New Hampshire
Department of Education

Learn Everywhere Program Initial Application

1.0 Applicant Information [Ed 1403.01(b)(2)].

Organization Name: Cairn Educational Consulting, LLC. (Cairn)

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2.0 Purpose, mission statement, or both [Ed 1403.01(b)(1)].

As experienced educators and scientists, we are dedicated to delivering a world-class curriculum that not only fosters a love for learning but also prepares our students for the academic rigor of top-tier institutions. Through personalized instruction, we intend to nurture critical thinking, problem-solving, and intellectual curiosity in our students, ensuring they develop a strong foundation across physical and environmental sciences. Our commitment to academic excellence, combined with a supportive and stimulating learning environment, will empower our students to achieve their highest potential and become competitive applicants for the finest universities around the globe.

3.0 A description of the demonstrated instructor qualifications required for the program(s) and a statement assuring that the instructor(s) satisfies those qualifications [Ed 1403.01(b)(3)].

All of our current instructors hold doctoral degrees and valid teaching licenses. Any future employees will hold at least a Master's degree in their scientific discipline or in education. Cairn assures that the instructor will satisfy these minimum qualifications.

4.0 Either a criminal history records check policy that provides for an annually recurring records check or a one-time records check upon employment and includes a statement affirming that the sponsoring entity shall not allow instruction or student contact by a person who has been charged pending disposition for, or convicted of, any violation or attempted violation of any of the offenses outlined in RSA 189:13-a, V; or a statement that a criminal history records check policy is not included in the applicant's learn everywhere program.

The applicant shall also provide a statement assuring they will notify the parents, in writing, regarding its criminal records check policy prior to the enrollment of a student in the learn everywhere program. [Ed 1403.01(b)(4)].

In accordance with SaF-C 5703.06-11, "All staff, contractors, and volunteers will be subject to a criminal background check and child welfare and private adoption agency systems check as required by He-C 4003.14 – "Verification of Staff Qualifications", Both Dr. MacDonald and Dr. Calderara have a current criminal history record check on file with the New Hampshire Department of Education. While there are no plans to add employees to Cairn, if in the future more employees are added, they would also be required to pass a criminal history record check. The criminal background check at Cairn will be done upon initial employment. Cairn affirms that they shall not allow instruction or student contact by a person who has been charged pending disposition for, or convicted of, any violation or attempted violation of any of the offenses as outlined in RSA 189:13-a, V pursuant to a criminal history records check conducted by the department of safety as outlined in Saf-C 5703.06 through Saf-C 5703.11.

Cairn assures they will notify the parents, in writing, regarding its criminal records check policy prior to the enrollment of a student in the Learn Everywhere program.

5.0 Identification of the required subject from Ed 306.27(v) for which students completing the learn everywhere program shall receive high school credit(s) [Ed 1403.01(e)(1)(a)].

Students that successfully complete the Biomolecules from Atoms to Organisms class would be awarded a certificate for credit in Biological Science while students that complete Earth's Hydrosphere, Earth's Atmosphere, Earth's Lithosphere, Earth's Systems & Sustainability, Organic Chemistry 1, Organic Chemistry 2, College Chemistry for High Schoolers 1, College Chemistry for High Schoolers 2, Honors Chemistry 1, and Honors Chemistry 2 would receive a certificate for credit in Physical Science toward meeting high school graduation requirements.

6.0 An outline of each program for which approval is sought, which includes goals, competencies, a detailed description of the course of instruction, and a description of expected student outcomes [Ed 1403.01(e)(1)(b)].

The following is a detailed description, including goals, expected student outcomes, competencies, and the course of instruction for all Cairn Learn Everywhere offerings. A summary table of each course's alignment with the New Hampshire Model Science Competencies (Cross-cutting), approved by the State Board of Education on May 13, 2014, has been appended to the end of this application.

Honors Chemistry I

Course Description:

Honors Chemistry I is an accelerated exploration of the fundamental principles and concepts that govern the behavior of matter. This course is designed for students who have a strong interest in chemistry or a keen interest in pursuing careers in science, engineering, or related fields. Through lessons, discussions, and activities, students will take a closer look at matter, discover the relationships and patterns seen in chemistry, and investigate the physical and chemical nature of matter. This course prepares students for Honors Chemistry II as it builds the foundational concepts utilizing problem solving strategies and critical thinking starting at the atomic level. While this course is a prerequisite for Honors Chemistry II, students can take Honors Chemistry I as an individual semester course.

Course Goals:

The goal of the Honors Chemistry I course is to build a strong foundation for students beginning with the atom and its subatomic particles . The entire content of the course will continue to build from this foundation. The goal for utilizing this approach is for students to have a solid understanding of atomic behavior based on electrostatic forces as described by Coulomb's Law. The goal is for students to think critically and make connections, rather than use rote memorization.

Course of Instruction:

This course will utilize a synchronized online learning platform. Each week, students will participate in two 90 minute lessons, with the instructor and other students, using Google Meets as the video conferencing application. In addition, students will be given materials, assignments and supplemental resources, to complete the learning objectives. Students will have weekly assignments to aid in their learning of the material. A research paper will be assigned over a topic that pertains to the course topics. During the research process, the instructor will reinforce the science literacy cross cutting concepts of the NGSS in the way a paper is researched and written for science. Unit tests will be used to assess students' comprehension of the topics. Lab reports are another cross cutting concept that will be taught while using hands-on activities to help students construct their understanding of microscopic atomic behavior with tangible evidence.

Honors Chemistry I		
Topic	**NGSS**	**Outcomes** **Students will be able to…**
A Closer Look at Matter: ● Early models of the atom: Dalton to Rutherford ● Quantum theory and the Bohr Model of the atom ● Beyond Bohr: The Quantum mechanical model of the atom ● Applying quantum mechanics to electrons in atoms	HS PS1-3 HS PS4-1 HS PS2-4	● Describe the development of the model of the atom ● Describe the subatomic structures of atoms, ions, isotopes, using calculations where appropriate. ● Use Coulomb's Law to describe the attractive and repulsive forces between subatomic particles.
Relationships and Patterns in Chemistry: ● The development of the periodic table ● Periodic trends: regular changes in elemental properties ● Describing chemical bonding	HS PS1-1 HS PS1-2 HS PS1-6	● Describe the development of the modern periodic table. ● Draw conclusions about the similarities and trends in the properties of elements, with reference to the periodic table.

● Lewis structure diagrams ● The shape and behavior of molecules ● What does and what doesn't dissolve: "like dissolves like"		● Justify chemical and physical properties in terms of electron population. ● Demonstrate knowledge of various types of chemical bonding, ● Apply understanding of bonding to create formulas and Lewis Structures

The Nature of Matter: ● Properties of matter ● Classification of matter ● Separating the substances of a mixture ● Names and Formulas of inorganic compounds	HS PS3-1 HS PS3-2 HS PS3-4	● Relate the observable properties and characteristics of elements, compounds, and mixtures to the concept of atoms and molecules ● Write the names and formulas for ionic and covalent compounds ● Differentiate between physical and chemical changes ● Select an appropriate way of separating the components of a mixture.

Honors Chemistry II

Course Description:

Honors Chemistry II is an accelerated course that continues on from the topics completed in the Honors Chemistry I accelerated course. Through lessons, discussions, and activities, students will learn the skills and processes of chemistry, the nature of matter, the mole-the central unit of chemistry, expressing and measuring chemical change.

Course Goals:

The overall goal of Honors Chemistry II is for students to complete the course having a solid understanding of the fundamental concepts in chemistry while being able to apply problem solving and critical thinking skills. Upon successful completion of this course, students will be well prepared to study **first** semester, college level general chemistry.

Course of Instruction:

This course will utilize a synchronized online learning platform. Each week, students will participate in two 90 minute lessons, with the instructor and other students, using Google Meet as the video conferencing application. In addition, students will be given materials, assignments and supplemental resources, to complete the learning objectives. Students will have weekly assignments to aid in their learning of the material. A research paper will be assigned over a topic that pertains to the course topics. During the research process, the instructor will reinforce the science literacy cross cutting concepts of the NGSS in the way a paper is researched and written for science. Unit tests will be used to assess students' comprehension of the topics. Lab reports are another cross cutting concept that will be taught while using hands-on activities to help students construct their understanding of microscopic atomic behavior with tangible evidence.

Honors Chemistry II		**Outcomes** **Students will be able to…** ● Demonstrate appropriate safety techniques and proper use of protective equipment.
Topic	**NGSS**	
Skills and Processes of Chemistry: ● Staying safe around matter ● Laboratory and reporting skills ● Measuring and recording significant data ● Analysis of units and conversions	HS PS1-2 HS PS1-7 HS PS1.B.3	● Demonstrate skills in measuring and in recording data. ● Communicate results and data in clear and understandable forms.
The Nature of Matter: ● Properties of matter ● The classification of matter ● Separating the substances of a mixture ● Names and formulas of inorganic compounds	HS PS1.A.2 HS PS1-2 HS PS2-6	● Relate the observable properties and characteristics of elements, compounds, and mixtures to the concept of atoms and molecules. ● Write the names and formulas for ionic and covalent compounds, given a periodic table. ● Differentiate between physical and chemical changes. ● Select an appropriate way of separating the components of a mixture.
The Mole-The Central Unit of Chemistry: ● Relative atomic mass ● Introducing the mole-the central unit of chemistry ● The wheel model of mole	HS PS1-7	● Explain the significance and use of the mole. ● Perform calculations involving the mole. ● Determine relationships between molar quantities of gases at STP. ● Perform calculations involving

conversions ● Molar volume ● Composition analysis-determining formulas ● Molar concentration ● Dissociation equations and solution conductivity ● pH and pOH		molecular and empirical formulas to identify a substance. ● Describe concentration in terms of molarity ● Identify acids and bases through experimentation. ● Calculate and relate pH and pOH.

Expressing and Measuring Chemical Change ● Writing and balancing chemical equations-the magic of chemistry ● Classifying chemical changes and predicting products ● Identifying electron transfer ● Stoichiometry-calculating with chemical change ● Excess/limiting amounts, percentage yield, and impurities	HS PS1-7 HS PS1-B.3	● Explain chemical reactions in terms of the rearrangement of the atoms as bonds are broken and new bonds are formed. ● Apply the law of conservation of mass (First Law of Thermodynamics) to balance formula equations. ● Devise balanced equations for various chemical reactions. ● Perform stoichiometric calculations involving chemical reactions.

College Chemistry for High School I

Course Description:

College Chemistry for High School I is designed to provide students with a rigorous and comprehensive understanding of the fundamental principles of chemistry. College Chemistry for High School I is specifically tailored to prepare high school students for college, who are interested in studying chemistry and other related fields that require a strong chemistry background. Through a combination of theoretical concepts, laboratory experiments, and problem-solving exercises, students will delve deep into the structure, behavior, and reactions of matter at the atomic and molecular levels. Due to the nature of this course, students can expect to spend additional time reading independently as well as continuing to work through practice problems in order to solidify their understanding of the content. This course places a strong emphasis on helping students develop the problem solving strategies and critical thinking skills that are necessary for true proficiency in chemistry.

