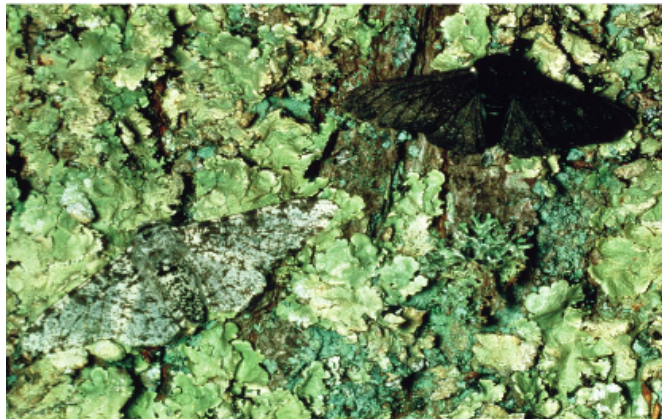


# Chapter 18 - Variation and Evolution

**Variation** - means that there are **differences** between individuals of species.

Inherited variations are caused by

1. Sexual Reproduction
2. Mutations.



18.2 Colour variation in peppered moths: light (lower left) and dark (upper right)



# Mutations

A **mutation** is a change in the amount or structure of DNA.



Mutations can be good, bad or have no effect at all.

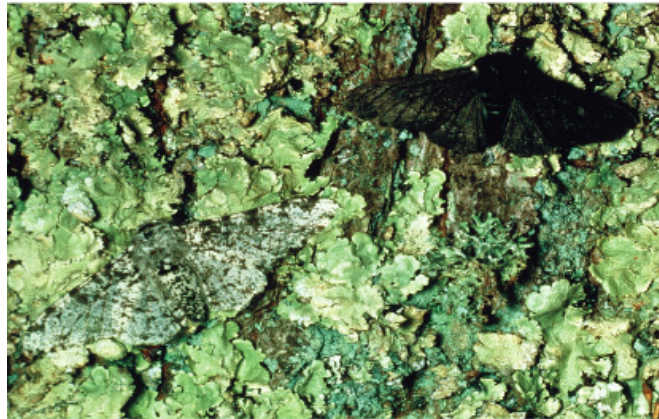
An effect that is good helps an individual **survive** in a particular environment.

They have an advantage over others and can get more food and have more offspring.

The mutation will probably be passed on to the offspring and help them survive also.

Individuals without this mutation may die out.

Eventually all of the population will have this mutation.



**18.2** Colour variation in peppered moths: light (lower left) and dark (upper right)

## Causes of mutations

Mutations can occur naturally or can be caused by something else, called **mutagens**.

**Mutagens** are agents that cause mutations.



Examples are,

- Ionizing radiation such as x-rays, gamma rays, cosmic rays and ultraviolet (UV) radiation.
- Chemicals such as formaldehyde, tobacco smoke, dioxins, caffeine and many drugs, preservatives and pesticides.

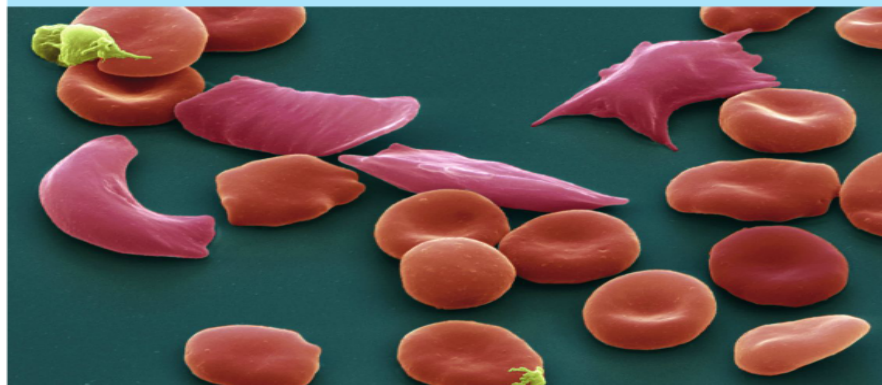
## Types of Mutations

**Gene (or point) mutations** are changes in a single gene.



Examples of gene mutations are cystic fibrosis (the inability to remove mucous from the lung), haemophilia (the inability to form proper blood clots), albinism (lack of the skin pigment melanin), cancers and sickle cell anaemia.

