

High School Course Description for **Honors Chemistry w/Lab**

Course Title: Honors Chemistry w/Lab**Curricular Area:** Science**Course Number:** TBD**Length:** One year**Grade Level:** 11-12**Prerequisites:**

- 1 year of Algebra w/ B or better
- Geometry w/ B or better *or* taking Geometry concurrently
- 1 year of Biology and/or Earth Science w/B or better

Meets a UC a-g Requirement: Yes**Meets NCAA Requirement:** Yes**Meets High School Graduation Requirement for:**

Laboratory Physical Science

Course Description

Honors Chemistry is an in-depth investigation of matter, structures, reactions and changes designed to prepare the students to continue their studies in science in AP Chemistry and at the college level. From the basics of atomic structure to a deeper understanding of the matter-energy relationships associated with a wide range of physical and chemical changes, students will use many tools to gain an understanding of the chemical world. Honors Chemistry is an inquiry-based course in which laboratory work, observational skills, critical thinking, the writing of arguments related to specific chemistry content, and clearly-written explanations of technical processes and experiments are developed and honed by building an excellent foundation for further science exploration.

Students should possess curiosity, the ability to follow instructions, a respect for safety while dealing with chemicals, and knowledge of fundamental mathematics.

Lab activities will include the use of data collection devices and utilization of computer analysis of data. Formal lab reports will include pre-lab requirements for researching each topic, answering questions to ensure the understanding of the topics under investigation, as well as, a formal presentation of the results of the experiment, an analysis of the results, and logical conclusions based on theory and actual results.

Alignment:

This course meets the UC a - g entrance requirements, and is aligned with the Science Content Standards for California Public Schools Grades Nine through Twelve—Chemistry. It is also based on the Next Generation Science Standards (NGSS) to reflect a deeper inquiry approach to chemistry. Each semester, students will complete a project that addresses the following NGSS scientific and engineering practices that students should engage in throughout their K-12 education.

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out Investigations
4. Analyzing and interpreting data
5. Using mathematics, information and computer technology, and computational thinking
6. Construction explanations and designing solutions
7. Engaging in argument from evidence and
8. Obtaining, evaluating, and communicating information.

Alignment with Common Core Standards for Literacy in Science: This course is created to meet these requirements. Quarterly projects requiring research projects and writing over an extended time frame to allow summarizing research, reflecting on the implications of the topics and revision of the written document will be completed. The key concepts of these standards that students will need to meet are:

Reading Standards for Literacy in Science:

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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 science/technical texts in the grades 11–CCR text

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 Science, and Technical Subjects 6–12

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.

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- 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 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).

Production and Distribution of Writing

3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
4. 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.
5. 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.

Research to Build and Present Knowledge

6. 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.
7. 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..
8. Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

9. 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.

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Instructional Materials

Required Textbook(s)

1. **Holt Chemistry.** Meyers, Oldham and Tocci. Holt, Reinhart and Wilson
ISBN: 0-03-092204-6

Supplemental Materials

1. **Holt Modern Chemistry.** Davis, Frey, Sarquis and Sarquis
2. Instructor's resource Center on DVD
3. Vernier Chemistry Labs
4. Class set subscription to *ChemMatters* and teacher's subscription to *Chemical Education*, both ACS publications.

Web Sites: Web sites will be identified and utilized to offer opportunities outside of class to explore topics in greater detail and greater depth. The following represent several options.

- <http://www.khanacademy.org/science/chemistry>
- <http://www.brightstorm.com/science/chemistry/>
- <http://www.wwnorton.com/college/chemistry/gilbert2/chemtors.asp>

Grading Criteria

<u>Activities</u>	<u>Percentage</u>
Homework/Class work.....	15%
Research papers and projects	15%
Laboratory activities	30%*
Benchmark Tests/ Quizzes.....	30%*
Final Examination.....	10%
Total:	100%

* *Grading will be more heavily weighted toward Labs/projects and Tests/Quizzes to prepare the students for the focus of the AP course which requires students to perform in a test environment.*

Development Team: This course of study was written and updated by Rodger Golgart, GTHS. Materials were reviewed by Michael Gill, BHS, and Armando Ponce, CHS.

