COURSE GUIDE: POWER STANDARDS & LEARNING TARGETS

A Tradition of Pride

CHEMISTRY (11-12)		
Students will predict the relative properties of elements and the interactions and structures of their atoms using the periodic table.	Students will communicate information about specific chemical species using chemical nomenclature and knowledge of the periodic table.	Students will predict and explain the outcomes of chemical reactions.
Students will make quantitative arguments about chemical substances and the outcomes of reactions using stoichiometry.	Students will discuss and make predictions about the properties and quantities of matter, solutions, and gases using mathematical relationships and molecular-level knowledge.	Students will discuss and make predictions about the properties and quantities of acids and bases using mathematical relationships and molecular-level knowledge.
Students will classify matter by its composition into pure substances (Elements and Compounds) and mixtures (Homogeneous and Heterogeneous).	Students will clearly communicate scientific information using scientific reasoning and appropriate evidence to support their arguments.	Students will develop models that manage, explain, interpret, or demonstrate the application and understanding of scientific concepts.

LEARNING TARGET DESCRIPTIONS
☐ Level 3 learning targets **demonstrate understanding of foundational and complex knowledge.** ☐ Level 2 learning targets **demonstrate understanding of foundational knowledge.**

POWER STANDARD:	LEARNING TARGET: STUDENTS WILL ...
Students will predict the relative properties of elements and the interactions and structures of their atoms using the periodic table.	**Level 3**
	❏ Describe and illustrate the subatomic structure of an atom according to the Bohr model
	❏ Explain how chemicals are able to absorb energy and emit electromagnetic radiation (spectroscopy)
	❏ Analyze mass spectroscopy data to identify different isotopes and the corresponding element.
	❏ Explain how the electronic structure of an atom, according to the Bohr model and the periodic trends (electronegativity, atomic radius, electron affinity, and ionization energy) are connected

	❏ Write, compare, and interpret electron configurations using orbital diagrams and electron configuration notation
	❏ Use photoelectron spectroscopy to identify individual elements
	Level 2
	❏ Recite the names and symbols of elements 1-38, 47, 50, 53-56, 74, 78-80, 82-83, 86-88, 92, and 94 from memory
	❏ Identify an atom's number of protons, electrons, and neutrons based on its atomic symbol
	❏ Recognize scientists' models of the atom from past to present day and place them chronologically along a timeline.
	❏ Identify the charges of elements as ions based on their position on the periodic table
	❏ Explain how the periodic table has evolved over time and how the modern periodic table is organized today
	❏ List the different types of orbitals and the number of electrons that will occupy them for a specific element
	❏ Perform calculations to connect an element's atomic spectra to the Bohr model
POWER STANDARD	**LEARNING TARGET: STUDENTS WILL ...**
Students will communicate information about specific chemical species using chemical nomenclature and knowledge of the periodic table.	**Level 3**
	❏ Determine the name of an ionic compound from its formula or vice versa
	❏ Draw the lewis dot structure for a molecule
	❏ Find the formal charge of an atom, and use that to find the most stable form of a molecule
	❏ Predict and illustrate the geometry of a covalent molecule using VSEPR theory
	❏ Use bond dipoles and molecular geometry to determine a molecule's net dipole
	❏ Determine the name of a covalent compound from its formula or vice versa

	Level 2
	❑ Determine the number of valence electrons based on the element's location on the periodic table
	❑ Define ionic bonds and identify them based on the elements present in a compound
	❑ Illustrate an ionic crystal structure using a particulate model
	❑ Explain and illustrate how metallic bonds operate in pure substances and alloys
	❑ Define covalent bonds and identify them based on the elements present in a compound
	❑ Identify and explain how electronegativity influences the polarity of a covalent bond
	❑ Identify the relative strength of a bond based on bond length, bond order, and Coulomb's Law
POWER STANDARD	**LEARNING TARGET: STUDENTS WILL ...**
Students will predict and explain the outcomes of chemical reactions.	**Level 3**
	❑ Use evidence to show that a chemical reaction has occurred
	❑ Interpret and create energy diagrams for chemical reactions
	❑ Balance chemical equations
	❑ Translate chemical reactions into particulate models and vice versa
	❑ Convert a molecular chemical equation to a net ionic equation
	❑ Describe acid/base, combustion, single replacement, and precipitation reactions
	❑ Predict products of acid/base, combustion, single replacement, and precipitation reactions
	Level 2
	❑ Define and identify the following terms in chemical equations: reactants and products; reaction arrow; subscripts and charges; and solids, liquids, and gases

	❑ Identify if a reaction is exothermic or endothermic
	❑ Identify acid/base, combustion, single replacement, and precipitation reactions
POWER STANDARD:	**LEARNING TARGET: STUDENTS WILL ...**
Students will make quantitative arguments about chemical substances and the outcomes of reactions using stoichiometry.	**Level 3**
	❑ Convert from moles to mass, volume (using density and molarity), or number of particles and vice versa
	❑ Explain the relationship between moles, number of molecules, and coefficients of balanced chemical equations
	❑ Use a balanced chemical reaction to calculate the amounts of reactants consumed and the amounts of products produced in a reaction
	❑ Calculate the amount of excess reactant remaining after a reaction is complete
	❑ Determine the empirical and molecular formula of a compound using percentages or lab data
	Level 2
	❑ Recite the value of the mole from memory and explain how and why the mole is used for counting large quantities
	❑ Use the periodic table to determine the molar mass of elements and compounds
	❑ Determine the mole ratios from a balanced chemical equation
	❑ Identify the limiting and excess reactants for balanced chemical equations
POWER STANDARD:	**LEARNING TARGET: STUDENTS WILL ...**
Students will discuss and make predictions about the properties and quantities of matter, solutions, and gases using mathematical relationships and molecular-level knowledge.	**Level 3**
	❑ Explain the relationships between pressure, volume, and temperature of gas samples and how these relate to the molar volume of a gas
	❑ Use the ideal gas law to qualitatively and quantitatively relate the pressure, volume, temperature, and number of moles of a gas

