**Formative Assessment Task 3**

**6th grade Properties of Matter – beginning of second unit on this topic**

**Performance Expectation target**

**06-PS1-4**. **Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed**. [*Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.*]

**Lesson context** after FINISHING a multi-week unit on particle-level states of matter, this is the first lesson in the next unit which emphasizes change of state and related energy transfers.

Students for several previous lessons (approximately 2 weeks) have been exploring particle-level behavior of gas, liquid, and solid when heat is added.

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**This lesson**: begins new unit by targeting change of state and energy considerations. Uses humans as particle-level models to explore addition and removal of heat. Connects to a number of real-world contexts, especially the idea that evaporation is a cooling process (e.g. sweating, air coolers in dry climates). It includes exploration of the following processes: evaporation, condensation, melting, freezing, sublimation, and deposition

NOTE: this is a double-period lesson, approximately 1hr 50 min.

1. Draw a cartoon strip showing particles of a substance as heat is continually added, starting as a solid and changing state to a liquid, and then continuing until a gas. Pay attention to as many particle details as possible (e.g. motion, number, sizes, etc.) *NOTE: The shape of the character starts as a solid square, but appropriately changes shape to fit in the ‘box’ of the cartoon panel as it changes phas*e. In addition to the 3 panels for each phase, there are 2 additional panels for the “during phase change” time when the substance is a mix of two different states.

(*draw particles inside square*)



I’m “*Square*.”

You want hot?!

I’ll show you hot!

Hello… My name is “*Beautiful*” because I’m very

hot!

!

 (*draw new shape & particles in other boxes*)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Heat energy addedMore heat energy addedEven more heat energy addedStill more heat energy addedName for phase change fromsolid to liquid = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Name for phase change fromLiquid to gas = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |  |  |
| **Solid** | **Solid & Liquid** | **Liquid** | **Liquid & Gas** | **Gas** |

Label the name of each phase change in the boxes below

2. After *Square* had completely transformed to a gas, *Beautiful* said, “OK, OK, you may be hot. But as a gas, you certainly don’t have much energy, and I don’t know if I want to date such a low-energy creature.”

1. Explain why *Beautiful* is wrong about her statement to *Square*. Include details in your response to support the claim that she is wrong.
2. After being corrected, *Beautiful* realized that she wants to be gassy like *Square*, but she doesn’t have any outside source of energy to add. So instead, she takes all of that energy away from *Square* that he had added in the cartoon, so that she could use it to transform into a gas too. Then her plan was for the two of them to be gassy together, intermingle their particles, and live happily ever after.

Where is the science flaw in B*eautiful’s* plan?