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Instructional Guide for Honors Chemistry w/Lab

Learning Experiences and Instruction:

Teachers utilize the Direct Interactive Instruction model to introduce new skills and concepts that are essential to the grade level content standards, then reinforce and develop those skills each quarter with the goal of bringing students to mastery by the end of the fourth quarter. All instruction will be based on the “I do, We do, You do” scaffolding model with an emphasis on individual differentiation as needed. Teachers will use a variety of the following:

- Inquiry-based learning
- Engaged reading opportunities
- Think-pair-share
- Reciprocal teaching
- Cloze reading & writing
- Guided reading & writing
- Cognitive modeling
- Questioning strategies
- Graphic organizers/concept attainment
- Student-led groups
- Peer pairing
- Metacognitive learning: self-regulation, goal-setting, self-monitoring, and self-questioning

Support for English Language Learners:

Extra time or modified versions of assignments will be given. The District will provide a language assistant. Additional strategies will be developed through the Response to Intervention plans –such as:

- SDAIE strategies
- Texts/materials in first language.
- Flexible grouping
- Structured engagement
- Peer pairing
- Academic vocabulary development
- Realia

Stretching the Lesson for GATE Students:

Differentiated curriculum will be provided to challenge the student and provide the student with opportunities to develop their identified talent. Teachers will use a variety of the following:

- Independent study supplemented with mentoring/tutoring
- Compacting
- Acceleration
- Depth & Complexity icons
- Modified texts
- Modified assignments
- Flexible grouping
- Inquiry-based Learning
- Enriched materials and learning experiences

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Semester 1—Quarter 1

Chapter	Topics covered	California State Standards	Objectives
Chapter 1	<p>The Science of Chemistry</p> <p>Topics: Mass, volume, density, units, conversions, molecules, compounds, mixtures</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab <ul style="list-style-type: none"> o Procedures & Safety o Density Lab - Interactive notebook - Project Commitments for S-1 project 	<p>Chemical Bonds</p> <p>2d. 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.</p> <p>Chemical Thermodynamics</p> <p>7b. Students know chemical processes can either release (exothermic) or absorb (endothermic) thermal energy.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Distinguish between physical and chemical properties, • Classify changes of matter as physical or chemical • Identify four observations that suggest a chemical change has taken place. • Explain gas, liquid and solid particles in terms of particles. • Distinguish between a mixture and a pure substance. • Learn the names and symbols and masses of key elements. • Be able to list the characteristics of metals, metalloids, and nonmetals.
Chapter 2	<p>Matter and Energy</p> <p>Topics: Temperature, heat, energy, conservation of energy, scientific notation, sig figs, precision, accuracy</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o Specific Heat Capacity - Interactive notebook - Enthalpy problems - Project presentations (see chapter 1) 	<p>4e. Students know how to convert between the Celsius and Kelvin temperature scales.</p> <p>4f. Students know there is no temperature lower than 0 Kelvin.</p> <p>Chemical Thermodynamics</p> <p>7a. Students know how to describe temperature and heat flow in terms of the motion of molecules (or atoms).</p> <p>7b. Students know chemical processes can either release (exothermic) or absorb (endothermic) thermal energy.</p> <p>Investigation and Experimentation</p> <p>1a: Select and use appropriate tools and technology to perform tests, collect data, analyze relationships and display data</p> <p>1b: Identify and communicate sources of unavoidable experimental error</p> <p>1c: Identify possible reason for inconsistent results</p> <p>1d: Formulate explanations by using logic and evidence</p> <p>1f: distinguish between hypothesis and theory as scientific terms</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Explain chemical and physical changes in terms of transfers of energy. • Distinguish between heat and temperature. • Be able to convert between Celsius and Kelvin temperatures. • Apply the conservation of matter and energy to chemical and physical changes. • Describe how to use the scientific method. • Understand the use of controls and dependent and independent variables. • Explain the difference between an hypothesis, a theory and a law. • Distinguish between accuracy and precision in experimental results. • Calculate changes in energy to calculate specific heat. • Use scientific notation and significant figures.

