CHEMISTRY AND BIOCHEMISTRY

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The Chemistry and Biochemistry Department at Creighton University is certified by the American Chemical Society (ACS) and offers four majors: an ACS-certified major (B.S.Chm.) with tracks in Chemistry or Biochemistry, comprehensive majors (B.S.) in Chemistry and Biochemistry and an Applied Chemistry major (B.S.) suitable for students interested in pursuing the 3-2 engineering program.

Requirements for Admission to the Chemistry major

Satisfactory completion of two lecture courses within the Creighton Chemistry and Biochemistry department and completion of MTH 245 Calculus I with a grade of C or better. MTH 246 Calculus II and General Physics I PHY 201 General Physics for the Life Sciences or PHY 213 General Physics for the Physical Sciences I or PHY 221 Advanced General Physics I:Modeling the Physical World) are prerequisites for CHM 341 Physical Chemistry I; General Physics II PHY 202 General Physics for the Life Sciences II or PHY 214 General Physics for the Life II or PHY 222 Advanced General Physics II:Modeling the Physical World) is prerequisite or co-requisite for CHM 341 Physical Chemistry I.

Bachelor of Science (B.S.) majors

- B.S., Chemistry (http://catalog.creighton.edu/undergraduate/arts-sciences/chemistry/chemistry-generalist-bs/)
- B.S., Biochemistry (http://catalog.creighton.edu/undergraduate/arts-sciences/chemistry/biochemistry-track-bs/)
- B.S., Applied Chemistry (http://catalog.creighton.edu/undergraduate/arts-sciences/chemistry/applied-chemistry-bs/)

Bachelor of Science in Chemistry (B.S.Chm.) majors

- B.S.Chm., Chemistry Track (American Chemical Society certified) (http://catalog.creighton.edu/undergraduate/arts-sciences/chemistry/chemistry-bschm/)
- B.S.Chm., Biochemistry Track (American Chemical Society certified) (http://catalog.creighton.edu/undergraduate/arts-sciences/chemistry/biochemistry-bschm/)

Courses

CHM 105. Introductory Chemistry. 3 credits. FA
A one-semester introduction to the theories and problem-solving skills foundational to the science of chemistry. Topics critical to the general chemistry sequence are introduced at a more manageable pace, and with more background. Topics include the scientific method, measurements, calculations, stoichiometry, matter, energy, the periodic table, atomic theory, chemical nomenclature, ionic and covalent bonding, chemical reactions, and thermodynamics. Recommended as an entry-level course for those who lack significant preparation in chemistry and/or mathematics.

CHM 111. Fundamentals of General Chemistry. 3 credits. FA
A one-semester survey of general chemistry for nursing students. Topics covered include electronic structure and periodicity, molecular structure, chemical reactions, states of matter, acid-base chemistry, and nuclear chemistry. P. Registration in Nursing Program or IC.

CHM 112. Fundamentals Of Biological Chemistry. 3 credits. SP
Survey of organic and biological chemistry for nursing students. Includes the study of organic functional groups and reactivity, plus the chemistry of biomolecules such as proteins, carbohydrates, lipids, and nucleic acids. P. CHM 111 or equivalent with a grade of "C" or better and Registration in Nursing Program or Instructor Consent; CO: CHM 113.

CHM 113. Fundamentals Of Chemistry Laboratory. 1 credit. SP
Laboratory course to be taken in conjunction with CHM 112 which demonstrates basic chemical tools and illustrates basic chemical principles. P. CHM 111 or equivalent with a grade of "C" or better and Registration in Nursing Program; CO: CHM 112.

CHM 201. Chemistry of Consumer Products. 3 credits.
Course in chemistry of consumer products. Topics include basic concepts of chemistry, molecular structure and chemical properties as related to consumer products including foods, paints, cleaning products, lawn and garden products, preservatives, petroleum products, plastics and materials and cosmetics.

CHM 203. General Chemistry I. 3 credits. FA, SU
Course in introductory chemistry which includes basic concepts: atomic structure, the mole, stoichiometry, gas laws, bonding theories, molecular structure and properties, thermochemistry, and some common reactions. This is the first half of a two semester sequence. P. Sophomore standing or Satisfactory completion of the QANS Placement Exam or a 'C' or better in CHM 105. CO: CHM 204.

CHM 204. General Chemistry I Laboratory. 1 credit. FA, SU
Laboratory portion of Chemistry 203. Experiments relevant to the content of CHM 203 are performed. CO: CHM 203.

