Perris Union High School District
Course of Study

A. COURSE INFORMATION

Course Title:
(limited to 34 characters with spaces in Infinite Campus)

Chemistry

- ☐ New
- ☑ Revised

If revised, the previous course name if there was a change

Transcript Course Code/Number:

104511, 104512

(To be assigned by Educational Services if it's a new course)

CREDIT TYPE EARNED:	CALPADS CODE:
Science	9325

Subject Area:

- ☐ Social Science
- ☐ English
- ☐ Mathematics
- ☑ Laboratory Science
- ☐ World Languages
- ☐ Visual or Performing Arts
- ☐ College Prep Elective
- ☐ Other

Is this classified as a Career Technical Education course?

- ☐ Yes
- ☑ No

If yes, which pathway does this course align to?
Pathway Name:

CTE CDE Code:

Grade Level(s)

- ☐ MS
- ☑ HS
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☑ 9
- ☑ 10
- ☑ 11
- ☑ 12

Was this course *previously approved by UC* for PUHSD?

- ☑ Yes
- ☐ No

(Will be verified by Ed Services)

Which A-G Requirement does/will this course meet?

D	☐ Pending

Credential Required to teach this course:
To be completed by Human Resources only.

Single Subject: Science: Chemistry; Specific Supplementary Auth: Chemistry; Specific Subject Matter Auth: Chemistry

3/15/2024

Signature **Date**

Submitted by: Matthew Thomas
Site: Student Services Center
Date: 03/12/24
Email: matthew.thomas@puhsd.org

Unit Value/Length of Course:

- ☐ 0.5 (half-year or semester equivalent)
- ☑ 1.0 (one-year equivalent)
- ☐ 2.0 (two-year equivalent)
- ☐ Other:

Approvals	Name/Signature	Date
Director of Curriculum & Instruction		03/20/24
Asst. Superintendent of Educational Services	Cindy Lee Mackamul	3/21/24
Governing Board		

Prerequisite(s) (REQUIRED):
C or better in Algebra 1
Corequisite(s) (REQUIRED):
None
Brief Course Description (REQUIRED):
This course is designed to give students a basic understanding of chemical principles. Upon completion of this course students should have the skills and content necessary to succeed in college level science courses. Major topics covered are atomic structure, bonding, reactions, states of matter, and solutions.

B. COURSE CONTENT

Course Purpose (REQUIRED):
What is the purpose of this course? Please provide a brief description of the goals and expected outcomes. Note: More specificity than a simple recitation of the State Standards is needed.

Given the speed with which scientific discoveries and research continuously expand scientific knowledge, many educators are faced with the challenge of balancing breadth of content coverage with depth of understanding. The chemistry course outlined in this framework embraces this challenge by deemphasizing a traditional "content coverage" model of instruction in favor of one that focuses on enduring, conceptual understandings and the content that supports them. This approach enables students to spend less time on factual recall and more time on inquiry-based learning of essential concepts, helping them develop the reasoning skills necessary to engage in the science practices used throughout their study of chemistry.

To foster this deeper level of learning, the breadth of content coverage in chemistry is defined in a way that distinguishes content essential to support the enduring understandings from the many examples or applications that can overburden the course. Illustrative examples are provided that offer you a variety of

optional instructional contexts to help your students achieve deeper understanding. Content that is outside the scope of the course is also identified.

This framework encourages student development of inquiry and reasoning skills, such as designing a plan for collecting data, analyzing data, applying mathematical routines, and justifying arguments using evidence. The result will be readiness for the study of advanced topics in a subsequent AP course.

Course Outline (REQUIRED):
Detailed description of topics covered. All historical knowledge is expected to be empirically based, give examples. Show examples of how the text is incorporated into the topics covered.

Unit 1: Structure and Properties of Matter

Developing Understanding:
This first unit sets the basis for foundational chemistry. Students will learn that all things are made of matter, and they can undergo physical and chemical properties. Students will learn that atoms are the fundamental building blocks of matter. Students will also dive into how electrons are arranged in atoms. Atoms have a unique arrangement of electrons, and the valence electrons contribute to their unique chemical properties. Lastly, students will learn how periodic trends allow us to predict physical and chemical properties.

Writing Assignments:

- **Element quest Activity:** As you look at the periodic table, do you wonder about newly discovered elements that exist for only a fraction of a second? These elements are not found in nature. They are found only in laboratories. What fuels the quest for new elements? In WebQuest, students will look for information about these new elements and prepare a news article describing your research findings.