Course Goals:

The overall goal of College Chemistry I is for students to complete the course having a solid understanding of the fundamental concepts in chemistry while being able to apply problem solving and critical thinking skills. Upon successful completion of this course, students will be well prepared to study **first** semester, college level general chemistry (General Chemistry I) for science, premed, and engineering majors.

Course of Instruction:

This course will utilize a synchronized online learning platform. Each week, students will participate in two 90 minute lessons, with the instructor and other students, using Google Meet as the video conferencing application. In addition, students will be given materials, assignments and supplemental resources, to complete the learning objectives. Students will have weekly assignments to aid in their learning of the material. A research paper, along with a formal poster presentation will be assigned on a topic that pertains to the contents of the course. During the research process, students will learn how a real scientist works. This includes how to properly research topics utilizing a literature review, develop strong laboratory skills and reporting skills. Unit tests will be used to assess students' comprehension of the topics as well as their efficiency of the test taking process itself. Lab reports are used to not only help students construct their understanding of microscopic atomic behavior with tangible evidence, but also to teach students the importance of reporting results that are significant and reproducible.

College Chemistry for High School I		
Topic	**Standards** (Based on College Board Standards for AP Chemistry)	**Outcomes** **Students will be able to…**
Atomic Structure and Properties: ● Moles and Molar Mass ● Mass Spectra of Elements ● Elemental Composition of Pure Substances ● Composition of Mixtures ● Atomic Structure and Electron Configuration ● Photoelectron Spectroscopy ● Periodic Trends ● Valence Electrons and Ionic Compounds	1.1.A 1.2.A 1.3.A 1.4.A 1.5.A 1.6.A 1.7.A 1.8.A	● Calculate quantities of a substance or its relative number of particles using dimensional analysis and the mole concept. ● Explain the quantitative relationship between the mass spectrum of an element and the masses of the element's isotopes. ● Explain the quantitative relationship between the elemental composition by mass and the empirical formula of a pure substance. ● Explain the quantitative relationship between the

		elemental composition by mass and the composition of substances in a mixture. ● Explain the relationship between trends in the reactivity of elements and periodicity. ● Represent the ground-state electron configuration of an atom of an element or its ions using the Aufbau principle. ● Explain the relationship between the photoelectron spectrum of an atom or ion and: i. The ground-state electron configuration of the species. ii. The interactions between the electrons and the nucleus. ● Explain the relationship between trends in the reactivity of elements and periodicity.
Compound Structure and Properties ● Types of Chemical Bonds ● Intramolecular Force and Potential Energy ● Structure of Ionic Solids ● Structure of Metals and Alloys ● Lewis Diagrams ● Resonance and Formal Charge ● VSEPR and Hybridization	2.1.A 2.2.A 2.3.A 2.4.A 2.5.A 2.6.A 2.7.A	● Explain the relationship between the type of bonding and the properties of the elements participating in the bond. ● Represent the relationship between potential energy and distance between atoms, based on factors that influence the interaction strength. ● Represent an ionic solid with a particulate model that is consistent with Coulomb's law and the proper ● Represent a metallic solid

		and/or alloy using a model to show essential characteristics of the structure and interactions present in the substance. ● Represent a molecule with a Lewis diagram. ● Represent a molecule with a Lewis diagram that accounts for resonance between equivalent structures or that uses formal charge to select between nonequivalent structures. ● Based on the relationship between Lewis diagrams, VSEPR theory, bond orders, and bond polarities: i. Explain structural properties of molecules. ii. Explain electron properties of molecules.
Properties of Substances and Mixtures ● Intermolecular and Interparticle Forces ● Properties of Solids ● Solids, Liquids, and Gases ● Ideal Gas Law ● Kinetic Molecular Theory ● Deviation from Ideal Gas Law ● Solutions and Mixtures ● Representations of Solutions ● Separation of Solutions and Mixtures ● Solubility ● Spectroscopy and the Electromagnetic Spectrum ● Properties of Photons ● Beer-Lambert Law	3.1.A 3.2.A 3.3.A 3.4.A 3.5.A 3.6.A 3.7.A 3.8.A 3.9.A 3.10.A 3.11.A 3.12.A 3.13.A	● Explain the relationship between the chemical structures of molecules and the relative strength of their intermolecular forces when: i. The molecules are of the same chemical species. ii. The molecules are of two different chemical species. ● Explain the relationship among the macroscopic properties of a substance, the particulate-level structure of the substance, and the interactions between these particles. ● Represent the differences between solid, liquid, and gas phases using a particulate level model. ● Explain the relationship between the macroscopic

		properties of a sample of gas or mixture of gases using the ideal gas law. ● Explain the relationship between the motion of particles and the macroscopic properties of gases with: i. The kinetic molecular theory (KMT). ii. A particulate model. iii. A graphical representation. ● Explain the relationship among non-ideal behaviors of gases, interparticle forces, and/or volumes. ● Calculate the number of solute particles, volume, or molarity of solutions. ● Using particulate models for mixtures: i. Represent interactions between components. ii. Represent concentrations of components. ● Explain the results of a separation experiment based on intermolecular interactions. ● Explain the relationship between the solubility of ionic and molecular compounds in aqueous and nonaqueous solvents, and the intermolecular interactions between particles. ● Explain the relationship between a region of the electromagnetic spectrum and the types of molecular or electronic transitions associated with that region. ● Explain the properties of an absorbed or emitted photon in relationship to an electronic transition in an atom or molecule. ● Explain the amount of

		light absorbed by a solution of molecules or ions in relationship to the concentration, path length, and molar absorptivity.
Chemical Reactions ● Introduction for Reactions ● Net Ionic Equations ● Representations of Reactions ● Physical and Chemical Changes ● Stoichiometry ● Introduction to Titration ● Types of Chemical Reactions ● Introduction to Acid-Base Reactions ● Oxidation-Reduction (Redox) Reactions	4.1.A 4.2.A 4.3.A 4.4.A 4.5.A 4.6.A 4.7.A 4.8.A 4.9.A	● Identify evidence of chemical and physical changes in matter. ● Represent changes in matter with a balanced chemical or net ionic equation: i. For physical changes. ii. For given information about the identity of the reactants and/or product. iii. For ions in a given chemical reaction. ● Represent a given chemical reaction or physical process with a consistent particulate model. ● Explain the relationship between macroscopic characteristics and bond interactions for: i. Chemical processes. ii. Physical processes. ● Explain changes in the amounts of reactants and products based on the balanced reaction equation for a chemical process. ● Identify the equivalence point in a titration based on the amounts of the titrant and analyte, assuming the titration reaction goes to completion. ● Identify a reaction as acid-base, oxidation-reduction, or precipitation. ● Identify species as Brønsted-Lowry acids, bases, and/or conjugate

		acid-base pairs, based on proton-transfer involving those species. ● Represent a balanced redox reaction equation using half-reactions.
Kinetics ● Reaction Rates ● Introduction to Rate Law ● Concentration Changes Over Time ● Elementary Reactions ● Collision Model ● Reaction Energy Profile ● Introduction to Reaction Mechanisms ● Reaction Mechanisms and Rate Law ● Pre-equilibrium Approximation ● Steady-State Approximation ● Multistep Reaction Energy Profile ● Catalysis	5.1.A 5.2.A 5.3.A 5.4.A 5.5.A 5.6.A 5.7.A 5.8.A 5.9.A 5.10.A 5.11.A 5.12.A	● Explain the relationship between the rate of a chemical reaction and experimental parameters. ● Represent experimental data with a consistent rate law expression. ● Identify the rate law expression of a chemical reaction using data that show how the concentrations of reaction species over time. ● Represent an elementary reaction as a rate law expression using stoichiometry. ● Explain the relationship between the rate of an elementary reaction and the frequency, energy, and orientation of particle collisions. ● Represent the activation energy and overall energy change in an elementary reaction using a reaction energy profile. ● Identify the components of a reaction mechanism. ● Identify the rate law for a reaction from a mechanism in which the first step is rate limiting. ● Identify the rate law for a reaction from a mechanism in which the first step is not rate limiting. ● Represent the activation energy and overall energy change in a multistep reaction with a

		reaction energy profile. ● Explain the relationship between the effect of a catalyst on a reaction and changes in the reaction mechanism.

College Chemistry for High School II

Course Description:

College Chemistry for High School II picks up where College Chemistry for High School I ends. College Chemistry for High School II continues to provide students with a rigorous and comprehensive understanding of chemistry topics that are built up the fundamental principles of chemistry. There is a strong emphasis on learning how to use problem solving strategies as well as helping students develop critical thinking skills. This course is specifically tailored to prepare high school students for college who are interested in studying chemistry. or other related fields that require chemistry. Through a combination of theoretical concepts, laboratory experiments, and problem-solving exercises, students will delve deep into chemistry topics including thermochemistry, equilibrium, acids and bases, thermodynamics, and electrochemistry. Due to the nature of this course, students can expect to spend additional time reading independently as well as continuing to work through practice problems in order to solidify their understanding of the content. This course places a strong emphasis on helping students develop the problem solving strategies and critical thinking skills that are necessary for true proficiency in chemistry.

Course Goals:

The overall goal of College Chemistry for High School II is for students to complete the course having a solid understanding of the fundamental concepts in chemistry while being able to apply problem solving and critical thinking skills. Upon successful completion of this course, students will be well prepared to study **second** semester, college level general chemistry (General Chemistry II) for science, premed, and engineering majors.

Course of Instruction:

This course will utilize a synchronized online learning platform. Each week, students will participate in two 90 minute lessons, with the instructor and other students, using Google Meet as the video conferencing application. In addition, students will be given materials, assignments and supplemental resources, to complete the learning objectives. Students will have weekly assignments to aid in their learning of the material. A research paper, along with a formal poster presentation will be assigned on a topic that pertains to the contents of the course. During the research process, students will learn how a real scientist works. This includes how to properly research topics that include a literature review, possess strong laboratory skills and reporting skills. Unit tests will be used to assess students' comprehension of the topics as well as their efficiency of the test taking process itself. Lab reports are used to not only help

students construct their understanding of microscopic atomic behavior with tangible evidence, but also to teach students the importance of reporting results that are significant and reproducible.

