Active Chemistry Correlation to Tennessee State Framework

Students should explore chemistry through inquiry, hands-on laboratory investigations, individual studies and group activities. Students' experiences in chemistry should enable them to understand the role of chemistry in their lives by investigating substances that occur in nature, in living organisms and those that are created by humans. Their study should include both qualitative and quantitative descriptions of matter and the changes that matter undergo. Students should practice the necessary precautions for performing safe inquiries and activities and appreciate the risks and benefits of producing and using chemical substances.

In Active Chemistry:

- The inquiry process is used in all chapters.
- Each chapter is designed to do both group studies and individual experimentation.
- Each chapter is built on real life issues and allows students to discover solutions to these issues.
- Qualitative and quantitative analysis are used in different activities.

Course Description	The Periodic Table	Cool Chemistry Show	Movie Special Effects
Standard 1: Atomic Structure			
The student will investigate atomic structure and its implications for physical and chemical properties. **Learning Expectations**: The student will:			
1.1 Compare and contrast various models of the atom as they have emerged historically, from the Greeks to the modern electron-cloud model.	X		
1.2 Investigate the basic organization of the modern Periodic Table, including atomic number and atomic properties.	X		
1.3. Describe models of the atom in terms of orbital, electron configuration, orbital notation, quantum numbers and electron-dot structures.	X		
1.4 Investigate the composition of the nucleus so as to explain isotopes and nuclear reactions.	X		
1.5 Relate the spectral lines of an atoms emission spectrum to the transition of electrons between different energy levels within an atom.	X		
Performance Indicators State: As documented through state assessment. Level 1, the student is able to:			
Categorize an element as a metal, metalloid, nonmetal or noble gas based on its position in the Periodic Table.	X		
Identify an element's atomic number and name or symbol, given the number of protons or electrons in a neutral atom using the Periodic Table.	X		

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Identify protons, neutrons and electrons with regard to their relative mass, relative charge and/or location in an atom.	X		
Performance Indicators State: As documented through state assessment, Level 2, the student is able to:			
Identify the major characteristics of various models of the atom: Democritus, Thomson, Rutherford, Bohr, and the modern quantum mechanical model.	X		
Determine the number of protons, neutrons and/or electrons in an atom or ion, given the symbol of the atom or ion and the Periodic Table.	X		
Compare *s* and *p* orbitals in an energy level in terms of general shape, energy and/or numbers of electrons possible.	X		
Determine the Lewis electron-dot structure or number of valence electrons for an atom of any main group element (1, 2, 13-18), given its atomic number or its position in the Periodic Table.	X		
Performance Indicators State: As documented through state assessment, Level 3, the student is able to:			
Describe the trends present in the Periodic Table with respect to atomic size, ionization energy, electron affinity or electronegativity.	X		
Performance Indicators Teacher: As documented through teacher observation, Level 1, the student is able to:			
Identify an isotope when given the number of protons and neutrons.	X		
Draw Bohr models for the first 18 elements.	X		
Performance Indicators Teacher: As documented through teacher observation, Level 2, the student is able to:			
Write the arrangement of electrons in the following three ways: orbital notation, electron configuration notation, electron-dot notation.			
Predict the charge of an ion usually formed by the main-group elements (1, 2, 13-18) using the Periodic Table.	X	X	X
Organize atoms from the main-group elements (1, 2, 13-18) based on atomic radii.	X		
Support the existence of the atom using the Laws of Definite Composition, Conservation of Matter and Multiple Proportion.	X		
Calculate the average atomic mass of an element from the percent distribution and	X		

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masses of isotopes.			
Identify and/or explain the formation of anions and cations.	X	X	X
Use the Bohr model to draw an electron moving from its ground state to an excited state, and/or represent the emission of energy as it returns from an excited state to a lower energy state.	X		
Recognize names of famous scientists and identify their major contributions: Neils Bohr, James Chadwick, John Dalton, Max Planck, Ernest Rutherford, J.J. Thomson.	X		
Describe the differences between the Bohr model of the atom and the quantum mechanical (QM) electron-cloud model of the atom.	X		
Calculate wavelength, frequency or energy of a photon of electromagnetic radiation, given the formula and constants.			
Research careers that relate to atomic structure, such as astronomy, nuclear medical technician, research physicist, chemist, etc.	X		
Performance Indicators Teacher: As documented through teacher observation, Level 3, the student is able to:			
Compare *p*, *d*, and *f* orbitals in an energy level in terms of general shape, energy or number of electrons possible.	X		
Determine quantum numbers for elements given the electron configuration.	X		
Explain in a paragraph why some elements do not have the predicted electron configuration; for example, copper tends to have an electron configuration of [Ar]4s13d10 instead of [Ar] 4s23d9.			
Justify the quark combinations that make protons and neutrons, given the charges of the up and down quarks.			
Write the nuclear equation involving alpha or beta particles, given the mass number of the parent isotope and complete symbols for alpha or beta emissions.			
Sample Task: Flame Test Demonstration glass petri dishes or watch glasses chloride compounds ($CuCl_2$, $SrCl_2$, $CaCl_2$, LiCl, etc.) ethanol (ethyl alcohol) or isopropanol (isopropyl alcohol) Place .5 g of each salt in separate watch glasses or petri dishes; add 20 mL of alcohol. Stir to distribute the salt in the			X

