

**Tamalpais Union High School District  
Larkspur, California**

**Course of Study**

**Advanced Placement Chemistry 1-2**

**I. INTRODUCTION**

Advanced Placement (AP) Chemistry is a year-long course intended for students who have completed Chemistry 1-2 or Honors Chemistry 1-2. AP Chemistry provides students who have a particular interest in Chemistry and/or the Physical Sciences and/or want to get a head start on college Chemistry to have a second year of Chemistry during high school. Many science disciplines depend on students having a strong background in Chemistry (e.g. medicine, pharmacy, nursing, environmental science, biochemistry, molecular genetics, physiology, nutrition and dietetics, etc.).

AP Chemistry is a nationally developed, standardized curriculum which has been designed to be the equivalent of a first year college general chemistry course. The overall goal of the course is the understanding and application of fundamental chemical principles and concepts. Students develop their abilities to think critically and clearly, solve problems and communicate their ideas with clarity and logic. AP Chemistry prepares students to take the AP Chemistry examination and receive college credit while still in high school (depending on the policy of specific universities and colleges).

Chemistry is one of the three fundamental science courses taught in high school and college (Chemistry, Physics and Biology). With the addition of AP Chemistry all three of these courses will be available at the AP level within the District.

AP Chemistry emphasizes the learning of chemistry through laboratory experiences, providing opportunities for students to improve their skills in making observations of chemical reactions and substances; recording data; calculating and interpreting results based on the quantitative data obtained; communicating effectively the results of experimental work.

AP Chemistry is a highly quantitative science course, more so than Chemistry or Honors Chemistry. It requires 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.

This course is not intended to replace Physics, but rather expands the upper division Physical Sciences offerings.

**This course addresses the following Tam 21<sup>st</sup> Century goals:**

1. Student Success. Prepare our students for lives of personal, academic, and professional, growth, achievement, and fulfillment.
2. Instruction. Prepare our students to think conceptually, solve complex problems, acquire knowledge, communicate ideals and work individually and collaboratively. The focus of AP Chemistry is on developing students' skills in analysis, critical thinking and problem-solving.
3. Governance. Provide the district and school sites the vision, leadership and support to achieve the District mission. AP Chemistry expands the District offerings of higher level science courses, rounding out the three core science subjects – Physics, Chemistry and Biology.

**This course addresses the following Student Learning Outcomes:**

- Outcome 1 – Communicate articulately, effectively, and persuasively when speaking and writing
- Outcome 2 – Read/view and analyze material in a variety of disciplines
- Outcome 3 – Use technology to access information, analyze/solve problems, and communicate ideas
- Outcome 5 – Apply mathematical knowledge and skills to analyze and solve problems
- Outcome 6 - Demonstrate scientific literacy

**II. STUDENT LEARNING OUTCOMES**

**A. During AP Chemistry in the Tamalpais Union High School District, students will:**

(Numbered references are for specific Chemistry Content student objectives from the Science Content Standards for California Public Schools, 2000, pages 36-41)

- Understand and apply fundamental chemical principles and concepts, including how the structure of the atom relates to bonding and reactivity of specific elements and states of matter. (1a-g, 4)
- Develop analytical and problem-solving skills, especially the application of algebra to quantitative chemistry problems. (3a-f, 4c-e, h, i, 5f, 6d,e, 7d, 8b, 9, 11f)
- Describe and compare different chemical elements and compounds, including organic compounds; describe and compare how these elements and compounds react, quantitatively and qualitatively, with each other. (2-11)

- Develop laboratory skills, including the use of more advanced laboratory equipment than that used in Chemistry or Honors Chemistry; collect, analyze and draw conclusions from data; devise experiments to test specific hypotheses.

**B. Outcome indicators for the above-listed learning outcomes include:**

Take the Advanced Placement Chemistry examination. The specific topics, concepts, and themes are defined in the College Board's AP Chemistry syllabus. This examination has both multiple choice and essay formats, with some of the questions based upon required laboratory work.

Other outcome indicators will be embedded in the student assessments and include:

- Students will interpret word problems which require calculations of the following
  - percentage composition,
  - determination of empirical and molecular formulas from experimental data
  - molar masses from gas density, freezing point, and boiling point measurements
  - gas laws, including the Ideal Gas Law, Dalton's Law, and Graham's Law
  - stoichiometric relations using the concept of the mole; titration calculations
  - mole fractions; molar and molal solutions
  - Faraday's laws of electrolysis
  - Equilibrium constants and their applications, including their use for simultaneous equilibria
  - Standard electrode potentials and their use; Nernst equation
  - Thermodynamic and thermochemical calculations
  - Kinetics calculations
- In all cases, students will:
  - identify what mathematical formula(s) is/are required to solve the problem, the "knowns" and "unknowns" in the problem, including units
  - explicitly use dimensional analysis in their calculations,
  - correctly complete the calculations,
  - explicitly evaluate their answer using some type of estimate or "common sense" method.
- Given a periodic table and the name and symbol of a representative element students will
  - describe the structure of an atom or ion of that element and one of its isotopes, showing energy levels and electron configuration;

- compare that element with other elements in the periodic table in terms of properties such as ionization energy, atomic and ionic radii, electronegativity, electron affinity, oxidation state(s), boiling point, melting point and density
  - describe how this element reacts with other elements
- Students will identify and describe hydrocarbons and their functional groups in terms of their structure, nomenclature and chemical properties
- During a laboratory exercise, students will:
- correctly identify and safely use standard chemical laboratory equipment to make accurate measurements;
  - perform one or more of the following general types of laboratory work: synthesis of a compound, separation of a pure substance, titration, spectrophotometry, gravimetric analysis
  - given a problem and background information, design and conduct a laboratory experiment which accurately solves a problem;
  - perform a qualitative analysis experiment emphasizing observational skills, logic and problem-solving techniques to correctly identify an unknown substance.

