Science

The mission of the Science Department is to develop life-long learners who are critical consumers of information and can contribute to an equitable and sustainable global community. We do this by guiding students to make connections between foundational and novel knowledge, to practice new skills, embrace challenges, and deepen their appreciation and understanding of the natural world. Through experimentation and observation, students are introduced to scientific models and asked to apply them to predict the behavior of the world around them. Students are encouraged not only to study natural phenomena, but also to recognize the influence science and society have on one another. To create a collaborative community, students work together to grapple with difficult problems in a supportive and inclusive learning environment. We encourage such collaboration to build a strong community of learners with a common scientific language that they can use to effectively communicate through an objective and just lens. Through all of this, we aim to spark curiosity in our students and for them to experience joy in their ideas and those of others.

A note on 400-level Science classes:

Students who wish to take two 400-level science classes concurrently will require special permission from the department and should be sure to speak with their Grade Dean.

Requirements:

Biology (SCI 210)
One of the following: Chemistry (SCI 220), Physics through Inquiry (SCI 230), Physics (SCI 311) or Physics Honors (SCI 312H)

Elective Courses Offered in 2026-27:

300-level

- Physics (SCI 311)
- Physics Honors (SCI 312H)
- Biotechnology (SCI 320)
- Human Anatomy and Physiology (SCI 321)
- Chemistry, Consumerism, and Citizenship (SCI 323)
- Astronomy: From Black Holes to Supernovae (SCI 324)
- Science Research 1: Research Theory and Skills (SCI 350)

400-level

- Molecular Genetics, Cells and Physiology (SCI 410.1)
- Molecular Genetics and Evolution (SCI 410.2)
- Organic Chemistry and Its Applications in Biochemistry (SCI 420)
- Atomic Structure, Reactivity and Applications of Chemistry (SCI 425)
- Physics with Calculus (SCI 430)
- Environmental Science (SCI 440)
- Science Research 2: Analysis and Presentation of Research (SCI 450)

Courses Not Offered 2026-27

- Topics in Biology (SCI 301)
- Selected Topics in Physics (SCI 310)
- Experiments in Physics and Chemistry (SCI 322)

Introductory Courses:

SCI 210 - Biology

Full credit, meets 4 days/week, including one double lab period
Prerequisites: None

The course provides a survey of the major areas of inquiry in biology including: molecular biology, genetics, physiology, evolution, and ecology. Students have the opportunity to apply their knowledge in a laboratory setting during a double period every week. This hands-on approach allows them to develop important scientific skills such as experimental design and data analysis while supporting this understanding of biological phenomena. In addition, students engage in discussions and activities that explore current research and cutting-edge discoveries in the field of biology. By exploring real-world examples, students develop a greater appreciation for the impact of biology in our daily lives and on the world. During the second semester, students will collaborate on and present a laboratory or data-based project. This capstone project is a culmination of the skills developed throughout the course, and showcases their ability to design an experiment, analyze data, and draw meaningful conclusions.

SCI 220 - Chemistry

Full credit, meets 4 days/week, including one double lab period
Prerequisites: Biology (SCI 210)

Chemistry examines the composition and properties of matter. The topics discussed in the classroom are explored through demonstrations and reinforced through weekly labs. Topics include: atomic and electronic structure, bonding, reactions, stoichiometry, gas laws, states of matter, solutions, reaction kinetics, thermodynamics, equilibrium, and acid/base chemistry. In addition to traditional assessments, students will also complete one research-based project per semester. Both projects will include student collaboration, inquiry, and presentation.

SCI 230 - Physics through Inquiry

Full credit, meets 4 days/week, including one double lab period
Can be taken in Grade 10 or later
Prerequisites: Biology (SCI 210)

Physics Through Inquiry is a laboratory-based introductory class in which students work collaboratively with their peers. Through experimentation, students build and test scientific models of Newtonian mechanics, conservation of momentum and energy, wave behavior, and light. A project at the end of each semester focuses on our society's use of energy and technology. The course emphasizes the development of analytical reasoning skills which helps students become more comfortable with applying mathematical reasoning to the scientific process.
Physics through Inquiry (along with Biology and Chemistry) fulfills the prerequisite requirement for all 300- and 400-level science courses other than Astronomy (SCI 324) and Physics with Calculus (SCI 404), for which Physics or Physics Honors is required.