College Chemistry for High School II		
Topic	**Standards** (Based on College Board Standards for AP Chemistry)	**Outcomes** **Students will be able to…**
Thermochemistry ● Endothermic and Exothermic Processes ● Energy Diagrams ● Heat Transfer and Thermal Equilibrium ● Heat Capacity and Calorimetry ● Energy of Phase Changes ● Introduction to Enthalpy	6.1.A 6.2.A 6.3.A 6.4.A 6.5.A 6.6.A 6.7.A 6.8.A 6.9.A	● Explain the relationship between experimental observations and energy changes associated with a chemical or physical transformation. ● Represent a chemical or physical transformation with an energy diagram. ● Explain the relationship between the transfer of thermal energy and molecular collisions. ● Calculate the heat q absorbed or released by a system undergoing heating/ cooling based on the amount of the substance, the heat capacity, and the change in temperature. ● Explain changes in the heat q absorbed or released by a system undergoing a phase transition based on the amount of the substance in moles and the molar enthalpy of the phase transition. ● Calculate the heat q absorbed or released by a system undergoing a chemical reaction in relationship to the amount of the reacting substance in moles and the molar enthalpy of reaction. ● Calculate the enthalpy change of a reaction

		based on the average bond energies of bonds broken and formed in the reaction. ● Calculate the enthalpy change for a chemical or physical process based on the standard enthalpies of formation. ● Represent a chemical or physical process as a sequence of steps. ● Explain the relationship between the enthalpy of a chemical or physical process and the sum of the enthalpies of the individual steps.
Equilibrium ● Introduction to Equilibrium ● Direction of Reversible Reactions ● Reaction Quotient and Equilibrium Constant ● Calculating the Equilibrium Constant ● Magnitude of the Equilibrium Constant ● Properties of the Equilibrium Constant ● Calculating Equilibrium Concentrations ● Representations of Equilibrium ● Introduction to Le Châtelier's Principle ● Reaction Quotient and Le Châtelier's Principle ● Introduction to Solubility Equilibria ● Common-Ion Effect	7.1.A 7.2.A 7.3.A 7.4.A 7.5.A 7.6.A 7.7.A 7.8.A 7.9.A 7.10.A 7.11.A 7.12.A	● Explain the relationship between the occurrence of a reversible chemical or physical process, and the establishment of equilibrium, to experimental observations. ● Explain the relationship between the direction in which a reversible reaction proceeds and the relative rates of the forward and reverse reactions. ● Represent the reaction quotient Qc or Qp , for a reversible reaction, and the corresponding equilibrium expressions K c = Qc or K p = Qp . ● Calculate Kc or K p based on experimental observations of concentrations or pressures at equilibrium. ● Explain the relationship between very large or very small values of K and the relative concentrations of chemical species at

		equilibrium. ● Represent a multistep process with an overall equilibrium expression, using the constituent K expressions for each individual reaction. ● Identify the concentrations or partial pressures of chemical species at equilibrium based on the initial conditions and the equilibrium constant. ● Represent a system undergoing a reversible reaction with a particulate model. ● Identify the response of a system at equilibrium to an external stress, using Le Châtelier's principle. ● Explain the relationships between Q, K, and the direction in which a reversible reaction will proceed to reach equilibrium. ● Calculate the solubility of a salt based on the value of K sp for the salt. ● Identify the solubility of a salt, and/or the value of K sp for the salt, based on the concentration of a common ion already present in solution.
Acids and Bases ● Introduction to Acids and Bases ● pH and pOH for Strong Acids and Bases ● Weak Acid and Base Equilibria ● Acid-Base Reactions and Buffers	8.1.A 8.2.A 8.3.A 8.4.A	● Calculate the values of pH and pOH, based on K w and the concentration of all species present in a neutral solution of water. ● Calculate pH and pOH based on concentrations

● Acid-Base Titrations ● Molecular Structure of Acids and Bases ● pH and pKa ● Properties of Buffers ● Henderson-Hasselbalch Equation ● Buffer Capacity ● pH and Solubility	8.5.A 8.6.A 8.7.A 8.8.A 8.9.A 8.10.A 8.11.A	of all species in a solution of a strong acid or a strong base. ● Explain the relationship among pH, pOH, and concentrations of all species in a solution of a monoprotic weak acid or weak base. ● Explain the relationship among the concentrations of major species in a mixture of weak and strong acids and bases. ● Explain results from the titration of a mono- or polyprotic acid or base solution, in relation to the properties of the solution and its components. ● Explain the relationship between the strength of an acid or base and the structure of the molecule or ion. ● Explain the relationship between the predominant form of a weak acid or base in solution at a given pH and the pKa of the conjugate acid or the pKb of the conjugate base. ● Explain the relationship between the ability of a buffer to stabilize pH and the reactions that occur when an acid or a base is added to a buffered solution. ● Identify the pH of a buffer solution based on the identity and concentrations of the conjugate acid-base pair used to create the buffer. ● Explain the relationship between the buffer

		capacity of a solution and the relative concentrations of the conjugate acid and conjugate base components of the solution. ● Identify the qualitative effect of changes in pH on the solubility of a salt.
Thermodynamics and Electrochemistry ● Introduction to Entropy ● Absolute Entropy and Entropy Change ● Gibbs Free Energy and Thermodynamic Favorability ● Thermodynamic and Kinetic Control ● Free Energy and Equilibrium ● Free Energy of Dissolution ● Coupled Reactions ● Galvanic (Voltaic) and Electrolytic Cells ● Cell Potential and Free Energy ● Cell Potential Under Nonstandard Conditions ● Electrolysis and Faraday's Law	9.1.A 9.2.A 9.3.A 9.4.A 9.5.A 9.6.A 9.7.A 9.8.A 9.9.A 9.10.A 9.11.A	● Identify the sign and relative magnitude of the entropy change associated with chemical or physical processes. ● Calculate the standard entropy change for a chemical or physical process based on the absolute entropies (standard molar entropies) of the species involved in the process. ● Explain whether a physical or chemical process is thermodynamically favored based on an evaluation ΔG^{o}. ● Explain, in terms of kinetics, why a thermodynamically favored reaction might not occur at a measurable rate. ● Explain whether a process is thermodynamically favored using the relationships between K, ΔG^{o} , and T. ● Explain the relationship between the solubility of a salt and changes in the enthalpy and entropy that occur in the dissolution process. ● Explain the relationship between external

		sources of energy or coupled reactions and their ability to drive thermodynamically unfavorable processes. ● Explain the relationship between the physical components of an electrochemical cell and the overall operational principles of the cell. ● Explain whether an electrochemical cell is thermodynamically favored, based on its standard cell potential and the constituent half-reactions within the cell. ● Explain the relationship between deviations from standard cell conditions and changes in the cell potential. ● Calculate the amount of charge flow based on changes in the amounts of reactants and products in an electrochemical cell.

Organic Chemistry 1 for High School

Course Description:

Organic Chemistry 1 for High School is the study of carbon-containing compounds, which are the foundation of life and the backbone of many industries including pharmaceuticals, agriculture, and materials science. This course delves into the fundamental principles governing the structure and reactivity of organic molecules. Throughout the semester, students will explore the key concepts of organic chemistry, including understanding the hybridization, geometry, and bond properties of carbon compounds, resonance forms, molecular orbital theory, identification and classification of functional groups including how their properties influence the reactivity and behavior of organic molecules. The course emphasizes the application of theoretical knowledge to real-world problems, challenging students to think critically and creatively about organic chemistry's role in scientific research and industry.

Course Goals:

The goal of Organic Chemistry 1 is to prepare students for organic chemistry in college during their course of study as a chemist, chemical engineer, material science, premed, or related major. After completion of this course, students will be able to enter their organic chemistry course in college with a significant advantage over most of their peers. Students who successfully complete this course will have learned the foundational concepts that define organic chemistry as a whole. The overall goal is for these students to be able to enter their organic chemistry course in college with confidence. Historically, students who complete this course experience a considerable reduction in stress compared to their peers in their college organic chemistry course who have not had the opportunity to take this type of course in high school.

Course of Instruction:

This course will utilize a synchronized online learning platform. Each week, students will participate in two 90 minute lessons, with the instructor and other students, using Google Meet as the video conferencing application. In addition, students will be given materials, assignments and supplemental resources, to complete the learning objectives. Students will have weekly assignments to aid in their learning of the material. A research paper, along with a formal poster presentation will be assigned on a topic that pertains to the contents of the course. During the research process, students will learn how a real scientist works. This includes how to properly research topics, write a literature review and scientific paper, in addition prepare/present a poster for their peers. Unit tests will be used to assess students' comprehension of the topics as well as their efficiency of the test taking process itself.

Organic Chemistry 1 For High School		
Topics	**Standards** (Wade Organic Chemistry Text: Instructor created ID codes for standards based on sections in text)	**Outcomes** **Students will be able to…**
Introduction and Review ● Origins of Organic Chemistry ● Principles of Atomic Structure (Review) ● Electronic Structure (Review) ● Electron Configurations and Electronic Orbital Diagrams (Review) ● Octet Rule Ionic and Covalent Bonding (Review) ● Lewis Structures and Formal Charges (Review) ● Common Bonding Patterns for Organic Chemistry ● Structural Formulas:	WOC.1.1 WOC 1.2 WOC.1.3 WOC.1.4 WOC.1.5 WOC.1.6 WOC.1.7	● discuss the origins of organic chemistry - refer to section 1.1 ● use and apply the language of Atomic Structure (atomic number, mass number, isotopes) - refer to section 1.2 ● draw, interpret, and convert between Lewis (Kekule), Condensed, and Bond-line Structures - refer to sections 1.3, 1.4, 1.5, and 1.6 ● apply bonding patterns and polarity to organic compounds - refer to

Lewis, Kekule, Bond-Line, Condensed, and Perspective ● Electronegativity and Bond Polarity (Review) ● Resonance ● Arrhenius Acids and Bases (Review) ● Lewis Acids and Bases ● Distinguishing Between pH and pKa ● Predicting Relative Acidity ● Molecular Formulas and Empirical Formulas (Review) ● Bronsted-Lowry Acids and Bases (Review)	WOC.1.8 WOC.1.9 WOC.1.10 WOC.1.11 WOC.1.12 WOC.1.13 WOC.1.14 WOC.1.15 WOC.1.18	section 1.7 and 1.8 ● identify polar bonds and compounds - refer to section 1.9 ● draw resonance forms and predict the relative contribution of each resonance form to the overall structure of the compound or ion - refer to section 1.10 ● recognize acids and bases - refer to sections 1.11 and 1.12 ● use the definition of Lewis Acids and Bases to recognize electron movement in reactions - refer to section 1.13 ● predict reaction products of acid-base reactions - refer to sections 1.11, 1.12 ,and 1.13 ● determine relative strengths of acids and bases from their pKa values - refer to section 1.14 ● determine the form of an acid or base at a specified pH (given the pKa) - refer to section 1.14 ● predict relative strengths of acids and bases from their structure, bonding and resonance - refer to section 1.15 ● determine the empirical and molecular formulas from combustion data - refer to section 1.16
Structure and Properties of Organic Molecules ● Electrostatics and	WOC.2.1	

