**Davison Community Schools**
**ADVISORY CURRICULUM COUNCIL**
***Phase 2, April 25th, 2013***

| *Alt. Ed and HS Chemistry* | |
|---|---|
| **Course Essential Questions (from Phase I report):**<br>1. How does scientific inquiry and reflection impact how we understand and communicate about topics in chemistry?<br>2. How do you describe substances and their component parts?<br>3. How do substances interact with each other in chemical reactions?<br>4. What are the relationships between solids, liquids, and gases as they undergo chemical changes?<br>5. What are the characteristics of acids and bases and the properties of their interaction?<br>6. How do particles behave as they undergo changes? | |
| **Unit 1: Building Blocks; Atomic Theory, Periodic Table, and Quantum Mechanics (Chapters 1, 2, 3, 4 and 5)** | |
| **Essential Questions:**<br>1. How does the Atomic theory explain changes in substances?<br>2. How is the periodic table organized and useful?<br>3. What is the Quantum Theory about? | **Essential Understanding:**<br>• Physical, Chemical and nuclear changes are explained using the location and properties of subatomic particles<br>• The periodic table organizes all known elements and provides useful information for making predictions in chemistry<br>• Quantum Theory provides a foundation for the atomic model and the understanding of electron behavior and arrangement |
| **Curriculum Standards** | |
| C1.1A Generate new questions that can be investigated in the laboratory or field.<br>C1.1B Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.<br>C1.1C Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).<br>C1.1D Identify patterns in data and relate them to theoretical models.<br>C1.1E Describe a reason for a given conclusion using evidence from an investigation.<br>C1.1f Predict what would happen if the variables, methods, or timing of an investigation were changed.<br>C1.1g Based on empirical evidence, explain and critique the reasoning used to draw a scientific conclusion or explanation.<br>C1.1h Design and conduct a systematic scientific investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables.<br>C1.1i Distinguish between scientific explanations that are regarded as current scientific consensus and the emerging questions that active researchers investigate.<br>scientific consensus and the emerging questions that active<br>C1.2A Critique whether or not specific questions can be answered through scientific investigations.<br>C1.2B Identify and critique arguments about personal or societal issues based on scientific evidence.<br>C1.2E Evaluate the future career and occupational prospects of science fields.<br>C1.2h Describe the distinctions between scientific theories, laws, hypotheses, and observations. | |

C1.2i Explain the progression of ideas and explanations that lead to science theories that are part of the current scientific consensus or core knowledge.
C2.2B Describe the various states of matter in terms of the motion and arrangement of the molecules (atoms) making up the substance.
C2.4a Describe energy changes in flame tests of common elements in terms of the (characteristic) electron transitions.
C2.4b Contrast the mechanism of energy changes and the appearance of absorption and emission spectra.
C2.4c Explain why an atom can absorb only certain wavelengths of light.
C2.4d Compare various wavelengths of light (visible and nonvisible) in terms of frequency and relative energy.
C2.r5d Describe how and where all the elements on earth were formed. (recommended)
C4.6a Calculate the number of moles of any compound or element given the mass of the substance.
C4.6b Calculate the number of particles of any compound or element given the mass of the substance.
C4.7b Compare the density of pure water to that of a sugar solution.
C4.8A Identify the location, relative mass, and charge for electrons, protons, and neutrons.
C4.8B Describe the atom as mostly empty space with an extremely small, dense nucleus consisting of the protons and neutrons and an electron cloud surrounding the nucleus.
C4.8C Recognize that protons repel each other and that a strong force needs to be present to keep the nucleus intact.
C4.8D Give the number of electrons and protons presentif the fluoride ion has a -1 charge.
C4.8e Write the complete electron configuration of elements in the first four rows of the periodic table.
C4.8h Describe the shape and orientation of s and p orbitals.
C4.9A Identify elements with similar chemical and physical properties using the periodic table.
C4.9b Identify metals, non-metals, and metalloids using the periodic table.
C4.9c Predict general trends in atomic radius, first ionization energy, and electonegativity of the elements using the periodic table.
C4.10A List the number of protons, neutrons, and electrons for any given ion or isotope.
C4.10B Recognize that an element always contains the same number of protons.
C4.10c Calculate the average atomic mass of an element given the percent abundance and mass of the individual isotopes.
C4.10d Predict which isotope will have the greatest abundance given the possible isotopes for an element and the average atomic mass in the periodic table.
C4.10e Write the symbol for an isotope, , where Z is the atomic number, A is the mass number, and X is the symbol for the element.
C5.2B Distinguish between chemical and physical changes in terms of the properties of the reactants and products.
C5.2g Calculate the number of atoms present in a given mass of element.
C5.8C Recognize that proteins, starches, and other large biological molecules are polymers.

