

Evolution and Darwin

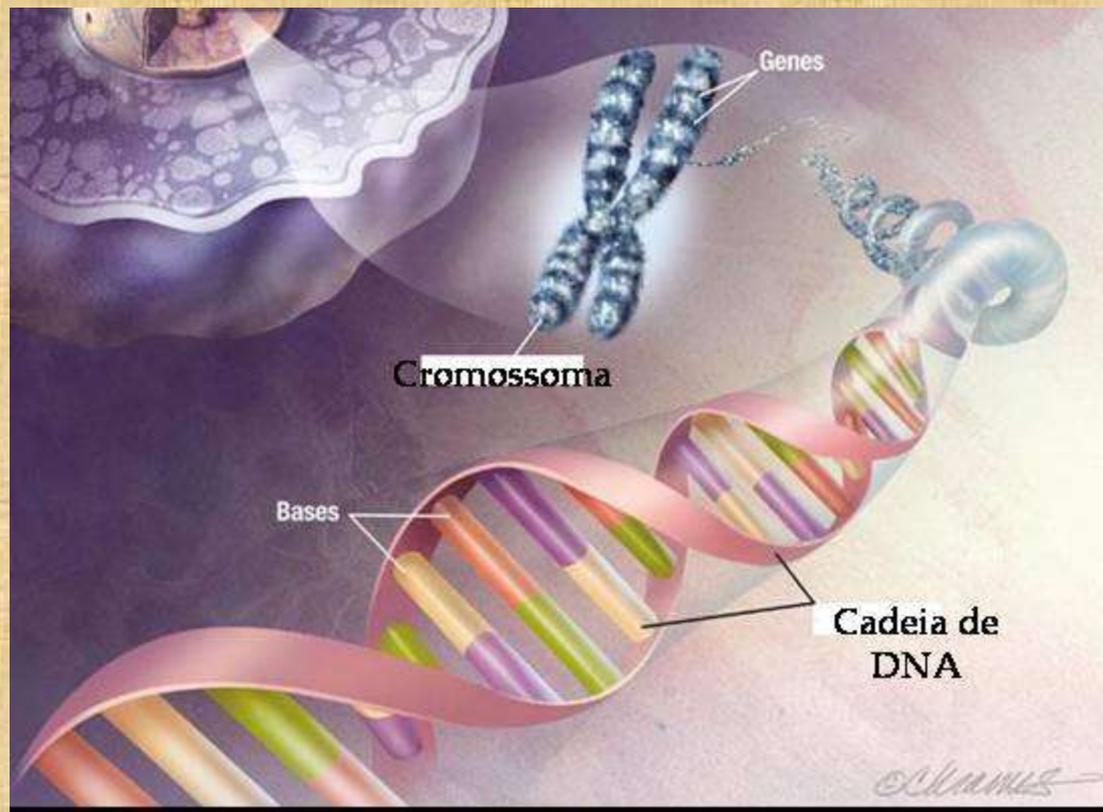
Natural Selection and Evolution

- Our plant has been evolving from its simplest beginnings into a vast range of organisms present today
- This has happened by natural selection