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Chapter 3	<p>Atoms and Moles</p> <p>Topics: Atomic theory, structure of atoms, electron configuration, counting atoms</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o Emission spectra of gases - Interactive notebook - Energy of energy level transitions calculations - Project presentations (see chapter 1) 	<p>Investigation and Experimentation</p> <p>g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.</p> <p>k. Recognize the cumulative nature of scientific evidence.</p> <p>Atomic and Molecular Structure</p> <p>e. Students know the nucleus of the atom is much smaller than the atom yet contains most of its mass.</p> <p>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.</p> <p>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.</p> <p>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 ($E=h\nu$)</p> <p>Conservation of Matter and Stoichiometry</p> <p>3 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.</p> <p>c. Students know one mole equals 6.02×10^{23} particles (atoms or molecules).</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • State the three laws that support existence of atoms • State the 5 principles of John Dalton's atomic theory. • Understand the evolution of the models of the atom. • Explain how emission spectra of elemental gases provide information about the electron energy levels. • Write the electron configuration of an atom using the aufbau principle, Hund's rule and the Pauli Exclusion Principle. • Describe the significance of the 4 quantum numbers.

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Chapter 4	<p>The Periodic Table</p> <p>Topics: Periodic law, structure of periodic table, trends in periodic table, origin of elements</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Exercise: <ul style="list-style-type: none"> o Periodicity of Aliens - Interactive notebook - Project presentations (see chapter 1) - Poster for periodic trends 	<p>Atomic and Molecular Structure</p> <p>1. 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, nonmetals, and halogens.</p> <p>c. Students know how to use the periodic table to identify alkali metals, alkaline earth metals and transition metals, trends in ionization energy, electro-negativity, and the relative sizes of ions and atoms.</p> <p>d. Students know how to use the periodic table to determine the number of electrons available for bonding.</p> <p>e. Students know the nucleus of the atom is much smaller than the atom yet contains most of its mass.</p> <p>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.</p> <p>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.</p> <p>2. g.* Students know how electronegativity and ionization energy relate to bond formation.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Describe the historical development of the periodic table. • Describe the organization of the periodic table according to the periodic law. • Locate the families of the main group elements, describe their characteristic properties, and relate these properties to their electron configuration. • Locate metals on the periodic table and relate their properties to their electron configuration. • Describe the periodic trends in ionization energy, electron affinity, atomic radius, electro negativity, ionic size, and melting and boiling points. • Appreciate how the elements in the universe were and are formed. • Understand how particle accelerators are used to create artificial elements.
Chapter 5	<p>Ions and Ionic Compounds</p> <p>Topics: Simple ions, ionic bonding and salts, naming and writing formulas of ionic compounds</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o Tests for Fe(II)/Fe(III), Cu(I)/Cu(II) - Interactive notebook - Project presentations (see chapter 1) 	<p>1 d. Students know how to use the periodic table to determine the number of electrons available for bonding.</p> <p>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.</p> <p>2a. Students know atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.</p> <p>c. Students know salt crystals, such as NaCl, are repeating patterns of positive and negative ions held together by electrostatic attraction.</p> <p>g.* Students know how electronegativity and ionization energy relate to bond formation.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Relate ionic electron configuration to chemical reactivity • Determine an atom's number of valence electrons and use the octet rule to predict what stable ions are likely to form. • Explain why ion's properties are different than the parent atom. • Describe the process of forming an ionic bond. • Explain how the nature of ionic bonds affects the properties of ionic compounds. • Be able to name cations, anions and ionic compounds. • Understand the character of polyatomic ions and how their formulas relate to their names.

