edTPA Lesson Plan #1 (4 Page Limit)

Grade Level: 10 - 12

Subject / Content area: Chemistry

Unit of Study: Energy

Lesson Title: Lesson #1 – Introducing Heat (q) Equations

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| **Central Focus for the learning segment:** How do scientists measure the amount of energy being absorbed or released in processes? |
| **Content Standard(s):** NYS CCLS or Content Standards (List the number and text of the standard. If only a portion of a standard is being addressed, then only list the relevant part[s].)  NYS P-12 Science Standards:   * **HS-PS3-1.** Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. * **HS-PS3-4.** Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). |
| **Learning Objectives** associated with the content standards:  Students will demonstrate their understanding of how to use heat equations through correctly completing in-class practice problems. |
| **Instructional Resources and Materials** to engage students in learning**:**   * SmartBoard (Agenda, Notes, clicker program) * NYS Chemistry Reference Tables * Notes packet for students to follow notes and add questions or comments * Review packet for unit (practice problems and worksheets) * Brain Buster practice packet * Small whiteboards and markers (1 per table) |
| **Instructional Strategies and Learning Tasks** that support diverse student needs. (Include what you and students will be doing.)**:**   * Students should pick up a brain buster packet on the way in. * Warm up: Complete page 4 of packet – students begin individually, then are asked to work with their tables, then tables will be called upon to share out. Answers will be written on Smartboard. Teacher will ask probing questions as necessary to ensure students understand the answers. – A variation of the “think pair share” strategy, activating prior knowledge of what they learned the day before. Teacher will make sure to check in with students with 504 plans and those with language needs. * Students shade their personal reference tables, highlighting important equations (heat equations) and sections (physical constants for water) and adding notes as guided by the teacher (arrows between Tables T and B, labels of units for each variable) * Notes on q-equations, led by teacher. 1 slide of recap of the vocabulary (specific heat, heat of fusion, heat of vaporization), 1 slide of explanation of how to use q equations, 3 examples. Students must work at tables to solve the given problems. They show their work on the small whiteboard at each table. The scribe switches for each problem as prompted by questions from the teacher to encourage students to learn about each other (ex. “the student who plays the most sports writes first”, etc.) Students hold up the whiteboards so the teacher can see at a glance which groups understand. Teacher asks one group to explain their work and direct her as she writes it on the board. While students work, teacher circulates to check in with each group, as well as the students with 504 plans, language needs, and those struggling with math. * Students may begin their brain buster practice packet. They are instructed that this is practice using the equations they learned that day, and that it should be completed gradually over the next week and turned in with their lab (which they will do in class over the next two days). The first question is done together as a sample. Students are required to show their work, have a correct answer, and use correct significant figures for full credit. While students work, teacher continues circulating to check in with each group, as well as the students with 504 plans, language needs, and those struggling with math. |
| **Differentiation and planned universal supports:**  Students are given a physical printout of the notes (powerpoint slides) with room for notes. Students may also take individual notes if preferred. Different activities and demonstrations are used to accommodate visual and audial learners. In this lesson, the white board practice during notes was aimed at accommodating visual and kinesthetic learners, and the discussion-based warm up was intended to assist audial learners. In addition, the teacher will provide regular check-ins for students with 504 plans, language needs, and those who are designated as struggling with math. |
