# CAIE Biology A-level

## Topic 17: Selection and Evolution

Flashcards

Describe the difference between continuous and discontinuous variation.

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- **Continuous variation** - shown by a characteristic that can have any value over a range e.g. human height
- **Discontinuous variation** - shown by a characteristic that can only take certain values e.g eye colour or blood group

# Explain the genetic basis of continuous variation.

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Characteristics that show continuous variation are often controlled by many genes. The alleles at each gene locus have a small effect, all of which are added together to control a characteristic.

# Explain the genetic basis of discontinuous variation.

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Typically characteristics that show discontinuous variation are controlled by one or a few genes. The alleles present at these gene loci have a large effect on the characteristic.

State how the phenotype arises.

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The phenotype results from the interactions between the genotype and the environment.

# Why is the t-test used?

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The t-test is used to determine whether there is a statistically significant difference between the means of two data sets that show normal distribution.

# Why is genetic variation important for selection?

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Variation in a population increases the likelihood that some individuals will have a phenotype which is better suited to the environment, particularly as environmental changes occur. These individuals will have more reproductive success.

# Explain why natural selection occurs.

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Natural selection occurs because populations have the capacity to produce many offspring and increase their numbers exponentially. The individuals of the population must compete for resources; those who are better adapted (due to genetic variation) will survive, reproduce and pass on their alleles to the next generation.

# Describe stabilising selection.

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In stabilising selection, the extremes of a characteristic are selected against. This eliminates some genetic variation, and so tends to occur when environmental conditions are constant for a long time.

Give an example of stabilising selection.

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Human birth weights - babies born too far below or above the optimum weight may not survive infancy. They therefore cannot reproduce and pass on their alleles. The extremes are selected against.

# Describe and give an example of directional selection.

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When environmental conditions change, individuals with a characteristic away from the mean will be better suited to the new environment, and this extreme is selected for. An example of this is antibiotic resistance in bacteria.

# What is disruptive selection?

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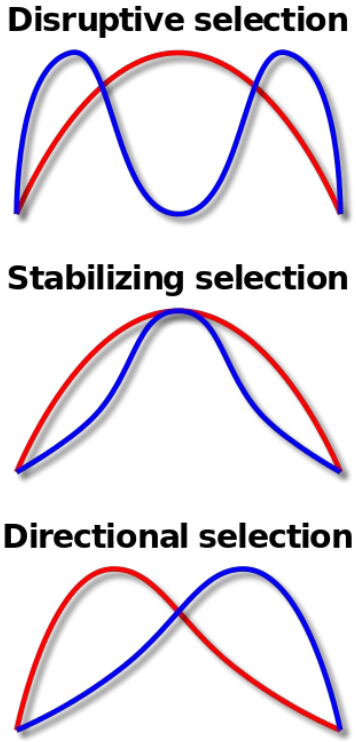
The extremes of a characteristic are favoured and the mean is selected against. This can result in two subpopulations with different phenotypes, and is important for evolutionary change.



# How does selection affect allele frequency in a population?

# How does selection affect allele frequency in a population?

Environmental factors exerting the forces of selection change the allele frequency of a population by increasing advantageous alleles. Selection does not affect the probability of new mutant alleles arising, it affects the frequency of the alleles already in the population.

# What is genetic drift?

# What is genetic drift?

A change in allele frequency in a small population due to chance.

# Describe the founder effect.

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The founder effect is a type of genetic drift. It occurs when a small subpopulation is isolated from the larger parent population. This small population has less genetic variation and may not the same proportion of alleles as there was in the original population.

# State the Hardy-Weinberg equation.

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

p = the frequency of the dominant allele

q = the frequency of the recessive allele

State the conditions that have to be satisfied in the Hardy-Weinberg principle.

# State the conditions that have to be satisfied in the Hardy-Weinberg principle.

- The proportion of dominant and recessive alleles remain the same over generations
- No mutations arise
- There is no selection
- The population must be large
- There must be no flow of alleles into or out of the population
- Random mating

# What is selective breeding?

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The process by which humans artificially select organisms with desirable characteristics and breed them to produce offspring with desirable phenotypes.

