Chemistry Applications

Overview

The academic standards for Chemistry Applications establish the scientific inquiry skills and core content for all Chemistry Applications classes in DoDEA schools. The course should provide students with a conceptual understanding of the world around them—a basic knowledge of the chemical universe that should serve as the foundation for other high school science courses.

Teachers, schools, and districts should use these standards to make decisions concerning the structure and content for Chemistry Applications classes that are taught in their schools. These decisions will involve choices regarding additional content, activities, and learning strategies and will depend on the particular objectives of the individual classes. All Chemistry Applications classes must include inquiry-based instruction, allowing students to engage in problem solving, decision making, critical thinking, and applied learning. In other words, students should spend more of their class time choosing the right method to solve a problem and less time solving problems that merely call for repetitive procedures.

Chemistry Applications is a laboratory course (minimum of 30 percent hands-on investigation) that integrates principles of chemistry and Chemistry. Chemistry Applications laboratories will need to be stocked with all of the materials and apparatuses necessary to complete investigations in both the chemistry and applied portions of the course.

Scientific Inquiry

The skills of scientific inquiry, including knowledge and use of tools, are not taught as separate skills in science, but are embedded throughout because these process skills are fundamental to all science instruction and content. A table of the PK–12 of scientific inquiry standards and Indicators: is provided in appendix A.

Standard:	**CAa:**	**The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.**
Indicators:	**CAa.1:**	Apply established rules for significant digits, both in reading a scientific instrument and in calculating a derived quantity from measurement.
	CAa.2:	Use appropriate laboratory apparatuses, technology, and techniques safely and accurately when conducting a scientific investigation.
	CAa.3:	Use scientific instruments to record measurement data in appropriate metric units that reflect the precision and accuracy of each particular instrument.
	CAa.4:	Design a scientific investigation with appropriate methods of control to test a hypothesis (including independent and dependent variables), and evaluate the designs of sample investigations.
	CAa.5:	Organize and interpret the data from a controlled scientific investigation by using mathematics (including formulas and dimensional analysis), graphs, models, and/or technology.
	CAa.6:	Evaluate the results of a scientific investigation in terms of whether they verify or refute the hypothesis and what the possible sources of error are.
	CAa.7:	Evaluate a technological design or product on the basis of designated criteria.
	CAa.8:	Use appropriate safety procedures when conducting investigations.
Standard:	**CAb:**	**Chemistry Applications: Structure and Properties of Matter** **The student will demonstrate an understanding of the structure and properties of atoms.**
Indicators:	**CAb.1:**	Compare the subatomic particles (protons, neutrons, electrons) of an atom with regard to mass, location, and charge, and explain how these particles affect the properties of an atom (including identity, mass, volume, and reactivity).
	CAb.2:	Illustrate the fact that the atoms of elements exist as stable or unstable isotopes.
	CAb.3:	Explain the trends of the periodic table based on the elements' valence electrons and atomic numbers.
	CAb.4:	Use the atomic number and the mass number to calculate the number of

		protons, neutrons, and/or electrons for a given isotope of an element.
	CAb.5:	Predict the charge that a representative element will acquire according to the arrangement of electrons in its outer energy level.
	CAb.6:	Explain the consequences that the use of nuclear applications (including medical technologies and nuclear power plants) can have.
	CAb.7:	Describe the importance of geometric isomerism in drug action.
Standard:	**CAc:**	**Chemistry Applications: Structure and Properties of Matter** **The student will demonstrate an understanding of various properties and classifications of matter.**
Indicators:	**CAc.1:**	Distinguish chemical properties of matter (including reactivity) from physical properties of matter (including boiling point, freezing/melting point, density [with density calculations], solubility, viscosity, and conductivity).
	CAc.2:	Infer the practical applications of organic and inorganic substances on the basis of their chemical and physical properties.
	CAc.3:	Illustrate the difference between atom, molecule and ionic compound.
	CAc.4:	Classify matter as a pure substance (either an element or a compound) or as a mixture (either homogeneous or heterogeneous) on the basis of its structure and/or composition.
	CAc.5:	Compare the properties of the four states of matter—solid, liquid, gas, and plasma—in terms of the arrangement and movement of particles.
	CAc.6:	Explain the processes of phase change in terms of temperature, heat transfer, and particle arrangement.
	CAc.7:	Classify various solutions as acids or bases according to their physical properties, chemical properties (including neutralization and reaction with metals), generalized formulas, and pH (using pH meters or pH paper).
Standard:	**CAd:**	**Chemistry Applications: Structure and Properties of Matter** **The student will demonstrate an understanding of chemical reactions and the classifications, structures, and properties of chemical compounds.**
Indicators:	**CAd.1:**	Explain the role of bonding in achieving chemical stability.
	CAd.2:	Explain how the process of covalent bonding provides chemical stability through the sharing of electrons.
	CAd.3:	Illustrate the fact that ions attract ions of opposite charge from all directions and form crystal lattices.
	CAd.4:	Classify compounds as crystalline (containing ionic bonds) or molecular (containing covalent bonds) based on whether their outer electrons are transferred or shared.

	CAd.5:	Predict the ratio by which the representative elements combine to form binary ionic compounds, and represent that ratio in a chemical formula.
	CAd.6:	Distinguish between chemical changes (including the formation of gas or reactivity with acids) and physical changes (including changes in size, shape, color, and/or phase).
	CAd.7:	Summarize characteristics of balanced chemical equations (including conservation of mass and changes in energy in the form of heat—that is, exothermic or endothermic reactions).
	CAd.8:	Summarize evidence (including the evolution of gas; the formation of a precipitate; and/or changes in temperature, color, and/or odor) that a chemical reaction has occurred.
	CAd.9:	Apply a procedure to balance equations and recognize simple chemical equations (including single replacement and double replacement) as being balanced or not balanced.
	CAd.10:	Summarize the oxidation and reduction processes (including oxidizing and reducing agents).
	CAd.11:	Illustrate the uses of electrochemistry as they apply to solutions.
	CAd.12:	Describe the chemical composition of lipids (fats and oils), carbohydrates and proteins.
	CAd.13:	Describe the recycling of metal, glass, plastic and paper products, and outline its benefits.
Standard:	**CAe:**	**Chemistry Applications: The Interactions of Matter and Energy** **The student will demonstrate an understanding of the nature of forces and motion.**
Indicators:	**CAe.1:**	Explain the behaviors of gas; the relationship among pressure, volume, and temperature; and the significance of the Kelvin (absolute temperature) scale, using the kinetic molecular theory as a model.
	CAe.2:	Apply the gas laws to problems concerning changes in pressure, volume, or temperature (including Charles's law, Boyle's law, and the combined gas law).
	CAe.3:	Distinguish between an ideal gas and a real gas.
Standard	**CAf:**	**Chemistry Applications: The Interactions of Matter and Energy** **The student will demonstrate an understanding of the nature, conservation, and transformation of energy.**
Indicators:	**CAf.1:**	Summarize the process by which solutes dissolve in solvents, and the effects of varying pressure and temperature on solubility.
	CAf.2:	Compare solubility of various substances in different solvents (including

polar and nonpolar solvents).

CAf.3: Carry out calculations to find the concentration of solutions in terms of percent mass.

CAf.4: Represent common acids and bases by their names and formulas.

CAf.5: Interpret solubility curves to determine saturation at different temperatures.

CAf.6: Use a variety of procedures for separating mixtures (including distillation, crystallization, and filtration).

CAf.7: Explain how the law of conservation of energy applies to the transformation of various forms of energy.

CAf.8: Calculate the energy value of a food from enthalpy of combustion data.