

Solution Key

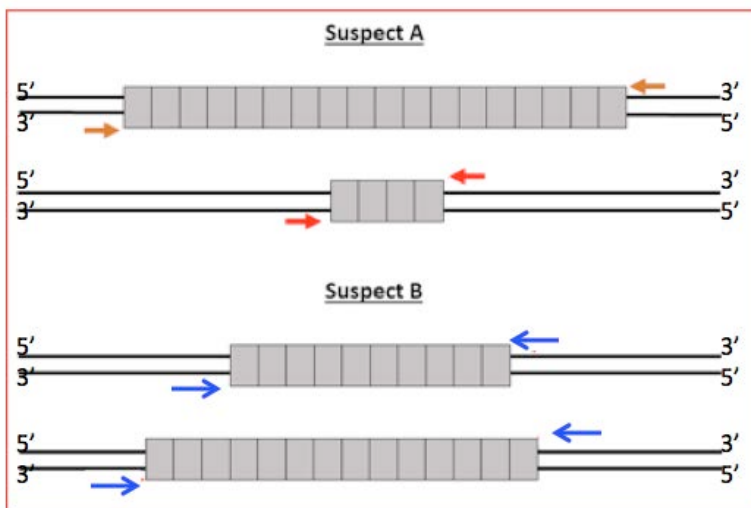
PCR can be used in forensics to identify a criminal among a pool of suspects by comparing PCR products derived from regions of the suspects' DNA with DNA found at the crime scene. The figure below depicts one genomic region in 2 different suspects. The two alleles for each suspect are shown. Each of the gray boxes represents a copy of a short tandem repeat (STR) sequence 4 bases long.



a) Why the STR sequences are not longer than 4-16 bases?

If the repeats would recombine out and the STR would not be inherited stably.

b) The orange arrows in the figure above depict the forward and reverse primer binding sites on the genomic region of the maternal chromosome of Suspect A. The arrowhead is the 3' end of the primer. On the diagram, indicate where the primers will bind in each region.



c) What molecular force allows the primers to bind in the correct location?

Hydrogen bonding between the bases of the primer and the bases of the DNA.

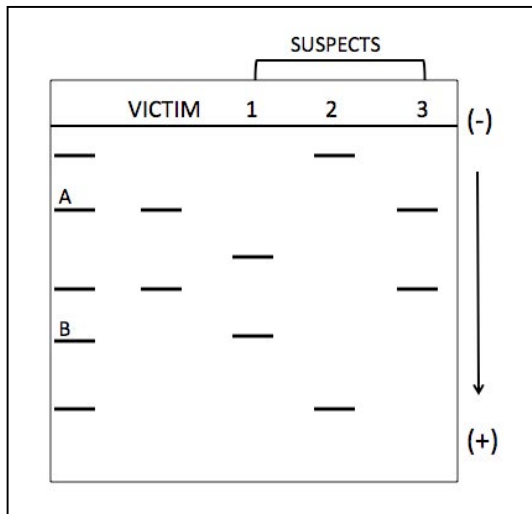
d) To perform the experiment DNA was isolated from each suspect as well as from the crime scene. Using one tube per sample (Suspect A, Suspect B, & crime scene DNA), the forensic scientists

added all the necessary PCR ingredients and began the PCR reaction. If the scientists made an error in their PCR program such that they omitted the 95°C step, how would this affect their result? Explain why.

The PCR would not be successful because the genomic DNA would not denature. This would prevent the PCR primers from binding to the template, and without primer binding, the DNA

d) The CODIS loci are a set of 13 genomic loci used in forensic STR mapping. Why are 13 loci employed, rather than one in the example.

This will give $(2)^{13}$ STR variants each almost unique to an individual. This makes the data a lot more reliable.



e) The gel electrophoresis data below is from a crime scene. The electrodes are shown.

- i. Which is the larger fragment: Fragment A or Fragment B? **Explain** your choice.

Fragment A, since it migrates slowly on the gel as opposed to Fragment B.

- ii. Which suspect is most likely the criminal? **Explain** your choice

Suspect 2, Bands completely matches with crime scene bands.

- iii. Why might the data not be entirely clear?

The crime scene DNA may be mixed with victim/area DNA.

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