Sodium-Potassium Pump

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

Open **peebedu.com** and navigate to **Sodium-Potassium Pump**. Click the **Start Pumping!** button to begin. Read the introduction popup, which describes the Na+/K+-ATPase pump: it transports 3 Na+ ions out and 2 K+ ions in per cycle, using 1 ATP molecule as an energy source.

Free Response Questions

Question 1 — Conceptual Analysis

Simulation Task: *In the Na+/K+ Pump Simulator, complete one full pump cycle by dragging 3 Na+ ions to the pump, adding 1 ATP molecule, then dragging 2 K+ ions to the pump. Observe the membrane potential readout before and after the cycle. Then complete two more cycles and record the membrane potential after each.*

(A) (1 pt) **Describe** the molecule that supplies the energy the Na+/K+ pump uses to move ions across the membrane.

(B) (1 pt) **Explain** why the interior of a cell becomes more negatively charged after multiple cycles of the Na+/K+ pump, given that the pump moves three positive ions out and two positive ions in per cycle.

(C) (1 pt) **Predict** what would happen to the membrane potential of a cell if its supply of ATP were completely depleted while its ion channels remained functional.

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

Question 2 — Analyze Model / Visual Representation

> **Simulation Task:** *In the Na+/K+ Pump Simulator, attempt to drag a Na+ ion directly through the membrane (not to the pump protein). Then drag a Na+ ion to the pump and observe what happens. Complete one full pump cycle and note the conformational change of the pump protein.*

(A) (1 pt) **Describe** the property of Na+ and K+ ions that prevents them from passing through the phospholipid bilayer on their own.

(B) (1 pt) **Explain** why facilitated diffusion through a channel protein cannot accomplish the ion movement that the Na+/K+ pump carries out.

(C) (1 pt) **Represent** the Na+/K+ pump cycle by drawing the pump protein embedded in a phospholipid bilayer in two stages: one with the pump open to the intracellular side binding Na+ ions with ATP present, and one with the pump open to the extracellular side binding K+ ions, labeling the Na+ ions, K+ ions, ATP, phosphate group, and both sides of the membrane.

Draw your diagram here.

(D) (1 pt) **Explain** how the specific sequence of amino acids in the pump protein determines the overall three-dimensional shape that allows it to bind Na+ and K+.

2.6.A.1, 2.6.A.2