BIOLOGY I

freshmen and sophomores

This introductory course is organized around four biological themes: change over time, communication, transfer of energy and matter, and homeostasis. Through the lens of these themes, students are able to more deeply understand and appreciate all biological systems. Topics studied include evolution, cell and molecular biology, and human anatomy and physiology. The use of hands-on modeling activities enhances student engagement and understanding. In the lab, students learn how to design well-controlled experiments and how to analyze collected data. Through this lab work, students gain hands-on experience with current techniques used in research laboratories.

ADVANCED BIOLOGY I

sophomores, juniors, seniors

This course is an introductory biology class for students who have had a full year of chemistry. It covers the same topics as Biology I but emphasizes the biochemical processes in greater depth and detail. As with Biology I, students learn to think critically about how living organisms evolve and survive and are encouraged to make connections to all biological processes within the natural world. The course makes frequent use of case studies to facilitate application of the course content to complex real-world problems. Students spend ample time in the laboratory practicing many of the techniques used in research laboratories today, collecting and analyzing data, and discussing current research topics. Prerequisites: Chemistry and permission of the department

CHEMISTRY I

Students in this introductory class improve their scientific literacy by developing analytical and problem-solving skills through the lens of basic chemical principles such as atomic theory, chemical reactions and bonding, stoichiometry, gases, solutions, equilibrium, acids and bases, and electrochemistry. Students engage in small-group and individual problem-solving, laboratory investigations, and exercises to hone written and graphical communication. Prerequisite: Algebra I; Co-requisite: Algebra II or permission of the department

ADVANCED CHEMISTRY I

This course is designed for those students with strong quantitative ability and who also possess an avid interest and proven achievement in science. Through this rigorous and fast-paced course, students come to an understanding of the methods and principles of modern chemical theory. The development of scientific writing and analytical problem-solving skills are emphasized. Topics draw from the basic principles of inorganic chemistry: electronic structure of the atom, periodicity of elements, stoichiometry, chemical bonding, molecular structure, gas laws and kinetic molecular theory, equilibrium, kinetics, acids and bases, oxidation-reduction, and electrochemistry. Throughout the course, students are involved in an extensive laboratory curriculum. Prerequisite: permission of the department; Co-requisite: Advanced Algebra II or Algebra II with permission of the department

PHYSICS I

sophomores, juniors, seniors

This course introduces students to Newtonian physics and a variety of problem-solving techniques. Through laboratory investigation and class discussion, students explore mechanics, energy, waves, optics, electricity, and magnetism. This course emphasizes a practical approach to understanding physics concepts using familiar objects and everyday situations. Physics I is designed to assist students in developing a greater appreciation for real-world problem-solving situations. Co-requisite: Advanced Precalculus or Precalculus with permission of the department

ADVANCED PHYSICS I

sophomores, juniors, and seniors

Challenging laboratory explorations, engaging classroom derivations and demonstrations, and intimate small group investigations form the core learning experience in Advanced Physics I. Students work together to develop the conceptual understanding, analytical skills, and self-confidence needed to master a wide array of physics topics. The major area of emphasis in the fall term is Newtonian mechanics. In the winter term, students explore electrostatics and circuits. In the spring, the focus shifts to studies of magnetism and geometric optics. The course stresses problem solving with an emphasis on graphical interpretation and incorporating vector mathematics. It is appropriate for students with good aptitude and proven achievement in both science and mathematics. Prerequisite: one previous science course and permission of the department; Co-requisite: Advanced Precalculus with Differential Calculus or Advanced Precalculus with permission of department

CL CHEMISTRY II

This course continues the study of chemical principles and theory at a level consistent with that of a first-year college offering. It covers all of the topics of the first level course, but at a deeper level and at a faster pace. Inquiry-based laboratory experiments follow the suggestions of the AP curriculum and support the concepts studied in class. Lab work helps students develop proficiency with basic analytical laboratory techniques, and students are frequently asked to design their own protocols to solve problems. This course prepares students for the Advanced Placement examination. Prerequisite: Advanced Chemistry I and/or permission of the department

