Biotechnology

- **Biotechnology** is the alteration and use of living organisms to develop products or technologies. Humans have used biotechnology for thousands of years. For example, humans have used selective breeding in agriculture to produce higher quality foods and medicines.

- Some more recent examples of biotechnology include genetic modification and cloning.

- Biotechnology has the potential to play a significant role in addressing the challenge of feeding an increasing global population. One way it can do this is by using genetic modification and other techniques to improve the productivity and resilience of crops.

- For example, genetically modified crops can be made resistant to:

    1. **Herbicides** – These allow crops to be resistant, so only the weeds are killed and not the crop itself.
    2. **Pests** – Crops can be engineered to produce compounds that deter or kill pests, reducing the need for external pesticides.
    3. **Drought** – Crops can be engineered to thrive in dry conditions, requiring less water.

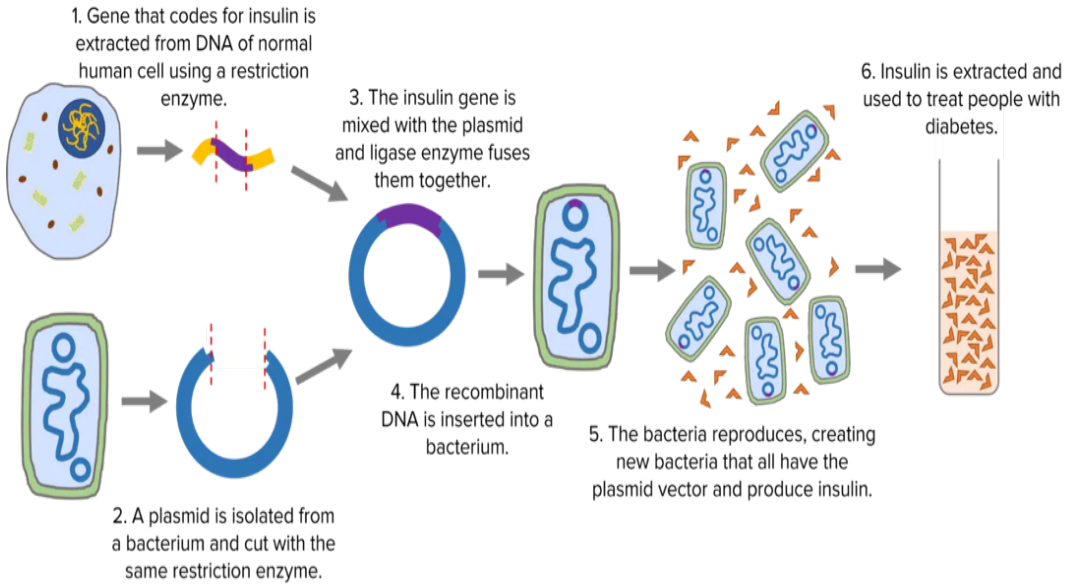
- Biotechnology can enable populations to produce foods that were previously unavailable in certain regions due to specific environmental factors. This can help to diversify food sources and make them more resilient to local challenges such as drought or pests.

Production of Human Insulin

- **Bacteria** can be **genetically engineered** to produce **human insulin** which is used to treat **diabetes**.

    1. The **gene** that codes for **insulin production** is cut out of a normal human chromosome using a **restriction enzyme**. Restriction enzymes ensure that the correct gene is cut out and leaves **unpaired bases** at either end called **sticky ends**.
    2. A **plasmid** is removed from a **bacteria** and cut open using the same **restriction enzyme** which will leave the same **sticky ends** as the **insulin gene**.

3. The **plasmid**, **insulin gene** and **enzyme** '**ligase**' are mixed together. Ligase will cause the **sticky ends** from the plasmid and insulin gene to fuse together creating **recombinant DNA**.
4. The **recombinant DNA** is inserted into a **bacteria cell**.
5. The bacterium is grown under **controlled conditions** in a vat. All the bacteria produced will produce **insulin**.
6. The insulin is **collected** and **purified** before being used to treat people with **diabetes**.



Mycoprotein

- **Biotechnology** is the manipulation of **living organisms** and processes to create **products** useful for humans. The production of **mycoprotein** is an example of this.
- **Mycoprotein** is a **protein-rich meat substitute** for **vegetarians**. It is made the fungus **Fusarium** in large **fermenters**. The fermenters provide everything the fungus needs to grow efficiently such as **optimum pH**, **optimum temperature**and lots of **oxygen** and **glucose** syrup for **aerobic respiration**. The **biomass** is **harvested** and **purified** before being turned into food.

Genetically modified Crops (GM Crops)

- In **developing countries**, there are often problems with **food security** or a lack of food **variety**. Crops can be **genetically modified** to help overcome these issues.

- Crops can be modified to be **resistant** to certain **pests** and **diseases** or to grow better in extreme **weather conditions** such as **droughts**. This will improve **crop yields**, providing food for people who need it.
- **Crops** can also be **genetically modified** to be more **nutritious** e.g. **golden rice** produces a chemical that is converted to **vitamin A** in the body.