CHEMISTRY

Chemistry is a dynamic, an extremely creative, and yet also a practical discipline. Chemists *analyze* and *quantitate*, like when testing environmental or forensic samples; they *measure* specific characteristics of substances, like the defects present in a material, or the optical properties of atmospheric particles; they *design* and *synthesize* new substances, like antibiotics, catalysts for hydrogen production, and polymers for flexible electronics; they also generate *models* and *theories* that can explain what happens in the laboratory or in Nature. Chemistry is integral to modern science and, ultimately, most phenomena in biology, engineering, environmental science, geology, materials science, and medicine can be described in terms of the chemical and physical behavior of atoms and molecules—because of this, chemistry is often called "The Central Science". Chemists are vital members of the interdisciplinary teams tackling the complicated problems facing our world, including issues in energy, health, security, and defense. Chemists are essential in developing the technologies and materials that support modern life!

The study of chemistry provides students with the critical thinking and problem-solving skills necessary to be successful in a wide variety of careers. You'll find chemists in many industries, including agricultural/food products, biotechnology, coatings, materials, paper, personal care products, petrochemicals, pharmaceuticals, plastics, renewable energy, semiconductors, and solar cells. Chemists are also involved in environmental and health-related sciences, making public policies, patent law and intellectual property, and educating future generations of scientists.

Students are also well-prepared for graduate-level work in chemistry, chemical biology, chemical physics, biochemistry, biophysics, materials chemistry, and other related fields. Students who excel in undergraduate chemistry coursework are often able to obtain funding for their graduate work through teaching or research assistantships and fellowships. Chemistry majors have also been successful in a variety of professional programs where they have studied medicine, pharmacy, dentistry, veterinary medicine, business, or law.

The chemistry program at The University of New Hampshire is small enough to be personal, but broad enough to provide excellent opportunities for challenge and growth. Students interested in pursuing chemistry as an undergraduate degree have three options available to them. These are the Bachelor of Science in Chemistry (B.S.) degree, Bachelor of Science in Chemistry: Chemical Biology option (B.S.) degree, and a Bachelor of Arts (B.A.) degree. The B.S. degrees are certified by the American Chemical Society; the B.A. degree may also lead to ACS certification, depending on program plan. Since the required courses for each degree program are very similar in the first and second years, it is easy to change from one program to another. A chemistry faculty advisor is assigned to a student once they enter the program. The student's advisor provides academic guidance concerning the choice of courses to meet both major and university requirements.

https://ceps.unh.edu/chemistry

Programs

- Chemistry Major (B.A.)
- Chemistry Major (B.S.)
- Chemistry Major: Chemical Biology Option (B.S.)
- Chemistry Minor

Courses

Chemistry (CHEM)

CHEM 400 - Freshman Seminar
Credits: 1
An introduction to the chemistry profession. Talks and workshops on the career of a chemist in academia, industry, medicine, law, teaching and government. Required for chemistry majors.
Repeat Rule: May be repeated for a maximum of 2 credits.
Grade Mode: Credit/Fail Grading

