Water in Motion

Track energy, temperature, and particles through changes of state.

8.2 "Develop and manipulate models to explain changes in particle motion, temperature, and state of a pure substance when thermal energy is added to or removed from a system."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline where thermal energy enters or leaves the water, circle each stated temperature, and number the three changes of state in the order described. Use your marks to track what must change in a particle model.

From Ice to Droplets

1. On a cold morning, a student places a beaker containing only ice made from pure water on a warm plate. The ice first warms toward 0°C. Its particles stay in an orderly arrangement and vibrate faster as thermal energy enters; the temperature rises. At 0°C, melting begins. Energy keeps entering, but the temperature holds at 0°C while some particles leave their fixed positions and begin sliding past neighbors. Until the last bit of ice melts, a particle model must show both solid and liquid water.

2. The plate continues heating the liquid water. With no ice left, the water's temperature rises, and its particles move faster while remaining close together. At normal air pressure, boiling begins at about 100°C. During boiling, added thermal energy separates particles into water vapor rather than raising the temperature of the boiling water. A useful model shows liquid particles close together and vapor particles far apart, moving freely through the space above the beaker. The water remains the same pure substance in either state.

3. A cool metal lid is held above the beaker without sealing it. Some water vapor touches the lid and loses thermal energy. Its particles slow and come closer together, forming liquid droplets on the metal. The lid catches droplets that can fall back into the beaker. If the droplets cool further, their particles move more slowly, but they still slide past one another. A model can use arrows pointing away from the vapor and droplets to show thermal energy leaving the water and entering the lid.

2 ANSWER WITH EVIDENCE

Use the passage

1. How would you change a particle model of ice as it warms toward 0°C, before any melting begins? Include motion, arrangement, and temperature.

2. How should a model show the water partway through melting at 0°C? Explain what the added energy changes.

3. At normal air pressure, the plate adds energy while the water boils. What changes in a particle model, and what happens to the boiling water's temperature?

4. How would you change a model of water vapor that touches the cool lid and forms droplets? Include the direction of thermal energy transfer.

3 YOUR TURN

Your own words

A sample of pure substance X is a liquid at 25°C, freezes at 20°C, and then cools as a solid to 15°C while thermal energy leaves it. In three panels, model its particles at 25°C, partway through freezing at 20°C, and at 15°C, label each state and the energy direction, use motion arrows, and write one sentence explaining why its temperature stays at 20°C until freezing ends.

ANSWER KEY

Water in Motion

GRADE 8 · 8.2

PART 1 · READ AND MARK

Underline where thermal energy enters or leaves the water, circle each stated temperature, and number the three changes of state in the order described. Use your marks to track what must change in a particle model. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How would you change a particle model of ice as it warms toward 0°C, before any melting begins? Include motion, arrangement, and temperature.	**Show faster vibrations and a rising temperature, but keep the particles in an orderly arrangement.**
2	How should a model show the water partway through melting at 0°C? Explain what the added energy changes.	**Show both orderly solid particles and liquid particles sliding past neighbors. Added energy changes the state while the temperature stays at 0°C.**
3	At normal air pressure, the plate adds energy while the water boils. What changes in a particle model, and what happens to the boiling water's temperature?	**Some close-together liquid particles become far-apart vapor particles that move freely. The boiling water stays at about 100°C.**
4	How would you change a model of water vapor that touches the cool lid and forms droplets? Include the direction of thermal energy transfer.	**Show particles slowing and coming closer together as liquid droplets form. Thermal energy moves from the water to the lid.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Panel 1: Liquid, 25°C. Closely spaced particles are arranged randomly, with arrows showing motion past one another. An energy arrow points out. Panel 2: Freezing, 20°C. Some particles form orderly rows while others still move past one another. An energy arrow points out. Panel 3: Solid, 15°C. Particles form orderly rows with small vibration arrows. An energy arrow points out. The temperature stays at 20°C during freezing because energy leaving changes the state rather than lowering the temperature.

Accept varied particle sketches if they show the correct spacing or arrangement, motion, and energy direction. Partway through freezing, the model should include both liquid and solid regions.