ENVISION 21
DEEP LEARNING • CFSD

Science Standard
Catalina Foothills School District
High School - Chemistry: Environmental

Chemistry: Environmental is a laboratory-based course that focuses on essential real world concepts and environmental issues. Students will explore concepts related to the environment, natural renewable resources, structure of matter, molar relationships, gas laws, chemical reactions, qualitative analysis, oxidation-reduction, and periodic law. Hands-on and laboratory experimentation enhance class lectures. Research-based projects will heighten students' awareness of community and global issues and involve them in thinking and problem-solving activities. Chemistry: Environmental fulfills the CFHS chemistry graduation requirement.

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

3A. SYSTEMS THINKING: CHANGE OVER TIME	
CHEMENV.3a.1	Explains how a system's components change over time *(for example: radioactive decay, ozone depletion)*.
3B. SYSTEMS THINKING: INTERDEPENDENCIES	
CHEMENV.3b.1	Explains the causal relationships in a system as being either positive or negative feedback relationships *(for example: equilibrium reactions, global warming, ozone depletion, pesticides, steroids, alternative fuel sources)*.
3C. SYSTEMS THINKING: SYSTEM-AS-CAUSE	
CHEMENV.3c.1	Explains reasons why specific behaviors result from the organization of a system *(for example: phases of matter related to the kinetic theory)*.
4. STRUCTURE OF MATTER	
CHEMENV.4.1	Explains the identity and structure of an atom, using the relationships between sub-atomic particles.
CHEMENV.4.2	Describes the historical development of the atom *(required: Dalton, Rutherford, Bohr, Schroedinger; for example: Democritus, Quantum Model)*.
CHEMENV.4.3	Explains the details of the atomic structure *(required: orbitals, Valence electrons, Lewis-dot diagrams; for example: electron configuration, energy levels, shielding)*.
CHEMENV.4.4	Explains the role of environmentally significant elements *(required: C, N, O, S, P, H; heavy metals & radioactive elements)*.
5. PROPERTIES OF MATTER	
CHEMENV.5.1	Differentiates substances based on their physical and chemical properties (*for example: oil spill clean-up density lab, mined products, water: soft/hard)*.
CHEMENV.5.2	Predicts and explains properties of elements and compounds using trends of the Periodic Table *(for example: electronegativity, electron affinity, ionic radius, atomic radius, ionization energy, reactivity)*.
CHEMENV.5.3	Analyzes elemental circumstances resulting from mining (*for example: heavy metal affects, non-renewable resources, radioactive decay)*.
6. THERMOCHEMISTRY	
CHEMENV.6.1	Describes different types of energy *(required: potential, kinetic, thermal, nuclear, solar, hydro-electric, chemical cells, bio-fuels, geo-thermal, wind)*.
CHEMENV.6.2	Analyzes energy transfer *(required: $Q_{lost} - Q_{gained}$)*.
CHEMENV.6.3	Analyzes the molecular motion relationship within phase changes.
CHEMENV.6.4	Explains the energy transfers within chemical reactions *(for example: endothermic, exothermic, catalyst-energy diagram)*.
7. CHEMICAL REACTIONS - QUANTITATIVE	
CHEMENV.7.1	Utilizes the law of conservation of mass to explain and balance chemical equations.
CHEMENV.7.2	Solves abstract problems using mole conversions *(required: mass⇔mole⇔particles, molarity, $M_1V_1=M_2V_2$)*.
CHEMENV.7.3	Manipulates chemical quantities using scientific conventions and mathematical procedures (*for example: dimensional analysis, scientific notation, significant figures, algebraic expressions, and graphical analysis*).
CHEMENV.7.4	Quantifies the relationships between reactants and products in chemical reactions *(for example: stoichiometry, equilibrium, energy transfers, percent yield, empirical formula, and percent compositions)*.
CHEMENV.7.5	Compares the concentration of acids and bases given pH and pOH values *(required: calculate pH, pOH, $[H^+]$, $[OH^-]$, acid rain, household and industrial chemicals)*.

8. CHEMICAL REACTIONS - QUALITATIVE	
CHEMENV.8.1	Predicts the products of a chemical reaction using types of reactions *(required: synthesis, decomposition, single displacement, double displacement, combustion)*.
CHEMENV.8.2	Compares the nature and behavior of acids and bases *(required: acid rain, household and industrial chemicals)*.
CHEMENV.8.3	Determines if a change is physical or chemical using the indicators of chemical change *(required: release or absorption of heat energy, formation of a precipitate or gas, color change, and odor change; for example: dissolved oxygen titration, stream analysis).*
9. CHEMICAL BONDING	
CHEMENV.9.1	Predicts the type of bond based on the positions of the elements in the Periodic Table *(required: ionic, covalent, metallic)*.
CHEMENV.9.2	Applies the properties of electric charge and the conservation of electric charge *(required: naming compounds, writing formulas, electrical conductivity and thermal conductivity)*.
CHEMENV.9.3	Predicts molecular shape utilizing Lewis dot structures.
CHEMENV.9.4	Explains the types of chemical reactions in the atmosphere that contribute to ozone depletion *(for example: CFC's destroying ozone)*.
10. INTERACTIONS OF ENERGY AND MATTER	
CHEMENV.10.1	Applies the kinetic molecular theory (KMT) to explain how reaction rate is affected by temperature, concentration, particle size, and agitation (for example: *ozone depletion issue)*.
CHEMENV.10.2	Applies the kinetic molecular theory (KMT) to explain the behavior of matter *(required: Boyle's Law, Charles' Law, Combined Gas Law, Ideal Gas Law, Dalton's Law, Graham's Law, Gay-Lussac's Law)*.
11. ENVIRONMENTAL IMPACTS	
CHEMENV.11.1	Evaluates the effects of human activities on the environment *(for example: urban development, personal consumption and consumer demands, ozone depletion, global warming).*
CHEMENV.11.2	Evaluates the commercial use and environmental issues of nuclear energy *(for example: storage, contaminant and disposal of nuclear wastes and medical uses of radioisotopes).*
CHEMENV.11.3	Analyzes the cost, benefits, and risks of energy sources *(required: nuclear power, solar power, wind power, fossil fuels, hydrogen fuel cells, biofuels).*
CHEMENV.11.4	Assesses factors that impact current and future water, air, and land quality and quantity *(for example: acid rain and pollution)*.