand all of the terms used.

3.If you are unsure of which choice to make in a couplet, follow both forks (one at a time). After working through a couple of more couplets, it may become apparent that one fork does not fit your sample at all.

4.Work with more than one sample if possible. This will allow you to compare.

5.When a measurement is given make sure that you take the measurement and do not take a guess

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Making a simple dichotomous identification key.

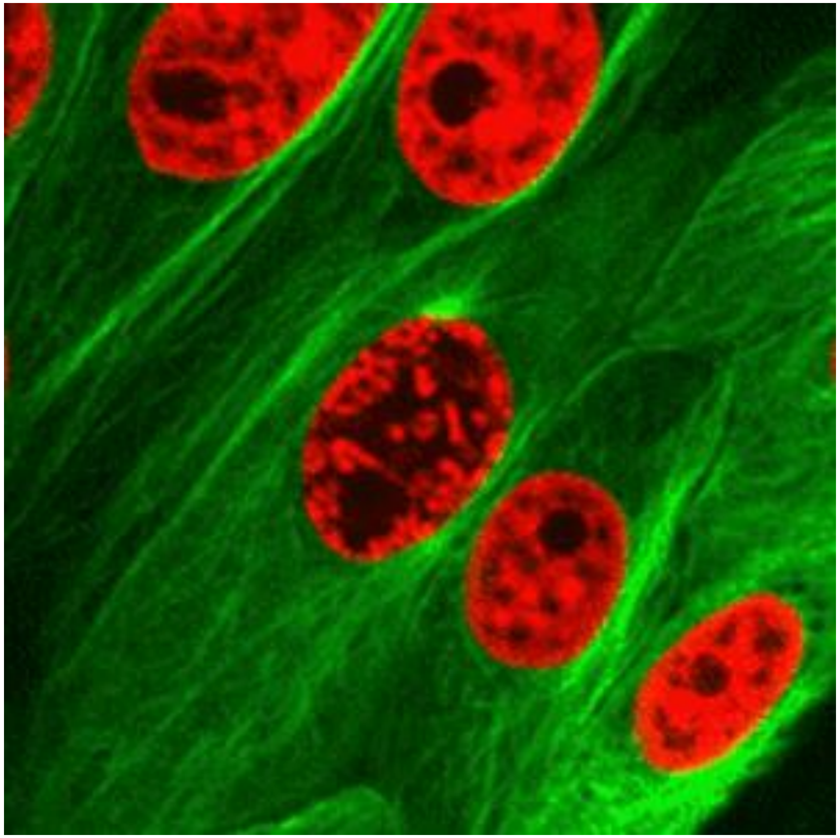
If we are making a key based on observations of physical features that we can see, the first step must be a feature that can divide all of the living organisms into two groups.
For example below, we could divide the birds into those that have tuffs of feathers on their heads (spotted shag and crested penguin) and those that do not (wax-eye, brown kiwi, paradise duck, kingfisher, yellow head, spotted dotterel)

https://www.stampcommunity.org/topic.asp?TOPIC_ID=5934&whichpage=23

Other features such as thickness of beak, tail or not, one colour or many colours – can be used to further divide each bird group.
The key is finished when each individual has its own path and the key leads to a name for each.

All living organisms are made up of cells.

All living organisms are made up of cells, the smallest structural (how it looks) and functional (How it works) unit.
Organisms can be **Unicellular** – consisting of one independent cell, or be **multicellular** – organised networks of cells with different functions and structures; humans have over 100 trillion cells.



The structure of a typical plant cell includes a cell membrane, cytoplasm, nucleus, cell wall, vacuole, and chloroplast.

Cell Wall

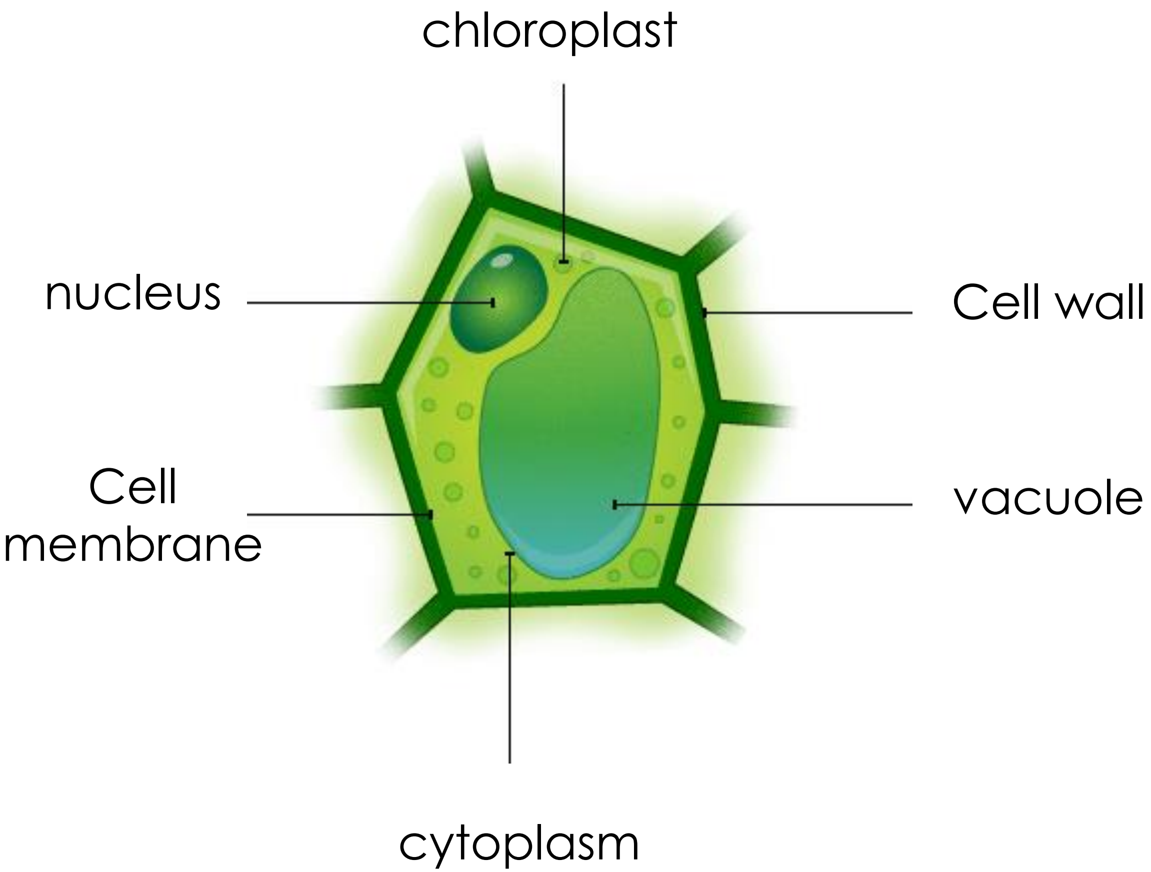
Gives the cell rigidity and a more angular appearance.

Chloroplasts

The site of photosynthesis, gives the cell its characteristic green colour

Vacuole

Assists with storage and structure



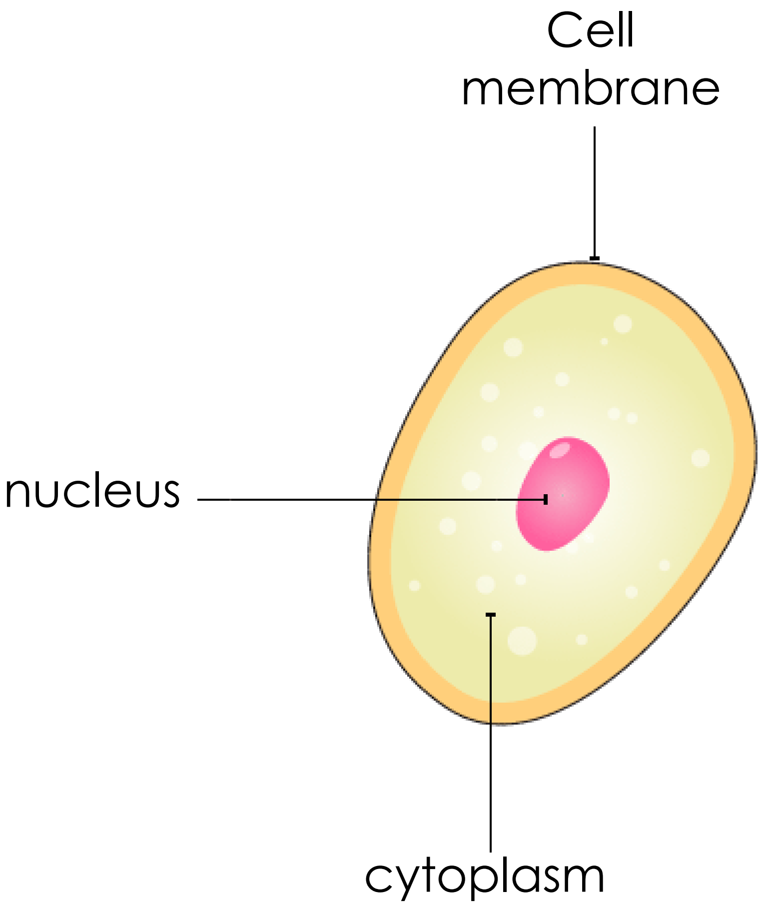
The structure of a typical animal cell includes a cell membrane, cytoplasm and nucleus

Cell membrane

Surrounds cell and controls passage of nutrients and chemicals. Flexible and allows cell to change shape.