| **Knowledge/Content**<br>Students will know about…. | **Skills/Processes**<br>Students will be able to…… |
|---|---|
| • Protons, neutrons, and electrons and their properties<br>• Chemical/physical changes and properties<br>• Classifications of matter<br>• Element names and symbols<br>• Scientific method and how they are applied in a chemistry class<br>• Units of measurement and the quantities they describe<br>• Unit conversion<br>• Precision and accuracy<br>• Significant figures and how they are used<br>• The locations of groups and properties those groups share<br>• Elemental notation<br>• Avogadro's number and the mole<br>• Wave properties<br>• Quantum numbers and how they describe the location and behavior of the electrons<br>• Electron configuration<br>• Trends from the periodic table | • Identify the number of protons, neutrons and electrons in an isotope<br>• Identify examples of chemical/physical changes/properties and identify elements that share those properities<br>• Classify the type of matter of a substance<br>• Write electron configurations<br>• Convert between units<br>• Write symbols for isotopes<br>• Calculate the average atomic mass from the % abundance<br>• Describe the shapes of s and p orbitals<br>• Identify metals, nonmetals, and metalloids<br>• Predict general trends of atomic radius, ionization energy, and electronegativity<br>• Calculate wavelength, frequency, and energy of waves |

| Unit 2: Chemical Bonding and Chemical Reactions (Chapters 6, 7, 8, 9, and 13) | |
|---|---|
| **Essential Questions:**<br>1. What are the essential attractive forces that occur between atoms?<br>2. How do you correctly write chemical formulas, and how are compounds named?<br>3. How do you predict the relative ratios of the substance in a chemical reaction?<br>4. What are the intermolecular forces that exist and what are their properties? | **Essential Understanding:**<br>• There are attractions between atoms that increase their stability.<br>• Elements form compounds in predictable ratios that can be named systematically.<br>• Chemical reactions are described by balanced chemical equations which obey the Law of Conservation of Mass.<br>• Many physical properties of substances can be determined by knowing the type of intermolecular forces that exists between particles. |

**Curriculum Standards**

C1.1A Generate new questions that can be investigated in the laboratory or field.

C1.1B Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.

C1.1C Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).

C1.1E Describe a reason for a given conclusion using evidence from an investigation.

C1.1f Predict what would happen if the variables, methods, or timing of an investigation were changed.

C1.1g Based on empirical evidence, explain and critique the reasoning used to draw a scientific conclusion or explanation.

C1.1h Design and conduct a systematic scientific investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables.

C1.1i Distinguish between scientific explanations that are regarded as current scientific consensus and the emerging questions that active researchers investigate.

C1.2A Critique whether or not specific questions can be answered through scientific investigations.

C1.2E Evaluate the future career and occupational prospects of science fields.

C1.2f Critique solutions to problems, given criteria and scientific constraints.

C1.2g Identify scientific tradeoffs in design decisions and choose among alternative solutions.

C1.2h Describe the distinctions between scientific theories, laws, hypotheses, and observations.

C1.2i Explain the progression of ideas and explanations that lead to science theories that are part of the current scientific consensus or core knowledge.

C1.2k Analyze how science and society interact from a historical, political, economic, or social perspective.

C2.1a Explain the changes in potential energy (due to electrostatic interactions) as a chemical bond forms and use this to explain why bond breaking always requires energy.