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Chapter 6	<p>Covalent Compounds</p> <p>Topics: Covalent bonds, drawing and naming compounds, VSEPR theory and geometric structure.</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o Conductivity as an Indicator of Bond Type - Interactive notebook - Project presentations (see chapter 1) 	<p>1c. 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.</p> <p>2 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.</p> <p>b. Students know chemical bonds between atoms in molecules such as H₂, CH₄, NH₃, HCCH₂, N₂, Cl₂, and many large biological molecules are covalent.</p> <p>e. Students know how to draw Lewis dot structures.</p> <p>f.* Students know how to predict the shape of simple molecules and their polarity from Lewis dot structures.</p> <p>g.* Students know how electronegativity and ionization energy relate to bond formation.</p> <p>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</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Explain the role and location of electrons in covalent bonds. • Distinguish between nonpolar and polar covalent bonds and ionic bonds as a function of electronegativity differences. • Draw Lewis structures to show the arrangement of valence electrons in molecules and polyatomic ions. • Explain the difference between single, double and triple bonds. • Draw resonance structures for simple molecules and polyatomic ions and recognize when they are required. • Name binary inorganic covalent compounds by using prefixes, roots and suffixes. • Predict the shape of molecules based on VSEPR theory.

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Semester 1—Quarter 2

Chapter	Topics covered	California State Standards	Objectives
Chapter 7	<p>The Mole and Chemical Composition</p> <p>Topics: Avogadro's number, mole conversions, relative atomic mass, chemical formulas, percent composition</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o Measuring molar amount of elements and compounds. - Interactive notebook - Mole calculations worksheets/problems - Project presentations (see chapter 1) 	<p>Investigation and Experimentation</p> <p>e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.</p> <p>3 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.</p> <p>c. Students know one mole equals 6.02×10^{23} particles (atoms or molecules).</p> <p>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.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Use the concept of the mole as a counting unit for particles, atoms or molecules. • Use Avogadro's number to convert between amounts in moles and numbers of particles atoms or molecules. • Solve problems converting between mass, amount in moles or number of atoms or molecules using Avogadro's number. • Determine the molar mass of a compound from its formula. • Infer information about a compound from its chemical formula.
Chapter 8	<p>Chemical Equations and Reactions</p> <p>Topics: Describing Chemical reactions, balancing chemical equations, classifying chemical reactions, reaction types, net ionic equations.</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o Activity Series - Interactive notebook - Balancing Chemical equations worksheet - Project presentations (see chapter 1) 	<p>3 a. Students know how to describe chemical reactions by writing balanced equations.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • List evidence that suggests a chemical reaction has occurred and evidence that proves a chemical reaction has occurred. • Describe a chemical reaction by using both word and formula equations. • Interpret notations in formula equations, such as, states of matter, reaction conditions, etc. • Relate the concept of the conservation of mass to the rearrangement of atoms in a chemical reaction. • Write and interpret a balanced chemical reaction. • Balance chemical equations. • Identify the 5 main types of chemical reactions. • Write total and net ionic equations to describe reactions in aqueous solutions.

