CHEMISTRY

Chemistry is the science of molecules. Scientific, medical, and technological phenomena ultimately are understood in terms of molecular structure and interactions. Understanding chemistry is essential to effective work in all sciences, and some knowledge of chemistry is useful in such fields as law, government, business, and art. Many aspects of our high-technology society can be understood better from the viewpoint of chemistry.

The following are typical important chemical problems: the structure of DNA, the molecular details of the resistance of bacteria to penicillin, the chemistry of biofuel production, the synthesis of new molecules that might be expected to have medical applications, the consequences of putting electrons and photons into molecules, the details of what happens as two molecules collide, the fundamental basis of the energies of molecules, and the synthesis of nanomaterials. These are all areas of research by Wesleyan faculty and their undergraduate and graduate coworkers.

FACULTY

Michael A. Calter  
BS, University of Vermont; PHD, Harvard University  
Professor of Chemistry

Carlos Alberto Jimenez Hoyos  
MA, Rice University; PHD, Rice University  
Assistant Professor of Chemistry

Joseph L. Knee  
BA, SUNY at Binghamton; PHD, SUNY at Stony Brook  
Dean of the Natural Sciences and Mathematics; Beach Professor of Chemistry; Professor of Chemistry

Brian Hale Northrop  
BA, Middlebury College; PHD, University of California LA  
Associate Professor of Chemistry; Associate Professor, Integrative Sciences

Stewart E. Novick  
BS, SUNY at Stony Brook; MA, Harvard University; MAA, Wesleyan University; PHD, Harvard University  
Joshua Boger University Professor of the Sciences and Mathematics; Professor of Chemistry; Professor, Integrative Sciences

Michelle Louise Personick  
BA, Middlebury College; PhD, Northwestern University  
Assistant Professor of Chemistry; Assistant Professor, Integrative Sciences

Andrea Roberts  
BS, Cornell University; MS, Polytechnic University; PHD, Wesleyan University  
Associate Professor of the Practice in Chemistry

Irina M. Russu  
BS, University of Bucharest; MAA, Wesleyan University; PHD, University of Pittsburgh  
E. B. Nye Professor of Chemistry; Professor of Chemistry; Professor, Integrative Sciences

Colin A. Smith  
BA, New York University; PHD, University of California, San Francisco  
Assistant Professor of Chemistry; Assistant Professor, Molecular Biology and Biochemistry; Assistant Professor, Integrative Sciences

Erika A. Taylor  
BS, University of Michigan; PHD, University of Illinois Urbana  
Associate Professor of Chemistry; Associate Professor, Environmental Studies; Associate Professor, Integrative Sciences

T. David Westmoreland  
BS, Massachusetts Institute of Technology; PHD, University of North Carolina at Chapel Hill  
Associate Professor of Chemistry; Chair, Chemistry; Associate Professor, Integrative Sciences

AFFILIATED FACULTY

Stephen Anthony Cooke  
Visiting Scholar in Chemistry

Candice Marie Eton  
BA, New York University; BFA, New York University; PHD, Harvard University  
Assistant Professor of Physics; Assistant Professor, Chemistry; Assistant Professor, Molecular Biology and Biochemistry

Michael J. Frisch  
Research Professor in Chemistry

Quanli Gu  
Visiting Scholar in Chemistry

Rachel D. Lowe  
Research Scientist in Chemistry

Melisa Moreno Garcia  
Visiting Scholar in Chemistry

Herbert M. Pickett  
Research Professor in Chemistry

VISITING FACULTY

Suara A. Adediran  
Visiting Professor of Chemistry

Anthony P. Davis  
BS, U.S. Coast Guard Academy; MS, Ohio State University; PHD, Wesleyan University  
Visiting Associate Professor of Chemistry

John Mantzaris  
BS, Central Connecticut State University; MA, Wesleyan University; PHD, Wesleyan University  
Visiting Professor of Chemistry

EMERITI

David L. Beveridge  
BA, College of Wooster; MAA, Wesleyan University; PHD, University Cincinnati  
Joshua Boger University Professor of the Sciences and Mathematics, Emeritus; Co-Director, Susan B. and William K. Wasch Center for Retired Faculty

Philip H. Bolton  
BS, Michigan State University; MAA, Wesleyan University; PHD, University of California, San Diego
issues related to drugs and disease will form a focus of the course. Topics to be covered will include psychoactive and performance-enhancing drugs, mad cow, cancer, viral and bacterial diseases, and the chemistry of foods.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: MB&B119
Prereq: None

CHEM120 Science and Humanity
This course will provide an introduction to the important concepts of writing in science. We will discuss the major components of scientific writing while viewing scientific issues from an analytical and interdisciplinary perspective. We will discuss contemporary problems influenced by technological advantages and the effects they have on science and humanity. This course assumes basic knowledge in chemistry and biology at the high school level.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: None

