CHEMISTRY

Chemistry is a study of the fundamental structure of matter that serves as a basic understanding of science needed in today's world. It is a study of matter, energy, atomic and molecular structure, composition, bonding, the periodic law, chemical equations, acid-base reactions, solutions, gas laws, equilibrium, electrochemistry, and nuclear reactions. The course is designed to foster scientific literacy by using real-life examples and case studies that allow students to use the concepts and skills of chemistry to make informed decisions about current issues and situations. Students will be expected to communicate in a variety of ways the results of their research and investigations. A major part of Chemistry is extensive laboratory experiences in which students will design experiments, control variables, conduct safe investigations, and analyze data.

Prerequisites:

successful completion of Biology

successful completion of Algebra I or Basic Algebra

Prerequisites for honors level:

above average math and reading ability
B or better in Algebra I
Science Department recommendation

New Haven Public Schools
Chemistry Curriculum Pacing

Quarter	Unit	Sequence of instruction	Timeline
1	Matter	• Types of Matter • Chemical Properties/Changes • Density • Elements and Compounds • Mixtures & Separation Techniques • Conservation of Matter • Kinetic Theory of Matter • States of Matter • Changes of State	2 weeks
1	Energy	• Conservation of Energy	2 weeks

		• Temperature and Kinetic Energy • Evaporation/Condensation • Vapor Pressure and Boiling • Heat of Vaporization • Melting/Freezing • Heat of Fusion • Exothermic/Endothermic	
1	Atomic Structure	• Dalton's atomic theory • Structure of the atom • Atomic models Periodic Table (atomic number, mass number) • Development of periodic table • Isotopes	2 weeks
1	Nuclear chemistry	• Release of energy by unstable nuclei • Types of nuclear radiation • Half-life • Fission and fusion • Nuclear chain reaction • Detection devices • Use of radioisotopes in medicine	2 weeks
2	Periodic table	Periodic Table • Development of periodic table • Periodic law • Classes/Families/Groups/Periods/Blocks • Elements and Uses • Periodic trends (radius, electronegativity) Electron configuration • Quantum mechanics model • Uncertainty Principle • Atomic orbitals and principal energy levels • (Aufbau principle, Pauli exclusion principle and Hund's rule)	4 weeks

2	Bonding & Compounds	Ionic Bonding • Octet rule • Formation of ions • Properties • Monatomic and polyatomic ions • Naming ionic compounds • Writing formulas for ionic compounds Covalent Bonding • Properties • Single, double, triple covalent bonds • Diatomic molecules • Naming molecular compounds • Writing formulas for molecular compounds • Polarity • Naming and writing formulas for acids	4 weeks
3	Chemical Reactions & Equations	• Chemical Equations • Balancing Chemical Equations • Indications of a Chemical • Reaction • Types of Chemical Reactions	4 weeks
3	Stoichiometry & Reaction rates	• The mole • Molar mass • Mole conversions • Stoichiometry • Limiting Reactants	4 weeks
4	Acids & Bases	• Arrhenius, Bronsted-Lowry and Lewis definitions • Molecular Properties of Acids • Molecular Properties of Bases • Strengths of Acids and Bases • Neutralization Reactions	3 weeks

		• The pH Scale	
4	Water & Solutions	WATER • Water and Its Solutions • Molecular Structure of Water • Hydrogen Bonding • Physical Properties of Water • Water and the Environment SOLUTIONS • Solvation • Solution Concentration • Solubility • Coligative properties • Colloids	3 weeks
4	Gases	• Behavior of Gases • Gas Pressure • Devices to Measure Pressure • Pressure Units • Boyle's Law • Charles's Law • Combined Gas Law • Dalton's Law • Ideal Gas Law	2 weeks
4	Organic chemistry (Hydrocarbons)	• Use and impact of hydrocarbons as a source of energy • Use and existence of organic compounds • Structural & molecular formulas • Naming organic compounds • Shapes of organic molecules based on their structural formulas • Monomers and polymers • Formation of linear, branched and/or cross-linked polymers • Combustion reactions	3 weeks

