Geneva CUSD 304
Content-Area Curriculum Frameworks
Grades 6-12
Science

Mission Statement	<u>The Mission of Science Education Is:</u> 1. To nurture an active interest in science that continues throughout life. 2. To teach the learning skills and concepts necessary for the scientific process. 3. To develop student understanding of the interrelationships between science, society, and the environment 4. To encourage students to discover and develop their talent in science.
Course Sequence **(Grades 6-12)**	**6th grade:** Earth Science **7th grade:** Life Science **8th grade:** Physical Science **9th grade:** General Science Earth Science Biology Biology Honors **10th ,11th,12 grade:** Chemistry Chemistry Honors Physics Astronomy Natural Disasters Anatomy and Physiology I and II Horticulture I and II AP Chemistry AP Biology AP Environmental Science

Course Framework

Course Title	**Chemistry**
Grade Level	10^{th}/11th
Semesters (1-2-3-4)	2
Prerequisite	Biology, Algebra I (a grade of B or better in Algebra is required or department approval)
Course Description	This laboratory science deals with the structure of matter and the changes it undergoes. Chemistry is an elective course that is a prerequisite to many upper level science courses and offers the serious student a high level of challenge. Chemistry is physical science, and an experimental and mathematical approach to problem solving is emphasized throughout the course. A hands-on approach is stressed throughout the course. Areas of study include atomic structure and bonding; reactions and reaction mechanisms; solutions, acid-base systems; equilibrium; and oxidation-reduction reactions. Students who desire to take AP Chemistry are required to earn an A in this course or receive departmental approval.
District-approved Materials and/or Resources	Modern Chemistry Publisher: Holt Rinehart and Winston ISBN: 0-03-056537-5 Copy write: 2002

Unit Frameworks

<table>
<tr><td>Unit of Study:
major topics</td><td colspan="2">Lab Safety</td><td>Resources that will support instruction
Flinn Safety Contract
Equipment Demonstrations</td></tr>
<tr><td>Illinois Learning Standards, Benchmarks,

National Standards Assessment Frameworks, or other standards that will be taught in this unit</td><td colspan="3">11.A.5a Formulate hypotheses referencing prior research and knowledge.
11.A.5b Design procedures to test the selected hypotheses.
13.A.5a Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities.
13.B.5c Design and conduct an environmental impact study, analyze findings and justify recommendations.</td></tr>
<tr><td>Objectives
o Conceptual
o Factual
o Procedural</td><td colspan="3">Demonstrate the knowledge and skills that form a foundation for the study of chemistry.
A. Perform correct safety procedures when working in the laboratory
B. Find and define the usage of specific chemistry laboratory equipment
C. Know how to use and the location of safety equipment in the laboratory</td></tr>
<tr><td>Assessments</td><td colspan="2">Performance Tasks
Flinn Safety Contract
Safety Test</td><td>Other Evidence</td></tr>
</table>

Unit Frameworks

<table>
<tr><td>Unit of Study:
major topics</td><td>Matter and Change</td><td><u>Resources that will support instruction</u>
Textbook
Worksheets
Penny Lab
Physical/Chemical Change Lab</td></tr>
<tr><td>Illinois Learning Standards, Benchmarks,

National Standards Assessment Frameworks, or other standards that will be taught in this unit</td><td colspan="2">11.A.5c Conduct systematic controlled experiments to test the selected hypotheses.
11.A.5e Report, display, and defend the results of investigations to audiences that may include professionals and technical experts.
12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems.
12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures.
12.D.5b Analyze the effects of gravitational, electromagnetic, and nuclear forces on a physical system.
13.A.5b Explain criteria that scientists use to evaluate the validity of scientific claims and theories.
13.B.5a Analyze challenges created by international competition for increases in scientific knowledge and technological capabilities (e.g., patent issues, industrial espionage, technology obsolescence).</td></tr>
<tr><td>Objectives
o Conceptual
o Factual
o Procedural</td><td colspan="2">A. What is Chemistry?
1. Define Chemistry
2. Divisions of Chemistry
3. Comparison of current research and technological development to ancient practice of alchemy
B. Matter and Its Properties
1. Analyze physical, chemical and nuclear change (and properties) in matter
a. States of matter (explain the gaseous, liquid, and solid states of matter in terms of particles, shape, and volume)
b. Examples of physical, chemical and nuclear changes
2. Analyze mixtures and pure substances
a. Determine if a substance is homogeneous or heterogeneous
b. Discuss properties and techniques that can be used to</td></tr>
</table>

	determine whether matter is a mixture or a pure substance c. Distinguish between elements and compounds C. Introduction to the Periodic Table 1. Describe the origins of the periodic table 2. Analyze the main groups of elements in the periodic table and be able to describe whether an element is a metal, metalloid, or non-metal	
Assessments	<u>Performance Tasks</u> Homework Completion Labs/Lab Reports Quizzes Tests	<u>Other Evidence</u>