Sterics ● Molecular Orbital Theory (Review) ● Hybridization and Molecular Shapes (Review) ● Conjugated Pi Bond Systems ● Lone Pair Electrons and Bonding Theories ● Bond Rotation ● Isomerism Introduction ● Hydrocarbons and the Homologous Series ● Organic Functional Groups ● Intermolecular Forces IMF's (Review) ● Intermolecular Forces and Relative Boiling Points ● Intermolecular Forces and Solubilities ● Organic Functional Groups, H-Bond Donors and H-Bond Acceptors	WOC.2.2 WOC.2.3 WOC.2.4 WOC.2.5 WOC.2.6 WOC.2.7 WOC.2.8 WOC.2.9 WOC.2.10 WOC.2.11 WOC.2.12 WOC.2.14	● define the terms "sterics" and "electrostatics" ● write and interpret molecular orbital (MO) diagrams ● predict the hybridization and geometry of atoms in a molecule ● draw accurate 3-D representations of molecules with approximate bond angles ● recognize conjugated pi bond systems ● recognize that benzene is aromatic ● identify the orbitals occupied by lone pair electrons ● distinguish between bonds that can rotate and those that cannot ● recognize the relationships between constitutional (structural) isomers, conformational isomers, and geometric isomers ● classify hydrocarbons as saturated or unsaturated ● classify hydrocarbons as alkanes, alkenes, alkynes, cycloalkanes, or aromatics (arenes) ● apply the homologous series to organic molecules with 1-10 carbons ● recognize and classify the common functional groups of organic chemistry (alkanes, alkenes, alkynes, alkyl halides, alcohols, amines, ethers, aldehydes, ketones, carboxylic acids, esters, and amides ● determine the dominant

		intermolecular forces (IMFs) of organic compounds ● predict the relative boil points of organic compounds ● predict whether a mixture of compounds will a form homogeneous or heterogeneous solution ● distinguish between organic compounds that are H-bond donors versus H-bond acceptors

Structure and Stereochemistry of Alkanes ● Hydrocarbon Functional Groups ● Physical Properties of Alkanes ● Structure and Conformations of Alkanes ● Conformations of Butane ● Conformations of higher alkanes ● Cycloalkanes and Ring Strain ● Cyclohexane Conformations ● Conformations of Monosubstituted Cyclohexanes ● Cis-Trans Isomerism in Cycloalkanes ● Conformations of Disubstituted Cyclohexanes ● Joined Rings ● Uses and Sources of Alkanes ● Reactions of Alkanes a Brief Overview	WOC.4.1 WOC.4.2 WOC.4.3 WOC.4.4 WOC.4.5 WOC.4.6 WOC.4.7 WOC.4.8 WOC.4.9 WOC.4.10 WOC.4.11 WOC.4.12 WOC.4.13	● distinguish between the different hydrocarbon functional groups ● explain & predict the physical properties of alkanes including relative bp and solubility in a mixture ● interpret and draw the rotation about a carbon-carbon single bond using Newman projections and sawhorse structures ● correlate energies of conformations with rotational energy diagrams ● interpret and draw the rotation about a carbon-carbon single bond using Newman projections and sawhorse structures ● correlate energies of conformations with rotational energy diagrams and predict the most stable conformations for

		butane ● interpret and draw the rotation about a carbon-carbon single bond using Newman projections and sawhorse structures ● correlate energies of conformations with rotational energy diagrams and predict the most stable conformations for higher alkanes ● explain the partial rotation of carbon-carbon single bonds in rings ● explain ring strain and its relationship to cycloalkane stability ● draw cyclohexane conformations (chair & boat) ● correlate energies of conformations with rotational energy diagrams and predict the most stable conformations for cyclohexane ● draw mono-substituted cyclohexane conformers (chair only) ● correlate energies of conformations with rotational energy diagrams and predict the most stable conformations for butane, higher alkanes, cyclohexane, mono-substituted cyclohexanes, and disubstituted cyclohexanes ● identify & draw the geometric (cis/trans) isomers of cycloalkanes ● draw di-substituted cyclohexane conformers

		(chair only) ● correlate energies of conformations with rotational energy diagrams and predict the most stable conformations for disubstituted cyclohexanes ● recognize, classify, and draw the three ways to join two rings ● describe the uses and sources of alkanes

Organic Chemistry 2 for High School

Course Description:

Organic Chemistry 2 for High School picks up where Organic Chemistry 1 for High School concludes. This course begins with an introduction to different types of organic reactions and then continues onto reaction mechanism notations and symbols, polar reactions, equilibrium and free energy descriptions of reactions, homolytic cleavage and bond dissociation energies, reaction energy diagrams and transition states, reactive intermediates, free-radical halogenation of alkanes, reactivity and selectivity, and a comparison between biological reactions and laboratory reactions. The course emphasizes the application of theoretical knowledge to real-world problems, challenging students to think critically and creatively about organic chemistry's role in scientific research and industry.

Course Goals:

The goal of Organic Chemistry 2 for High School is to further prepare students for organic chemistry in college during their course of study as a chemist, chemical engineer, material science, premed, or related major. After completion of this course, students will be able to enter their organic chemistry course in college with a significant advantage over most of their peers. Students who successfully complete this course will have learned the foundational concepts that define organic chemistry as a whole. The overall goal is for these students to be able to enter their organic chemistry course in college with confidence and a considerable reduction in stress that many students endure.

Course of Instruction:

This course will utilize a synchronized online learning platform. Each week, students will participate in two 90 minute lessons, with the instructor and other students, using Google Meet as the video conferencing application. In addition, students will be given materials, assignments and supplemental resources, to complete the learning objectives. Students will have weekly assignments to aid in their learning of the material. A research paper, along with a formal poster presentation will be assigned on a

topic that pertains to the contents of the course. During the research process, students will learn how a real scientist works. This includes how to properly research topics, write a literature review and scientific paper, in addition prepare/present a poster for their peers. Unit tests will be used to assess students' comprehension of the topics as well as their efficiency of the test taking process itself.

Organic Chemistry 2 for High School		
Topics	**Standards** (Wade Organic Chemistry Text: Instructor created ID codes for standards based on sections in text)	**Outcomes** **Students will be able to…**
An Introduction to Organic Reactions Using Free Radical Halogenation of Alkanes ● Types of Organic Reactions ● Reaction Mechanism Notations and Symbols ● Polar Reactions: The Dance of the Nucleophile and Electrophile ● Describing a Reaction: Equilibrium and Free-Energy Changes ● Homolytic Cleavage and Bond Dissociation Energies ● Reaction Energy Diagrams and Transition States ● Reactive Intermediates-Carbocations ● Reactive Intermediates-Radicals ● Reactive Intermediates-Carbanions and Carbon Acids ● Free-Radical Halogenation	WOC.5.1 WOC.5.2 WOC.5.3 WOC.5.4 WOC.5.5 WOC.5.6 WOC.5.7 WOC.5.8 WOC.5.9 WOC.5.10 WOC.5.11	● recognize and distinguish between the four major types of organic reactions (additions, eliminations, substitutions, and rearrangements) ● accurately and precisely use reaction mechanism notation and symbols including curved arrows to show the flow of electrons ● identify nucleophiles and electrophiles in polar reactions ● relate bond polarity to chemical reactivity ● perform calculations using the equation $\Delta G^o = -RT\ln K = -2.303RT \log_{10} K$ and explain the relationship between equilibrium and free energy ● calculate reaction enthalpies from bond dissociation energies ● draw Reaction Energy Diagrams from the thermodynamic and kinetic data/information ● use a reaction energy diagram to discuss transition states, Ea, intermediates & rate determining step ● draw the transition state of a reaction

of Alkanes ● Reactivity and Selectivity		● describe the structure & relative stabilities of carbocations ● describe the structure & relative stabilities of free radicals ● describe the structure & relative stabilities of free radicals ● compare the reactivity and selectivity of halogens during alkane halogenation
Stereochemistry at Tetrahedral Centers ● Chirality ● Fischer Projections to Communicate Chirality ● Absolute Configuration and the (R) and (S) System ● Diastereomers - more than one chiral center ● Meso Compounds ● Isomerism Summary Diagram ● Optical Activity and Racemic Mixtures ● Resolution (Separation) of Enantiomers ● Stereochemistry of Molecules with 3 or More Asymmetric Centers ● Absolute and Relative Configuration -the Distinction ● Chirality at Nitrogen, Phosphorous, and Sulfur ● Biochemistry of Enantiomers ● Discovery of Enantiomers	WOC.6.1 WOC.6.2 WOC.6.3 WOC.6.4 WOC.6.5 WOC.6.6 WOC.6.7 WOC.6.8 WOC.6.9 WOC.6.10 WOC.6.11 WOC.6.12 WOC.6.13	● recognize and classify molecules as chiral or achiral and identify planes of symmetry ● draw, interpret, and convert between perspective formulae and Fischer projections for chiral compounds ● name chiral compounds using (R) & (S) nomenclature ● recognize and classify diastereomers ● recognize and classify meso compounds ● distinguish and discern the structural and chemical relationships between isomeric compounds ● define and explain the lack of optical activity of racemic mixtures ● determine the percent composition of an enantiomeric mixture from polarimetry data and the for specific rotation formula ● explain how to resolve (separate) a pair of enantiomers ● interpret the stereoisomerism of compounds with three or more chiral centers ● compare and contrast absolute configuration with relative configuration ● interpret the stereoisomerism of compounds with nitrogen, phosphorus, or sulfur as chiral centers ● recognize and explain biochemical applications of chirality ● describe Jean Baptiste Biot and Louis Pasteur's contributions to the understanding of optical isomers

Class Title: Biomolecules: From Atoms to Organisms

Course Description

Biomolecules: From Atoms to Organisms, is an introductory course that explores the foundational principles of biology. This course is designed to provide students with a comprehensive understanding of the key concepts and processes that govern life. Through lessons, discussions, and activities, students will investigate the properties of water, biological molecules, DNA structure and function, the hierarchy of biological systems, homeostasis, photosynthesis, cellular respiration, and mitosis. This course aims to build a strong foundation for further studies in biological sciences.

Course Goals:

The goal of the Biomolecules: From Atoms to Organisms course to lay the foundation for the future study of biological processes. This course introduces students to the 4 biomolecules that are essential for living organisms as well as the chemical composition of DNA and the chemical process of protein synthesis. Another goal of this course is to illustrate the hierarchical organization of interacting systems that provide specialized functions within multicellular organisms and the need for homeostasis in that organism and how it is achieved. The next goal of the course is to introduce cellular respiration and photosynthesis as the opposing chemical reactions that take place on the cellular level. The final goal of this course is to explain the role of mitosis in differentiating and maintaining multicellular organisms.

Course of Instruction:

This course will utilize a synchronized online learning platform. Each week, students will participate in a 90 minute lesson, with the instructor and other students, using Google Meets as the video conferencing application. In addition, students will be given materials, assignments and supplemental materials, to complete the learning objectives. Students will have weekly assignments to aid in their learning of the material. A research paper will be assigned over a topic that pertains to the course topics. During the research process, the instructor will reinforce the science literacy cross cutting concepts of the NGSS in the way a paper is researched and written for science. Unit tests will be used to assess students' comprehension of the topics. Lab reports are another cross cutting concept that will be taught while using hands-on activities to help students construct their understanding of the atoms to organisms curriculum standards.