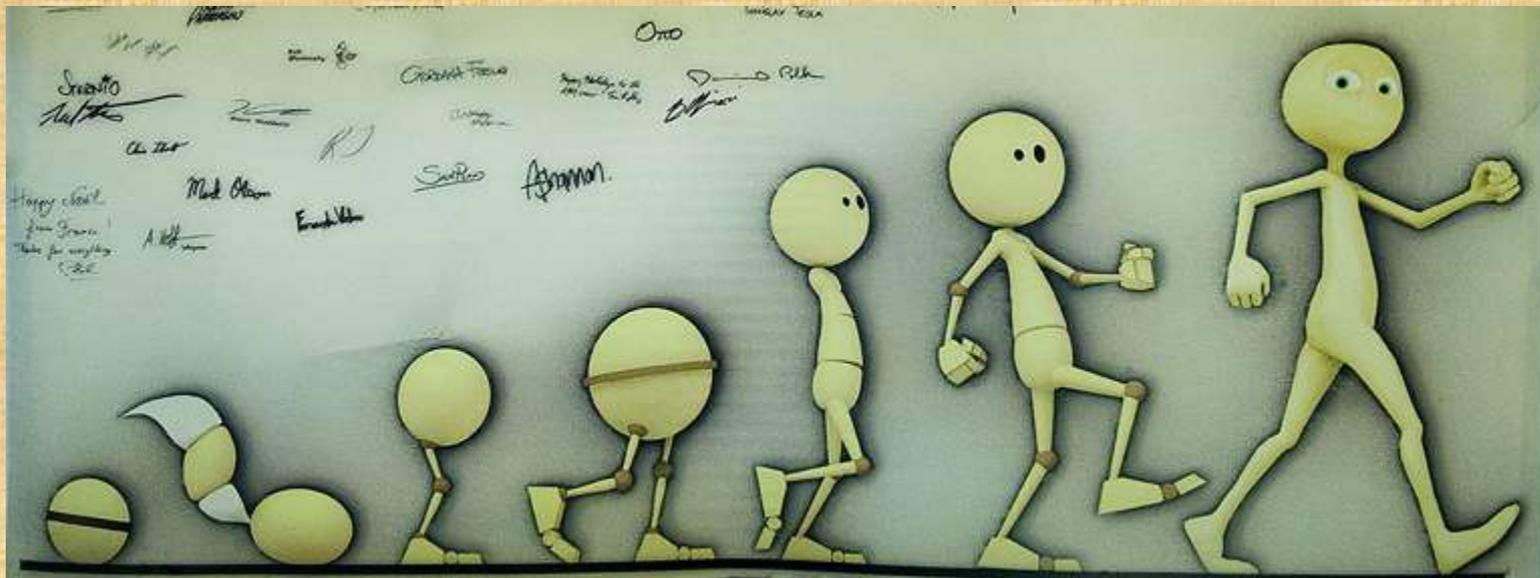
Natural Selection and Evolution

- A **change** in the **genes!!!!!!!**



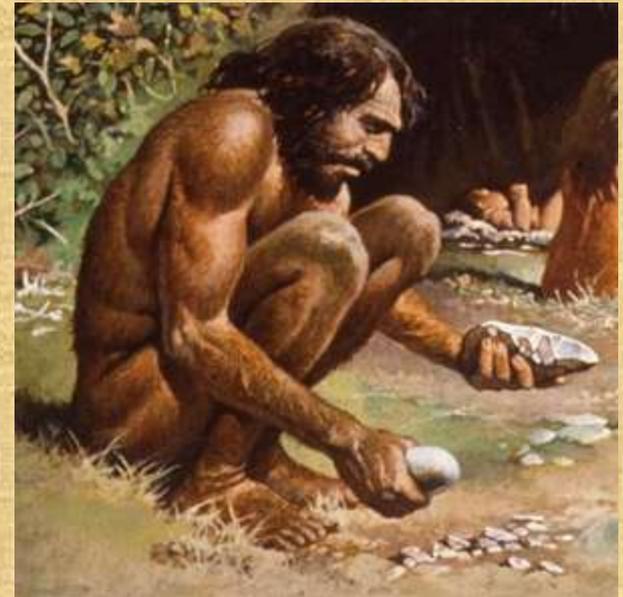
Natural Selection and Evolution

- **EVOLUTION** is a gradual change in the range of organisms
- New species arise while other become extinct



Natural Selection and Evolution

- Natural selection is the mechanisms by which new species arise
- Allows different forms of a species to survive in different areas



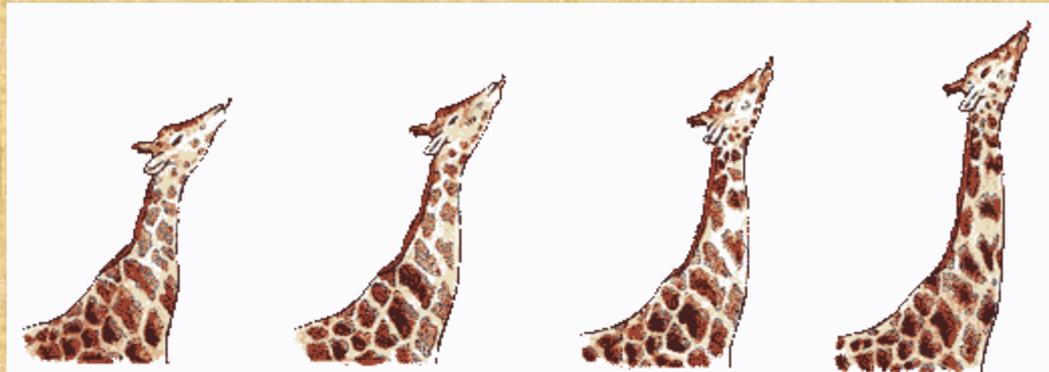
Old Theories of Evolution

- Jean Baptiste Lamarck (early 1800's) proposed:
 - “The inheritance of acquired characteristics”
- He proposed that by using or not using its body parts, an individual tends to develop certain characteristics, which it passes on to its offspring.



“The Inheritance of Acquired Characteristics”

- Example:
- A giraffe acquired its long neck because its ancestor stretched higher and higher into the trees to reach leaves, and that the animal’s increasingly lengthened neck was passed on to its offspring.



“The Inheritance of Acquired Characteristics”

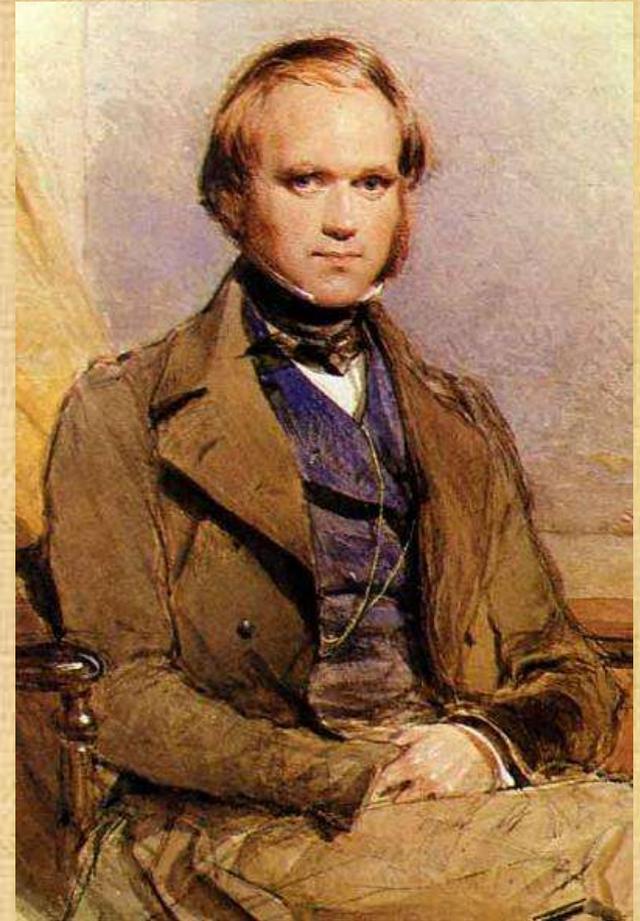
- There is some debate on this theory because there is not fossil record to support.

Charles Darwin

Influenced by Charles Lyell who published

“Principles of Geology”.

This publication led Darwin to realize that natural forces gradually change Earth’s surface and that the forces of the past are still operating in modern times.



