2018
Version

Cells and Ecology

Junior Science

http://www.kwipped.com/rentals/laboratory/microscopes/324

All living things share the characteristics described in MRS C GREN

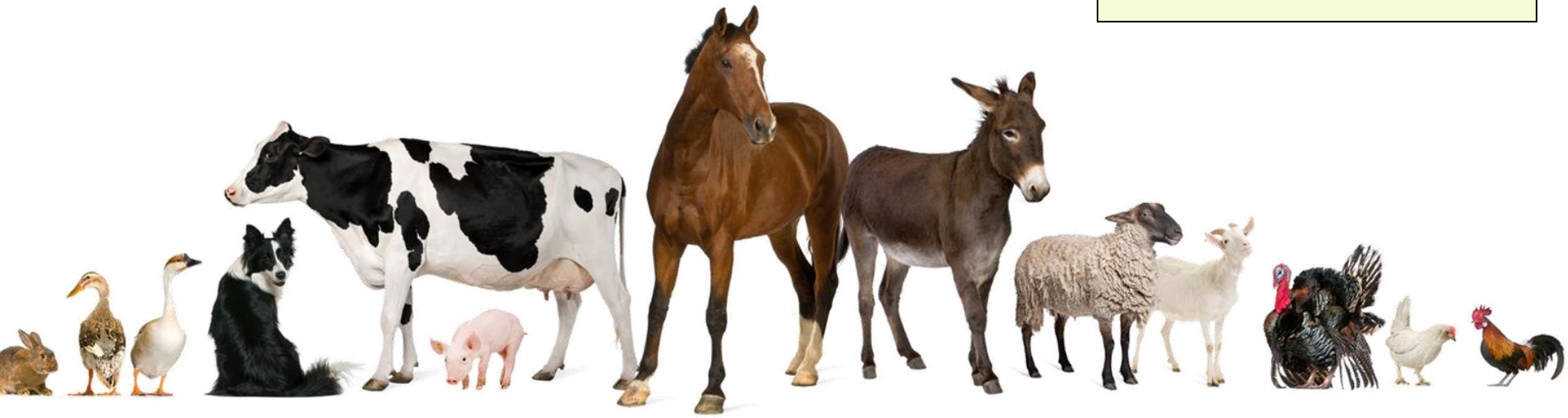
Biology is the study of living things

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.



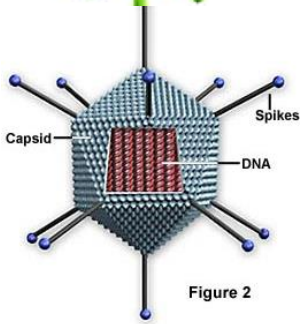
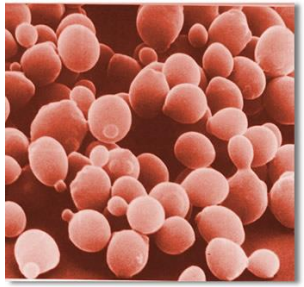
All living things share the characteristics described in MRS C GREN

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

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 MRS C GREN – living objects show **ALL** of the life processes, not just some, and are made up of **CELLS.**

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

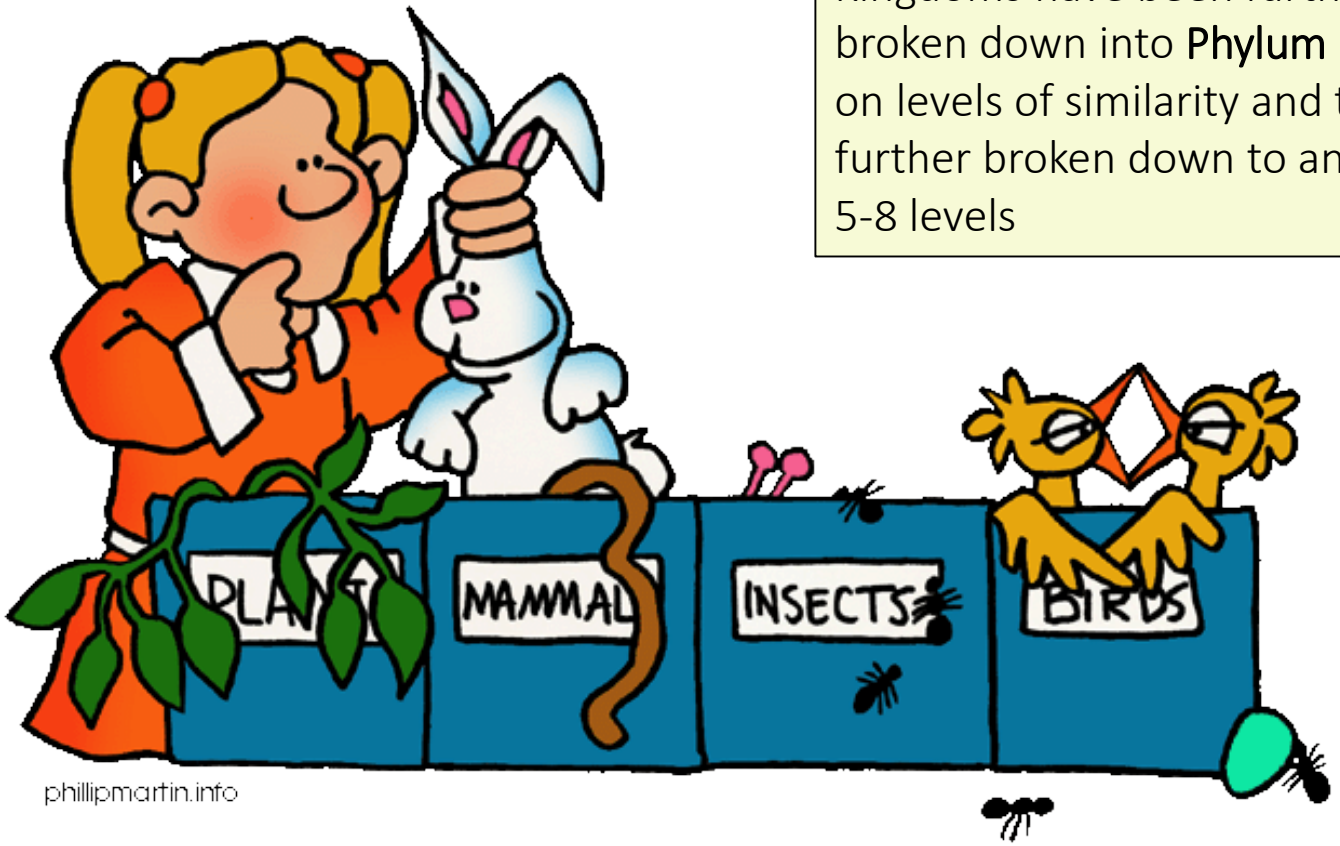
fire 	fish 	virus 	algae 
jellyfish 	coral 	mould 	bacteria 
amoeba 	crystals 	yeast 	fungus 

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.

Kingdoms have been further broken down into **Phylum** based on levels of similarity and then further broken down to another 5-8 levels

extra info



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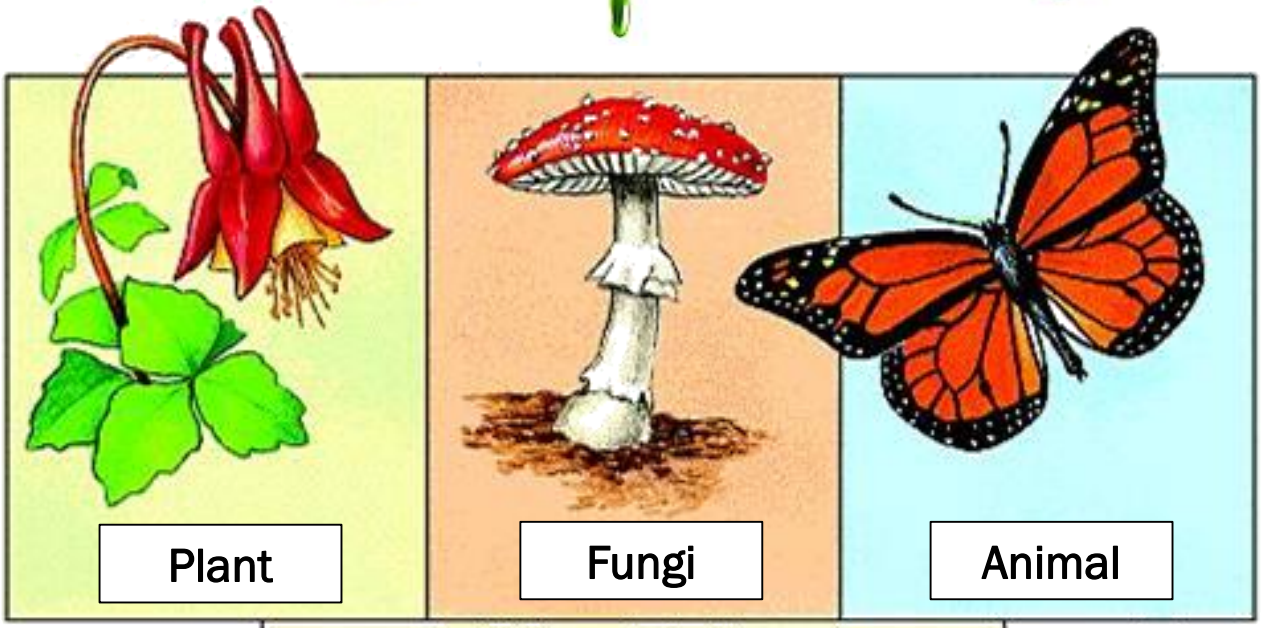
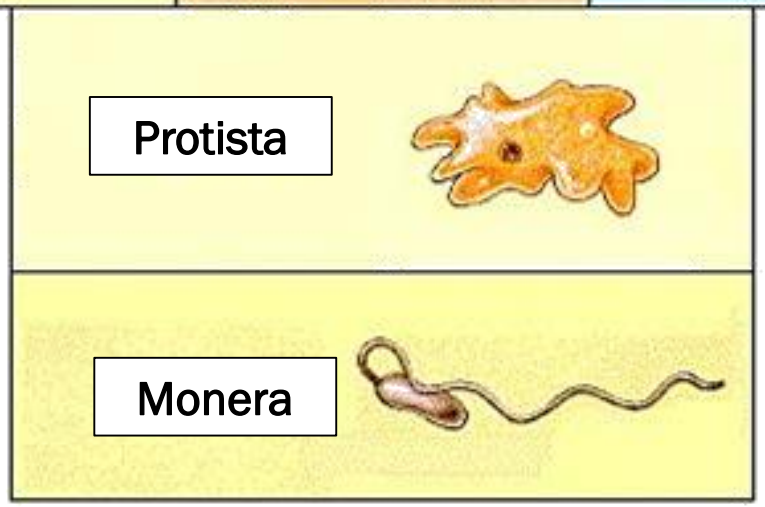
The main groups that living things are classified into; Bacteria (Monera), Protists, Animals, Plants, Fungi

Traditional classification of organisms into 5 kingdoms is based on differences in body structure





Single celled organisms

Bacteria

extra info

After the development of microscopes, scientists discovered there was more differences at cellular level within the **Monera** (Bacteria) Kingdom than between all the other 4 kingdoms put together.

extra info

The Kingdoms can be further divided into Phylum

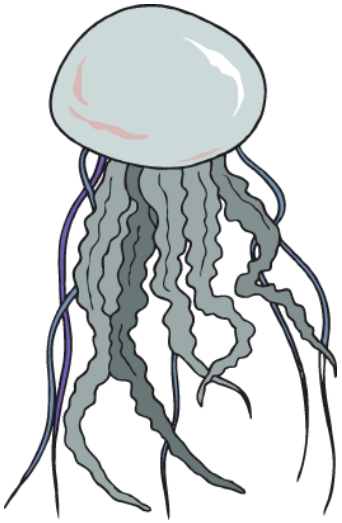
The **Kingdoms** have been broken down into smaller groups called **Phylum**.