CHM 205. General Chemistry II. 3 credits. SP, SU
Continuation of CHM 203. Concepts and theories covered include thermodynamics, kinetics, chemical equilibria, and applications of equilibrium theory to solubility, acids and bases, oxidation-reduction, and coordination chemistry. P. CHM 203 with a grade of "C" or better. CO: CHM 206.

CHM 206. General Chemistry II Laboratory. 1 credit. SP, SU
Laboratory portion of Chemistry 205. Experiments relevant to the content of CHM 205 are performed. P. CHM 203 and CHM 204 with grades of "C" or better; CO: CHM 205.

CHM 285. Advanced General Chemistry II. 3 credits. SP
A second-semester general chemistry course designed for potential chemistry majors and for those students interested in the health sciences who want an advanced treatment of general chemistry topics. The course will focus on kinetics, thermodynamics, and expressions of solution equilibria with applications to quantitative chemical analysis. The approach will be from a conceptual understanding of solution chemistry leading into a quantitative treatment of solution phenomena. P. CHM 203 with a grade of "B" or better. CO: CHM 286.

CHM 286. Chemical and Statistical Analysis Laboratory. 2 credits. SP
A laboratory-based course covering the theories and methods used in classical chemical analysis. Topics include statistical methods for evaluating and interpreting data, theory of chemical analysis and sources of error, and experiments based upon the principles of stoichiometry and equilibrium as applied to titration, precipitation, electrochemistry, and spectroscopy. P. CHM 203, grade of B or better in CHM 204; Magis Mathematical Reasoning course. CO: CHM 285.

CHM 297. Directed Research. 0-2 credits. FA, SP, SU
Participation in a research project under the direction of a member of the faculty. This course can be repeated for a maximum of 3 credits. P. IC.

CHM 315. Quantitative and Statistical Analysis. 4 credits. SP
An integrated lecture and laboratory course that presents the theories and chemical methods for solving a variety of real problems in chemical analysis. Topics covered include: statistical methods for evaluating and interpreting data, sources of error in chemical analysis, principles of stoichiometry and equilibrium as applied to precipitation, acid-base, complexometric, electrochemical, and spectroscopic analysis. Three hours of lecture and three hours of laboratory per week. P. CHM 205; CHM 206; Mathematical Reasoning course.

CHM 321. Organic Chemistry I. 3 credits. FA, SU
Study of the structure and properties of organic compounds, as exemplified by alkenes, alkynes, alcohols, and alkyl halides. Stereochemistry, molecular structure, principles of reaction theory, and reaction mechanisms. P. CHM 205 or CHM 285 with a grade of "C" or better. CO: CHM 322.

CHM 322. Organic Chemistry I Laboratory. 1 credit. FA, SU
Fundamental techniques of experimental organic chemistry. Isolation, purification, and organic synthetic methods. P. CHM 205 and CHM 206 or CHM 285 and CHM 286 with grades of "C" or better; CO: CHM 321.

CHM 323. Organic Chemistry II. 3 credits. SP, SU
Continuation of Chemistry 321. Further study of the principles of organic structure and reaction theory, including delocalized systems. Exploration of the chemistry of aromatic compounds, carbonyl compounds, and others, with additional emphasis on organic synthesis and structural analysis by spectroscopic methods. P. CHM 321 with a grade of "C" or better. CO: CHM 324.

CHM 324. Organic Chemistry II Laboratory. 1 credit. SP, SU
Further study of practical organic reactions, the use of spectroscopic methods (NMR and IR) to elucidate and confirm organic structures, and multistep organic synthesis. P. CHM 321 and CHM 322 with grades of "C" or better; CO: CHM 323.

CHM 331. Concepts of Physical Chemistry. 3 credits.
A one-semester survey of physical chemistry. Topics include thermodynamics, equilibrium, kinetics, quantum theory, and spectroscopy. An emphasis will be placed on application with examples taken from chemical and biochemical systems. This course is for students in the Biochemistry (B.S.) major only. All other students should take CHM 341. This course does not fulfill the requirement for the B.S.Chm. degree. P. MTH 246 and PHY 201 or PHY 213 or PHY 221. P or CO: PHY 202 or PHY 214 or PHY 222.

CHM 341. Physical Chemistry I. 3 credits. FA
An introduction to thermodynamics including equations of state, the first and second laws of thermodynamics, heat capacity, enthalpy, adiabatic processes, entropy, and Gibbs free energy. An introduction to kinetics including the Maxwell-Boltzmann distribution, collision frequency, mean free path, reaction rates, collision density, elementary reactions, and approximate rate laws. The additional mathematics required to understand these topics will also be covered. P. MTH 246 or MTH 249 and PHY 201 or PHY 213 or PHY 221. P or CO: PHY 202 or PHY 214 or PHY 222.