CHEM125 Chemistry and Society
An introductory course for non-science majors emphasizing the role of chemistry in environmental and technological problems of concern to society such as air and water pollution, current energy sources and alternatives, nuclear chemistry, household chemicals, pharmaceuticals, plastics and recycling, and food and agriculture.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: None

CHEM132 Seminars in Physical Science
Each student will give one 50-minute talk on a topic they choose in chemistry, physics, astronomy, or mathematics. Students will consult with the instructor on the choice of their topic and in the organization of their presentation. Possible topics might include (chosen at random): the origin of the periodic table; the transition from alchemy to chemistry; cold fusion; various Nobel Prize in Chemistry or Physics topics; dark matter, dark energy; the nature of galaxies; why stars shine; the roles of amateurs in modern astronomical research; visualizing the fourth dimension; Einstein's "greatest blunder"; Bose-Einstein condensates; the race toward absolute zero; the interaction of radiation and matter; the Heisenberg Uncertainty Principle; how prime numbers are used in cryptography; the discovery of C60; the list is almost inexhaustible.

Offering: Host
Grading: Cr/U
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: None

CHEM141 Introductory Chemistry I
This course emphasizes rigorous descriptive reasoning. While intended for students with little or no previous background in chemistry, the course is taught at a relatively high level. The topical coverage emphasizes the relationships between electronic structure, chemical reactivity, and the physical properties of the elements and their compounds.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: None
CHEM142 Introductory Chemistry II
This course is a continuation of CHEM141. CHEM152, the associated laboratory course, may be taken concurrently. The lab should be taken by those who plan to take more than one year of chemistry.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM141

CHEM143 Principles of Chemistry I
An introduction to chemistry intended for motivated students with a solid high school chemistry background and exposure to calculus, this course will emphasize the fundamental principles of chemistry and is recommended for students interested in pursuing majors in science or mathematics. This course will focus on the concepts of equilibrium, thermodynamics, and kinetics with applications. This course provides the best basic foundation for further study of chemistry and is strongly recommended for chemistry and MB&B majors.
CHEM143, with CHEM144, satisfies premedical general chemistry requirements.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: None

CHEM144 Principles of Chemistry II
This second semester of the general chemistry course is recommended for science students. The focus of the course is the fundamentals of structure and bonding, with an emphasis on predicting reactivity.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM143

CHEM152 Introductory Chemistry Laboratory
This course provides an introduction to the application of chemical concepts in the laboratory. The course will focus on practical aspects of fractional distillation, qualitative inorganic analysis, and synthesis of inorganic compounds. It should be taken by those who plan to take more than one year of chemistry.
Offering: Host
Grading: A-F
Credits: 0.25
Gen Ed Area: NSM-CHEM
Prereq: CHEM143

CHEM241 Informal Science Education for Elementary School Students I
This service-learning course will focus on designing and implementing original, effective, and engaging science-based lesson plans for elementary age children in an afterschool program setting at five local elementary schools. The classroom component includes writing, testing, and critiquing lesson plans and organizing a once-a-semester event, Science Saturday. Members of the class are required to volunteer weekly, co-lead Science Saturday, complete individual work, and organize meetings for projects outside of class. This course is a continuation of CHEM241.
Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-CHEM
Prereq: None

CHEM242 Informal Science Education for Elementary School Students II
This service-learning course will focus on designing and implementing original, effective, and engaging science-based lesson plans for elementary age children in an afterschool program setting at five local elementary schools. The classroom component includes writing, testing, and critiquing lesson plans and organizing

CHEM250 Pre-Organic Chemistry: Key Concepts and Fundamental Principles
This course is designed to assist students in the transition from CHEM 142 & CHEM 144 to CHEM 251. This course will review key General Chemistry concepts and apply them to organic molecules. Thematic presentation of material will use visual lecture and demonstration methods, small-group problem solving, peer-group workshops and lecture format. A broad understanding of Organic Chemistry terminology, structures, nomenclature, applications and basic concepts will provide students will a firm foundation for success in CHEM 251.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM142 OR CHEM144

CHEM251 Principles of Organic Chemistry I
This course offers an introduction to the chemistry of carbon compounds with emphasis on the relationship between structure and reactivity. The laboratory course CHEM257 is normally elected concurrently but is not required.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM142 OR CHEM144

CHEM252 Principles of Organic Chemistry II
This course is a continuation of the chemistry of carbon compounds with emphasis on the chemistry of important functional groups. The laboratory course CHEM258 is normally elected concurrently but is not required.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM251

CHEM254 Honors Organic Chemistry
This course is a honors level continuation of the chemistry of carbon compounds with emphasis on the chemistry of important functional groups. The laboratory course CHEM258 is normally elected concurrently but is not required.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM251

