



Park Hill School District

Building Successful Futures • Each Student • Every Day

Topics Chemistry I

This document contains the entire Chemistry I Curriculum that is taught in a regular education setting. Items that are highlighted and have the word **TOPICS preceding have been designated as priority information to be taught in the Biology I class. Items in italics are additional modifications suggested by special education teachers.*

Course Description: This hands-on laboratory course is central to the foundation of all sciences. The course has some emphasis on mathematical applications, real-world scenarios, and problem solving. Topics of study include scientific processes, atoms and the periodic table, structure of matter and its properties, chemical reactions, quantitative relationships using the mole, rates of reactions, equilibrium, energy transformation, nuclear energy, and electromagnetic radiation.

Course Standards: Missouri Department of Elementary and Secondary Education

Scope and Sequence:

Timeframe	Unit	Instructional Topics
TOPICS: 10 blocks	<i>Unit 0: Review of Science Processes</i>	<i>Topic 1: Experimental Design</i> <i>Topic 2: Graphical Analysis</i> <i>Topic 3: Lab Safety</i> <i>Topic 4: SI Units</i>
15 blocks TOPICS: 12 blocks	<u>Atoms & Periodic Table</u>	<u>Topic 1: Safety and SI Units</u> -move to unit 0 <u>Topic 2: Atomic Structure</u> <u>Topic 3: Isotopes</u> <u>Topic 4: Periodic Table</u> <u>Topic 5: Periodic Table Trends</u>
14 blocks	<u>Compounds & Bonding</u>	<u>Topic 1: Types of Bonds</u> <u>Topic 2: Ions and Ionic Compounds</u> <u>Topic 3: Molecular Compounds</u>
10 blocks	<u>Mixtures & Matter</u>	<u>Topic 1: States of Matter & Intermolecular Forces</u> <u>Topic 2: Physical and Chemical Properties</u> <u>Topic 3: Classification of Matter</u> <u>Topic 4: Polarity and Solubility</u> <u>Topic 5: Separation Techniques</u>
10-12 blocks TOPICS: 9-11 blocks	<u>Chemical Reactions</u>	<u>Topic 1: Physical and Chemical Changes</u> <u>Topic 2: Chemical Reactions</u> <u>Topic 3: Balancing Chemical Equations</u> <u>Topic 4: Reaction Rates/Kinetics</u>
12 blocks TOPICS: 8 blocks	<u>Stoichiometry Foundations</u>	<u>Topic 1: Dimensional Analysis</u> <u>Topic 2: The Mole Concept</u> <u>Topic 3: Stoichiometry</u>
11 blocks TOPICS: 9 blocks	<u>Energy & Thermochemistry</u>	<u>Topic 1: Energy</u> <u>Topic 2: Specific Heat</u> <u>Topic 3: Nuclear Energy</u>
6 blocks TOPICS: 8 blocks	<u>Acids & Bases</u>	<u>Topic 1: Acids and Bases</u> <u>Topic 2: Neutralization</u> <u>Topic 3: Equilibrium</u>

Unit 0: Review of Scientific Processes

Subject: Chemistry I

Grade: 10

Name of Unit: Review of Scientific Processes

Length of Unit: 10 blocks

Overview of Unit: This unit is an introduction to scientific practices such as lab equipment and procedures, as well as analyzing and displaying data in science. Students will become familiar with qualitative and quantitative measurements used in lab experiments and how to approach a problem thinking logically and scientifically. Topics include: Experimental design, graph analysis, lab safety and SI (International System of Units) units.

Priority Standards for unit:

- *MTE.1.C.c1 - Demonstrate familiarity with good laboratory practice*

Supporting Standards for this unit:

- *9-12.ETS1.B.1- 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.*

Essential Questions:

1. *Why is lab safety important in chemistry?*
2. *How is experimental design used as a means to conduct scientific investigations?*
3. *How are quantitative and qualitative measurements observed and analyzed in scientific experiments?*
4. *Why is it useful to display data and experimental evidence in charts or graphs?*

Enduring Understanding/Big Ideas:

1. *Lab safety is important in the chemistry lab to ensure that learning can occur in a safe environment free from distractions or harmful interactions.*
2. *Experiments are used to test hypotheses in scientific investigations. Designing reliable and valid experiments are necessary to collect, analyze, and communicate data and results that focus on scientific concepts.*

3. *Quantitative and qualitative measurements can be collected using scientific tools of measurement. Measurements are recorded using the metric system. Measurements can be evaluated on their accuracy and precision.*
4. *Charts and graphs are a way to visually represent data. These representations can provide an analysis and summary of scientific result*

Topic 1: Experimental Design

Engaging Experience 1

Title: Experimental Design Activity

Suggested Length of Time: 1 day

Standards Addressed

Priority:

- *MTE.1.C.c1 - Demonstrate familiarity with good laboratory practice.*

Detailed Description/Instructions: *Students will read a scenario and determine the variables and proper components needed to develop a lab.*

Bloom's Levels:

Understanding

Webb's DOK: 3

Topic 2: Graphical Analysis

Engaging Experience 1

Title: *Graphing Activity*

Suggested Length of Time: 60 minutes

Standards Addressed

Priority:

- *ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.*

Detailed Description/Instructions: *Students will use data to construct and analyze line graphs.*

Bloom's Levels: *Analyze*

Webb's DOK: 2

Topic 3: Lab Safety

TOPICS: Engaging Experience 1 - moved from unit 1 to unit 0 if possible.

Title: Safety Poster/ 1 pager

Suggested Length of Time: 1 day

Standards Addressed

Priority:

- **MTE.1.C.c1** - Demonstrate familiarity with good laboratory practice

Detailed Description/Instructions: Students create a visual aid covering safety aspects for the chemistry lab. Rules come from the Flinn/Carolina Lab Safety Contract. Students are required to turn in a signed safety contract.

Bloom's Levels: Apply

Webb's DOK: 2

Potential accommodations/modifications/alternate activities: Offer word bank of key vocabulary words to use; offer sentence stems; provide sample of finished product; chunk into smaller segments, provide outline/rubric for organization.

Topic 4: SI units

TOPICS: Engaging Experience 2

Title: Measurement Challenge

Suggested Length of Time: 1 day

Standards Addressed

Priority:

- **MTE.1.C.c1** - Demonstrate familiarity with good laboratory practice

Detailed Description/Instructions: Students will practice measuring with SI units through hands-on activities, such as estimating how many centimeters their straw will travel before measuring the actual distance. They will compare their predictions to their measured results, helping them build familiarity with different SI units. As an extension, students can search the classroom for objects they believe match specific measurements, allowing them to apply and demonstrate their growing understanding of units.

Bloom's Levels: Apply

Webb's DOK: 2

Potential accommodations/modifications/alternate activities: Allow students to work with a peer on this activity; provide visuals to aid in metric unit conversions.

Engaging Scenario: *Rainbow Measurement Precision Lab: Students will use science equipment to work on precision and accuracy when following instruction/task analysis for a lab. Students will observe, analyze, identify if their measurements and ability to follow directions were precise and accurate to show an end result of a row of test tubes that show the colors of the rainbow when accurately and precisely followed steps/measurement.*

Unit 1: Atoms & Periodic Table

Subject: Chemistry 1

Grade: 10

Name of Unit: Atoms & Periodic Table

Length of Unit: 15 blocks **TOPICS:** 12 blocks

Overview of Unit: This unit will introduce the structure of the atom and how it is related to the chemical properties of an atom and the arrangement of elements on the periodic table. Students will become familiar with the function of valence electrons and how they are used to form chemical bonds between different types of elements.

Priority Standards for unit: TOPICS

- **TOPICS: MTE.1.C.c1** - Demonstrate familiarity with good laboratory practice
- **TOPICS: 9-12.PS1.A.1** - Use the organization of the periodic table 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.]

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
● TOPICS: Use a model to predict the relationships between systems or between components of a system (A.1) ● TOPICS: Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (A.2)	● TOPICS: Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. ● TOPICS: The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. ● <i>The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer</i>	● TOPICS- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (A.1), (A.2)

	<i>electron states. <u>This is repeated DCI</u></i>	
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TOPICS: Priority Standard: MTE.1.C.c1 - Demonstrate familiarity with good laboratory practice	
Learning Targets	Webb's DOK Level
	Bloom's Level
TOPICS: I can set up, use, and clean lab equipment safely and correctly.	2
	Apply
TOPICS: I can explain how good lab skills and careful data recording help chemists understand reactions and make accurate conclusions.	2
	Apply

TOPICS: Priority Standard: 9-12.PS1.A.1 - Use the organization of the periodic table to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Learning Targets	Webb's DOK Level
	Bloom's Level
TOPICS: Students will be able to identify the number of valence electrons of an element from its location on the periodic table	1
	Understanding
TOPICS: Students will be able to predict which elements will have similar properties.	2
	Applying
TOPICS: Students will be able to determine the number of subatomic particles given a specific element/isotope.	3
	Analyzing
TOPICS: Students will be able to identify the family of an element based on its location on the periodic table.	2
	Applying
Students will be able to predict trends of elements such as atomic radius, electronegativity, and ionization energy.	3
	Analyzing

Essential Questions:

1. How do we safely and accurately measure using SI units in a laboratory setting?
2. What is an atom composed of and how can subatomic particles be determined?
3. What is an isotope and how does it affect the average atomic mass of an element?
4. How does the organization of the periodic table help us predict the properties of elements?
5. How can we use the periodic table to accurately predict trends such as atomic radius, electronegativity, and ionization energy?

Enduring Understanding/Big Ideas:

1. Accurate scientific work depends on consistent measurement practices; using SI units and proper lab techniques ensures that data are reliable, comparable, and safe to collect.
2. Atoms are composed of subatomic particles whose number and arrangement determine an element's identity, charge, and chemical behavior.
3. Atoms of the same element can vary in neutron number, forming isotopes, and the weighted average of these isotopes determines an element's atomic mass.
4. The periodic table is organized by atomic number in a way that reveals repeating patterns in element properties and allows scientists to predict behavior.
5. The periodic table is a predictive model that organizes elements by atomic structure, allowing scientists to identify patterns and anticipate chemical properties and behavior.

