Curriculum Development
In the Fairfield Public Schools

Fairfield Public Schools
FAIRFIELD, CONNECTICUT

CHEMISTRY 31

Board of Education Approved 05/22/2007

CHEMISTRY 31

Statement of Purpose

Science education promotes essential understandings of the natural world and nurtures students' abilities to apply scientific knowledge to make informed and logical judgments about personal and societal issues. As such, this education requires that the fundamental approach to science be a creative and logical process for investigating, reasoning, critiquing and communicating about ideas, not just a static body of facts to be memorized. Understanding the interconnections between science and technology and their shared impact on the environment and societal issues is essential for all students.

Chemistry is an investigative science that deals with the composition of materials and the qualitative and quantitative changes that these materials undergo. Through the study of chemistry, students will understand the nature of these changes. This will help them to manipulate natural materials to their benefit. In addition, an understanding of these concepts will allow individuals to make informed choices and seek solutions to scientific and technological problems that citizens of the 21st century will face.

Audience

Chemistry 31 is a full-year; two-credit course designed for academically motivated, high achieving grade 10 or 11 students with a strong interest in science. Students must demonstrate high proficiency in mathematical thinking, abstract reasoning and algebraic problem solving.

Prerequisite

Should be in the honors sequence for math/science, "C" or better in Biology 21 and Algebra or teacher recommendation.

Design and Description

Chemistry 31 is an honors level class. The course meets seven periods a week including two double lab periods. This advanced sequence course will provide students with a detailed and intricate knowledge of chemistry and will prepare students for entry into the advanced placement program. Major topics of study include: atomic and molecular structure, chemical reactions, the periodic table, the separation of substances, energy in chemical change, and solutions.

Students will investigate these topics through a variety of classroom activities which include: pre-written and open-ended laboratory experiments; small group discussions; lectures and note taking; viewing videos; learning and applying problem-solving techniques; and relating chemical principles to daily experience. Students will understand the role of chemistry in explaining natural phenomena and in seeking solutions to scientific and technological problems that citizens of the 21st century will face.

Course Objectives

Students will be able to:

Skill Objectives
Students will:

Science Core Standards

Chemistry Enrichment Standards

Essential Questions

Focus Questions

UNITS of STUDY

Unit 1: Scientific Knowledge & Reasoning

Science Core Standards

Scientific Inquiry

Students will engage in a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.

Students will engage in a continuous process of questioning, data collection, analysis and interpretation.

Students will share findings and ideas for critical review by colleagues and other scientists.

Scientific Literacy

Students will read, write, discuss and present coherent ideas about science.

Students will search for and assess the relevance and credibility of scientific information found in various print and electronic media.

Essential Question

- How is scientific knowledge created and communicated?

Focus Questions

- How do Chemists use the scientific method?
- When does a hypothesis become a law?

Core Topics

- Scientific method
- Laboratory safety

Unit Objectives

Students will be able to:

- define the field of chemistry and explain the importance of studying it.
- identify several ways in which chemistry affects daily life.
- apply the steps of the scientific method.
- trace how a hypothesis may become a natural law.
- identify the reason for each laboratory safety rule.

Skill Objectives

Students will:

- Demonstrate basic safety rules when working in the laboratory.
- Demonstrate proper use of basic laboratory safety equipment.
- Identify common laboratory equipment.

Sample Assessment
Evidence of Interaction

Pacing
1 week

Unit 2: Dimensional Analysis, problem solving & significant figures

Standards
Scientific Numeracy

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

Students will identify questions that can be answered through scientific investigation.

Students will read, interpret and examine the credibility and validity of scientific claims in different sources of information.

Students will formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.

Students will design and conduct appropriate types of scientific investigations to answer different questions.

Students will identify independent and dependent variables, including those that are kept constant and those used as controls.

Students will assess the reliability of the data that was generated in the investigation.

Essential Questions
How is scientific knowledge created and communicated?

Focus Questions
How is mathematics used as a tool to investigate chemical concepts?

