Unit 2: Atomic Structure, Periodic Table, Chemical Interactions

Content Area: **Science**
Course(s):
Time Period: **Trimester 1**
Length: **9-10 weeks**
Status: **Published**

Atomic Structure, Periodic Table, Chemical Interactions Summary

In this unit, students will investigate the relationship between atomic structure, the Periodic Table, and chemical interactions through inquiry-based learning and hands-on experimentation. They will examine the development of atomic theory, explore how the Periodic Table is organized, and learn how electron configuration influences an element's properties and reactivity. Through guided research and lab activities, students will practice key scientific skills, including hypothesis formation, data collection, analysis, and interpretation. Special emphasis will be placed on using the Periodic Table to predict and explain chemical behaviors. Students will also build foundational laboratory techniques and safety awareness. To demonstrate their understanding, students will complete a project that involves scientific writing, effective communication of results, and visual representation of data. This unit emphasizes critical thinking, collaboration, and the real-world application of chemistry concepts.

Revision Date: July 2025

Essential Questions/Enduring Understandings

Essential Questions

How does understanding the fundamental structure of an atom provide the foundation for all of chemistry and our understanding of matter?

What is the purpose of the Periodic Table, and how does its organization serve as a key for unlocking the properties of all known elements?

How can we use the patterns and trends within the Periodic Table to predict an element's chemical behavior and its potential to form compounds?

Enduring Understanding

The behavior of all matter is governed by the interactions of its atoms, especially the transfer and sharing of electrons during chemical bonding.

The scientific method is a foundational, systematic framework for safe and ethical inquiry, providing the tools to develop testable hypotheses and investigate the natural world.

The structure of an atom, particularly the arrangement and number of its electrons, fundamentally determines an element's unique chemical properties and how it will bond with other elements.

Objectives

Students will be skilled at distinguishing between properties and changes, both physical and chemical.
Students will be skilled at explaining how mass is conserved during physical and chemical changes.
Students will be skilled at assembling the structure of the atom using average atomic mass and atomic number to develop a model for an atom with an accurate number of protons, neutrons, and electrons.
Students will be skilled at using the periodic table to classify and predict the characteristics of an element.
Students will be skilled at explaining how atoms combine to form compounds and molecules that are chemically stable.
Students will be skilled at distinguishing between ionic and covalent bonds.
Students will be skilled at writing and naming chemical compounds.

Students will know that chemical formulas represent the elements in a compound and the ratio of their atoms.

Students will know the components of each bond type and what the electrons will do.

Students will know that atoms bond to achieve a full outer electron shell (usually eight valence electrons).

Students will know that compounds form when atoms of different elements chemically combine.

Students will know that elements are organized by increasing atomic number and grouped by similar properties.

Students will know that groups (columns) share similar chemical behaviors due to their valence electrons.

Students will know that metals, nonmetals, and metalloids have characteristic physical and chemical properties.

Students will know that physical changes do not alter the substance's identity, while chemical changes result in new substances.

Learning Plan

1. **Discuss and practice science lab safety procedures**
   Students will learn and demonstrate proper lab safety practices, including how to use goggles, handle chemicals responsibly, respond to accidents, and follow classroom safety rules to ensure a safe learning environment.
2. **Complete Investigate Lab: Properties of Substances through the online textbook.** Students will practice identifying unknown compounds by their physical and chemical properties.

3. **Discuss the periodic table of the elements, its history, and its uses**
   Students will learn about the development of the periodic table, explore how it is organized, and discuss why it's useful for understanding elements and their properties.

4. **Color-code a periodic table to become familiar with similarities in structure and properties**
   Students will color-code different element groups (e.g., metals, nonmetals, noble gases) to visually compare patterns and similarities in the periodic table.

5. **Practice reading the periodic table to determine the number of protons, neutrons, and electrons in a given element**
   Students will use atomic number and mass to calculate the number of subatomic particles (protons, neutrons, electrons) for various elements.

6. **Discuss Bohr diagrams**
   Students will draw Bohr models to show how electrons are arranged in energy levels around the nucleus of an atom.

7. **Distinguish between elements and compounds**
   Students will compare visual and written examples of elements and compounds and classify them based on composition.