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alcohol. Light and observe the characteristic color of each metal's spectrum. The students may also look at the flame through a spectroscope or diffraction grating.			
Integration/Linkages: physics, mathematics, graphing, radioactivity, nuclear medicine, nuclear physics, imagination, problem-solving skills, history, calculator and computer skills, laboratory skills, scale and model, careers, culture, visual arts, and writing.	X		
Standard 2: Matter and Energy			
The student will investigate the characteristics of matter and the interaction of matter and energy. **Learning Expectations**: The student will:			
2.1 Investigate the characteristics of matter.		X	
2.2 Explore the interactions of matter and energy.		X	
Performance Indicators State: As documented through state assessment, Level 1, the student is able to:			
Identify a pure substance as element or compound, when given its chemical name or formula.		X	X
Distinguish among elements, compounds, solutions, colloids, and suspensions, given examples.		X	X
Classify changes in matter as physical or chemical, given examples or scenarios.		X	X
Classify properties of matter as physical or chemical when given examples or scenarios.		X	X
Distinguish between heat content and temperature when given a unit, a definition and/or an example.		X	X
Performance Indicators State: As documented through state assessment, Level 2, the student is able to:			
Distinguish among gases, liquids and solids in terms of particle spacing and relative movement, given a diagram or scenario.		X	X
Predict the effect of changing one gas variable (volume, temperature or pressure) on one of the others, given a scenario.			
Demonstrate an understanding of the Law of Conservation of Matter, given experimental data.	X	X	X
Categorize a process as endothermic or exothermic, given an example or scenario.		X	
Performance Indicators State: As documented through state assessment. Level 3, the student is able to:			
Demonstrate an understanding of the law of conservation of energy by equating heat loss			

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and heat gain in an interaction, given the formulas $-q = q$ and $q = mcD t$, and the specific heat.			
Performance Indicators Teacher: As documented through teacher observation, Level 1, the student is able to:			
Estimate equivalent Fahrenheit and Celsius temperatures and convert between Celsius and Kelvin temperature scales.		X	
Measure the mass and volume of solids and liquids using appropriate equipment, methods and units.	X	X	X
Determine the density of solids and liquids.			X
Read a thermometer and express the temperature accurately.		X	X
Performance Indicators Teacher: As documented through teacher observation, Level 2, the student is able to:			
Distinguish between accuracy and precision.			
Create data tables and graphs from experimental data.	X	X	X
Analyze data by computing a percentage error.			
Record measurements and results of calculations using the correct number of significant figures.	X	X	X
Characterize a relationship between two variables as directly or inversely proportional.			
Use conversion factors, dimensional analysis and/or ratio and proportion to convert between quantities.			X
Express large and small numbers using scientific notation and perform calculations in scientific notation.	X		
Practice appropriate safety procedures when working in the laboratory.	X	X	X
Research careers that relate to matter and energy such as, surveyor, carpenter, structural engineer, HVAC technician, pathologist, etc.			
Performance Indicators Teacher: As documented through teacher observation, Level 3, the student is able to:			
Use a calorimeter and identify an unknown metal by determining its specific heat.			
Sample Task: Bell, Jerry. "Mystery Powders": An Inquiry Activity. Chemistry in the National Science Education Standards. Chapter 5. Students are given samples of seven white powders, each of which is a common household substance,		X	

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and five test reagents. They are to develop a procedure to the powders based on their physical and chemical properties, and to identify each powder when given a chart of expected results. The seven white solids are baking powder, baking soda, sugar, flour, sugar substitute, washing soda, and calcium supplement. The test reagents are water, phenolphthalein (or pH test paper), vinegar, iodine solution and alcohol.			
Integration/Linkages: physical science, mathematics, problem-solving skills, environmental science, Earth/space science, biology, scientific inquiry skills, analysis and representation of data, graphing skills.	X	X	X
Standard 3: Interactions of Matter			
The student will examine the interactions of matter. **Learning Expectations**: The student will:			
3.1 Investigate chemical bonding.		X	X
3.2 Analyze chemical reactions.		X	X
3.3 Explore the mathematics of chemical formulas and equations.		X	X
Performance Indicators State: As documented through state assessment, Level 1, the student is able to:			
Distinguish between a chemical symbol and a chemical formula, given examples.	X	X	X
Identify the parts (reactants or products) of a chemical reaction, given a balanced chemical equation.	X	X	X
Identify the types of chemical reactions (composition, decomposition, double replacement, single replacement), given a balanced equation.	X	X	X
Determine the number of atoms, formula units or molecules of a particular substance, given a balanced equation.	X	X	X
Performance Indicators State: As documented through state assessment, Level 2, the student is able to:			
Distinguish between ionic and covalent compounds, given binary formulas.	X	X	X
Identify the formula for a compound using the Periodic Table and a list of common ions, given the name of the compound.	X	X	X
Identify the name of compounds and common acids (sulfuric acid, nitric acid, hydrochloric acid, acetic acid, and phosphoric acid), using the Periodic Table and a list of common ions.		X	X
Select a correctly balanced chemical		X	X

