

Name _____

Date _____ Hour _____

Analyzing DNA Fingerprints

Problem:

How can the analysis of DNA fragments be used as a tool for identifying individuals?

Background:

The technique of DNA fingerprinting is a way to determine the identity or relationships of individuals. Except identical twins, no two people have the same DNA and the same DNA fingerprint. The technique of DNA fingerprinting is very reliable and requires only a small sample of DNA.

The following laboratory exercises will introduce the methods and principles of DNA fingerprinting. In the first part you will be given the results of a simulated criminal investigation in which you will determine the identity of criminals. In the second part you will be provided with sequences of DNA from three different individuals. You will analyze the samples with different probes and restriction enzymes to see the effects that they have on DNA banding patterns.

Objectives:

- Explain how DNA fingerprinting is used for identification (Part I)
- Interpret the results of hypothetical DNA fingerprinting analyses in order to identify likely suspects in a crime (Part I)
- Find the size of DNA fragments after treatment of DNA sequences from three individuals with two different restriction enzymes (Part II)
- Find the DNA banding patterns caused by two different DNA probes (Part II)

Materials:

Pencil, Ruler, Calculator

Part I:

1. Using record sheet 11-1, review the DNA fingerprint patterns for Case 1. Determine the guilt or innocence of the three suspects.
2. Using record sheet 11-1, review the DNA fingerprint patterns for Case 2. Determine the guilt or innocence of the three suspects.

What are the Initials of the Criminal? Part I

DATA

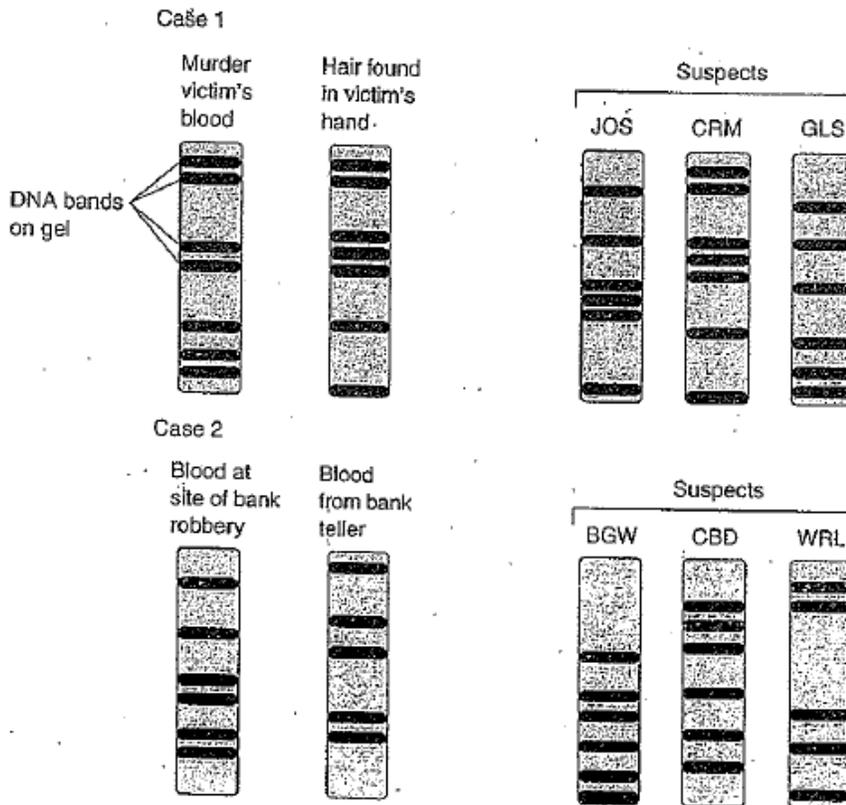


FIGURE 1

ANALYSES AND CONCLUSIONS

- 1a. For case 1; compare the DNA fingerprint patterns of the suspects with patterns from samples at the scene of the crime. Do any of the patterns match? Name any matching patterns.

- b. Based on the evidence, were any of the suspects involved in the murder? Explain your reasoning.

- 2a. For case 2, compare the DNA fingerprint patterns of the suspects with patterns from samples at the scene of the crime. Do any of the patterns match? Name any matching patterns.

- b. Based on the evidence, were any of the suspects involved in the bank robbery? Explain your reasoning.

