COURSE INFORMATION

Unified Laboratory Science

The students will be introduced to basic concepts in chemistry and physics through laboratories and activities. This class is designed to help students become better problem solvers. This class will emphasize hands-on activities intended to improve student creativity and critical thinking skills.

Grade Level:	9
Length:	1 Year
Period(s) Per Day:	1

ESSENTIAL UNDERSTANDING

Unified Lab Science is the introductory course to the physical sciences. Along with gaining experience with fundamental concepts in chemistry and physics, students will have the opportunity to improve their problem solving skills through inquiry-based laboratory work. Emphasis will be place on utilizing the scientific method along with skills considered critical to the scientific process such as persistence, creativity and critical thinking.

THEME SAMPLES:

- Scientific Method
- Laboratory Safety
- Energy and Matter
- Models
- Patterns
- Data Analysis
- Critical Thinking
- Cause and Effect
- Structure and Function
- Stability and Charge

COURSE OBJECTIVES AND EXPECTATIONS:

- Developing and Using Models
- Planning and Carrying out Investigations
- Constructing Explanations and Designing Solutions
- Analyzing and Interpreting Data
- Patterns and Systems
- Using Mathematics and Computational Thinking
- Engaging in argument from evidence
- Obtaining, Evaluating and Communicating Information
- Technology's influence on the natural world

STUDENT OBJECTIVES

Upon completion of this course, students will be able to:

- apply the scientific method to solve a problem
- analyze data and form a conclusion
- safely conduct laboratory experiments using proper equipment and techniques
- name the different parts of the atom and where they are located
- identify an atom and its properties based off its isotope symbol
- develop a comprehension of Atomic Theory and its evolvement throughout time and the scientists associated with it
- describe the location of electrons in terms of energy levels and orbitals
- determine element charge
- determine relative reactivity of elements
- determine relative size of elements
- classify elements as metals, nonmetals or metalloids
- write electron configuration based on element placement
- define and differentiate between ionic and covalent bonding
- describe the difference between polar and non-polar covalent bonds and provide examples of each
- identify strength of bonds as it relates to single, double or triple bonds
- identify and draw the different molecular shapes
- describe intermolecular bonds
- classify compounds by bonds based on melting and boiling points
- classify matter as pure or mixture and by its state
- describe methods for chemically and physically separating matter
- describe and classify properties as chemical or physical
- name and evaluate chemical formulas
- understand the law of constant composition
- identify the type of bonding within molecules
- identify the type of bonding between molecules
- explain heating trends as a material undergoes a phase change
- calculate density as it relates to a material and explain density trends between different phases of matter
- explain Archimedes' Principle and its effects on buoyancy
- use Charles's Law and Boyle's Law to explain the relationship between the pressure, volume and temperature as they relate to gasses
- observe some chemical properties of gas
- write and balance a chemical equation
- identify types of chemical reactions
- identify an acid or a base using indicators

- explain the purpose of a catalyst and different types of catalysts
- use chemical properties to identify an unknown
- Define the different types of radioactive decay and complete decay equations
- Explain the process of carbon-14 dating and its limitations
- describe the differences between the customary system and the metric system
- explain the importance of using the metric system
- convert between units within the metric system
- make and take measurements in the metric system
- write numbers in scientific notation and in standard form
- Determine which units are significant when taking measurements or making calculations
- define friction and apply its concepts to everyday situations
- define and calculate speed and acceleration
- graphically represent and interpret states of motion
- use Newton's three laws of motion as they apply to our world
- describe the rate of gravity as an acceleration and tell how its effects on all object
- determine the effects objects will have on one another if they collide
- relate inertia to centripetal motion
- describe the energy associated with objects in various states of motions and positions
- quantify measurements through calculations
- relate advanced motion concepts to real world situations
- Define and calculate work and power
- Describe how work and power are used in your everyday life
- identify simple machines
- calculate/measure input and output forces associated with simple machines
- calculate/measure input and output distance associated with simple machines
- calculate the efficiency of the simple machine
- describe how simple machines make your life easier
- describe how the 3 most common temperature scales were derived
- convert between the different temperature scales
- determine the heat capacity of different materials, including water
- determine how much energy food holds
- use conservation of energy as it applies to heat and temperature
- describe how heat and temperature apply to your everyday life
- draw and label the different parts of longitudinal and transverse waves
- describe and measure reflection and refraction angles
- describe and quantify what happens to light as it travels through different media
- use lenses to focus bent light
- describe how sound travels
- explain the effects of moving further from a light or sound source using the inverse square law,
- describe the color of light and how it mixes to form new colors
- explain the advantages of wearing light colored clothing on hot days