- **Analyzing and Identifying White Solids (Lab):** Conduct chemical and physical tests on a variety of white powders. Identify an unknown white powder by comparing its chemical and physical changes to those of known powders. Students will write out a hypothesis, conduct the experiment, and write a report documenting their results.

Unit 1 Project: Utilizing Properties of matter in Constructions: For this project, students will need to refocus their thinking. There are many possible solutions for this project. Students will be presented with a real-world problem that can be solved by applying the scientific knowledge that they have accumulated through this unit. Solid research, critical thinking, and applying different approaches to solve various engineering challenges are the key to this project. Students must think about the conditions that a house is subjected to during wildfires, tornadoes, or hurricanes and the chemical properties of material that would best resist these conditions.

Key Question: How can knowledge of physical and chemical properties be used to select building materials for a home and rainwater harvesting system?

Assessments:

- Module 1 Test: Structure and Properties of Matter
- Module 2 Test: Matter and Property Changes
- Module 3 Test: The Structure of an Atom
- Module 4 Test: Electrons in Atoms
- Module 5 Test: The Periodic Table and the Periodic Law

Lab

- Module 2: Matter—Properties and Changes
  - Laboratory: Properties of Water
    - Objective: Graph the estimated boiling point of water. Collect, graph, and interpret temperature versus time data. Compare the heat capacity of sand with that of water. Calculate and compare the densities of liquid water and ice.
    - Description: Students will explore a few of the properties of water. They will discover what makes water unique.

- Module 3: The Structure of the Atom
  - Laboratory: Simulation of Rutherford's Gold Foil Experiment
    - Objective: Students will calculate the trajectory of an alpha particle as it passes near the nucleus of a gold atom.
      Estimate the size of a gold atom's nucleus using Geiger's data.
    - Description: Rutherford's collaborator Hans Geiger was investigating the structure of the atom by observing how a beam of an alpha particle scattered after hitting a thin sheet of gold foil. Students will calculate the trajectory of an alpha particle as it passes near a gold atom's nucleus.

- Module 4: Electrons in Atoms
  - Laboratory: Electron Charge-to-Mass Ratio
    - Objective: Determine the ratio of charge e to mass m for an electron.
    - Description: Students will explore the charge and mass of an electron. They will follow in Thomson's footsteps and determine the charge to mass ratio of an atom.

- Module 5: The Periodic Table and Periodic Law
  - Laboratory: Properties of the Periodic Table
    - Objective: Students will construct a simplified version of the periodic table. Identify trends and relationships among elements in the same group. Students will identify trends and relationships among elements in the same period. They will draw conclusions about the predictability of chemical properties of the elements.
    - Description: Students will identify several elements based on their properties and the properties of the surrounding elements in the periodic table. They will make the connection of how the periodic table is organized by the chemical and physical properties.

Unit 2: Chemical Bonding and Reactions

Developing Understanding:

Students will learn how ionic compounds are held together by chemical bonds formed by the attraction of oppositely charged ions. Students will learn about covalent bond formation by atoms sharing one or more pairs of elections and the respective energy needed to break a covalent bond. Students will learn that millions of chemical reactions in and around them transform reactants into products resulting in the absorption or release of energy. Students will develop an understanding of moles and convert mole to particle and mass. Students will apply their knowledge of moles to determine empirical formula, molecular formula and percent composition. Students will determine the relationship among atomic mass, molar mass and Avogadro's number. Students will learn that chemists use mole ratios in stoichiometric calculations to predict the amounts of reactants used and products formed in any specific reaction.

Writing Assignments:

- **Formal Lab Report: Stoichiometry of a Chemical Reaction** Components of this formal lab report will include; Pre-Lab, Title, guiding question for the investigation, introduction (background information and purpose), hypothesis, experimental design, materials, safety precautions, procedures, results (data, graphs, calculations, drawings, observations), conclusions, and references.

- **Performance Task:** Students will research the challenges in delivering safe drinking water to people worldwide. Students will design a self-contained water purification system capable of removing biological contaminants, chemical contaminants, and sediment from water. This performance task includes ideas from this unit.