Charles Darwin

- Darwin set sail on the H.M.S. Beagle (1831-1836) to survey the south seas (mainly South America and the Galapagos Islands) to collect plants and animals.
- On the Galapagos Islands, Darwin observed species that lived no where else in the world.
- These observations led Darwin to write a book.

Charles Darwin

- Wrote in 1859: “On the Origin of Species by Means of Natural Selection”

Charles Darwin

- Two important deductions:
 - 1. There is a struggle for existence. Many offspring are produced, yet the population stays the same size.
 - 2. Some offspring survive whilst others die, those organisms best equipped or best suited to their environment.

Charles Darwin

- Darwin was not aware of genes and how they determined characteristics
- Mendel had not yet published his work on inheritance

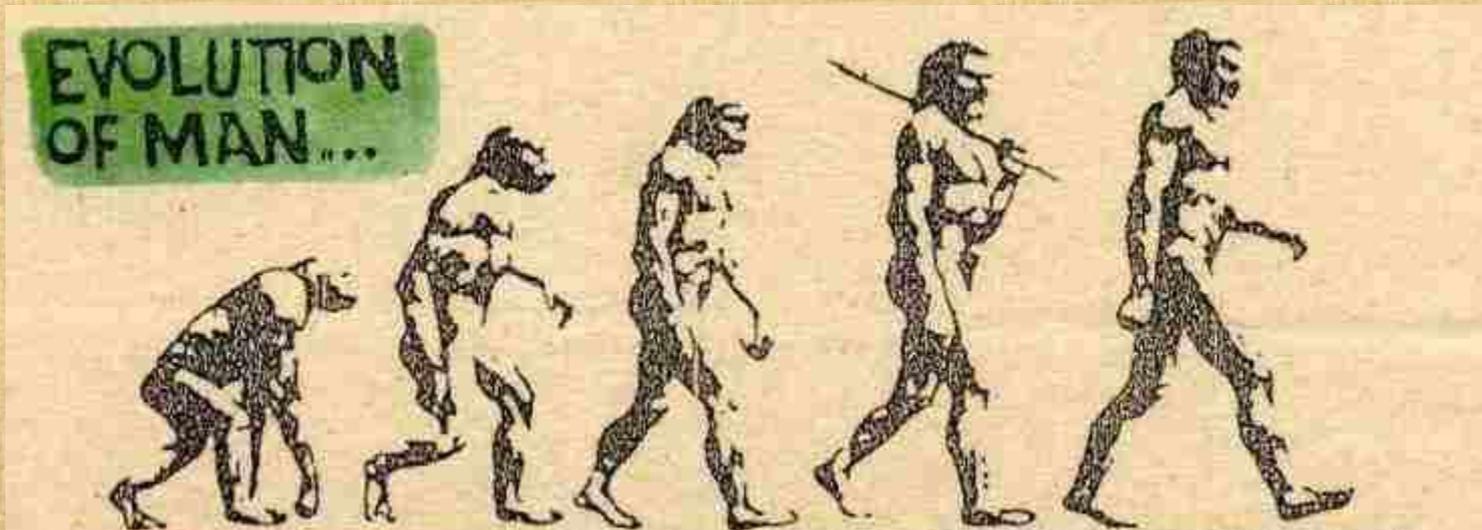
Charles Darwin

- Survival of the fittest meant how well suited, or well adapted, an organisms is to its environment



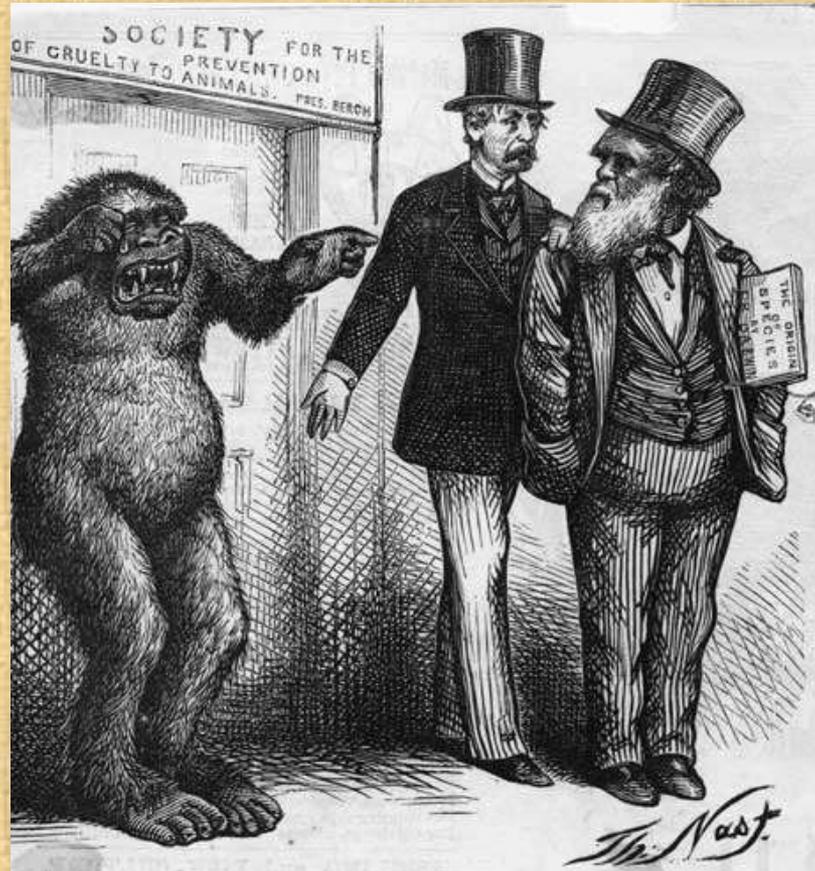
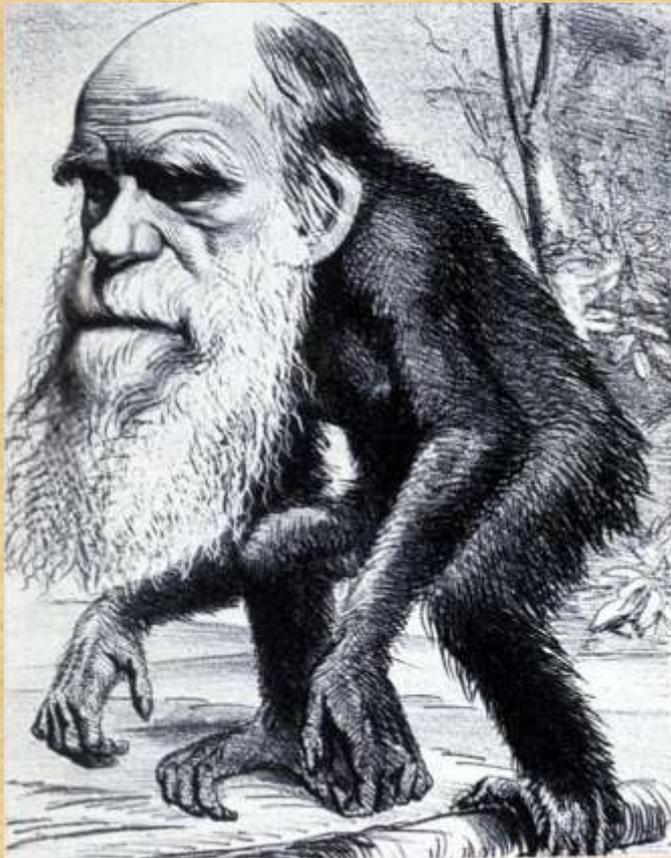
Charles Darwin

