BIOCHEMISTRY

The biochemistry major provides interdisciplinary training, education and experience in the chemical and biological sciences. Biochemistry focuses on understanding the chemical processes of living organisms, the reaction pathways that sustain life, the principles of how structure defines function and the physical basis of biomolecular interactions. Students who major in biochemistry are prepared for diverse careers in medicine, scientific research, biotechnology, pharmacy, biomedical consulting, teaching and education, among other professions.

Because biochemistry connects to scientific disciplines ranging from genetics, human physiology, microbiology, neuroscience, cell biology, chemistry and geology, biochemistry majors are given the freedom to explore advanced electives in many of these subjects. Additional information about the biochemistry BA can be found on the Biochemistry Department website (https://www.colorado.edu/biochemistry/).

Course code for this program is BCHM.

Bachelor's Degree

- Biochemistry - Bachelor of Arts (BA) (https://catalog.colorado.edu/undergraduate/colleges-schools/arts-sciences/programs-study/biochemistry/biochemistry-bachelor-arts-ba/)

Minor

- Biochemistry - Minor (https://catalog.colorado.edu/undergraduate/colleges-schools/arts-sciences/programs-study/biochemistry/biochemistry-minor/)

Faculty

While many faculty teach both undergraduate and graduate students, some instruct students at the undergraduate level only. For more information, contact the faculty member's home department.

Ahn, Natalie (https://experts.colorado.edu/display/fisid_106044/)
Distinguished Professor; PhD, University of California, Berkeley

Aydin, Halil (https://experts.colorado.edu/display/fisid_167398/)
Assistant Professor; PhD, University of Toronto

Batey, Robert T. (https://experts.colorado.edu/display/fisid_122668/)
Professor; PhD, Massachusetts Institute of Technology

Cameron, Jeffrey C. (https://experts.colorado.edu/display/fisid_156473/)
Assistant Professor; PhD, Washington University

Caruthers, Marvin H. (https://experts.colorado.edu/display/fisid_103328/)
Distinguished Professor; PhD, Northwestern University

Cech, Thomas R. (https://experts.colorado.edu/display/fisid_103252/)
Distinguished Professor; PhD, University of California, Berkeley

Falke, Joseph J. (https://experts.colorado.edu/display/fisid_101970/)
Professor; PhD, California Institute of Technology

Goodrich, James (https://experts.colorado.edu/display/fisid_109239/)
Professor, Chair; PhD, Carnegie Mellon University

Kasinath, Vignesh (https://experts.colorado.edu/individual/fisid_167418/)
Assistant Professor; PhD, University of Pennsylvania

Khanal, Akhil
Instructor; PhD, University of Delaware

Kuchta, Robert (https://experts.colorado.edu/display/fisid_100844/)
Professor; PhD, Brandeis University

Kugel, Jennifer F. (https://experts.colorado.edu/display/fisid_109472/)
Research Professor; PhD, University of Colorado Boulder

Liu, Xuedong (https://experts.colorado.edu/display/fisid_118458/)
Professor; PhD, University of Wisconsin–Madison

Mchenry, Charles
Professor Emeritus; PhD, University of California, Santa Barbara

Palmer, Amy E. (https://experts.colorado.edu/display/fisid_141901/)
Professor; PhD, Stanford University

Pardi, Arthur
Professor Emeritus; PhD, University of California, Berkeley

Parker, Roy Robert (https://experts.colorado.edu/display/fisid_151440/)
Distinguished Professor; PhD, University of California, San Francisco

Rinn, John (https://experts.colorado.edu/display/fisid_159338/)
Professor; PhD, Yale University

Schnizer-Luger, Karoline (https://experts.colorado.edu/display/fisid_156579/)
Endowed Chair, Professor; PhD, Univ of Basel (Switzerland)

Sousa, Marcelo Carlos (https://experts.colorado.edu/display/fisid_122806/)
Professor; PhD, Univ of Buenos Aires (Argentina)

Spencer, Sabrina Leigh (https://experts.colorado.edu/display/fisid_154911/)
Associate Professor; PhD, Massachusetts Institute of Technology

Stephen, Ricardo Hugh (https://experts.colorado.edu/display/fisid_145994/)
Senior Instructor; PhD, University of Colorado Boulder

Taatjes, Dylan J. (https://experts.colorado.edu/display/fisid_102436/)
Professor; PhD, University of Colorado Boulder

Whiteley, Aaron (https://experts.colorado.edu/display/fisid_166299/)
Assistant Professor; PhD, University of California, Berkeley

Whiteley, Alexandra (https://experts.colorado.edu/display/fisid_166300/)
Assistant Professor; PhD, University of California, San Francisco

Wuttke, Deborah S. (https://experts.colorado.edu/display/fisid_108412/)
Professor, Associate Chair; PhD, California Institute of Technology

Courses

BCHM 1020 (1) A Path to Success: Introduction to the Biochemistry Major
This course will help students navigate their first year of college and develop the skills needed for academic success as Biochemistry majors. Students will improve academic strategies (i.e. time management, problem-solving and study skills), identify available campus resources, learn how to get involved in clubs and gain research experience, and explore career opportunities as a biochemistry graduate. This is a first-year elective course specifically designed for first year and other students exploring their educational and career opportunities.
Recommended: New BCHM majors.

