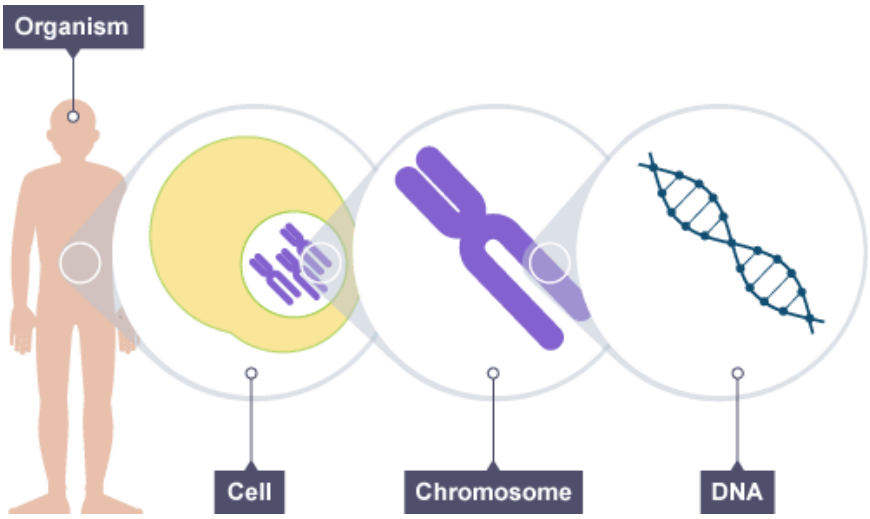
Knowledge Organiser: Inheritance, Variation and Evolution

DNA

DNA stands for **deoxyribonucleic acid**. It is a chemical made up of two long molecules. The molecules are arranged in a spiral, like a twisted ladder. We call this the **double helix** structure.



There is DNA in the **nucleus** of every cell. DNA carries genetic information. It has all the instructions that a living organism needs to grow, reproduce and function.

Genes

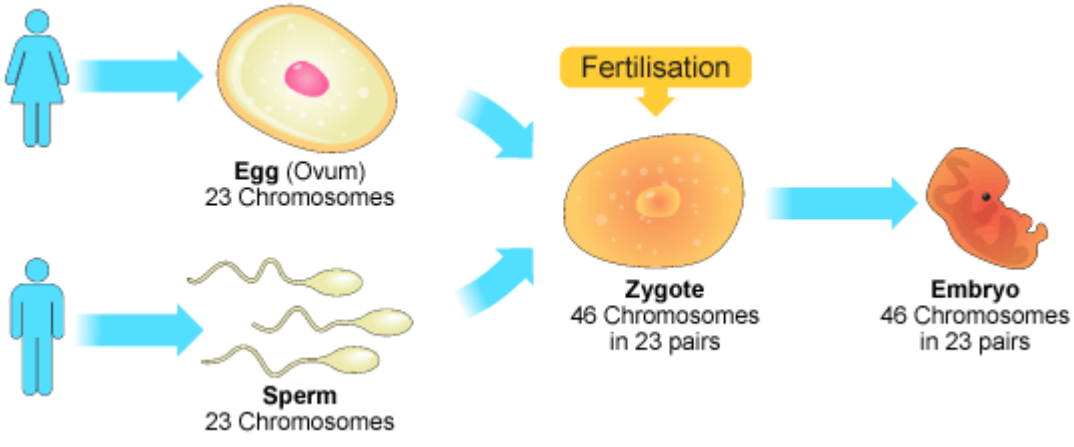
Genes are short sections of DNA. Genes carry information for particular characteristics, such as ear shape or eye colour. Different sets of genes carry information for different characteristics. There are many genes in a chromosome.

Chromosomes

In a cell nucleus, DNA is organised into coiled strands called **chromosomes**. Humans have 46 chromosomes in each cell.

Half the chromosomes are inherited from one parent and half from the other. As humans, therefore, we have **23 chromosomes** from each parent.

Children generally look a little like their mother and their father, but are not identical to either. They inherit their features from each parent's DNA. Every sperm and egg cell contains half of the genetic information needed for an individual. When the chromosomes fuse during fertilisation, a new cell is formed, which is known as a zygote. It has all the genetic information needed for an individual.

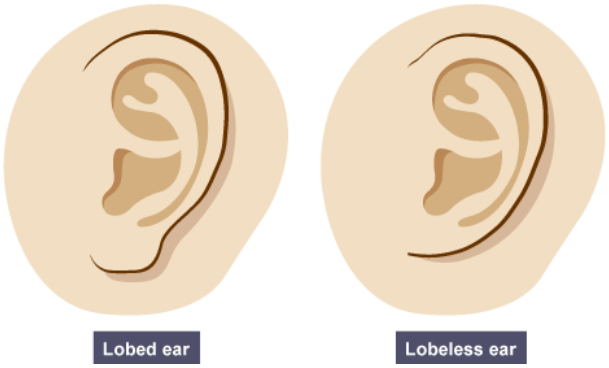


Variation

Individuals in a population are usually similar to each other, but not identical. Some of the variation within a species is genetic, some is environmental - the conditions in which they have developed and some is a combination of both.