CHEM257 General Chemistry Laboratory
Normally taken along with CHEM251, this course provides laboratory work in quantitative chemical procedures and introductory chemical laboratory practices. This course is required by most medical, dental, and veterinary schools and is a prerequisite for CHEM258.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM251

CHEM252 Honors Organic Chemistry
This course is a honors level continuation of the chemistry of carbon compounds with emphasis on the chemistry of important functional groups. The laboratory course CHEM258 is normally elected concurrently but is not required.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM251

CHEM257 General Chemistry Laboratory
Normally taken along with CHEM251, this course provides laboratory work in quantitative chemical procedures and introductory chemical laboratory practices. This course is required by most medical, dental, and veterinary schools and is a prerequisite for CHEM258.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM251

CHEM252 Honors Organic Chemistry
This course is a honors level continuation of the chemistry of carbon compounds with emphasis on the chemistry of important functional groups. The laboratory course CHEM258 is normally elected concurrently but is not required.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM251

CHEM257 General Chemistry Laboratory
Normally taken along with CHEM251, this course provides laboratory work in quantitative chemical procedures and introductory chemical laboratory practices. This course is required by most medical, dental, and veterinary schools and is a prerequisite for CHEM258.
CHEM258 Organic Chemistry Laboratory
This course presents laboratory techniques of organic chemistry.
Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-CHEM
Prereq: (CHEM251 AND CHEM252)

CHEM307 Molecular Biophysics Journal Club I
This course includes presentation and active discussion of a series of current research articles in the field of molecular biophysics and biophysical chemistry from journals including but not limited to the Biophysical Journal, Biopolymers, Current Opinion in Structural Biology, Journal of Biomolecular Structure and Dynamics, and the Annual Review of Molecular Biophysics and Biomolecular Structure.
Offering: Host
Grading: Cr/U
Credits: 0.50
Gen Ed Area: NSM-CHEM
Identical With: MB&B307, CHEM507, MB&B507, PHYS317, PHYS517
Prereq: None

CHEM308 Molecular Biophysics Journal Club II
Offering: Host
Grading: Cr/U
Credits: 0.50
Gen Ed Area: NSM-CHEM
Identical With: MB&B308, CHEM508, MB&B508, PHYS318, PHYS518
Prereq: None

CHEM309 Molecular and Cellular Biophysics
This course is an integrated consideration of the biophysics and biophysical chemistry of biological systems from molecules to cells. The objective is to develop a critical sense of the quantitative data currently being obtained from microscopy to spectroscopy, considering both ensemble and single-molecule experiments, and to gain familiarity and facility with interpretation using mathematical and computational models. Biological systems are inherently complex, and some form of modeling is always involved in developing an explanation of how they work. However, these models typically involve only a few basic constructs (simple harmonic motion, ideal fluids, two-state Ising models, random walks, electrostatic interactions, classical dynamics, rate equations, QM energy levels, distribution functions, and network analysis) and only elementary aspects of linear algebra, calculus, differential equations, and statistics. This course deals with how these constructs are integrated in the framework of Boltzmann statistical mechanics to formulate mathematical models of biological phenomena, how these models are validated and refined, and how they are used to form explanations and make testable predictions. Model systems to be considered include the nucleosome, the ribosome, membrane dynamics and ion channels, molecular devices and motors, prototype signal transduction systems, and regulatory processes. This course is suitable for physics and chemistry students who wish to learn about biological applications and for molecular and cellular biology students to develop skills with quantitative physicochemical modes of inquiry applied to the life sciences.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: MB&B309, CHEM509, MB&B509, PHYS339, PHYS539
Prereq: (CHEM251 AND CHEM252)

CHEM314 Environmental Chemistry
This course is designed for students with college-level general and organic chemistry background. Examples of topics to be covered include energy production and consumption, chemical pollution and environmental clean-up, among others. Analysis and criticism of environmental literature are included.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: (CHEM141 AND CHEM142 AND CHEM251 AND CHEM257) OR (CHEM143 AND CHEM144 AND CHEM251 AND CHEM257)

CHEM317 Analytical Chemistry
This course is an overview of the broad subject of analytical chemistry, with an emphasis on quantitative chemical analysis. This course will focus on classical methods of chemical analysis, rather than instrumental analysis.