Assessment:

- Module 6 and 7 Assessment: Ionic and Covalent Compounds
- Module 8 Assessment: Chemical Reactions
- Module 9 and 10 Assessment: The Mole and Stoichiometry

Lab

- Module 6: Ionic Compounds and Metals
  - Formation of a Salt
    - Description: Students will observe the reaction $NaHCO_3$ with HCl in order to observe the formation of a salt.
- Module 7: Covalent Bonding
  - Modeling Molecular Shapes
    - Description: Students will use the VSEPR model to help predict molecular shapes.
- Module 8: Chemical Reactions
  - Laboratory: Double-Replacement Reactions
    - Description: Students will identify double replacement reactions and write balanced chemical equations for chemical reactions.

- Module 9: The Mole
  - Launch Lab: How much is a mole?
    - Description: Students will determine how much a mole is through the use of various objects and $6.02x10^{23}$.
- Module 10: Stoichiometry
  - Laboratory: Stoichiometry of a Chemical Reaction
    - Objective: React known amounts of carbonates and hydrogen carbonates with acid. Determine the stoichiometric relationships among the reactants and products. Identify an unknown carbonate by the amount of product formed.

Unit 3: Matter, Energy and Equilibrium

Development and Understanding

In the chemistry unit, students will delve into the intricate mechanisms underlying the vulnerability of corals to bleaching and other threats by investigating changes in ocean chemistry. Through the lens of the kinetic-molecular theory, they will explore the behavior of solids, liquids, and gasses, understanding how gasses respond predictably to alterations in pressure, temperature, volume, and particle count. They will grasp that the majority of substances in our environment exist as mixtures, and chemical reactions, while capable of absorbing or releasing energy, adhere to the law of conservation of energy. Additionally, students will comprehend that chemical reactions progress at a defined rate, subject to modification by altering reaction conditions, with many eventually reaching equilibrium where reactants and products are formed at equal rates. Furthermore, they will learn that the concentrations of hydrogen ions and hydroxide ions dictate the acidity, basicity, or neutrality of aqueous solutions, providing a comprehensive understanding of the intricate interplay of chemical processes in our natural world.

Writing Assignments:

- **Ocean Acidification Prevention**
  Students will research what can be done to mitigate the causes and effects of ocean and acidification. Since oceans readily absorb CO, ocean acidification is mainly a result of the chemical by-products of human activity and modern industry. Students will become familiar with the work of engineers and scientists to protect our oceans. This project incorporates the following ideas from the Unit:
    - Human impact on natural systems
    - Acids and Bases
    - Chemical Equilibrium
    - Formal Lab Report for the lab that includes the following components: Title, guiding question for the investigation, abstract, introduction (background information and purpose), hypothesis, experimental design, materials, safety precautions, procedures, results (data, graphs, calculations, drawings, observations), conclusions, and references.

Assessment:

- Module 12: Gases
- Module 13: Mixtures and Solutions
- Module 14: Energy and Chemical Change
- Module 15: Reaction Rates
- Module 16: Chemical Equilibrium
- Module 17: Acids and Bases
- Module: Earth and Space Science: Ocean Acidification

Lab:

- Module 11 - States of matter
  - Melting and Freezing Points
    - Objectives: Describe the process of melting and freezing.
    - Determine the melting and freezing points of two substances. When adding heat to a substance, the average kinetic energy of its particles rises, leading to a potential change in state. Conversely, when substances lose heat, particle interactions intensify, resulting in a more ordered arrangement. The temperature remains constant during a state change, with absorbed energy utilized to overcome intermolecular attractions rather than increasing the substance's kinetic energy. In the upcoming lab, you will ascertain the melting/freezing points of water and the food preservative BHT (butylated hydroxytoluene, $C_{15}H_{24}0$)
- Module 12 - Gases
  - Charles's Law
    - Objective: Verify Charles's law by investigating the linear relationship between the volume and Kelvin temperature of a confined gas at constant pressure.
    - Jacques Charles demonstrated in 1787 that gasses exhibit linear expansion with increasing temperature and contraction with decreasing temperature, maintaining constant pressure. The resulting graphical plot of temperature against volume yields a straight line, with all extrapolations converging at -273°C, known as absolute zero, expressed as 0 K in Kelvin. This relationship is described by Charles's law, stating that the volume of a confined gas at constant pressure is directly proportional to its Kelvin temperature, as depicted by the equation $V_1/T_1 = V_2/T_2$.
- Module 13 - Mixtures and Solutions
  - Freezing Point Depression
    - Objective: Investigate the colligative property of freezing point depression by studying how the dissolution of a solute affects the freezing point of a solvent.
    - When a solute dissolves in a solvent, it alters various properties of the solvent such as its freezing point, boiling point, and vapor pressure, collectively referred to as colligative properties. This experiment focuses on investigating the colligative property of freezing point depression.
- Module 14 - Energy and Chemical Change
  - Specific Heat of Metals
    - Objective: Construct a calorimeter. Measure changes in the temperature of water in

the calorimeter when warmer metals are added. Calculate the specific heat of each metal.

