

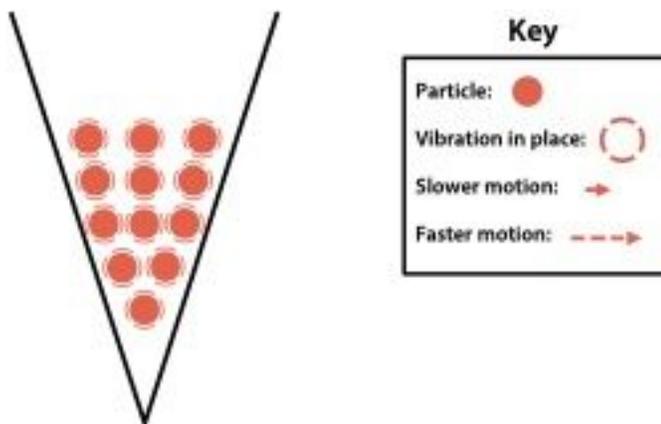
Sample Student Responses for Assessment Items for Physical Science 1-4

Item 1 Sample Student Response

Marcus found a small icicle outside and brought it inside to show his sister. Marcus put the icicle in a bowl and left it on the table in the warm kitchen. After a while, the icicle melted. Marcus was surprised the next morning when he found that the melted icicle had completely evaporated away. He wondered what caused these changes. He also wondered what was different about the water when it was an icicle compared to when it was liquid water and when it evaporated to become water vapor. Complete the model below to help explain to Marcus how changes to the water particles caused the changes he observed.



Below is a particle model that shows the particles in the icicle when Marcus first brought it inside and a brief caption that explains the model. The symbols in the key represent particles and their motion. Note that the particle sizes and distances between particles are not to scale.

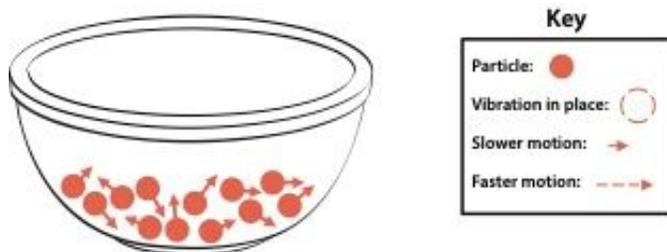


The water is frozen solid. The particles vibrate in place but do not move around.

a. First, the icicle melted. As a first step toward answering Marcus' questions, use symbols from the key to draw a particle model of the water in the bowl just after the icicle melted. Be sure your model includes each of the following:

- The spacing and location of the particles.
- The motion of the particles.
- A caption that describes what happened to the state of the water and how the particle motion has changed.

Expected Student Response

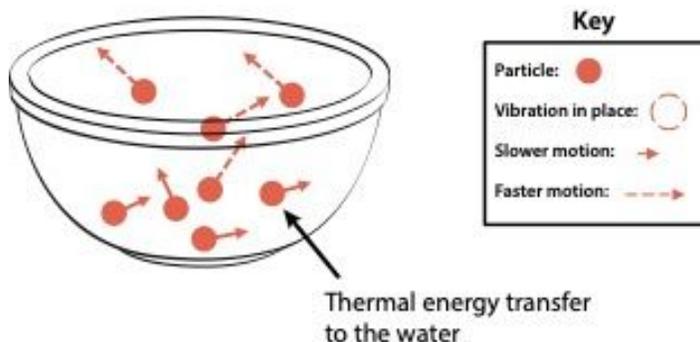


Caption: *The water has melted and is now liquid. Particles are able to move around.*

b. Eventually, the water in the bowl evaporated. Use symbols from the key to draw a particle model to show what happened as the water evaporated from the liquid water in the bowl. Use symbols from the key and labels or captions to explain why the water evaporated. Be sure your model includes each of the following:

- The spacing and location of the particles.
- The motion of the particles.
- Labeled arrows identifying thermal energy transfer.
- A caption that describes changes in the motion of the particles and what caused the water to evaporate.

Expected Student Response



Caption: *The thermal energy transferred to the water from the environment causes the particles to move faster and then move apart as they change state from liquid to gas.*

Scoring notes: For a complete and correct response, either the model or the caption should indicate that the thermal energy transfers to the water from the surroundings, environment, etc.

Item 2 Sample Student Response

Josie needed to boil some water to cook pasta. She put a pot of room temperature (20°C) water on the stove and turned the burner on. After 5 minutes, the water had not boiled yet. Josie got a phone call and stopped checking the water. When she returned to check the water 15 minutes after she turned on the stove, it was boiling rapidly and half of the water was gone. She started to wonder: *What happened to the water from the time I put it in the pot until it boiled? Why is some of the water no longer in the pot?*

Complete the model below and use it to explain to Josie what happened. The model shows the same pot before the stove was turned on, after 5 minutes, and when Josie returned after 15 minutes. The model for the room temperature water is provided. Use symbols from the key to complete the model. Then, fill in the box below each pot with a caption to explain how your model shows what was happening at each stage to:

- the temperature change of the water.
- the state(s) of the water (solid, liquid, or gas).
- spacing between particles.
- particle motion.
- what causes an changes in the water.

Expected Student Response

Key

Particle: ●

Vibration in place: ○

Slower motion: →

Faster motion: - - - - ->

Much faster motion: - - - - ->

Start

The water is at room temperature (20°C) and it is a liquid. The particles are close together, but as the short arrows show, they are able to move.

5 minutes

The water is getting hotter and it is still all a liquid. The particles are still close together, but they are moving faster than in the first pot, as shown by the longer arrows, because thermal energy from the burner is heating the water.

15 minutes

The water is boiling. Some of the water is liquid and some is gas. The liquid particles are still close together, but moving even faster than before. In the model, the fastest particles are becoming gas, spreading farther apart, and escaping the pot. These changes are caused by the thermal energy transferring to the water so it changes state to become a gas.

Scoring notes: Students might say that the pot at 15 minutes is at 100°C. To be completely accurate, the particles in the pot at 5 minutes should be the same distance apart as at the start, but students will need room to show arrows, as in the sample answer. As long as the particles are in the bottom of the pot, accept changes in spacing to fit the arrows. To be completely accurate, the particles at 15 minutes should be half in the bottom of the pot as liquid, and half as gas, but students are likely to only show the formation of the gas as shown in the sample answer.