

**Science Standard
Catalina Foothills School District
High School: Chemistry – Forensics (Bioscience)**

Chemistry: Forensics is an inquiry-based laboratory course that emphasizes essential concepts with real world applications and forensic science as the over-arching theme. Students will explore topics such as structure of matter, molar relationships, gas laws, chemical reactions, qualitative analysis, acid/base reactions, and periodicity. Laboratory experiments are enhanced by skills, such as scientific inquiry, data analysis, and critical thinking. A combination of guided instruction and collaborative learning will enrich the learning experience of students with varied learning styles. Chemistry: Forensics fulfills the CFHS chemistry graduation requirement.

1A. SCIENTIFIC INQUIRY: GENERATING SCIENTIFIC QUESTIONS	
CHEMF.1a.1	Frames testable questions showing evidence of observations and connections to prior knowledge.
CHEMF.1a.2	Develops a testable question appropriate to the scientific domain being investigated.
1B. SCIENTIFIC INQUIRY: FORMULATING HYPOTHESES	
CHEMF.1b.1	Develops a testable hypothesis based upon evidence of scientific principles, probability and/or modeling.
CHEMF.1b.2	Clearly distinguishes relationships between variables (<i>required: cause and effect or correlation</i>) within a testable hypothesis).
1C. SCIENTIFIC INQUIRY: DESIGNING INVESTIGATIONS	
CHEMF.1c.1	Specifies the parameters of measurement.
CHEMF.1c.2	Describes suitable controls for the investigation.
CHEMF.1c.3	Designs procedures that appropriately address the hypothesis.
1D. SCIENTIFIC INQUIRY: DATA COLLECTION	
CHEMF.1d.1	Creates and demonstrates safe and ethical procedures.
CHEMF.1d.2	Uses units of measurement with appropriate degree of accuracy.
CHEMF.1d.3	Creates procedures that appropriately and adequately address the hypothesis (<i>for example: adequate sample size, multiple trials</i>).
CHEMF.1d.4	Creates a suitable method of recording data.
1E. SCIENTIFIC INQUIRY: ANALYSIS	
CHEMF.1e.1	Interprets data to describe relationships between variables (<i>for example: positive, negative, no relationship</i>).
CHEMF.1e.2	Incorporates mathematical analysis, where appropriate.
CHEMF.1e.3	Critiques the investigation for possible sources of error and suggests corrections.
1F. CONCLUSIONS AND EXTENSIONS	
CHEMF.1f.1	Makes evidence-based predictions (<i>for example: extrapolations and interpolations</i>).
CHEMF.1f.2	Evaluates whether the data support the hypothesis.
1G. COMMUNICATION	
CHEMF.1g.1	Uses suitable media to inform an audience about an investigation.
CHEMF.1g.2	Applies appropriate ethics (<i>for example: language, style, citations</i>).
2. INTERACTION OF SCIENCE AND SOCIETY	
CHEMF.2.1	Describes the interaction of science, human curiosity and societal needs (<i>for example: positive and negative impact of controversial chemistry: nuclear power, hydrogen bomb</i>).
CHEMF.2.2	Critically analyzes the science concepts behind societal issues (<i>for example: nanotechnology, environmental issues</i>).
CHEMF.2.3	Compares the evidence from a crime scene based on reports collected from forensic specialists (<i>required: medical examiner, forensic pathologists, entomologists, anthropologists</i>).

