Southern Cayuga Central School District – Curriculum Map

Subject: **Chemistry** School Year: **2021-2022**

Title or Topics w/ NYS Standards	Essential Questions & Vocabulary	Content Skills (Activities to cover Essential Questions)	Major Assessments (Tests, Project, etc.)	Time Frame
Unit 1: Matter and Measurement *NGSS Standards:* *HS PS1-1* *HS PS1-3*	1.Classify types of matter 2.Draw particle diagrams to represent different types of matter 3.Recognize various techniques that can be used to separate matter 4.Convert between units of measurement 5.Differentiate between accuracy and precision 6.Write numbers in scientific notation 7.State rules to determine significant figures 8.Count significant figures 9.Understand the importance of significant figures 10.Calculate the volume and density of an object Vocabulary: S.I. unit, meter, liter, gram, mass, weight, volume, density, intensive, extensive, significant figures, precision, accuracy, matter, element, compound, mixture, heterogeneous mixture, homogeneous mixture, pure substance, particle diagram, chromatography, filtration, distillation, scientific notation	• Branches of Chemistry • Classifying Matter • Separation of Matter • Scientific Notation • Dimensional Analysis • Sig Figs • Density	Lab: Safety Lab: Quantitative Observations Lab: Qualitative Observations Lab: Mixture Separation Test: Unit 1 Exam	2 Weeks

Unit 2: Atomic Theory *NGSS Standards:* *HS PS1-1* *HS PS1-3* *HS PS1-7* *HS PS2-6*	1.Understand that the modern model of the atom has evolved over a long period of time through the work of many scientists 2.Discuss the evolution of the atomic model 3.Relate experimental evidence to models of the atom 4.Identify the subatomic particles of an atom(proton, neutron, and electron) 5.Know the properties (mass, location, and charge) of subatomic particles 6.Determine the number of protons, neutrons, and electrons in a neutral atom and an ion 7.Differentiate between atomic number, mass number, and (average) atomic mass 8.Differentiate between and anion and a cation 9. Understand the derivation/basis of the atomic mass unit (amu) 10.Distinguish between ground and excited state 11.Identify and define isotopes 12.Calculate the (average) atomic mass for all isotopes of an element 13. Write electron configurations 14.Generate Bohr diagrams 15. Differentiate between kernel and valence electrons 16.Draw Lewis Dot Diagrams for an element or ion <u>Vocabulary:</u> allotrope, anion, atom, atomic mass, atomic mass unit(amu), atomic number, Bohr model, cation, compound, electron, electron configuration, element, excited state, ground state, ion, isotope, kernel electrons, Lewis dot diagram, mass number, neutron, nuclear charge, nucleons, nucleus, orbit, orbital, proton, quantum theory, valence electrons, wave-mechanical model	• Evolution of the atomic model • Rutherford Experiment • Parts of an atom • Atoms vs. Ions • Calculating atomic mass	Project: Isotope Google Collaboration Lab: Isotopes of Pennium Lab: Rutherford Simulation Test: Unit 2 Exam	3 Weeks

Unit 3: Periodic Table *NGSS Standards:* *HS PS1-1* *HS PS1-3* *HS PS2-6*	1.Describe the origin of the periodic table 2.State the modern period law 3."Key" the periodic table according to metals vs. nonmetals and all 3 phases 4. Explain how an element's electron configuration is related to the element's placement within a period and a group on the periodic table 5. Identify and state the properties of the following groups in the periodic table: alkali metals, alkaline earth metals, halogens, noble gases, transition metals 6. State the trends of the following properties within period and groups of elements including: ionization energy, electronegativity, atomic radius, chemical reactivity, metallic/nonmetallic character <u>Vocabulary</u>: ionization energy, electronegativity, atomic radius, ionic radius, chemical reactivity, metallic character, nonmetallic character, metals, metalloids, nonmetals, alkali metals, alkaline earth metals, halogens, noble gases, transition metals, periodic, periodic law, periods, groups, octet, phases of matter, solids, liquids, gases, diatomic elements, allotrope, isoelectronic, families	• Chemical Periodicity • Periodic Table Coloring • Pumpkin Halloween Explosion with Sodium • Periodic Trends	Lab: Flame Tests Case File #1: Conflict and Cans Report: *The Disappearing Spoon* by Sam Kean Lab: Breakout Room Test: Unit 3 Exam	3 Weeks