The course format will be a hybrid lecture/lab sequence, with lecture time spent investigating the background of each laboratory experiment.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM251 AND CHEM257

CHEM320 Scientific Research Ethics
This course involves critical consideration of the ethical issues that arise in the conduct of scientific research. The course will begin with an overview of the ethical issues commonly encountered in research, including what is and is not an ethical issue and how ethical issues are dealt with in principle and in practice. Initial topics include record keeping, conflict of interest, responsible authorship, ownership of projects, policies for handling misconduct, policies regarding the use of human and animal subjects, and data management and distribution. The course proceeds to consider a series of case studies based on instances in the recent scientific literature in which ethical problems were encountered.
Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-CHEM
Identical With: CHEM520
Prereq: None

CHEM321 Biomedical Chemistry
This course is designed to explore the molecular basis of disease and treatment options. Topics will reflect the importance of chemistry and biochemistry in the advancement of medicine today and will include treatment of metabolic disorders, rational drug design, and mode of drug action. A large portion of the course will be dedicated to learning computer programs used in computational drug design as part of a final drug design project.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: MB&B321
Prereq: (CHEM251 AND [CHEM383 or MB&B383])

CHEM325 Introduction to Biomolecular Structure
This course aims to provide a framework for understanding three-dimensional structures of proteins, nucleic acids, and their complexes. The first half of the course emphasizes structural modules and topological patterns in major classes of proteins and nucleic acids. The second part of the course covers novel structural motifs, such as helix-turn-helix, zinc-finger, and leucine zipper, that are responsible for recognition of specific nucleotide sequences in nucleic
acids by proteins. Analysis of structures using tools available on the Web and independent exploration of protein and nucleic acid databases are strongly encouraged.

Offering: Host  
Grading: OPT  
Credits: 1.00  
Gen Ed Area: NSM-CHEM  
Identical With: MBB&325  
Prereq: [MB&B181 or BIOL181] OR [MB&B191 or BIOL191]

**CHEM337 Physical Chemistry I: Quantum Mechanics and Spectroscopy**  
A rigorous introduction to quantum mechanics, this course covers wave mechanics, operator methods, matrix mechanics, perturbation theory, angular momentum, molecular vibrations, atomic and molecular structure, symmetry, and spectroscopy.

Offering: Host  
Grading: A-F  
Credits: 1.00  
Gen Ed Area: NSM-CHEM  
Prereq: (CHEM141 AND CHEM142 AND MATH121 AND MATH122) OR (CHEM143 AND CHEM144 AND MATH121 AND MATH122)

**CHEM338 Physical Chemistry II: Thermodynamics, Statistical Mechanics, and Kinetics**  
This course investigates chemical aspects of statistical mechanics and the laws of thermodynamics including free energy, chemical potential and chemical equilibrium, and rates of chemical reactions.

Offering: Host  
Grading: A-F  
Credits: 1.00  
Gen Ed Area: NSM-CHEM  
Prereq: (MATH121 AND MATH122 AND CHEM141 AND CHEM142) OR (MATH121 AND MATH122 AND CHEM143 AND CHEM144)

**CHEM340 Physical Chemistry IV: Introduction to Quantum Chemistry**  
This course is an introduction to modern concepts of atomic and molecular quantum mechanics, molecular orbital theory, and qualitative and quantitative concepts of molecular electronic structure. The second half of the course will emphasize numerical calculations with commonly used approximations in many electron calculations on atomic and molecular systems using currently popular computer programs.

Offering: Host  
Grading: A-F  
Credits: 1.00  
Gen Ed Area: NSM-CHEM  
Prereq: CHEM337 OR PHYS214

**CHEM341 Physical Chemistry IVB: Quantum Chemistry**  
This survey of lab initio electronic structure theory studies basis sets, many-body perturbation theory, coupled cluster theory, and density functional methods. These methods will be applied to molecular geometry optimizations, calculations of vibrational frequencies, NMR spectra, and thermochemistry including transition states for chemical reactions. The thermochemical methods covered include the complete basis set (CBS) models.

Offering: Host  
Grading: A-F  
Credits: 0.50  
Gen Ed Area: NSM-CHEM  
Prereq: CHEM337 OR PHYS214 OR [PHYS315 or PHYS515]

**CHEM342 Molecules to Medicine**  
This course will explore the process of drug development, including target selection, lead discovery using computer-based methods and combinatorial chemistry/high-throughput screening, organic synthesis, bioavailability, clinical trials, and other factors (some economics and politics) involved in bringing a drug to the marketplace. Critical consideration of the variables to contend with at each step will be described and discussed, including aspects of research ethics and patent law. The basic science of molecular recognition, computer-aided drug design, and the role of factors from synthetic chemistry to toxicology will be presented. Case studies of the development of drugs recently successful in making the journey from molecule to medicine will be discussed, as well as the story of some that did not, and why. Emerging new design strategies such as fusion-protein therapies, crisper technology, and enhanced use of rational design and combinatorial methods will be emphasized, and how pharmaceutical research is evolving in the postgenomic era, particularly with biologics. Job opportunities in the pharmaceutical industry will be discussed.

Offering: Host  
Grading: A-F  
Credits: 1.00  
Gen Ed Area: NSM-CHEM  
Prereq: CHEM141 and CHEM251

**CHEM353 Applications of Spectroscopic Methods in Organic Chemistry**  
The use of NMR infrared and mass spectroscopy in structure determinations will be discussed.

