Unit 6: Thermochemistry

Content Area: **Science**
Course(s):
Time Period: **Marking Period 4**
Length: **15 Days**
Status: **Published**

Summary

Both physical and chemical changes involve energy in some way. Describing the role energy plays in the process is known as thermochemistry. In this unit, students will investigate that role to describe exothermic and endothermic process and the preference nature has. Additionally, the randomness of reactions will be analyzed and when combined with energy students will be able to predict whether any chemical reaction will occur or not. Students will also build their own calorimeters in order to monitor the energy released, or absorbed, by a reaction.

Revised July 2021

MA.N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
LA.RST.9-10.2	Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
LA.RST.9-10.5	Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
LA.RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
LA.RST.9-10.10	By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.
LA.WHST.9-10.1.D	Establish and maintain a style and tone appropriate to the audience and purpose (e.g., formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
LA.WHST.9-10.1.E	Provide a concluding paragraph or section that supports the argument presented.
LA.WHST.9-10.2.A	Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
LA.WHST.9-10.2.C	Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
LA.WHST.9-10.2.D	Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.

LA.WHST.9-10.2.E	Establish and maintain a style and tone appropriate to the audience and purpose (e.g., formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
LA.WHST.9-10.2.F	Provide a concluding paragraph or section that supports the argument presented.
SCI.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.
SCI.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).
SCI.HS-ESS2-5	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
SCI.HS-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.
WRK.K-12.P.3	Consider the environmental, social and economic impacts of decisions.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.
TECH.9.4.12.CT	Critical Thinking and Problem-solving
TECH.9.4.12.TL	Technology Literacy
TECH.9.4.12.GCA	Global and Cultural Awareness
TECH.9.4.12.IML	Information and Media Literacy

Essential Questions / Enduring Understandings

Essential Questions

What is the "driving force" behind all chemical reactions?

What are the principles of energy flow?

How can calorimetry be used to determine the identity of unknown substances?

Enduring Understandings

Enthalpy (energy), entropy (randomness), and temperature all play an intertwined role in chemical reactions.

Calorimeters apply the principles of heat flow in order to measure the amount of heat involved in a chemical reaction or process.

Objectives

Students will know the factors that affect the rate of chemical reactions.

Students will know know heat is the flow of energy from one object to another.

Students will know the definitions and roles of enthalpy and entropy.

Students will know how to find the activation energy of a process.

Students will be skilled at analyzing data in order to calculate the specific heat of a material.

Students will be skilled at designing and/or utilizing calorimeters to determine the amount of heat involved in a chemical/physical change.

Students will be skilled at recognizing processes – chemical reactions or phase changes – as exothermic or endothermic.

Students will be skilled at graphing the energy of a process in order to identify it as exothermic or endothermic.

Learning Plan

Preview essential questions and connect them to the concepts we will cover in the unit.

Investigate rates by analyzing how quickly solutions can be made with water at various temperatures.

Analyze chemical reaction rates in the “Alka-Seltzer” lab adding other factors like surface area and pressure.

Re-analyze phase diagrams (Unit 1) with the focus on what role “heat” had.

Model the principles of heat flow using the “qmcat” equation.

Determine the specific heat of metals using simple “coffee cup” calorimeters.

Design (or redesign) a calorimeter to investigate the heat from a chemical reaction (Marshmallow Calorimetry Lab) and/or solvation process (Enthalpy of Solutions Lab).

Compare and contrast enthalpy with entropy and how both can be used to predict whether a process will occur.

Assessment

Formative Assessment

Determine the factors that affect the rate of a reaction and describe how they affect the rate.

Analyze phase diagrams with respect to thermodynamic concepts.

Calculate heat flow.

Describe how enthalpy and entropy can be used to predict the spontaneity of a chemical process.

Benchmark Assessment
Final Exam

Alternative Assessment

Interpret data from the “Alka-Seltzer” lab to propose how the new factors (not in the solutions activity) affect the rate.

Utilize the heat flow equation and data obtained via experiment to determine the specific heat of metals.

Design and build a calorimeter.

Use a calorimeter to determine the enthalpy of a chemical process.

Summative Assessment

Unit Quizzes

Unit Tests

Materials

Chemistry Textbook

Guided notes or teacher handouts

Lab Handouts (Alka-Seltzer Lab, Specific Heat of Metals Lab, Marshmallow Calorimetry Lab, Enthalpy of Solutions Lab, NOTE: Supplies for each lab included on handout.)

Simulations

“Energy Forms and Changes” [https://phet.colorado.edu/en/simulation/energy-forms-and-changes]

“Calorimetry Simulations” [https://media.pearsoncmg.com/bc/bc_0media_chem/chem_sim/calorimetry/Calor.php]

Integrated Accommodations and Modifications Spec Ed., ELL, At-Risk, G&T, Career Education, 504s

https://docs.google.com/spreadsheets/d/1CvoX6NXdGUPtTPcEqPOsnWbqpDLS4Ego1W1eaIrGYTo/