8. **Discuss counting the number of elements in a given compound. Discuss rules involving coefficients, subscripts, and parentheses**
   Students will practice breaking down chemical formulas to count how many atoms of each element are present, using subscripts, coefficients, and parentheses.

9. **Introduce the relationship between mass, volume and density**
   Students will measure the mass and volume of various objects and use the density formula (D = M/V) to calculate and compare densities.

10. **Introduce Archimedes' Principle and buoyant forces**
    Students will observe objects in water and conduct experiments to understand why some sink and others float, using displacement and buoyancy concepts.

11. ***Archimedes' principle of buoyancy gizmo.*** Students will complete an online simulation exploring different unknown interactions with water and calculating density.

12. **Introduce molecular attraction, adhesion, cohesion, capillary action, and surface tension**
    Students will conduct hands-on demonstrations (like water drops on pennies or capillary tubes) to explore how water molecules stick together and to other surfaces.

13. **Properties of Water Lab**
    Students will investigate water's unique properties (such as surface tension, cohesion, and density) through a series of guided lab activities.

14. **Create a graphic organizer to define and discuss homogeneous and heterogeneous substances, pure substances and mixtures, colloids and suspensions, solutes and solvents, and elements and compounds**
    Students will organize information into a visual chart or diagram comparing types of matter, using definitions, examples, and visuals.

15. **Define and discuss solutions, solvents, and solutes. Compare and contrast unsaturated, saturated, and supersaturated solutions**
    Students will define key terms and observe or simulate different types of solutions, then compare their characteristics based on solubility.

16. **Introduce the Lewis dot structure for drawing elements and the Octet rule**

Students will draw Lewis dot diagrams showing valence electrons and apply the Octet Rule to predict how atoms bond.

17. **Un-Mix a Mixture Activity**
    Students will hypothesize, design, and carry out a method to separate a mixture of sand, salt, and iron filings using filtration, magnetism, and evaporation.

Advanced

1. **Discuss how to write and name the chemical formulas for molecular compounds**
   Students will practice using element names and prefixes (like di-, tri-) to write and name molecular compound formulas correctly.

2. **Discuss how to use oxidation numbers to find subscripts for these compounds**
   Students will learn how to use oxidation numbers to balance charges and determine subscripts in ionic compound formulas.

Lab Safety will be reviewed before all Lab Activities

Assessment

Science courses are designed to promote skill attainment. Student progression and pace through which they proceed through the performance tasks is based on their affinity for and ability to reach skill attainment. The teacher will determine formative and summative skill attainment; alternative assessments will be incorporated for each student based on their strengths and challenges.

Formative Assessments:

Worksheets

Exit Tickets

Class Discussion

Quizzes

Gizmos

Check for Understandings

***Some Suggested Options**:*

Parts of an Atom

Functions of Subatomic Particles

How to use a Periodic Table

Number of Atoms in a Molecule

Number of Electrons per Energy Level

Number of Valence Electrons

Drawing Lewis Dot and Bohr Diagrams

Summative Assessment:

Quizzes

***Some Suggested Options**:*

Parts of an Atom

Functions of Subatomic Particles

How to use a Periodic Table

Number of Atoms in a Molecule

Number of Electrons per Energy Level

Number of Valence Electrons

Drawing Lewis Dot and Bohr Diagrams

Unit Tests

Atomic Structure

Periodic Table

Chemical Interactions

Bench Marks:

Formal Lab Reports/Lab Write-ups

Lab Work

***Some Suggested Options**:*

Properties of Metals

Flame Color/ Firework Test

Do Oil and Water Mix?

