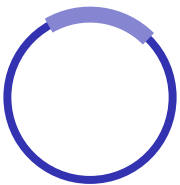
Genetic Technology

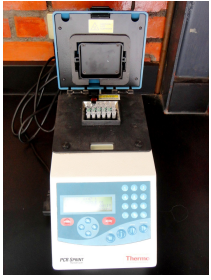
A-Level Biology ▪ Topic 19

A-Level Biology



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

The tools

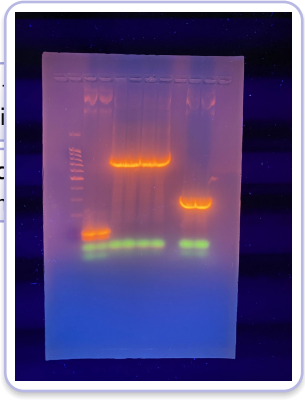
restriction enzyme 限制性内切酶 – cuts DNA, leaving sticky ends

ligase 连接酶 – joins DNA pieces

plasmid 质粒 – **tor 载体** carryi

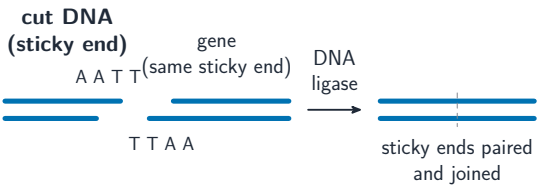
reverse transc – DNA from m

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



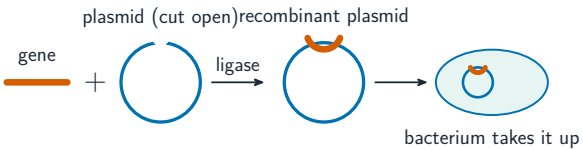
gel photo

Cut and paste DNA



gm cotton

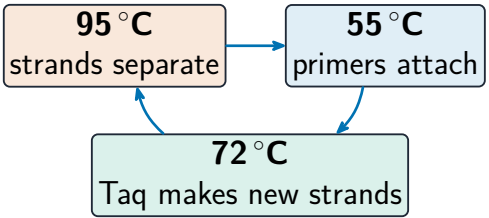
The plasmid vector



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

PCR

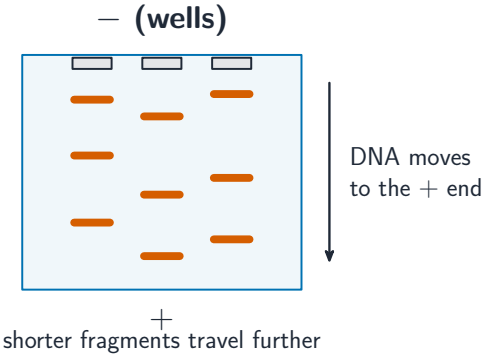


each cycle **doubles** the DNA → millions of copies

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.

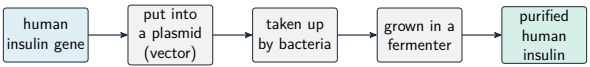
Gel electrophoresis



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.

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
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?

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

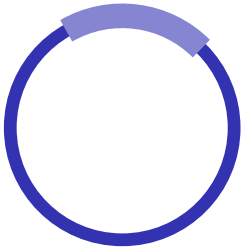
PCR amplifies; electrophoresis sorts by length

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