

# AQA Biology B2 – Cells and Transpiration

All plant and animal cells have

- A **nucleus** (controls cell activity)
- **Cytoplasm** (chemical reactions take place in here)
  - A **cell membrane** (controls which molecules enter and leave the cell)
- **Mitochondria** (these **release energy** from cellular respiration)
- **Ribosomes** (where **proteins** are **synthesised**)

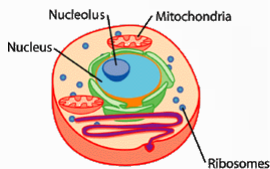


Image: spinelessscience.blogspot.com

All plant cell also has

- A **cell wall** made of **cellulose** (to **strengthen** the cell)
- A **vacuole** (filled with **cell sap**)
- **Chloroplasts** (filled with chlorophyll to absorb light energy needed for **photosynthesis**)

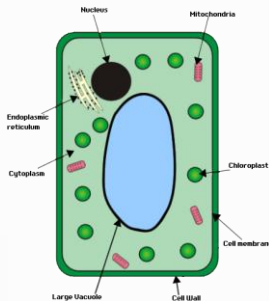


Image: lakshyaeducation.in



Cells

Bacterial cells have

- **Cytoplasm**
  - A **cell membrane**
  - A **cell wall**
  - **Genetic material** (not contained in a distinct nucleus)
- **Plasmids** (small DNA rings)
- **Flagella** (protein strands used for movement)

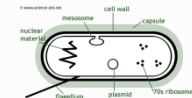


Image: scienceaid.co.uk



Comparing cells

Yeast cells have

- A **nucleus**
- **Cytoplasm**
  - A **cell membrane**
  - A **cell wall**.

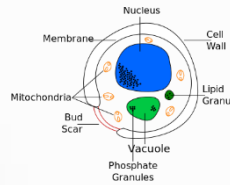
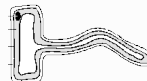


Image: commons.wikimedia.com

**Root hair cells** have

Fine hair like extension. These provide a **large surface area**. Root hair cells are also **only one cell thick**.



← Videos:  
[www.my-GCSEscience.com](http://www.my-GCSEscience.com)

Exam questions & answers →

Fat cells have

- **Little cytoplasm**
- Lots of fat
  - Few mitochondria
- **Elastic cell membrane** (to expand as it fills with fat)

**Sperm cells** have

- A long tail for movement
- A middle section filled with mitochondria (to release energy needed for movement)



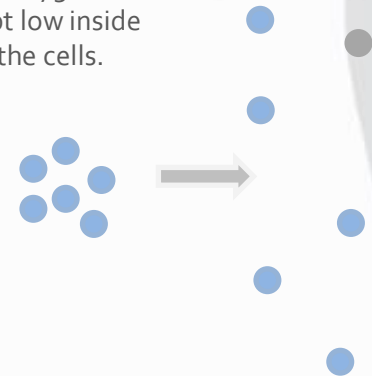
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**Diffusion**

Molecules spread from an area of high concentration to an area of low concentration.

Oxygen needs to diffuse into cells. This means that the concentration of oxygen is kept low inside the cells.



# AQA Biology B2 – Tissues and Organs

As an organism develops its **cells differentiate** so that they become specialised for a particular function.



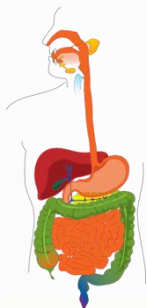
A group of cells with similar structure and function is called a **tissue**.



Different tissues working together make up an **organ**.



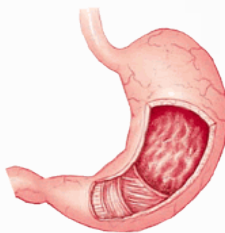
Different organs performing a particular function are called an **organ system** (for example the digestive system is made of the stomach, liver, intestines, etc.



## Tissue types:

- **Muscular** tissue brings about movement by contracting and relaxing
- **Glandular** tissue secretes hormones and enzymes
- **Epithelial** tissue covers surfaces to protect the cells in the organ

## Stomach tissues



- **Muscular** tissue to **churn** the food
- **Glandular** tissue to produce the digestive enzyme **protease**
- **Epithelial** tissue which covers the stomach lining to **protect against** the **hydrochloric acid** and **protease**

## Functions of the digestive system

**Salivary glands** produce **saliva** which contains **amylase** to begin starch digestion. Food moves into the **stomach** where **protease** begins protein digestion. The **liver** produces **bile** which emulsifies fats and provides alkaline conditions inside the small intestines. The **pancreas** produces the enzymes **lipase**, **protease** and **amylase**. Digestion is completed inside the **small intestines** and broken down food is **absorbed into the blood stream**. Undigested food passes into the **large intestines** where **excess water** is absorbed.