| **Language Function students will develop. Additional language demands and language supports:** Solve problems. Students will practice their technique for isolating variables and solving for specific values. Appropriate use of variables and equations with heat flow shows students’ skill with syntax in this topic. Students will develop discourse through the use of the new academic vocabulary they gain. This should include heat of fusion, heat of vaporization, specific heat, temperature, and heat. Students will also seek information from word problems as one of their language demands by connecting the vocabulary learned to the value assigned to it in the word problems. Students are practicing distilling information given in words into numbers. Language supports include giving students many opportunities to practice their language use in class, and encouraging the use of the appropriate vocabulary in class discussions. |
| **Type of Student Assessments and what is being assessed:**   * **Informal Assessment:**   + - Warm-up practice.     - Practice problems throughout notes using whiteboards. * **Formal Assessment**:   + - Brain Buster (will be graded when turned in with the lab) * **Modifications to the Assessments:** *Student with English as a Second Language:* Everyday language was used in the problems on the Brain Buster packet, with the exception of specific academic vocabulary. *Students struggling with math/students with ADHD:* Group work for the practice problems; the Brain Buster packet is due several days after it is assigned. In that time, there will be several opportunities to work on it in class, and multiple examples similar to the packet questions will be provided during lessons. Students with 504 plans did not require any assessment modifications due to their classification. |
| **Evaluation Criteria:** Students’ work on the Brain Buster will be graded on three items, addressed in the instructions: shown work, correct significant figures, and a correct answer. |
| Relevant theories and/or research best practices:As shown by the research described in the book, *Classroom Instruction That Works: Research Based Strategies for Increasing Student Achievement* by Dean et al., cooperative learning is a positive strategy for helping students learn. The book describes the cooperative learning model as a combination of several elements – positive interdependence, face-to-face promotive interaction, individual and group accountability, interpersonal and small-group skills, and group processing (Dean et al., 2012). Lesson 1 uses the first two, positive interdependence and face-to-face promotive interaction, to help students develop their initial knowledge about heat transfer. Students are practicing their skills in a group and presenting an answer (group accountability), but also rotating roles per question (individual accountability). This creates interdependence and positive interaction, allowing students to “sink or swim” together. By using cooperative learning strategies in combination with notes, students avoid disconnect and engage with the information. The whiteboard group activities allow each member of the group to contribute to solve the problems and prepares students for individual work with the Brain Buster packet. Having students engage in practicing the skills they learn is more effective when it happens consistently over time rather than all at once. In light of this, the Brain Buster packet was used as an opportunity for continual practice over the three-lesson segment. Students were able to try problems on their own, receive feedback as needed, and continue practicing how to complete the problems on their own schedule over several days.A second strategy used in this lesson, also described in *Classroom Instruction That Works: Research Based Strategies for Increasing Student Achievement*, describes how modeling and training students in note-taking and study strategies allows them to become capable of using these strategies on their own (Dean et al., 2012). In Lesson 1, the teacher guides the students through shading by color and adding notes to their personal copy of the NYS Regents Chemistry Reference Tables. Color coding and annotating are useful strategies students should develop when reviewing their notes. By demonstrating this strategy throughout the year, students will learn a new study skill to add to their repertoire. |
| **Lesson Timeline**:   * **Warm up – modified Think-Pair-Share for page 4 in practice packet.** * **Shade and makes notes on Reference Table** * **Notes on q-equations (with embedded practice problems)** * **Begin Brain Buster questions (with demonstration from teacher)** |

