

Course Scope and Sequence: Advanced Physical Science Honors

SEMESTER #1: Scientific Inquiry and Chemistry

I. **Course Introduction**

- A. What is Science?
 - i. Making inferences vs. observations
 - ii. Attributes of a good scientist
 - ii. Scientific method
- B. Designing Experiments and Analyzing Experiment Validity
 - i. Independent vs. dependent variables
 - ii. Control and experimental setups
 - iii. Elements of a controlled experiment
 - iv. Evaluating valid experimental designs
- C. Science in Practice
 - i. Laboratory safety and types of laboratory equipment
 - iii. Methodical calculation (3 steps) and algebra review
 - iv. Metric measurement and units
 - v. Conversion factors/dimensional analysis
 - vi. Scientific notation
 - vii. Significant figures

II. **Introduction to Chemistry**

- A. What is matter?
 - i. Classifying matter – metals vs. nonmetals
 - ii. Chemical properties and indicators of chemical changes
 - iii. Physical properties, states of matter, and physical changes
 - iv. Phase changes, physical equilibrium, and endo/exothermic, phase change diagram
 - v. Calculations for q , H_f , H_v
- B. Gas Laws
 - i. Kinetic theory of gases, real vs. ideal gases
 - ii. Pressure and other affecting variables and units used
 - iii. Boyle's Law, Charles' Law, Gay Lussac's Law, Combined

III. **Atomic Structure and Elemental Composition**

- A. Atoms and Subatomic Particles
 - i. Introduction to atomic structure and history
 - ii. Atomic properties – atomic mass, atomic #, mass #, isotopes
 - iii. Electron configuration, ions, electron dots, orbital notation
 - iv. Quantum theory and quantum numbers
 - v. Flame tests, the electromagnetic spectrum, excited state vs. ground state

- B. Periodic Table of Elements
 - i. Trends in organization and group properties
 - ii. Atomic radius, ionization energy, electronegativity, and reasons for trends
 - iii. Chemical symbols
- IV. **From Elements to Compounds**
 - A. Bonding
 - i. Ionic vs. covalent bonds
 - ii. Ionic vs. covalent compounds
 - iii. Electron dot structures for compounds
 - iv. Polar vs. nonpolar covalent bonds
 - v. Polar vs. nonpolar molecules
 - vi. Determination of shape, VSEPR theory
 - B. Nomenclature
 - i. Naming and writing formulas (ionic compounds)
 - ii. Naming and writing formulas (covalent molecules)
- V. **Chemical Reactions and Stoichiometry**
 - A. Reactions and Moles
 - i. Types of reactions
 - ii. Avogadro's number, the mole, and GFM
 - ii. Mole ratios and balancing equations
 - B. Stoichiometry
 - i. Simple mole/mass problems
 - ii. Mass/mass problems
 - iii. Determination of experimental mole ratios in lab (time permitting)
 - vii. Determination of percent yield in lab
 - C. Kinetics and Equilibrium (Time Permitting)
 - i. Factors affecting reaction rates
 - ii. Chemical equilibrium and Le Chatelier's Principle
- VI. **Organic Chemistry**
 - i. Hydrocarbons
 - iii. Naming with different -R groups
 - iv. Basics of organic synthesis reactions (Time Permitting)

MID-TERM!!!! (Please note that the chemistry curriculum will go into the third marking period and that the mid-term will take place during this third marking period and count for that given report card grade.)

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SEMESTER #2: Physics

- VII. **Motion**
 - A. Basic one-dimensional analysis
 - i. Vectors vs. scalars
 - ii. Displacement and velocity at uniform acceleration
 - iii. Free-fall problems
 - iv. Motion graphs
 - B. Vector Motion
 - i. Vector addition
 - ii. Vector subtraction
 - iii. Simple vector problems – algebraic and graphic solution
- VIII. **Newton**
 - A. Laws of Motion
 - i. Balanced vs. Unbalanced Forces – Newton’s 1st Law
 - ii. Types of friction and problems with opposing force
 - iii. Weight and the Force of Gravity
 - iv. Net Force – Newton’s 2nd Law – Zero Net Force
 - v. Newton’s 3rd Law and Momentum
 - vi. Law of Conservation of Momentum
 - vii. Impulse
- IX. **Work and Energy**
 - A. Work
 - i. Definitions and calculations for work and power
 - ii. Simple calculations for work and power
 - iii. Calculations for work when $F_{\text{net}} = 0$ (Review of Forces)
 - B. Mechanical Energy
 - i. Gravitational potential energy vs. elastic
 - ii. Kinetic energy
 - iii. Categories of energy besides mechanical
 - iv. Conservation of mechanical energy and free fall
 - v. Simple harmonic motion and the pendulum

***** Monster Problems – combine all of the concepts so far**

- X. **Waves (TIME PERMITTING)**
- A. Introduction
 - i. Types of waves
 - ii. Characteristics of waves
 - iii. Properties of waves
 - v. Reflection, refraction, and diffraction
 - vi. Snell's Law
 - vii. Interference
 - B. Sound
 - i. Properties specific to sound waves
 - ii. Doppler Effect
 - iii. Music
 - C. Light
 - i. Polarization
 - ii. Prisms and rainbows
 - iii. Electromagnetic spectrum

- XI. **Optics (TIME PERMITTING)**
- A. Introduction to Mirrors and Lenses
 - i. Differences between and definitions of terminology
 - ii. Images differences and types
 - B. Image Determination
 - i. Concave lens/Convex mirror calculations
 - ii. Convex lens/ concave mirror calculations
 - iii. Magnification
 - iv. Ray diagrams

End of Semester 2

FINAL EXAM!!!! (Please note that the final exam will cover both semesters of material)