## Plant tissues

- The plant is covered in **epidermal tissue**
- The **mesophyll tissue** is made of cells that contain **chloroplasts** for **photosynthesis**
- The **xylem** and **phloem** tissues transport **water** and **sugar** around the plant

## Plant organs

The three plant organs are roots, stem and leaves

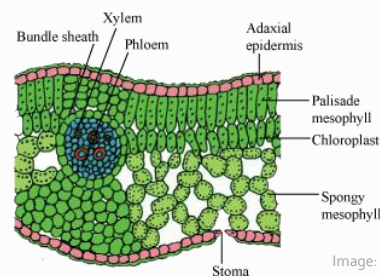
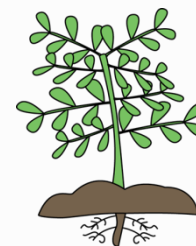


Image: www.meritnation.com



Cells, Tissues, Organs



Plant tissues

← Videos:  
[www.my-GCSEscience.com](http://www.my-GCSEscience.com)

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# AQA Biology B2 - Photosynthesis



## The equation

Water + carbon dioxide  
↓  
Glucose + oxygen

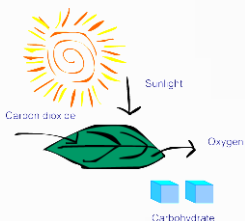


Image: www.excellup.com

**Light energy** is absorbed by **chlorophyll** inside **chloroplasts** to convert carbon dioxide from the air and water from the soil into sugar. **Oxygen** is a waste product which **diffuses** out of the leaf.

## Glucose uses

Some glucose is used during **respiration**.

Some is converted to **insoluble starch** and **stored** in organs.

Some is converted to **cellulose** to strengthen the **cell wall**.

Some is reacted with **nitrate ions** from the soil to produce **proteins**.

Some is used to produce **fats** and **oils** which act as **energy stores**.



Photosynthesis

## Limiting factors

The rate of photosynthesis is affected by the three factors **light intensity**, **temperature** and **levels of carbon dioxide**.

A **shortage** of any of the three will **limit** the **rate of photosynthesis**.

Gardeners and farmers carefully control these three factors inside **greenhouses**.



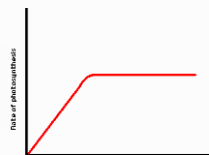
Some plants are grown in water with the perfect amount of mineral ions. This is known as **hydroponics**. Turnover is fast and profits are high.



Limiting factors

At the beginning **light intensity** is the limiting factor.

As light intensity increases, the rate of photosynthesis also increases up to a point where the amount of carbon dioxide and temperature are limiting factors.

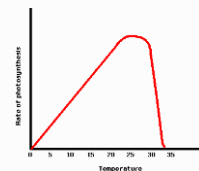


The same explanation can be applied to describe the relationship between **carbon dioxide** concentration and rate of photosynthesis.

← Videos:  
[www.my-GCSEscience.com](http://www.my-GCSEscience.com)  
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As the **temperature** increases so does the rate of photosynthesis.

Once the temperature goes beyond 40-50°C the **enzymes** that control photosynthesis **denature** and the rate of photosynthesis falls until it reaches zero.



Graphs from  
[moodle.schoolnet.lk](http://moodle.schoolnet.lk)



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## A classic experiment

As the light source is moved further from the pondweed, the number of **oxygen bubbles** produced per time unit decreases. The beaker of water acts as a **heat shield** to ensure only one variable (light intensity) is changed. The pondweed is immersed in a **saturated sodium bicarbonate** solution to fix the amount of carbon dioxide available.