edTPA Lesson Plan #2 (4 Page Limit)

Grade Level: 10 - 12

Subject / Content area: Chemistry

Unit of Study: Energy

Lesson Title: Lesson #2 - Ice Cube Inquiry Lab

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| **Central Focus for the learning segment:** How can the scientific method be used to solve problems? |
| **Content Standard(s):** NYS CCLS or Content Standards (List the number and text of the standard. If only a portion of a standard is being addressed, then only list the relevant part[s].)  NYS P-12 Science Standards:   * **HS-PS3-1.** Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. * **HS-PS3-4.** Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). |
| **Learning Objectives** associated with the content standards:   * Students will create and perform a procedure to experimentally determine the heat of fusion of water. |
| **Instructional Resources and Materials** to engage students in learning**:**   * Lab worksheet * Procedure hints * Lab materials: Styrofoam cup, thermometer, water, ice cubes, electronic balance * NYS Chemistry Reference Tables (if students chose) |
| **Instructional Strategies and Learning Tasks** that support diverse student needs. (Include what you and students will be doing.)**:**   * **Warm up** – Students will pick up a copy of their lab worksheet as they come in and read the first page for the warm up. They should highlight/underline the purpose of the lab, and brainstorm a claim they might use for this lab. Teacher will circulate and answer any questions that may arise. * **Lab** – Teacher will introduce the lab and go over safety requirements. Students will split into pairs for this lab. They will be expected to try to develop a procedure on their own; however, if they find themselves stuck, they may complete a Brain Buster problem to “purchase” the procedure hint from the teacher. The procedure hint scaffolds the process, giving students the steps of the procedure separately and requiring them to put the steps in order. Students must have their procedure approved before beginning the experiment. During the lab, students are expected to follow their procedure steps using appropriate laboratory technique. The teacher will circulate to answer questions and probe student understanding using higher level questioning. Teacher will check in with students listed with 504 plans as well as those with language needs and those struggling with math. * **Post-lab** – Students should work on completing their Brain Buster packet, which will be graded as part of the data analysis of the lab. |
| **Differentiation and planned universal supports:** Mixed groups, procedure hints, verbal as well as visual instructions, teacher check-ins for students with 504 plans, language needs, and those who are designated as struggling with math. |
| **Language Function students will develop. Additional language demands and language supports:** Synthesize. Students will use their knowledge of heat transfer and heat equations to create and perform a lab procedure that will allow them to determine the heat of fusion of water experimentally. Academic vocabulary includes: heat of fusion, temperature, solid, liquid, gas, phase change, vaporization, melting/fusion. Language supports include giving students many opportunities to practice their language use in class, and encouraging the use of the appropriate vocabulary in class discussions. Students will demonstrate their skill in academic discourse by using specific and appropriate vocabulary in their lab procedures and while discussing the lab, and their skill with syntax when organizing their knowledge into a working lab procedure. |
| **Type of Student Assessments and what is being assessed:**   * **Informal Assessment:** Probing questions posed to students while they are developing their procedure and performing the experiment. * **Formal Assessment**: Lab, which will consist of the procedure students created, answers to the data analysis questions in the worksheet, completed Brain Buster packet, and a lab write-up (CEI). * **Modifications to the Assessments:** Common language was used for the lab worksheet, with the exception of specific content-based vocabulary. Regarding the calculations section of the lab, students were allowed to work in groups and were not graded on the individual correctness of their math; instead, points were given on having the set up the formula correctly. Students with 504s did not require any modifications to this assessment per their plans. |
| **Evaluation Criteria:** The lab will be graded according to the points chart on the lab cover page in conjunction with the instructions in the lab packet. The labs will be graded for correctness. Students are encouraged to self-grade their lab as a method of rechecking their work. |
| Relevant theories and/or research best practices: Lessons 2 and 3 were based on the practice of teaching science through having students practice experimental design. In the book, *Taking Science to School: Learning and Teaching Science in Grades K-8*, Duschl, et al. examine the positive applications of teaching science through having students design, complete, and critique their own experiments. In Lesson 2, students are having their first encounter with this method, and as such, it is more structured at first. The book mentioned above advises that teaching students experimental design can be very challenging for students encountering it for the first time, and as such, they may need more teacher guidance (Duschl, et al. 2007). This is reflected in the adaptations to this lesson through the hints system and opportunities for group work and teacher check-ins. Having students create their own experiment encourages them to think critically about the process they are analyzing and make connections using their pre-existing knowledge. |
| **Lesson Timeline**:   * Warm up (read and annotate first page of lab) * Introduce lab (teacher) * Create procedure (students in partners) * Perform lab (students in partners) * Work on Brain Buster problems (if extra time) |

edTPA Lesson Plan #3 (4 Page Limit)