- describe what happens to a light or sound wave when frequency and amplitude change
- draw and explain what happens when two waves come in contact with one another
- describe the mechanics of how a charge forms
- explain how different charges interact with one another
- use the triboelectric series to determine good electron donors and acceptors
- build a simple galvanic cell labeling all parts
- determine the best materials to make batteries
- build, compare and contrast different types of circuits
- apply the mathematical relationship between current, voltage, resistance and power.

PACING/TIMELINE AND STANDARDS

Semester 1: Introduction to Chemistry (18 Weeks)

Unit 0: Lab Safety and the Scientific Method (NGSS Standards: HS-PS1-2, HS-PS1-6, HS-PS2-3)

Duration: ~2 Weeks

- Classroom and Laboratory Safety Practices and Procedures
- Laboratory Equipment Identification and Uses
- Scientific Method Definitions and Applications

Unit 1: Atomic Theory (NGSS Standards: HS-PS1-1, HS-PS1-2, HS-PS1-3)

Duration: ~2.5 Weeks

- Timeline of Atomic Theory
- Atomic Theory Contributors
- Structure of an Atom
- Classifications of Atoms
- Quantitative Representations of Atoms (Isotope Symbols)
- Electron Placement within an Atom
- Qualitative Analysis of the Bohr Model of the Atom

Unit 2: The Periodic Table (NGSS Standards: HS-PS1-1, HS-PS1-2, HS-PS1-3)

Duration: ~2 Weeks

- Organization of Elements on Periodic Table
- Classification of Elements on Periodic Table
    - Metal, Non-Metal, Metalloid
    - Alkali Earth Metals, Alkaline Earth Metals, Transition Metals, Rare Earth Metals, Poor Metals, Metalloids, Non-Metals, Halogens, Nobel Gasses
    - Electron Arrangement: s-block, p-block, d-block, f-block
- General Trends within Periodic Table
    - Number of valence electrons, charge, atomic size, Coulombic attractive forces, reactivity, trends within periods, trends within groups, ionization energy, electronegativity
- Properties of Metals, Non-Metals and Metalloids
- Properties of Specific Groups/Periods

- Law of Constant Composition

Unit 3: Atomic Bonding (NGSS Standards: HS-PS1-1, HS-PS1-4)
Duration: ~2.5 Weeks

- Primary Bonding
- Ionic Bonding
- Covalent Bonding
- Polar and Non-Poplar Covalent Bonding
- Molecular Geometry
- Lewis Dot Structures
- Applications and Uses of Specific Bonding Types
- Polyatomic Ions
- Naming and Classify Chemical Compounds

Unit 4: Classifying Matter (NGSS Standards: HS-PS1-1, HS-PS1-3)
Duration: ~2.5 Weeks

- Definitions and Classifications of Matter
    - Matter, Mixture, Homogeneous, Heterogeneous, Pure Substance, Compound, Element
- Chemical and Physical Separation of Matter
- Chemical and Physical Properties and Changes
- Types of Liquid Mixtures
- Applications and Uses of Chemical and Physical Separation of Matter

Unit 5: Phases of Matter (NGSS Standards: HS-PS1-3, HS-PS1-5)
Duration: ~2.5 Weeks

- Primary and Secondary Bonding
- Atomic Forces and Molecular Forces
- States of Matter
- Changes in Matter
- Density of Matter
- Archimedes' Principle
- Gas Laws

Unit 6: Chemical Reactions (NGSS Standard:HS-PS1-1,HS-PS1-5, HS-PS1-6, HS-PS1-7, HS-PS1-8)
Duration: ~3 Weeks

- Apply Scientific Method
- Indications of a Chemical Reaction
- Balancing Chemical Reactions
- Law of Conservation of Mass
- Classify Chemical Reactions Types
    - Double Replacement reactions, single replacement reactions, synthesis reactions, decomposition reactions, combustion reactions, acid base reactions

- Energy in Chemical Reactions
- Effects on Chemical Reaction Rates
- Properties of Acids and Bases

Unit 7: Nuclear Chemistry (NGSS Standard: HS-PS1-7, HS-PS1-8, HS-PS4-4)
Duration: ~1 Week