Cytoplasm

A liquid filling the cell and containing all the chemicals the cell needs to function



http://www.bbc.co.uk/bitesize/standard/biology/investigating_cells/cells_and_diffusion/revision/5/

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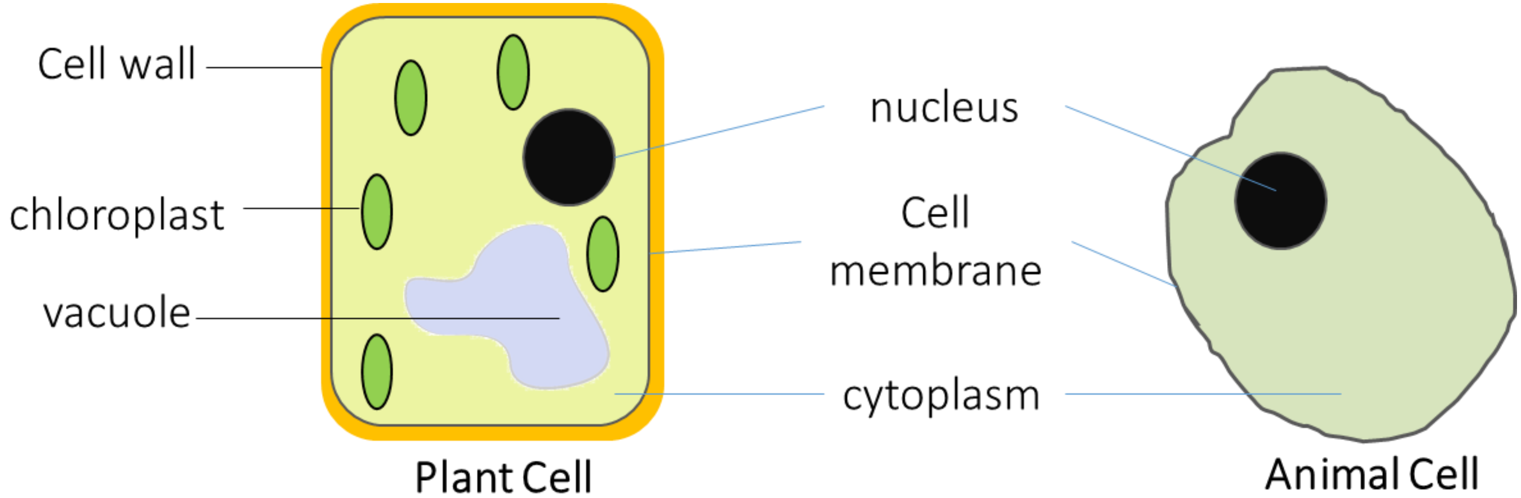
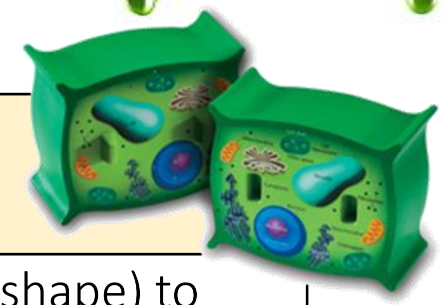
Plant and animal cells similarities and differences.

Similarities	Differences
1.BOTH cells have a 'skin', called the membrane, protecting it from the outside environment. 2. BOTH cells have a nucleus. The ‘information storage' of the cell. 3. BOTH cells have Cytoplasm, a fluid that protects the inside of the cell and carries nutrients	1. ONLY Plants have a cell wall that help define the shape and give structure to the plant. 2. ONLY plant cells contains chloroplasts that helps in the plants photosynthesis. 3. Plant cells are generally larger than animal cells. 4. Plants have a larger Vacuole.



The summary of the differences in structure between animal and plant cells.



	Animal Cell	Plant Cell
Shape:	Round (irregular shape)	Rectangular (fixed shape) to interlock for support.
Chloroplast:	Animal cells don't have chloroplasts	Plant cells have chloroplasts because they make their own food
Vacuole:	One or more small vacuoles (much smaller than plant cells).	One, large central vacuole taking up 90% of cell volume which is required for storage
Cell wall:	Absent	Present for a plant's support.
Plasma Membrane:	only cell membrane	cell wall and a cell membrane

Using a Microscope

Most cells are to small to be clearly seen by eye and require a microscope to view.

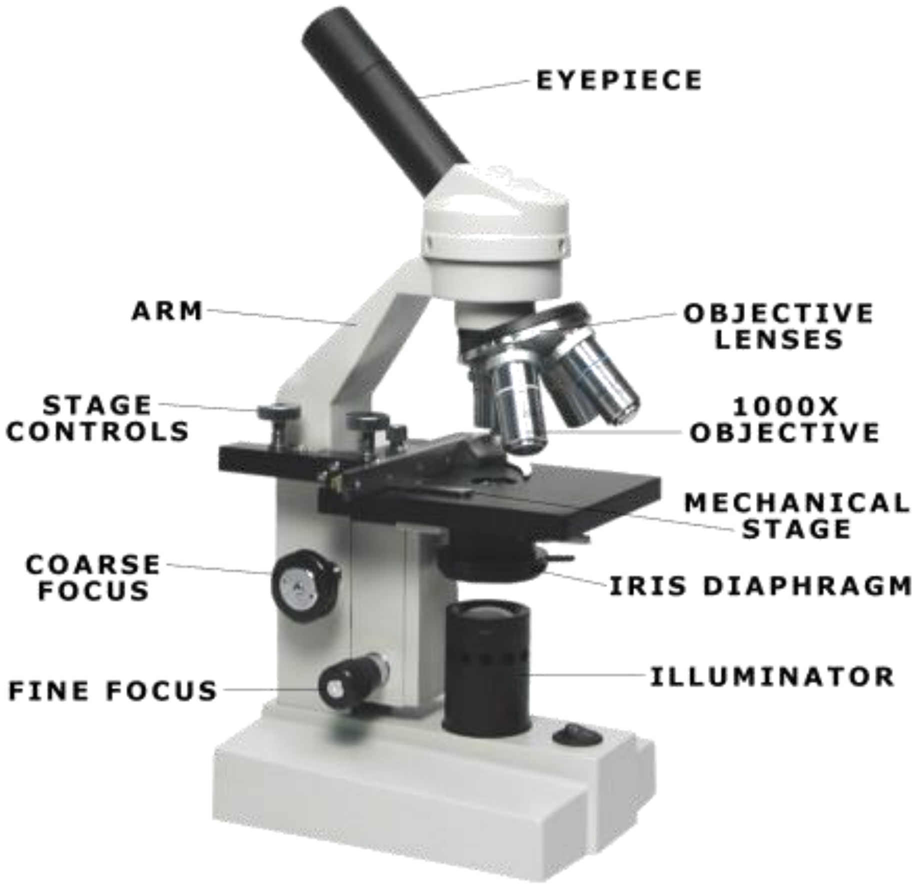
Definitions:

Magnification: the number of times the image is enlarged

Resolution: the clarity (how clear) and ability to see detail in the image

Microscope parts and function

arm - this attaches the eyepiece and body tube to the base.
base - this supports the microscope.
coarse focus adjustment - a knob that makes large adjustments to the focus.
eyepiece - where you place your eye.
fine focus adjustment - a knob that makes small adjustments to the focus (it is often smaller than the coarse focus knob).
high-power objective - a large lens with high magnifying power.
low-power objective - a small lens with low magnifying power.
mirror (or illuminator) - this directs light upwards onto the slide.
stage - the platform on which a slide is placed.



Using a microscope safely

1. Make sure the lowest power objective lens (e.g. 4x) is clicked into position.

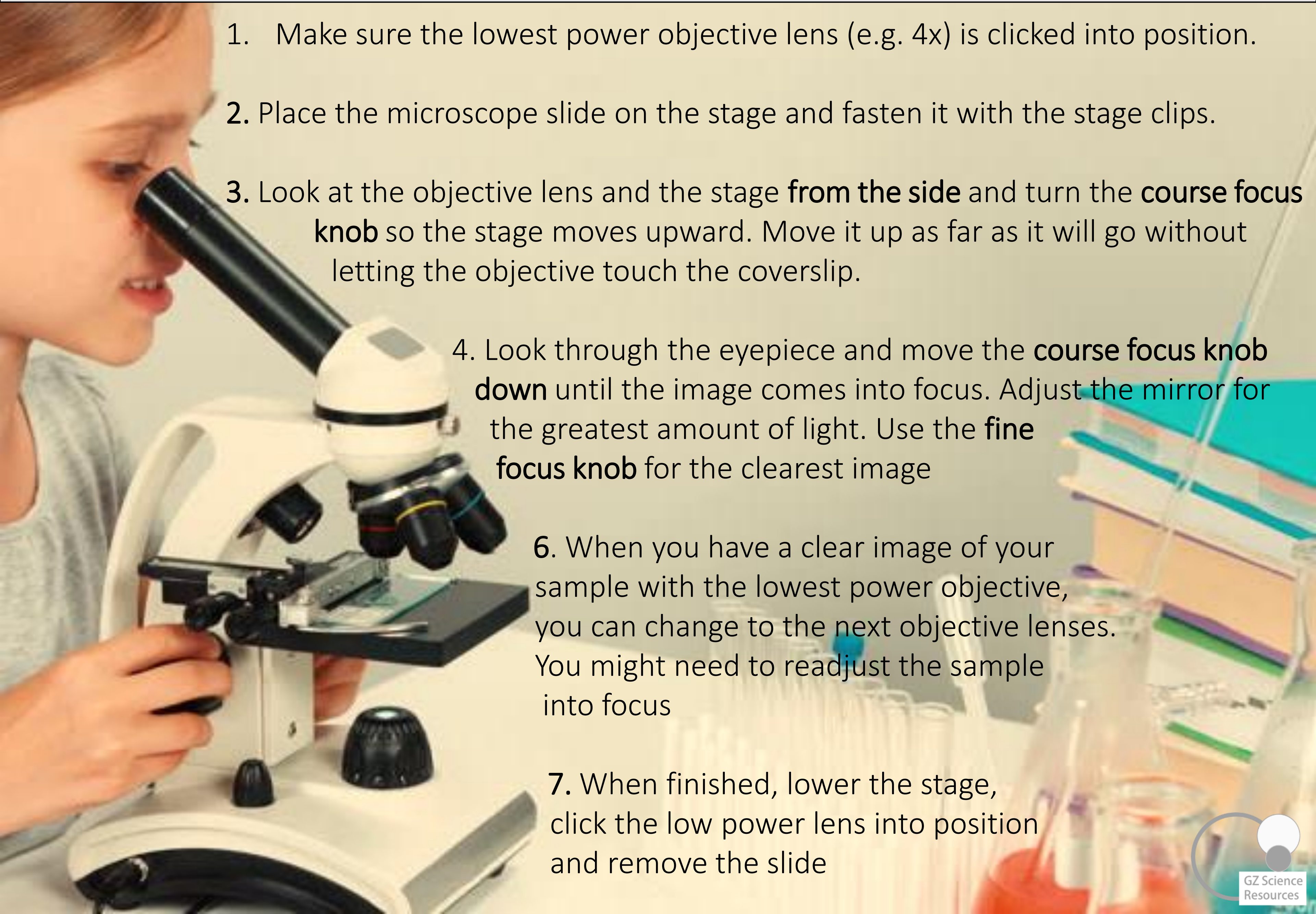
2. Place the microscope slide on the stage and fasten it with the stage clips.

