AVENTA LEARNING

Alignment Document

State of Virginia
And
Aventa Learning Chemistry

Chemistry
2005-2007 Benchmark Blueprint

State Standard Number	State Standard Area / Description	Unit Name	Course Topic Description
0	Chemistry		
CH.1 a, b, c	The student will investigate and understand that experiments in which variables are measured, analyzed, and evaluated produce observations and verifiable data.		
CH.1 a, b, c.1	Make the following measurements, using the specified equipment:		
CH.1 a, b, c.11	volume: graduated cylinder, pipette, volumetric flask, buret		
CH.1 a, b, c.12	mass: electronic or dial-a-gram		
CH.1 a, b, c.13	temperature: thermometer and/or temperature probe	Measurement	Temperature
CH.1 a, b, c.14	pressure: barometer or pressure probe.		
CH.1 a, b, c.2	Identify, locate, and know how to use laboratory safety equipment, including aprons, goggles, gloves, fire extinguishers, fire blanket, safety shower, eye wash, broken glass container, and fume hood.		
CH.1 a, b, c.3	Demonstrate the following basic lab techniques: filtering, decanting, using chromatography, and lighting a gas burner.		
CH.1 a, b, c.4	Identify the following basic lab equipment: beaker, flask, graduated cylinder, test tube, test tube rack, test tube holder, ring stand, wire gauze, clay triangle, crucible with lid, evaporation dish, watch glass, wash bottle, and dropping pipette.		

CH.1 a, b, c.5	Understand Material Safety Data Sheet (MSDS) warnings, including handling chemicals, lethal dose (LD), hazards, disposal, and chemical spill cleanup.		
CH.1 a, b, c.6	Demonstrate safe laboratory practices, procedures, and techniques.		
CH.1 d, e	The student will investigate and understand that experiments in which variables are measured, analyzed, and evaluated produce observations and verifiable data.		
CH.1 d, e.1	Design and perform experiments to test predictions.	Organic Chemistry	Lab: Make Slime (polymers)
		Equilibrium	Le Chatelier's Principle
CH.1 d, e.2	Identify variables.		
CH.1 d, e.3	Predict outcome(s) when a variable is changed.	Equilibrium	Le Chatelier's Principle
CH.1 d, e.4	Record data, using the significant digits of the measuring equipment.	Measurement	Significant Figures
CH.1 d, e.5	Demonstrate precision (reproducibility) in measurement.		
CH.1 d, e.6	Recognize accuracy in terms of closeness to the true value of a measurement.	Measurement	Uncertainty
		Measurement	Lab: Accuracy and Uncertainty in measurements
CH.1 f, g	The student will investigate and understand that experiments in which variables are measured, analyzed, and evaluated produce observations and verifiable data.		
CH.1 f, g.1	Discover and eliminate procedural errors.	Measurement	Uncertainty
CH.1 f, g.2	Know most frequently used SI prefixes and their values (milli-, centi-, deci-, kilo-).	Measurement	SI Units
		Gases	Pressure
CH.1 f, g.3	Demonstrate the use of scientific notation, using the correct number of significant digits with powers of ten notation for the decimal place.	Measurement	Scientific Notation
CH.1 f, g.4	Correctly utilize the following when graphing data:		
CH.1 f, g.4.1	dependent variable (vertical axis)		
CH.1 f, g.4.2	independent variable (horizontal axis)		
CH.1 f, g.4.3	scale and units of a graph	Gases	Temperature

