Biochemistry and Molecular Biology

Chair

Kris A. DeMali

Undergraduate major: biochemistry and molecular biology (BA, BS)

Graduate degrees: MS in biochemistry and molecular biology; PhD in biochemistry and molecular biology

Website: https://bmb.medicine.uiowa.edu

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 and Molecular Biology offers undergraduate and graduate degrees, and determines the curricula for those programs. Undergraduate students majoring in biochemistry and molecular biology receive their degrees (Bachelor of Arts or Bachelor of Science) from the College of Liberal Arts and Sciences. 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 and molecular, cellular, developmental, computational, and structural biology. Their research is supported by grants from the National Institutes of Health (NIH), the National Science Foundation (NSF), the American Heart Association, the American Cancer Society, the Muscular Dystrophy Association (MDA), and other sources. To learn more about the department's faculty members and areas of research, visit the Department of Biochemistry and Molecular Biology website.

Programs

Undergraduate Programs of Study

Majors

- Major in Biochemistry and Molecular Biology (Bachelor of Arts)
- Major in Biochemistry and Molecular Biology (Bachelor of Science)

Graduate Programs of Study

- Master of Science in Biochemistry and Molecular Biology
- Doctor of Philosophy in Biochemistry and Molecular Biology

Facilities

The Department of Biochemistry and Molecular Biology 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, and 1,450 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. Faculty, staff, and students in the department have access to a variety of shared Carver College of Medicine resources, including the Protein and Crystallography Facility, the Iowa Institute of Human Genetics Genomics Division (DNA Facility), the Nuclear Magnetic Resonance Facility, and the Central Microscopy Research Facility.

Courses

Biochemistry and Molecular Biology Courses

BMB: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. Prerequisites: CHEM:2210 with a minimum grade of C- or CHEM:2230 with a minimum grade of C-. Recommendations: college-level biology course.

BMB:3120 Biochemistry and Molecular Biology I **3 s.h.**
First of the two-semester sequence of biochemistry courses, followed by BMB:3130. Physical and chemical foundations of biochemistry, structure of biological molecules, catalysis, transport, biosignaling, glycolysis, and gluconeogenesis. Prerequisites: CHEM:2210 with a minimum grade of C- or CHEM:2230 with a minimum grade of C-. Recommendations: college-level biology course.

BMB:3130 Biochemistry and Molecular Biology II **3 s.h.**
Second of the two-semester comprehensive biochemistry sequence. Glycogen metabolism, citric acid cycle and the molecular principles of photosynthesis and oxidative phosphorylation; metabolism of lipids, amino acids, and nucleic acids; DNA replication, transcription, and protein translation; team-taught, didactic lecture style. Prerequisites: BMB:3120 with a minimum grade of C-.

BMB:3140 Experimental Biochemistry **3 s.h.**
Use of modern instruments and techniques to fractionate, identify, and characterize constituents of biochemical systems. Prerequisites: BMB:3120 with a minimum grade of C-. Requirements: two semesters of general chemistry and one semester of organic chemistry.

BMB:3150 Development of Senior Research Project **2 s.h.**
Preparation for biochemistry majors pursuing a senior research project in BMB: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: BMB:3120 or BMB:3140 or BMB:3130. Requirements: biochemistry major, and junior or senior standing.

BMB:3310 Practical Data Science and Bioinformatics 3 s.h.
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/RStudio, 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: BIOL:1411 with a minimum grade of C- and BIOL:1412 with a minimum grade of C-. Requirements: college algebra. Recommendations: BMB:3110, or BMB:3120 and BMB:3130, or other upper-level life sciences courses. Same as CBIO:3310, MMED:3310.

BMB:3800 Biochemistry Teaching Practicum arr.
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.

BMB:3993 Undergraduate Biochemistry Research arr.
Preparation for BMB:4999; directed research with a biochemistry and molecular biology faculty member; experience in an active biochemistry and molecular biology 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 and molecular biology faculty member.

BMB:4240 Biophysics and Advanced Biochemistry 3 s.h.
Principles and experimental approaches used to study macromolecular structure, stability, and function; ligand binding and macromolecular interactions; enzyme kinetics and mechanisms; X-ray crystallography and NMR spectroscopy; single molecule and other biophysical approaches. Prerequisites: BMB:3120 and BMB:3130 with a minimum grade of C-. Requirements: one year of biochemistry. Recommendations: physical chemistry course and one semester of calculus.

