SACRAMENTO CITY UNIFIED SCHOOL DISTRICT
BOARD OF EDUCATION

Agenda Item 9.1h

Meeting Date: July 16, 2015

Subject: Course of Study Approval: Medical Chemistry 1P, 2P

- ☐ Information Item Only
- ☒ Approval on Consent Agenda
- ☐ Conference (for discussion only)
- ☐ Conference/First Reading (Action Anticipated: _____)
- ☐ Conference/Action
- ☐ Action
- ☐ Public Hearing

Division: Academic Office/Curriculum & Instruction

Recommendation: Approve the Course of Study for Medical Chemistry 1P, 2P

Background/Rationale: "Medical Chemistry" is part of the Health Science and Medical Technology Linked Learning Pathway program. It is designed to fill the role of regular high school Chemistry and to prepare students for a four-year college. The course addresses all of the California State Standards in Chemistry and includes a focus on atomic structure, chemical bonding, nomenclature, stoichiometry, redox, gas laws, acids, bases, solutions, equilibrium, nuclear and organic chemistry. Each topic of study includes hands-on learning and practical connections to medicine and living systems. Laboratory activities will comprise 30-40% of the curriculum. Students will also have the opportunity to participate in volunteer community based health programs. Students who enroll are invested in a medical or scientific career. Students enrolled in "Medical Chemistry" will be prepared to take AP Chemistry the following year.

Financial Considerations: None

LCAP Goal(s): College and Career Ready Students

Documents Attached:
1. Course of Study for Medical Chemistry 1P, 2P

Estimated Time of Presentation: NA
Submitted by: Olivine Roberts, Chief Academic Officer and Iris Taylor, Assistant Superintendent for Curriculum & Instruction
Approved by: José Banda, Superintendent

Sacramento City Unified School District

COURSE OF STUDY

FOR

Medical Chemistry1P, 2P
QCS171, QCS172

Segment	High School
Length of Course	One Year
Developed by	Daniel Darby
First Edition	*Fall, 2014*

SACRAMENTO CITY UNIFIED SCHOOL DISTRICT

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Medical Chemistry

SECTION ONE — GENERAL INFORMATION

COURSE DESCRIPTION

Chemical reactions are at the core of all living systems and understanding these processes and how they occur are the focal points of this class. Students who enroll are invested in a medical or scientific career. Students will be prepared to take AP Chemistry the following year. This first year course, in lieu of regular chemistry, will cover all California State Standards in Chemistry to include atomic structure, chemical bonding, nomenclature, stoichiometry, redox, gas laws, acids, bases, solutions, equilibrium, nuclear and organic chemistry. Each topic will include hands-on learning and practical connections to medicine and living systems. Laboratory activities will comprise 30-40% of the curriculum.

RATIONALE

Medical Chemistry is part of the Health Science and Medical Technology Linked Learning Pathway program. It is designed to fill the role of regular high school Chemistry and to prepare students for a four-year college. They will have the opportunity to participate in volunteer community based health programs. This course is the same course as regular college preparatory chemistry with the addition of labs and other activities that relate to topics in the medical field.

COURSE GOALS

1) Thoroughly teach the facts, terminology, and key concepts of Chemistry as well as the scientific methods and mathematical approaches used by chemists.

2) Expect student mastery of the course content in order for optimal college preparedness.

3) Robustly develop students' scientific inquiry and critical thinking skills.

4) Support standards-based instruction and foster student curiosity using hands and minds-on key assignments.

5) Promote continuity and connectedness between chemistry, mathematics, medicine and biology with the use of student research and laboratories.

COURSE STANDARDS

CALIFORNIA CONTENT STANDARDS: CHEMISTRY

ATOMIC AND MOLECULAR STRUCTURE

1. The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure. As a basis for understanding this concept:

a. Students know how to relate the position of an element in the periodic table to its atomic number and atomic mass.

b. Students know how to use the periodic table to identify metals, semimetals, non-metals, and halogens.

c. Students know how to use the periodic table to identify alkali metals, alkaline earth metals and transition metals, trends in ionization energy, electronegativity, and the relative sizes of ions and atoms.

d. Students know how to use the periodic table to determine the number of electrons available for bonding.

e. Students know the nucleus of the atom is much smaller than the atom yet contains most of its mass.

f. *Students know how to use the periodic table to identify the lanthanide, actinide, and transactinide elements and know that the transuranium elements were synthesized and identified in laboratory experiments through the use of nuclear accelerators.

g.*Students know how to relate the position of an element in the periodic table to its quantum electron configuration and to its reactivity with other elements in the table.

h.*Students know the experimental basis for Thomson's discovery of the electron, Rutherford's nuclear atom, Millikan's oil drop experiment, and Einstein's explanation of the photoelectric effect.

i.* Students know the experimental basis for the development of the quantum theory of atomic structure and the historical importance of the Bohr model of the atom.

j.* Students know that spectral lines are the result of transitions of electrons between energy levels and that these lines correspond to photons with a frequency related to the energy spacing between levels by using Planck's relationship (E = hv).

