PEEBEDU

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 type of energy input required for the Na+/K+ pump to move ions across the membrane and why this energy is necessary.

(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 the pump protein changes shape after ATP is hydrolyzed and how this shape change results in ions being released on the opposite side of the membrane from where they were bound.

(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 a heritable mutation that reduces the efficiency of an ion pump could affect an organism's fitness in a population competing for limited resources.

2.6.A.1, EK 2.8.A.1

© PEEBEDU — Free for educational use.