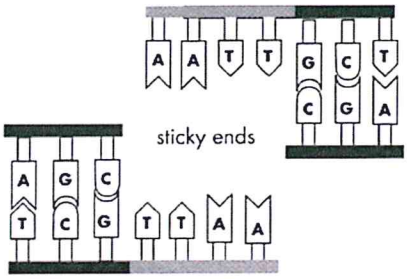
Genetic modification (gene transfer)

- The genetic code is **universal** – if a gene is transferred from one species to another, e.g. human → bacterium, the bacterium will make the same polypeptide / protein as the human.
- Organisms that have had genes transferred to them are called **GMO** (genetically modified organisms) or **transgenic** organisms.

Using *E. coli* bacteria to make human insulin – there are 3 stages:

1. Extracting the human insulin gene:

- mRNA coding for human insulin is extracted from β-cells in the pancreas.
- Reverse transcriptase makes single-stranded DNA.
- DNA polymerase makes double-stranded DNA.
- A **sticky end** sequence of bases is added to the DNA and restriction endonuclease makes a staggered cut (sticky end) making a gene with unpaired bases.



2. Making a recombinant plasmid:

- *E. coli* bacteria have **plasmids** (small loops of DNA).
- An *E.coli* plasmid is treated with the same **sticky end** sequence of bases and the same restriction endonuclease makes a staggered cut (sticky end) leaving unpaired bases.
- The 'sticky ends' insulin gene is inserted into the 'sticky ends' plasmid – complementary base pairs in the sticky ends link with H bonds and DNA ligase links the sugar – phosphate molecules.
- The recombinant plasmid can now be used as a **vector** to carry the human insulin gene into **host** *E. coli* bacteria.

3. Making insulin:

- Host *E.coli* bacteria are mixed with the recombinant plasmids and absorb them.
- The *E.coli* bacteria are now genetically modified, placed in a fermenter and start to make human insulin.
- The human insulin is extracted and purified for use by people with Type 1 diabetes.