



Greenwich Public Schools Curriculum Overview On-Level Chemistry

Personalized learning is achieved through standards-based, rigorous and relevant curriculum that is aligned to digital tools and resources.

Note: Teachers retain professional discretion in how the learning is presented based on the needs and interests of their students.

Course Description

Prerequisite: Grade of C or better in Algebra 1 or Grade of B or better in Extended Algebra. This college preparatory, laboratory-oriented course is designed to develop understanding and skills in four areas of chemistry: fundamental concepts, practical applications, laboratory techniques and mathematical applications.

Unit Guide

➤ Unit 1: Atomic Energy

- Module 1: Chernobyl, UV Radiation, and Cancer
 - *Electromagnetic spectrum, Wavelength, frequency, energy*
- Module 2: Structure of an atom
 - *Structure of the atom, Isotopes, Ions, Atomic mass, Atomic orbital, Electron configuration*
- Module 3: Periodic Table and Trends
 - *First ionization energy, Electronegativity, Electron Affinity, Atomic radius, Family/Group*

➤ Unit 2: Food Chemistry

- Module 1: Physical Thermodynamics
- Module 2: Chemical Thermodynamics
 - *Phases/states of matter, heating curve, specific heat, conduction and convection*
- Module 3: Why do onions make you cry?
 - *Types of chemical bonds and reactions*
- Module 4: The Impossible Burger
 - *Calorimetry*
- Module 5: Brew Challenge
 - *Stoichiometry, The mole, heats of formation*

➤ Unit 3: Environmental Chemistry

- Module 1: Ocean Acidification and Coral Bleaching
 - *Acid, base, pH, photosynthesis reaction,*
- Module 2: Sea Floor Spreading - Earth Science / Geology
 - *Conduction, convection, plate tectonics, density*
- Module 3: Oil Spill
 - *Bonding, intermolecular/intramolecular forces, molecular geometry, Lewis structure, Polarity*
- Module 4: Sea Ice

- *Solutions, Solubility, Density*

➤ Unit 4: Human Chemistry

- Module 1: Alcohol Flush/Pharmacokinetics
 - *Reaction rate, Collision theory/kinetic molecular theory, Catalyst, Factors affecting reaction rate*
- Module 2: The Haber Process -OR- Acidosis Case Study
 - *Le Chatelier's principle*

➤ Unit 5: Chemical Engineering and Design

- Module 1: Typhoons and Mangroves

Enduring Understanding and/or Performance Tasks

➤ Unit 1: Atomic Energy

○ **Enduring Understandings**

- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.
- Atoms are conserved during chemical reactions

○ **Performance Tasks**

- Make claims based on evidence about radiation and the epidemiology of cancer.
- Ask questions, defining problems, and analyzing and interpreting data based on the relationship between periodic trends.
- Plan and carry out an investigation to explain how energy affects atomic structure.
- Evaluate models of the atom based on evidence throughout history.
- Construct an initial explanation of how ultraviolet radiation leads to melanoma.
- Obtaining, evaluating, and communicating information as well as analyzing and interpreting data for each periodic trend

➤ Unit 2: Food Chemistry

○ **Enduring Understandings**

- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems, or converted to thermal energy.
- Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution
- As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.

○ **Performance Tasks**

- Carrying out a specific heat investigation and applying computational thinking to analyze the results
- Carrying out and asking questions about a chemical reaction between barium hydroxide and ammonium nitrate
- Carrying out an investigation to compare the enthalpy changes between various chemical and physical changes
- Applying mathematical thinking to a reaction by calculating changes in enthalpy.
- Conducting experiments to examine the types of chemical reactions, specifically synthesis and combustion.

- Carrying out a calorimetry investigation to quantify the energy stored in food
- Use models to construct explanations about the movement of energy through cellular respiration
- Use mathematics and computational thinking to determine a balanced chemical reaction and predict the amount of product formed.

➤ Unit 3: Environmental Chemistry

○ **Enduring Understandings**

- The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection.
- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.
- Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.
- Water has the capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials; and lower the viscosities and melting points of rocks.