- Module 15 - Reaction Rates
  - The Rate of a Reaction
    - Objective: Measure the amount of time it takes for a uniform strip of Mg ribbon to react completely with HCl under varying conditions. Graph the data. Infer the relationships between reaction rates and varied temperatures and concentrations.
- Module 16 - Equilibrium
  - Exploring Chemical Equilibrium
    - Objective: Prepare serial dilutions of a standard solution. Estimate the color intensity of solutions at equilibrium. Relate color-intensity values to the concentration of $FeSCN^{2+}$ at equilibrium. Calculate the equilibrium constant for the reaction between Fe^{3+} and SCN^-
- Module 17 - Acids and Bases
  - Testing the Acidity of Aspirin
    - Objective: Measure the pH of solutions of unbuffered and buffered aspirin. Titrate each solution with a base. Make and use a graph of pH versus volume of base for the two pain relievers.

Unit 4: Organic and Nuclear Chemistry

Developing Understanding:
In the comprehensive study of hydrocarbons, students will delve into the intricate realm of carbon-containing organic compounds, recognizing their pivotal role as a crucial source of both energy and raw materials. Moving beyond basic understanding, the exploration extends to substituted hydrocarbons and their reactions. This module unveils the transformative process wherein diverse functional groups replace hydrogen atoms in hydrocarbons, giving rise to a myriad of organic compounds with distinct properties and applications in fields such as pharmaceuticals and polymers. Transitioning seamlessly into "The Chemistry of Life," students will gain insights into the molecular intricacies of proteins, carbohydrates, lipids, and nucleic acids. This module elucidates how these biological molecules intricately interact, orchestrating the essential activities required for the sustenance of living cells. Lastly, the course encompasses "Nuclear Chemistry," where students uncover the broad spectrum of applications, ranging from electricity production to advancements in medical diagnosis and treatment. Understanding the principles governing nuclear reactions, this module highlights the profound impact of nuclear chemistry on our daily lives and its significant role in shaping diverse industries.

Writing Assignments:

- Students will evaluate the positive and negative consequences of moving away from fossil fuels and towards alternative energy sources. They will consider the by-products of fossil fuels, such carbon dioxide, that are major contributors to the greenhouse effect. Students will research how energy audits are conducted, and they will use this information to complete an energy audit for their home or school.

- This project incorporates the following ideas from the Unit:
    - Functional groups
    - Hydrocarbon energy sources
    - Particulate matter

This project bundles these performance expecta-tions:

Assessment:

- Module 18: Hydrocarbons
- Module 19: Substituted Hydrocarbons and Their Reactions
- Module 20: The Chemistry of Life
- Module 21: Nuclear Chemistry.
- Module: Earth and Space Science: Climate Change

Labs:

- Module 18: Hydrocarbons
    - The Ripening of Fruit with Ethene
        - Objective: Understand the role of ethene in fruit ripening, observing how its presence transforms starch and acids into sugars while softening the fruit's texture by breaking down cell wall pectin, and to explore optimal harvesting and storage methods to prevent premature spoilage.
        - How a natural source of ethene ripens fruit. The contrast between the taste and texture of an unripe green apple and a ripe, typically red apple is significant, with the ripening process, driven by hydrocarbons like ethene, transforming the fruit's starch and acids into sugars while softening it by breaking down cell wall pectin. To witness the entire development and ripening cycles, it's crucial to leave the fruit on the plant, as waiting until all fruits are ripe before shipping risks premature spoilage, and refrigeration only slows the process once ethene is generated.

- Module 19: Substituted Hydrocarbons and Their Reactions
    - The Characterization of Carbohydrates
        - Objective: Understand the significance of carbohydrates in biological systems, their synthesis in plants via photosynthesis, their roles as energy stores and structural components, and their classification based on hydrolysis products, along with distinguishing reducing sugars using chemical tests like Benedict's test.
        - Carbohydrates, essential to life, are polyhydroxy aldehydes or ketones or their breakdown products, constituting the majority of organic carbon atoms. Synthesized mainly by plants through photosynthesis, they function as energy stores (starch) and structural components (cellulose) made of glucose units. Carbohydrates are categorized by their hydrolysis products; for instance, monosaccharides such as glucose are non-reducing, while disaccharides like sucrose yield two monosaccharides. Reducing sugars, distinguishable by tests like Benedict's test, reduce copper(I) ions to copper metal.