Unit Frameworks

Unit of Study: major topics	**Measurement & Calculations**	Resources that will support instruction Textbook Worksheets Density Lab
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	11.A.5a Formulate hypotheses referencing prior research and knowledge. 11.A.5b Design procedures to test the selected hypotheses. 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results 11.A.5e Report, display, and defend the results of investigations to audiences that may include professionals and technical experts. 11.B.5c Build and test different models or simulations of the design solution using suitable materials, tools, and technology. 11.B.5d Choose a model and refine its design based on the test results 11.B.4f Evaluate the test results based on established criteria, note sources of error and recommend improvements. 13.A.5b Explain criteria that scientists use to evaluate the validity of scientific claims and theories. 13.A.5c Explain the strengths, weaknesses, and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling, and statistical studies. 13.A.5d Explain using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims.	
Objectives o **Conceptual** o **Factual** o **Procedural**	A. Scientific Method 1. Describe purpose of the Scientific Method 2. Distinguish between qualitative and quantitative observations 3. Describe differences between hypotheses, theories, and models B. Apply the use of the metric system to chemistry	

<table>
<tr><td></td><td colspan="2">1. Solve problems using appropriate metric system units
2. Convert SI units using dimensional analysis (factor-label method)
3. Recognize the meaning of base SI units including their abbreviations and the quantities those units describe
4. Solve problems using scientific notation, exponentiation, and significant figures
C. Examine Density
1. Perform density calculations
2. Given an unknown substance, synthesize an experiment to identify the substance
3. Identify the similarities/differences between a direct relationship and an indirect (inverse) relationship and recognize graphs of these relationships
D. Apply techniques to evaluate measurements in chemistry
1. Distinguish between accuracy and precision
2. Define error and perform calculations
3. Perform percent error calculations</td></tr>
<tr><td>Assessments</td><td><u>Performance Tasks</u>
Homework Completion
Labs/Lab Reports
Quizzes
Tests</td><td><u>Other Evidence</u></td></tr>
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Unit Frameworks

<table>
<tr><td>Unit of Study:
major topics</td><td colspan="2">The Atom</td><td><u>Resources that will support instruction</u>
Textbook
Worksheets</td></tr>
<tr><td>Illinois Learning Standards, Benchmarks,

National Standards Assessment Frameworks, or other standards that will be taught in this unit</td><td colspan="3">11.A.5c Conduct systematic controlled experiments to test the selected hypotheses.
11.A.5d Apply statistical methods to make predictions and to test the accuracy of results
11.A.5e Report, display, and defend the results of investigations to audiences that may include professionals and technical experts.
11.B.5b Select criteria for a successful design solution to the identified problem.
12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems.
12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures.
12.D.5b Analyze the effects of gravitational, electromagnetic, and nuclear forces on a physical system.
13.A.5b Explain criteria that scientists use to evaluate the validity of scientific claims and theories.
13.A.5c Explain the strengths, weaknesses, and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling, and statistical studies.
13.A.5d Explain using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims.
13.B.5e Assess how scientific and technological progress has affected other fields of study, careers, and job markets and aspects of everyday life.</td></tr>
<tr><td>Objectives
o Conceptual
o Factual
o Procedural</td><td colspan="3">A. Investigate the history and make-up of the atom
1. Survey the atomic models of Dalton, Thomson, Rutherford, and Bohr
a. The five essential points to Dalton’s atomic theory
b. Explain the relationship between Dalton’s atomic theory and the law of conservation of mass, the law of definite</td></tr>
</table>

	proportions, and the law of multiple proportions c. Summarize the observed properties of cathode rays that led to the discovery of the electron d. Summarize the experiments conducted by Rutherford that led to the discovery of the nucleus 2. Analyze the basic components of the atom (protons, neutrons, electrons) a. Describe the properties of the basic components of the atom b. Describe the way the atom is held together (four fundamental forces) 3. Determine the number of protons/neutrons/electrons contained in a particular element (atomic number, atomic mass) a. Define atomic number and atomic mass b. Define atom and isotope (isotopic notation) c. Discriminate between average atomic mass and relative atomic mass 4. Differentiate between an ion and a neutral atom B. Investigate the mole concept 1. Examine the concept of the mole 2. Define a mole in terms of Avogadro's number 3. Calculate and apply molar mass 4. Apply the mole concept by determining mole, grams, and/or atoms/molecules of a sample using dimensional analysis (factor-label method)	
Assessments	<u>Performance Tasks</u> Homework Completion Labs/Lab Reports Quizzes Tests	<u>Other Evidence</u>

Unit Frameworks

Unit of Study: major topics	**Electrons in Atoms**	Resources that will support instruction Textbooks Worksheets Atomic Spectra Lab
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	11.A.5a Formulate hypotheses referencing prior research and knowledge. 11.A.5b Design procedures to test the selected hypotheses. 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. 12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. 12.D.5a Analyze factors that influence the relative motion of an object (e.g., friction, wind shear, cross currents, potential differences). 12.D.5b Analyze the effects of gravitational, electromagnetic, and nuclear forces on a physical system. 12.F.5a Compare the processes in the life cycle of stars (e.g., gravitational collapse, thermonuclear fusion, nova) and evaluate the supporting evidence 12.F.5b Describe the size and age of the universe and evaluate the supporting evidence (e.g., red-shift, Hubble's constant). 13.A.5c Explain the strengths, weaknesses, and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling, and statistical studies. 13.A.5d Explain using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims. 13.B.5a Analyze challenges created by international competition for increases in scientific knowledge and technological capabilities (e.g., patent issues, industrial espionage, technology obsolescence).	

