

Grade & Course: 9 -12 Chemistry		Topic: Thermochemistry	Duration: 3 weeks
<p>Georgia Standards and Content:</p> <p>SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes.</p> <p>a. Plan and carry out an investigation to calculate the amount of heat absorbed or released by chemical or physical processes. (<i>Clarification statement:</i> Calculation of the enthalpy, heat change, and Hess' Law are addressed in this element.)</p> <p>b. Construct an explanation using a heating curve as evidence of the effects of energy and intermolecular forces on phase changes.</p> <p>SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds.</p> <p>g. Develop a model to illustrate the release or absorption of energy (endothermic or exothermic) from a chemical reaction system depends upon the changes in total bond energy.</p>			
Narrative / Background Information			
<p>Prior Student Knowledge: (REFLECTION – PRIOR TO TEACHING THE UNIT)</p> <p>SPS7. Obtain, evaluate, and communicate information to explain transformations and flow of energy within a system.</p> <p>c. Analyze and interpret specific heat data to justify the selection of a material for a practical application (e.g., insulators and cooking vessels).</p> <p>d. Analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves.</p>			
<p>Year-Long Anchoring Phenomena: (LEARNING PROCESS)</p> <p>Changes to the measurement of chemicals added to Flint Michigan's water supply created dangerous levels of lead contamination in the drinking water.</p>			
<p>Unit Phenomena (LEARNING PROCESS)</p> <p>Hot Hands use exothermic reactions to generate heat</p>			
<p>MYP Inquiry Statement:</p> <p>Energy transformations influence systems and can be measured and modeled.</p>			
<p>MYP Global Context:</p> <p>Scientific and Technical Innovation</p>			
<p>Approaches to Learning Skills:</p> <ul style="list-style-type: none"> • Communication skills: negotiate ideas and knowledge with peers and teachers • Research skills: collect, record, and verify data • Thinking skills: analyse complex concepts and projects into their constituent parts and synthesize them to create new understanding 	<p>Disciplinary Core Ideas:</p> <ul style="list-style-type: none"> • Enthalpy <ul style="list-style-type: none"> • Heat (formation, vaporization, fusion) • Specific Heat • Enthalpy • Heat Change • Hess' Law • Phase Changes • Heating Curves • Energy <ul style="list-style-type: none"> • Calorie and Calorimetry • Joule • Endothermic • Exothermic 	<p>Crosscutting Concepts:</p> <ul style="list-style-type: none"> • Systems and System Models • Stability and Change • Scale, Proportion, and Quantity • Cause and Effect <p>MYP Key and Related Concepts:</p> <p>Key Concept(s)</p> <ul style="list-style-type: none"> • Systems • Change <p>Related Concept(s)</p> <ul style="list-style-type: none"> • Models • Balance • Interaction • Transfer 	
<p>Possible Preconceptions/Misconceptions: (REFLECTION – PRIOR TO TEACHING THE UNIT)</p>			

- Heat is the same as temperature.

Key Vocabulary: (KNOWLEDGE & SKILLS)

- Heat
- Enthalpy
- Standard enthalpy of formation
- Hess's Law
- Heating curve
- Energy
- Calorie
- Joule
- Specific heat
- Calorimeter
- Phase change
- Heat of vaporization
- Heat of fusion

Inquiry Questions:

Factual - What determines if a reaction has a positive or negative delta H value?

Conceptual - What implications does thermodynamic properties have in our daily lives?

Debatable - When should people manipulate the laws of thermodynamics in order to start or stop a reaction from being spontaneous and proceeding forward?

MYP Objectives		Summative assessment	
<ul style="list-style-type: none"> MYP Criterion B (iii): explain how to manipulate the variables, and explain how data will be collected MYP Criterion C (i): present collected and transformed data 		Relationship between summative assessment task(s) and statement of inquiry: Students will perform tasks and respond to assessment items that will gauge their mastery of reactions as required by the Georgia Standards of Excellence. Mastery of these concepts is necessary to move forward in our student of chemical behavior.	
Learning Activities and Experiences	Inquiry & Obtain: (LEARNING PROCESS)	Evaluate: (LEARNING PROCESS)	Communicate: (LEARNING PROCESS)
Week 1: Georgia Standards of Excellence: SC5(b) - Construct an explanation using a heating curve as evidence of the effects of energy and intermolecular forces on phase changes.			
Lesson 1 (Exothermic vs. Endothermic Systems)	Engage - connect to Gas Laws unit - what happens to particle motion when energy is added? (particle diagrams) Explore - cold pack vs. hand warmer demo - introduce endothermic vs. exothermic (where is energy lost? where is energy absorbed?)	Explain - define temperature, heat, system, surroundings, energy flows hot to cold - practice with classification of scenarios (exothermic or endothermic? where is energy flowing?) Elaborate - exploration of various endothermic and exothermic processes beyond what is discussed above	Evaluate - Ticket out the Door or similar (possible question: Why does melting ice require energy?)

Lesson 2 (Heating Curves and Phase Changes)	Engage - why does boiling water stay at 100 °C even while heating continues? Explore - heating curve graphs, discussion of each segment, difference between temperature change (kinetic energy change) and phase change (IMF change)	Explain - students label a heating curve and draw particle models for each region Elaborate - exotic phases of matter beyond solid, liquid, gas	Evaluate - Ticket out the Door or similar Day 2 - heating curve lab (simple version: heat ice to boiling and collect temperatures at regular time intervals)
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Weeks 2 and 3:

Georgia Standards of Excellence:

SC5(a) - Plan and carry out an investigation to calculate the amount of heat absorbed or released by chemical or physical processes. (Clarification statement: Calculation of the enthalpy, heat change, and Hess' Law are addressed in this element.)

SC2(g) - Develop a model to illustrate the release or absorption of energy (endothermic or exothermic) from a chemical reaction system depends upon the changes in total bond energy.

Lesson 3 (Heat Calculations and Calorimetry) SC5(a)	Engage - what requires more energy? (heat 50 g water by 10 degrees OR heat 200 g by 10 degrees) Explore - introduce $Q = mc\Delta T$, sign convention for Q, calorimetry method and math	Explain - practice with $Q = mc\Delta T$ (heating water and comparing heat changes) Elaborate - explore different methods of calorimetry	Evaluate - Calorimetry Lab (Day 2)
Lesson 4 (Enthalpy and Hess's Law) SC5(a)	Engage - what do we do when we cannot directly measure heat change? Explore - define enthalpy, introduce and model Hess's Law	Explain - practice with Hess's Law Elaborate - advanced Hess's Law, explore entropy and Gibbs Free Energy	Evaluate - Ticket out the Door or similar
Lesson 5 (Bond Energy) SC2(g)	Engage - revisit bonding from previous unit Explore - introduce bond energy (energy is required to break bonds and released when bonds formed), model calculations using $\Delta H = \text{bonds broken} - \text{bonds formed}$	Explain - practice calculating with bond energies Elaborate - why is combustion so highly exothermic?	Evaluate - Common Formative Assessment (Quiz) on unit standards

Resources (hyperlink to model lessons and/or resources):

Discovery Education Science Techbook

Reflection: Considering the planning, process and impact of the inquiry

Prior to teaching the unit	During teaching	After teaching the unit