Curriculum Map for: Regents Physical Setting/Chemistry

Prepared May 18, 2007 by C. Darkangelo Wood and J.Grizzaffi

Prerequisites: Biology and Earth Science co-requisite Math Course I and II or Math A

Scope:

Assessment:

Assessment comes in a variety of forms and wherever possible should be used to reflect and enhance the teaching and learning process that occurs in a classroom. Assessment should not be seen as a separate activity, but as an integral part of the teaching and learning process. Alternative assessments apply to any and all assessments that differ from multiple choice, timed, one-shot approaches that characterize most standardized and classroom assessment. Authentic assessments are assessments that engage students in applying knowledge and skills in the same way they are used in the real-world. Performance assessment is a broad term, encompassing many of the characteristics of both authentic and alternative assessments.

As this course of study demonstrates, it is clear that no single type of assessment could provide an accurate measurement of the learning experience. Students should have the best opportunity to demonstrate their understanding of the learning experience. Therefore, it is suggested that a variety of data gathering methods be used such as objective tests, observations, products, written reports, performances and a collection of student works.

The **TIME** column offers a suggested time-line so that all topics listed in the **CONTENT/SKILLS** column are feasibly met. It is understood that times will need adjustments as the course develops. The **APPLICATION/PROJECT IDEAS** column offers suggestions and sources for the teacher. This column should be updated periodically to keep current and as new ideas are generated. The **KEY IDEA/PERFORMANCE INDICATOR** column coordinates topics with the NYS standards.

TIME	CONTENT/SKILLS	APPLICATIONS/PROJECT IDEAS	KEY IDEA/PERFORM INDICATOR
September (10 days)	Math and Measurement Metric Scientific Notation Solving Word problems Precision and accuracy Significant Figures Factor label conversion Graphing	Lab Safety (1 day) Safety Book **LAB** Measurements Lab (3 days) School Island	*Std 1**Key Idea 1:*** **Abstraction and symbolic representation are used to communicate mathematically.** M1.1 Use algebraic and geometric representations to describe and compare data. • organize, graph, and analyze data gathered from laboratory activities or other sources • measure and record experimental data and use data in calculations • recognize and convert various scales of measurement Std 6 Key Idea 3 3.2 Extend the use of powers of ten notation to understanding the exponential function and performing operations with exponential factors.
Sept/Oct (10 days)	Phases of Matter Physical & Chemical Properties Physical & Chemical Changes Types of matter Physical separation of mixtures Elements on the Periodic table	Careers in Chemistry **LAB** How to write a lab report (1 day) Demos Hydrolysis of water Classification of matter Physical/chemical properties & Changes Chromatography School Island **LAB** Physical and Chemical Changes in Matter (4 days)	Std 4 **Key Idea 3:** **Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity.** 3.1q Matter is classified as a pure substance or as a mixture of substances. 3.1kkThe three phases of matter (solids, liquids, and gases) have different properties. 3.1r A pure substance (element or compound) has a constant composition and constant properties throughout a given sample, and from sample to sample. 3.1u Elements are substances that are composed of atoms that have the same atomic number. Elements cannot be broken down by

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			chemical change. 3.1s Mixtures are composed of two or more different substances that can be separated by physical means. When different substances are mixed together, a homogeneous or heterogeneous mixture is formed. 3.1t The proportions of components in a mixture can be varied. Each component in a mixture retains its original properties. 3.1w Elements can be differentiated by physical properties. Physical properties of substances, such as density, conductivity, malleability, solubility, and hardness, differ among elements. 3.1x Elements can also be differentiated by chemical properties. Chemical properties describe how an element behaves during a chemical reaction. 3.1nnDifferences in properties such as density, particle size, molecular polarity, boiling and freezing points, and solubility permit physical separation of the components of the mixture. 3.1ooA solution is a homogeneous mixture of a solute dissolved in a solvent. The solubility of a solute in a given amount of solvent is dependent on the temperature, the pressure, and the chemical natures of the solute and solvent. 3.2a A physical change results in the rearrangement of existing particles in a substance. A chemical change results in the formation of different substances with changed properties. 3.1jj The structure and arrangement of particles and their interactions determine the physical state of a substance at a given temperature and pressure.
Oct (7 days)	Atomic Structure History of the atom Atomic Particles	History Timeline Cathode Ray Tube Internet simulations of experiments	Std 4 3.1a The modern model of the atom has evolved over a long period of time through the