	13.B.5e Assess how scientific and technological progress has affected other fields of study, careers, and job markets and aspects of everyday life.	
Objectives o **Conceptual** o **Factual** o **Procedural**	A. Investigate Waves 1. Understand Electromagnetic Radiation 2. Define Waves and Wave Properties a. Crest b. Trough c. Wavelength d. Amplitude e. Frequency 3. Apply the relationship between the speed of light, frequency, and wavelength of waves ($c = \nu\lambda$) through problem-solving 4. Differentiate the various parts of the electromagnetic spectrum 5. Apply the idea of Planck's constant to calculate the energy of a wave ($E = h\nu$, $h = 6.6262 \times 10^{-34}$ Js) a. Apply equation to problem-solving b. Evaluate the concept of atomic spectrum (emission spectrum) to the energy of electrons c. Analyze the energy of an electron to the energy level concept 6.Analyze the Bohr Model of the Atom a. Use a spectroscope to analyze the atomic spectrum of elements b. Apply Heisenberg's Uncertainty Principle B. Quantum Numbers and Atomic Orbitals 1. Define the four principle quantum numbers and describe their significance 2. Complete electron configurations using the quantum numbers for the elements 3. State the Aufbau Principle, the Pauli Exclusion Principle, and Hund's Rule	
Assessments	<u>Performance Tasks</u> Homework Completion Labs/Lab Reports Quizzes Tests	<u>Other Evidence</u>

Unit Frameworks

Unit of Study: major topics	**The Periodic Law**	Resources that will support instruction Textbook Worksheets Periodic Trends Lab
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	11.B.5f Using available technology, prepare and present findings of the tested design solution to an audience that may include professional and technical experts. 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. 12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. 12.D.5b Analyze the effects of gravitational, electromagnetic, and nuclear forces on a physical system. 13.B.5b Analyze and describe the processes and effects of scientific and technological breakthroughs.	
Objectives o **Conceptual** o **Factual** o **Procedural**	A. Development of the Periodic Table 1. Explain the roles of Mendeleev and Moseley in the development of the periodic table 2. Describe the modern periodic table B. Explain how the periodic table can be used to predict the physical and chemical properties of elements C. Study the families on the periodic table and recognize their general properties D. Periodic Trends 1. Define valence electron and state how many are present in atoms 2. Analyze the trend in Atomic Radii 3. Analyze the trend in Ionization Energy 4. Analyze the trend in Ionic Size 5. Analyze the trend in Electronegativity 6. Analyze the trend in Electron Affinity E. Trends in Electron Configuration 1. Identify the various blocks on the periodic table and relate those blocks to element's electron configuration. 2. Describe the trend of an element's valence electrons	

Assessments	Performance Tasks Homework Completion Labs/Lab Reports Quizzes Tests	Other Evidence

Unit Frameworks

Unit of Study: major topics	**Chemical Bonding**	Resources that will support instruction Textbook Worksheets Molecular Models Lab
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	11.A.5a Formulate hypotheses referencing prior research and knowledge. 11.A.5b Design procedures to test the selected hypotheses. 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. 12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. 12.D.5b Analyze the effects of gravitational, electromagnetic, and nuclear forces on a physical system. 13.A.5c Explain the strengths, weaknesses, and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling, and statistical studies. 13.A.5d Explain using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims. 13.B.5b Analyze and describe the processes and effects of scientific and technological breakthroughs.	
Objectives o **Conceptual** o **Factual** o **Procedural**	A. Types of Chemical Bonding 1. Define Chemical Bond 2. Describe ionic and covalent bonds 3. Apply the concept of polarity to molecules 4. Using electronegativity of elements, determine whether a bond will be ionic, polar covalent, or non-polar covalent B. Ionic Bonding 1. Identify an ionic compound 2. Discuss the arrangement of ions in crystals 3. Define lattice energy 4. List the properties of ionic compounds C. Covalent Bonding 1. Define molecule and molecular formula 2. State the octet rule 3. Apply concepts of valence electrons to predict the formation of single, double, and triple covalent bonds	