Mg in HCl

Speedy Solution

Laboratory Techniques

Alternative:

Long-Term Projects

Adopt an Element

Elemental Superheros

Laboratory Practical

Materials

General lab equipment

General lab kits

General classroom supplies

Safety Equipment

- goggles, gloves, lab aprons, sinks, fire extinguisher, fire blanket, eye wash station, safety shower, fume hood, first aid kit, safety contract for students, tongs, hot plate

Elevate Science Physical Savvas Realize

Science Explorer Modules Physical Science Prentice Hall

Computer(s)

Smartboard

Access to Internet

Powerpoints

Relevant worksheets/notes

Relevant videos

Relevant virtual activities

Relevant interactive programs

Various Lab Chemicals

Pennies

Periodic Table

pH paper

Antacid

Standards

SCI.MS-PS1-1	Develop models to describe the atomic composition of simple molecules and extended structures.
	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.
	Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).
ELA.L.KL.8.2.A	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases.
SCI.MS-PS1-2	Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
	Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.
MATH.8.EE.A.3	Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.
MATH.8.EE.B.5	Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.
	Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
SCI.MS-PS1-3	Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
ELA.RI.CR.8.1	Cite a range of textual evidence and make clear and relevant connections (including informational text features such as charts, graphs, and diagrams) that strongly support an analysis of multiple aspects of what an informational text says explicitly, as well as inferences drawn from the text.
	Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.

SCI.MS-PS1-4	Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
MATH.8.F.B.5	Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.
ELA.W.AW.8.1	Write arguments on discipline-specific content (e.g., social studies, science, technical subjects, English/Language Arts) to support claims with clear reasons and relevant evidence.
ELA.W.AW.8.1.A	Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically. In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.
ELA.W.AW.8.1.B	Support claim(s) with logical reasoning and relevant evidence, using relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources. The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material.
ELA.W.IW.8.2	Write informative/explanatory texts (including the narration of historical events, scientific procedures/experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
ELA.W.IW.8.2.D	Use precise language and domain/grade-level-specific vocabulary to inform about or explain the topic. Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.
ELA.W.WR.8.5	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
SCI.MS-PS1-6	Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
ELA.SL.ES.8.3	Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and relevance and sufficiency of the evidence and identifying when irrelevant evidence is introduced. Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
WRK.K-12.P.1	Act as a responsible and contributing community members and employee.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them. An essential aspect of problem solving is being able to self-reflect on why possible solutions for solving problems were or were not successful.

Economic, political, social and cultural aspects of society drive development of new technological products, processes, and systems.

Engineering design requirements and specifications involve making trade-offs between competing requirements and desired design features.

Technology interacts with society, sometimes bringing about changes in a society's economy, politics, and culture, and often leading to the creation of new needs and wants. New needs and wants may create strains on local economies and workforces. Improvements in technology are intended to make the completion of tasks easier, safer, and/or more efficient.

Advancements in computing technology can change individuals' behaviors. Society is faced with trade-offs due to the increasing globalization and automation that computing brings.

Resources need to be utilized wisely to have positive effects on the environment and society. Some technological decisions involve trade-offs between environmental and economic needs, while others have positive effects for both the economy and environment.

Data is represented in many formats. Software tools translate the low-level representation of bits into a form understandable by individuals. Data is organized and accessible based on the application used to store it.

Troubleshooting a problem is more effective when knowledge of the specific device along with a systematic process is used to identify the source of a problem.

Multiple solutions often exist to solve a problem.

Increases in the quantity of information available through electronic means have heightened the need to check sources for possible distortion, exaggeration, or misrepresentation.

Computer models can be used to simulate events, examine theories and inferences, or make predictions.

Engineering design is a systematic, creative, and iterative process used to address local and global problems. The process includes generating ideas, choosing the best solution, and making, testing, and redesigning models or prototypes.

Technology advances through the processes of innovation and invention which relies upon the imaginative and inventive nature of people. Sometimes a technology developed for one purpose is adapted to serve other purposes. Engineers use a systematic process of creating or modifying technologies that is fueled and constrained by physical laws, cultural norms, and economic resources. Scientists use systematic investigation to understand the natural world.

Sources of information are evaluated for accuracy and relevance when considering the use of information.

Technological disparities have consequences for public health and prosperity.

Digital tools make it possible to analyze and interpret data, including text, images, and sound. These tools allow for broad concepts and data to be more effectively communicated.

Suggested Strategies for Modifications

This link includes content specific accommodations and modifications for the populations listed below the link.

https://docs.google.com/spreadsheets/d/1-5KhjcdFRswaPUN1joj7W_KCoowH0TRTHF6kBkW_P_o/copy