Course Description: Chemistry A introduces students to the science of chemistry beginning with exploring why scientists are interested in studying matter at a submicroscopic level. Students will continue to learn how scientific methods are used to understand the natural world and will continue to develop their skills in this area. Chemistry A covers topics in the characteristics of matter, atomic structure, chemical periodicity, chemical bonds and compounds, and chemical formula writing and naming. An algebra background is recommended because of the amount and type of math involved.

Module	Lesson Title	Objectives
Module 1: Chemistry Basics	1.1: Chemistry and Society	• Define chemistry and matter. • Explain why chemists are interested in studying matter at a submicroscopic level. • Differentiate among the different branches of chemistry. • Identify careers in which chemistry is used.
	1.2: The Scientific Method of Investigation	• Describe how scientific methods are used to understand the natural world. • Identify and describe the common steps of the scientific method. • Compare and contrast types of variables. • Describe the difference between a scientific theory and a scientific law.
	1.3: Matter and Measurement	• Differentiate between qualitative and quantitative data. • Identify the seven SI base units. • Identify the meanings and relative values of the prefixes used in the metric system.
	1.4: Uncertainty in Measurement	• Distinguish between measured numbers and exact numbers. • Discuss the uncertainty in measurements using the terms accuracy and precision. • Use absolute error and percent error to reflect the uncertainty of measurements.
	1.5: Dimensional Analysis	• Use dimensional analysis to convert between units.
	Project: Energy Sources	• Analyze the challenge of fossil fuel use and design and evaluate solutions based on criteria and constraints. • Apply principles of engineering design and project management to design, build, and refine a device that converts energy from one form to another.

Module	Lesson Title	Objectives
Module 2: Basics of Matter	2.1: States of Matter	• Describe the three main states of matter in terms of their shape, volume, particle motion, and compressibility. • Explain what happens to particles in a substance as the temperature is increased or decreased.
	2.2: Pure Substances	• Identify the characteristics of a pure substance. • Explain the difference between elements and compounds. • Identify the type of elements in the chemical formula of a compound.
	2.3: Mixtures	• Differentiate between pure substances and mixtures. • Differentiate between heterogeneous and homogeneous mixtures. • List and describe methods that can be used to separate the components in a mixture.
	2.4: Physical and Chemical Properties and Changes	• Identify and differentiate between physical and chemical properties of matter. • Identify and differentiate between physical and chemical changes of matter. • Identify the parts of a chemical equation. • Apply the law of conservation of mass to chemical reactions.
Module 3: The Atom	3.1: Atomic Theory	• Define an atom and explain how atomic theory has developed over time. Compare the atomic models of Democritus and Dalton. • List the parts of Dalton's atomic theory.
	3.2: Atomic Structure	Distinguish among protons, neutrons, and electrons in terms of relative charge and location in the atom. • Describe the experiments that led to the discovery of the electron and the nucleus. • Identify the atomic number and mass number of an atom given its nuclear notation. • Determine the number of protons and neutrons in an atom given its mass number and atomic number.

Module	Lesson Title	Objectives
	3.3: Isotopes and Atomic Mass	• Describe how the isotopes of a given element are the same and how they are different. • Differentiate among protons, neutrons, and electrons in terms of relative mass. • Determine the number of protons, neutrons, and electrons in isotopes. • Calculate average atomic mass of an element using isotopic composition.
	3.4: Nuclear Chemistry	• Explain the relationship between unstable nuclei and radioactive decay. • Explain and compare nuclear reactions (radioactive decay, fission and fusion), the energy changes associated with them, and their associated safety issues. • Describe the characteristics of alpha, beta, and gamma radioactive decay processes in terms of balanced nuclear equations.
	Project: Nuclear Processes	• Model the changes in the composition of the atom during fission, fusion, and radioactive decay. • Model the energy released during fission, fusion, and radioactive decay. • Analyze nuclear power as a technological innovation and evaluate its use as an alternative energy source.
Module 4: Electronic Structure and Periodicity	4.1: The Periodic Table	• Describe how Mendeleev organized his periodic table and how his periodic table differs from the periodic table used today. • Categorize elements as alkali metals, alkaline earth metals, halogens, noble gases, transition metals, metals, nonmetals, and metalloids based on their location in the periodic table. • Identify the properties of metals, nonmetals, and metalloids.
	4.2: The Atomic Model	• Describe the development of atomic theory, including contributions from Democritus, Dalton, Thomson, Rutherford, Bohr, and Schrödinger. • Explain the impact of de Broglie's wave-particle duality and the Heisenberg uncertainty principle on the modern view of electrons in atoms. • Describe quantized energy levels of electrons in atoms.
	4.3: Electron Configuration	• Explain and apply the Aufbau principle, the Pauli exclusion principle, and Hund’s rule to write electron configurations. • Identify the s, p, d, and f blocks on the periodic table based on electron configuration.

