

**OXFORD HIGH SCHOOL SCIENCE DEPARTMENT**  
**ACADEMIC CONCEPTUAL CHEMISTRY CURRICULUM**

#330 Conceptual Chemistry (A) (11-12)      Full Year      1.0 Credit

This course is designed to be a hands-on inquiry-based exploration of chemistry. Always focused on making the connections between science and technology and their impact on the quality of our lives, the study of chemistry uses multiple pathways of scientific reasoning with specific emphasis on written and oral communication as well as logical reasoning to explore atomic and molecular structure, chemical bonds, conservation of matter, reaction rates, organic chemistry, nuclear chemistry, and biochemistry. The prerequisite for this course is Biology.

## ENDURING UNDERSTANDINGS (BROAD IDEAS, USUALLY GROUNDED IN THE DISCIPLINE):

Science is a creative endeavor that uses logical, analytical processes.

### SCIENTIFIC INQUIRY

- Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
- Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.
- Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists

### SCIENTIFIC LITERACY

- Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.
- Scientific literacy also includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.

### SCIENTIFIC NUMERACY

- Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.

## COURSE SPECIFIC GOALS (ALIGNED WITH CONTENT STANDARDS):

**SCIENTIFIC MEASUREMENT** - Chemistry involves experimental and analytical investigations, and concepts are illustrated with practical applications that include examples. The use of laboratory techniques, manipulation of chemical quantities, and problem-solving applications are inherent throughout Chemistry.

**MATTER AND CHANGE** - Matter is made of atoms, atoms join to form compounds. The properties of a compound differ from the properties of the atoms that compose it. Matter can change forms through chemical reactions. Matter is classified according to its properties.

**THE MOLE** - Chemical compounds are analyzed quantitatively using molar mass as well as the unit “mole”.

**CHEMICAL FORMULAE** - Compounds in chemistry are classified according to the types of atoms of which they are composed. Chemical (IUPAC) nomenclature allows the scientific world to name and write formulas for matter using the same language.

**PERIODIC LAW (CT-HSC-1)** - The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.

**BONDING (CT-HSC-2)** - Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.

**CHEMICAL REACTIONS** - In a chemical reaction, new substances are formed as atoms and molecules are rearranged. Properties of compounds can be used to identify newly formed products.

**ATOMIC THEORY** - The current model of the atom has been modified over time to incorporate scientific discoveries of many scientists. The current model consists of the view that particles compose an atom and relate to its structure and behavior. Changes in the nucleus of an atom result in emission of radioactivity.

**ARRANGEMENT OF ELECTRONS IN ATOMS** - There is a relationship between the energy changes in an atom and the movement of electrons between energy levels in an the atom. The movement of electrons results in the emission or absorption of quantum energy.

**EQUILIBRIUM** - Many factors influence chemical reactions and some reactions can achieve a state of dynamic equilibrium.

**ACIDS AND BASES** - Acid and basic solutions can be determined by their hydrogen or hydroxide ion concentrations. Acids and bases undergo specific reactions with other species. Through the process of titrations, the concentration of unknown solutions can be determined.

**ELECTROCHEMISTRY** - Through the use of oxidation numbers, components of a chemical reaction undergoing oxidation and reduction can be identified. The transfer of electrons that is indicative of electrochemical reactions creates voltaic cells in which electrical energy can be harnessed from a chemical reaction.

**ORGANIC CHEMISTRY (CT-HSC-5)** - The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes and chemical properties, and provide the biochemical basis for life.

COMMON UNIT EXPECTED PERFORMANCES (ALIGNED WITH STATE EXPECTED PERFORMANCES):

Standard #	Standard/Expected Performance
C-1	Identify questions that can be answered through scientific investigation.
C-2	Read, interpret and examine the credibility and validity of scientific claims in different sources of information.
C-3	Design and conduct appropriate types of scientific investigations to answer different questions.
C-4	Identify independent variables, dependent variables, constants and controls in an experiment.
C-5	Use appropriate tools and techniques to make observations and gather data.
C-6	Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms.
C-7	Articulate conclusions and explanations based on research data, and assess results based on the design of the investigation.
C-7	Assess the reliability and validity of the data that was generated in an investigation and justify confidence in results.
C-8	Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.
C-9	Identify an issue and its implications completely.
C-10	Develop an action plan that addresses all aspects of the issue in detail.
C-11	Use a variety of reliable sources of relevant information, data, knowledge, or experiences to take and support a critical stance.