The major Phylum of the Animal Kingdom that we are familiar with include the sponges, Jelly fish, worms, molluscs, Arthropods (Insects/spiders/crustaceans) and Vertebrates (all animals with a backbones)

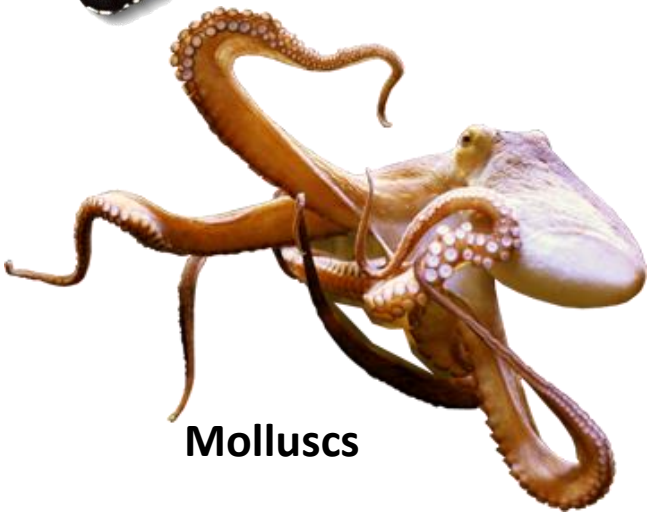
worms

Arthropods

Vertebrates



jellyfish



Molluscs

extra info

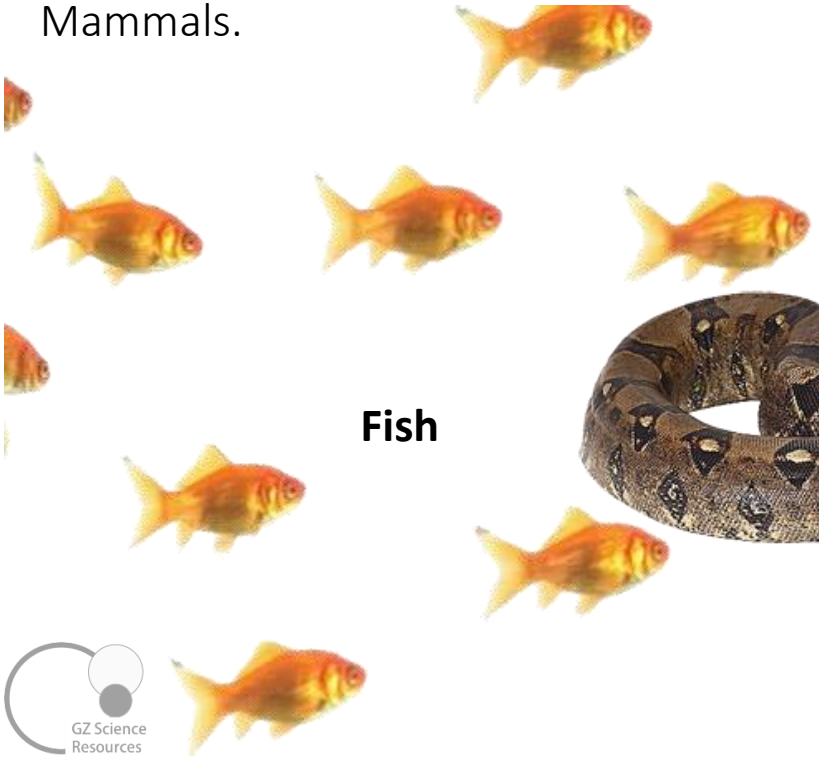
Phylum can be divided into Classes

The **Phylum** of Animals with internal skeletons (actually called Chordata – for the spinal chord) is divided into groups called **Classes**.

The main classes are; Fish, Amphibians, Reptiles, Birds and Mammals.

Amphibian

Mammal



Fish

Reptile

Bird

extra info

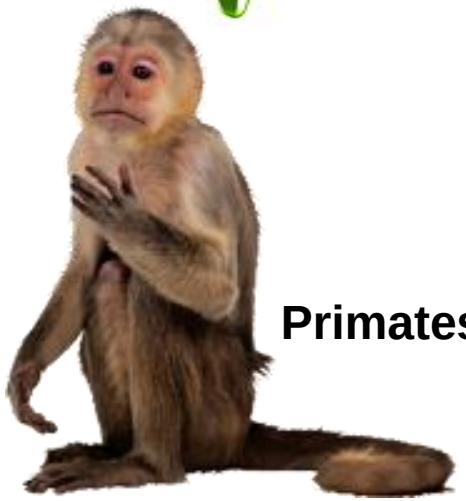
Classes can be divided into Orders

The **Class** of Mammals can be further divided up into many **Orders**.

Some of the common Orders of Mammal include; Carnivores, elephants, Whales, Rodents and our Order the Primates.

Although Mammals have been around as long as the dinosaurs, most of the modern Orders evolved rapidly at the start of the Palaeocene 65 Million years ago once the Dinosaurs and many other Reptile species became extinct. This left many niches open for Mammals to fill and since that time Mammals have gone on to live in the water, the air, underground and nearly every place above ground.

Seals



Primates

Whales

Carnivores

Bats

Background Knowledge

Scientific Naming

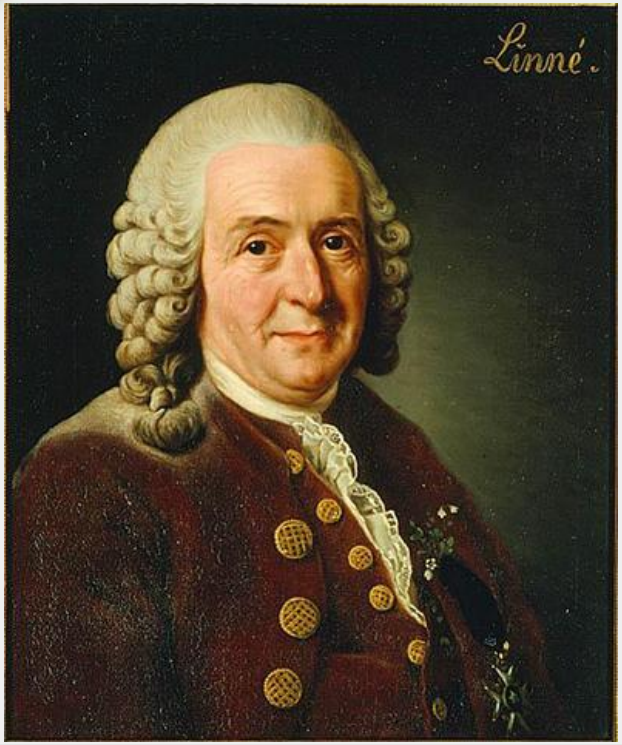
extra info

In the **binomial system**, every organism is classified given two names:

First the name of the **Genus** that the organism is in. This is written first with a capital letter.

Second the name of the **species**. This is written in lower case.

Both names are either underlined or written in italics.

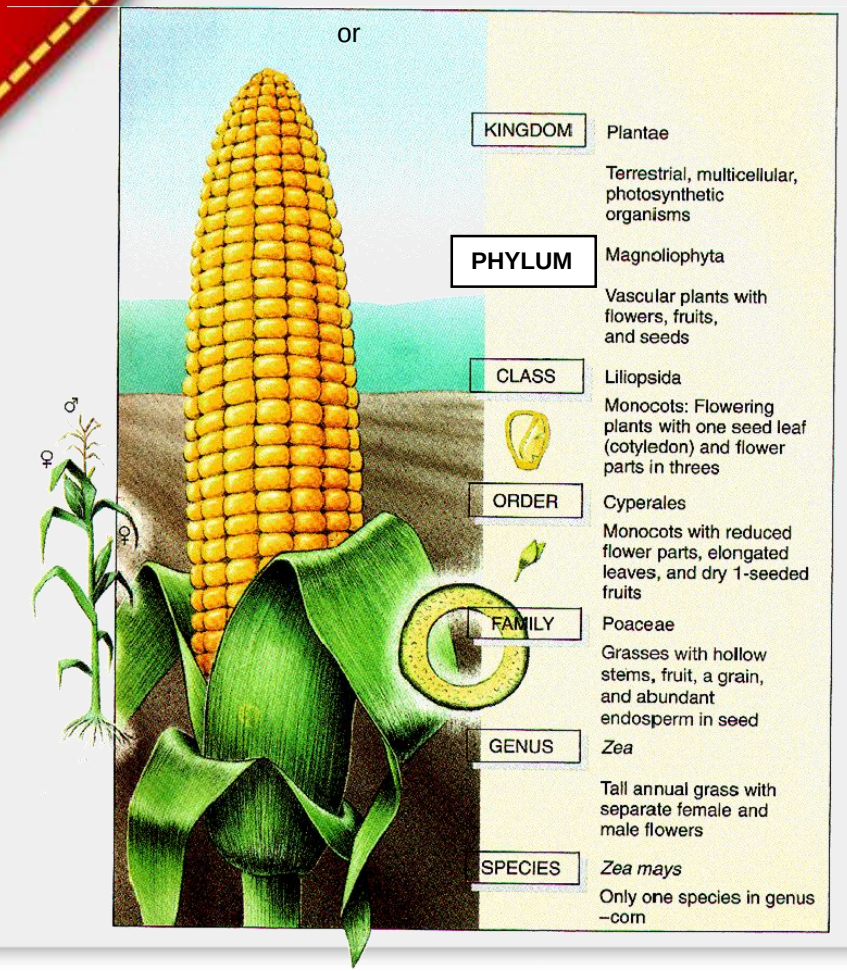


The adoption of a system of binomial naming is due to Swedish botanist and physician Carolus Linnaeus (1707 – 1778) who attempted to describe the entire known natural world and gave **every species** a two-part name.

Background Knowledge

Classification System

extra info



Grouping of organisms is made by comparing their fossil histories, body structures, DNA, behaviour etc.

The lowest level in the Classification is the species – A species is defined as all organisms that can breed together to produce viable (alive and able to reproduce) offspring.

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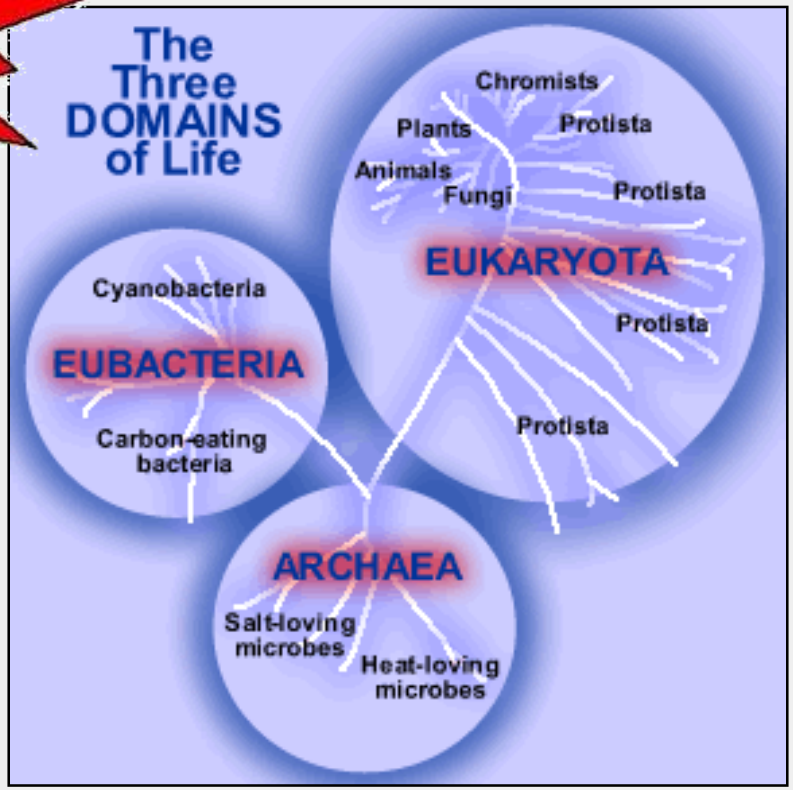
Background Knowledge

Classification of living organisms

extra info

Recent advancements in Science have lead biologists to develop a new classification system, grouping organisms into **domains**.