Unit Vocabulary:

Academic Cross-Curricular Words	Content/Domain Specific
Celsius (°C) temperature scale Centimeter (cm) Gram (g) Kelvin (K) temperature scale Kilogram (kg) Line graph Liter (L) Mass Measured numbers Meter (m) Metric System/International System of Units (SI) Milliliter (mL) Second (s) Volume (V)	Alkali metals Alkaline earth metals Amu Atom Atomic number Atomic radius Average atomic mass Electron Electronegativity Group Halogens Hyphen notation Ionization Energy Isotope Mass number Metalloids Metals Neutron Noble gases Nonmetals Nucleus Nuclide notation Period Proton Transition metals Valence electron

Topic 1: Safety and SI Units - move to unit 0

TOPICS: Engaging Experience 1 - move to unit 0

Title: Safety Poster/ 1 pager

Suggested Length of Time: 1 day

Standards Addressed

Priority:

- **MTE.1.C.c1** - Demonstrate familiarity with good laboratory practice

Detailed Description/Instructions: Students create a visual aid covering safety aspects for the chemistry lab. Rules come from the Flinn/Carolina Lab Safety Contract. Students are required to turn in a signed safety contract.

Bloom's Levels: Apply

Webb's DOK: 2

Potential accommodations/modifications/alternate activities: Offer word bank of key vocabulary words to use; offer sentence stems; provide sample of finished product; chunk into smaller segments, provide outline/rubric for organization.

TOPICS: Engaging Experience 2 - move to unit 0

Title: Measurement Challenge

Suggested Length of Time: 1 day

Standards Addressed

Priority:

- **MTE.1.C.c1** - Demonstrate familiarity with good laboratory practice

Detailed Description/Instructions: Students will practice measuring with SI units through hands-on activities, such as estimating how many centimeters their straw will travel before measuring the actual distance. They will compare their predictions to their measured results, helping them build familiarity with different SI units. As an extension, students can search the classroom for objects they believe match specific measurements, allowing them to apply and demonstrate their growing understanding of units.

Bloom's Levels: Apply

Webb's DOK: 2

Potential accommodations/modifications/alternate activities: Allow students to work with a peer on this activity; provide visuals to aid in metric unit conversions.

Topic 2: Atomic Structure

TOPICS: Engaging Experience 1

Title: PhET Building an Atom

Suggested Length of Time: 1 Day

Standards Addressed

Priority:

- **9-12.PS1.A.1** - Use the organization of the periodic table to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Detailed Description/Instructions: Students will use the PhET “Build an Atom” simulation (<https://phet.colorado.edu/en/simulations/build-an-atom>) to investigate atomic structure and identify subatomic particles. The simulation also provides an accessible way to introduce concepts such as charge and stability. As an extension, students can complete the built-in games for immediate feedback and reinforcement of their understanding.

Bloom’s Levels: Applying

Webb’s DOK: 2

Potential accommodations/modifications/alternate activities: Create a variety of atomic structure models using different mediums (use of candy, art products, drawing, cut/paste, etc), when using phet activity utilize vivi/projector for guidance in instruction while students are mirroring on their laptops moving to independence.

Topic 3: Isotopes

Engaging Experience 1

Title: M&M Isotope Lab

Suggested Length of Time: 1

Standards Addressed

Priority:

- **9-12.PS1.A.1** - Use the organization of the periodic table to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Detailed Description/Instructions: Students model the abundance of isotopes using different colors of M&Ms. Students calculate the average atomic mass, given mass of specific isotopes correlating to different M&M colors.

Bloom's Levels: Applying

Webb's DOK: 2

Engaging Experience 2

Title: PhET Isotopes & Atomic Mass

Suggested Length of Time:

Standards Addressed

Priority:

- **9-12.PS1.A.1** - Use the organization of the periodic table to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Detailed Description/Instructions: Students will use the PhET “Isotope and Atomic Mass” simulation (<https://phet.colorado.edu/en/simulations/isotopes-and-atomic-mass>) to explore subatomic particles related to isotopes and practice calculating average atomic mass.

Bloom's Levels: Applying

Webb's DOK: 2

Topic 4: Periodic Table

TOPICS: Engaging Experience 1

Title: Label and Annotate the Periodic Table

Suggested Length of Time: 1 day

Standards Addressed

Priority:

- **9-12.PS1.A.1** - Use the organization of the periodic table to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Detailed Description/Instructions: Students will use color to label and annotate key features of the periodic table, such as element families, metals and nonmetals, valence electron patterns, and the arrangement of groups and periods.

Bloom's Levels: Understanding

Webb's DOK: 1

Potential Accommodations/Modifications/alternate activities: Students create their own periodic table using names/visuals of common items (ex: a candy periodic table) where students will work on organizing different types of candy into a periodic table that represents an organizational pattern.

Topic 5: Periodic Table Trends

Engaging Experience 1

Title: Periodic Table Trends Graphing

Suggested Length of Time: 1 day

Standards Addressed

Priority:

- **9-12.PS1.A.1** - Use the organization of the periodic table to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Detailed Description/Instructions: Students will investigate periodic trends such as ionization energy and electronegativity by graphing element data. Through this activity, they will strengthen their graphing skills, identify patterns in the trends, and answer questions that deepen their understanding of how these properties change across the periodic table.

Bloom's Levels: Understanding

Webb's DOK: 1

Engaging Scenario

TOPICS Engaging Scenario: Element Wanted Poster: In this scenario, students pick a specific common element to research. Information that students would gather includes the element's atomic structure, *isotopes(omit?)*, physical and chemical properties, and examples of compounds that it forms. The project would be presented in the format of a Wanted Poster and placed around the room as a gallery walk.

Potential Accommodations/Modifications/alternate activities: Offer word bank of key vocabulary words to use; offer sentence stems; provide sample of finished product; chunk into smaller segments, provide outline/rubric for organization.

Summary of Engaging Learning Experiences for Topics

Topic	Engaging Experience Title	Description	Suggested Length of Time
TOPICS: Safety and SI Units	Safety Poster/ 1 pager	Students create a visual aid covering safety aspects for the chemistry lab. Rules come from the Flinn/Carolina Lab Safety Contract. Students are required to turn in a signed safety contract.	1 day
TOPICS: Safety and SI Units	Measurement Olympics	Students will practice measuring with SI units through hands-on activities, such as estimating how many centimeters their straw will travel before measuring the actual distance. They will compare their predictions to their measured results, helping them build familiarity with different SI units. As an extension, students can search the classroom for objects they believe match specific measurements, allowing them to apply and demonstrate their growing understanding of units.	1 day
TOPICS: Atomic Structure	PhET Building an Atom	Students will use the PhET “Build an Atom” simulation (https://phet.colorado.edu/en/simulations/build-an-atom) to investigate atomic structure and identify subatomic particles. The simulation also provides an accessible way to introduce concepts such as charge and stability. As an extension, students can complete the built-in games for immediate feedback and reinforcement of their understanding.	1 day

Isotopes	M&M Isotope Lab	Students model the abundance of isotopes using different colors of M&Ms. Students calculate the average atomic mass, given mass of specific isotopes correlating to different M&M colors.	1 day
Isotopes	PhET Isotopes & Atomic Mass	students will use the PhET “Isotope and Atomic Mass” simulation (https://phet.colorado.edu/en/simulations/isotopes-and-atomic-mass) to explore subatomic particles related to isotopes and practice calculating average atomic mass.	1 day
TOPICS: Periodic Table	Label and Annotate the Periodic Table	Students will use color to label and annotate key features of the periodic table, such as element families, metals and nonmetals, valence electron patterns, and the arrangement of groups and periods.	1 day
Periodic Trends	Periodic Table Trends Graphing	Students will investigate periodic trends such as ionization energy and electronegativity by graphing element data. Through this activity, they will strengthen their graphing skills, identify patterns in the trends, and answer questions that deepen their understanding of how these properties change across the periodic table.	1 day

Unit 2: Compounds & Bonding

Subject: Chemistry I

Grade: 10

Name of Unit: Compounds & Bonding

Length of Unit: 14 blocks

Overview of Unit: In this unit, students build on atomic structure and periodic trends to explain how and why atoms form ionic and covalent bonds. Using the periodic table as a predictive tool, students determine ion formation, bond type, and compound structure, then model electron transfer and sharing through Lewis structures and formula writing. Laboratory investigations connect particle-level electrostatic forces to observable properties such as conductivity, solubility, and melting point. Students also develop fluency in naming and writing formulas for ionic and molecular compounds, reinforcing how chemical nomenclature communicates composition and ratios. Throughout the unit, emphasis is placed on using models and evidence to link microscopic structure to macroscopic properties.

Priority Standards for unit:

- **TOPICS: 9-12.PS1.A.1** - Use the organization of the periodic table 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.]*
- **TOPICS: 9-12.PS1.A.4** - Apply the concepts of bonding and crystalline/molecular structure to explain the macroscopic properties of various categories of structural materials, i.e. metals, ionic (ceramics), and polymers. *[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.]*
- **TOPICS: 9-12.PS1.B.3** - Use symbolic representations and mathematical calculations 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.]*

Supporting Standards for unit:

- **9-12.PS1.A.3** - Plan and conduct an investigation to gather evidence to compare physical and chemical properties of substances such as melting point, boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive 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.]

