

# AQA Biology GCSE

## 6.2 - Variation and Evolution

### Flashcards

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# What is variation?



# What is variation?

Differences in the characteristics of individuals in a population is called variation.



What are the causes of variation within a species?



What are the two causes of variation within a species?

- Genetics
- Environment
- A mixture of both of the above



# What is genetic variation?



# What is genetic variation?

- Variations in the genotypes of organisms of the same species due to the presence of different alleles.
- Creates differences in phenotypes.



# What creates genetic variation in a species?





# What creates genetic variation in a species?

- Spontaneous mutations
- Sexual reproduction



# What is a mutation?



## What is a mutation?

A random change to the base sequence in DNA which results in genetic variants. They occur continuously.



State the three types of gene mutation



# State the three types of gene mutation

- Insertion
- Deletion
- Substitution



How may a gene mutation affect an organism's phenotype? (3)



# How may a gene mutation affect an organism's phenotype? (3)

- Neutral mutation does not change the sequence of amino acids. Protein structure and function same. No effect on phenotype.
- Mutation may cause a minor change in an organism's phenotype e.g. change in eye colour.
- Mutation may completely change the sequence of amino acids. This may result in a non-functional protein. Severe changes to phenotype.



What is the consequence of a new phenotype caused by a mutation being suited to an environmental change?





What is the consequence of a new phenotype caused by a mutation being suited to an environmental change?

There will be a rapid change in the species.



# What is evolution?



# What is evolution?

- A gradual change in the inherited traits within a population over time.
- Occurs due to natural selection which may result in the formation of a new species.



# Outline the theory of natural selection



# Outline the theory of natural selection

All species of living things have evolved from simple life forms that first developed more than 3 billion years ago.

1. Genetic variation exists due to spontaneous mutations.
2. Selection pressures (e.g. competition, disease) exist.
3. Random mutation gives an organism a selective advantage.
4. Organism is better adapted to the environment and survives.
5. Organism reproduces, passing on its beneficial alleles.
6. Frequency of advantageous alleles increase.



# How do two populations become different species?



How do two populations become different species?

When their phenotypes become different to the extent that they can no longer interbreed to produce fertile offspring.



# What is selective breeding?





# What is selective breeding?

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



# Outline the main steps involved in selective breeding



# Outline the main steps involved in selective breeding

1. Identify a desired characteristic e.g. disease resistance.
2. Select parent organisms that show the desired traits and breed them together.
3. Select offspring with the desired traits and breed them together.
4. Process repeated until all offspring have the desired traits.



Give examples of characteristics selected for in selective breeding.



Give examples of characteristics selected for in selective breeding.

- Disease resistance in crops
- Higher milk or meat production in animals
- Gentle nature in domestic dogs
- Large flowers



What is the main advantage of selective breeding?



# What is the main advantage of selective breeding?

Creates organisms with desirable features:

- Crops produce a higher yield of grain
- Cows produce a greater supply of milk
- Plants produce larger fruit
- Domesticated animals



Other than in agriculture, where else is selective breeding useful?





Other than in agriculture, where else is selective breeding useful?

- In medical research
- In sports e.g. horse racing



# Outline the disadvantages of selective breeding (4)



## Outline the disadvantages of selective breeding (4)

- Reduction in the gene pool (which becomes especially harmful if sudden environmental change occurs).
- Inbreeding results in genetic disorders.
- Development of other physical problems e.g. respiratory problems in bulldogs.
- Potential to unknowingly select harmful recessive alleles.



# What is genetic engineering?



# What is genetic engineering?

- The modification of the genome of an organism by the insertion of a desired gene from another organism - genes from chromosomes of humans and other organisms can be 'cut out' and transferred to cells of other organisms.
- Enables the formation of an organism with beneficial characteristics.



Give an example of uses for genetically modified plants.



Give an example of uses for genetically modified plants.

- Disease resistance
- Produce larger fruits



What is a use for genetically modified bacteria cells?





What is a use for genetically modified bacteria cells?

To produce human insulin to treat diabetes mellitus.



# Describe the benefits of genetic engineering (3)



## Describe the benefits of genetic engineering (3)

- Increased crop yields for growing population e.g. herbicide-resistance, disease-resistance.
- Useful in medicine e.g. insulin-producing bacteria, anti-thrombin in goat milk, possibility to overcome some inherited disorders (being explored in medical research).
- GM crops produce scarce resources e.g. GM golden rice produces beta-carotene (source of vitamin A in the body).



# Describe the risks of genetic engineering (4)



## Describe the risks of genetic engineering (4)

- Long-term effects of consumption of GM crops unknown.
- Negative environmental impacts e.g. reduction in biodiversity, impact on food chain, contamination of non-GM crops forming 'superweeds'.
- Late-onset health problems in GM animals.
- GM seeds are expensive. LEDCs may be unable to afford them or may become dependent on businesses that sell them.