Core Topics
- Dimensional analysis
- Significant digits
- Graph construction
- Graph interpretation

Unit Objectives
Students will be able to:
- Distinguish among a quantity, a unit, and a measurement standard.
- Distinguish between mass and weight.
- Evaluate data using the concepts of accuracy and precision.
- Distinguish between inversely and directly proportional relationships.
- Translate a calculated ratio into a meaningful written statement.

Skill Objectives
Students will:
- Apply the rules of significant digits in measurements and calculations.

- Collect valid data to determine mass, volume and density.
- Perform calculations with numbers in scientific notation.
- Draw and interpret graphs of scientific data
- Apply dimensional analysis to solve problems.

Sample Assessment
Classroom measurements

Pacing
1 week

Unit 3: States of matter & energy changes

Standards

Chemical Bonds

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

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.

Essential Question

How does the structure of matter affect the properties and uses of materials?

Focus Questions

What is matter?
What is energy?
What do we use to distinguish one substance from another?
How do we separate substances?

Core Topics

- Physical vs. chemical
- States of matter
- Kinetic molecular theory

Unit Objectives

Students will be able to:

- Differentiate between chemical and physical properties and changes
- Apply the Law of Conservation of Matter/Energy.
- Distinguish between kinetic and potential energy.
- Apply the kinetic molecular theory to describe the motion of particles in solids, liquids, and gases and the phase changes that they undergo.

Skill Objectives

Students will:

- Separate a mixture of substances based on their physical and chemical properties.
- Classify a substance as an element, compound, or mixture based on observable physical and chemical properties.

Sample Assessment

Solar Cooker

Pacing

2 weeks

Unit 4: Structure of matter

Standards

Properties of Matter

Atoms react with one another to form new molecules.

Students will describe the general structure of the atom, and explain how the properties of the first 20 elements in the Periodic Table are related to their atomic structure.

Atomic and Molecular Structure

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

Students will explain that the nucleus of the atom is much smaller than the atom yet contains most of its mass.

Students will explain that the quantum model of the atom is based on experiments and analyses by many scientists, including Dalton, Thomson, Bohr, Rutherford, Millikan, and Einstein.

Students will relate the position of an element in the periodic table to its atomic number.

Essential Questions

How does the structure of matter affect the properties and uses of materials?

Focus Questions

What are atoms made of?
What evidence supports current atomic theory?
What is radioactivity?
What is light?

Core Topics

- Use laboratory data to determine the strength of an acid or base.
- History of atomic theory
- Atomic structure
- Octet rule
- Lewis dot notation
- Radioactivity
- Wave properties

Unit Objectives

Students will be able to:

- Sequence the development of atomic theory from early Greek models to present knowledge; Democritus, Dalton, Thomson, Millikan, Rutherford, Bohr, Heisenberg, Schrödinger, Einstein

- Apply the postulates of Dalton's atomic model to explain the Law of Conservation of Mass and the Law of Definite Composition.
- Relate atomic number, mass number, and location on the periodic table to subatomic particles and isotopes.
- Contrast the processes of nuclear fission and fusion.
- Describe a wave in terms of its frequency, wavelength, speed, and amplitude.
- Relate the electron configuration of an atom to its reactivity and to its location in the periodic table.

Skill Objectives

Students will:

- Calculate average atomic mass of an element, and calculate percentage abundance of an isotope given its average atomic mass.
- Write, balance, and interpret a nuclear equation.
- Calculate the amount of a radioactive substance that remains after a given period of time.
- Diagram the electromagnetic spectrum showing trends in frequency, wavelength and energy.
- Calculate the energy of a photon
- Write the electron configuration for any element using the Aufbau principle, the Pauli Exclusion Principle and Hund's rule. Use these configurations to predict chemical behavior.
- Draw the Lewis dot structure for any atom or ion.

Sample Assessment

Flame tests

Pacing

2 weeks

Unit 5: Periodic table

Standards

Atomic and Molecular Structure

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

Students will use that the periodic table to identify metals, semimetals, non-metals, and halogens.

