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)

A glow stick glows due to a chemiluminescent chemical reaction.

MYP Inquiry Statement:

Forces and interactions influence the balance and motion of systems.

MYP Global Context:

Globalization and Sustainability

Approaches to Learning Skills:

- Communication skills: collaborate with peers and experts using a variety of digital environments and media
- Self-management skills: set goals that are challenging and realistic
- Thinking skills: use models and simulations to explore complex systems and issues

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
  - Pressure
- Equilibrium
- Le Chatelier's Principle

Crosscutting Concepts: (KNOWLEDGE & SKILLS)

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

MYP Key and Related Concepts:

Key Concepts:

- Systems
- Change

Related Concepts:

- Models
- Energy
- Movement
- 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**
• MYP Criterion D(ii): discuss and evaluate the various implications of the use of science and its application in solving a specific problem or issue	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 content as required by the Georgia Standards of Excellence.

Learning Activities and Experiences	**Inquiry & Obtain: (LEARNING PROCESS)**	**Evaluate: (LEARNING PROCESS)**	**Communicate: (LEARNING PROCESS)**
Weeks 1 and 2: **Georgia Standards of Excellence:** SC4(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.) SC4(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.) SC4(c) - Construct an explanation of the effects of a catalyst on chemical reactions and apply it to everyday examples.			
Lesson 1 (Collision Theory and Catalysts) **SC4(b)** **SC4(c)**	Engage - phenomenon of catalyst - initial ideas of how it works Explore - Collision Theory, successful or effective collisions, activation energy, drawing reaction coordinate diagrams, transition state, catalysts	Explain - reaction coordinate diagram of catalyzed vs. uncatalyzed reaction (construct an explanation), Collision Theory PhET Simulation Elaborate - Maxwell-Boltzmann curves	Evaluate - writing activity on catalyst examples (MYP)
Lesson 2 (Factors Affecting Rate of Reaction) **SC4(a)**	Engage - brainstorm factors that affect rate of a reaction (concentration, temperature, pressure, surface area) Explore - experimental design for Alka-Seltzer reaction lab	Explain - carry out the investigation and demonstrate the effect of a chosen factor on the reaction rate Elaborate - apply Maxwell-Boltzmann or similar to explanations of lab results	Evaluate - presentation of lab findings, Ticket out the Door or similar
Week 3: **Georgia Standards of Excellence:** SC4(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.)			
Lesson 3 (Equilibrium and LeChatelier's Principle)	Engage - analogies of equilibrium from other disciplines to understand the definition in chemistry Explore - reversible reactions, dynamic equilibrium, closed system,	Explain - practice with LeChatelier's Principle and altering conditions Elaborate - equilibrium expression and constant	Evaluate - Common Formative Assessment (CFA) for all unit standards in preparation for Common Summative Assessment (CSA)

	equilibrium position and yield, LeChatelier's Principle		

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