Biomolecules: From Atoms to Organisms		
Topics	**NGSS Competencies**	**Outcomes** ***Students will be able to . . .***
Properties of Water	HS-PS1-2	● Explain how the properties of water are

		important to life
Biological Molecules Topics: ● 4 classes of biomolecules ● Dehydration synthesis/hydrolysis ● Importance of a protein's shape ● Enzymes	HS-LS1-6	● List the 4 major biomolecules ● Describe the structure of biomolecules in terms of monomer/polymer ● Explain the role of water in synthesis and hydrolysis ● Explain how the shape of a protein relates to its function ● Explain how an enzyme functions
DNA: Structure & Function ● Structure of DNA ● Protein synthesis	HS-LS1-1	● Explain how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.
Hierarchy of Biological Systems	HS-LS1-2.	● Illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
Homeostasis	HS-LS1-3.	● Explain how feedback mechanisms maintain homeostasis.
Photosynthesis	HS-LS1-5.	● Illustrate how photosynthesis transforms light energy into stored chemical energy.
Cellular Respiration	HS-LS1-7	● Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.
Mitosis	HS-LS1-4.	● Illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms

Class Title: Earth's Hydrosphere

Course Description:

This course delves into the intricate interactions between water and the lithosphere, exploring how these interactions shape various bodies of water. Students will gain a comprehensive understanding of the physical and chemical properties of water, the processes of water deposition and erosion, and the key parameters that determine water quality in the environment.

Course Goals:

To understand water and lithosphere interactions comprehensively, it is essential to explore how water shapes various landforms and bodies of water through processes such as erosion, deposition, and weathering. Learning about the mechanisms and effects of water erosion and deposition reveals how features like river valleys, deltas, and floodplains form. Analyzing the unique chemical properties of water highlights their environmental and biological significance. Investigating key water quality parameters demonstrates how these factors impact aquatic ecosystems and human health. Developing analytical skills to assess and interpret data related to water systems and water quality fosters critical thinking and problem-solving abilities in environmental science contexts.

Course of Instruction:

This course will utilize a synchronized online learning platform. Each week, students will participate in a 90 minute lesson, with the instructor and other students, using Google Meets as the video conferencing application. In addition, students will be given materials, assignments and supplemental materials, to complete the learning objectives. Students will have weekly assignments to aid in their learning of the material. A research paper will be assigned over a topic that pertains to the course topics. During the research process, the instructor will reinforce the science literacy cross cutting concepts of the NGSS and the AP Earth & Environmental Courses, in the way a paper is researched and written for science. Unit tests will be used to assess students' comprehension of the topics. Lab reports are another cross cutting concept that will be taught while using hands-on activities and environmental field trips to help students construct their understanding of the fresh water systems and human impact upon them.

Earth's Hydrosphere		
Topics	**Competencies**	**Outcomes** ***Students will be able to . . .***
Water Systems: How water interacts with the lithosphere and creates various bodies of water	NGSS HS-ESS2-5	● Develop a model to illustrate how Earth's internal and surface processes at different spatial and temporal scales to form continental and ocean-floor

		features.
Water Deposition & Erosion	NGSS HS-ESS2-5	● Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
Chemical properties of water: ● Water is polar ● Water is an excellent solvent. ● Water has high heat capacity. ● Water has a high heat of vaporization. ● Water has cohesive and adhesive properties. ● Water is less dense as a solid than as a liquid.	NGSS HS-ESS2-5	● Explain polarity and its importance to the properties of water. ● Explain why water is an excellent solvent. ● Describe the cohesive and adhesive properties of water and give examples of both. ● Explain the significance of water being less dense as a solid than as a liquid.
Water quality: Investigate the quality of water in the environment to include, but not limited to, the following parameters: ● Coliform ● pH ● Nitrates ● Phosphates ● Turbidity ● Dissolved Oxygen ● temperature	AP Earth & Environmental	● Explain the sources of the various pollutants. ● Collect and analyze environmental water samples for the listed pollutants in order to determine the health of the water system.

Class Title: Earth's Lithosphere

Course Description

This course offers a comprehensive study of the dynamic processes shaping the Earth's surface and the formation and properties of soil. Students will explore the principles of plate tectonics, the processes involved in soil formation, and the key properties that characterize different types of soil.

Course Goals:

To gain a comprehensive understanding of soil science, one must first grasp the fundamental concepts of plate tectonics, including the movement of lithospheric plates, as these geological processes significantly impact soil formation. It is crucial to understand the physical, chemical, and biological weathering processes that break down rocks and minerals into smaller particles, contributing to soil development. Another goal of this course is to examine physical properties and its chemical characteristics. Exploring methods for maintaining and improving soil fertility, such as using fertilizers, composting, and sustainable agricultural practices, helps ensure long-term soil productivity and environmental sustainability.

Course of Instruction:

This course will utilize a synchronized online learning platform. Each week, students will participate in a 90 minute lesson, with the instructor and other students, using Google Meets as the video conferencing application. In addition, students will be given materials, assignments and supplemental materials, to complete the learning objectives. Students will have weekly assignments to aid in their learning of the material. A research paper will be assigned over a topic that pertains to the course topics. During the research process, the instructor will reinforce the science literacy cross cutting concepts of the NGSS and the AP Earth & Environmental Courses, in the way a paper is researched and written for science. Unit tests will be used to assess students' comprehension of the topics. Lab reports are another cross cutting concept that will be taught while using hands-on activities and environmental field trips to help students construct their understanding of the Earth's lithosphere and human impact upon it.

Earth's Lithosphere		
Topics	**Competencies**	**Outcomes** ***Students will be able to . . .***
Plate Tectonics	AP Earth & Environmental Course: ERT 4.A.1-5	Describe the geological changes and events that occur at convergent, divergent, and transform plate boundaries. Illustrate divergent, convergent, and transform boundaries and the geological features they create. Explain Plate Movements and Interactions: the processes of subduction, seafloor spreading, and continental drift. Model the formation of mountains, earthquakes, volcanoes, and oceanic trenches as a result of plate movements.
Soil Formation	AP Earth & Environmental Course:	Describe the characteristics and formation of soil.

	ERT 4.B.1-3	Explain the roles of parent material, climate, organisms, topography, and time in soil formation. Describe the stages of soil development from initial rock breakdown to mature soil profiles.
Soil Properties	AP Earth & Environmental Course: ERT 4.C.1-4	Describe similarities and differences between properties of different soil types. Explain the development of soil horizons (O, A, E, B, C, and R) and their characteristics. Describe soil taxonomy and the classification systems used to categorize different soil types.

Class Title: Earth's Atmosphere

Course Description:

This course provides an in-depth exploration of weather and climate, examining the factors that influence atmospheric conditions and climate patterns on Earth. Students will study the Earth's atmosphere, global wind patterns, solar radiation, and the impact of Earth's geography on climate. The course also covers the structure and composition of the atmosphere and the changes in climate over time.

Course Goals:

The first goal of this course is to understand the layers of the atmosphere. This is followed by an understanding of both weather and climate. Building upon this foundation, this course will offer an introduction to solar radiation and Earth's seasons and how geography and climate are interwoven.

Course of Instruction:

This course will utilize a synchronized online learning platform. Each week, students will participate in a 90 minute lesson, with the instructor and other students, using Google Meets as the video conferencing application. In addition, students will be given materials, assignments and supplemental materials, to complete the learning objectives. Students will have weekly assignments to aid in their learning of the material. A research paper will be assigned over a topic that pertains to the course topics. During the research process, the instructor will reinforce the science literacy cross cutting concepts of the NGSS and the AP Earth & Environmental Courses, in the way a paper is researched and written for science. Unit tests will be used to assess students' comprehension of the topics. Lab reports are another cross cutting

concept that will be taught while using hands-on activities and environmental field trips to help students construct their understanding of the Earth's atmosphere and human impact upon it.

Earth's Atmosphere		
Topics	**Competencies**	**Outcomes** ***Students will be able to . . .***
Weather & Climate	NGSS:HS ESS2.D	Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that causes changes to other Earth systems.
Changes in Climate	NGSS: HS ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
Earth's Atmosphere	AP Earth & Environmental Course: ERT 4.4.4	Describe characteristics of an environmental concept, process, or model represented visually.
Global Wind Patterns	AP Earth & Environmental Course: ERT 4.4.5	Explain how environmental factors can result in atmospheric circulation. Explain relationships between different characteristics of environmental concepts, processes, or models represented visually: ● In theoretical contexts ● In applied contexts
Solar Radiation & Earth's Seasons	AP Earth & Environmental Course: ENG2.4.7	Describe and explain how global wind patterns primarily result from the most intense solar radiation arriving at the equator, resulting in density differences and the Coriolis effect.
Earth's Geography and Climate	AP Earth & Environmental Course: ENG2.4.8	Explain relationships between different characteristics of environmental concepts, processes, or models represented visually: ● In theoretical contexts ● In applied contexts
Earth's Atmospheric Structure	AP Earth & Environmental Course: ERT4.D.1	Describe the structure of the Earth's atmosphere.
Earth's Atmospheric Composition	AP Earth & Environmental Course: ERT4.D.2	Describe composition of the Earth's atmosphere.

Class Title: Earth's Systems & Sustainability

Course Description:

This course provides an in-depth examination of natural resources, their production, and the various impacts of human activities and technological advancements on these resources and Earth's systems. Students will explore the balance between resource utilization and environmental sustainability, and the role of social regulations in managing natural resources.

Course Goals:

The first goal of this course is to explain how natural resources and energy production has influenced both the history of society and the future of human society. The second goal of this course is to delve into the impact of human activity on the sustainability of Earth's Systems for the present and future.

Course of Instruction:

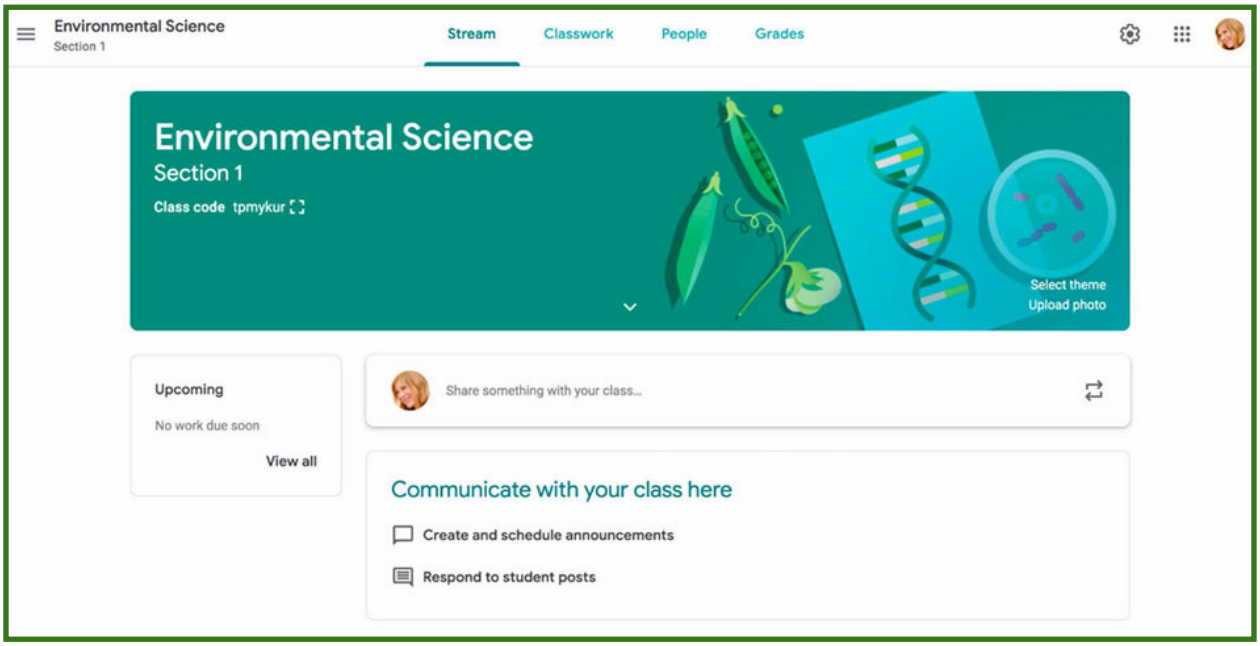
This course will utilize a synchronized online learning platform. Each week, students will participate in a 90 minute lesson, with the instructor and other students, using Google Meets as the video conferencing application. In addition, students will be given materials, assignments and supplemental materials, to complete the learning objectives. Students will have weekly assignments to aid in their learning of the material. A research paper will be assigned over a topic that pertains to the course topics. During the research process, the instructor will reinforce the science literacy cross cutting concepts of the NGSS in the way a paper is researched and written for science. Unit tests will be used to assess students' comprehension of the topics. Lab reports are another cross cutting concept that will be taught while using hands-on activities and environmental field trips to help students construct their understanding of the Earth's Systems & Sustainability and human impact upon it.