SCI 311 - Physics

Full credit, meets 4 days/week, including one double lab period
Prerequisites: Biology (SCI 210); Chemistry (SCI 220) recommended
Physics is an introductory, algebra-based course covering Newtonian mechanics, work, energy, momentum, electricity, waves, and modern physics. This course focuses on developing both a conceptual understanding of the basic principles of physics and problem-solving skills. Weekly laboratory work allows students to explore the concepts learned in class and gain experience designing and conducting experiments.

SCI 312H - Physics Honors

Full credit, meets 5 days/week, including one double lab period
Prerequisites: Biology (SCI 210); Chemistry (SCI 220) recommended; departmental approval (see below)
Physics Honors is an introductory, algebra-based, college-level physics course. Topics are studied in greater depth than in Physics, and some additional topics, which vary from year to year, are covered. The concepts developed in this course are applied in a broad range of contexts, and the problem-solving is designed to encourage creativity and to challenge students' conceptual and analytical reasoning abilities. Extensive use is made of advanced mathematical methods and students are expected to solve challenging problems with a high degree of independence. The laboratory work places a greater emphasis on independent work, projects, and computer modeling.
Generally, students need to have earned grades of A- or better in all science and mathematics courses to be considered. All interested students must also complete a placement exercise in June, which is designed to assess the readiness of students for this course. Interested students are encouraged to talk with their current science teacher and/or the Department Chair prior to requesting Physics Honors. Given the significant demands of Physics Honors, the department does not generally give permission for concurrent enrollment in Physics Honors and a 400-level Science; students who are interested in this option must speak with their current science teacher and the Department Chair before submitting their Course Request Sheet. Physics Honors may not be taken by students who have completed Physics or Physics through Inquiry.

300-level Elective Courses:

SCI 320 - Biotechnology

Full credit, meets 3 days/week, including one double lab period
Prerequisites: Biology (SCI 210), and either Chemistry (SCI 220) or Physics through Inquiry (SCI 230)

This is an upper-level course in Biology that introduces students to common techniques used in molecular biology research. While hands-on laboratory experience is emphasized, students are challenged to consider the bioethical issues associated with advancing technology. This course builds on foundational biology and chemistry concepts learned in the ninth and tenth grades to further understand the molecular biology behind topics like: infectious disease and immunology, antibiotic resistance, genetically modified organisms, advances in cancer biology, and human evolution. Techniques that students will learn include: agarose gel electrophoresis, restriction enzyme mapping primer design, DNA amplification by Polymerase Chain Reaction (PCR), genetic engineering including CRISPR-CAS 9 gene editing, bacterial/yeast transformations, nucleic acid extraction and purification, DNA sequencing, microarray analysis, protein purification by column chromatography and polyacrylamide gel electrophoresis, and detection of antigens using Enzyme-Linked Immunosorbent Assays (ELISA). Students will conduct experiments, analyze their results and write reports on selected labs. Students will also spend time exploring the historical, technical, and social issues influenced by advances in biotechnology by writing papers and making presentations to the class on these issues.

SCI 321 - Human Anatomy and Physiology

Full credit, meets 4 days/week, including one double lab period
Prerequisites: Biology (SCI 210), and either Chemistry (SCI 220) or Physics Through Inquiry (SCI 230)

This upper-level course in biology examines the structures and functions of cells, tissues, organs, and organ systems found in the human body. Course content covers the complexity of many features found in body systems, such as: the microscopic anatomy of bones in the skeletal system, the sliding filament model of the muscular system, action potential propagation in the nervous system, and the cardiac cycle of the cardiovascular system. The class will emphasize the relationship between structure and function as well as the connection of the physiological aspects of the organ systems to one another. Additionally, students will complete research projects and presentations, where they will be able to focus on a specific topic, disorder, disease, treatment, or surgery related to the body systems discussed in class. Possible research topics include common skin disorders, knee replacement surgery, muscular dystrophy, and the impact of specific drugs on neurons. Laboratory investigations will include performing a variety of dissections, measuring bodily activity, and modeling physiological processes.