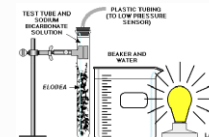


Image: www.junglekey.fr





# AQA Biology B2 – Organisms in their environment



In any habitat the **distribution of organisms** is affected by the following factors:



## Temperature

(many organisms require a specific temperature range to survive)



Availability of **nutrients and food**



Amount of **light** (needed for photosynthesis)



Availability of **water**

Availability of **oxygen** (needed for respiration) and **carbon dioxide** (needed for photosynthesis)

## Sampling technique 1

A **quadrat** (square metal frame) is placed **randomly** and the number and identity of each species inside the quadrat is determined.

The process is **repeated many times** and the mean number of organisms per m<sup>2</sup> is then calculated.

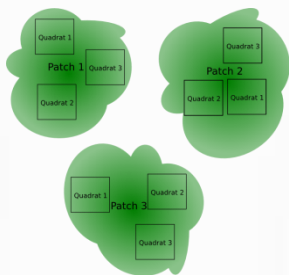


Image: [climateecology.wordpress.com](http://climateecology.wordpress.com)

## Sampling technique 2

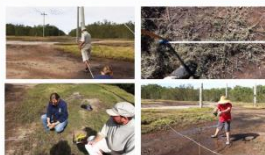


Image: [saltmarsch.enviroed.com.au](http://saltmarsch.enviroed.com.au)

A **line transect** is not random. This is what you need to do: use a **tape measure** to produce a transect **along** the sample area, i.e. a stream. Place the quadrat at **regular intervals** along the tape and count each plant species inside the quadrat. **Repeat** the transect several times at **random or regular intervals** along the stream.

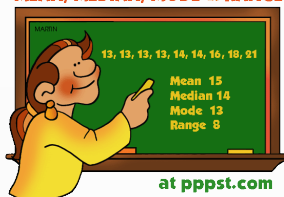


Distribution of organisms

## What to do with data

Once you collected your data, you can either work out the **range** (difference between highest and lowest value), **median** (middle value), **mode** (most common value) or **mean** (average value).

### MEAN, MEDIAN, MODE & RANGE



at [pppst.com](http://pppst.com)

← Videos: [www.my-GCSEscience.com](http://www.my-GCSEscience.com)

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## How good is your data?

One of the most important factors is **sample size**.



If you have only counted the number of species in 2 quadrats but the field you are looking at is the size of a football field, then your data is not going to be very valid or reproducible. It is important that your sample size (in this case the number of quadrats looked at) is as large as possible.



## Valid

How **suitable** the procedure is to answer a scientific question

## Reproducible

If someone else **repeats** the experiment using the same of different method or equipment and gets the **same results**, then your results are reproducible.

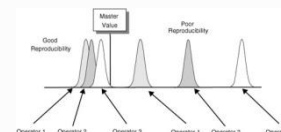


Image: [www.cqacademy.com](http://www.cqacademy.com)





Enzymes are proteins that catalyse reactions inside plants and animals.

Other proteins found in the human body are hormones, antibodies and fibres such as muscle tissue.

Each enzyme is a long chain of amino acids folded into a unique and specific shape.

The part of the shape where the chemical reaction takes place is called the active site.

Molecules that fit into the active site of the enzyme (red) are called substrates (blue):

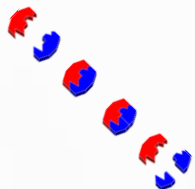


Image:  
www.london-oratory.org

## Optimum conditions

Enzymes work best at **specific temperatures and pH levels**.

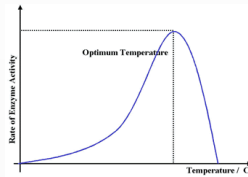


Image: www.revisionworld.com

If the temperature is too high, the shape of the active site changes and the substrate can no longer bind to it. The enzyme **denatures**. If the temperature is too low, the rate of reaction is too **slow** as not enough energy is available.



Enzymes and digestion

## Digestive enzymes



Digestive enzymes work outside body cells inside the gut.

**Amylase** is produced by the **salivary glands, the pancreas and the small intestines**.

Amylase breaks **starch into sugar** molecules in the mouth and small intestines.

**Protease** is produced by the **stomach, the pancreas and the small intestines**. It catalyses the breakdown of **proteins into amino acids** in the stomach (where the pH is low) and the small intestines (where the pH is in the alkaline region).



Enzymes in Industry

# AQA Biology B2 - Enzymes

**Lipase** is produced by the **pancreas and the small intestines** to break down **fats into fatty acids and glycerol** in the small intestines.

