

Unit 1: DNA & the Genome

Key Area 7: Evolution

Evolution involves the changes in organisms over generations as a result of genome variations.

Selection

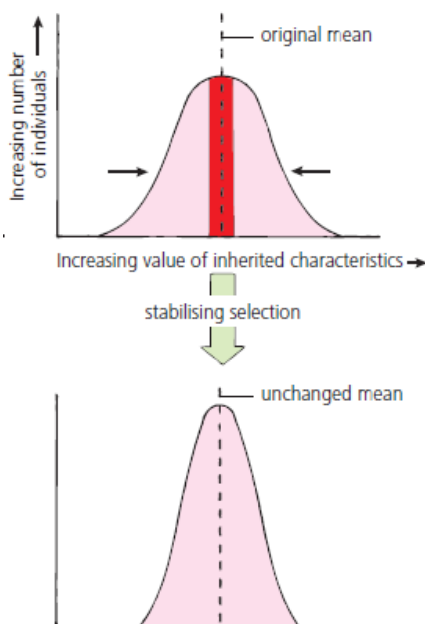
Natural Selection

This is the **non-random increase in frequency of DNA sequences that increase survival** and the **non-random reduction in the frequency of deleterious sequences**.

The **changes in phenotype frequency** will be due to one of the following types of natural selection:

- **Stabilising**
- **Directional**
- **Disruptive**

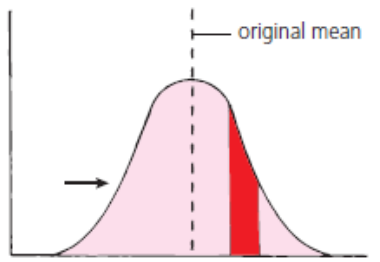
Stabilising selection occurs when the **average phenotype is selected for** and **extremes of the phenotype range are selected against**.



When natural selection has a stabilising effect, the **mean phenotype remains unchanged** but the **range of phenotypes is narrower**.

KEY → direction in which selection is about to act
■ phenotypes about to be selected

Directional selection occurs when **one extreme of the phenotype range is selected for**.



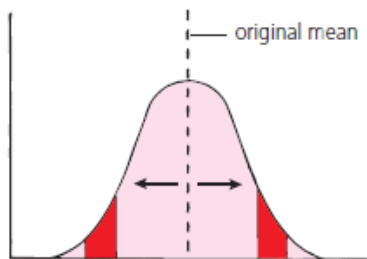
directional selection



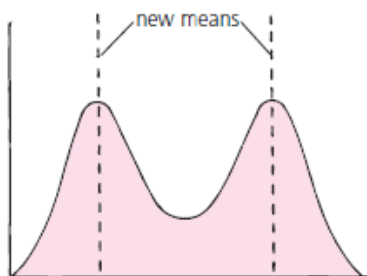
When natural selection has a directional effect, the **mean phenotype and range of phenotypes change**.

KEY → direction in which selection is about to act
■ phenotypes about to be selected

Disruptive selection occurs when **2 or more phenotypes are selected for**.



disruptive selection



When natural selection has a disruptive effect, **2 new mean phenotypes result** and the **range of phenotypes is altered**.

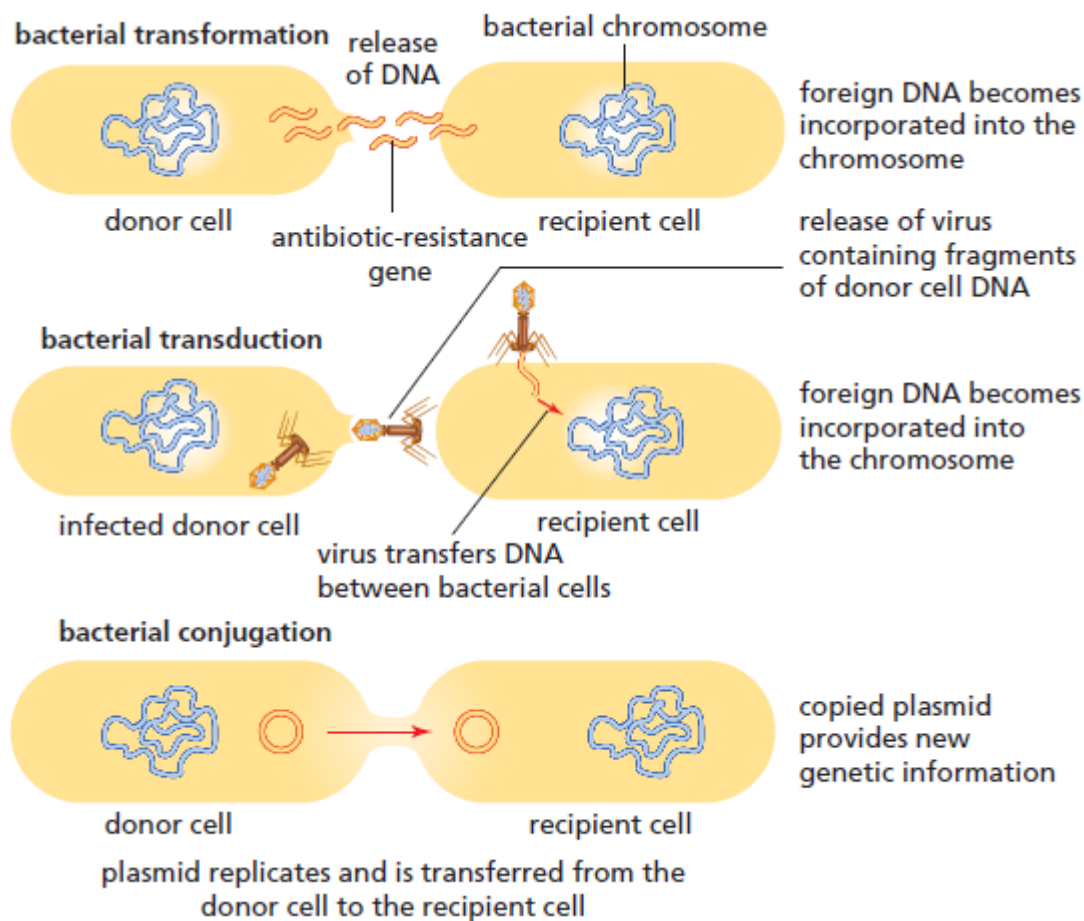
KEY → direction in which selection is about to act
■ phenotypes about to be selected