Beginning Curriculum Map	Subject: Chemistry	Grade: 11-12

	August/September	October
Essential Questions	How is matter classified, and observed? How do we measure matter? What are the uses of physical and chemical properties?	How have scientists used models to explain atoms? How can we use knowledge of nuclear chemistry and reactions in deciding on current energy, environmental and political issues?
Content	Structure of Matter Measurement	Structure of the Atom Nuclear
Objectives	**1. Use properties to distinguish types of matter.** **2. Determine the density of objects from measurements and grap** **3. Know that matter is composed of particles and how these particles are held together.** **4. Describe the three phases of matter.** **5. Know the properties of metals and non-metals.** **6. Define and contrast physical, chemical, and nuclear changes.** **7. Determine whether a substance is a mixture, element, or compound.** **8. Use properties of matter to separate mixtures.**	**1. Develop atomic theory in an historical perspective comparing and contrasting different models.** **2. Describe the discovery of the parts of the atom.** **3. Know atomic structure in terms of protons, neutrons, and elections.** **4. Define and use concepts of atomic number, mass number, and isotopes.** **5. Develop the concept of atomic weight.** **6. Describe the nuclear changes that release energy.** **7. Use the concepts of half life to predict the results of nuclear decay.** **8. Know natural and man-made occurrences of fission and fusion, including medical, industrial and military applications.** **9. Use the scientific concepts involved in nuclear power generation to make decisions about current societal issues.**
Instructional Strategies/ Activities	1. Use a graph to find area. 2. Pre/post 1980 penny - mass measurement. 3. Density Lab –various metals, water, glycerin. 4. Percentage error calculations. 5. Analysis of various physical and chemical changes. 6. Investigate the Laws of Conservation of	1. Beanium. 2. Funky Sand Lab. 3. Fission chain reaction model. 4. Half life activities.

	Mass& Energy.	
Assessment Types		Innovations in Chemistry Project Nuclear Energy Debate
Science Inquiry Skills	Measurement skills. Numeracy skills. Experimentation skills.	Using science to make societal decisions.
Interdisciplinary Connections		

Beginning Curriculum Map	**Subject:** Chemistry	**Grade: 11-12**
	November	**December**
Essential Questions	How does the arrangement of elements in the Periodic Table predict properties? How does electron configuration predict properties? What are they types of elements and compounds and how are they used?	How do compound bonds determine behavior in a chemical reaction? How is matter and energy conserved in a chemical reaction? How are chemical reactions analyzed?
Content	Periodic Table Electron Configuration Elements and Properties Compounds and formulas	Simple Compound Bonds Types of Chemical Reactions Chemical Equations
Objectives	**1. Describe the historical development of the organization of the Periodic Table and the modern periodic law.** **2. Describe atomic properties such as atomic radius, ionization energy, oxidation number, and electron affinity using the periodic table and charts.** **3. Develop the concept of chemical activity as it relates to atomic structure.** **4. Know the trends in properties of the**	**1. Determine whether a chemical bond between any two elements is ionic or covalent.** **2. Develop the concept of conservation of mass.** **3. Be able to write and balance common equations.** **4. Identify the different types of chemical reactions.** **5. Develop the concept of mass relationships in a chemical reaction.** **6. Identify endothermic and exothermic reactions.**

	families and series on the Periodic Table. **5. Describe the uses of some common elements.** **6. Write correct formulas for compounds using ratios and ion charts.** **7. Identify names and formulas and uses for common compounds and elements.**	
Instructional Strategies/ Activities	1. Flame Test. 2. Electron arrangements. 3. The Periodic Law (game). 4. Element Project. 5. Make ion models. 6. MgO Empirical formula determination.	1. Balance single and double replacement reactions. 2. Basic introduction to Redox reactions – Activity of Metals Laboratory. 3. Determination of reaction ratio using $PbNO_3$ + KI.
Assessment Types	Project: Element Project Supermarket Chemistry	
Science Inquiry Skills		
Interdisciplinary Connections		

Beginning Curriculum Map	Subject: Chemistry	Grade: 11-12

	January	February
Essential Questions	How can we analyze chemical reactions, both qualitatively and quantitatively? How do chemical reactions affect our life?	How is energy transformed or conserved in chemical reactions? How is the kinetic molecular theory used and applied? What is the relationship between heat and phase changes?
Content	Reactions and Equations Moles and Stoichiometry Chemistry of Cars	Endo and Exothermic Reactions Kinetic Molecular Theory Caloriemetry Phases and Phase Changes
Objectives	**1. Determine the molecular mass of a compound.** **2. Determine empirical and molecular formulas for compounds.** **3. Determine the chemical composition and write a compound's formula by using percent composition and mole ratios.** **4. Given data in mass or moles, calculate masses and yields of reactants and products in a reaction.** **5. Understand the concepts behind limiting reactions**	**1. Identify endothermic and exothermic reactions.** **2. Identify the three basic assumptions of the kinetic molecular theory.** **3. Describe the basic differences between solids, liquids, and gases in terms of the kinetic theory.** **4. Be able to apply the concepts of phase change to explain everyday phenomena.** **5. Describe energy changes accompanying a change of state.** **6. Describe how the intermolecular forces affect the properties of condensed states of matter.** **7. Read and interpret phase change graphs.** **8. Describe the factors that effect phase changes.**
Instructional Strategies/ Activities	1. Molar Lab using iron filings. 2. Percent of hydration in crystalline substances.	1. Volatility laboratory experiences. 2. Phase Change labs and graphs. 3. Specific Heat Capacity Labs 4. Coffee Cup Project