Unit 4: Bonding *NGSS Standards:* *HS PS1-3* *HS PS1-4* *HS PS1-7* *HS PS3-3*	1.Compounds can be differentiated by their chemical and physical properties 2.Two major categories of compounds are ionic and molecular(covalent) compounds 3. Chemical bonds are formed when valence electrons are: transferred from one atom to another (ionic); shared between atoms (covalent); mobile within a metal(metallic). 4. In a multiple covalent bond, more than one pair of electrons is shared between two atoms. Unsaturated organic compounds contain at least one double or triple bond. 5. Molecular polarity can be determined by the shape and distribution of that charge. Symmetrical (nonpolar) molecules include CO_2, CH_4, and diatomic elements. Asymmetrical (polar) molecules include HCl, NH_3, and H_2O. 6. When an atom gains one or more electrons, it becomes a negative ion and its radius increases. When an atom loses one or more electrons, it becomes a positive ion and its radius decreases. 7. When a bond is broken, energy is absorbed. When a bond is formed, energy is released. 8. Atoms attain a stable valence electron configuration by bonding with other atoms. Noble gases have stable valence electron configurations and tend not to bond. 9. Physical properties of substances can be explained in terms of chemical bonds and intermolecular forces. These properties include conductivity, malleability, solubility, hardness, melting point, and boiling point. 10. Electron-dot diagrams (Lewis structures) can represent the valence electron arrangement in elements, compounds, and ions. 11. Electronegativity indicates how strongly an atom of an element attracts electrons in a chemical bond. Electronegativity values are assigned according to an arbitrary scale.	• Common types of compounds • Naming and writing chemical formulas • Oxidation numbers • Electron Dot Diagrams • Ionic formula writing activity • Polar vs. Nonpolar	Lab: 3D Models of Covalent Bonds Case File #2: When Bonds Break Test: Unit 4 Exam	3 Weeks

	12. The electronegativity difference between two bonded atoms is used to assess the degree of polarity in the bond. 13. Metals tend to react with nonmetals to form ionic compounds. Nonmetals tend to react with other nonmetals to form molecular (covalent) compounds. Ioniccompounds containing polyatomic ions have both ionic and covalent bonding. 14. Determine the noble gas configuration an atom will achieve when bonding. 15. Demonstrate bonding concepts, using Lewis dot structures, representing valence electrons: transferred (ionic bonding); shared (covalent bonding); in a stable octet. 16. Distinguish between nonpolar and covalent bonds (two of the same nonmetals)and polar covalent bonds. <u>Vocabulary:</u> molecule, compound, bond, octet rule, exothermic, endothermic, ionic bond, covalent bond, oxidation number, polyatomic ions, stock system, binary compound, ternary compound, polar molecule, nonpolar molecule, intermolecular forces (IMF's)			

Unit 5: Moles and Stoichiometry *NGSS Standards:* *HS PS1-2* *HS PS1-7* *HS PS3-3*	1 .Determine amount of moles in a substance and be able to efficiently convert between grams. 2. Identify when equations are not balanced and calculate proper molar ratios. 3. Differentiate between equation types. 4. Calculate percent composition within a compound. <u>Vocabulary:</u> mole, formula mass, gram formula mass, coefficient, subscript, species, law of conservation of mass, law of conservation of energy, balanced equation, synthesis reaction, decomposition reaction, single-replacement reaction, double-replacement reaction, molecular formula, empirical formula, percent mass	• Percent Composition • What is a mole? • Gram to Mole conversions • Balancing Equations • Types of Reactions • Snowman Activity • Empirical Formula • Silver Ornament	Lab: Composition of Hydrates Lab: Conservation of Mass Lab: Relating Moles to Coefficients Case File #3: Case of the Poisonous Pill Test: Unit 5 Exam	3 Weeks