- Darwin changed the way in which biologists think about how species arise
- Suggested that humans could have evolved from ape-like ancestors



Charles Darwin

- Darwin's ideas were and are still unpopular.

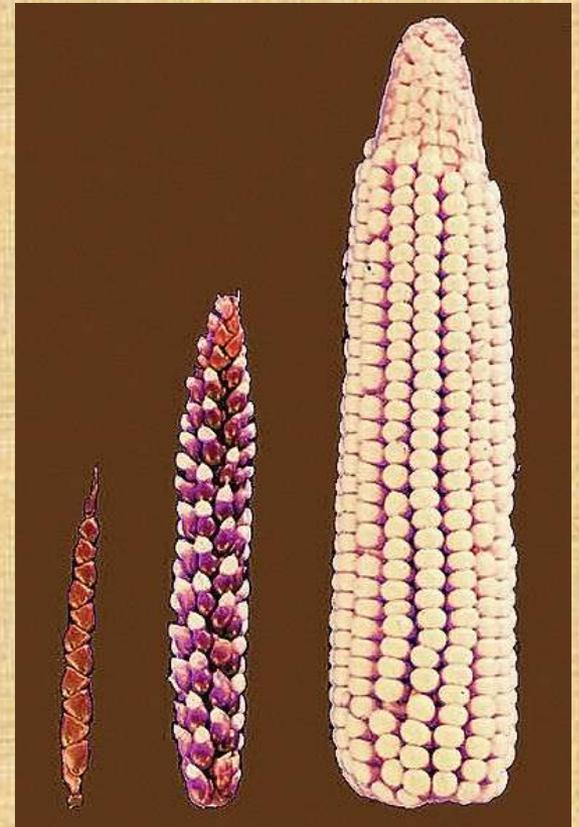




Natural Selection

Natural selection

- The theory of natural selection proposes that some factor in the environment 'selects' which forms of a species will survive



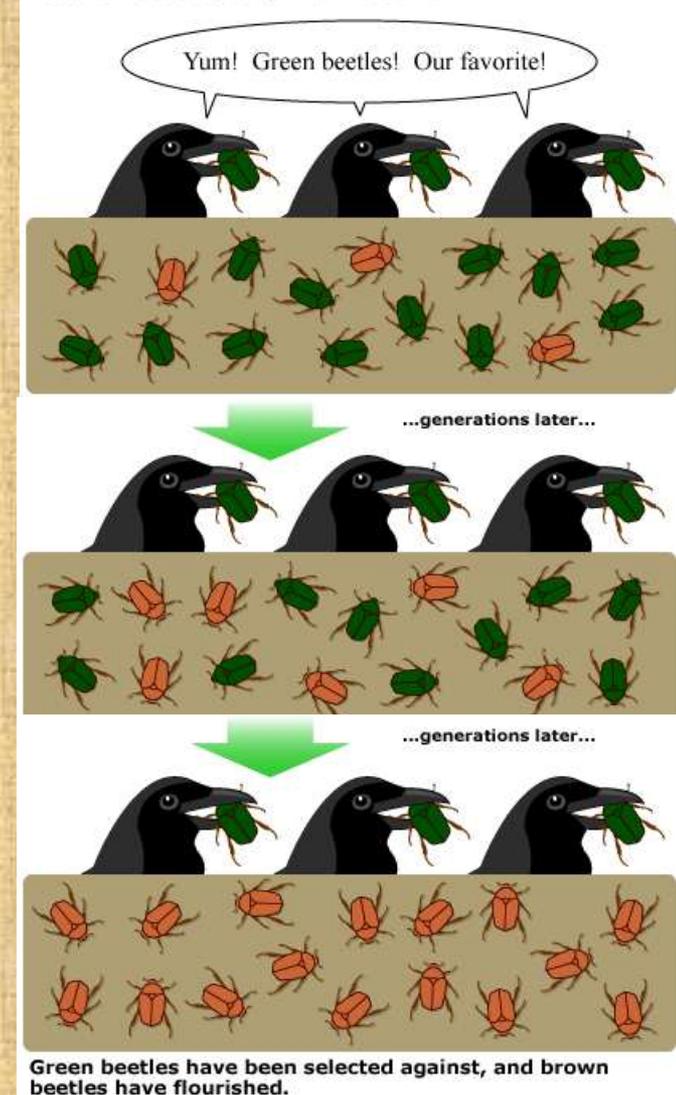
Natural selection

- Must show
 - There is variation within the species
 - Changing conditions (**selection pressure**) favour one particular form of the species (**selective advantage**)
 - Frequency of the favoured form increases
 - Changes are not due to other factors