Assessment Types	Chemistry in A Car Forum/Project	Coffee Cup Project
Science Inquiry Skills		
Interdisciplinary Connections		

Beginning Curriculum Map	**Subject:** Chemistry	**Grade: 11-12**

	March	**April**
Essential Questions	How does pressure, volume and temperature affect the properties of gases? How can the property of gases be used to explain everyday phenonomena?	How can we investigate the behavior of chemicals in solutions (including electrochemical reactions) in order to analyze commercial and technological processes?
Content	Gas Laws	Solutions ElectroChemistry
Objectives	**1. Describe the physical properties of gases.** **2. Describe volume, temperature, and pressure of a gas and their units of measurement.** **3. Apply the relationships between pressure, temperature, concentration and volume to gas behavior (i.e. Boyle's Law, Charles' Law).**	**1. Describe the types of solutions, the solution process, and the influence of temperature and pressure on solubility.** **2. Analyze and explain the behavior of saturated solutions.** **3. Develop the conceptual understanding of solution concentration and apply this to conductivity..** **4. Make a solution of a specific concentration and**

	4. Develop a conceptual understanding of the ideal gas law. **5.Develop the concept of the absolute zero and the Kelvin temperature scale.** **6. Be able to use formulas to solve real world gas law problems.** **7. Apply gas laws involving temperature and pressure to natural phenomena.**	**describe the effect the solute has on the physical properties of the solution.** **5. Describe dissociation and ionization.** **6. Describe the behavior of ions in solution.** **7. Analyze crystals.**
Instructional Strategies/ Activities	1. Charles' and Boyle's Law laboratories and activities. 2. Determination of R constant with butane. 3. Investigate the molar volume of a gas.	1. Electrochemistry lab 2. Crystal Lab 3. Create solubility graphs. 4. Net ionic equations.
Assessment Types	Gas Laws and Hot Air Balloons	Labs Tests Quizzes
Science Inquiry Skills		
Interdisciplinary Connections		

Beginning Curriculum Map	**Subject:** Chemistry	**Grade: 11-12**

	May	**June**
Essential Questions	How do acid/base/salt reactions show the principles of chemistry?	What are the uses of organic compounds and plastics? How can we investigate the structure and behavior of common carbon-based compounds and their role in

	What are the application of acid/base reactions and their impact on our lives and the environment?	manufacturing, living organisms. and the environment?
Content	Acid/Base Structure Acid/base reactions	Organic Bonding Plastics/Petroleum
Objectives	**1. Define acids and bases in the traditional and modern sense.** **2. Distinguish between forms of acids and bases using their properties.** **3. Compare the strengths of acids and bases and apply these concepts to buffer solutions.** **4. Be able to complete an acid base neutralization reaction and predict the products.** **5. Use the concept of molarity to determine the concentrations of a titration reaction.**	**1. Model covalent bonds using electron-dot diagrams.** **2. Hypothesize the shapes of molecules based on their bonds.** **3. Be able to draw structural formulas and name organic compounds.** **4. Describe the existence and uses of some organic compounds.** **5. Be able to identify and analyze monomers and polymers.**
Instructional Strategies/ Activities	1. pH Lab 2. titration lab 3. acid rain simulation and debate	1. making plastic lab 2. petroleum lab 3. recycling plastic activities 4. tie-dye lab
Assessment Types	Acid Rain debate/Project	Labs Tests Quizzes
Science Inquiry Skills		

Interdisciplinary Connections		

CHEMISTRY

Essential Questions: How is matter classified, and observed?
How do we measure matter?
What are the uses of physical and chemical properties?

OBJECTIVES	CORRESPONDING CT FRAMEWORKS	RECOMMENDED INSTRUCTIONAL STRATEGIES	ASSESSMENT TOOL	TIMELINES	RESOURCE
1. Use properties to distinguish types of matter. **2. Determine the density of objects from measurements and grap** **3. Know that matter is composed of particles and how these particles are held together.** **4. Describe the three phases of matter.** **5. Know the properties of metals and non-metals.** **6. Define and contrast physical, chemical, and nuclear changes.** **7. Determine whether a substance is a mixture, element, or compound.** **8. Use properties of matter to separate mixtures.**		1. Use a graph to find area. 2. Pre/post 1980 penny - mass measurement. 3. Density Lab – various metals, water, glycerin. 4. Percentage error calculations. 5. Analysis of various physical and chemical changes. 6. Investigate the Laws of Conservation of Mass& Energy.		**3 weeks**	

CHEMISTRY

Essential Questions: How have scientists used models to explain atoms?
How can we use knowledge of nuclear chemistry and reactions in deciding on current energy , environmental and political issues?