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
● TOPICS: Use a model to predict the relationships between systems or between components of a system. (A.1) ● TOPICS: Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (A.4)	● TOPICS: Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (A.1) ● TOPICS: The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (A.1) ● Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (A.1) ● A substance will have certain macroscopic properties due to the types of bonds and arrangements between the atoms that make up the substance. Atoms that form ionic bonds typically have distinct characteristics because of the lattice framework. Covalently bonded molecules have certain properties. (A.4)	● TOPICS: Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (A.1), (A.4)

TOPICS: Priority Standard: 9-12.PS1.A.1 - Use the organization of the periodic table to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Learning Targets	Webb's DOK Level
	Bloom's Level
TOPICS: Students will identify ionic vs. covalent compounds given their name, formula, or location of elements on the periodic table.	2
	Applying
TOPICS: Students will identify the ionic charge of an element based on its location on the periodic table.	2
	Applying

Priority Standard: 9-12.PS1.A.4 - Apply the concepts of bonding and crystalline/molecular structure to explain the macroscopic properties of various categories of structural materials, i.e. metals, ionic (ceramics), and polymers.

Learning Targets	Webb's DOK Level
	Bloom's Level
TOPICS: Students will identify the properties of covalently bonded compounds.	2
	Applying
TOPICS: Students will identify the properties of ionically bonded compounds.	2
	Applying

Priority Standard: 9-12.PS1.B.3 - Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Learning Targets	Webb's DOK Level
	Bloom's Level
TOPICS: Students will be able to name ionic and covalent compounds.	1
	Remembering
TOPICS: Students will be able to write formulas for ionic and covalent compounds.	2
	Applying Understanding
TOPICS: Students will successfully draw Lewis structures and connect it to how valence electrons contribute to bonding.	2
	Applying

Essential Questions:

1. Why do atoms form chemical bonds?
2. How does the type of bonding affect a substance's physical and chemical properties?
3. How do ions form and interact to create ionic compounds?
4. How does the naming system reveal the composition and structure of a compound?
5. How can models represent bonding and electron behavior?

Enduring Understanding/Big Ideas:

1. Atoms bond to achieve stable electron configurations, forming new substances with distinct properties.
2. The type of bond (ionic, covalent, metallic) influences properties such as melting point, solubility, conductivity, and reactivity.
3. Ionic bonds form through electrostatic attraction between oppositely charged ions.
4. Standardized chemical nomenclature communicates the elements, ratios, and structure of compounds clearly and consistently.
5. Lewis structures and Electron Dot Diagrams visualize valence electrons and predict bonding patterns.

Unit Vocabulary:

Academic Cross-Curricular Words	Content/Domain Specific
	- Anion - Cation - Chemical formula - Covalent bond - Electron - Formula unit - Ion - Ionic bond - Lewis (electron) dot structure - Metalloids - Metals - Molecules - Nonmetals - Octet rule - Valence electron

Topic 1: Types of Bonds

TOPICS: Engaging Experience 1

Title: Bonding POGIL (Process-Oriented Guided-Inquiry Learning)

Suggested Length of Time: ½ Block

Standards Addressed

Priority:

- **9-12.PS1.A.1** - Use the organization of the periodic table to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Detailed Description/Instructions: Students will use a POGIL activity to recognize patterns and predict the differences between ionic and molecular compounds. The activity builds on their prior understanding of where metals and nonmetals are located on the periodic table. By the end, students will apply these patterns to predict which elements will combine to form specific types of compounds.

Bloom's Levels: Applying

Webb's DOK: 2

Potential Accommodations/Modifications/alternate activities: Classification/sorting (metals and non-metals, ionic and molecular) to help students predict differences; provide POGIL activity through vivi/projector as whole class discussion while students are completing activity.

TOPICS: Engaging Experience 2

Title: Bonding Inquiry Activity

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **9-12.PS1.B.3** - Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Detailed Description/Instructions: Students model valence electrons with red and blue beads on laminated Bohr model cards. Students work in groups to try and figure out how many electrons are transferred or shared to give all atoms a full octet. Students then draw Lewis structures, write formulas, and explain the behavior of valence electrons in the bond.

Bloom's Levels: Applying

Webb's DOK: 2

Potential Accommodations/Modifications/alternate activities: Bohr model diagrams can also be made using other items such as M&M's, skittles, Fruit loops, etc.

Engaging Experience 3

Title: Ionic and Covalent Lab

Suggested Length of Time: 1 Block

Standards Addressed

Priority:

- **9-12.PS1.A.4** - Apply the concepts of bonding and crystalline/molecular structure to explain the macroscopic properties of various categories of structural materials, i.e. metals, ionic (ceramics), and polymers.

Detailed Description/Instructions: Students compare the physical and chemical properties of several common ionic and molecular substances by observing how they behave when heated, dissolved, and tested for conductivity. Throughout the activity, they record observations and look for patterns that connect these properties to the type of bonding present.

Bloom's Levels: Applying

Webb's DOK: 2

Topic 2: Ions and Ionic Compounds

TOPICS: Engaging Experience 1

Title: Ionic Compound Lab

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **9-12.PS1.A.4** - Apply the concepts of bonding and crystalline/molecular structure to explain the macroscopic properties of various categories of structural materials, i.e. metals, ionic (ceramics), and polymers.

Supporting:

- **9-12.PS1.A.3** - Plan and conduct an investigation to gather evidence to compare physical and chemical properties of substances such as melting point, boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive forces between particles.

Detailed Description/Instructions: Students will combine various aqueous ionic solutions in a well plate to carry out micro-scale reactions. They will record their observations, identify the precipitates that are formed, and write and name the ionic compound produced.

Bloom's Levels: Applying

Webb's DOK: 2

Potential Accommodations/Modifications/alternate activities: Focus on analyzing the changes occurring in rxn when substance is heated or cooled; work on writing and naming the compound produced in a whole group instruction/discussion.

TOPICS: Engaging Experience 2**Title:** Naming Patterns in Ionic Compounds**Suggested Length of Time:** 1 block**Standards Addressed****Priority:**

- **9-12.PS1.B.3** - Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Detailed Description/Instructions: Students work through a guided inquiry activity to determine the patterns of naming and writing formulas for ionic compounds.**Bloom's Levels:** Applying**Webb's DOK:** 2

Potential Accommodations/Modifications/alternate activities: Compound formula/name sorting game (Matching, Go Fish, etc); provide step-by-step instructions/visuals when writing or naming ionic compounds; provide visuals showing which element types combine to form an ionic compound.

Topic 3: Molecular Compounds

TOPICS: Engaging Experience 1

Title: Patterns in Naming Molecular Compounds

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **9-12.PS1.B.3** - Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Detailed Description/Instructions: Students use a table of covalent compound names and formulas to determine the rules for molecular nomenclature.

Bloom's Levels: Applying

Webb's DOK: 2

Potential Accommodations/Modifications/alternate activities: Compound formula/name sorting game (Matching, Go Fish, etc); provide step-by-step instructions/visuals when writing or naming molecular compounds; provide visual showing which element types combine to form a molecular compound.

Engaging Scenario

Engaging Scenario: Sports Drink Lab: Students investigate why some sports drinks function as better electrolyte solutions by comparing the conductivity of different beverages and connecting those results to the behavior of ions in solution. Because electrolytes come from ionic compounds that dissociate into charged particles when dissolved in water, drinks with more dissolved ions conduct electricity more effectively. Using conductivity probe, students test a variety of beverages from distilled water to Pedialyte Plus to observe how the presence and concentration of ions influence conductivity. As they analyze their data, students distinguish between ionic compounds that break apart into mobile ions and molecular substances like sugar that dissolve but do not conduct electricity. The investigation helps students link real-world products to particle-level chemistry, showing how the number and type of ions in a solution determine how well an electrolyte drink can support hydration and performance.

Household product research: Students will research a household product which is chemically combined through Ionic or Molecular bonding (Carbon Dioxide, Table Salt, pure water, baking soda, Sugar, etc) and will determine the type of bonding and recall the "why" as to it being a certain bond. Students will also show review in identifying elements found in the

chemical formula and how represented on the periodic table, number of atoms in the chemical formula, physical/chemical characteristics of each element in the product vs. physical/chemical characteristics of the household product researching. Students will also identify uses of the product, safety precautions, etc.

Summary of Engaging Learning Experiences for Topics

Topic	Engaging Experience Title	Description	Suggested Length of Time
TOPICS: Types of Bonds	Bonding POGIL	Students will use a POGIL activity to recognize patterns and predict the differences between ionic and molecular compounds. The activity builds on their prior understanding of where metals and nonmetals are located on the periodic table. By the end, students will apply these patterns to predict which elements will combine to form specific types of compounds.	½ Block
TOPICS: Types of Bonds	Bonding Inquiry Activity	Students model valence electrons with red and blue beads on laminated Bohr model cards. Students work in groups to try and figure out how many electrons are transferred or shared to give all atoms a full octet. Students then draw Lewis structures, write formulas, and explain the behavior of valence electrons in the bond.	1 Block
TOPICS: Types of Bonds	Ionic and Covalent Lab	Students compare the physical and chemical properties of several common ionic and molecular substances by observing how they behave when heated, dissolved, and tested for conductivity. Throughout the activity, they record observations and look for patterns that connect these properties to the type of bonding present.	1 Block
Ions and Ionic Compounds	Ionic Compound Lab	Students will combine various aqueous ionic solutions in a well plate to carry	

		out micro-scale reactions. They will record their observations, identify the precipitates that are formed, and write and name the ionic compound produced.	
TOPICS: Ions and Ionic Compounds	Naming Patterns in Ionic Compounds	Students work through a guided inquiry activity to determine the patterns of naming and writing formulas for ionic compounds.	1 Block
TOPICS: Molecular Compounds	Patterns in Naming Molecular Compounds	Students use a table of covalent compound names and formulas to determine the rules for molecular nomenclature.	1 Block

Unit 3: Mixtures & Matter

Subject: Chemistry 1

Grade: 10

Name of Unit: Mixtures & Matter

Length of Unit: 10 blocks

Overview of Unit: In this unit, students investigate how particle-level interactions determine the observable properties of matter. Through classification activities and laboratory investigations, students distinguish between pure substances and mixtures and analyze physical and chemical properties such as density, solubility, melting behavior, and conductivity. Emphasis is placed on how intermolecular forces and polarity influence state of matter, phase changes, and solubility patterns. Students plan and conduct investigations to gather evidence, then use that data to explain how differences in particle attraction account for macroscopic behavior and enable separation of mixtures through physical processes.