3. Look at the objective lens and the stage **from the side** and turn the **course focus knob** so the stage moves upward. Move it up as far as it will go without letting the objective touch the coverslip.

4. Look through the eyepiece and move the **course focus knob down** until the image comes into focus. Adjust the mirror for the greatest amount of light. Use the **fine focus knob** for the clearest image

6. When you have a clear image of your sample with the lowest power objective, you can change to the next objective lenses. You might need to readjust the sample into focus

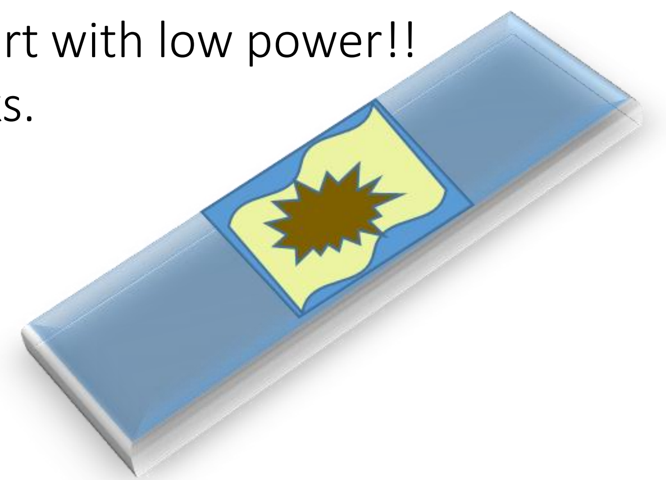
7. When finished, lower the stage, click the low power lens into position and remove the slide



Making a Microscope Slide

Onion Cell Slides

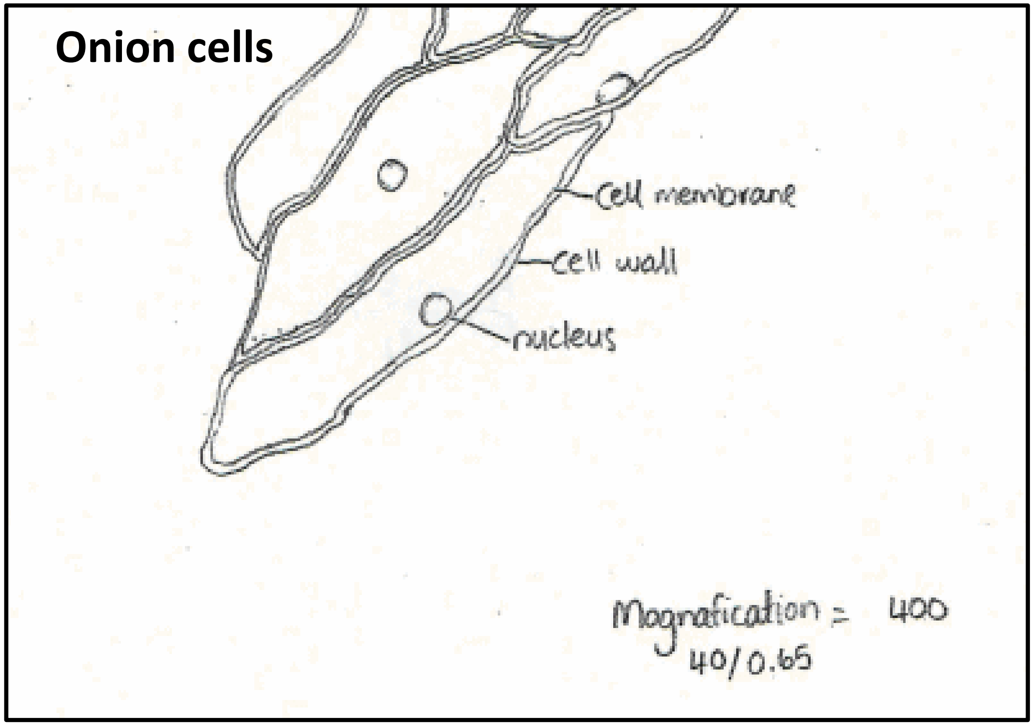
1 Collect onion, slide and cover slip, lamp and microscope.
2. Peel the epidermal cells (skin between layers) from the onion tissue.
3. Place the cell sample on your slide – spread it out and make sure it is not folded.
4. Add 2 drops of iodine (or other stain) to the onion slide.
5. Lower cover slip onto the slide one side at a time so there are no bubbles
6. Focus under the microscope – remember to start with low power!!
7. Draw 2-3 cells about 10 lines big into your books.
8. Return used slides and slips to the ice cream container with disinfectant.



Biological drawings are a useful way of recording information from your observations.

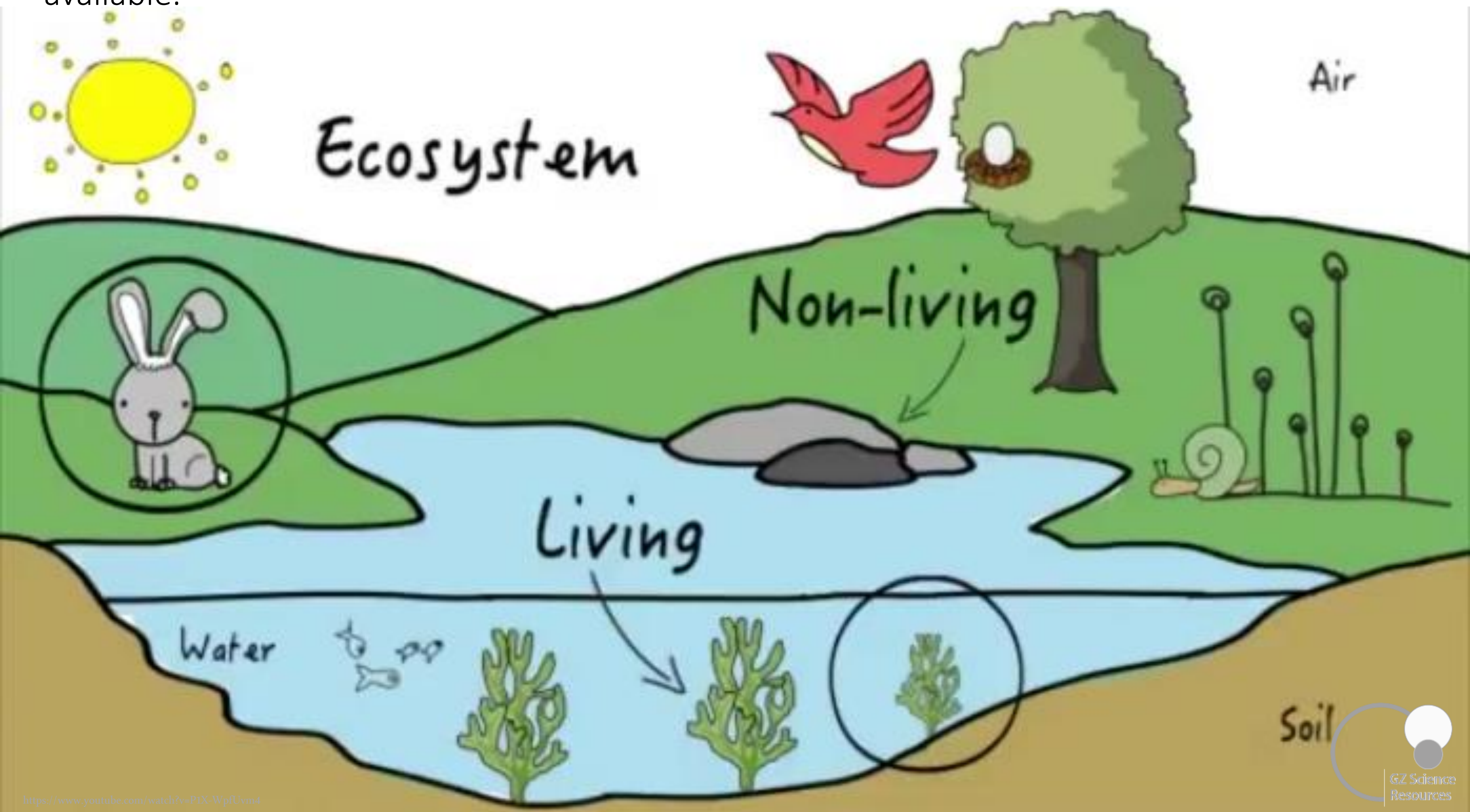
Rules for drawing a cell

1. Use unlined paper.
2. Draw in pencil.
3. Always print.
4. Give the drawing a title
5. Use a large area of the paper
6. Label all visible parts and never cross lines.
7. Name the specimen
8. Print your name and other Information such as scale or magnification used on the microscope



An ecosystem is the habitat and the community considered together.