Chemical Bonds

2. Biological, chemical, and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules. As a basis for understanding this concept:

a. Students know atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.

CALIFORNIA CONTENT STANDARDS: CHEMISTRY

b. Students know chemical bonds between atoms in molecules such as H2, CH4, NH3, H2CCH2, N2, Cl2 and many large biological molecules are covalent.

c. Students know salt crystals, such as NaCl, are repeating patterns of positive and negative ions held together by electrostatic attraction.

d. Students know the atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form.

e. Students know how to draw Lewis dot structures.

f. *Students know how to predict the shape of simple molecules and their polarity from Lewis dot structures.

g.*Students know how electronegativity and ionization energy relate to bond formation.

h.*Students know how to identify solids and liquids held together by Van der Waals forces or hydrogen bonding and relate these forces to volatility and boiling/melting point temperatures.

CONSERVATION OF MATTER AND STOICHIOMETRY

3. The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants. As a basis for understanding this concept:

a. Students know how to describe chemical reactions by writing balanced equations.

b. Students know the quantity one mole is set by defining one mole of carbon 12 atoms to have a mass of exactly 12 grams.

c. Students know one mole equals 6.02 x 1023 particles (atoms or molecules).

d. Students know how to determine the molar mass of a molecule from its chemical formula and a table of atomic masses and how to convert the mass of a molecular substance to moles, number of particles, or volume of gas at standard temperature and pressure.

e. Students know how to calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products and the relevant atomic masses.

f.* Students know how to calculate percent yield in a chemical reaction.

g.* Students know how to identify reactions that involve oxidation and reduction and how to balance oxidation-reduction reactions.

GASES AND THEIR PROPERTIES

4. The kinetic molecular theory describes the motion of atoms and molecules and explains the properties of gases. As a basis for understanding this concept:

a. Students know the random motion of molecules and their collisions with a surface create the observable pressure on that surface.

b. Students know the random motion of molecules explains the diffusion of gases.

c. Students know how to apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.

d. Students know the values and meanings of standard temperature and pressure (STP).

e. Students know how to convert between the Celsius and Kelvin temperature scales.

f. Students know there is no temperature lower than 0 Kelvin.

g.*Students know the kinetic theory of gases relates the absolute temperature of a gas to the average kinetic energy of its molecules or atoms.

h.*Students know how to solve problems by using the ideal gas law in the form PV = nRT.

i.* Students know how to apply Dalton's law of partial pressures to describe the composition of gases and Graham's law to predict diffusion of gases.

ACIDS AND BASES

5. Acids, bases, and salts are three classes of compounds that form ions in water solutions. As a basis for understanding this concept:

a. Students know the observable properties of acids, bases, and salt solutions.

b. Students know acids are hydrogen-ion-donating and bases are hydrogen-ion-accepting substances.

c. Students know strong acids and bases fully dissociate and weak acids and bases partially dissociate.

d. Students know how to use the pH scale to characterize acid and base solutions.

e.*Students know the Arrhenius, Brønsted-Lowry, and Lewis acid-base definitions.

f.* Students know how to calculate pH from the hydrogen-ion concentration.

g.*Students know buffers stabilize pH in acid-base reactions.

SOLUTIONS

6. Solutions are homogenous mixtures of two or more substances. As a basis for understanding this concept:

a. Students know the definitions of solute and solvent.

b. Students know how to describe the dissolving process at the molecular level by using the concept of random molecular motion.

c. Students know temperature, pressure, and surface area affect the dissolving process.

d. Students know how to calculate the concentration of a solute in terms of grams per liter, molarity, parts per million, and percent composition.

e.*Students know the relationship between the molality of a solute in a solution and the solution's depressed freezing point or elevated boiling point.

f. *Students know how molecules in a solution are separated or purified by the methods of chromatography and distillation.

CHEMICAL THERMODYNAMICS

7. Energy is exchanged or transformed in all chemical reactions and physical changes of matter. As a basis for understanding this concept:

a. Students know how to describe temperature and heat flow in terms of the motion of molecules (or atoms).

b. Students know chemical processes can either release (exothermic) or absorb (endothermic) thermal energy.

c. Students know energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.

d. Students know how to solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.

e.*Students know how to apply Hess's law to calculate enthalpy change in a reaction.

f. *Students know how to use the Gibbs free energy equation to determine whether a reaction would be spontaneous.

