PEEBEDU

Virtual Gel Electrophoresis

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

> Open **peebedu.com** and navigate to **Virtual Gel Electrophoresis**. Read the introduction popup, which explains that gel electrophoresis separates DNA fragments by size using an electric field. Select the **Sickle Cell** scenario to begin, then explore other scenarios as directed.

Part 1 — Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Virtual Gel Electrophoresis simulation as a scientific model.

M — Mode

What type of model is the Virtual Gel Electrophoresis simulation? Describe how this computational simulation represents the process of separating DNA fragments. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about gel electrophoresis.

A — Accuracy

(a) Identify two things this simulation represents **accurately** about gel electrophoresis. For each, name the specific simulation feature and explain what aspect of the real laboratory technique it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about gel electrophoresis. Consider what you cannot observe in the simulation that would be important for a complete understanding of how DNA is separated and visualized in a real lab.

P — Purpose

What is the learning goal of this simulation? Explain how the Virtual Gel Electrophoresis simulation is designed to help you understand how DNA fragments are separated by size and charge using an electric field. In your answer, connect at least one specific simulation feature to a biological application of why gel electrophoresis matters for analyzing DNA.

P — Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries or technologies might change or improve a simulation like Virtual Gel Electrophoresis. Explain why scientific models, including computational simulations, are revised as new evidence becomes available.

Small-Group Discussion

With your group, discuss the following:

- What are the strengths of this simulation as a model for gel electrophoresis?
- What are its limitations?
- If you could add one feature to improve this simulation, what would it be and why?
- How does the Molecular View panel help you connect macroscopic gel results to molecular-level explanations of DNA migration?

Part 2 — Free Response Questions

Conceptual Analysis

Question 1 — Separating Sickle Cell Genotypes

> *Simulation Task: Click **Select Mission** and choose the **Sickle Cell** scenario. Load all samples into the lanes and click **Run Gel** at the default voltage (100V). Observe the band patterns that appear in each lane and note which lanes produce different banding patterns.*

(A) (1 pt) **Describe** how gel electrophoresis separates DNA fragments by size and charge.

(B) (1 pt) **Explain** why a point mutation in the beta-globin gene, such as the one that causes sickle cell disease, can produce a different banding pattern on a gel compared to the normal allele.

(C) (1 pt) **Predict** the banding pattern you would expect to see for an individual who is heterozygous for the sickle cell allele (genotype HbA/HbS) compared to a homozygous normal individual (HbA/HbA) and a homozygous sickle cell individual (HbS/HbS).

(D) (1 pt) **Justify** your prediction by explaining how the presence of both alleles in a heterozygous individual produces a combined banding pattern and how this result demonstrates that gel electrophoresis can be used to distinguish between genotypes.

EK 6.8.A.1(i)

Analyze Model / Visual Representation

Question 2 — Interpreting Gel Results for Genetic Screening

> *Simulation Task: Click **Select Mission** and choose the **Cystic Fibrosis** scenario. Load all samples and click **Run Gel**. Then switch to the **Custom Scenario**, load a DNA Ladder in Lane 1 and any other sample in Lane 2, set the voltage to 50V, run the gel, reset, then re-run at 150V. Compare how band positions change with voltage.*

(A) (1 pt) **Describe** how genetic engineering techniques, including gel electrophoresis, can be used to detect whether an individual carries the ΔF508 mutation associated with cystic fibrosis.

(B) (1 pt) **Explain** why smaller DNA fragments migrate farther through the gel matrix than larger fragments during electrophoresis.

(C) (1 pt) **Represent** a gel electrophoresis result for genetic screening.

Draw your diagram here.

(D) (1 pt) **Explain** how the sickle cell allele detected by gel electrophoresis is maintained at relatively high frequencies in certain human populations.

EK 6.8.A.1