Natural Selection

- Individuals with favorable traits are more likely to leave more offspring better suited for their environment.
- Also known as “Differential Reproduction”

Natural selection, in a nutshell:



Evidence of natural selection

- Example:
- English peppered moth,- light and dark phases



Evidence of natural selection

- Original moth was greyish white
- Nearly all moths were the peppered type
- The first recorded dark moth in Manchester was in 1848
- By 1895 98% of the moths were the dark form.

Evidence of natural selection

- WHY?

Industrial Revolution

Evidence of natural selection

- HOWEVER,

Evidence of natural selection

- The two types are both part of the same species, and can interbreed.
- Moreover, both types existed before the industrial revolution.
- It is only the frequency of the different types which has changed.

Evidence of natural selection

- Since smoke pollution has decreased in the UK, the light coloured moths have started to become more common again.
- The process which took place after the industrial revolution is beginning to be reversed.
- By 2019, the dark moths are only expected to make up 1% of the peppered moth population in Britain.

Evidence of natural selection

- Only provides evidence for fluctuating frequencies of different types of moth.
- It does not give evidence for large scale evolutionary changes involving new organs or body plans.
- It does not show us how moths came into existence in the first place.

| Feature of natural selection | Effect on peppered moths |
|---|---|
| Selection pressure | Predation by birds on moths on sooted tree trunks |
| Natural variation in the species | Some moths are peppered others are dark |
| Type with selective advantage | Dark form camouflage on dark sooted surfaces |
| Type selected for | Dark form |
| Type selected against | Peppered form |
| Result of natural selection over many generations | % of dark form increases or remains high |

Side note

- After this was published the “Clean Air Act” was passed
- Overtime the Peppered Moths survived to reproduce
- Showed Natural Selection in one direction, then reversing

Evidence of natural selection

- Antibiotic-resistant bacteria
 - Mutations within bacteria are constant
 - With the increase of antibiotics, bacteria are becoming resistant
 - The generation time in bacteria is 20 min
 - The possibility of “super bugs”



| Feature of natural selection | Effect on population of non-resistant bacteria |
|--|---|
| Selection pressure | Repeated use of antibiotics |
| Natural variation in the species | Some are resistant |
| Type with selective advantage | Resistant type |
| Type selected for | Resistant type |
| Type selected against | Non-resistant type |
| Results of natural selection over many generations | % of resistant types in the population increases |

Jumping Genes

- Bacteria can occasionally transfer genes between different species
- One resistant bacteria can transfer its resistance to another bacteria resistance to a different type of antibiotic producing a bacteria resistant to two different antibiotic.

Evidence of natural selection

- Sickle cell anaemia
 - Affects the formation of haemoglobin
 - Can be fatal in homozygous individuals
 - Heterozygous carriers show no symptoms
 - These individuals are resistant to malaria



| Feature of natural selection | Effect on incidence of sickle cell anaemia |
|--|---|
| Selection pressure | Infection by the malarial parasite |
| Natural variation in the species | Carriers (people who are heterozygous) |
| Type with selective advantage | Carriers – parasite can't complete life cycle |
| Type selected for | Carriers |
| Type selected against | People with 100% normal haemoglobin |
| Results of natural selection over many generations | Numbers of heterozygote's in population are higher than areas where malaria is absent |

Natural selection

- Natural selection is simply the logical result of four features of living systems:
 - Variation
 - individuals in a population vary from one another
 - Inheritance
 - parents pass on their traits to their offspring genetically

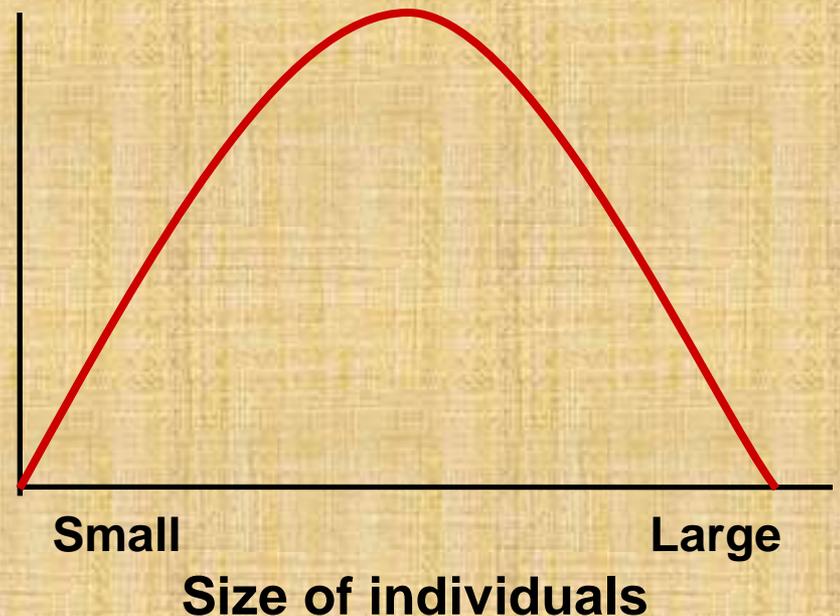
Natural selection

- Selection
 - some variants reproduce more than others
- Time
 - successful variations accumulate over many generations