REACTION RATES

8. Chemical reaction rates depend on factors that influence the frequency of collision of reactant molecules. As a basis for understanding this concept:

a. Students know the rate of reaction is the decrease in concentration of reactants or the increase in concentration of products with time.

b. Students know how reaction rates depend on such factors as concentration, temperature, and pressure.

c. Students know the role a catalyst plays in increasing the reaction rate.

d.*Students know the definition and role of activation energy in a chemical reaction.

CHEMICAL EQUILIBRIUM

9. Chemical equilibrium is a dynamic process at the molecular level. As a basis for understanding this concept:

a. Students know how to use LeChatelier's principle to predict the effect of changes in concentration, temperature, and pressure.

b. Students know equilibrium is established when forward and reverse reaction rates are equal.

c.*Students know how to write and calculate an equilibrium constant expression for a reaction.

ORGANIC CHEMISTRY AND BIOCHEMISTRY

10. The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis of life. As a basis for understanding this concept:

a. Students know large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.

b. Students know the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.

c. Students know amino acids are the building blocks of proteins.

d.*Students know the system for naming the ten simplest linear hydrocarbons and isomers that contain single bonds, simple hydrocarbons with double and triple bonds, and simple molecules that contain a benzene ring.

e.*Students know how to identify the functional groups that form the basis of alcohols, ketones, ethers, amines, esters, aldehydes, and organic acids.

f. *Students know the R-group structure of amino acids and know how they combine to form the polypeptide backbone structure of proteins.

NUCLEAR PROCESSES

11. Nuclear processes are those in which an atomic nucleus changes, including radioactive decay of naturally occurring and human-made isotopes, nuclear fission, and nuclear fusion. As a basis for understanding this concept:

a. Students know protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.

b. Students know the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by E=mc2) is small but significant in nuclear reactions.

c. Students know some naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.

d. Students know the three most common forms of radioactive decay (alpha, beta, and gamma) and know how the nucleus changes in each type of decay.

e. Students know alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and have different penetrations.

f. *Students know how to calculate the amount of a radioactive substance remaining after an integral number of half-lives have passed.

g.*Students know protons and neutrons have substructures and consist of particles called quarks.

INVESTIGATION AND EXPERIMENTATION

1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:

a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.

b. Identify and communicate sources of unavoidable experimental error.

c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.

d. Formulate explanations by using logic and evidence.

e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.

f. Distinguish between hypothesis and theory as scientific terms.

g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.

h. Read and interpret topographic and geologic maps.

i. Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).

j. Recognize the issues of statistical variability and the need for controlled tests.

k. Recognize the cumulative nature of scientific evidence.

l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.

m. Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.

n. Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).

CA NEXT GENERATION SCIENCE STANDARDS (NGSS) GRADES 9-12

HS-PS1 MATTER AND ITS INTERACTIONS

Students who demonstrate understanding can:

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. [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.]

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. [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.]

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. [Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.]

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. [Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.] [Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.]

HS-PS1-5: Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. [Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.] [Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.]

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.* [Clarification Statement: Emphasis is on the application of Le Chatlier's Principle and on refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products.] [Assessment Boundary: Assessment is limited to specifying the change in only one variable at a time. Assessment does not include calculating equilibrium constants and concentrations.]

HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.]

HS-PS1-8: Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. [Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.] [Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.]

HS-PS2 MOTION AND STABILITY: FORCES AND INTERACTIONS

Students who demonstrate understanding can:

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. [Clarification Statement:

Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force.] [Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.]

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. [Clarification Statement: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle.] [Assessment Boundary: Assessment is limited to systems of two macroscopic bodies moving in one dimension.]

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.* [Clarification Statement: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute.] [Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.]

HS-PS2-4: Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. [Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields.] [Assessment Boundary: Assessment is limited to systems with two objects.]

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 an electric current. [Assessment Boundary: Assessment is limited to designing and conducting investigations with provided materials and tools.]

HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.* [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.]

HS-PS3 ENERGY

Students who demonstrate understanding can:

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. [Clarification Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model.] [Assessment Boundary: Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.]

HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields. [Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.]

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.* [Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency.] [Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.]

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). [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.] [Assessment Boundary: Assessment is limited to investigations based on materials and tools provided to students.]

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. [Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other, including an explanation of how the change in energy of the objects

is related to the change in energy of the field.] [Assessment Boundary: Assessment is limited to systems containing two objects.]

HS-PS4 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. [Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.] [Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.]

HS-PS4-2: Evaluate questions about the advantages of using a digital transmission and storage of information. [Clarification Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.]

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. [Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.] [Assessment Boundary: Assessment does not include using quantum theory.]

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. [Clarification Statement: Emphasis is on the idea that different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.] [Assessment Boundary: Assessment is limited to qualitative descriptions.]