C2.1b Describe energy changes associated with chemical reactions in terms

C2.r5c Describe the potential energy changes as two protons approach each other. (recommended)

C3.2b Describe the relative strength of single, double, and triple covalent bonds between nitrogen atoms.

C3.3c Explain why it is necessary for a molecule to absorb energy in order to break a chemical bond.

C4.1a Calculate the percent by weight of each element in a compound based on the compound formula.

C4.1b Calculate the empirical formula of a compound based on the percent by weight of each element in the compound.

C4.1c Use the empirical formula and molecular weight of a compound to determine the molecular formula.
C4.2A Name simple binary compounds using their formulae.
C4.2B Given the name, write the formula of simple binary compounds.
C4.2c Given a formula, name the compound.
C4.2d Given the name, write the formula of ionic and molecular compounds.
C4.3c Compare the relative strengths of forces between molecules based on the melting point and boiling point of the substances.
C4.3d Compare the strength of the forces of attraction between molecules of different elements. (For example, at room temperature, chlorine is a gas and iodine is a solid.)
C4.3e Predict whether the forces of attraction in a solid are primarily metallic, covalent, network covalent, or ionic based upon the elements' location on the periodic table.
C4.3f Identify the elements necessary for hydrogen bonding (N, O, F).
C4.3g Given the structural formula of a compound, indicate all the intermolecular forces present (dispersion, dipolar, hydrogen bonding).
C4.3h Explain properties of various solids such as malleability, conductivity, and melting point in terms of the solid's structure and bonding.
C4.3i Explain why ionic solids have higher melting points than covalent solids. (For example, NaF has a melting point of 995°C while water has a melting point of 0° C.)
C4.4b Identify if a molecule is polar or nonpolar given a structural formula for the compound.
C4.7a Investigate the difference in the boiling point or freezing point of pure water and a salt solution.
C4.8g Predict oxidation states and bonding capacity for main group elements using their electron structure.
C5.2A Balance simple chemical equations applying the conservation of matter.
C5.2B Distinguish between chemical and physical changes in terms of the properties of the reactants and products.
C5.2C Draw pictures to distinguish the relationships between atoms in physical and chemical changes.
C5.2d Calculate the mass of a particular compound formed from the masses of starting materials.
C5.4e Compare the melting point of covalent compounds based on the strength of IMFs (intermolecular forces).
C5.5A Predict if the bonding between two atoms of different elements will be primarily ionic or covalent.
C5.4B Predict the formula for binary compounds of main group elements.
C5.5c Draw Lewis structures for simple compounds.
C5.5d Compare the relative melting point, electrical and thermal conductivity, and hardness for ionic, metallic, and covalent compounds.
C5.6b Predict single replacement reactions.

| **Knowledge/Content**<br>Students will know about…. | **Skills/Processes**<br>Students will be able to…… |
|---|---|
| • the properties of ionic, covalent and metallic bonds<br>• the rules for naming and formula writing<br>• the relative strengths of ionic and covalent bonds<br>• empirical and molecular formulas<br>• dipole-dipole, hydrogen bonding, and London dispersion forces and their relative strengths<br>• the geometric arrangement of atoms based on the VSEPR theory<br>• polar versus nonpolar compounds<br>• the different classifications of chemical reactions<br>• balanced chemical reactions<br>• coefficients relating the molar ratios of the compounds in a chemical reaction | • identify ionic versus covalent molecules<br>• name binary ionic and molecular compounds<br>• write chemical formulas using oxidation numbers<br>• draw Lewis dot structures<br>• calculate % by weight of each element in a compound<br>• predict the states of matter based on intermolecular forces<br>• identify if a molecule is polar or nonpolar<br>• determine the geometric structure of a compound using the VSEPR theory<br>• balance chemical equations<br>• predict the products of single and double replacement reactions<br>• use stoichiometry to determine amounts of substances in a chemical reaction, % yield, and limiting reactants |

| Unit 3: States of Matter (Chapters 10 and 11) | |
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| **Essential Questions:**<br>1. How does attraction between particles affect the state of matter?<br>2. What is the relationship between Pressure, Volume, Temperature and Quantity? | **Essential Understanding:**<br>• States of matter can be explained by attraction between particles.<br>• States of matter can be explained under various conditions of temperature, volume and pressure |