Students will use the periodic table to identify trends in ionization energy, electronegativity, the relative sizes of ions and atoms and the number of electrons available for bonding.

Students will relate the electronic configuration of elements and their reactivity to their position in the periodic table.

Essential Questions

How does the structure of matter affect the properties and uses of materials?

Focus Questions

How are elements arranged in the Periodic Table?
Why does the Periodic Table have the shape that it does?

Core Topics

- History of the Periodic table
- Sections of the table
- Periodic law
- Periodic trends

Unit Objectives

Students will be able to:

- Trace the development of the modern periodic table.
- Identify areas of the periodic table that contain metals, non-metals and metalloids.
- Apply the periodic law.
- Distinguish patterns in electron configuration within groups and periods.
- Relate the trends in atomic mass, atomic number, atomic radius, electronegativity, ionic size, ionization energy, and electron affinity to electron configuration

Skill Objectives

Students will:

- Predict the physical and chemical properties of elements using the periodic table.
- Predict the charge or oxidation number of an element from its position on the periodic table.

Sample Assessment
Unknown Periodic Table

Pacing
3 weeks

Unit 6: Bonding & molecular structure

Standards

Chemical Structures and Properties – Properties of Matter

Due to its unique chemical structure, carbon forms many organic and inorganic compounds.

Students will explain how the structure of the carbon atom affects the type of bonds it forms in organic and inorganic molecules.

Students will explain the general formation and structure of carbon-based polymers, including synthetic polymers, such as polyethylene, and biopolymers, such as carbohydrate.

Chemical Bonds

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

Students will explain that atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.

Students will identify chemical bonds between atoms in molecules such as H_2, CH_4, NH_3, H_2CCH_2, N_2, Cl_2, and many large biological molecules as covalent.

Students will use Lewis dot structures to show models of atoms and molecules.

Students will predict the shape of simple molecules and their polarity from Lewis dot structures.

Chemical Structures and Properties – Science, Technology and Society

Chemical technologies present both risks and benefits to the health and well being of humans, plants and animals.

Students will explain how simple chemical monomers can be combined to create linear, branched and/or cross-linked polymers.

Students will explain how the chemical structure of polymers affects their physical properties.

Students will explain the short- and long-term impacts of landfills and incineration of waste materials on the quality of the environment.

Essential Questions
How does the structure of matter affect the properties and uses of materials?

Focus Questions
Why do atoms form chemical bonds?
Are there different types of chemical bonds?
How strong are chemical bonds?
Does the arrangement of chemical bonds affect the strength of materials?

Core Topics
- Driving force behind bonding
- Types of chemical bonds
- VSEPR theory
- Molecular shape
- Polymerization

Unit Objectives
Students will be able to:
- Explain why atoms form chemical bonds.
- Trace the formation of a chemical bond in terms of change in potential energy.
- Compare and contrast ionic, covalent and metallic bonding.
- Differentiate between a molecule and a formula unit
- Predict the shapes, bond angles, and polarities of molecules and polyatomic ions.
- Predict the formation of single, double and triple bonds.
- Classify bonds as sigma and/or pi bonds.
- Discuss polymerization and the resulting physical properties of polymers

Skill Objectives
Students will:
- Illustrate ionic and covalent bonding using orbital notation and Lewis dot structures.

Sample Assessment
Synthetic Polymers

Pacing
3 weeks

Unit 7: Formula writing

Standards

Properties of Matter

Atoms react with one another to form new molecules.

Students will describe how atoms combine to form new substances by transferring electrons (ionic bonding) or sharing electrons (covalent bonding).

Essential Questions

How does the structure of matter affect the properties and uses of materials?

Focus Questions

What does a chemical formula tell us?
How are chemical formulae written?
How are compounds named?