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.* [Clarification Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.] [Assessment Boundary: Assessments are limited to qualitative information. Assessments do not include band theory.]

Common Core State Standards for Literacy Across Content Areas

READING STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS 6-12 - The standards below begin at grade 6; standards for K–5 reading in history/social studies, science, and technical subjects are integrated into the K–5 Reading standards. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations—the former providing broad standards, the latter providing additional specificity.

Key Ideas and Details

1. Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Craft and Structure

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.
5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

Integration of Knowledge and Ideas

7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Range of Reading and Level of Text Complexity

10. By the end of grade 12, read and comprehend science/ technical texts in the grades 11–CCR text complexity band independently and proficiently.

WRITING STANDARDS FOR LITERACY IN HISTORY/SOCIAL STUDIES, SCIENCE, AND TECHNICAL SUBJECTS 6-12 the standards below begin at grade 6; standards for K–5 writing in history/social studies, science, and technical subjects are integrated into the K–5 Writing standards. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations—the former providing broad standards, the latter providing additional specificity. Grades 6-8 Students: Grades 9-10 Students: Grades 11-12 Students:

Text Types and Purposes

1. Write arguments focused on discipline-specific content.
    a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
    b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
    c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
    d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
    e. Provide a concluding statement or section that follows from or supports the argument presented.
2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
    a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
    b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
    c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
    d. Use precise language, domain-specific vocabulary and d. techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
    e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).
3. (See note; not applicable as a separate requirement)

Note: Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In history/social studies, students must be able to incorporate narrative accounts into their analyses of individuals or events of historical import. In science and technical subjects, students must be able to write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results.

Craft and Structure

4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Integration of Knowledge and Ideas
7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
9. Draw evidence from informational texts to support analysis, reflection, and research.
Range of Reading and Level of Text Complexity
10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Note: Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In history/social studies, students must be able to incorporate narrative accounts into their analyses of individuals or events of historical import. In science and technical subjects, students must be able to write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results.

INSTRUCTIONAL MATERIALS

Textbook: Chemistry: Matter and Change
Edition: California Edition, 2005
Publisher: Glencoe

SUPPLEMENTAL MATERIALS

SUGGESTED AVERAGE TIME FOR COVERING MAJOR UNITS

Unit	Days
Unit I: **Investigation and Experimentation**	17
Unit II: **Atomic and Molecular Structure**	17
Unit III: **Chemical Bonding**	23
Unit IV: **Chemical Reaction**.	22
Unit V: **Gas Laws and Gas Properties**	16
Unit VI: **Acids and Bases**	12
Unit VII: **Solutions**	17
Unit VIII: **Chemical Thermodynamics**	14
Unit IX: **Organic Chemistry and Biochemistry**	20
Unit X: **Nuclear Chemistry**	12

TEACHER RESOURCES

Books
Standard Lab Supplies

RECOMMENDED STUDENT RESOURCES

ALIGNMENT TO HPHS LEARNING OUTCOMES IS LISTED IN APPENDIX B

SECTION TWO — COURSE UNITS

UNIT I: Investigation and Experimentation

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other five reporting clusters, students should develop their own questions and perform investigations.

Standards Addressed

CA Content Standards for Chemistry: CHE 1a – n
NGSS: HS-PS1-1, HS-PS2-6, HS-PS3-1, HS-PS3-2, HS-PS4-1
CCSS – Science – R1, R2, R3, R4, R8, R9, W1, W3, W4, W7, W9, W10

Instructional Objectives

Students will be able to:

- Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
- Identify and communicate sources of unavoidable experimental error.
- Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
- Formulate explanations by using logic and evidence.
- Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.
- Distinguish between hypothesis and theory as scientific terms.
- Recognize the usefulness and limitations of models and theories as scientific representations of reality.
- Read and interpret topographic and geologic maps.
- Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).
- Recognize the issues of statistical variability and the need for controlled tests.
- Recognize the cumulative nature of scientific evidence.
- Analyze situations and solve problems that require combining and applying concepts from more than one area of science.
- Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.

Suggested Activities

- *Core Lab:* Treating Symptoms with the Rite-Aid®: Demystifying Over-the-Counter Pharmaceuticals
- *Explore Your World* **Nutrition Units**
- *Case Study* **Cell Phone Use and Cancer**
- *Case Study* **Does a One-Size Drug Dose Fit All**
- *Case Study* **Is *Guaiacum sanctum* Effective Against Arthritis**
- *Case Study* **Kermit to Kermette**
- *Case Study* **Sometimes Less is Better—Treatment of Venous Thrombolism**

Suggested Assessment

- *Questions and Problems* **Chemistry & Chemicals**
- *Questions and Problems* **Scientific Method**
- *Questions and Problems* **Units of Measurements**
- *Questions and Problems* **Scientific Notation**
- *Questions and Problems* **Significant Figures**
- *Questions and Problems* **Significant Figures in Calculations**
- *Questions and Problems* **Prefixes and Equalities**
- *Questions and Problems* **Writing Conversion Factors**
- *Questions and Problems* **Problem Solving**
- *Questions and Problems* **Density**

UNIT II: Atomic and Molecular Structure

The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.