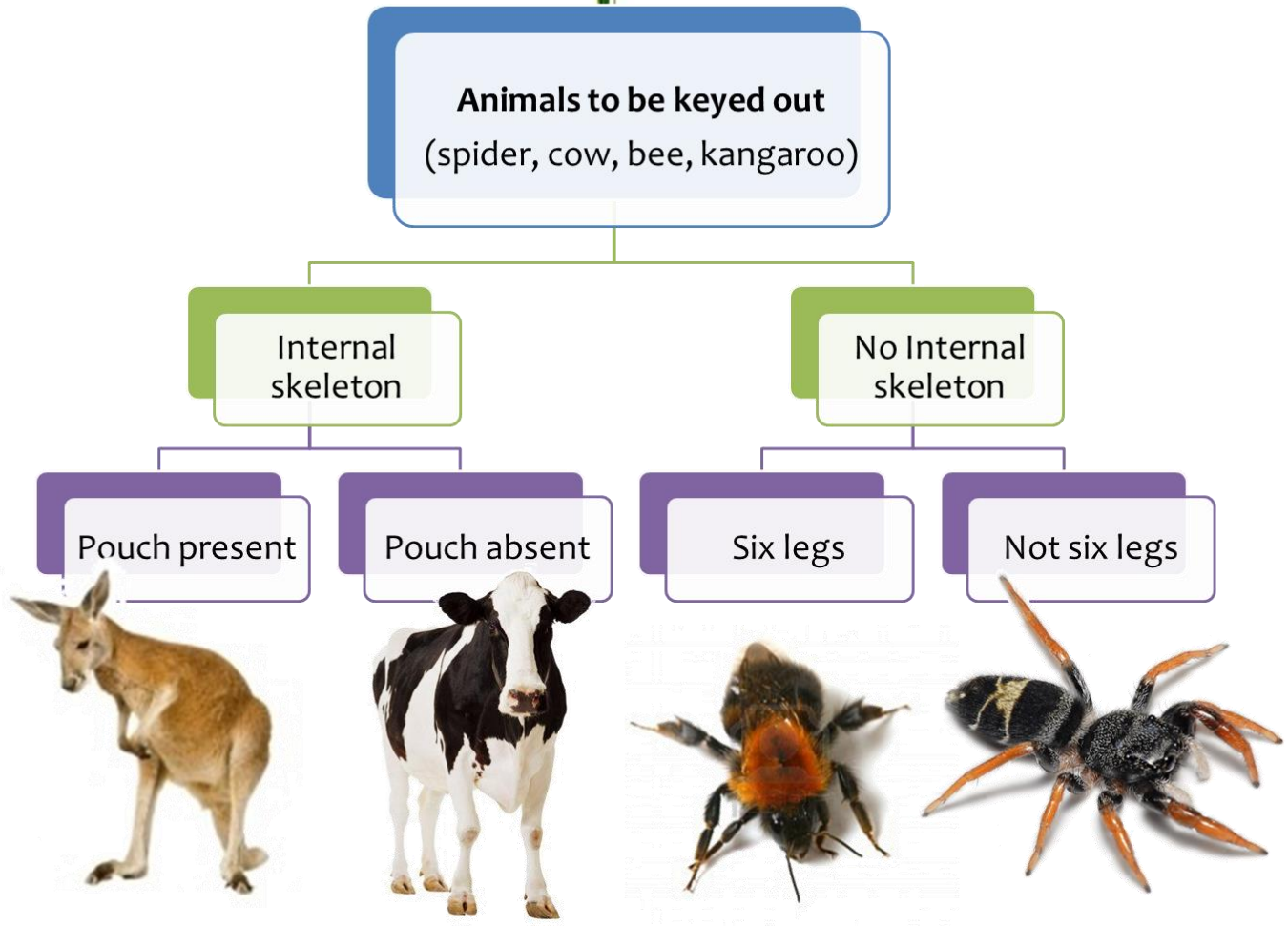
News Flash!



The **Prokaryotes** (cells with no nucleus) are divided into Bacteria and the more 'primitive' Archaea. These were once combined as the Monera kingdom.
The **Eukaryotes** share similar cell structure with organelles and a nucleus. These were once divided into the Fungi, Protista, Plant and Animal kingdoms

What is a dichotomous identification key?

Dichotomous means branched. 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**.



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 at all 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

Making a simple dichotomous identification key.

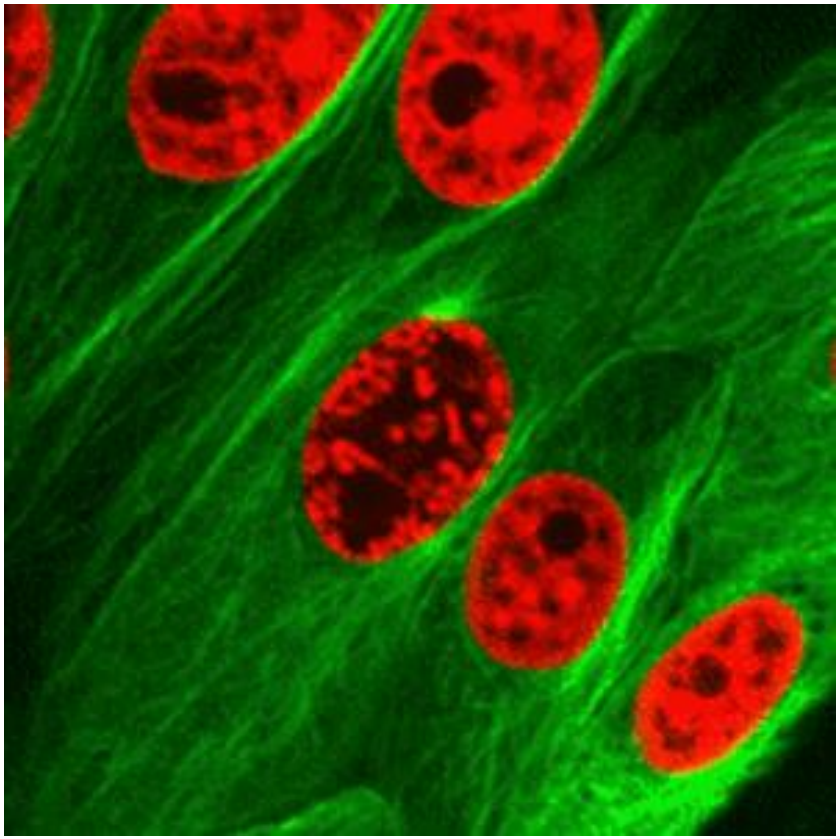
If we are making a key based on observations of physical features that we can see, the first step must be a feature that can divide all of the living organisms into 2 groups.
For example below we could divide the birds below into those that have tuffs of feathers on their heads (spotted shag and crested 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 it's 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** – consist of one independent cell, or be **multicellular** – organised networks of cells with different functions and structures; humans have 100 trillion cells.



extra info

Organisms are divided into two groups by their cell type; **Prokaryotes (Bacteria)** and **Eukaryotes (All other kingdoms)**.

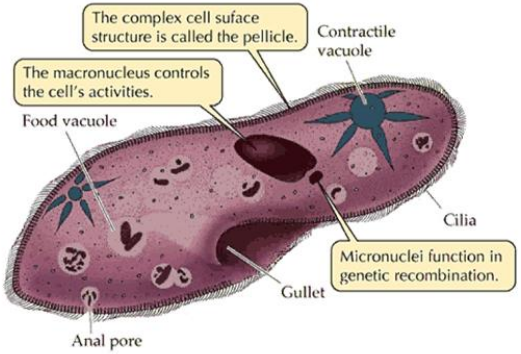
Background Knowledge

All living organisms are made up of cells.

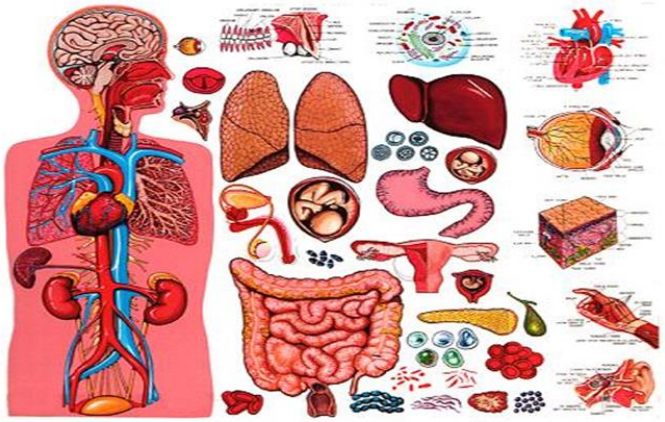
extra info

Unicellular	Multicellular
>fully functioning (MRS C GREN) independent cell unit >can be grouped into colonies (eg algae) but are still able to separate and survive >most kingdoms have examples of unicellular organism	>cells within an organism are specialised to perform a life function (or part of one) >single cells cannot live independently >all cells co-ordinate into one organism to collectively perform all the functions of life. >generally Plant and Animal kingdoms are multicellular

Paramecium - Protist



Human - Animal



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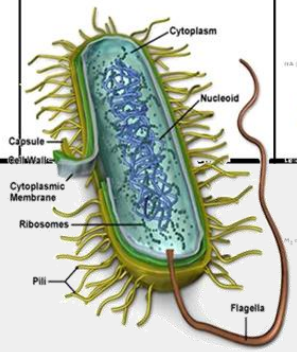
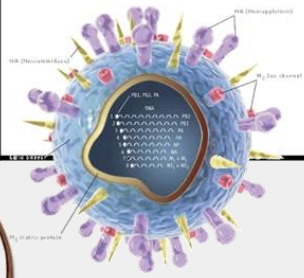
Background Knowledge

All living organisms are made up of cells.

extra info

Animal	Plant	Bacteria	Virus
enclosed by a plasma membrane and containing a membrane-bound nucleus and organelles. >small vacuoles, **no** chloroplasts, **no** cell wall.	similar to the animal cell, <u>but</u> >It **does** have a rigid cell wall, central vacuole, and chloroplasts.	Does not have nucleus or organelles (except ribosomes).	Not considered living or consisting of cells but contains genetic material (RNA/DNA) similar to all other living things.





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

Cell Wall

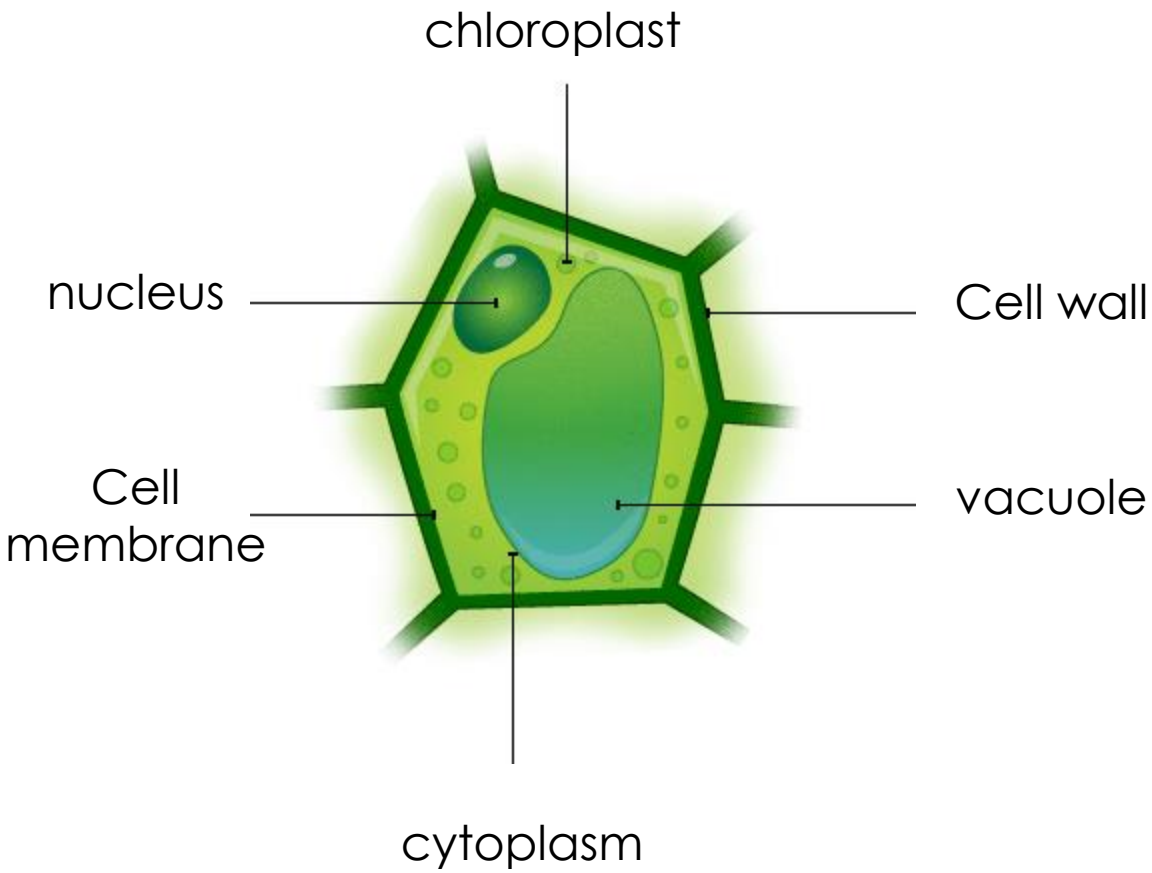
Gives the cell rigidity and a more angular appearance.