Core Topics

- Ratios of elements
- Subscripts
- Formula construction
- Oxidation numbers

Unit Objectives

Students will be able to:

- Evaluate the significance of a chemical formula.
- Distinguish between ionic and molecular compounds.
- Differentiate among empirical, molecular, and structural formulas

Skill Objectives

Students will:

- Construct the correct chemical formula for a given ionic or molecular compound.
- Name and write formulas for acids, bases, polyatomic ions, and hydrates.
- Name and write formulas for simple organic compounds.
- Apply the rules for assigning oxidation numbers in elements and compounds.

Sample Assessment

Formula of an ionic conpound

Pacing

2.5weeks

Unit 8: Mathematics of Chemical Formulas

Standards

Conservation of Matter and Stoichiometry

The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.

Students will apply the definition that one mole equals $6.02.x\ 10^{23}$ particles (atoms or molecules).

Students will determine the molar mass of a molecule from its chemical formula and a table of atomic masses

Essential Questions

How does the structure of matter affect the properties and uses of materials?

Focus Questions

What is a "mole"?
How is the mole used in Chemistry?

Core Topics

- Mole as amount
- Conversions
- Empirical and molecular formulas

Unit Objectives

Students will be able to:

- Relate the mole concept and Avogadro's number
- Explain molar volume of a substance and describe factors that affect its value.

Skill Objectives

Students will:

- Calculate formula mass, molar mass and percent composition of elements, compounds, and hydrates.
- Convert among grams, moles, particles, and volume.
- Calculate the mass of a single atom or molecule.
- Calculate empirical and molecular formula from percent composition data, actual mass data, and analysis of experimental results.

Sample Assessment

m & m mountain

Pacing

3.5 weeks
MID-YEAR COMPLETION POINT

Unit 9: Types of Reactions

Standards

Chemical Structures and Properties – Properties of Matter

Due to its unique chemical structure, carbon forms many organic and inorganic compounds.

Students will describe combustion reactions of hydrocarbons and their resulting by-products.

Essential Questions

How does the structure of matter affect the properties and uses of materials?
How do science and technology affect the quality of our lives?

Focus Questions

How can we describe chemical reactions?
What types of chemical reactions exist?
How do we predict the products of a reaction?

Core Topics

- Parts of a chemical equation
- Evidence for chemical reactions
- Types of reactions
- Net ionic equations
- Solubility tables
- Reaction driving forces

Unit Objectives

Students will be able to:

- Predict the products of simple reactions, given the reactants.
- Identify forms of evidence that a chemical reaction has occurred.
- Interpret a balanced equation in terms of atoms, molecules, and ions.
- Classify a reaction as synthesis, decomposition, single replacement, double replacement, combustion, neutralization, precipitation, and redox reaction.
- Predict whether a reaction will occur using the activity series of metals.
- Compare and contrast dissolution and precipitation

Skill Objectives

Students will:

- Write the word equation, formula equation, and balanced chemical equation for a given chemical reaction.
- Write the net ionic equation of a precipitation reaction.
- Collect data and use solubility tables to predict precipitate formation.
- Assign oxidation numbers to reactants and products

Sample Assessment
Acid Rain

Pacing
3 weeks

Unit 10: Stoichiometry of Chemical Reactions

Standards

Conservation of Matter and Stoichiometry

The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.

Students will describe chemical reactions by writing balanced equations.

Essential Question

How does the structure of matter affect the properties and uses of materials?

Focus Questions

What are the quantitative relationships in a chemical reaction?

Core Topics

- Ratios and amounts
- Limiting reactant
- Theoretical, actual and percent yield

Unit Objectives

Students will be able to:

- Determine the mole ratios of substances in a balanced chemical reaction.
- Determine which of two reactants the limiting reactant in a given equation is.

Skill Objectives

Students will:

- Calculate the quantity of a reactant or product in a balanced chemical equation.
- Convert among mass, moles, particles, and volumes between reactants and products using a balanced chemical equation.
- Calculate the maximum amount of a product in a given reaction using the limiting reactant.
- Calculate theoretical yield, actual yield and percent yield.

