Chapter 14: 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.

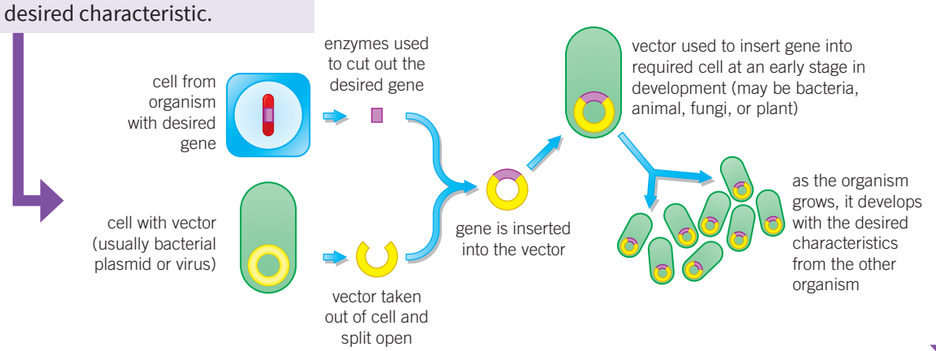
Disadvantages of selective breeding:

- 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).

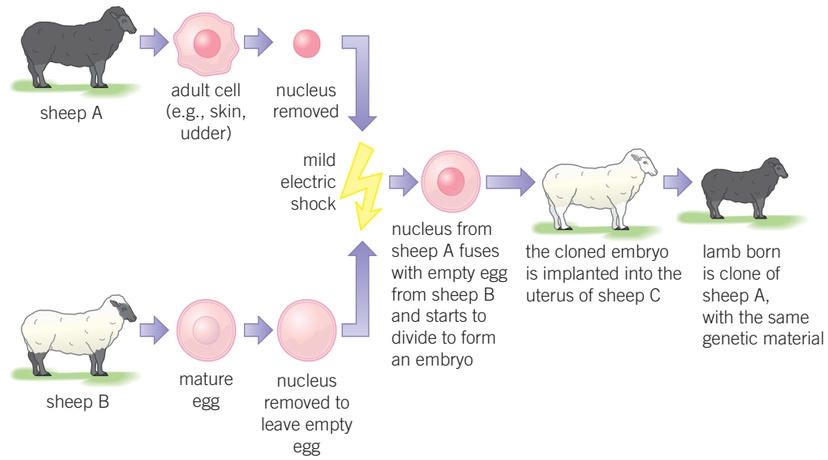


Benefits	Risks
• potential to overcome some inherited human diseases • can lead to higher value of crops as GM crops have bigger yields than normal • crops can be engineered to be resistant to herbicides, make their own pesticides, or be more resistant to environmental conditions	• genes from GM plants 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

Cloning

A **clone** is an individual that has been produced **asexually** and is genetically identical to its parent.

Adult cell cloning



Methods of cloning

Tissue culture

Small groups of cells from part of a plant are used to grow identical new plants. This is important for preserving rare plant species and growing plants commercially in nurseries.

Cutting

An older, simple method used by gardeners to produce many identical plants from a parent plant.

Embryo transplant

Cells are split apart from a developing animal embryo before they become specialised, then the identical embryos are transplanted into host mothers.

Benefits	Risks
• large number of identical offspring produced • quick and economical • desired characteristics guaranteed	• limits variation and causes reduction in gene pool • clones may be vulnerable to diseases/ changes in the environment • ethical considerations around cloning living organisms

Key terms

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

asexual *clone* *cutting* *embryo transplant* *genetically modified* *genetic engineering* *inbreeding* *mutation* *selective breeding* *tissue culture* *variation*

Chapter 14: Variation and evolution

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.

B14 questions	Answers
1 What is variation?	differences in the characteristics of individuals in a population
2 What can cause variation?	genetic causes, environmental causes, and a combination of genes and the environment
3 How do new phenotype variants occur?	mutations
4 What is selective breeding?	breeding plants and animals for particular characteristics
5 Describe the process of selective breeding.	**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?	inherited defects and disease
7 What is genetic engineering?	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?	to be resistant to diseases/herbicides/pesticides, to produce bigger fruits, to give higher yields
9 How have bacteria been genetically engineered?	to produce useful substances, such as human insulin to treat diabetes
10 What are enzymes used for in genetic engineering?	cut out the required gene
11 What is used to transfer the required gene into the new cell in genetic engineering?	vector (e.g., bacterial plasmid or virus)
12 Describe the steps involved in adult cell cloning.	**1** nucleus removed from unfertilised egg cell **2** nucleus from adult body cell inserted into egg cell **3** electric shock stimulates egg cell to divide to form an embryo **4** embryo develops and is inserted into the womb of an adult female
13 What is tissue culture cloning?	using small groups of cells from plants to grow identical new plants
14 Why is tissue culture cloning of plants important?	preserve rare species and for growing plants commercially in nurseries
15 What is cutting as a cloning method?	simple method used by gardeners to produce many identical plants from a parent plant
16 Describe cloning through using embryo transplants.	cells split apart from a developing animal embryo before they are specialised, then the identical embryos are transplanted into host mothers

Put paper here