Describe how the selective breeding of dairy cattle is used to improve milk yield.

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Cows with high milk yields are interbred, as are their offspring. This increases the frequency of alleles that confer high milk yields in the population.

Give examples of how selective breeding can improve crops.

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- Introducing disease resistance into wheat and rice varieties to limit loss of crops by disease
- Incorporating mutated alleles for gibberellin synthesis into dwarf varieties. This increases the proportion of energy put into grain, therefore increasing the yield
- In maize, inbreeding and hybridisation produces uniform, vigorous maize crops

List the ways in which evolutionary relationships can be deduced from molecular evidence.

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- Amino acid sequences of proteins
- DNA sequences
- The mitochondrial DNA sequence

# Describe how subpopulations of a species can be separated.

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- Geographically
- Ecologically
- Behaviourally

# What is allopatric speciation?

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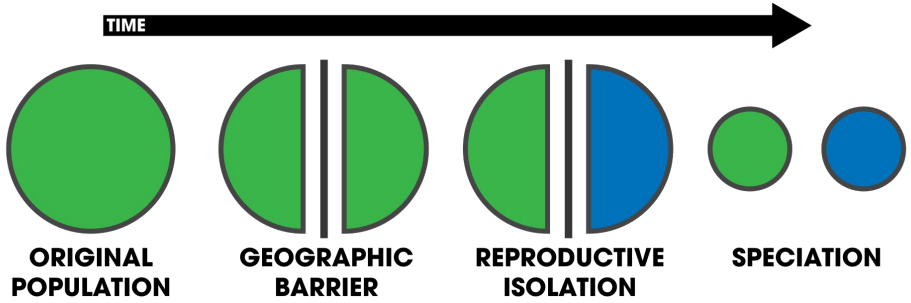
Speciation that occurs due to geographical separation. The two isolated populations may be exposed to different environments, in which there are different selection pressures. This results in changes in allele frequencies and eventually two new species emerge.

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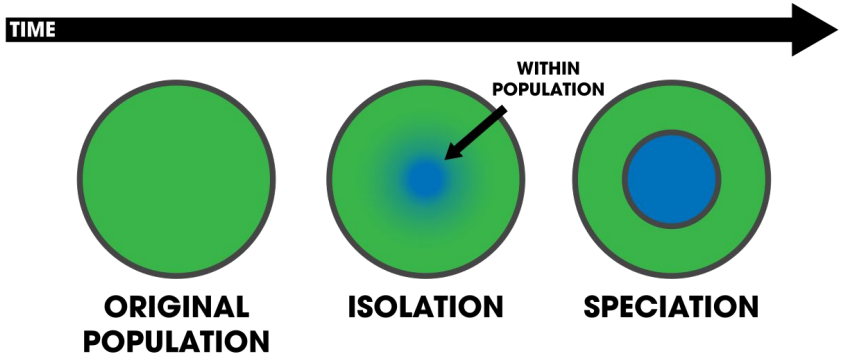
# Explain how sympatric speciation may occur.

# Explain how sympatric speciation may occur.

Within the same geographical region, subpopulations of a species can become reproductively separated, e.g. they live in different habitats, they may not mate at the same time. The different environmental conditions in each situation exert selective forces, therefore over time the populations become separate species.

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# Explain the role of prezygotic isolation in the evolution of new species.

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Prezygotic isolation prevents individuals breeding and fertilisation occuring. Examples of prezygotic isolation mechanisms include:

- Organisms physically not able to mate
- Organisms not recognising each other as mates
- Gametes are not able to fuse

# Explain the role of postzygotic isolation in the evolution of new species.

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Postzygotic isolation mechanisms ensure that the hybrid between two species will not survive or reproduce. Mechanisms of postzygotic isolation include:

- The zygote does not survive
- The offspring are not viable or are sterile

# Why do organisms become extinct?

# Why do organisms become extinct?

- Climate change - changes in environmental conditions that none of the species can survive
- New predators
- New diseases
- Losing the competition for resources from better adapted organisms e.g. humans