Priority Standards for unit:

- **TOPICS: 9-12.PS1.A.3** - Plan and conduct an investigation to gather evidence to compare physical and chemical properties of substances such as melting point, boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive 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.]

Supporting Standards for unit:

- **9-12.PS1.A.4** - Apply the concepts of bonding and crystalline/molecular structure to explain the macroscopic properties of various categories of structural materials, i.e. metals, ionic (ceramics), and polymers. [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.]

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
● TOPICS: Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (A.3)	● TOPICS: The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (A.3) ● A substance will have certain macroscopic properties due to the types of bonds and arrangements between the atoms that make up the substance. Atoms that form ionic bonds typically have distinct characteristics because of the lattice framework. Covalently bonded molecules have certain properties. (A.4) ● Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (A.3)	● TOPICS: Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (A.4)

TOPICS: Priority Standard: 9-12.PS1.A.3 - Plan and conduct an investigation to gather evidence to compare physical and chemical properties of substances such as melting point, boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive forces between particles.	
Learning Targets	Webb's DOK Level
	Bloom's Level
Students can identify the main types of intermolecular forces.	2
	Applying
TOPICS: Students can identify physical and chemical properties of a substance.	2
	Applying
TOPICS: Students can classify matter as elements, compounds, homogenous mixtures, and heterogenous mixtures.	2
	Applying
Students can identify the intermolecular forces of polar and nonpolar substances.	2
	Applying

Essential Questions:

1. How do the attractions between particles affect a substance's state and properties?
2. How do you identify a physical vs chemical property?
3. How can matter be classified based on composition?
4. How does polarity affect whether a substance will dissolve in another?
5. How can mixtures be separated without changing their components?

Enduring Understanding/Big Ideas:

1. The physical state of matter and many of its observable properties depend on the strength and type of intermolecular forces between particles.
2. Pure substances have fixed composition; mixtures are physical combinations with variable ratios.
3. Solubility depends on interactions between solute and solvent particles, including polarity.
4. Polarity and intermolecular forces influence boiling point, solubility, and phase changes.
5. Physical properties such as solubility and particle size can be used to separate mixtures.

Unit Vocabulary:

Academic Cross-Curricular Words	Content/Domain Specific
Subscript Superscript	Chemical properties Chromatography Compounds Density Elements Evaporation Filtration Gas Heterogeneous mixtures Homogeneous mixtures Intermolecular Forces Liquid Mixtures Nonpolar covalent bond Physical properties Polar covalent bond Pure substance Solid Solute Solutions Solvent States of matter

Topic 1: States of Matter & Intermolecular Forces

TOPICS: Engaging Experience 1

Title: PhET States of Matter Activity

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **9-12.PS1.A.3** - Plan and conduct an investigation to gather evidence to compare physical and chemical properties of substances such as melting point, boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive forces between particles.

Detailed Description/Instructions: This online activity requires students to manipulate the temperature of a substance and observe the change in the spacing and motion of the particles of substance. They compare the particles of different states of matter to one another.

Bloom's Levels: Applying

Webb's DOK: 2

Potential Accommodations/Modifications/alternate activities: Allow students to work in pairs, focus on the properties related to: melting point, boiling point, surface tension.

Topic 2: Physical and Chemical Properties

TOPICS: Engaging Experience 1

Title: Identification of an Unknown Substance Based on Density

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **9-12.PS1.A.3** - Plan and conduct an investigation to gather evidence to compare physical and chemical properties of substances such as melting point, boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive forces between particles.

Supporting:

- **9-12.PS1.A.4** - Apply the concepts of bonding and crystalline/molecular structure to explain the macroscopic properties of various categories of structural materials, i.e. metals, ionic (ceramics), and polymers.

Detailed Description/Instructions: Students will be given an unknown cylinder (metals, plastics, wood, etc.) and are tasked with identifying the substance by calculating its density.

Bloom's Levels: Applying

Webb's DOK: 2

Potential Accommodations/Modifications/alternate activities:

**Alternate/additional activities: Make a Density tower using different household materials;*

**Density cube lab: Using different cubes of materials provided- hypothesize/investigate if the cube will sink or float in water. In this lab, students can also use math concepts to figure the mass, volume of each cube and thus finding the density.*

Topic 3: Classification of Matter

TOPICS: Engaging Experience 1

Title: Classification of Matter POGIL

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **9-12.PS1.A.3** - Plan and conduct an investigation to gather evidence to compare physical and chemical properties of substances such as melting point, boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive forces between particles.

Supporting:

- **9-12.PS1.A.4** - Apply the concepts of bonding and crystalline/molecular structure to explain the macroscopic properties of various categories of structural materials, i.e. metals, ionic (ceramics), and polymers.

Detailed Description/Instructions: Students will use their knowledge of the atom to classify the different types of matter. They will go through the activity learning the differences between compounds and mixtures.

Bloom's Levels: Applying

Webb's DOK: 2

Potential Accommodations/Modifications/alternate activities: Sort common household items into compounds or mixtures.

Topic 4: Polarity and Solubility

TOPICS: Engaging Experience 1

Title: Lava Lamp Lab

Suggested Length of Time: ½ Block **TOPICS:** 1 block

Standards Addressed

Priority:

- **9-12.PS1.A.3** - Plan and conduct an investigation to gather evidence to compare physical and chemical properties of substances such as melting point, boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive forces between particles.

Detailed Description/Instructions: Students will investigate how polarity affects solubility by mixing water, food coloring, vegetable oil, and Alka Seltzer. As they watch which liquids blend and which stay separate, they will start to notice how polar and nonpolar substances behave differently. The activity helps them connect what they see happening to how molecules interact at the particle level.

Bloom's Levels: Applying

Webb's DOK: 2

Potential Accommodations/Modifications/alternate activities: After making the lava lamp, brainstorm household items/substances that show common characteristics to the lava lamp related to polarity (Italian salad dressing, dish soap, etc.).

Topic 5: Separation Techniques

TOPICS: Engaging Experience 1

Title: Food Dye Chromatography with Skittles

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **9-12.PS1.A.3** - Plan and conduct an investigation to gather evidence to compare physical and chemical properties of substances such as melting point, boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive forces between particles.

Supporting:

- **9-12.PS1.A.4** - Apply the concepts of bonding and crystalline/molecular structure to explain the macroscopic properties of various categories of structural materials, i.e. metals, ionic (ceramics), and polymers.

Detailed Description/Instructions: Students use paper chromatography to separate the mixture of dyes found in different colored candies and food colorings. After applying small dots of dissolved dye to chromatography paper and placing it in a dilute salt solution, the solvent carries the dye components upward at different rates. This process allows students to visually separate the mixture into its individual pigments and observe how differences in particle interactions lead to separation.

Bloom's Levels: Applying

Webb's DOK: 2

Potential Accommodations/Modifications/alternate activities: Work in pairs/small groups.

TOPICS: Engaging Experience 2

Title: Separation of a Mixture Lab

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **9-12.PS1.A.3** - Plan and conduct an investigation to gather evidence to compare physical and chemical properties of substances such as melting point, boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive forces between particles.

Detailed Description/Instructions: Students are given a mixture of iron, beads, sand, and salt. Their objective is to separate the four materials. They must choose appropriate lab equipment (such as filter paper, magnet, water, beaker, hot plate, etc.) to separate all 4 components of the mixture.

Bloom's Levels: Applying

Webb's DOK: 2

Potential Accommodations/Modifications/alternate activities: Work in small groups/pairs, detailed task analysis.

Engaging Scenario

TOPICS: Engaging Scenario: Identifying Unknowns Using Intermolecular Forces Lab: This lab helps students connect observable physical properties to particle-level interactions by analyzing a set of unknown liquids and solids. Through simple tests such as solubility in polar and nonpolar solvents, evaporation rate, melting behavior, and conductivity, students gather evidence to classify substances as ionic, polar molecular, or nonpolar molecular. The activity reinforces the big ideas that intermolecular forces determine many physical properties, that solubility depends on particle interactions and polarity, and that mixtures can be separated using differences in physical properties. The goal is for students to use their data to explain how the strength and type of intermolecular forces influence phase changes, solubility patterns, and the behavior of pure substances compared to mixtures.

Potential Accommodations/Modifications/alternate activities: Whole group demonstration focusing on rates of change and observations of mixtures being separated.

Summary of Engaging Learning Experiences for Topics

Topic	Engaging Experience Title	Description	Suggested Length of Time
TOPICS: States of Matter & Intermolecular Forces	PhET States of Matter Activity	This online activity requires students to manipulate the temperature of a substance and observe the change in the spacing and motion of the particles of substance. They compare the particles of different states of matter to one another.	1 Block
TOPICS: Physical and Chemical Properties	Identification of an Unknown Substance Based on Density	Students will be given an unknown cylinder (metals, plastics, wood, etc) and are tasked with identifying the substance by calculating its density.	1 Block
TOPICS: Classification of Matter	Classification of Matter POGIL	Students will use their knowledge of the atom to classify the different types of matter. They will go through the activity learning the differences between compounds and mixtures.	1 Block
TOPICS: Polarity and Solubility	Lava Lamp Lab	Students will investigate how polarity affects solubility by mixing water, food coloring, vegetable oil, and Alka Seltzer. As they watch which liquids blend and which stay separate, they will start to notice how polar and nonpolar substances behave differently. The activity helps them connect what they see happening to how molecules interact at the particle level.	½ Block
TOPICS: Separation Techniques	Food Dye Chromatography with Skittles	Students use paper chromatography to separate the mixture of dyes found in different colored candies and food colorings. After applying small dots of	1 Block

		dissolved dye to chromatography paper and placing it in a dilute salt solution, the solvent carries the dye components upward at different rates. This process allows students to visually separate the mixture into its individual pigments and observe how differences in particle interactions lead to separation.	
TOPICS: Separation Techniques	Separation of a Mixture Lab	Students are given a mixture of iron, beads, sand, and salt. Their objective is to separate the four materials. They must choose appropriate lab equipment (such as filter paper, magnet, water, beaker, hot plate, etc.) to separate all 4 components of the mixture.	1 Block

Unit 4: Chemical Reactions

Subject: Chemistry I

Grade: 10

Name of Unit: Chemical Reactions

Length of Unit: 10-12 blocks **TOPICS:** 9-11 blocks

Overview of Unit: In this unit, students investigate how and why chemical reactions occur by distinguishing physical changes from chemical changes, identifying evidence of new substance formation, and modeling reactions symbolically. Emphasis is placed on the law of conservation of mass through balancing equations and analyzing reactions in open versus closed systems. Students also explore reaction rates, applying collision theory to explain how temperature, concentration, and surface area influence the frequency and energy of particle collisions. Throughout the unit, students plan and conduct investigations, use mathematical representations to support claims, and connect particle-level rearrangements of atoms to observable macroscopic changes.