<table>
<tr><td></td><td colspan="2">between different elements
4. Draw Lewis dot structures of compounds showing the bonding and the unshared pairs of electrons
5. Define resonance
6. Write the Lewis Structure for a polyatomic ion
D. Molecular Geometry
1. Define the VSEPR Theory
2. Predict the geometry of molecules
3. Explain how shapes of molecules are accounted for by hybridization
4. Explain molecular polarity</td></tr>
<tr><td>Assessments</td><td><u>Performance Tasks</u>
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Labs/Lab Reports
Quizzes
Tests</td><td><u>Other Evidence</u></td></tr>
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Unit Frameworks

Unit of Study: major topics	**Chemical Formulas and Compounds**	Resources that will support instruction Textbook Worksheets Percent Composition Lab
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	11.A.5a Formulate hypotheses referencing prior research and knowledge. 11.A.5b Design procedures to test the selected hypotheses. 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results 11.A.5e Report, display, and defend the results of investigations to audiences that may include professionals and technical experts. 11.B.5f Using available technology, prepare and present findings of the tested design solution to an audience that may include professional and technical experts. 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. 12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. 12.D.5b Analyze the effects of gravitational, electromagnetic, and nuclear forces on a physical system. 13.A.5a Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities. 13.A.5b Explain criteria that scientists use to evaluate the validity of scientific claims and theories.	
Objectives o **Conceptual** o **Factual** o **Procedural**	A. Apply knowledge of bonding to Chemical Nomenclature 1. Fixed Metal & Non-metal 2. Transition Metal & Non-metal 3. Non-metal & Non-metal 4. Ternary Compounds (include polyatomic ions) 5. Binary & Ternary Acids	

	B. Apply concepts to determine the Chemical Composition of a compound 1. Review of Moles 2. Calculate percent composition of a compound 3. Determine the empirical formula of a compound 4. Determine the molecular formula of a compound	
Assessments	<u>Performance Tasks</u> Homework Completion Labs/Lab Reports Quizzes Tests	<u>Other Evidence</u>

Unit Frameworks

Unit of Study: major topics	**Chemical Equations and Reactions**	Resources that will support instruction Textbook Worksheets Chemical Reaction Lab
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	11.A.5a Formulate hypotheses referencing prior research and knowledge. 11.A.5b Design procedures to test the selected hypotheses. 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results 11.A.5e Report, display, and defend the results of investigations to audiences that may include professionals and technical experts. 11.B.5b Select criteria for a successful design solution to the identified problem. 11.B.5e Apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks and consequences for the tested design solution and recommend modifications and refinements 11.B.5f Using available technology, prepare and present findings of the tested design solution to an audience that may include professional and technical experts. 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. 12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. 13.A.5a Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities. 13.A.5b Explain criteria that scientists use to evaluate the validity of scientific claims and theories. 13.A.5c Explain the strengths, weaknesses, and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling, and statistical studies.	

<table>
<tr><td>Objectives
(What will students know and be able to do as a result of their learning?)

o Conceptual
o Factual
o Procedural</td><td colspan="2">A. Describing Chemical Reactions
1. List the indicators of a chemical reaction
2. Write chemical equations using the names of chemicals
3. Apply the various symbols used in chemical equations
4. Apply the conservation of matter by balancing chemical equations
B. Writing Chemical Equations
1. Define and give general equations for combustion, synthesis, decomposition, single replacement, and double replacement reactions
2. Classify a reaction as one of the five types
3. List the types of decomposition reactions
4. Predict the products when given the reactants</td></tr>
<tr><td>Assessments</td><td><u>Performance Tasks</u>
Homework Completion
Labs/Lab Reports
Quizzes
Tests</td><td><u>Other Evidence</u></td></tr>
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Unit Frameworks

Unit of Study: major topics	**Stoichiometry**	Resources that will support instruction Textbook Worksheets Stoichiometry (Percent Yield) Lab
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	11.A.5a Formulate hypotheses referencing prior research and knowledge. 11.A.5b Design procedures to test the selected hypotheses. 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results 11.A.5e Report, display, and defend the results of investigations to audiences that may include professionals and technical experts. 11.B.5b Select criteria for a successful design solution to the identified problem. 11.B.5e Apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks and consequences for the tested design solution and recommend modifications and refinements 11.B.5f Using available technology, prepare and present findings of the tested design solution to an audience that may include professional and technical experts. 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. 12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. 13.A.5a Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities. 13.A.5b Explain criteria that scientists use to evaluate the validity of scientific claims and theories. 13.A.5c Explain the strengths, weaknesses, and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling, and statistical studies. 13.B.5e Assess how scientific and technological progress has affected other fields of study, careers, and job	