Natural Selection in Prokaryotes

Natural Selection in prokaryotes is **more rapid**.

Prokaryotes can exchange genetic material (genes) **horizontally**, resulting in faster evolutionary change than organisms that only use vertical gene transfer (from parent to offspring/one generation to the next)

Horizontal gene transfer is where **genes are transferred between individuals in the same generation**.



(From August 2018 you do not need to know the methods of horizontal gene transfer)

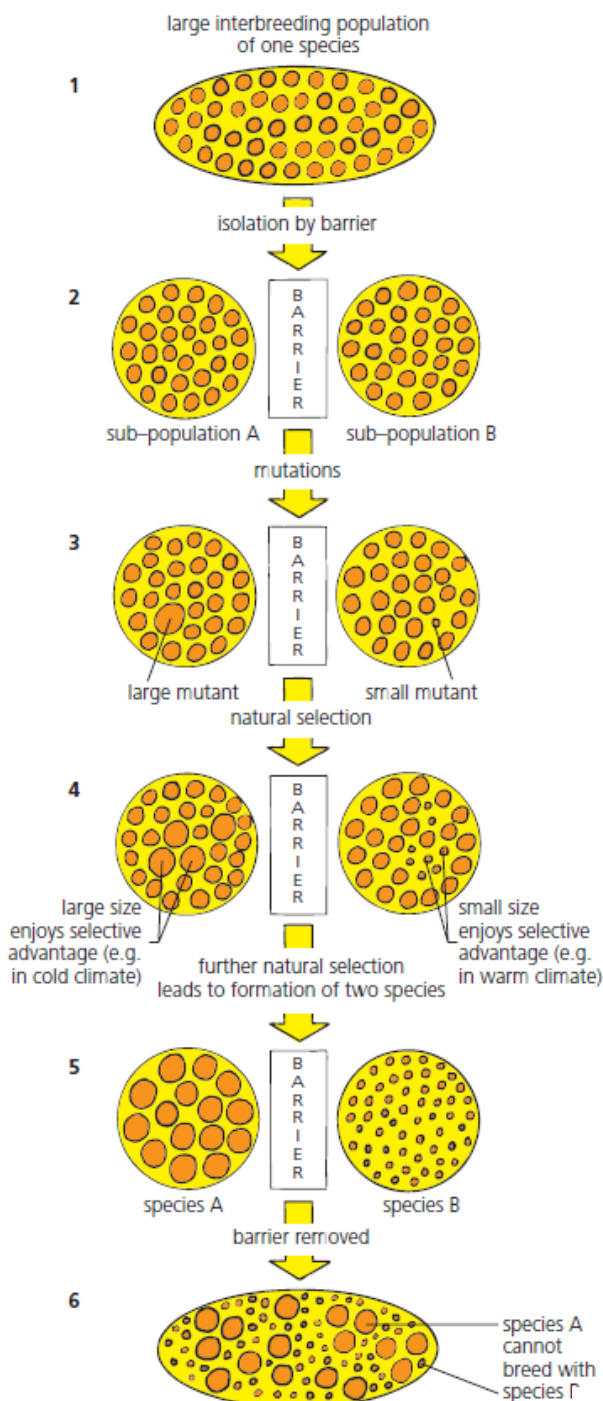
Vertical Gene Transfer is where genes are transferred from **parent to offspring** (different generation) as a result of **sexual or asexual reproduction**.

Speciation

A **species** is a **group of organisms capable of interbreeding and producing fertile offspring**, and which does not normally breed with other groups.

Speciation is the **generation of new biological species by evolution** as a result of:

- **Isolation**
- **Mutation**
- **Selection**



Initial **large interbreeding population** of one species, **sharing genes**.

An **Isolation barrier** splits the original population into **sub-populations** and **prevents gene flow** between the sub-populations.

A **different mutation** occurs in each sub-population.

Some **mutations may be favourable** and are **selected for by natural selection**.

After **many generations**, the frequency of the mutation increases in each sub-population.

After a **very long time**, the 2 sub-populations are now so genetically different that they can **no longer interbreed to produce fertile offspring** i.e **2 separate species**.

The **type of Isolation** barrier determines the type of Speciation which occurs.

Geographical barriers (e.g. mountain range, desert, river, sea) lead to **Allopatric Speciation**.

Behavioural or Ecological barriers lead to **Sympatric Speciation**.

In Sympatric speciation the behavioural or ecological barriers prevent gene flow between populations living side by side but do not interbreed and so natural selection is able to act separately on the 2 sub-populations.