Biochemistry

Chair
• Charles M. Brenner

Undergraduate major: biochemistry (B.A., B.S.)
Graduate degrees: M.S. in biochemistry; Ph.D. in biochemistry

Faculty: https://medicine.uiowa.edu/biochemistry/people/
primary-appointments
Website: https://medicine.uiowa.edu/biochemistry/

Biochemistry is the study of basic chemical processes that occur in and govern all living systems. Nearly all areas of the life sciences engage in biochemical research.

The Department of Biochemistry offers undergraduate and graduate degrees, and determines the curricula for those programs. Undergraduate students majoring in biochemistry receive their degrees (Bachelor of Arts or Bachelor of Science) from the College of Liberal Arts and Sciences, and their studies are governed by that college's undergraduate academic policies. The Master of Science and the Doctor of Philosophy degrees are awarded by the Graduate College.

Faculty and Research

The department's faculty members supervise research in biochemistry; molecular, cellular, developmental, computational, and structural biology; and model system genetics. Their work is supported by grants from the National Institutes of Health, the National Science Foundation, the American Heart Association, the American Cancer Society, the Muscular Dystrophy Association, and other sources. To learn more about the department's faculty members and areas of research, visit the Department of Biochemistry website.

Undergraduate Programs of Study

Majors
• Major in Biochemistry (Bachelor of Arts)
• Major in Biochemistry (Bachelor of Science)

Graduate Programs of Study

Majors
• Master of Science in Biochemistry
• Doctor of Philosophy in Biochemistry

Facilities

The Department of Biochemistry occupies 36,700 square feet on the fourth floor of the Bowen Science Building, 3,500 square feet on the third floor of the Medical Education Research Facility, 2,000 square feet in the Eckstein Medical Research Building, and 2,900 square feet on the fourth floor of the Pappajohn Biomedical Discovery Building in the Fraternal Order of Eagles Diabetes Research Center on the University's health sciences campus. It has a number of well-equipped research laboratories and other departmental facilities, including the Biochemistry Stores, the Mattill Biochemistry Reading Room, and the Heath Conference Room.

The department makes available a number of shared instruments, including an Applied PhotoPhysics stopped flow spectrometer SX20; a Horiba fluorlog-3 spectrofluorometer; and a Beckman Coulter ultra XLI analytical centrifuge.

Faculty, staff, and students in the department have access to a variety of shared Carver College of Medicine resources, including the Protein Crystallography Facility, the Iowa Institute of Human Genetics Genomics Division (DNA Facility), the Nuclear Magnetic Resonance Facility, the Proteomics Facility, the Flow Cytometry Facility, the Viral Vector Core Facility, the Small Animal Imaging Core Facility, and the Genome Editing Facility. The University also supports resources such as the Central Microscopy Research Facilities and the High Throughput Screening Facility.

Courses

Biochemistry Courses

BIOC:2120 Life-Oriented Organic Chemistry I 3 s.h.
Rigorous treatment of organic chemistry with emphasis on reactivity of biological molecules and reactions of functionalized organic molecules; prepares students to major in any life science including biochemistry, biology, health and human physiology, microbiology, neuroscience, and psychology; satisfies the organic chemistry requirement for further study in the health professions; preparation for biochemistry coursework, conducting research, teaching and/or pursuing policy, regulatory, or legal careers in the life sciences. Requirements: Advanced Placement (AP) chemistry score of 5 or CHEM:1110 or one semester of collegiate chemistry.

BIOC:3110 Biochemistry 3 s.h.
One-semester survey of basic concepts in modern biochemistry and molecular biology; emphasis on application of biochemical concepts to human metabolism; appropriate for students who plan to pursue a career in health care or want an overview of biochemistry as a discipline. Requirements: one year each of college-level biology and chemistry. Recommendations: one semester of organic chemistry.

BIOC:3120 Biochemistry and Molecular Biology I 3 s.h.
Physical and chemical foundations of biochemistry, structure of biological molecules, catalysis, transport, and oxidative reactions in biology; first course of two-semester sequence that concludes with BIOC:3130. Requirements: two semesters of general chemistry and one of organic chemistry. Recommendations: BIOL:1411, BIOL:1412, and an additional organic chemistry course.

BIOC:3130 Biochemistry and Molecular Biology II 3 s.h.
Molecular principles of photosynthesis and biosignaling; metabolism of lipids, amino acids, and nucleic acids; DNA replication, transcription, and protein translation; team-taught, didactic lecture style; second of a two-semester comprehensive biochemistry sequence. Prerequisites: BIOC:3120 with a minimum grade of C-.

BIOC:3140 Experimental Biochemistry 2 s.h.
Use of modern instruments and techniques to fractionate, identify, and characterize constituents of biochemical systems. Prerequisites: BIOC:3120 with a minimum grade of C. Requirements: two semesters of general chemistry and one semester of organic chemistry.
BIOC:3150 Development of Senior Research Project  
Preparation for biochemistry majors pursuing a senior research project in BIOC:4999; communicating technical information through writing and speaking; presenting scientific journal articles and writing experimental protocols; developing detailed proposal for one-year senior research project. Prerequisites: BIOC:3130 or BIOC:3120 or BIOC:3140. Requirements: biochemistry major, and junior or senior standing.