**C. Prerequisite skills and concepts**

Students are expected to have gained the following skills and knowledge in Chemistry before enrolling in AP Chemistry (Numbered references are for specific Chemistry Content student objectives from the Science Content Standards for California Public Schools, 2000, which should have been met during Chemistry 1-2 or 1h-2h):

- Application of algebra and the concept of the mole to quantitative chemistry problems. (3a-f, 4c-e, h, 5f, 6d, 7d, 8b)
- Basic chemistry laboratory skills, including the safe use of standard chemistry laboratory equipment such as Bunsen burners, beakers, graduated cylinders, thermometers, balances.
- Collect, analyze and draw conclusions from data; graphically present data using independent and dependent variables; devise experiments to test specific hypotheses.
- Understand and apply their knowledge of how the structure of the atom relates to the organization of the periodic table and to the properties of the elements. (1a-e)
- Understand and apply their knowledge of how and why chemical elements bond and interact with each other; describe these chemical interactions in the

language of chemistry (chemical equations). (2a-e, 4a, b, g, 5a-f, 6a-d, 7a-d, 8a-d, 9a, b)

#### **D. Content Area Descriptions**

Details about the specific topics covered in the AP Chemistry examination can be found in the College Board's AP Chemistry syllabus. Numbered references to specific Chemistry Content student objectives (Science Content Standards for California Public Schools, 2000, pages 36-41) are included in parentheses.

Percentages in parentheses represent the approximate weighting in each topic area.

1. Structure of matter (20%) (1a, d-j, 2, 11)
  - a. Atomic theory and atomic structure
  - b. Chemical bonding
  - c. Nuclear chemistry
2. States of matter (20%) (2, 4, 6)
  - a. Gases, including kinetic molecular theory
  - b. Liquids and solids
  - c. Solutions
3. Reactions (35-40%) (3, 5, 7, 8, 9)
  - a. Reaction types, including acid-base reactions, precipitation reactions and oxidation-reduction reactions
  - b. Stoichiometry
  - c. Equilibrium
  - d. Kinetics
  - e. Thermodynamics
4. Descriptive Chemistry (10-15%) (1a-d, g, 10)
  - a. Chemical reactivity and products of chemical reaction
  - b. Relationships within the periodic table: horizontal, vertical, and diagonal, with examples from alkali metals, alkaline earth metals, halogens, and the first series of transition elements
  - c. Introduction to organic chemistry: hydrocarbons and functional groups
5. Laboratory (5-10%)
  - making observations of chemical reactions and substances
  - recording data
  - calculating and interpreting results based on the quantitative data obtained
  - communicating effectively the results of experimental work

### III. ASSESSMENT

#### A. Student Assessment

Students will be evaluated by laboratory performance (including reports, quizzes, and technique), teacher observation, written projects, quizzes and examinations, homework performance, and oral presentations.

Students will be given the grading criteria at the beginning of the course, preferably in writing.

#### B. Course Assessment

The course will be evaluated through a comparison of participation in and scores on the AP Chemistry Examination.

### IV. METHODS AND MATERIALS

#### A. Methods

Lecture, individual and group problem solving, inquiry activities, lab activities (inquiry, skill development, application), individual and group projects, research papers, oral presentations.

#### B. Materials

The college-level textbook as approved by the Board of Trustees; laboratory directions; teacher generated lecture notes, activities and practice problems; AP practice examinations; laboratory equipment and consumable materials; reference materials as needed (Internet, periodicals, reference texts); audiovisual materials.

Teachers will annually review the College Board's AP Chemistry syllabus to ensure that content, activities, and materials are consistent with those expectations.

#### C. Technology

The following technologies will be used: laboratory equipment, calculators, visual media (DVDs, LCD projector, TV, videos, laser discs, overhead projector), computers (Internet research, data collection and analysis).

#### D. Suggested Instructional Time Allocation

The approximate time allocation, by content area, is described in II. D. Content Area Description above.

General Time Allocation: class time will be divided approximately equally among the following activities: lab work; information delivery and discussion; individual and group student practice and assessment.

**E. School to Career Activities**

Practical applications of chemistry, including careers, are embedded in all aspects of the course. Careers related to chemistry are an integral part of the textbook and World of Chemistry videos. Relevant newspaper and magazine articles, publicity of job shadow and internship opportunities; publicity of talks and lectures outside of class and occasional guest speakers are other avenues used to introduce AP Chemistry students to chemistry-related careers.

**V. GENERAL INFORMATION**

AP Chemistry is a 10 credit course open to all students who have completed Chemistry 1-2 or Honors Chemistry 1-2 and meet the prerequisites.

Students should take Physics as well as AP Chemistry rather than enrolling in AP Chemistry instead of Physics.

**A. Prerequisites:**

Students must have passed Advanced Algebra 1-2 or Advanced Algebra 1h-2h with a grade of “B” or better each semester and Chemistry 1-2 or Chemistry 1h-2h with a grade of “B” or better each semester, and have the wholehearted recommendation of their current Chemistry 1-2 or Chemistry 1h-2h teacher.

**B. Requirements Met**

This course may be used as elective credit towards graduation but does not meet any specific graduation requirement.

This course is accepted towards the UC/CSU “d” or “g” admissions requirement.

**References:**

- The College Board. Advanced Placement Program. 2004, 2005 Course Description for AP Chemistry. 2003.
- Tamalpais Union High School District Values Statements. April 17, 2002.