To ensure optimum conditions for the enzymes, **hydrochloric acid** is produced by the stomach for a low pH. The liver produces **bile** which is released into the small intestines to neutralise the acid and provide alkaline conditions.

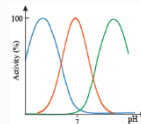


Image:  
www.smoop.com

Bile also acts as an emulsifier and increases the surface area of fats.

← Videos:  
www.my-GCSEscience.com  
Exam questions & answers →

## Enzymes in industry

**Biological washing powders** contain proteases and lipases to help break down protein and fat residues on clothes.



Some people are **allergic** to proteins and to the washing powder. The washing powder can also be used only at **low temperatures**, which does save energy and **reduces CO<sub>2</sub>** emissions but **does not kill all bacteria** on the clothes.

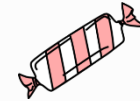


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**Baby food** contains **proteases** to **pre-digest** the food.



**Sweets** contain **carbohydrases** which convert **starch into sugar syrup**. Starch is much cheaper than syrup.



**Slimming foods** contain **isomerase** to convert **glucose into fructose** which is sweeter so less is eaten.



# AQA Biology B2 - Respiration

## Aerobic respiration

Respiration is an **enzyme catalysed chemical reaction** between **oxygen** and **glucose** that **releases energy**.

Aerobic respiration **occurs continuously** in animal and plant cells **inside the mitochondria**.

The more mitochondria the cell contains, the more active it is.



The **word equation** for aerobic respiration is:

Glucose + oxygen  
↓  
Carbon dioxide + water  
(+ energy)

Aerobic respiration releases energy.

The **four main uses for this energy** are as follows:

To use smaller molecules to **build larger molecules** (for example using amino acids to build proteins)



To allow **muscles to contract** (to bring about movement)



To maintain a **steady body temperature** (mammals and birds only)

**Plants** use the energy **to build up amino acids** from glucose and nitrate ions.



Aerobic respiration

## Anaerobic respiration

When **insufficient oxygen** is available, glucose is broken down into **lactic acid** instead of carbon dioxide and water.

**Less energy** is released than during aerobic respiration.

The word equation for anaerobic respiration is:

Glucose  
↓  
Lactic acid (+energy)



Anaerobic respiration

## Exercise and respiration

When you exercise, your **heart rate increases to increase the flow of blood** to your muscles.



**Glycogen**, which is stored by the muscle cells is converted back to glucose so respiration can take place.

**Oxygen and more glucose** are delivered to your muscle cells, **carbon dioxide is removed**.

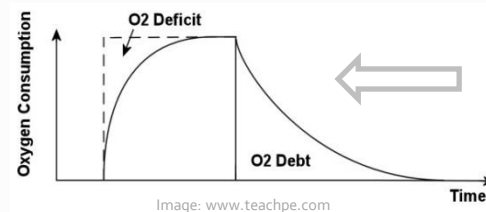
← Videos:  
[www.my-GCSEscience.com](http://www.my-GCSEscience.com)

Exam questions & answers →

## Muscle fatigue

**Vigorous exercise** often results in **muscle fatigue**; muscles no longer contract efficiently and you can suffer from **cramps**.

Not enough oxygen is delivered to the muscle cells so the glucose is broken down **anaerobically** to provide energy quickly. **Lactic acid** builds up in the muscles.



The amount of oxygen needed to break down the lactic acid is known as the oxygen debt.

## Oxygen debt

Although you might have stopped exercising vigorously, you continue to breathe heavily for some time after the exercise. This is to ensure enough oxygen reaches the muscle cells to break down the lactic acid that accumulated.



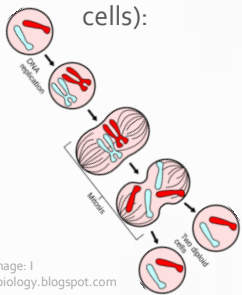
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# AQA Biology B2 – Inheritance I

Each human body cell, apart from **gametes** (egg and sperm cells), contain 23 chromosome pairs. Chromosomes contain the body's genetic information.

Body cells divide by a process called **mitosis** (making identical twin sister cells):



First, **copies** of the chromosomes are made. Then the **cell divides** and forms **two identical** body cells with the same number of chromosomes as the original cell. This process happens to grow new body cells for **growth and repair**.

