

## BPS Science Department Chemistry – Unit 10

### Chemistry Unit 10 – Kinetics and Equilibrium

**Unit Overview:** In this unit, students will study how chemical reactions occur using Collision Theory. The energy generated or lost will be expressed with a potential energy diagram and the factors that change the rate of reaction will be discussed. Students will learn about reversible reactions and describe the effects when a stress is placed upon a reaction.

#### Essential Questions:

- What is equilibrium and how is it affected by changing conditions?
- How do catalysts affect reactions?
- What is Collision Theory?
- What factors affect the rate of a chemical reaction?
- What are the parts of a potential energy diagram and what information can we obtain from it?

#### MST Standard 4 - Science

**Key Idea 3: Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity.**

**Key Idea 4: Energy exists in many forms, and when these forms change energy is conserved.**

#### New York State Science Learning Standards Performance Expectations:

**HS-PS 1-4 Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.**

**HS-PS 1-5 Apply scientific principles and evidence to explain how the rate of a physical or chemical change is affected when conditions are varied.**

**HS-PS 1-6 Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.**

**HS-PS 3-1 Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.**

**HS-PS 3-2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).**

**HS-PS 3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.**

**HS-PS 3-4 Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).**

**HS-ETS 1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.**

**HS-ETS 1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.**

**HS-ETS 1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.**

**HS-ETS 1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem**

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Time Frame	Skills, Practices, or Expectations	Specific Standards / Performance Indicators	Resources	Content Vocabulary	Measurement of Student Learning
<p>2.06.2023 - 2.17.2023</p> <p>2.20.2023 President's Day</p> <p>2.20.23 -2.24.23 Mid-Winter Recess</p>	<p><b>Collision Theory</b> Understand the factors necessary for an effective collision.</p> <p><b>Rates of Reactions</b> Explain the factors that affect the rate of a reaction.</p> <p><b>Equilibrium</b> Define equilibrium and dynamic equilibrium Predict the effect of stress on a system at equilibrium</p> <p><b>Potential Energy Diagram</b> Construct and interpret the parts of a potential energy diagram. Determine the effect of a catalyst on equilibrium and a potential energy diagram.</p> <p><b>Spontaneous Reactions</b> Explain conditions that make reactions spontaneous in terms of energy and entropy.</p>	<p><b>MST Standard 4 Science Key Idea 3</b></p> <p><b>3.1</b> - Explain the properties of matter in terms of the arrangement and properties of the atoms that compose them.</p> <p><b>3.1II</b> - Entropy is a measure of the randomness or disorder of a system. A system with greater disorder has greater entropy.</p> <p><b>3.1mm</b> - Systems in nature tend to undergo changes toward lower energy and higher entropy.</p> <p><b>3.4</b> - Use Kinetic Molecular Theory (KMT) to explain rates of reactions and the relationships among temperature, pressure, and volume of a substance.</p> <p><b>3.4d</b> – Collision Theory states that a reaction is most likely to occur if reactant particles collide with the proper energy and orientation.</p> <p><b>3.4f</b> – The rate of a chemical reaction depends on several factors: temperature, concentration, nature of the reactants, surface area, and the presence of a catalyst.</p> <p><b>3.4g</b> - A catalyst provides an alternate reaction pathway, which has a lower activation energy than an uncatalyzed reaction.</p> <p><b>3.4h</b> – Some chemical and physical changes can reach equilibrium.</p> <p><b>3.4i</b> – At equilibrium the rate of the forward reaction equals the rate of the reverse reaction. The measurable quantities of reactants and products remain constant at equilibrium.</p> <p><b>3.4j</b> – LeChatelier's Principle can be used to predict the effect of stress</p>	<p>Castle Learning- Access through Clever</p> <p><a href="#">BPS Science Department Recommended Virtual Labs</a> – must be logged into BPS google document account through BPS Gmail account to access</p> <p><i>Holt NY Chemistry</i> Textbook Chapters 14, 16</p> <p><a href="#">Regents Chemistry Reference Tables</a> - Table I</p> <p><a href="#">Dynamic Periodic Table</a></p> <p>BPS Science K-12 Schoology Folder 9-12 Resources Chemistry Resources</p> <p><b>PhET Interactive:</b> <a href="#">Collision Lab</a></p> <ul style="list-style-type: none"> <li>• <a href="#">Intro - Explore 1D &amp; Explore 2D</a> - Visualize collisions between molecules, including kinetic energy; can add reflecting border</li> <li>• <a href="#">Inelastic</a> - Visualize various inelastic collisions</li> </ul> <p><a href="#">Reaction &amp; Rates</a></p> <ul style="list-style-type: none"> <li>• <a href="#">Single Collisions</a> - For several reactions, change temperature and starting energy to see effect on rate</li> <li>• <a href="#">Many Collisions</a> - For several reactions, change temperature, number of molecules to see effect on rate</li> <li>• <a href="#">Rate Experiments</a> - Set starting conditions and visualize experiment results</li> </ul> <p><a href="#">Reversible Reactions</a> - Add molecules, change temperature and see effects</p> <p><b>Virtual PPTs:</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Reaction Energy</a> - Exothermic and endothermic PE diagrams</li> </ul>	<ul style="list-style-type: none"> <li>• activated complex</li> <li>• activation energy</li> <li>• catalyst</li> <li>• Collision Theory</li> <li>• common ion effect</li> <li>• enthalpy</li> <li>• entropy</li> <li>• equilibrium</li> <li>• heat of reaction</li> <li>• Kinetic Theory</li> <li>• Le Chatelier's Principle</li> <li>• rate of reaction</li> <li>• reversible reaction</li> <li>• spontaneous reaction</li> </ul>	<ul style="list-style-type: none"> <li>• Ticket Out</li> <li>• Think-Pair –Share</li> <li>• Formative Assessment</li> <li>• Weekly Quiz</li> <li>• Unit Test</li> <li>• Homework</li> <li>• Review Questions</li> <li>• DDI process using data from Edocrina &amp; Castle Learning to generate data</li> </ul> <p><b>Higher Level Questions:</b> Regents Exam: <a href="#">January 2019</a> Questions 74-76</p>