**UNIT I: SCIENTIFIC MEASUREMENT:** CHEMISTRY INVOLVES EXPERIMENTAL AND ANALYTICAL INVESTIGATIONS, AND CONCEPTS ARE ILLUSTRATED WITH PRACTICAL APPLICATIONS THAT INCLUDE EXAMPLES. THE USE OF LABORATORY TECHNIQUES, MANIPULATION OF CHEMICAL QUANTITIES, AND PROBLEM-SOLVING APPLICATIONS ARE INHERENT THROUGHOUT CHEMISTRY.

Time: 2 weeks

Standard #	Standard/Expected Performance	Common Experiences
I-1	To utilize SI units in measurements and calculations	<i>Labs:</i> Mass, Volume, Density The Bunsen Burner: Orange vs. Blue Flames
I-2	Calculate and compare the densities of solids, liquids, and gases.	
I-3	Assess accuracy and precision	
I-4	Determine percent error and assess accuracy and precision of measurement	

**UNIT II: MATTER AND CHANGE:** MATTER IS MADE OF ATOMS, ATOMS JOIN TO FORM COMPOUNDS. THE PROPERTIES OF A COMPOUND DIFFER FROM THE PROPERTIES OF THE ATOMS THAT COMPOSE IT. MATTER CAN CHANGE FORMS THROUGH CHEMICAL REACTIONS. MATTER IS CLASSIFIED ACCORDING TO ITS PROPERTIES.

Time: 2 weeks

Standard #	Standard/Expected Performance	Common Experiences
II-1	Characterize the three states of matter by particle arrangement and intermolecular forces.	<i>Labs:</i> Observing a Chemical Reaction Physical & Chemical Changes  <i>Common Experiences</i> Mixture Separation
II-2	Define and identify physical and chemical properties of matter.	
II-3	Define and identify physical and chemical changes that matter undergoes.	
II-4	Classify matter as an element, compound, mixture, or solution.	
II-6	Using physical properties of data, design a method to separate a heterogeneous mixture.	

**UNIT III: THE MOLE:** CHEMICAL COMPOUNDS ARE ANALYZED QUANTITATIVELY USING MOLAR MASS AS WELL AS THE UNIT “MOLE”.

Time: 2 weeks

Standard #	Standard/Expected Performance	Common Experiences
III-1	Understand the basis for the masses of atoms based on one mole of carbon.	<i>Labs:</i> Determine the Percent of Water in a Hydrate Determine the Empirical Formula of a Compound Design a method to prepare a given molar solution.
III-2	Perform calculations using Avogadro's number: $6.02 \times 10^{23}$ (number of particles per mole).	<i>Common Experiences</i> Determine the Percent of Oxygen in Potassium Chlorate

**UNIT IV: CHEMICAL FORMULAS:** COMPOUNDS IN CHEMISTRY ARE CLASSIFIED ACCORDING TO THE TYPES OF ATOMS OF WHICH THEY ARE COMPOSED. CHEMICAL (IUPAC) NOMENCLATURE ALLOWS THE SCIENTIFIC WORLD TO NAME AND WRITE FORMULAS FOR MATTER USING THE SAME LANGUAGE.

Time: 2 weeks

Standard #	Standard/Expected Performance	Common Experiences
IV-1	Identify the subatomic particles in an atom.	<i>Labs:</i> Empirical Formula of a Compound
IV-2	Differentiate between atoms and ions, ionic compounds and molecular compounds.	
IV-3	Write formulas and name: a. binary ionic compounds b. binary molecular compounds c. ternary compounds d. compounds involving transitions metals e. acids	

**UNIT V: PERIODIC LAW:** CT-HSC-1. THE PERIODIC TABLE DISPLAYS THE ELEMENTS IN INCREASING ATOMIC NUMBER AND SHOWS HOW PERIODICITY OF THE PHYSICAL AND CHEMICAL PROPERTIES OF THE ELEMENTS RELATES TO ATOMIC STRUCTURE.