- Alpha, Beta and Gamma Radiation
- Half – Life of Elements
- Carbon-14 Dating
- Uranium Decay Process
- Effects of Radiation

Semester 2: Introduction to Physics (18 Weeks)
Unit 0: Quantitative Analysis (NGSS Standard: HS-ETS1-1, HS-ETS1-2)
Duration: ~1.5 Weeks

- Measuring Systems
- Customary System and Metric System
- Converting within the Metric System
- Scientific Notation
- Significant Figures
- Operations with Significant Figures

Unit 1: Forces and Motion (NGSS Standard: HS-PS2-1, HS-PS2-2, HS-PS2-3, HS-PS2-6)
Duration: ~3 Weeks

- Friction
- Speed
- Acceleration
- Graphical Representations of Motion
- Calculations with Motion
- Newton's Laws of Motion
- Forces Affecting Motion

Unit 2: Complex Motion (NGSS Standard: HS-PS2-1, HS-PS2-2, HS-PS2-3, HS-PS2-6)
Duration:~2.5 Weeks

- Gravity
- Momentum
- Two Dimensional Motion
- Centripetal Motion
- Conservation of Energy
- Calculations with Motion

Unit 3: Work, Energy and Simple Machines (NGSS Standard: HS-PS3-1, HS-PS3-2, HS-PS3-3)

Duration: ~2.5 Weeks

- Work
- Power
- Energy
- Simple Machines
- Inclined Plane, Lever, Pulley, Wheel and Axles

Unit 4: Heat and Temperature (NGSS Standard: HS-PS3-1, HS-PS3-2, HS-PS3-4)
Duration: ~3 Weeks

- Temperature Scales
- Conversions between Temperature Scales
- Graphical Representations of Temperature Scales
- Calibration of Thermometers
- Heat and Temperature Definitions
- Heat Transfer
- Heat Capacity of Materials
- Heat Rates of Water (Heat of Fusion)
- Units of Energy
- Conservation of Energy

Unit 5: Light and Sound Waves (NGSS Standard: HS-PS4-1, HS-PS4-3, HS-PS4-4, HS-PS4-5)
Duration: ~3 Weeks

- Transverse Waves
- Electromagnetic Spectrum
- Reflection of Waves
- Refraction of Waves
- Index of Refraction
- Lens Cases
- Longitudinal Waves
- Light and Sound Intensity
- Wave Equation
- Relationship between Wavelength, Frequency and Energy

Unit 6: Electricity (NGSS Standard: HS-PS3-1, HS-PS3-5, HS-PS2-5, HS-PS2-6)
Duration: ~2.5 Weeks

- Creating Charged Objects
- Triboelectric Series
- Interactions with Charged Particles
- Batteries
- Circuits
- Mathematical Relationship between Power, Voltage, Current and Resistance

Montana Content Standards

HS-PS1 Matter and Interactions

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

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.

HS-PS1-3 Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles

HS-PS1-4 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

HS-PS1-5 Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature of concentration of the reacting particles on the rate at which the reaction occurs.

HS-PS1-6 Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

HS-PS-7 Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical process.

HS-PS1-8 Develop models that illustrate the changes in the composition of the nucleus of the atom and energy released during the processes of fission, fusion, and radioactive decay.

HS-PS2 Motion and Stability: Forces and Interactions

HS-PS2-1 Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

HS-PS2-2 Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

HS-PS2-3 Apply scientific and engineering ideas to design, evaluate and refine a device that minimizes the force on a macroscopic object during a collision.

HS-PS2-5 Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce current.

HS-PS2-6 Communicate scientific and technical information about why the molecular-level structure is important in functioning of designed materials.

HS-PS3 Energy

HS-PS3-1 Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).

HS-PS3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
HS-PS3-4 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).
HS-PS3-5 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

HS-PS4 Waves and their Applications in Technologies for Information Transfer
HS-PS4-1 Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
HS-PS4-3 Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
HS-PS4-4 Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
HS-PS4-5 Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

HS-ETS1 Engineering Design
HS-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

RESOURCES
Wysession, Michael, et al. *Pearson Physical Science: Concepts in Action.* Pearson, 2011.
"Next Generation Science Standards." *NGSS Fact Sheet | Next Generation Science Standards,* 15 Jan. 2019, www.nextgenescience.org/.
"Havre High School / Science." */ Definition & Purpose*, www.blueponyk12.com/Page/263.