Genetic causes of variation

Examples of genetic variation in humans include **blood group**, **skin colour**, **natural eye colour** and whether you have **lobed or lobe less ears.**



Environmental causes of variation

Characteristics of animal and plant species can be affected by factors such as climate, diet, accidents, culture and lifestyle. For example, if you eat too much you will become heavier, and if you eat too little you will become lighter. A plant in the shade of a big tree will grow taller to reach more light.

Other examples of features that show environmental variation include:

- scars
- language and accent
- flower colour in hydrangeas as these plants produce blue flowers in acidic soil and pink flowers in alkaline soil

Genetic and environmental causes together

Some features vary because of a combination of genetic and environmental causes. For example, tall parents will pass genes to their children for height. Their children have the genetic potential to also be tall. However, if their diet is poor then they will not grow very well: their environment also has an impact on their height.

Natural selection

Natural selection is a process where organisms that are **better adapted** to an environment will survive and have more offspring. This means their **genes** are passed on to the future generations.

Natural selection explains how a species can evolve over time:

- Individuals in a species show a wide range of **variation** and this variation is because of **differences** in their genes.
- Individuals with characteristics most suited to their environment are more likely to **survive** and **reproduce**. The genes that allow these individuals to be successful are passed to their offspring.
- Those that are poorly adapted to their environment are less likely to survive and reproduce. This means that their genes are **less likely** to be passed on to the next generation.
- Given time, a species will gradually **evolve**.
- Both genes and the environment can cause variation, but only genetic variation can be passed on to the next generation.

A famous example of this is the **peppered moth**.

During the nineteenth century, pollution killed off some of the lichens and soot deposits caused the bark on trees to appear darker. Light coloured moths were no longer camouflaged and were eaten by birds. The dark moths had a better camouflage.

As a result, dark moths had a greater chance of reproducing and passing on the genes that made them dark. This led to a gradual increase in the proportion of dark moths until light moths became very rare in industrial areas.

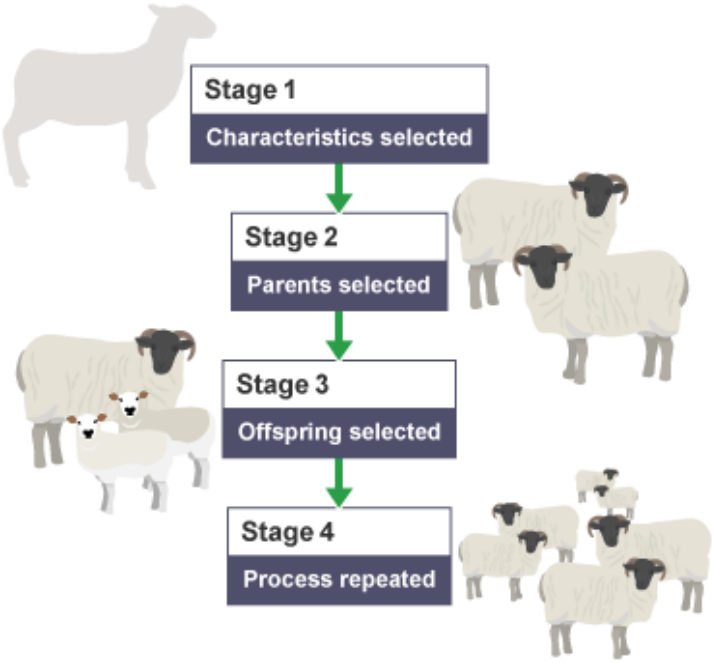
Selective Breeding

Selective breeding or artificial selection is when humans breed plants and animals for particular genetic characteristics.

Main steps involved:

Selective breeding takes place over many generations. These are the main steps for both plants and animals involve:

1. Decide which characteristics are important enough to select.
2. Choose parents that show these characteristics from a mixed population. They are bred together.
3. Choose the best offspring with the desired characteristics to produce the next generation.
4. Repeat the process continuously over many generations, until all offspring show the desired characteristics.



Farmers selectively breed different types of cows with highly desirable characteristics in order to produce the best meat and dairy.

Desired characteristics in plants:

- disease resistance in food crops
- wheat plants that produce lots of grain
- large or unusual flowers

Desired characteristics in animals:

- animals that produce lots of milk or meat
- chickens that lay large eggs
- domestic dogs that have a gentle nature

Risks of selective breeding include:

- reduced genetic variation can lead to attack by specific insects or disease, which could be extremely destructive

Genetic Engineering

Genetic engineering is also called genetic modification or GM. It involves modifying the genome of an organism by introducing a gene from another organism to result in a desired characteristic.

Genetic engineering involves these steps:

1. selection of the desired characteristic
2. the gene responsible for the characteristic is 'cut out' of the chromosome
3. the gene is transferred and inserted into another organism
4. replication of the modified organism.

Plant crops have been genetically engineered to be disease resistant or to produce bigger fruits.

Uses of Genetic Engineering

Diabetes is a disorder in which the body's blood glucose levels remain too low or too high. It can be treated by injecting insulin. The extra insulin allows the glucose to be taken up by the liver and other tissues, which results in cells receiving the glucose they need, and blood glucose levels stay normal.

Bacterial cells have been genetically modified to produce substances such as human insulin.

Genetically modified crops

Current genetically modified crops include those that are resistant to insect attack or are herbicide resistant, this produced increased yields. Herbicide resistant crops allow them to tolerate the herbicide, but the weeds are killed by it, thus overall less herbicide is needed.