SCI 323 - Chemistry, Consumerism, and Citizenship

Full credit, meets 4 days/week

Prerequisites: Biology (SCI 210), and either Chemistry (SCI 220) or Physics Through Inquiry (SCI 230)

This course explores the intersection of science and society that features diversity, inclusion, and equity at the foreground of the chemical concepts introduced. This course will discuss the communication of scientific knowledge by analyzing the role and function of various forms of writing, including journalistic, educational, and social media to communicate scientific understanding. Students will examine the intention, design, consumption, disposal and impact of innovations and consumer goods on the well-being of communities, the economy, and the environment. Major assessments will include research papers, presentations, student-led discussions and multimedia projects on the impacts of chemistry. Students who are interested in analyzing developments in the energy industry and urban planning, discussing research informing and influencing public policy on nutrition and tobacco, and recognizing how to critically consume fashion and skincare products should consider taking this course.

SCI 324: Astronomy: From Black Holes to Supernovae

Full credit, meets 4 days/week, including one single-period lab

Prerequisites: Biology (SCI 210), Chemistry (SCI 220) as well as Physics (SCI 311) or Physics Honors (SCI 312H). Physics may be taken concurrently.

This is a laboratory-based, year-long introductory astronomy course. The objective of this course is to understand several of the most important topics in historical and modern astronomy and space exploration. Topics include stellar evolution, the planets of our solar system, cosmology, telescopes, and the search for extraterrestrial life. Weekly labs will give students the opportunity to practice the methods that astronomers use, as well as to apply concepts learned in chemistry and physics to locate, study, and understand objects beyond the Earth. Students will gain an appreciation of the art of astronomical observation, and apply their knowledge of algebra and trigonometry to analyze astronomical data. Labs may include: building a pinhole camera, using skyview software to find celestial objects and predict their paths, geometric optics, and locating and observing objects in the sky with binoculars. There will be one required overnight trip to Dorr for night-time observation, and one required daytime trip to a local planetarium.

400-level Elective Courses:

SCI 410.1 - Molecular Genetics, Cells, and Physiology

Full credit, meets 4 days/week, including one double lab period

Prerequisites: Biology (SCI 210), Chemistry (SCI 220), and Physics Through Inquiry (SCI 230) or Physics (SCI 311) or Physics Honors (SCI 312H); departmental approval required (see below)

Molecular Genetics and Cell Physiology is an advanced biology course. During the

first half of the course, students learn about modern molecular genetics, from the classic experiments that identified the proteins involved in DNA replication and repair and gene expression, to cutting-edge assays and gene editing. Then, the focus shifts to the cell, the foundational building block for all living things, and students learn about cellular structure and processes. This course addresses cell structure, cellular signaling, physiology of various types of cells including neurons, as well as the endocrine and immune system cellular responses. The course draws upon a solid foundation of basic chemical knowledge and integrates it into the understanding of how cells function within multicellular organisms. Conceptual learning is supported by hands-on inquiry-driven investigations and readings of primary research papers that emphasize experimental design, data analysis, and scientific communication. Current events are used throughout the course to examine the ways modern biology intersects with other disciplines. The course includes topics that will span both prokaryotic and eukaryotic organisms, but focuses on multicellular eukaryotic organisms. Approval requirements: Students must have an average grade of B+ or better in Biology, Chemistry, and Physics Through Inquiry, Physics, or Physics Honors. A minimum grade of an exact B+ or better when averaging both semester grades in Biology is required. Particularly outstanding and interested students may be permitted to take Physics concurrently.
Note: Students who take SCI 410.1 will not be permitted to take SCI 410.2 due to overlap of course content.

SCI 410.2 - Molecular Genetics and Evolution
Full credit, meets 4 days/week, including one double lab period
Prerequisites: Biology (SCI 210), Chemistry (SCI 220), and Physics Through inquiry (SCI 230) or Physics (SCI 311) or Physics Honors (SCI 312H); departmental approval required (see below)
Molecular Genetics and Evolution is an advanced biology course. During the first half of the course, students learn about modern molecular genetics, from the classic experiments that identified the proteins involved in DNA replication and repair and gene expression, to cutting-edge assays and gene editing. The second half of the course focuses on the processes and evidence of evolution as a means to study biological diversity. Students build an understanding of the fundamentals of organismal development and life history, and how evolution shapes ecological relationships and allows organisms to adapt to changing environments and leads to the formation of new species. We also examine how evolution functions on a smaller scale in ways that directly impact human health: driving evolution of viruses and bacteria responsible for infectious diseases, and providing a basis for an understanding of the development of cancer. Conceptual learning is supported by hands-on inquiry-driven investigations and readings of primary research papers that emphasize experimental design, data analysis, and scientific communication. Current events are used throughout the course to examine the ways modern

biology intersects with other disciplines. Approval requirements: Students must have an average grade of B+ or better in Biology, Chemistry, and Physics Through Inquiry, Physics, or Physics Honors. An average grade of B+ or better in Biology is required. Particularly outstanding and interested students may be permitted to take Physics concurrently.
Note: Students who take SCI 410.2 will not be permitted to take SCI 410.1 due to overlap of course content.

