Paulsboro Schools

Curriculum

Honors Chemistry

Grade 10

2011 - 2012

*** For adoption by all regular education programs**
Board Approved: June 2011
as specified and for adoption or adaptation by
all Special Education Programs in accordance
with Board of Education Policy.

PAULSBORO SCHOOL DISTRICT

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Paulsboro Schools Mission Statement

The mission of the Paulsboro School District is to provide each student educational opportunities to assist in attaining their full potential in a democratic society.

Our instructional programs will take place in a responsive, community based school system that fosters respect among all people.

Our expectation is that all students will achieve the New Jersey Core Curriculum Content Standards (NJCCCS) at every grade level.

INTRODUCTION, PHILOSOPHY OF EDUCATION, AND EDUCATIONAL GOALS

Introduction/Philosophy: "Today more than ever before, science holds the key to our survival as a planet and our security and prosperity as a nation"(Obama, 2008)
Scientific literacy assumes an increasingly important role in the context of globalization. The rapid pace of technological advance, access to an unprecedented wealth of information, and the pervasive impact of science and technology on day-to-day living require a depth of understanding that can be enhanced through quality science education. In the 21st century, science education focuses on the practices of science that lead to a greater understand of the growing body of scientific knowledge that is required of citizens in an ever-changing world.

Educational Goals (taken from NJCCCS)

The main goals of Honors Chemistry is to help students gain an appreciation of science as a process as well as being the equivalent of a college introductory chemistry course usually taken by Chemistry majors during their first year. Due to the many advances in technology, Chemistry is an every changing subject matter. The primary emphasis in this course is to give students an overall understanding of larger chemistry concepts rather than a narrow view of terms and processes that need to be memorized. Essential to this conceptual understanding of Chemistry is a grasp of science as a process rather than as an accumulation of facts. This conceptual understanding can be achieved through scientific inquiry and critical thinking assessments rather than memory skills. The goal of this course is to provide students with the knowledge of college level chemistry by giving them the skills they need to conceptualize chemistry rather than memorize chemistry.

Honors Chemistry
Scope and Sequence Map

<table>
<tr><th colspan="2">Quarter 1</th></tr>
<tr><td>This unit will cover the concepts of the various roles and procedures of chemists, matter, energy and the different forms of energy, decision making and measurement.
I. Chemistry and measurement
a. Review Basic measurement
b. Potential and Kinetic energy
c. Temperature and density measurements
d. Significant figures and scientific notation</td><td>This unit will cover the concepts matter, heterogeneous and homogeneous, mixtures, and solutions. Organic and inorganic substances, physical and chemical properties and reactions, energy transfer (exothermic vs. endothermic)
II. Matter
a. homogeneous vs. heterogeneous
b. Solutions (Solute vs. solvent)
c. Physical and chemical changes and properties
d. Heat and energy transfer</td></tr>
<tr><td>This unit will cover the concepts early atomic theory, multiple proportions vs. definite proportions, atomic mass, atomic number, isotopes, subatomic particles
III. Early Atomic Theory and development
a. Early atomic model
b. John Daltons theory of multiple and definite proportions
c. Modern periodic table
d. Nuclear structure (leptons, hadrons, quarks)</td><td>This unit will cover the concepts modern atomic structure, principal quantum number, atomic sublevels, orbitals, atomic structure.
IV. Modern atomic theory
a. de Broglie hypothesis
b. Heisenberg uncertainty principle.
c. Quantum mechanics
d. Electron configuration and cloud probability</td></tr>
<tr><th colspan="2">Quarter 2</th></tr>
<tr><td>This unit will cover the concepts formula writing and reading chemical formulas, oxidation states for common monatomic and polyatomic ions and elements.
V. Chemical Formulas
a. Naming and writing binary and polyatomic compounds
b. Oxidation of elements
c. Molecular and empirical formulas.</td><td>This unit will cover the concepts of the “Mole”. Use of factor label method and formula based units.
VI. The Mole and molar solutions.
a. Factor label method
b. Avogadro’s constant
c. Molarity and molar solutions.
d. Percent Composition
e. Hydrates
f. Molar calculations of gases</td></tr>
<tr><td>This unit will cover the concepts of Chemical Reactions. The concept of reactants and products, molar ratios and balancing of the six different types of chemical reactions.
VII. Chemical Reactions
a. Balancing chemical reactions
b. Differentiate between the six types of chemical reactions
c. Percent Yield
d. Stoichiometry</td><td></td></tr>
</table>

Scope and Sequence Map Page 2

Quarter 3

This unit will cover the concepts of periodic trends on the periodic table and how they can be used to predict reactivity and chemical properties. VII. Periodic Properties a. Atomic and ionic radii of elements b. Prediction of oxidation of elements c. Ionization Energy d. Electron affinity	This unit will cover the concept of how groups, periods and families will dictate how an element bonds and the chemical properties that it exhibits. VIII. Typical Elements a. Common Families and Groups b. Shielding effect c. Family/group chemical properties d. Importance of Nitrogen and Phosphorus in living organisms. e.Characteristics of main group metals. f. Transition metals.
This unit will cover the concepts of chemical bonding. Electronegativity and its effects on chemical bonding. Ionic and covalent bonding. Molecular motions. Inter and Intramolecular forces. VIII. Chemical bonding a. Electronegativity b. Ionic/ Covalent bonds c. Metallic bonds d. Ionic and covalent radii e. Polar vs. covalent f. Ligands g. Dipole-dipole, van der Waals, Hydrogen bonding	This unit will cover the concepts of kinetics and how pressure and pressure play a vital part in kinetics, energy transfer, manometers, barometers, calculations involving gas molecules and states of matter. IX. Kinetic Theory a. Kinetic Theory b. Pressure vs. Temperature c. Absolute zero d. Phase diagrams/ triple point e. Enthalpy vs. Entropy