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Chapter	Topics covered	California State Standards	Objectives
Chapter 9	<p>Stoichiometry</p> <p>Topics: Calculating quantities in reactions, limiting reactants, percent yield</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o none - Interactive notebook - Stoichiometry worksheets - Project presentations (see chapter 1) 	<p>3 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.</p> <p>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.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Use proportional reasoning to determine mole ratios from a balanced chemical equation. • Solve stoichiometric problems involving mass by using molar masses. • Solve stoichiometric problems involving Volume by using density. • Solve stoichiometric problems involving atoms or molecules by using Avogadro's number. • Identify the limiting reactant and use it to calculate theoretical yield. • Perform calculations involving percent yield.
Chapter 12	<p>Gases</p> <p>Topics: Characteristics of gases, gas laws, standard temperature and pressure, KMT, ideal gas law, Stoichiometry of gas reactions</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o Pressure-Volume Relationships: Understanding Boyle's Law - Interactive notebook - Gas Law worksheets - Project presentations (see chapter 1) 	<p>3 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.</p> <p>4 a. Students know the random motion of molecules and their collisions with a surface create the observable pressure on that surface.</p> <p>b. Students know the random motion of molecules explains the diffusion of gases.</p> <p>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.</p> <p>d. Students know the values and meanings of standard temperature and pressure (STP).</p> <p>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.</p> <p>h.* Students know how to solve problems by using the ideal gas law in the form $PV=nRT$.</p> <p>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.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Describe the general properties of gases • Define pressure, give the SI unit for pressure and convert between standard units of pressure. • Relate the kinetic molecular theory to the properties of an ideal and a real gas. • State and be able to relate Boyle's law, Charles's law, Gay-Lussac's law, and Avogadro's law to solve problems involving pressure, volume, temperature and amount of a gas. • Understand how the ideal gas law is a blending of all 4 of these laws. • Apply the concepts of reaction Stoichiometry to solve gas Stoichiometry problems.

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Semester 2—Quarter 3

Chapter	Topics covered	California State Standards	Objectives
Chapter 10	<p>Cause of Change (Thermodynamics)</p> <p>Topics: Energy transfer, enthalpy, changes in enthalpy, exothermic, endothermic, order and spontaneity</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o Constructing a Heating/Cooling Curve for water, calculate the ΔH for each section of heating curve - Interactive notebook - Enthalpy/Entropy/Gibbs Energy worksheets - Project Commitments for S-2 project 	<p>7 a. Students know how to describe temperature and heat flow in terms of the motion of molecules (or atoms).</p> <p>b. Students know chemical processes can either release (exothermic) or absorb (endothermic) thermal energy.</p> <p>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.</p> <p>e.* Students know how to apply Hess's law to calculate enthalpy change in a reaction.</p> <p>f.* Students know how to use the Gibbs free energy equation to determine whether a reaction would be spontaneous.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • State the kinetic molecular theory and relate the implications to the states of matter. • Define and work with the concept of Enthalpy. • Distinguish between heat and temperature. • Perform calculations using molar heat capacity. • Calculate the enthalpy change for a given substance for a given temperature change. • Use a calorimeter and calculate the heat content of foods or the enthalpy change for a chemical reaction. • Use Hess's law and standard enthalpies to calculate ΔH

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Chapter	Topics covered	California State Standards	Objectives
Chapter 11	<p>States of Matter & Intermolecular Forces</p> <p>Topics: States and state changes, intermolecular forces, energy of state changes, phase equilibrium</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o Paper Chromatography - Interactive notebook - S-2 project Presentations 	<p>2 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.</p> <p>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.</p> <p>4 a. Students know the random motion of molecules and their collisions with a surface create the observable pressure on that surface.</p> <p>7 c. Students know energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.</p> <p>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.</p> <p>f.* Students know how to use the Gibbs free energy equation to determine whether a reaction would be spontaneous.</p> <p>9 b. Students know equilibrium is established when forward and reverse reaction rates are equal.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Relate the properties of a state to the energy content and particle arrangement of that state of matter. • Explain the forces and energy changes involved in changes of state. • Contrast ionic and molecular substances in terms of their physical characteristics and the types of forces that govern their behavior. • Describe dipole-dipole forces and relate to polar and non-polar substances. • Understand the implications of Hydrogen bonding and how it is responsible for many of water's properties. • Describe London dispersion forces and relate their strength to other types of attractions. • Define molar enthalpy of both fusion and vaporization and identify them for a substance using a heating curve. • Describe enthalpy and entropy and how they relate to the states of matter. • Predict whether a state change or reaction is likely to occur based on Gibb's free energy. • Calculate the melting point and boiling point of a substance using entropy and enthalpy. • Understand boiling point in terms of vapor pressure.