## BPS Science Department Chemistry – Unit 10

		<p>(change in pressure, volume, concentration, and temperature) on a system of equilibrium.</p> <p><b>4.1</b> – Observe and describe transmission of various forms of energy.</p> <p><b>4.1c</b> – Energy released or absorbed during a chemical reaction can be represented by a potential energy diagram.</p> <p><b>4.1d</b> – Energy released or absorbed during a chemical reaction (heat of reaction) is equal to the difference between the potential energy of the products and potential energy of the reactants.</p>	<ul style="list-style-type: none"> <li>● <a href="#">Kinetics</a> – Potential energy diagrams and factors affecting rate including catalysts</li> <li>● <a href="#">Equilibrium</a> - Equilibrium, Le Chatelier’s principle</li> </ul> <p><b>CK12:</b>  <a href="#">Fizzy vs. Flat Soda</a> -Interactive - Visualize dynamic equilibrium; recognize chemical equilibrium as equal rates, not equal concentrations; predict how pressure, volume, temperature and concentration will change the behavior of the system; observe equilibrium constant, real world connections</p> <p><b>Chemical Thinking:</b></p> <ul style="list-style-type: none"> <li>- <a href="#">Reaction Kinetics</a> - Kinetics Interactive - (modify factors on a potential energy diagram to see effects)</li> </ul>		
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### Resources

- <http://ngss.nsta.org/Classroom-Resources.aspx> - Searchable NYSSLS/NGSS aligned resources curated by NSTA
- [Buffalo Public Schools Science Department Chemistry Webpage](#) – BPS chemistry curriculum resource hub
- [BPS Science Department Recommended Virtual Labs](#) – Virtual lab resources with embedded links to virtual labs and student sheets. Must be logged into BPS google document account through BPS Gmail account to access.
- [NYS Regents Chemistry Exams 2012-2020](#) NYSED’s Office of State Assessment webpage for released Regents Chemistry Examinations
- [NYS MST Science Learning Standards Physical Setting/Chemistry](#) – Current NYS Physical Setting/Chemistry Standards
- [NYS P-12 Science Learning Standards \(HS\)](#) – NYSSLS High School Standards
- [Regents Chemistry Reference Tables](#) – Reference Tables for Regents Chemistry