BMB:4310 Computational Biochemistry 3 s.h.
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: BMB:3110 or BMB:3120. Same as BME:4310.

BMB:4999 Advanced Undergraduate Biochemistry Research arr.
Advanced directed research with a biochemistry and molecular biology 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 and molecular biology faculty member and taken after completion of core biochemistry and molecular biology curriculum. Prerequisites: BMB:3120 with a minimum grade of B- and BMB:3130 with a minimum grade of B- and BMB:3140 with a minimum grade of B- and BMB:3150 with a minimum grade of B- and (BMB:3993 or URES:3994 or HONR:3994).

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

BMB:5240 Biophysics and Advanced Biochemistry 3 s.h.
Principles and experimental approaches used to study macromolecular structure, stability, and function; ligand binding and macromolecular interactions; enzyme kinetics and mechanisms; X-ray crystallography and NMR spectroscopy; single molecule and other biophysical approaches. Requirements: one year of biochemistry. Recommendations: physical chemistry course and one semester of calculus.

BMB:5261 Research Techniques 1-6 s.h.
Laboratory rotation for first-year graduate students in biochemistry.

BMB:5282 Seminar 0-2 s.h.
How to evaluate reports of scientific investigations critically; techniques for presenting scientific information.

BMB:5875 Perspectives in Biotechnology 1 s.h.
Topics related to careers in biotechnology with an emphasis on preparing graduate students for careers outside of academia; discussions led by a series of guest speakers from leading biotech industries; understanding the societal impact of basic research; participation in round-table discussions; and presentation of student research findings. Requirements: graduate standing and good academic standing in a participating department supported by the Predoctoral Training Program in Biotechnology. Same as CBE:5875, CEE:5875, CHEM:5875, MICR:5875, PHAR:5875.

BMB:7251 Introduction to Protein Structures 1 s.h.
Basics of protein structures and amino acids; module covers selected chapters of Lehninger's *Principles of Biochemistry*. Recommendations: first-year graduate standing in biosciences or physical sciences.

BMB:7252 Enzymes, Carbohydrates, Nucleic Acids, Lipids, and Membranes 1 s.h.
Basics of enzyme kinetics and enzyme mechanisms, carbohydrates, nucleic acids, and lipids; module covers selected chapters of Lehninger's *Principles of Biochemistry*. Recommendations: first-year graduate standing in biosciences or physical sciences.

BMB:7253 Introduction to Metabolism 1 s.h.
Introduction to metabolism including bioenergetics of metabolic reactions, biochemical signaling, and the basics of carbohydrate metabolism (glycolysis, gluconeogenesis, the pentose phosphate pathway). Module covers selected chapters of Lehninger's *Principles of Biochemistry*. Recommendations: first-year graduate standing in biosciences or physical sciences.

BMB:7254 Metabolism I 1 s.h.
Glycogen metabolism, the citric acid cycle, and amino acid and fatty acid catabolism. Module covers selected chapters of Lehninger's *Principles of Biochemistry*. Recommendations: first-year graduate standing in biosciences or physical sciences.

BMB:7255 Metabolism II 1 s.h.
Oxidative phosphorylation, photosynthesis, the synthesis of nitrogen-containing compounds (amino acids, nucleotides), and principles of hormonal regulation of metabolic pathways. Module covers selected chapters of *Principles of Biochemistry* by Lehninger. Recommendations: first-year graduate standing in biosciences or physical sciences.

BMB:7256 Molecular Biology 1 s.h.
Chromosomal organization, DNA replication, gene expression, RNA processing, and translation; module covers selected chapters of Lehninger's *Principles of Biochemistry*; for graduate students who wish to refresh or advance their knowledge of the central dogma of molecular biology. Recommendations: first-year graduate standing in biosciences or physical sciences.

BMB:7292 Research Biochemistry arr.
Thesis research.

BMB:8101 Biochemistry for Dental Students 3 s.h.
Biochemical concepts and application to clinical problems. Requirements: CHEM:2210 and DDS enrollment. Recommendations: CHEM:2220.