Course Title: Chemistry A/B Little Chute Science: 10th, 11th, 12th

Course Overview: The Little Chute High School Chemistry course teaches the fundamentals of the central science. Topics covered include atomic theory, chemical reactions, chemical mathematics, thermochemistry, and essential laboratory technique and reporting. The course will prepare students for the AP Chemistry program. Chemistry is open to students who have passed Algebra and Physical Science in good standing.

Standard Sheet

Scope and Sequence

Timeframe	Unit	Instructional Topics
1st Semester 2.5 Weeks	**Unit 1:** Scientific Method and Calculations	Experimental Design Unit Conversion Significant Figures
2 Weeks	**Unit 2:** The Nature of Matter	Classification of Matter Density States of Matter
3 Weeks	**Unit 3:** Atomic Theory and Structure	Periodic Table Atomic Structure Ions and Isotopes Average Atomic Mass
3 Weeks	**Unit 4:** Quantum Theory	Light and Waves Bohr Model Electron Configuration
1.5 Weeks	**Unit 5:** Periodicity	Periodic Trends
5 Weeks	**Unit 6:** Chemical Bonding and Nomenclature	Chemical Bonding Molecular Geometry Chemical Nomenclature Intermolecular Forces
2nd Semester 3 Weeks	**Unit 7:** Chemical Reactions	Mass Conservation Classifying Reactions Predicting Products Kinetics
5 Weeks	**Unit 8:** Stoichiometry	The Mole Empirical Formula Molarity Stoichiometry Limiting Reagent
4 Weeks	**Unit 9:** Thermochemistry	Calorimetry Reaction Enthalpy Hess' Law
3 Weeks	**Unit 10:** Gas Law	KMT Gas Laws Gas System Stoichiometry
2 Weeks	**Unit 11:** Acids and Bases	Acid/Base Structure and Function pH Scale Titrations

UNIT 1: Scientific Method and Calculations

Duration of Unit: 2.5 Weeks

Description of Unit: Application of the scientific method and calculations to the central science.

Essential Questions and/or Enduring Understandings: Higher level of experimental design and data collection for the chemistry program is covered. Students will learn the writing of a formal lab report and keep a lab notebook. Applying principles of scientific calculations.

ESSENTIAL Standards	Learning Targets
1.1: Data Analysis	1: I can determine the type of graph (scatter plot or bar) that best represents a set of data. 2: I can sort raw lab data into organized tables for graphical analysis. 3: I can sort raw lab data into an organized table for analysis of patterns or trends. In addition, create a graph of the data with independent and dependent variables on the correct axes; furthermore, analyze the trend/pattern in the data (develop an equation from data).
1.2: Experimental Design	1: I can, with limited ability, identify independent, dependent, and controlled variables in a data set. 2: I can identify the independent, dependent, and controlled variables when given data sets or experimental research summaries. 3: I can write a research question, identify the independent, dependent, and controlled variables. In addition, develop a table for data collection.
1.3: Dimensional Analysis	1: I can convert metric measurements by units of ten 2: I can convert units of measurement using conversion factors. 3: I can apply unit conversions in a laboratory setting
1.4: Significant Figures	1: I can identify the correct number of significant digits in a measurement. 2: I can record and apply principles of significant figures within scientific calculations. 3: I can carry out data collection in an experiment and complete required calculations using the correct significant digits and scientific calculations (completed independently by student).

UNIT 2: The Nature of Matter

Duration of Unit: 2 Weeks

Description of Unit: The various properties of matter are observed, described, and measured.

Essential Questions and/or Enduring Understandings: Students will understand the various states of matter and their energies. The physical properties of a substance and mixture will be quantified in a laboratory setting. Identify and describe a physical or chemical change based on observation.

