2019 CHEM Unit 1: Structure and Properties of Matter

Content Area: **Science**
Course(s): **Chemistry**
Time Period: **September**
Length: **60 days**
Status: **Published**

Unit Overview:

In this unit of study, students use investigations, simulations, and models to makes sense 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 are able to use the periodic table as a tool to explain and predict the properties of elements. Students are expected to communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. The crosscutting concepts of structure and function, patterns, energy and matter, and stability and change are called out as the framework for understanding the disciplinary core ideas. Students use developing and using models, planning and conducting investigations, using mathematical thinking, and constructing explanations and designing solutions. Students are also expected to use the science and engineering practices to demonstrate proficiency with the core ideas.

Enduring Understandings:

- All matter is made of atoms. There are a limited number of types of atoms; these are atoms.
- Atoms are conserved during physical and chemical changes.
- Atoms are so small they are difficult to study directly, and there fore we learn through macroscopic data collected during experimentation.
- Elements display trends with their properties when arranged by atomic number.
- Most chemical equations can be classified as one of five major types of reactions.
- Realizing that matter cannot be created nor destroyed, a balanced chemical equation is written which allows scientists within different organizations to produce products in the most efficient way.
- The atoms of each element have unique structures arising from interactions between electrons and nuclei.
- The use of the mole allows us to determine ratios of elements in a compound.
- The world has agreed to a set of rules for representing what happens during a chemical reaction.

Essential Questions:

- How are chemical and physical changes different?
- How are chemistry problems solved?
- How are solids, liquids, and gases of the same substance similar and how are they different?

- How did our understanding of matter's structure develop?
- How do chemists communicate/illustrate the location of the electrons and why is it important?
- How do chemists make measurements in chemical reactions?
- How do we determine the chemical formula of a substance?
- How does industry predict how much of a product can be obtained from a chemical reaction?
- How is matter classified?
- How is matter structured?
- How is the position of an element on the periodic table related to that element's properties?
- What are matter's different properties?
- What are the ways we can categorize chemical compounds?
- What are the ways we can classify chemical reactions?
- What does light and the electromagnetic spectrum have to do with electrons and energy?
- What is a mole and why do chemists use the mole concept?
- What is the key concept that determines how atom's behave?
- What is the relationship of energy and pressure to changes of state?
- What makes gases behave the way they do?
- What makes gases behave the way they do?
- Why are some compounds named with just the elements name like sodium chloride and others named with prefixes like carbon dioxide?
- Why do chemical reactions happen or not happen?

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.

Standards/Indicators/Student Learning Objectives (SLOs):

- Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.* [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.]
- Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [Assessment Boundary:

Assessment is limited to chemical reactions involving main group elements and combustion reactions.]

- 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.

- 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. [Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.]

- 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.

- Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.]

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-PS2-6	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
9-12.HS-PS1-2	Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
9-12.HS-PS1-1	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
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.

Lesson Titles:

- Atomic Structure
- Bonds
- Electron Configuration
- Formulas
- Heating Curve
- Ions
- Moles
- Periodic Table
- Phase Diagrams

- Polarity
- Properties of Matter
- Trends

Equity Considerations

Asian American and Pacific Islander Mandate

Topic (Person and Contribution Addresses): Students will engage in discussion centered around notable Asian Americans in the STEM field.

Materials Used: https://ideas.ted.com/8-asian-americans-and-pacific-islanders-whose-innovations-have-changed-your-life-really/

Addresses the Following Component of the Mandate:

- Social

Climate Change

Topic (Person and Contribution Addresses): Understanding the links between Chemistry and climate change. Students will engage in discussion centered around how chemistry plays a part in climate change.

Materials Used: https://www.openaccessgovernment.org/chemistry-climate-change/23849/

Addresses the Following Component of the Mandate:

- social

SCI.HS-ESS3-5	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

LGBTQ and Disabilities Mandate

Lessons will include multiple perspectives from the LGBTQ and Disabilities population, including John F. Nash (chemist that suffered from Schizophrenia).

https://www.nobelprize.org/prizes/economic-sciences/1994/nash/biographical/

STEM

LGBTQ:

Sir Francis Bacon (1561–1626)

Florence NightingaleFrancis Bacon | Philosophy, Scientific Method, & Facts | Britannica(1820-1910)

George Washington Carver (1861-1943)

Sara Josephine Baker (1873-1945)

Alan Turing (1912-1954)

Allan Cox (1926-1987)

Sally Ride (1951-2012)

Ben Barres (1954-2017)

Ruth Gates (1962-2018)

Tim Cook (1960)

Disabilities:

Leonardo da Vinci (1452-1519)- Dyslexia

Isaac Newton (1664-1727)- Epilepsy

Thomas Edison (1847-1931)- Hearing

Charles Darwin (1809-1882)- Stutter, Dyslexia

Alexander Graham Bell (1847-1922)- Deaf

Albert Einstein (1879-1955)- Aspergers

Florence B. Seibert (1897-1991)- Mobility

Stephen Hawking (1942-2019)- ALS

John Forbes Nash (1928-2015)-

Schizophrenia

Temple Grandin (1947)- Autism

- Social

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:

- Atomic Structure Simulation
- Basic of the PT Activity
- Basics of the Periodic Table
- Bonding Notes
- Building Lab
- Copper Lab
- Density Activity
- Electron Configuration Notes
- Equations Demonstrations
- Heating Curve Notes
- History of the Atom Reading Excerpt
- Hydrate Lab
- Ion Activity
- Isotopes Simulation
- Mole Notes
- Nomenclature Games
- Nomenclature Notes
- Periodic Table Puzzle
- Phase Diagram Notes

- Phase Lab
- Polarity Activity
- Spectra Lab
- Trends Activity
- Types of Equations Activity

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:

- Copper Lab Report
- Hydrate Lab Report
- Marking Period Exam
- Phase Lab Report
- Quiz (Basic Skills and Density)
- Quiz (Electron configuration)
- Quiz (Energy and Phases)
- Quiz (Equations)
- Quiz (Nomenclature)
- Quiz (Periodic Table)
- Quiz (Single and Double Replacement)
- Spectra Lab Report
- Test (Atom & Periodic Table)
- Test (Compounds)
- Test (Matter)
- Test (Reactions)

Resources & Materials:

- Castle of Mendeleev: Students engage in a fantasy world that requires them to make claims, based on evidence, regarding the identity of unknown materials.
http://www.newburyparkhighschool.net/dogancay/hchem/labs/hlab02_mendeleev.pdf
- Path to Periodic Table: This investigation provides students with the opportunity to make sense of how and why the periodic table is organized the way that it is. Students will re-create the thought process that Dmitri Mendeleev and Julius Lothar Meyer went through to devise their early periodic tables.
http://www.chemheritage.org/discover/online-resources/chemistry-in-history/activities/path-to-the-periodic-table.aspx
- Shall We Dance? – Classifying Types of Chemical Reactions: Students identify and differentiate between four types of chemical reactions: synthesis, decomposition, single replacement and double replacement. Students also develop models for chemical reactions and identify the limitations of the models using evidence.

Technology:

- Build an Atom: This simulation allows students to create different illustrations of atoms and provides evidence that protons determine the identity of the element.
http://phet.colorado.edu/en/simulation/build-an-atom
- Chromebooks
- Graphing Calculators

- LoggerPro
- Periodic Table Trends: This is a virtual investigation of the periodic trends.
http://www.mhhe.com/biosci/genbio/virtual_labs/periodic_table/main.html
- 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.

Alternative Assessments

Alternative assessments:

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