- Module 20: The Chemistry of Life
  - How do you test for simple sugars?
    - Objective: The objective of this lab is to investigate the energy content of various food sources by analyzing the concentration of simple sugars present in each sample. By understanding how different foods supply energy through the bonds of simple sugars, students will gain insight into the diverse sources of energy utilized by the body.

- Module 21: Nuclear Chemistry.
  - Modeling Isotopes
    - Objective: Understand the concept of isotopes, which are variants of an element with the same number of protons but differing numbers of neutrons, by using two types of pennies as analogs to demonstrate that despite compositional differences, they represent the same element.
    - The defining characteristic of an atom is its number of protons, which determine its chemical element. Isotopes, variations of an element with the same number of protons but different numbers of neutrons, have identical chemical properties due to their matching numbers of protons and electrons but exhibit distinct masses. In the experiment, two types of pennies serve as analogs for isotopes, highlighting the concept that despite differences in composition, they represent the same element.

- Module: Earth and Space Science: Climate Change
  - Radioisotope Dating
  - Objective: employ potassium-argon radiochemical dating to estimate the age of the Zag meteorite, discovered in August 1998, with a focus on elucidating the age of the solar system through analysis of its unique halite crystals containing an abundance of 128Xe isotopes.
  - Determine the age of the Zag meteorite. In August 1998, the Zag meteorite fell in the western Sahara of Morocco, exhibiting a unique characteristic with small halite (table salt) crystals. These crystals contained an unusually high abundance of 128Xe, suggesting the presence of a short-lived iodine isotope in the early solar system. As part of this lab, potassium-argon radiochemical dating will be employed to estimate the age of the Zag meteorite and, by extension, provide insights into the age of the solar system.

Writing Assignments (REQUIRED):
Give examples of the writing assignments and the use of critical analysis within the writing assignments.

Unit 1: Writing Assignments

- **Element quest Activity:** As you look at the periodic table, do you wonder about newly discovered elements that exist for only a fraction of a second? These elements are not found in nature. They are found only in laboratories. What fuels the quest for new elements? In WebQuest, students will look for information about these new elements and prepare a news article describing your research findings.

- **Analyzing and Identifying White Solids (Lab):** Conduct chemical and physical tests on a variety of white powders. Identify an unknown white powder by comparing its chemical and physical changes to those of known powders. Students will write out a hypothesis, conduct the experiment, and write a report documenting their results.

Unit 2: Writing Assignments

- **Formal Lab Report: Stoichiometry of a Chemical Reaction** Components of this formal lab report will include; Pre-Lab, Title, guiding question for the investigation, introduction (background information and purpose), hypothesis, experimental design, materials, safety precautions, procedures, results (data, graphs, calculations, drawings, observations), conclusions, and references.

- **Performance Task:** Students will research the challenges in delivering safe drinking water to people worldwide. Students will design a self-contained water purification system capable of removing biological contaminants, chemical contaminants, and sediment from water. This performance task includes ideas from this unit.

Unit 3: Writing Assignments

- **Ocean Acidification Prevention**
  Students will research what can be done to mitigate the causes and effects of ocean and acidification. Since oceans readily absorb CO, ocean acidification is mainly a result of the chemical by-products of human activity and modern industry. Students will become familiar with the work of engineers and scientists to protect our oceans. This project incorporates the following ideas from the Unit:

  - Human impact on natural systems
  - Acids and Bases
  - Chemical Equilibrium
  - Formal Lab Report for the lab that includes the following components: Title, guiding question for the investigation, abstract, introduction (background information and purpose), hypothesis, experimental design, materials, safety precautions, procedures, results (data, graphs, calculations, drawings, observations), conclusions, and references.