CH.1 f, g.4.4	regression line (best fit curve).		
CH.1 f, g.5	Calculate mole ratios, percent composition, conversions, and relative atomic mass.	Matter	The Mole
		Solutions	Concentration
CH.1 f, g.6	Use the rules for performing operations with significant digits.	Measurement	Significant Figures
CH.1 f, g.7	Utilize dimensional analysis.		
CH.1 f, g.8	Use graphing calculators correctly.		
CH.1 f, g.9	Read a measurement from a graduated scale, stating measured digits plus the estimated digit.	Measurement	Significant Figures
CH.1 f, g.10	Use data collected to calculate percent error.	Measurement	Uncertainty
CH.1 f, g.11	Determine the mean of a set of measurements.		
CH.1 h, i	The student will investigate and understand that experiments in which variables are measured, analyzed, and evaluated produce observations and verifiable data.		
CH.1 h, i.1	Use appropriate technology for data collection and analysis, including probeware interfaced to a graphing calculator and/or computer.		
CH.1 h, i.2	Use probeware to gather data.		
CH.1 h, i.3	Explain the emergence of modern theories based on historical development. For example, students should be able to explain the origin of the atomic theory beginning with the Greek atomists and continuing through the most modern Quantum models.	Atoms	The Atom
CH.2 a, b, c	The student will investigate and understand that the placement of elements on the periodic table is a function of their atomic structure.		
CH.2 a, b, c.1	Electrons have little mass and a negative (-) charge. They are located in electron clouds or probability clouds outside the nucleus.	Atoms	Electrons in Atoms
CH.2 a, b, c.2	Protons have a positive (+) charge. Neutrons have no charge. Protons and neutrons are located in the nucleus of the atom and comprise most its mass.	Atoms	The Atom

CH.2 a, b, c.3	An isotope is an atom that has the same number of protons as another atom of the same element but has a different number of neutrons. Some isotopes are radioactive; many are not.	Nuclear Chemistry	Radioactive Decay
		Nuclear Chemistry	Radioactive Isotopes
		Atoms	The Atom
CH.2 a, b, c.4	Half-life is the length of time required for half of a given sample of a radioactive isotope to decay.	Nuclear Chemistry	Radioactive Decay
		Nuclear Chemistry	Lab: Construct a Bohr Model of C-13 atom
CH.2 a, b, c.5	Using a periodic chart, determine the atomic number, atomic mass, the number of protons, the number of electrons, and the number of neutrons of any neutral atom of a particular element.	Atoms	The Periodic Table
		Atoms	Valence Electrons
		Atoms	Regions of the Periodic Table
		Atoms	Lab: Periodic Table (P/P only)
		Atoms	Trends in the Periodic Table
		Atoms	The Elements
		Matter	Molar Mass
		Nuclear Chemistry	Radioactive Isotopes
CH.2 a, b, c.6	Determine the half-life of a radioactive substance.		
CH.2 a, b, c.7	Describe alpha, beta, and gamma radiation with respect to penetrating power, shielding, and composition.	Nuclear Chemistry	Radioactive Decay
CH.2 d, e, f	The student will investigate and understand that the placement of elements on the periodic table is a function of their atomic structure.		
CH.2 d, e, f.1	The Periodic Law states that when elements are arranged in order of increasing atomic numbers, their physical and chemical properties show a periodic pattern.	Atoms	The Periodic Table
		Atoms	Valence Electrons
		Atoms	Regions of the Periodic Table
		Atoms	Lab: Periodic Table (P/P only)
		Atoms	Trends in the Periodic Table
		Atoms	The Elements

CH.2 d, e, f.2	The names of groups and periods on the periodic chart are alkali metals, alkaline earth metals, transition metals, halogens, noble gases, and metalloids.	Bonding	Metallic Bonding
CH.2 d, e, f.3	Periods and groups are named by numbering columns and rows.	Atoms	The Periodic Table
CH.2 d, e, f.4	Some elements, such as oxygen, hydrogen, fluorine, chlorine, bromine, and nitrogen, naturally occur as diatomic molecules.		
CH.2 d, e, f.5	Electronegativity increases from left to right within a period and decreases from top to bottom within a group.	Atoms	Trends in the Periodic Table
CH.2 d, e, f.6	Shielding effect is constant within a given period and increases within given groups from top to bottom.		
CH.2 d, e, f.7	Atomic radius decreases from left to right and increases from top to bottom within given groups.	Atoms	Trends in the Periodic Table
CH.2 d, e, f.8	Ionization energies generally increase from left to right and decrease from top to bottom of a given group.	Atoms	Trends in the Periodic Table
CH.2 d, e, f.9	Use an element's electron configuration to determine the number of valence electrons and possible oxidation numbers.	Atoms	Valence Electrons
CH.2 g	The student will investigate and understand that the placement of elements on the periodic table is a function of their atomic structure.		
CH.2 g.1	Electrons are added one at a time to the lowest energy levels first (Aufbau Principle).	Atoms	Electrons in Atoms
CH.2 g.2	An orbital can hold a maximum of two electrons (Pauli Exclusion Principle).	Atoms	Electrons in Atoms
CH.2 g.3	Electrons occupy equal-energy orbitals so that a maximum number of unpaired electrons results (Hund's Rule).	Atoms	Electrons in Atoms
CH.2 g.4	Energy levels are designated 1-7. Orbitals are designated s, p, d, and f according to their shapes	Atoms	Electrons in Atoms

