

Genetic engineering

Revision notes • What genetic engineering is, and the main stages of the process using restriction enzymes, ligase and vectors.

For Edexcel GCSE Combined Science 1SC0. **Higher tier** is only on the Higher paper.

Genetic engineering Spec 4.10–4.12B

What is genetic engineering? Spec 4.10

Genetic engineering is a process which involves modifying the **genome** of an organism to introduce desirable characteristics.

Usually a gene for the characteristic is taken from one organism and inserted into another organism of a different species. The organism produced is called a genetically modified (GM) organism. It can now make the protein coded for by the new gene.

Examples of genetic engineering		
Organism	Gene inserted	Desirable characteristic
Bacteria	Human gene for insulin	Bacteria make human insulin, to treat diabetes
Crop plants	Gene for resistance to insect pests	Plants are not damaged by the pest

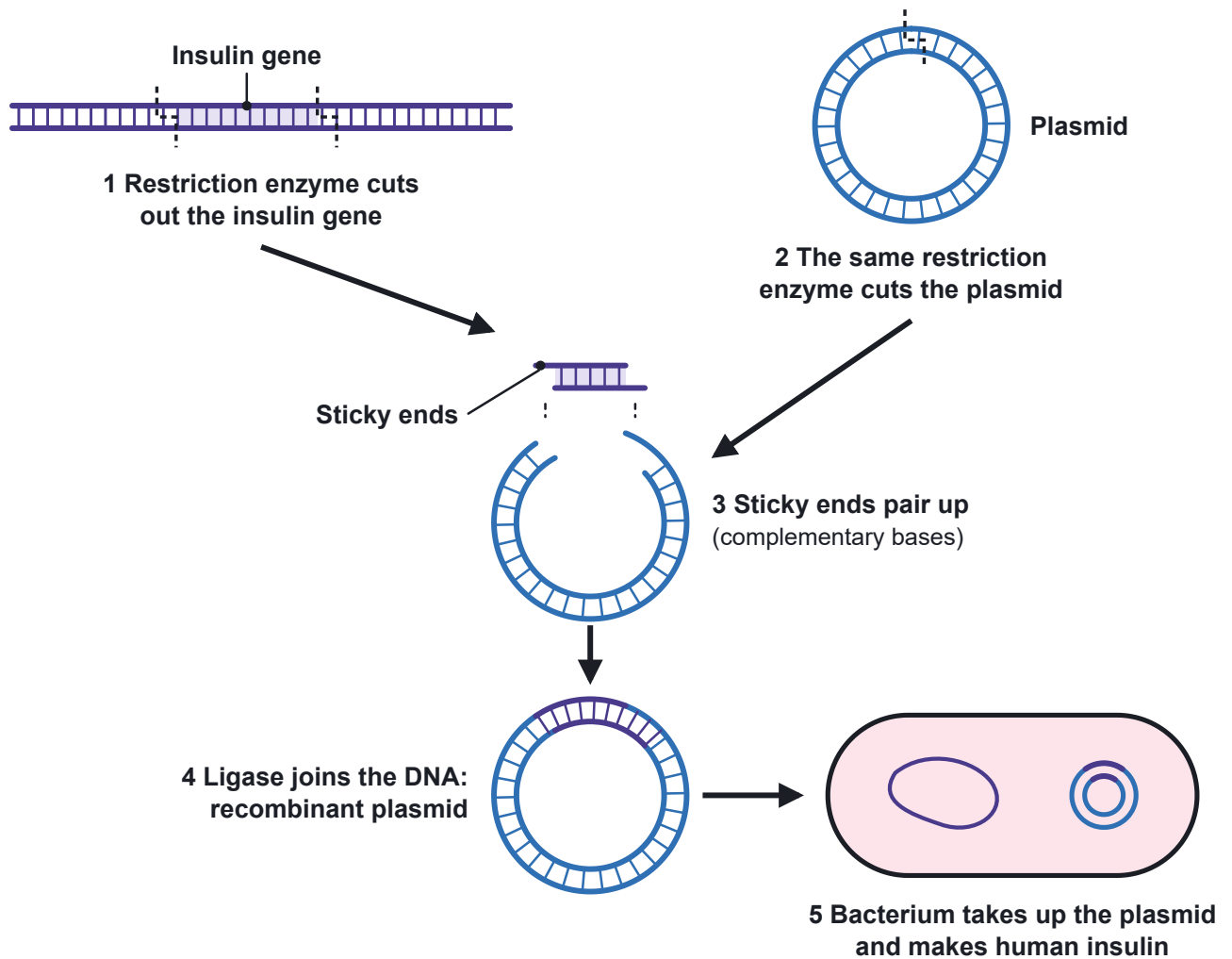
Common mistake: Genetic engineering is not the same as selective breeding. Selective breeding uses the genes already in a species; genetic engineering changes the genome directly.

The main stages of genetic engineering Spec 4.11 Higher tier

1. The gene for the desired characteristic is cut out of the chromosome of the donor organism using a **restriction enzyme**. Each restriction enzyme cuts DNA at a specific sequence of bases.
2. The cut leaves short, unpaired strands of DNA at each end. These are called **sticky ends**.
3. The **vector** is cut open using the same restriction enzyme, so it has matching sticky ends. A vector is something used to carry the gene into the new cell, such as a bacterial plasmid or a virus.
4. The gene and the vector are mixed. The sticky ends join by complementary base pairing, and the enzyme **ligase** joins the DNA strands together permanently. This makes recombinant DNA, for example a recombinant plasmid.
5. The vector is used to insert the gene into the cells of the target organism (for example a bacterium, or a plant or animal at an early stage of development). The organism's cells now make the protein.

Restriction enzyme	An enzyme that cuts DNA at a specific base sequence.
Sticky ends	Short, unpaired strands of DNA left at the ends of a cut, which can join with complementary sticky ends.
Ligase	An enzyme that joins pieces of DNA together.
Vector	A carrier, such as a plasmid or virus, used to insert a gene into another organism's cells.

Exam tip: Use the same enzyme to cut both the gene and the vector. That gives matching sticky ends. Ligase then does the joining.



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Same **restriction enzyme** gives matching **sticky ends**; **ligase** joins them to make a recombinant plasmid.

Quick check

1. What is genetic engineering?
2. What does a GM organism contain that a normal organism does not?
3. Give one example of a desirable characteristic introduced by genetic engineering.

Quick check answers

Genetic engineering

1. Modifying the genome of an organism to introduce desirable characteristics.
2. A gene transferred from another organism.
3. For example, bacteria making human insulin, or crop plants resistant to insects.