3A. SYSTEMS THINKING: CHANGE OVER TIME	
CHEMF.3a.1	Explains how a system's components change over time (<i>for example: radioactive decay</i>).
3B. SYSTEMS THINKING: INTERDEPENDENCIES	
CHEMF.3b.1	Explains the causal relationships in a system as being either positive or negative feedback relationships (<i>for example: equilibrium reactions</i>).
3C. SYSTEMS THINKING: SYSTEM-AS-CAUSE	
CHEMF.3c.1	Explains reasons why specific behaviors result from the organization of a system (<i>for example: phases of matter related to the kinetic theory</i>).
4. STRUCTURE OF MATTER	
CHEMF.4.1	Explains the identity and structure of an atom, using the relationships between sub-atomic particles.
CHEMF.4.2	Describes the historical development of the atom (<i>required: Dalton, Rutherford, Bohr; for example: Democritus, Quantum Model</i>).
CHEMF.4.3	Explains the details of the atomic structure (<i>required: orbitals, Valence electrons, Lewis-dot diagrams; for example: electron configuration, energy levels</i>).
5. PROPERTIES OF MATTER	
CHEMF.5.1	Differentiates substances based on their physical and chemical properties.
CHEMF.5.2	Predicts and explains properties of elements and compounds using trends of the Periodic Table (<i>for example: EN, atomic radius, ionization energy, and reactivity</i>).
CHEMF.5.3	Selects appropriate solvents to perform chromatography separation of mixtures.
CHEMF.5.4	Compares and contrasts various substances through chemical analysis.
6. THERMOCHEMISTRY	
CHEMF.6.1	Describes different types of energy (<i>required: potential, kinetic, thermal</i>).
CHEMF.6.2	Interprets the molecular motion relationship within phase changes.
CHEMF.6.3	Explains the energy transfers within chemical reactions (<i>for example: endothermic, exothermic, catalyst-energy diagram</i>).
7. CHEMICAL REACTIONS - QUANTITATIVE	
CHEMF.7.1	Utilizes the law of conservation of mass to explain and balance chemical equations.
CHEMF.7.2	Solves abstract problems with consideration to significant figures using mole conversions (<i>required: mass\leftrightarrowmole\leftrightarrowparticles, molarity, $M_1V_1=M_2V_2$, stoichiometry, ideal gas law, $M_aV_a=M_bV_b$</i>).
CHEMF.7.3	Quantifies the relationships between reactants and products in chemical reactions (<i>required: stoichiometry, % yield; for example: equilibrium, energy transfers</i>).
CHEMF.7.4	Compares the concentration, pH and pOH of acids and bases (<i>required: calculate pH, pOH, $[H^+]$, $[OH^-]$</i>).
8. CHEMICAL REACTIONS - QUALITATIVE	
CHEMF.8.1	Predicts the products of a chemical reaction using types of reactions and applies to crime scene reconstruction (<i>required: synthesis, decomposition, single displacement, double displacement, combustion</i>).
CHEMF.8.2	Compares the nature and behavior of acids and bases.
CHEMF.8.3	Determines if a change is physical or chemical using the indicators of chemical change and applies to crime scene reconstruction (<i>required: release or absorption of heat energy, formation of a precipitate or gas, color change, and odor change</i>).
9. CHEMICAL BONDING	
CHEMF.9.1	Predicts the type of bond based on the positions of the elements in the Periodic Table (<i>required: ionic, covalent, metallic</i>).
CHEMF.9.2	Applies the properties of electric charge and the conservation of electric charge (<i>required: naming compounds, writing formulas, electrical conductivity and thermal conductivity, % composition</i>).
CHEMF.9.3	Predicts molecular shape and polarity utilizing Lewis dot structures.

10. INTERACTIONS OF ENERGY AND MATTER	
CHEMF.10.1	Applies the kinetic molecular theory (KMT) to explain how reaction rate is affected by temperature, concentration, particle size, and agitation.
CHEMF.10.2	Applies the kinetic molecular theory (KMT) to explain the behavior of matter (<i>required: Boyle's Law, Charles' Law, Combined Gas Law, Ideal Gas Law</i>).
11. ENVIRONMENTAL CHEMISTRY	
CHEMF.11.1	Describes the services of a typical comprehensive crime laboratory in the criminal justice system (<i>for example: analysis of biological, chemical and physical evidence</i>).
CHEMF.11.2	Analyzes the cost, benefits and risks of energy sources (<i>required: nuclear power, solar power, wind power, hydrological power, fossil fuels</i>).
CHEMF.11.3	Assesses factors that impact current and future water quality and quantity (<i>for example: acid rain and pollution</i>).
12. ETHICAL PRACTICES	
CHEMF.12.1	Selects acceptable and ethical forensic investigation practices from preferential practices when conducting tests on physical evidence.
CHEMF.12.2	Defends analysis of physical evidence based on ethical forensic investigation techniques.
CHEMF.12.3	Utilizes methods that optimally preserve the integrity of evidence to the highest standard (<i>for example: trace evidence packaging, sterile swabs</i>).
13. TECHNOLOGY AND TOOLS	
CHEMF.13.1	Uses advanced software applications (<i>required: Vernier Lab Pro, Spec 20</i>) to accurately collect information/data (<i>for example: temperature, motion data, bullet projection</i>).
CHEMF.13.2	Applies appropriate technology resources (<i>for example: video capture, still photo analysis</i>) to test and analyze evidence.
CHEMF.13.3	Uses technology to enhance the nature of the evidence and to construct technology-enhanced models (<i>for example: narrating a crime re-creation using analysis of evidence, DNA evidence, and ballistics</i>).