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	AMU Periodic Table and Atomic Structure Isotopes Ions Weighted Atoms	Flash card concept mapping	work of many scientists. 3.1b Each atom has a nucleus, with an overall positive charge, surrounded by negatively charged electrons. 3.1c Subatomic particles contained in the nucleus include protons and neutrons. 3.1d The proton is positively charged, and the neutron has no charge. The electron is negatively charged. 3.1e Protons and electrons have equal but opposite charges. The number of protons equals the number of electrons in an atom. 3.1f The mass of each proton and each neutron is approximately equal to one atomic mass unit. An electron is much less massive than a proton or a neutron. 3.1g The number of protons in an atom (atomic number) identifies the element. The sum of the protons and neutrons in an atom (mass number) identifies an isotope. Common notations that represent isotopes include: $_{14}C$, $_{14}C$, carbon-14, C-14. 3.1h In the wave-mechanical model (electron cloud model) the electrons are in orbitals, which are defined as the regions of the most probable electron location (ground state). 3.1l The outermost electrons in an atom are called the valence electrons. In general, the number of valence electrons affects the chemical properties of an element. 3.1m Atoms of an element that contain the same number of protons but a different number of neutrons are called isotopes of that element. 3.1n The average atomic mass of an element is the weighted average of the masses of its naturally occurring isotopes.
Oct (7 days)	Nuclear Chemistry Radioactive Decay Decay Reactions Artificial and natural Transmutation Fission and Fusion Parts of Fission reactor	Decay graphing Video on Chernobyl M and M Decay	Std 4 3.1o Stability of an isotope is based on the ratio of neutrons and protons in its nucleus. Although most nuclei are stable, some are

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	Use of Radioisotopes Radioactive Waste Half-life		unstable and spontaneously decay, emitting radiation. 3.1p Spontaneous decay can involve the release of alpha particles, beta particles, positrons, and/or gamma radiation from the nucleus of an unstable isotope. These emissions differ in mass, charge, ionizing power, and penetrating power. **Key Idea 4:** **Energy exists in many forms, and when these forms change energy is conserved.** 4.4a Each radioactive isotope has a specific mode and rate of decay (half-life). 4.4b Nuclear reactions include natural and artificial transmutation, fission, and 4.4c Nuclear reactions can be represented by equations that include symbols which represent atomic nuclei (with mass number and atomic number), subatomic particles (with mass number and charge), and/or emissions such as gamma radiation. 4.4d Radioactive isotopes have many beneficial uses. Radioactive isotopes are used medicine and industrial chemistry for radioactive dating, tracing chemical and biological processes, industrial measurement, nuclear power, and detection and treatment diseases. 4.4e There are inherent risks associated with radioactivity and the use of radioactive isotopes. Risks can include biological exposure, long-term storage and disposal, nuclear accidents. 4.4f There are benefits and risks associated with fission and fusion reactions. **Key Idea 5:** **Energy and matter interact through forces that result in changes in motion.** 5.2a Chemical bonds are formed when valence electrons are: • transferred from one atom to another (ionic)

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Nov (4 days) .	Electrons Bohr Model Orbital Model Electron Configuration Ground state/ Exited state Valence Electrons Lewis Dot Ions	Electron Spectra Electron song	• shared between atoms (covalent) • mobile within a metal (metallic) 5.2b Atoms attain a stable valence electron configuration by bonding with other atoms. Noble gases have stable valence configurations and tend not to bond. 5.2c 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. Std 4 3.1i Each electron in an atom has its own distinct amount of energy. 3.1j When an electron in an atom gains a specific amount of energy, the electron is at a higher energy state (excited state). 3.1k When an electron returns from a higher energy state to a lower energy state, a specific amount of energy is emitted. This emitted energy can be used to identify an element. 3.1l The outermost electrons in an atom are called the valence electrons. In general, the number of valence electrons affects the chemical properties of an element. 5.2c 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. 5.2d Electron-dot diagrams (Lewis structures) can represent the valence electron arrangement in elements, compounds, and ions.
Nov	Compounds and Reactions	**LAB** Bite the Bubble (1 day)	Std 4 3.1ccA compound is a substance composed of two or more different elements that are chemically combined in a fixed proportion. A chemical compound can be broken down