Standards Addressed

CA Content Standards for Chemistry: CH 1a – e.
NGSS: HS-PS1-1, HS-PS1-3, HS-PS1-8, HS-PS2-6
CCSS – Science – R1, R2, R3, R4, R8, R9, W1, W3, W4, W7, W9, W10

Instructional Objectives

- *Students know* how to relate the position of an element in the periodic table to its atomic number and atomic mass.
- *Students know* how to use the periodic table to identify metals, semimetals, non-metals, and halogens.
- *Students know* how to use the periodic table to identify alkali metals, alkaline earth metals and transition metals, trends in ionization energy, electronegativity, and the relative sizes of ions and atoms.

- *Students know* how to use the periodic table to determine the number of electrons available for bonding.
- *Students know* the nucleus of the atom is much smaller than the atom yet contains most of its mass.

Suggested Activities

- Core lab: Elemental Design: The Significance of Elements in Healthcare
- Core lab: Flame Test and Component Identification and Analysis
- Explore Your World Repulsion and Attraction p.97
- Lab: Flame Test
- Lab: Metal Detoxification of C. elegans
- Case study A Case of Iron Deficiency: Anemia
- Case study Osteoporosis—Marissa, Jeremy, Eleanor
- Case study The Chemistry of Cooley's Anemia
- Case study Thinking Inside the Box
- Literacy activity: Lead essay
- Lab: Alien Periodic Table
- Lab: Periodic Table Poker
- Project: Water Quality Monitoring and Testing

Suggested Assessment

- *Questions and Problems* **States of Matter**
- *Questions and Problems* **Classification of Matter**
- *Questions and Problems* **Elements and Symbols**
- *Questions and Problems* **The Periodic Table**
- *Questions and Problems* **The Atom**
- *Questions and Problems* **Atomic Number and Mass Number**
- *Questions and Problems* **Isotopes and Atomic Mass**
- *Questions and Problems* **Electron Energy Levels**
- *Questions and Problems* **Periodic Trends**

UNIT III: Chemical Bonding

Biological, chemical, and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.

Standards Addressed

CA Content Standards for Chemistry: CH 2a – e.
NGSS: HS-PS1-2, HS-PS1-4, HS-PS1-5, HS-PS1-6, HS-PS1-7
CCSS – Science – R1, R2, R3, R4, R8, R9, W1, W3, W4, W7, W9, W10

Instructional Objectives

- *Students know* atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.
- *Students know* chemical bonds between atoms in molecules such as H_2, CH_4, NH_3, H_2CCH_2, N_2, Cl_2 and many large biological molecules are covalent.
- *Students know* salt crystals, such as NaCl, are repeating patterns of positive and negative ions held together by electrostatic attraction.
- *Students know* the atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form.
- *Students know* how to draw Lewis dot structures

Suggested Activities

- *Core lab:* A Closer Look at Aspirin
- *Core lab:* Forensic Chemistry of Drug Detection Kit
- *Core lab:* The Gloves are Off: Comparing Ionic Compounds and Covalent Compounds
- *Case Study* **Baffled by the Baby Bottle**
- Lab: Oobleck, Flubber, Goop

Suggested Assessment

- *Questions and Problems* **Periodic Trends**
- *Questions and Problems* **Octet Rule and Ions**
- *Questions and Problems* **Ionic Compounds**
- *Questions and Problems* **Naming and Writing Ionic Formulas**
- *Questions and Problems* **Polyatomic Ions**
- *Questions and Problems* **Covalent Compounds**
- *Questions and Problems* **Electronegativity and Bond Polarity**
- *Questions and Problems* **Shapes and Polarity of Molecules**
- *Questions and Problems* **Attractive Forces in Compounds**

UNIT IV: Chemical Reactions

Chemical reaction rates depend on factors that influence the frequency of collision of reactant molecules. Chemical equilibrium is a dynamic process at the molecular level. The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants. As a basis for understanding this concept:

Standards Addressed

CA Content Standards for Chemistry: CH 3a – e, CH 8 a – c, and CH 9 a – b.
NGSS: HS-PS1-2, HS-PS1-4, HS-PS1-5, HS-PS1-6, HS-PS1-7
CCSS – Science – R1, R2, R3, R4, R8, R9, W1, W3, W4, W7, W9, W10

