02 - Atomic Theory and the Periodic Table

Content Area: **Science**
Course(s):
Time Period: **Full Year**
Length: **9 Blocks**
Status: **Published**

General Overview, Course Description or Course Philosophy

Chemistry CP aims to provide students with a fundamental understanding of the composition, structure, properties, and transformations of matter. Through a combination of theoretical concepts, laboratory investigations, and real-world applications, students will explore the principles and laws that govern chemical reactions and interactions. The course emphasizes the development of scientific inquiry skills, critical thinking abilities, and the application of problem-solving strategies. Students will actively engage in the process of scientific discovery, asking questions, seeking answers, and making connections between theory and practical applications. Laboratory experiences will integrate with theoretical knowledge, fostering the development of practical skills, scientific inquiry, and responsible practices. Students will also explore the ethical considerations and societal implications of chemistry, promoting informed decision-making as responsible citizens. By the end of the course, students will have a deepened appreciation for the relevance of chemistry in everyday life and will be prepared for further study and careers in scientific fields.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Objectives:

- Describe the historical development of atomic theory and its impact on our understanding of matter.
- Explain the fundamental concepts of atomic structure, including the subatomic particles, electron configuration, and energy levels.
- Analyze and interpret the periodic table, including the organization of elements, groups, periods, and trends in atomic properties.
- Identify and apply periodic trends, such as atomic radius, ionization energy, and electronegativity, to predict and explain chemical behavior.
- Understand and apply the principles of chemical bonding, including ionic, covalent, and metallic bonding, based on atomic structure and periodic trends.
- Investigate and explain the relationship between the structure of atoms, the arrangement of elements, and the formation of compounds through hands-on experiments and models.
- Apply the knowledge of atomic theory and the periodic table to explain and predict the properties and behavior of elements and compounds.
- Demonstrate critical thinking and problem-solving skills by analyzing and evaluating experimental data, scientific claims, and real-life applications related to atomic theory and the periodic table.
- Communicate scientific ideas and findings effectively using appropriate terminology, diagrams, and representations.

Essential Questions:

- How does the atomic theory help us explain the properties and behavior of matter?
- What is the significance of the periodic table in organizing elements and predicting their properties?

- How do the structure of atoms and the arrangement of elements in the periodic table influence chemical reactions and bonding?

Enduring Understandings:

- The atomic theory provides a framework for understanding the composition, structure, and behavior of matter.
- The periodic table is a powerful tool for organizing and predicting the properties of elements.
- An understanding of atomic structure and periodic trends enables us to explain and manipulate chemical reactions.

CONTENT AREA STANDARDS

SCI.9-12.HS-PS1-1	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
SCI.9-12.HS-PS2-4	Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.
SCI.9-12.HS-PS1-2	Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

MA.N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
TECH.K-12.1.3.d	build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.
LA.RST.9-10.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.9-10.2	Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
TECH.K-12.1.4.a	know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
LA.RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

STUDENT LEARNING TARGETS

Refer to the 'Declarative Knowledge' and 'Procedural Knowledge sections.

Declarative Knowledge

Students will understand that:

- The atomic structure of materials determines its properties.
- Understanding that the development of scientific ideas and models is essential for building science knowledge.
- Explain the historical experiments that led to today's modern model of the atom.
- Determine an element's valence electron structure by its position in the periodic table.
- Use the periodic table to predict chemical properties of element, and classify them as metals, nonmetals, or metalloids.

Procedural Knowledge

Students will be able to:

- Identify and describe the components of the model that are relevant for their predictions, including:
    - Elements and their arrangement in the periodic table;
    - A positively-charged nucleus composed of both protons and neutrons, surrounded by negatively-charged electrons;
    - Electrons in the outermost energy level of atoms (i.e., valence electrons);
    - The number of protons in each element.
- Construct an explanation of the outcome of the given reaction, including:
    - The idea that the total number of atoms of each element in the reactant and products is the same;
    - The numbers and types of bonds (i.e., ionic, covalent) that each atom forms, as determined by the outermost (valence) electron states and the electronegativity;]
    - The outermost (valence) electron state of the atoms that make up both the reactants and the products of the reaction is based on their position in the periodic table;
    - A discussion of how the patterns of attraction allow the prediction of the type of reaction that occurs (e.g., formation of ionic compounds, combustion of hydrocarbons).
- Describe that the ratio between electric forces between objects with a given charge and mass is a pattern that is independent of distance, given mathematical models.

EVIDENCE OF LEARNING

Refer to the 'Formative Assessments' and 'Summative Assessments' sections.

Formative Assessments

- POGIL Activities:
  - Isotopes
  - Ions
  - Average Atomic Mass
- Labs
  - Rutherford Gold Foil Experiment
  - Bean Bag Isotopes / Atomic Mass of Candium
  - It's in the Cards (Mendeleev Simulation)
- Group practice
  - History of Atomic Structure
  - Atomic Number, Mass Number, and Isotopes
  - Ions
  - Calculating Atomic Mass
- Performance Scale/ Student Tracking Chart
- Whiteboards
- Exit Tickets
- Homework

Summative Assessments

- Benchmarks – departmental benchmark given at the end of MP1, MP2, and MP3 based on lab practices
- Alternative Assessments
  - Lab inquiries and investigations
  - Lab Practicals
  - Exploratory activities based on phenomenon
  - Gallery walks of student work
  - Creative Extension Projects
  - Build a model of a proposed solution
  - Let students design their own flashcards to test each other
  - Keynote presentations made by students on a topic
  - Portfolio

RESOURCES (Instructional, Supplemental, Intervention Materials)

CK-12 Online Textbook

POGIL Chemistry

Gizmos Simulations

PhET Simulations

Khan Academy

Bozeman Science

American Chemical Society

INTERDISCIPLINARY CONNECTIONS

ELA/Literacy

Mathematics

Technology

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.