SCI 420 - Organic Chemistry and its Applications in Biochemistry
Full credit, meets 4 days/week, including one double lab period
Prerequisites: Biology (SCI 210), Chemistry (SCI 220), and Physics Through Inquiry (SCI 230) or Physics (SCI 311) or Physics Honors (SCI 312H); departmental approval required (see below)
This rigorous, advanced elective course focuses on chemistry that bridges the fundamentals of carbon-based chemistry and biological applications. Students will have the opportunity to engage with advanced organic and biochemistry material in a collaborative environment and be challenged to think independently and creatively. The organic-focused semester will build a foundation in Lewis acid-base theory, organic nomenclature, stereochemistry, and reaction mechanisms. In the biochemistry semester, students will focus on how the structure and function of macromolecules in biological systems interact. Students will explore the biochemical requirements and mechanisms of biological pathways. Many of the laboratory experiments are multi- week projects and require students to think critically while introducing essential organic chemistry and biochemistry laboratory skills. Approval requirements: A grade of B+ or higher in each semester of Chemistry is required. A B+ average is required in other foundational science courses (Biology, Physics through Inquiry/Physics/Physics Honors). Particularly outstanding and interested students may be permitted to take Physics concurrently.

SCI 425 - Atomic Structure, Reactivity and Applications of Chemistry
Full credit, meets 5 days/week, including one double lab period
Prerequisites: Biology (SCI 210), Chemistry (SCI 220) and Physics Through Inquiry (SCI 230), Physics (SCI 311), or Physics Honors (SCI 312H); departmental approval required (see below)
This course is comparable to an introductory college course in general chemistry and will draw heavily on the foundation established in tenth grade chemistry. The course will emphasize the conceptual and quantitative understanding of how compounds and molecules interact and the design and execution of inquiry-based chemistry experiments to support that understanding. This course will also focus on making connections to real-world applications of chemistry. Semester 1 will focus on chemical structure and bonding, and semester 2 will focus on chemical equilibrium, free energy and reaction kinetics. Strong problem solving skills and

mathematical reasoning are required to master this course.
Approval requirements: A grade of A- or higher in each semester of Chemistry is required. Students must have an average grade of B+ or higher in Biology, and Physics Through Inquiry, Physics, or Physics Honors. Students must be enrolled in or have completed Precalculus with Theory or Precalculus with Theory Honors. Particularly outstanding and interested students may be permitted to take Physics concurrently.

SCI 430 - Physics with Calculus
Full credit, meets 5 days/week, including one double lab period
Prerequisites: Biology (SCI 210), Chemistry (SCI 220), and Physics (SCI 311) or Physics Honors (SCI 312H); departmental approval required (see below)
Co-requisite: Calculus with Theory (MATH 420) or Calculus with Theory Honors (MATH 421H)
Physics with Calculus is an advanced study of mechanics and electricity and magnetism with a focus on the way rates of change and calculus allow us to better understand the universe. It is a second year course that builds on the framework established by Physics and Physics Honors. Topics include: Newton's laws; conservation of energy; momentum and angular momentum; gravitation; rotational dynamics; oscillations; electric and magnetic fields (including Gauss's law and Ampère's law); static and moving charges; circuits; and electromagnetism (including Faraday's law). Ideas from introductory physics are amplified and more broadly applied, and new ideas are introduced. This course focuses heavily on the mathematical concepts and the meaning behind them. All calculus techniques are discussed before they are applied. This course reinforces ideas taught in Calculus with Theory and Calculus with Theory Honors. Laboratory investigations involve a variety of experimental techniques and methods of data analysis. Analysis of experimental error is emphasized and formal laboratory reports are required periodically. Students have substantial freedom in designing their own experiments, and many experiments are carried out over several weeks. A final project may be assigned.
Approval requirements: A grade of A- or higher in each semester of Physics, or B+ or higher in each semester of Physics Honors is required. A grade of A- or higher in each semester of Precalculus with Theory (MATH 410) or B+ or higher in each semester of Precalculus with Theory Honors (MATH 411H) is required. An average grade of B+ or higher in Biology, Chemistry, and Physics or Physics Honors is required. Algebra II and Algebra II Honors grades will be considered. Students must be enrolled in, or have completed Calculus with Theory (MATH 420) or Calculus with Theory Honors (MATH 421H)