**18.3** Sickle cell anaemia: note the misshaped red blood cells



### EXAMPLE OF A GENE MUTATION

**Sickle cell anaemia** is an inherited blood disorder caused by a mutation in the haemoglobin gene.

A person with two copies of the recessive allele produces haemoglobin with one incorrect amino acid. This results in an insoluble form of haemoglobin that causes the red blood cells to take on a curved or sickle shape. This causes the breakdown and clumping of red blood, which in turn leads to paleness, weakness, heart failure, severe pains, damage to the brain and other organs and, very often, death.

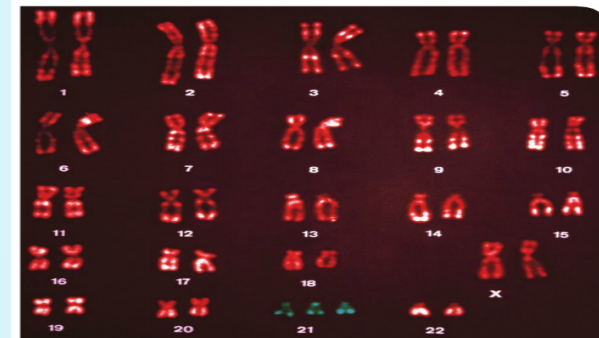
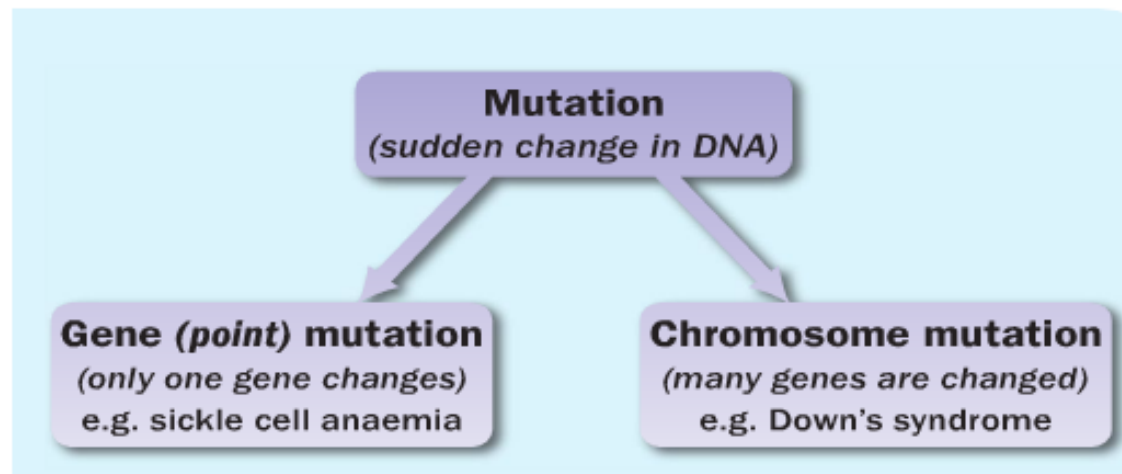
Apart from treating the symptoms of the disorder, the most common treatment involves total blood transfusions. Such a treatment is only temporary and is not easily available in many parts of Africa.



# Chromosome Mutations

**Down's Syndrome** - is a mutation caused by an extra chromosome. The extra chromosome comes from the mother and is an extra 'number 21' chromosome.

It causes too much of a brain enzyme to be produced and causes the brain to form incorrectly.





