

Chapter 13: Variation and evolution

Knowledge organiser

Variation in populations

Differences in the characteristics of individuals in a population are called **variation**.

Variation may be due to differences in

- the genes they have inherited, for example, eye colour.
- the environment in which they have developed, for example, language.
- a combination of genes and the environment.

Mutation

There is usually a lot of genetic variation within a population of a species – this variation arises from **mutations**.

A mutation is a change in a DNA sequence:

- mutations occur continuously
- very rarely a mutation will lead to a new phenotype, but some may change an existing phenotype and most have no effect
- if a new phenotype is suited to an environmental change, it can lead to a relatively rapid change in the species.

Selective breeding

Selective breeding (artificial selection) is the process by which humans breed plants and animals for particular genetic characteristics.

Process of selective breeding:

- 1 choose parents with the desired characteristic from a mixed population
- 2 breed them together
- 3 choose offspring with the desired characteristic and breed them
- 4 continue over many generations until all offspring show the desired characteristic

The characteristic targeted in selective breeding can be chosen for usefulness or appearance, for example:

- disease resistance in food crops
- animals that produce more meat or milk
- domestic dogs with a gentle nature
- larger or unusual flowers.

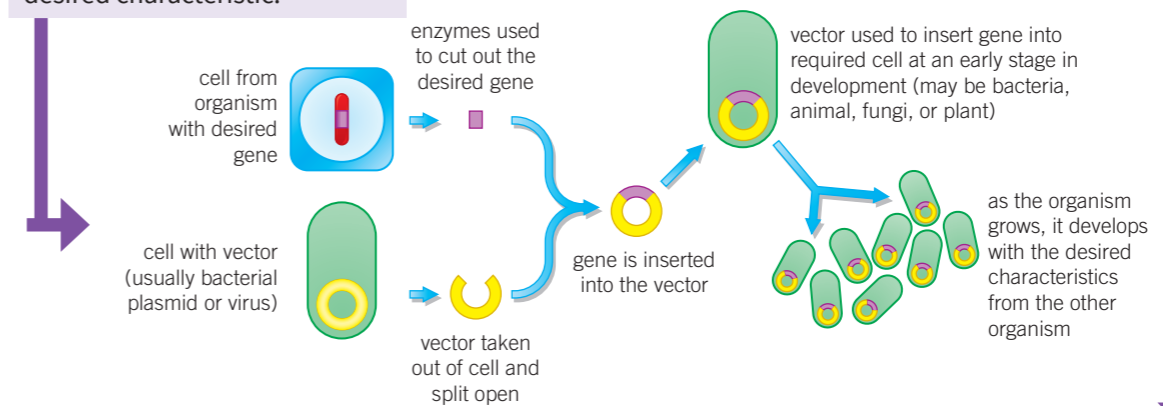
Disadvantages of selective breeding:

- can lead to **inbreeding**, where some breeds are particularly prone to inherited defects or diseases
- reduces variation, meaning all of a species could be susceptible to certain diseases

Genetic engineering (HT only)

Genetic engineering is a process that involves changing the genome of an organism by introducing a gene from another organism, to produce a desired characteristic.

- Bacterial cells have been genetically engineered to produce useful substances, such as human insulin to treat diabetes.
- Plant crops have been genetically engineered to be resistant to diseases, insects, or herbicides, or to produce bigger and better fruits and higher yields. Crops that have undergone genetic engineering are called **genetically modified (GM)**.



Benefits	Risks
<ul style="list-style-type: none"> • potential to overcome some inherited human diseases • can lead to higher value of crops as GM crops have bigger yields than normal • crops can be engineered to be resistant to herbicides, make their own pesticides, or be more resistant to environmental conditions 	<ul style="list-style-type: none"> • genes from GM plants and animals may spread to other wildlife, which could have devastating effects on ecosystems • potential negative impacts on populations of wild flowers and insects • ethical concerns, for example, in the future people could manipulate the genes of children to ensure certain characteristics • some believe the long-term effects on health of eating GM crops have not been fully explored

Key terms

Make sure you can write a definition for these key terms.

embryo transplant
inbreeding

genetically modified
mutation

genetic engineering
selective breeding

variation

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Retrieval questions

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

B13 questions

Answers

1 What is variation?	Put paper here	differences in the characteristics of individuals in a population
2 What can cause variation?	Put paper here	genetic causes, environmental causes, and a combination of genes and the environment
3 How do new phenotype variants occur?	Put paper here	mutations
4 What is selective breeding?	Put paper here	breeding plants and animals for particular characteristics
5 Describe the process of selective breeding.	Put paper here	1 choose parents with the desired characteristic 2 breed them together 3 choose offspring with the desired characteristic and breed again 4 continue over many generations until all offspring show the desired characteristic
6 What are the consequences of inbreeding?	Put paper here	inherited defects and disease
7 What is genetic engineering?	Put paper here	modifying the genome of an organism by introducing a gene from another organism to give a desired characteristic
8 How have plant crops been genetically engineered?	Put paper here	to be resistant to diseases/herbicides/pesticides, to produce bigger fruits, to give higher yields
9 How have bacteria been genetically engineered?	Put paper here	to produce useful substances, such as human insulin to treat diabetes
10 What are enzymes used for in genetic engineering?	Put paper here	cut out the required gene
11 What is used to transfer the required gene into the new cell in genetic engineering?	Put paper here	vector (e.g., bacterial plasmid or virus)