<p><b>ELL Enhancement</b></p> <p>To access <a href="#">hyperlinked</a> material, you must be logged into your BPS Google Drive</p>	<p><b>Listening</b></p> <ul style="list-style-type: none"> <li>● <a href="#">Cross- Linguistic Practices:</a> Gives students opportunities to make connections between what they hear and their home language (For example, allow students to listen to a passage and identify cognates.)</li> <li>● <a href="#">Build background knowledge</a></li> <li>● <a href="#">Activating Prior Knowledge</a> Activating prior knowledge means</li> </ul>	<p><b>Speaking</b></p> <ul style="list-style-type: none"> <li>● <a href="#">Sentence Frames</a> - to begin a sentence - such as <i>Evolution is...</i> or <i>I think that evolution is...</i></li> <li>● <a href="#">Academic Conversation Starters:</a> Have a visual of a list of academic sentence starters that students can refer to in a discussion. Examples include-</li> </ul>	<p><b>Reading</b></p> <ul style="list-style-type: none"> <li>● <a href="#">Supplementary Text</a> to help reinforce concepts. If necessarily, use lower Lexile levels to ensure comprehension.</li> <li>● <a href="#">Visual Aids</a> - Pictures or models to support vocabulary words and concepts</li> <li>● Video to review or introduce a topic - use <a href="#">closed captioning</a> to help</li> </ul>	<p><b>Writing</b></p> <ul style="list-style-type: none"> <li>● <a href="#">Sentence Frames</a> - to begin a sentence- such as <i>Biodiversity is...</i> or <i>An example of competition is....</i></li> <li>● <a href="#">Cloze passages</a> with word banks</li> <li>● <b>Word banks</b></li> </ul>	<p><b>Instructional Accommodations (depending on the student’s needs)</b></p> <ul style="list-style-type: none"> <li>● <b>Extended time</b> for tests in class, projects and assignments</li> <li>● <b>Directions read.</b> Broken down as necessary</li> <li>● <b>Model</b> how to complete the activity in the lesson</li> </ul>
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## BPS Science Department Chemistry – Unit 10