CL PHYSICS II

This problem-solving intensive course pushes students to consider more deeply the topics introduced in Advanced Physics I and to investigate challenging questions incorporating calculus techniques. Dynamic classroom discussions, extensive small group investigations, and laboratory work centered on experimental design enable students to develop confidence and a strong conceptual mastery. The first half of the course focuses on mechanics — covering Newton's laws, conservation of energy and momentum, rotational dynamics, simple harmonic motion, and universal gravitation. The second half explores electricity and magnetism — delving deeply into Coulomb's Law, Gauss's Law, Ampere's Law, Faraday's Law, and circuits involving capacitors and inductors. This course fully prepares students for Advanced Placement examinations in both Mechanics and Electricity & Magnetism. Prerequisite: Advanced Physics I; Co-requisite: CL Calculus BC or CL Calculus AB with permission of department

CL ENVIRONMENTAL SCIENCE GESC

This course provides students with the scientific concepts and methodologies to understand the interrelationships within the natural world. Through on-campus field trips and hands-on activities, students will come to a solid understanding of the core ecological principles. In addition, they will learn to identify and analyze environmental problems within the natural world; relative risks will be evaluated and alternative solutions to problems will be examined. Topics covered include ecological foundations and principles, introduction to plant science, energy, climate change, human population and demographics, toxicology, pollution and pandemics, freshwater resources,

water quality, and global water issues. Students learn to observe environmental systems critically and to develop and conduct well-designed experiments with the goal of making positive changes to the local Loomis Chaffee campus and surrounding ecosystem and in the spirit of environmental stewardship and sustainability. This course covers the majority, but not the entirety, of the AP Environmental Science curriculum; those students interested in sitting for the AP Environmental Science exam in May will need to complete some independent work to prepare for that exam and should consult with the instructor to identify those additional topics. Prerequisites: biology, chemistry, and permission of the department

Elective Term Courses

ASTRONOMY I: INTRODUCTION TO ASTRONOMY AND THE SOLAR SYSTEM

fall term/juniors and seniors

The fall term course introduces students to observational astronomy and methods for measuring distances in the solar system and universe. Students gain an understanding of the foundations of astronomical evidence for our place in the universe by studying the historical development of astronomy from the ancient Greeks to Kepler and Newton as well as modern techniques for studying planets and stars. The course also provides an overview of our solar system. Students will have the opportunity to view the night sky with the school's telescopes and make use of the O'Brien Planetarium. Prerequisite: Chemistry or Physics

ASTRONOMY II: OBSERVING THE UNIVERSE

two-term course/winter and spring /juniors and seniors

This course focuses on stars, galaxies, and cosmology. Major topics include the structure and evolution of stars; stellar explosions and the formation of neutron stars and black holes; the creation of galaxies; relativity and theories about the origin and fate of the universe, with emphasis on the Big Bang; and current questions about the role of dark matter and dark energy. Students will also explore astrobiology, recent space missions, and the possibility of locating habitable planets outside our own solar system. Prerequisite: Chemistry or Physics

COMPARATIVE ANATOMY

term course/juniors and seniors

This course investigates the anatomy of several different vertebrate organisms including humans. Systems such as the muscular system, nervous system, digestive system and skeletal system are compared between a variety of organisms. The class includes many hands-on activities with a heavy emphasis on dissection; potential organisms for dissection include fetal pig, snake, rat, mink, and fish as examples. This course focuses on comparing anatomical structure and function and facilitates a greater understanding of evolution and common ancestry among vertebrates. Students interested in this course do not need a deep background in the field of biology but should be interested in animal body systems and function and should not be afraid to take part in dissections. Prerequisites: Biology and Chemistry

GENETICS

term course/juniors and seniors

This course explores some of the most recent advances in the study of genetics. A review of Mendelian genetics, the structure and function of DNA, and the central dogma of biology enables students to gain deeper understandings of these basic genetic concepts before further investigating the more complex aspects of cancer, evolution, and genetic diseases. Lab work and hands-on activities include exploration of gene expression, genetic engineering, and gene therapy. Prerequisites: Biology and Chemistry