Earth's Systems & Sustainability		
Topics	**Competencies**	**Outcomes** ***Students will be able to . . .***
Natural Resources	NGSS: HS ESS3.1	Explain how the availability of natural resources has guided the development of human society.
Energy & Natural Resource Production	NGSS: HS ESS3.1	Explain the associated economic, social, environmental and geopolitical costs and risks as well the benefits to the various forms of energy production and other resources.
The impact of social	NGSS: HS ESS3.2	Describe how regulations and new technologies can

regulations and new technologies on natural resources		impact the production of energy and other natural resources.
Human Impact on Earth's Systems	NGSS: HS ESS3.3	Describe how the sustainability of human societies and the biodiversity that supports them require responsible management of natural resources. Explain the major contributions of science and engineering that have decreased pollution and waste and that preclude ecosystem degradation.

7.0 A plan for recording student progress in meeting expected student outcomes [Ed 1403.01(e)(1)(c)].

The same platform and procedures are followed for all courses offered by Cairn. Students will be informed of their progress with feedback on each weekly assignment, discussions with the instructor during synchronized learning sessions, and formal feedback on tests, research papers and lab reports. Cairn uses the Google Classroom platform to facilitate courses. This platform allows students to see their assignments and instructor comments as soon as assignments are graded. The platform also allows for easy communications between instructor and students. Below is a snapshot of a class page using Google Classroom.



8.0 A description of assessments of student learning outcomes, including, but not limited to:

1. Instructor observation of project-based learning, including off-site learning projects;
2. Competency-based or performance-based assessments;
3. Instructor observations of student performance;
4. Project evaluation rubrics used to evaluate program proficiencies; and
5. Other assessment approaches as determined by the applicant's learn everywhere program

[Ed 1403.01(e)(1)(d)].

Lab Reports: For all Cairn courses that include labs, the Science Writing Heuristic is the assessment tool used. See Appendix IV for a detailed description of the rubric.

All Cairn courses include **competency-based assessments (tests) and weekly assignments.** See the appendix for individual class rubrics which evaluate student proficiency on these and how they factor into the overall evaluation of student proficiency in the course.

All Cairn courses that include a **research paper** have a **competency-based rubric that** evaluates student proficiency and how this factors into the overall evaluation of student proficiency in the course. See the appendix for individual class rubrics.

Poster Presentation: For all Cairn courses that include poster presentations, there is a competency-based rubric that evaluates student proficiency of the poster presentation and how this factors into the overall evaluation of student proficiency in the course. See the appendix for individual class rubrics.

2 out of 3 is an adequate competency rating for credit in the class. Cairn will also provide a numerical average which is based off of the percentage of student competency for districts and/or schools who require this in order to incorporate our classes into the student GPA.

9.0 The number of credits the program will fulfill [Ed 1403.01(e)(1)(e)].

Cairn Educational Consulting

Courses and Corresponding Credit Values

Course Name	Credit Value
Honors Chemistry I	0.5
Honors Chemistry II	0.5
College Chemistry for High School I	1.0
College Chemistry for High School II	1.0
Organic Chemistry 1 for High School	1.0
Organic Chemistry 2 for High School	1.0
Biomolecules: Atoms to Organisms	0.5

Earth's Hydrosphere	0.25
Earth's Lithosphere	0.25
Earth's Atmosphere	0.25
Earth's Systems & Sustainability	0.25

10.0 A description of the competency-based grading system [Ed 1403.01(e)(1)(f)].

At Cairn, we employ a competency-based grading system through the use of learning objectives, multiple opportunities to demonstrate mastery of the subject matter, formative assessments and feedback throughout the course. Within each course outline, every Cairn class has a comprehensive description of the competencies being employed as well as the course objectives (student outcomes) for each competency. Each Cairn course offers multiple opportunities for students to demonstrate mastery. A variety of these include: the use of weekly assignments, laboratory experiences, research papers, poster presentations and tests. Each Cairn class is unique, to see specifically what multiple opportunities are available for each course please see the individual course outlines. Each Cairn course includes weekly assignments that are formative in nature designed to help students understand and complete concepts and skills. Weekly assignments and weekly sessions with other students and the instructor provide ongoing feedback for all students. Individuals also receive detailed feedback on assignments such as lab reports and research papers.

11.0 A description of methods for admission which shall not be designed, intended, or used to discriminate or violate individual civil rights in any manner prohibited by law [Ed 1403.01(e)(2)(a)].

Students from 8th through 12th grade are eligible for our programs based on a first come, first served basis. Acceptance into a Cairn course/program is based on educational appropriateness and parental permission. Our targeted student is one who seeks more rigorous and college directed science instruction and does not necessarily have access to this level of education.

Criteria for our admission policy:

- Age appropriateness. Our courses are designed for high school credit and therefore students should be in high school with the exception of advanced 8th graders.
- Course prerequisite requirements: Our courses require that students have completed some general science courses in order to be able to be successful in our advanced science courses.

The application process is not designed, intended or used to discriminate or violate individuals' civil rights in any manner prohibited by law, but is used by Cairn staff to assess student interest, goals, grade level, credit requirement (if any) and experience. Students seeking school credit will be required to disclose their school and district information, including the name and contact information for their school guidance department.

Any student who completes a course with Cairn will be issued a certificate for credit for that course. Students seeking school credit will be required to disclose their school and district information, including the name and contact information for their school guidance department.

12.0 A description of how the program will liaison with the LEA for students with an education plan pursuant to section 504 of the Rehabilitation Act [Ed 1403.01(e)(2)(b)].

At the time of enrollment, Cairn offers parents the opportunity to disclose any information regarding ongoing 504 education plan related accommodations and modifications required for their child. With the parent's permission, Cairn will contact the student's Local Education Agency (LEA) to coordinate recommended 504 accommodations and/or modifications in the Cairn programs. Although Cairn instructors are not explicitly certified to work with students with 504 plans, they are caring, patient and compassionate and can work with the student's LEA representative to understand how to implement recommended accommodations and/or modifications. If Cairn determines it is unable to provide the required accommodations and/or modifications for a student, the parents will be informed before committing to enrolling their child in a Cairn program.

13.0 A description of how the program will liaison with the LEA for a student with disabilities, consistent with the student's IEP to include, but not be limited to coordinating

1. Required special education programs;
2. Support services; and
3. Least restrictive environment.

[Ed 1403.01(e)(2)(c)].

Cairn gives all parents the opportunity to disclose any sorts of disabilities, including any related Individualized Education Program (IEPs). If requested, Cairn will work with the parent to contact the student's Local Education Agency (LEA) to assist in the coordination of the student's IEP to include, but not be limited to, the required special education programs, support services, and least restrictive environment. At the parent's request, a Cairn representative will participate in IEP team meetings that discuss revisions to the student's IEP needed to participate in an Cairn program. Cairn will also coordinate with the LEA in fulfilling the LEA's responsibility to provide any special education, related services, supplementary aids and services, accommodations, and modifications the IEP team has determined the student needs. The provision of these services is not the direct responsibility of Cairn.

14.0 A statement that the applicant understands that it has certain responsibilities, pursuant to Section 504 of the Rehabilitation Act, if it receives federal funds, or the Americans with Disabilities Act, as amended, to provide students with disabilities with equal access and equal opportunities to participate in the learn everywhere program, including by providing the student with reasonable accommodations [Ed 1403.01(e)(2)(d)].

Cairn understands that it has certain responsibilities, pursuant to Section 504 of the Rehabilitation Act, if it receives federal funds, or the Americans with Disabilities Act, as amended, to provide students with disabilities with equal access and equal opportunities to participate in the Learn Everywhere program, including by providing the student with reasonable accommodations as required in Ed 1403.01(b)(2)(d).

15.0 A description of facilities to be used for educational instruction and a description of how the facilities will meet the priorities of the program [Ed 1403.01(e)(3)(a)].

Much of the instruction at Cairn is online and either asynchronous or synchronous. Activities that do require in person instruction will be held in community spaces such as public libraries. Environmental field trips will be conducted in New Hampshire's state and national parks and environmental education centers, for example, The Seacoast Science Center in Rye, NH.

16.0 A statement affirming that the facilities shall comply with all applicable federal and state health and safety laws, rules, and regulations, including but not limited to the following

1. Fire safety; and
2. Barrier-free access under Abfd 300, code for barrier-free design, and the Americans with Disabilities Act of 1990 (ADA), as amended by the ADA Amendments Act of 2008

[Ed 1403.01(e)(3)(b)].

Cairn affirms that when selecting locations to hold classes, it complies with all applicable federal and state health and safety laws, rules, and regulations, as required by the Department's rule Ed 1403.01(e)(3)(b).

17.0 Disclosure of insurance, if any, which would cover the participants in the Learn Everywhere program [Ed 1403.01(e)(4)].

Cairn maintains $2,000,000 of general aggregate insurance with $1,000,000 worth of insurance for each occurrence. We also carry a Professional Liability rider of $1,000,000 per claim. We use CGI Business Insurance, 5 Dartmouth Drive in Auburn, NH 03032. Our agent's name is Connor Walsh. If necessary, Cairn will disclose our insurance information to a parent of Learn Everywhere participants prior to enrollment of their student.

