Name: **Date:** **Section:**

Na-K Pump Activity: Active Transport in Cells

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

1. **Binding Phase (Inside):**

- What must be present for binding? _____
- Pump shape: OPEN INSIDE / OPEN OUTSIDE

1. **ATP Phase:**

- The pump changes shape to: OPEN INSIDE / OPEN OUTSIDE
- Na^+ ions are: RELEASED / STILL BOUND

1. **Second Binding Phase (Outside):**

- From which side? INSIDE / OUTSIDE
- Na^+ ions have been: RELEASED / KEPT

1. **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:

1. **Ion Movement Pattern:**

- Na^+ always moves: IN → OUT / OUT → IN
- K^+ always moves: IN → OUT / OUT → IN

1. **Energy Requirement:**

- Cycles without ATP: WORK / DON'T WORK

Phase 3: EXPLAIN (6 minutes)

Understanding the Mechanism

1. **Why ATP?**

Moving ions against their gradients requires:

1. **The 3:2 Ratio:**

For every ATP used, the pump moves:

- 3 Na^+ _____ (in/out)

This creates a net movement of _____ positive charge out.

1. **Shape Changes:**

The pump has two main shapes:

- E1: Open _____, binds _____

ATP causes the change from _____ to _____.

1. **Why This Matters:**

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

Phase 4: ELABORATE (1 minute)

Real-World Connections

1. **Digitalis (Heart Medicine):**

This drug partially blocks the pump.

Effect: _____ Na^+ inside heart cells

Result: Stronger heart contractions

1. **Nerve Function:**

Without this pump, neurons couldn't:

Phase 5: EVALUATE (1 minute)

Quick Assessment

1. **Active vs Passive:**

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

1. **Energy Flow:**

ATP → Pump _____ → Ions move _____ gradient → _____ established

Reflection:

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