**Curriculum Standards**

C1.1A Generate new questions that can be investigated in the laboratory or field.
C1.1B Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.
C1.1C Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).
C1.1D Identify patterns in data and relate them to theoretical models.
C1.1E Describe a reason for a given conclusion using evidence from an investigation.
C1.2j Apply science principles or scientific data to anticipate effects of technological design decisions.
C1.2k Analyze how science and society interact from a historical, political, economic, or social perspective.
C2.1c Compare qualitatively the energy changes associated with melting various types of solids in terms of the types of forces between the particles in the solid.
C2.2B Describe the various states of matter in terms of the motion and arrangement of the molecules (atoms) making up the substance.
C2.2c Explain changes in pressure, volume, and temperature for gases using the kinetic molecular model.
C2.2d Explain convection and the difference in transfer of thermal energy for solids, liquids, and gases using evidence that molecules are in constant motion.
C3.3B Describe melting on a molecular level.
C3.4g Explain why gases are less soluble in warm water than cold water.
C4.3A Recognize that substances that are solid at room temperature have stronger attractive forces than liquids at room temperature, which have stronger attractive forces than gases at room temperature.
C4.3B Recognize that solids have a more ordered, regular arrangement of their particles than liquids and that liquids are more ordered than gases.
C4.3c Compare the relative strengths of forces between molecules based on the melting point and boiling point of the substances.
C4.3h Explain properties of various solids such as malleability, conductivity, and melting point in terms of the solid's structure and bonding.
C4.4a Explain why at room temperature different compounds can exist in different phases.
C4.5a Provide macroscopic examples, atomic and molecular explanations, and mathematical representations (graphs and equations) for the pressure-volume relationship in gases.
C4.5b Provide macroscopic examples, atomic and molecular explanations, and mathematical representations (graphs and equations) for the pressure-temperature relationship in gases.
C4.5c Provide macroscopic examples, atomic and molecular explanations, and mathematical representations (graphs and equations) for the temperature-volume relationship in gases.
C4.7a Investigate the difference in the boiling point or freezing point of pure water and a salt solution.

C4.7b Compare the density of pure water to that of a sugar solution.
C5.2f Predict volumes of product gases using initial volumes of gases at the same temperature and pressure.
C5.4c Explain why both the melting point and boiling points for water are significantly higher than other small molecules of comparable mass (e.g., ammonia and methane).
C5.4d Explain why freezing is an exothermic change of state.
C5.4e Compare the melting point of covalent compounds based on the strength of IMFs (intermolecular forces).
C5.5d Compare the relative melting point, electrical and thermal conductivity, and hardness for ionic, metallic, and covalent compounds.
C5.5e Relate the melting point, hardness, and electrical and thermal conductivity of a substance to its structure.

| **Knowledge/Content**<br>Students will know about…. | **Skills/Processes**<br>Students will be able to…… |
|---|---|
| • The five assumptions of the kinetic molecular theory<br>• Physical properties that are based on the kinetic molecular theory<br>• Ideal gases<br>• The motion of particles in gases, liquids and solids<br>• Phase changes<br>• Phase diagrams<br>• The properties of gases and how they are related (P, T, V laws) | • Solve problems using the gas laws<br>• Explain the relationships between pressure, temperature, and volume<br>• Interpret phase diagrams<br>• Identify and describe the changes between states of matter |