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(12 days)	Building and Naming binary compounds Oxidation numbers Polyatomic ions Building and Naming polyatomic compounds Naming molecular compounds Types of chemical reactions Synthesis Decomposition Single and double replacement Combustion Activity series of metals Balancing equations Writing reactions from words Predicting the products	**LAB** Hydrate (4 days) **LAB** Hydrogen (3 days) **LAB** Types of Reactions (4 days) **LAB** Single replacement (3 days) Demo Reactions…… Precipitate Combustions Mg	by chemical means. A chemical compound can be represented by a specific chemical formula and assigned a name based on the IUPAC system. 3.3a In all chemical reactions there is a conservation of mass, energy, and charge. 3.3c A balanced chemical equation represents conservation of atoms. The coefficients in a balanced chemical equation can be used to determine mole ratios in the reaction. 3.2b Types of chemical reactions include synthesis, decomposition, single replacement, and double replacement. 5.2g Two major categories of compounds are ionic and molecular (covalent) compounds. 5.2h Metals tend to react with nonmetals to form ionic compounds. Nonmetals tend to react with other nonmetals to form molecular (covalent) compounds. Ionic compounds containing polyatomic ions have both ionic and covalent bonding.
Nov/Dec (7 days)	Energy and Thermodynamics Law of Conservation of Energy Endothermic and Exothermic Kinetic theory of heat Temperature Absolute Zero Energy Measurements Heat calculations Energy and Phase change Heating and Cooling curves Enthalpy Entropy and Spontaneity Calorimetry	**LAB** Heat of Fusion (3 days)	4.1a Energy can exist in different forms, such as chemical, electrical, electromagnetic, thermal, mechanical, nuclear. 4.1b Chemical and physical changes can be exothermic or endothermic. 4.2a Heat is a transfer of energy (usually thermal energy) from a body of higher temperature to a body of lower temperature. Thermal energy is the energy associated with the random motion of atoms and molecules. 4.2b Temperature is a measurement of the average kinetic energy of the particles in a sample of material. Temperature is not a form of energy. 4.2c The concepts of kinetic and potential energy can be used to explain physical processes that include: fusion (melting), solidification (freezing), vaporization (boiling,

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			evaporation), condensation, sublimation, and deposition.
Dec (9 days)	Periodic Table History and development of PT Reading Periodic Table Metals, Nonmetals, metalloids Electron configurations Periodic Trends (atomic radios, ionic radius, ionization energy, electronegativity, reactivity) Group of elements and properties	Graphing trends Reactivity of Alkali metals with water **LAB** Periodic table quiz	Std 4 3.1v Elements can be classified by their properties and located on the Periodic Table as metals, nonmetals, metalloids (B, Si, Ge, As, Sb, Te), and noble gases. 3.1y The placement or location of an element on the Periodic Table gives an indication of the physical and chemical properties of that element. The elements on the Periodic Table are arranged in order of increasing atomic number. 3.1z For Groups 1, 2, and 13-18 on the Periodic Table, elements within the same group have the same number of valence electrons (helium is an exception) and therefore similar chemical properties. 3.1aaThe succession of elements within the same group demonstrates characteristic trends: differences in atomic radius, ionic radius, electronegativity, first ionization energy, metallic/nonmetallic properties. 3.1bb The succession of elements across the same period demonstrates characteristic trends: differences in atomic radius, ionic radius, electronegativity, first ionization energy, metallic/nonmetallic properties. 5.2f Some elements exist in two or more forms in the same phase. These forms differ in their molecular or crystal structure, and hence in their properties.
Jan (11 day)	Bonding Ionic Bonds Transfer diagram Lewis Diagram Covalent Bonds Molecular Diagrams	Bonding chart for solids Microscope Conductivity of mobile ions	

