

Chapter 19 - Genetic Engineering

Learning objectives

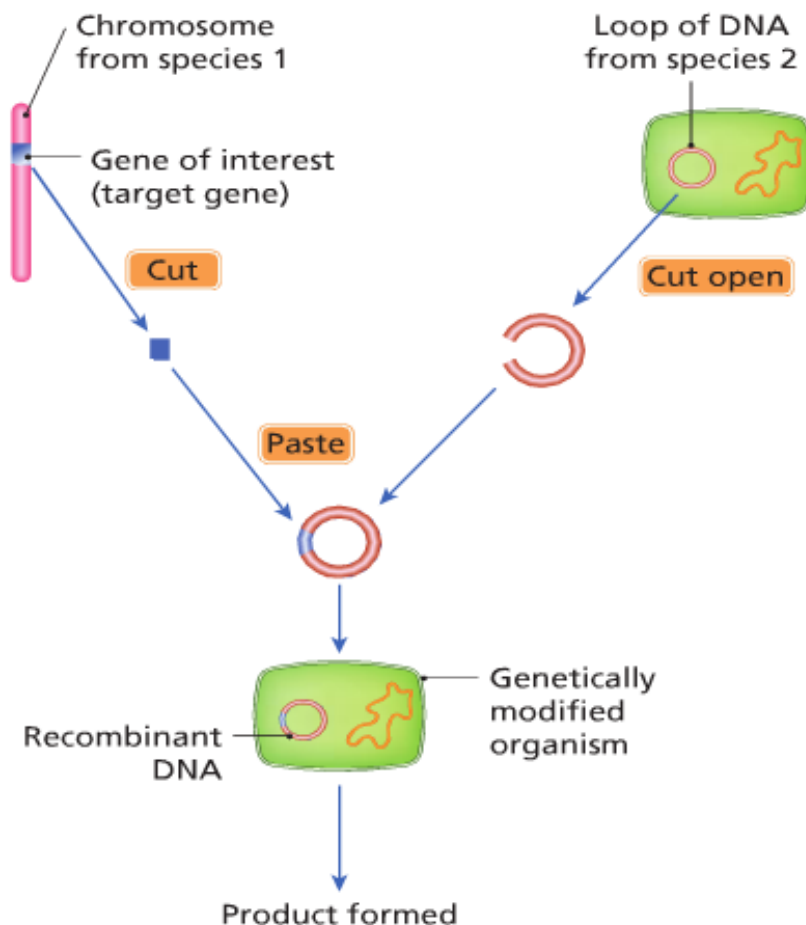
- To define genetic engineering
- To explain the process of genetic engineering, including isolation, cutting, transformation (ligation), introduction of base sequence changes and expression
- To describe three applications of genetic engineering, one in a plant, one in an animal and one in a micro-organism.

Genetic engineering is the artificial manipulation or alteration of genes.



The genes we want to use is called the **Target** gene.
We take it from one organism and put it into another organism.
This is a '**cut and paste process**'.
It is placed into the second organism and is called **Recombinant DNA**.
(The two different DNAs are combined)
The altered organism is called a **GMO** (Genetically Modified Organism).

Tools used in Genetic Engineering



1. A **source** of DNA - the target gene from species 1.

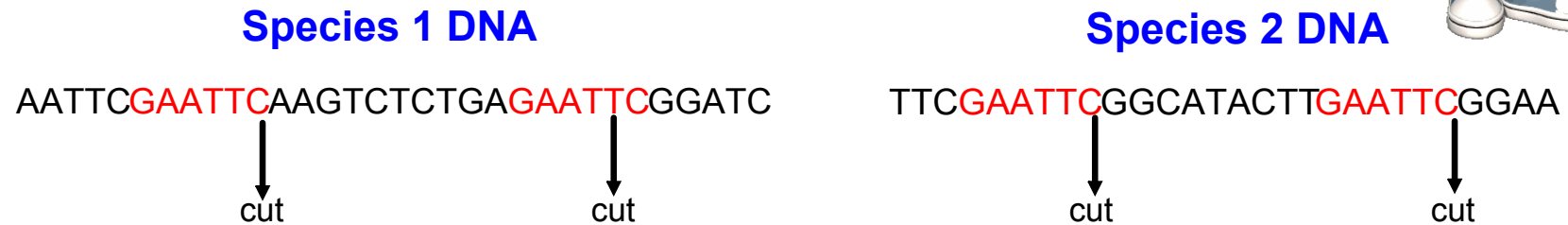
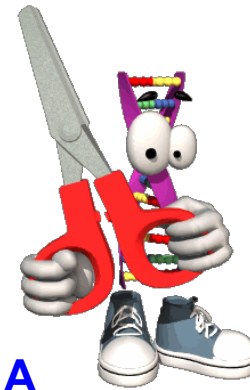
2. A **cloning vector** - bacterial plasmid (loop).

3. **Restriction enzymes** - these cut the DNA in a certain place as genetic scissors.

4. **DNA Ligase** - acts as a genetic glue.

Restriction Enzymes

These enzymes will only cut DNA at certain places.
For example one enzyme will only cut where the base sequence of GAATTC occurs.