Unit 4: Writing Assignments

- Students will evaluate the positive and negative consequences of moving away from fossil fuels and towards alternative energy sources. They will consider the by-products of fossil fuels, such carbon di-oxide, that are major contributors to the greenhouse effect. Students will research how energy audits are conducted, and they will use this information to complete an energy audit for their home or school.
- This project incorporates the following ideas from the Unit:

- Functional groups
- Hydrocarbon energy sources
- Particulate matter

INSTRUCTIONAL MATERIALS (REQUIRED)	
Textbook #1	
Title: California Inspire Chemistry	Edition: 1st
Author: McGraw Hill	ISBN: 978-0021381159
Publisher: McGraw Hill	Publication Date: August 6, 2018
Usage: ☑ Primary Text ☐ Read in entirety or near	
Textbook #2	
Title:	Edition:
Author:	ISBN:
Publisher:	Publication Date:
Usage: ☐ Primary Text ☐ Read in entirety or near	
Supplemental Instructional Materials *Please include online, and open source resources if any.*	
Estimated costs for classroom materials and supplies (REQUIRED). *Please describe in detail.* If more space is needed than what is provided, please attach a backup as applicable.	
Cost for a class set of textbooks: $	Description of Additional Costs:
Additional costs:$	
Total cost per class set of instructional materials:	$

Key Assignments (REQUIRED):

Please provide a detailed description of the Key Assignments including tests, and quizzes, which should incorporate not only short answers but essay questions also. How do assignments incorporate topics? Include all major assessments that students will be required to complete

Unit 1: Structure and Properties of Matter

- **Analyzing and Identifying White Solids (Lab):** Conduct chemical and physical tests on a variety of white powders. Identify an unknown white powder by comparing its chemical and physical changes to those of known powders. Students will write out a hypothesis, conduct the experiment, and write a report documenting their results.

- **Unit 1 Project: Utilizing Properties of matter in Constructions:** For this project, students will need to refocus their thinking. There are many possible solutions for this project. Students will be presented with a real-world problem that can be solved by applying the scientific knowledge that they have accumulated through this unit. Solid research, critical thinking, and applying different approaches to solve various engineering challenges are the key to this project. Students must think about the conditions that a house is subjected to during wildfires, tornadoes, or hurricanes and the chemical properties of material that would best resist these conditions.

- **Module 2: Matter - Properties and Changes**
  - Laboratory: Properties of Water
  - Objective: Graph the estimated boiling point of water. Collect, graph, and interpret temperature versus time data. Compare the heat capacity of sand with that of water. Calculate and compare the densities of liquid water and ice.
    Description: Students will explore a few of the properties of water. They will discover what makes water unique.
- **Module 3: The Structure of the Atom**
  - Laboratory: Simulation of Rutherford's Gold Foil Experiment
    Objective: Students will calculate the trajectory of an alpha particle as it passes near the nucleus of a gold atom. Estimate the size of a gold atom's nucleus using Geiger's data.
    Description: Rutherford's collaborator Hans Geiger was investigating the structure of the atom by observing how a beam of an alpha particle scattered after hitting a thin sheet of gold foil. Students will calculate the trajectory of an alpha particle as it passes near a gold atom's nucleus.
- Module 4: Electrons in Atoms
  - Laboratory: Electron Charge-to-Mass Ratio
    Objective: Determine the ratio of charge e to mass m for an electron.
    Description: Students will explore the charge and mass of an electron. They will follow in Thomson's footsteps and determine the charge to mass ratio of an atom.
- Module 5: The Periodic Table and Periodic Law
  - Laboratory: Properties of the Periodic Table
    Objective: Students will construct a simplified version of the periodic table.
    Identify trends and relationships among elements in the same group. Students will identify trends and relationships among elements in the same period. They will draw conclusions

about the predictability of chemical properties of the elements.
Description: Students will identify several elements based on their properties and the properties of the surrounding elements in the periodic table. They will make the connection of how the periodic table is organized by the chemical and physical properties.

Unit 2: Chemical Bonding and Reactions

- **Formal Lab Report: Stoichiometry of a Chemical Reaction:** Components of this formal lab report will include; Pre-Lab, Title, guiding question for the investigation, introduction (background information and purpose), hypothesis, experimental design, materials, safety precautions, procedures, results (data, graphs, calculations, drawings, observations), conclusions, and references.
    - Description of Lab: In this experiment, you will react samples of three known carbonates and an unknown carbonate with hydrochloric acid. You will determine the stoichiometric relationships among the reactants and products. You will then determine the identity of the unknown carbonate by comparing its experimental results with those of the known carbonate.

Performance Task: Students will research the challenges in delivering safe drinking water to people worldwide. Students will design a self-contained water purification system capable of removing biological contaminants, chemical contaminants, and sediment from water. This performance task includes ideas from this unit.