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Jan/Feb (8 day)	Multiple bonds Coordinate covalent Metallic bonds Network bonds Molecular Attractions Partial Charges Molecular Geometry Types of attractions (VDW, dipole, hydrogen bonding, molecular-ion)	Building molecules Graphing strength of attractions Reading on Water Water Song	Std 4 3.1dd Compounds can be differentiated by their physical and chemical properties. 5.2a Chemical bonds are formed when valence electrons are: • transferred from one atom to another (ionic) • shared between atoms (covalent) • mobile within a metal (metallic) 5.2b Atoms attain a stable valence electron configuration by bonding with other atoms. Noble gases have stable valence configurations and tend not to bond. 5.2d Electron-dot diagrams (Lewis structures) can represent the valence electron arrangement in elements, compounds, and ions. 5.2e In a multiple covalent bond, more than one pair of electrons are shared between two atoms. Unsaturated organic compounds contain at least one double or triple bond. 5.2g Two major categories of compounds are ionic and molecular (covalent) compounds. 5.2h Metals tend to react with nonmetals to form ionic compounds. Nonmetals tend to react with other nonmetals to form molecular (covalent) compounds. Ionic compounds containing polyatomic ions have both ionic and covalent bonding. 5.2i When a bond is broken, energy is absorbed. When a bond is formed, energy is released. 5.2j Electronegativity indicates how strongly an atom of an element attracts electrons in a chemical bond. Electronegativity values are assigned according to arbitrary scales. 5.2k The electronegativity difference between two bonded atoms is used to assess the degree of polarity in the bond.

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			Std 4 5.2l Molecular polarity can be determined by the shape of the molecule and distribution of charge. Symmetrical (nonpolar) molecules include CO_2, CH_4, and diatomic elements. Asymmetrical (polar) molecules include HCl, NH_3, and H_2O. 5.2m Intermolecular forces created by the unequal distribution of charge result in varying degrees of attraction between molecules. Hydrogen bonding is an example of a strong intermolecular force. 5.2n 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.

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Feb/ Mar (15 days)	Moles and Stoichiometry Gram formula mass Mole conversion Multi-step conversions Percent composition by mass Empirical Formula Molecular Formula Mole to mole stoichiometry Mass to Mass stoichiometry Limiting Reagents Percent Yield	Billion Pieces of Rice activity **LAB** Moles and Coefficients lab **LAB** Molar Volume Lab	Std 4 3.1ee Types of chemical formulas include empirical, molecular, and structural. 3.3d The empirical formula of a compound is the simplest whole-number ratio of atoms of the elements in a compound. It may be different from the molecular formula, which is the actual ratio of atoms in a molecule of that compound. 3.3e The formula mass of a substance is the sum of the atomic masses of its atoms. The molar mass (gram-formula mass) of a substance equals one mole of that substance. 3.3f The percent composition by mass of each element in a compound can be calculated mathematically.
Mar (7 days)	Gas Laws Kinetic Molecular Theory Pressure conversions Boyle's Law Charles' Law Avogadro's Law Combined Gas Law Ideal Gas Law Dalton's Law Ideal vs. Real gas Vapor Pressure	**LAB** Molar Volume Lab	3.4a The concept of an ideal gas is a model to explain the behavior of gases. A real gas is most like an ideal gas when the real gas is at low pressure and high temperature. 3.4b Kinetic molecular theory (KMT) for an ideal gas states that all gas particles: • are in random, constant, straight-line motion. • are separated by great distances relative to their size; the volume of the gas particles is considered negligible. • have no attractive forces between them. • have collisions that may result in a transfer of energy between gas particles, but the total energy of the system remains constant. 3.4c Kinetic molecular theory describes the relationships of pressure, volume, temperature, velocity, and frequency and force of collisions among gas molecules. 3.4e Equal volumes of gases at the same temperature and pressure contain an equal

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			number of particles.
Mar/ April (7 days)	Solutions Solubility Colligative Properties Molarity Molar dilution Percent by mass Percent by volume Part per million		3.1oo A solution is a homogeneous mixture of a solute dissolved in a solvent. The solubility of a solute in a given amount of solvent is dependent on the temperature, the pressure, and the chemical natures of the solute and solvent. 3.1pp The concentration of a solution may be expressed in molarity (M), percent by volume, percent by mass, or parts per million (ppm). 3.1qq The addition of a nonvolatile solute to a solvent causes the boiling point of the solvent to increase and the freezing point of the solvent to decrease. The greater the concentration of solute particles, the greater the effect.
April (10 days)	Kinetics and equilibrium Equilibrium Le Chatelier's principle Collision Theory Potential energy diagrams Heat of Reaction Factors that effect rate of reaction Entropy Spontaneous reactions	**LAB** Rates lab Breathing fire (demo)	3.4d Collision theory states that a reaction is most likely to occur if reactant particles collide with the proper energy and orientation. 3.4f The rate of a chemical reaction depends on several factors: temperature, concentration, nature of the reactants, surface area, and the presence of a catalyst. 3.4g A catalyst provides an alternate reaction pathway, which has a lower activation energy than an uncatalyzed reaction. 3.4h Some chemical and physical changes can reach equilibrium. 3.4i At equilibrium the rate of the forward reaction equals the rate of the reverse reaction. The measurable quantities of reactants and products remain constant at equilibrium. 3.4j LeChatelier's principle can be used to predict the effect of stress (change in pressure, volume, concentration, and temperature)