# Evolution

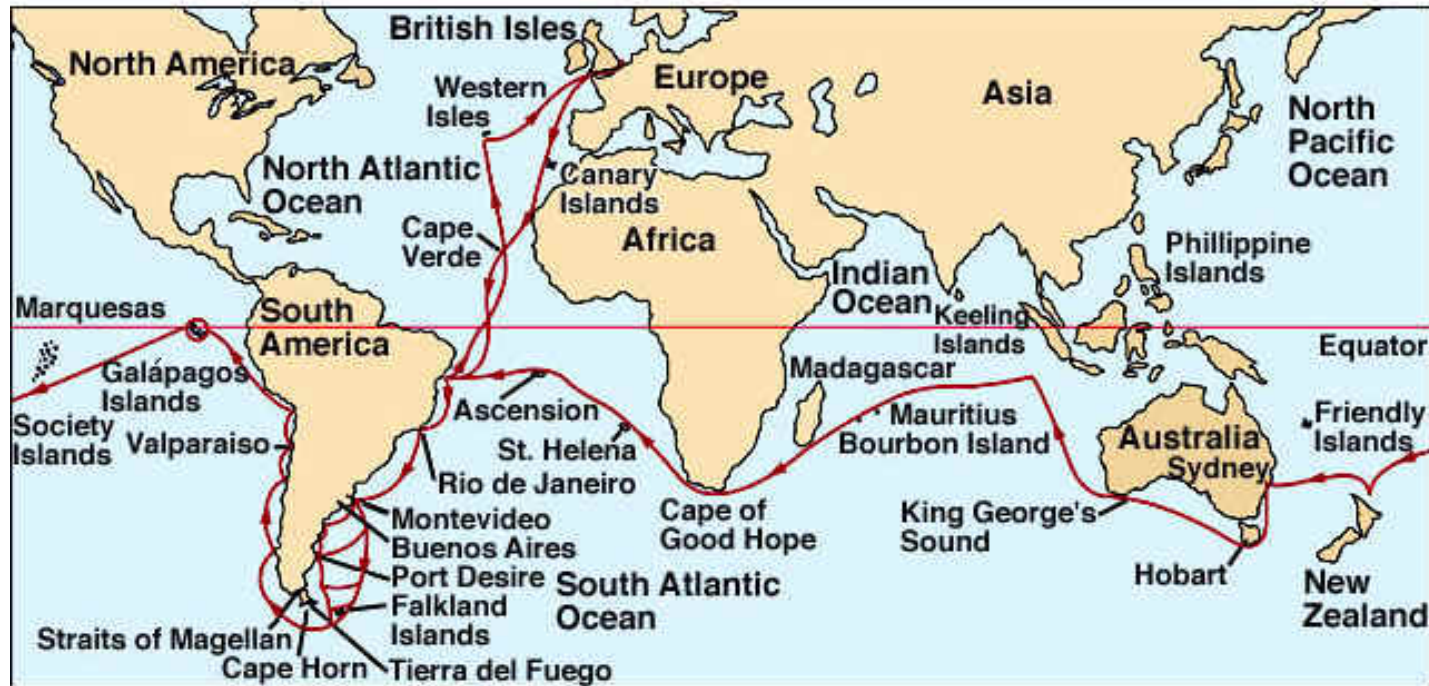
**Evolution** is the way in which living things change genetically to produce new forms of life over long periods of time.



Outline of the theory of natural selection	
Observations	Conclusions
<p><b>1. Overbreeding</b> Darwin noted that organisms produce large numbers of offspring. For example, trees produce thousands of seeds and oysters lay millions of eggs.</p>	<p><b>1. There is a struggle for existence</b> If more offspring are formed and the environment cannot support all of them, then there must be competition for scarce resources. This means that animals compete for food, water, shelter, and mates. Plants compete for space, light, water, and minerals.</p>
<p><b>2. Population numbers remain constant</b> The number of organisms of the same species (called a population) in an area will continue to increase until the environment can no longer support any more. Then the number of organisms stays more or less the same.</p>	<p><b>2. Natural selection</b> Those organisms that have variations which enable them to adapt better to their environment will survive and reproduce. They will pass their variations on to the next generation. Organisms with unfavourable variations will not survive and they will not be able to pass on their variations to the next generation. Natural selection is also called survival of the fittest, but this expression is misleading. Natural selection is not about fitness in terms of physical or mental abilities. Instead, it relates to the suitability of a species (or organism) to its environment. The essence of natural selection is how well adapted organisms are to their environment.</p>
<p><b>3. Inherited variations occur in populations</b> The members of a population or species show genetic or inherited differences. These variations may arise from sexual reproduction, mutations or genetic engineering (variations arising due to the environment are not passed on, e.g. broken legs, learned abilities).</p>	