Offering: Host  
Grading: A-F  
Credits: 1.00  
Gen Ed Area: NSM-CHEM  
Prereq: (CHEM251 AND CHEM252)

**CHEM358 Structure and Mechanism**  
This course will cover several important aspects of traditional and contemporary physical organic and mechanistic chemistry, including frontier molecular orbital theory and pericyclic reactions, organic photochemistry reactive intermediates (carbocations, carbanions, radicals, and carbenes), the thermodynamics and kinetics of organic reactions, and polymer chemistry.

Offering: Host  
Grading: A-F  
Credits: 1.00  
Gen Ed Area: NSM-CHEM  
Prereq: (CHEM251 AND CHEM252)

**CHEM359 Advanced Organic Synthesis**  
The control of reactivity and selectivity to achieve specific syntheses is one of the overarching goals of organic chemistry. This course is intended to provide advanced undergraduate and graduate students in chemistry with a sufficient foundation to comprehend and use research literature in organic chemistry. Concentrating on the most important reactions and efficient synthetic methods used for organic synthesis, this course presents the material by reaction type. The planning and execution of multistep synthesis will also be included.

Offering: Host  
Grading: A-F  
Credits: 1.00  
Gen Ed Area: NSM-CHEM  
Prereq: None

**CHEM361 Advanced Inorganic Chemistry**  
This course is a survey of the chemistry of the inorganic elements, focusing on the relationship between electronic structure, physical properties, and reactivity across the periodic table.

Offering: Host  
Grading: A-F  
Credits: 1.00  
Gen Ed Area: NSM-CHEM  
Prereq: CHEM252

**CHEM375 Integrated Chemistry Laboratory I**  
This advanced laboratory course in chemistry involves work from the major subdisciplines: organic, inorganic, biochemical, physical, and instrumental.
Emphasis will be placed on integrating aspects of chemical synthesis, spectroscopic characterization, and determination of physical properties in each exercise.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM251 AND CHEM252 AND CHEM257 AND CHEM258

CHEM376 Integrated Chemistry Laboratory II
This advanced laboratory course in chemistry involves work from the major subdisciplines: organic, inorganic, biochemistry, physical, and instrumental. Emphasis will be placed on integrating aspects of chemical synthesis, spectroscopic characterization, and determination of physical properties in each exercise.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM375

CHEM377 Chemistry of Materials and Nanomaterials
This course will provide an introduction to materials chemistry, with a special emphasis on nanomaterials. Topics covered will include colloidal metal nanomaterials; semiconductors and quantum dots; carbon nanotubes, fullerenes, and graphene; metal-organic frameworks; self-assembly and metamaterials; electron and scanning probe microscopies; and lithography. The course will also discuss applications of these materials and techniques in areas such as plasmonics and sensing, catalysis, energy generation, and medicine.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: PHYS377
Prereq: CHEM251

CHEM379 Nanomaterials Lab
This course will be a combination of weekly lecture and laboratory exercises designed to introduce students to new developments in the chemistry of materials and nanomaterials. Concepts and theoretical background will be discussed during weekly lectures. Students will then apply these concepts to the preparation of materials/nanomaterials in weekly lab sections. Students will synthesize quantum dots, build solar cells, pattern surfaces using both photolithography and soft lithography, make conductive carbon nanofiber films, prepare high-temperature superconductors, and learn scanning probe microscopy techniques.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: MB&B382
Prereq: None

CHEM380 Physical Chemistry for the Life Sciences
The course is concerned with the basic physicochemical principles and model systems essential to understanding, explaining, and predicting the behavior of biological systems in terms of molecular forces. The course integrates fundamental concepts in thermodynamics, kinetics, and molecular spectroscopy with the structures, functions, and molecular mechanisms of biological processes. The objectives of the course are to (1) familiarize life science students at the advanced undergraduate and beginning graduate level with basic physicochemical laws, theories, and concepts important to the life sciences; (2) provide a working knowledge of mathematical methods useful in life science research; (3) develop a critical perspective on explanation of biological processes and understanding biological systems; and (4) survey the main applications of physical chemistry in the life sciences with an emphasis on spectroscopy and microscopy. Theory, methodology, and biophysical concepts are distributed throughout the course and are presented in the context of case studies including respiration, light harvesting and photosynthesis, ATP hydrolysis, NAD/NADH redox, energy transfer, FRET spectroscopy, with an emphasis on single molecule as well as ensemble experiments and their interpretation.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B381, MB&B385
Prereq: CHEM141 AND CHEM142 AND MATH17 AND CHEM251) OR (CHEM143 AND CHEM144 AND MATH121 AND CHEM251)

CHEM382 Practical NMR
This course will cover how a spectrometer works as well as the theory and application of NMR experiments. The topics will include one-dimensional proton and heteronuclear experiments as well as decoupling. The course will begin with how the spectrometer works and how data processing is carried out, as well as how to calibrate the spectrometer and shim the magnet. The one-dimensional TOCSY and NOESY experiments will then be covered. The course will also cover heteronuclear and homonuclear two-dimensional NMR experiments. The experiments will include two-dimensional DQFCOSY, TOCSY, NOESY, and ROEY proton experiments as well as heteronuclear experiments to correlate the chemical shifts of protons and heteronuclei, as well as how to select heteronuclear resonances on the basis of the number of directly attached protons.