Grade Level: 10 - 12

Subject / Content area: Chemistry

Unit of Study: Energy

Lesson Title: Lesson #3 - Ice Cube Inquiry Data Analysis

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| **Central Focus for the learning segment:** How can experimental data be used to determine real-life scientific constants? |
| **Content Standard(s):** NYS CCLS or Content Standards (List the number and text of the standard. If only a portion of a standard is being addressed, then only list the relevant part[s].)  NYS P-12 Science Standards:   * **HS-PS3-1.** Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. * **HS-PS3-4.** Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). |
| **Learning Objectives** associated with the content standards:   * Students will calculate the heat of fusion experimentally based on collected data, then discuss their results using appropriate academic language |
| **Instructional Resources and Materials** to engage students in learning**:**   * Lab worksheet * Analysis hints * Visual on side white board * NYS Chemistry Reference Tables (if students chose) |
| **Instructional Strategies and Learning Tasks** that support diverse student needs. (Include what you and students will be doing.)**:**   * Students will work in table groups (4-5 people) to try to combine the heat equations they learned in a way that will allow them to solve for Hf, the heat of fusion. Teacher will ask guiding questions and move from table to table, checking in with students with 504s, language needs, and those designated as struggling with math. * After trying it on their own, students will be given the hints, a step by step procedure for rearranging the equations to solve for the heat of fusion. This should allow them to solve for the heat of fusion. * Class will rejoin as a whole, compare answers of each group, discuss trends and the scientific processes involved in the lab, and identify sources of error in this experiment. * Bonus question will be asked for the class to answer for a prize: Do plastic ice cubes follow the same process? How do they work? Why is this similar? |
| **Differentiation and planned universal supports:** Students will attempt the calculation on their own first, then will be given the hints for the process. After some time working with lab partners, groups may combine to help with the calculations. As a support for visual learners, a visual aid hinting at how q-equations relate to the Law of Conservation of Energy will be located on the side board and later used during the discussion. In addition, there will be regular teacher check-ins for students with 504 plans, language needs, and those who are designated as struggling with math. |
| **Language Function students will develop. Additional language demands and language supports:** Analyze and justify. Students will mathematically determine the relationship between heat transfer, phase change, and heat of fusion in order to solve for the constant Hf. They will also discuss how the Laws of Thermodynamics are obeyed in everyday phenomena, using evidence from the lab. Students will practice using their knowledge of syntax regarding the heat equations they put together and translating it into academic discourse by making use of appropriate academic language, including the vocabulary terms of heat of fusion, temperature, solid, liquid, phase change, melting/fusion. Language supports include giving students many opportunities to practice their language use in class, and encouraging the use of the appropriate vocabulary in class discussions. |
| **Type of Student Assessments and what is being assessed:**   * **Informal Assessment:** Questioning will be used throughout the lesson, particularly when students are working in their lab groups initially, beginning their data analysis. Students will be asked to explain their answers when sharing during the class-wide discussion. * **Formal Assessment**: The lab worksheet will be graded along with the Brain Buster packet. Both should be turned in along with the student’s lab write-up for a grade and to earn lab minutes for the Regents requirement. * **Modifications to the Assessments:** The lab assessment is modified for students who struggle with math by the additional step of giving out hints to each group during the data analysis stage, and going over the work as a class. Students with 504s did not require any additional modifications to the assessments, as per their plans. |
| **Evaluation Criteria:** Students will complete the lab data analysis and complete a write-up (CEI) following the criteria given. They should self-assess their work before turning it in. It will be graded on completeness, correctness, and accuracy according to the specified guidelines. |
| Relevant theories and/or research best practices:This lesson draws upon the research outlined in the book, *Taking Science to School: Learning and Teaching Science in Grades K-8*, regarding teaching science as practice rather than a series of facts and problems with only one solution (Duschl, et al., 2007). This lesson continues the lab from Lesson 2 into a data analysis based on the collected data. The research from *Taking Science to School* describes the benefits of having students engage in designing, carrying out, and analyzing the results of their own experiments (Duschl, et al., 2007). This leads to students developing deeper understandings of key concepts and can help students understand the practical applications of science practices and ideas. The book also cautions that this method can require teachers to provide significant guidance and students to have a strong base in the relevant scientific concepts (Duschl, et al., 2007). Taking this into account, several methods of support were used, including small group work, large group discussions, hints for more complicated math sections, and teacher circulation and questioning. |
| **Lesson Timeline**:   * Students will work in table groups (4-5 people) to try to combine the heat equations they learned in a way that will allow them to solve for Hf, the heat of fusion. Teacher will ask guiding questions and move from table to table. * After trying it on their own, students will be given the hints, a step by step procedure for rearranging the equations to solve for the heat of fusion. This should allow them to solve for the heat of fusion. * Class will rejoin as a whole, compare answers of each group, and discuss why this works, and identify sources of error in this experiment. * Bonus question will be asked for the class to answer: Do plastic ice cubes follow the same process? How do they work? Why is this similar? |

References:

Dean, C. B., & Marzano, R. J. (2012). *Classroom instruction that works: research-based strategies for increasing student achievement*. Alexandria, VA: ASCD.

Duschl, R. A., Schweingruber, H. A., & Shouse, A. W. (2007). *Taking science to school learning and teaching science in grades K-8*. Washington, DC: National Academies Press.