3. Do you think that DNA fingerprinting is totally reliable? Explain why or why not.

Part II:

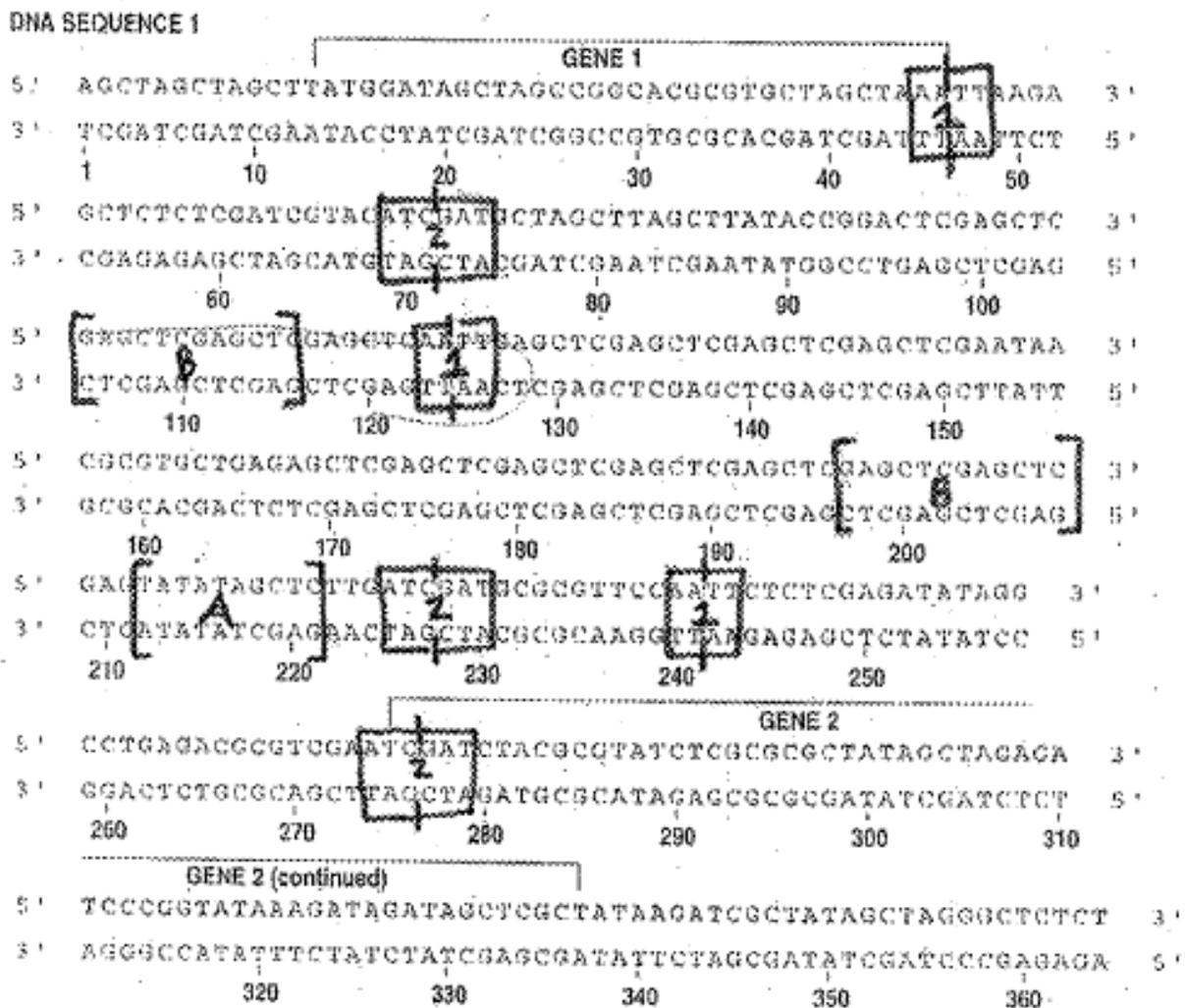
1. Restriction enzymes recognize specific DNA sequences. In this exercise, two different restriction enzymes have been applied to the DNA of three individuals.

- Enzyme 1 recognizes the DNA sequence 5' AATT 3' and cuts between the middle A and T.
- Enzyme 2 recognizes the DNA sequence 5' ATCGAT 3' and cuts between the middle C and G.

2. On the pages following, notice that the DNA of the three individuals has been marked with the locations of the cuts of both restriction enzymes as well as both probes.

3. On Data Sheet 1, fill in the charts with the required information. Once you have done this, you are ready to construct a DNA fingerprint that results from *using restriction enzyme 1*.

4. On Data Sheet 2, fill in the charts with the required information. Once you have done this, you are ready to construct a DNA fingerprint that results from *using restriction enzyme 2*.