CHEM 403 - General Chemistry I
Credits: 0 or 4
Fundamental laws and concepts applied to nonmetals, metals, and their compounds. For students who plan to take further chemistry courses. Previous chemistry recommended. Knowledge of algebra, exponentials, and logarithms required. Lab. Cannot be taken for credit if credit received for CHEM 405. Required for chemistry majors.
Attributes: Discovery Lab Course; Physical Science(Discovery)
Equivalent(s): CHEM 405
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 404 - General Chemistry II
Credits: 0 or 4
Fundamental laws and concepts applied to nonmetals, metals, and their compounds. For students who plan to take further chemistry courses. Previous chemistry recommended. Knowledge of algebra, exponentials, and logarithms required. Required for chemistry majors. Lab.
Attributes: Discovery Lab Course; Physical Science(Discovery)
Prerequisite(s): CHEM 403 with a minimum grade of D-.
Equivalent(s): CHEM 404H, CHEM 405, CHEM 415, CHEM 416
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 404H - Honors/General Chemistry II
Credits: 0 or 4
Fundamental laws and concepts applied to nonmetals, metals, and their compounds. For students who plan to take further chemistry courses. Previous chemistry recommended. Knowledge of algebra, exponentials, and logarithms required. Required for chemistry majors. Lab. Honors course is designed for students who have enrolled in the honors degree program. Lab. Cannot be taken for credit if credit received for CHEM 402.
Attributes: Discovery Lab Course; Honors course; Physical Science(Discovery)
Prerequisite(s): CHEM 403 with a minimum grade of D-.
Equivalent(s): CHEM 404, CHEM 405, CHEM 415, CHEM 416
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 405 - Chemical Principles for Engineers
Credits: 0 or 4
Basic principles; atomic structure, bonding, equilibria, and thermodynamics. One year of high school chemistry, algebra, and knowledge of logarithms. Cannot be taken for credit if credit received for CHEM 403 and CHEM 404. Required for chemical engineering, mechanical engineering, electrical and computer engineering, environmental engineering: industrial majors. Not applicable for credit for majors in chemistry or biochemistry.
Attributes: Discovery Lab Course; Physical Science(Discovery)
Equivalent(s): CHEM 403, CHEM 404, CHEM 404H, CHEM 413, CHEM 414
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 408 - Green Goggles: Introduction to Green Chemistry
Credits: 4
In this course, we investigate the principles and practice of Green Chemistry as they connect to real world examples. Green Chemistry is the field of science that uses a principle-based approach to design chemical reactions and processes to make them more sustainable. In exploring green chemistry, many of the fundamental concepts of a general chemistry course are investigated. Some topics include use of renewable feedstocks, atom economy, catalysis, waste prevention, and design for degradation.
Attributes: Physical Science(Discovery)
Equivalent(s): CHEM 444G
Grade Mode: Letter Grading

CHEM 409 - Chemistry and Society
Credits: 4
Elementary survey of chemistry; integrates principles and applications. For students who do not intend to take any other chemistry courses and those interested in satisfying a general education science requirement. Not a prerequisite for any other chemistry courses. (Not offered every year.) Chemistry majors are excluded from taking this course.
Attributes: Physical Science(Discovery); Inquiry (Discovery)
Grade Mode: Letter Grading

CHEM 411 - Introductory Chemistry for Life Sciences
Credits: 0 or 4
Fundamental and pragmatic aspects of chemistry, particularly as foundation for nutritional biochemistry. Includes basics of bonding, acid/base behavior, reaction energy, intermolecular forces, stoichiometry, and equilibrium. High school chemistry not required. This course is not a replacement to CHEM 403 and is not an acceptable pre-requisite for CHEM 404.
Attributes: Discovery Lab Course; Physical Science(Discovery)
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 413 - General Chemistry Lecture I
Credits: 3
Fundamental laws and concepts applied to nonmetals, metals, and their compounds. For students who plan to take further chemistry courses. Previous chemistry recommended. Knowledge of algebra, exponentials, and logarithms required. Not offered every summer. Cannot be taken for credit if credit received for CHEM 401, CHEM 403, CHEM 405, or CHEM 409.
Equivalent(s): CHEM 403, CHEM 405
Grade Mode: Letter Grading

CHEM 415 - General Chemistry Lecture II
Credits: 3
Fundamental laws and concepts applied to nonmetals, metals, and their compounds. For students who plan to take further chemistry courses. Previous chemistry recommended. Knowledge of algebra, exponentials, and logarithms required. Cannot be taken for credit if credit received for CHEM 402 or CHEM 404.
Prerequisite(s): (CHEM 403 with a minimum grade of D- or CHEM 413 with a minimum grade of D-).
Equivalent(s): CHEM 404, CHEM 404H
Grade Mode: Letter Grading