ESSENTIAL Standards	Learning Targets
2.1: Classification of Matter	1: I can identify physical and chemical changes 2: I can classify matter by physical and chemical properties and distinguish matter into elements, compounds, and mixtures. 3: I can separate matter in a laboratory setting according to physical properties.
2.2: Density	1: I can qualitatively identify differences in density based on given observations. 2: I can quantitatively determine the density of an object given mass and volume measurements. 3: I can independently quantitatively calculate an unknown variable given mass, volume, or density measurements (this may involve collection of data).
2.3: Kinetic Molecular Theory	1:I can identify atomic structures of solids, liquids, and gases and explain the relative energy state of each. 2:I can identify states of matter on a phase change graph and transitions. 3:I can explain a phase change graph using the kinetic molecular theory. Include the following vocabulary: liquid and gas, solid and liquid, gas, solid, liquid, heat of vaporization, and heat of fusion.

UNIT 3: Atomic Theory and Structure

Duration of Unit: 2 Weeks

Description of Unit: The timeline of the development of various models of the atom. Understand the basic structure of an atom. Understand the mass, charge, and location of subatomic particles. Reading the periodic table to predict atomic structure as an ion, isotope, or ground state element.

Essential Questions and/or Enduring Understandings: Students will know relative mass, charge, and location of subatomic particles within an atom. Illustrations of the structure of an atom using the Bohr model. Reading the periodic table to predict atomic structure as an ion, isotope, or ground state of an identified element.

ESSENTIAL Standards	Learning Targets
3.1: Atomic Models and Subatomic Particles	1: I can identify the location, mass, and charge of subatomic particles in an atom. 2: I can explain atomic models, subatomic particles, isotopes, and ions. 3: I can determine the charge and mass of an atom based on changes to the number of electrons and neutrons
3.2: Atomic Isotopes	1: I can define an isotope and explain why masses are reported as decimals on the periodic table. 2: I can utilize correct nomenclature for describing elements and predict the most common isotope of an element based on average atomic mass. 3: I can calculate average atomic mass from percent abundance and atomic mass.

UNIT 4: Quantum Theory

Duration of Unit: 3 Weeks

Description of Unit: Learn the relationship between light, energy, and electron configuration. Calculate various properties of electromagnetic radiation. Write electron configurations of neutral elements and ions.

Essential Questions and/or Enduring Understandings: The magnitude of light energy emitted from electron transitions determines the distance an electron is from the nucleus. Electron configurations show the probable locations of electrons and their respective orbitals around the nucleus.

ESSENTIAL Standards	Learning Targets
4.1 EMR and Light Energy	1: I can describe the qualitative relationship between the energy, wavelength, and color of light. 2: I can explain how the lines in an emission spectrum relate to the energy levels of electrons in an atom. 3: I can summarize how spectral lines are produced outside the visible spectrum and identify individual elements in a mixture of gases given spectral data
4.2 Electron Configuration	1: I can identify elements on the periodic table given the orbital diagram or electron configuration. 2: I can record the electron configuration of elements using only the periodic table and use valence electrons (Lewis Dot Diagrams) to predict ionic charges. 3: I can create an orbital diagram or electron configuration for excited state electrons.

UNIT 5: Periodicity

Duration of Unit: 1.5 Weeks

Description of Unit: The periodic table is organized in a way where various properties of elements can be predicted.

Essential Questions and/or Enduring Understandings: The properties of atomic radius, electronegativity, and ionization energy can be predicted based on their location on the periodic table. Those properties are also related to the attraction between the nucleus and the electrons, which is connected to quantum theory and atomic structure.

ESSENTIAL Standards	Learning Targets
5.1 Periodicity	1: I can identify trends on the periodic table given sets of data (qualitative description of data). 2: I can explain trends on the periodic table qualitatively. 3: I can predict trends/properties of elements using the periodic table in a lab setting.

UNIT 6: Chemical Bonding and Nomenclature

Duration of Unit: 5 Weeks

Description of Unit: Classify compounds bonding type as ionic, covalent, or metallic. Name and formulate compounds based on ionic, molecular, and acidic rules.

Essential Questions and/or Enduring Understandings: Represent compounds as ionic or covalent using drawings. Ability to name and formulate compounds quickly based on what elements compose.

