PEEBEDU

Water Properties Explorer

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

> Open **peebedu.com** and navigate to **Water Properties Explorer**. Click the **Start Exploring** button to begin. Read the introduction popup, which describes four key properties of water: Polarity, Cohesion, Heat Capacity, and Density.

Part 1 — Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Water Properties Explorer as a scientific model.

M — Mode

What type of model is the Water Properties Explorer? Describe how this computational simulation represents water's properties. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about water.

A — Accuracy

(a) Identify two things this simulation represents **accurately** about water's properties. For each, name the specific simulation feature and explain what property of water it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about water's properties. Consider what you cannot observe in the simulation that would be important for a complete molecular-level understanding of water.

P — Purpose

What is the learning goal of this simulation? Explain how the Water Properties Explorer is designed to help you understand how water's polarity and hydrogen bonding produce emergent properties that sustain life. In your answer, connect at least one specific simulation feature to a biological example of why that property matters for living organisms.

P — Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries might change or improve a simulation like the Water Properties Explorer. Explain why scientific models, including computational simulations, are revised as new evidence becomes available.

Small-Group Discussion

With your group, discuss the following:

- What are the strengths of this simulation as a model for water's properties?
- What are its limitations?
- If you could add one feature to improve this simulation, what would it be and why?
- How does the simulation help you connect macroscopic observations to molecular-level explanations?

Part 2 — Free Response Questions

Conceptual Analysis

Question 1 — Water's High Specific Heat Capacity

> *Simulation Task: Set the temperature slider to 0°C and note both the Air Temp and Water Temp readouts. Then slowly move the slider to 40°C and observe how each readout changes. Pay attention to the difference between the two temperatures as you slide.*

(A) (1 pt) **Describe** how water's high specific heat capacity results from hydrogen bonding between water molecules.

(B) (1 pt) **Explain** why the water temperature in the simulation changes more slowly than the air temperature.

(C) (1 pt) **Predict** what would happen to the body temperature of an aquatic organism living in a lake if water had a low specific heat capacity instead of a high one, during a day when air temperature rises rapidly.

(D) (1 pt) **Justify** your prediction by explaining how water's high specific heat capacity contributes to the maintenance of homeostatic body temperature in living organisms.

EK 1.1.A.1.ii

Analyze Model / Visual Representation

Question 2 — Ice Density and Aquatic Life

> *Simulation Task: Move the temperature slider to −15°C and observe the lake. Note where the ice layer forms relative to the liquid water and what is happening beneath it. Then move the slider back to 20°C and observe the changes.*

(A) (1 pt) **Describe** how hydrogen bonds between water molecules form a crystalline lattice structure when water freezes.

(B) (1 pt) **Explain** the relationship between the position of the ice layer at the top of the lake and the survival of aquatic organisms beneath it during winter.

(C) (1 pt) **Represent** the density difference between ice and liquid water at the molecular level.

Draw your diagrams here.

(D) (1 pt) **Explain** how the density property of water demonstrated in the simulation functions as an essential abiotic factor that maintains biodiversity in aquatic ecosystems.

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