genetic engineering

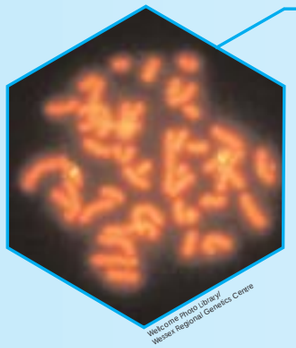
new horizons in medicine

Since genetic engineering (also known as **recombinant DNA technology** or **genetic modification**) was first developed in the 1970s scientists have discovered more and more ways in which this new technology can be used in human medicine. The same basic technique is used in modifying the genetic material of bacteria, plants and animals.

Pharming

Microorganisms, animals and plants can be genetically modified to produce medically useful products. These transgenic organisms are already used regularly to produce substances such as human insulin, human growth hormone and blood clotting factors for haemophiliacs.

Diagnostic tests and targeted drugs

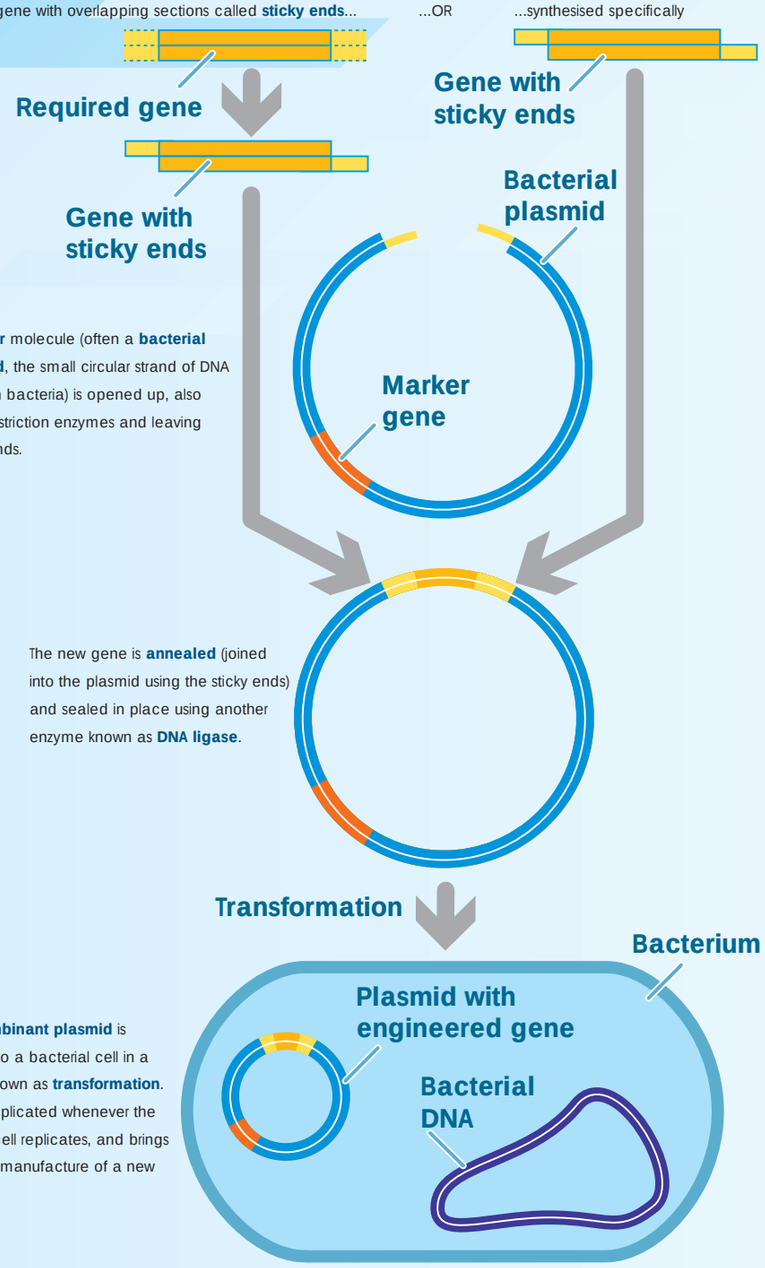


Genetic engineering is opening up opportunities to produce very specific and sensitive diagnostic tests for many diseases, using engineered proteins. This new technology is also opening up novel ways of delivering medicines to specific targets.

The basic steps in the genetic engineering of a bacterium

The required gene is EITHER cut from the DNA of an organism using enzymes called **restriction endonucleases** which leave the gene with overlapping sections called **sticky ends**...

...OR ...synthesised specifically

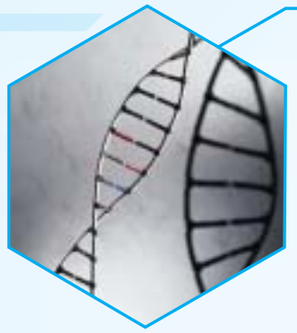


A **vector** molecule (often a **bacterial plasmid**, the small circular strand of DNA found in bacteria) is opened up, also using restriction enzymes and leaving sticky ends.

The new gene is **annealed** (joined into the plasmid using the sticky ends) and sealed in place using another enzyme known as **DNA ligase**.

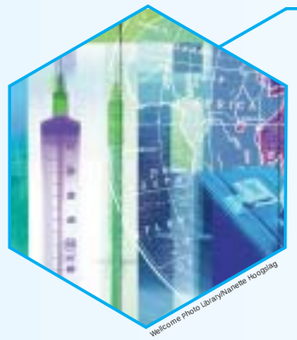
The **recombinant plasmid** is inserted into a bacterial cell in a process known as **transformation**. It is then replicated whenever the bacterial cell replicates, and brings about the manufacture of a new protein.

Gene therapy



Gene therapy is still in it's very early stages. It involves modifying human DNA either to repair it or to replace a faulty gene. The idea of gene therapy is to overcome the effects of a mutation which causes a genetic disease. Cystic fibrosis is the best known disease where gene therapy has been tried. There have been no long term successes – yet!

Vaccines



Some vaccines are very dangerous to make using conventional methods. Genetically engineered microbes can be used to produce the antigens needed in a safe and controllable way. The use of genetically modified yeast cells to produce a vaccine against the hepatitis B virus has been a major success story.

Xenotransplantation

The DNA of pigs has been modified using recombinant DNA technology so their cells develop without certain genes which trigger the human immune response. The hope is that these genetically modified organs might be accepted by a human recipient. In time pigs may even be given genes which code for human antigens – but there are many ethical and safety questions still to be answered in this area of genetic engineering.

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