PEEBEDU

AR Protein Visualizer

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

> Open **peebedu.com** and navigate to **AR Protein Visualizer**. Click **Launch Interactive** to open the app. Read the introduction popup, which describes the controls: touch and drag to rotate, pinch to zoom, and two fingers to pan. Click **Start Exploring** to begin. Use the category filter buttons and protein dropdown to select different proteins for viewing.

Free Response Questions

Question 1 — Conceptual Analysis

> **Simulation Task:** *In the AR Protein Visualizer, select the* **Protein Synthesis** *category. Load the* **Protein Factory** *(Ribosome Complex) and rotate the 3D model to observe its overall shape. Click* **Protein Information** *to read about its structure. Then switch to the* **Metabolism** *category and load* **Oxygen Carrier** *(Hemoglobin). Compare the shapes and structural features of both proteins.*

(A) (1 pt) **Explain** the types of bonds and interactions that maintain each level of protein structure, from the linear chain of amino acids to the association of multiple polypeptide subunits.

(B) (1 pt) **Explain** why a polypeptide chain folds into a specific three-dimensional shape rather than remaining as a linear strand in the aqueous environment of the cell.

(C) (1 pt) **Explain** how the rate of aerobic cellular respiration in muscle tissue would be affected if a single amino acid substitution replaced a nonpolar residue buried in the interior of a hemoglobin subunit with a charged residue, disrupting the protein's ability to bind oxygen.

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

1.7.A.4, 1.7.A.5, 1.7.A.6

Question 2 — Analyze Model / Visual Representation

> **Simulation Task:** *In the AR Protein Visualizer, select the* **Protein Synthesis** *category and load the* **Protein Factory** *(Ribosome Complex). Click* **Protein Information** *and read about its function. Then load the* **Gene Switch** *(Transcription Factor) from the same category. Rotate both models and compare their structures.*

(A) (1 pt) **Explain** where in prokaryotic and eukaryotic cells the mRNA codons are read and the polypeptide chain is assembled.

(B) (1 pt) **Explain** why changing even a single codon in an mRNA sequence can result in a protein that has a different three-dimensional shape and a different biological function.

(C) (1 pt) **Explain** In the box below, draw a labeled diagram showing the path from an mRNA molecule to a folded, functional protein. Your diagram must include: (1) an mRNA strand with at least three codons, (2) a ribosome translating the mRNA, (3) the growing polypeptide chain, and (4) the final folded protein with at least one labeled secondary structure element (alpha-helix or beta-pleated sheet). Do NOT draw a concept map.

(D) (1 pt) **Explain** how an allele that causes a harmful phenotype when homozygous could persist at a high frequency in a population over many generations.

6.4.A.1, 1.7.A.4, 1.7.A.5, 1.7.A.6