Chemistry CPA

Course Description

Chemistry is that branch of science that deals with the properties, composition, and structure of matter, how it can change, and the energy that is released or absorbed during this change. This course is designed to give students a thorough introduction to chemistry concepts, scientific reasoning, and chemistry-related laboratory skills. Students study atomic structure, the periodic table, chemical formulas and balancing equations, and acid-base chemistry. In addition, they conduct controlled laboratory experiments, observe results and collect data, analyze the results, draw conclusions and write analysis reports (lab reports). Throughout the course, students are given benchmark assessments to inform instruction and measure progress, and, in each unit of study, they take written (unit) assessments which measure content knowledge and skills.

This course teaches and reinforces dispositions and skills defined in the ***Portrait of the Crusader.*** Students learn to approach problems and situations with an open-mind, use inquiry and innovation to solve problems, think critically about the information presented before responding with questions or feedback, and show respect for others' ideas.

Course Essential Questions

- Why is chemistry considered the central science?
- What is matter composed of? What is the relationship between matter and energy?
- What explains the physical and chemical properties of matter?
- What is a chemical reaction and what factors affect chemical reactions?
- What role does energy play in physical and chemical changes?

Unit I. Introduction to Chemistry

Focus Questions:

- Why is chemistry considered to be an interdisciplinary science? What is the work of chemists?
- How can we use the scientific method to learn about the living world?
- How do we gather and organize accurate data for analysis and reporting?

Concepts/Skills:

- Explain how chemistry informs physics, biology, and the earth sciences.
- Investigate the five types of chemists and determine the contributions of each type.
- Detail each step of the scientific method and explain how this method can be used to investigate specific real-world phenomena.
- Demonstrate the ability to use metric devices, a triple beam and electronic balance. Explain why the metric system is used in chemistry.
- Appropriately use safety equipment (e.g. goggles, gloves, aprons)
- Apply scientific reasoning skills to observe, gather and analyze basic qualitative and quantitative data, make inferences and draw conclusions, and communicate findings.

Labs:

- Scientific Method Lab

Summative Assessments:

- Chemist Project and Presentation
- Formal Lab Report - focus on format and content

Unit II. Scientific Measurement

Focus Questions:

- What is the importance of using scientific notation?
- What is the importance of finding an acceptable error and percent error in laboratory experiments?
- Why is it important to be consistent with rounding and significant figures when collecting and analyzing data?
- How do we calculate density and how does it relate to an object?
- How do we convert between units on the metric system?

Concepts/Skills:

- Explain why scientific notation is used in the study of science and chemistry in particular.
- Write, multiply and divide using scientific notation to solve problems.
- Round using significant figures and determine
- Calculate error, percent error, and density.
- Use dimensional analysis to complete metric conversions.
- DIfferentiate between the concepts of precision and accuracy.

Labs:

- Accuracy and Precision Lab with error and percent error
- Density Lab

Formative and Summative Assessments:

- Benchmark assessments
- Lab Reports for Accuracy and Precision and Density Lab
- Unit Test covering terminology, scientific and mathematical concepts, and problem-solving

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III. Properties of Matter and Atomic Structure

Focus Questions:

- What is matter composed of?
- How do scientists define and deduce the physical and chemical properties of matter?
- What is the structure of the atom?

- How do sub particles combine to form elements with unique properties? How do elements combine to form compounds with unique properties?

Concepts/Skills: Properties of Matter

Section 1: Physical Properties of Matter

- Identify the physical properties of matter.
- Explain and recognize types of physical change: changing state, making a solution, separating a mixture, physical alteration.
- Define the three states of matter and analyze how the introduction of thermal energy or pressure can cause a change of state. Model the proximity and activity of molecules in a solid, liquid and gas.
- Classify mixtures as heterogeneous or homogeneous (solution).
- Investigate how physical properties can be used to separate mixtures, including filtration and distillation.
- Define the terms element and compound.
- Examine why the physical properties of compounds are different from their component elements.

Section 2 - Chemical Properties and Changes

- Define chemical properties, chemical change/reaction, reactant and product.
- Identify the processes that can cause chemical change.
- Explain why compounds can only be broken down by chemical reaction.
- Provide examples of how chemists deduce chemical properties in the laboratory (transfer of energy, change in color, production of gas, or formation of a precipitate.)
- Summarize how the law of conservation of mass applies to physical and chemical changes.

Section 3 - **Atomic Structure**

- Model the structure of the atom, including electrical charge.
- Define atomic number and mass number. Explain how subatomic particles combine to form elements with unique properties.
- Define isotope.
- Calculate atomic mass. Explain amu.
- Recognize chemical symbols and the components of chemical formulas.
- Recognize chemical formulas for common compounds.
- Understand the history of atomic theory (Rutherford, Bohr, Schrodinger/quantum mechanical model).

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Labs:

- Physical and Chemical Change Lab
- Mixtures Lab

Formative and Summative Assessments:

- Benchmark assessments after each section.
- Lab Reports for Physical and Chemical Changes (formal) and Mixtures Lab.
- Research/Presentation focused on the evolution of atomic theory.
- Unit Test.

Unit IV. Electron Configuration and the Periodic Table

Focus Questions:

- How is the Periodic Table organized? What are the major trends of the Periodic Table?
- What does the Period Table show us about electron configuration?
- What are valence electrons? How do valence electrons affect the properties of an element?
- How can elements be classified based on electron configuration?
- What is an ion? What determines if an ion is a cation or anion?