Chloroplasts

The site of photosynthesis, gives the cell it's characteristic green colour

Vacuole

Assists with storage and structure



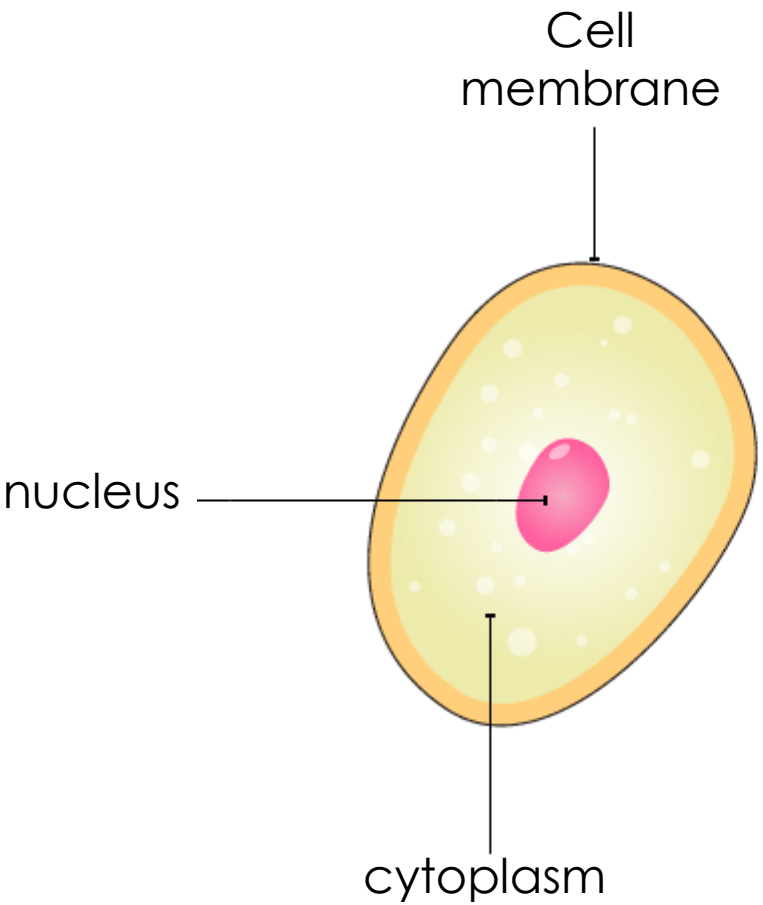
http://www.bbc.co.uk/bitesize/standard/biology/investigating_cells/cells_and_diffusion/revision/5/

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



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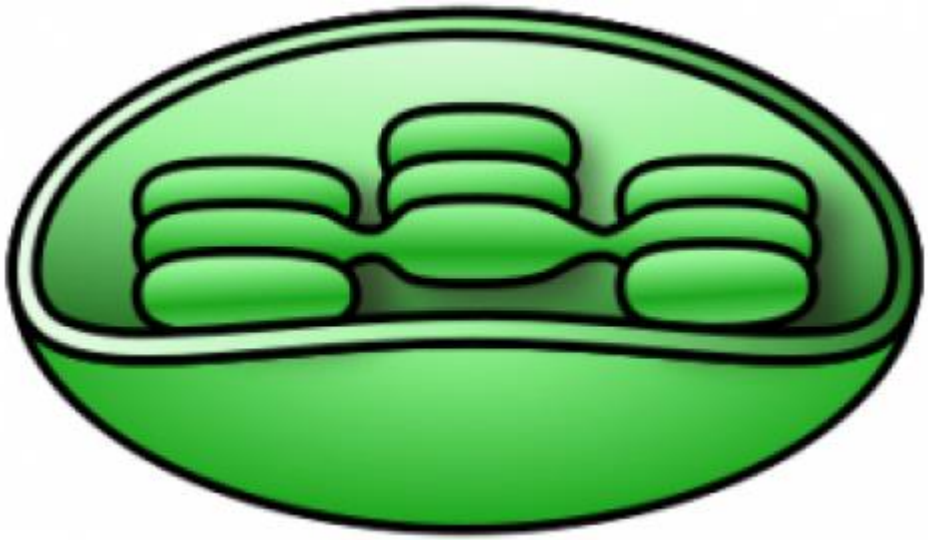
Chloroplast (Plant cells only)

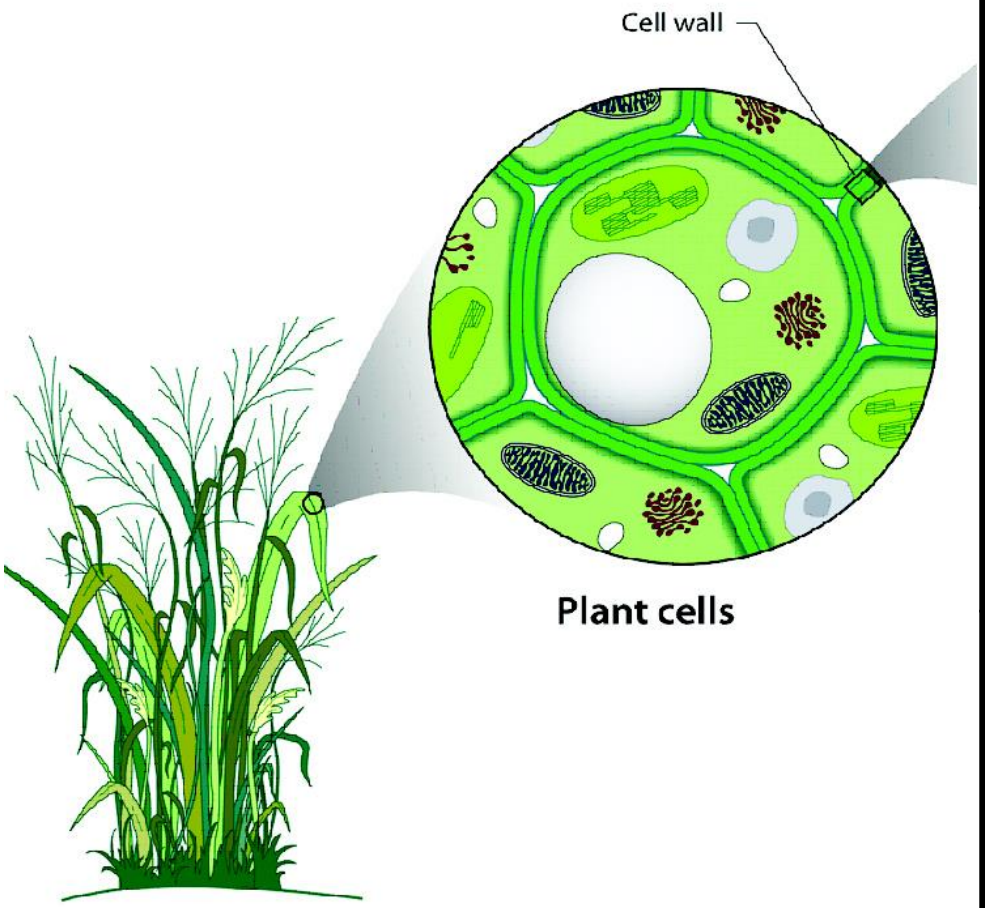
extra info



Location:	Spread within the cytoplasm of plant cells only. Most found in plant leaves.
Relative size:	Can be seen with a light microscope, about 10 micro meters.
Function:	Site of photosynthesis converting sunlight into stored energy for the organism.

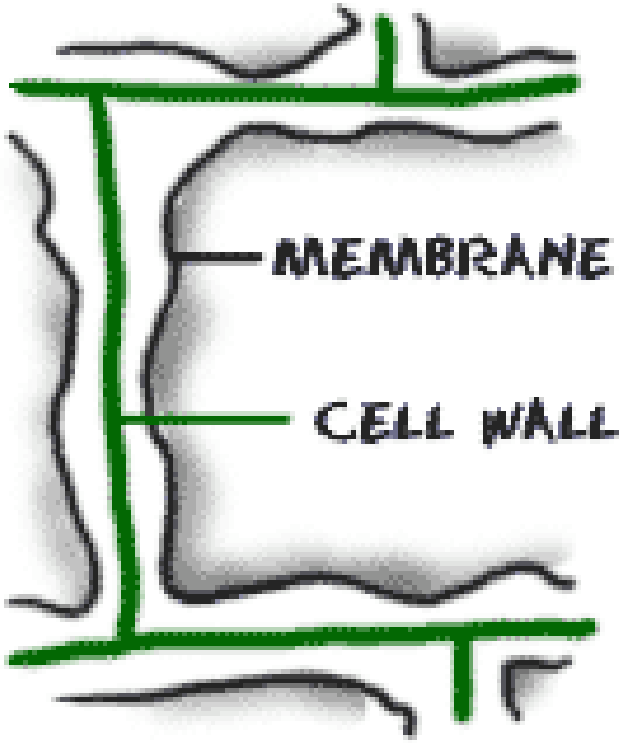
extra info

Plant Cell Wall.



Location:	The rigid, outermost covering of plant cells.
Relative size:	Much thicker than the cell membrane, varies with position on plant.
Function:	Protects the cell contents and gives rigidity to the plant to hold it upright

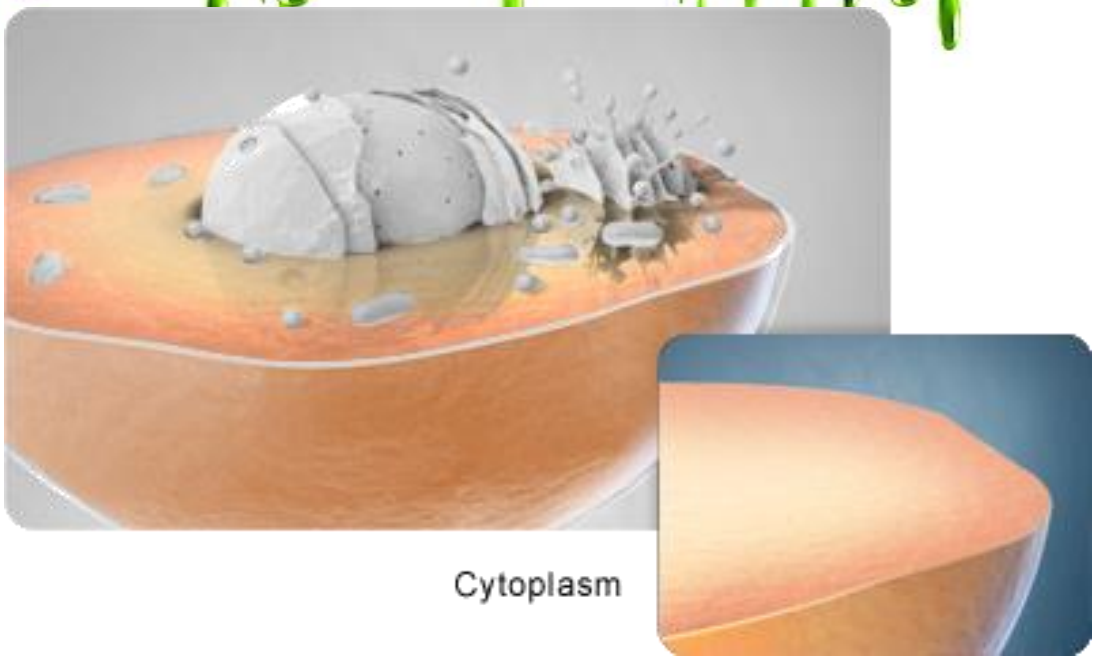
Cell Membrane.