Quarter 4

This unit will cover the concepts of the ideal gas and STP. Boyles, Dalton and Charles laws and calculations. Calculations involving changing more than one condition for gases. X. Gases a. Ideal Gas and STP (Standard temperature and pressure) b. Boyles law c. Daltons law d. Charles law e. Combined gas law f. Diffusion	This unit will cover the concepts reaction rates and chemical equilibrium, reaction rates, equilibrium constant, heterogeneous and heterogeneous catalysts XI. Chemical equilibrium and reaction rate a. Reaction rate b. Homogeneous vs. heterogeneous reactions c. Rate determining step/ reaction mechanism d. Equilibrium Constant e. Le Chateliers Principle
This unit will cover the concepts of acids, bases, salts and solutions, theories of Arrhenius, Bronsted-Lowry, and Lewis bases, anhydrides and acid/base strengths. XII. Acids and Bases **a.** Electrolytes **b.** Conjugate base/ acid **c.** Binary acids **d.** Strong acids/Strong bases, Weak acids and bases **e.** Salts **f.** Common Ion effect	This unit will cover the concepts of energy and disorder, thermodynamics, enthalpies of reaction, Gibbs Free energy and cell voltage, electrochemistry, nuclear chemistry. XIII. Thermo, Electro, nuclear chemistry a. Enthalpy b. Entropy c. Gibbs Free Energy d. Accelerators and fission reactors e. Half-life calculations

	f. Fission and Fusion g. Cations vs. Anions h. Electrolysis i. Voltaic Cells j. Redox (Reduction vs. Oxidation)

5.2 Physical Science All students will understand that physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science.

A. A. Properties of Matter: All objects and substances in the natural world are composed of matter. Matter has two fundamental properties: matter takes up space, and matter has inertia.

Essential Questions	Enduring Understandings
How do the particles of an atom influence the overall characteristics of an element? What is Chemistry? How do scientists do science? How certain are measurements that we make in science? What are the basic ways we can handle numbers?	Atoms are comprised of smaller particles which will determine the overall characteristics and bonding nature of the element.
Content Statements	**Cumulative Progress Indicators**
Electrons, protons, and neutrons are parts of the atom and have measurable properties, including mass and, in the case of protons and electrons, charge. The nuclei of atoms are composed of protons and neutrons. A kind of force that is only evident at nuclear distances holds the particles of the nucleus together against the electrical repulsion between the protons.	Use atomic models to predict the behaviors of atoms in interactions. **(5.2.12.A.1)**

Instructional Focus:

- Modeling (using physical or digital tools) the three major particles of atoms.
- Determining how each particle is essential to the function of the atom.
- Determine how protons and neutrons determine the characteristics of individual elements.

Desired Results	Investigations, Labs, and Sense Making Experiences
Describe the three major subparticles of an atom. (electron, proton, neutron). Explain how an atom is held together by strong nuclear forces. Describe how each subatomic particle is carries a specific charge and has its own mass. Recognize that the atom is comprised of smaller subatomic particles (Quarks and Leptons). Each carries a charge and lifetime. Describe the Heisenberg uncertainty principle. Compare and contrast the various scientist and the theories that made them famous. Define the term atom List the postulates of Dalton's atomic theory	- Detailed chapter outlines for each unit - Literature review research papers based on current scientific articles - Discussions and discussion analyses - Answer essential questions - Webquest: Major contributions of scientists in the early atomic theory. - Advanced Topic Research Paper. (1-2 page) - ACS Style Lab Reports. - Concept Mastery Presentation. **Honors Lab: Physical vs. Chemical Change** **Lab objectives:** Students take various laboratory chemicals and or household chemicals and put them through a series of experiments to determine if the change observed is chemical or physical.

Discuss important contributions toward modern atomic theory Name and describe three sub-atomic particles Determine the number of protons, neutrons and electrons in a atom or ion Define isotopes and atomic mass Describe the changes the accompany nuclear reactions and define radioactivity Describe a light wave in terms of its frequency, wavelength and speed Identify the major regions of the electromagnetic spectrum Explain what is meant by a quantum of energy State the main ideas behind Bohr's model of the atom	

A. Properties of Matter: All objects and substances in the natural world are composed of matter. Matter has two fundamental properties: matter takes up space, and matter has inertia.	
Essential Questions	**Enduring Understandings**
How does molecular structure of a molecule determine the characteristics of the molecule? How is matter structured? How do we know that the modern atomic theory is correct?	Solid, liquid and gas structures and characteristics are determined by how atoms are arranged in a molecule.
Content Statements	**Cumulative Progress Indicators**
Differences in the physical properties of solids, liquids, and gases are explained by the ways in which the atoms, ions, or molecules of the substances are arranged, and by the strength of the forces of attraction between the atoms, ions, or molecules.	Account for the differences in the physical properties of solids, liquids, and gases. **(5.2.12.A.2)**

Instructional Focus:

- Explain how molecules are arranged in a specific order and have a large range of intermolecular forces which dictate the attraction between molecules, atoms, and ions.
    - *Assessments will include naming of various binary and polyatomic molecules.*
- Recognizing that intermolecular attractions are a direct result of specific arrangement of molecules, atoms, and ions.
- Conducting experiments to demonstrate that temperature has a direct effect on volume and density.
- Interpret Dalton's atomic theory in terms of Laws of Conservation of Mass, Constant Composition, and Multiple Proportions.
- Identify the major components of the nuclear atom and explain how they interact.

Desired Results	**Investigations, Labs, and Sense Making Experiences**

Compare and contrast the effect of temperature on volume and density. Recognize the difference in solids, liquids and gases. Calculate density of various materials when a volume and weight is given or obtained in the laboratory. Be able to develop a method of measuring various materials for volume, weight and ultimately density. Describe in detail the different properties of solids, liquids and gases. Explain why chemistry is important. List and describe the steps in the scientific method. Identify the metric units of measurement. Explain what causes uncertainty in measurements. Explain how to use significant digits and scientific notation. Calculate percent error. Use dimensional analysis and conversion factors. Name basic forms of energy. State the laws of Conservation of energy and mass. Name and describe the four state of matter. Compare homogeneous and heterogeneous mixtures. Explain the difference between an element and a compound.	**Honors Lab 2: Density Lab** - **Lab Objectives:** Measure various materials for volume and density. Explore the role of temperature on volume and ultimately density. - Detailed chapter outlines for each unit - Literature review research papers based on current scientific articles - Discussions and discussion analyses - Answer essential questions - Advanced Topic Research Paper. (1-2 page) - ACS Style Lab Reports. - Concept Mastery Presentation. **Honors Lab 3: Polymers** **- Lab Objectives:** Students will produce and observed various physical characteristic of polymers. Discuss various uses of polymers in everyday life.

