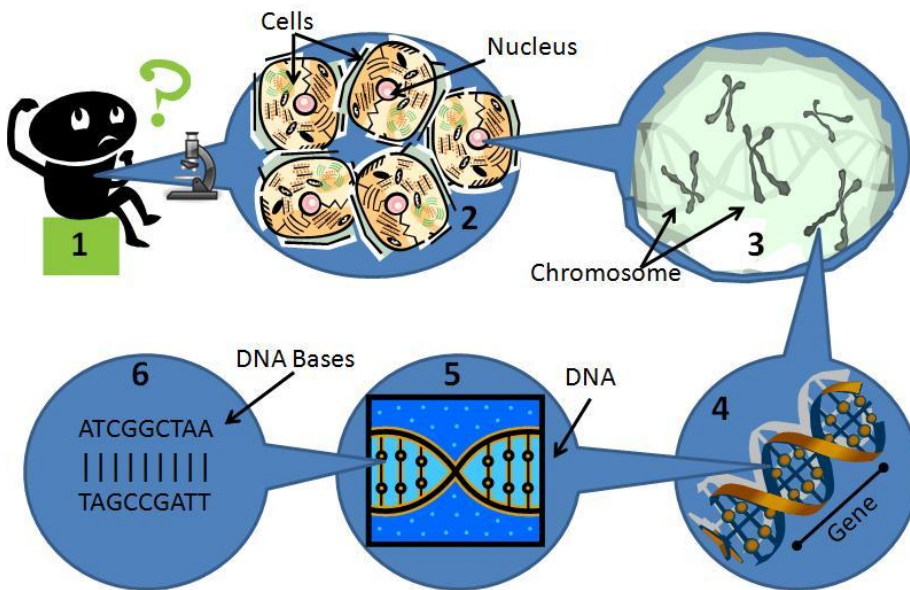




Cystic Fibrosis is a recessive inherited condition caused by a dysfunctional gene mutation in the *cftr* gene on chromosome 7. This mutation leads to faulty proteins that cause the body to produce a thick sticky mucus that blocks the bronchial tubes in the lungs and prevents the body's natural enzymes from digesting food.

**This factsheet explains how a gene mutation can lead to faulty proteins being created.**

## What is a gene?

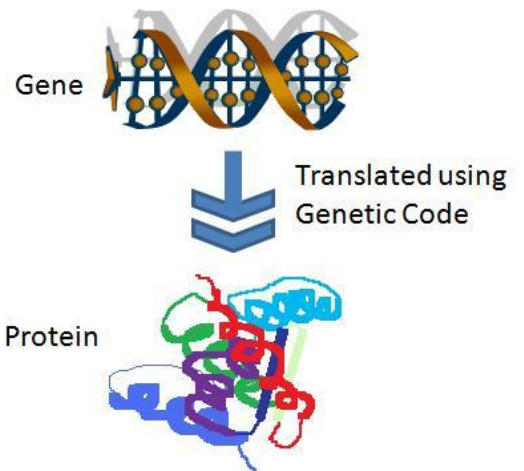


1. Our bodies are composed of different types of tissue e.g. muscle, nerves, skin etc. Each tissue is made up of a large number of tissue-specific **cells**.
2. In each cell there is a **nucleus** which controls the cell – the “brain” of the cell.
3. The nucleus is made up of 23 pairs of **chromosomes** in humans.
4. Each chromosome contains hundreds of **genes**.
5. Genes are formed by 2 strands of **DNA** linking to form a double helix pattern.
6. **DNA bases** are the most basic element of DNA strands. A-T or G-C bind together to form sequences.

## How do genes form protein?

Genes are translated into proteins. Thousands of proteins need to be formed correctly every day in each cell of our bodies for them to function properly.

Some proteins are like teachers and give instructions to the cell. Some are like traffic lights and cause a function to stop, go or slow down. Some are like workers and carry out instructions depending on the conditions in your body. Some are like “An Post” and pick up and deliver messages.



The DNA sequence in the gene enables the protein to be made as it contains the instructions for each building block of the protein. These building blocks (called amino acids) are joined to form a protein.