<table>
<tr><td></td><td colspan="2">markets and aspects of everyday life.</td></tr>
<tr><td>Objectives
o Conceptual
o Factual
o Procedural</td><td colspan="2">A. Conceptualizing the Mole Ratio
1. Define mole ratio and describe its role in stoichiometry calculations
2. Give the mole ratio for any two substances in a chemical reaction
3. Solve mole-mole, mole-mass, mass-mass problems
B. Analysis of Chemical Reactions
1. Define limiting reactant
2. Find the limiting reactant in a chemical reaction
3. Determine the amount of product being produced using the limiting reactant
4. Find the excess reactant and how much will be left over
C. Percent Yield
1. Define theoretical yield, actual yield, and percent yield
2. Calculate the percent yield of a product given the actual yield or determining the amount of actual yield through experimental procedures</td></tr>
<tr><td>Assessments</td><td><u>Performance Tasks</u>
Homework Completion
Labs/Lab Reports
Quizzes
Tests</td><td><u>Other Evidence</u></td></tr>
</table>

Unit Frameworks

Unit of Study: major topics	**Gas Laws & The Molecular Composition of Gases**	Resources that will support instruction Textbook Worksheets Gas Laws Lab
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	11.A.5a Formulate hypotheses referencing prior research and knowledge. 11.A.5b Design procedures to test the selected hypotheses. 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results 11.A.5e Report, display, and defend the results of investigations to audiences that may include professionals and technical experts. 11.B.5b Select criteria for a successful design solution to the identified problem. 11.B.5e Apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks and consequences for the tested design solution and recommend modifications and refinements 11.B.5f Using available technology, prepare and present findings of the tested design solution to an audience that may include professional and technical experts. 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. 12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. 13.A.5a Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities. 13.A.5b Explain criteria that scientists use to evaluate the validity of scientific claims and theories. 13.A.5c Explain the strengths, weaknesses, and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling, and statistical studies.	

<table>
<tr><td>Objectives
o Conceptual
o Factual
o Procedural</td><td colspan="2">A. Analyze the Kinetic Theory of Gases
1. State the premises of the kinetic theory of gases
2. Describe how it explains certain properties of gases
3. Distinguish between a Real Gas and an Ideal Gas
B. Apply the macroscopic variables to describe the behavior of gases
1. Define and convert between various units of volume
2. Define and convert between various units of pressure
3. Define and convert between various units of temperature
C. Evaluation of Gas Laws
1. Dalton’s Law of Partial Pressure
2. Graham’s Law of Diffusion & Effusion
3. Boyle’s Law
4. Charles’s Law
5. Gay-Lussac’s Law
6. Avogadro’s Principle
7. Ideal Gas Law
8. Combined Gas Law
D. The Analysis of chemical reactions using Gas Law Stoichiometry
1. Define and apply the molar volume of gases
2. Calculate the molar volume of gases at STP from obtained data</td></tr>
<tr><td>Assessments</td><td><u>Performance Tasks</u>
Homework Completion
Labs/Lab Reports
Quizzes
Tests</td><td><u>Other Evidence</u></td></tr>
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Unit Frameworks

Unit of Study: major topics	**Liquids and Solids**	Resources that will support instruction Textbook Worksheets
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	11.A.5a Formulate hypotheses referencing prior research and knowledge. 11.A.5b Design procedures to test the selected hypotheses. 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results 11.A.5e Report, display, and defend the results of investigations to audiences that may include professionals and technical experts. 11.B.5b Select criteria for a successful design solution to the identified problem. 11.B.5e Apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks and consequences for the tested design solution and recommend modifications and refinements 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. 12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. 12.E.5 Analyze the processes involved in naturally occurring short-term and long-term Earth events (e.g., floods, ice ages, temperature, sea-level fluctuations). 13.A.5a Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities. 13.A.5b Explain criteria that scientists use to evaluate the validity of scientific claims and theories. 13.A.5c Explain the strengths, weaknesses, and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling, and statistical studies.	

<table>
<tr><td>Objectives
o Conceptual
o Factual
o Procedural</td><td colspan="2">A. Liquids
1. Describe the motion of particles in liquids and the properties of liquids according to the Kinetic Molecular Theory
2. Discuss phase changes
3. Interpret phase diagrams
B. Investigate the Properties of Water
1. Analyze the structure of water
2. Evaluate the effect the structure of water has on surface tension, heat capacity, and density
3. Compare the physical properties of water with other substances with similar molar masses</td></tr>
<tr><td>Assessments</td><td><u>Performance Tasks</u>
Homework Completion
Labs/Lab Reports
Quizzes
Tests</td><td><u>Other Evidence</u></td></tr>
</table>

Unit Frameworks

Unit of Study: major topics	**Solutions & Ions in Aqueous Solutions and Colligative Properties**	Resources that will support instruction Textbook Worksheets Mixtures Lab Solubility Lab
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	11.A.5a Formulate hypotheses referencing prior research and knowledge. 11.A.5b Design procedures to test the selected hypotheses. 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results 11.A.5e Report, display, and defend the results of investigations to audiences that may include professionals and technical experts. 11.B.5b Select criteria for a successful design solution to the identified problem. 11.B.5e Apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks and consequences for the tested design solution and recommend modifications and refinements 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. 12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. 12.E.5 Analyze the processes involved in naturally occurring short-term and long-term Earth events (e.g., floods, ice ages, temperature, sea-level fluctuations). 13.A.5a Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities. 13.A.5b Explain criteria that scientists use to evaluate the validity of scientific claims and theories. 13.A.5c Explain the strengths, weaknesses, and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling, and statistical studies. 13.B.5e Assess how scientific and technological progress	