CH.2 g.5	s, p, d, f orbitals relate to the regions of the Periodic Table.	Atoms	Electrons in Atoms
		Atoms	Lab: Periodic Table (P/P only)
		Atoms	Trends in the Periodic Table
		Atoms	The Elements
		Atoms	The Periodic Table
		Atoms	Valence Electrons
CH.2 g.6	Loss of electrons from neutral atoms results in the formation of an ion with a positive charge (cation).	Bonding	Ionic Bonding
CH.2 g.7	Gain of electrons by a neutral atom results in the formation of an ion with a negative charge (anion).	Bonding	Ionic Bonding
CH.2 g.8	Transition metals can have multiple oxidation states.	Bonding	Ionic Bonding
CH.2 h	The student will investigate and understand that the placement of elements on the periodic table is a function of their atomic structure.		
CH.2 h.1	Matter occurs as elements (pure), compounds (pure), and mixtures, which may be homogeneous (solutions) or heterogeneous.	Bonding	Ionic Bonding
		Solutions	Concentration
		Solutions	Definitions
		Solutions	Lab: make solution of kool-aid
		Solutions	The Dissolution Process
		Solutions	Factors that Affect the Dissolution Process
CH.2 h.2	Important physical properties are density, conductivity, melting point, boiling point, malleability, and ductility.	Solutions	Lab: make solution of kool-aid
CH.2 h.3	Reactivity is the tendency of an element to enter into a chemical reaction.	Bonding	Introduction
CH.2 i	The student will investigate and understand that the placement of elements on the periodic table is a function of their atomic structure.		
CH.2 i.1	Major insights regarding the atomic model of the atom and principal scientists include:		
CH.2 i.1.1	particles - Democritus	Atoms	The Atom
CH.2 i.1.2	first atomic theory of matter - John Dalton	Atoms	The Atom

CH.2 i.1.3	discovery of the electron - J. J. Thompson	Atoms	The Atom
CH.2 i.1.4	discovery of the nucleus - Ernest Rutherford	Atoms	The Atom
CH.2 i.1.5	discovery of charge of electron - Robert Millikan	Atoms	The Atom
CH.2 i.1.6	planetary model of atom - Niels Bohr	Nuclear Chemistry	Inside the Atom
CH.2 i.1.7	periodic table by atomic mass - Demitry Mendeleev	Matter	Molar Mass
CH.2 i.1.8	periodic table by atomic number - Henry Moseley	Nuclear Chemistry	Radioactive Isotopes
CH.2 i.1.9	quantum nature of energy - Max Planck		
CH.2 i.1.10	uncertainty principle - Werner Heisenberg	Atoms	The Atom
CH.2 i.1.11	wave theory - Louis de Broglie.	Atoms	Electrons in Atoms
CH.3 a, b, c, d	The student will investigate and understand how conservation of energy and matter is expressed in chemical formulas and balanced equations.		
CH.3 a, b, c,1	When pairs of elements form two or more compounds, the masses of one element that combine with a fixed mass of the other element form simple, whole-number ratios (Law of Multiple Proportions).	Bonding	Ionic Bonding
CH.3 a, b, c,2	The empirical formula shows the simplest whole-number ratio in which the atoms of the elements are present in the compound.		
CH.3 a, b, c,3	The molecular formula shows the actual number of atoms of each element in one molecule of the substance.	Bonding	Covalent Bonding
CH.3 a, b, c,4	Structural formulas also show the arrangements of atoms and bonds.	Nuclear Chemistry	Inside the Atom
CH.3 a, b, c,5	Covalent bonds involve the sharing of electrons.	Bonding	Covalent Bonding
		Bonding	Lab: Bonding (P/P only)
CH.3 a, b, c,6	Ionic bonds involve the transfer of electrons.	Bonding	Ionic Bonding
		Bonding	Lab: Bonding (P/P only)

