Name: _____ **Date:** _____

Section: _____

Na-K Pump Activity

Investigating the Na^+/K^+ Pump

Phase 1: ENGAGE (2 minutes)

Getting Started: Open peebedu.com and navigate to Sodium-Potassium Pump Interactive

Observe the membrane and pump setup.

Essential Question: How do cells maintain different ion concentrations inside vs outside? _____

Initial Observation:

- Where is sodium concentration higher? INSIDE / OUTSIDE
- Where is potassium concentration higher? INSIDE / OUTSIDE
- This pump must work: WITH / AGAINST concentration gradients

Phase 2: EXPLORE (10 minutes)

Operate the Pump

Click through the pump cycle and observe.

Part A: The Transport Cycle

Binding Phase (Inside):

- How many Na^+ ions bind? _____

- Pump shape: OPEN INSIDE / OPEN OUTSIDE

ATP Phase:

- What happens to ATP? _____
- The pump changes shape to: OPEN INSIDE / OPEN OUTSIDE
- Na^+ ions are: RELEASED / STILL BOUND

Second Binding Phase (Outside):

- How many K^+ ions bind? _____
- From which side? INSIDE / OUTSIDE
- Na^+ ions have been: RELEASED / KEPT

Return Phase:

- The pump returns to: OPEN INSIDE / OPEN OUTSIDE
- K^+ ions are: RELEASED / STILL BOUND
- Ready for another cycle? YES / NO

Part B: Pattern Recognition

After several cycles, observe:

Ion Movement Pattern:

- Na^+ always moves: IN $\rightarrow$ OUT / OUT $\rightarrow$ IN
- K^+ always moves: IN $\rightarrow$ OUT / OUT $\rightarrow$ IN

Energy Requirement:

- Cycles without ATP: WORK / DON'T WORK

Phase 3: EXPLAIN (6 minutes)

Understanding the Mechanism

Why ATP?

Moving ions against their gradients requires:

The 3:2 Ratio: For every ATP used, the pump moves:

- 3 Na^+ _____ (in/out)

This creates a net movement of _____ positive charge out.

Shape Changes: The pump has two main shapes:

- E1: Open _____, binds _____

ATP causes the change from _____ to _____.

Why This Matters:

The Na^+/K^+ gradient is used for:

Phase 4: ELABORATE (1 minute)

Real-World Connections

Digitalis (Heart Medicine): This drug partially blocks the pump. Effect: _____ Na^+ inside heart cells

Result: Stronger heart contractions

Nerve Function: Without this pump, neurons couldn't: _____

Phase 5: EVALUATE (1 minute)

Quick Assessment

Active vs Passive: The Na^+/K^+ pump is active transport because:

Energy Flow: Complete the sequence: _____ ATP → Pump _____ → Ions move _____ gradient → _____ established

Reflection: Why do cells spend ~30% of their ATP on this one pump? _____