DNA SEQUENCE 2

GENE 1

5' AGCTAGCTAGCTTATGGATAGCTAGCCGGCACCAGCTGCTAGCTAACTAAAGA 3'
 3' TCGATCGATCGAATACCTATCGGATCGGECGTCGGCAAGATCGATTGATTTCT 5'
 1 10 20 30 40 50
 5' GCTCTCTCGATCGTACATCGATGCTAGCTTACCTTATACCGGACTCGAGCTC 3'
 3' CGAGAGAGCTAGCATCTAGCTACGATCGAATCGAATATGGCCTGAGCTCGAG 5'
 60 70 80 90 100
 5' GAGCTCGAGCTCGAGCTCGAATTGAGCTCGAGCTCGAGCTCGAGCTCGAATAA 3'
 3' CTCGAGCTCGAGCTCGAGCTCGAATTGAGCTCGAGCTCGAGCTCGAGCTTATT 5'
 110 120 130 140 150
 5' CCGGTGCTGAGAGCTCGAGCTCGAGCTCGAGCTCGAGCTCGAGCTCGAGCTC 3'
 3' GCGCAGGACTCTCGAGCTCGAGCTCGAGCTCGAGCTCGAGCTCGAGCTCGAG 5'
 160 170 180 190 200
 5' GACTATATAGCTCTGATCGATGCGCGTCCGATTTCTCTCGAGATATAGG 3'
 3' CTGATATATCGAGAACTAGCTAGCGCGCAAGCTTAGAGAGCTCTATATCC 5'
 210 220 230 240 250

GENE 2

5' CCTGAGACCGCTCGACTACAGCTACGCGTATCTCGCGGCTATAGCTAGAGA 3'
 3' GGAGTCTGCGCAGCTGATGTCGATGCGCATAGAGCGCGGATATCGATCTCT 5'
 260 270 280 290 300 310
 5' TCCCGGTATAAAGATAGATAGCTCGCTATAAGATCGCTATAGCTAGGCTCTCT 3'
 3' AGGCCATATTTCTATCTATCGAGCGATATTTCTAGCGATATCGATCCCGAGAGA 5'

DNA SEQUENCE 3

GENE 1

5' GCTCTCTCGATCGTACATCGATGCTAGCTTATGGATACTAGCCGG 3'
 3' CGAGAGAGCTAGCATCTAGCTACTCGATCGAATACCTATCGATCGGCC 5'
 1 10 20 30 40 50
 5' CCGCGTGTAGCTAGCTTAAAGACTAGCTTATACCGGACTCGAGCTC 3'
 3' GTCGSCAGGATCGATCTGATCGAATCGAATATGGCCTGAGCTCGAG 5'
 60 70 80 90 100
 5' GAGCTCGAGCTCGAGCTCGAATTGAGCTCGAGCTCGAGCTCGAGCTCGAATAA 3'
 3' CTCGAGCTCGAGCTCGAGCTCGAATTGAGCTCGAGCTCGAGCTCGAGCTTATT 5'
 110 120 130 140 150
 5' CCGGTGCTGAGAGCTCGAGCTCGAGCTCGAGCTCGAGCTCGAGCTCGAGCTC 3'
 3' GCGCAGGACTCTCGAGCTCGAGCTCGAGCTCGAGCTCGAGCTCGAGCTCGAG 5'
 160 170 180 190 200
 5' GACTATATAGCTCTGATCGATGCGCGTCCGATTTCTCTCGAGATATAGG 3'
 3' CTGATATATCGAGAACTAGCTAGCGCGCAAGCTTAGAGAGCTCTATATCC 5'
 210 220 230 240 250

GENE 2

5' CCTGAGACCGCTCGACTACAGCTACGCGTATCTCGCGGCTATAGCTAGAGA 3'
 3' GGAGTCTGCGCAGCTGATGTCGATGCGCATAGAGCGCGGATATCGATCTCT 5'
 260 270 280 290 300 310

GENE 2 (continued)

5' TCCCGGTATAAAGATAGATAGCTCGCTATAAGATCGCTATAGCTAGGCTCTCT 3'
 3' AGGCCATATTTCTATCTATCGAGCGATATTTCTAGCGATATCGATCCCGAGAGA 5'

DATA SHEET 1 -- Fill in the following chart for **Enzyme 1 (AATT)** – Part of it is completed for you

Individual #1

Fragment #	Ending b.p. # (where the restriction enzyme cuts)	Beginning b.p. #	Length of fragment (subtract beginning # from ending #)	Is there a probe in front of this fragment? A, B or Both?
1		0		
2		47		
3		125		
4		242		