Priority Standards for unit:

- **TOPICS: 9-12.PS1.A.3** - Plan and conduct an investigation to gather evidence to compare physical and chemical properties of substances such as melting point, boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive 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.]
- **TOPICS: 9-12.PS1.B.1** - 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.]
- **TOPICS: 9-12.PS1.B.3** - Use symbolic representations and mathematical calculations 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.]

Supporting Standards for unit:

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
● TOPICS: Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (A.3) ● TOPICS: Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (B.1) ● TOPICS: Use mathematical representations of phenomena to support claims. (B.3)	● The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (A.3) ● TOPICS: Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (A.3) ● 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. (B.1) ● TOPICS: 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. (B.3)	● TOPICS: Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (A.3) ● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (B.1) ● TOPICS: The total amount of energy and matter in closed systems is conserved. (B.3)

TOPICS: Priority Standard: 9-12.PS1.A.3 - Plan and conduct an investigation to gather evidence to compare physical and chemical properties of substances such as melting point, boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive forces between particles.

Learning Targets	Webb's DOK Level
	Bloom's Level
TOPICS: Students will be able to effectively plan and safely conduct an investigation to identify physical properties and changes.	3
	2
TOPICS: Students will be able to effectively plan and safely conduct an investigation to identify chemical properties and changes.	Analyze
	Applying

TOPICS: Priority Standard: 9-12.PS1.B.1 - 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.

Learning Targets	Webb's DOK Level
	Bloom's Level
TOPICS: Students will be able to determine the effect of concentration of reactants on the rate of reaction.	3
	Analyze
TOPICS: Students will be able to determine the effect of temperature on the rate of a reaction.	3
	Analyze

TOPICS: Priority Standard: 9-12.PS1.B.3 - Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Learning Targets	Webb's DOK Level
	Bloom's Level
TOPICS: Students will be able to identify products and reactants given a chemical equation.	2
	Applying
TOPICS: Students will be able to obey the law of conservation of mass by balancing chemical reactions.	2
	Applying

Essential Questions:

1. How can we tell the difference between a physical change and a chemical change?
2. How can you tell when a chemical reaction has occurred?
3. Why must chemical equations be balanced?
4. What factors affect how fast reactions occur?

Enduring Understanding/Big Ideas:

1. Physical changes alter how matter looks or behaves, while chemical changes create new substances with different properties.
2. Signs like color change, gas production, temperature change, or precipitate formation indicate that new substances are forming.
3. Balanced equations reflect the law of conservation of mass, so equations must show equal numbers of each atom before and after the reaction.
4. Reaction rate depends on factors like temperature, concentration, and surface area that affect particle collisions.

Unit Vocabulary:

Academic Cross-Curricular Words	Content/Domain Specific
Coefficient Surface area	Aqueous Catalyst Chemical change Chemical equation Chemical reaction Collision theory Law of conservation of mass Physical change Product Rate of reaction Reactant

Topic 1: Physical and Chemical Changes

TOPICS: Engaging Experience 1

Title: Physical and Chemical Changes Lab

Suggested Length of Time: 2 blocks

Standards Addressed

Priority:

- **9-12.PS1.A.3** - Plan and conduct an investigation to gather evidence to compare physical and chemical properties of substances such as melting point, boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive forces between particles.

Detailed Description/Instructions: Students will rotate through a series of small investigations, most of which demonstrate chemical changes. As they work, students document the physical properties they observe and identify evidence that a chemical change has occurred. After completing the stations, students extend their learning by designing their own simple chemical change, making predictions about the outcome, and explaining the signs they expect to observe.

Bloom's Levels: Analyzing

Webb's DOK: 3

Potential Accommodations/Modifications/alternate activities: Extension learning- brainstorm ideas to create own simple chemical change; then as a class choose 1 to complete as a group.

Topic 2: Chemical Reactions

Engaging Experience 1

Title: Chemical Reaction Demo

Suggested Length of Time: ½ block

Standards Addressed

Priority:

- **Priority Standard: 9-12.PS1.B.3** - Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction

Detailed Description/Instructions: Teacher will demo chemical reactions (such as woosh bottle, burning magnesium, copper and silver nitrates, Lead (II) Nitrate solution and Potassium Iodide, etc.) and guide students to understanding the parts of a chemical reaction.

Bloom's Levels: Applying

Webb's DOK: 2

Topic 3: Balancing Chemical Equations

TOPICS: Engaging Experience 1

Title: Law of Conservation of Mass Lab

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **9-12.PS1.B.3** - Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Detailed Description/Instructions: Students will perform 2 types of chemical reactions (ex. baking soda with vinegar or Alka-Seltzer and water) and determine the effect of the reaction taking place in an open vs. closed system. Students will take the mass of the system before and after the reaction to observe that mass is conserved when in a closed system.

Bloom's Levels: Applying

Webb's DOK: 2

Potential Accommodations/Modifications/alternate activities: Work in pairs/small groups, detailed task analysis.

TOPICS: Engaging Experience 2

Title: Balancing Chemical Equations PhET Simulation

Suggested Length of Time: ½ Block **TOPICS:** 1 block

Standards Addressed

Priority:

- **9-12.PS1.B.3** - Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Detailed Description/Instructions: Students will use the simulation to develop an understanding of how mass is conserved in a chemical reaction. Through this, they will then learn how the chemical equation is balanced using coefficients within the equation.

Bloom's Levels: Understand

Webb's DOK: 2

Potential Accommodations/Modifications/alternate activities: Model step-by-step (through use of vivi/projector) as students interact with this on-line activity to develop better understanding of use of coefficients.

Topic 4: Reaction Rates/Kinetics

TOPICS: Engaging Experience 1

Title: Alka-Seltzer Rocket Lab

Suggested Length of Time: 1 Block

Standards Addressed

Priority:

- **9-12.PS1.B.1** 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.

Detailed Description/Instructions: In this guided inquiry lab, students design an experiment to investigate how changing water temperature, amount of Alka-Seltzer, and surface area of Alka-Seltzer affects the rate of reaction.

Bloom's Levels: Apply

Webb's DOK: 3

Potential Accommodations/Modifications/alternate activities: Work in pairs/small groups, detailed task analysis.

TOPICS: Engaging Experience 2

Title: Iodine Clock Reaction

Suggested Length of Time: ½ Block

Standards Addressed

Priority:

- 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.

Detailed Description/Instructions: In this demonstration, students will see how different factors such as temperature, concentration, and catalysts affect the rate at which iodine is produced.

Bloom's Levels: Apply

Webb's DOK: 3

Potential Accommodations/Modifications/alternate activities: Possibly use as a demonstration lab.

Engaging Scenario

Engaging Scenario: Introduction to Chemical Reactions: In this scenario-based lab, students are given a set of reactants and basic equipment and must design their own investigation. They decide what question to explore, what data to collect, and how to use the materials to test their ideas. Students develop a procedure, carry out their plan, and gather evidence to determine whether a chemical change has occurred when the reactants are combined. The activity emphasizes student choice, experimental design, and using observable signs of chemical reactions to draw supported conclusions.

Potential Accommodations/Modifications/alternate activities: Provide students with a list of household products that could potentially make a safe chemical reaction. Products such as: Baking soda, vinegar, hydrogen peroxide, yeast, lemon juice, steel wool, cookie dough, etc. Students will research what 2 products could be combined to form a chemical reaction. Students will make a hypothesis, set up their steps of the experiment, complete the experiment, make an analysis and a conclusion.