ESSENTIAL Standards	Learning Targets
6.1 Fundamentals of Ionic Bonds	1: I can identify ionic compounds based on the composition of elements. 2: I can classify the properties and use correct nomenclature of ionic compounds. 3: I can write chemical names and formulas for ionic compounds containing polyatomic ions and transition metals with multiple charges. In addition, I can write dissociation equations for ionic compounds dissolved in water.
6.2 Fundamentals of Covalent Bonds	1: I can identify covalent compounds based on the composition of elements. 2: I can classify the properties and use correct nomenclature of molecular compounds. 3: I can diagram covalent compounds with correct single, double, and triple bonds.
6.3 Fundamentals of Acidic Compounds	1: I can identify an acid based on its chemical formula 2: I can classify the properties and use correct nomenclature of acidic compounds. 3: I can name and formulate acidic compounds composed of polyatomic ions.
6.4 Intermolecular Forces	1: I can describe the influence of polar molecules on each other (i.e. hydrogen bonding). 2: I can identify the intermolecular forces of substances based on periodicity. 3: I can diagram the polarity of bonds in a molecule (dipoles).
6.5 Molecular Geometry	1: I can draw correct Lewis structures for elements and compounds. 2: I can predict molecular geometry for molecules with up to four domains around the central atom. 3: I can explain how repulsion among electron domains alters the shape of molecules.

UNIT 7: Chemical Reactions

Duration of Unit: 3 Weeks

Description of Unit: Chemical reactions can be classified into 6 basic types. The products of a chemical reaction can be predicted by classifying the type of reaction based on the reactants present. The law of mass conservation is used to balance chemical reactions.

Essential Questions and/or Enduring Understandings: The classification of chemical reactions depends on the nature of the reactants and products. Products of reactions are predictable. Chemical reactions must be balanced in accordance with the law of mass conservation.

ESSENTIAL Standards	Learning Targets
7.1 Balancing Chemical Equations	1: I can summarize the necessity of balancing a chemical equation (conservation of matter). 2: I can balance the number of atoms on the reactants and products side of a chemical equation. 3: I can mathematically demonstrate the conservation of matter in a balanced chemical equation.
7.2 Types of Chemical Reactions and Predicting Products	1: I can identify types of chemical reactions. 2: I can classify and predict the products of a chemical reaction. 3: I can predict the products of a chemical reaction, balance charges of new compounds, and balance chemical reactions.
7.3 Kinetics	1: I can identify characteristics that affect rates of chemical reactions. 2: I can explain why rates of reaction are dependent on temperature and concentration. 3: I can predict how reaction rates change given changes in concentration of products, surface area of reactants, volume of vessel, and introduction of a catalyst.
7.4 Reactivity Series	1: I can use a given activity series to predict if a chemical reaction will occur. 2: I can use the activity series to predict the likelihood of a chemical reaction and write the chemical reaction. 3: I can create an activity series of metals from laboratory analysis of chemical reactions in a single replacement reaction.

UNIT 8: Stoichiometry and Molarity

Duration of Unit: 5 Weeks

Description of Unit: Chemical quantities can be calculated using principle of the mole and Avagadro's constant. The concentration of a solution is measured in molarity.

Essential Questions and/or Enduring Understandings: Predicting the quantities of products produced or reactants needed in a reaction can be calculated using stoichiometry. Molarity and molar mass can be used as conversion factors to calculate quantities of chemicals. Solutions can be prepared at various molarities from a dry solid or diluting a concentrated stock solution.

ESSENTIAL Standards	Learning Targets
8.1 The Mole and Molar Mass	1: I can use coefficients from a balanced chemical equation to create molar ratios. 2: I understand the concept of the mole and its importance in calculating the amount of reactant needed or products produced in a chemical reaction. 3: I can explain conservation of quantities (amount of reactants = amount of products) in a chemical equation.
8.2 Empirical and Molecular Formulas	1: I can define and identify empirical versus molecular formulas. 2: I can calculate the empirical formula of a substance 3: I can, given experimental data, calculate an empirical formula and molecular formula.
8.3 Limiting and Excess Reagents	1: I can define terms "limiting" and "excess reactant." 2: I can identify the limiting and excess reagent and calculate yields in a chemical reaction. 3: I can calculate the actual yield percentage in a laboratory setting.
8.4 Molarity	1: I can identify solutions as dilute or concentrated when given two solutions to compare. 2: I can express molarity as a value based on the ratio of moles of solute per unit liter of solution. 3: I can calculate molarity when given the amount of solute in moles or grams and the volume of solution in mL/L.
8.5 Solution Prep	1: I can distinguish the solute and solvent components of a solution. 2: I can prepare solutions from dry solute and concentrated stock solution. 3: I can show all applicable calculations with appropriate labels and significant figures when preparing a solution from dry solute and concentrated stock solutions.

