

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. Graphing and graphic organizers
 - v. 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
 - v. Conversion factors and units
 - 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
 - iv. Flame tests, the electromagnetic spectrum, excited state vs. ground state
- B. Periodic Table of Elements (Some self-study)
 - 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 compounds
 - ii. Ionic vs. covalent bonds
 - iii. Polar vs. nonpolar bonds
 - iv. Polar vs. nonpolar molecules
 - v. Determination of shape, VSEPR theory
 - vi. Electron dot structures for compounds
 - vi. Bonding practice
 - B. Nomenclature (some self-study, extra practice)
 - i. Naming and writing formulas (ionic compounds)
 - ii. Naming and writing formulas (covalent molecules)
 - iii. Practice naming and formula writing
- V. **Stoichiometry**
- A. Moles
 - i. Avogadro's number, the mole, and GFM
 - ii. Mole ratios and balancing equations (mole/mole problems)
 - iii. Simple mole/mass problems
 - iv. Mass/mass problems
 - v. Determination of experimental mole ratios in lab
 - vi. Determination of percent yield in lab
- VI. **Chemical Reactions** (TIME PERMITTING)
- A. Thermodynamics
 - i. Types of reactions
 - ii. Reaction prediction
 - iii. Thermodynamics of reactions and catalysts
 - iv. Reaction coordinate graphical analysis
 - v. ΔH , ΔS , ΔG – spontaneity and calculations
 - B. Kinetics and Equilibrium
 - i. Factors affecting reaction rates
 - ii. Chemical equilibrium and Le Chatelier's Principle
- VI. **Organic Chemistry** (TIME PERMITTING)
- i. Hydrocarbons
 - iii. Naming with different -R groups
 - iv. Basics of organic synthesis reactions

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 of algebraic and trigonometric 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)