Unit 6: Physical Behavior of Matter *NGSS Standards:* *HS PS1-3* *HS PS1-4* *HS PS1-9*	1. Distinguish between the three phases of matter by identifying their different properties and representing them with particle diagrams. 2. Perform simple conversions between Celsius and Kelvin temperature scales. 3. Differentiate between exothermic and endothermic reactions/changes. 4. Identify phase changes, and understand how to read a heating or cooling curve. 5. Define heat, and understand how it varies from temperature. 6. Solve heat equations. 7. Solve gas law problems using the following laws: Avogadro's Law, Combined Gas Law, and Daltons Law of Partial Pressures. 8. State and understand the Kinetic Molecular Theory (KMT). 9. Understand the relationship between temperature, volume, and pressure among gases using the following gas laws: Charles Law, Boyles Law, Gay Lussacs Law. <u>Vocabulary:</u> Absolute Zero, Avogadro's Law, normal boiling point, compound cooling curve, deposition, energy, element, evaporation, heat, heat of fusion, heat of vaporization, heating curve, heat transfer, kinetic energy, kinetic molecular theory, lattice, matter, mixture, melting point, potential energy, sublimation, temperature, vapor pressure	• Energy • Temperature vs. Heat • Phase Diagrams • Energy Diagrams • Calculating Energy • Vapor Pressure • Gas Laws	Lab: Heating and Cooling Curve Lab Lab: Calorimetry Lab: Molar Volume of a Gas Test: Unit 6 Exam	3 Weeks

Unit 7: Solutions *NGSS Standards:* *HS PS1-7* *HS PS2-6* *HS PS1-10*	1. Differentiate between heterogeneous and homogeneous mixtures. 2. Identify the various types of heterogeneous and homogenous mixtures and their properties. 3. Define solubility and understand the factors that contribute to solubility. 4. Distinguish between saturated, unsaturated, or supersaturated solutions. 5. Read the solubility curve (Table G) to determine if a solution is saturated, unsaturated, or supersaturated. 6. Differentiate between dilute and concentrated solutions. 7. Calculate various concentrations of a solution using the following: molarity, percent by mass, percent by volume, parts per million. 8. Prepare a solution of known concentration. 9. Explain a solute's effect on a solution (colligative properties). <u>Vocabulary:</u> Alloy, aqueous, boiling point, boiling point elevation, colligative properties, colloid, concentration, dilute, freezing point depression, heterogeneous, homogeneous, insoluble, miscible, mixture, molarity, parts per million, percent by mass, percent by volume, precipitate, saturated, solubility, soluble, solution, solute, solvent, supersaturated, suspension, Tyndall effect, unsaturated.	• Demo Day (sodium acetate, hairspray, colloids) • Solubility Curve • Factors of solubility • Calculating Concentrations • Phet Simulations	Lab: Solubility Curve of KNO3 Lab: Ice Cream Lab: Bonds, Polarity, Solubility Test: Unit 7 Exam	3 Weeks

Unit 8: Kinetics and Equilibrium *NGSS Standards:* *HS PS1-2* *HS PS1-4* *HS PS1-5* *HS PS1-6* *HS PS1-7* *HS PS2-3*	1. Explain how the collision theory applies to energy and phases of matter in a reaction. 2. Calculate how a reaction can reach equilibrium. 3. Read potential energy diagrams to obtain information about a reaction. 4. Compare properties of phases of matter and contrast how they differ in entropy. 5. Explain how a catalyst affects the reaction pathway and activation energy. Vocabulary: Reaction rate, collision theory, reaction mechanism, nature of reactants, concentration, surface area, pressure, catalyst, temperature, equilibrium, physical equilibrium, phase equilibrium, solution equilibrium, chemical equilibrium, le chatelier's principle, enthalpy, entropy, potential energy diagram, endothermic reaction, exothermic reaction, activated complex, activation energy	• Kinetics • Rates of Reaction • Potential Energy Diagrams • Entropy • Equilibrium • Le Chatiliers Principle	Lab: Rates of Reaction Lab: Equilibrium Mini Lab Lab: Le Chatiliers Principle Lab: Breakout Room Test: Unit 8 Exam	3 Weeks

Unit 9: Acids and Bases *NGSS Standards:* *HS PS1-11* *HS PS1-2* *HS PS2-6*	1. Compare and contrast properties of acids, bases, and salts. 2. Compare the Arrhenius and Bronsted-Lowry theories of acids and bases. 3. Explain and give examples of neutralization reactions 4. Using the titration equation, determine the molarity of an unknown solution. 5. Understand how pH works. 6. Using Table M, determine the pH of a given solution. <u>Vocabulary</u>: Amphoteric, Arrhenius acid, Arrhenius base, bronsted-lowry acid, bronsted-lowry base, electrolyte, hydronium ion, hydroxide ion, indicator (acid/base), neutralization, pH scale, titration	• Naming Rules • Acid/Base Theory • pH scale and math • Titration/ Neutralization	Lab: Properties of Acids and Bases Lab: Titration Test: Unit 9 Exam	3 Weeks

