2019 CHEM Unit 3: Bonding and Reactions

Content Area: **Science**
Course(s): **Chemistry**
Time Period: **January**
Length: **30 days**
Status: **Published**

Unit Overview:

In this unit of study, students develop and using models, plan and conduct investigations, use mathematical thinking, and construct explanations and design solutions as they develop an understanding of the substructure of atoms and to provide more mechanistic explanations of the properties of substances. Chemical reactions, including rates of reactions and energy changes, can be understood by students at this level in terms of the collisions of molecules and the rearrangements of atoms. Students also apply an understanding of the process of optimization and engineering design to chemical reaction systems. The crosscutting concepts of patterns, energy and matter, and stability and change are the organizing concepts for these disciplinary core ideas. Students are expected to demonstrate proficiency in developing and using models, planning and conducting investigations, using mathematical thinking, and constructing explanations and designing solutions.

Enduring Understandings:

- Spontaneous reactions tend to be reaction that produce more disorder and release heat.
- The efficiency of a reversible reaction can be increased by properly stressing the environment in which the reaction takes place.
- The rate of a chemical reaction is affected by various factors.

Essential Questions:

- Is it possible to change the rate of a reaction or cause two elements to react that do not normally want to?
- What can we do to make the products of a reaction stable?
- What is different inside a heat pack and a cold pack?
- Where do the atoms go during a chemical reaction?

Standards/Indicators/Student Learning Objectives (SLOs):

- 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. [Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.] [Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.]
- Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering

• 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. [Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.] [Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.]

• Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.* [Clarification Statement: Emphasis is on the application of Le Chatlier's Principle and on refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products.] [Assessment Boundary: Assessment is limited to specifying the change in only one variable at a time. Assessment does not include calculating equilibrium constants and concentrations.]

• Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.]

9-12.HS-ETS1-3	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.
9-12.HS-ETS1-4	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.
9-12.HS-PS1-3	Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
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.
9-12.HS-PS1-8	Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
9-12.HS-PS2-6	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
9-12.HS-PS1-7	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
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.
9-12.HS-PS1-7.5.1	students learn that the total amount of energy and matter in closed systems is conserved. They can describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
9-12.HS-PS1-4.PS1.A.1	A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart.
9-12.HS-PS1-6.PS1.B.1	In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present.

9-12.HS-PS1-5.PS1.B.1	Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.
9-12.HS-PS1-2.PS1.B.1	The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.
9-12.HS-PS1-4.PS1.B.1	Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.

Lesson Titles:

- Balancing Equations
- Enthalpy
- Entropy
- Equilibirium
- Equilibrium Constants
- Gibbs Free Energy
- Limits
- Math of Reactions
- Potential Energy Diagrams
- Rates of Reactions
- Spontaneity
- Stress

Career Readiness, Life Literacies & Key Skills

WRK.K-12.P.1	Act as a responsible and contributing community members and employee.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.

Inter-Disciplinary Connections:

LA.RST.11-12.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.11-12.2	Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

LA.RST.11-12.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
LA.RST.11-12.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
LA.RST.11-12.5	Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
LA.RST.11-12.6	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
LA.RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
LA.RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
LA.RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
LA.WHST.11-12.1.A	Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
LA.WHST.11-12.1.B	Develop claim(s) and counterclaims using sound reasoning and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline appropriate form that anticipates the audience’s knowledge level, concerns, values, and possible biases.
LA.WHST.11-12.1.C	Use transitions (e.g., words, phrases, clauses) to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
LA.WHST.11-12.1.D	Establish and maintain a style and tone appropriate to the audience and purpose (e.g., formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
LA.WHST.11-12.1.E	Provide a concluding paragraph or section that supports the argument presented.
MA.A-REI.A	Understand solving equations as a process of reasoning and explain the reasoning
MA.A-REI.D	Represent and solve equations and inequalities graphically
TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.1.12.C	Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
TECH.8.1.12.E	Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
TECH.8.1.12.F	Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
TECH.8.2.12	Technology Education, Engineering, Design, and Computational Thinking - Programming:

	All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.
TECH.8.2.12.E	Computational Thinking: Programming: Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.