A. Properties of Matter: All objects and substances in the natural world are composed of matter. Matter has two fundamental properties: matter takes up space, and matter has inertia.	
Essential Questions	**Enduring Understandings**
How does the understanding of the periodic table and its trends enable us to predict the reaction and formation of new substances?	The periodic table is arranged by atomic number and has specific trends which allow chemists to predict outcomes to various reactions.
Content Statements	**Cumulative Progress Indicators**

In the Periodic Table, elements are arranged according to the number of protons (the atomic number). This organization illustrates commonality and patterns of physical and chemical properties among the elements.	Predict the placement of unknown elements on the Periodic Table based on their physical and chemical properties. **(5.2.12.A.3)**

Instructional Focus:

- Explaining Early atomic theory and compare and contrast to the modern day periodic table.
- Model how the periodic table is arranged by common physical and chemical properties.
    - Assessment includes the demonstration of comparing and contrasting elements and their physical and chemical properties
- Demonstrate the ability to determine outcomes of various reactions based on an elements placement on the periodic table.

  Explain the periodic trends of the periodic table. (Electronegativity, electron affinity, atomic radius, ionization energies)

Desired Results	Investigations, Labs, and Sense Making Experiences
Determine the outcome of any reaction when given the reactants by using the periodic table to predict how various elements Compare and contrast early periodic table to modern day periodic table. Determine some common physical or chemical properties of an element based on its location on the periodic table. Understand that the atomic number determines the number of protons and electrons in a neutral atom. Explain the relationship of an element's position on the periodic table to its atomic number and mass. Use the periodic table to identify metals, nonmetals, metalloids, families (groups), periods, valence electrons, and reactivity with other elements in the table.	**Lab 5: Family of elements lab** **Lab Objectives:** *Predict the outcome of various chemical reactions of elements from the same families.* *Gain an understanding that elements of the same family will bond to produce the same type of products.* - Detailed chapter outlines for each unit - Literature review research papers based on current scientific articles - Discussions and discussion analyses - Answer essential questions - Advanced Topic Research Paper. (1-2 page) - ACS Style Lab Reports. - Concept Mastery Presentation.

A. Properties of Matter: All objects and substances in the natural world are composed of matter. Matter has two fundamental properties: matter takes up space, and matter has inertia.

Essential Questions	Enduring Understandings
How does the number of protons and electrons determine what the element is? Do all substances disappear over time and how do you calculate it? What is the difference between a neutral atom and an isotope? What is an isotope?	The number of protons and electrons determine the element in a neutral atom. Atoms can possibly carry the same number of protons and electrons but differ in neutrons which produce an element with the same type of characteristics but is an isotope. All substance will be diminished over a certain amount of time (half-life).
Content Statements	**Cumulative Progress Indicators**
In a neutral atom, the positively charged nucleus is surrounded by the same number of negatively charged electrons. Atoms of an element whose nuclei have different numbers of neutrons are called isotopes.	Explain how the properties of isotopes, including half-lives, decay modes, and nuclear resonances, lead to useful applications of isotopes. **(5.2.12.A.4)**

Instructional Focus:

- Explain that neutral atoms consist of the same number of protons and electrons which determine the element.
- Determine that the same element can contain the same number of protons but differ in neutrons which will give the same characteristics but differ in mass. (Isotopes)
- Present evidence that all substances will diminish at a certain rate over time which is expressed as half-life.

Desired Results	Investigations, Labs, and Sense Making Experiences
Explain how an elements atomic mass is calculated by taking all of an elements naturally occurring isotope and doing a weighted average. Determine what element when given an atoms number of protons and electrons. Calculate the half-life of any given substance. Explain the concept of half-life of a radioactive element. Explain why the half-life of C14 has made carbon dating a powerful tool in determining the age of very old objects. Describe alpha, beta, and gamma particles. Discuss the properties of alpha, beta, and gamma radiation: write balanced nuclear reactions.	**Lab 6: Atomic Model and half life lab.** **Lab Objectives***:* -Build atomic models of various elements when given the number of protons and electrons. -Calculate the half life and total time for decomposition of substance X. - Detailed chapter outlines for each unit - Answer essential questions - Literature review research papers based on current scientific articles - Discussions and discussion analyses - Advanced Topic Research Paper. (1-2 page) - ACS Style Lab Reports. - Concept Mastery Presentation.

A. Properties of Matter: All objects and substances in the natural world are composed of matter. Matter has two fundamental properties: matter takes up space, and matter has inertia.

Essential Questions	Enduring Understandings
What is a solution? What is a precipitate? What is a solute, solvent, solution? What is a mole? Why do scientists use moles? What is stoichiometry?	A compound is a substance composed of two or more different elements that are chemically combined in a fixed proportion. The molar mass (gram formula mass) of a substance equals one mole of that substance. The mole is an essential concept to understanding the mechanisms of chemistry.
Content Statements	**Cumulative Progress Indicators**
Solids, liquids, and gases may dissolve to form solutions. When combining a solute and solvent to prepare a solution, exceeding a particular concentration of solute will lead to precipitation of the solute from the solution. Dynamic equilibrium occurs in saturated solutions. Concentration of solutions can be calculated in terms of molarity, molality, and percent by mass.	Describe the process by which solutes dissolve in solvents. **(5.2.12.A.5)**

Instructional Focus:

- Recognizing that all matter (solids, liquids and gases), when put into a solution will make up molar solutions and in some cases form precipitates.
- Calculating moles, molar solutions and molality.
- Measure and or predict saturation points of various compounds.
- Recognize the difference between solute, solvent, solution.
- Differentiate among saturated and unsaturated solutions.
- Calculate mole fraction and percent yield.

Desired Results	Investigations, Labs, and Sense Making Experiences

Calculate and prepare molar solutions when given a solute and solvent. Define solution, solvent, solute. Solubility, precipitate, moles, molarity, mole fraction, saturated and unsaturated. Give examples and calculate concentration of various molar solutions. Gather information and construct graphs to show solubility and saturation points of various compounds. Describe the dynamic equilibrium that occurs in saturated solutions. Calculate the freezing point depression and boiling point elevation of a solution. Write net ionic equations for precipitation reactions in aqueous solutions.	**AP Lab 7: Determination of the hardness of water** **Lab Objectives:** Calculate the %Mg and Ca in the schools tap water. **Honors Lab 8: Freezing Point Depression with Anitfreeze.** **Lab Objectives:** Calculate the the freezing point depression of a solution and the affect of anitifreeze on the calculation. - Weekly quiz on lessons. - Detailed chapter outlines for each unit - Literature review research papers based on current scientific articles - Discussions and discussion analyses - ACS style lab report - Advanced Topic Research Paper. (1-2 page) - Concept Mastery Presentation.