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May (6 days)	Acid, bases, and salts Arrhenius Theory Bronsted-Lowry Theory pH calculations Measuring pH Indicators Titration Neutralization Electrolytes	**LAB** Acid Base Titration Lab Electrolyte demo	on a system at equilibrium. 4.1c Energy released or absorbed during a chemical reaction can be represented by a potential energy diagram. 4.1d Energy released or absorbed during a chemical reaction (heat of reaction) is equal to the difference between the potential energy of the products and potential energy of the reactants. 3.1ll Entropy is a measure of the randomness or disorder of a system. A system with greater disorder has greater entropy. 3.1mm Systems in nature tend to undergo changes toward lower energy and higher entropy. 3.1rr An electrolyte is a substance which, when dissolved in water, forms a solution capable of conducting an electric current. The ability of a solution to conduct an electric current depends on the concentration of ions. 3.1ss The acidity or alkalinity of an aqueous solution can be measured by its pH value. The relative level of acidity or alkalinity of these solutions can be shown by using indicators. 3.1tt On the pH scale, each decrease of one unit of pH represents a tenfold increase in hydronium ion concentration. 3.1uuBehavior of many acids and bases can be explained by the Arrhenius theory. Arrhenius acids and bases are electrolytes. 3.1vvArrhenius acids yield H+(aq), hydrogen ion as the only positive ion in an aqueous solution. The hydrogen ion may also be written as H_3O^+(aq), hydronium ion. 3.1ww Arrhenius bases yield OH-(aq), hydroxide ion as the only negative ion in an aqueous solution. 3.1xx In the process of neutralization, an Arrhenius acid and an Arrhenius base react to

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			form a salt and water. 3.1yy There are alternate acid-base theories. One theory states that an acid is an H+ donor and a base is an H+ acceptor. 3.1zz Titration is a laboratory process in which a volume of a solution of known concentration is used to determine the concentration of another solution.
May (8 days)	Redox Oxidation and reductions Assigning oxidation numbers Half reactions Balancing redox reactions Activity series Voltaic cells Electrolytic cells	Lemon battery demo SPAM batter Electrolysis of water Electroplating a spoon	3.2d An oxidation-reduction (redox) reaction involves the transfer of electrons (e-). 3.2e Reduction is the gain of electrons. 3.2f A half-reaction can be written to represent reduction. 3.2g Oxidation is the loss of electrons. 3.2h A half-reaction can be written to represent oxidation. 3.2i Oxidation numbers (states) can be assigned to atoms and ions. Changes in oxidation numbers indicate that oxidation and reduction have occurred. 3.2j An electrochemical cell can be either voltaic or electrolytic. In an electrochemical cell, oxidation occurs at the anode and reduction at the cathode. 3.2k A voltaic cell spontaneously converts chemical energy to electrical energy. 3.2l An electrolytic cell requires electrical energy to produce a chemical change. This process is known as electrolysis. 3.3b In a redox reaction the number of electrons lost is equal to the number of electrons gained.
May/June (5 days)	Organic Hydrocarbons Functional Groups Organic reactions		3.1ff Organic compounds contain carbon atoms, which bond to one another in chains, rings, and networks to form a variety of structures. Organic compounds can be named using the IUPAC system. 3.1gg Hydrocarbons are compounds that contain

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			only carbon and hydrogen. Saturated hydrocarbons contain only single carbon-carbon bonds. Unsaturated hydrocarbons contain at least one multiple carbon-carbon bond. 3.1hh Organic acids, alcohols, esters, aldehydes, ketones, ethers, halides, amines, amides, and amino acids are categories of organic compounds that differ in their structures. Functional groups impart distinctive physical and chemical properties to organic compounds. 3.1ii Isomers of organic compounds have the same molecular formula, but different structures and properties. 3.2c Types of organic reactions include addition, substitution, polymerization, esterification, fermentation, saponification, and combustion. 5.2e In a multiple covalent bond, more than one pair of electrons are shared between two atoms. Unsaturated organic compounds contain at least one double or triple bond.