

## Modern Genetics

Mendel did not know about chromosomes or meiosis when his work was published. It wasn't until the work of Walter Sutton in the early 1900s that the importance of chromosomes became understood.

Sutton was working with grasshopper sperm during meiosis when he and his co-worker released the chromosomes behaved like Mendel's 'factors'. The pairing and then separating of chromosomes led them to form the Chromosome Theory of Inheritance:

- Mendel's factors (genes) are on chromosomes
- the segregation and independent assortment of chromosomes during meiosis can account for patterns of inheritance

In 1910, Morgan, while working with fruit flies, made several important discoveries. He discovered that certain genes did not follow Mendel's law of independent assortment. He also was first to discover that a gene was linked to a specific chromosome when he studied eye colour in fruit flies. He noticed that some genes tended to be inherited together.

Morgan discovered that these linked genes do sometimes segregate and sometimes do not. The reasoning behind this goes back to crossing over during meiosis: **Genes located very close together on a chromosome will usually be inherited together, but genes further apart are more likely to be separated during crossing over.**

Combining Morgan's work with Mendel's allows us to restate the **Law of Independent Assortment in modern terms:**

*If crossing over does not occur, genes located on different chromosomes will assort independently while genes located on the same chromosome will be inherited together.*

## SEX DETERMINATION

Late in the 1890s, scientists noticed that certain chromosomes in males and females were shaped differently. These are the sex chromosomes.

Human Females	XX
Human Males	XY

During meiosis, females can only pass on an X, whereas male sperm can carry either an X or a Y. Males therefore determine the sex of offspring. The Punnett square shows there is a 1: 1 ratio of girls to boys.

## SEX-LINKED TRAITS

The Y chromosome is smaller than the X, almost like there are pieces missing. This change in shape results in traits that are **recessive in females** and **dominant in males**

Any trait that is controlled by a gene found on the sex chromosome is called a sex-linked trait. Some of these traits result in genetic diseases or disorders like :

- colour-blindness (disorder)
- hemophilia (disease)
- muscular dystrophy (disease)

In these cases, the female can carry the defective gene but because they have another X chromosome to dominate, it is recessive. Since males don't have another X chromosome, the defective gene on the X chromosome will be dominant.

For colour-blindness in humans:

Let X = X chromosome with normal colour vision

Let X<sup>-</sup> = X chromosome with allele for colour-blindness

Let Y = Y chromosome