Appendices

I. About Us

Cairn Educational Consulting was created by two highly experienced science teachers who hold doctoral degrees in STEM Curriculum and Chemistry. Having both worked at STEM based schools, we have a wealth of insight on what the current needs are for students looking to go into majors in STEM fields. At Cairn, our goal is to provide advanced and rigorous science courses to students, whether it be through homeschooling or students who need more individualized instruction than traditional school can offer. Sometimes students simply do not have enough time in their school schedule and wish to take an additional class. We offer quality science instruction that is flexible to the student's needs and provides plenty of face time with the instructor. To accommodate for the necessary lab experience these classes offer, we will be partnering with the New Hampshire Academy of Sciences, to ensure our students receive a complete science curriculum.

Dr. MacDonald holds a Doctorate degree in Polymer Chemistry from University of Massachusetts at Lowell and has spent the past 14 years dedicated to shaping the academic trajectory of students in public and charter schools. As the science chair at the Academy for Science and Design, she played a pivotal role in developing and implementing innovative science curricula that exceeded state standards, fostering a culture of academic excellence. Dr. MacDonald's instructional expertise spans a wide range of scientific disciplines, including middle school chemistry, college prep chemistry, honors chemistry, advanced chemistry, AP chemistry, organic chemistry, conceptual and advanced physics, advanced biology, algebra II, and pre-calculus. Dr. MacDonald has been actively involved in enriching students and educational experiences through extracurricular activities and mentorship programs. She has coached Science Olympiad and Science Bowl teams, guiding students to success in regional and national competitions. Additionally, Dr. MacDonald has served as a mentor for aspiring scientists, supporting students in their own chemistry research projects and fostering a spirit of scientific inquiry and discovery.

Dr. Calderara holds a Doctorate degree in Science Education from North Carolina State which is complemented by a Master's Degree in Curriculum and Instruction (UNCG). Spanning over 20 years, Dr. Calderara has held various leadership roles in education, across multiple disciplines. As a curriculum coach for all core content subjects, she has spearheaded initiatives to enhance instructional practices and align curriculum with state standards, ensuring a rigorous and engaging learning experience for students. Dr. Calderara's specialization in science education is evident in her role as a science coach for grades 3-8, where she has provided targeted support and professional development opportunities for educators to improve science instruction as well as student achievement. Her impact extends to the administrative realm, having served as the Curriculum Director for the Academy for Science & Design, overseeing curriculum development and implementation for grades 6-12.

CAIRN EDUCATIONAL CONSULTANTS

WAIVER AND RELEASE BY PARENT OF MINOR CHILD

I, _____, on behalf of _____ (hereinafter referred to as "CHILD") HEREBY WAIVE AND RELEASE, indemnify, hold harmless and forever discharge CAIRN EDUCATIONAL CONSULTANTS and its teachers, agents, employees, officers, directors, affiliates, successors, members, trustees, alumni, and assigns, of and from any and all claims, demands, debts, contracts, expenses, causes of action, lawsuits, damages and liabilities, of every kind and nature, whether known or unknown, in law or equity, that I or CHILD ever had or may have, arising from or in any way related to CHILD'S participation in any of the functions or activities conducted by, on the premises of, or for the benefit of, CAIRN EDUCATIONAL CONSULTANTS provided that this waiver of liability does not apply to any acts of gross negligence, or intentional, willful or wanton misconduct.

I understand that the activities that said CHILD will participate in are inherently dangerous and may cause serious or grievous injuries, including bodily injury, damage to personal property and/or death. On behalf of myself, CHILD, my heirs, assigns and next of kin, I and said CHILD waive all claims for damages, injuries and death sustained to me or my property, that I or said CHILD may have against the aforementioned released party to such activity.

CHILD has the necessary and requisite skills to participate in all aspects of this school function, except as noted below. The nature of the activities has been fully disclosed and any flyer, advertisement, or brochure relating to the participating activities is expressly made a part of this WAIVER AND RELEASE.

By this Waiver, I, on behalf of said CHILD, assume any risk, and take full responsibility and waive any claims of personal injury, death or damage to personal property associated with CAIRN EDUCATION CONSULTANTS , including but not limited to participating in the function or event, using the facility and its equipment in any manner, form or fashion, and transportation to and from the function.

This WAIVER AND RELEASE contains the entire agreement between the parties, and supercedes any prior written or oral agreements between them concerning the subject matter of this WAIVER AND RELEASE. The provisions of this WAIVER AND RELEASE may be waived, altered, amended or repealed, in whole or in part, only upon the prior written consent of all parties.

The provision of this WAIVER AND RELEASE will continue in full force and effect even after the termination of the activities conducted by, on the premises of, or for the benefit of, CAIRN EDUCATIONAL CONSULTANTS by agreement, by operation of law, or otherwise.

I have read, understand and fully agree to the terms of this WAIVER AND RELEASE. I understand and confirm that by signing this WAIVER AND RELEASE said CHILD and I have given up considerable future legal rights. I have signed this Agreement freely, voluntarily, under no duress or threat of duress, without inducement, promise or guarantee being communicated to me. My signature is proof of my intention to execute a complete and unconditional WAIVER AND RELEASE of all liability to the full extent of the law.

Medical Conditions. CHILD is subject to the following allergies or medical conditions, and I authorize the facility to disclose these conditions to a physician or other medical professional in the event said CHILD should require emergency medical care: _____

_____

_____

_____

Prohibited Activities. As a result of the above-mentioned medical conditions, I, on behalf of said CHILD, am prohibiting involvements in the following specific activities: _____

_____

_____

_____

_____

_____
Date

_____
Printed Name of CHILD

_____
Printed Name of Parent (Guardian)

_____
Signature of Parent (Guardian)

III. Cairn Educational Consulting Course Rubrics

Honors Chemistry I & II Rubric				
	3	**2**	**1**	**Student Score**
Weekly Assignments	All assignments were attempted and completed independently. Student was present and participated in the weekly class discussions.	90% of weekly assignments were attempted and completed independently. Student was present and participated 90% of the time during weekly class discussions.	80% or less of weekly assignments were attempted and completed independently. Student was present and participated 80% or less of the time during weekly class discussions.	
Tests	Tests Correctly answering over 90% of the test material that illustrates a thorough understanding of the subject matter.	Tests Correctly answering over 80% of the test material that illustrates a thorough understanding of the subject matter.	Tests Correctly answering over 70% of the test material that illustrates a thorough understanding of the subject matter.	
Quizzes	Quiz correctly answering over 90% of the test material that illustrates a thorough understanding of the subject matter.	Quiz Correctly answering over 80% of the test material that illustrates a thorough understanding of the subject matter.	Quiz Correctly answering over 70% of the test material that illustrates a thorough understanding of the subject matter.	
Lab Reports	Grading of lab reports will follow the *Scientific Writing Heuristic Lab Report Rubric*. See Appendix IV			
			Average Student Score /12 =	

College Chemistry for High School I and II Rubric				
	3	**2**	**1**	**Student Score**
Weekly Assignments	All assignments were attempted and completed independently. Student was present and participated in the weekly class discussions.	90% of weekly assignments were attempted and completed independently. Student was present and participated 90% of the time during weekly class discussions.	80% or less of weekly assignments were attempted and completed independently. Student was present and participated 80% or less of the time during weekly class discussions.	
Tests	Tests Correctly answering over 90% of the test material that illustrates a thorough understanding of the subject matter.	Tests Correctly answering over 80% of the test material that illustrates a thorough understanding of the subject matter.	Tests Correctly answering over 70% of the test material that illustrates a thorough understanding of the subject matter.	
Research Paper	Final Research Paper is well written with a command of the supporting science concepts. Paper includes the following sections: • Introduction • Materials	The paper contains all of the required sections, but some information may be missing or miscategorized. The data is presented in figures and tables, but some legends or captions are missing. There are some errors in	Spelling and grammar errors make the paper difficult to understand. Sections are missing from the paper. The data is not reported graphically, or not reported at all. There are no legends or captions.	

	• Methods • Results • Discussion • Conclusion • Bibliography There are some spelling and grammar errors, but they do not hinder communication. The data is organized well into figures and tables with legends and captions. Appropriate statistical analysis has been conducted and is correctly displayed. The paper effectively communicates the research conducted and demonstrates an understanding of the project and how it fits into the body of scientific knowledge	the statistical analysis, or it is incorrectly displayed. The paper adequately communicates the research conducted. There are some gaps in the understanding of the project and how it fits into the body of scientific knowledge.	No attempt at statistical analysis has been made. The paper does not communicate the research conducted. The experimenter clearly did not understand the project. There is no context given for how the project fits into the body of scientific knowledge.	
Poster Presentation	All information was conveyed clearly and logically. There were no	There were some deficiencies in the clear and logical organization of the presentation.	The information presented did not at all follow a clear or logical path.	

	factual errors in the presentation. The research was presented within a narrative that had a clear beginning, middle, and end. The key findings from the research were communicated, and the general structure of standard format was followed. The student showed a comfort with and confidence in the scientific concepts of the research presented.	The presentation included a few factual errors. The narrative of the research was at times difficult to follow, Some key findings from the summary paper were omitted. The presentation did not consistently follow the standard format. Some discomfort was evident in lack of confidence in the scientific concepts of research.	The presentation included many factual errors. There was minimal clear narrative to the research presented. The presentation did not follow the standard format. Many key findings were not presented. The student demonstrated modest understanding of or comfort with the scientific concepts in the research.	
Lab Reports	Grading of lab reports will follow the *Scientific Writing Heuristic Lab Report Rubric*. See Appendix IV			
			Average Student Score	**/15**

Organic Chemistry 1 and 2 for High School Rubric				
	3	**2**	**1**	Student Score

Weekly Assignments	All assignments were attempted and completed independently. Student was present and participated in the weekly class discussions.	90% of weekly assignments were attempted and completed independently. Student was present and participated 90% of the time during weekly class discussions.	80% or less of weekly assignments were attempted and completed independently. Student was present and participated 80% or less of the time during weekly class discussions.	
Tests	Tests Correctly answering over 90% of the test material that illustrates a thorough understanding of the subject matter.	Tests Correctly answering over 80% of the test material that illustrates a thorough understanding of the subject matter.	Tests Correctly answering over 70% of the test material that illustrates a thorough understanding of the subject matter.	
Research Paper	Final Research Paper Paper is well written with a command of the supporting science concepts. Paper includes the following sections: • Introduction • Materials • Methods • Results • Discussion • Conclusion • Bibliography There are some spelling and grammar errors, but they do not	The paper contains all of the required sections, but some information may be missing or miscategorized. The data is presented in figures and tables, but some legends or captions are missing. There are some errors in the	Spelling and grammar errors make the paper difficult to understand. Sections are missing from the paper. The data is not reported graphically, or not reported at all. There are no legends or captions. No attempt at statistical analysis has been made. The paper does	

	hinder communication. The data is organized well into figures and tables with legends and captions. Appropriate statistical analysis has been conducted and is correctly displayed. The paper effectively communicates the research conducted and demonstrates an understanding of the project and how it fits into the body of scientific knowledge	statistical analysis or it is incorrectly displayed. The paper adequately communicates the research conducted. There are some gaps in the understanding of the project and how it fits into the body of scientific knowledge.	not communicate the research conducted. The experimenter clearly did not understand the project. There is no context given for how the project fits into the body of scientific knowledge.	
Poster Presentation	All information was conveyed clearly and logically. There were no factual errors in the presentation. The research was presented within a narrative that had a clear beginning, middle, and end. The key findings	There were some deficiencies in the clear and logical organization of the presentation. The presentation included a few factual errors. The narrative of	The information presented did not at all follow a clear or logical path. The presentation included many factual errors. There was minimal clear narrative to the research presented.	

	from the research were communicated, and the general structure of standard format was followed. The student showed a comfort with and confidence in the scientific concepts of the research presented.	the research was at times difficult to follow, Some key findings from the summary paper were omitted. The presentation did not consistently follow the standard format. Some discomfort was evident in lack of confidence in the scientific concepts of research.	The presentation did not follow the standard format. Many key findings were not presented. The student demonstrated modest understanding of or comfort with the scientific concepts in the research.	
			Average Student Score	**/12 =**

Biomolecules: Atoms to Organisms Course Rubric				
	3	**2**	**1**	**Student Score**
Weekly Assignments	All assignments were attempted and completed independently. Student was present and participated in the weekly class discussions.	90% of weekly assignments were attempted and completed independently. Student was present and participated 90% of the time during weekly class discussions.	80% or less of weekly assignments were attempted and completed independently. Student was present and participated 80% or less of the time during weekly class discussions.	