Instructional Objectives

- Students know how to describe chemical reactions by writing balanced equations.
- Students know the quantity one mole is set by defining one mole of carbon 12 atoms to have a mass of exactly 12 grams.
- Students know one mole equals 6.02×10^{23} particles (atoms or molecules).
- Students know how to determine the molar mass of a molecule from its chemical formula and a table of atomic masses and how to convert the mass of a molecular substance to moles, number of particles, or volume of gas at standard temperature and pressure.
- Students know how to calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products and the relevant atomic masses.
- *Students know* how to use LeChatelier's principle to predict the effect of changes in concentration, temperature, and pressure.
- *Students know* equilibrium is established when forward and reverse reaction rates are equal.
- *Students know* the rate of reaction is the decrease in concentration of reactants or the increase in concentration of products with time.
- *Students know* how reaction rates depend on such factors as concentration, temperature, and pressure.
- *Students know* the role a catalyst plays in increasing the reaction rate.

Suggested Activities

- *Core lab:* Lab Aids* Identification of Chemical Reactions
- *Core lab:* Synthesis of Aspirin
- *Core lab:* Chemical Reactions for Living Systems
- *Explore Your World* **Calculating Moles in the Kitchen** p.169
- **Explore Your World* **Oxidation of Fruits and Vegetables** p.186
- *Case Study* **Avogadro Goes to Court**
- *Case Study* **Get the Lead Out**
- Lab: Biobridge—*Sensible Smell*
- *Core lab:* Understanding Enzymes
- **Biobridge Lab:** Enzymes and Pharmacy
- Lab: The Effects of pH and Temperature on the Catalase Enzyme in Potatoes
- *Case study* **Sometimes Less is Better—Treatment of Venous Thrombolism**
- *Core lab*: Buffering Capacity of Blood
- *Core lab:* The Effectiveness of Antacids

- *Case study* **A Better Yield**

Suggested Assessment

- *Questions and Problems* **The Mole**
- *Questions and Problems* **Molar Mass**
- *Questions and Problems* **Chemical Changes**
- *Questions and Problems* **Chemical Equations**
- *Questions and Problems* **Types of Reactions**
- *Questions and Problems* **Oxidation-Reduction Reactions**
- *Questions and Problems* **Mole Relationships in Chemical Equations**
- *Questions and Problems* **Mass Calculations for Reactions**
- *Questions and Problems* **Energy in Chemical Reactions**
- *Questions and Problems* **Enzyme Action**
- *Questions and Problems* **Factors Affecting Enzyme Activity**
- *Questions and Problems* **Enzyme Cofactors**

UNIT V: Gas Laws and Gas Properties

The kinetic molecular theory describes the motion of atoms and molecules and explains the properties of gases.

Standards Addressed

CA Content Standards for Chemistry: CH 4a – e.
NGSS: HS-PS3-1, HS-PS3-2
CCSS – Science – R1, R2, R3, R4, R8, R9, W1, W3, W4, W7, W9, W10

Instructional Objectives

- *Students know* the random motion of molecules and their collisions with a surface create the observable pressure on that surface.
- *Students know* the random motion of molecules explains the diffusion of gases.
- *Students know* how to apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.
- *Students know* the values and meanings of standard temperature and pressure (STP).
- *Students know* how to convert between the Celsius and Kelvin temperature scales.
- *Students know* there is no temperature lower than 0 Kelvin.

Suggested Activities

- *Core lab:* Lung Capacity: The Molar Volume of Human Lungs
- *Core lab:* Aspire to Respire: Building a Respiration Model

- *Explore Your World* **Forming a Gas** p.213
- *Case study* **A Killer Lake**
- *Case study* **Gas Cylinders and Safety**

Suggested Assessment

- *Questions and Problems* **Properties of Gases**
- *Questions and Problems* **Gas Pressure**
- *Questions and Problems* **Pressure and Volume (Boyle's Law)**
- *Questions and Problems* **Temperature and Volume (Charles' Law)**
- *Questions and Problems* **Temperature and Pressure**
- *Questions and Problems* **The Combined Gas Law**
- *Questions and Problems* **Volume and Moles (Avogadro's Law)**
- *Questions and Problems* **Partial Pressure (Dalton's Law)**

UNIT VI: Acids and Bases

Acids, bases, and salts are three classes of compounds that form ions in water solutions.

Standards Addressed

CA Content Standards for Chemistry: CH 5a – d.
NGSS: HS-PS1-1, HS-PS1-2, HS-PS1-3, HS-PS1-4, HS-PS1-5, HS-PS1-6, HS-PS1-7
CCSS – Science – R1, R2, R3, R4, R8, R9, W1, W3, W4, W7, W9, W10

Instructional Objectives

- *Students know* the observable properties of acids, bases, and salt solutions.
- *Students know* acids are hydrogen-ion-donating and bases are hydrogen-ion-accepting substances.
- *Students know* strong acids and bases fully dissociate and weak acids and bases partially dissociate.
- *Students know* how to use the pH scale to characterize acid and base solutions.

