HIGH SCHOOL CURRICULUM FRAMEWORK

Course Title: AP Chemistry **Course Number:** 1721

Department: Science **ADS Number:** 1721

Prerequisites: Algebra I & II

Length of Course: 2 Semesters **Credit/PRI Area:** 0.5 credits per semester; plus 0.5 lab credits/sem **Grade Level(s):** 11-12

Important Notes: Emphasis is first year college preparatory level. National AP exam is required for AP credit. The student will receive a grade on a 5-point scale. A lab is included for the lab credit.

COURSE DESCRIPTION

This is a high school general chemistry course. Course topics include: atomic theory; stoichiometry; thermochemistry; electronic structure; gasses, solids, and liquids; acid-base equilibria. Students are expected to partake in rigorous problem solving and laboratory work.

SYLLABUS

1. Units of Study**:**
   a) Atomic Theory: Matter and Measurement; Properties of Matter; Atoms, Molecules and Ions; The Periodic Table.
   b) Stoichiometry: Calculations with Chemical Formulas and Equations; Molecular Weights; Moles and Masses.
   c) Thermochemistry: Heat; Temperature and atomic kinetic theory; Gases, liquids, and solids; Entropy.
   d) Electronic Structure: Quantum Mechanics and Atomic Orbitals; Photons; Electron Configurations and Affinities.
   e) Gasses, Solids, and Liquids: Gas Laws; Kinetic-Molecular Theory; State Structures; Phase Diagrams.
   f) Acid-Base Equilibria: Properties of Solutions; Lewis Structure; Chemical Equilibrium.
2. Skills:
   a) Scientific thinking and practice: Prepares studends to ask scientific questions and conduct research to find solutions. Critical thinking is required.
   b) Content of Science: Knowledge and skills provide the foundation that students need for critical thinking and problem solving.
   c) Science and society: Prepares students to understand the ways in which science influences the individual and society.

STRATEGIES: Paideia Methodology

Didactic: Lecture, guided discussion, and textbook chapter summary review.
Intellectual Coaching: All students present problem solving on the board to the other students. Solution methods are shared with the class.
Seminar: Related media topics are shared, with consideration of individual impacts.

ASSESSMENTS

Oral: Class participation with demonstration of problem solving.
Tests: Chapter tests and semester final exams.
Class work: Chapter problem sets submitted prior to chapter test

SUGGESTED TEXTBOOKS AND INSTRUCTIONAL MATERIALS
Chemistry: The Central Science by Brown/LeMay/Bursten

SUGGESTED TITLES/AUTHORS WEB SITES
Various.

SEMINAR PIECES OR USE
Seminar pieces are brief historical backgrounds of a scientist or a branch of chemistry**.**

STRAND I: SCIENTIFIC THINKING AND PRACTICE
CONTENT STANDARD 1: UNDERSTAND THE PROCESSES OF SCIENTIFIC INVESTIGATIONS AND USE INQUIRY AND SCIENTIFIC WAYS OF OBSERVING, EXPERIMENTING, PREDICTING, AND VALIDATING TO THINK CRITICALLY.

A. BENCHMARK: *Use accepted scientific methods to collect, analyze, and interpret data and observations and to design and conduct scientific investigations and communicate results.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	1. Describe the essential components of an investigation, including appropriate methodologies, proper equipment, and safety precautions. 2. Design and conduct scientific investigations that include: • testable hypotheses • controls and variables • methods to collect, analyze, and interpret data • results that address hypotheses being investigated • predictions based on results • re-evaluation of hypotheses and additional experimentation as necessary • error analysis. 3. Use appropriate technologies to collect, analyze, and communicate scientific data (e.g., computers, calculators, balances, microscopes). 4. Convey results of investigations using scientific concepts, methodologies, and expressions, including: • scientific language and symbols • diagrams, charts, and other data displays • mathematical expressions and processes (e.g., mean, median, slope, proportionality) • clear, logical, and concise communication • reasoned arguments 5. Understand how scientific theories are used to explain and predict natural phenomena (e.g., plate tectonics, ocean currents, structure of atom	From the lab report discussion requirements: Scientists know that lab reports are a very important part of every experiment. The purpose of an experiment is to answer a question by testing a hypothesis. During an experiment you may collect a lot of information, or data. But that data is not very useful unless it is organized. The purpose of a lab report is to organize and communicate what you did in your experiment. A good lab report explains exactly what you have done. It can be used to repeat the experiment or to test other hypotheses in new experiments.