Modes of action

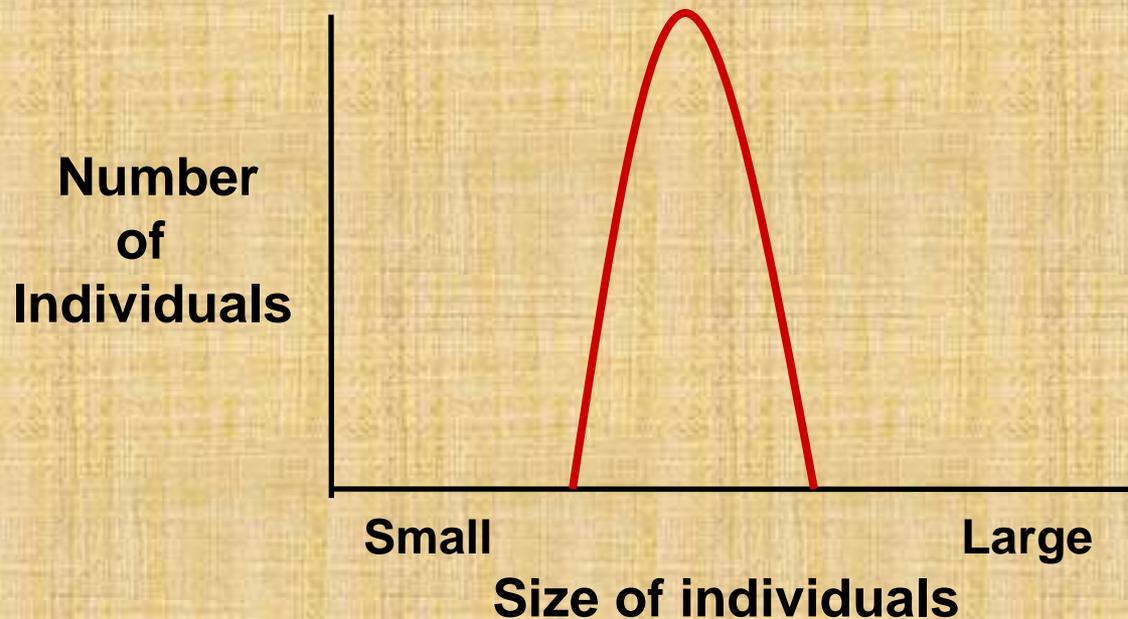
- Natural selection has three modes of action:
 1. Stabilizing selection
 2. Directional selection
 3. Diversifying selection

Number
of
Individuals



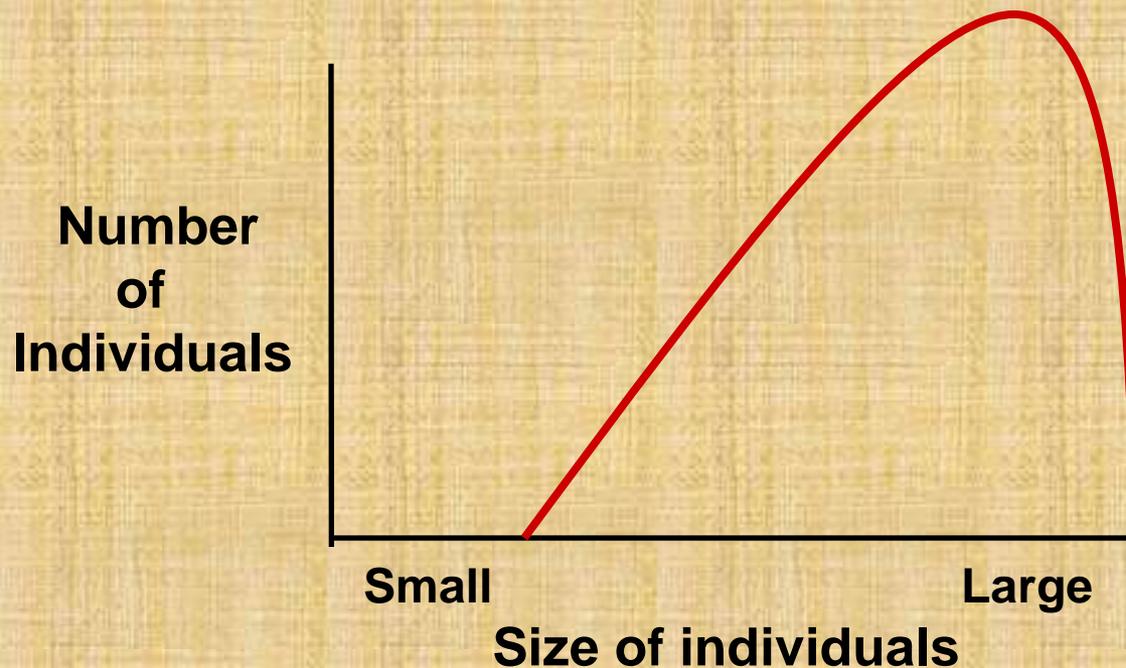
1. Stabilizing selection

- Acts upon extremes and favors the intermediate.