CHEM 416 - General Chemistry Lab II
Credits: 1
Lab application of fundamental laws and concepts applied to nonmetals, metals and their compounds. Previous general chemistry lecture required. Special permission. Not offered every summer. Cannot be taken for credit if credit received for CHEM 402 or CHEM 404. Not open to Chemistry majors.
Prerequisite(s): (CHEM 403 with a minimum grade of D- or CHEM 414 with a minimum grade of D-).
Equivalent(s): CHEM 404, CHEM 404H
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 501 - Peer-led Team Learning in Chemistry
Credits: 2
Initial experience as peer instructional leader. Practical application of theories of cognition, group dynamics, learning, and motivation to helping other students learn chemistry in general chemistry. Requires one weekly meeting with students.
Prerequisite(s): (CHEM 403 with a minimum grade of D- or CHEM 404 with a minimum grade of D- or CHEM 404H with a minimum grade of D-).
Grade Mode: Letter Grading

CHEM 502 - Advanced Peer-led Team Leadership in Chemistry
Credits: 1
Development and assessment of leadership skills. Practical application of theories of cognition, group dynamics, learning, and motivation to helping other students learn chemistry in general chemistry. Requires one weekly meeting with students.
Prerequisite(s): CHEM 501 with a minimum grade of D- or INCO 501 with a minimum grade of D-.
Grade Mode: Letter Grading

CHEM 503 - Mentoring for Peer Team Learning
Credits: 1
Experienced leaders mentor a new leader in implementation of PLTL model, including initial co-leading and observational formative assessment. Mentors report on mentee development, visit other experienced leaders, and provide a final evaluation. Mentors lead their own weekly group and assist part-time in the PLTL leader meetings.
Prerequisite(s): CHEM 501 with a minimum grade of D-.
Grade Mode: Letter Grading

CHEM 517 - Introduction to Chemical Measurement Science
Credits: 3
Application of chemical principles, particularly equilibrium, to quantitative measurement of chemical substances. Measurement design and control, accuracy and precision, calibration of instruments, sample representativeness and integrity.
Prerequisite(s): (CHEM 404 with a minimum grade of D- or CHEM 405 with a minimum grade of D-).
Grade Mode: Letter Grading

CHEM 518 - Practical Chemical Measurement Techniques and Instrumentation
Credits: 2
Development of practical skills for quantitative measurement of chemical substances, proper use of laboratory tools and instruments. Introduction to analytical separations, ion-selective electrodes, spectrophotometry.
Co-requisite: CHEM 517
Prerequisite(s): (CHEM 404 with a minimum grade of D- or CHEM 405 with a minimum grade of D-).
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 545 - Organic Chemistry
Credits: 3
Introductory study of carbon compounds for those who desire a brief terminal course. This course is a one semester course only. CHEM 545 and 546 are not applicable for pre-med, pre-vet, pharmacological majors or minors requiring a year long course of organic. CHEM 545 and CHEM 546 cannot be used to meet semester 1 of the year long-organic course (CHEM 547 or CHEM 651). CHEM 545 and CHEM 546L are co-requisites and must be taken together.
Co-requisite: CHEM 546
Prerequisite(s): (CHEM 404 with a minimum grade of D- or CHEM 404H with a minimum grade of D- or CHEM 405 with a minimum grade of D-).
Grade Mode: Letter Grading

CHEM 546 - Organic Chemistry Laboratory
Credits: 2
Introductory study of carbon compounds for those who desire a brief terminal course. Lab.
Co-requisite: CHEM 545
Prerequisite(s): (CHEM 404 with a minimum grade of D- or CHEM 404H with a minimum grade of D- or CHEM 405 with a minimum grade of D-).
Grade Mode: Letter Grading

CHEM 547 - Organic Chemistry I
Credits: 3
Principal classes of organic compounds, aliphatic and aromatic; class reactions and structural theory. Intended primarily for chemistry and biochemistry majors. Students receiving credit for CHEM 547-548 may not receive credit for either CHEM 545 or CHEM 651 and CHEM 652.
Co-requisite: CHEM 549
Prerequisite(s): (CHEM 404 with a minimum grade of D- or CHEM 404H with a minimum grade of D- or CHEM 405 with a minimum grade of D-).
Equivalent(s): CHEM 651
Grade Mode: Letter Grading