SCI 440 - Environmental Science

Full credit, meets 4 days/week, including one double lab period
Prerequisites: Biology (SCI 210), Chemistry (SCI 220), and Physics Through Inquiry (SCI 311) or Physics (SCI 311) or Physics Honors (SCI 312H); departmental approval required (see below)

How do you define our planet and the environment in which we live? How do various parts of our ecosystem interact with each other? How do we, as humans, fit into this complex and interconnected web?

Throughout this course, students strive to answer those questions as they learn about climate change, biodiversity loss, pollution, ecosystem dynamics, sustainability, resource management, and more. They explore the complexities of interactions throughout our world by performing hands-on labs such as modeling ecosystems with EcoColumns and investigating bioremediation with bacteria. The labs selected for this course are mostly student driven, with an emphasis on experimental design, including data collection, analysis, and interpretation. At the conclusion of the class, students not only have a deeper understanding of the dynamic environmental systems that support life on earth and the challenges facing our planet, but also the knowledge to develop and implement effective solutions to environmental challenges facing us now and in the future.

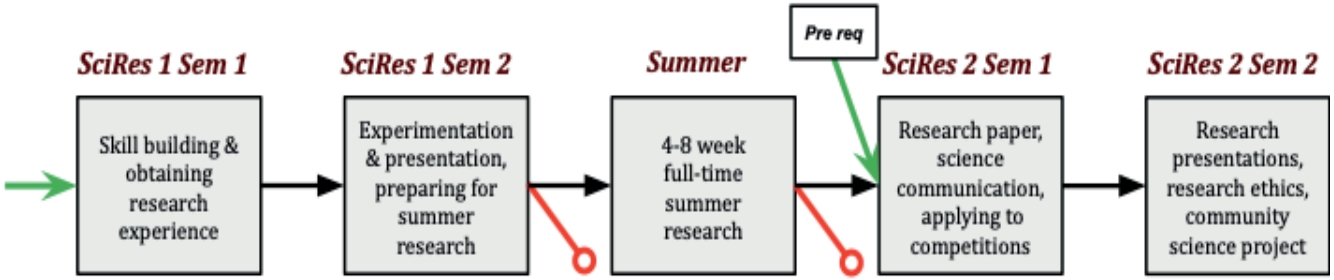
Approval requirements: Students must have an average grade of B+ or better in Biology, Chemistry, and Physics Through Inquiry or Physics or Physics Honors. Particularly outstanding and interested students may be permitted to take Physics concurrently.

Science Research at HM

The goal of the Science Research Program at Horace Mann School is to prepare and support students through a science research experience. This support begins in Science Research 1 by providing students with the understanding of scientific method and skills necessary to perform research. It then continues through the summer/external research experience. Students in Science Research 1 search for an outside lab experience for the summer between Science Research 1 and Science Research 2 and are coached through the process of securing a research experience. Students in Science Research 2 are supported as they present their research, create a research poster, and write a full research paper. The course meets five days in every ten-day cycle.

Approval requirements: Science Research is open only to students in grade 10 and above. Selection is at the discretion of the department. Students planning to enroll in Science Research 1 will be required to attend an informational meeting regarding course expectations. Science Research 2 students must meet with the Science Research Program Coordinator to ensure their research experience meets course requirements. Due to the highly independent nature of coursework, students should consider discussing their fit for the program with their Grade Dean or advisor and current science teacher prior to completing the application.

Science Research Program Overview



Allowed entry point

Allowed exit point

Prerequisite: *Completes application* to confirm attainment of an appropriate summer research experience and agreement to share data in the fall semester. Department approval required.*

** Applications must be submitted to the Science Research Program Coordinator during program planning the spring before course enrollment.*

Exit point: *After completing SciRes 1, if conducting summer research is not desired, or before SciRes 2 if scheduling issues arise.*

SCI 350 - Science Research 1: Research Theory and Skills

Half credit, meets five days in every ten-day cycle

Prerequisites: Interested students must attend the information session.