<table>
<tr><td></td><td colspan="2">has affected other fields of study, careers, and job markets and aspects of everyday life.</td></tr>
<tr><td>Objectives
o Conceptual
o Factual
o Procedural</td><td colspan="2">A. Distinguish solutions from other mixtures
1. Differentiate between homogeneous and heterogeneous mixtures
2. Define solute and solvent
3. Distinguish between a solution, colloid, and suspension.
4. Apply the Tyndall effect
5. Describe the types of solutions
6. Differentiate between electrolytes and nonelectrolytes
B. Apply solubility concepts to chemistry
1. Explain the process of dissolving (solvation)
2. Describe saturated, unsaturated, and supersaturated solutions
3. Using solubility graphs, solve problems dealing with solubility
4. Explain the factors that influence the rate of dissolving solids in liquids
5. Explain the energy changes that occur when a substance dissolves
C. Calculate the concentration of solutions
1. Molarity
2. Molality
D. Analyze the Colligative Properties of Solutions
1. Write chemical equations for reactions in solutions
a. Dissociation Reactions
b. Complete Ionic Reactions
c. Net Ionic Reactions
2. Scrutinize the colligative properties of vapor pressure lowering, freezing point depression, and boiling point elevation
3. Calculate changes in freezing point and boiling point of solutions</td></tr>
<tr><td>Assessments</td><td><u>Performance Tasks</u>
Homework Completion
Labs/Lab Reports
Quizzes
Tests</td><td><u>Other Evidence</u></td></tr>
</table>

Unit Frameworks

Unit of Study: major topics	**Acids and Bases**		Resources that will support instruction Textbook Worksheets Titration Lab
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	11.A.5a	Formulate hypotheses referencing prior research and knowledge.	
	11.A.5b	Design procedures to test the selected hypotheses.	
	11.A.5c	Conduct systematic controlled experiments to test the selected hypotheses.	
	11.A.5d	Apply statistical methods to make predictions and to test the accuracy of results	
	11.A.5e	Report, display, and defend the results of investigations to audiences that may include professionals and technical experts.	
	11.B.5a	Identify a design problem that has practical applications and propose possible solutions, considering such constraints as available tools, materials, time, and costs.	
	11.B.5b	Select criteria for a successful design solution to the identified problem.	
	11.B.5e	Apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks and consequences for the tested design solution and recommend modifications and refinements	
	11.B.5f	Using available technology, prepare and present findings of the tested design solution to an audience that may include professional and technical experts.	
	12.C.5a	Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems.	
	12.C.5b	Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures.	
	12.E.5	Analyze the processes involved in naturally occurring short-term and long-term Earth events (e.g., floods, ice ages, temperature, sea-level fluctuations).	
	13.A.5a	Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities.	

	13.A.5b	Explain criteria that scientists use to evaluate the validity of scientific claims and theories.
	13.A.5c	Explain the strengths, weaknesses, and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling, and statistical studies.
	13.B.5c	Design and conduct and environmental impact study, analyze findings, and justify recommendations.
	13.B.5d	Analyze the costs, benefits, and effects of scientific and technological policies at the local, state, national, and global levels (e.g., genetic research, Internet access).

Objectives
- **Conceptual**
- **Factual**
- **Procedural**

A. General Properties of Acids and Bases
   1. Examine the properties of acids and bases
   2. Define acids and bases using the definitions of Arrhenius, Bronsted, and Lewis
   3. Analyze acid and base strength
   4. Identify conjugate pairs in acid/base reactions

B. Acid and Base Reactions
   1. Write neutralization reactions
   2. Write dissociation reactions for acids and bases
   3. Analyze the role of chemical equilibrium in acid/base chemistry

C. The pH Concept
   1. Explain the meaning of pH
   2. Analyze the autoionization of water
   3. Calculate pH, pOH, $[H^+]$, $[OH^-]$ given one of the four unknowns

D. Titrations
   1. Explain the chemistry principles of titration
   2. Explain the role of indicators and how indicators work
   3. Perform calculations involving titrations of strong acids and strong bases

Assessments	Performance Tasks	Other Evidence
	Homework Completion Labs/Lab Reports Quizzes Tests	