CHEM 548 - Organic Chemistry II
Credits: 3
Principal classes of organic compounds, aliphatic and aromatic; class reactions and structural theory. Intended primarily for chemistry and biochemistry majors. Students receiving credit for CHEM 547 and CHEM 548 may not receive credit for either CHEM 545 or CHEM 651 and CHEM 652. Only listed majors allowed: Chemistry (BS), Chemistry (BA), Bchmmolcebio, and Biochemistry.
Co-requisite: CHEM 550
Prerequisite(s): (CHEM 404 with a minimum grade of D- or CHEM 404H with a minimum grade of D- or CHEM 405 with a minimum grade of D-) and CHEM 547 with a minimum grade of D-.
Equivalent(s): CHEM 652
Grade Mode: Letter Grading

CHEM 549 - Organic Chemistry Laboratory
Credits: 2
Lab.
Co-requisite: CHEM 547
Equivalent(s): CHEM 546, CHEM 653
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 550 - Organic Chemistry Laboratory
Credits: 2
Organic Chemistry Laboratory.
Co-requisite: CHEM 548
Equivalent(s): CHEM 654
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 574 - Chemistry Across the Periodic Table
Credits: 4
Ninety-eight elements form the building blocks of every substance on Earth-they are elegantly organized into what we now call The Periodic Table. This course will discuss the structure/property/reactivity patterns inherent in The Periodic Table, their origins according to the quantum mechanical model of the atom, and how they are manifest in current research advancements and modern applications of main group element chemistry, transition metal chemistry, and the chemistry of solids and materials.
Attributes: Inquiry (Discovery)
Prerequisite(s): (CHEM 404 with a minimum grade of D- or CHEM 404H with a minimum grade of D- or CHEM 405 with a minimum grade of D-).
Grade Mode: Letter Grading

CHEM 576 - Experimental Inorganic Chemistry
Credits: 2
This laboratory course is an introduction to synthetic methods in inorganic chemistry and the study of the elements across the periodic table. This course will emphasize the use of spectroscopic and analytical techniques specifically aimed at characterizing and identifying inorganic compounds, such as multi-nuclear NMR, UV\Vis, IR spectroscopy, X-ray diffraction and mass spectrometry. An introduction to scientific writing will be included.
Prerequisite(s): CHEM 574 (may be taken concurrently) with a minimum grade of D-.
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 651 - Organic Chemistry I
Credits: 3
Principal classes of organic compounds, aliphatic and aromatic, class reactions and structural theory. Intended primarily for pre-healing arts, biological science, and health science students. Students receiving credit for CHEM 651 and CHEM 652 may not receive credit for either CHEM 545 or CHEM 547 and CHEM 548.
Co-requisite: CHEM 653
Prerequisite(s): (CHEM 404 with a minimum grade of D- or CHEM 404H with a minimum grade of D- or CHEM 405 with a minimum grade of D-).
Equivalent(s): CHEM 547
Grade Mode: Letter Grading

CHEM 652 - Organic Chemistry II
Credits: 3
Principal classes of organic compounds, aliphatic and aromatic, class reactions and structural theory. Intended primarily for pre-healing arts, biological science, and health science students.
Co-requisite: CHEM 654
Prerequisite(s): CHEM 651 with a minimum grade of D- and CHEM 653 with a minimum grade of D-.
Equivalent(s): CHEM 548
Grade Mode: Letter Grading

CHEM 652A - Organic Chemistry II
Credits: 3
Principal classes of organic compounds, aliphatic and aromatic, class reactions, and structural theory. Intended primarily for pre-healing arts, biological science, and health science students. Students receiving credit for CHEM 651 and CHEM 652 may not receive credit for either CHEM 545 or CHEM 547 and CHEM 548. This course is for Chemical Engineers only.
Prerequisite(s): CHEM 651 with a minimum grade of D- and CHEM 653 with a minimum grade of D-.
Grade Mode: Letter Grading

