TAMALPAIS UNION HIGH SCHOOL DISTRICT
Larkspur, California

Course of Study

Chemistry 1-2

Schools where the course will be taught: Redwood High School, Tamalpais High School, Sir Francis Drake High School

Length of Course: 1 school year

Subject Area and Discipline: Science - Chemistry

Grade Levels: 10 - 12

Is this course an integrated course? No

Course Overview:
This course provides a strong background for college bound students and students who plan to take more elective science courses.

The goals of this course are to present chemistry as a highly organized body of knowledge held together by unifying principles and based on systematic investigations of our environment through experimentation.

Chemistry should provide maximum opportunity for students to learn through laboratory experiences, enabling them to appreciate the importance of making careful observations, weighing facts objectively and framing logical conclusions. Students should leave the course having an understanding and appreciation of how chemistry affects their daily lives.

Chemistry 1-2 is a highly quantitative laboratory based science course, requiring application of basic algebra concepts and skills such as solving equations for different variables, using data to represent independent and dependent variables, applying scientific notation, solving proportions, and manipulating formulas. Students will have the opportunity to be involved in hands-on lab activities at least 25 % of the time in the class.

This course addresses all of the content covered by the chemical concepts listed in the NGSS standards, plus additional concepts that the authors deem necessary to prepare students for college chemistry and other science courses.

Prerequisites and Corequisites: Students must have passed Algebra 1-2 or equivalent with a grade of "C" or better and Integrated Science 3-4 with a grade of "C" or better each semester. Students must have completed or be concurrently enrolled in Advanced Algebra. These prerequisites help ensure that students taking chemistry are prepared for the rigor of the course they are signing up for. Students should consult with their current IS teacher to help determine their readiness for the class. Also, students must pass Chemistry 1 to enroll in Chemistry 2 (i.e. receive at least a "D" in Chemistry 1).

Course Content:
Note: Due to the fact that this course includes content beyond the scope of the relevant NGSS chemistry content, the authors have listed the relevant NGSS Performance Expectations directly from the official NGSS website. http://www.nextgenscience.org/next-generation-science-standards These standards are listed underneath each topic descriptor when applicable. These topics are listed in one possible order for teaching, but there are many valid ways to modify this topic order.

● **Topic 1: Matter and Energy**--Chemistry is a study of matter and energy and their relationship to each other. The basic classification of matter is reviewed and the physical and chemical properties and changes of matter are defined. Students are introduced to the chemistry laboratory.

Representative Assignment: Chemical and Physical Changes Lab: In the laboratory, groups will perform and observe several chemical and physical changes. For each part, students will make observations on what happened before and after the change and record them in their lab notebook. Students will collaboratively determine whether a chemical or a physical change has taken place and explain what evidence led them to that conclusion. They will also determine whether each change was endothermic or exothermic and why.

● **Topic 2: Atomic and Molecular Structure**--Students will learn about the evolution of the modern atomic model and the discoveries that led to the changes from one model to the next. These improvements in the understanding of the atomic model have led to powerful knowledge regarding subatomic particles and their impact on chemical interactions. 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.

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.]

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.]

Representative Assignment: Students will use manipulatives having different masses as a model for different isotopes of an atom. Using these models, they will calculate average atomic masses and use average atomic masses to calculate the percent composition of the sample 'elements'.

● **Topic 3: Chemical Bonds**--Students will learn that 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.

Representative Assignment: Students compare ionic compounds, covalent compounds and metals with respect to identifying properties in a laboratory activity. Examples of the properties examined are brittleness, solubility in water and hexane, and conductivity. These observations are then used to identify substances of unknown bonding types.

● **Topic 4: Conservation of Matter and Stoichiometry**--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.

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.]

Representative Assignment: (Stoichiometry Lab) Students carry out reactions in order to predict the amount of a salt produced from a given amount of reactants. Students analyze the data and compare it to the predicted amount. A discussion of errors is included as well as a calculation of % error.