- Module 6: Ionic Compounds and Metals
    - Formation of a Salt
        - Description: Students will observe the reaction $NaHCO_3$ with HCl in order to observe the formation of a salt.
- Module 7: Covalent Bonding
    - Modeling Molecular Shapes
        - Description: Students will use the VSEPR model to help predict molecular shapes.
- Module 8: Chemical Reactions
    - Laboratory: Double-Replacement Reactions
        - Description: Students will identify double replacement reactions and write balanced chemical equations for chemical reactions.
- Module 9: The Mole
    - Launch Lab: How much is a mole?
        - Description: Students will determine how much a mole is through the use of various objects and 6.02×10^{23}.
- Module 10: Stoichiometry
    - Laboratory: Stoichiometry of a Chemical Reaction
        - Objective: React known amounts of carbonates and hydrogen carbonates with acid. Determine the stoichiometric relationships among the reactants and products. Identify an unknown carbonate by the amount of product formed.

Unit 3: Matter, Energy and Equilibrium

- Module 11 - States of matter

- Melting and Freezing Points
  - Objectives: Describe the process of melting and freezing.
  - Determine the melting and freezing points of two substances. When adding heat to a substance, the average kinetic energy of its particles rises, leading to a potential change in state. Conversely, when substances lose heat, particle interactions intensify, resulting in a more ordered arrangement. The temperature remains constant during a state change, with absorbed energy utilized to overcome intermolecular attractions rather than increasing the substance's kinetic energy. In the upcoming lab, you will ascertain the melting/freezing points of water and the food preservative BHT (butylated hydroxytoluene, $C_{15}H_{24}0$)
- Module 12 - Gases
  - Charles's Law
    - Objective: Verify Charles's law by investigating the linear relationship between the volume and Kelvin temperature of a confined gas at constant pressure.
    - Jacques Charles demonstrated in 1787 that gasses exhibit linear expansion with increasing temperature and contraction with decreasing temperature, maintaining constant pressure. The resulting graphical plot of temperature against volume yields a straight line, with all extrapolations converging at -273°C, known as absolute zero, expressed as 0 K in Kelvin. This relationship is described by Charles's law, stating that the volume of a confined gas at constant pressure is directly proportional to its Kelvin temperature, as depicted by the equation $V_1/T_1 = V_2/T_2$.
- Module 13 - Mixtures and Solutions
  - Freezing Point Depression
    - Objective: Investigate the colligative property of freezing point depression by studying how the dissolution of a solute affects the freezing point of a solvent.
    - When a solute dissolves in a solvent, it alters various properties of the solvent such as its freezing point, boiling point, and vapor pressure, collectively referred to as colligative properties. This experiment focuses on investigating the colligative property of freezing point depression.
- Module 14 - Energy and Chemical Change
  - Specific Heat of Metals
    - Objective: Construct a calorimeter. Measure changes in the temperature of water in the calorimeter when warmer metals are added. Calculate the specific heat of each metal.
- Module 15 - Reaction Rates
  - The Rate of a Reaction
    - Objective: Measure the amount of time it takes for a uniform strip of Mg ribbon to react completely with HCl under varying conditions. Graph the data. Infer the relationships between reaction rates and varied temperatures and concentrations.
- Module 16 - Equilibrium
  - Exploring Chemical Equilibrium
    - Objective: Prepare serial dilutions of a standard solution. Estimate the color intensity of solutions at equilibrium. Relate color-intensity values to the concentration of $FeSCN^{2+}$ at equilibrium. Calculate the equilibrium constant for the reaction between

Fe^{3+} and SCN^-

- Module 17 - Acids and Bases
  - Testing the Acidity of Aspirin
    - Objective: Measure the pH of solutions of unbuffered and buffered aspirin. Titrate each solution with a base. Make and use a graph of pH versus volume of base for the two pain relievers.