STRAND I: SCIENTIFIC THINKING AND PRACTICE
CONTENT STANDARD 1: UNDERSTAND THE PROCESSES OF SCIENTIFIC INVESTIGATIONS AND USE INQUIRY AND SCIENTIFIC WAYS OF OBSERVING, EXPERIMENTING, PREDICTING, AND VALIDATING TO THINK CRITICALLY.

B. BENCHMARK: *Understand that scientific processes produce scientific knowledge that is continually evaluated, validated, revised, or rejected.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	1. Understand how scientific processes produce valid, reliable results, including: • consistency of explanations with data and observations • openness to peer review • full disclosure and examination of assumptions • testability of hypotheses • repeatability of experiments and reproducibility of results. 2. Use scientific reasoning and valid logic to recognize: • faulty logic • cause and effect • the difference between observation and unsubstantiated inferences and conclusions • potential bias 3. Understand how new data and observations can result in new scientific knowledge. 4. Critically analyze an accepted explanation by reviewing current scientific knowledge. 5. Examine investigations of current interest in science (e.g., superconductivity, molecular machines, age of the universe). 6. Examine the scientific processes and logic used in investigations of past events (e.g., using data from crime scenes, fossils), investigations that can be planned in advance but are only done once (e.g., expensive or time-consuming experiments such as medical clinical trials), and investigations of phenomena that can be repeated easily and frequently.	Each chapter of the textbook contains an historical background of the relevant subjects of the chapter's information. Original theories which were proven not correct are tied historically with the current ideas. Sometimes, a discussion of possible new ideas also appears.

STRAND I: SCIENTIFIC THINKING AND PRACTICE
CONTENT STANDARD 1: UNDERSTAND THE PROCESSES OF SCIENTIFIC INVESTIGATIONS AND USE INQUIRY AND SCIENTIFIC WAYS OF OBSERVING, EXPERIMENTING, PREDICTING, AND VALIDATING TO THINK CRITICALLY.

C. BENCHMARK: *Use mathematical concepts, principles, and expressions to analyze data, develop models, understand patterns and relationships, evaluate findings, and draw conclusions.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	1. Create multiple displays of data to analyze and explain the relationships in scientific investigations. 2. Use mathematical models to describe, explain, and predict natural phenomena. 3. Use technologies to quantify relationships in scientific hypotheses (e.g., calculators, computer spreadsheets and databases, graphing software, simulations, modeling). 4. Identify and apply measurement techniques and consider possible effects of measurement errors. 5. Use mathematics to express and establish scientific relationships (e.g., scientific notation, vectors, dimensional analysis).	The textbook is a first year college textbook, and the problem requirements include a thorough understanding of high school mathematics. Laboratory results require computation of measured data, using the principles gathered from the textbook.

STRAND II: CONTENT OF SCIENCE: PHYSICAL SCIENCE
CONTENT STANDARD I : UNDERSTAND THE STRUCTURE AND PROPERTIES OF MATTER, THE CHARACTERISTICS OF ENERGY, AND THE INTERACTIONS BETWEEN MATTER AND ENERGY.

