**Modeling DNA Fingerprinting**

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NC Essential Standard 3.3.1

 Interpret how DNA is used for comparison and identification of organisms.

**Introduction:**

DNA fingerprinting is a technique that is used to separate fragments of DNA, based on size to create a unique banding pattern – a “DNA fingerprint”. A gel electrophoresis system uses an electrical current to separate the fragments of DNA. Smaller fragments (with fewer base pairs) move the fastest and furthest through the gel, while the larger fragments (with more base pairs) move the slowest. DNA fragments are produced from a large DNA molecule using restriction enzymes. Restriction enzymes cut the DNA at a specifically recognized sequence. Since different individuals have different DNA sequences, the restriction enzymes will cut the DNA in different places, resulting in fragments of varying size. In this activity, you will model the process of DNA fingerprinting by using scissors to represent restriction enzymes to cut your DNA strand, and drawing the DNA fingerprint that would result from gel electrophoresis.

**Part A: Your DNA**

1. Identify your phenotype for the following traits:
2. Eye color \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Hair color \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Skin tone 1(light) 2 3 4(dark)
5. Height \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Length of thumb \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (round to nearest inch)
7. Use the table below to turn your phenotype into a DNA strand! Write out your DNA strand on the paper strip provided by your teacher.

Eyes Hair Skin tone Height Thumb length

Blue ACG Brown GAG 1 CAC Each foot TA Each inch GC

Brown ACA Blonde GGA 2 CAG Each inch C

Green ATC Red GCA 3 CAA

Hazel ATA Black GGG 4 CAT

1. Draw a line on your DNA strand in each location it would be cut by one of the following restriction enzymes. You must search for restriction sites using ALL of the enzymes, always starting at the beginning of the DNA strand.
2. ACG/G d. TATATAT/A
3. AT/GG e. CC/CCG
4. GCAA/T f. CGCG/C
5. Using scissors to represent the restriction enzymes cut the DNA at each location you drew a line.

How many fragments did you end up with? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Determine the size of each fragment by counting the nitrogen base pairs. Remember, you are only using one side of the DNA (the complementary strand is not shown) so you are actually counting only the number of nitrogen bases.

Record the size of each fragment: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Make a “gel” using your DNA pieces. Each fragment should be placed beside the number of base pairs that fragment has. Once you have placed all of your DNA fragments, draw a band, or line, to represent that fragment. If you have two fragments that are the same length, draw a thick, double band. All of your bands should be drawn in a column under “Your DNA Sample”.

Your DNA Sample Lab Partner’s DNA Sample

40

7. Switch papers with your lab partner, and draw your banding pattern on the other person’s paper.

30

20

10

5

2

Analysis:

1. Is your DNA fingerprint the same as your lab partner’s? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Why/Why not? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. In reality, is it likely that any two people will have exactly the same DNA fingerprint? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Are there any exceptions? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Why would the use of more than one restriction enzyme lead to creating DNA fingerprints that display more differences between two individuals?

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**Part B: Application**

DNA and restriction enzymes can be usd to track down criminals. But this technology is new! As late as the 1980’s, DNA evidence was not used in criminal trials. As an appeals judge, you must decide if the following case deserves an appeal.

The case: 20 years ago, a man was convicted of murder and sent to prison. Part of the evidence found at the crime scene was a collection of blood splatters. Because the victim obviously fought his attacker, the police tested for blood types (DNA fingerprinting was not available). The accused man’s blood type (AB) and the victim’s (O) were found. Combined with other circumstantial evidence, Roy G. Biv was convicted. However, he claims innocence! Below is the DNA fingerprint of the type AB blood found at the scene – prepared by the police forensics lab. Also below is Roy’s DNA sequence, provided by a blood sample he gave. Construct his DNA fingerprint and settle this appeals case!

Roy’s DNA: ACAGCACGTAGACTAATTACGTGCAACGGACCACGTAGATATATT

Restriction site: AC/GT

Gel: AB sample Roy’s sample

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 \_\_\_\_\_\_\_\_\_

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 15

 14

 13

 12

 10

 8

 4

Conclusion: Does Roy deserve an appeal? Explain the results of the gel electrophoresis and the resulting DNA fingerprint!