Unit Frameworks

Unit of Study: major topics	**Reaction Energy and Kinetics**		Resources that will support instruction Textbook Worksheets Themodynamics Lab Kinetics Lab
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	11.A.5a	Formulate hypotheses referencing prior research and knowledge.	
	11.A.5b	Design procedures to test the selected hypotheses.	
	11.A.5c	Conduct systematic controlled experiments to test the selected hypotheses.	
	11.A.5d	Apply statistical methods to make predictions and to test the accuracy of results	
	11.A.5e	Report, display, and defend the results of investigations to audiences that may include professionals and technical experts.	
	11.B.5a	Identify a design problem that has practical applications and propose possible solutions, considering such constraints as available tools, materials, time, and costs.	
	11.B.5b	Select criteria for a successful design solution to the identified problem.	
	11.B.5e	Apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks and consequences for the tested design solution and recommend modifications and refinements	
	11.B.5f	Using available technology, prepare and present findings of the tested design solution to an audience that may include professional and technical experts.	
	12.C.5a	Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems.	
	12.C.5b	Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures.	
	13.A.5a	Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities.	
	13.A.5b	Explain criteria that scientists use to evaluate the validity of scientific claims and theories.	
	13.A.5c	Explain the strengths, weaknesses, and uses of	

<table>
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13.B.5c Design and conduct and environmental impact study, analyze findings, and justify recommendations.
13.B.5d Analyze the costs, benefits, and effects of scientific and technological policies at the local, state, national, and global levels (e.g., genetic research, Internet access).</td></tr>
<tr><td>Objectives
o Conceptual
o Factual
o Procedural</td><td colspan="2">A. Thermochemistry
1. Define heat and state its units
2. Perform specific heat calculations
3. Explain and solve problems involving heat of formation, heat of combustion, and enthalpy change
B. Driving Forces
1. Explain enthalpy, entropy, and free energy
2. Apply enthalpy, entropy, and free energy to determine the tendency of a reaction to occur
C. The Reaction Process
1. Explain the concept of reaction mechanism
2. Use the collision theory to interpret chemical reactions
3. Define activated complex
4. Relate activation energy to heat of reaction
D. Reaction Rate
1. Define chemical kinetics, and explain the two conditions necessary for chemical reactions to occur
2. Discuss the five factors that influence reaction rate
3. Define catalyst, and discuss two different types
4. Explain and write rate laws for chemical reactions</td></tr>
<tr><td>Assessments</td><td><u>Performance Tasks</u>
Homework Completion
Labs/Lab Reports
Quizzes
Tests</td><td><u>Other Evidence</u></td></tr>
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Unit Frameworks

Unit of Study: major topics	**Chemical Equilibrium**		Resources that will support instruction Textbook Worksheets Equilibrium Lab
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	11.A.5a	Formulate hypotheses referencing prior research and knowledge.	
	11.A.5b	Design procedures to test the selected hypotheses.	
	11.A.5c	Conduct systematic controlled experiments to test the selected hypotheses.	
	11.A.5d	Apply statistical methods to make predictions and to test the accuracy of results	
	11.A.5e	Report, display, and defend the results of investigations to audiences that may include professionals and technical experts.	
	11.B.5b	Select criteria for a successful design solution to the identified problem.	
	11.B.5e	Apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks and consequences for the tested design solution and recommend modifications and refinements	
	11.B.5f	Using available technology, prepare and present findings of the tested design solution to an audience that may include professional and technical experts.	
	12.C.5a	Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems.	
	12.C.5b	Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures.	
	13.A.5a	Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities.	
	13.A.5b	Explain criteria that scientists use to evaluate the validity of scientific claims and theories.	
	13.A.5c	Explain the strengths, weaknesses, and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling, and statistical studies.	
	13.B.5e	Assess how scientific and technological progress has affected other fields of study, careers, and job markets and aspects of everyday life.	

<table>
<tr><td>Objectives
o Conceptual
o Factual
o Procedural</td><td colspan="2">A. Nature of Chemical Equilibrium
1. Define chemical equilibrium
2. Explain the nature of K and apply to chemical reactions
B. Shifting Equilibrium
1. Define Le Chatelier’s Principle
2. Apply Le Chatelier’s Principle to chemical reactions
C. Applications of Equilibrium
1. Define and apply acids, bases, salts in terms of K
2. Define and apply solutions in terms of K</td></tr>
<tr><td>Assessments</td><td><u>Performance Tasks</u>
Homework Completion
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Unit Frameworks

Unit of Study: major topics	**Oxidation – Reduction Reactions**		Resources that will support instruction Textbook Worksheets Electrochemistry Lab
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	11.A.5a	Formulate hypotheses referencing prior research and knowledge.	
	11.A.5b	Design procedures to test the selected hypotheses.	
	11.A.5c	Conduct systematic controlled experiments to test the selected hypotheses.	
	11.A.5d	Apply statistical methods to make predictions and to test the accuracy of results	
	11.A.5e	Report, display, and defend the results of investigations to audiences that may include professionals and technical experts.	
	11.B.5b	Select criteria for a successful design solution to the identified problem.	
	11.B.5e	Apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks and consequences for the tested design solution and recommend modifications and refinements	
	12.C.5a	Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems.	
	12.C.5b	Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures.	
	13.A.5a	Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities.	
	13.A.5b	Explain criteria that scientists use to evaluate the validity of scientific claims and theories.	
	13.A.5c	Explain the strengths, weaknesses, and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling, and statistical studies.	
	13.B.5e	Assess how scientific and technological progress has affected other fields of study, careers, and job markets and aspects of everyday life.	
Objectives o **Conceptual** o **Factual** o **Procedural**	A. Oxidation and Reduction 1. Assign oxidation numbers to reactant and product species 2. Define oxidation and reduction 3. Explain what an oxidation – reduction reaction is		

