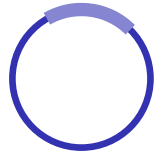


Genetic Technology

A-Level Biology ■ Topic 19

A-Level Biology



Genetic Technology

What we will cover

- 1 The tools
- 2 Cut & paste DNA
- 3 The plasmid vector
- 4 PCR & electrophoresis
- 5 Recombinant proteins
- 6 GMOs & ethics



a PCR machine copies DNA

1 Tools

The tools

restriction enzyme 限制性内切酶 – cuts DNA, leaving sticky ends

ligase 连接酶 – joins DNA pieces

plasmid 质粒 – a cloning vector 载体 carrying the gene in

reverse transcriptase 逆转录酶 – DNA from mRNA

Recombinant DNA 重组 DNA joins DNA from two sources; the gene is cut out, made from mRNA, or built chemically.

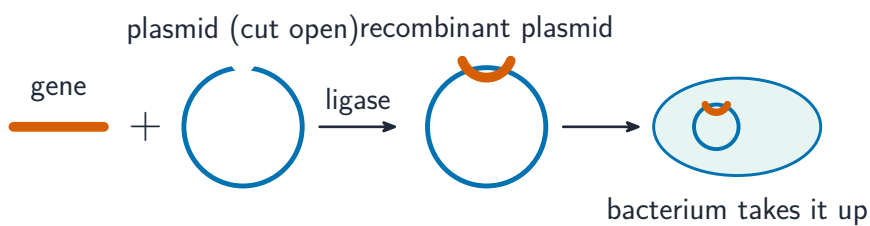
Cut and paste DNA

A **restriction enzyme** 限制酶 cuts DNA at a specific palindromic sequence, often leaving sticky ends. **DNA ligase** DNA 连接酶 joins matching sticky ends – that is how a gene is pasted into a plasmid.

The plasmid vector

The gene is joined into a **plasmid** 质粒, taken up by a bacterium.

- a **promoter** 启动子 switches the gene on
- a **marker gene** 标记基因 (e.g. glowing) shows it worked



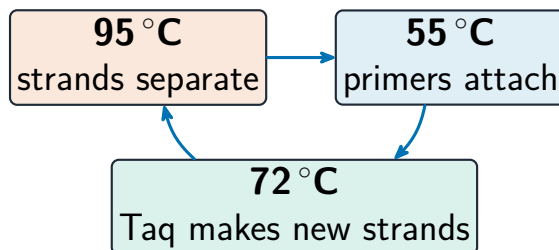
2 Copying and sorting

Genetic Technology
↳ Copying and sorting

PCR

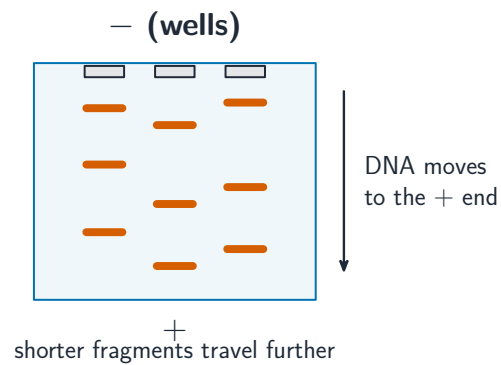
The **polymerase chain reaction** 聚合酶链式反应 (PCR) **amplifies** 扩增 DNA.

It repeats heat-and-cool cycles with heat-stable **Taq polymerase** Taq 聚合酶; each cycle **doubles** the DNA – millions of copies.



Genetic Technology
↳ Copying and sorting

Gel electrophoresis



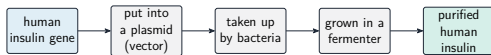
Gel electrophoresis 凝胶电泳 separates DNA **fragments** 片段 by length.

Fragments move towards the + end; **shorter** ones travel further, sorting into bands.

3 Medicine and GMOs

Genetic Technology
└ Medicine and GMOs

Recombinant proteins in medicine



A human gene in bacteria makes a **recombinant** 重组 human protein – e.g. **insulin** 胰岛素 for **diabetes** 糖尿病. **Genetic screening** 基因筛查 tests for disease alleles; **gene therapy** 基因治疗 adds a working gene.

Genetic Technology
└ Medicine and GMOs

GMOs and ethics

GM salmon
grow faster

GM soybean
herbicide 除草剂-resistant

GM cotton
pest 害虫-resistant

GMOs 转基因生物 raise **ethical** 伦理 questions: are they safe to eat, could the genes spread, and who controls the food supply?

4

Recap

Worked example – reading a gel

DNA is cut with a restriction enzyme and run on a gel. Explain how the bands separate.

- DNA is **negatively charged** (phosphate groups), so it moves towards the **anode (+)**.
- The gel is a mesh: **small fragments travel furthest**, large ones are held back.
- So distance moved depends on **fragment length**.
- Compare with a **ladder** of known sizes to read each band ⇒ **a DNA profile**.

Load at the **negative** end – DNA runs towards +. Bands are made visible by a stain or a **labelled probe**, since DNA itself is colourless.

Topic 19 – key takeaways

1

Tools

restriction enzyme, ligase, plasmid vector

2

Insertion

sticky ends; promoter & marker gene

3

Copying

PCR amplifies; electrophoresis sorts by length

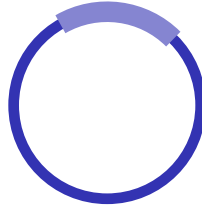
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Uses

recombinant insulin; gene therapy; GMOs

Check yourself

- 1 Which enzyme leaves sticky ends?
- 2 What carries the gene into a bacterium?
- 3 What does each PCR cycle do to the DNA?
- 4 In a gel, which fragments travel furthest?



Answers 1. a restriction endonuclease 2. a plasmid (vector) 3. doubles it 4. the shortest