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# H.M.S. *Beagle* Voyage



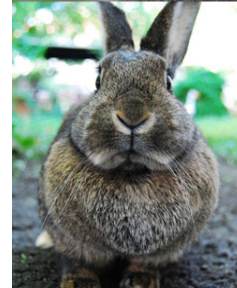


# Natural Selection

**Natural selection** is the process by which those organisms with genetically controlled characteristics that allow them to be well adapted to their environments will survive and reproduce to pass on their genes to following generations.



Example using Wolves and Rabbits



# Evidence for Evolution

## Syllabus



*Evidence in support of evolution comes from three main areas: the study of fossils, comparative anatomy (comparing structures in different organisms) and the study of embryos. The syllabus requires evidence from only one of these sources.*

**DNA evidence** is now a huge part also but not yet part of the syllabus!

**Paleontology** is the study of fossils. Fossils are generally rocks that have kept the shape of an organism.

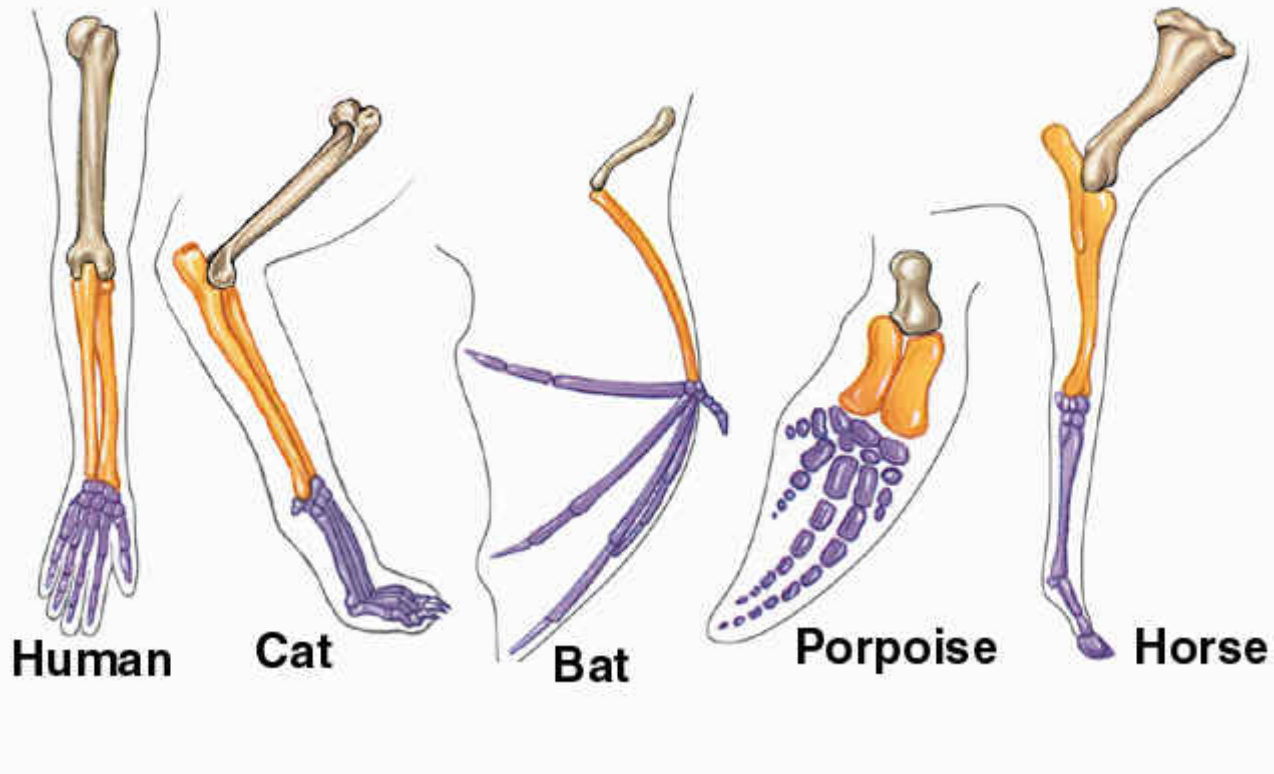
Fossils can be aged very precisely. 98% of organisms that have ever lived have gone extinct.