The course will consist of lectures as well as a laboratory component in which the Mercury 300 will be used to obtain data that will be analyzed using the methods developed in the lecture part of the course. This course is specifically aimed at general users of the Mercury spectrometer who wish to learn how to carry out and analyze advanced one-dimensional and two-dimensional NMR experiments.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: MB&B382
Prereq: None

CHEM383 Biochemistry
This introductory course to the principles and concepts of contemporary biochemistry presents both the biological and chemical perspectives. The major themes will be the structure of proteins and the basis of enzymatic activity, cellular metabolism and the generation and storage of metabolic energy, and general principles of the biosynthesis of cellular components.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: MB&B383
Prereq: CHEM251 AND CHEM252

CHEM385 Advanced Biochemistry: Enzyme Kinetics
This course presents an introduction to the theory and practice of enzyme kinetics, both steady-state and presteady-state.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-CHEM
Identical With: MB&B385
Prereq: [CHEM383 or MB&B383]
CHEM386 Biological Thermodynamics
This course is addressed to undergraduate and graduate students interested in biological chemistry and structural biology. The course presents thermodynamic methods currently used to relate structure to function in biological molecules. Topics include binding curves, chemical ligand linkages, binding polynomial, cooperativity, site-specific binding processes, and allosteric effects. Several models for allosteric systems, such as the Monod-Wyman-Changeux model, the induced-fit model, and the Pauling model, are analyzed in detail. Applications of these models are illustrated for functional regulation of respiratory proteins and for protein-nucleic-acid complexes involved in control of gene expression.

Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B386
Prereq: (MATH121 AND MATH122)

CHEM387 Enzyme Mechanisms
The chemical mechanisms involved in the action of a series of typical enzymes will be considered.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-CHEM
Identical With: MB&B387
Prereq: [CHEM383 or MB&B383]

CHEM390 Practical Methods in Biochemistry
This course centers on currently used techniques for protein separation, characterization, and purification, such as ultracentrifugation, gel electrophoresis, and chromatography. These topics will be introduced within the general context of the behavior of macromolecules in solution. The relative stability of proteins in different media, the forces stabilizing protein structure, and the interaction of proteins will be discussed. We will explicitly consider different techniques used to study proteins. Relatively novel techniques to be discussed include surface plasmon resonance, microarray methods and mass spectrometry, and single molecule microscopy. In the course, we will go through three or four different protein purification protocols and discuss the methods used in each one. We will also touch upon the commonly used spectroscopic techniques used to characterize proteins, including absorption, fluorescence, and circular dichroism. The course will focus on biochemical techniques and understanding the physical principles underlying these techniques and will also discuss tactics for optimizing established isolation and purification procedures and for isolating and characterizing an unknown protein.

The course content is appropriate for advanced undergraduates (juniors/seniors) and beginning graduate students from chemistry, biology, molecular biophysics or MB&B.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B340
Prereq: [MB&B208] OR [CHEM383 or MB&B383] OR (CHEM144 AND MATH122) OR (PHYS111 AND PHYS112) OR CHEM338

CHEM395 Structural Biology Laboratory
One of the major catalysts of the revolution in biology that is now under way is our current ability to determine the physical properties and three-dimensional structures of biological molecules by x-ray diffraction, nuclear magnetic resonance (NMR) spectroscopy, and other spectroscopic methods. This course is designed to familiarize students with current research techniques in biochemistry and molecular biophysics. Students will perform spectroscopic investigations on a protein that they have isolated and characterized using typical biochemical techniques, such as electrophoresis, enzyme extraction, and column chromatography. The course will provide hands-on experience with spectroscopic methods such as NMR, fluorescence, UV-Vis absorption, and Raman as well as bioinformatic computational methods. All of these methods will be applied to the study of biomolecular structure and energetics. This course provides a broad knowledge of laboratory techniques valuable for independent research at the undergraduate level and beyond.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B395, PHYS395
Prereq: (MB&B208 or BIOL208) AND CHEM141 AND CHEM142) OR (MB&B208 or BIOL208) AND CHEM143 AND CHEM144)

CHEM396 Molecular Modeling
The theory behind molecular modeling techniques will be discussed, along with hands-on experience using HyperChem. Techniques such as energy minimization, Monte Carlo, molecular dynamics, Brownian dynamics, and quantum simulations will be discussed in detail. Relevant statistical mechanical concepts will be reviewed. Algorithms, implementations, limitations, and problems associated with existing modeling techniques will then be examined. Theory and implementation of selected free-energy simulation techniques will be discussed. Hands-on session using HyperChem on a 486-PC will involve direct application of techniques such as performing EM on a molecule of choice.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM396
Prereq: CHEM337

CHEM401 Individual Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

CHEM402 Individual Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

CHEM407 Senior Tutorial (downgraded thesis)
Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.