OBJECTIVES	CORRESPONDING CT FRAMEWORKS	RECOMMENDED INSTRUCTIONAL STRATEGIES	ASSESSMENT TOOL	TIMELINES	RESOURCE
1. Develop atomic theory in an historical perspective comparing and contrasting different models. **2. Describe the discovery of the parts of the atom.** **3. Know atomic structure in terms of protons, neutrons, and elections.** **4. Define and use concepts of atomic number, mass number, and isotopes.** **5. Develop the concept of atomic weight.** **6. Describe the nuclear changes that release energy.** **7. Use the concepts of half life to predict the results of nuclear decay.** **8. Know natural and man-made occurrences of fission and fusion, including medical, industrial and military applications.** **9. Use the scientific concepts involved in nuclear power generation to make decisions about current societal issues.**		1. Beanium. 2. Funky Sand Lab. 3. Fission chain reaction model. 4. Half life activities.	Innovations in Chemistry Project Nuclear Energy Debate	**4 weeks**	

CHEMISTRY

Essential Questions: How does the arrangement of elements in the Periodic Table and electron configuration predict properties?
What are they types of elements and compounds and how are they used?

OBJECTIVES	CORRESPONDING CT FRAMEWORKS	RECOMMENDED INSTRUCTIONAL STRATEGIES	ASSESSMENT TOOL	TIMELINES	RESOURCE
1. Describe the historical development of the organization of the Periodic Table and the modern periodic law. **2. Describe atomic properties such as atomic radius, ionization energy, oxidation number, and electron affinity using the periodic table and charts.** **3. Develop the concept of chemical activity as it relates to atomic structure.** **4. Know the trends in properties of the families and series on the Periodic Table.** **5. Describe the uses of some common elements.** **6. Write correct formulas for compounds using ratios and ion charts.** **7. Identify names and formulas and uses for common compounds and elements.**		1. Flame Test. Electron arrangements. 2. The Periodic Law (game). 3. Element Project. 4. Make ion models. 5. MgO Empirical formula determination.	Element Project Supermarket Chemistry	**3 weeks**	

CHEMISTRY

Essential Questions: How do compound bonds determine behavior in a chemical reaction?
How is matter and energy conserved in a chemical reaction?
How are chemical reactions analyzed?

OBJECTIVES	CORRESPONDING CT FRAMEWORKS	RECOMMENDED INSTRUCTIONAL STRATEGIES	ASSESSMENT TOOL	TIMELINES	RESOURCE
1. Determine whether a chemical bond between any two elements is ionic or covalent. **2. Develop the concept of conservation of mass.** **3. Be able to write and balance common equations.** **4. Identify the different types of chemical reactions.** **5. Develop the concept of mass relationships in a chemical reaction.** **6. Identify endothermic and exothermic reactions.**		1. Balance single and double replacement reactions. 2. Basic introduction to Redox reactions – Activity of Metals Laboratory. 3. Determination of reaction ratio using $PbNO_3$ + KI.	Labs Tests Quizzes	**4 weeks**	

CHEMISTRY

Essential Questions: How can we analyze chemical reactions, both qualitatively and quantitatively?
How do chemical reactions affect our life?

OBJECTIVES	CORRESPONDING CT FRAMEWORKS	RECOMMENDED INSTRUCTIONAL STRATEGIES	ASSESSMENT TOOL	TIMELINES	RESOURCE
1. Determine the molecular mass of a compound. **2. Determine empirical and molecular formulas for compounds.** **3. Determine the chemical composition and write a compound's formula by using percent composition and mole ratios.** **4. Given data in mass or moles, calculate masses and yields of reactants and products in a reaction.** **5. Understand the concepts behind limiting reactions**		Molar Lab using iron filings. Percent of hydration in crystalline substances.	Chemistry in A Car Forum/Project **MIDTERM EXAM** **(atoms, elements, compounds, reactions)**	**4 weeks**	

CHEMISTRY

Essential Questions: How is energy transformed or conserved in chemical reactions?
How is the kinetic molecular theory used and applied?
What is the relationship between heat and phase changes?

