



Curriculum & Instruction

SUMMIT PUBLIC SCHOOLS

Content Area: Science
Course: Chemistry CPA
Grade(s): 10

Course Overview

Chemistry is a college-preparatory laboratory course that provides students with a working knowledge of atomic theory, chemical periodicity, the mole concept, and energy changes in chemical reactions. Extensive laboratory work and problem solving are used to develop an understanding of equilibrium, rates of reaction, and oxidation-reduction. This course is recommended for students anticipating careers in the sciences, medicine, or engineering. It is also the appropriate course for college-bound, liberal arts students hoping for acceptance at a competitive college. This course is part of a science sequence that includes biology and physics.

New Jersey State Learning Standards

Summit Public Schools curriculum aligns with the [New Jersey Student Learning Standards](#).

Content Standards

- HS-PS1-1. Matter and its Interactions: Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
- HS-PS1-2. Matter and its Interactions: Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
- HS-PS1-3. Matter and its Interactions: Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
- HS-PS1-4. Matter and its Interactions: Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
- HS-PS1-5. Matter and Its Interactions: Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

- HS-PS1-6. Matter and Its Interactions: Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.
- HS-PS1-7. Matter and Its Interactions: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
- HS-PS1-8. Matter and its Interactions: Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
- HS-PS2-6. Motion and Stability: Forces and Interactions: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
- HS-PS4-3. Waves and Their Applications in Technologies for Information Transfer: Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
- HS-PS4-4. Waves and Their Applications in Technologies for Information Transfer: Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
- HS-PS4-5. Waves and Their Applications in Technologies for Information Transfer: Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
- HS-ESS1-6. Earth's Place in the Universe: Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
- HS-ESS2-1. Earth's Systems: Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
- HS-ESS2-3. Earth's Systems: Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
- HS-LS2-3. Ecosystems: Interactions, Energy, and Dynamics: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

Interdisciplinary Standards:

NJSLS ELA/Literacy:

- RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
- RST.9-10.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text.
- RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

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- RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as used in scientific or technical contexts.
- RST.9-10.5 Analyze the structure of relationships among concepts in a text, including relationships among key terms.
- RST.9-10.7 Translate quantitative or technical information expressed in words into visual form and information expressed visually or mathematically into words.
- RST.9-10.9 Compare and contrast findings presented in a text with those from other sources, including their own experiments.
- RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.
- WHST.9-12.2 Write informative/explanatory texts, including scientific procedures, experiments, and technical processes.
- WHST.9-12.4 Produce clear and coherent writing appropriate to task, purpose, and audience.
- WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

NJSLS Mathematics Standards:

- MP.2 Reason abstractly and quantitatively.
- MP.6 Attend to precision.

Career Readiness, Life Literacies and Key Skills Standards:

- 9.1.12.FP.5 Evaluate how behavioral bias (e.g., overconfidence, confirmation, recency, loss aversion, etc.) affects decision-making.
- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST.3 Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.
- 9.3.ST.6 Demonstrate technical skills needed in a chosen STEM field.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.4.12.CT.2 Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

Computer Science and Design Thinking Standards:

- 8.1.12.DA.1 Create interactive data visualizations using software tools to help others better understand real-world phenomena.
- 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.

Career Ready Practices

- CRP 1. Act as a responsible and contributing citizen and employee.
- CRP 2. Apply appropriate academic and technical skills.
- CRP 3. Attend to personal health and financial well-being.
- CRP 4. Communicate clearly and effectively and with reason.
- CRP 5. Consider the environmental, social and economic impacts of decisions.
- CRP 6. Demonstrate creativity and innovation.
- CRP 7. Employ valid and reliable research strategies.
- CRP 8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP 9. Model integrity, ethical leadership and effective management.
- CRP 10. Plan education and career paths aligned to personal goals.
- CRP 11. Use technology to enhance productivity.
- CRP 12. Work productively in teams while using cultural global competence.

New Jersey Curriculum Mandates:

This curriculum integrates lessons that address the following interdisciplinary New Jersey Curriculum Mandates:

- [Climate Change Education](#) (Grades K - 12)

Learning Objectives

Learning objectives are clear, specific statements that define what students should know, understand, and be able to do by the end of a lesson or course.

- Precisely follow a multi-step laboratory procedure to record qualitative observations and quantitative data.
- Observe chemical and physical processes in the laboratory.
- Translate quantitative information regarding chemical quantities and reactions between symbolic formulas, visual models, and mathematical equations.
- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence.
- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.
- Analyze historical scientific texts describing indirect experimental evidence.
- Construct a written scientific explanation tracing how cosmological and physical evidence transformed atomic theory.
- Evaluate the claims, reasoning, and spectroscopic evidence that justified the transition to the modern, probability-based quantum mechanical model.
- Communicate scientific ideas using visual charts and nucleosynthesis models to explain nuclear fusion.
- Construct and analyze graphical models to explain how the ratio of protons to neutrons dictates nuclear stability.
- Gather and critically evaluate multiple digital resources to draft a comparison between high-energy ionizing radiation and low-energy non-ionizing radiation.