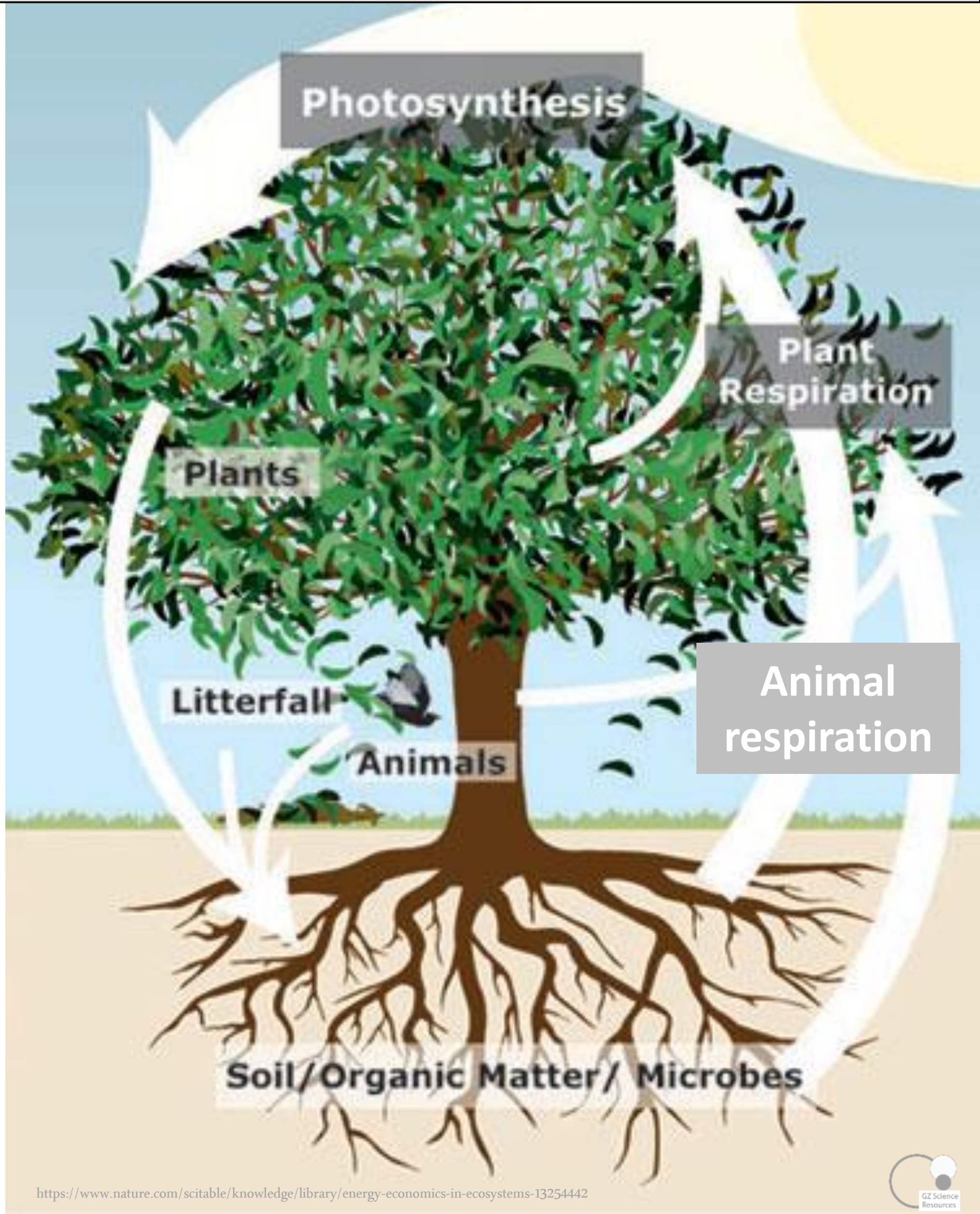
An **ecosystem** includes all of the living organisms in a specific area. These systems consist of a living part called the **community** made up of all the plants and animals, which interact with their non-living environments (weather, Earth, Sun, soil, atmosphere) which determine the **habitats** available.



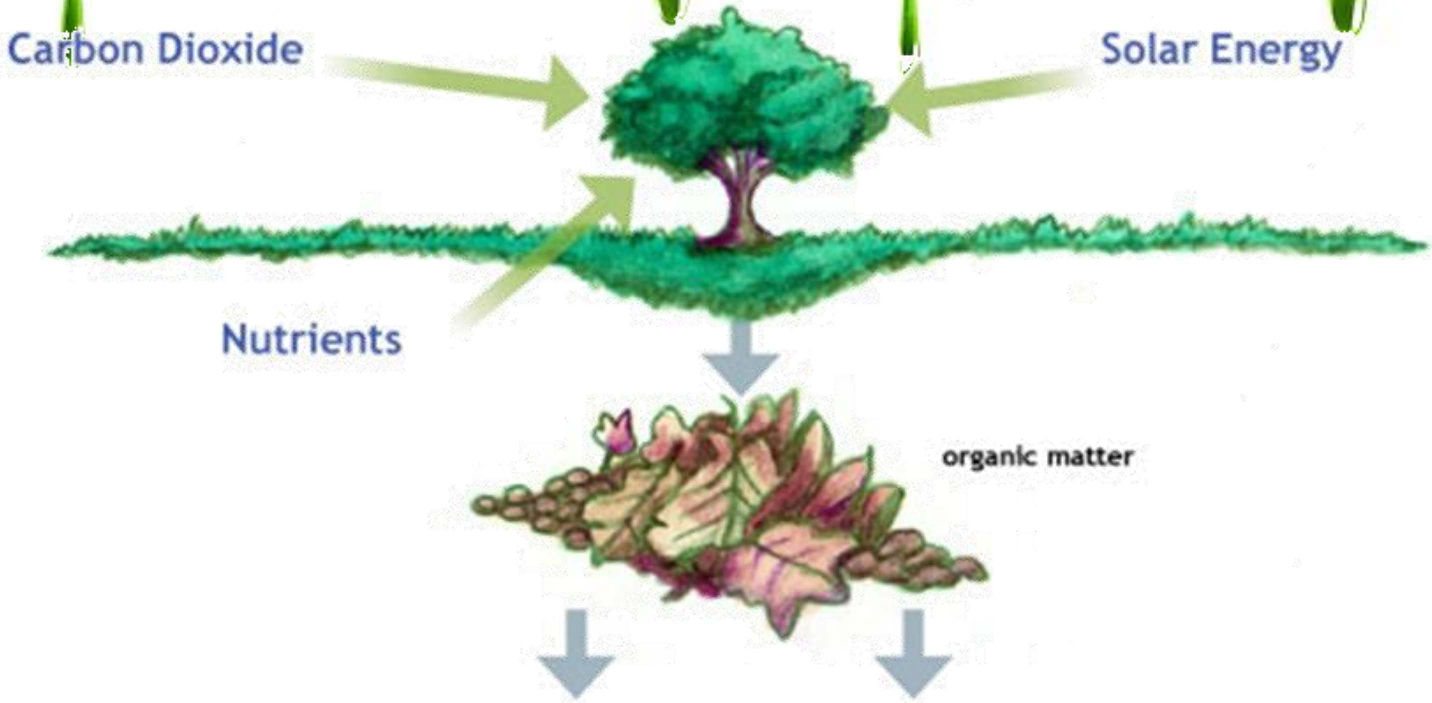
Plants fill the role of Producers in a community

Plants are special because they have leaves and are able to produce their own food by the process of **photosynthesis** from sunlight using raw materials that they get from the air and soil.
Plants can be thought of as 'food factories' which provide most living organisms on Earth with a source of energy and food.
They produce the energy that is at the start of any food chain and therefore the group of plants are known as **Producers**.

Community – a group of different species living together and interacting



The importance of plants as producers.



Food entering the food chain

Producers are at the beginning of a food chain. On land, Producers are plants. Plants are at the beginning of every food chain that involves the Sun. All energy comes from the Sun and plants make food with that energy using the process of **photosynthesis**. Energy in the form of nutrients and food are passed onto other organisms when they eat (consume) the plants.

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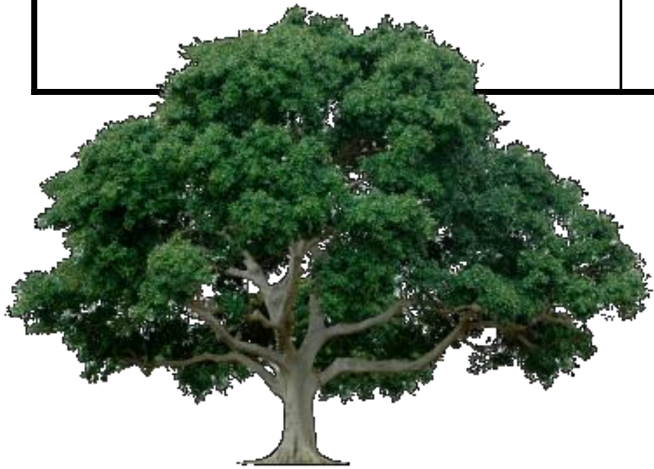
The role of producers, consumers and decomposers in food chains and webs.

Three feeding roles that species can have in a community are as producers, consumers or decomposers.

Producers	Consumers	Decomposers
Plants that make food from carbon dioxide, light and water	Herbivores that eat plants and carnivores that eat other animals	Fungi and bacteria that break down the bodies of dead plants and animals



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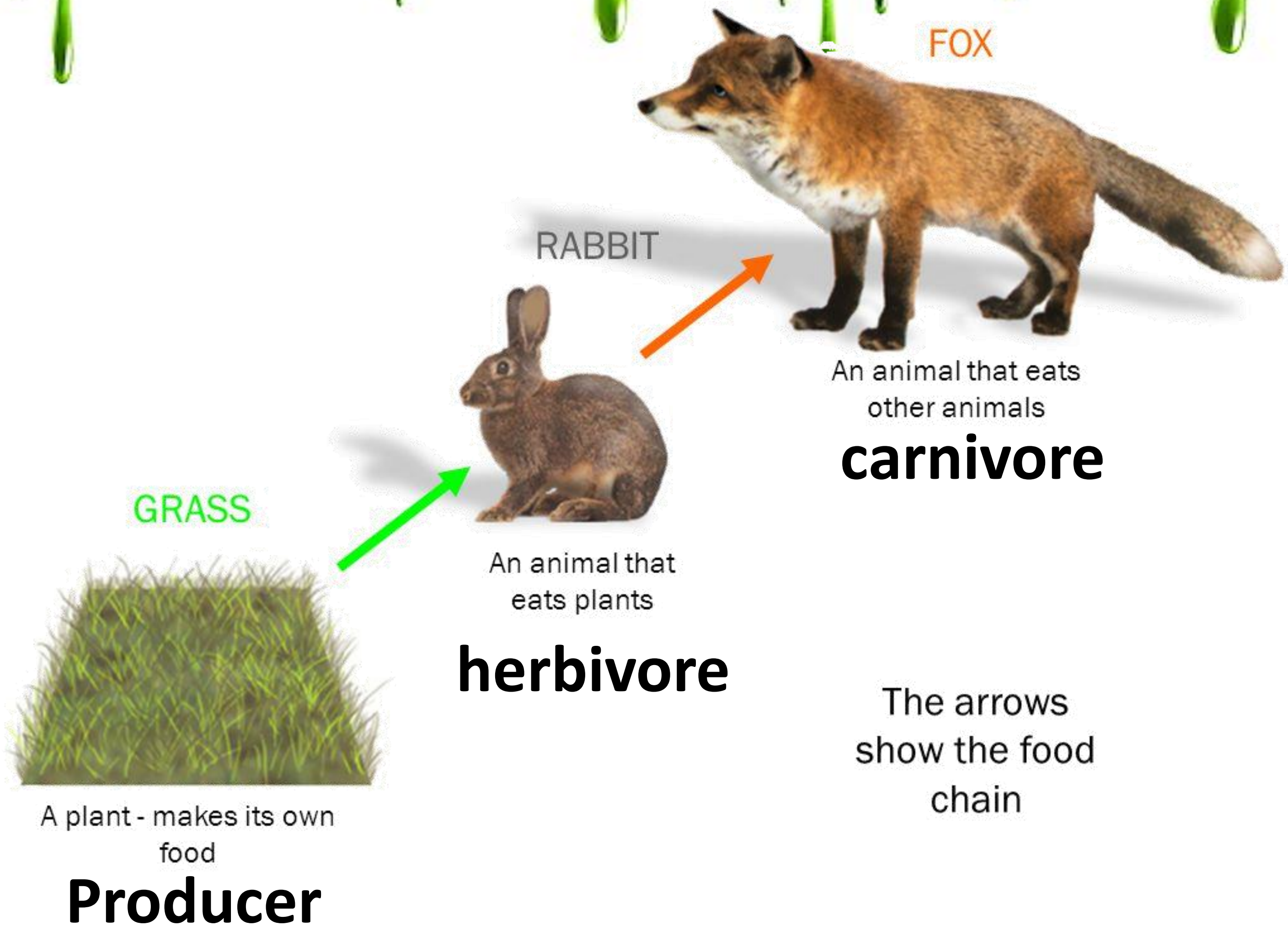
The definition of consumers