Time: 2 weeks

Standard #	Standard/Expected Performance	Common Experiences
V-1	Use the periodic table to identify metals, nonmetals, and metalloids.	<i>Labs:</i> Reactivity of Halides Reactivity of Metals  <i>Common Experiences:</i> Element Project
V-3	Differentiate between periods and families of the periodic table; classify elements according to families.	
V-4	Identify trends in ionization energy, atomic and ionic radius, electronegativity, and electron affinity using the periodic table.	
V-5	Explain the contributions of Mendeleev and Moseley to the construction of the Modern Periodic Table.	

**UNIT VI: BONDING:** CT-HSC-2. BIOLOGICAL, CHEMICAL AND PHYSICAL PROPERTIES OF MATTER RESULT FROM THE ABILITY OF ATOMS TO FORM BONDS FROM ELECTROSTATIC FORCES BETWEEN ELECTRONS AND PROTONS AND BETWEEN ATOMS AND MOLECULES.

Time: 2 weeks

Standard #	Standard/Expected Performance	Common Experiences
VI-1	Combine atoms to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.	<i>Labs:</i> Molecular Models
VI-2	Compare and contrast ionic, covalent, and metallic bonding.	
VI-3	Compare and contrast intermolecular and intramolecular forces.	
VI-4	Understand that the atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form.	
VI-5	Draw Lewis dot structures to provide models of atoms and molecules.	

**UNIT VII: CHEMICAL REACTIONS:** IN A CHEMICAL REACTION, NEW SUBSTANCES ARE FORMED AS ATOMS AND MOLECULES ARE REARRANGED. PROPERTIES OF COMPOUNDS CAN BE USED TO IDENTIFY NEWLY FORMED PRODUCTS.

Time: 3 weeks

Standard #	Standard/Expected Performance	Common Experiences
VII-1	Identify reactants and products of a chemical reaction.	<i>Labs:</i> Classifying, Predicting, & Verifying Reactions  <i>Common Experiences:</i> Mystery Solutions
VII-2	Complete, write and balance chemical equations that represent the following reaction types: a. Synthesis b. Decomposition c. Single Replacement d. Double Displacement e. Combustion	
VII-3	Utilize the Activity Series to determine if a reaction occurs.	
VII-4	Utilize a solubility chart to determine if a reaction occurs.	

**UNIT VIII: ATOMIC THEORY:** THE CURRENT MODEL OF THE ATOM HAS BEEN MODIFIED OVER TIME TO INCORPORATE SCIENTIFIC DISCOVERIES OF MANY SCIENTISTS. THE CURRENT MODEL CONSISTS OF THE VIEW THAT PARTICLES COMPOSE AN ATOM AND RELATE TO ITS STRUCTURE AND BEHAVIOR. CHANGES IN THE NUCLEUS OF AN ATOM RESULT IN EMISSION OF RADIOACTIVITY.

Time: 3 weeks

Standard #	Standard/Expected Performance	Common Experiences
VIII-1	Explain the reason for the difference between the relative size of an atom to its mass.	<i>Labs:</i> Conservation of Mass
VIII-2	Explain the development of the model of the atom including the contributions and shortcomings of: <ul style="list-style-type: none"> <li>a. The Early Greek Philosophers</li> <li>b. John Dalton</li> <li>c. J. J. Thomson</li> <li>d. Lord Ernest Rutherford</li> <li>e. Neils Bohr</li> <li>f. Quantum Mechanical Model</li> </ul>	
VIII-3	Identify the three subatomic particles and their functions in an atom.	

**UNIT IX: ARRANGEMENT OF ELECTRONS IN ATOMS:** THERE IS A RELATIONSHIP BETWEEN THE ENERGY CHANGES IN AN ATOM AND THE MOVEMENT OF ELECTRONS BETWEEN ENERGY LEVELS IN AN THE ATOM. THE MOVEMENT OF ELECTRONS RESULTS IN THE EMISSION OR ABSORPTION OF QUANTUM ENERGY.