CH.3 a, b, c,7	Ionization energy is the energy required to remove the most loosely held electron from a neutral atom. Elements with low ionization energy form positive ions (cations) easily. Elements with high ionization energy form negative ions (anions) easily.	Bonding	Ionic Bonding
CH.3 a, b, c,8	Electronegativity is the measure of the attraction of an atom for electrons in a covalent bond.	Bonding	Covalent Bonding
		Bonding	Lab: Bonding (P/P only)
CH.3 a, b, c,9	Polar molecules result when a molecule behaves as if one end were positive and the other end negative.	Bonding	Covalent Bonding
CH.3 a, b, c,10	The IUPAC system is used for naming compounds.	Bonding	Ionic Bonding
CH.3 a, b, c,11	Name binary covalent compounds.	Bonding	Covalent Bonding
CH.3 a, b, c,12	Name binary ionic compounds (using the Roman numeral system where appropriate).	Bonding	Covalent Bonding
CH.3 a, b, c,13	Predict, draw, and name molecular shapes (bent, linear, trigonal planar, tetrahedral, and trigonal pyramidal).	Equilibrium	Le Chatelier's Principle
CH.3 a, b, c,14	Determine formulas, write equations, and balance chemical equations.	Matter	Equation Balancing
		Matter	Classifying Chemical Reactions
CH.3 a, b, c,15	Write the chemical formulas for certain common substances, such as ammonia, water, carbon monoxide, carbon dioxide, sulfur dioxide, and carbon tetraflouride.	Bonding	Covalent Bonding
CH.3 a, b, c,16	Recognize the formulas and names of certain polyatomic ions, such as carbonate, sulfate, nitrate, hydroxide, phosphate, and ammonium, and use these polyatomic ions for naming and writing the formulas of ionic compounds.	Bonding	Ionic Bonding
CH.3 a, b, c,17	Draw Lewis Dot Diagrams to show covalent bonding.	Bonding	Covalent Bonding
		Bonding	Lab: Bonding (P/P only)
CH.3 e, f	The student will investigate and understand how conservation of energy and matter is expressed in chemical formulas and balanced equations.		

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CH.3 e, f.1	Major types of chemical reactions are		
CH.3 e, f.1.1	synthesis (A+B --> AB)	Matter	Classifying Chemical Reactions
CH.3 e, f.1.2	decomposition (BC --> B+C)	Matter	Classifying Chemical Reactions
CH.3 e, f.1.3	single replacement (A+BC --> B+AC)	Matter	Classifying Chemical Reactions
CH.3 e, f.1.4	double replacement (AC+BD --> AD+BC).	Matter	Classifying Chemical Reactions
CH.3 e, f.2	Chemical reactions based on the net heat energy are exothermic reaction (heat producing) and endothermic reaction (heat absorbing).	Equilibrium	Temperature
		Matter	Classifying Chemical Reactions
		Thermodynamics	Chemical Processes
CH.3 e, f.3	Reactions can occur in two directions simultaneously.	Equilibrium	Definition
CH.3 e, f.4	Le Chatelier's Principle indicates the qualitative prediction of direction of change with temperature, pressure, and concentration.	Equilibrium	Pressure
		Equilibrium	Lab: Le Chatelier's Principle (P/P only)
		Equilibrium	Le Chatelier's Principle
		Equilibrium	Temperature
CH.3 e, f.5	Catalysts decrease the amount of activation energy needed.	Rates	Catalyst
CH.3 e, f.6	Recognize equations for redox reactions and neutralization reactions.		
CH.3 e, f.7	Interpret reaction rate diagrams.	Rates	Temperature
		Rates	Pressure
		Rates	Definition of Reaction Rates
		Rates	Catalyst
		Rates	Concentration
		Rates	Lab: Factors affecting Rate of Reaction
		Equilibrium	Definition of Chemical Equilibrium
		Equilibrium	Pressure
		Equilibrium	Le Chatelier's Principle
		Equilibrium	Lab: Le Chatelier's Principle (P/P only)
		Equilibrium	Concentration
		Equilibrium	Temperature