Herbivores	Omnivores	Carnivores
Herbivores are animals that eat plants only. (plant eaters) In a food web they are directly above the producers	Omnivores eat both plants and other consumers. They obtain their food from more than one source.	Carnivores eat only other consumers (meat eaters). This also includes birds that eat only insects.

The role of producers in food chains and webs.



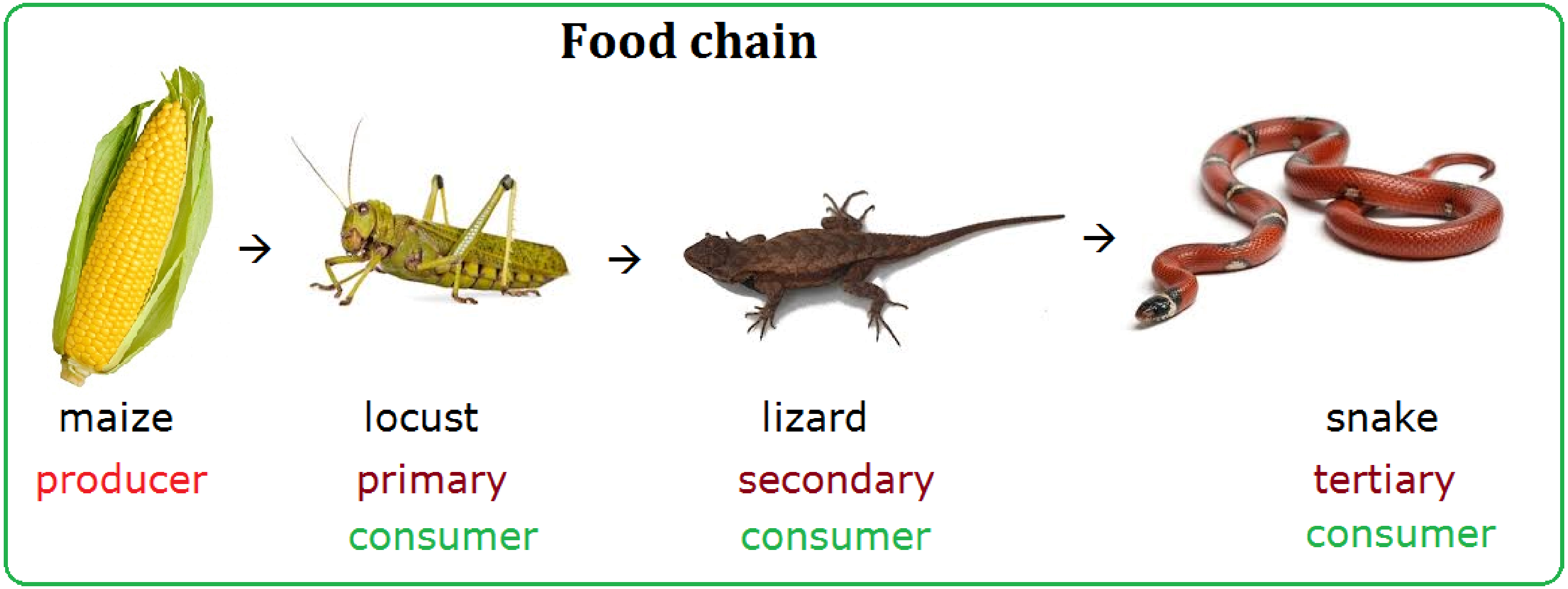
A food chain is a series of organisms through which energy flows; first link is always a plant.

The role of producers, consumers and decomposers in food chains and webs.

Food Chains

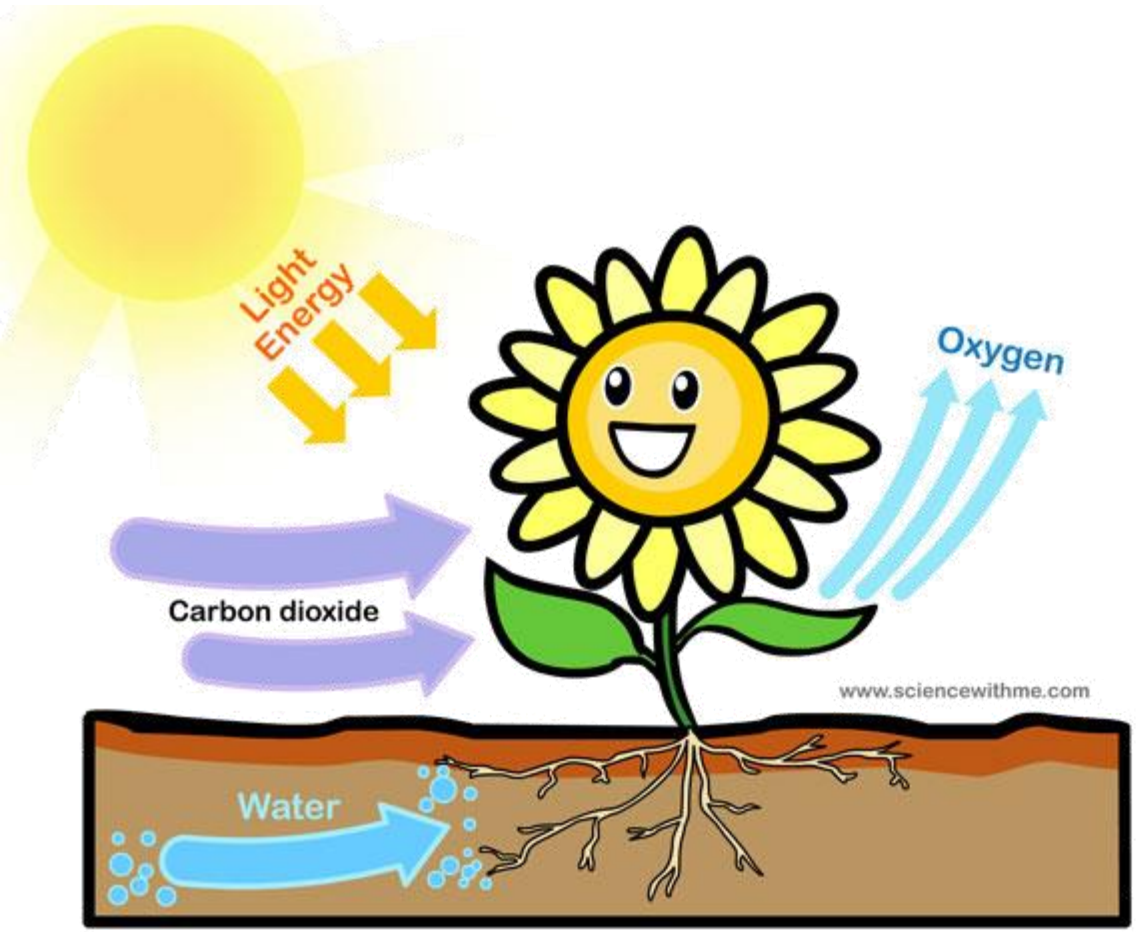
The feeding of one organism upon another in a sequence of food transfers is known as a food chain.

Arrows go from the organism being eaten to the organism eating it showing the direction of flow of energy



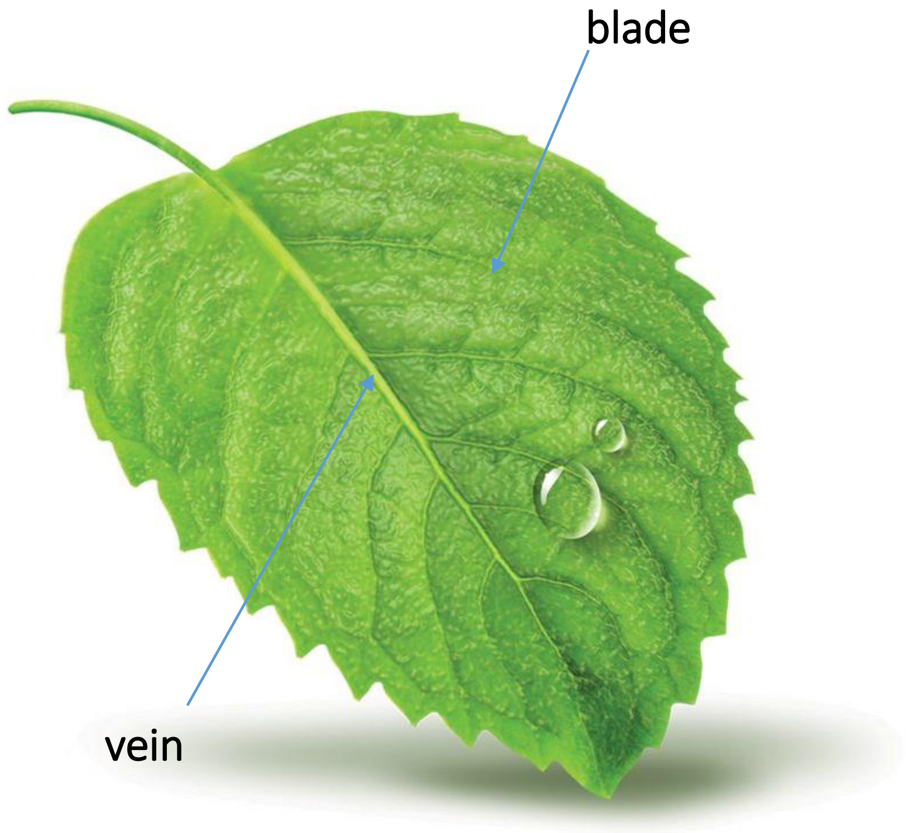
https://www.tes.com/lessons/cqHs1lgfbIsRtQ/food-chain-references

The significance of photosynthesis in making food



Most living organisms depend on plants to survive. Plants convert (change) energy from sunlight into food stored as carbohydrates through **photosynthesis**. Because animals cannot make their own food, they must eat plants (producers) to gain nutrition. Plants produce oxygen, which is released during photosynthesis, which all organisms need for **respiration**.