Time: 2 weeks

Standard #	Standard/Expected Performance	Common Experiences
IX-1	Write the electron configurations, orbital filling diagrams, and Lewis Dot Structures of elements.	<i>Common Experiences:</i> Flame Tests
IX-2	Use the position of an element on the periodic table to determine its atomic number, electron configuration, and physical and chemical properties.	

**UNIT X: EQUILIBRIUM:** MANY FACTORS INFLUENCE CHEMICAL REACTIONS AND SOME REACTIONS CAN ACHIEVE A STATE OF DYNAMIC EQUILIBRIUM.

Time: 3 weeks

Standard #	Standard/Expected Performance	Common Experiences
X-1	Define a system in equilibrium and relate it to the rates of the forward and reverse reactions.	<i>Labs:</i> LeChatelier's Principle
X-2	Apply changes in temperature, pressure, common ions, and concentration to LeChatelier's Principle.	

**UNIT XI: ACIDS AND BASES:** ACID AND BASIC SOLUTIONS CAN BE DETERMINED BY THEIR HYDROGEN OR HYDROXIDE ION CONCENTRATIONS. ACIDS AND BASES UNDERGO SPECIFIC REACTIONS WITH OTHER SPECIES. THROUGH THE PROCESS OF TITRATIONS, THE CONCENTRATION OF UNKNOWN SOLUTIONS CAN BE DETERMINED.

Time: 3 weeks

Standard #	Standard/Expected Performance	Common Experiences
XI-1	Differentiate between acids and bases.	<i>Labs:</i> Introduction and Properties of Acids and Bases  <i>Common Experiences:</i> Titration Analyses
XI-2	Explain the use of indicators.	
XI-3	Describe and identify neutralization reactions.	
XI-4	Perform acid-base titrations and analyze data to determine molarity of unknown.	

**UNIT XII: ELECTROCHEMISTRY:** THROUGH THE USE OF OXIDATIONS NUMBERS, COMPONENTS OF A CHEMICAL REACTION UNDERGOING OXIDATION AND REDUCTION CAN BE IDENTIFIED. THE TRANSFER OF ELECTRONS THAT IS INDICATIVE OF ELECTROCHEMICAL REACTIONS CREATES VOLTAIC CELLS IN WHICH ELECTRICAL ENERGY CAN BE HARNESSSED FROM A CHEMICAL REACTION.

Time: 2 weeks

Standard #	Standard/Expected Performance	Common Experiences
XII-1	Relate electron transfer to oxidation-reduction reactions and electrochemical cells.	<i>Labs:</i> Determining Cell Voltage Daniell Cells Redox Reactions  <i>Common Experiences:</i> Draw and label all components of a voltaic cell.
XII-3	Relate electron transfer to oxidation-reduction reactions and electrochemical cells. Sketch and label all components of a voltaic cell.	
XII-4	Determine cell voltage.	

**UNIT XIII: ORGANIC CHEMISTRY: CT-HSC-5.** THE BONDING CHARACTERISTICS OF CARBON ALLOW THE FORMATION OF MANY DIFFERENT ORGANIC MOLECULES OF VARIED SIZES, SHAPES AND CHEMICAL PROPERTIES, AND PROVIDE THE BIOCHEMICAL BASIS FOR LIFE.

Time: 2 weeks

Standard #	Standard/Expected Performance	Common Experiences
XIII-1	Understand that the bonding characteristics of carbon result in the formation of a large variety of structures, ranging from simple hydrocarbons to complex biological molecules and synthetic polymers.	<i>Labs:</i> Polymers
XIII-2	Describe various hydrocarbon classes, their sources and uses; draw and name their constituents.	
XIII-3	Describe polymerization reactions and uses of polymers.	
XIII-4	Explain the role of proteins, amino acids, and lipids in living organisms.	
XIII-5	Describe nucleic acids and how they relate to DNA and RNA.	

