PEEBEDU

Virtual Restriction Digest

Name: _____ **Period:** _____ **Date:** _____

> Open **peebedu.com** and navigate to **Virtual Restriction Digest**. When the mode selection dialog appears, choose **Case 3: Sickle Cell Screening**. Read the case introduction, which explains how the MstII restriction enzyme is used to screen patients for sickle cell genotypes by cutting the HBB (beta-globin) gene at specific recognition sites.

Free Response Questions

Question 1 — Conceptual Analysis

> **Simulation Task:** *In the simulation, select* **Case 3: Sickle Cell Screening***. Use the MstII restriction enzyme to digest HBB Gene samples from three patients. After the digestion is complete, click* **View Results** *to observe the gel electrophoresis banding patterns. Compare the fragment patterns for a normal (AA) individual, a carrier (AS), and an affected (SS) individual.*

(A) (1 pt) **Describe** the feature of a DNA sequence that determines where a restriction enzyme will cut, and how a mutation at that location affects the resulting fragments.

(B) (1 pt) **Explain** why DNA from an individual with the sickle cell genotype (SS) produces fewer fragments than DNA from a normal individual (AA) when both samples are digested with the same restriction enzyme that recognizes a site within the beta-globin gene.

(C) (1 pt) **Predict** how the gel banding pattern of an offspring with the SS genotype would compare to the pattern of a carrier parent (AS genotype) when both samples are digested with the same restriction enzyme.

(D) (1 pt) **Justify** your prediction.

Question 2 — Analyze Model / Visual Representation

> **Simulation Task:** *In the simulation, select* **Standard Lab Mode***. Drag the* **Lambda** *DNA sample and the* **EcoRI** *restriction enzyme into the workspace. Click* **Perform Digestion** *and then* **View Results** *to observe the gel electrophoresis pattern. Next, repeat the experiment using* **HindIII** *on the same Lambda DNA. Compare the two gel patterns.*

(A) (1 pt) **Describe** why the same DNA molecule produces a different number and size of fragments when cut by two different restriction enzymes.

(B) (1 pt) **Explain** why the bands closest to the wells on a completed gel represent the largest DNA fragments while the bands farthest from the wells represent the smallest fragments.

(C) (1 pt) **Represent** In the box below, draw a labeled diagram showing how a restriction enzyme recognizes and cleaves a double-stranded DNA molecule at a palindromic recognition site. Your diagram should include: the double-stranded DNA with complementary base pairs at the recognition site, the enzyme bound to the DNA, and the resulting fragments with their sticky ends after cleavage.

Draw your diagram here.

(D) (1 pt) **Explain** how restriction enzyme analysis of a population could reveal that multiple alleles of a gene are being maintained rather than one allele replacing the other.

6.8.A.1