CHEM 653 - Organic Chemistry Laboratory
Credits: 2
Lab.
Co-requisite: CHEM 651
Equivalent(s): CHEM 546, CHEM 549
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 654 - Organic Chemistry Laboratory
Credits: 2
Organic Chemistry Laboratory.
Co-requisite: CHEM 652
Equivalent(s): CHEM 550
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 683 - Physical Chemistry I
Credits: 3
Topics may be chosen from: properties of gases, liquids, and solids; thermochemistry, and thermodynamics; chemical equilibria; reaction rates; quantum chemistry and spectroscopy.
Co-requisite: CHEM 685
Prerequisite(s): (CHEM 404 with a minimum grade of D- or CHEM 404H with a minimum grade of D- or CHEM 405 with a minimum grade of D-) and (MATH 426 with a minimum grade of D- or MATH 426H with a minimum grade of D-) and (PHYS 402 (may be taken concurrently) with a minimum grade of D- or PHYS 407 (may be taken concurrently) with a minimum grade of D- or PHYS 407H (may be taken concurrently) with a minimum grade of D- or PHYS 407S (may be taken concurrently) with a minimum grade of D-).
Grade Mode: Letter Grading

CHEM 684 - Physical Chemistry II
Credits: 3
Topics may be chosen from: properties of gases, liquids, and solids; thermochemistry, and thermodynamics; chemical equilibria; reaction rates; quantum chemistry and spectroscopy.
Co-requisite: CHEM 686
Prerequisite(s): CHEM 683 with a minimum grade of D- and (MATH 426 with a minimum grade of D- or MATH 426H with a minimum grade of D-).
Grade Mode: Letter Grading

CHEM 685 - Physical Chemistry Laboratory
Credits: 2
Measurement of thermodynamic properties, chemical kinetics, and methods of determining the structure of matter.
Co-requisite: CHEM 683
Prerequisite(s): (CHEM 404 with a minimum grade of D- or CHEM 404H with a minimum grade of D- or CHEM 405 with a minimum grade of D-) and (MATH 426 with a minimum grade of D- or MATH 426H with a minimum grade of D-) and (PHYS 407 (may be taken concurrently) with a minimum grade of D- or PHYS 407H (may be taken concurrently) with a minimum grade of D- or PHYS 402 (may be taken concurrently) with a minimum grade of D- or PHYS 407S (may be taken concurrently) with a minimum grade of D-).
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 686 - Physical Chemistry Laboratory
Credits: 2
Measurement of thermodynamic properties, chemical kinetics, and methods of determining the structure of matter.
Co-requisite: CHEM 684
Prerequisite(s): CHEM 683 with a minimum grade of D- and CHEM 685 with a minimum grade of D- and (PHYS 407 (may be taken concurrently) with a minimum grade of D- or PHYS 407H (may be taken concurrently) with a minimum grade of D- or PHYS 402 (may be taken concurrently) with a minimum grade of D- or PHYS 407S (may be taken concurrently) with a minimum grade of D-).
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 696 - Independent Study
Credits: 1-4
For exceptional students. Individual reading, writing, or laboratory work carried out under the tutelage of a faculty member. May be used to replace specific required courses in chemistry.
Prerequisite(s): (CHEM 404 with a minimum grade of D- or CHEM 404H with a minimum grade of D- or CHEM 405 with a minimum grade of D-).
Grade Mode: Letter Grading

CHEM 708 - Spectroscopic Investigations of Organic Molecules
Credits: 3
Identification and structural analysis of chemical compounds by selected instrumental methods. Typical topics include proton and carbon-13 NMR spectroscopy, IR and UV spectroscopy, and mass spectrometry.
Grade Mode: Letter Grading

CHEM 740 - Chemical Biology
Credits: 3
How does the COVID vaccine work? What is an antibody conjugate? What is bioconjugation? How do we see mRNA in living cells? How do we evolve enzymes? Chemical Biology is the interdisciplinary study of the chemicals and chemical reactions involved to probe, manipulate, and control biological systems in vitro and in vivo. This course is designed for biologists, chemists, and engineers who want to understand cutting edge and relevant research techniques used in modern medicine.
Attributes: Biological Science(Discovery)
Prerequisite(s): (CHEM 547 with a minimum grade of D- and CHEM 548 with a minimum grade of D-) or (CHEM 651 with a minimum grade of D- and CHEM 652 with a minimum grade of D-).
Grade Mode: Letter Grading