Open to students in Grades 10-12

The curriculum of Science Research 1 is focused on reading scientific literature; gathering background information on a science research project and discussing others' research; specifying research interests; and developing research projects. An overview of the scientific method and practice of science research will be studied. Students will also learn how to build a resume, interview, and write emails to outside labs as they are supported in finding outside research opportunities. *(Note: there is no guarantee of placement in a research lab, and it is strongly suggested that students enroll only if they are 16 years of age by the summer of 2027, due to strict age restrictions in research labs).* During the year, students will conduct an in-house research project to be presented at the annual Sci Tech event, which students are required to attend.

Summer Research Experience at Horace Mann: In the event that a student is unable to secure an outside research experience, or if a student needs a more scaffolded research experience with close supervision, it is anticipated that a Summer Research Opportunity will be in place at Horace Mann School for a select few students. Details regarding application steps and program structure will be provided to students in the Spring.

SCI 450 - Science Research 2: Analysis and Presentation of Research

Half credit, meets five days in every ten-day cycle

Prerequisites: Departmental approval required. Before submitting their Course Request sheet, interested students must fill out an interest form and meet with the Science Research Coordinator. Students must also complete an application to confirm attainment of an appropriate summer research experience and agreement to share data in the fall semester.

Open to students in Grades 11-12

Students enrolled in Science Research 2 will focus on practicing various forms of science communication about their summer research projects, and other scientific topics of their interest. Students will receive scaffolded guidance on how to write a scientific research paper, which can then be used to enter various competitions and symposiums. They will also practice orally presenting their work during presentations and with a research poster. Additionally, the class will discuss how to communicate science to different audiences, how ethics applies to research, and how to discuss scientific papers in a group. Students are required to participate in the annual Sci Tech event.

Courses Not Offered in 2026-27

SCI 301 -Advanced Topics in Biology
[Course not offered 2026-27]
Full credit, meets 4 days/week, including one double lab period
Prerequisites: Biology (SCI 210), Chemistry (SCI 220)
This is a second course in biology for students who wish to explore certain topics in greater detail and with greater freedom than in a traditional textbook-oriented course. A majority of class time will be spent in laboratory experiments, discussion, and presentations, rather than lecture. Students will design and conduct experiments and lead discussions on scientific articles, while incorporating aspects of other areas of study, such as engineering, ecology, physiology, physics, chemistry, and history. The course will focus on various topics of interest in biology, which will vary from year to year. Past topics include: the biology of food; biomimicry; urban ecology and biodiversity; exercise physiology; and bacteriology and microbiology.

SCI 310 - Selected Topics in Physics
[Course not offered 2026-27]
Full credit, meets 4 days/week
Prerequisites: Biology (SCI 210), Chemistry (SCI 220)
This course does not fulfill the Physics prerequisite for 400-level Science courses.
The class is intended to work as a seminar, emphasizing cooperative and collaborative learning as a means of carrying out research. Thus, there are no tests or quizzes except as diagnostic exercises. Assessment is based on contributions to class discussion as well as presentations and projects, individually and in small groups throughout the year. The informal tone of the course therefore demands a genuine interest in and dedication to both the material and the sincere learning dynamic.
Each semester, students will explore one or more paired themes-a foundational one followed by a broader application to something more wide-ranging, which may include social, political, or even philosophical aspects. Some examples of thematic combinations are: Astronomy and Cosmology, Sound and Music, Energy and Climate Change, Technological Development and Ethics, Chaos Theory and Predictability. Students are encouraged to pursue topics within these themes that matter to them.

SCI 322 - Experiments in Physics and Chemistry

[Course not offered 2026-27]

Full credit, meets 4 *days/week, including one double lab period*

Prerequisites: Biology (SCI 210), and Chemistry (SCI 220), Physics Through Inquiry (SCI 230), or *Physics (SCI 311)*

This course is designed for those students who are interested in exploring topics in Chemistry and Physics from an experimental perspective. This provides direct experience with scientific investigation. It also stresses presenting scientific findings in oral and written form. The course consists of five to seven units, investigating such topics as: analytical chemistry, chemical synthesis, organic chemistry, forensics, food science, novel materials, mechanics, waves, sound, and light, analog and digital circuits, energy, and magnetic fields. In the second semester, each student will pursue an independent project on a subject of interest to them, selected in consultation with the teacher. Although some library-based research will be involved, the major emphasis of the course will be explorations that involve data collection and analysis in the chemistry and physics labs.