Instructional Strategies, Learning Activities, and Levels of Blooms/DOK:

- Al/Cu Lab
- Balancing Game
- Balancing Notes
- Enthalpy Notes
- Entropy Lab
- Entropy Notes
- Equilibrium Activity
- Equilibrium Constants Notes
- Gibbs Free Energy Notes
- Limit Activity
- Math of Reactions Notes
- Potential Energy Diagram Notes
- Rates of Reactions Demonstrations
- Rates of Reactions Lab
- Spontaneity Notes
- Stress Lab
- Stress Notes

Modifications

ELL Modifications:

- 1:1 testing
- Be flexible with time frames and deadlines
- Digital translators
- Group students
- Offer alternate/modify assessments
- Offer resources for specific topics in primary language

- Provide formal and informal verbal interaction to provide practice
- Provide multiple literacy strategies
- Repeat, reword, clarify
- Tap prior knowledge
- Use real objects when possible

IEP & 504 Modifications:

- Allowing student to edit with teacher comments the first attempt at a graded assignment
- Breaking up larger assignments into shorter tasks with clear deadlines for each section
- Less problems/questions per page or assignment
- Modeling and showing lots of examples
- Non-verbal redirection of behaviors
- Provide a copy of the notes from class
- Provide paraphrased or modified reading materials at the student's reading level
- Provide student with content vocab prior to lesson that includes that vocab
- Provide study guides that pare down the material to study
- Pull student(s) aside for individualized teaching by the special ed teacher
- Rewording questions
- Teach main concept multiple ways over multiple days or interactions

G&T Modifications:

- Allow generation and testing of hypotheses
- Ask students higher level questions to make conclusions and connections
- Employ differentiated curriculum to keep interest high
- Encourage further exploration of topics through reading or investigations
- Offer additional activities that solicit a deeper understanding of the material
- Offer opportunities for peer leadership or mentoring
- Provide additional challenging problems
- Provide different test items
- Provide opportunities for inquiry based learning
- Refrain from having them complete more work in the same manner
- Require graphical analysis and interpretation

At Risk Modifications

- Assign a peer to help keep the student on task
- Break tests down into smaller increments

- Check in with student often to keep on task
- If possible, one on one testing or oral exams
- Increase interaction time between you and the student
- Make directions and instruction short and simple
- Modify or reduce assignments
- Preferential seating
- Provide hands on tasks when applicable
- Regular communication with parents and guardians

Formative Assessment:

- Demonstration
- Exit ticket
- Google survey
- Image/Video clip
- Kahoot
- KWL form
- Lesson summary
- Object
- Previous class review
- Question of the day
- Think-pair-share

Summative Assessment:

- Al/Cu Lab Report
- Entropy Lab Report
- Equilibrium Activity Post Lab
- Limit Activity Post Lab
- Marking Period Exam
- Quiz (balancing/rxn math)
- Rate of Reactions Lab Report
- Stress Lab Report
- Test (Rates and Heat)
- Test (Reactions)
- Test (Stress and Equilibrium)

Alternative Assessments

Performance tasks

Project-based assignments
Problem-based assignments
Presentations
Reflective pieces
Concept maps
Case-based scenarios
Portfolios

Benchmark Assessments

Skills-based assessment
Reading response
Writing prompt
Lab practical

Resources & Materials:

- American Association for the Advancement of Science: http://www.aaas.org/programs
- American Chemical Society: http://www.acs.org/content/acs/en/education.html
- International Technology and Engineering Educators Association: http://www.iteaconnect.org/
- Science NetLinks: http://www.aaas.org/program/science-netlinks

Technology:

- Chromebooks
- Concord Consortium: Virtual Simulations: http://concord.org/
- Graphing Calculators
- LoggerPro
- Phet: Interactive Simulations https://phet.colorado.edu/
- Temperature Probe

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.1.12.A	Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
TECH.8.1.12.C	Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
TECH.8.1.12.E	Research and Information Fluency: Students apply digital tools to gather, evaluate, and

	use information.
TECH.8.1.12.F	Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.