Location:	Surrounding the cytoplasm of all cells (between cell wall and cytoplasm in plants)
Relative size:	Very thin layer only a few molecules in width. Approx 1nm (1mm = million nm)
Function:	Controls transport of specific molecules and nutrients to enter the cell and waste materials to leave the cell. Small molecules, such as oxygen, carbon dioxide, and water, are able to pass freely across the membrane

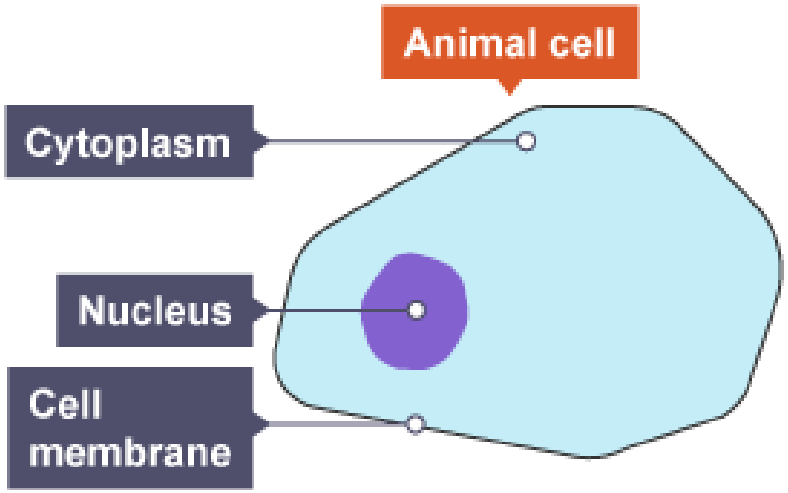
Cytoplasm.

extra info



Location:	Contained within the cell membrane, organelles located within it.
Relative size:	Dependant on cell size and number and size of vacuoles within it.
Function:	Contains the organelles of the cell as well as the material that the cell uses for growth and reproduction. Assists the movement of materials around the cell. Gives the cell its shape.

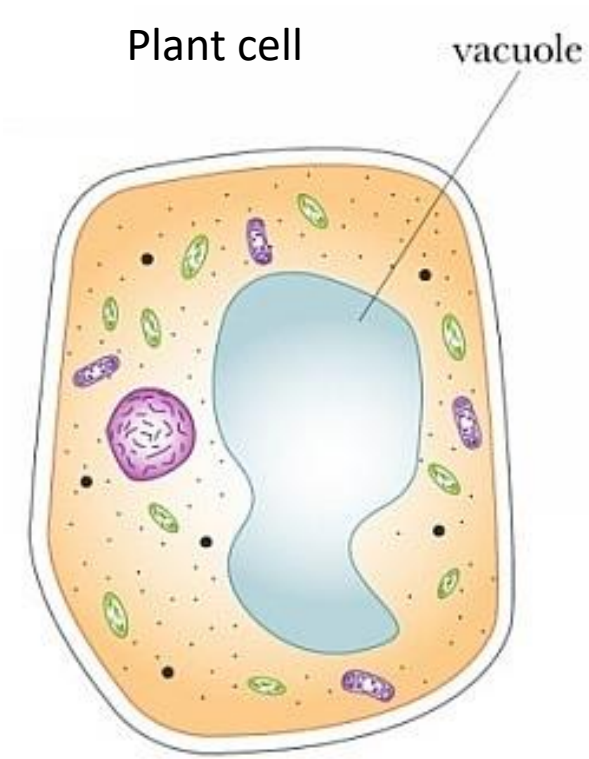
Nucleus.



Location	Often found in the central area of the cell within the cytoplasm.
Relative size	Large enough to be seen with a light microscope, often the most visible structure in the cell. Takes up to 10% of cells volume.
Function	It stores the cell's hereditary material, or DNA, and it coordinates the cell's activities, which include growth and reproduction (cell division).

https://www.bbc.co.uk/education/guides/zr46fg8/revision/2

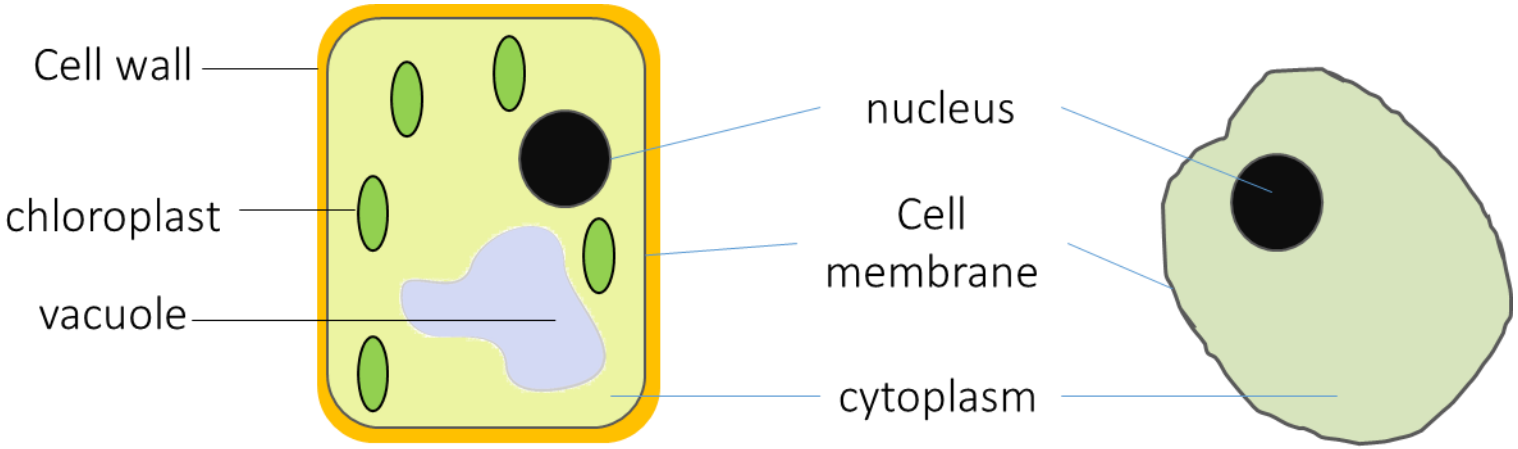
Vacuole.



Location:	Found within the cytoplasm of a cell
Relative size:	Can take up most of the cell in plants but tend to be much smaller in animal cells
Function:	In plants: important in providing structural support, as well as serving functions such as storage, waste disposal, protection, and growth. In animals: temporarily store materials or to transport substances.

Plant and animal cells similarities and differences.

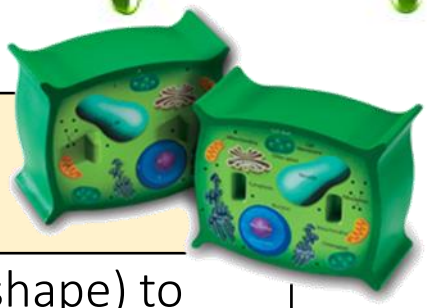
Similarities	Differences
1.BOTH cells have a 'skin', called the membrane, protecting it from the outside environment. 2. BOTH cells have a nucleus. The 'information storage' of the cell. 3. BOTH cells have Cytoplasm, a fluid that protects the inside of the cell and carries nutrients	1. ONLY Plants have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



Plant Cell

Animal Cell

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

extra info

The branch of biology relating to preparation and viewing tissue (groups of cells) under a microscope is known as **Histology.**

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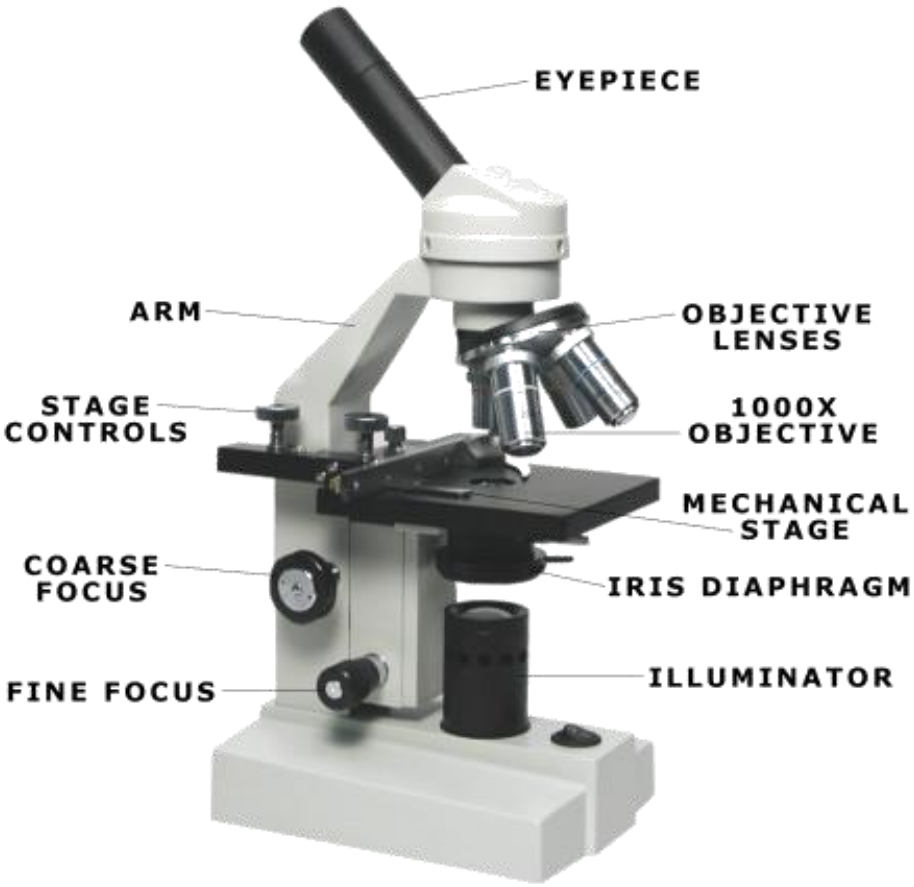
Microscope parts and function

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 (eg. 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

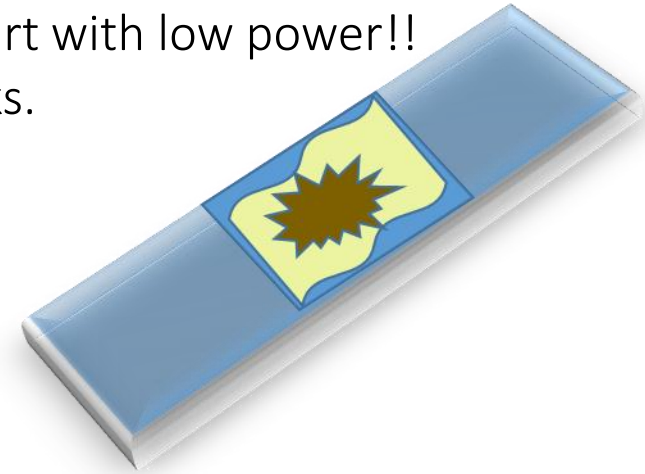
6. When you have a clear image of your sample with the lowest power objective, you can change to the next objective lenses. You might need to readjust the sample into focus

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 isn't 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.