Summary of Engaging Learning Experiences for Topics

Topic	Engaging Experience Title	Description	Suggested Length of Time
TOPICS: Physical and Chemical Changes	Physical and Chemical Changes Lab	Students will rotate through a series of small investigations, most of which demonstrate chemical changes. As they work, students document the physical properties they observe and identify evidence that a chemical change has occurred. After completing the stations, students extend their learning by designing their own simple chemical change, making predictions about the outcome, and explaining the signs they expect to observe.	2 blocks
Chemical Reactions	Chemical Reaction Demo	Teachers will demo chemical reactions (such as woosh bottle, burning magnesium, copper and silver nitrate, Lead (II) Nitrate solution and Potassium Iodide, etc.) and guide students to understanding the parts of a chemical reaction.	½ block
TOPICS: Balancing Chemical Equations	Law of Conservation of Mass Lab	Students will perform 2 types of chemical reactions (ex. baking soda with vinegar or Alka seltzer and water) and determine the effect of the reaction taking place in an open vs. closed system. Students will take the mass of the system before and after the reaction to observe that mass is conserved when in a closed system.	1 block

TOPICS: Balancing Chemical Equations	Balancing Chemical Equations PhET Simulation	Students will use the simulation to develop an understanding of how mass is conserved in a chemical reaction. Through this, they will then learn how the chemical equation is balanced using coefficients within the equation.	½ block
TOPICS: Reaction Rates/Kinetics	Alka-Seltzer Rocket Lab	In this guided inquiry lab, students design an experiment to investigate how changing water temperature, amount of Alka-Seltzer, and surface area of Alka Seltzer affects the rate of reaction.	1 block
TOPICS: Reaction Rates/Kinetics	Iodine Clock Reaction	In this demonstration, students will see how different factors such as temperature, concentration, and catalysts affect the rate at which iodine is produced.	½ block

Unit 5: Stoichiometry Foundations

Subject: Chemistry 1

Grade: 10

Name of Unit: Stoichiometry Foundations

Length of Unit: 12 blocks **TOPICS:** 8 blocks

Overview of Unit: In this unit, students develop the mathematical foundation needed to quantify chemical reactions. Emphasis is placed on dimensional analysis, unit conversions, and the mole as a bridge between atomic-scale particles and measurable mass. Students calculate molar mass, convert between grams, moles, and particles, and use coefficients in balanced equations as mole ratios to predict quantities of reactants and products. Throughout the unit, students use symbolic representations and proportional reasoning to demonstrate conservation of matter and apply stoichiometric relationships to real-world laboratory contexts.

Priority Standards for unit:

- **TOPICS: 9-12.PS1.B.3-** Use symbolic representations and mathematical calculations 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.]
- **TOPICS: 6.RP.A.3d** - Convert measurements within units and between two systems of measurement.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
TOPICS: Use mathematical representations of phenomena to support claims.	TOPICS: 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.	TOPICS: The total amount of energy and matter in closed systems is conserved.

TOPICS: Priority Standard: 9-12.PS1.B.3- Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Learning Targets	Webb's DOK Level
	Bloom's Level
Students will understand 1 mole of any substance has 6.02×10^{23} particles.	2
	Understanding
Students will be able to calculate the molar mass of a substance and understand the relationship between moles and grams.	3
	Applying

TOPICS: Priority Standard: 6.RP.A.3d - Convert measurements within units and between two systems of measurement.

Learning Targets	Webb's DOK Level
	Bloom's Level
TOPICS: Students will be able to determine and use conversion factors to convert between units.	2
	Understanding
TOPICS: Students will use dimensional analysis to calculate measurements in different SI units.	3
	Applying
Students will understand the coefficients in a balanced chemical reaction is the ratio used to convert between moles of different substances in a reaction.	2
	Understanding

Essential Questions:

1. How can units and conversion factors guide us to the correct answer in chemistry problems?
2. How do chemists count tiny particles like atoms and molecules?
3. How do chemists use stoichiometry to calculate mass of products or reactants required for a chemical reaction?

Enduring Understanding/Big Ideas:

1. Units act as a roadmap that helps track quantities and ensure accurate calculations.
2. The mole allows chemists to count particles using mass, making atomic-scale measurements practical.
3. Stoichiometry uses mathematical relationships, especially mole ratios, to connect mass measurements and predict the quantities and outcomes of chemical reactions.

Unit Vocabulary:

Academic Cross-Curricular Words	Content/Domain Specific
Coefficient Conversion factor Dimensional analysis Exponent Scientific Notation Unit	Avogadro's number Molar mass Mole Mole ratios Stoichiometry

Topic 1: Dimensional Analysis

TOPICS: Engaging Experience 1

Title: Dimensions Analysis Lab

Suggested Length of Time: 1 block **TOPICS:** 1-2 blocks

Standards Addressed

Priority:

- **9-12.PS1.B.3-** Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Detailed Description/Instructions: Students measure how many cm they can jump, how many seconds it takes for them to walk 10m, and how long it takes them to eat a Starburst. They then use a guided note guide to convert units to determine how many jumps it would take them to jump 1km, how long it would take to walk to Mizzou, and how long it would take to eat each 1kg of Starburst.

Bloom's Levels: Apply

Webb's DOK: 2

Potential Accommodations/Modifications/alternate activities: Provide different activities to measure and convert units that are relatable to real-life situations or within the realm of testing within the classroom (distance a paper airplane travels, the time it takes a paper helicopter to drop from a distance, etc.), break into smaller steps (potential 2 days: 1 day for measurement, day 2 for conversions).

Topic 2: The Mole Concept

Engaging Experience 1

Title: Chalk Mole Lab

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **Priority Standard: 9-12.PS1.B.3-** Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Detailed Description/Instructions: Students record mass of chalk before and after drawing with the chalk. Students then calculate how many moles of chalk they used in their drawing.

Bloom's Levels: Applying

Webb's DOK: 3

Engaging Experience 2

Title: Calculating Molar Mass

Suggested Length of Time: ½ block

Standards Addressed

Priority:

- **9-12.PS1.B.3-** Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Detailed Description/Instructions: Students are given one mole of six unknown substances. They have to calculate the molar mass of each unknown and determine what it is from a list of potentially known substances. Then, students are given various amounts of six known substances and must determine the particle count and the number of moles for each substance using its mass.

Bloom's Levels: Applying

DOK: 2

Engaging Experience 3

Title: Moles, Atoms, Grams OH MY!

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **9-12.PS1.B.3-** Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Detailed Description/Instructions: Students mass out various substances after calculating the mass given moles, molecules, atoms, etc. When they have the correct mass, they bring their sample to the front lab table for the instructor to check.

Bloom's Levels: Analyzing

DOK: 3

Topic 3: Stoichiometry

Engaging Experience 1

Title: Aluminum Foil with Copper Sulfate Lab

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **9-12.PS1.B.3-** Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
- **6.RP.A.3d** - Convert measurements within units and between two systems of measurement.

Detailed Description/Instructions: Students will complete a lab heating aluminum foil with aqueous copper sulfate. Students will complete stoichiometry calculations and a possible extension on limiting reactants concept.

Bloom's Levels: Applying

Webb's DOK: 3

Engaging Scenario

Engaging Scenario: Ice Cream Calculation Lab: Students will use a recipe for ice cream and convert the amounts of ingredients from units such as atoms, molecules, grams into units such as cups, tablespoons, and teaspoons. Students will then use their calculated amounts to make their own ice cream. Recommended that the teacher makes ice cream in an ice cream maker while students are working, or that the following block the class measures and makes the ice cream with measurements agreed upon by groups.

Potential accommodations/modifications/alternate lessons: Units of measurement dimensional analysis lab: Students (individual or in pairs) will create a real-life situation using the measurement of time, distance, volume or mass to create a dimensional analysis set-up problem. Students will provide the starting information and description of what they are measuring and in what units they want to convert to. Once their dimensional analysis example is set-up/provided then each situation will be put into stations around the room for students to complete.

Summary of Engaging Learning Experiences for Topics

Topic	Engaging Experience Title	Description	Suggested Length of Time
TOPICS: Dimensional Analysis	Dimensions Analysis Lab	Students measure how many cm they can jump, how many seconds it takes for them to walk 10m, and how long it takes them to eat a Starburst. They then use a guided note guide to convert units to determine how many jumps it would take them to jump 1km, how long it would take to walk to Mizzou, and how long it would take to each 1kg of Starburst.	1 block
The Mole Concept	Chalk Mole Lab	Students record the mass of chalk before and after drawing with the chalk. Students then calculate how many moles of chalk they used in their drawing.	1 block
The Mole Concept	Calculating Molar Mass	Students are given one mole of six unknown substances. They have to calculate the molar mass of each unknown and determine what it is from a list of potential known substances. Then, students are given various amounts of six known substances and must determine the particle count and the number of moles for each substance using its mass.	½ block
The Mole Concept	Moles, Atoms, Grams OH MY!	Students mass out various substances after calculating the mass given moles, molecules, atoms, etc. When they have the correct mass, they bring their sample	1 block

		to the front lab table for the instructor to check.	
Stoichiometry	Aluminum Foil with Copper Sulfate Lab	Students will complete a lab heating aluminum foil with aqueous copper sulfate. Students will complete stoichiometry calculations and a possible extension on limiting reactants concept.	1 block

Unit 6: Energy and Thermochemistry

Subject: Chemistry I

Grade: 10

Name of Unit: Energy and Thermochemistry

Length of Unit: 11 blocks **TOPICS:** 9 blocks

Overview of Unit: Using the law of conservation of energy students will learn about the transformation of energy between different types such as potential and kinetic energy. Students will be able to apply this knowledge to the concept of specific heat and how energy can be transformed from one substance to another, thus conserving energy. Renewable energy sources, including nuclear chemistry, will be discussed.

Priority Standards for unit:

- **9-12.PS1.C.1** - Use symbolic representations to illustrate the changes in the composition of the nucleus of the atom and the energy released during the process of fission, fusion, and radioactive decay. [Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations]
- **TOPICS: 9-12.PS1.A.5-** 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 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.]
- **TOPICS: 9-12.PS3.B.1-** Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperatures are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.]

Supporting Standards for unit:

- **9-12.ETS1.B.1-** 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.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
● TOPICS: Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (C.1) ● TOPICS: Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (A.5) ● Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (B.1)	● Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. (C.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. (A.5) ● TOPICS: 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. (A.5),(B.1)	● In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (C.1) ● TOPICS: Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (A.5) ● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (B.1)

Priority Standard: 9-12.PS1.C.1 - Use symbolic representations to illustrate the changes in the composition of the nucleus of the atom and the energy released during the process of fission, fusion, and radioactive decay.

Learning Targets	Webb's DOK Level
	Bloom's Level
Students will be able to calculate the amount of radioactive material left given half-life and age of material.	2
	Applying
Students will be able to differentiate between types of radioactive decay.	3
	Analyzing
Students will be able to predict the products of nuclear reactions.	3
	Analyzing

TOPICS: Priority Standard: 9-12.PS1.A.5- 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.