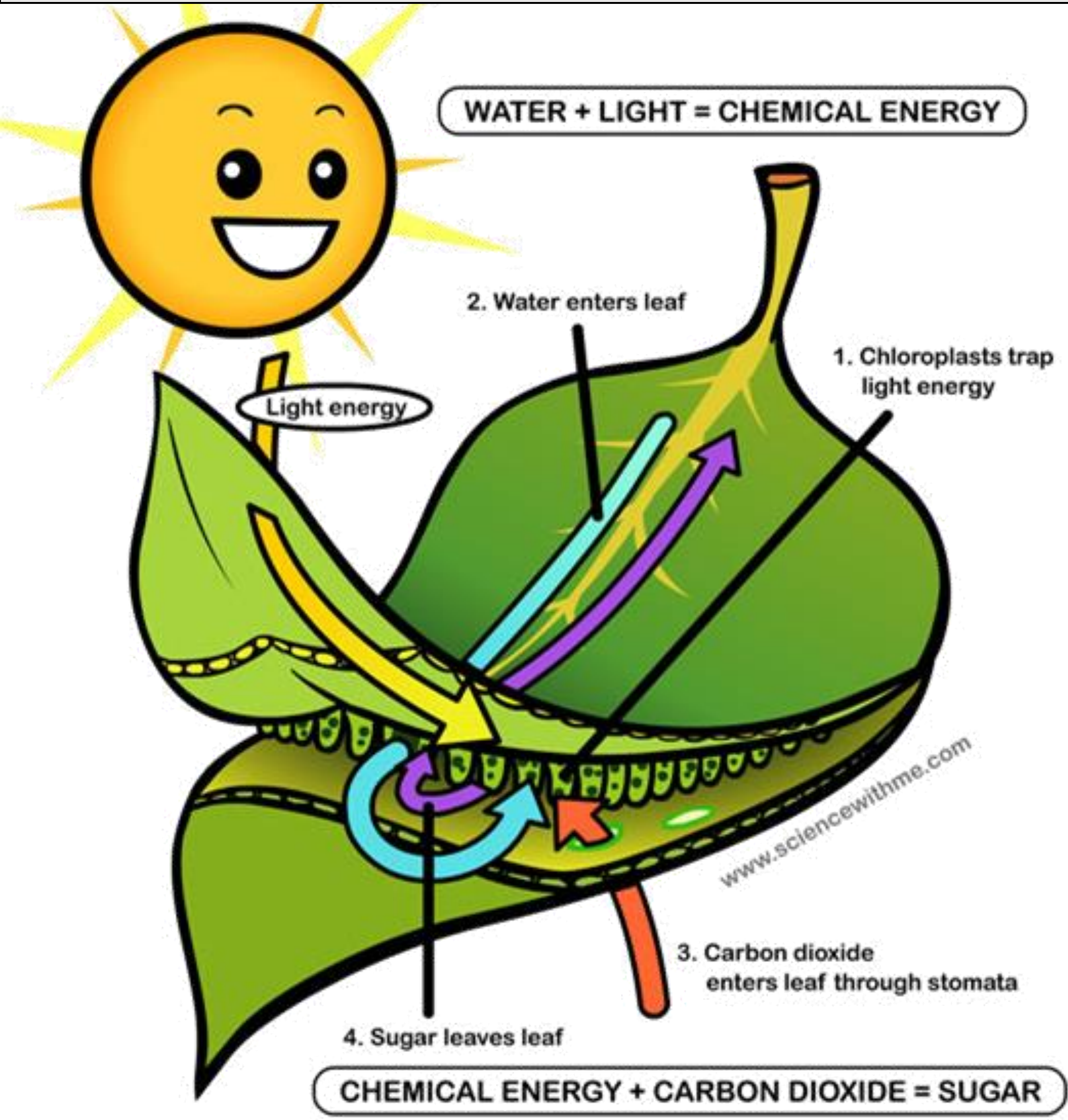
The leaf is the location of most photosynthesis



The **flat surface** of the leaf called the blade helps capture maximum sunlight for **photosynthesis**.
The leaf is attached by a stem to the plant which branch out into veins.
The **large surface area** of the leaf helps capture as much sunlight as possible.
The **green colour** is due to chlorophyll in the leaf cells that captures the light, and where photosynthesis takes place.
The **leaf is thin** to allow light (and carbon dioxide gas from the air) to circulate to every cell in the leaf.

http://www.kja-artists.com/open.asp?p=11673

Photosynthesis transfers energy from sunlight into energy in chemicals such as glucose and starch.



Light enters the leaf and is trapped by a green substance called chlorophyll contained within structures called the chloroplasts in the cells.

Water is transported via water tube cells to the leaf cell and the **carbon dioxide** enters through the <u>stomata</u> and diffuses (spreads) to the leaf cells.

These substances react chemically within the chloroplasts; powered by the light then **glucose** (a sugar) is produced along with **oxygen,** which diffuses out. The sugar leaves the leaf via sugar/food tube cells.

Reactants and products of photosynthesis

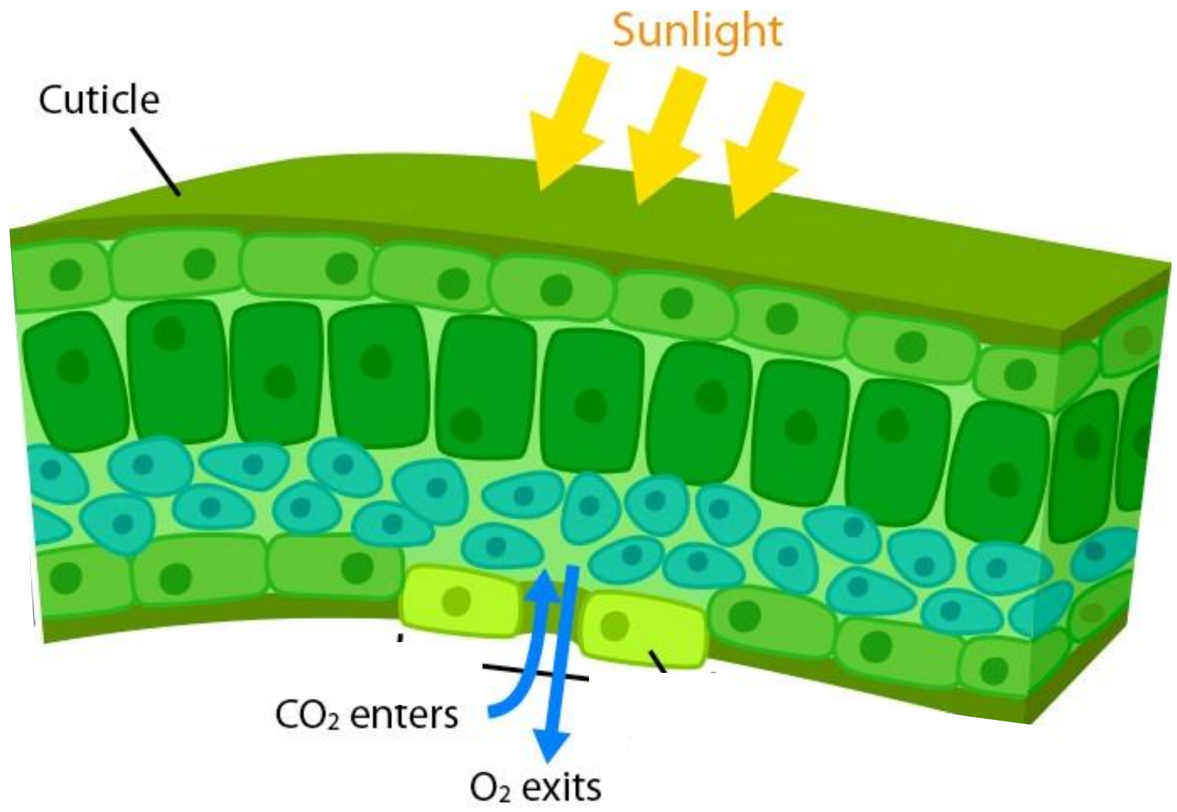
The photosynthesis reaction can be written as a chemical equation with the reactants needed on the left and the products produced on the right

$$\text{Carbon dioxide} + \text{Water} \xrightarrow{\text{light}} \text{Glucose} + \text{Oxygen}$$

Word equation

Photosynthesis happens in the chloroplasts/ chlorophyll in the leaf cells

The cells at the top of the leaf are filled with **chlorophyll,** which gives leaves the green colour. The chlorophyll allows the leaf to absorb light energy, which is required for photosynthesis. The **spaces between cells** in the middle allow carbon dioxide to diffuse around through the cells.

