Krug Chemistry – Deep Run Daily Planning Guide

Date of Lesson: Q1 Day 12 – Heat, Temperature, Specific Heat

Topic /Big Questions: (Question Stems & Question Creation Chart)

- **How is heat different from temperature?**
- **How is heat transferred from one object to another?**
- **How does temperature affect the nature of matter?**
- **How are heat and temperature measured?**

State SOL	Unpacking the Standards (Video explanation shown at 3:18)
CH 2 h CH 5 a, d, e	**CH.2** The student will investigate and understand that the placement of elements on the periodic table is a function of their atomic structure. The periodic table is a tool used for the investigations of: **h)** chemical and **physical properties**; and **CH.5** The student will investigate and understand that the phases of matter are explained by kinetic theory and forces of attraction between particles. Key concepts include: **a)** pressure, **temperature**, and volume**; d) phase changes; e) molar heats of fusion and vaporization;** and g) colligative properties.

Visible Learning (For the three items with asterisks*, think from a student perspective. Use simple language)

***What am I learning today?** Heat is a form of energy transferred from hot objects to cold objects. Temperature is a measure of the average kinetic energy of the particles in matter. The amount of heat energy determines the state of matter. The direction of heat flow determines the phase change of matter.

***Why is it important?** Understanding how heat and temperature affect matter is important because chemicals have different melting and boiling points. It is also important for proper handling and storage of chemicals.

***How will I know I've learned it?** Students will understand that heat is a form of energy that can be absorbed or released by matter. Temperature is a measure of the movement of particles that contain heat energy. Students will be able to interpret a Phase Diagram and a Heat Curve. Students will be able to calculate specific heat of matter.

Differentiation strategies:

~~**Methane Explosion Lab**~~ - ***not allowed***

Temperature Misconception Video

Direct Instruction – phase changes and heat curves

Specific Heat Lab

Accommodations and/or modifications are being met for students with IEP's/504's.

Access to all materials on Schoology, frequent checks for understanding; CER activity in small groups;

Daily Plan/Sequence of Instruction:

~~Begin with the Methane Explosion Lab demonstration. Follow instructions in Methane Explosion CER Notes. Students should sketch BEFORE, DURING, and AFTER images in their notebooks and whiteboards. Ask the inquiry questions as listed in the CER notes. The main goal is for students to understand that:~~

MATTER CONTAINS ENERGY THAT CAN BE RELEASED IN THE FORM OF HEAT, LIGHT, AND SOUND.

Next open the Unit 2 Intro to Matter and Energy PowerPoint to slide #16 "Phase Changes". Explain how matter must absorb or release heat in order to undergo a PHASE change. Point out sublimation and deposition phase changes. Advance to next slide #17 and allow students to identify types of phase changes. Advance to Phase Diagram slide #18 and explain while students copy information in notebook. Point out critical point and triple point. Show YouTube videos for each. (Critical point - https://www.youtube.com/watch?v=9Y6RynSyPSI and Triple Point - https://www.youtube.com/watch?v=Juz9pVVsmQQ) Advance to Heating Curve slide #19 and explain how the sloped lines represent the solid, liquid, and gas phase. Point out that the temperature and energy are changing along these lines but the state of matter stays the same. So, for example, water can be liquid at room temperature around 20 °C and it is still liquid when it is heated to 85 °C. Point out the flat areas, where the slope is zero. Explain that the temperature is staying the same, but the matter is absorbing or releasing energy so it undergoes a phase change. Ask students to complete **Heating Curve and Phase Diagram Worksheet**.

Show Temperature Misconception Video on YouTube. Talk about the difference between heat and temperature. Explain that objects feel hot or cold because of the ability to hold on to the heat energy inside them. If the object releases the heat energy quickly, it will feel cold and your hand will feel hot because it is absorbing the heat the object gave away. Explain that the objects ability to hold heat energy is called specific heat capacity. Metals have low heat capacities because heat can transfer in and out of the material quickly. Plastic, ceramics, and Styrofoam have high heat capacities because they hold on to heat longer. Water has a very high heat capacity. That's why when you are at a pool in the spring and fall, it feels warmer to be in the water than to get out and dry off in the air. The water remains warm even though the air temperature has dropped during the day.

Next do the Specific Heat Lab. To do this lab, students must record the initial mass of their metal pieces before heating. Then they will place the pieces of copper and steel on a hot plate. (I just bought some small metal pieces at the local hardware store.) Set the hot plate to the highest setting and allow metal to absorb heat. Record the temperature of the metal with an infrared thermometer. (If an infrared thermometer is not available, place a beaker of water on the hot plate for the same amount of time. When the beaker boils, record that temperature and use it for the initial temperature of the metal. It won't be exactly the same, but it works well enough, and you can talk about percent error and later.) Next, the students will insert one Styrofoam cup inside another and record the total mass. The students will fill the cup with about 50 ml of water and record the new mass. The difference in mass is the initial mass of the water. Use a regular thermometer to measure the initial temperature of the water. Use tongs to transfer the hot metal into the water. It will sizzle. It's okay! ☺ Allow the metal to cool and the water to heat up. When the temperature stops changing (takes about 5 -8 min), record the final temperature. Note the final temperature for the metal equals the final temperature of the water. Follow the calculations on the lab worksheet to calculate the Heat energy of the water and the specific heat of the metal. Use the Engineer's Edge to obtain the acceptable specific heats for each metal:

https://www.engineersedge.com/materials/specific_heat_capacity_of_metals_13259.htm

Calculate the percent error for each metal.

Point out the Conservation of Matter and Energy - "neither created nor destroyed" means it just changes form

Assessments (List all formative/summative assessments used to check for understanding during this lesson. Summative assessments may occur during a different class period.):

Demo and notes (formative)

Specific heat Lab (summative)

After assessing today's lesson are you and your students comfortable moving forward with your next objective?

Yes - Students actively participated and scored 80% or higher on Specific Heat Lab

No, remediation required to proceed – If students did not participate or take good notes, teacher will email parent/guardian to inform them of lack of progress. Teacher will recommend that student copies notes from a classmate in order to catch up. Teacher will allow students to come to One Lunch to do lab corrections for up to a 65% passing score.

Teacher reflection: Weaker students tend to rush through the specific heat lab. They record masses and temperatures but they don't truly understand what happened. Other students tell them what to write and so they don't process the fact that the temperature of the metal drops and the temperature of the water rises and they both end up at the same temperature. They also have trouble answering if the heat went into the metal or into the water? It is important to check for understanding. Heat, temperature, and heat transfer are a major part of this unit.