

UNIT 07-Equilibrium

Content Area: **Science**
Course(s): **IB Chemistry, SL**
Time Period: **Second Marking period**
Length: **1 Week**
Status: **Published**

Unit Overview

STAGE 1- DESIRED RESULTS

2020 New Jersey Student Learning Standards- Science

SCI.9-12.HS-PS1-5	Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
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SCI.9-12.HS-PS1-6	Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.
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SCI.6-8.MS-PS4-1	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
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SCI.6-8.MS-PS4-2	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
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Science and Engineering Practices

- Analyzing and Interpreting Data
- Asking Questions and Defining Problems
- Constructing Explanations and Designing Solutions
- Developing and Using Models
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information
- Planning and Carrying Out Information
- Using Mathematics and Computational Thinking

Cross Cutting Concepts

- Cause and Effect
- Energy and Matter
- Influence of Engineering, Technology, and Science on Society and the Natural World
- Interdependence of Science, Engineering, and Technology
- Patterns
- Scale, Proportion, and Quantity
- Stability and Change
- Structure and Functions
- Systems and System Models

Disciplinary Core Ideas

Obtaining evidence for scientific theories—isotopic labelling and its use in defining equilibrium.

Common language across different disciplines—the term dynamic equilibrium is used in other contexts, but not necessarily with the chemistry definition in mind.

Physical Sciences

- PS1A: Structure and Properties of Matter
- PS1B: Chemical Reactions
- PS1C: Nuclear Processes
- PS2A: Forces and Motion
- PS2B: Types of Interaction
- PS3A: Definitions of Energy
- PS3B: Conservation of Energy and Energy Transfer
- PS3C: Relationship Between Energy and Forces
- PS3D: Energy in Chemical Processes and Everyday Life
- PS4A: Wave Properties
- PS4B: Electromagnetic Radiation
- PS4C: Information Technologies and Instrumentation

Engineering. Technology. and Applications of Science

- ETS1A: Defining and Delimiting an Engineering Problem
- ETS1B: Developing Possible Solutions
- ETS1C: Optimizing the Design Solution

Essential Questions

Why are some reactions reversible?

What is a state of equilibrium?

What conditions affect the position of reaction equilibrium?

Enduring Understanding

- A state of equilibrium is reached in a closed system when the rates of the forward and reverse reactions are equal.
- The equilibrium law describes how the equilibrium constant (K_c) can be determined for a particular chemical reaction.
- The magnitude of the equilibrium constant indicates the extent of a reaction at equilibrium and is temperature dependent.
- The reaction quotient (Q) measures the relative amount of products and reactants present during a reaction at a particular point in time.
- Q is the equilibrium expression with non-equilibrium concentrations.
- The position of the equilibrium changes with changes in concentration, pressure, and temperature.
- A catalyst has no effect on the position of equilibrium or the equilibrium constant.

Students will know...

- A state of equilibrium is reached in a closed system when the rates of the forward and reverse reactions are equal.
- The equilibrium law describes how the equilibrium constant (K_c) can be determined for a particular chemical reaction.
- The magnitude of the equilibrium constant indicates the extent of a reaction at equilibrium and is temperature dependent.
- The reaction quotient (Q) measures the relative amount of products and reactants present during a reaction at a particular point in time. Q is the equilibrium expression with non-equilibrium concentrations. The position of the equilibrium changes with changes in concentration, pressure, and temperature.
- A catalyst has no effect on the position of equilibrium or the equilibrium constant.
- Le Châtelier's principle for changes in concentration can be explained by the equilibrium law.

- **Misconceptions:**

The major misconception students have in this topic is that chemical equilibrium means equal concentrations of reactants and products.

Students will be able to...

- Explain the characteristics of chemical and physical systems in a state of equilibrium.
- Deduce the equilibrium constant expression (K_c) from an equation for a homogeneous reaction.
- Determine the relationship between different equilibrium constants (K_c) for the same reaction at the same temperature.
- Apply Le Châtelier's principle to predict the qualitative effects of changes of temperature, pressure and concentration on the position of equilibrium and on the value of the equilibrium constant.