A. BENCHMARK: *Understand the properties, underlying structure, and reactions of matter.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	**Properties of Matter** 1. Classify matter in a variety of ways (e.g., element, compound, mixture; solid, liquid, gas; acidic, basic, neutral). 2. Identify, measure, and use a variety of physical and chemical properties (e.g., electrical conductivity, density, viscosity, chemical reactivity, pH, melting point). 3. Know how to use properties to separate mixtures into pure substances (e.g., distillation, chromatography, solubility). 4. Describe trends in properties (e.g., ionization energy or reactivity as a function of location on the periodic table, boiling point of organic liquids as a function of molecular weight).	The textbook table of contents include these: Chemistry: The Central Science, Brown, LeMay, Bursten 1 Introduction: Matter and Measurement 2 Atoms, Molecules, and Ions 3 Stoichiometry: Calculations with Chemical Formulas and Equations 4 Aqueous Reactions and Solution Stoichiometry 5 Thermochemistry 6 Electronic Structure of Atoms 7 Periodic Properties of the Elements 8 Basic Concepts of Chemical Bonding 10 Gases 11 Intermolecular Forces, Liquids, and Solids 12 Modern Materials 13 Properties of Solutions 14 Chemical Kinetics 15 Chemical Equilibrium 16 Acid-Base Equilibria

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
		17 Additional Aspects of Equilibria 18 Chemistry of the Environment 19 Chemical Thermodynamics 20 Electrochemistry 22 Chemistry of the Nonmetals 23 Metals and Metallurgy 24 Chemistry of Coordination Compounds

STRAND II: CONTENT OF SCIENCE: PHYSICAL SCIENCE
CONTENT STANDARDI : UNDERSTAND THE STRUCTURE AND PROPERTIES OF MATTER, THE CHARACTERISTICS OF ENERGY , AND THE INTERACTIONS BETWEEN MATTER AND ENERGY.

A. BENCHMARK: *Understand the properties, underlying structure, and reactions of matter.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	**Structure of Matter** 5. Understand that matter is made of atoms and that atoms are made of subatomic particles. 6. Understand atomic structure, including: • most space occupied by electrons • nucleus made of protons and neutrons • isotopes of an element • masses of proton and neutron 2000 times greater than mass of electron • atom held together by proton-electron electrical forces 7. Explain how electrons determine the properties of substances by: • interactions between atoms through transferring or sharing valence electrons • ionic and covalent bonds • the ability of carbon to form a diverse array of organic structures. 8. Make predictions about elements using the periodic table (e.g., number of valence electrons, metallic character, reactivity, conductivity, type of bond between elements). 9. Understand how the type and arrangement of atoms and their bonds determine macroscopic properties (e.g., boiling point, electrical conductivity, hardness of minerals). 10. Know that states of matter (i.e., solid, liquid, gas) depend on the arrangement	See the relevant chapters as listed above.

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
	of atoms and molecules and on their freedom of motion. 11. Know that some atomic nuclei can change, including: • spontaneous decay • half-life of isotopes • fission • fusion (e.g., the sun) • alpha, beta, and gamma radiation.	

STRAND II: CONTENT OF SCIENCE: PHYSICAL SCIENCE
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A. BENCHMARK: *Understand the properties, underlying structure, and reactions of matter.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	**Chemical Reactions** 12. Know that chemical reactions involve the rearrangement of atoms, and that they occur on many timescales (e.g., picoseconds to millennia). 13. Understand types of chemical reactions (e.g., synthesis, decomposition, combustion, redox, neutralization) and identify them as exothermic or endothermic. 14. Know how to express chemical reactions with balanced equations that show: conservation of mass products of common reactions. 15. Describe how the rate of chemical reactions depends on many factors that include temperature, concentration, and the presence of catalysts.	These subjects are covered both in the textbook and in the laboratory.

STRAND II: CONTENT OF SCIENCE: PHYSICAL SCIENCE
CONTENT STANDARDI : UNDERSTAND THE STRUCTURE AND PROPERTIES OF MATTER, THE CHARACTERISTICS OF ENERGY, AND THE INTERACTIONS BETWEEN MATTER AND ENERGY.

