

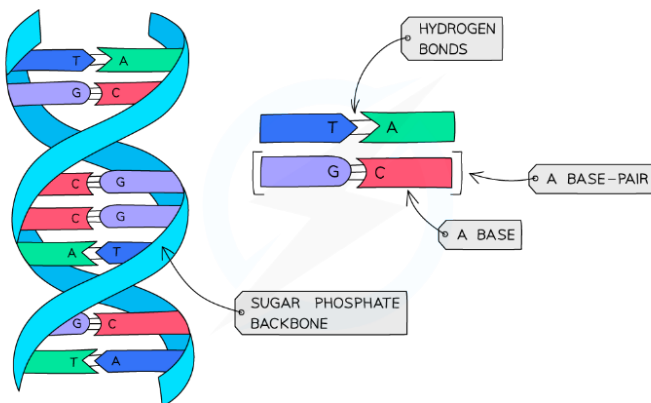
Knowledge Organiser Y9: Inheritance, Variation and Evolution

DNA Structure

DNA is a **polymer** (a molecule made from many **repeating subunits**) made up of **two long strands** forming a double helix (also referred to as a twisted ladder).

The long strands of DNA consist of alternating sugar and phosphate sections (sugar phosphate backbone).

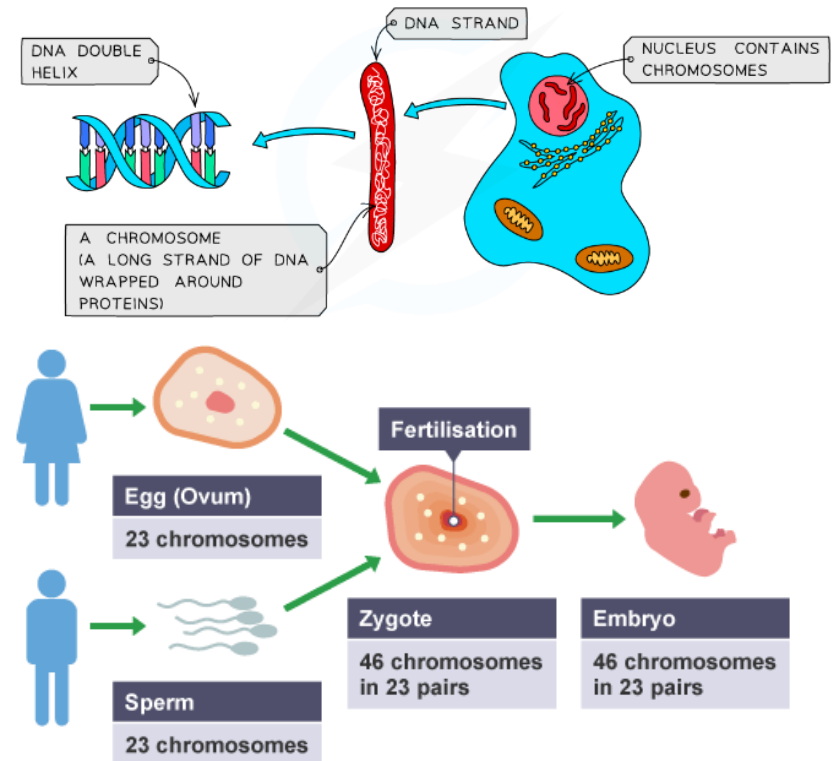
Attached to each sugar is one of the four bases (A, T, C and G). The base from one strand is joined to the other strand by a hydrogen bond. Bases always pair in the same way (A to T and C to G).



Chromosomes and Genes

DNA is the molecule that contains the **instructions for growth and development** of all organisms. DNA is contained in structures called **chromosomes**.

Genes are small sections of DNA that code for inherited characteristics such as ear shape or eye colour.



Variation

The differences between the individuals in a species is called variation.

Some of the variation within a species is genetic, some is environmental, and some is a combination of both.

Genetic Variation

Because we inherit chromosomes from each parent, we inherit **pairs of genes** for most characteristics (one from each parent).

Examples of genetic variation in humans include blood group, skin colour and natural eye colour.

Environmental variation

Characteristics of animal and plant species can be affected by factors such as climate, diet, accidents, culture and lifestyle. Examples include scars, language and accent.

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Predicting Inheritance

As we have **two copies** of each chromosome (one from the egg and one from the sperm), we have two copies of each gene.

Each gene might have different forms, and these are called **alleles** (different versions of a particular gene). One of the alleles is inherited from the mother and the other from the **father**.

Alleles can be **dominant** or **recessive**.

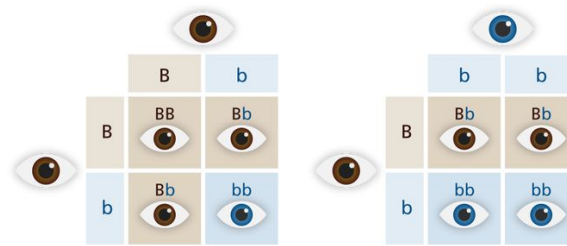
A dominant allele only needs to be inherited from one parent in order for the characteristic to show up.

A recessive allele needs to be inherited from both parents in order for the characteristic to show.

When completing genetic diagrams, alleles are abbreviated to single letters.

The dominant allele is given a **capital letter** and the recessive allele is given the same letter, but **lower case**.

A Punnett square diagram shows the **possible combinations of alleles** that could be produced in the offspring.