A. Properties of Matter: All objects and substances in the natural world are composed of matter. Matter has two fundamental properties: matter takes up space, and matter has inertia.	
Essential Questions	**Enduring Understandings**
What are acids and bases? Why are acids and bases essential to chemistry? How does pH play a part in industry and life?	Living systems, chemical reactions all are influenced by pH. pH is a measurement of acid or base concentration. Acids and bases play a vital role in chemistry.
Content Statements	**Cumulative Progress Indicators**
Acids and bases are important in numerous chemical processes that occur around us, from industrial to biological processes, from the laboratory to the environment.	Relate the pH scale to the concentrations of various acids and bases. **(5.2.12.A.6)**
Instructional Focus: • Describe what an acid and a base are. How acids and bases play a vital role in various living systems and industry. • How to recognize various acids and bases. Recognize and calculate various concentrations of acids and bases (pH and pOH) • Demonstrate how a change in concentration of acids and bases directly influence pH. • Recognize the difference between a strong acid and weak acid and a strong base and a weak base. • Indentify the difference between Lewis acids and Lewis bases.	
Desired Results	**Investigations, Labs, and Sense Making Experiences**

Describe the structure and function of various acids and bases. Discuss the results of reacting various acids and bases. Determine the end result of the various reactions. Calculate pH and pOH of various concentrations of acids and bases. Describe the difference between strong acids and weak acids. Discuss the difference between strong bases and weak bases. Recognize and differentiate between Lewis acids and bases. State the Bonsted-Lowry definition of acids and bases. Identify the common physical and chemical properties of acids and bases. Explain what dissociation constants indicate about an acid or base. Explain what most acidic hydrogen atoms have in common. Explain how indicators are used in titration and how they are chosen.	**Lab 9: Acids and Bases** **Lab Objectives:** Determine the pH of various laboratory chemicals and some household chemicals. Calculate the concentration of acid/base when given the pH - Detailed chapter outlines for each unit - Literature review research papers based on current scientific articles - Discussions and discussion analyses - Advanced Topic Research Paper. (1-2 page) - ACS Style Lab Reports. - Concept Mastery Presentation. - **Lab 10: Acid Base indicators and Titrations.** **Lab Objectives:** Determine concentrations of unknown compounds by various methods in titration (pH, indicator, potentiometric).

5.2 Physical Science: All students will understand that physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science.	
B. Changes in Matter: Substances can undergo physical or chemical changes to form new substances. Each change involves energy.	
Essential Questions	**Enduring Understandings**
What role does the electron play in chemical bonding? What are the difference valence and non-valence electrons? What is a chemical bond? How are molecules held together?	Electrons, especially the outermost electrons determine how an atom interacts with other atoms. Chemical bonds are the result of interactions between two atoms. Molecules can still have an attraction between the two even though they are not chemically combined.
Content Statements	**Cumulative Progress Indicators**
An atom's electron configuration, particularly of the outermost electrons, determines how the atom interacts with other atoms. Chemical bonds are the interactions between atoms that hold them together in molecules or between oppositely charged ions.	Model how the outermost electrons determine the reactivity of elements and the nature of the chemical bonds they tend to form. **(5.2.12.B.1)**

Instructional Focus:

- Determining the electron configuration of any element to determine the number of valence electrons for that element.
- Explain how atoms are made up of various energy levels and that electrons will occupy those energy levels in a certain configuration.
- Discuss the various types of chemical bonds (ionic, covalent). Discuss how hybridization plays a part in chemical bonding.
- Construction of Lewis Dot structures of various elements.
- Define electronegativity and electron affinity and how it plays a role in determining the type of bond.
- Describe the VESPR theory
- Explain and determine how binary and polyatomic molecules are named including acids and bases.

Desired Results	Investigations, Labs, and Sense Making Experiences
Successfully construct the electron configuration of any element on the periodic table. Determine the highest energy level occupied by electrons and calculate the number of valence electrons for any element. Construct a Lewis Dot structure once the electron configuration is determined. Discuss the types of bonds within a molecule by determining the overall change in electronegativity. List the postulates of Dalton's atomic theory. Explain what is meant by a quantum of energy. Describe a light wave in terms of its frequency, wavelength and speed. State the main ideas behind Bohr's model of the atom. Describe atomic orbitals in terms of their shape, size and energy. Determinine the molecular makeup of binary and polyatomic molecules including acids and bases.	- Detailed chapter outlines for each unit - Answer essential questions - Discussions and discussion analyses - ACS style lab report - Advanced Topic Research Paper. (1-2 page) - Concept Mastery Presentation. **Lab 11: Periodic trends lab.** **Lab Objectives:** Students will use the periodic table to determine the number of valence electrons for various elements and therefore determine the empirical formula for various compounds and the types of bonds they possess. Students will become familiar with utilizing the periodic table for determining how various elements form chemical bonds. Students will also be able to determine the overall change in electronegativity of any chemical bond and therefore the type of bond it is forming.

B. Changes in Matter: Substances can undergo physical or chemical changes to form new substances. Each change involves energy.	
Essential Questions	**Enduring Understandings**
Why do things rust? What is oxidation? What is reduction? How does oxidation/ reduction play a vital part in everyday life? What are ways to prevent corrosion? What are electrochemical cells? What is a fuel cell?	Oxidation/reduction is due to the gaining or loss of an atoms electrons. The reaction of copper on the statue of liberty, the reaction in a battery is both examples of redox reactions.
Content Statements	**Cumulative Progress Indicators**
A large number of important reactions involve the transfer of either electrons or hydrogen ions between reacting ions, molecules, or atoms. In other chemical reactions, atoms interact with one another by sharing electrons to create a bond.	Describe oxidation and reduction reactions, and give examples of oxidation and reduction reactions that have an impact on the environment, such as corrosion and the burning of fuel. **(5.2.12.B.2)**

Instructional Focus:

