PEEBEDU

Epigenetics Simulator

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

> Open **peebedu.com** and navigate to **Epic Genetics**. Click the **Let's Start!** button to begin. Read the introduction popup, which describes how genetic information flows from DNA to RNA to protein through the central dogma. Use the **Generate DNA** button to create a new DNA sequence, then explore the **Molecular Tools** panel on the left side of the screen.

Free Response Questions

Question 1 — Conceptual Analysis

> **Simulation Task:** *In the Epic Genetics simulator, click* **Generate DNA** *to create a new sequence. First, attempt to use* **RNA Polymerase** *without adding a Promoter — observe what happens. Then add the* **Promoter** *and the* **Transcription Factor***, and use* **RNA Polymerase** *again. Compare the Sim Status panel before and after adding the Transcription Factor, noting the change in transcript count.*

(A) (1 pt) **Describe** the relationship between regulatory DNA sequences and regulatory proteins in controlling whether a gene is transcribed.

(B) (1 pt) **Explain** why RNA polymerase is unable to begin transcribing a gene until specific proteins have first bound to a region of DNA upstream of that gene.

(C) (1 pt) **Predict** how the production of a tissue-specific enzyme required for cellular respiration in muscle cells would be affected if a mutation prevented the transcription factor that activates that gene from binding to its promoter.

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

6.5.A.1, 6.5.A.3

Question 2 — Analyze Model / Visual Representation

> **Simulation Task:** *In the Epic Genetics simulator, generate a new DNA sequence. Complete the full central dogma pathway: add the Promoter, use RNA Polymerase, then use the* **Spliceosome** *to process the pre-mRNA. Note the mature mRNA sequence. Now click* **Reset***, generate the same or new DNA, and this time use the* **Alt Spliceosome** *instead. Compare the two mature mRNA sequences and the resulting polypeptide chains.*

(A) (1 pt) **Describe** how the same DNA sequence in a single gene can give rise to more than one version of a mature mRNA molecule.

(B) (1 pt) **Explain** why a neuron and a liver cell in the same organism contain identical DNA yet produce different sets of proteins.

(C) (1 pt) **Represent** In the box below, draw a labeled diagram showing how one gene can produce two different proteins through alternative splicing. Your diagram should include: a DNA sequence with at least three exons and two introns, two different splicing patterns, and the two resulting mRNA and protein products. Label all components clearly.

Draw your diagram here.

(D) (1 pt) **Connect** how heritable epigenetic modifications that differ between individuals in a population could contribute to variation in fitness.

6.5.A.2, 6.5.A.3