CHM 342. Physical Chemistry Laboratory. 2 credits. SP
Experiments explore topics from chemical thermodynamics, equilibrium, kinetics, quantum mechanics, spectroscopy, and statistical mechanics. Experimental results are analyzed and reported in a format appropriate for publication in a peer reviewed physical chemistry journal. CO: CHM 343. P. One Magis Core Contemporary Composition course.

CHM 343. Physical Chemistry II. 3 credits. SP
An introduction to chemical applications of quantum mechanics including the particle-in-a-box, the harmonic oscillator, the rigid rotor, the hydrogen atom, and approximate methods for atoms and molecules. An introduction to spectroscopy including selection rules, rotational, vibrational, rovibrational, and electronic spectra, and lasers. The additional mathematics required will also be covered. P. CHM 341; CO: CHM 342.

CHM 351. Descriptive Inorganic Chemistry. 2 credits. OD
A systematic study of the main-group elements with an emphasis on chemical reactions, properties, and processes important to the natural world. Lecture topics will be integrated with laboratory experiments to provide a broad introduction to descriptive inorganic chemistry and its key concepts. P. CHM 205 and CHM 206 or CHM 285 and CHM 286.

CHM 371. Biochemistry of Metabolism. 3 credits. FA, SP
A one-semester survey of biochemistry. Topics covered include structure and function of biomolecules, metabolism and bioenergetics. An emphasis will be placed on biomedical examples. Does not fulfill the requirements for the B.S.Chm.:Biochemistry Track. P. Junior standing and C or better in CHM 323 and BIO 202; OR Junior standing and a B or better in both CHM 321 and BIO 362 (or both CHM 321 and BIO 317), with CHM 323 being corequisite.

CHM 382. Biochemistry Laboratory. 2 credits. FA, SP
Introduction to several important biochemical and biophysical measurements and methods including strategies for analyzing biologically-important compounds, assaying biological activity, and purifying nucleic acids. P or CO: CHM 371 or CHM 383 or Instructor consent; open to all majors/tracks within the Chemistry department or Instructor consent.

CHM 383. Biochemistry I. 3 credits. FA
Structure and function of the major classes of biomolecules including proteins, nucleic acids, lipids, and carbohydrates. Enzymatic reaction mechanisms and kinetics will also be studied. P. CHM 323 with a grade of C or better. Note: this course is only open to students accepted to any track/major of the Chemistry Department or by Instructor Consent; it is the first in a two-course sequence and by itself does not constitute sufficient preparation for the MCAT, PCAT, or other professional school exams.

CHM 384. Biochemistry II. 3 credits. SP
An overview of biological membranes and transport, as well as biosignaling. Metabolic processes and energy utilization of carbohydrates, lipids, nucleic acids and proteins will be emphasized. P. CHM 383 with a grade of C or better; open to all tracks/majors of the Chemistry Department or Instructor consent.

CHM 392. Forensic Chemistry. 3 credits.
A one semester laboratory course designed to investigate topics in forensic biochemistry, this class will focus on the processing techniques for: biological, chemical, drug, hair, and other evidentiary items found in crime scenes; as well as the instruments used in processing; FTIR, GCMS, and Bioanalyzer. P. CHM 371 or 381 or instructor permission; Oral Communication course; Contemporary Composition course; Ethics course.

CHM 421. Selected Topics In Organic Chemistry. 3 credits. OD
Study of classes of compounds and reactions of organic chemistry not covered in the regular two-semester sequence (CHM 321, 323). Possible topics include stereochemistry, natural products, computational methods in organic chemistry, physical organic chemistry, photochemistry and other topics of current interest. P. CHM 323.

CHM 445. Chemical Thermodynamics. 2 credits. OD
This course will provide a more extensive introduction to classical thermodynamic theory, including treatments of the laws of thermodynamics, conditions of equilibrium, thermodynamics of gases and solutions, and ideal and non-ideal behavior. P. CHM 343.

CHM 446. Statistical Mechanics. 2 credits. OD
The mathematical study of the connection between quantum mechanical behavior of individual atoms and molecules and their consequent macroscopic properties and phenomena. P. CHM 343.

