International Baccalaureate
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MYP/3D Science Unit Planner

Marietta City Schools

MARIETTA CITY SCHOOLS

Grade & Course: 9-12 Chemistry	**Topic:** Thermochemistry, Kinetics, and Equilibrium	**Duration:** 7 weeks

Georgia Standards and Content:

SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds.

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.

SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction.

a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (Clarification statement: Pressure should not be tested experimentally.)

b. Construct an argument using collision theory and transition state theory to explain the role of activation energy in chemical reactions. (Clarification statement: Reaction coordinate diagrams could be used to visualize graphically changes in energy (direction flow and quantity) during the progress of a chemical reaction.)

c. Construct an explanation of the effects of a catalyst on chemical reactions and apply it to everyday examples.

d. Refine the design of a chemical system by altering the conditions that would change forward and reverse reaction rates and the amount of products at equilibrium.(Clarification statement: Emphasis is on the application of LeChatelier's principle.)

SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes.

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's Law are addressed in this element.)

b. Construct an explanation using a heating curve as evidence of the effects of energy and intermolecular forces on phase changes.

Narrative / Background Information

Prior Student Knowledge: (REFLECTION – PRIOR TO TEACHING THE UNIT)

SPS6b. Plan and carry out investigations to determine how temperature, surface area, and agitation affect the rate solutes dissolve in a specific solvent.

SPS7b. Plan and carry out investigations to describe how molecular motion relates to thermal energy changes in terms of conduction, convection, and radiation.

SPS7c. Analyze and interpret specific heat data to justify the selection of a material for a practical application (e.g., insulators and cooking vessels).

SPS7d. Analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves.

Year-Long Anchoring Phenomena: (LEARNING PROCESS)

Changes to the measurement of chemicals added to Flint Michigan's water supply created dangerous levels of lead contamination in the drinking water.

Unit Phenomena (LEARNING PROCESS)

Luminescent chemical reactions release energy as photons creating mesmerizing glows and vivid colors that are often observed in fireflies and marine organisms and utilized in forensic investigations.

MYP Inquiry Statement:

Chemical reactions are governed by the energy changes and feasibility of the reactions and the factors that influence the speed and outcome of diverse chemical transformations.

MYP Global Context:

Globalization and Sustainability

Approaches to Learning Skills:

- Communication skills
- Social skills
- Self Management skills
- Research skills
- Thinking skills

Disciplinary Core Ideas: (KNOWLEDGE & SKILLS)

- Heat
- Endothermic
- Exothermic
- Enthalpy
- Heat Change
- Hess' Law

Crosscutting Concepts: (KNOWLEDGE & SKILLS)

- Systems and System Models
- Energy and Matter
- Stability and Change
- Cause and Effect

	● Phase Changes ● Heating Curves ● Reaction Rates ● Collision Theory ● Transition State Theory ● Activation Energy ● Changing Reaction Rates ● Catalysts ● Forward Reaction ● Reverse Reaction ● LeChatelier's Principle	**MYP Key and Related Concepts:** ● Systems ● Change **Related Concept(s)** ● Models ● Energy ● Movement ● Function ● Conditions ● Evidence ● Consequences ● Transfer

Possible Preconceptions/Misconceptions: (REFLECTION – PRIOR TO TEACHING THE UNIT)

- Heat is not the same as temperature
- Exothermic does not mean the reaction is "cold"
- Endothermic does not mean the reaction is "hot"
- The reaction is the system and everything else is the surroundings
- Catalysts are not consumed in a reaction
- Catalysts are not always biological
- Catalysts does not alter the starting energy or ending energy of chemicals
- A reaction can be reversible

Key Vocabulary: (KNOWLEDGE & SKILLS)

Endothermic
Exothermic
Temperature
Pressure
Collision Theory
Transition State Theory (can also introduce "intermediate")
Activation energy
Reaction coordinate
Catalyst
Energy
Reaction Rate
LeChatelier's
Equilibrium
Heat
Enthalpy (including diagrams) (calculation via calorimetry and Hess' Law, no calculation of bond energy)
Standard enthalpy of Formation
Hess's Law
Heating Curve
Calorie
Joule
Specific heat
Calorimeter
Phase change
Heat of vaporization
Heat of fusion

Inquiry Questions:

Thermochemistry:

Factual: What is the specific heat capacity of water?