- Develop a system model of a nuclear fission reactor to explain how controlled nuclear chain reactions release thermal energy..
- Construct and evaluate scientific models of electromagnetic radiation to analyze wave-particle duality.
- Calculate and translate quantitative relationships between energy, frequency, and wavelength.
- Use the periodic table as a predictive model to analyze the structural layout of electron configurations.
- Research, evaluate, and argue the physical laws governing quantum electronic behaviors.
- Interpret stellar absorption and emission spectra.
- Explain how an element's unique atomic number defines its identity and placement on the periodic table.
- Develop potential energy system models to illustrate the breaking of chemical bonds.
- Translate between systematic names, symbolic chemical formulas, and visual molecular structures .
- Plan and carry out investigations to gather bulk-scale data to infer the relative strength of microscopic electrical forces between particles.
- Construct and manipulate symbolic systems of atomic models.
- Explain how underlying bond polarity and charge distributions cause macroscopic solubility ("like dissolves like") and electrical conductivity, contrasting the movement of charges in electrolyte aqueous solutions with non-electrolytes.
- Predict and write balanced chemical equations for chemical reactions.
- Calculate percent composition and mathematically determine its empirical and molecular formulas.
- Write and utilize balanced chemical equations demonstrating that total mass and atoms are conserved.
- Calculate the theoretical product yield and determine the percent yield based on experimental outputs.
- Applying the rules of significant figures, scientific notation, and dimensional unit prefixes to reflect laboratory measurement limitations.
- Explain how changes in temperature and pressure affect macroscopic properties of solids, liquids, and gases.
- Explain how substances with differing molecular structures and intermolecular forces can exist in different physical states.
- Evaluate geoscience data to construct an evidence-based argument.
- Explain how the polar covalent molecular structure of water drives its ability to form hydrogen bonds.
- Model the steps of the water cycle to explain how phase transitions.
- Predict whether a substance will be soluble or insoluble in water by analyzing its molecular geometry, polarity, and potential intermolecular forces.
- Construct a conceptual model demonstrating that total energy is conserved in a system.
- Use Kinetic Molecular Theory to describe how kinetic energy flows during molecular collisions.
- Measure heat transfer and calculate enthalpy changes (ΔH) during changes of state and chemical reactions (Hess's Law).
- Evaluate physical and chemical changes based on experimental evidence, and apply Le Chatelier's Principle.

- Explain how changing temperature or concentration alters the collision rate of reacting particles.
- Construct and analyze system models to show that a chemical reaction requires an input of activation energy to break existing chemical bonds and initiate molecular rearrangements.
- Research and argue how engineering chemical reaction rates (such as catalytic converters in transport or enzymatic stabilization in pharmaceuticals) addresses human problems, and analyze the ethical, economic, and environmental trade-offs of these technologies.
- Refine the design of a simulated chemical system by specifying precise changes in temperature, pressure, or concentration to shift the reaction pathway and optimize product yield.
- Construct a scientific explanation distinguishing between static and dynamic balance, using particle-level models to show that dynamic equilibrium involves continuous chemical transformations with stable macroscopic concentrations.

Units of Study

Units of study are organized collections of lessons and learning experiences focused on a specific topic and set of skills within a course. Each unit is guided by a set of essential questions.

Unit 1: Study of Matter Using Experimental Methods (~10 days)

- How do scientists use observations, measurements, and evidence to define, understand, and classify matter?
- How does the structure of matter determine its properties and behavior?
- How can we determine whether a change in matter is physical or chemical?
- How do scientists represent, measure, and communicate information about matter accurately?
- Why is it important to differentiate between elements and compounds?
- What is the source of elements, and what does that mean about the history of the universe?

Unit 2: Atomic Structure and Nuclear Chemistry (~20 days)

- How do we know what we cannot see?
- How has scientific evidence transformed our understanding of the atom and the universe?
- Is there evidence that exists that suggests our current model of the atom is not sufficient?
- Where did all the elements on Earth originate?
- Why are some nuclei stable while others release radiation?
- Are all forms of radiation harmful?
- How can nuclear reactions be both a source of tremendous energy and a potential risk?
- How has our understanding of nuclear science changed the way we produce energy, study Earth's history, and treat disease?

Unit 3: Periodicity and Atomic Spectrum (~15 days)

- How can something behave as both a continuous wave and a discrete particle, and how does this duality challenge our understanding of reality?
- How can a beam of light serve as an invisible bridge to reveal the internal structure of an atom?
- How does the invisible architecture of an element's electrons dictate the tangible physical and chemical properties of our world?

- How do unexpected "surprises" or failures in existing scientific theories force us to rethink the laws of nature?
- How has human mastery over the behavior of unseen electrons shaped the landscape of modern technology?
- How can a light signature traveling across billions of miles of empty space tell us what the stars are made of, and what does that reveal about our own origin?