What is the name for crops that have had their genes modified?



What is the name for crops that have had their genes modified?

Genetically modified (GM) crops e.g. those modified to be resistant to insect attack and herbicides.



What is *Bacillus thuringiensis* (Bt)?





## What is *Bacillus thuringiensis* (Bt)?

- Insect larvae are harmful to crops.
- Bt is a bacterium which secretes a toxin that kills insect larvae.



How is genetic engineering used to protect crops against insects?



## How is genetic engineering used to protect crops against insects?

- The gene for toxin production in Bt can be isolated and inserted into the DNA of crops.
- Bt crops now secrete the toxin which kills any insect larvae that feed on it.



# What are the benefits of Bt crops? (3)



## What are the benefits of Bt crops? (3)

- Increased crop yields (fewer crops damaged).
- Lessens the need for artificial insecticides.
- Bt toxin is specific to certain insect larvae so is not harmful to other organisms that ingest it.



# What are the risks of Bt crops? (3)



## What are the risks of Bt crops? (3)

- Long term effects of consumption of Bt crops unknown.
- Insect larvae may become resistant to the Bt toxin.
- Killing insect larvae reduces biodiversity.



# Describe the process of genetic engineering (higher)





# Describe the process of genetic engineering (higher)

1. DNA is cut at specific base sequences by **restriction enzymes** to create **sticky ends**.
2. **Vector DNA** cut using the same restriction enzymes to create complementary sticky ends.
3. **Ligase enzymes** join the sticky ends of the DNA and vector DNA forming **recombinant DNA**.
4. Recombinant DNA mixed with and 'taken up' by target cells.



# What is a vector? (higher)



What is a vector? (higher)

A structure that delivers the desired gene into the recipient cell e.g. plasmids, viruses.



# How can plants be cloned? (2)

## (biology only)



## How can plants be cloned? (2) (biology only)

- Taking plant cuttings
- Tissue culture



# What is tissue culture? (biology only)



What is tissue culture? (biology only)

Using small groups of cells from part of a plant to grow identical new plants.



Describe how plants are grown using  
tissue culture (biology only)





# Describe how plants are grown using tissue culture (biology only)

1. Select a plant that shows desired characteristics.
2. Cut multiple small sample pieces from meristem tissue.
3. Grow in a petri dish containing growth medium.
4. Transfer to compost for further growth.



What must be ensured when preparing  
tissue cultures? (biology only)



What must be ensured when preparing tissue cultures? **(biology only)**

Ensure aseptic conditions to prevent contamination by microorganisms.



What does the growth medium contain?  
(biology only)



What does the growth medium contain?  
(biology only)

Nutrients and growth hormones



What are the advantages of growing plants by tissue culture? (4)  
(biology only)



## What are the advantages of growing plants by tissue culture? (4) (biology only)

- Fast and simple process.
- Requires little space.
- Enables the growth of many plant clones with the same desirable characteristics.
- Useful in the preservation of endangered plant species.



What are the disadvantages of growing plants by tissue culture? (4)  
(biology only)





## What are the disadvantages of growing plants by tissue culture? (2) (biology only)

- Reduction in the gene pool.
- Plant clones often have a low survival rate.
- Could unknowingly increase the presence of harmful recessive alleles.



Give a brief overview of the plant cuttings method of plant cloning  
(biology only)



Describe the plant cuttings method of plant cloning  
(biology only)

Older but simpler method than tissue culture.

Gardeners use this method to produce many identical new plants from a parent plant.



# Detail the process of the plant cuttings method of plant cloning (biology only)



## Detail the process of the plant cuttings method of plant cloning (biology only)

1. A branch is cut off from the parent plant.
2. The lower leaves of the branch are removed and the stem is planted.
3. Plant hormones are used to encourage new root development.
4. A plastic bag is used to cover the new plant to keep it warm and moist.
5. New roots and a new plant is formed after a few weeks.



# What does embryo transplanting involve? (biology only)



# What does embryo transplanting involve? (biology only)

- Pre-specialised cells from a developing animal embryo are split apart.
- The resulting separate but identical embryos are transplanted into host mothers.



Describe how adult cell cloning is  
performed  
(biology only)





# Describe how adult cell cloning is performed

## (biology only)

1. The nucleus is removed from an unfertilised egg cell.
2. The nucleus from an adult body cell, such as a skin cell, is inserted into the egg cell.
3. An electric shock stimulates the nucleated egg cell to divide and it forms an embryo.
4. The embryo cells contain the same genetic information as the adult body cell.
5. When the embryo is a ball of cells, it is inserted into the uterus of an adult female to continue developing.

