TOPICS COVERED IN CHEM 100

Campus Farrington HS/DOE Standards Instructor(s) Bebi Davis/serves on DOE cmte for science standards

Please use the following to answer this questionnaire. If the topic is NOT covered, check nothing. Darken the first box if the concept is used by students for a test, quiz, or homework. Darken the second box if the concept is covered just for enrichment, ie, is not put on a test, quiz, or homework. If there are concepts that you want to add to this, please use the other box and describe them.

☐☐ Leave blank if not covered
■☐ Students use concept, tested
☐■ Use only to enrich, don't make them use concept, not tested

UNIT 1	Concept
Calculator/math skills	■☐ Understand the direct proportion in conversion factors and graphs
	☐■ Calculate the slope of a straight line
	☐■ Understand the difference between y = mx + b, and y = mx
	■☐ Conversions within the metric system
	■☐ Students memorize conversions within the metric system
	■☐ Conversions between the metric system and the American system
	☐■ Students memorize conversions within the American system
	■☐ Scientific notation on calculator
	■☐ Significant figures in calculations
	■☐ Understand uncertainty
	■☐ Understand accuracy and precision
	☐☐ Other
	☐☐ Other
Science in society	☐☐ Why you are in college: NEA income vs education data
	☐☐ Why you are in college: education and politics and society
	☐■ Differences between science and religion
	☐■ How statistics can be used to deceive the public
	☐■ Scientific data on bottled water, vitamins, energy drinks, coffee
	☐■ Other-integration of technology in science and society
	☐☐ Other
Matter	■☐ Homogeneous vs heterogeneous matter
	■☐ Atoms, molecules, elements, compounds
	■☐ Laws of Definite Proportion and Multiple Proportions
	■☐ Density calculations
	☐■ Specific gravity calculations
	■☐ Chemical rxs vs nuclear rxs
	■☐ Chemical properties vs physical properties (changes)
	☐☐ Other
	☐☐ Other
Energy	■☐ Definitions of energy and work
	☐☐ Definitions of force, velocity, acceleration, weight, and mass
	■☐ Definitions of heat and temperature,
	■☐ Definitions of KE, PE, chemical E, Total E (Conservation of E)
	■☐ Specific heat calculations
	☐■ Food label calculations and calorimetry

☐■ Food energy vs energy expenditure by various activities
☐☐ Other
☐☐ Other

Atomic theory
■☐ 3 particle model and atomic structure (Rutherford-Bohr model)
☐■ How subatomic particles were discovered
■☐ Isotopes
■☐ Relative mass vs mass conversions (direct proportion)
☐■ Mass spectrometer function and data provided
■☐ Calculating average atomic masses (weighted averages) on
■☐ Masses on the periodic table
☐☐ Other
☐☐ Other

UNIT 2 Concept

Periodic table
■☐ Periodic law and organization
■☐ Representative vs non-representative elements
■☐ Main group vs transition and inner transition metals
■☐ Metals vs nonmetals
☐■ Natural vs man-made
■☐ Know groups names: alkali, alkaline, halogens, noble gases
☐☐ Other
☐☐ Other

Periodic trends
■☐ Ionization potential,
■☐ Electronegativity
■☐ Atomic radius
■☐ Other-electron affinity
☐☐ Other

Nuclear radiation
☐☐ Classical radiation vs cosmic radiation
☐☐ Ionizing radiation and Geiger counters
☐☐ Ionizing radiation affects: radicals and DNA
☐☐ Units of measure: non-dosage vs dosage
☐■ Radon gas in homes
☐■ Food sterilization
☐■ Isotopic labeling in biology
☐☐ Diagnosis and imaging
☐☐ Radiation therapy
☐☐ Other
☐☐ Other

Nuclear rxs
■☐ Completing nuclear rxs
■☐ Recognizing types of nuclear rxs (radiation, fission, bombardment, electron capture, fusion, transmutation)
■☐ Half-life problems – solve for mass or time
☐■ Nuclear reactors and fuel
☐■ Nuclear bombs
☐☐ Russian and Japanese disasters
☐☐ Decay sequences and waste storage issues

☐☐ Other
☐☐ Other

Electrons in atoms

■☐ Ground state vs excited state
■☐ Valence and core electrons
■☐ Shell, subshells, orbitals on the periodic table
■☐ Probability maps and orbital shapes
■☐ Concept of the 4 quantum numbers
■☐ Aufbau Principle
☐☐ Other
☐☐ Other