Unit 4: Bonding and Chemical Reactions (~20 days)

- How does the internal structure of an atom dictate its position and the repeating patterns found on the periodic table?
- Why do elements in the same column share similar chemical properties, and how do their outer electron states drive reactivity?
- Why does a stable molecule possess lower energy than its separated component atoms?
- How can we use the language of Chemistry to refer to substances by name or by formula?
- How do microscopic attractions and repulsions between electric charges explain macroscopic contact forces and material transformations?
- How can we visually represent what is happening when a bond forms?
- What determines the properties of substances, such as solubility in water and electrical conductivity?
- How can we represent a chemical reaction both quantitatively and qualitatively?
- How can the conservation of atoms and periodic trends be used to accurately describe and predict the outcomes of chemical reactions?

Unit 5: Calculations in Chemistry (~20 days)

- How can the interpretation or manipulation of quantitative data be used to determine the chemical composition of a substance?
- How are balanced chemical equations used to calculate quantities of substances in chemical reactions?
- Why is it important that we are able to determine a limiting reactant?
- How can you choose a level of accuracy that is appropriate to limitations on measurement when reporting quantities?

Unit 6: Phases of Matter and Aqueous Solutions (~15 days)

- What factors affect the properties of the different states of matter?
- How can matter exist at different states at the same temperature and pressure?
- Has the composition of our atmosphere remained consistent over time?
- Why is water a unique chemical substance?
- What steps of the water cycle are natural purification techniques?
- What happens to a substance when it dissolves?
- Why are some substances soluble in water and others aren't?

Unit 7: Energy in Chemical and Physical Changes (~15 days)

- What is energy?
- What is the difference between heat and temperature?
- What factors affect the ability of material to absorb or release heat?
- Are chemical and physical changes reversible?
- What factors affect the amounts of product formed in a chemical reaction?

- What factors determine whether or not a chemical reaction will happen?

Unit 8: Kinetics and Equilibrium (~15 days)

- Are chemical and physical changes reversible?
- What factors affect the amounts of product formed in a chemical reaction?
- How can the rate of a chemical reaction be measured and changed?
- What factors determine whether or not a chemical reaction will happen?
- How do the rates of chemical reactions directly impact our lives?
- Under what conditions can a reaction be manipulated to proceed in one particular direction?
- What is the difference between static and dynamic equilibrium?

Instructional Resources and Materials

Instructional resources are the information sources teachers utilize to guide their teaching and assessing. Instructional materials are the texts students read or review. The instructional resources and materials may vary in order to meet the learning needs of students.

Required:

- Wilbraham, A. C., Staley, D. D., Matta, M. S., & Waterman, E. L. (2005). *Prentice Hall chemistry*. Pearson Prentice Hall
- New Jersey State Science Standards (NJSLS-S)

Recommended:

- NJ Department of Education (NJDOE) — NJSLS-S standards, curriculum guidance, and instructional resources (NJDOE Science Standards & Resources)
- American Association of Chemistry Teachers (AACT) — Chemistry lessons, labs, demonstrations, safety, measurement, matter, properties, and separation activities (AACT Classroom Resources)
- American Chemical Society (ACS) — Chemistry content, laboratory safety, periodic table resources, element discovery, and real-world applications (ACS High School Chemistry Resources)
- PhET Interactive Simulations — Interactive simulations for atoms, elements, states of matter, particle behavior, and physical/chemical concepts (PhET Interactive Simulations)
- New Jersey Science Teachers Association (NJSTA) — NJ-specific teaching resources, NJSLS connections, phenomena, and science instructional materials (NJSTA Resource Center)
- OpenSciEd — Phenomenon-based, inquiry-centered instructional materials aligned with three-dimensional science learning (OpenSciEd)
- ACS ChemMatters — Short, accessible readings connecting chemistry concepts to real-world applications, technology, Earth, and society (ChemMatters)

- NJDOE Earth & Space Science Resources — Standards and instructional guidance for Earth's layers, composition, and Earth-system concepts (NJDOE Earth & Space Science Standards)

Assessment Strategies

Assessment measures a student's mastery of a course standard and learning objective. Assessment can be used for both instructional purposes and for evaluative purposes. Teachers may choose one or more of the following ideas to assess learners. They may also modify these ideas to make the assessment more responsive to students' interests and needs.

Formative:

- Lab Practicals & Station Activities
- Card Sorts & Concepts Sorts
- Whiteboard Challenges & Modeling Sessions
- Exit Tickets & Digital Polls
- Laboratory Investigations & Activities
- Models, Activities & Simulations

Summative Assessments:

- Unit Tests & Quizzes: Chapter and Unit tests featuring multiple choice, short answer, mathematical calculations and open-ended conceptual explanations.

Benchmark Assessments:

- Unit-level exams assessing mastery of course standards and interdisciplinary skills at major curriculum intervals.

Alternative Assessments:

- Projects & Reports:
 - *Chemistry and Cooking Project*
 - *Nuclear Power Debate* (risk-benefit and opportunity-cost analysis of nuclear technology)
 - *Radioisotopes Technical Project* (researching rates of decay, medical diagnosis/therapy applications, or age calculations of Earth materials)
 - *Formal Lab Reports* (e.g., Calorimetry, Gas Properties, or Stoichiometry)

Suggested Strategies for Modification & Differentiation

[Modifications Chart](#)