Genetic Technology

A-Level Biology ▪ Topic 19

A-Level Biology

What we will cover

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.

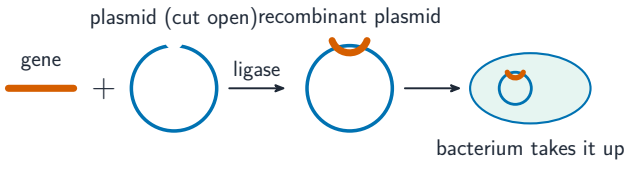
Cut and paste DNA

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

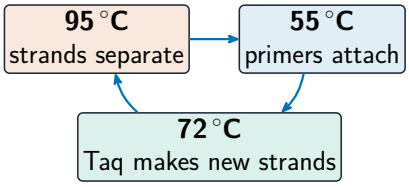


2 Copying and sorting

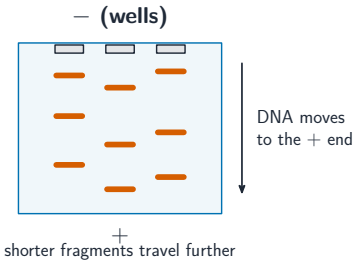
PCR

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.



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

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.

GMOs and ethics

GM salmon	**GM soybean**	**GM cotton**
grow faster	**herbicide** 除草剂-resistant	**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.

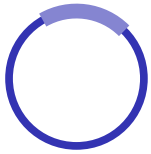
Load at the negative end – DNA runs towards +. Bands are made visible by a stain or a labelled probe, since DNA itself is colourless.

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
4. **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