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

Water Potential Activity: Water Movement in Plants

Water Movement and Cell Survival

Phase 1: ENGAGE (8 minutes)

- *Getting Started:**

Open peebedu.com and navigate to Interactive Water Potential Simulation

- *First Look:**

1. What can you control in this simulation?

- Solute type: ____

- Solution volume: ____

1. Click "Add Solute" - what happens?

1. **Think About It:**

Why do your fingers wrinkle in the bathtub?

- *Essential Question:** How do cells survive in environments with different water concentrations?

Phase 2: EXPLORE (18 minutes)

- *Mission 1: Understanding Water Potential**

Water potential (Ψ) = tendency of water to move

- Higher Ψ → Lower Ψ (water flows "downhill")
- Pure water: Ψ = 0
- Solutions: Ψ < 0 (negative)

Create these solutions and observe:

- *Solution Comparison:**

Solute Added	**Concentration**	**Water Potential**	**More or Less than Pure Water?**
None (pure)	0.0M	0.00 MPa	Reference point
5 clicks sucrose	___M	___ MPa	
5 clicks NaCl	___M	___ MPa	
5 clicks $CaCl_2$	___M	___ MPa	

  - *Discovery:** Which solute creates the lowest water potential at the same amount? _______
  - *Mission 2: Cell Responses**

Insert different cells into a 0.3M sucrose solution:

  - *Cell Behavior Chart:**

Cell Type	Internal Ψs	Solution Ψs	Water Moves?	Cell Response
Plant	-0.7 MPa	In / Out	Shrinks / Swells / Same	
Animal	-0.4 MPa	In / Out	Shrinks / Swells / Same	
RBC	-0.3 MPa	In / Out	Shrinks / Swells / Same	

- *Pattern:** When does water move into cells? ________________________________
- *Mission 3: Creating Safe Environments**

Your goal: Make each cell stay the same size (isotonic)

- *Isotonic Solutions:**

Cell Type	Target Internal Ψs	Solute Used	Clicks Needed	Final Concentration
RBC	-0.3 MPa			
Plant	-0.7 MPa			
Bacteria	-1.2 MPa			

- *Challenge:** Which cell needs the most concentrated solution? ______________
- *Mission 4: Environmental Changes**

Start with plant cell in isotonic solution, then:

- *Environmental Effects:**

Action	Prediction	Observation	Explanation
Increase temp to 50°C			
Evaporate water			
Dilute solution			

Phase 3: EXPLAIN (15 minutes)

- *Understanding Osmosis Through Water Potential**

1. **The Equation:**

$\Psi s = -iCRT$

- i = particles formed (sucrose=1, NaCl=2, $CaCl_2$=3)
- C = concentration (molarity)
- R = constant (0.00831)
- T = temperature (Kelvin)

Why is there a negative sign? ________________________________

1. **Tonicity Terms:**

Match the condition to the outcome:

```

Hypertonic solution • • Cell swells

Hypotonic solution • • Cell shrinks

Isotonic solution • • Cell stays same

```

1. **Cell Survival Strategies:**

How do these cells avoid bursting or shrinking?

- Plant cells: ____

- Bacteria: ____

1. **Real-World Connections:**

Explain using water potential:

- Why salt kills slugs: ____

- Why IV fluids must be isotonic: ______________________________

Phase 4: ELABORATE (7 minutes)

- *Apply Your Knowledge**

1. **Medical Application:**

A patient needs IV fluids. Blood has Ψ ≈ -0.7 MPa.

- What happens with pure water IV? ______________________________

- Why use saline instead of pure water? __________________________

1. **Agricultural Problem:**

Farmers notice crops dying after road salt runoff.

- What happens to soil water potential? ______________________________

- Suggest a solution: ____

1. **Marine Biology:**

Compare freshwater and saltwater fish:

Environment	Water Potential	Fish Challenge	Adaptation
Freshwater	≈ 0 MPa		
Saltwater	≈ -2.4 MPa		

Phase 5: EVALUATE (7 minutes)

- *Check Your Understanding**

1. **Predict and Explain:**

A plant cell ($\Psi s = -0.7$ MPa) is placed in each solution. Fill in:

Solution	Water Movement	Cell Response
Pure water		
0.1M sucrose		
0.5M NaCl		

1. **Problem Solving:**

Red blood cells burst in pure water but not in blood plasma.

- Internal RBC Ψs: ____

- Why cells burst: ____

1. **Design Challenge:**

Create a solution where bacterial cells neither shrink nor swell:

- Bacterial Ψs = -1.2 MPa

- Calculate concentration needed: ________________________________

1. **Data Analysis:**

Temperature increased from 25°C to 37°C. Solution has 0.2M NaCl.

- Original Ψs: ____

- Effect on cells: ____

1. **Critical Thinking:**

Why do grocery stores spray vegetables with water?

- *Exit Reflection:**

Complete the water potential concept map:

```

Water Potential → affected by → [_________] and [_________]

↓

determines → [_________] direction

↓

causes cells to → [_________], [_________], or [_________]

```

One real-world example I can now explain:

____

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Extension Activities:

1. **Home Investigation:**
- Soak gummy bears in different solutions
- Measure and graph size changes
- Relate to water potential
- Present findings with photos
1. **Research Project:**
- How do desert plants conserve water?

- What are aquaporins?
- How do kidneys concentrate urine?
- Create infographic

1. **Engineering Challenge:**

- Design a way to preserve cut flowers
- Test different solution concentrations
- Measure flower longevity
- Explain using water potential

Key Terms to Remember:

- **Water potential (Ψ):** Water's tendency to move
- **Solute potential (Ψs):** Effect of dissolved particles
- **Hypertonic:** Higher solute concentration (lower Ψ)
- **Hypotonic:** Lower solute concentration (higher Ψ)
- **Isotonic:** Equal solute concentration (equal Ψ)
- **Plasmolysis:** Cell shrinkage in hypertonic solution