- Compare and contrast the difference between oxidation and reduction.
- Determine the oxidation number of various elements. Describe how to assign oxidation numbers to atoms in compounds.
- Explain what constitutes an oxidizing agent and a reducing agent.
- Indentify how to identify oxidation-reduction reactions.
- Electrochemistry
- Fuel Cells

Desired Results	Investigations, Labs, and Sense Making Experiences
Give examples of various oxidation and or reduction reaction. Compare and contrast between the two types of reactions. Understand the loss of electrons is considered to be oxidation. And the gain of electrons within a chemical reaction is considered reduction. Indentify the reducing agent and the oxidizing agent in a redox reaction. Identify the oxidized reactant and the reduced reactant in a redox reaction. Successfully assign oxidation numbers to atoms in various compounds. Describe common applications of redox reactions. List the steps in balancing redox reactions. Relate standard electrode potentials to standard cell potentials. Compare and contrast fuel cells and batteries. Describe some applications of electrolytic cells.	- Detailed chapter outlines for each unit - Answer essential questions - Discussions and discussion analyses - ACS style lab report - Advanced Topic Research Paper. (1-2 page) - Concept Mastery Presentation. **Lab 12**: **Copper plating using Copper Sulfate**: **Lab Objectives:** Students will electroplate a common house key with copper using low voltage and Copper Sulfate. Students will be able to calculate the number of moles lost at the anode and the number of moles gained at the cathode. Students will also be able to calculate the number of electrons transferred. (Redox) **Lab 13: Flame test:** **Lab Objectives:** Students will witness the effect of adding energy to various compounds with different metallic components. Students will notice that different metals will emit different colors. Students will then determine the composition of an unknown solution.

B. Changes in Matter: Substances can undergo physical or chemical changes to form new substances. Each change involves energy.	
Essential Questions	**Enduring Understandings**
What is the law of conservation of mass? How is mass conserved if I boil water away or if I burn a match? What is a balance chemical equation? How is balancing equations related to the "Law of Conservation of Mass"?	No matter the type of reaction, the total mass of the system never changes. It may change form but the mass does not. The Law of Conservation of mass can be expressed by any balanced chemical equation. The total mass of reactants will equal the total mass of products in any chemical reaction.
Content Statements	**Cumulative Progress Indicators**
The conservation of atoms in chemical reactions leads to the ability to calculate the mass of products and reactants using the mole concept.	Balance chemical equations by applying the law of conservation of mass. **(5.2.12.B.3)**
Instructional Focus:	

- Explain the “Law of Conservation of Mass”. Demonstrate that in any case, mass is conserved.
- Explain the six different types of chemical reactions and how in each case that mass is conserved between reactants and products.
- Explain stoichiometry and how it can be used to demonstrate the law of conservation of mass.

Desired Results	Investigations, Labs, and Sense Making Experiences
Define the law of conservation of mass and give examples through various types of chemical reactions. Explain the importance for a system to maintain the law of conservation of mass. Give examples of six different types of chemical reactions. What set them apart from each other? Properly balance the six different types of chemical reactions by using whole numbers to determine molar ratio. Properly balance equations stoichiometrically. Determine the limiting reagent. Calculate the amount of product produced when given various amounts of reactants.	**Lab 14: Reaction of alkali halides with Silver nitrate.** **Lab Objectives:** Observe precipitates and use of a centrifuge to separate phases. To prove that the mass of reactants will result in the same mass of products. - Detailed chapter outlines for each unit - Literature review research papers based on current scientific articles - Discussions and discussion analyses - ACS style lab report - Advanced Topic Research Paper. (1-2 page) - Concept Mastery Presentation.

5.2 Physical Science: All students will understand that physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science.

C. Forms of Energy: Knowing the characteristics of familiar forms of energy, including potential and kinetic energy, is useful in coming to the understanding that, for the most part, the natural world can be explained and is predictable.

Essential Questions	Enduring Understandings
Why does hot air rise? What makes a hot air balloon rise? How does temperature affect molecular motion? How does pressure affect molecular motion? What is kinetic energy? What is absolute zero?	The overall kinetic energy is influenced by various variables such as temperature, pressure, amount of gas. Volume, pressure and temperature can be calculated with accuracy because they are all dependant on each other.
Content Statements	**Cumulative Progress Indicators**
Gas particles move independently and are far apart relative to each other. The behavior of gases can be explained by the kinetic molecular theory. The kinetic molecular theory can be used to explain the relationship between pressure and volume, volume and temperature, pressure and temperature, and the number of particles in a gas sample. There is a natural tendency for a system to move in the direction of disorder or entropy.	Use the kinetic molecular theory to describe and explain the properties of solids, liquids, and gases. **(5.2.12.C.1)**

Instructional Focus:

- Define kinetic theory. Discuss the three assumptions about gases when talking about gases.

- Discuss absolute zero and Kelvin scale. Discuss atmospheric pressure and temperature.
- Explain the concept of Ideal Gas and its laws
- Discuss in detail Boyle's law and apply.
- Discuss and apply Dalton's law of partial pressures.
- Discuss and apply Charles law for gases.
- Explain diffusion and Graham's law.

Desired Results	Investigations, Labs, and Sense Making Experiences
Explain the concept of the "Ideal Gas". Why is called an ideal gas. Describe the conditions of STP. Give examples and compare and contrast. Compare and contrast the laws of Boyle, Dalton, and Charles and perform calculations using these law Describe the kinetic molecular theory of matter and explain how it accounts for observed behavior of gases, liquids, and solids. Compare ideal and real gases using the ideal gas law. Describe vaporization, condensation and boiling. Describe freezing and melting. Construct and analyze a phase diagram. Define viscosity and surface tension and explain their relationship to intermolecular forces. Explain what gas pressure means and describe how it is measured.	- Detailed chapter outlines for each unit - Answer essential questions - Discussions and discussion analyses - ACS style lab report - Advanced Topic Research Paper. (1-2 page) - Concept Mastery Presentation. **Lab 15: Ideal gas law**: **Lab Objectives:** Students will attempt to boil water under different changes in pressure on a vessel. By reducing the atmospheric pressure of a vessel student will be able to observe that water will actually boil at a much lower temperature. Objectives: Students will hypothesize about how pressure will affect the boiling point of water. Students will also be able to calculate the final boiling point of water when given the new pressure. PV=nRT.