Offering: Host
Grading: A-F

CHEM408 Senior Tutorial (downgraded thesis)
Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.

Offering: Host
Grading: A-F

CHEM409 Senior Thesis Tutorial
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

CHEM410 Senior Thesis Tutorial
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

CHEM411 Group Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.

Offering: Host
CHEM419 Student Forum
Student-run group tutorial, sponsored by a faculty member and approved by the chair of a department or program.
Offering: Host
Grading: Cr/U

CHEM420 Student Forum
Student-run group tutorial, sponsored by a faculty member and approved by the chair of a department or program.
Offering: Host
Grading: Cr/U

CHEM421 Undergraduate Research, Science
Individual research projects for undergraduate students supervised by faculty members.
Offering: Host
Grading: OPT

CHEM422 Undergraduate Research, Science
Individual research projects for undergraduate students supervised by faculty members.
Offering: Host
Grading: OPT

CHEM423 Advanced Research Seminar, Undergraduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM424 Advanced Research Seminar, Undergraduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM491 Teaching Apprentice Tutorial
The teaching apprentice program offers undergraduate students the opportunity to assist in teaching a faculty member's course for academic credit.
Offering: Host
Grading: OPT

CHEM492 Teaching Apprentice Tutorial
The teaching apprentice program offers undergraduate students the opportunity to assist in teaching a faculty member's course for academic credit.
Offering: Host
Grading: OPT

CHEM495 Research Apprentice, Undergraduate
Project to be arranged in consultation with the tutor.
Offering: Host
Grading: Cr/U

CHEM496 Research Apprentice, Undergraduate
Project to be arranged in consultation with the tutor.
Offering: Host
Grading: Cr/U

CHEM500 Graduate Pedagogy
The elements of good teaching will be discussed and demonstrated through lectures, practice teaching sessions, and discussions of problems encountered in the actual teaching environment. The staff consists of faculty and experienced graduate students. An integral part of the course is a required one-day workshop BEFORE the first day of formal classes.

Training in pedagogy in the first semester of attendance is required for all incoming Wesleyan MA and PhD students who have not already fulfilled this requirement at Wesleyan. BA/MA students are not required to get training in pedagogy but may choose to do so.
Offering: Crosslisting
Grading: Cr/U
Gen Ed Area: None
Identical With: CHEM507, MB&B307, MB&B507, PHYS317, PHYS517
Prereq: None

CHEM501 Individual Tutorial for Graduates
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM502 Individual Tutorial for Graduates
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM504 Selected Topics, Graduate Science
Topic to be arranged in consultation with the tutor. A seminar primarily concerned with papers taken from current research publications designed for, and required of, graduate students.
Offering: Host
Grading: OPT

CHEM507 Molecular Biophysics Journal Club I
This course includes presentation and active discussion of a series of current research articles in the field of molecular biophysics and biophysical chemistry from journals including but not limited to the Biophysical Journal, Biopolymers, Current Opinion in Structural Biology, Journal of Biomolecular Structure and Dynamics, and the Annual Review of Molecular Biophysics and Biomolecular Structure.
Offering: Crosslisting
Grading: Cr/U
Gen Ed Area: NSM-CHEM
Identical With: CHEM307, MB&B307, MB&B507, PHYS317, PHYS517
Prereq: None

CHEM508 Molecular Biophysics Journal Club II
Offering: Crosslisting
Grading: Cr/U
Gen Ed Area: NSM-CHEM
Identical With: CHEM308, MB&B308, MB&B508, PHYS318, PHYS518
Prereq: None

CHEM509 Molecular and Cellular Biophysics
This course is an integrated consideration of the biophysics and biophysical chemistry of biological systems from molecules to cells. The objective is to develop a critical sense of the quantitative data currently being obtained from microscopy to spectroscopy, considering both ensemble and single-molecule experiments, and to gain familiarity and facility with interpretation using mathematical and computational models. Biological systems are inherently complex, and some form of modeling is always involved in developing an explanation of how they work. However, these models typically involve only a few basic constructs (simple harmonic motion, ideal fluids, two-state ising
models, random walks, electrostatic interactions, classical dynamics, rate equations, QM energy levels, distribution functions, and network analysis) and only elementary aspects of linear algebra, calculus, differential equations, and statistics. This course deals with how these constructs are integrated in the framework of Boltzmann statistical mechanics to formulate mathematical models of biological phenomena, how these models are validated and refined, and how they are used to form explanations and make testable predictions. Model systems to be considered include the nucleosome, the ribosome, membrane dynamics and ion channels, molecular devices and motors, prototype signal transduction systems, and regulatory processes. This course is suitable for physics and chemistry students who wish to learn about biological applications and for molecular and cellular biology students to develop skills with quantitative physicochemical modes of inquiry applied to the life sciences.