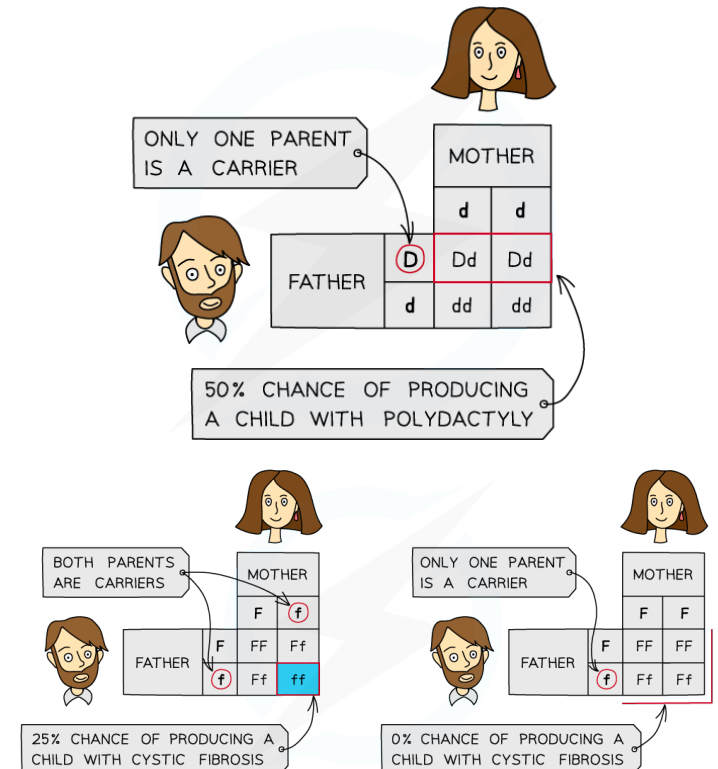
B - dominant brown eye allele
 b - recessive blue eye allele
 BB - brown eyes
 Bb - brown eyes
 bb - blue eyes

Inherited Disorders

Polydactyly is the presence of extra fingers or toes. This is caused by a dominant allele, therefore, if any of the offspring inherit the allele for polydactyly, they will most definitely suffer from the condition.

Cystic Fibrosis is another genetic condition. Some cells produce a secretion known as mucus. Sufferers of Cystic Fibrosis secrete extra thick mucus. This can cause huge breathing difficulties to patients. It is caused by a recessive allele. Therefore, it can be passed on by unaffected parents (both parents carry one recessive allele for cystic fibrosis but do not have the condition themselves).

Key term	Definition
Gamete	Gametes are sex cells (in animals: sperm and ovum; in plants pollen nucleus and ovum).
Chromosome	Chromosomes are thread-like structures of DNA , carrying genetic information in the form of genes . They are located in the nucleus of cells.
Gene	Genes are short lengths of DNA found on chromosomes. They code for specific proteins .
Allele	Alleles are different versions of a particular gene.
Dominant	A dominant allele is always expressed , even if only one copy is present .
Recessive	A recessive allele is only expressed if two copies are present (therefore no dominant allele present).



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Natural Selection

Individuals in a species show a **range of variation** caused by differences in genes.

There is **competition** for food and other resources which results in a '**struggle for survival**'.

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.

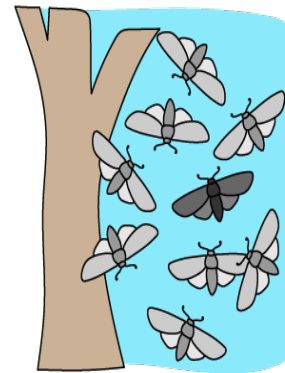
This means that in the next generation, there will be a **greater number of individuals** with the **better adapted variations** in characteristics.

This theory of natural selection was put forward by **Charles Darwin** and became known as '**survival of the fittest**'.

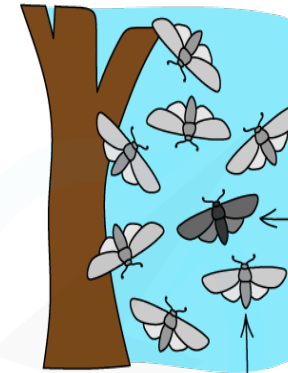
Over time, this will bring about a change in the characteristics of the species – it will produce **evolution**.

Evolution is defined as the **change in adaptive features of a population over time as a result of natural selection**.

1 THERE IS VARIATION WITHIN THE PEPPERED MOTH POPULATION. LIGHT MOTHS > DARK MOTHS

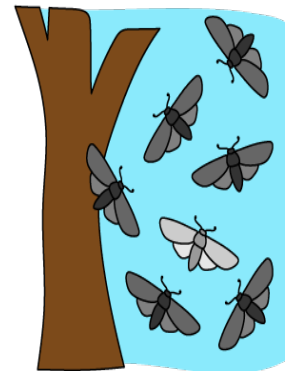


2 POLLUTION LEADS TO DARKER BARK ON TREES. THE ENVIRONMENTAL CHANGE IS BENEFICIAL TO THE DARK MOTHS. THEY NOW HAVE THE ABILITY TO CAMOUFLAGE AGAINST THE BARK OF THE TREES.



4 DARK MOTHS ARE NOW MORE LIKELY TO SURVIVE AND REPRODUCE, PASSING ON THEIR ALLELES FOR A DARK PHENOTYPE TO THEIR OFFSPRING

3 LIGHT MOTHS ARE NOW MORE LIKELY TO BE EATEN BY BIRDS, AND LESS LIKELY TO REPRODUCE



5 OVER TIME, THERE IS A GRADUAL INCREASE IN THE PROPORTION OF DARK MOTHS. DARK MOTHS > LIGHT MOTHS