C. Forms of Energy: Knowing the characteristics of familiar forms of energy, including potential and kinetic energy, is useful in coming to the understanding that, for the most part, the natural world can be explained and is predictable.

Essential Questions	Enduring Understandings
Why do different solids melt at different temperatures? What causes various compounds to boil? Why do ice cubes float?	Temperature is a form of energy and when enough of this energy is placed on a pure substance, the vibrational energy within the bonds becomes so great that the substance will actually melt and or boil.

Content Statements	Cumulative Progress Indicators
Heating increases the energy of the atoms composing elements and the molecules or ions composing compounds. As the kinetic energy of the atoms, molecules, or ions increases, the temperature of the matter increases. Heating a pure solid increases the vibrational energy of its atoms, molecules, or ions. When the vibrational energy of the molecules of a pure substance becomes great enough, the solid melts.	Account for any trends in the melting points and boiling points of various compounds. **(5.2.12.C.2)**

Instructional Focus:

- Explaining the affect of temperature on chemical bonds. As the temperature increases, the vibration of the chemical bonds is increases to the point of melting or boiling.
- Explain the difference between intermolecular forces and intramolecular forces.
- Explain that substances that have a lower or weak intermolecular force will therefore have a lower melting point and boiling point.
- Compare the difference between polar and non polar compounds and determine the relative melting points and boiling points.

Desired Results	Investigations, Labs, and Sense Making Experiences
Define kinetic theory and its assumptions. Construct a representation that links temperature and vibrational energy. Explain what is happening at the molecular level when heat is applied to a system and why something ultimately melts. Compare and contrast the difference between strong and weak intermolecular forces and how it plays a part in melting points and boiling points. Compare and contrast between polar and non-polar compounds discuss some trends as far as melting and boiling points.	**Lab 16: Melting points** **Lab Objectives:** *Successfully operate the melting point apparatus. Determine melting points of various known materials. Ultimately determine the melting point of an unknown and compare to the results of the known compounds.* - Detailed chapter outlines for each unit - Discussions and discussion analyses - ACS style lab report on Melting Points. - Advanced Topic Research Paper. (1-2 page) - Concept Mastery Presentation.

5.2 Physical Science: All students will understand that physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science.

D. Energy Transfer and Conservation*:* The conservation of energy can be demonstrated by keeping track of familiar forms of energy as they are transferred from one object to another.

Essential Questions	Enduring Understandings
What does it mean when a system is continually moving toward disorder? How does this concept relate to our own universe? How can one drop of dye completely color an entire glass of water? How can a lemon produce electricity? What's the difference between concentrated and diluted?	All systems move toward a greater level of disorder or chaos. All systems want to naturally move toward equilibrium and the only way to do this is through entropy or disorder. Electricity is just the movement of electrons from an anode to a cathode. Concentration is directly proportional to temperature.
Content Statements	**Cumulative Progress Indicators**
The driving forces of chemical reactions are energy and entropy. Chemical reactions either release energy to the environment (exothermic) or absorb energy from the environment (endothermic).	Describe the potential commercial applications of exothermic and endothermic reactions. **(5.2.12.D.2)**
Instructional Focus:	

- Describe the various changes in entropy.
- Describe and give various examples of exothermic and endothermic reactions.
- Describe and give examples of changes in entropy.
- Cell voltage.
- Definition and calculations involving Beers Law

Desired Results	Investigations, Labs, and Sense Making Experiences
Compare and contrast the idea of entropy and how it relates to our own universe. Students will be able to give examples of changes in entropy. Be able to relate Gibbs free energy to the spontaneity of reactions. Perform calculations involving Gibbs free energy, and cell voltage. Students will be able to determine the 4 ways that energy can be transferred within a system. Students will be able to calculate the heat of formation and work done within a system or reaction. Compare and contrast entropy and enthalpy and how they are related. Calculate the Gibbs free energy within a voltaic cell.	- Detailed chapter outlines for each unit - Answer essential questions - Literature review research papers based on current scientific articles - Discussions and discussion analyses - ACS style lab report - Advanced Topic Research Paper. (1-2 page) - Concept Mastery Presentation. **Lab 17: Heat of reaction/ endothermic vs. exothermic**: Students will measure the amount of heat absorbed and released within a closed system. All measurements will be calculated and graphed. **Lab 18: Beer Law:** Student s make a series of serial dilutions of a known compound. They will then analyze the solutions for absorbency using the spec 20. They will then graph the results showing that the concentration is linear. They will then analyze an unknown for concentration and report the results.

5.2 Physical Science All students will understand that physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science.

D. Energy Transfer and Conservation: The conservation of energy can be demonstrated by keeping track of familiar forms of energy as they are transferred from one object to another.

Essential Questions	Enduring Understandings
How is nuclear energy produced? What's the difference between fission and fusion? How does nuclear radiation affect living tissue? How can radioactivity be used in the medical field?	Nuclear reactions take place at the atomic level. Although nuclear energy is very reliable, it also has a downside such as waste. Fusion only takes place at very high temperatures like our sun.
Content Statements	**Cumulative Progress Indicators**
Nuclear reactions (fission and fusion) convert very small amounts of matter into energy.	Describe the products and potential applications of fission and fusion reactions. **(5.2.12.D.3)**

Instructional Focus:

- Analyzing the operation of particle accelerators and fission reactors. Describe the probing of nucleus through the use of accelerators.
- Explain the concept of half-life.
- Explain and give examples of transmutation of a radioactive nucleus.
- Compare and contrast nuclear fusion and nuclear fission.

Desired Results	Investigations, Labs, and Sense Making Experiences
Explain what is meant by the half-life of a radioactive element.	**Lab 18: Soponification:** **Lab Objectives:**

Describe what happens in a nuclear bombardment reaction. Describe how radiation affects living things and some possible natural sources. Discuss beneficial applications of radioisotopes. Compare nuclear fission and fusion. Explain how nuclear reactors are used to produce energy.	Students will produce and utilize soap. Students will compare and contrast soaps to detergents. Using vegetable oil and sodium hydroxide, students will produce soap. - Detailed chapter outlines - Literature review research papers based on current scientific articles - Discussions and discussion analyses - Advanced Topic Research Paper. (1-2 page) - ACS Style Lab Reports. - Concept Mastery Presentation.