	<p>both eliciting from students what they already know and building initial knowledge that they need in order to access upcoming content</p> <ul style="list-style-type: none"> <li>● <a href="#">Activating Prior Knowledge</a></li> <li>● <a href="#">Visuals</a> - GIFs, pictures- will assist students in understanding what they are listening to. Use <a href="#">visual thinking strategies</a> to set the lens for learning.</li> <li>● Video to review or introduce a topic – use <a href="#">closed captioning</a> to help students see the words and pronunciations while they listen to the content.</li> <li>● <a href="#">Word stretching / Vowel stretching</a> when instructing allows student to listen closely to the pronunciation of the word</li> <li>● <a href="#">Performance Level Descriptors</a> this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of listening Scroll for grades 9-12.</li> </ul>	<p>I expect ____ to happen. My data shows that... This helps students have a more science focused dialogue.</p> <ul style="list-style-type: none"> <li>● <a href="#">Choral Reading</a> - To build fluency, self-confidence and motivation with <a href="#">reading/speaking</a></li> <li>● Create <a href="#">movement</a> to go with the word. Movement can be a motivating factor, as well as a kinesthetic tool for conceptualizing the rhythm and flow of fluent reading while triggering brain function for optimal learning</li> <li>● <a href="#">Performance Level Descriptors</a> This document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of speaking. Scroll for grades 9-12</li> </ul>	<p>students read along while they listen to the content</p> <ul style="list-style-type: none"> <li>● <a href="#">4 Square / Frayer models</a> to help students gain a deeper understanding of vocabulary.</li> <li>● <a href="#">Highlighting</a> important text to assist students in answering questions after the reading.</li> <li>● <a href="#">Chunking</a>-Break reading of text into chunks or paragraphs</li> <li>● <a href="#">Vocabulary Morphology</a>- Morphology relates to the segmenting of words into affixes (prefixes and suffixes) and roots or base words, and the origins of words. Understanding that words connected by meaning can be connected by spelling can be critical to expanding a student’s vocabulary</li> <li>● <a href="#">Performance Level Descriptors</a> this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of reading. Scroll for grades 9-12.</li> </ul>	<ul style="list-style-type: none"> <li>● <a href="#">Graphic Organizers</a> to help break down the writing process and organize thoughts</li> <li>● <a href="#">Standards-based sentence stems</a></li> <li>● <a href="#">Performance Level Descriptors</a> this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of writing. Scroll for grades 9-12.</li> </ul>	<ul style="list-style-type: none"> <li>● <b>Oral simplification</b> of directions or questions</li> <li>● <b>Translated version</b> of test when available. Student may have both version English and native language version</li> <li>● Use of <a href="#">approved bilingual glossaries</a> from NYS in each subject</li> </ul>
<p><b>Special Education Modifications</b></p> <p>Special Education students must have accommodations as per Individual Educational Plan (IEP)</p>	<p><b>Instructional</b></p> <ul style="list-style-type: none"> <li>● <b>Pre-teach</b> vocabulary</li> <li>● Use <b>picture vocabulary</b></li> <li>● Scaffold <b>Depth of Knowledge</b> questions</li> <li>● Provide copy of notes/<b>notes in “cloze”</b> form</li> <li>● Use of <b>Think, Pair, and Share</b> strategy to help process information</li> <li>● <b>Scaffold</b> written assignments with the use of <b>graphic organizers</b></li> <li>● Allow for <b>multiple ways to respond</b> (verbal, written, response board)</li> <li>● Provide <b>model of performance task</b></li> <li>● <b>Modify informational text</b> to fit the needs of the students</li> <li>● Provide a digital or paper <b>interactive notebook</b></li> <li>● Present complex <b>tasks in multiple ways</b></li> <li>● Provide <b>mnemonic strategies</b> for Chemistry concepts</li> </ul>	<p><b>Technology:</b></p> <ul style="list-style-type: none"> <li>● <b>Audio</b> reading of text</li> <li>● <b>Text to type</b> functions</li> <li>● <b>Videos</b> to clarify/visualize Chemistry concepts</li> <li>● <b>Record class lecture/discussions</b> and make accessible to student</li> <li>● <b>Nearpod</b>- interactive presentations of notes</li> <li>● <b>Playposit</b> - show a video clip about the topic and add your own questions for them to answer as they watch</li> <li>● Allow students to type answers in chat on <b>Teams</b></li> </ul> <p><b>Other:</b></p> <ul style="list-style-type: none"> <li>● Arrange seating for maximum engagement and minimum distraction</li> <li>● Accessible lab space (counter level)</li> </ul>	<p><b>In Class Assessments</b></p> <ul style="list-style-type: none"> <li>● Provide <b>review packet or review sheet</b> of concepts covered on the test</li> <li>● Practice similar questions prior to the test</li> <li>● Provide <b>multiple options</b> for projects</li> <li>● Give a <b>timeline</b> of when things are due and remind them of the process often.</li> <li>● <b>Use of timer</b> in class</li> <li>● Break all complex tasks into chunks</li> </ul>		

## BPS Science Department Chemistry – Unit 10

<b>Step Up to Writing</b> Step Up to Writing materials can be found in BPS Science K-12 Schoology Folder 9-12 Resources Chemistry Resources Curriculum Materials	<b><u>SUTW Strategy</u></b> <ul style="list-style-type: none"><li>● Informal Outline</li><li>● Color-Coding – Informative/Explanatory Text</li><li>● Two-column notes</li><li>● I-V-F Topic Sentence progressing to Four Step Summary Paragraph</li><li>● CUPS – Capitalization, Usage, Punctuation, Spelling</li><li>● Transitions</li></ul>
<b>Culturally and Linguistically Responsive Teaching (CLRT) in the Science Classroom</b>	Materials, resources, and/or discussions address diverse cultural backgrounds and real-world applications <ul style="list-style-type: none"><li>● Artifacts (posters, charts, etc.) in the science classroom are representative of the cultures of the student population</li><li>● All students are given an opportunity to engage in science discourse</li><li>● Teacher demonstrates high expectations for all students</li></ul> CLRT resources which align to Science content are denoted with a *