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Chapter	Topics covered	California State Standards	Objectives
Chapter 13	<p>Solutions</p> <p>Topics: What are solutions, concentration and molarity, solubility, dissolving process, physical properties of solutions</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o Effect of Temperature on Solubility of a Salt - Interactive notebook - Solubility worksheets - S-2 project Presentations 	<p>5 a. Students know the observable properties of acids, bases, and salt solutions.</p> <p>6 a. Students know the definitions of solute and solvent.</p> <p>b. Students know how to describe the dissolving process at the molecular level by using the concept of random molecular motion.</p> <p>c. Students know temperature, pressure, and surface area affect the dissolving process.</p> <p>d. Students know how to calculate the concentration of a solute in terms of grams per liter, molarity, parts per million, and percent composition.</p> <p>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.</p> <p>f.* Students know how molecules in a solution are separated or purified by the methods of chromatography and distillation.</p> <p>IE 1a. 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.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Distinguish between solutions, suspensions and colloids. • Describe and apply some of the methods chemists use to separate mixtures. • Calculate concentrations using standard units. • Define molarity and molality of a solution. • Describe the procedure for making solutions of specific concentrations. • Use molarity in stoichiometric calculations. • Identify applications of solubility principles and relate them to polarity and intermolecular forces. • Explain what happens, at the particle level when a solid dissolves in a liquid. • Predict the solubility of an ionic compound using a solubility table. • Describe solutions in terms of the degree of saturation. • Describe the factors that affect the solubility of gases in liquids. • Distinguish between electrolytes, non-electrolytes and weak electrolytes. • Explain how surfactants work. • Understand the implications of colligative properties.

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Chapter	Topics covered	California State Standards	Objectives
Chapter 14	<p>Chemical Equilibrium</p> <p>Topics: Reversible reactions, systems at equilibrium, equilibrium systems and stress, LeChatelier's principle</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Demo: <ul style="list-style-type: none"> o Color changes in solutions as indications of shifts in equilibrium - Interactive notebook - Equilibrium problems/worksheets - S-2 project Presentations 	<p>9a. Students know how to use LeChatelier's principle to predict the effect of changes in concentration, temperature, and pressure.</p> <p>b. Students know equilibrium is established when forward and reverse reaction rates are equal.</p> <p>c.* Students know how to write and calculate an equilibrium constant expression for a reaction.</p> <p>IE 1 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.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Contrast reactions that go to completion with reversible ones. • Describe chemical equilibrium. • Give examples of chemical equilibria that involve complex ions. • Write K_{eq} expressions for reactions in equilibrium and perform calculations with them. • Write K_{sp} expressions for the solubility of slightly soluble salts and perform calculations with them. • State LeChatelier's principle. • Apply LeChatelier's principle to determine whether a forward or reverse reaction is favored when a stress is applied, such as, a change in temperature, concentration, or pressure. • Discuss the common ion effect in the context of LeChatelier's principle. • Discuss the practical uses of LeChatelier's principle.

