

4.2

GENETICS AND INHERITANCE

The role of genes in human behaviour

Each individual inherits 50% of their genes from each parent. A **gene** contains information, and carries a set of instructions. It consists of long strands of **DNA** (deoxyribose nucleic acid), which has the function of controlling cellular activity. Every human has a **genotype** which is controlled by genetic makeup (this can be XX for women and XY for men). They also have a **phenotype** which is what the individual *becomes* when environment interacts with genetics.

The term **genome** refers to all the genes within a cell. Humans have 23 pairs of chromosomes in all body cells, except **gametes** (sex cells – i.e. egg and sperm) which only have 23 chromosomes – or one from each pair.

Genes can be separated into two groups. A **dominant gene** is one which will always lead to a certain characteristic in offspring. For example, having brown eyes is a dominant **allele** (version of a gene). It only takes one parent to have that allele and to pass it on in order for their child to share the allele. A **recessive gene** is one which has to be present in both chromosomes in a pair in order to have the characteristic. For example, having blue eyes is a recessive allele. A child will need to inherit that very allele from both parents in order to have blue eyes.

	B	b
b	Bb	bb
b	bb	bb

We can use a **Punnett square** to help show this. The brown eyes allele (dominant) is shown with a capital letter using its initial, so **B**. The recessive allele takes the same letter of the lower case, in this example **b**. The Punnett square below shows the two parents which have the alleles **Bb** and **bb** respectively. The parent with **Bb** will have brown eyes, as although it has both the brown and blue eyes alleles, the brown eyed one is dominant so that is the result. The parent with **bb** will therefore have blue eyes – there is no brown eyed allele present. As the two produce an offspring, 50% of the genes from each parent are inherited by that child. Therefore there are four possible outcomes for the child's alleles for eye colour as shown (only one allele from each of the parents' pairs is inherited). There is a 75% chance of the child having **bb** (blue eyes) and a 25% chance of the child having **Bb** (brown eyes).

EXAMPLES OF THE EFFECTS OF GENES ON HUMANS

- When one parent contributes two copies of chromosome 21, the result is that the child will have three copies of that chromosome – the consequence of this is **Down's syndrome**
- Some diseases and characteristics are sex-linked in that they are controlled by the sex genes – this is why some diseases and characteristics are more common in one particular sex (for example, colour-blindness primarily in men)
- There is a marker known as G8 present in chromosome 4, and whilst its contribution towards genetic makeup is not certain yet, the gene for Huntington's disease lies close to it, and if a parent and child both have the disease, then in 98% of cases they both have the same form of G8 marker – suggesting that the gene for Huntington's disease travels with the G8 marker
- Cancer involves damage to the DNA as cells divide, and, for example, with one type of leukaemia, almost every white blood cell carries an unusually small chromosome 22

Some genes do not influence a person's makeup from day one. Instead they might have **environmental triggers**. This means they require the right environmental conditions to be "switched on". An example is **phenylketonuria** (PKU), which is a disease which leads to brain damage. When a baby is born, they have a blood sample taken from their heels immediately after birth, to test for PKU disease. This is because when diet is controlled, the effect of PKU can be avoided, so the effect of the gene can be averted if diet (an environmental, not genetic, factor) is controlled.