

Integrated Physics and Chemistry Course Overview

The new Integrated Physics and Chemistry course has been developed to support Maryland's adoption of the Next Generation Science Standards (NGSS).

This new course merges physics and chemical concepts. The NGSS standards addressed by this course include all of the Physical Sciences (PS) Performance Expectations (PE's), as well as a few PEs from the Engineering Design domain. The NGSS call for an integration of three dimensions – disciplinary core ideas, science and engineering practices, and crosscutting concepts.

The goal of each unit is to develop an understanding of specific phenomena through the lens of physical science processes. Each unit also incorporates the engineering design process which includes identifying a challenge/issue, synthesizing new learning, and brainstorming and/or evaluating possible solutions.

The following chart provides information on each unit:

Unit Title	Unit Summary
Fireworks	Students begin the unit by exploring color of fireworks and how atomic structure provides an explanation for the emission of electromagnetic radiation as visible light. Students will then explore the explosion of a firework. Students then study chemical reactions to explain the conservation of matter and energy. Finally, students investigate fireworks as a rocket projectile in order to explain the process by which it accelerates forward. Through their investigation, students will develop a foundation of physics, including a basic understanding of the causes and descriptions of motion, and a conceptual understanding of the relationship between kinetic and potential energy. Furthermore, while exploring rockets, students will analyze graphs of motion, and explain that forces cause a change in motion. At the end of this unit, students will design a firework show for a 4th of July celebration at the Inner Harbor.
Disasters	Students begin the unit by exploring how interactions between a spacecraft and other objects cause changes in motion and how mass, force, acceleration, and energy are related. Students then explore the importance of energy and momentum on an egg during a collision in order to decrease the force of a landing. Furthermore, students will use their knowledge of velocity, wavelength, frequency, and period in order to justify whether a shelter is durable enough to feasibly be built at a colonization site. Students will design a treatment solution for an oil spill based on intermolecular forces. At the end of this unit students will complete a MISA style assessment.
Powering the World	Students begin this unit by exploring how energy can transfer in a system with a focus on heat energy and heat capacity in order to design an experiment to determine the best fuel source. Students will then complete a MISA style assessment to construct an argument for which fuel source the U.S. should use based upon the energy released through a combustion reaction and related thermodynamic calculations. Additionally, students will construct a battery using their knowledge of redox reactions, reaction rates, equilibrium, and Le Chatelier's Principle. Students will also investigate nuclear reactors to explore various forms of nuclear decay, nuclear fission, and nuclear fusion. Students will explore mechanical and electrical energy in order to design and refine a power plant that can create enough electricity to power Baltimore County given specific criteria and constraints. At the end of this unit students will have to design a off-grid energy system to provide power to their home for 7 days in the event of a disaster.

Innovations	Students begin this unit exploring their cell phone's communication capabilities and conduct an investigation to determine the effect of placing their cell phone in various shielding materials such as a Faraday Cage. Students will then use their cell phones to explore waves (properties, interactions) and how sounds, colors, and energy are able to move through space. Afterwards students will delve deeper into electromagnetic radiation, exploring wavelengths outside of the visible spectrum and their effects, or lack thereof, on the human body. Students will then explore the wave-particle duality of light and create an infographic which conveys this information to their peers. At the end of this unit students will have to create a presentation that describes the process by which a photograph is taken and uploaded for viewing on a social media website.
Capstone Project	The Integrated Physics and Chemistry course concludes with students developing and presenting a proposal for an exhibit that portrays how an innovation in technology has change over time as well as how humans interact with one another and the environment.