CHM 448. Group Theory. 2 credits. OD
This course will present an introduction to the theory of group representations. Topics will include the mathematical foundations of abstract group theory, including reducible and irreducible representations. Physical applications of group theory will include crystallographic point groups, group theoretical techniques in quantum mechanics, angular momentum, and vibrational spectroscopy. P. CHM 343.

CHM 451. Inorganic Chemistry I. 3 credits. FA
Relation of atomic and molecular structure to chemical and physical properties. Periodicity and descriptive chemistry of inorganic classes and groups. Topics covered include group theory, MO theory, molecular and ionic structures, redox reactions, acid/base theories, and coordination compounds. P. CHM 343.

CHM 456. Instrumental Analysis. 3 credits. FA
A senior level course on instrumental techniques used in analytical chemistry. Emphasis will be on modern instrumentation theory and applications in spectroscopy, electrochemistry, and chromatography. P. CHM 331 or CHM 343; CO: CHM 466.

CHM 466. Instrumental Analysis Laboratory. 2 credits. FA
A laboratory-based course covering the theories and methods used in modern instrumental analysis. Topics include the theory and practice of instrumental techniques, statistical methods for evaluating and interpreting data, sources of noise and error, and experimental methods in spectroscopy, electrochemistry, and chromatography. One hour of recitation and three hours of laboratory per week. P. CHM 286 or CHM 315; CO: CHM 456.

CHM 492. Industrial Internship. 1-3 credits. FA, SP
Each student will spend one day per week or its equivalent in an industrial plant or laboratory. Registration must be preceded by the student submitting a resume, a letter of application, and arranging for a personal interview with one or more industrial concerns prior to the registration date. Each student must be accepted by or have worked for an industrial employer prior to registration. P. CHM 315 or CHM 285, and CHM 286.

CHM 493. Directed Independent Readings. 0-3 credits. FA, SP, SU
Assigned reading in a special area of interest. The course is repeatable for a max of 6 credits.

CHM 495. Directed Independent Study. 1-3 credits. FA, SP, SU

CHM 496. Directed Independent Research I. 0-3 credits. FA, SP, SU
Participation in a pre-approved independent research project under the direction of a member of the department faculty. The course is repeatable for a max of 8 credits. P. CHM 323 and CHM 324 or CHM 285 and CHM 286; IC; Ethics course.

CHM 497. Directed Independent Research II. 0-2 credits. FA, SP, SU
Final participation in a pre-approved independent research project under the direction of a member of the department faculty. Students register for this course in their final semester of research. They are required to give a public presentation of their work and submit a research report. Research projects in chemistry conducted outside the department may also be acceptable. The course is repeatable for a max of 2 credits. P. CHM 324 or CHM 285, CHM 286; IC; Oral Communication course.

CHM 498. Directed Independent Research - Special. 0-2 credits.
Participation in a pre-approved independent research project conducted outside the Creighton University Chemistry Department. The course is repeatable for a max of 6 credits. P. CHM 324 or CHM 285; CHM 286; IC.

CHM 499. Chemistry Seminar. 1 credit.
Presentations on chemical and biochemical research and career-oriented topics by visiting scientists and scholars, and Creighton faculty and students. Modern ethical challenges in the discipline will also be considered. Prereq: Ethics; CHM 323; CHM 324.

CHM 502. Inorganic Chemistry II. 3 credits. SP
Additional topics in inorganic chemistry. Emphasis on organometallic chemistry of transition metals, synthesis and chemical reactivities of inorganic and organometallic compounds. P. CHM 451.

CHM 515. Green and Sustainable Chemistry Laboratory. 2 credits.
Green chemistry is a set of ideals that considers human beings and the environment when designing a chemical reaction, experiment, or process. This laboratory-based course implements the twelve principles of green chemistry to various areas of chemistry. The experiments focus on pollution prevention, energy minimization, and safety. A one-hour recitation where theories are presented and discussed accompanies the laboratory.

CHM 521. Advanced Organic Chemistry: Synthetic Organic Methods. 3 credits. OD
A contemporary survey of the analysis, design, and execution of new methods and innovative total syntheses in organic chemistry. Approaches and techniques for critical reading, discussion, and application of the literature of organic chemistry will be introduced and developed. P. CHM 323; Magis Core Ethics course; Magis Core Contemporary Composition course; Magis Core Oral Communication course.

CHM 523. Bioorganic Chemistry. 3 credits. OD
A survey of current topics at the interface of organic chemistry and biology, with emphasis on a chemical understanding of biological infrastructure, the interactions of small organic molecules within biochemical systems, structure-activity relationship profiling of natural and synthetic drugs, and the relevance of small molecule therapeutics in modern society. P. CHM 383.

