**Modeling**

**Assessment:** This assessment is a part of teaching sequence. You can watch how our teacher used this assessment in the Stephanie’s video.

**Background Information:**

Before video recorded teacher started heat and energy topic. Initially, teacher gave

homework included a reading and study packet on the concepts of heat, temperature, energy transfer, and phases of matter.

At the beginning of the following day, students watched a video that got the students thinking about heat as a different concept than temperature, followed by a brief discussion of what they had read. The last part of that day was spent collecting the incremental recording of the temperature of water as it was heated from ice to boiling. Students whiteboarded graphs of temperature.

Then they plotted it and were asked to draw a particle diagram for each of the sections. Figure 1 shows an example of the particle diagrams that a student drew.

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|   Figure 1: Particle Diagrams |

**VIDEO BEGINS**

Students whiteboarded temperature versus time graphs a day before. Video begins with students’ discussions on different starting points and temperatures on their graphs. Teacher lead the discussion to graph and relate states of matter to temperature graph. Teacher asked, “How did you represent movement of particles? How did you represent structure? How can we model ice on the whiteboard?” These questions were helped her to understand students’ thinking and make students to think on what their graphs actually means.

Teacher compared graphs on student whiteboards from previous day and had a class discussion on time difference for the phase changes in their graphs. Following that teacher showed a video, and revisit the temperature and heat concepts. Then she provided students a practice sheet (can be found x) and students worked on the sheet as a group.

Additionally in the video you can watch teacher discusses importance of collaboration and how being able to work collaboratively is an essential skills for all students and everyone.

**Classes after the video:**

After the video, the lesson on heat and temperature continued. On the next day, we white-boarded their particle diagrams until we came to agreement as to what was needed and then discussed a method of accounting for the energy – energy bar charts. In this method, we assigned a bar chart to each “end” of a section of the graph. We could then discuss how the system is storing the energy – as either phase energy (energy used to keep the matter in a specific state) or thermal energy (energy used to keep the molecules moving at a certain speed) – and assigned relative heights of bars to each. We can then compare the energy storage at one point in the graph to that in another. For example, in the Figure 3, the student is showing ice – at point A on the heating curve from figure 1 – (one bar of Eph) at below 0˚C (less than one bar of Eth) being warmed to ice – at point B on figure 1 – (again, one bar of Eph) at 0˚C (exactly one bar of Eth) by adding one bar worth of energy to the water.

**Homework**

Homework for that day was practice using the bar charts and particle diagrams.

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|  Figure 2: Energy Bar Charts |

**The final day**

Final class period was then spent on a lecture over the equations that allow us to quantify the amounts of energy in the bar charts. The students then practiced with the equations and began working on their homework. The students were given the heating curve quiz the next, and final, day of this section of the unit. After the quiz, the students were to perform a lab in which they placed a sample of hot (unknown) metal into cooler water and collected temperature readings in order to try to determine the specific heat of an unknown metal.

**Homework**

Homework following that lab was the post-lab and another reading about energy transfers between systems. The results of the lab were discussed the next class and a lecture/discussion ensued. The end of that day was practice and, finally, a quiz over specific heat was given on the seventh day of the unit.

**Summative Assessments – NEED A MODELING ASSESSMT HERE TOO (CAN BE SHORT) for example, draw a particle diagram and explain….(do more NGSS practices on the summative assmt)**

Specific Heat Quiz:

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| Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Class \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Calculate the specific heat of a metal if a 55.0 g sample of an unknown metal at 99.0 °C causes a 1.7 °C rise in water temperature when added to 225.0 g of water at 22.0 °C. |

Heating Curve Quiz:

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| Directions: Draw a heating/cooling curve, complete an energy bar chart for each section, and solve the problem. |
| Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Class \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| What is the change in energy, measured in Joules, when 5.36 g of water as ice at -18.0°C is heated to vapor at 172.8°C? |