FORENSIC SCIENCE

term course/juniors and seniors

This course focuses on the application of various science techniques used to solve crimes including fingerprinting, blood typing, blood spatter analysis, and DNA profiling. Students combine their knowledge of biology and chemistry in order to solve multiple crime scenes. Students will also learn the basics of the American criminal justice system and discuss its structure, intentions, successes, and shortcomings. The course emphasizes forensic science as a discipline that provides strong, but not infallible, evidence for criminal proceedings. Care is always taken to note the reliability of all techniques studied. Prerequisite: Biology and Chemistry

ECOLOGY GESC

fall term/juniors and seniors

This course focuses on ecological principles and introduces laboratory skills to help students understand the interactions among organisms and between organisms and their environments. Students begin to explore the key ecosystem services provided by natural ecosystems and learn about energy flow, biotic and abiotic factors, and cycling of matter (water, nutrients, etc.) in the ecosystem. Prerequisite: Biology and Chemistry are strongly recommended.

CLIMATE CHANGE GESC

winter term/juniors and seniors

This course explores one of the biggest challenges of the modern world: climate change. Students will examine different types of scientific data to better understand how climate has fluctuated in Earth's history and how the rate of change has increased exponentially since the industrial revolution. Through current events and case studies, students will explore the science of climate change as well as its impacts on such areas as food security, water security, public health, human population, sea levels, ocean acidification, severe weather events, and biodiversity. Throughout the term, research-based projects and laboratory studies will enable students to apply their learning and understand these concepts more fully. Prerequisite: Biology and Chemistry are strongly recommended.

SUSTAINABILITY: SOIL, WATER, AND AGRICULTURE GESC

spring term/juniors and seniors

This hands-on, project-based course investigates both local and global sustainable agricultural practices with a focus on water use in those practices. The course addresses current water issues, including water pollution, and access to clean drinking water. Students will investigate the specific impact of both traditional and sustainable agriculture on soil health, the hydrologic cycle, and climate change. As a culmination of previous work done in environmental science, students use the Loomis Chaffee campus as a microcosm for learning how to use sustainable practices to improve their local environments. Prerequisite: Biology and Chemistry are strongly recommended.

CL ASTROPHYSICS

term course

CL Astrophysics provides an in-depth study of the application of physics and mathematics to the field of astronomy. Major topics include celestial mechanics, the internal structure and evolution of stars, the properties and evolution of galaxies, and the large-scale structure and evolution of the universe. In addition, students will collect, process, and interpret astronomical data obtained from a variety of sources, and will make use of the recently renovated O'Brien Planetarium. Pre-/co-requisites: CL Calculus AB or BC. Pre-requisite: Physics I Advanced or permission of the department

CL BIOLOGY II: GENETICS

fall term/juniors and seniors

This college-level course studies the profound implications of recent advances in genetics. Topics include the discovery, structure, and function of DNA, Mendelian and non-Mendelian patterns of inheritance as well as the control of gene expression and epigenetics. The course has a significant laboratory component that emphasizes the use of modern techniques such as the isolation of DNA, polymerase chain reaction (PCR), and DNA sequencing. Examples of projects include those focused on genetic engineering and the creation of genetic knockouts as well as DNA sequence analysis aimed at uncovering alterations associated with physical traits. Prerequisites: Biology, Chemistry, and permission of the department

CL BIOLOGY II: CELL BIOLOGY I *(winter)* CL BIOLOGY II: CELL BIOLOGY II *(spring)*

One- or two-term course/juniors and seniors/ winter only or winter and spring

Cells are the smallest living things that can perform the functions of life and understanding how cells work is fundamental to all biological science. In this course, students study cells from the outside in, beginning with an investigation of membranes and transport followed by explorations of how a cell responds to its environment. Particular emphasis is placed on the study of enzymes, eukaryotic organelles, cellular communication, and cell division and cancer. Students spend time in the lab exploring cell culture and visualizing cells using microscopy. Prerequisites: Biology, Chemistry, and permission of the department *Note: The spring term of Cell Biology may only be taken when following the winter term of Cell Biology.*