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Chapter	Topics covered	California State Standards	Objectives
Chapter 15	<p>Acids and Bases</p> <p>Topics: Acid base theories, Ionization constant of water, K_a, K_b, pH, pOH, titrations, neutralizations, equilibria of weak acids and bases</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o Acid-Base Titration, or o Household acids and bases or o Buffer Capacity in Commercial Beverages - Interactive notebook - Acid-Base problem/worksheets - S-2 project Presentations 	<p>5 a. Students know the observable properties of acids, bases, and salt solutions.</p> <p>b. Students know acids are hydrogen-ion-donating and bases are hydrogen-ion-accepting substances.</p> <p>c. Students know strong acids and bases fully dissociate and weak acids and bases partially dissociate.</p> <p>d. Students know how to use the pH scale to characterize acid and base solutions.</p> <p>e.* Students know the Arrhenius, Brønsted-Lowry, and Lewis acid–base definitions.</p> <p>f.* Students know how to calculate pH from the hydrogen-ion concentration.</p> <p>g.* Students know buffers stabilize pH in acid–base reactions.</p> <p>IE 1 e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Understand acid-base chemistry as a special type of equilibrium reaction. • Describe the distinctive properties of strong and weak acids and bases. • Compare and contrast the Arrhenius, Bronsted-Lowry and Lewis acid-base theories. • Identify conjugate acid base pairs. • Write chemical equations that show how an amphoteric species can behave as either an acid or a base. • Use K_w in calculations. • Explain the relationship between pH and $[H_3O^+]$. • Perform calculations using pH, pOH, $[H_3O^+]$, $[OH^-]$, and K_w. • Work with acid-base indicators. • Describe the conditions at the equivalence point of an acid-base titration. • Perform acid-base titrations and determine the concentration of an unknown acid or base. • Write an equilibrium expression/equation that shows how a weak acid is in equilibrium with its conjugate base. • Calculate the K_a for the hydronium ion concentration of a weak acid solution. • Describe the components of a buffer solution and explain how a buffer solution resists changes in pH.

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Semester 2—Quarter 4

Chapter	Topics covered	California State Standards	Objectives
Chapter 16	<p>Reaction Rates</p> <p>Topics: Rates of reactions, what effects reaction rates, chemical kinetics, activation energy, activated complex, catalysis, reaction mechanisms</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o none - Interactive notebook - Reaction rate problems/worksheets - S-2 project Presentations 	<p>8 a. Students know the rate of reaction is the decrease in concentration of reactants or the increase in concentration of products with time.</p> <p>b. Students know how reaction rates depend on such factors as concentration, temperature, and pressure.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Define the rate of a reaction in terms of concentration changes over time. • Calculate the rate of a reaction from concentration versus time data. • Explain how concentration, pressure, and temperature affect the rate of a reaction. • Explain why, for surface reactions, surface area is an important factor. • Write a rate law using experimental rate versus time data from a chemical reaction. • Explain the role of activation energy and collision orientation in a chemical reaction. • Describe the effect of catalyst on reaction rate and how this effect occurs. • Describe the role of enzymes as catalysts in living systems.
Chapter 18	<p>Nuclear Chemistry</p> <p>Topics: Atomic nuclei, nuclear stability, nuclear change, radioactivity, radioactive decay, nuclear energy</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Labette: <ul style="list-style-type: none"> o Half-life with Pennies - Interactive notebook - Radioactive decay problems/worksheets - S-2 project Presentations 	<p>11 a. Students know protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.</p> <p>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 $e=mc^2$) is small but significant in nuclear reactions.</p> <p>c. Students know some naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.</p> <p>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.</p> <p>e. Students know alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and have different penetrations.</p> <p>f.* Students know how to calculate the amount of a radioactive substance remaining after an integral number of half-lives have passed.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Describe how the strong force attracts nucleons. • Relate binding energy and mass defect. • Predict the stability of a nucleus by considering factors such as binding energy, and the ratio of neutrons to protons in the nucleus. • Predict the particles and electromagnetic waves produced by different types of radioactive decay and write equations for nuclear decays. • Identify examples of nuclear fission, and describe the potential benefits and hazards of its use. • Describe nuclear fusion and its potential as an energy source. • Define the half-life of a radioactive nuclide, and explain how it can be used to determine the half life of an object's age. • Compare acute and chronic exposures to radiation.