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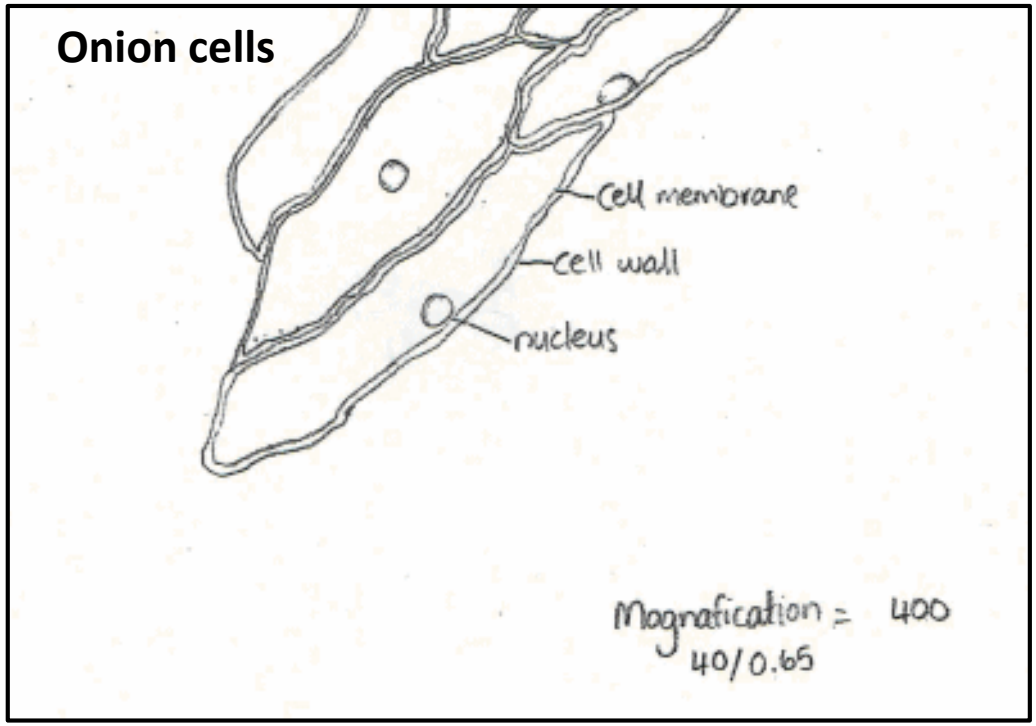
Biological drawings are a useful way of recording information from your observations.

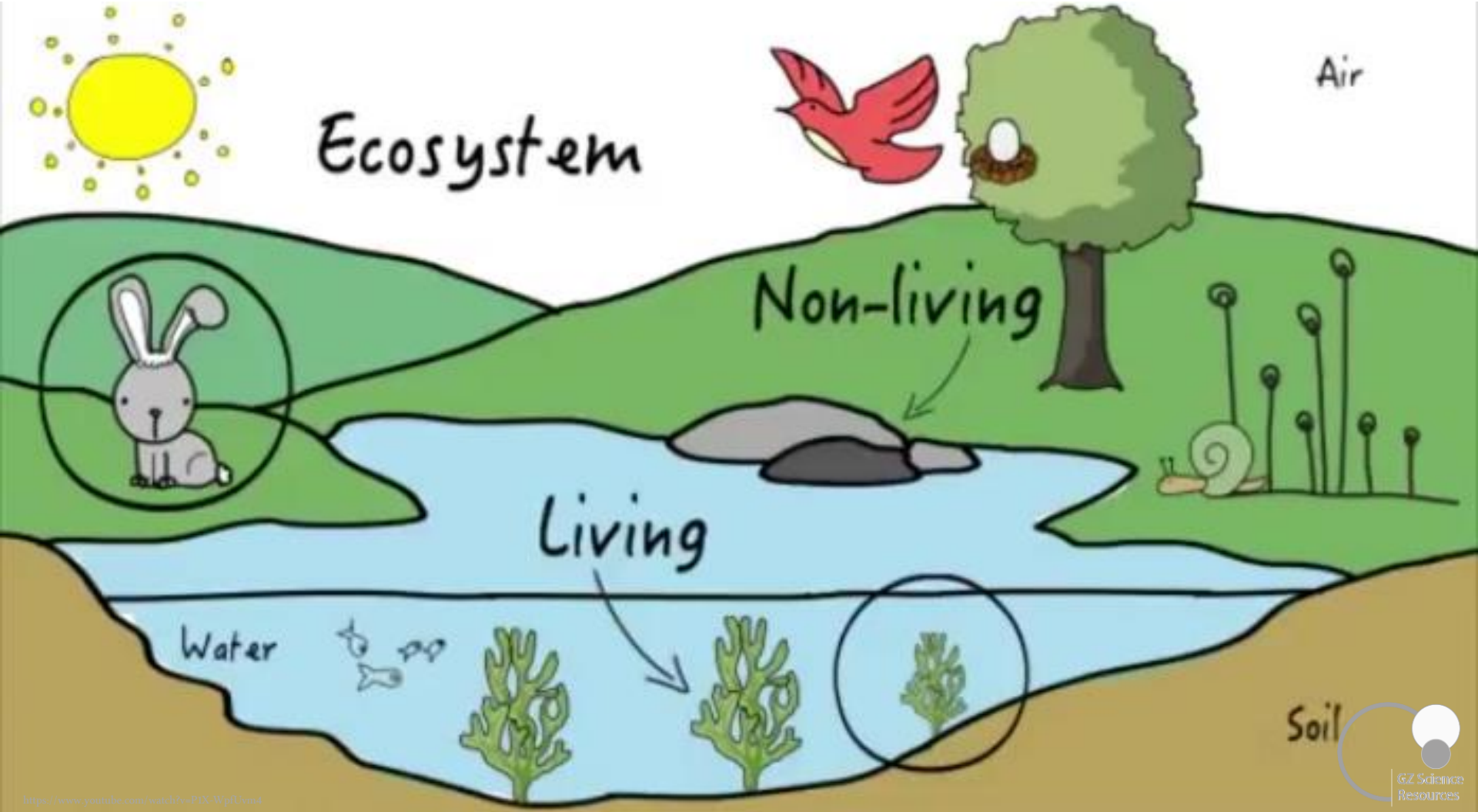
Rules for drawing a cell

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



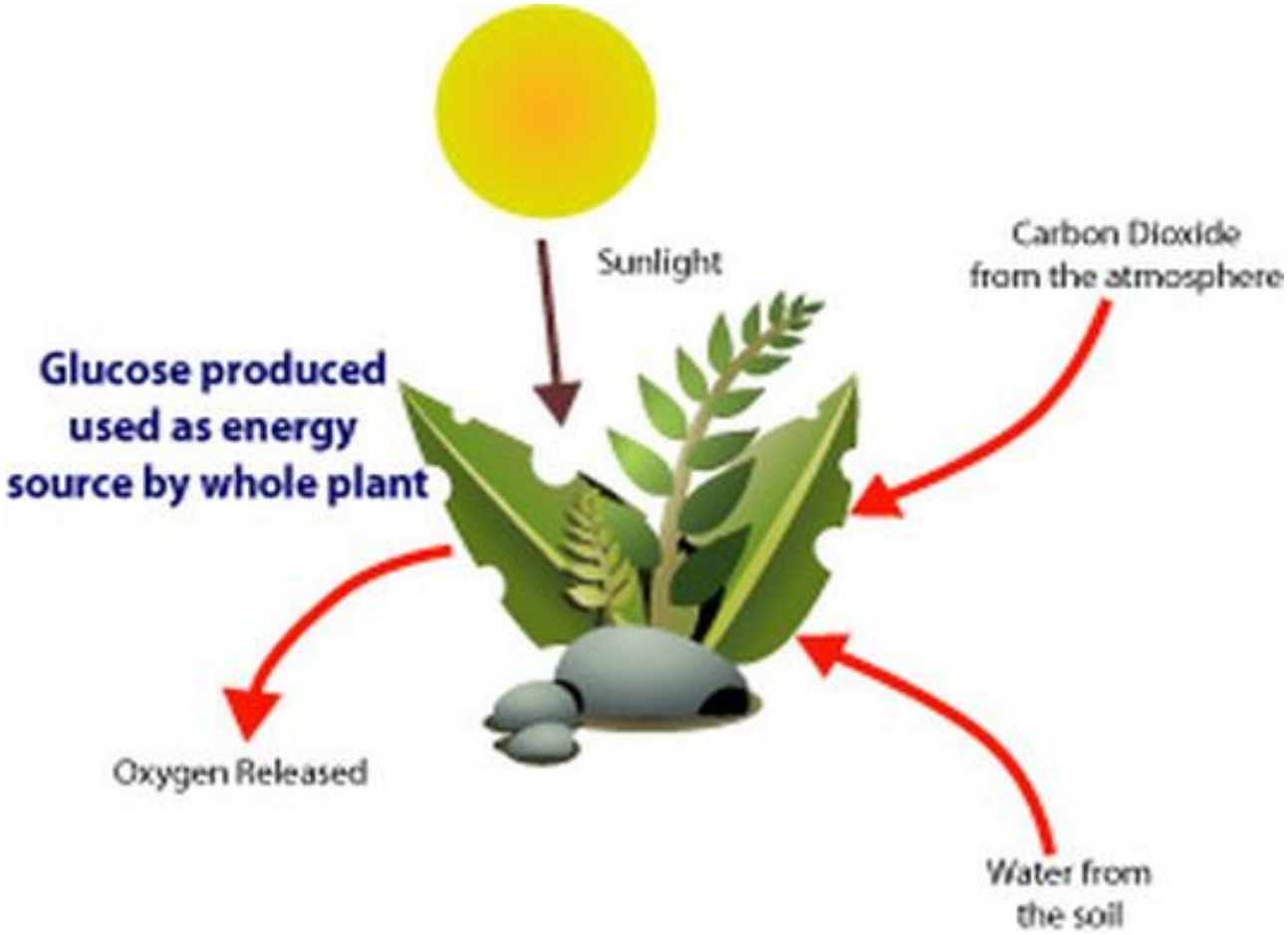
An ecosystem is the habitat and the community considered together.

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.



The role of plants as producers in a community

Plants are a very important part of the community as they (usually) provide all of the energy for all other living organisms through the process of **photosynthesis**. This energy is passed through the community by being consumed (eaten) and allows all living things to carry out the life functions (MRS C GREN)



http://huckleberryfinnclc.weebly.com/producers.html

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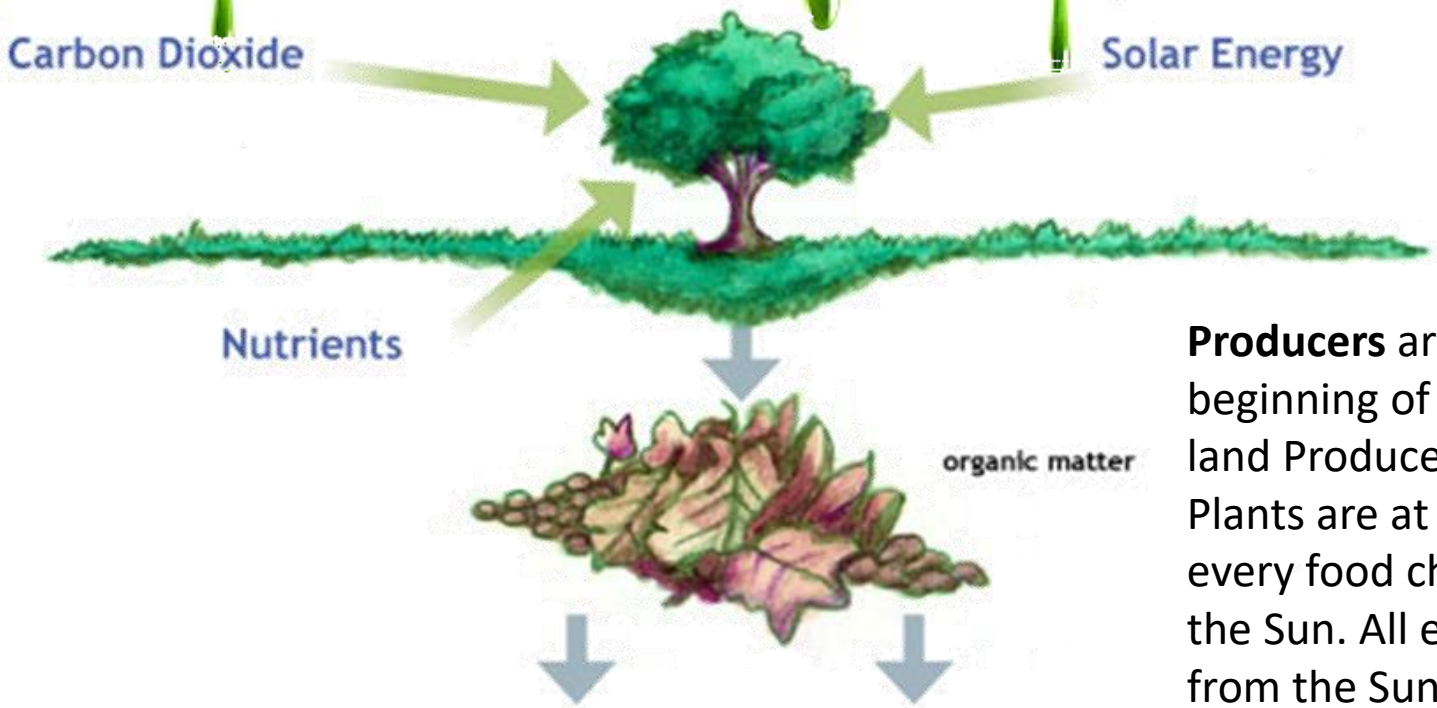
The importance of plants as producers.