Module	Lesson Title	Objectives
		• Draw electron-dot structures representing an atom's valence electrons.
	4.4: The Nature of Light	• Compare the wave and particle models of light. • Describe Einstein's explanation of the photoelectric effect. • Describe the mathematical relationships among energy, frequency, and wavelength of light. • Calculate the frequency and energy of light using Planck's relationship.
	Project: Models of Light	• Evaluate claims that light can be described by a wave model or a particle model. • Provide evidence showing that the wave model is more useful for explaining some situations involving light, while the particle model is more useful for describing other situations. • Describe how different technologies have shaped our understanding of light, and how these technologies, in turn, have driven further progress in other scientific fields.
	4.5: Periodic Trends	• Describe period and group trends in atomic radius, ionization energy, and electronegativity. • Relate period and group trends in atomic radius, ionization energy, and electronegativity to electron configuration. • Compare elements in terms of atomic radius, ionization energy, and electronegativity.
Module 5: Ionic Compounds	5.1: Ions	• Use the octet rule to explain why atoms form ions and to describe the formation of negative and positive ions. • Determine the charges formed by elements based on the number of valence electrons and their location in the periodic table. • Name cations and anions.
	5.2: Ionic Bonding	• Define chemical bonding and explain chemical bond formation in terms of electron configuration. • Define ionic bonding and distinguish ionic bonds from metallic and covalent bonds.

Module	Lesson Title	Objectives
		• Use electron dot structures to Illustrate ionic bonding between two atoms.
	5.3: Metallic Bonds and Properties	• Describe metallic bonding. • Explain the physical properties of metals in terms of metallic bonding. • Describe the arrangement of atoms in the crystalline structures of metals. Define an alloy and describe how the composition of an alloy affects its properties.
	5.4: Binary Ionic Compounds	• Identify and explain the properties of ionic compounds. • Relate the properties of ionic compounds to the structure of crystal lattices. • Write the names and formulas of binary ionic compounds.
	5.5: Ternary Ionic Compounds	• Identify the names and formulas of common polyatomic ions. Write the names and formulas of ternary ionic compounds.
Module 6: Covalent Compounds	6.1: Covalent Bonding	• Define covalent bonding and distinguish covalent bonds from ionic bonds. Differentiate among ionic, polar, and nonpolar bonds based on the electronegativity differences between the atoms in the bond and their location on the periodic table. • Differentiate among single, double, and triple bonds. • Use electron dot structures to Illustrate covalent bonding between atoms and to explain why some elements exist as diatomic molecules
	6.2: Molecular Compounds	• Write the names and formulas of molecular compounds. • Name acidic solutions.
	6.3: Molecular Shape and Polarity	• Define VSEPR theory. • Determine the shape of molecules from Lewis structures. • Describe how polar bonds affect the polarity of a molecule.
	6.4: Forces of Attraction	• Describe and compare intramolecular (bonding) forces and intermolecular forces. • Describe and compare dispersion forces, dipole-dipole forces, and hydrogen bonds. • Identify and explain the properties of molecular compounds.

Module	Lesson Title	Objectives
	6.5: Water and Its Properties	• List and describe the unique properties of water. • Relate intermolecular forces to the process of solvation in aqueous solutions.
	Project: Analyzing Water	• Describe how solubility and surface tension relate to the forces between the particles of a substance. • Collect and use experimental data to compare the strength of forces between the particles within various substances. • Plan and conduct an experiment using local water samples to analyze how common pollutants affect water.