STAGE 2- EVIDENCE OF LEARNING

Formative Assessment

- 3- Minute Pause
- A-B-C Summaries
- Analogy Prompt
- Choral Response
- Debriefing
- Exit Card / Ticket
- Hand Signals
- Idea Spinner
- Index Card Summaries
- Inside-Outside Circle Discussion (Fishbowl)
- Journal Entry
- Misconception Check
- Observation
- One Minute Essay
- One Word Summary
- Portfolio Check
- Questions & Answers
- Quiz
- Self-Assessment
- Student Conference
- Think-Pair-Share
- Web or Concept Map

Authentic Assessments

Investigate the effect of an increase in concentration on equilibrium shift.

Benchmark Assessments

STAGE 3- LEARNING PLAN

Instructional Map

Notes and discussions to explain the following concepts, students work in groups to present and explain learned material.

Labs and demos

Frequent quizzes

- The characteristics of chemical and physical systems in a state of equilibrium.
- Deduction of the equilibrium constant expression (K_c) from an equation for a homogeneous reaction.
- Determination of the relationship between different equilibrium constants (K_c) for the same reaction at the same temperature.
- Application of Le Châtelier's principle to predict the qualitative effects of changes of temperature, pressure and concentration on the position of equilibrium and on the value of the equilibrium constant.
- Physical and chemical systems should be covered.
- Relationship between K_c values for reactions that are multiples or inverses of one another should be covered.
- Specific details of any industrial process are not required.

Modification/Differentiation of Instruction

Differentiation Strategies for Special Education Students

- Remove unnecessary material, words, etc., that can distract from the content

- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Differentiation Strategies for Gifted and Talented Students

- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Differentiated Strategies for ELL Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials, including visuals
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Allow students to work at their own pace
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Role play
- Provide graphic organizers, highlighted materials
- Strategy and flexible groups based on formative assessment

Differentiation Strategies for At Risk Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language

- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment

504 Plans

Students can qualify for 504 plans if they have physical or mental impairments that affect or limit any of their abilities to:

- walk, breathe, eat, or sleep
- communicate, see, hear, or speak
- read, concentrate, think, or learn
- stand, bend, lift, or work

Examples of accommodations in 504 plans include:

- preferential seating
- extended time on tests and assignments
- reduced homework or classwork
- verbal, visual, or technology aids
- modified textbooks or audio-video materials
- behavior management support
- adjusted class schedules or grading
- verbal testing
- excused lateness, absence, or missed classwork
- pre-approved nurse's office visits and accompaniment to visits
- occupational or physical therapy

Modification Strategies

- Cooperative Grouping
- Extended Time
- Frequent Breaks

- Highlighted Text
- Interactive Notebook
- Modified Test
- Oral Directions
- Peer Tutoring
- Preferential Seating
- Re-direct
- Repeated Drill and Practice
- Shortened Assignment
- Teacher Notes
- Tutorials
- Use of Additional Reference Materials
- Use of Audio Resources

Differentiation Strategies

High Preparation

- Alternative Assessments
- Choice Boards
- Games and Tournaments
- Group Investigations
- Guided Reading
- Independent Research / Project
- Interest Groups
- Learning Contracts
- Leveled Rubrics
- Literature Circles
- Multiple Intelligence Options
- Multiple Texts
- Personal Agendas
- Project Based Learning (PBL)
- Stations / Centers
- Think-Tac-Toe
- Tiered Activities / Assignments
- Varying Graphic Organizers

Low Preparation

- Choice of Book / Activity
- Cubing Activities
- Exploration by Interest (using interest inventories)
- Flexible Grouping
- Goal Setting With Student
- Homework Options
- Jigsaw
- Mini Workshops to Re-teach or Extend Skills
- Open-ended Activities
- Think-Pair-Share by Readiness, Interest, or Learning Style
- Use of Collaboration
- Use of Reading Buddies
- Varied Journal Prompts
- Varied Product Choice
- Varied Supplemental Materials
- Work Alone / Together

Horizontal Intergration- Interdisciplinary Connections

See Appendix

Vertical Integration- Discipline Mapping

Eighth grade Chemical Interactions

Tenth Grade Honors Chemistry

Additional Materials

Pearson IB Chemistry, Catrin Brown&Mike Ford

Richard Thornley Video Lessons.

WWW. IBChem.com