Bands and Bacteria

How DNA tools support identification and medicine

GEN.3 "Students will investigate biotechnology applications and bioengineering practices. Explain and demonstrate the use of various tools and techniques of DNA manipulation and their applications in forensics (e.g...."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each DNA tool or technique in the passage, and circle what it does. Number the checks that help the technician judge whether a DNA match is reliable.

Two Jobs for DNA Tools

1. After a storm, a hospital must match an unlabeled blood sample to one of two patients. A technician copies several variable DNA regions from the sample and from each patient's reference swab using polymerase chain reaction, or PCR. The technician then places the copied DNA in separate wells of a gel. An electric current pulls the negatively charged DNA through the gel. Shorter pieces travel farther than longer pieces. At the tested regions, the unknown sample and Patient A show matching band positions, while Patient B has a band in a different position. Matching positions support an identification, but they do not prove it alone.

2. Before reporting a match, the technician checks a negative control containing no DNA. If it shows bands, contamination may have entered the test. The technician also repeats the test with more variable regions because two people can share some band positions by chance. A DNA profile compares selected regions, not every base in a person's genome. These safeguards matter in forensic identification, including investigations of unidentified victims. Gel electrophoresis separates DNA pieces by size; it does not change their sequence. PCR copies chosen regions, so a strong conclusion depends on reliable samples, useful regions, and clean controls.

3. The same hospital treats patients with diabetes using insulin made by engineered cells. To produce it, scientists insert a human insulin gene into a DNA carrier called a plasmid, then introduce that plasmid into bacteria. Cells that take up the plasmid can make insulin protein. Technicians grow those cells and purify the protein, separating it from cell parts and other proteins before testing its quality. This process changes what the bacteria produce, unlike the gel test, which only separates DNA for comparison. In a classroom, students may use harmless bacteria and a visible marker gene to model transformation, not to make medicine.

2 ANSWER WITH EVIDENCE

Use the passage

1. Why does the unknown sample point toward Patient A rather than Patient B? Why is the match not proof by itself?

2. If the negative control shows bands, how does that affect the technician's claim of a match?

3. Explain the different jobs of PCR and gel electrophoresis in the identification test.

4. How do plasmid transformation and protein purification help make insulin, and how is the gel test's purpose different?

3 YOUR TURN

Your own words

Plan a classroom gel test to find out whether changing run time improves separation of two DNA pieces. State what you would change, two conditions you would keep the same, what you would measure, and how a no-DNA control would help you judge the result.

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PART 1 · READ AND MARK

Underline each DNA tool or technique in the passage, and circle what it does. Number the checks that help the technician judge whether a DNA match is reliable. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Why does the unknown sample point toward Patient A rather than Patient B? Why is the match not proof by itself?	**The unknown and Patient A have matching band positions at the tested regions, while Patient B has a band in a different position. People can share some band positions by chance.**
2	If the negative control shows bands, how does that affect the technician's claim of a match?	**Bands in the no-DNA control suggest contamination, so the technician cannot rely on the match without resolving that problem.**
3	Explain the different jobs of PCR and gel electrophoresis in the identification test.	**PCR copies selected DNA regions. Gel electrophoresis separates the copied pieces by size so their band positions can be compared.**
4	How do plasmid transformation and protein purification help make insulin, and how is the gel test's purpose different?	**Introducing the insulin-gene plasmid lets bacteria make insulin. Purification separates insulin from other cell materials. The gel test separates DNA for comparison rather than changing what cells produce.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would load equal amounts of the same two DNA pieces into two identical gels and run one for 15 minutes and the other for 25 minutes. I would keep the gel material and electric current the same. I would measure the distance between the two bands in each gel and check that neither band ran off the gel. A no-DNA lane in each gel should show no bands; bands there would suggest contamination.

Accept other controlled run times and valid measures of separation. The plan should change only run time, name two controlled conditions, and explain that bands in a no-DNA control would call the results into question.