Conceptual: How does the specific heat capacity of water influence the amount of heat absorbed or released during a chemical

or physical process involving water?

Debatable: To what extent does the unique value of water's specific heat capacity contribute to its role as a vital regulator of Earth's climate, and how might variations in this property impact ecological systems and global climate patterns?

Kinetics/Equilibrium:

Factual: What factors influence the rate of a chemical reaction?

Conceptual: How does collision theory help us understand the relationship between molecular collisions and the rate of chemical reactions?

Debatable: To what extent do varying environmental conditions, such as temperature and pressure, impact the rate of chemical reactions, and how might the trade-offs between reaction efficiency and safety considerations influence decisions in industrial processes?

MYP Objectives	Summative assessment	
Sciences	Criterion A: Knowing and Understanding ● Common Summative Assessment Criterion B: Inquiring and Designing Criterion C: Processing and Evaluating ● Common Laboratory Experience	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.

Unit Objectives:

Learning Activities and Experiences	Inquiry & Obtain: (LEARNING PROCESS)	Evaluate: (LEARNING PROCESS)	Communicate: (LEARNING PROCESS)
Weeks 1-4:	**Engage:** ● Core Interactive Text: Thinking About Thermochemistry ● Image: After a long run, how can hot and cold therapies help your body recover? ● Image: How does an ice pack work? ● Image: What is happening to the energy of reactants and products of the chemical reactions that occur during a fireworks show? **Explore:** ● Core Interactive Text: How Do You Distinguish Between Exothermic and Endothermic Processes? ● Video: Energy is absorbed and released during physical and chemical energy. What	**Evaluate:** ● Common Formative Assessment ● Common Summative Assessment	**Explain:** ● Core Interactive Text: Explaining Thermochemistry **Elaborate:** ● Image: How does a refrigerator keep food cold? ● Video: How do air conditioners use a substance like Freon to cool air? ● Image: A concentrating solar power tower in Spain uses molten salts to capture the sun's energy. How could this process advance the solar power industry?

	are the characteristics of thermochemistry? ● Video: Exothermic reactions release stored chemical bond energy as heat; endothermic reactions absorb heat from surroundings and increase the amount of stored chemical energy. Where does this energy go? ● Core Interactive Text: What is the relationship between a system and its surroundings? ● Video: Exothermic and endothermic reactions, respectively, release and absorb energy. How can you tell whether a reaction will be exothermic or endothermic? ● Video: Calorimetry is the study of measuring heat. How does the amount of heat absorbed by an object relate to the amount of heat lost by its surroundings? ● Exploration: Use a calorimeter to determine the specific heat of a metal. What affects the specific heat of the metal? ● Image: To start the exothermic chemical reactions of a sparkler, a flame must first supply the activation energy. Why is the energy of the products lower than the energy of the reactants?		
Weeks 5-6:	**Engage:** ● Core Interactive Text: Thinking about Reaction Rate ● Image: Why do we put our food in the refrigerator? ● Image: How could the chemical reaction responsible for fireworks be sped up or slowed down? **Explore:** ● Core Interactive Text: What factors influence reaction rate, and what is their impact? ● Video: Many factors influence the rate of a chemical reaction. What are the factors that affect reaction rates?	**Evaluate:** ● Common Formative Assessment	**Explain:** ● Core Interactive Text: Explaining Reaction Rate **Elaborate:** ● Video: Grain dust, a combination of cornstarch and corn oil, is extremely flammable when it comes in contact with air. How do corn storage facilities take precautions against grain dust? ● Video: What is NASA's low-temperature oxidation catalyst used for?

	● Video: External agents can act as catalysts that affect reaction rates. How do scientists and engineers use them to affect reaction rates for specific purposes?		
Week 7:	**Engage:** ● Core Interactive Text: Life is a Balancing Act **Explore:** ● Core Interactive Text: How is Le Chatelier's Principle used to predict the effect of stress applies to a system at equilibrium?	**Evaluate:** ● Common Formative Assessment ● Common Summative Assessment	**Explain:** ● Core Interactive Text: Explaining Chemical Equilibrium **Elaborate:** ● Video: What factors can change a chemical system at equilibrium?

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
(click here)	(click here)	(click here)