Learning Targets	Webb's DOK Level
	Bloom's Level
TOPICS: Students will be able to differentiate between endothermic and exothermic reactions.	3
	Analyzing
TOPICS: Students will conduct an investigation to observe evidence of transfer of thermal energy in a chemical reaction.	4
	3 Evaluating Analyzing

Priority Standard: 9-12.PS3.B.1- 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).

Learning Targets	Webb's DOK Level
	Bloom's Level
Students will be able to use the equation $q=mc\Delta T$ to calculate an unknown.	2
	Applying
Students conduct an investigation to determine the amount of heat transferred from substance to another.	4
	Evaluating

Essential Questions:

1. How is energy transformed from one form to another, and how do these energy changes explain why some reactions release heat while others absorb it in everyday life?
2. Why do some substances heat up faster than others?
3. How do nuclear reactions release energy differently than chemical reactions?

Enduring Understanding/Big Ideas:

1. Energy changes form while the total amount remains constant, and chemical reactions release or absorb energy as bonds break and form, all of which reflects the law of conservation of energy.
2. Different substances require different amounts of energy to change temperature due to their specific heat.
3. Nuclear reactions release much more energy than chemical reactions because they involve changes in the atomic nucleus rather than just rearranging electrons. In nuclear reactions, splitting heavy nuclei (fission) or combining light nuclei (fusion) releases enormous amounts of energy, and understanding these processes is important for energy production, medical applications, and natural radioactive phenomena.

Unit Vocabulary:

Academic Cross-Curricular Words	Content/Domain Specific
Calorie Heat Joule Kinetic Energy Potential Energy	Alpha particle Beta particle Chain reaction Endothermic Exothermic Fission Fusion Gamma ray Half-life Law of conservation of energy Nuclear radiation Radioactive decay Specific heat

Topic 1: Energy

TOPICS: Engaging Experience 1

Title: Endothermic versus Exothermic Lab

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **Priority Standard: 9-12.PS1.A.5-** 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.

Detailed Description/Instructions: Students receive four substances (calcium chloride, water, phenol red, and sodium bicarbonate) and design and carry out tests to determine which combinations produce endothermic changes and which produce exothermic changes.

Bloom's Levels: Evaluating

Webb's DOK: 4

Potential Accommodations/Modifications/alternate activities: Use as a lab or whole group demonstration; brainstorm real world examples of endo and exo reactions (hand warmers, ice packs, etc.).

Engaging Experience 2

Title: Ice Cream in a Bag endothermic reaction lab

Suggested Length of Time: 1 block

Standards Addressed

Priority: 9-12.PS3.B.1- Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperatures are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

Detailed Description/Instructions: Ice cream in a bag lab: Students will mix materials in a bag and place them inside another bag, so it is surrounded by ice and salt. Students will identify an endothermic reaction by explaining that the heat is transferred from the ingredients mixed to the ice/salt; therefore, causing the ingredients to freeze.

Bloom's Levels: Analyzing

Webb's DOK: 3

Topic 2: Specific Heat

Engaging Experience 1

Title: Cheeto Lab

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **9-12.PS3.B.1-** Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperatures are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

Detailed Description/Instructions: Students will burn Cheetos as a fuel source to heat water in an aluminum can, measuring the resulting temperature change to explore how food stores chemical energy. After collecting their data, they use the $Q=mc\Delta T$ relationship to calculate the amount of energy released. Students will use stoichiometry to compare the energy they calculated from the lab to the value listed on the food's nutrition label, then determine the percent error between the two. To extend the investigation, students can test Funyuns or other snack foods to compare how different chips vary in the energy they provide.

Bloom's Levels: Evaluating

Webb's DOK: 4

Engaging Experience 2

Title: Specific Heat of an Unknown Metal

Suggested Length of Time: ½ block

Standards Addressed

Priority:

- **9-12.PS3.B.1-** Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperatures are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

Detailed Description/Instructions: Students will set up a calorimeter and measure the metal's specific heat to determine its identity. They will also measure the metal's density and use it as a reference to compare their results and determine which process is more accurate.

Bloom's Levels: Evaluating

Webb's DOK: 4

Topic 3: Nuclear Energy

Engaging Experience 1

Title: Radioactive Skittles

Suggested Length of Time: ½ block

Standards Addressed

Priority:

- **Priority Standard: 9-12.PS1.C.1** - Use symbolic representations to illustrate the changes in the composition of the nucleus of the atom and the energy released during the process of fission, fusion, and radioactive decay.

Detailed Description/Instructions: Students will investigate the concept of radioactive decay and half-lives using Skittles as the radioactive isotope. After collecting their data, students will create a decay curve.

Bloom's Levels: 3

Webb's DOK: Analyzing

Engaging Experience 2

Title: Determine the Age of an Object Using Radiometric Dating

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **Priority Standard: 9-12.PS1.C.1** - Use symbolic representations to illustrate the changes in the composition of the nucleus of the atom and the energy released during the process of fission, fusion, and radioactive decay.

Detailed Description/Instructions: Students will create graphs of half-life data. Given the parent-daughter isotope ratio students will calculate the age of an artifact.

Bloom's Levels: 3

Webb's DOK: Analyzing

Engaging Experience 3

Title: Alpha Stations

Suggested Length of Time: ½ block

Standards Addressed

Priority:

- **Priority Standard: 9-12.PS1.C.1** - Use symbolic representations to illustrate the changes in the composition of the nucleus of the atom and the energy released during the process of fission, fusion, and radioactive decay.

Detailed Description/Instructions: Students will visit stations with a printed card that has information over various components of alpha radioactive decay.

Bloom's Levels: 2

Webb's DOK: Applying

Engaging Scenario

Engaging Scenario: Nuclear Research Project: In this scenario-based research project, students investigate a historical event or modern application of nuclear chemistry to understand how nuclear processes shape medicine, energy production, national security, and everyday technologies. Students select a topic such as nuclear power generation, radiation-based medical treatments, nuclear accidents, or consumer devices that use radioisotopes, and conduct guided research using high-quality sources. Their work focuses on identifying the nuclear process involved, explaining how it operates at the particle level, examining the materials and isotopes used, and evaluating the real-world problem the technology or event was intended to address. Students then analyze the solution through criteria and tradeoffs including safety, cost, environmental impact, and societal benefit. To demonstrate understanding, students create an open-ended, student-designed presentation such as a diagram, comic, video, model, podcast, or interactive timeline that includes a handwritten component and clearly communicates their findings, evidence, and perspective on nuclear energy.

Engaging Scenario:

Energy project: Students will investigate a source of energy and how it relates to our environment. Their work will focus on identifying their energy source, how the energy is made, stored, used, advantages/disadvantages, and effect on the environment. To demonstrate understanding, students create a poster, slide presentation, video presentation that clearly communicates their findings.

Potential Accommodations/Modifications/alternate activities: Students could research different types of energy resources used (nuclear energy, solar energy, wind energy, electricity, natural gas, etc).

Summary of Engaging Learning Experiences for Topics

Topic	Engaging Experience Title	Description	Suggested Length of Time
TOPICS: Energy	Endothermic versus Exothermic Lab	Students receive four substances (calcium chloride, water, phenol red, and sodium bicarbonate) and design and carry out tests to determine which combinations produce endothermic changes and which produce exothermic changes.	1 block
Energy	<i>Ice Cream in a bag endothermic lab</i>	<i>Ice cream in a bag lab: Students will mix materials in a bag and place them inside another bag, so it is surrounded by ice and salt. Students will identify an endothermic reaction by explaining that the heat is transferred from the ingredients mixed to the ice/salt; therefore, causing the ingredients to freeze.</i>	1 block
Specific Heat	Cheeto Lab	Students will burn Cheetos as a fuel source to heat water in an aluminum can, measuring the resulting temperature change to explore how food stores chemical energy. After collecting their data, they use the $Q=mcT$ relationship to calculate the amount of energy released. Students will use stoichiometry to compare the energy they calculated from the lab to the value listed on the food's nutrition label, then determine the percent error between the two. To extend the investigation, students can test Funyuns or other snack foods to	1 block

		compare how different chips vary in the energy they provide.	
Specific Heat	Specific Heat of an Unknown Metal	Students will set up a calorimeter and measure the metal's specific heat to determine its identity. They will also measure the metal's density and use it as a reference to compare their results and determine which process is more accurate.	½ block
Nuclear Energy	Radioactive Skittles	Students will investigate the concept of radioactive decay and half-lives using Skittles as the radioactive isotope. After collecting their data, students will create a decay curve.	½ block
Nuclear Energy	Determine the Age of an Object Using Radiometric Dating	Students will create graphs of half-life data. Given the parent-daughter isotope ratio students will calculate the age of an artifact.	1 block
Nuclear Energy	Alpha Stations	Students will visit stations with a printed card that has information over various components of alpha radioactive decay.	½ block

Unit 7: Acids & Bases

Subject: Chemistry I

Grade: 10

Name of Unit: Acids & Bases

Length of Unit: 6 blocks **TOPICS:** 8 blocks

Overview of Unit: In this unit, students investigate the properties of acids and bases through pH analysis, neutralization reactions, and dynamic equilibrium. Students analyze how hydrogen ion and hydroxide ion concentrations determine pH and how changes in concentration affect reaction rate and solution behavior. Through laboratory investigations and simulations, they model neutralization at the particle level and connect observable changes to molecular interactions. The unit concludes with an exploration of equilibrium and Le Chatelier's Principle, where students predict how changes in temperature, concentration, or pressure shift the balance of a reversible reaction and refine system conditions to influence product formation.

Priority Standards for unit:

- **TOPICS: 9-12.PS1.B.1-** 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.]
- **TOPICS: 9-12.PS1.B.2-** Refine the design of a chemical system by specifying a change in conditions that would alter the amount of products at equilibrium. [Clarification Statement: Emphasis is on the application of Le Chatelier'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.]