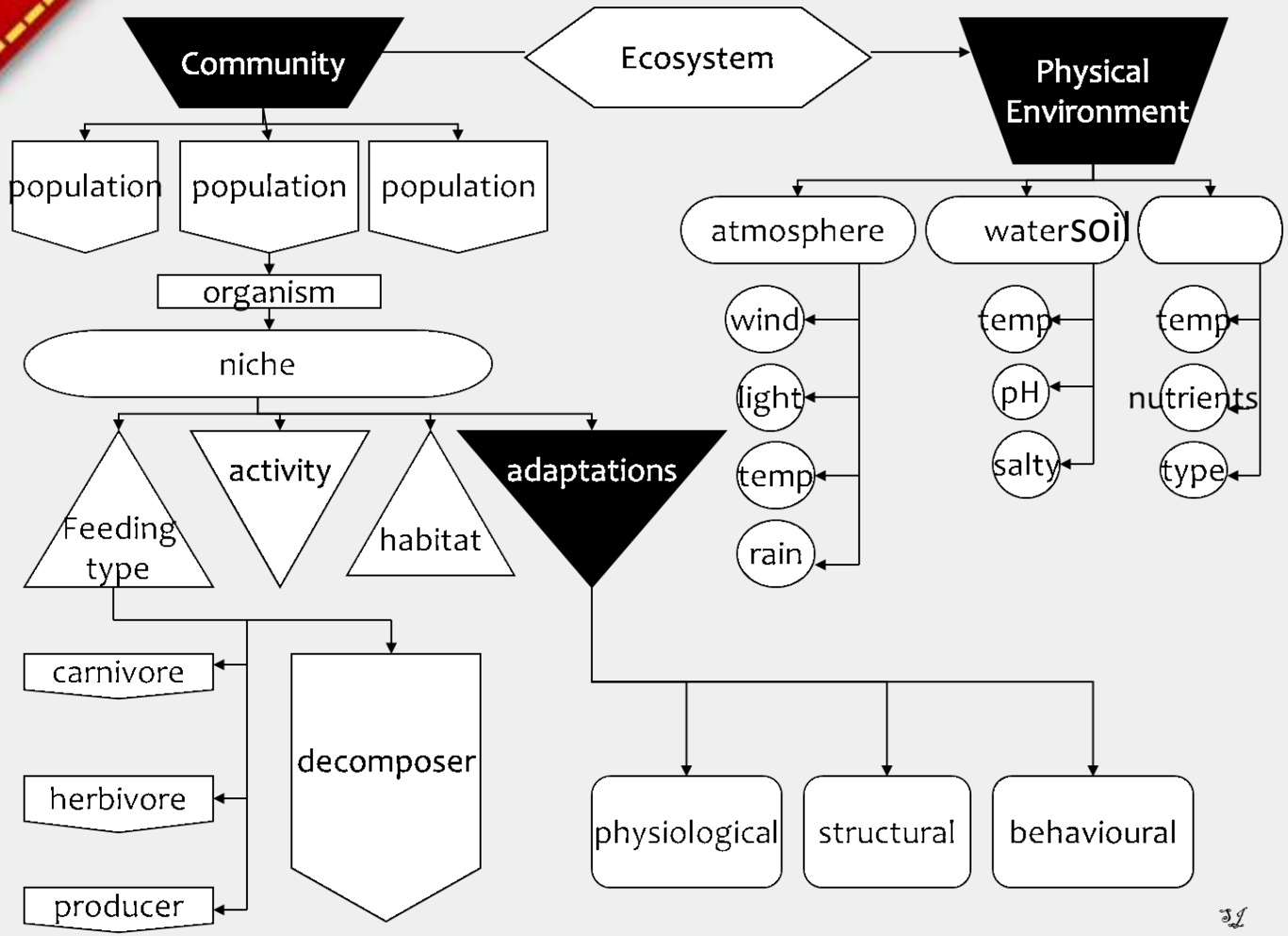
Food entering the food chain

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.

There are also photosynthetic protista and bacteria (called **phytoplankton**)that start food chains. These will be found floating on the surface of the ocean acting as food for small unicellular animals called **zooplankton.**

Background Knowledge

An ecosystem is the habitat and the community considered together.



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Background Knowledge

The roles of and links between organisms in a community - Niche

The New Zealand kiwi is a flightless bird that lives in a NZ bush habitat that has a temperate climate. The kiwi is an omnivore and is nocturnal.

The **niche** of a species describes how members make a living in the environment in which they are found. Describing the niche of a species would include:

The **habitat**, which means where the species lives and reproduces.

The environmental conditions that the species experiences; these are called **environmental factors.**

The **feeding role** that the species has in the community.

Background Knowledge

The roles of and links between organisms in a community - Habitat

A habitat is a specific place, location or environment that a species may be found.

Some species have more precise requirements of a habitat than others.

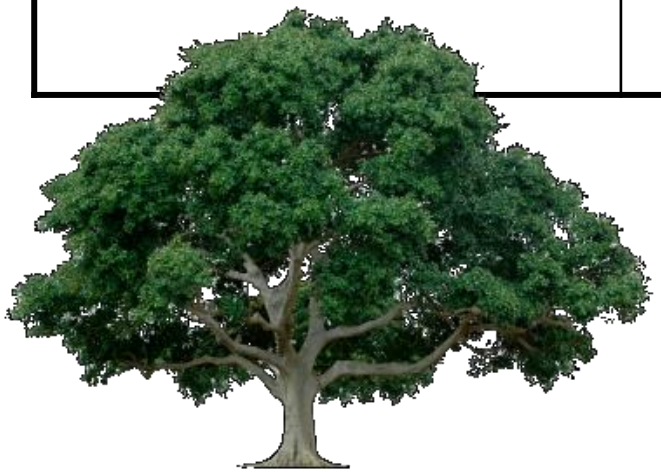
Emperor penguins found only in the Antarctic polar region

A NZ Keas habitat is in South Island alpine regions

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.

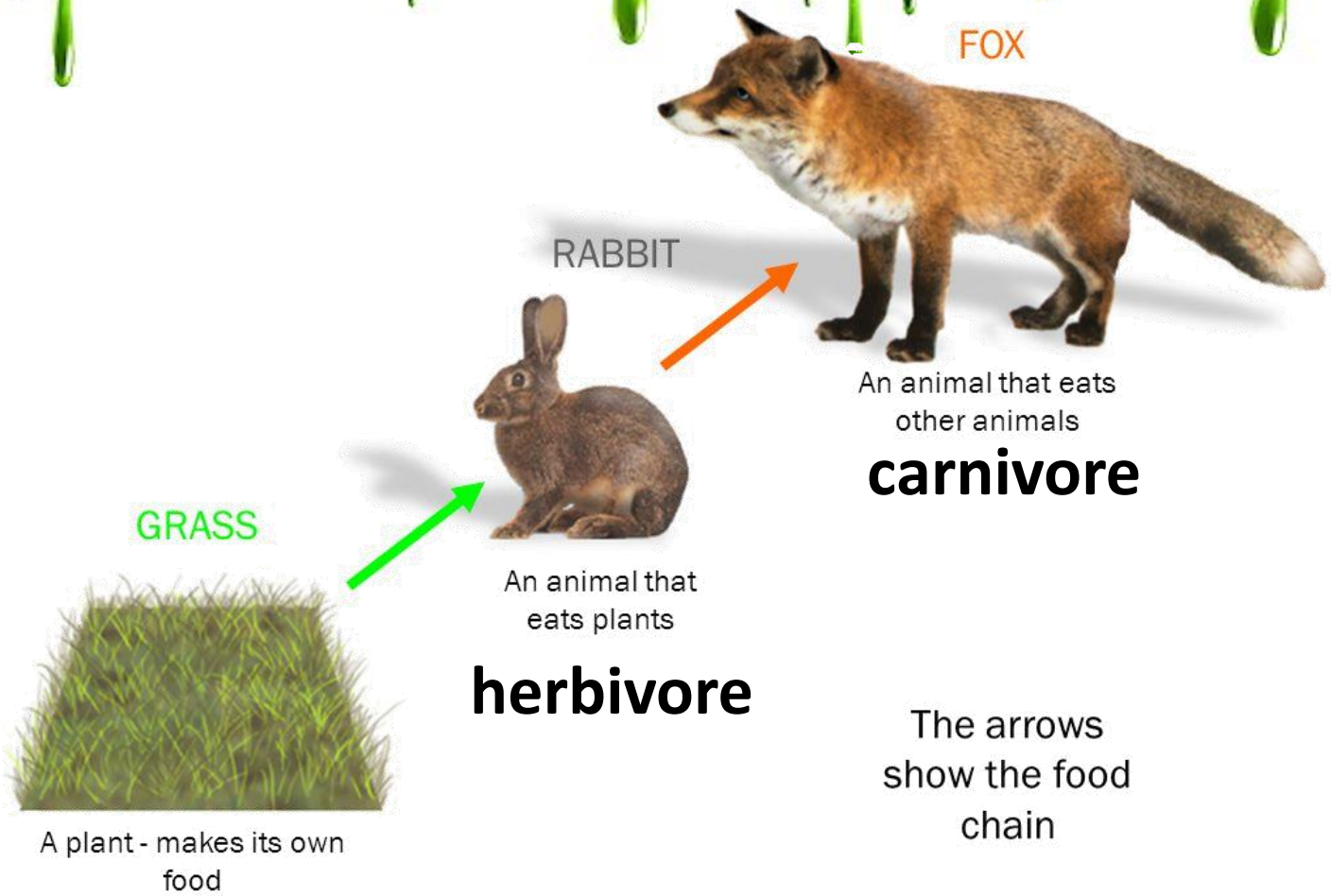
Producers	Consumers	Decomposers
Plants that make food from carbon dioxide, light and water	Herbivores that eat plants and carnivores that eat other animals	Fungi and bacteria that break down the bodies of dead plants and animals



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.



