1.7. Evolution

Evolution is the change in organisms over generations as a result of **genomic variations**.

Inheritance

Types of gene transfer:	
Vertical	Genetic material passed from parent to offspring as a result of **sexual** or **asexual** reproduction.
Horizontal (prokaryote to prokaryote)	Prokaryotes can exchange genetic material horizontally, from cell to cell, resulting in **rapid evolutionary change**. This type of transfer has led to antibiotic resistance, due to the transfer of plasmids (that carry resistance genes) between bacterial cells.
Horizontal (prokaryote to eukaryote)	Prokaryotes and viruses can transfer DNA sequences horizontally directly into the genome of **eukaryotes**, where it is incorporated into the DNA of the eukaryote cell.

Selection

Darwin's theory of natural selection:

Organisms produce more **offspring** than the environment can support. Genetic variation occurs within individuals of a **population**. Individuals **compete** for available resources such as food and mates. Individuals with **favourable** genes, which give them an **advantage** in the environment, are more likely to **survive** and pass these genes onto the next **generation**.

Therefore, Natural selection is:

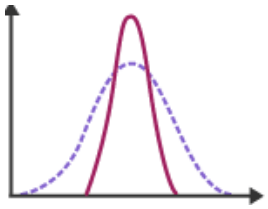
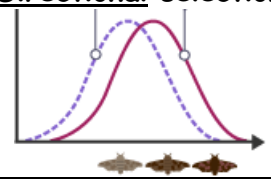
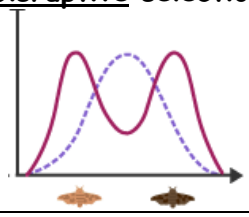
- the **non-random** increase in **frequencies** of DNA sequences that **increase** an organism's chances of survival
- and the **non-random** reduction in **deleterious** sequences which **decrease** an organism's chances of survival.

Sexual selection:

Sexual selection is the **non-random increase** in frequency of DNA sequences that **increase reproductive** success. For example, male competition which involves male deer competing with **physical aggression** by colliding their antlers until one backs down. The winning deer mates with the female passing on strong **genetic traits**.

Type of selection pressure

Natural selection can affect the frequency of a measurable trait within a large population in 3 ways.

Stabilising selection 	This is when natural selection tends to result in phenotypes in a range becoming more aligned with a **mean value**. **An example** of this is clutch size (number of eggs laid in a single brood) in birds: • Birds that lay too many eggs have an increased chance of losing offspring to starvation. • Birds which lay too few have a decreased chance of these birds surviving and passing their genes on.
Directional selection 	This is when natural selection tends to move the average phenotype towards **an extreme** value in a range. **An example** of this is industrial melanism; in this case nature favours dark moths over lighter ones.
Disruptive selection 	This is when natural selection tends to favour **two extreme** phenotypes, and results in two or more common phenotypes. **An example** of this is, if there are dark trees covered in areas of light lichen: • moths with lots of melanin, will camouflage against the dark trees, • moths with very little melanin, will camouflage against the light coloured lichen.

Genetic Drift

Genetic drift is the random increase and decrease in frequency of DNA sequences, particularly in small populations, as a result of **chance events**, **neutral mutations** and **founder effects**.

Origin of genetic drift	Effect on gene frequency
chance event	Random loss of individuals with specific DNA sequences, results in a significant change in frequency of genes among the survivors and future generations.
neutral mutation	Gene frequency changes by mutations but the effect on phenotypes is minor and does not offer a selective advantage one way or another.
colonisation	**Founder effect** – by chance the colonising population (species which has spread to a new areas) has different gene frequencies from the original population.

Speciation

*****A species is a group of organisms that can interbreed to produce fertile offspring*****

Speciation is the generation of new biological species by evolution as a result of **isolation**, **mutation** and **natural selection**.

- **Allopatric speciation** – Sub-populations of a species become separated from each other by a geographical barrier such as rivers or mountains.
- **Sympatric speciation** – Sub-populations of a species become separated from each other by ecological (e.g. pH and salinity) or behavioural barriers (e.g. mating rituals).

Both types of speciation prevent **gene flow** from occurring between the sub-populations and they build up separate **genetic** differences based on natural selection acting on different **mutations**.

However, such barriers are rarely entirely complete and so **hybrid zones** can form where the ranges of two very similar and closely related species meet and attempt to interbreed.