UNIT 9: Thermochemistry

Duration of Unit: 4 Weeks

Description of Unit: Enthalpy is a measurement of a system's energy. Chemical bonds contain potential chemical energy. Chemical reactions can be classified by the absorbance or release of thermal energy.

Essential Questions and/or Enduring Understandings: The enthalpy of a chemical process can be quantified and calculated in various ways. Standard enthalpy data can be used to calculate enthalpy change. Calorimetry can be used as a lab technique to quantify enthalpy change. The summation of multiple chemical processes's enthalpies is equal to the summated reaction's enthalpy change.

ESSENTIAL Standards	Learning Targets
9.1 Enthalpy and Calorimetry	1: I can explain the conservation of energy and its applications in thermochemistry. 2: I can classify a chemical reaction as exothermic or endothermic according to the enthalpy of the chemical reaction. 3: I can use calorimetry to calculate the enthalpy of a chemical reaction in a lab setting.
9.2 Enthalpy of Formation and Hess's Law	1: I can explain the concepts of enthalpy of formation and Hess' Law 2: I can calculate enthalpy of reactions using Hess' Law and reaction data. 3: I can calculate the enthalpy of a target chemical reaction in a laboratory setting using Hess' Law

UNIT 10: Gas Laws

Duration of Unit: 3 Weeks

Description of Unit: Gases, their behavior, and calculations of gas systems are studied.

Essential Questions and/or Enduring Understandings: The combined gas law and ideal gas law can be used to calculate conditions of a gas system. During a chemical reaction, the ideal gas law is used to calculate properties of a gaseous substance. Established and indexed properties of gases are determined under standard conditions.

ESSENTIAL Standards	Learning Targets
10.1 Gas Variables	1: I can qualitatively assess gas variables given data 2: I can quantitatively calculate gas variables given data. 3: I can calculate gas variables in a lab setting.
10.2 General Gas Laws	1: I can qualitatively assess how gases behave in non-flexible and flexible containers given changes in pressure, volume, number of particles, and temperature. 2: I can determine if two gas variables have a direct or inverse proportional relationship given data. 3: I can develop an equation, with a constant, describing the relationship between variables in a gas law.
10.3 Ideal Gas Law	1: I can, given direct variables, use the ideal gas law to calculate the unknown variable. 2: I can use the ideal gas law to perform stoichiometry calculations of gas systems. 3: I can use the ideal gas law in a laboratory setting.

UNIT 11: Acids and Bases

Duration of Unit: 2 Weeks

Description of Unit: The nature of acids and bases and their effect on the pH of a solution.

Essential Questions and/or Enduring Understandings: Strong acids and bases drastically change the pH of a solution by dissociating completely in a solution resulting in a large increase in the concentration of hydrogen or hydroxide ions respectively. Weak acids and bases affect the pH to a less significant degree because they only partially dissociate and increase the concentration of hydrogen or hydroxide ions. The pH scale is a logarithmic scale based on the concentration of hydrogen ions in a solution.

ESSENTIAL Standards	Learning Targets
11.1 Acids and Bases	1: I can describe the physical and chemical properties of acids and bases. 2: I can describe the role of an acid or base in a reaction as either a hydrogen ion donor or acceptor. 3: I can identify acid-base conjugate pairs in a reaction.
11.2 The pH Scale and Titrations	1: I can qualitatively compare the concentrations of H+ and OH- in an acidic or basic solution given. 2: I can calculate pH or pOH of a solution given concentration data. 3: I can calculate the concentration of an acid given data from an acid-base titration.
11.3 Strong vs. Weak Acids and Bases	1: I can describe what happens at the particulate level that makes a strong acid different from a weak acid. 2: I can appropriately describe an acidic solution using the terms concentrated or dilute and weak or strong according to conductivity. 3: I can write the dissociation equation for strong and weak acids and bases.