

Selection & Evolution

What causes variation.

- Independent assortment
- Crossing over b/w chromatids
- Random fertilisation of gametes
- Random mating b/w organisms within a species

These all cause shuffling of alleles causing phenotypic variation. However mutation creates new alleles.

Variation causes some individuals to have an advantage over others. Environment can also cause phenotypic variation but this is not genetically passed on.

* Continuous Variation

→ It is a kind of variation that is distributed normally and is quantitative in nature and cannot be placed into distinct categories.
Eg:- height, weight

* Discontinuous Variation

→ A kind of variation that can be placed into distinct categories. Ex:- Blood group
This variation has no intermediates.

Variation

Continuous

- No categories
- Quantitative
- Controlled by many genes
- Strongly influenced by environment

Discontinuous

- Distinct categories
- Qualitative
- Controlled by few genes
- Unaffected by environment

diff ~~also~~ genes have an additive effect

A large no of genes can have a combined effect on a phenotype. (Polygenes)

Diff genes at single gene locus have large effects on phenotypes

* Variation due to Environment

- Environmental factors can either allow the full genetic potential of an organism to be reached or may stunt the genetic expression, leading to a diff phenotype.

Ex

Light intensity for growth of plant

* How to do t - test

- The t - test is used to determine whether or not the mean values of two ~~different~~ sets of normally distributed data are significantly different from one another.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}}$$

mean of 1st → $\bar{x}_1$ → mean of 2nd → $\bar{x}_2$
 S.D of 1st → S_1 → S.D of 2nd → S_2
 Number of 1st → N_1 → Number of 2nd → N_2

$$SD = \sqrt{\frac{\sum (x - \bar{x})^2}{n}}$$

Calculate t-value

$$\text{degree of freedom} = (n_1 - 1) + (n_2 - 1)$$

Then check degree of freedom and p to find corresponding t-value

compare calc t value with t value in table

$p > 0.05 \rightarrow$ the diff is not significant

$p < 0.05 \rightarrow$ the diff is significant

* Natural Selection

- Organism have the potential to reproduce exponentially in suitable environmental conditions.

Factors that affect the survival of a species

- Biotic**: this means that they are caused by other living organisms. Ex: predation, competition for food.
- Abiotic**: these are caused by non-living environmental components such as water supply or nutrient availability.

AS environmental pressure increase, population decreases until a certain point where the environment is able to sustain an increase in population again

Natural Selection: The process by which ~~the~~ individuals with a particular set of alleles become more likely to survive & reproduce than those with other alleles; over time and many generations, these advantageous alleles become more frequent in the population.

Fitness: The fitness of an organism is described as its capacity to survive & transmit its genotype to its offspring.

* Forces of Natural Selection

- Natural selection seeks to keep things the way they are, ensuring that the best-adapted organisms in a population survive; known as stabilising selection.
- There are other factors (ex - environmental) in which the frequency of alleles shift and change resulting in directional selection.
- Disruptive ~~selection~~ selection is a type of selection where two extremes in a population are favoured, resulting in different phenotypes within a population.

Directional selection: A certain part of the population is acted ^{upon} by selection pressure results in a shift in genotypes that are passed on by the next generations.

* Natural selection influencing evolution.

- Antibiotic resistance
- Sickle cell anaemia

* Genetic Drift

- Genetic drift is a change in allele frequency that occurs because only some of the organisms in a population reproduce. It occurs purely by chance.
- When a small group is separated from a large population, the group cannot have the same

* Hardy - Weinberg Principle

- This principle is used to calculate the frequency in a randomly mating population. The genotype frequency is its frequency in relation to the total population. The proportions are always given as decimals and the total population is given a value of 1.

Dominant allele is represented as p and recessive allele is represented as q .

$$p + q = 1$$

Chance of being homozygous dominant = p^2
 Chance of being homozygous recessive = q^2
 Chance of being heterozygous = $p \times q + p \times q = 2pq$

$$p^2 + 2pq + q^2 = 1$$

You cannot use Hardy-Weinberg Principle when

- the population is small
- There is significant selection pressure against one of the phenotypes
- There is migration of individuals carrying one of the two alleles out of the population
- There is non-random mating.

* Artificial selection is a process in which humans select organisms with desired traits to survive and reproduce; also known as selective breeding.

Uses

- The cattle which show desired trait (docility, fast growth rates, high milk yield) ensuring that these alleles are passed on to the next generation increasing its allele frequency.

- ~~Reed~~ Selective breeding also takes place with maize where farmers cross disease resistant maize with shorter stems and having higher yields.

Inbreeding: a technique used to preserve desirable traits within a population.

- Due to intensive inbreeding, it can cause offspring to be weak hence outbreeding (crossing plants which are not related) can increase the strength of the offspring.

★ Evolution

Species

- A species is a group of organisms with similar morphological, physiological, biochemical and behavioural features which can interbreed to produce fertile offspring, and are reproductively isolated from other species
- Morphological features are structural features; physiological features are the way the body works and biochemical features included the sequences of bases in DNA.
- Scientists can determine two organisms of same species if they can interbreed to produce fertile offspring.

Speciation

★ Allopatric Speciation

- Geographical isolation has played a major role in the evolution of many species. It requires a barrier that exists that prevents them from mixing. Selection pressure causes certain alleles to survive. Eventually over the years, the two populations evolve differently.

★ Sympatric Speciation

- A geographic barrier is not always necessary for a new species to occur. Sometimes they occur within populations that are not separated in any way. Ecological isolation, genetic divergence or ~~or~~ can all occur.