Sample Assessment

Sodium bicarbonate vs. Sodium carbonate

Pacing

2 weeks

Unit 11: Thermochemistry

Standards

Energy Transformations – Energy Transfer and Transformations

Energy cannot be created or destroyed; however, energy can be converted from one form to another.

Students will describe the effects of adding energy to matter in terms of motion of atoms and molecules, and the resulting phase changes.

Students will explain how energy is transferred by conduction, convection and radiation.

Students will describe energy transformations among heat, light, electricity and motion.

Conservation of Matter and Stoichiometry

The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.

Students will use Hess' Law to calculate enthalpy change in a reaction.

Essential Question

What is the role of energy in our world?

Focus Questions

What is heat?
How is heat measured?
How is energy used in chemical reactions?

Core Topics

- Heat vs. temperature
- Calorimetry
- Hess'Law
- Exothermic vs. endothermic processes

Unit Objectives

Students will be able to:

- Compare and contrast heat and temperature.
- Apply Hess' law to determine enthalpy change for a chemical reaction.
- Determine whether a reaction is exothermic or endothermic using experimental data and/or energy term placement.

Skill Objectives

Students will:

- Calculate energy changes in a chemical reaction using heat of reaction (ΔH).

- Convert among the units of heat and temperature.
- Illustrate exothermic and endothermic changes, activation energy, and the effect of catalysts using potential energy diagrams.
- Calculate specific heats of substances, heats of reaction, heats of formation, and heats of combustion.
- Use calorimetry to experimentally determine the quantity of heat transferred in a chemical reaction.

Sample Assessment
Burning Fritos™

Pacing
2 weeks

Unit 12: Gas laws

Standards

Global Interdependence – Science, Technology and Society

The use of resources by human populations may affect the quality of the environment.

Students will explain how the accumulation of carbon dioxide (CO_2) in the atmosphere increases Earth's greenhouse effect and may cause climate change.

Conservation of Matter and Stoichiometry

The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.

Students will convert among moles, number of particles, or volume of gas at standard temperature and pressure using the mass of a molecular substance.

Essential Question

How do science and technology affect the quality of our lives?

Focus Questions

How do gasses behave?
What is a "greenhouse" gas?

Core Topics

- Kinetic-molecular theory
- Pressure/temperature/volume relationships
- Real vs. ideal gasses

Unit Objectives

Students will be able to:

- Apply the kinetic-molecular theory to describe changes of state and the relationships among pressure, temperature, volume and number of moles of gases.
- Identify the physical properties of gases including the greenhouse effect.
- Explain the significance of standard temperature and pressure (STP).
- Compare and contrast real and ideal gases.

Skill Objectives

- Illustrate how a barometer and a manometer work.
- Convert among the measurement units of the four gas variables.
- Perform calculations using Boyle's Law, Charles' Law, Avogadro's Hypothesis and Gay-Lussac's Law.
- Solve problems involving the combined gas law, Dalton's law of partial pressure, Graham's law of diffusion, and the ideal gas laws.
- Collect data to determine the molar volume of a gas.

- Calculate volumes, masses, particles, and molar amounts of gaseous reactants or products using volume ratios and the gas laws.

Sample Assessment
Molar Volume of Hydrogen Lab

Pacing
2.5 weeks

Unit 13: Solids, Liquids, and Solutions

Standards

Chemical Bonds

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

Students will explain that solids and liquids held together by van der Waals forces or hydrogen bonds have effects on their volatility and boiling/melting point temperatures.

Students will explain 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.

Essential Questions

How does the structure of matter affect the properties and uses of materials?

Focus Questions

How do solids and liquids behave?
What factors affect solubility?
How do solutions differ from pure substances?