Unit 10: Redox Chemistry *NGSS Standards:* *HS PS1-12* *HS PS3-3* *HS PS1-3*	1. Define and identify oxidation reactions 2. Define and identify reduction reactions 3. Assign oxidation numbers to elements in a compound 4. Write and balance half reactions 5. Identify oxidizing agents and reducing agents 6. Distinguish between voltaic and electrolytic cells. 7. Identify the components of an electrochemical cell. 8. Indicate the direction of electrons and ions through an electrochemical cell. 9. Determine, using Table J, whether a reaction is spontaneous or not. <u>Vocabulary</u>: Redox, Reduction, Oxidation, Reducing agent, oxidizing agent, oxidation number, half reaction, electrode, voltaic cell, salt bridge, electrochemical cell, electrolytic cell, anode, cathode	• Oxidation vs. Reduction • How to assign oxidation numbers • Table J • Half Reactions	Lab: Redox Station Experiments and Demos Test: Unit 10 Exam	2 Weeks

Unit 11: Organic Chemistry *NGSS Standards:* *HS PS2-6* *HS PS1-2*	1. Identify organic compounds verses inorganic compounds based on structure, name, or characteristics of an unknown compound. 2. Recognize the characteristics of organic compounds. 3. Differentiate between aliphatic, aromatic, saturated, and unsaturated compounds. 4. Name organic compounds based on IUPAC rules, with the help of table P and Q 5. Draw organic compounds from an IUPAC name. 6. Distinguish between alkynes, alkenes, and alkanes. 7. Name and identify isomers. 8. Identify various functional groups of organic compounds using Table R. 9. Categorize various organic reactions properly including addition, substitution, polymerization, esterification, fermentation, saponification, and combustion. <u>Vocabulary</u>: Addition reaction, alcohol, aldehyde, alkane, alkene, alkyne, amide, amine, amino acid, dehydration synthesis, ester, esterification, ether, fermentation, functional group, halide, hydrocarbon, isomer, ketone, monomer, organic acid, organic chemistry, polymer, polymerization, primary, saponification, saturated hydrocarbon, secondary, substitution reaction, tertiary, unsaturated hydrocarbon	• What classifies as organic? • Isomers • Hydrocarbon series • Functional groups • Organic Reactions	Lab: Organic Model Lab Report: *Napoleon's Buttons* by Jay Burreson and Penny Le Couteur Test: Unit 11 Exam	3 Weeks

Unit 12: Nuclear Chemistry *NGSS Standards:* *HS PS1-1* *HS PS2-6* *HS PS1-8* *HS PS4-3* *HS PS3-3*	1. Predict the stability of an isotope based on the ratio of neutrons and protons in its nucleus. 2. Understand that while most nuclei are stable, some are unstable and spontaneously decay emitting radiation. 3. Calculate the initial amount of the fraction remaining, or the half- life of a radioactive isotope, using the half- life equation. 4. Understand the concept of half-life. 5. Differentiate between the following emissions based on mass, charge, ionizing power, and penetrating power: alpha, beta, positron, and gamma. 6. Determine the type of decay and write nuclear equations. 7. Compare and contrast fission and fusion reactions. 8. Distinguish between natural and artificial transformations. 9. Complete nuclear equations and predict missing partible from nuclear equations. 10. Understand the change in energy in a nuclear reaction. 11. Be aware of the risks associated with radioactivity. 12. Recognize the beneficial uses and real world application of radioactive isotopes. <u>Vocabulary</u>: alpha particle, artificial transmutation, beta particle, fission, fusion, gamma radiation, half-life, radioactive tracer, radioisotope, transmutation	• Radio Active Decay • Artificial vs. Natural Transmutation • Half Life • Fraction Remaining Calculations • Chernobyl Activity	Lab: Twizzler Half Life Debate: The Building of a Power Plant Test: Unit 12 Exam	2 Weeks
Regents Review	1. Identify areas of weakness for further practice. 2. Practice regents style questions to get acquainted with the test.	• Old regents exam • Review Book quizzes • Topic specific packets	Lab: S' mores Stoich Review Exam: Practice Regents	2 Weeks