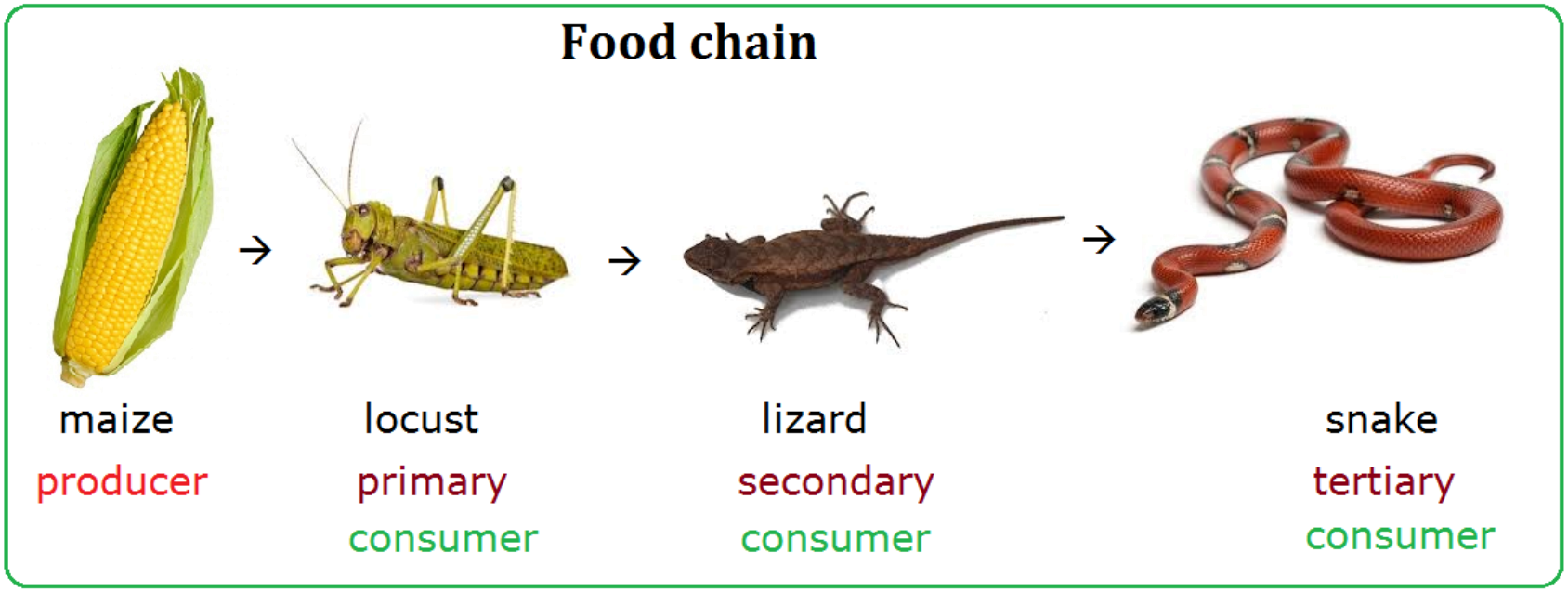
A food chain is a series of organisms through which energy flows; first link is always a plant.

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

Food Chains

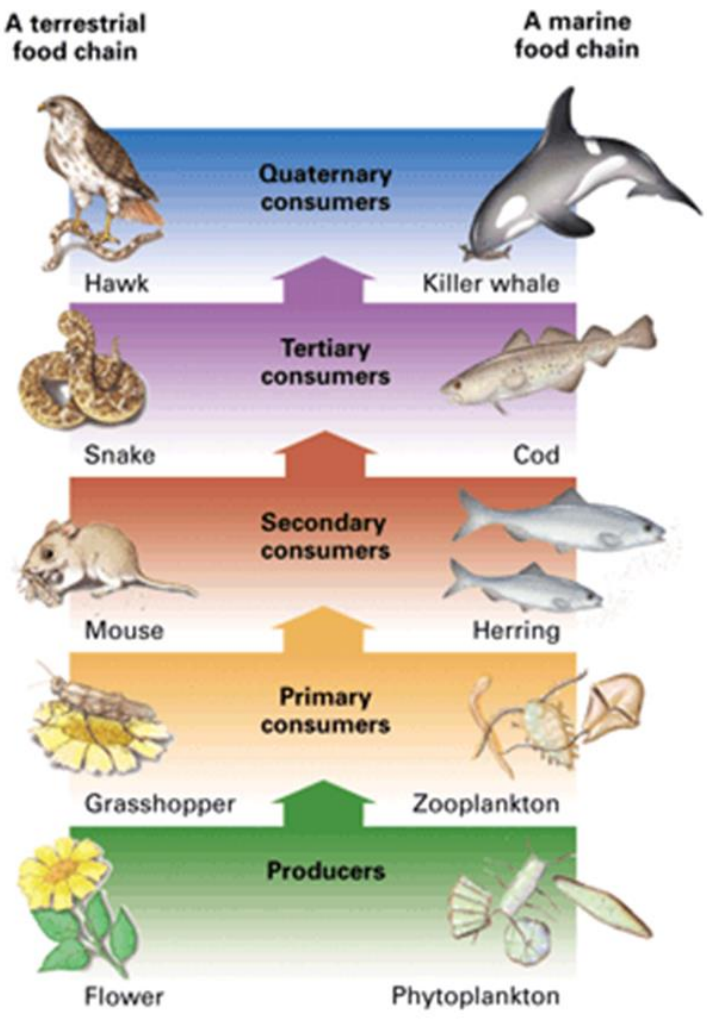
The feeding of one organism upon another in a sequence of food transfers is known as a food chain.

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

Energy enters an ecosystem in sunlight, which is transferred to energy in plants by photosynthesis and that this energy is then passed along food chains.



extra info

Trophic levels are the feeding positions in a food chain such as primary producers, herbivore, primary carnivore, etc.

Green plants and phytoplankton form the first trophic level, the **producers.** Herbivores form the second trophic level, while carnivores form the third and even the fourth trophic levels, all called the **consumers**.

Energy is passed from one trophic level to another starting from the producers.

Food webs and **food chains** are used to show which species of organism is at each level and how energy moves between them.

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

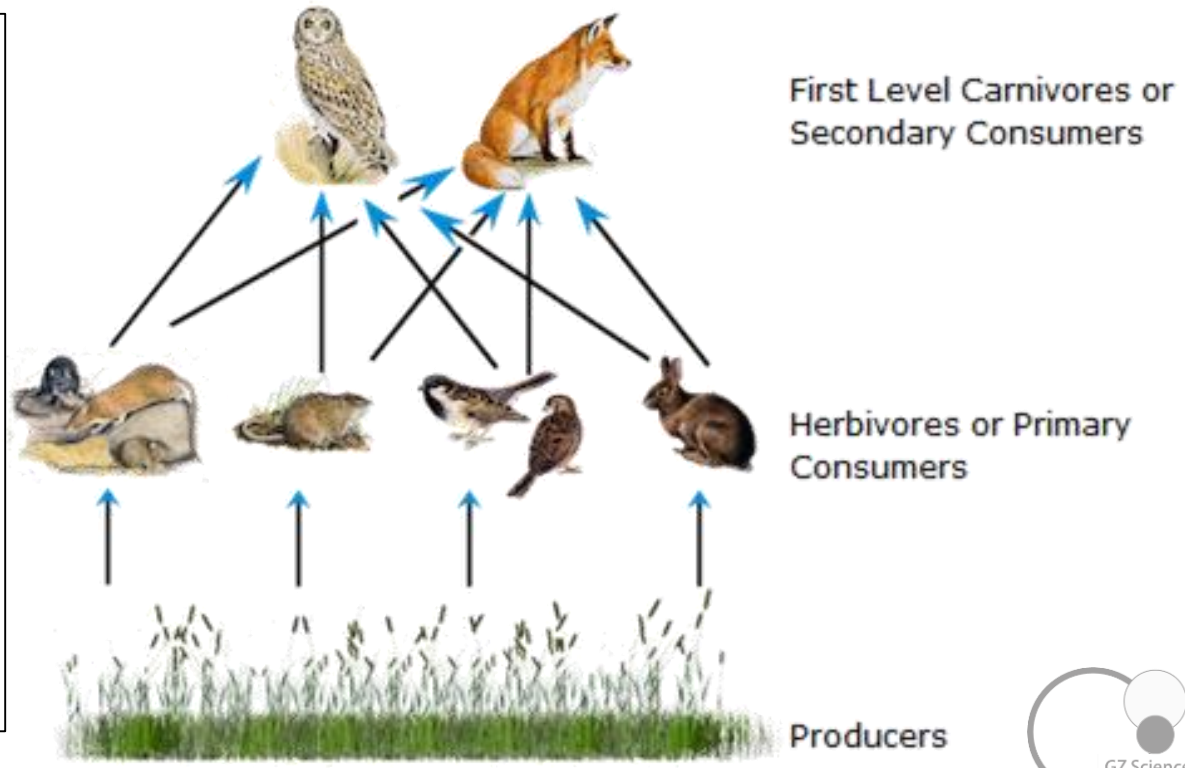
extra info

Food Webs

In an ecosystem there are many different food chains and many of these are cross-linked to form a food web. Ultimately all plants and animals in an ecosystem are part of this complex food web.

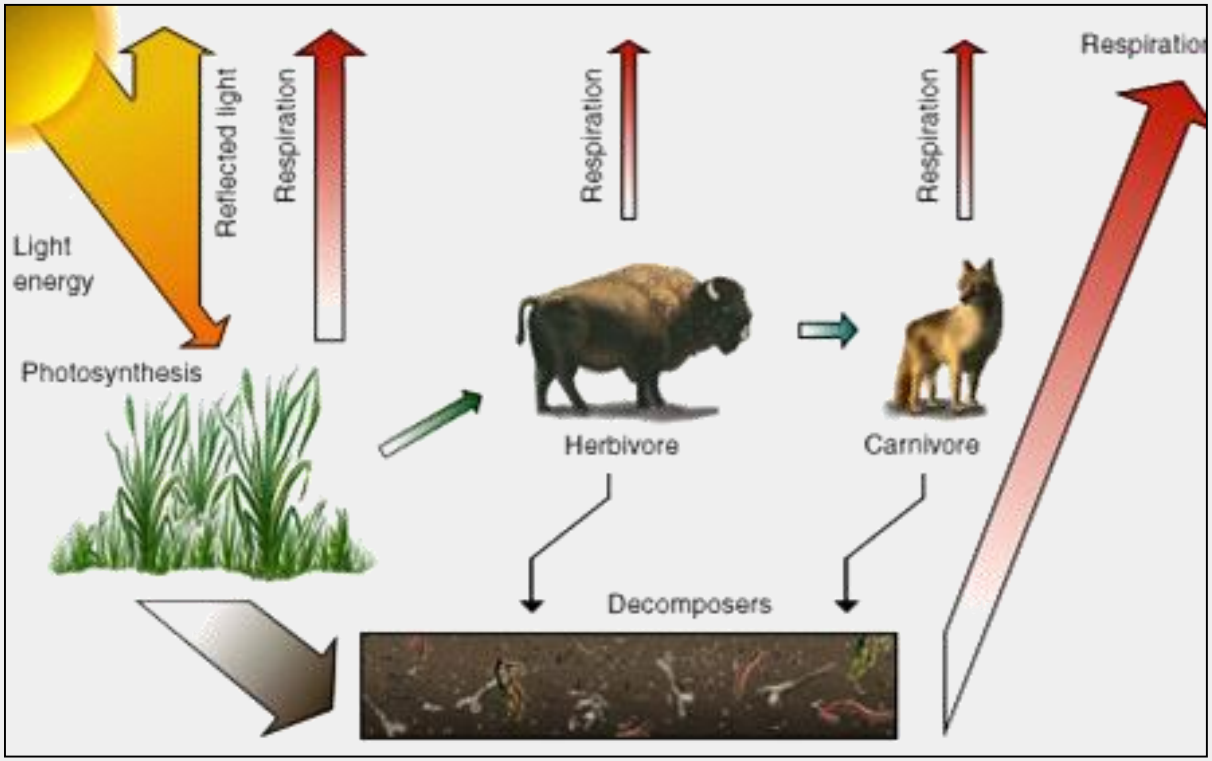
If one species in the food web changes in numbers it will affect all other species in the food web.

For example if all the rabbits are removed the predators would need to start eating more of the birds, mice and rats. The grass that the rabbits ate would increase and feed more of the other herbivores.



Background Knowledge

Energy losses occur along a food chain



extra info

All energy that enters an ecosystem originates from the sun (with a few rare exceptions)
The energy that drives an ecosystem is ultimately converted to heat, which cannot be reused and is radiated out into space.
Energy flow is one way.

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