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Chapter	Topics covered	California State Standards	Objectives
Chapter 19	<p>Carbon and Organic Chemistry</p> <p>Topics: Allotropes, hydrocarbons, alkanes, alkenes, alkynes, functional groups, isomers, nomenclature, structure, organic reactions</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o Making Soap - Interactive notebook - Naming carbohydrates / functional group worksheets - S-2 project Presentations 	<p>2 b. Students know chemical bonds between atoms in molecules such as H_2, CH_4, NH_3, $HCCH_2$, N_2, Cl_2, and many large biological molecules are covalent.</p> <p>10 a. Students know large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.</p> <p>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.</p> <p>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.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Explain the unique properties of carbon that make the formation of organic molecules possible. • Relate the structure of diamond, graphite, and other allotropes of carbon to their properties. • Describe the nature of the bonds formed by carbon in alkanes, alkenes, alkynes, aromatic compounds, and cyclic compounds. • Classify organic compounds such as alcohols, esters, ketones and carboxylic acids by their functional groups. • Explain how the structural differences between isomers are related to the differences in their properties. • Name simple hydrocarbons from their structural formulas. • Name branched hydrocarbons from their structural formulas. • Identify functional groups from a structural formula, and assign names to the compounds containing functional groups. • Draw an interpret structural formulas and skeletal structures for common organic compounds. • Describe and distinguish between substitution and addition reactions. • Describe and distinguish between condensation and elimination reactions.

Star Testing

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Chapter	Topics covered	California State Standards	Objectives
Chapter 20	<p>Biological Chemistry</p> <p>Topics: Carbohydrates, lipids, proteins, nucleic acids</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o none - Interactive notebook - S-2 project Presentations 	<p>2 b. Students know chemical bonds between atoms in molecules such as H_2, CH_4, NH_3, $HCCH_2$, N_2, Cl_2, and many large biological molecules are covalent</p> <p>10 a. Students know large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.</p> <p>c. Students know amino acids are the building blocks of proteins.</p> <p>f.* Students know the R-group structure of amino acids and know how they combine to form the polypeptide backbone structure of proteins.</p>	<p>To be able to:</p> <ul style="list-style-type: none"> • Describe the structure of carbohydrates. • Relate the structure of carbohydrates to their role in biological systems. • Identify the reactions that lead to the formation and breakdown of carbohydrate polymers. • Describe the properties of lipids. • Describe the general amino acid structure. • Explain how amino acids form proteins through condensation reactions. • Explain the significance of amino acid side chains to the three dimensional structure and function of a protein. • Describe how enzymes work and how the structure and function of an enzyme is affected by changes of temperature and pH. • Relate the structure of nucleic acids to their function as carriers of genetic information. • Describe how DNA uses the genetic code too control the synthesis of proteins.

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Chapter	Topics covered	California State Standards	Objectives
Chapter 17	<p>Oxidation, Reduction and ElectroChemistry (Optional topic if time – not in CA standards)</p> <p>Topics: Oxidation reduction reactions, electrochemistry, galvanic cells, electrolytic cells, corrosion, standard electrode potential</p> <p>Key Assignments</p> <ul style="list-style-type: none"> - Lab: <ul style="list-style-type: none"> o Electroplating a key - Interactive notebook - Redox reaction problems/worksheets - S-2 project Presentations 		<p>To be able to:</p> <ul style="list-style-type: none"> • Identify atoms that are oxidized or reduced through electron transfer. • Assign oxidation numbers to atoms in compounds and ions. • Identify Redox reactions by analyzing changes in oxidation numbers for different atoms in the reaction. • Balance equations for oxidation reduction reactions through the half reaction method. • Describe the relationship between voltage and the movement of electrons. • Identify the parts of an electrochemical cell and their functions. • Write electrode reactions for =cathodes and anodes. • Describe the operation of galvanic cells, including dry cells, lead-acid batteries and fuel cells. • Identify conditions that lead to corrosion and ways to prevent it. • Calculate cell voltages from a tale of standard electrode potentials. • Describe how electrolytic cells work. • Describe the process of electrolysis in the decomposition of water and in the production of metals. • Describe the process of electro-plating