Core Topics

- Changes of state
- Vapor pressure
- Solubility
- Colligative properties

Unit Objectives

Students will be able to:

- Apply kinetic molecular theory to explain the properties of solids and liquids and changes of state
- Compare and contrast the different types of intermolecular forces.
- Differentiate between electrolytes and non-electrolytes
- Compare and contrast ionic, molecular, metallic, and network covalent solids
- Apply the principles of equilibrium to explain the concept of vapor pressure.
- Relate the unusual properties of water to hydrogen bonding.
- Trace the solution process and the factors affecting solubility.
- Interpret data in solubility curves and tables
- Identify the four colligative properties of a solution.

Skill Objectives

Students will:

- Draw and interpret a heating curve (Temperature/Heat Energy)

- Draw and interpret a phase diagram (P/T).
- Demonstrate the formation of the different types of solutions: saturated, supersaturated, unsaturated, dilute, and concentrated
- Solve concentration problems using the concepts of molarity, molality, mass percent and mole fraction.
- Measure and calculate the effects of dissolved substances on the vapor pressure, the freezing point, and the boiling point of a solution.
- Calculate the molar mass of a substance from freezing point and boiling point data

Sample Assessment
Molarity and Solution Preparation

Pacing
2 weeks

Unit 14: Kinetics, Equilibrium, and Thermodynamics

Standards

Reaction Rates

Chemical reaction rates depend on factors that influence the frequency of collision of reactant molecules.

Students will explain that the rate of reaction is the decrease in concentration of reactants or the increase in concentration of products with time.

Students will explain that reaction rates depend on such factors as concentration, temperature and pressure.

Students will explain that equilibrium is established when forward and reverse reaction rates are equal.

Students will explain that catalysts play a role in increasing the reaction rate by changing the activation energy in a chemical reaction.

Essential Questions

What is the role of energy in our world?

Focus Questions

What factors affect reaction rate?
What is chemical equilibrium?

Core Topics

- Reaction rate
- Catalyst
- Le Chatelier's principle
- Free Energy

Unit Objectives

Students will be able to:

- Apply collision theory to explain the factors that affect the rate of reaction.
- Trace the role of a catalyst.
- Apply the concept of equilibrium to explain physical and chemical changes.
- Distinguish between a reversible reaction that is in equilibrium and one that is not.
- Apply Le Chatelier's principle to explain the effects of changes in concentration, pressure and temperature on an equilibrium system.
- Apply equilibrium concepts to increase the amount of product formed in the Haber process.

Skill Objectives

Students will:

- Draw and interpret potential energy diagrams including activation energy, heat of reaction, and the activated complex
- Write, calculate and interpret the value of the equilibrium constant for a given reaction.
- Predict precipitate formation using the solubility product (K_{sp})
- Predict shifts solubility equilibria using the common ion effect.
- Measure enthalpy changes in chemical reactions.
- Predict the spontaneity of a physical or chemical change using the driving forces of enthalpy and entropy.
- Calculate the Gibbs free energy change of a chemical reaction and relate its value to spontaneity.

Sample Assessment
Rate of a chemical reaction

Pacing
2.5 weeks

Unit 15: Acids & bases

Standards

Properties of Matter

Atoms react with one another to form new molecules.

Students will explain the chemical composition of acids and bases, and explain the change in pH in neutralization reactions.

Essential Questions

How do science and technology affect the quality of our lives?

Focus Questions

What is an acid?
What is a base?
How do we categorize acids and bases?

Core Topics

- Classification acids and bases
- pH and pOH
- K_a and K_b
- titration

Unit Objectives

Students will be able to:

- Identify the common physical and chemical properties of acids and bases.
- Classify acids, bases, and salts, and recognize their presence in common substances.
- Compare and contrast the Arrhenius and Bronsted-Lowry models for acids and bases.
- Summarize the role of buffers.

Skill Objectives

Students will:

- Predict the products and write balanced equations for acid-base reactions
- Categorize acids and bases based on strength.
- Use laboratory data to determine the strength of an acid or base.
- Calculate the hydrogen ion and hydroxide ion concentrations in any solution.
- Calculate pH and pOH from hydrogen ion concentration or hydroxide ion concentration.
- Calculate the acid ionization constant (K_a) and the base ionization constant (K_b) from experimental data.
- Perform an acid-base titration to determine the concentration of an unknown solution.