Tests	Tests Correctly answering over 90% of the test material that illustrates a thorough understanding of the subject matter.	Tests Correctly answering over 80% of the test material that illustrates a thorough understanding of the subject matter.	Tests Correctly answering over 70% of the test material that illustrates a thorough understanding of the subject matter.	
Research Paper	Final Research Paper - Paper is well written with a command of the supporting science concepts. Paper includes a Bibliography. There are some spelling and grammar errors, but they do not hinder communication. The paper effectively demonstrates an understanding of the topic.	The paper contains all of the required sections, but some information may be missing or miscategorized. There are some spelling and grammar errors. The paper adequately communicates the research conducted.	Spelling and grammar errors make the paper difficult to understand. Sections are missing from the paper. The student clearly did not understand the project.	
Lab Reports	Grading of lab reports will follow the *Scientific Writing Heuristic Lab Report Rubric* (as seen above). *Greenbowe & Hand. (2005). Introduction to the Science Writing Heuristic. In Cooper, Pienta, Greenbowe (Eds.) Chemists' Guide to Effective Teaching Volume I (pp. 140-154).*			
			Average Student Score	**/12 =**

Earth & Environmental Course Rubric: Used for Earth's Atmosphere, Earth's Lithosphere, Earth's Atmosphere and Earth's Systems & Sustainability Classes				
	3	**2**	**1**	**Student Score**
Weekly Assignments	All assignments were attempted and completed independently. Student was present and participated in the weekly class discussions.	90% of weekly assignments were attempted and completed independently. Student was present and participated 90% of the time during weekly class discussions.		
Tests	Tests Correctly answering over 90% of the test material that illustrates a thorough	Tests Correctly answering over 80% of the test material that	Tests Correctly answering over 70% of the test material that illustrates a	

	understanding of the subject matter.	illustrates a thorough understanding of the subject matter.	thorough understanding of the subject matter.	
Research Paper	Final Research Paper Paper is well written with a command of the supporting science concepts. Paper includes the following sections: • Introduction • Materials • Methods • Results • Discussion • Conclusion • Bibliography There are some spelling and grammar errors, but they do not hinder communication. The data is organized well into figures and tables with legends and captions. Appropriate statistical analysis has been conducted and is correctly displayed. The paper effectively communicates the research conducted and demonstrates an understanding of the project and how it fits into the body of scientific knowledge	The paper contains all of the required sections, but some information may be missing or miscategorized. The data is presented in figures and tables, but some legends or captions are missing. There are some errors in the statistical analysis or it is incorrectly displayed. The paper adequately communicates the research conducted. There are some gaps in the understanding of the project and how it fits into the body of scientific knowledge.	Spelling and grammar errors make the paper difficult to understand. Sections are missing from the paper. The data is not reported graphically, or not reported at all. There are no legends or captions. No attempt at statistical analysis has been made. The paper does not communicate the research conducted. The experimenter clearly did not understand the project. There is no context given for how the project fits into the body of scientific knowledge.	
Lab Reports	Grading of lab reports will follow the *Scientific Writing Heuristic Lab Report Rubric* (as seen above).			

	Greenbowe & Hand. (2005). Introduction to the Science Writing Heuristic. In Cooper, Pienta, Greenbowe (Eds.) Chemists' Guide to Effective Teaching Volume I (pp. 140-154).	
		Average Student Score /12 =

IV. Cairn Educational Consulting Science Writing Heuristic Format and Rubric for Laboratory Reports

SWH Lab Report Format:

Question:

Write one or more questions that can be answered in the lab. Questions should not be trivial (ie: avoid yes/no or true/false questions) and should demonstrate knowledge of lab variables.

Materials and Procedures

A clear, bulleted or numbered list of procedures. Along with setup instructions, the procedures should specify which variables are to be measured as well as how they will be measured. Someone unfamiliar with the lab should be able to complete the lab by following these instructions. You should include diagrams and/or lists of equipment.

Safety

A list of safety precautions that will be taken before, during, or after the lab to ensure the safety of the group and the equipment. Safety precautions should be specific and should show understanding of the unique nature of each lab.

Data

Data is complete and presented in data tables that are labeled with appropriate headings and units.

Data Analysis (data manipulation)

Graphs have appropriate titles, column labels, and units. Graphs have been linearized as appropriate and include a line of best fit. All graphs should include equations written below the graph. Equations should not use units in place of variables. If any lab data was calculated (rather than directly measured) then

sample calculations must be included. Sample calculations should be labeled, show all appropriate steps, and include units.

All chemical equations are balanced and written in net ionic form as appropriate.

Claims

One or two sentences that state the answer(s) to the overall lab question(s) in both a numerical and conceptual manner. This means including written statements describing the variable relationships along with any appropriate equations. Depending on the nature of the lab you may have more than one claim. This is a simple summary of results – do not attempt to explain or provide support for the claim in this section.

Evidence

Restate the claim and then explain the evidence that supports the claim. This section goes far beyond the basic descriptive level; simply describing graphs and including calculated results is not enough.

Explain the physical meaning of important graphical features such as slope and axis intercepts and how they relate to your claim. Include and explain any equations that were derived from the graph and how they relate to your claim. Explain the meaning of any calculated results and observational data and how they relate to your claim. Explain any theories or scientific principles that were involved in arriving at your claim and why they are important to your claim. Include definitions of new terminology.

Make sure that you explain the evidence for ALL the claims you made.
This section should be in paragraph form and use complete, grammatically correct sentences.

Lab Reflection

Address each of the following topics in paragraph form using complete sentences:

What were the possible sources of error? How would that error have affected the data? Note – do NOT use "human error" as a possible source of error. Be specific.

How did your data compare to the class data? How does your data compare to textbook or literature data? Include percent error and/or rms error calculations as appropriate. Be specific.

How have your ideas changed? Do you have new questions? What connections can you draw between this lab and other experiences?

Lab Questions

Answer any lab questions that may be given to you. Not all labs will include lab questions.

Group Reflection

Complete the Lab Group Reflection form and attach it to the lab report.

SWH Lab Report Rubric

Category	No Credit (0 pt)	Poor (1 pt)	Fair (2 pt)	Good (3 pt)
Beginning Question(s)	No question is evident	Question is not related to the lab or is trivial (ex: yes/no questions).	Question is not trivial and can be answered by doing the lab.	Question is not trivial and demonstrates clear understanding of lab variables.
Materials and Procedures	No procedures are listed.	Procedures are missing key steps or do not specify what data is to be collected.	Includes references to all key steps. Specifies some but not all of the data to be collected.	Someone who is unfamiliar with the lab could perform the lab using the listed procedures. Specifies all data that is to be collected.
Safety Precautions	No safety precautions are listed.	Safety precautions are not related to the lab or are very general.	Safety precautions are specific and related to the lab but are incomplete.	All significant safety factors relevant to the lab have been taken into consideration.
Data Table	No data is present.	Minimal or incomplete data, data tables are missing headings and/or	Data is complete, data tables are missing headings and/or units.	Data is complete, data tables include all appropriate headings and units.

		units, poor organization.		
Data Analysis	No evidence of analysis (graphs, calculations, equations, etc).	Minimal or incomplete analysis, graphs are missing headings and/or units, equations are missing or don't match data, many calculation errors.	Graphs, equations, and sample calculations are all present but are missing headings, units, or include other minor errors.	Graphs, equations, and sample calculations are all present with correct headings and units with no errors. Equations match the graphs and use appropriate variables.
Claim(s)	No claim is made or claims are unrelated to the original question or claim contradicts itself.	Claims only address portions of the data.	Claims address all data and include either equations or relationship descriptions but not both.	Claims address all data in both a numerical and conceptual manner. Equations and descriptions of relationships are included.
Evidence: interpretation of data and observations	Graphs, equations, calculations, and observations are not explicitly discussed or interpretation contains major errors.	Discussion and interpretation of graphs, equations, calculations, and observations contain moderate errors and/or inconsistencies.	Discussion and interpretation of graphs, equations, calculations, and observations is accurate but incomplete .	Accurate and complete interpretation of graphs (including slopes, intercepts, areas under curves, etc), calculation results, equations and observations.
Category	**No Credit (0 pt)**	**Poor (1 pt)**	**Fair (2 pt)**	**Good (3 pt)**
Evidence: supporting the claim	Evidence statements do not support claims.	Claims are restated but support is weak or contains minor errors and/or not all	All claims are restated and logically supported with some reference made to most of	All claims are restated and logically supported by in-depth discussion of graphs, equations, observations, and scientific principles.

		claims are addressed.	the following: graphs, equations, observations, and scientific principles.	
Lab Reflection	Missing 2 or more of the following: sources of error, result comparisons, self-reflection.	Missing 1 of the following: sources of error, result comparisons, self-reflection.	All components are addressed but in a basic or incomplete manner.	All components of the reflection are present and are fully and thoughtfully addressed.
Lab Questions (not all labs will include this)	Not evident or less than 20% correct.	Between 20-59% correct	Between 60-79% correct.	Between 80-100% correct.
Group Work Reflection Form	Not included or mostly blank.	All rankings are given but descriptions are blank or incomplete.	Form is complete but descriptions do not reflect rankings and/or descriptions are generic and lack depth.	Form is complete. Descriptions match rankings and demonstrate thoughtful analysis.
Formatting, neatness, and organization	Illegible writing, missing headings, written in pencil, and/or written on both sides of paper.	Hand written in blue or black ink with proper headings. Claims, evidence, and reflections are in paragraph form. Writing is on the front side of paper only.	Typed with all proper headings. Claims, evidence, and reflections are in paragraph form. Moderate grammar or spelling issues.	Typed with all proper headings. Claims, evidence, and reflections are complete sentences and in paragraph form. Very few grammar or spelling mistakes.