Concepts/Skills:

- Explain the organization of the modern Periodic Table.
- Recognize the information that can be found: element name, symbol, atomic number, atomic mass, number of electrons in each energy level.
- Organize and classify elements as metals, nonmetals, and metalloids.
- Identify orbitals and energy levels on the periodic table.
- Classify elements - noble gasses, representative elements, transition metals and inner transition metals- based on their electron configurations.
- Define ion, cation, anion, ionization energy and electronegativity.
- Understand that positive and negative ions form when electrons are transferred between atoms.
- Examine the periodic table to draw conclusions about ionic size, the size of cations and anions and electronegativity values. Define the major trends of the Periodic Table.

Labs:

- Flame Test Lab
- Periodic Trends Lab

Summative Assessments:

- Unit Test
- Flame Test Formal Lab Report; Periodic Trends Informal Lab Report
- Elements Project

V. Bonding

Focus Questions:

- What is chemical bonding?
- How do ionic, metallic and covalent bonds form? How do they differ?
- How are chemical bonds broken?
- What is the relationship between energy and bonding?
- How do the Laws of Conservation of Mass and Conservation of Energy apply to bonding?

Concepts/Skills:

Section 1 : Ionic and Metallic Bonding

- Explain the concept of bonding, including the role of valence electrons.
- Define and contrast exothermic and endothermic reactions.
- Explain the octet rule.
- Define formula units and ionic compounds and explain why they are electrically neutral.
- Examine/model how ionic bonds form.
- Interpret and write chemical formulas that represent ionic compounds.
- Use electron dot structures to predict the formulas of ionic compounds.
- Define the term metallic bond and model the valence electrons of atoms in a pure metal.
- Summarize the properties unique to metals.
- Examine the benefits of alloys.

Section 2 - Covalent Bonding

- Define covalent and coordinate covalent bonds, molecule, diatomic molecule, molecular compound, molecular formula.
- Explain the octet rule in covalent bonding.
- Identify the groups on the Periodic Table most likely to form covalent bonds (4A, 5A, 6A, 7A).
- Contrast ionic and covalent bonds. Given the formulas classify compounds as ionic or covalent.
- Interpret molecular formulas.
- Recognize structural formulas for single, double and triple covalent bonds.
- Draw electron dot structures for specific molecules.
- Analyze how the Laws of Conservation of Mass and Energy apply to bonding.

Labs:

- Molecular Formula Lab
- Freezing Point Depression Lab

Summative Assessments:

- Unit Test
- Molecular Formula Informal Lab Report; Freezing Point Depression Informal Lab Report

Unit VI. Chemical Quantities - The Mole

Focus Questions:

- When and why do chemists use the mole?
- What does the mole represent? What is Avagadro's Constant?
- What is the importance of standard temperature and pressure (STP)?
- How do you calculate moles, molar mass, and molar volumes?

Concepts/Skills:

- Explain the form and function of Avogadro's Constant.
- Calculate mole problems.
- Recognize molar units.
- Define molar mass and calculate molar mass of a compound.
- Calculate the volume of a mole using STP.

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Labs:

- Mole Calculation Lab
- Calculating Moles Problem Set

Summative Assessments:

- Unit Test
- Mole Calculation Lab Report

VII. Describing Chemical Reactions (Writing and Balancing Chemical Equations)

Focus Questions:

- What is the difference between a reactant and product in a chemical reaction?
- What are catalysts and what do they do in a chemical reaction?
- What is the form and function of a chemical equation?
- How do we read and write chemical equations?
- What is the purpose of balancing chemical equations?
- How does this process relate to the Law of Conservation of Mass?
- What are the steps of balancing a chemical equation?

Concepts/Skills:

- Review/explain the terms reactant, product, and catalyst.
- Identify the components of a chemical equation including coefficients and subscripts.
- Read and write chemical equations using accurate terminology.
- Define the term balanced equation and recognize balanced equations.
- Recognize that the coefficients can be used to determine mole ratios in the reaction.
- Analyze the Law of Conservation of Mass and how this law relates to balancing equations. Explain that a balanced equation represents conservation of atoms.

- Explain the steps to balance chemical equations.
- Balance chemical equations, moving from simple to complex.

Labs:

- Balancing Equations Lab and Problem Set

Summative Assessments:

- Unit Test

VII. Acids and Bases

Focus Questions:

- What are the factors when determining if a substance is an acid or a base?
- What does the pH of a solution mean? What is the importance of the pH Scale?
- How can we measure the pH of a substance?
- What is neutralization and how does this occur?
- What is a buffer?

Concepts/Skills:

- Define pH and explain how it is used in the study of chemistry.
- Explain how the constant of water determines the range of the pH scale.
- Classify substances as acid or base.
- Discuss the pro's and con's of acid-base indicators and pH meters.
- Determine the purpose of buffers.
- Analyze the causes of heartburn and how to neutralize the condition.

Labs:

- pH Lab

Summative Assessments:

- Unit Test
- pH Informal Lab Report

IX. Gas Laws

(This unit reinforces varied chemistry concepts and may be taught at different times in the course)

Focus Questions:

- What is the theory behind Boyle's Law, Charles Law, and the Ideal Gas Law?
- How do we use the gas laws to solve problems?
- What are the relationships between variables used in the gas laws?

Concepts/Skills:

- Summarize the gas laws studied in class.
- Explain how pressure, temperature, volume, and molecular weight affect how particles in a gas behave.
- Predict the spatial distribution, interaction, and motion of particles in a gas sample as variables are changed.
- Use the gas laws to solve problems.
- Interpret trends in data by examining graphs associated with each of the gas laws.
- Compare the density of gasses based on their behavior.
- Convert temperatures in Celsius to Kelvin.

Labs:

- Gas Law Problem Sets

Summative Assessments:

- Unit Test

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Resources

- *Pearson Chemistry 2017*
- *Current articles related to topics studied*
- *Websites accessed during research*

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Grading Policy

- Point System Used for Grading