CL BIOLOGY II: MICROBIOLOGY

fall term/juniors and seniors

Microbiology is the study of the tiniest living things, beings so small they cannot be seen with the naked eye. Yet despite their size, these tiny cells have a massive impact on our world, being responsible for recycling nutrients in ecosystems, causing infectious diseases, providing tools for medicine and research, and serving as models for our understanding of all living things. This course will impart to students an understanding of the structure, function, and societal relevance of bacteria, archaea, and viruses. Students spend the majority of the course in the laboratory, conducting a long-term research project aimed at discovering and characterizing viruses yet unknown to science. By the end of this laboratory-intensive class, students will have gained the skills and experience needed to work safely and professionally in a real microbiology laboratory. Prerequisites: Biology, Chemistry, and permission of the department

CL BIOLOGY II: MOLECULAR BIOLOGY I *(winter)* CL BIOLOGY II: MOLECULAR BIOLOGY II *(spring)*

one or two-term course/juniors and seniors/ winter only or winter and spring

Molecular biology is the study of the critical molecules that allow our cells to function. This two-term course explores the vital roles played by proteins and DNA. The winter term of this laboratory-intensive course focuses on the structure, function, and regulation of proteins. In addition to learning the science of proteins, students will conduct a long-term laboratory project aimed at purifying a recombinant human enzyme from an engineered bacterial host. During this process, they will develop strong laboratory skills and gain experience with a variety of techniques commonly used in industrial and research laboratories. Students will conclude the winter term by designing their own genetically engineered microbes. In the spring term, students will turn their attention to the study of DNA as they build these new genetically engineered microbes, creating organisms with new features and new capabilities. Prerequisites: Biology, Chemistry, and permission of the department *Note: The spring term of Molecular Biology may only be taken when following the winter term of Molecular Biology.*

CL ORGANIC CHEMISTRY I

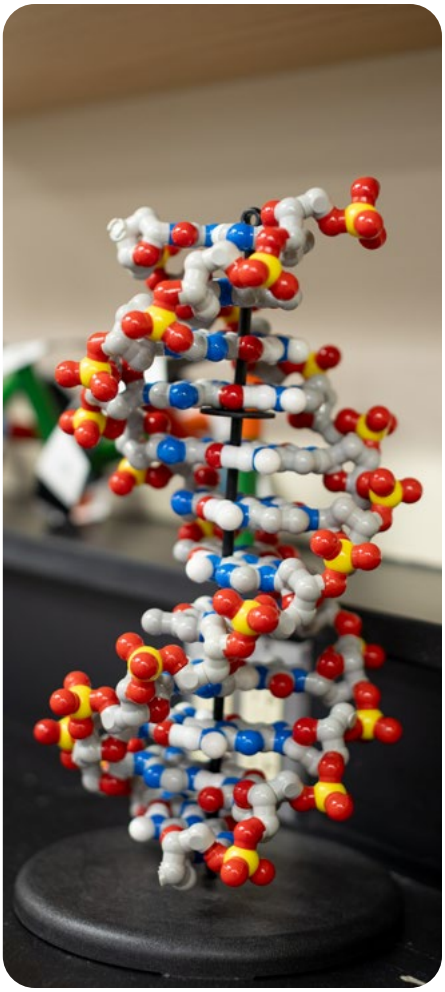
winter term/juniors and seniors

The goal of this course is to give students an introduction to and strong foundation in organic chemistry. Topics covered include chemical structure and bonding, molecular representations, nomenclature, and physical and chemical properties of alkanes, alkenes, alkynes, alkyl halides, alcohols, ketones, and carboxylic acids. This course also introduces students to drawing resonance structures, curved arrows, and reaction mechanisms such as SN1, SN2, E1, and E2. Students will hone their laboratory skills through practical work that involves investigations such as determining the boiling point and melting point of organic substances, extraction of caffeine, simple and fractional distillation, and the classical synthesis of esters. Prerequisites: Chemistry Advanced or CL Chemistry; co-requisite of Physics or permission of the department