Suggested Activities

- *Core lab:* Titration of Aspirin
- *Core lab:* Titration of Antacids
- *Core lab:* Ocean Acidification
- *Core lab:* A Closer Look at Toothpaste
- *Core lab:* How Effective is an Antacid?
- *Explore Your World* **Using Vegetables and Flowers as pH Indicators**
- *Case study* **A Killer Lake**
- *Case study* **An End to Ulcers**
- *Case study* **Salton, A Sea of Controversy**

Suggested Assessment

- *Questions and Problems* **Acids and Bases**
- *Questions and Problems* **Strengths of Acids and Bases**
- *Questions and Problems* **Ionization of Water**
- *Questions and Problems* **The pH Scale**
- *Questions and Problems* **Reactions of Acids and Bases**
- *Questions and Problems* **Buffers**

UNIT VII: Solutions

Solutions are homogenous mixtures of two or more substances. As a basis for understanding this concept:

Standards Addressed

CA Content Standards for Chemistry: CH 6a – d.
NGSS: HS-PS1-1, HS-PS1-2, HS-PS1-3, HS-PS1-4, HS-PS1-5, HS-PS1-6, HS-PS1-7
CCSS – Science – R1, R2, R3, R4, R8, R9, W1, W3, W4, W7, W9, W10

Instructional Objectives

- *Students know* the definitions of *solute* and *solvent*.
- *Students know* how to describe the dissolving process at the molecular level by using the concept of random molecular motion.
- *Students know* temperature, pressure, and surface area affect the dissolving process.
- *Students know* how to calculate the concentration of a solute in terms of grams per liter, molarity, parts per million, and percent composition.

Suggested Activities

- *Core lab:* IV Drips: Making Molar Solutions
- *Core lab:* Investigating Water Pollutants and Water Analysis Activity
- *Core Lab:* Lab Aids* Simulated Urinalysis Kit
- *Explore Your World* **Like Dissolves Like** p. 245
- *Explore Your World* **Preparing Solutions** p. 253
- *Explore Your World* **Everyday Osmosis** p. 270
- *Case study* **A Killer Lake**
- *Case study* **The Case of Ruth James**
- *Case study* **Woe to That Child**
- Lab: Ice Cream Lab: Tasty Solutions
- Lab: Testing Sports Drinks and the Presence of Electrolytes

Suggested Assessment

- *Questions and Problems* **Solutions**
- *Questions and Problems* **Electrolytes and Nonelectrolytes**
- *Questions and Problems* **Solubility**
- *Questions and Problems* **Percent Concentration**
- *Questions and Problems* **Molarity and Dilution**
- *Questions and Problems* **Solutions in Chemical Reactions**
- *Questions and Problems* **Properties of Solutions**

UNIT VIII: Chemical Thermodynamics

Energy is exchanged or transformed in all chemical reactions and physical changes of matter.

Standards Addressed

CA Content Standards for Chemistry: CH 7a – d.
NGSS: HS-PS3-1, HS-PS3-2, HS-PS3-3, HS-PS3-4, HS-PS1-5
CCSS – Science – R1, R2, R3, R4, R8, R9, W1, W3, W4, W7, W9, W10

Instructional Objectives

- *Students know* how to describe temperature and heat flow in terms of the motion of molecules (or atoms).
- *Students know* chemical processes can either release (exothermic) or absorb (endothermic) thermal energy.
- *Students know* energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.
- *Students know* how to solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.

Suggested Activities

- *Core lab*: Counting Calories
- *Case study* **A Can of Bull**

Suggested Assessment

- *Questions and Problems* **Energy in Chemical Reactions**

UNIT IX: Organic Chemistry and Biochemistry

The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis of life.

Standards Addressed

CA Content Standards for Chemistry: CH 10a – c.
NGSS: HS-PS1-1, HS-PS1-2, HS-PS1-3, HS-LS1-5, HS-LS1-6, HS-LS2-5
CCSS – Science – R1, R2, R3, R4, R8, R9, W1, W3, W4, W7, W9, W10

Instructional Objectives

- *Students know* large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.
- *Students know* the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.
- *Students know* amino acids are the building blocks of proteins.