Electron configurations

■☐ Elements and ions
■☐ Give the complete electron configuration
■☐ Give the noble gas electron configuration, and for each group
■☐ Give the generalized electron configuration for a group (eg s^2p^6)
■☐ Correlate to chemical reactivity and stability
■☐ Prediction of bonding behavior
■☐ Non-representative element behavior and exceptions
■☐ Orbital diagrams, Pauli and Hund's rules
☐☐ Other
☐☐ Other

Origin of electron theories

■☐ Nature of light, spectrum and etc
■☐ Calculations using $E = h\nu = hc/\lambda$
☐■ Atomic emission spectroscopy and electron configuration
☐■ Photoelectric effect
☐☐ Other
☐☐ Other

Lewis electron structures

■☐ For atoms and monoatomic ions
■☐ For transition metals
☐☐ Other
☐☐ Other

Types of bonds

■☐ Ionic: metal – nonmetal
■☐ Covalent: nonmetal – nonmetal
■☐ Metallic: metal – metal
☐☐ Other
☐☐ Other

Oxidation numbers

■☐ Find on periodic table, do not memorize
■☐ Memorize charges from group number
☐■ Use to predict bonding behavior
☐■ Understand oxidation and reduction
■☐ Use to predict formula of ionic compounds
■☐ Use to predict formula of covalent compounds
■☐ Use in naming
☐☐ Other
☐☐ Other

Nomenclature	■☐ Name covalent compounds
	■☐ Use of empirical vs molecular formulas
	■☐ Name ionic cmpds (Stock method)
	■☐ Use of formula unit
	■☐ Memorize 18 polyatomic ions
	I have students memorize ___12___ polyatomic ions
	☐☐ Other
	☐☐ Other

UNIT 3	Concept
Molecular structure	■☐ Lewis dot of atoms and monoatomic ions (review)
	■☐ Identify central atom, total valence electrons, satisfy octet rule
	■☐ Lewis structures for one central atom, CH_4
	■☐ Lewis structures for two central atoms, C_2H_4
	■☐ Lewis structures for multiple, simple organic molecules
	■☐ Lewis structures for polyatomic ions
	☐■ Identify Regions of Electron Density (0, 2, 3, 4)
	■☐ Determine shape (diatomic, linear, bent, pyramidal, tetrahedral)
	■☐ Determine approximate bond angles (180^o, 120^o, 109.5^o)
	☐■ Exceptions that do not meet the octet rule (radicals, expanded)
	☐☐ Other
	☐☐ Other
Polar vs nonpolar molecules	■☐ Use ΔEN to determine type of bond (nonpolar cov, polar cov, ionic)
	■☐ Use shape to determine if symmetrical or asymmetrical
	■☐ Asymmetrical molecules with polar bond(s) are polar
	■☐ Polar molecules behave like magnets, use to predict properties
	■☐ Polar molecules dissolve in water, nonpolar in oil
	■☐ Ionic molecules are extremely polar
	☐☐ Other
	☐☐ Other
Molecular orbitals	☐☐ Introduced to molecular orbitals (hybridization) so they know difference between atomic and molecular orbitals
	☐☐ Other
	☐☐ Other
Molar mass	■☐ Calculate the molar mass of atoms, molecules, formula units
	☐☐ Know AW, MW, FW, GAW, GMW, GFW (archaic)
	■☐ Convert between g ↔ mol ↔ atoms, molecules, FU
	■☐ Calculate % composition
	■☐ Calculate quantities using %composition
	■☐ Understand how %composition leads to empirical formula
	☐☐ Other
	☐☐ Other
Molecular formula	■☐ Convert between mol ↔ mol element (4 mol H = 1 mol CH_4)
	☐☐ Other
	☐☐ Other

Chemical rxs	■☐ Evidence for a rx
	☐■ How to determine a missing product
	■☐ Guidelines for balancing
	■☐ Recognize types of rxs (synthesis, decomposition, double displcmt, single displcmt, neutralization, combustion, redox)
	☐☐ Other
	☐☐ Other
Oxidation numbers	■☐ Use to identify redox rxs
	■☐ Use to identify oxidizing agent/reducing agent
	☐■ Use to understand voltaic cells
	☐☐ Other
	☐☐ Other
Predict if the rx will happen	☐■ Use solubility rules and gas formation for double displacement rxs,
	■☐ Use activity series for single displacement rxs
	■☐ Exothermic vs endothermic rxs
	☐■ PE and energy diagrams
	☐☐ Other
	☐☐ Other