Sample Assessment

Titration

Pacing

2 weeks

Unit 16: Oxidation, Reduction and Electrochemistry

Standards

Conservation of Matter and Stoichiometry

The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.

Students will describe chemical reactions by writing balanced equations.

Essential Questions

What is the role of energy in our world?

Focus Questions

How do batteries work?

Core Topics

- Types of redox reactions
- Voltaic vs. electrolytic cells
- Half reactions

Unit Objectives

Students will be able to:

- Identify types of oxidation-reduction reactions in practical, everyday examples: synthesis, decomposition, single replacement, and combustion.
- Compare and contrast voltaic cells and electrolytic cells
- Compare the chemistry of a disposable and rechargeable battery.

Skill Objectives

Students will:

- Identify oxidizing and reducing agents in a balanced equation
- Combine half reactions to produce a balanced net redox equation
- Illustrate the construction and operation of a voltaic cell and an electrolytic cell

Sample Assessment

Construct a battery

Pacing

2 weeks

CAPT PREPARATION

The following standards must be addressed for all grade 10 students prior to March 1st of each school year. Below each standard is a link to the online resources students may use. These may be done independently by students outside of class time.

Global Interdependence – The Changing Earth
Elements on Earth move among reservoirs in the solid earth, oceans, atmosphere and organisms as part of biogeochemical cycles.

Students will explain how chemical and physical processes cause carbon to cycle through the major earth reservoirs.

Students will explain how solar energy causes water to cycle through the major earth reservoirs.

Students will explain how internal energy of the Earth causes matter to cycle through the magma and the solid earth.

LINKS:
http://earthobservatory.nasa.gov/Library/CarbonCycle/carbon_cycle3.html
http://www2.wwnorton.com/college/chemistry/gilbert/tutorials/ch4.htm
http://ga.water.usgs.gov/edu/watercyclesummary.html
http://www.physicalgeography.net/fundamentals/10a.html

Energy Transformations - Energy Transfer and Transformations
The electrical force is a universal force that exists between any two charged objects.

Students will explain the relationship among voltage, current and resistance in a simple series circuit.

Students will explain how electricity is used to produce heat and light in incandescent bulbs and heating elements.

Students will describe the relationship between current and magnetism.

Energy Transformations - Science and Technology in Society
Various sources of energy are used by humans and all have advantages and disadvantages.

Students will explain how heat is used to generate electricity.

Students will describe the availability, current uses and environmental issues related to the use of fossil and nuclear fuels to produce electricity.

Students will describe the availability, current uses and environmental issues related to the use of hydrogen fuel cells, wind and solar energy to produce electricity.

LINKS:
http://www.thinkquest.org/library/websitena.html?28032
http://www.nfcrc.uci.edu/fcresources/FCexplained/FC_animation.htm
http://www2.wwnorton.com/college/chemistry/gilbert/tutorials/ch4.htm
http://www.ballard.com/be_informed/fuel_cell_technology/how_the_technology_works#

Global Interdependence – Science and Technology in Society
The use of resources by human populations may affect the quality of the environment.

Students will explain how the release of sulfur dioxide (SO_2) into the atmosphere can form acid rain, and how acid rain affects water sources, organisms and human-made structures.

Students will explain how the accumulation of mercury, phosphates and nitrates affects the quality of water and the organisms that live in rivers, lakes and oceans.

Some materials can be recycled, but others accumulate in the environment and may affect the balance of the Earth systems.

Students will explain how land development, transportation options and consumption of resources may affect the environment.

Students will describe human efforts to reduce the consumption of raw materials and improve air and water quality.

LINKS:
http://www.epa.gov/acidrain/what/index.html
http://www.umich.edu/~gs265/society/waterpollution.htm
http://www.eia.doe.gov/kids/energyfacts/index.html