Types of evolution

- **Divergent** – accumulation of differences between groups and can lead to speciation.
- **Convergent** – development of similar structures in groups without a common ancestor (antifreeze in Arctic and Antarctic fishes)
- **Parallel** – Parallel evolution is the development of a similar trait in different not closely related species, but descending from the same ancestor. (In butterflies, many close similarities are found in the patterns of wing colouration, both within and between families.)
- ***Co-evolution** -the change of a biological object triggered by the change of a related object (Newt's neurotoxin and garter snake's resistance)

BUT, why and how does this all happen?

The main mechanisms of evolution are:

1. Natural selection
2. Mutation
3. Genetic Drift
4. Migration

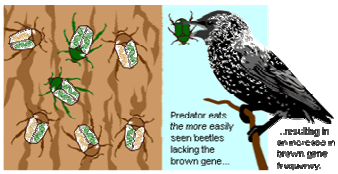
These are also known as the ***"forces of evolution"***

1 . Natural selection

Traits that provide a *reproductive advantage* tend to increase in frequency in a given population over time, while traits that leave individuals at a reproductive disadvantage tend to decrease

Natural selection probably accounts for more changes in allele frequency than any other microevolutionary process

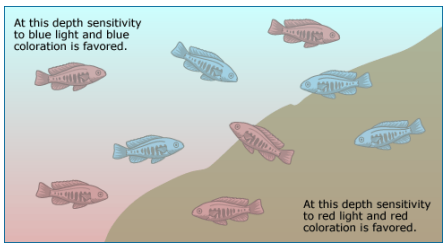
- It occurs when environmental conditions affect the ability of individuals to survive or reproduce depending on their genotype



1 . Natural selection

- All populations have the reproductive capacity to increase in size, thus threatening their own survival, forcing a competition for limited resources.
- Individuals of a population share in the same gene pool, but differ in phenotypic details.
- Some alleles promote survival and reproduction and therefore increase in frequency over generations resulting in individuals that differ in one or more heritable traits (evolution).
- There is a difference in the survival and reproductive success of different phenotypes.

Natural selection



What should the outcome be here over time?

Three possible outcomes for natural selection:

- A shift in the range of values for a given trait in some direction.
- Stabilization of an existing range of values.
- Disruption of an existing range of values.

1 . Natural selection

• It acts directly on phenotypes and indirectly on genotypes

• Over time, the alleles that produce the most successful phenotypes will increase in the population.

• Less successful alleles will become less common.

• Change leads to increased fitness and increased adaptation to environment.

Main mechanisms or forces of evolution

2. Mutations

"a heritable change in DNA (genetic information) of a gene that can alter gene expression."

Mutations provide new alleles & therefore are the ultimate source of variation

Mutations need not change gene expression, or have an effect on phenotype; because of the redundancy of the genetic code

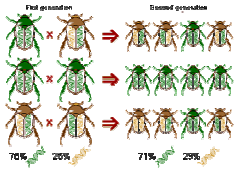
- Mutations can alter both the DNA and the protein it expresses
  - Neutral - have no effect on the viability or reproduction of the organism
  - Beneficial - meaning that they are advantageous to the organism
  - harmful or lethal if the change they cause in the protein is detrimental to the organism

The main mechanisms of evolution...

3. Genetic drift

The random fluctuation in allele frequencies over time, due to chance occurrences alone. It is more significant in small populations.

the increase of the other allele is not because it is better adapted (or "fittest") but simply random chance



There are two forms of genetic drift

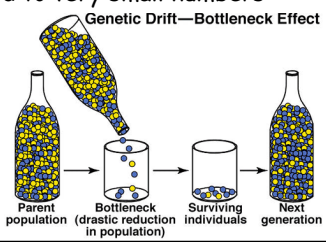
The founder effect:

A small number of individuals break off and form a separate population . The ratio of alleles in the new population may be very different from the larger previous population.

Genetic bottlenecks:

When populations (or species) are reduced to a very small number such that the genetic diversity of the small population may be much less than the previous population

Often endangered overfished species are reduced to very small numbers



Inbreeding

Inbreeding refers to the nonrandom mating among closely related individuals, which have many alleles in common.

Inbreeding is a form of genetic drift.

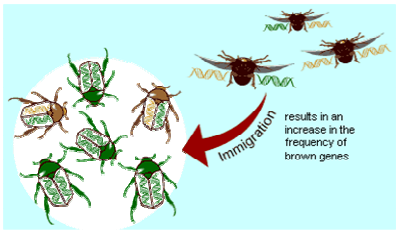
It leads to more homozygosity (having two identical alleles of the same gene).

It can lower fitness when deleterious recessive alleles are expressed.

Bottlenecks and inbreeding are especially deleterious to endangered species (**restocking**).

4. Migration (or gene flow):

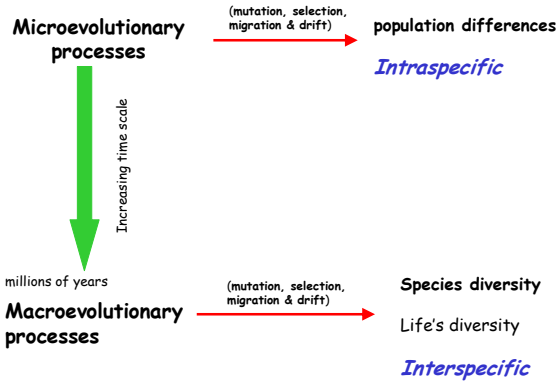
When individuals migrate from another population, or some beetles carrying genes that are introduced into a new population

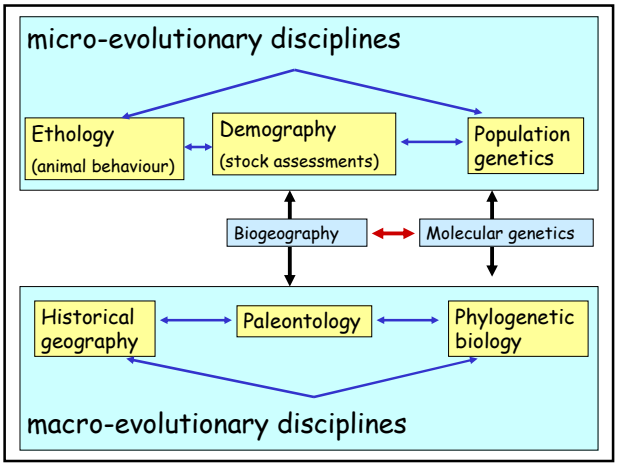


Gene flow

is the physical flow of alleles into a population. It tends to keep the gene pools of populations similar. It counters the differences that result from mutation, natural selection, and genetic drift (example Galjoen).

Genes move with the individuals when they move out of, or into, a population. The physical flow (and resultant shuffling) tends to minimize genetic variation between populations.





The process of evolution in three sentences:

Genes mutate.

Individuals are selected.

Populations evolve

Summary

1. All life forms (species) have developed from other species.

2. All living things are related to one another to varying degrees through common decent (share common ancestors).

3. All life on Earth has a common origin. On other words, that in the distant past, there once existed an original life form and that this life form gave rise to all subsequent life forms.

4. The process by which one species evolves into another involves random heritable genetic mutations (change), some of which are more likely to spread and persist in a gene pool than others.