| **Unit 4: Acid, Bases and Solutions (Chapter 12,18 and 14,15)** | |
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| **Essential Questions:**<br>1. How do we know a solution is acidic, base, or neutral?<br>2. How does stress change equilibrium?<br>3. Why are solution concentrations important? | **Essential Understanding:**<br>• Hydrogen ion concentration determines pH of the solution which allows its classification and nomenclature as either acidic, basic or neutral<br>• Predicting shifts in chemical systems caused by changing conditions<br>• The concentration of an solution is important because different concentrations effect the interaction between substances and solution |
| **Curriculum Standards** | |
| C1.1A Generate new questions that can be investigated in the laboratory or field.<br>C1.1B Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.<br>C1.1C Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).<br>C1.1D Identify patterns in data and relate them to theoretical models.<br>C1.1E Describe a reason for a given conclusion using evidence from an investigation.<br>C1.1f Predict what would happen if the variables, methods, or timing of an investigation were changed.<br>C1.1g Based on empirical evidence, explain and critique the reasoning used to draw a scientific conclusion or explanation.<br>C1.1i Distinguish between scientific explanations that are regarded as current scientific consensus and the emerging questions that active researchers investigate.<br>C1.2B Identify and critique arguments about personal or societal issues based on scientific evidence.<br>C1.2E Evaluate the future career and occupational prospects of science fields.<br>C1.2f Critique solutions to problems, given criteria and scientific constraints.<br>C1.2i Explain the progression of ideas and explanations that lead to science theories that are part of the current scientific consensus or core knowledge.<br>C1.2k Analyze how science and society interact from a historical, political, economic, or social perspective.<br>C1.1A Generate new questions that can be investigated in the laboratory or field.<br>C1.1B Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.<br>C1.1C Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).<br>C1.1D Identify patterns in data and relate them to theoretical models.<br>C1.1E Describe a reason for a given conclusion using evidence from an investigation.<br>C1.1f Predict what would happen if the variables, methods, or timing of an investigation were changed.<br>C1.1g Based on empirical evidence, explain and critique the reasoning used to draw a scientific conclusion or explanation.<br>C1.1i Distinguish between scientific explanations that are regarded as current scientific consensus and the emerging questions that active researchers investigate. | |

C1.2B Identify and critique arguments about personal or societal issues based on scientific evidence.
C1.2E Evaluate the future career and occupational prospects of science fields.
C1.2f Critique solutions to problems, given criteria and scientific constraints.
C1.2i Explain the progression of ideas and explanations that lead to science theories that are part of the current scientific consensus or core knowledge.
C1.2k Analyze how science and society interact from a historical, political, economic, or social perspective.
C5.3a Describe equilibrium shifts in a chemical system caused by changing conditions (Le Chatelier's Principle).
C5.3b Predict shifts in a chemical system caused by changing conditions (Le Chatelier's Principle).
C5.3c Predict the extent reactants are converted to products using the value of the equilibrium constant.
C5.7A Recognize formulas for common inorganic acids, carboxylic acids, and bases formed from familiesI and II.
C5.7B Predict products of an acid-base neutralization.
C5.7C Describe tests that can be used to distinguish an acid from a base.
C5.7D Classify various solutions as acidic or basic, given their pH.
C5.7E Explain why lakes with limestone or calcium carbonate experience less adverse effects from acid rain than lakes with granite beds.
C5.7f Write balanced chemical equations for reactions between acids and bases and perform calculations with balanced equations.
C5.7g Calculate the pH from the hydronium ion or hydroxide ion concentration.
C5.7h Explain why sulfur oxides and nitrogen oxides contribute to acid rain.
C5.r7i Identify the Brønsted-Lowry conjugate acid-base pairs in an equation. (recommended)

| **Knowledge/Content**<br>Students will know about…. | **Skills/Processes**<br>Students will be able to…… |
|---|---|
| • Concentration of solutions<br>• Properties of solutions, suspensions and colloids<br>• Properties of saturated, unsaturated and supersaturated solutions<br>• Electrolyte versus nonelectrolyte<br>• Naming acids and bases<br>• Neutralization reactions<br>• General properties of acids and bases<br>• The various definitions of acids and bases<br>• The pH scale<br>• Hydronium and hydroxide ion concentrations<br>• Steps in titration<br>• Le Chatlier's principle<br>• Equilibrium expressions | • Calculate molarity and molality<br>• Identify the type of mixture<br>• Predict products of and balance neutralization reactions<br>• Name acids and bases<br>• Identify conjugate acid/base pairs<br>• Calculate pH and pOH and $[H_3O^+]$ and $[OH^-]$<br>• Perform a titration<br>• Predict shifts in equilibrium using le Chatlier's principle<br>• Write an equilibrium expression |

| Unit 5: Thermodynamics and Reaction Energy and Kinetics (Chapter 16 and 17) | |
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| **Essential Questions:**<br>1. How is the behavior of matter determined by the flow of energy?<br>2. What is the relationship between entropy, enthalpy and the spontaneity of a reaction? | **Essential Understanding:**<br>• The flow of energy, measured by temperature, influences the behavior of matter.<br>• The spontaneity of a reaction is determined by the change in Gibbs Free Energy which is dependent on temperature and the changes in enthalpy and entropy. |