CH.4 a, b	The student will investigate and understand that quantities in a chemical reaction are based on molar relationships.		
CH.4 a, b.1	Avogadro's number = 6.02 × 1023 particles per mole.	Matter	The Mole
CH.4 a, b.2	Molar volume = 22.4 dm3/mole and/or 22.4 L/mole for any gas at STP.	Gases	Pressure
		Gases	Temperature
CH.4 a, b.3	Molar mass of a substance is its average atomic mass in grams from the Periodic Table.	Matter	Molar Mass
		Matter	Atoms, Molecules, and Moles
		Solutions	Concentration
CH.4 a, b.4	Total grams of reactant(s) = total grams of product(s).	Matter	Equation Balancing
CH.4 a, b.5	Make calculations involving the following relationships:		
CH.4 a, b.5.1	mole-mole;	Matter	Lab: Conservation of mass (P/P only)
		Matter	Molar Mass
		Matter	Atoms, Molecules, and Moles
		Matter	Stoichiometry
CH.4 a, b.5.2	mass-mass;	Matter	Lab: Conservation of mass (P/P only)
		Matter	Molar Mass
		Matter	Atoms, Molecules, and Moles
		Matter	Stoichiometry
CH.4 a, b.5.3	mole-mass;	Matter	Lab: Conservation of mass (P/P only)
		Matter	Molar Mass
		Matter	Atoms, Molecules, and Moles
		Matter	Stoichiometry
CH.4 a, b.5.4	mass-volume;	Matter	Lab: Conservation of mass (P/P only)
		Matter	Molar Mass
		Matter	Atoms, Molecules, and Moles
		Matter	Stoichiometry
CH.4 a, b.5.5	mole-volume; and	Matter	Lab: Conservation of mass (P/P only)
		Matter	Molar Mass
		Matter	Atoms, Molecules, and Moles
		Matter	Stoichiometry

CH.4 a, b.5.6	volume-volume.	Matter	Lab: Conservation of mass (P/P only)
		Matter	Molar Mass
		Matter	Atoms, Molecules, and Moles
		Matter	Stoichiometry
CH.4 a, b.6	Identify the limiting reactant (reagent) in a reaction.		
CH.4 a, b.7	Calculate percent yield of a reaction.		
CH.4 c, d, e, f	The student will investigate and understand that quantities in a chemical reaction are based on molar relationships.		
CH.4 c, d, e,1	The pressure and volume of a sample of a gas at constant temperature are inversely proportional to each other (Boyle's Law).	Gases	Lab: Observe gas laws by changing P, V, T
		Gases	Gas Laws
CH.4 c, d, e,2	At constant pressure, the volume of a fixed amount of gas is directly proportional to its absolute temperature (Charles' Law).	Gases	Lab: Observe gas laws by changing P, V, T
		Gases	Gas Laws
		Gases	Temperature
CH.4 c, d, e,3	The sum of the partial pressures of all the components in a gas mixture is equal to the total pressure of a gas mixture (Dalton's law of partial pressures).	Gases	Gas Laws
		Gases	Lab: Observe gas laws by changing P, V, T
CH.4 c, d, e,4	Ideal Gas Law states that PV = nRT.	Gases	Gas Laws
		Gases	Lab: Observe gas laws by changing P, V, T
CH.4 c, d, e,5	Molarity = moles/dm cubed or moles/L of solution.	Solutions	Lab: make solution of kool-aid
		Solutions	Concentration
CH.4 c, d, e,6	Pressure Units include K Pa and mm of Hg.	Gases	Pressure
CH.4 c, d, e,7	Solve problems and interpret graphs involving the gas laws.	Gases	Gas Laws
		Gases	Temperature
		Gases	Lab: Observe gas laws by changing P, V, T

