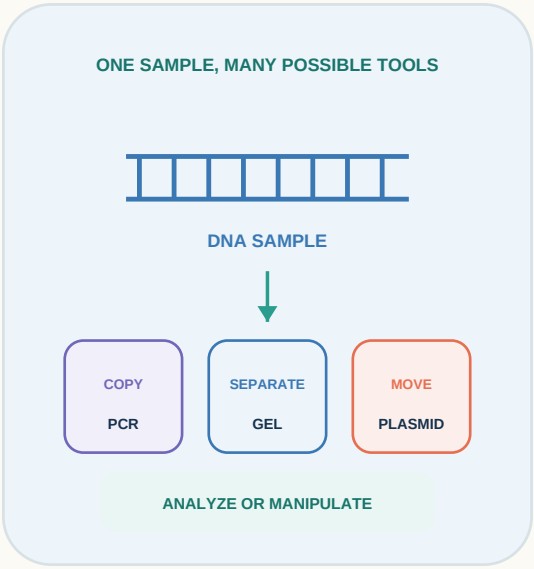
AP BIOLOGY | UNIT 6

TOPIC 6.8

Biotechnology

Biotechnology uses biological tools to copy, separate, read, compare, or deliberately move genetic information.



THE CORE WORKFLOW

QUESTION — what must be learned?

→

PREPARE — isolate or copy DNA

→

MEASURE — separate or read

→

INTERPRET — compare or modify

BY THE END, YOU SHOULD BE ABLE TO...

1. Explain how PCR amplifies a selected DNA region.
2. Interpret how a gel separates and compares DNA fragments.
3. Connect plasmids and transformation to genetic engineering.

CENTRAL IDEA

Choose a technique by its function: PCR copies a target, gels separate fragments, sequencing reads bases, and vectors move DNA into cells.

1 PCR copies DNA; gels separate DNA fragments

PCR creates enough target DNA to analyze, while gel electrophoresis reveals fragment sizes as a pattern of bands.

PCR: REPEAT A THREE-STEP CYCLE

1 DENATURE

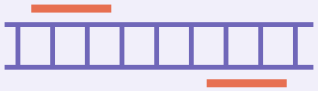
about 95 C



Heat separates the two template strands.

2 ANNEAL

about 50-65 C



Primers bind beside the selected target sequence.

3 EXTEND

about 72 C

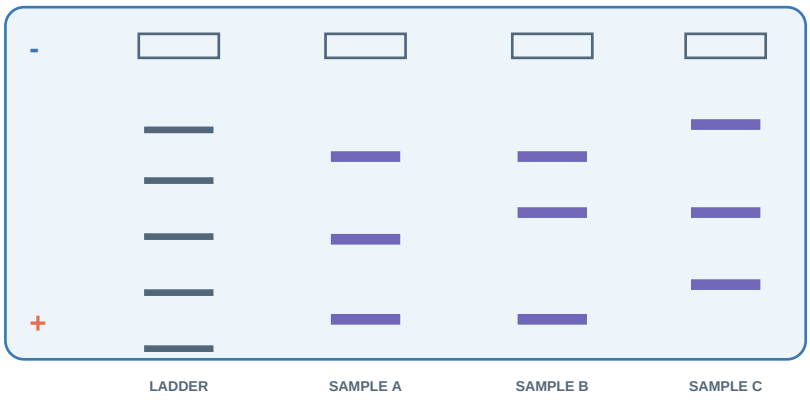


Heat-stable DNA polymerase extends from each primer.

Each successful cycle roughly doubles the target: after n cycles, about 2^n copies are possible.

GEL ELECTROPHORESIS

GEL ELECTROPHORESIS: FRAGMENT SIZE BECOMES A BAND PATTERN



DNA moves toward +

READ THE GEL

1. Smaller fragments travel farther.
2. Bands at the same position are the same size.
3. A ladder estimates fragment length.

INTERPRETATION CHECK

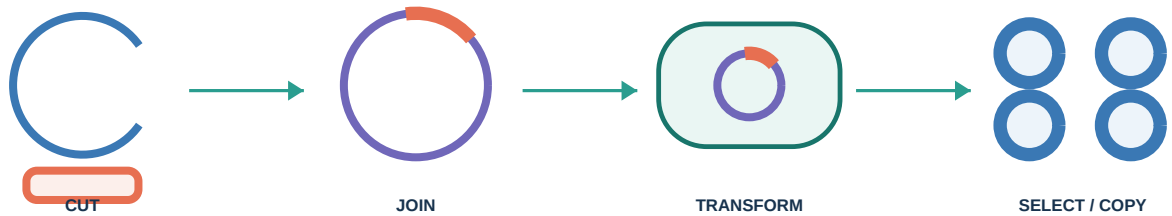
DNA is negatively charged because of its phosphate backbone, so fragments move toward the positive electrode. The gel separates by size, not by gene function.

2 Vectors move DNA; other tools read and compare it

Plasmids can deliver selected DNA into bacteria, while sequencing and fingerprinting answer different questions about genetic information.

BACTERIAL TRANSFORMATION AND GENE CLONING

BUILDING AND USING A RECOMBINANT PLASMID



CUT	JOIN	TRANSFORM	SELECT / COPY
plasmid + gene	DNA ligase	bacterial cell	clone or express

A plasmid is a vector: a DNA carrier used to deliver a selected sequence into a cell.

MATCH THE TOOL TO THE QUESTION

DNA SEQUENCING

Determines the nucleotide order in a DNA fragment.

DNA FINGERPRINTING

Compares variable fragment or marker patterns among samples.

GENE CLONING

Produces many copies of a selected gene, often using a vector and cells.

WHAT EACH RESULT LOOKS LIKE

PCR	GEL	SEQUENCING	TRANSFORMATION
many target copies	band pattern	base order	cells carrying DNA

DO NOT CONFUSE

PCR amplifies a selected region, but it does not determine the complete base sequence. A gel shows fragment sizes, but it does not directly reveal every nucleotide.

FINAL MAP

Copy with PCR -> separate with a gel -> read with sequencing -> move DNA with a vector -> compare or engineer biological systems.