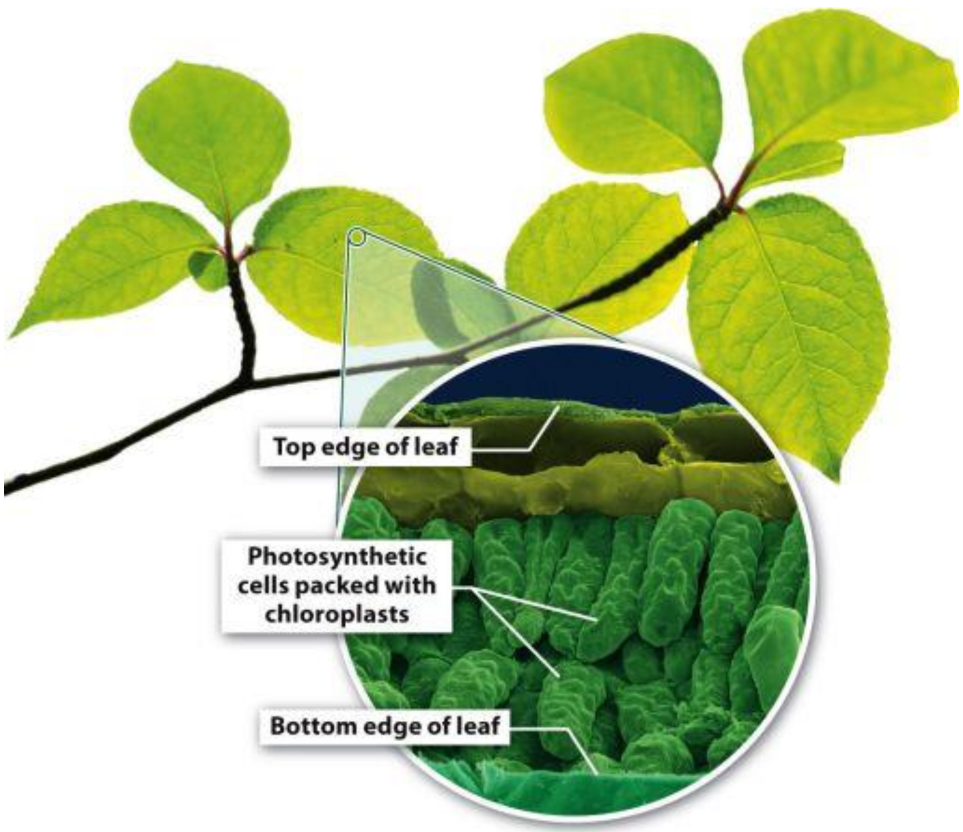


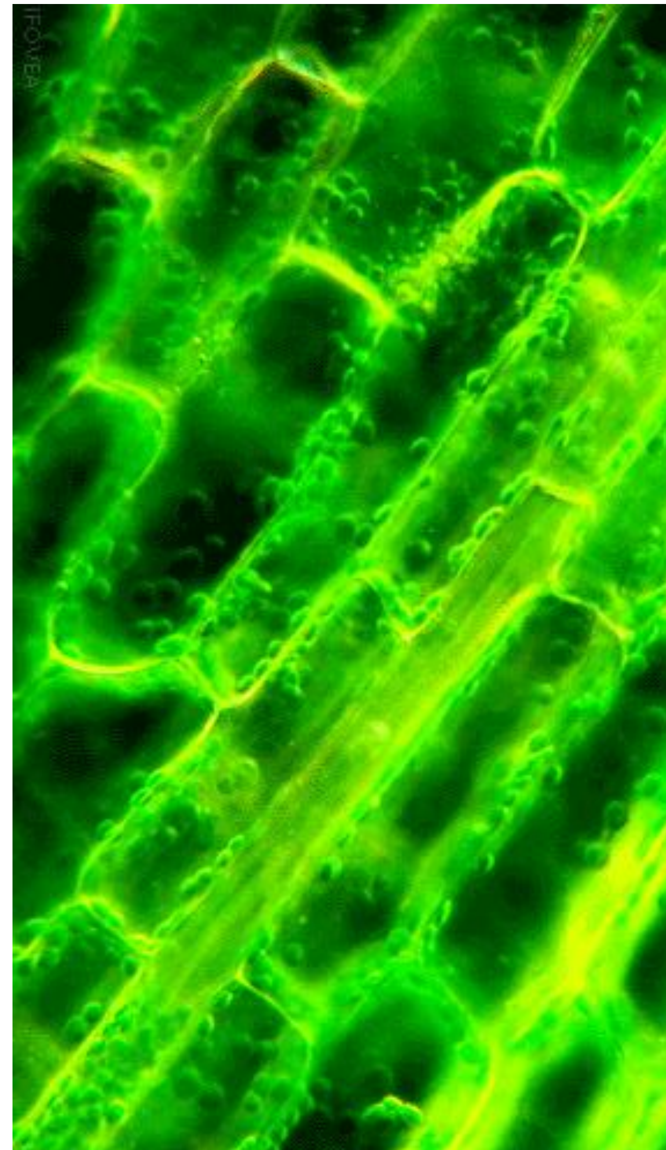
Cross-section of a leaf

https://askabiologist.asu.edu/cam-plants

Photosynthesis happens in the chloroplasts/ chlorophyll in the leaf cells

The chloroplasts circulate around the cells, especially the layer of cells that are close to the top of the leaf. This allows maximum amounts of light to be distributed to the chloroplasts for photosynthesis to take place.





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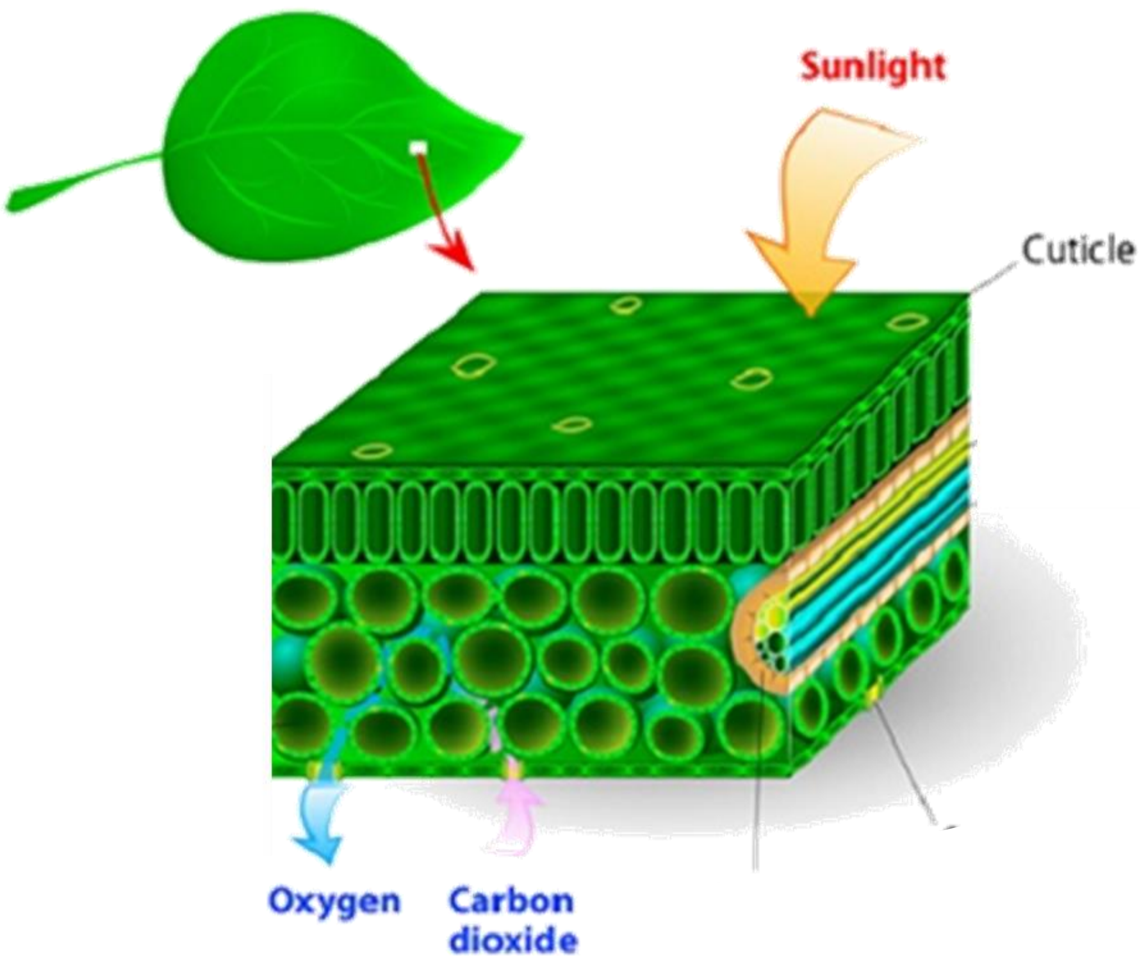
The adaptations of leaves for photosynthesis

