Virginia Science

Chemistry

The student will demonstrate an understanding of scientific and engineering practices by CH.1

a asking questions and defining problems CH.1.A

- i ask questions that arise from careful observation of phenomena, examination of a model or theory, unexpected results, and/or to seek additional information CH.1.A.I
- ii determine which questions can be investigated within the scope of the school laboratory CH.1.A.II
- iii make hypotheses that specify what happens to a dependent variable when an independent variable is manipulated CH.1.A.III
- iv generate hypotheses based on research and scientific principles CH.1.A.IV
- v define design problems that involve the development of a process or system with interacting components, criteria and constraints CH.1.A.V

b planning and carrying out investigations CH.1.B

- i individually and collaboratively plan and conduct observational and experimental investigations CH.1.B.I
- ii plan and conduct investigations or test design solutions in a safe manner, including planning for response to emergency situations CH.1.B.II
- iii select and use appropriate tools and technology to collect, record, analyze, and evaluate data CH.1.B.III

c interpreting, analyzing and evaluating data CH.1.C

- i record and present data in an organized format that communicates relationships and quantities in appropriate mathematical or algebraic forms CH.1.C.I
- ii use data in building and revising models, supporting explanations for phenomena, or testing solutions to problems CH.1.C.II
- iii solve problems using mathematical manipulations including the International System of Units (SI), scientific notation, derived units, significant digits, and dimensional analysis CH.1.C.III
- iv analyze data using tools, technologies, and/or models (e.g., computational, mathematical) to make valid and reliable scientific claims or determine an optimal design solution CH.1.C.IV
- v analyze data graphically and use graphs to make predictions CH.1.C.V
- vi differentiate between accuracy and precision of measurements CH.1.C.VI
- vii consider limitations of data analysis when analyzing and interpreting data CH.1.C.VII
- viii analyze data to optimize a design CH.1.C.VIII

d constructing and critiquing conclusions and explanations CH.1.D

- i construct and revise explanations based on valid and reliable evidence obtained from a variety of sources CH.1.D.I
- ii apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena or design solutions CH.1.D.II
- iii compare and evaluate competing arguments in light of currently accepted explanations and new scientific evidence CH.1.D.III
- iv construct arguments or counterarguments based on data and evidence CH.1.D.IV
- v differentiate between scientific hypothesis, theory, and law CH.1.D.V

e developing and using models CH.1.E

- i evaluate the merits and limitations of models CH.1.E.I
- ii develop, revise, and/or use models based on evidence to illustrate or predict relationships CH.1.E.II
- iii use models and simulations to visualize and explain the movement of particles, to represent chemical reactions, to formulate mathematical equations, and to interpret data sets CH.1.E.III

	f obtaining, evaluating, and communicating information CH.1.F i compare, integrate, and evaluate sources of information presented in different media or formats to address a scientific question or solve a problem CH.1.F.I ii gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and credibility of each source CH.1.F.II iii communicate scientific and/or technical information about phenomena and/or a design process in multiple formats CH.1.F.III
The student will investigate and understand that elements have properties based on their atomic structure. The periodic table is an organizational tool for elements based on these properties. Key information pertaining to the periodic table includes CH.2	**a average atomic mass, isotopes, mass number, and atomic number;** CH.2.A **b nuclear decay;** CH.2.B **c trends within groups and periods including atomic radii, electronegativity, shielding effect, and ionization energy** CH.2.C **d electron configurations, valence electrons, excited electrons, and ions; and** CH.2.D **e historical and quantum models** CH.2.E
The student will investigate and understand that atoms are conserved in chemical reactions. Knowledge of chemical properties of the elements can be used to describe and predict chemical interactions. Key ideas include CH.3	**a chemical formulas are models used to represent the number of each type of atom in a substance;** CH.3.A **b substances are named based on the number of atoms and the type of interactions between atoms;** CH.3.B **c balanced chemical equations model rearrangement of atoms in chemical reactions;** CH.3.C **d atoms bond based on electron interactions;** CH.3.D **e molecular geometry is predictive of physical and chemical properties; and** CH.3.E **f reaction types can be predicted and classified.** CH.3.F
The student will investigate and understand that molar relationships compare and predict chemical quantities. Key ideas include CH.4	**a Avogadro's principle is the basis for molar relationships; and** CH.4.A **b stoichiometry mathematically describes quantities in chemical composition and in chemical reactions.** CH.4.B

The student will investigate and understand that solutions behave in predictable and quantifiable ways. Key ideas include CH.5	**a** molar relationships determine solution concentration CH.5.A
	b changes in temperature can affect solubility; CH.5.B
	c extent of dissociation defines types of electrolytes; CH.5.C
	d pH and pOH quantify acid and base dissociation; and CH.5.D
	e colligative properties depend on the extent of dissociation CH.5.E
The student will investigate and understand that the phases of matter are explained by the kinetic molecular theory. Key ideas include CH.6	**a** pressure and temperature define the phase of a substance; CH.6.A
	b properties of ideal gases are described by gas laws; and CH.6.B
	c intermolecular forces affect physical properties. CH.6.C
The student will investigate and understand that thermodynamics explains the relationship between matter and energy. Key ideas include CH.7	**a** heat energy affects matter and interactions of matter; CH.7.A
	b heating curves provide information about a substance; CH.7.B
	c reactions are endothermic or exothermic; CH.7.C
	d energy changes in reactions occur as bonds are broken and formed; CH.7.D
	e collision theory predicts the rate of reactions; CH.7.E
	f rates of reactions depend on catalysts and activation energy; and CH.7.F
	g enthalpy and entropy determine the extent of a reaction. CH.7.G