Representative Assignment: (Introduction to Reactions Lab) Students carry out various chemical changes and take detailed observations in order to classify the reaction as either Synthesis, Decomposition, Single Replacement, Double Displacement or Combustion. Students also need to write a complete balanced chemical reaction for each change carried out.

● **Topic 5: Gases and Their Properties**--Students will understand that kinetic molecular theory describes the motion of atoms and molecules and explains the properties of gases.

Representative Assignment: KMT lab - station lab where students investigate properties of gases, including the development of mathematical relationships.

● **Topic 6: Acids and Bases**--Acids, bases, and salts are three classes of compounds that form ions in water solutions.

Representative Assignment: Students will carry out a basic titration lab in order to determine the molarity of an acid of unknown concentration.

● **Topic 7: Solutions**--Solutions are homogenous mixtures of two or more substances.

Representative Assignment: Students will show proficiency in being able to correctly calculate how to make a particular solution and then, actually make a solution of a given molarity using a volumetric flask and the proper technique.

● **Topic 6: Chemical Thermodynamics**--Energy is exchanged or transformed in all chemical reactions and physical changes of matter.

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.]

Representative Assignment: Students will experimentally determine the change in enthalpy used to burn a candle.

● **Topic 7: Reaction Rates**--Chemical reaction rates depend on factors that influence the frequency of collision of reactant molecules. As a basis for understanding this concept:

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.]
Representative Assignment: Students carry out a clock reaction lab in order to quantitatively determine how concentration and temperature impact reaction rate.

● **Topic 8: Chemical Equilibrium**--Chemical equilibrium is a dynamic process at the molecular level.

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 Chatelier'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.]

Representative Reactions: Students study the effect of concentration and temperature changes on a reaction in equilibrium.

● **Topic 9: Nuclear Processes**--Atomic Nuclei do not change during a chemical process, but can undergo spontaneous decay (radioactivity) which can be described qualitatively (alpha, beta, and gamma decay) and quantitatively (half-life calculations). Nuclei can also be broken down or built up using a linear or circular accelerator which can help us understand the structure of matter.

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.]

Representative Assignment: Students complete nuclear reactions by predicting products and/or reactants to balance the equations.

● **Laboratory Skills and Experimental Design**--These lab skills are demonstrated, taught, practiced and evaluated throughout all of the above units. It is suggested that students engage in hands-on lab work as often as possible, averaging at least 3 labs a month.

Representative Assignment: Marshmallow Nuclei Activity - This is a modeling activity used to help simulate the decay and fusion reactions that can change an atomic nucleus.

Skills:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations in collaboration with other students, especially in the laboratory using standard laboratory equipment

4. Analyzing and interpreting data
5. Using mathematics (especially the application of algebra and the concept of the mole) and computational thinking to analyze and solve problems
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
9. Communicating effectively
10. Demonstrating personal and scientific integrity while working in a team

Assessment Criteria:

Student Assessment

Student's knowledge and skill success will be evaluated by teacher observation (daily), written projects, quizzes (weekly) and examinations (approximately every 3-4 weeks), weekly lab performance (including reports, quizzes, and technique), homework/classwork performance, and oral presentations.

Course Assessment

The course will be evaluated through common district assessments such as: The Thickness of Aluminum Foil Lab Performance, the Electron Configuration Quiz, and the Spring Final Exam. These assessments are to be administered, analyzed and the data shared with the chemistry teacher team so that teaching methods can be reflected upon and collaboratively updated. These materials are available to teachers and administrators upon request from a site chemistry teacher.

Materials

A textbook; laboratory directions; teacher generated lecture notes, activities and practice problems; laboratory equipment and consumable materials; reference materials as needed (internet, periodicals, reference texts); audiovisual materials.

Technology

1. Laboratory Equipment
2. Calculators
3. Visual Media (iPad applications, DVD's, videos, lab simulations)
4. Computers (internet research, data collection and analysis)

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