CHEM 741 - Chemical Biology Laboratory
Credits: 4
In this course we will perform 3 month-long experiments that will demonstrate the three major pillars of chemical biology: Perceive, profile, and perturb. This will demonstrate how chemical entities can be used to further understand biological systems and organisms.
Prerequisite(s): CHEM 740 with a minimum grade of D-.
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 755 - Advanced Organic Chemistry
Credits: 3
Methods of synthesis and determination of structure, including stereochemistry of complex organic compounds.
Prerequisite(s): (CHEM 548 with a minimum grade of D- or CHEM 652 with a minimum grade of D-).
Grade Mode: Letter Grading

CHEM 762 - Advanced Chemical Analysis Instrumentation
Credits: 3
Theory, instrumentation, and application of methods to qualitative identification and quantitative measurement of trace chemical substances including environmental pollutants. Includes methods of such as atomic spectroscopy, gas and liquid chromatography, IR and UV-VIS spectrophotometry, electrochemistry, fluorescence, mass spectrometry, X-ray techniques.
Co-requisite: CHEM 763
Prerequisite(s): CHEM 517 with a minimum grade of D- and CHEM 518 with a minimum grade of D-.
Grade Mode: Letter Grading

CHEM 763 - Advanced Chemical Instrumentation Laboratory
Credits: 2 or 3
Hands-on experience with modern instrumentation for trace chemical analysis described in CHEM 762. Performance capabilities and limitations, care, and safety.
Co-requisite: CHEM 762
Prerequisite(s): CHEM 518 with a minimum grade of D-.
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 774 - Inorganic Chemistry
Credits: 3
Basic theoretical concepts and their applications to inorganic reactions and compounds.
Prerequisite(s): (CHEM 548 with a minimum grade of D- or CHEM 652 with a minimum grade of D-).
Grade Mode: Letter Grading

CHEM 776 - Physical Chemistry III
Credits: 3
Application of quantum theory to atomic electron structure, molecular structure, and spectroscopy. Advanced topics in physical chemistry.
Prerequisite(s): CHEM 684 with a minimum grade of D-.
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 777 - Advanced Synthesis and Characterization
Credits: 0 or 3
This is an advanced laboratory course involving the synthesis and characterization of organic and inorganic compounds. Students will leave this course with sufficient proficiency to reproduce synthetic procedures and prepare compounds from the chemical literature.
Prerequisite(s): CHEM 550 with a minimum grade of D- and CHEM 576 with a minimum grade of D-.
Grade Mode: Letter Grading
Special Fee: Yes

CHEM 795 - Special Topics
Credits: 2-4
New or specialized topics not covered in regular course offerings.
Repeat Rule: May be repeated for a maximum of 4 credits.
Grade Mode: Letter Grading

CHEM 798 - Senior Seminar
Credits: 1
Student reports on topics of interest.
Attributes: Writing Intensive Course
Prerequisite(s): (CHEM 548 with a minimum grade of D- or CHEM 652 with a minimum grade of D-) and CHEM 684 with a minimum grade of D-.
Equivalent(s): CHEM 698
Grade Mode: Credit/Fail Grading

CHEM 799 - Senior Thesis
Credits: 4
Yearlong investigation in a selected topic, with background and experimental investigation. For chemistry majors who have completed CHEM 548, CHEM 694, and CHEM 762. Required for B.S. majors. Strongly recommended for B.A. chemistry majors. 2.50 average and approval of department chairperson. Lab. Two semesters of 4 credits each are required.
Attributes: Writing Intensive Course
Prerequisite(s): CHEM 548 with a minimum grade of D- and CHEM 684 with a minimum grade of D-.
Repeat Rule: May be repeated up to 1 time.
Equivalent(s): CHEM 699
Grade Mode: Letter Grading

Faculty

Chemistry Department Faculty