Offering: Crosslisting
Grading: A-F
Credits: 0.25
Gen Ed Area: NSM-CHEM
Identical With: CHEM309, MB&B309, MB&B509, PHYS339, PHY5539
Prereq: (CHEM251 AND CHEM252)

CHEM511 Group Tutorial, Graduate
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM512 Group Tutorial, Graduate
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM519 Structural Mechanisms of Protein-Nucleic Acid Interactions
This course focuses on recent advances in the understanding of the structural basis of the recognition of nucleic acids by proteins. Macromolecular systems to be discussed include site-specific DNA endonucleases, topoisomerases, the histone fold, helicases, site-specific recombinases, nuclear RNA-protein complexes, tRNA-binding proteins, and the ribosome.

Offering: Host
Grading: OPT
Credits: 0.50
Gen Ed Area: None
Identical With: MB&B519
Prereq: (CHEM251 AND CHEM252)

CHEM520 Scientific Research Ethics
This course involves critical consideration of the ethical issues that arise in the conduct of scientific research. The course will begin with an overview of the ethical issues commonly encountered in research, including what is and is not an ethical issue and how ethical issues are dealt with in principle and in practice. Initial topics include record keeping, conflict of interest, responsible authorship, ownership of projects, policies for handling misconduct, policies regarding the use of human and animal subjects, and data management and distribution. The course proceeds to consider a series of case studies based on instances in the recent scientific literature in which ethical problems were encountered.

Offering: Crosslisting
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-CHEM
Identical With: CHEM320
Prereq: None

CHEM521 Chemistry Symposia I
Weekly seminars by distinguished national and international chemists.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: PHY5588
Prereq: None

CHEM549 Advanced Research Seminar, Graduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM550 Advanced Research Seminar, Graduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM557 Seminar in Organic and Inorganic Chemistry
This graduate-level seminar in organic and inorganic chemistry will include weekly presentations and discussions based on current research. Speakers will present the details of their topic using specific examples and will place the research in a broader context with respect to the current literature while also providing adequate background information and drawing concepts together with critical concluding analysis.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Prereq: None

CHEM558 Seminar in Organic and Inorganic Chemistry
This graduate-level seminar in organic and inorganic chemistry will include weekly presentations and discussions based on current research. Speakers will present the details of their topic using specific examples and will place the research in a broader context with respect to the current literature while also providing adequate background information and drawing concepts together with critical concluding analysis.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Prereq: None

CHEM561 Graduate Field Research
Research in the field, normally on thesis project.
Offering: Host
Grading: OPT

CHEM565 Physical Methods in Chemistry
An introduction to the use of physical methods to characterize the structures and dynamics of chemical systems with a particular emphasis on applications in inorganic chemistry. Topics will include a variety of spectroscopies (e.g., optical absorption, circular dichroic techniques, infrared and Raman spectroscopies, NMR techniques), small molecule X-ray crystallography, and magnetic susceptibility measurements. Group theoretical techniques will be used extensively to develop selection rules.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM361 OR CHEM337

CHEM587 Seminar in Biological Chemistry
This course involves weekly presentations and discussions based on current research.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: MB&B588
Prereq: (CHEM383 or MB&B383 or CHEM325 or MB&B325 or MB&B208) OR [CHEM383 or MB&B383]

CHEM588 Seminar in Biological Chemistry
This course involves weekly presentations and discussions based on current research.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: MB&B588
Prereq: (CHEM383 or MB&B383 or CHEM325 or MB&B325 or MB&B208) OR [CHEM383 or MB&B383]

CHEM596 Molecular Modeling
The theory behind molecular modeling techniques will be discussed, along with hands-on experience using HyperChem. Techniques such as energy minimization, Monte Carlo, molecular dynamics, Brownian dynamics, and quantum simulations will be discussed in detail. Relevant statistical mechanical concepts will be reviewed. Algorithms, implementations, limitations, and problems associated with existing modeling techniques will then be examined. Theory and implementation of selected free-energy simulation techniques will be discussed. Hands-on session using HyperChem on a 486-PC will involve direct application of techniques such as performing EM on a molecule of choice.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM396
Prereq: CHEM337

Prereq: [CHEM383 or MB&B383 or CHEM325 or MB&B325 or MB&B208] OR [CHEM383 or MB&B383]