Suggested Activities

- *Core lab:* Food Chemistry and Nutrition
- *Core lab:* Sensable Smells
- *Core lab:* Food Chemistry: The Identification of Macromolecules
- *Explore Your World* **Unsaturation in Fats and Oils** p. 391
- *Explore Your World* **Ripening Fruit** p. 384
- *Explore Your World* **Polymers and Recycling Plastics** p.394
- *Explore Your World* **Alchohols in Household Products** p.407
- *Explore Your World* **Sugar and Sweeteners** p.500
- *Explore Your World* **Polysaccharides** p.505
- *Explore Your World* **Types of Fats** p. 528
- *Explore Your World* **Denaturation of Milk** p. 569
- *Explore Your World* **Carbohydrate Digestion** p. 630
- *Explore Your World* **Fat Storage and Blubber** p. 658
- *Case study* **Baffled by the Baby Bottle**
- *Case study* **Should Bill Buy Sammy**
- *Case study* **The Campus Coffee Shop Caffeine Conundrum**
- *Case study* **To Spray or Not to Spray**
- *Case study* **What's in my Water Bottle**
- *Case study* **Would You Supersize My Cancer Please**
- *Plastics Demonstration*: Guest Speaker
- Lab: Flubber
- Modeling Polymers: Use Tangles, Plastic Beads or Baby toys
- Lab: Macromolecules

Suggested Assessment

- *Questions and Problems* **Functional Groups**
- *Questions and Problems* **Polymers of Alkenes**
- *Questions and Problems* **Carbohydrates**
- *Questions and Problems* **Lipids**
- *Questions and Problems* **Components of Nucleic Acids**
- *Questions and Problems* **DNA Double Helix**

UNIT X: Nuclear Chemistry

Nuclear processes are those in which an atomic nucleus changes, including radioactive decay of naturally occurring and human-made isotopes, nuclear fission, and nuclear fusion.

Standards Addressed

CA Content Standards for Chemistry: CH 11a – e.
NGSS: HS-PS1-1, HS-PS1-2, HS-PS4-1, HS-PS4-2, HS-PS4-3, HS-PS4-4, HS-PS4-5
CCSS – Science – R1, R2, R3, R4, R8, R9, W1, W3, W4, W7, W9, W10

Instructional Objectives

- *Students know* protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.
- *Students know* the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by $E = mc^2$) is small but significant in nuclear reactions.
- *Students know* some naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.
- *Students know* the three most common forms of radioactive decay (alpha, beta, and gamma) and know how the nucleus changes in each type of decay.
- *Students know* alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and have different penetrations.

Suggested Activities

- *Core lab:* Daily Dosage of Radiation
- *Core lab:* Unraveling the Mystery of Expiration Dates on Pharmaceutical Medication
- *Core lab:* The Use of Scanning in Diagnosing Patients
- *Explore Your World* **Modeling Half-Lives**
- *Case study* **Irradiation—Is It Consumer Friendly**
- *Case study* **Not Just Another Day at the Beach**

- *Case study* **The Benign Hamburger**

Suggested Assessment

- *Green Chemistry Note* **Radon in Our Homes**
- *Health Note* **Beta Emitters in Medicine**
- *Health Note* **Radiation and Food**
- *Health Note* **Brachytherapy**
- *Health Note* **Radiation Doses in Diagnostic and Therapeutic Procedures**
- *Health Note* **Other Imaging Methods**
- *Green Chemistry Note* **Nuclear Power Plants**
- *Questions and Problems* **Nuclear Fission and Fusion**

Appendix A: HPHS Learning Outcomes for Medical Chemistry

All students will achieve the following PRIDE skills in Chemistry by:

Powerfully Prepared for College and Career (by)

- Demonstrating proficiency in Chemistry on state standards
- Taking and passing practice SAT exams on Chemistry
- Researching, developing and writing a report on a current controversial health topic
- Understanding the process of investigation and experimentation

Responsible Citizen (by):

- Teaching underclassmen and community members about a nutritional topic
- Maintaining organization of papers and assignments
- Coming prepared to class to positively participate in class discussions
- Offering support and help in completing IUP's
- Attending class every day it is in session

Independent Critical Thinker (by)

- Reviewing several information sources and coming to a conclusion
- Supporting all answers with statements of fact
- Evaluating and revising assignments for correctness
- Using logic and reasoning to come to correct conclusions or answers
- Evaluating a problem and devising a experimental procedure to determine an answer
- Understanding and explaining specific chemistry terms and how they are used

Determined Lifelong Learner (by)

- Understanding how chemistry is related to your career choice
- Being intrinsically motivated to improve their ability to solve complex chemistry problems
- Taking an active role in supporting the peers

Excellent Communicator (by)

- Submitting work that is professional looking
- Answering questions with detailed thoughts
- Acting and speaking professionally during a nutrition health fair
- Demonstrating knowledge of correct English conventions when writing
- Writing to inform, persuade, or explain using advanced sentence structures and rhetorical devices
- Using various media and computer programs to enhance presentations and discussions