

# WJEC (Wales) Biology A-level

## Unit 4.4 - Variation and evolution

### Flashcards

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# What factors produce variation between individuals?



What factors produce variation between individuals?

Both genetic and environmental factors produce variation.



Name the types of variation.



Name the types of variation.

- Continuous and discontinuous
- Heritable and non-heritable



# What is discontinuous variation?



# What is discontinuous variation?

- Type of variation that can be categorised e.g. blood group
- A characteristic can only appear in **discrete values**
- It is influenced by one or two genes and environmental factors have little effect



# What is continuous variation?





# What is continuous variation?

- Type of variation that cannot be categorised e.g. height
- Produces a **continuous range** in which a characteristic can take any value
- It is influenced by multiple genes and is often significantly affected by environmental factors



# Compare heritable and non-heritable variation.



Compare heritable and non-heritable variation.

**Heritable** variation is the genetic differences between individuals whereas **non-heritable** variation is acquired differences in the phenotypes of individuals that cannot be inherited.



# What is evolution?



# What is evolution?

- The change in allele frequencies in a gene pool of a population over time
- Occurs due to natural selection



How does natural selection cause a change in allele frequencies over generations?



How does natural selection cause a change in allele frequencies over generations?

Organisms with advantageous characteristics are more likely to survive and pass their favourable alleles to offspring. Frequency of unfavourable alleles decreases.



# What are selection pressures?





# What are selection pressures?

- Environmental factors that drive evolution by natural selection and limit population sizes
- They can change the frequency of alleles in a population



Give examples of selection pressures.



Give examples of selection pressures.

- Predation
- Disease
- Competition (for food, habitats, mates)
- Environmental conditions, e.g. temperature



# How can allele frequencies be expressed?



# How can allele frequencies be expressed?

Expressed as a percentage or proportion of the total number of all alleles for that gene.



State the two types of competition.



State the two types of competition.

- Interspecific
- Intraspecific



# What is interspecific competition?





# What is interspecific competition?

A type of competition that takes place between members of **different** species.



# What is intraspecific competition?



# What is intraspecific competition?

A type of competition that takes place between members of the **same** species.



# Define gene pool



## Define gene pool

All of the different versions of genes (alleles) in the individuals that make up a population.



# What is genetic drift?



# What is genetic drift?

Variations in allele frequencies in small populations due to chance (rather than as a result of selection pressures).



# What is meant by the founder effect?





# What is meant by the founder effect?

When a small number of individuals become isolated, forming a new population with a limited gene pool. Allele frequencies are not reflective of the original population.



# What is the Hardy-Weinberg principle?



## What is the Hardy-Weinberg principle?

A model that allows the estimation of the frequency of alleles in a population, as well as whether allele frequency is changing over time.



State the assumptions made by the Hardy-Weinberg principle.



State the assumptions made by the Hardy-Weinberg principle.

- **No mutations** occur to create new alleles
- **No migration** in or out of the population
- **No selection**, alleles are all equally passed on to the next generation
- **Random mating**
- **Large population**



Explain the Hardy-Weinberg equation for calculating allele frequency.



Explain the Hardy-Weinberg equation for calculating allele frequency.

The frequencies of each allele for a characteristic must add up to 1.0 giving the equation:  **$p + q = 1.0$**

Where  $p$  = frequency of the dominant allele, and  
 $q$  = frequency of the recessive allele



Explain the Hardy-Weinberg equation for calculating genotype frequency.





# Explain the Hardy-Weinberg equation for calculating genotype frequency.

The frequencies of each genotype for a characteristic must add up to 1.0 giving the equation:  $p^2 + 2pq + q^2 = 1.0$

where  $p^2$  = frequency of homozygous dominant,  $2pq$  = frequency of heterozygous, and  $q^2$  = frequency of homozygous recessive



# Define speciation.



Define speciation.

The formation of new species due to the evolution of two reproductively separated populations.



# Why may speciation occur?



## Why may speciation occur?

- Genetic drift in isolated population
- Founder effect
- Natural selection



# What are the two types of speciation?



# What are the two types of speciation?

- Allopatric speciation
- Sympatric speciation



What is the term for speciation that occurs when two populations become geographically isolated?





What is the term for speciation that occurs when two populations become geographically isolated?

Allopatric speciation



What is the term for speciation that occurs when two populations within the same area become reproductively isolated?



What is the term for speciation that occurs when two populations within the same area become reproductively isolated?

Sympatric speciation



# Outline geographical isolation.



Outline geographical isolation.

A **physical barrier** (such as a river or mountain) separates two populations of the same species.



Name the potential isolation mechanisms  
in sympatric speciation.



Name the potential isolation mechanisms in sympatric speciation.

- **Morphological** isolation
- **Seasonal** isolation
- **Behavioural** isolation
- **Gametic** isolation
- **Hybrid sterility**
- **Hybrid inviability**



# What is morphological isolation?





## What is morphological isolation?

The reproductive isolation of two populations due to the incompatibility of their reproductive systems.



# What is behavioural isolation?



## What is behavioural isolation?

The reproductive isolation of two populations due to differences in their behaviour (such as different mating rituals).



Describe seasonal isolation.



Describe seasonal isolation.

The reproductive isolation of two populations due to differences in their breeding seasons.



Describe hybrid inviability.



Describe hybrid inviability.

- Post-zygotic barrier
- Successful fertilisation but embryo cannot develop into a living organism



# What is hybrid sterility?





# What is hybrid sterility?

The formation of sterile hybrid offspring from the reproduction of individuals of different species



Why may the reproduction of individuals of different species produce sterile offspring?



Why may the reproduction of individuals of different species produce sterile offspring?

The chromosome sets from each parent differ so are unable to pair up during meiosis.



Give an example of a sterile hybrid and a fertile hybrid.



Give an example of a sterile hybrid and a fertile hybrid.

- Sterile hybrid - mule
- Fertile hybrid - wheat



# What is gametic isolation?



# What is gametic isolation?

- Pre-zygotic barrier
- Successful fertilisation does not occur