	4. Differentiate between oxidizing and reducing agents B. Balancing Redox Equations 1. Explain what must be conserved in redox equations 2. Balance redox equations by using the half-reaction method C. Electrochemistry 1. Describe the nature of electrochemical cells 2. Calculate cell potentials from a table of standard potentials	
Assessments	<u>Performance Tasks</u> Homework Completion Labs/Lab Reports Quizzes Tests	<u>Other Evidence</u>

Unit Frameworks

<table>
<tr><td>Unit of Study:
major topics</td><td colspan="2">Organic Chemistry</td><td><u>Resources that will support instruction</u>
Textbook
Worksheets
Organic Chemistry Lab</td></tr>
<tr><td>Illinois Learning Standards, Benchmarks,

National Standards Assessment Frameworks, or other standards that will be taught in this unit</td><td colspan="3">11.A.5a Formulate hypotheses referencing prior research and knowledge.
11.A.5b Design procedures to test the selected hypotheses.
11.A.5c Conduct systematic controlled experiments to test the selected hypotheses.
12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy).
12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems.
12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures.
13.B.5b Analyze and describe the processes and effects of scientific and technological breakthroughs.
13.B.5e Assess how scientific and technological progress has affected other fields of study, careers, and job markets and aspects of everyday life.</td></tr>
<tr><td>Objectives
o Conceptual
o Factual
o Procedural</td><td colspan="3">A. Saturated Hydrocarbons
1. Identify functional groups and main compounds
2. Recognize geometric and structural isomers
B. Unsaturated Hydrocarbons
1. Identify functional groups and main compounds
2. Recognize geometric and structural isomers</td></tr>
<tr><td>Assessments</td><td colspan="2"><u>Performance Tasks</u>
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Unit Frameworks

Unit of Study: major topics	**Nuclear Chemistry**		Resources that will support instruction Textbook Worksheets Geiger Counter Demo.
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	11.A.5a	Formulate hypotheses referencing prior research and knowledge.	
	11.A.5b	Design procedures to test the selected hypotheses.	
	11.A.5c	Conduct systematic controlled experiments to test the selected hypotheses.	
	11.A.5d	Apply statistical methods to make predictions and to test the accuracy of results	
	11.A.5e	Report, display, and defend the results of investigations to audiences that may include professionals and technical experts.	
	11.B.5a	Identify a design problem that has practical applications and propose possible solutions, considering such constraints as available tools, materials, time, and costs.	
	11.B.5b	Select criteria for a successful design solution to the identified problem.	
	11.B.5e	Apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks and consequences for the tested design solution and recommend modifications and refinements	
	12.A.5b	Analyze the transmission of genetic traits, diseases, and defects.	
	12.C.5a	Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems.	
	12.C.5b	Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures.	
	12.D.5b	Analyze the effects of gravitational, electromagnetic and nuclear forces on a physical system.	
	12.E.5	Analyze the processes involved in naturally occurring short-term and long-term Earth events (e.g., floods, ice ages, temperature, sea-level fluctuations).	
	13.A.5a	Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities.	

	13.A.5b Explain criteria that scientists use to evaluate the validity of scientific claims and theories. 13.A.5c Explain the strengths, weaknesses, and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling, and statistical studies. 13.B.5b Analyze and describe the processes and effects of scientific and technological breakthroughs. 13.B.5c Design and conduct and environmental impact study, analyze findings, and justify recommendations. 13.B.5d Analyze the costs, benefits, and effects of scientific and technological policies at the local, state, national, and global levels (e.g., genetic research, Internet access). 13.B.5e Assess how scientific and technological progress has affected other fields of study, careers, and job markets and aspects of everyday life.	
Objectives o **Conceptual** o **Factual** o **Procedural**	A. The Nucleus 1. Explain what a nuclide is, and describe the different ways nuclides can be represented 2. Define and relate the terms mass defect an nuclear binding energy 3. Explain the relationship between nucleon number and stability of nuclei 4. Explain why nuclear reactions occur, and know how to balance a nuclear equation B. Radioactive Decay 1. Define and relater the terms radioactive decay and nuclear radiation 2. Describe the different types of radioactive decay and their effects on the nucleus 3. Define the term half-life, and explain how it relates to the stability of a nucleus 4. Discuss applications of radioactive nuclides	
Assessments	<u>Performance Tasks</u> Homework Completion Labs/Lab Reports Quizzes Tests	<u>Other Evidence</u>