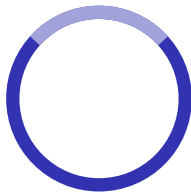


Biotechnology & Genetic Modification

IGCSE Biology ■ Topic 21

IGCSE Biology



What we will cover

1 Why bacteria are useful

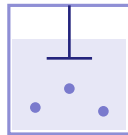
2 Yeast: biofuels & bread

3 Enzymes in industry

4 Fermenters

5 Genetic modification

6 GM examples



stirred, warm, sterile

fermenters

Why bacteria are useful

reproduce
very fast

make complex
molecules

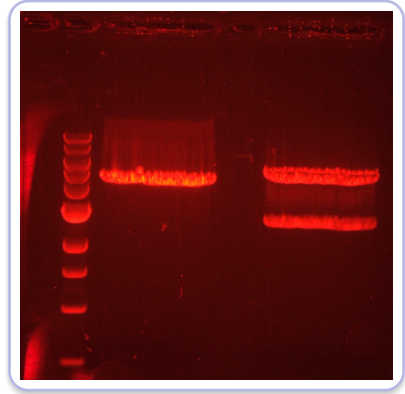
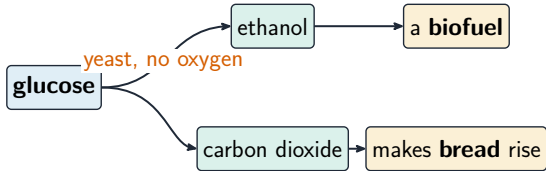
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Biotechnology 生物技术 uses living things (or their **enzymes** 酶) to make useful products.



Biotechnology uses living systems for products

Yeast: biofuels and bread



Genetic technology separates DNA fragments

Enzymes in industry

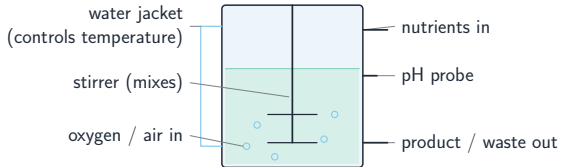
pectinase → more fruit juice

protease + lipase → wash out stains

lactase → lactose-free milk

- **pectinase** 果胶酶 – more, clearer fruit juice
- proteases & lipases – wash out stains
- **lactase** 乳糖酶 – lactose-free milk

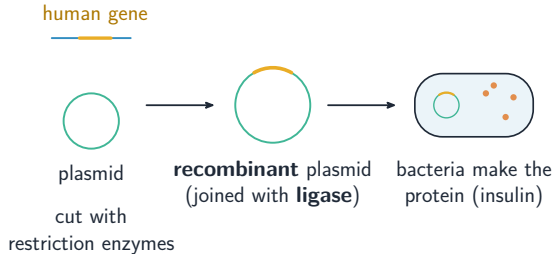
Fermenters



A **fermenter** 发酵罐 grows microbes to make **insulin** 胰岛素, **penicillin** 青霉素 & **mycoprotein** 真菌蛋白.

Control the temperature, pH, oxygen, nutrients & waste removal.

Genetic modification



Genetic modification 基因改造
moves genes between organisms:

- 1 restriction enzymes** 限制酶
cut (sticky ends)
- 2 ligase** 连接酶 joins the gene
into a plasmid
- 3 bacteria express** 表达 it →
the protein

GM examples

human **insulin** 胰岛素 from bacteria

herbicide 除草剂-resistant crops

insect-pest-resistant crops

crops with better nutrition

GM crops can give higher **yields** 产量, but raise worries about health, wild species & cost.

Worked example – making human insulin

Outline how bacteria are made to produce human insulin.

- Cut out the **human insulin gene** with a **restriction enzyme** 限制酶, leaving sticky ends.
- Cut a bacterial **plasmid** with the **same** enzyme, so the ends match.
- Join gene into plasmid with **DNA ligase** ⇒ recombinant plasmid.
- Put it into a bacterium and grow them in a **fermenter**: they read the gene and **make real human insulin**.

Use the **same restriction enzyme** on both, or the sticky ends will not match. The insulin is **identical** to human insulin, so fewer allergic reactions.

Topic 21 – key takeaways

1

Bacteria

fast, complex molecules, plasmids

2

Yeast

ethanol (biofuel) & CO₂ (bread)

3

Fermenter

insulin, penicillin; controlled conditions

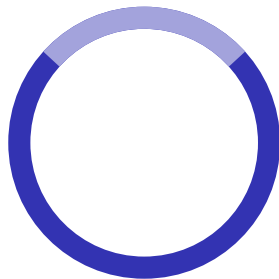
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GM

cut with restriction enzymes, join with ligase

Check yourself

- 1 Why are bacteria useful in biotechnology?
- 2 What two products does yeast make?
- 3 What enzyme cuts out a gene?
- 4 Name one use of genetic modification.



Answers 1. fast, make complex molecules, have plasmids 2. ethanol & carbon dioxide
3. a restriction enzyme 4. e.g. making insulin