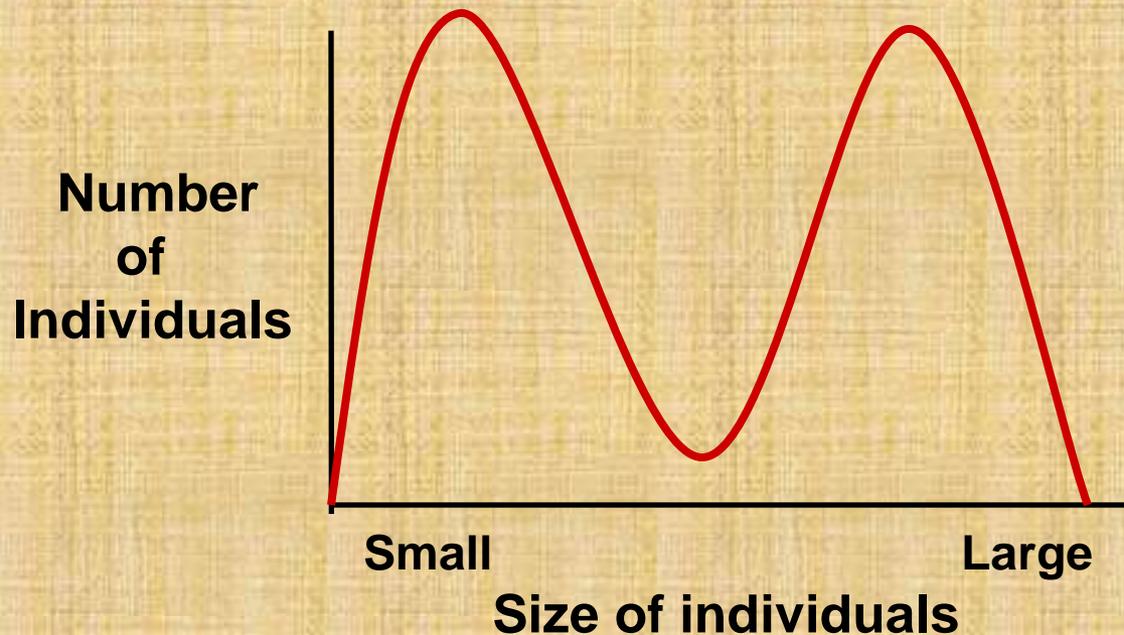
2. Directional selection

- Favors variants of one extreme.

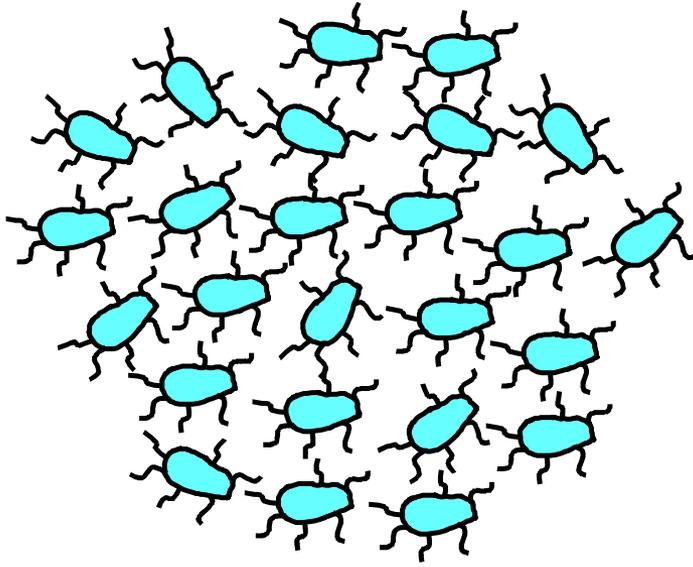


3. Diversifying selection

- Favors variants of opposite extremes.



How natural selection works



Resistance to antibacterial soap

Generation 1: **1.00 not resistant**
0.00 resistant

How natural selection works



Resistance to antibacterial soap

Generation 1: 1.00 not resistant
0.00 resistant

How natural selection works



Resistance to antibacterial soap

Generation 1: 1.00 not resistant
0.00 resistant

Generation 2: 0.96 not resistant
0.04 resistant

How natural selection works



Resistance to antibacterial soap

Generation 1: **1.00** not resistant

0.00 resistant

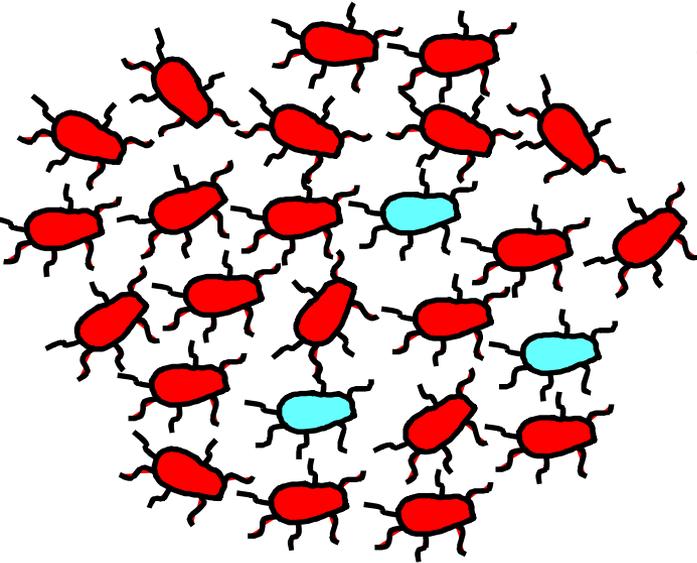
Generation 2: **0.96** not resistant

0.04 resistant

Generation 3: **0.76** not resistant

0.24 resistant

How natural selection works



Resistance to antibacterial soap

Generation 1: **1.00** not resistant
0.00 resistant

Generation 2: **0.96** not resistant
0.04 resistant

Generation 3: **0.76** not resistant
0.24 resistant

Generation 4: **0.12** not resistant
0.88 resistant

Formation of A New Species

Formation of a new species

- One species favours the survival of other individuals in the population
- Over time, the least well-adapted member does not survive to reproduce
- The favoured species becomes adapted to the environment