Individual #2

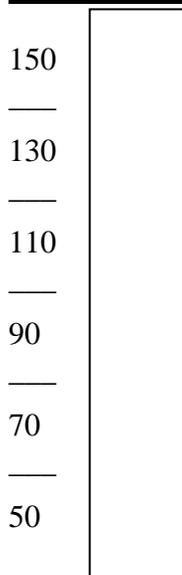
Fragment #	Ending b.p. # (where the restriction enzyme cuts)	Beginning b.p. #	Length of fragment (subtract beginning # from ending #)	Is there a probe in front of this fragment? A, B or Both?
1	124			
2	241			
3	364			

Individual #3

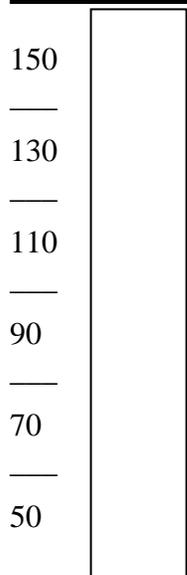
Fragment #	Ending b.p. # (where the restriction enzyme cuts)	Beginning b.p. #	Length of fragment (subtract beginning # from ending #)	Is there a probe in front of this fragment? A, B or Both?
1	69			
2		70		
3	241			
4		242		

Using the data from the ‘**length of fragment**’ column, mark a corresponding band on each of the DNA fingerprints below. Then to the right of each fingerprint, label the markers that have probes (A, B or Both)

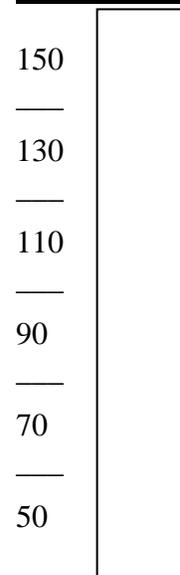
Individual #1



Individual #2



Individual #3



DATA SHEET 2 --Fill in the following chart for Enzyme 2(ATCGAT)

Individual #1

Fragment #	Ending b.p. # (where the restriction enzyme cuts)	Beginning b.p. #	Length of fragment (subtract beginning # from ending #)	Is there a probe in front of this fragment? A, B or Both?
1				
2				
3				
4				

Individual #2

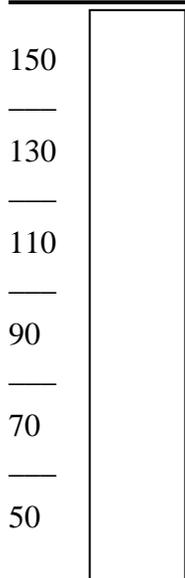
Fragment #	Ending b.p. # (where the restriction enzyme cuts)	Beginning b.p. #	Length of fragment (subtract beginning # from ending #)	Is there a probe in front of this fragment? A, B or Both?
1				
2				
3				
4				

Individual #3

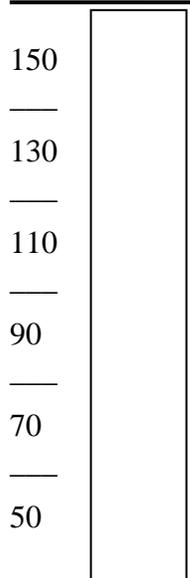
Fragment #	Ending b.p. # (where the restriction enzyme cuts)	Beginning b.p. #	Length of fragment (subtract beginning # from ending #)	Is there a probe in front of this fragment? A, B or Both?
1				
2				
3				

Using the data from the 'length of fragment' column, mark a corresponding band on each of the DNA fingerprints below. Then to the right of each fingerprint, label the markers that have probes (A, B or Both).

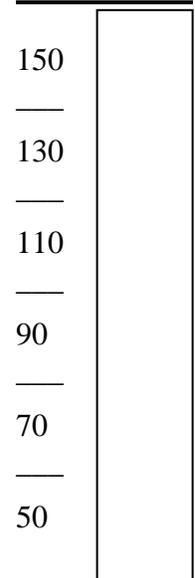
Individual #1



Individual #2



Individual #3



Part II Analysis and Conclusion:

1. What are restriction enzymes? _____

2. What are DNA probes? _____

3. Did the result that you obtained in Part II allow you to clearly distinguish among the three individuals? If not, explain why not. _____

4. To produce a DNA fingerprint, other techniques are required. Put the following procedures in the correct order and then give a definition of each: Gel electrophoresis, DNA fingerprinting, Apply Radioactive Probe, Polymerase Chain Reaction, Obtain DNA sample

1. _____ -

2. _____ -

3. _____ -

4. _____ -

5. _____ -