## Making gametes

The process is called **meiosis** (making eggs in ovaries and sperm in the 'sack' - testes).

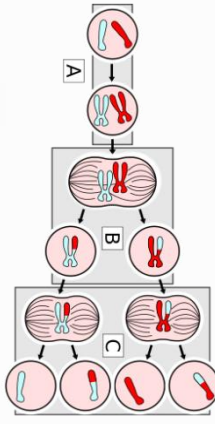


Image: education-portal.com

First, **copies** of the chromosomes are made. The cell **divides twice** and **4 cells are made**, each with **23 single chromosomes** that differ from each other.



Mitosis

## Fertilisation

Gametes join during fertilisation to form a cell with 23 pairs of chromosomes. The cell then divides by **mitosis** to form the embryo.

These cells are called **stem cells** as they can be made to **differentiate into any kind of human cell**. Stem cells can also be found in **adult bone marrow**.

Stem cell research is carried out as these cells can be used to treat many diseases. Using embryonic stem cells is **unethical** as the embryo will be destroyed after the stem cells have been extracted.

Removing bone marrow is **very painful**.



Meiosis

## Genes

During fertilisation, 23 single chromosomes carried by the sperm pair up with the 23 single chromosomes carried by the egg. Each chromosome is divided into genes. Genes that control the same characteristics are called alleles.

Alleles are either dominant or recessive. Recessive alleles control the development of the characteristic only if the dominant alleles are not present.

## Gene combinations

Dominant alleles tend to be assigned capital letter (B = brown eyes), recessive alleles small letters (b = blue eyes).

The genotype is the combination of alleles an organism has, eg Bb

The phenotype is the characteristic that shows, eg brown eyes

Heterozygous means that the two alleles are different, eg Bb

Homozygous means that the two alleles are the same, eg bb



Stem cells

## Genetic crosses

or Punnet squares- this is what we use to show how genes are inherited:

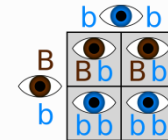


Image: Penpals.web.unc.edu

50-50 chance of having blue/brown eyes being a boy/girl

	X	Y
X	X X	X Y
X	X X	X Y



XX girl  
XY boy



Genetic diagrams



DNA fingerprinting

## DNA

DNA stands for deoxyribonucleic acid. It is a very long molecule that has a **double helix** structure and coils up to form **chromosomes**.



A small section of DNA is called a **gene**. Each gene codes for a particular combination of **amino acids** which are combined to make proteins (such as enzymes, hormones, pigments, etc).



Polydactyly video

## DNA fingerprinting

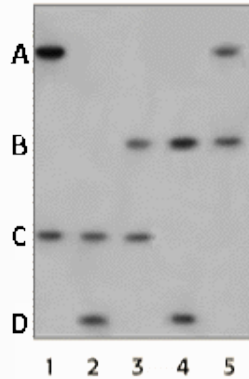


Image: www.biology.arizona.edu

Unless you are an identical twin, you have unique DNA. DNA can be used to **identify** criminals and bodies or for paternity testing.

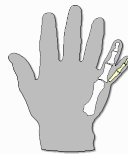
DNA finger printing can also be used to identify genetic disorders that could develop later in life.



Cystic Fibrosis video

## Inherited genetic disorders

One disorder which is caused by a dominant allele is polydactyly. Sufferers have extra fingers or toes.

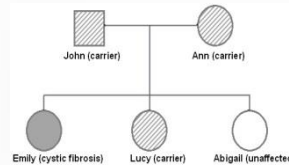


Embryo screening video

A disorder caused by two recessive alleles is Cystic Fibrosis. It is a disorder of the cell membrane and pancreas. One recessive allele **from each parent** is passed on to the child. A person who carries the gene but does not suffer from the condition is called a carrier.

$Cc$  carrier       $CC$  healthy

$CC$  sufferer



Mendel video

## Embryo screening

A controversial topic that divides opinions. Some people oppose the idea of screening for genetic disorders. During the process the **embryo might be damaged**, the procedure is **expensive** and parents might decide to **discard** the embryo.

On the other hand, identifying genetic disorders in embryos could **reduce health care costs** as no medical care is needed if the embryo is not allowed to develop further.