The more modern the fossil the more complex it is.



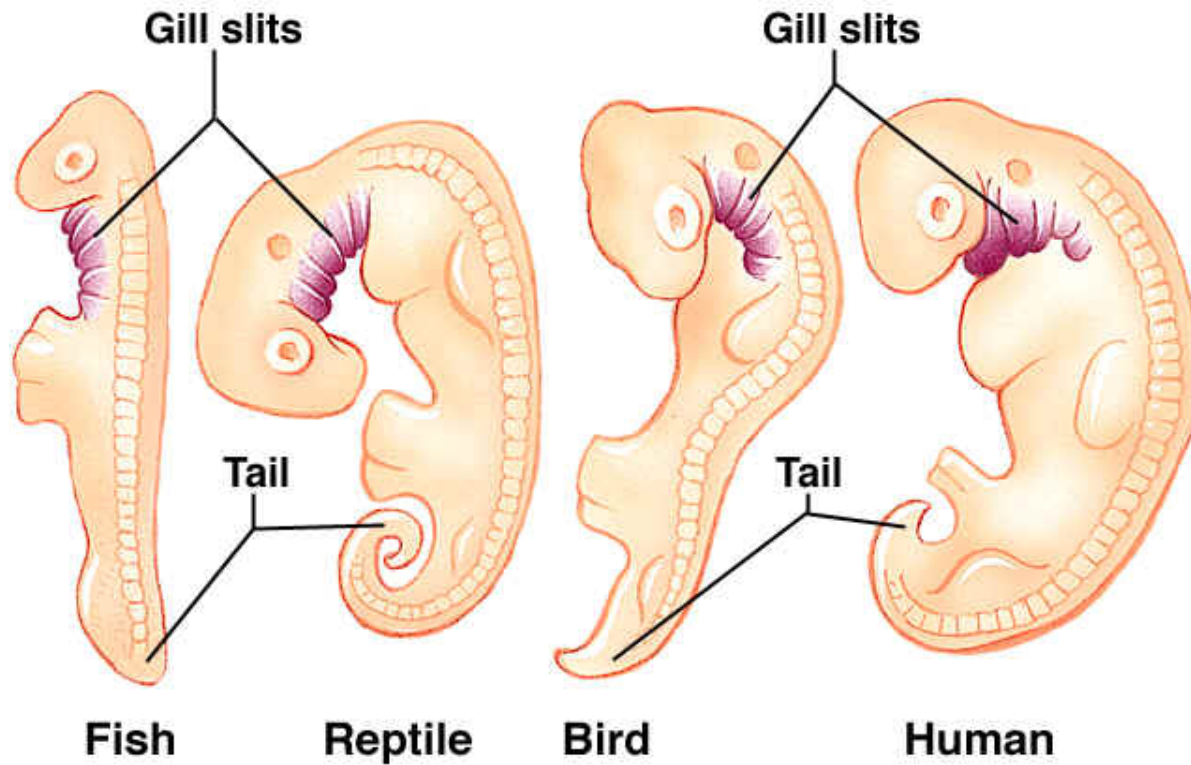
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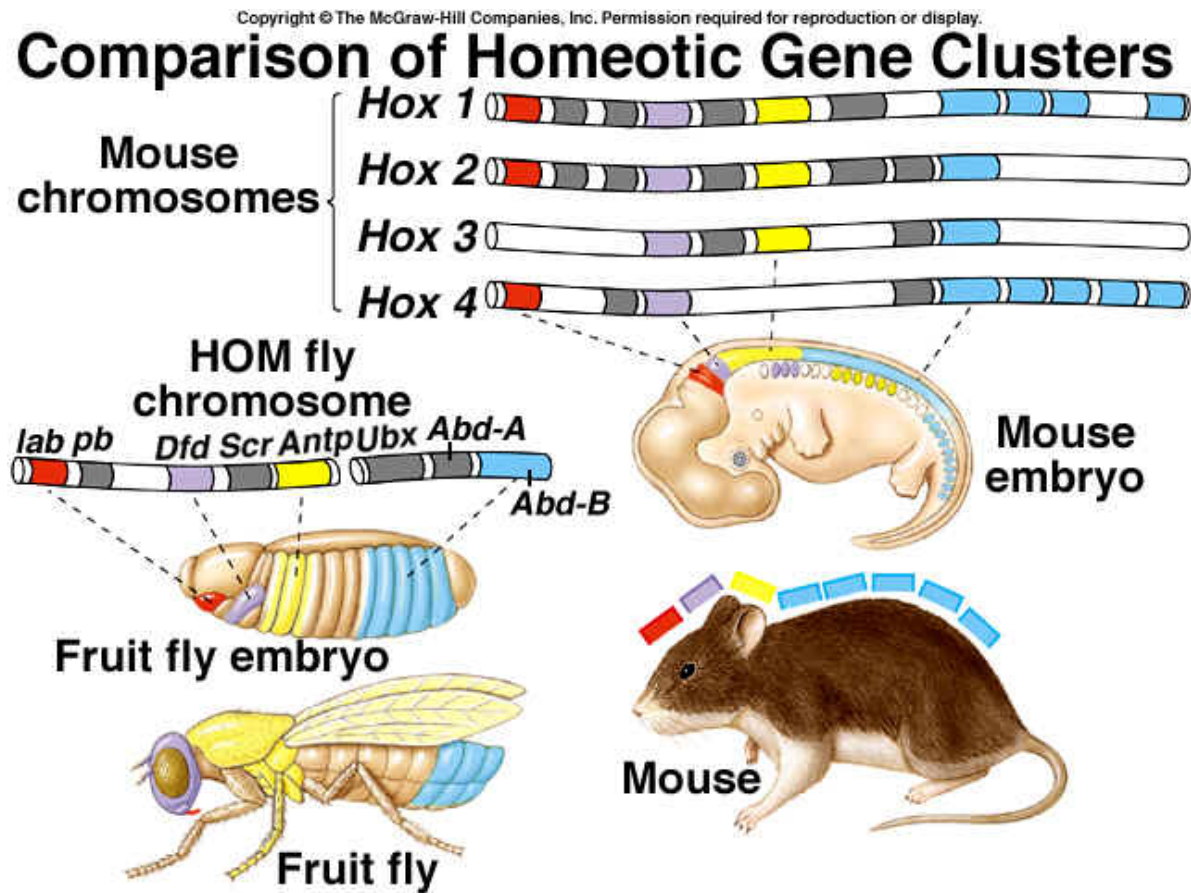
## Homology—Vertebrate Limbs



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# Embryos and Evolutionary History










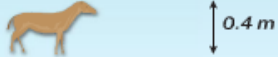
## Example of Evolution

### EVOLUTION OF THE HORSE

The fossil record of the modern horse is very well documented. It covers a time span of about 60 million years and involves many hundreds of species, most of which are now extinct.

There are many trends to be seen in the evolution of modern horses. The following account deals with one change: the height of the animal.

- The ancestor of the modern horse developed about 60 million years ago. These animals were about the size of a fox (0.4 m high).
- Fossils from about 30 million years ago show that the ancestors of the horse were larger (about the size of a German shepherd, 0.6 m high).
- Fossils from 15 million years ago show the existence of creatures that were the size of a Great Dane (1 m high).
- The modern horse first evolved about 1 million years ago. Horses are normally about 1.6 m high.

TIMESCALE	HEIGHT
1 million years ago to the present	
15 million years ago	
30 million years ago	
60 million years ago	



## Attachments

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