International Baccalaureate
Baccalauréat International
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MYP/3D Science Unit Planner

Marietta City Schools

MARIETTA CITY SCHOOLS

Grade & Course: 9-12 Chemistry	**Topic:** Kinetics and Equilibrium	**Duration:** 3 weeks

Georgia Standards and Content:

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.)

Narrative / Background Information

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

Understanding reactants and products in a chemical reaction.
Ability to balance chemical equations.
Recognizing different types of chemical reactions (synthesis, decomposition, single replacement, double replacement, combustion)
Basic knowledge of the collision theory

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)

Traditional hand warmers utilize the exothermic reaction between iron and oxygen to create iron oxide which can be sped up by increasing the concentration of oxygen present.
OR
Rechargeable batteries are crucial for powering modern electronic devices, from smartphones to electric vehicles. Improving their design involves understanding and manipulating the chemical reactions within the battery, as well as optimizing various engineering factors.

MYP Inquiry Statement:

Chemical reactions are governed by 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)

- Energy
- Collision Theory
- Transition State Theory
- Activation Energy
- Reaction coordinate diagram
- Reaction Rates
- Forward Reaction
- Reverse Reaction
- Changing Reaction Rates
- Catalysts
- Concentration
- Temperature

Crosscutting Concepts: (KNOWLEDGE & SKILLS)

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

MYP Key and Related Concepts:

Systems
Change
Models
Energy
Movement

	● Pressure ● Equilibrium ● LeChatelier's Principle	Function Conditions Evidence Consequences Transfer

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

All collisions lead to a reaction.
Increasing temperature always makes a reaction happen instantly.
A catalyst gets used up in a reaction.
Adding more reactant/product will always speed up the reaction.
Breaking bonds releases energy

Key Vocabulary: (KNOWLEDGE & SKILLS)

Concentration
Temperature
Pressure
Collision Theory
Transition State Theory
Activation Energy
Reaction Coordinate Diagram
Energy
Catalyst
LeChatelier's Principle
Equilibrium
Reaction Rate

Inquiry Questions:

Factual -

- What are the main factors that affect the rate of a chemical reaction, and how does each factor influence the reaction?
- How does a catalyst change the activation energy of a chemical reaction, and why is it not consumed in the process?
- According to Le Châtelier's Principle, how does a chemical system at equilibrium respond to changes in concentration, temperature, or pressure?

Conceptual -

- How can engineers manipulate reaction conditions to optimize industrial chemical production while minimizing costs and environmental impact?
- Why do some reactions require catalysts to occur at a practical rate, and how do catalysts impact energy use in chemical processes?
- How does understanding equilibrium principles help scientists and engineers design more efficient chemical systems, such as in pharmaceutical or agricultural industries?

Debatable -

- Should industries always prioritize increasing reaction rates and product yield, even if it leads to higher energy consumption and environmental consequences? Why or why not?
- Is it ethical to use catalysts that are rare or environmentally harmful if they significantly improve the efficiency of chemical production?
- Should governments regulate the use of equilibrium-altering techniques (e.g., high pressure in the Haber process) to reduce environmental impact, even if it lowers industrial efficiency and profitability?

MYP Objectives	Summative assessment

Sciences	Criterion A: Knowing and Understanding Criterion B: Inquiring and Designing Criterion C: Processing and Evaluating Criterion D: Reflecting on the Impacts of Science	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 **Week 2** **Week 3**	Engage: ● Core Interactive Text: Understanding the Importance of Mathematics of Formulas and Equations ● Video: Airbag Explosion - How do you think a chemist can use chemical formulas and equations to predict what will happen inside the airbag? Explore: ● Image: The Stoichiometry of Water - What is the ratio of hydrogen to oxygen in water? ● Core Interactive Text: How Are the Principles of Stoichiometry Used to Calculate Quantities of Reactants or Products in a Chemical Reaction? ● Video: Practicing with Limiting Reactants - Why are two calculations necessary? ● Exploration: Mathematics of Formulas and Equations - Can you calculate the yield of these chemical reactions?	Evaluate: ● Unit MYP B Design a experiment with baking soda Reaction ● Unit 5 CFA ● Unit 5 CSA	Explain: ● Core Interactive Text: Explaining Mathematics of Formulas and Equations Elaborate: ● Core Interactive Text: Applying Mathematics of Formulas and Equations ● Image: Baking Pastries - How can a professional baker use mathematics of formulas and equations to increase or decrease the size of a recipe?
Resources (hyperlink to model lessons and/or resources): Discovery Education Science Techbook PhET Simulations			

Reflection: Considering the planning, process and impact of the inquiry:		
Prior to teaching the unit	During teaching	After teaching the unit
Students May Struggle With Abstract Concepts Understanding collision theory and how molecular motion affects reaction rates can be challenging without visual models or simulations. Equilibrium concepts (dynamic balance, Le Châtelier's Principle) can be confusing because students often think reactions "stop" at equilibrium.	- What can we adjust or change? Did they do well on the CFA? What do we need to reteach? Spiral and reteach valence electrons (review SPS1a) What do they need to practice more? procedural skills to be able to complete assignments - more explicit teaching of skills not just content	How well did the summative assessment task serve to distinguish levels of achievement?