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equation, when given examples.			
Recognize a balanced chemical equation using appropriate symbols, given a word equation.		X	
Convert between any two of the following quantities of a substance: mass number of moles number of particles molar volume (at STP).			
Determine molar ratios expressed in balanced chemical equations.			
Analyze percent composition of the elements in a compound, given the formula.			
Solve mass to mass stoichiometry problems.			
Performance Indicators State: As documented through state assessment, Level 3, the student is able to:			
Identify and solve different types of stoichiometry problems (volume (at STP) to mass, moles to mass, etc.)			
Performance Indicators Teacher: As documented through teacher observation, Level 1, the student is able to:			
Write a balanced equation and identify the reactants and products.	X	X	X
Performance Indicators Teacher: As documented through teacher observation, Level 2, the student is able to:			
Draw models of atoms bonding ionically and covalently.	X	X	X
Write the formulas for compounds, given the names of compounds.	X	X	X
Write the names of compounds given examples of chemical formulas using the stock system.	X	X	X
Write a balanced chemical equation and classify as to type, given a word description of a chemical reaction.		X	
Calculate and measure the actual molar mass of a substance and relate it to the number of particles.			
Predict the products of a single or double replacement chemical reaction, given an activity series and solubility chart.			
Research careers that relate to interactions of matter, such as pharmacist technician, industrial chemist, chemical technician, chemical engineer, etc.		X	X
Performance Indicators Teacher: As documented through teacher observation, Level 3, the student is able to:			
Draw shapes of molecules and label bond angles, bond polarity and molecule polarity, given a formula.			

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Predict amounts of product given mole or mass amounts of reactants in an actual lab experience and compare actual yield to theoretical yield.			
Use percentage composition to determine the empirical or molecular formula of an unknown substance.			
Sample Task: 1) Using molecular model kits, have students construct shapes of various molecules. 2) Using marshmallows or gumdrops and toothpicks, have students construct elements and compounds involved in a balanced chemical equation. 3) Direct students to calculate the molar mass of a substance and measure that amount into baggies to demonstrate mole amounts. 4) Have students make a model of the molar volume of a gas using balloons or boxes.			
Integration/Linkages: physical science, mathematics, art skills, measurement skills and tools, problem-solving skills, scale and model, biology, nutrition science, Lifetime Wellness, Geometry, Cosmetology, and Building Trades.	X	X	X
Standard 4: Solutions and Acid/Bases			
The student will investigate the characteristics of solutions including solutions of acids and bases. **Learning Expectations**: The student will:			
4.1 Investigate the characteristics of solutions.		X	X
4.2 Investigate the characteristics of acids and bases.		X	
Performance Indicators State: As documented through state assessment, Level 1, the student is able to:			
Classify substances as acid or base, given the formula of an inorganic acid or base.		X	
Performance Indicators State: As documented through state assessment, Level 2, the student is able to:			
Identify the solute and solvent in a solid, liquid or gaseous solution, given its composition.		X	
Classify a solution as saturated, unsaturated or supersaturated, given the composition of the solution and a solubility graph.		X	
Calculate the concentration of a solution in terms of molarity or mass percent, given mass of solute and mass or volume of			

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solution.			
Classify a substance as an acid or a base, given at least two of the following properties: color of litmus, color of phenolphthalein, taste, pH and slippery or non-slippery.		X	
Performance Indicators State: As documented through state assessment, Level 3, the student is able to:			
Predict the products of a neutralization reaction involving inorganic acids and bases, given the reactants.		X	
Performance Indicators Teacher: As documented through teacher observation, Level 1, the student is able to:			
Demonstrate the factors (temperature, stirring, particle size and concentration) that affect the rate at which a solute dissolves.		X	
Investigate the acidity/basicity of substances by observing their effect on various indicators.		X	
Performance Indicators Teacher: As documented through teacher observation, Level 2, the student is able to:			
Investigate colligative properties, i.e., the effect on freezing point and boiling point when a solute is added to a solvent.			
Demonstrate knowledge of neutralization reactions by performing a titration.		X	
Calculate molality of solutions.			
Classify a solution as neutral, acidic, or basic, or calculate its pH, given the hydrogen ion concentration or hydroxide ion concentration.		X	
Sample Task: Students will classify various household substances as acid or base using various natural and synthetic indicators.		X	
Interactions/Linkages: biology, physical science, mathematics, Earth science, ecology, measuring skills and tools, critical thinking skills, problem-solving skills, calculator and computer-based skills, industry, research, writing, communications, science and society, history, careers, economics, natural resources, scale and model, food science, engineering, cosmetology, and Auto Technology.		X	X