	❑ Explain the effects of solutes on the following properties of water: boiling point, freezing point, and conductivity
	❑ Explain how agitation, heat, and pressure affect the solubility of solids and gases
	❑ Create solutions of appropriate concentration in the lab by dissolving a solid or diluting a stock solution
	Level 2
	❑ Apply kinetic molecular theory in multiple situations including particulate models
	❑ Use a pressure vs. temperature phase change diagram to determine the following information about a substance: boiling/condensation line, freezing/melting line, deposition/sublimation line, triple point, critical point, and the temperatures and pressures at which it is a solid, liquid, and gas
	❑ Distinguish between the 3 states of matter based on their properties
	❑ Distinguish between pure substances, heterogeneous mixtures, and homogenous mixtures
	❑ Analyze solubility curves
	❑ Identify a solution as saturated, unsaturated, or supersaturated and explain how to make each type of solution
	❑ Calculate the molarity of a solution and use molarity to elucidate other information about a solution
POWER STANDARD:	❑ **LEARNING TARGET: STUDENTS WILL ...**
Students will discuss and make predictions about the properties and quantities of acids and bases using mathematical relationships and molecular-level knowledge.	**Level 3**
	❑ Define and identify examples of Bronsted-Lowry acids and bases
	❑ Compare and contrast strong and weak acids/bases
	❑ Determine the relative strength of an acid or base using the magnitude of its equilibrium constant (K_a or K_b) or the log of its equilibrium constant (pK_a or pK_b)
	❑ Perform a titration or use titration data to determine the concentration of a solution of unknown concentration

	❑ Describe the purpose of a buffer solution and how to create an effective buffer solution
	Level 2
	❑ Identify acids and bases based on their formulae and properties
	❑ Recite the quantitative values of the pH spectrum from memory – i.e. acidity and basicity
	❑ Determine the pH, pOH, $[H^+]$, and $[OH^-]$ of a solution
	❑ Determine the equivalence point(s), half-equivalence points, and buffer regions of an analyte using titration data
	❑ Perform buffer calculations using the Henderson-Hasselbalch equation
POWER STANDARD	**LEARNING TARGET: STUDENTS WILL ...**
Students will classify matter by its composition into pure substances (Elements and Compounds) and mixtures (Homogeneous and Heterogeneous).	**Level 3**
	❑ Demonstrate and explain how ionic, covalent, and metallic substances can be identified via physical and chemical properties
	❑ Distinguish between physical and chemical changes given experimental evidence.
	❑ Identify the seven elements that exist in nature as diatomic molecules.
	Level 2
	❑ Classify matter as a metal, nonmetal, or metalloid, based on the properties of the substance and/or the location of the element on the periodic table
	❑ Locate metals, nonmetals, and metalloids on the periodic table.
	❑ Differentiate between atoms and molecules, pure substances and compounds, and physical and chemical properties.
POWER STANDARD:	**LEARNING TARGET: STUDENTS WILL ...**
Students will clearly communicate scientific information using scientific reasoning and appropriate evidence to support their arguments.	**Level 3**
	❑ Communicate scientific information in multiple formats including multimedia presentations, written documents, and oral presentation

	❑ Communicate the results of scientific investigations clearly through formal written lab reports
	❑ Evaluate the claims, evidence, and reasoning behind currently accepted theories and hypotheses to determine the merits of arguments
	❑ Peer-review each other's papers and offer constructive feedback based on scientific knowledge and understandings
	❑ Use print and electronic media to generate, research, and report on questions of interest
	Level 2
	❑ Clearly differentiate between correlation and causation, explaining how to determine which category a relationship falls under
	❑ Correctly use appropriate chemistry vocabulary to describe problems and/or physical events
	❑ Document their progress during engineering tasks, evaluating and supporting changes made to their designs
	❑ Organize and express in their own words important scientific concepts
	❑ Successfully exchange results and data with other students in order to further analyze scientific questions
POWER STANDARD:	**LEARNING TARGET: STUDENTS WILL ...**
Students will develop models that manage, explain, interpret, or demonstrate the application and understanding of scientific concepts.	**Level 3**
	❑ Demonstrate the ability to create, read, and interpret visual displays such as graphs and charts
	❑ Develop a mathematical model based on evidence to illustrate the relationships between systems or components of a system
	❑ Perform density calculations of solid or liquid using D=m/V.
	❑ Make inferences and justify conclusions from sample surveys, experiments, and observational studies
	Level 2
	❑ Analyze the types, quantity, and accuracy of data needed to produce reliable measurement and precision

	❑ Construct appropriate graphs from data and develop qualitative and quantitative statements about the relationships between experimental variables
	❑ Define appropriate quantities for the purpose of descriptive measurement
	❑ Write calculated results both in decimal form and in scientific notation.
	❑ Convert quantities between different units using the definitions of metric prefixes and other given conversion factors. (Factor Label Method)
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	❑ Explain how the periodic table has evolved over time and how the modern periodic table is organized today

Notes:

- The number(s) behind the course title indicate the grade(s) the course is offered.
- (L) = Omro Laude Course