**When the same enzyme is used for both species
the DNA will have complementary bases and will recombine easily.**

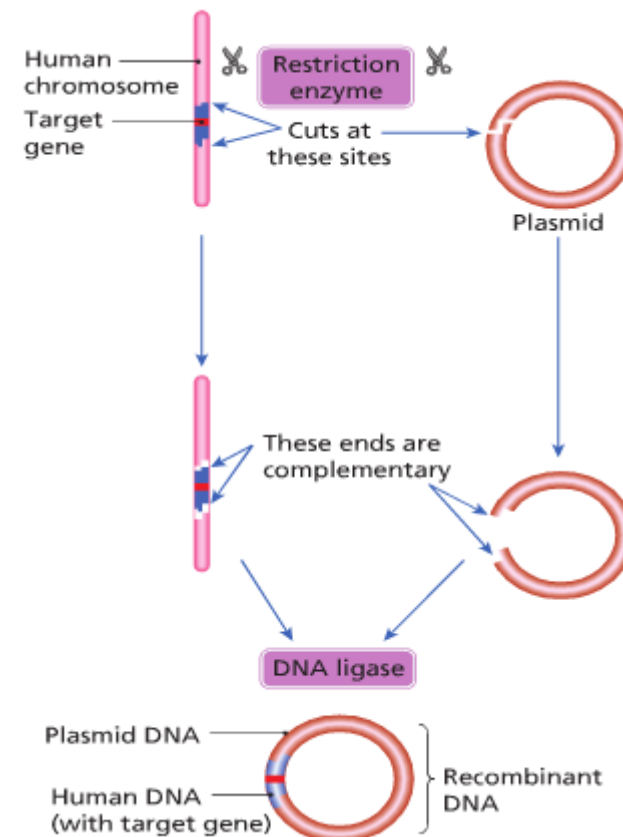
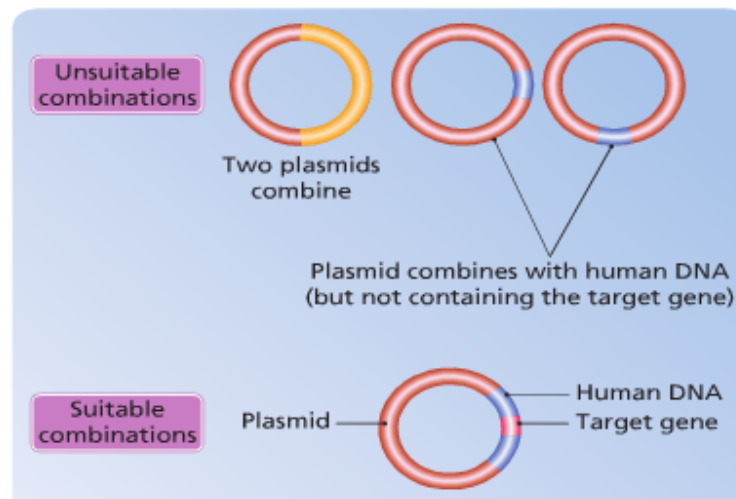
DNA Ligase

**An Anabolic enzyme that sticks
complementary DNA bases together.**

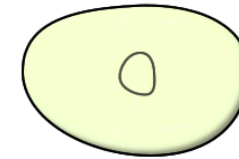
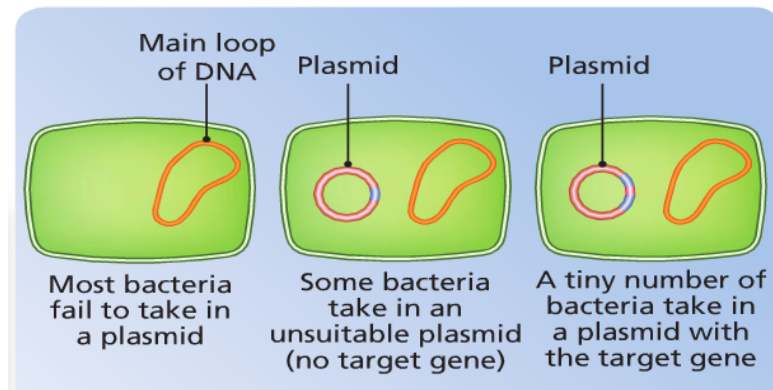


The Process

1. **Isolation** - target gene and plasmid removed
2. **Cutting** - same restriction enzyme cuts both
3. **Ligation** - the ends are stuck



4. Transformation - the uptake of DNA into a cell.



5. Cloning - produce identical copies of the bacterium.

6. Expression - the new DNA makes product.



3 Applications

1. **Bacterial genes into plants** -
makes weedkiller-resistant crops



2. **Human genes into animals** -
genes added to produce a protein
in the sheep milk to treat emphysema.

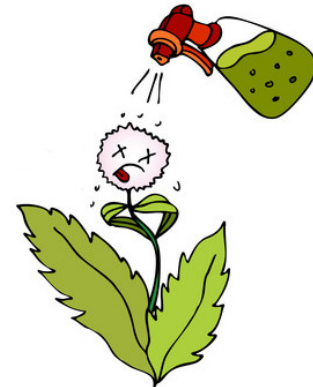


3. **Human genes into bacteria** -
genes added to make E.coli bacteria produce human insulin



Ethical issues

GMOs in the environment can cause problems.
e.g. some weeds are now weedkiller-resistant.



GMO as a food source - could they cause harm to us?

Will animals suffer from being modified?

Will human zygotes be modified?