UNIT 4	Concept
Stoichiometry	■☐ Moles ↔ moles, grams ↔ grams, grams ↔ joules
	■☐ Exothermic vs endothermic rxs (again)
	☐☐ Other
	☐☐ Other
Intermolecular attractions	■☐ London's, dipolar, H bond, ion-dipole
	☐■ Affects on physical state and solubility
	☐☐ Other
	☐☐ Other
Gases	■☐ Kinetic theory to explain behavior
	■☐ Ideal gas law calculations – no memorization of equations
	■☐ Ideal gas law calculations – memorization of laws and equations
	■☐ Partial pressures
	☐■ Gas diffusion in respiration
	☐■ Density at STP
	☐☐ Other
	☐☐ Other
Phase changes	☐■ Understand phase transitions gas ↔ liquid ↔ solid, triple point
	☐■ Understand the triple point
	■☐ Understand evaporation and boiling
	■☐ Understand pressure and temperature affects
	☐■ Calculate heating/cooling curves for water
	☐☐ Other
	☐☐ Other

Solids

☐■ Amorphous vs crystalline
☐■ Lattice points, types of crystals
☐■ Melting point vs attractive forces
☐☐ Other
☐☐ Other

Intermolecular attractions

☐■ Affect on mp, bp, vapor P, surface tension, heat of fusion, vaporization, and specific heat
☐☐ Other
☐☐ Other

Solutions 1

■☐ M calculations
■☐ Dilution problems
■☐ Stoichiometry and titrations
☐☐ Other
☐☐ Other

Solutions 2

☐■ Suspensions, colloids, solutions
☐■ Terminology such as electrolytes, miscible, hydrophobic
☐■ Solubility calculations
☐■ Factors affecting solubility
☐☐ Other
☐☐ Other

UNIT 5 Concept

Solutions 3

■■ Calculation of concentrations
☐■%m/m ☐■%v/v ☐■%m/v ☐■ppm, ppb, ppt
■☐M ☐☐osM ☐☐N
☐☐ Understand colligative properties with clinical applications
☐☐Osmotic P ☐☐Eq Vapor P ☐☐BP ☐☐FP
☐☐ Other
☐☐ Other

Acids and bases

■☐ Definitions, properties, and roles in every day life, pH
■☐ Recognize acids and bases by formula and properties
☐☐ Ionization equations, why acids ionize, why reactive
■☐ Naming acids, naming bases (again)
☐■ Memorize 8 strong acids, rest are weak
☐■ Memorize list of strong, moderate, and weak acids
☐■ Strength of bases ignoring solubility, just presence of OH^{-1}
☐■ Strength of bases including solubility
■☐ Identify conjugate acids and bases
■☐ Strength of conjugate acids and bases
☐☐ Other
☐☐ Other

Calculations

■☐ Ionization of water and K_W
■☐ $[H^+]$ and $[OH^-]$ calculations
■☐ pH, pOH calculations
■☐ Use $[H_3O^+][OH^-] = 1 \times 10^{-14}$

■☐ Use pH + pOH = 14
■☐ Calculate $[H^+]$ from pH, $[OH^-]$ from pOH
☐☐ Other
☐☐ Other

Buffers
☐■ Recognize buffer pairs
☐■ Understand buffering capacity and K_a
☐■ Calculate the pH of a buffer from K_a or pK_a and concentrations
☐☐ Calculate the pH of a buffer using Henderson-Hasselbalch eq
☐■ Calculate the K_a of an acid from the pH at a given concentration
☐☐ Understand the 3 major buffers in blood
☐■ Understand regulation of blood pH by breathing rate and CO_2 equilibria
☐☐ Other
☐☐ Other

Le Chatelier's
☐■ Identify the stress, then predict changes in concentration, temp, and P
☐■ Write K_{eq} for both homogeneous and heterogeneous equilibria
☐☐ Understand that $K^{forward} = 1/K^{reverse}$
☐☐ Understand how principle is used to manipulate rxs
☐☐ Other
☐☐ Other

Reaction rates
☐■ Calculate the rate from graph
☐☐ Write theoretical rate equations
☐☐ Understand that rate equations define K_{eq}
☐☐ Other
☐☐ Other

Thermodynamics
■☐ Understand the meaning of $\Delta G = \Delta H - T\Delta S$ and $\Delta G \approx \Delta H$ and relate to rxs
■☐ Calculations using $\Delta G = \Delta H - T\Delta S$ and $\Delta G = \Delta H$
☐■ Understand exergonic vs endergonic rxs
☐☐ Understand what $\Delta G = -7.3$ kcal/mol means for ATP
☐☐ Understand energy diagrams and collision theory
☐☐ Understand the concept of the transition state
☐☐ Other
☐☐ Other

If time allows:
☐☐ Use stoichiometry to calculate K_{eq}
☐■ Traditional, total, and net ionic equations
☐☐ Titrations again
☐☐ Other
☐☐ Other