CHM 525. Organic Spectroscopic Analysis. 3 credits. OD
A study of infrared, nuclear magnetic resonance, and ultraviolet spectroscopy and mass spectrometry. Emphasis on both the theoretical basis of each method and the application of the methods to structure determination and other interesting chemical problems. P. CHM 323, CHM 324, or IC.

CHM 526. Practical Spectroscopy: NMR. 2 credits.
A practical course of NMR operation and experiment design. NMR probe tuning, shimming, determination of 90 degree pulses and relaxation times, advanced 1D and basic 2D experiments will be described and practiced. P. IC.

CHM 527. Polymer Chemistry. 3 credits. OD
The goal of this course is to expose students to the fundamentals of polymer chemistry. The course will focus on some of the key synthetic methods and physical properties of polymers. Practical applications of polymer chemistry in society will be a theme throughout the course. P. CHM 323 or IC.

CHM 528. Polymer Chemistry Laboratory. 1 credit.
The goal of this course is to expose students to the fundamentals of polymer syntheses and characterization. The course will focus on some of the key synthetic methods for making plastics and the characterization techniques for determining the physical properties of the polymers. Practical applications of polymer chemistry in society will be a theme throughout the course. P or CO: CHM 527.

CHM 532. Mathematical Concepts In Chemistry. 3 credits.
Applications utilizing statistics, mathematical operators, vectors, determinants, group theory, series expansions, and basic differential equations in the modeling of chemical systems. P. MTH 246.

CHM 543. Selected Topics In Physical Chemistry. 3 credits. OD
Selected topics from physical chemistry that match the interests of faculty and students will be discussed. The course will begin with review of related material from CHM 341 and CHM 343 and end with current research. P. CHM 343.

CHM 544. Quantum Chemistry. 2 credits. OD
This course is designed to teach the mathematical background of quantum chemistry. Topics covered include operator algebra, quantum mechanical postulates, rigid rotor and harmonic oscillator model systems, applications to chemical systems, and computational chemistry. P. CHM 343.

CHM 545. Advanced Kinetics. 2 credits. OD
This course is designed to teach the mathematical skills necessary for modeling kinetic systems in chemistry. Topics covered include differential equation techniques, elementary rate laws, composite rate laws, collision theory, transition state theory, reaction dynamics, and potential energy surfaces. P. CHM 343.

CHM 548. Chemical Applications of Spectroscopy. 2 credits.
This is a laboratory course designed to illustrate the theory and applications of spectroscopic analysis to chemical research. Techniques investigated will include IR, UV-Visible Fluorescence/Phosphorescence, Raman, and NMR spectroscopy. Both gas-phase and solution-phase problems will be studied. P. CHM 343.

CHM 549. Computational Chemistry. 2 credits.
This course is designed to introduce students to the applications of computational chemistry in chemical research. Students will learn about the variety of computational methods available including molecular mechanics, semi-empirical, Hartree-Fock, and density functional theory. Laboratory projects will include application of these methods to problems in organic, inorganic, and biological chemistry P. CHM 343.

CHM 556. Electrochemical Methods. 3 credits.
This lecture course covers the fundamentals of electrochemistry and the application of electrochemical methods to chemical problems. It describes electrochemical terms, electrode potentials and processes, along with a historical perspective of electrochemical methods. It covers specific electrochemical techniques and the role of electrochemistry when applied to other fields of science. P. CHM 456.

CHM 575. Nucleic Acid Biochemistry. 3 credits. OD
This course presents an in-depth investigation of the current research in nucleic acid biochemistry. The class will focus on the structure and function of nucleic acids, biochemical processes involving nucleic acids, interactions of nucleic acids with proteins and drug molecules, catalytic nucleic acids, and the genome and genetic engineering. The current literature will serve as source material for study and discussion. P. CHM 371 or CHM 383.

CHM 576. Protein Biochemistry. 3 credits.
This course will introduce students to current views of protein structure and function. Students will become educated consumers of the wealth of information available in protein sequence and structure databases and will develop knowledge of techniques required to characterize their own proteins in the laboratory. P. CHM 371 or CHM 383.

CHM 577. Biophysical Chemistry. 3 credits.
An introduction to the principles and experimental approaches used to study structure and function of biological macromolecules. Topics include thermodynamics and kinetics of macromolecules and their interactions, protein and nucleic acid structure, folding and stability, and common biophysical methods. P. CHM 371, 381 or 383; CHM 331 or 341.