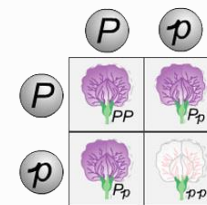


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## Gregor Mendel



A monk who pollinated peas with purple flowers with pollen from peas with white flowers. When all the offspring had purple flowers he decided to breed them together. The result was some peas with white flowers and some with purple flowers.



He concluded that peas have two factors for colour with one being stronger than the other. His work was not recognised until the early 1900s because he was a monk rather than a respected scientist and genes has not yet been discovered.



# AQA Biology B2 - Fossils

## Fossils



Fossils are the **remains** of plants and animals that were alive **millions of years ago**.

Fossils can be found in **rocks, ice or amber**.

## How fossils form

An animal might die and be buried in ice. The **temperatures are too low for microorganisms to decompose** the body so the animal is preserved in the ice.



Image: upall.co

These fossils reveal a lot about **colour, diet and genetic make up** of the prehistoric organisms.

An animal might get trapped in the **sap of a tree**.

When the sap hardens, **amber** is formed. As there is **no oxygen** present in the sap/amber, the animal is preserved.



Image: www.living-fossils.com

When an animal steps into soft mud, an imprint is left. As the mud hardens, the **impression** is preserved.



Other fossils include **droppings or burrows**.



Fossils

## Mould and cast

If an animal dies and falls to the ground, microorganisms will **decay its body**. The remaining skeleton is covered in sand and mud which are over time pressed into hard rock. Slowly the bones are **washed away** by ground water and **replaced by minerals** carried in the water. The minerals fill the spaces left behind by the skeleton and form a **cast**. Earth movements and erosion bring the cast to the surface.

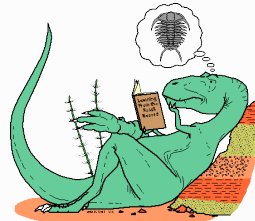


Image: terriblycurious.com



Extinction

## The fossil record



Because many early life forms were **soft-bodied** they left **few traces** when they died. Any traces that were left behind were destroyed by geological activity. For this reason the fossil record is incomplete.



← Videos:

[www.my-GCSEscience.com](http://www.my-GCSEscience.com)

Exam questions & answers →

## What can fossils teach us?

Mainly how much or how little organisms have changed over time.

1 million years ago	modern horse	Height: 1.5m
12 million years ago	Pachippus	Height: 1.0m
30 million years ago	Merchippus	Height: 1.0m
40 million years ago	Meshippus	Height: 0.8m
50 million years ago	Eohippus	Height: 0.4m

Early horses had spread toes as they lived in swamp-like habitats with soft ground.

Today's horses have one toe which forms the hoof. It is well adapted to running fast on hard ground.



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## Extinction

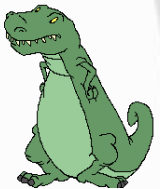
Species become extinct for the following reasons:

A new **predator** is introduced to a habitat

A new **disease** is introduced to the habitat

A new, more successful **competitor** is introduced to the habitat

**Natural disaster**



# AQA Biology B2- Speciation

## Isolation

Geological or human activity can result in a population becoming separated. This is called **geographical isolation**.



For example, humans can erect barriers so a fish population becomes separated. Another example could be a piece of land breaking off from the main land/continent.

Within a population animals and plants differ due to **variations** in their genetic make-up and some organisms find themselves now in a habitat that they are no longer **adapted** to. These organisms will not survive.



Organisms that have **alleles** that control characteristics which make them well adapted to their environment **survive, breed** and pass on their alleles to the next generation.

Over time, the separated populations become **genetically so different** that successful **interbreeding** is no longer possible (even if they were mating, their **offspring would be infertile**). They are now **different species**.

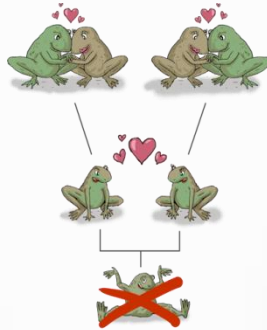


Image: [www.shmoop.com](http://www.shmoop.com)



The formation of new and different species by this separation, isolation and natural selection process is **called speciation**.

## Endemic species

These are organisms that **can only be found in one habitat and nowhere else on the planet**. They are often found on islands although not exclusively.

Mount Bosavi in Papua New Guinea is an extinct volcano. Its crater walls are 1km high and many animals that are trapped inside have evolved into endemic species:



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