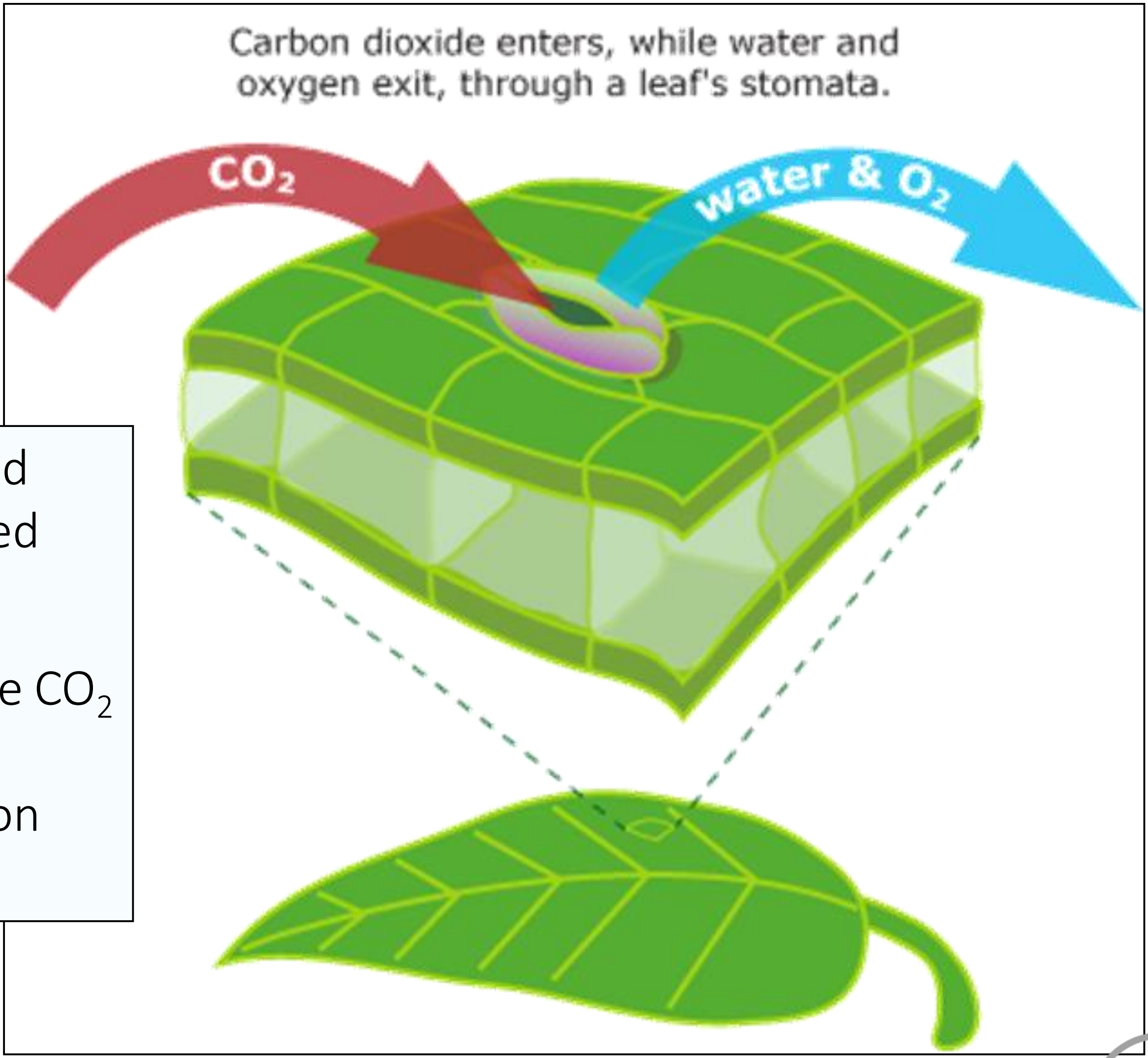


A waxy **cuticle** on the outside of the leaf provides a waterproof covering while remaining **transparent** to allow light into the leaf cells for photosynthesis.

Openings (usually on the underside of the leaf) called **stomata** allow carbon dioxide to enter and diffuse into cells as well as allowing oxygen to move in and out.

Two guard cells on either side of the stomata open and close the openings.

The role that stomata have in the process of photosynthesis



Stomata are normally found only on the under or shaded sides of leaves.

Their function is to capture CO_2 from the atmosphere by exchanging water for carbon dioxide.

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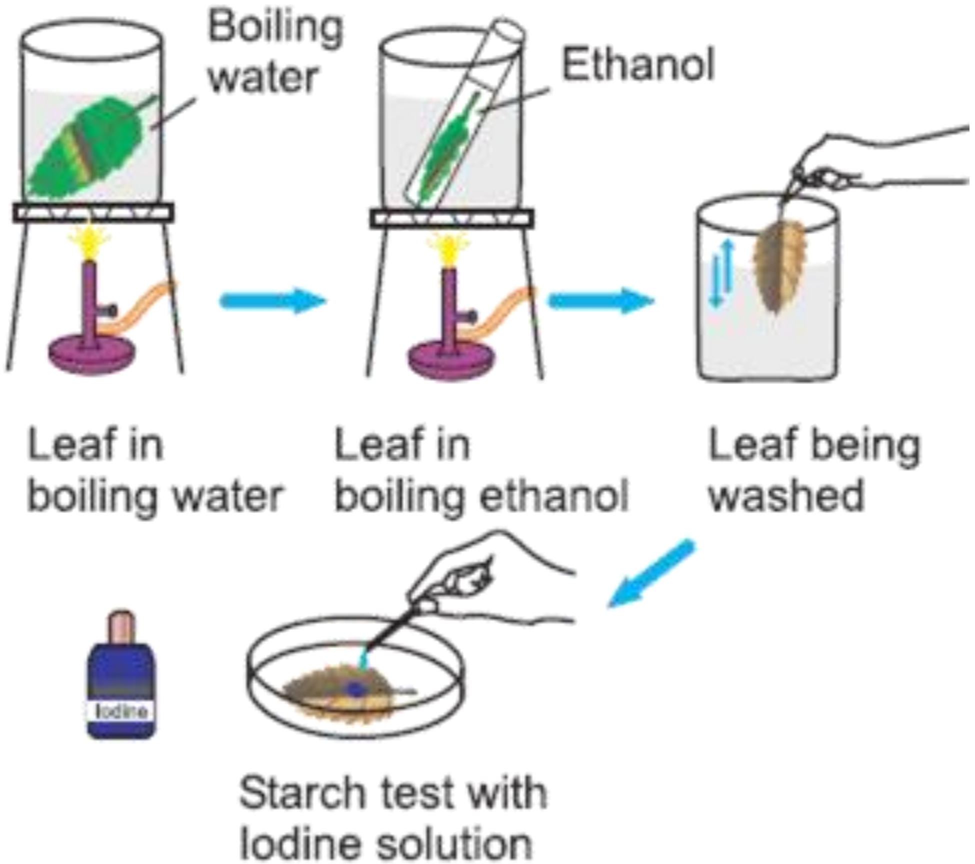
Starch test

A positive test for starch is the **leaf turning blue- black** when iodine is added. The starch is the storage product of the plant when it produces photosynthesis. A positive test means photosynthesis has occurred.



Step 1. The leaf is boiled in water to soften it.
Step 2. The leaf is then placed into a boiling tube of ethanol, which is placed in a beaker of water and heated gently. This will remove the green chlorophyll.
Step 3. The leaf is washed in water to remove all of the ethanol.
Step 4. Iodine added to the leaf. It will turn blue-black in the presence of starch. The starch indicates photosynthesis and the production of glucose has occurred.

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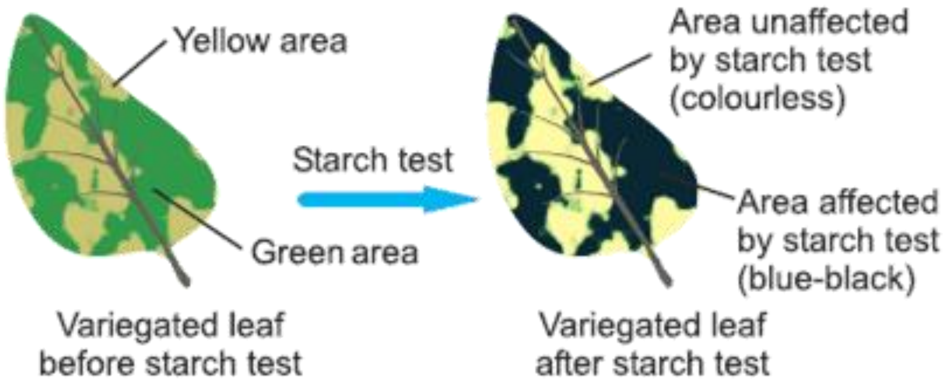
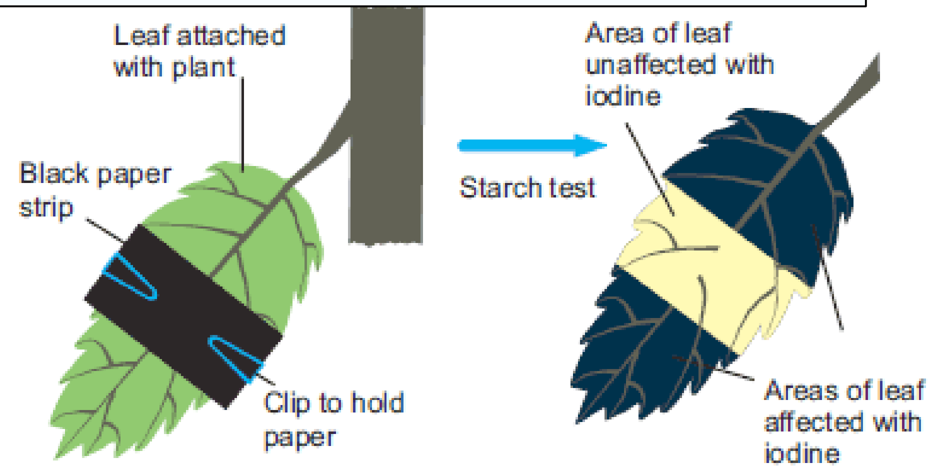
Investigations into photosynthesis requirements

We can Investigate that photosynthesis happens in the chloroplasts/chlorophyll in the leaf cells and use the starch test as evidence. When a plant undergoes photosynthesis, it produces glucose, which is converted into starch for storage. If we want to **investigate** what **factors** are required for **photosynthesis** we use the starch test to enable us to reach a conclusion. Factors include chlorophyll, water, carbon dioxide and light present.



Investigating if Chlorophyll is required for photosynthesis:
Select a leaf that is variegated leaf. The green parts contain chlorophyll and the white parts do not. To show chlorophyll is required for photosynthesis only the previous green areas will turn **blue - black.**



Investigating if light is required for photosynthesis:
Place a piece of black paper over a leaf and leave for a few days still on the plant. To show light is required for photosynthesis only the uncovered areas will turn **blue - black**.

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Māori scientific knowledge and understanding of their use of plants - Tawa

Over a long period of time Māori have built up their scientific knowledge and understanding of their use of plants for medicine (Rongoa), food, clothing and housing.
Many of these uses are still practiced today.

Tutu. Photographer: Michael Hall. © Te Papa & Ngati Toa. Tutu ointment being applied to arthritic wrist.

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Māori scientific knowledge and understanding of their use of plants - Rata

The rātā tree bark can be made into a lotion or poultice, and the flower nectar can used for sore throats.

White and Red Rata from Maungatautari

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Māori scientific knowledge and understanding of their use of plants - Kawakawa

Kawakawa can be made into a tea, poultice or chewed for toothache, sore stomach, and pains

[Te Ara - The Encyclopedia of New Zealand]
Photograph by Emily Tutaki

Kawakawa from Maungatautari

Māori scientific knowledge and understanding of their use of plants - Harakeke

The root can be boiled and then smeared it on as an ointment.

The flax root and leaf can be used for boils, bruises and bleeding, burns, toothache, worms, indigestion, measles.

Harakeke also has many uses as kete (baskets) and food carriers. The tough fibre in the plant can be used for fishing nets and traps, footwear, cords and ropes.

Various types (cultivars) of flax were seen as having specific uses by different iwi. ‘Māeneene’ - Ngāi Tūhoe -fine patterned mats. Ngāti Porou -‘Tākirikau’ - piupiu (kilts). ‘Kōhunga’ - Ngāti Maniapoto - finest cloaks.