CH.4 g	The student will investigate and understand that quantities in a chemical reaction are based on molar relationships.		
CH.4 g.1	Arrhenius acids are characterized by their sour taste, low pH, and the fact that they turn litmus paper red. Arrhenius bases are characterized by their bitter taste, slippery feel, high pH, and the fact that they turn litmus paper blue.	Acids & Bases	Properties
CH.4 g.2	Bronsted-Lowry-acids are proton donors, whereas bases are proton acceptors.	Acids & Bases	Properties of Acids and Bases
CH.4 g.3	The pH number denotes hydrogen (hydronium) ion concentration. The pOH number denotes hydroxide ion concentration.	Acids & Bases	The pH Scale
		Acids & Bases	Lab: Test household acids/bases
CH.4 g.4	pH + pOH = 14	Acids & Bases	Lab: Test household acids/bases
		Acids & Bases	The pH Scale
CH.4 g.5	pH is a number scale ranging from 0 to 14 that represents the acidity of a solution.	Acids & Bases	The pH Scale
		Acids & Bases	Lab: Test household acids/bases
CH.4 g.6	[ ] refers to molar concentration.	Solutions	Lab: make solution of kool-aid
		Equilibrium	Concentration
		Solutions	Concentration
CH.4 g.7	Strong acid-strong base titration is the process that measures [H+] and [OH-].		
CH.4 g.8	Indicators show color changes at certain pH levels.	Acids & Bases	The pH Scale
		Acids & Bases	Lab: Test household acids/bases
CH.4 g.9	Strong electrolytes dissociate completely. Weak electrolytes dissociate partially.		
CH.5 a, b	The student will investigate and understand that the phases of matter are explained by kinetic theory and forces of attraction between particles.		

CH.5 a, b.1	Pressure, temperature, and volume changes can cause a change in physical state.	Thermodynamics	Heat Flow
		Rates	Temperature
		Organic Chemistry	Lab: Make Slime (polymers)
CH.5 a, b.2	Forces of attraction include hydrogen bonding, dipoledipole attraction, and London dispersion (van der Waals) forces.		
CH.5 c, d, e, f	The student will investigate and understand that the phases of matter are explained by kinetic theory and forces of attraction between particles.		
CH.5 c, d, e,1	A liquid's boiling point and freezing point are affected by changes in atmospheric pressure.		
CH.5 c, d, e,2	A liquid's boiling point and freezing point are affected by the presence of certain solutes.	Solutions	Definitions
		Solutions	The Dissolution Process
		Solutions	Factors that Affect the Dissolution Process
CH.5 c, d, e,3	Graph and interpret a heating curve (temperature vs. time).	Gases	Temperature
CH.5 c, d, e,4	Calculate energy changes, using specific heat capacity.	Thermodynamics	Solving Problems Involving Heat Flow
CH.5 c, d, e,5	Calculate energy changes, using molar heat of fusion and molar heat of vaporization.	Thermodynamics	Solving Problems Involving Heat Flow
		Thermodynamics	Lab: Calc heat of fusion using calorimeter
CH.5 c, d, e,6	Interpret a phase diagram of water.	Thermodynamics	Solving Problems Involving Heat Flow
CH.5 c, d, e,7	Perform calorimetry calculations.	Thermodynamics	Solving Problems Involving Heat Flow
CH.5 c, d, e,8	Recognize polar molecules and non-polar molecules.	Bonding	Covalent Bonding