5.2 Physical Science All students will understand that physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science.	
***D. Energy Transfer and Conservation*:** The conservation of energy can be demonstrated by keeping track of familiar forms of energy as they are transferred from one object to another.	
Essential Questions	**Enduring Understandings**
How do we describe the rate of a reaction? What are reaction mechanisms and how do they differ from chemical equations? What is collision theory? What factors affect reaction rates? What is a spontaneous process? What is entropy?	Reaction rates are affected by temperature, pressure, particle size and concentration. Any change in any of the parameters will affect the chemical equilibrium in such a way to reduce the stress on the system.
Content Statements	**Cumulative Progress Indicators**
Chemical equilibrium is a dynamic process that is significant in many systems, including biological, ecological, environmental, and geological systems. Chemical reactions occur at different rates. Factors such as temperature, mixing, concentration, particle size, and surface area affect the rates of chemical reactions.	Model the change in rate of a reaction by changing a factor. **(5.3.12.D.5)**
Instructional Focus: • Distinguishing between thermodynamic stability and kinetic stability. • Describing and listing the factors that influence the rate of reaction. • Distinguishing among heterogeneous catalyst, homogeneous catalyst, and inhibitor. • Describing and determining reaction mechanisms for simple reactions. • Calculations involving reaction rates and concentrations.	
Desired Results	**Investigations, Labs, and Sense Making Experiences**
Define the rate of a chemical reaction. Indentify the intermediate products of a reaction mechanism. Describe the rate law for a chemical reaction. Understand chemical reactions in terms of collision theory.	- Detailed chapter outlines for each unit - Answer essential questions - Literature review research papers based on current scientific articles - Discussions and discussion analyses. - Advanced Topic Research Paper. (1-2 page) - ACS Style Lab Reports. - Concept Mastery Presentation.

Explain how energy is involved in chemical reactions. Define activation energy and activated complex. List the factors that affect reaction rates and explain them according to collision theory. Explain what is meant by a spontaneous process. Relate enthalpy changes to spontaneity. Define entropy. State the entropy criterion for a spontaneous process. State the criterion for reaction spontaneity in terms of Gibb's free energy changes.	**Labs 19: Reaction Kinetics lab:** **Lab Objectives:** By varying concentration of reactants, the rate law is determined. By varying the temperature, the activation energy is determined. The data is then graphed and analyzed. **Lab 20: Le Chateliers Principle:** **Lab Objectives:** **I**s a qualitative rule that allows the prediction of the effect of temperature, pressure, and concentration changes on chemical reactions. By adjusting one variable you can shift the equilibrium to the left or right in a chemical reaction.
Investigations, Labs, and Sense Making Experiences	**Investigations, Labs, and Sense Making Experiences**

Chlorine Analysis: Students will learn how a typical township septic plant operates. Students will discuss the importance of chlorine treatment in a process plant. Study the effects of over chlorinating of treatment water and release into a stream. Students will measure chlorine treated water and determine the effluent is safe to release into a stream. **Empirical Formulas and Hydrates:** Students will determine the empirical formula of various hydrates by dehydrating the compound and calculating the water loss. **Alchemy:** Students will get a little lesson of how chemistry got to be where it is today. Students will convert a simple penny to silver and then gold. **Hydrolysis of Water:** Students will convert simple tap water into hydrogen and oxygen by use of low voltage electricity. Students will then discuss the possibility of alternate fuels. **Endothermic vs. Exothermic:** Students will calculate the specific heat of two substances by performing a simple calorimetry experiment. **Liquid Nitrogen and Ice cream:** Students will study the effects and physical characteristics of liquid nitrogen. Students will the manufacturing of liquid nitrogen and some commercial uses. Students will then make ice cream using liquid nitrogen. **Use of Balance and %Error:** Students will learn the proper techniques in using the Sartorius balances. They will measure various objects on 3 types of balances and determine the percent error for each.	**pH and (H)Concentration:** Students will measure Hydrogen ion concentration and compare results to pH measurements. **Simple Distillation:** Students will perform the first distillation of a pure substance. This will give them exposure to simple distillation set up and measurement. **Complex Distillation:** Students will build upon their skills constructing a simple distillation but this time they will be given a solution of various materials and they will have to distill them into their original chemical makeup. **Aspirin Synthesis:** Students will use the skill of organic chemistry to synthesize aspirin. They will then check purity by melting point and spectroscopy. **Viscosity:** Students will measure and calculate various materials for viscosity by two different methods. We will discuss accuracy and precision in both methods and determine which method would be better for commercial use. **Simple Paper Chromatography:** Students will study how particle size and molecular polarity can be determined by use of simple paper chromatography. **Lab Safety Lab:** Students will get exposed to the various dangers that can be found in a typical chemistry laboratory. They will learn the proper techniques and waste disposal and the proper use of personal protective equipment. **Density/Refractive Index vs. Concentration:** Students will make a primary standard and make multiple serial dilutions off of the primary standard. They will then measure the standard for density and refractive index and graph density or refractive index vs. concentration. They will then be given an unknown for measurement.

5.1 Science Practices: Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science.

A. Understand Scientific Explanations: Students understand core concepts and principles of science and use measurement and observation tools to assist in categorizing, representing, and interpreting the natural and designed world.

Essential Question	Enduring Understanding
How do we build and refine models that describe and explain the natural and designed world?	Measurement and observation tools are used to categorize, represent and interpret the natural world.
Content Statement	**Cumulative Progress Indicator**
Mathematical, physical, and computational tools are used to search for and explain core scientific concepts and principles.	Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations. **(5.1.12.A.1)**

Instructional Focus:

- Learning facts, concepts, principles, theories and models; then
- Developing an understanding of the relationships among facts, concepts, principles, theories and models; then
- Using these relationships to understand and interpret phenomena in the natural world

Content Statement	Cumulative Progress Indicator
Interpretation and manipulation of evidence-based models are used to build and critique arguments/explanations.	Develop and use mathematical, physical, and computational tools to build evidence-based models and to pose theories. **(5.1.12.A.2)**

Instructional Focus:

- Using tools, evidence and data to observe, measure, and explain phenomena in the natural world
- Developing evidence-based models based on the relationships among fundamental concepts and principals
- Constructing and refining explanations, arguments or models of the natural world through the use of quantitative and qualitative evidence and data

Content Statement	Cumulative Progress Indicator
Revisions of predictions and explanations are based on systematic observations, accurate measurements, and structured data/evidence.	Use scientific principles and theories to build and refine standards for data collection, posing controls, and presenting evidence. **(5.1.12.A.3)**

Instructional Focus:

- Understanding that data differs in quality and strength of explanatory power based on experimental design
- Evaluating strength of scientific arguments based on the quality of the data and evidence presented
- Critiquing scientific arguments by considering the selected experimental design and method of data analysis

5.1 Science Practices: Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science.

B. Generate Scientific Evidence Through Active Investigations: Students master the conceptual, mathematical, physical, and computational tools that need to be applied when constructing and evaluating claims.