**Curriculum Standards**

C1.1A Generate new questions that can be investigated in the laboratory or field.
C1.1B Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.
C1.1C Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).
C1.1D Identify patterns in data and relate them to theoretical models.
C1.1E Describe a reason for a given conclusion using evidence from an investigation.
C1.1f Predict what would happen if the variables, methods, or timing of an investigation were changed.
C1.1g Based on empirical evidence, explain and critique the reasoning used to draw a scientific conclusion or explanation.
C1.2i Explain the progression of ideas and explanations that lead to science theories that are part of the current scientific consensus or core knowledge.
C1.2j Apply science principles or scientific data to anticipate effects of technological design decisions.
C1.2k Analyze how science and society interact from a historical, political, economic, or social perspective.
C2.1b Describe energy changes associated with chemical reactions in terms of bonds broken and formed (including intermolecular forces).
C2.2A Describe conduction in terms of molecules bumping into each other to transfer energy. Explain why there is better conduction in solids and liquids than gases.
C2.2e Compare the entropy of solids, liquids, and gases.
C2.3a Explain how the rate of a given chemical reaction is dependent on the temperature and the activation energy.
C2.3b Draw and analyze a diagram to show the activation energy for an exothermic reaction that is very slow at room temperature.
C3.1a Calculate the $\Delta H$ for a given reaction using Hess's Law.
C3.1b Draw enthalpy diagrams for exothermic and endothermic reactions.
C3.1c Calculate the $\Delta H$ for a chemical reaction using simple coffee cup calorimetry.
C3.1d Calculate the amount of heat produced for a given mass of reactant from a balanced chemical equation.
C3.3A Describe how heat is conducted in a solid.
C3.4A Use the terms endothermic and exothermic correctly to describe chemical reactions in the laboratory.
C3.4B Explain why chemical reactions will either release or absorb energy.
C3.4c Write chemical equations including the heat term as a part of equation or using $\Delta H$ notation.
C3.4d Draw enthalpy diagrams for reactants and products in endothermic and exothermic reactions.

C3.4e Predict if a chemical reaction is spontaneous given the enthalpy ($\Delta H$ ) and entropy ($\Delta S$ ) changes for the reaction using Gibb's Free Energy, $\Delta G = \Delta H - T\Delta S$ (Note: mathematical computation of $\Delta G$ is not required.)
C3.4f Explain why some endothermic reactions are spontaneous at room temperature.
C5.r1a Predict how the rate of a chemical reaction will be influenced by changes in concentration, temperature, and pressure. (recommended)
C5.r1b Explain how the rate of a reaction will depend on concentration, temperature, pressure, and nature of reactant. (recommended)
C5.2B Distinguish between chemical and physical changes in terms of the properties of the reactants and products.
C5.4A Compare the energy required to raise the temperature of one gram of aluminum and one gram of water the same number of degrees.
C5.4d Explain why freezing is an exothermic change of state.