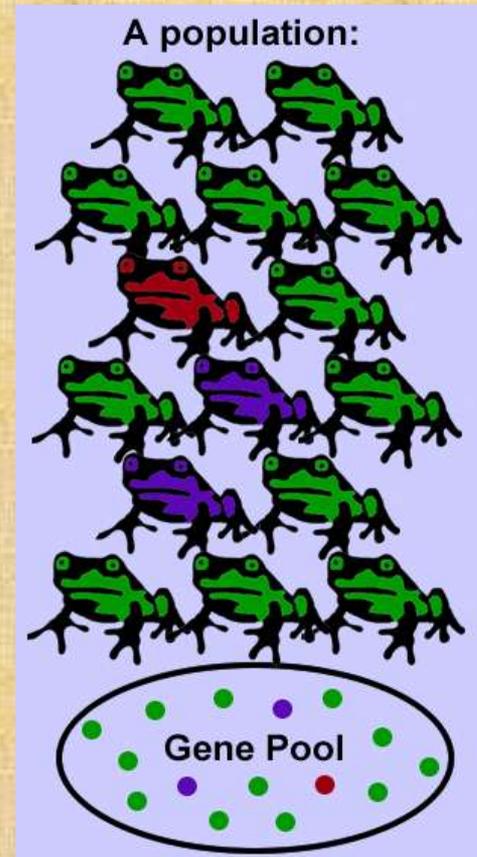
Formation of a new species

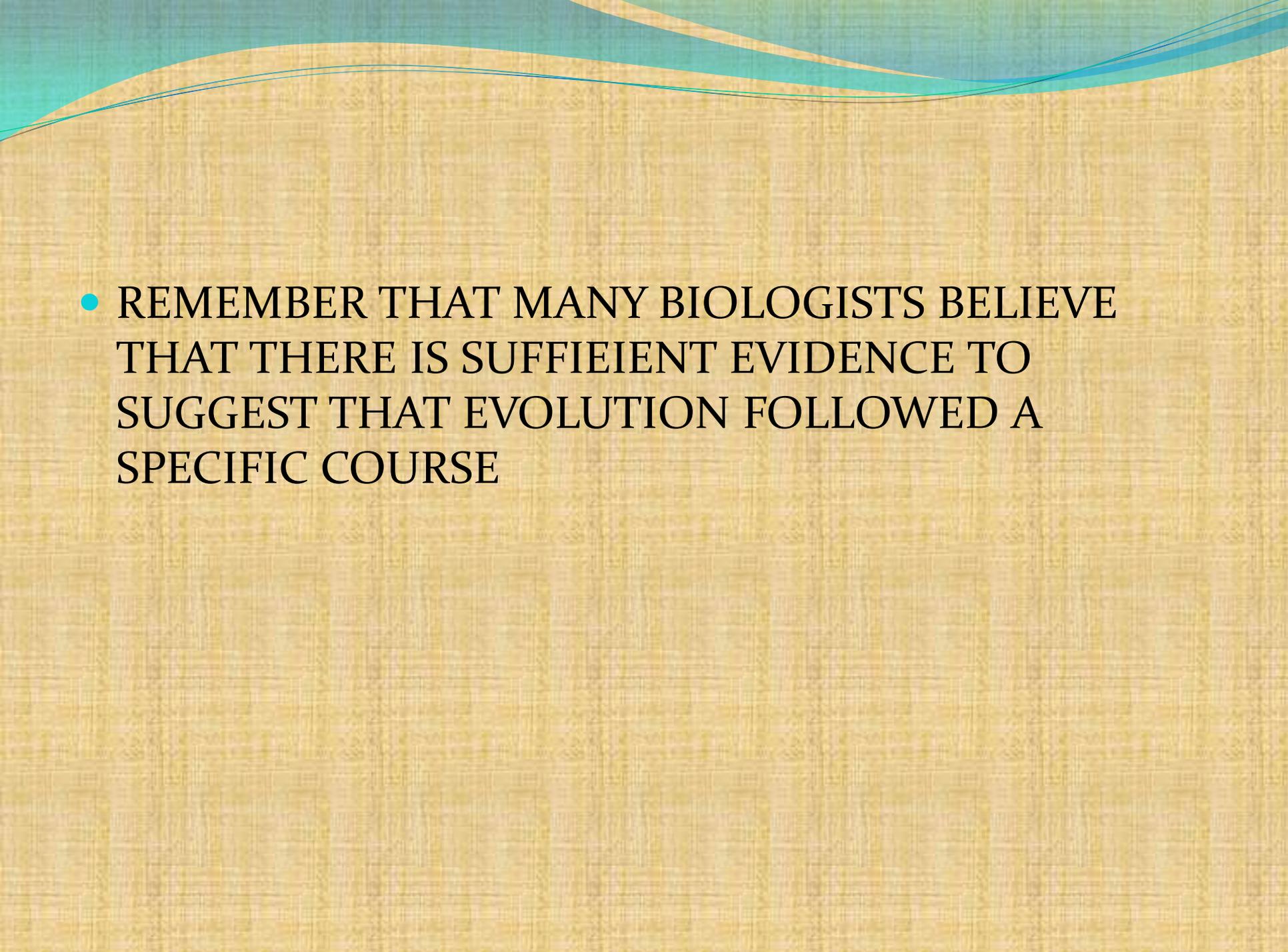
- Understand that mutations are responsible for many of these changes
- Some mutations are harmful but some are neutral and a few are beneficial.



Formation of a new species

- Mutations that favour a populations will be well adapted



- 
- REMEMBER THAT MANY BIOLOGISTS BELIEVE THAT THERE IS SUFFICIENT EVIDENCE TO SUGGEST THAT EVOLUTION FOLLOWED A SPECIFIC COURSE

Main Stages of Evolution