Essential Question	Enduring Understanding
What constitutes useful scientific evidence?	Evidence is used for building, refining, and/or critiquing scientific explanations.

Content Statement	Cumulative Progress Indicator
Logically designed investigations are needed in order to generate the evidence required to build and refine models and explanations.	Design investigations, collect evidence, analyze data, and evaluate evidence to determine measures of central tendencies, causal/correlational relationships, and anomalous data. **(5.1.12.B.1)**

Instructional Focus:

- Asking a question and deciding what to measure in order to answer the question
- Developing strategies for obtaining measurements, then systematically collecting data
- Structuring the gathered data, then interpreting and evaluating the data
- Using the empirical results to determine causal/correlational relationships

Content Statement	Cumulative Progress Indicator
Mathematical tools and technology are used to gather, analyze, and communicate results.	Build, refine, and represent evidence-based models using mathematical, physical, and computational tools. **(5.1.12.B.2)**

Instructional Focus:

- Using mathematics in the collection and treatment of data and in the reasoning used to develop concepts, laws and theories
- Using tools of data analysis to organize data and formulate hypotheses for further testing
- Using existing mathematical, physical, and computational models to analyze and communicate findings

Content Statement	Cumulative Progress Indicator
Empirical evidence is used to construct and defend arguments.	Revise predictions and explanations using evidence, and connect explanations/arguments to established scientific knowledge, models, and theories. **(5.1.12.B.3)**

Instructional Focus:

- Making claims based on the available evidence
- Explaining the reasoning, citing evidence, behind a proposed claim
- Connecting the claim to established concepts and principles

Content Statement	Cumulative Progress Indicator
Scientific reasoning is used to evaluate and interpret data patterns and scientific conclusions.	Develop quality controls to examine data sets and to examine evidence as a means of generating and reviewing explanations. **(5.1.12.B.4)**

Instructional Focus:

- Analyzing experimental data sets using measures of central tendency
- Representing and describing mathematical relationships among variables using graphs and tables
- Using mathematical tools to construct and evaluate claims

5.1 Science Practices: Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science.

C. Reflect on Scientific Knowledge: Scientific knowledge builds on itself over time.

Essential Question	Enduring Understanding
How is scientific knowledge constructed?	Scientific knowledge builds upon itself over time.
Content Statement	**Cumulative Progress Indicator**
Refinement of understandings, explanations, and models occurs as new evidence is incorporated.	Reflect on and revise understandings as new evidence emerges. **(5.1.12.C.1)**

Instructional Focus:

- Reflecting on the status of one's own thinking and learning (i.e. uncovering how a student knows what they know and why)
- Understanding that scientific knowledge can be revised as new evidence emerges

Content Statement	Cumulative Progress Indicator
Data and refined models are used to revise predictions and explanations.	Use data representations and new models to revise predictions and explanations. **(5.1.12.C.2)**

Instructional Focus:

- Recognizing that predictions or explanations can be revised on the basis of seeing new data and evidence
- Using data and evidence to modify and extend investigations
- Understanding that explanations are increasingly valuable as they account for the available evidence more completely

Content Statement	Cumulative Progress Indicator
Science is a practice in which an established body of knowledge is continually revised, refined, and extended as new evidence emerges.	Consider alternative theories to interpret and evaluate evidence-based arguments. **(5.1.12.C.3)**

Instructional Focus:

- Understanding that there might be multiple interpretations of the same phenomena
- Stepping back from evidence and explanations to consider whether another interpretation of a particular finding is plausible with respect to existing scientific evidence
- Considering alternative perspectives worthy of further investigations

5.1 Science Practices: Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science.

D. Participate Productively in Science: The growth of scientific knowledge involves critique and communication, which are social practices that are governed by a core set of values and norms.

Essential Question	Enduring Understanding
How does scientific knowledge benefit – deepen and broaden - from scientists sharing and debating ideas and information with peers?	The growth of scientific knowledge involves critique and communication - social practices that are governed by a core set of values and norms.

Content Statement	Cumulative Progress Indicator
Science involves practicing productive social interactions with peers, such as partner talk, whole-group discussions, and small-group work.	Engage in multiple forms of discussion in order to process, make sense of, and learn from others' ideas, observations, and experiences. **(5.1.12.D.1)**

Instructional Focus:

- Seeing oneself as an effective participant and contributor in science
- Interacting with others to test new ideas, soliciting and providing feedback, articulating and evaluating emerging explanations, developing shared representations and models, and reaching consensus
- Developing a sense of appropriate trust and skepticism when evaluating others' claims, evidence and reasoning

Content Statement	Cumulative Progress Indicator
Science involves using language, both oral and written, as a tool for making thinking public.	Represent ideas using literal representations, such as graphs, tables, journals, concept maps, and diagrams. **(5.1.12.D.2)**

Instructional Focus:

- Constructing literal representations from empirical evidence and observations
- Presenting and defending a scientific argument using literal representations
- Evaluating others' literal representations for consistency with their claims, evidence and reasoning
- Moving fluently between representations such as graphs, data, equations, diagrams and verbal explanations

Content Statement	Cumulative Progress Indicator
Ensure that instruments and specimens are properly cared for and that animals, when used, are treated humanely, responsibly, and ethically.	Demonstrate how to use scientific tools and instruments and knowledge of how to handle animals with respect for their safety and welfare. **(5.1.12.D.3)**

Instructional Focus:

- Selecting and using appropriate instrumentation to design and conduct investigations
- Understanding, evaluating and practicing safe procedures for conducting science investigations
- Demonstrating appropriate digital citizenship (i.e., cyber-safety and cyber-ethics) when accessing scientific data from collaborative spaces. (See NJCCCS 8.1 and 9.1)
- Ensuring that living organisms are properly cared for and treated humanely, responsibly, and ethically