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
● TOPICS: Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. ● Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence,	● 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.	● TOPICS: Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. ● TOPICS: Much of science deals with constructing explanations of how things change and how they remain stable.

prioritized criteria, and trade off considerations.	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.	
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TOPICS: Priority Standard: 9-12.PS1.B.1- 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.

Learning Targets	Webb's DOK Level
	Bloom's Level
TOPICS: I can explain how changing the concentration of an acid or base affects the rate of a neutralization reaction using evidence from particle interactions.	3
	Analyzing
TOPICS: I can explain how the concentration of acidic or basic particles affects pH and effectively use the pH scale.	3
	Analyzing

Priority Standard: 9-12.PS1.B.2- Refine the design of a chemical system by specifying a change in conditions that would alter the amount of products at equilibrium.

Learning Targets	Webb's DOK Level
	Bloom's Level
I can describe what it means for a chemical system to be at equilibrium and explain how the balance between forward and reverse reactions determines the amounts of reactants and products.	2
	Applying
I can predict Le Chatelier's Principle to explain how changes to an equation impact a chemical reaction.	2
	Applying

Essential Questions:

1. How can we tell whether a substance is an acid or a base?
2. What happens when an acid and a base mix?
3. How can changing conditions (temperature, concentration, pressure) affect a reaction at equilibrium?

Enduring Understanding/Big Ideas:

1. Acids release hydrogen ions (H^+) in solution, while bases release hydroxide ions (OH^-).
2. A neutralization reaction occurs when an acid reacts with a base to produce water and salt.
3. Le Chatelier's Principle allows chemists to predict and manipulate chemical systems for desired outcomes.

Unit Vocabulary:

Academic Cross-Curricular Words	Content/Domain Specific
	Acids Bases Chemical equilibrium Concentration Dilution Le Chatelier's Principle Neutral Neutralization pH Reversible reaction

Topic 1: Acids & Bases

TOPICS: Engaging Experience 1

Title: pH Testing of Household Substances

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **9-12.PS1.B.1-** 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.

Detailed Description/Instructions: Students will predict, measure and compare the pH of common household substances, then classify each as acidic, basic, or neutral, and relate results to everyday uses (cleaning, food, body products).

Bloom's Levels: Analyzing

Webb's DOK: 3

Potential Accommodations/Modifications/alternate activities: work in pairs/small groups. Check in for understanding, detailed task analysis.

TOPICS: Engaging Experience 2

Title: Phet Acid Base Simulation

Suggested Length of Time: 1 block

Standards Addressed

Priority:

- **9-12.PS1.B.1-** 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.

Detailed Description/Instructions: Students will use an online simulation https://phet.colorado.edu/sims/html/ph-scale-basics/latest/ph-scale-basics_all.html to explore the pH scale using common household chemicals.

Bloom's Levels: Analyzing -applying

Webb's DOK: 3 -2

Potential Accommodations/Modifications/alternate activities: provide online simulation on teacher Vivi/projector as students maneuver through the exploration, work in pairs, check in for understanding.

Topic 2: Neutralization

TOPICS: Engaging Experience 1

Title: Antacid Inquiry Lab

Suggested Length of Time: ½ Block **TOPICS:** 1 block

Standards Addressed

Priority:

- **9-12.PS1.B.1-** 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.

Detailed Description/Instructions: In this lab, students are comparing the strengths and effectiveness of store-bought antacids (Tums, Rolaids, Maalox, Alka-Seltzer). Students will crush or grind up the different antacids and add them into samples of hydrochloric acid (to simulate stomach acid). Using universal indicator or pH test strips, students will measure and record the pH of the resulting mixture. This could be extended to have students use stoichiometry to determine how much antacid is in each tablet.

Bloom's Levels: Analyzing

Webb's DOK: 3

Potential Accommodations/Modifications/alternate activities: could be whole group demonstration or lab working in small groups/pairs. Review lab safety rules. Check often for understanding and safety, detailed task analysis.

Topic 3: Equilibrium

Engaging Experience 1

Title: Paper Throwing Activity

Suggested Length of Time: ½ Block

Standards Addressed

Priority:

- **9-12.PS1.B.2-** Refine the design of a chemical system by specifying a change in conditions that would alter the amount of products at equilibrium.

Detailed Description/Instructions: Students are divided up into two groups and placed on opposite sides of the room. A set of desks or tables act as a barrier between the two groups. Prior to the lesson, students wad/crumple up a large quantity of paper (roughly 100 sheets). Disperse the paper wads to one side of the room, illustrating the start of a reaction with only reactants. Then students begin with throwing wads to the other side and return volley. After a minute, have students stop and count how many paper wads are on each side. For the next round, transfer some students from one side to the other so they are uneven. Then try this process again. This activity can be modified to change the room layout where one side has more space or starting with different amounts of paper on each side.

Bloom's Levels: Applying

Webb's DOK: 2

Engaging Experience 2

Title: Water Transfer with Straws Activity

Suggested Length of Time: ½ Block

Standards Addressed

Priority:

- **9-12.PS1.B.2-** Refine the design of a chemical system by specifying a change in conditions that would alter the amount of products at equilibrium.

Detailed Description/Instructions: For this activity, students are split into pairs, each with a 10 or 25mL graduated cylinder and a plastic straw. One student starts with a full graduated cylinder, and the other is empty. They begin moving water from their graduated cylinders back and forth in sync with each other by sticking their straw into the water, capping it with their thumb, and transferring it. Eventually, the two cylinders should be even. From there, changes can be made involving size of the straw, size of the graduated cylinder, if the students are in sync, etc.

Bloom's Levels: Applying

Webb's DOK: 2

Engaging Scenario

Engaging Scenario: Soda Lab - This hands-on investigation introduces students to the concept of chemical equilibrium through the familiar context of carbonated beverages. By observing the reversible reaction between dissolved carbon dioxide and water, students explore how changes in pressure, temperature, and concentration influence the position of equilibrium according to Le Chatelier's Principle. Using universal indicator, students track shifts in acidity as the system responds to stresses such as opening a soda bottle, heating the solution, and adding dry ice. The activity strengthens students' understanding of dynamic equilibrium, reinforces the relationship between observable changes and molecular behavior, and builds foundational skills in scientific observation and reasoning.

TOPICS: Acids and Bases 1-pager: Students will create a 1-pager that details their knowledge of acids and bases. Information included could be definition of acid, definition of base, properties of each, visual model of a Ph scale, household examples w/ description of uses for acids and bases.

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Summary of Engaging Learning Experiences for Topics

Topic	Engaging Experience Title	Description	Suggested Length of Time
TOPICS: Acids & Bases	pH Testing of Household Substances	Students will predict, measure and compare the pH of common household substances, then classify each as acidic, basic, or neutral, and relate results to everyday uses (cleaning, food, body products).	1 block
TOPICS: Acids & Bases	Phet Acid Base Simulation	Students will use an online simulation to explore the pH scale using common household chemicals.	1 block
TOPICS: Neutralization	Antacid Inquiry Lab	In this lab, students are comparing the strengths and effectiveness of store-bought antacids (Tums, Rolaid, Maalox, Alka-Seltzer). Students will crush or grind up the different antacids and add them into samples of hydrochloric acid (to simulate stomach acid). Using universal indicator or pH test strips, students will measure and record the pH of the resulting mixture. This could be extended to have students use stoichiometry to determine how much antacid is in each tablet.	½ block <i>TOPICS: 1 block</i>
Equilibrium	Paper Throwing Activity	Students are divided up into two groups and placed on opposite sides of the room. A set of desks or tables act as a barrier between the two groups. Prior to the lesson, students wad/crumple up a large quantity of paper (roughly 100 sheets). Disperse the paper wads to one side of the room, illustrating the start of	½ block

		a reaction with only reactants. Then students begin with throwing wads to the other side and return volley. After a minute, have students stop and count how many paper wads are on each side. For the next round, transfer some students from one side to the other so they are uneven. Then try this process again. This activity can be modified to change the room layout where one side has more space or starting with different amounts of paper on each side.	
Equilibrium	Water Transfer with Straws Activity	For this activity, students are split into pairs, each with a 10 or 25mL graduated cylinder and a plastic straw. One student starts with a full graduated cylinder, and the other is empty. They begin moving water from their graduated cylinders back and forth in sync with each other by sticking their straw into the water, capping it with their thumb, and transferring it. Eventually, the two cylinders should be even. From there, changes can be made involving size of the straw, size of the graduated cylinder, if the students are in sync, etc.	½ block

Unit of Study Terminology

Appendices: All Appendices and supporting material can be found in this course's shell course in the District's Learning Management System.

Assessment Leveling Guide: A tool to use when writing assessments in order to maintain the appropriate level of rigor that matches the standard.

Big Ideas/Enduring Understandings: Foundational understandings teachers want students to be able to discover and state in their own words by the end of the unit of study. These are answers to the essential questions.

Engaging Experience: Each topic is broken into a list of engaging experiences for students. These experiences are aligned to priority and supporting standards, thus stating what students should be able to do. An example of an engaging experience is provided in the description, but a teacher has the autonomy to substitute one of their own that aligns to the level of rigor stated in the standards.

Engaging Scenario: This is a culminating activity in which students are given a role, situation, challenge, audience, and a product or performance is specified. Each unit contains an example of an engaging scenario, but a teacher has the ability to substitute with the same intent in mind.

Essential Questions: Engaging, open-ended questions that teachers can use to engage students in learning.

Priority Standards: What every student should know and be able to do. These were chosen because of their necessity for success in the next course, the state assessment, and life.

Supporting Standards: Additional standards that support the learning within the unit.

Topic: These are the main teaching points for the unit. Units can have anywhere from one topic to many, depending on the depth of the unit.

Unit of Study: Series of learning experiences/related assessments based on designated priority standards and related supporting standards.

Unit Vocabulary: Words students will encounter within the unit that are essential to understanding. Academic Cross-Curricular words (also called Tier 2 words) are those that can be found in multiple content areas, not just this one. Content/Domain Specific vocabulary words are those found specifically within the content.