Unit 4: Organic and Nuclear Chemistry

- Module 18: Hydrocarbons
  - The Ripening of Fruit with Ethene
    - Objective: Understand the role of ethene in fruit ripening, observing how its presence transforms starch and acids into sugars while softening the fruit's texture by breaking down cell wall pectin, and to explore optimal harvesting and storage methods to prevent premature spoilage.
    - How a natural source of ethene ripens fruit. The contrast between the taste and texture of an unripe green apple and a ripe, typically red apple is significant, with the ripening process, driven by hydrocarbons like ethene, transforming the fruit's starch and acids into sugars while softening it by breaking down cell wall pectin. To witness the entire development and ripening cycles, it's crucial to leave the fruit on the plant, as waiting until all fruits are ripe before shipping risks premature spoilage, and refrigeration only slows the process once ethene is generated.
- Module 19: Substituted Hydrocarbons and Their Reactions
  - The Characterization of Carbohydrates
    - Objective: Understand the significance of carbohydrates in biological systems, their synthesis in plants via photosynthesis, their roles as energy stores and structural components, and their classification based on hydrolysis products, along with distinguishing reducing sugars using chemical tests like Benedict's test.
    - Carbohydrates, essential to life, are polyhydroxy aldehydes or ketones or their breakdown products, constituting the majority of organic carbon atoms. Synthesized mainly by plants through photosynthesis, they function as energy stores (starch) and structural components (cellulose) made of glucose units. Carbohydrates are categorized by their hydrolysis products; for instance, monosaccharides such as glucose are non-reducing, while disaccharides like sucrose yield two monosaccharides. Reducing sugars, distinguishable by tests like Benedict's test, reduce copper(I) ions to copper metal.
- Module 20: The Chemistry of Life
  - How do you test for simple sugars?
    - Objective: The objective of this lab is to investigate the energy content of various food sources by analyzing the concentration of simple sugars present in each sample. By understanding how different foods supply energy through the bonds of simple sugars, students will gain insight into the diverse sources of energy utilized by the body.
- Module 21: Nuclear Chemistry.
  - Modeling Isotopes

        - Objective: Understand the concept of isotopes, which are variants of an element with the same number of protons but differing numbers of neutrons, by using two types of pennies as analogs to demonstrate that despite compositional differences, they represent the same element.
        - The defining characteristic of an atom is its number of protons, which determine its chemical element. Isotopes, variations of an element with the same number of protons but different numbers of neutrons, have identical chemical properties due to their matching numbers of protons and electrons but exhibit distinct masses. In the experiment, two types of pennies serve as analogs for isotopes, highlighting the concept that despite differences in composition, they represent the same element.
- Module: Earth and Space Science: Climate Change
    - Radioisotope Dating
    - Objective: employ potassium-argon radiochemical dating to estimate the age of the Zag meteorite, discovered in August 1998, with a focus on elucidating the age of the solar system through analysis of its unique halite crystals containing an abundance of 128Xe isotopes.
    - Determine the age of the Zag meteorite. In August 1998, the Zag meteorite fell in the western Sahara of Morocco, exhibiting a unique characteristic with small halite (table salt) crystals. These crystals contained an unusually high abundance of 128Xe, suggesting the presence of a short-lived iodine isotope in the early solar system. As part of this lab, potassium-argon radiochemical dating will be employed to estimate the age of the Zag meteorite and, by extension, provide insights into the age of the solar system.

Instructional Methods and/or Strategies (REQUIRED):

Please list specific instructional methods that will be used.

- Oral In-Class Participation/Classwork/Homework
- Focus Activities
- Homework/Classwork
- Quizzes and Tests
- Writing Assessments
- Projects (including Artifact, Written and Oral Assessment)

Assessment Methods and/or Tools (REQUIRED):

Please list different methods of assessments that will be used.

Unit 1: Structure and Properties of Matter

- Module 1 Test: Structure and Properties of Matter
- Module 2 Test: Matter and Property Changes
- Module 3 Test: The Structure of an Atom
- Module 4 Test: Electrons in Atoms
- Module 5 Test: The Periodic Table and the Periodic Law

Unit 2: Chemical Bonding and Reactions

- Module 6 and 7 Assessment: Ionic and Covalent Compounds
- Module 8 Assessment: Chemical Reactions
- Module 9 and 10 Assessment: The Mole and Stoichiometry

Unit 3: Matter, Energy and Equilibrium

- Module 12 Test: Gases
- Module 13 Test: Mixtures and Solutions
- Module 14 Test: Energy and Chemical Change
- Module 15 Test: Reaction Rates
- Module 16 Test: Chemical Equilibrium
- Module 17 Test: Acids and Bases
- Module Test: Earth and Space Science: Ocean Acidification

Unit 4: Organic and Nuclear Chemistry

- Module 18 Test: Hydrocarbons
- Module 19 Test: Substituted Hydrocarbons and Their Reactions
- Module 20 Test: The Chemistry of Life
- Module 21 Test: Nuclear Chemistry.
- Module Test: Earth and Space Science: Climate Change