| **Knowledge/Content**<br>Students will know about…. | **Skills/Processes**<br>Students will be able to…… |
|---|---|
| • Heat, entropy, enthalpy and temperature<br>• Endothermic and exothermic reactions<br>• Temperature scales<br>• Energy calculations using the specific heat, mass and temperature change<br>• The relationships between activation energy, catalysts and enthalpy of products and reactants<br>• Calorimeters<br>• Factors that affect the rate of a reaction<br>• Rate laws | • Use a calorimeter to determine the specific heat of an object<br>• Draw a graph showing the relationship between activation energy, enthalpy of products and reactants in an exothermic and endothermic reaction<br>• Calculate the enthalpy of a reaction using Hess' law<br>• Predict the spontaneity of a reaction<br>• Calculate energy changes based off the mass, specific heat and change in temperature<br>• Calculate between Celcius and Kelvin temperature scales<br>• Use the rate influencing factors to predict reaction rates<br>• Determine the rate law given scientific data |

| **Unit 6: Redox Reactions and Electrochemistry (Chapter 19 and 20)** | |
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| **Essential Questions:**<br>1. How do electrons drive oxidation-reduction reactions and what applications do these reactions have for electrical devices? | **Essential Understanding:**<br>• Electron transfers as described by redox reactions impacts humans in both positive and negative ways. |
| **Curriculum Standards** | |
| C1.1C Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).<br>C1.1E Describe a reason for a given conclusion using evidence from an investigation.<br>C1.1f Predict what would happen if the variables, methods, or timing of an investigation were changed.<br>C1.1g Based on empirical evidence, explain and critique the reasoning used to draw a scientific conclusion or explanation.<br>C1.2B Identify and critique arguments about personal or societal issues based on scientific evidence.<br>C1.2f Critique solutions to problems, given criteria and scientific constraints.<br>C1.2g Identify scientific tradeoffs in design decisions and choose among alternative solutions.<br>C1.2j Apply science principles or scientific data to anticipate effects of technological design decisions.<br>C1.2k Analyze how science and society interact from a historical, political, economic, or social perspective.<br>C5.6a Balance half-reactions and describe them as oxidations or reductions.<br>C5.6c Explain oxidation occurring when two different metals are in contact.<br>C5.6d Calculate the voltage for spontaneous redox reactions from the standard reduction potentials.<br>C5.6e Identify the reactions occurring at the anode and cathode in an electrochemical cell. | |
| **Knowledge/Content**<br>Students will know about…. | **Skills/Processes**<br>Students will be able to…… |
| • Oxidation and reduction<br>• Half-reactions<br>• Oxidation numbers of elements/ions<br>• Anodes and cathodes<br>• Voltaic and electrolytic cells<br>• The arrangement of the standard reduction potential chart | • Write oxidation and reduction half-reactions<br>• Calculate voltages from the standard reduction potentials<br>• Identify anodes versus cathodes |

| **Unit 7: Organic Chemistry (Chapter 22)** | |
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| **Essential Questions:**<br>1. How do the unique bonding properties of carbon allow it to form a diversity of structures? | **Essential Understanding:**<br>• The structure and bonding of carbon lead to the diversity in number of organic compounds. |
| **Curriculum Standards** | |
| C1.1C Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).<br>C1.1E Describe a reason for a given conclusion using evidence from an investigation.<br>C1.1f Predict what would happen if the variables, methods, or timing of an investigation were changed.<br>C1.1g Based on empirical evidence, explain and critique the reasoning used to draw a scientific conclusion or explanation.<br>C1.1i Distinguish between scientific explanations that are regarded as current scientific consensus and the emerging questions that active researchers investigate.<br>C1.2A Critique whether or not specific questions can be answered through scientific investigations.<br>C1.2E Evaluate the future career and occupational prospects of science fields.<br>C1.2i Explain the progression of ideas and explanations that lead to science theories that are part of the current scientific consensus or core knowledge.<br>C5.7A Recognize formulas for common inorganic acids, carboxylic acids, and bases formed from families I and II.<br>C5.8A Draw structural formulas for up to ten carbon chains of simple hydrocarbons.<br>C5.8B Draw isomers for simple hydrocarbons.<br>C5.8C Recognize that proteins, starches, and other large biological molecules are polymers. | |
| **Knowledge/Content**<br>Students will know about…. | **Skills/Processes**<br>Students will be able to…… |
| • The chemical structure of carbon<br>• Structural formulas<br>• Isomers<br>• Hydrocarbons (saturated/unsaturated) | • Draw and name simple hydrocarbons<br>• Distinguish between saturated and unsaturated hydrocarbons<br>• Distinguish between alkanes, alkenes and alkynes |