OBJECTIVES	CORRESPONDING CT FRAMEWORKS	RECOMMENDED INSTRUCTIONAL STRATEGIES	ASSESSMENT TOOL	TIMELINES	RESOURCE
1. Identify endothermic and exothermic reactions. **2. Identify the three basic assumptions of the kinetic molecular theory.** **3. Describe the basic differences between solids, liquids, and gases in terms of the kinetic theory.** **4. Be able to apply the concepts of phase change to explain everyday phenomena.** **5. Describe energy changes accompanying a change of state.** **6. Describe how the intermolecular forces affect the properties of condensed states of matter.** **7. Read and interpret phase change graphs.** **8. Describe the factors that effect phase changes.**		1. Volatility laboratory experiences. 2. Phase Change labs and graphs. 3. Specific Heat Capacity Labs 4. Coffee Cup Project	**Coffee Cup Project**	**3 weeks**	

CHEMISTRY

Essential Questions: How does pressure, volume and temperature affect the properties of gases?
How can the property of gases be used to explain everyday phenonomena?

OBJECTIVES	CORRESPONDING	RECOMMENDED	ASSESSMENT	TIMELINES	RESOURCE

	CT FRAMEWORKS	INSTRUCTIONAL STRATEGIES	TOOL		
1. Describe the physical properties of gases. **2. Describe volume, temperature, and pressure of a gas and their units of measurement.** **3. Apply the relationships between pressure, temperature, concentration and volume to gas behavior (i.e. Boyle's Law, Charles' Law).** **4. Develop a conceptual understanding of the ideal gas law.** **5. Develop the concept of the absolute zero and the Kelvin temperature scale.** **6. Be able to use formulas to solve real world gas law problems.** **7. Apply gas laws involving temperature and pressure to natural phenomena.**		1. Charles' and Boyle's Law laboratories and activities. 2. Determination of R constant with butane. 3. Investigate the molar volume of a gas. 4. Gas Laws and Hot Air Balloons	Labs Tests Quizzes		

CHEMISTRY

Essential Questions: How can we investigate the behavior of chemicals in solutions (including electrochemical reactions) in order to analyze commercial and technological processes?

OBJECTIVES	CORRESPONDING CT FRAMEWORKS	RECOMMENDED INSTRUCTIONAL STRATEGIES	ASSESSMENT TOOL	TIMELINES	RESOURCE
1. Describe the types of solutions, the solution process, and the influence of temperature and pressure on solubility. 2. Analyze and explain the behavior of saturated solutions. 3. Develop the conceptual understanding of solution concentration and apply this to conductivity.. 4. Make a solution of a specific concentration and describe the effect the solute has on the physical properties of the solution. 5. Describe dissociation and ionization. 6. Describe the behavior of ions in solution. 7. Analyze crystals.		Electrochemistry lab Crystal Lab Create solubility graphs. Net ionic equations	Labs Tests Quizzes	**3 Weeks**	

CHEMISTRY

Essential Questions: How do acid/base/salt reactions show the principles of chemistry?
What are the application of acid/base reactions and their impact on our lives and the environment?

OBJECTIVES	CORRESPONDING CT FRAMEWORKS	RECOMMENDED INSTRUCTIONAL STRATEGIES	ASSESSMENT TOOL	TIMELINES	RESOURCE
1. Define acids and bases in the traditional and modern sense. **2. Distinguish between forms of acids and bases using their properties.** **3. Compare the strengths of acids and bases and apply these concepts to buffer solutions.** **4. Be able to complete an acid base neutralization reaction and predict the products.** **5. Use the concept of molarity to determine the concentrations of a titration reaction.**		**1.** pH Lab 2. titration lab 3. acid rain simulation and debate	acid rain simulation and debate	**3 weeks**	

CHEMISTRY

Essential Questions: What are the uses of organic compounds and plastics?

How can we investigate the structure and behavior of common carbon-based compounds and their role in manufacturing, living organisms. and the environment?

OBJECTIVES	CORRESPONDING CT FRAMEWORKS	RECOMMENDED INSTRUCTIONAL STRATEGIES	ASSESSMENT TOOL	TIMELINES	RESOURCES
1. Model covalent bonds using electron-dot diagrams. **2. Hypothesize the shapes of molecules based on their bonds.** **3. Be able to draw structural formulas and name organic compounds.** **4. Describe the existence and uses of some organic compounds.** **5. Be able to identify and analyze monomers and polymers.**		1.making plastic lab 2.petroleum lab 3.recycling plastic activities 4. tie-dye lab	labs FINAL EXAM (heat, gases, acids, solutions, organics)		