## What is a mutation?

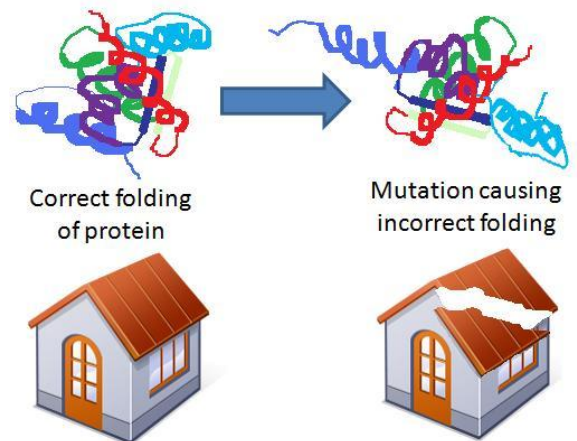
A mutation is a permanent change in the DNA sequence that makes up a gene. Mutations range in size from a single DNA base to a large segment of a chromosome.

Example: The most common mutation causing cystic fibrosis in Ireland is *deltaF508*. This is a deletion of the DNA bases (AAA) in position 508 of cystic fibrosis gene, *cftr*. These DNA bases are the instructions for the amino acid Phenylalanine (F). The CFTR protein that is made from this mutated gene is therefore missing an amino acid.

## Why do mutations lead to faulty proteins?

Amino Acids are the building blocks of a protein. If a protein has been made from a gene with a mutation, it is similar to a house with a faulty or missing brick.

Depending on the location of this brick, the house could be affected in different ways. If the brick is in the middle of the wall, the function of the house may only be mildly affected e.g., a draft. However, if the brick is supporting a vital component of the house e.g., the roof, then the house cannot function normally anymore.

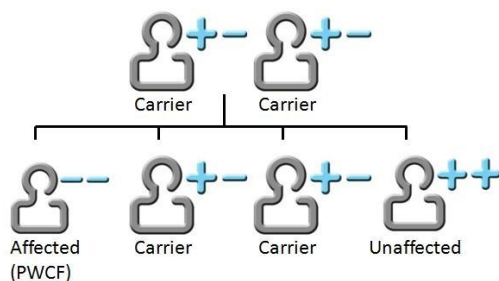


This is the same for a protein, if the mutation is located in a vital area for protein folding or function, then the protein will not be able to complete its job properly. In cystic fibrosis, the CFTR protein regulates the movement of salt and water between cells in the body which is vital for thin, free flowing mucus. When the protein does not function properly, this causes thick sticky mucus and salty sweat. The function of the CFTR protein is affected by the location of the mutation. This is why some mutations lead to more severe symptoms.

## What is the difference between recessive & dominant conditions?

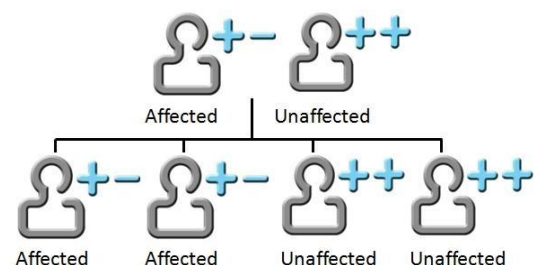
People with recessive conditions need to have **2 copies** of the mutated gene (- -) but people with dominant conditions need to have only **1 copy** of the mutated gene (+ -) to have **disease symptoms**. Because of this, inheritance (passing down from parents to children) is different for recessive and dominant conditions.

**Recessive condition:** e.g. Cystic Fibrosis



- **2 copies** of the mutated gene are needed (- -)
- **Each parent** is a carrier and has 1 copy of the mutated gene (-) & 1 copy of the normal gene (+)
- **25%** chance of a child with the condition

**Dominant condition:** e.g. Huntington's Disease



- Only **1 copy** of the mutated gene is needed (+ -)
- **One parent** has the condition/disease
- **50%** chance of child with the condition/disease
- No such thing as carriers of a dominant condition