○ **Performance Tasks**

- Mindmap the issues behind ocean acidification and evaluate a proposed solution for coral regeneration.
- Analyzing seismic data to develop a model of Earth's interior
- Distinguish between S and P waves and their movements
- Model the differences in the makeup of the inner layers of earth, and how that affects seismic waves
- Describe the cycling of matter
- Ask questions and make observations about oil spills (to determine how atoms are bonded together influences the properties)
- Model the structures of molecules using Lewis Dot Structures
- Model the structure of monomers and polymers
- Plan and conduct an investigation on how the strength and type of IMFs affect properties such as melting point, boiling point, conductivity, vapor pressure, and surface tension, and report findings as a CER
- Conduct research on oil spill clean-up methods and communicate about the molecular structure, polarity, IMFs, and electron movement of their chosen clean-up method (using both their research and knowledge gained from the unit)
- Design and conduct an investigation to expand the explanation of what was observed in the ice cube activity (to explore the properties of density, solubility, polarity, and the nature of hydrogen bonds)
- Analyze and interpret data on old versus new ice melt in glaciers and icebergs
- Apply the properties of water to changes in the Earth's surface through glaciers/ice sheets to explain why ice melt is accelerating faster than predicted computer models (stability and change)

➤ Unit 4: Human Chemistry

○ **Enduring Understandings**

- Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies

in the set of molecules that are matched by changes in kinetic energy. In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present.

○ **Performance Tasks**

- Carry out an investigation, and analyze and interpret data to write a scientific explanation on variables that affect reaction rate (temperature, concentration etc.)
- Analyze a case study of ketoacidosis
- Research information to maximize the amount of ammonia produced.
- Revise models to include how temperature impacts reaction rates.
- Students will be able to use Le Chatelier's Principle to make predictions.

➤ Unit 5: Chemical Engineering and Design

○ **Enduring Understandings**

- Natural hazards and other geologic events have significantly altered the sizes of human populations and have driven human migrations.
- The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.

○ **Performance Tasks**

- Asking questions and making observations about the impact of the 2005 Damrey Typhoon on Vietnam
- Reading and analyzing case studies from multiple reliable sources about the impact and reasoning behind mangrove deforestation
- Analyzing and interpreting data on shrimp farms, mangrove deforestation, and coastline health in Thailand
- Defining problems and communicating effective solutions to mangrove deforestation

Standards

➤ Vision of the Graduate Standards

- Pose and pursue substantive questions
 - Ask questions, based on observed phenomena and patterns, that can be answered empirically and distinguish a scientific question from a non-scientific question.
- Explore, define, and solve complex problems
 - Plan and conduct experimental procedures, identifying relevant variables and collecting appropriate data in order to identify causal relationships and make predictions.
- Critically interpret, evaluate, and synthesize information
 - Analyze data using mathematics and statistics, to look for patterns or to test whether data are consistent with a hypothesis.
- Collaborate with others to produce a unified work and/or heightened understanding
 - Use scientific evidence and models to construct explanations of phenomena or solve engineering problems.
- Communicate effectively for a given purpose
- Read, evaluate, and produce scientific texts and construct scientific arguments to communicate about science.

➤ Next Generation Science Standards Performance Expectations

- Unit 1: Atomic Energy
 - PS1-1
- Unit 2: Food Chemistry
 - PS3-4 ; PS1-4, PS1-2 , LS1-6 ; LS1-7 ; ETS1-1, PS1-7

- Unit 3: Environmental Chemistry
 - ESS3-5 ; ESS3-6 ; ETS1-1 ; LS1-5 ; ESS3-4, ESS2-3 , PS1-3 ; PS2-6 ; ESS3-2 ; ETS1-3, ESS2-5 ; ETS1-4
- Unit 4: Human Chemistry
 - PS1-5, PS1-6
- Unit 5: Chemical Engineering and Design
 - PS1-5, PS1-6

Resources and Assured Experiences

- Textbook:
- Flame Test Lab
- Atomic Spectrum Lab
- TuVA Data/Activity
- Radiation and cancer CER
- Impossible Burger lab
- Calorimetry Lab
- Brew Challenge
- Coral Reef Bleaching - bioGraphic
- TuVA Data Analysis
- Seismic Data Lesson - simulations
- Oil Spill Project
- Ice Cube Lab
- Iodine Clock Reaction
- Personalized Learning Kinetics Lab
- Acidosis Case Study
- Le Chatelier's Lab
- Engineering Design Challenge Project