CL ORGANIC CHEMISTRY II

spring term/juniors and seniors

This term course is a continuation of the first term of CL Organic Chemistry with an emphasis on instrumental analyses such as infrared (IR) spectroscopy and proton nuclear magnetic resonance (NMR) spectroscopy. More complex organic reactions such as nucleophilic substitution of the carbonyl group, esterification reactions, formation of enols and enolates, multistep synthesis reactions, and retrosynthesis are explored in this second term of organic chemistry. Students conclude the spring term by executing a project in which they come up with a novel way to synthesize an organic molecule of their choice. This class involves significant lab work and use of peer-reviewed scientific journals. Students must take the winter term of Organic Chemistry to be eligible for enrollment in the spring term course. Prerequisite: CL Organic Chemistry I



CL GUIDED RESEARCH PROJECTS IN MOLECULAR BIOLOGY

half course/seniors

Guided Research Projects are yearlong, half courses in the science department that allow students who have completed the graduation requirements for science, and those with an interest in the biological and biomedical sciences, to engage in sustained, significant, mentored scientific research. In this capstone class, students conduct authentic research in molecular biology, and with guidance, design their own research question using an established model system for that experimental work (one that matches the expertise of a Loomis Chaffee science faculty member). Projects involve sustained skill acquisition and the development of rigorous scientific methodology; they also require the student to master experimental techniques that go beyond the traditional science department curriculum. Students maintain a research quality notebook and document their results in either extended lab report or scientific poster format, and they present their research findings to an audience at the end of the school year. Acceptance into the Guided Research Project is a competitive process and interested students are required to complete a written application. Prerequisites: fulfillment of or co-enrollment in CL Biology electives and permission of the department

CL GUIDED RESEARCH PROJECTS IN ENVIRONMENTAL SUSTAINABILITY GESC

half course/seniors

This Guided Research Project is an experiential learning approach to environmental stewardship and sustainability using Loomis Chaffee as a location of study and action. Students learn about all the facets of campus sustainability including waste management, energy conservation, water demands, and agriculture. They then put their learning to work as they design and execute their own sustainability project here on campus. Student projects have included renewable energy generation, food waste reduction, residential weatherproofing, the invention of environmentally friendly cleaning products, environmental justice initiatives, and many others. Prerequisite: Biology, Chemistry; pre/co-requisite CL Environmental Science or Ecology and permission of the department

CL SENIOR WRITING SEMINAR: COMMUNICATING SCIENCE

term course/seniors

At the intersection of observation, experiment, and narrative lies the realm of scientific writing. In this course, students grapple with various forms of scientific communication — from the precise language of technical journals to the relatable prose of popular science. They learn to adapt complex topics for various audiences, craft persuasive arguments rooted in evidence, and communicate clearly through data presentation and visualization. This course is not confined to one scientific discipline but will explore a variety of topics which might include public health, particle physics, astrobiology, or cybernetics. At times, students will choose the scientific topics that most intrigue them for their written pieces. For instance, one student might write an abstract distilling a groundbreaking paper in particle physics, while another pens a persuasive article for the public on the need for increased funding to address mosquito-borne disease. This course not only develops key writing tools for students eyeing a future in scientific research but also opens doors for those writers who wish to bring the magic of science to broader audiences. Prerequisite: permission of the departments

INDEPENDENT STUDIES IN SCIENCE

term course

A student who has completed the two-year laboratory science requirement and who has exhausted the relevant course offerings may propose an Independent Study Project in science. Projects may involve either in-depth research of previously encountered topics or an independent study of material not presently offered. The student must arrange for a project advisor from within the department and **submit a written proposal**. The proposal will be evaluated by the project advisor, academic advisor, department head, and dean of faculty and may be approved if all criteria are met. Prerequisites: fulfillment of departmental requirements and permission of the department