BIOC:3310 Practical Data Science and Bioinformatics  
Understanding how to access large biological data sets and use them to answer biological questions is an important skill for researchers; immersive introduction to computational handling of data; how to access and analyze publicly available data; critically evaluate data quality and analysis in context of measuring gene expression; basic coding in R/RSstudio, plotting and data display, fitting and regression, statistical inference, statistical models, downloading and data wrangling; basic introduction to machine learning (clustering); for students with no computational background. Prerequisites: BIOC:1411 with a minimum grade of C- and BIOL:1412 with a minimum grade of C-. Requirements: college algebra. Prerequisites: BIOC:3110, or BIOC:3120 and BIOC:3130, or other upper-level life sciences courses. Same as CBOI:3310, MMED:3310.

BIOC:3800 Biochemistry Teaching Practicum  
Training for qualified junior or senior undergraduates majoring in biochemistry or a related field to contribute to undergraduate courses; interns may hold review sessions, offer regular office hours, draft questions for homework or exams, assist in proctoring exams, assist students in a laboratory setting, and help with course implementation; guidance from the faculty director and instructors in each course; interns are expected to work approximately three hours per week for each semester hour of credit earned. Requirements: completion of a course covering the same or equivalent material with a grade of B or higher, and must arrange for a short interview with the appropriate course director prior to registration.

BIOC:3993 Undergraduate Biochemistry Research  
Preparation for BIOC:4999; directed research with a biochemistry faculty member; experience in an active biochemistry research lab, learning and performing experiments relevant to current projects in that lab, including exposure to scientific literature; arranged in advance by student and biochemistry faculty member.

BIOC:4241 Biophysical Chemistry I  
Principles and experimental approaches used to study structure and function of biological macromolecules; protein structure, stability, and dynamics; macromolecular interactions; common biophysical methods. Prerequisites: BIOC:3120 with a minimum grade of C- and BIOC:3130 with a minimum grade of C-. Requirements: one year of biochemistry. Recommendations: physical chemistry course and one semester of calculus.

BIOC:4242 Biophysical Chemistry II  
Principles and experimental approaches used to study structure and function of biological macromolecules; ligand binding and enzyme catalysis; X-ray crystallography; NMR spectroscopy. Prerequisites: BIOC:3120 with a minimum grade of C- and BIOC:3130 with a minimum grade of C-. Requirements: one year of biochemistry. Recommendations: physical chemistry course and one semester of calculus.

BIOC:4310 Computational Biochemistry  
Introduction to biomolecular modeling and computer simulation techniques; biomolecular structure and molecular driving forces; principles of structural optimization and conformational sampling; applications to biomolecular phenotypes; scripting and molecular visualization in PyMol, setting up and running molecular dynamics simulations using VMD and NAMD, performing refinement of X-ray diffraction data sets using Phenix, and executing Poisson-Boltzmann electrostatic calculations using APBS. Prerequisites: (MATH:1560 or MATH:1860) and CHEM:1120. Recommendations: BIOC:3110 or BIOC:3120. Same as BME:4310.

BIOC:4999 Advanced Undergraduate Biochemistry Research  
Advanced directed research with a biochemistry faculty member; work on an individualized research project relevant to research goals of that lab; learning related scientific literature and presentation of research results; arranged in advance by student and biochemistry faculty member and taken after completion of core biochemistry curriculum. Prerequisites: BIOC:3120 with a minimum grade of B- and BIOC:3130 with a minimum grade of B- and BIOC:3140 with a minimum grade of B- and BIOC:3150 with a minimum grade of B-. Requirements: BIOC:3993 or URES:3994 or HONR:3994 or prior research experience or lab practicum.

BIOC:5215 Directed Readings for Graduate Students  
Directed readings with course content arranged with professor.

BIOC:5241 Biophysical Chemistry I  
Principles and experimental approaches used to study structure and function of biological macromolecules; protein structure, stability, and dynamics; macromolecular interactions; common biophysical methods. Requirements: one year of biochemistry. Recommendations: physical chemistry course and one semester of calculus.

BIOC:5242 Biophysical Chemistry II  
Principles and experimental approaches used to study structure and function of biological macromolecules; ligand binding and enzyme catalysis; X-ray crystallography; NMR spectroscopy. Requirements: one year of biochemistry. Recommendations: physical chemistry course and one semester of calculus.

BIOC:5243 Biophysical Chemistry I, Module I  
Overview of principles of protein structure, stability, folding, and dynamics; brief treatment of structural biology approaches to help students become critical users of models derived from X-ray crystallography and NMR; taken alone or as part of BIOC:5241. Requirements: introductory course in biochemistry.

BIOC:5244 Biophysical Chemistry II, Module I  
Enzymes as unparalleled catalysts that represent a unique class of drug targets; focus on organic chemistry of enzyme catalyzed reactions and enzyme inhibition by small molecules from a medicinal chemistry perspective; chemical and enzyme kinetics, sources of catalytic power, chemical mechanisms used in enzyme catalysis, role of coenzymes; strategies in enzyme inhibition, drug resistance, drug synergism, reversible enzyme inhibitors, transition state analogs, slow tight binding inhibitors, irreversible inhibition; taken alone or as part of BIOC:5242. Requirements: introductory course in biochemistry. Same as PHAR:5542.
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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<td>BIOC:5246</td>
<td>Biophysical Chemistry II, Module II</td>
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<td>Biophysical Chemistry I, Module III</td>
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<td>BIOC:5261</td>
<td>Research Techniques</td>
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<td>Seminar</td>
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<td>BIOC:5875</td>
<td>Perspectives in Biocatalysis</td>
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<td>BIOC:7251</td>
<td>Introduction to Protein Structures</td>
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<td>BIOC:7252</td>
<td>Enzymes, Carbohydrates, Nucleic Acids, and Bioenergetics</td>
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