B. BENCHMARK: *Understand the transformation and transmission of energy and how energy and matter interact.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	**Energy Transformation and Transfer** 1. Identify different forms of energy, including kinetic, gravitational (potential), chemical, thermal, nuclear, and electromagnetic. 2. Explain how thermal energy (heat) consists of the random motion and vibrations of atoms and molecules and is measured by temperature. 3. Understand that energy can change from one form to another (e.g., changes in kinetic and potential energy in a gravitational field, heats of reaction, hydroelectric dams) and know that energy is conserved in these changes. 4. Understand how heat can be transferred by conduction, convection, and radiation, and how heat conduction differs in conductors and insulators. 5. Explain how heat flows in terms of the transfer of vibrational motion of atoms and molecules from hotter to colder regions. 6. Understand that the ability of energy to do something useful (work) tends to decrease (and never increases) as energy is converted from one form to another.	These are basic concepts from the textbook.

STRAND II: CONTENT OF SCIENCE: PHYSICAL SCIENCE
CONTENT STANDARDI : UNDERSTAND THE STRUCTURE AND PROPERTIES OF MATTER, THE CHARACTERISTICS OF ENERGY, AND THE INTERACTIONS BETWEEN MATTER AND ENERGY.

B. BENCHMARK: *Understand the transformation and transmission of energy and how energy and matter interact.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	**Interactions of Energy and Matter** 7. Understand that electromagnetic waves carry energy that can be transferred when they interact with matter. 8. Describe the characteristics of electromagnetic waves (e.g., visible light, radio, microwave, X-ray, ultraviolet, gamma) and other waves (e.g., sound, seismic waves, water waves), including: • origin and potential hazards of various forms of electromagnetic radiation • energy of electromagnetic waves carried in discrete energy packets (photons) whose energy is inversely proportional to wavelength. 9. Know that each kind of atom or molecule can gain or lose energy only in discrete amounts. 10. Explain how wavelengths of electromagnetic radiation can be used to identify atoms, molecules, and the composition of stars. 11. Understand the concept of equilibrium (i.e., thermal, mechanical, and	Included in Chapter 6.

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
	chemical).	

STRAND III: SCIENCE AND SOCIETY
CONTENT STANDARD: UNDERSTAND HOW SCIENTIFIC DISCOVERIES, INVENTIONS, PRACTICES, AND KNOWLEDGE INFLUENCE, AND ARE INFLUENCED BY, INDIVIDUALS AND SOCIETIES.

A. BENCHMARK: *Examine and analyze how scientific discoveries and their applications affect the world, and explain how societies influence scientific investigations and applications.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	**Science and Technology** 1. Know how science enables technology but also constrains it, and recognize the difference between real technology and science fiction (e.g., rockets vs. antigravity machines; nuclear reactors vs. perpetual-motion machines; medical X-rays vs. Star-Trek tricorders). 2. Understand how advances in technology enable further advances in science (e.g., microscopes and cellular structure; telescopes and understanding of the universe). 3. Evaluate the influences of technology on society (e.g., communications, petroleum, transportation, nuclear energy, computers, medicine, genetic engineering) including both desired and undesired effects, and including some historical examples (e.g., the wheel, the plow, the printing press, the lightning rod). 4. Understand the scientific foundations of common technologies (e.g., kitchen appliances, radio, television, aircraft, rockets, computers, medical X-rays, selective breeding, fertilizers and pesticides, agricultural equipment). 5. Understand that applications of genetics can meet human needs and can create new problems (e.g., agriculture, medicine, cloning). 6. Analyze the impact of digital technologies on the availability, creation, and dissemination of information.	Each chapter of the textbook contains an historical background of the relevant subjects of the chapter's information. Original theories which were proven not correct are tied historically with the current ideas. Sometimes, a discussion of possible new ideas also appears.

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
	7. Describe how human activities have affected ozone in the upper atmosphere and how it affects health and the environment. 8. Describe uses of radioactivity (e.g., nuclear power, nuclear medicine, radiometric dating).	