BCHM 1041 (3) Biotechnology and Society
Covers recent advances in biotechnology and how those impact society. Content and discussion will focus on both the science behind technological advances, their impact on society, and the ethical issues raised by new technologies. Topics change each semester but can include: GMO crops, genome editing, drug discovery and development, stem cell therapies, development and use of new cancer treatments, human genome sequencing and its impact on diagnosis and treatments, human microbiome, neurodegenerative diseases. Formerly CHEM 1041.
Requisites: Restricted to students with 0-56 credits (Freshmen or Sophomore) only.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

BCHM 1701 (1) Biochemistry Program for Research Exploration and Planning
Biochem PREP is focused on developing first and second year student interest and engagement in undergraduate research. The program is designed to present participants with mentorship and opportunities to identify whether research is an opportunity students wish to participate in, and if so, get students connected to potential research opportunities. Participants will be provided with a cohort of their peers to explore and plan for research together through preparation workshops, research information sessions, and mentorship. The ultimate goal of the program is for participants to understand their research interests, possess the necessary skills to identify and obtain a research opportunity, and develop community with their peers and the Department of Biochemistry at large.
Requisites: Restricted to Biochemistry (BCHM) majors and minors only.

BCHM 2700 (4) Foundations of Biochemistry
Covers chemistry of aqueous solutions; energetics in biology; structure of proteins, nucleic acids, carbohydrates, and membranes; protein evolution; macromolecular interactions; enzyme kinetics, mechanism and regulation. Will be taught from a strong chemical perspective and mastery of basic concepts of general and organic chemistry will be required. Familiarity with basic concepts of molecular and cellular biology encouraged. Formerly CHEM 4700.
Requisites: Requires prerequisite course of CHEM 3311 or CHEM 3451 (minimum grade C-). Restricted to Biochemistry (BCHM) majors and minors only.

BCHM 3100 (2) Engineering RNA Aptamers
Provides laboratory experience working on an RNA sensor research project. Students will generate libraries of RNA aptamers and select and isolate aptamers that bind a novel ligand of interest. Topics covered include principles of RNA molecular recognition, polymerase chain reaction and molecular cloning, bacterial transformation, fluorescence reporter assays and high throughput screening.
Requisites: Requires prerequisite or corequisite course of BCHM 2700 or BCHM 4611 (minimum grade C-).

BCHM 3110 (1) Literature-based Co-seminar for BCHM 3100 CURE Laboratory Course
This course involves reading and discussion of primary literature. Each week students will read a scientific research article, and engage in a class discussion about the significance and impact, the scientific merits, the underlying premise of the research question and experimental plan, and whether data support conclusions of the paper. Papers will be focused on RNA structure and function, RNA molecular recognition, RNA aptamers, RNA engineering, RNA as a drug target, and fluorescent probes for RNA. Students will be responsible for reading each paper, one student will prepare a powerpoint and lead a class discussion each week, and all students are expected to participate in the discussion.
Requisites: Requires prerequisite or corequisite course of BCHM 2700 or BCHM 4611 (minimum grade C-).

BCHM 3491 (4) Organic Chemistry 2 for Biochemistry Majors
Covers amines, alkylation reactions, additions to unsaturated C-C bonds, aromaticity and aromatic reactivity, organic materials, biomolecules, nomenclature of organic compounds, reaction mechanism. Department enforced corerquisite: CHEM 3341 or CHEM 3381. Formerly CHEM 3491.
Equivalent - Duplicate Degree Credit Not Granted: CHEM 3471 and CHEM 3331
Requisites: Requires prerequisite courses of CHEM 3451 and CHEM 3321 or CHEM 3361 (all minimum grade C-). Restricted to Chemistry (CHEM) or Biochemistry (BCHM) majors only.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

BCHM 4312 (3) Quantitative Optical Imaging
Explores the fundamentals of optical imaging in biology, especially molecular and cellular biology. Covered topics include an introduction to optics and microscopes, fluorescence microscopy and image analysis, and biological applications. MATLAB will be taught at the beginning of the course and used throughout for image processing. Prior experience with MATLAB (or Python) is highly recommended but not required.
Equivalent - Duplicate Degree Credit Not Granted: MCDB 4312, MCDB 5312 and BCHM 5312
Grading Basis: Letter Grade

BCHM 4400 (4) Core Concepts in Physical Chemistry for Biochemists
Introduces thermodynamics, kinetics and spectroscopy, emphasizing macromolecule and biochemical applications. Includes thermodynamics, chemical and physical equilibriums, solution chemistry, rates of chemical and biochemical reactions, chemical bonds and principles and selected examples of spectroscopies applied to biological systems. Department enforced prerequisite or corequisite: PHYS 1120 or PHYS 2020. Formerly CHEM 4411.
Equivalent - Duplicate Degree Credit Not Granted: BCHM 5400 CHEM 4511
Requisites: Requires prerequisite courses BCHM 2700 or BCHM 4611 or BCHM 4700 or and PHYS 1110 or PHYS 2010 and MATH 2300 or APPM 1360 (all minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

BCHM 4491 (3) Modern Biophysical Methods
Covers the basic theory of biophysical methods widely employed in biochemistry and biology, including: electrophoresis, mass spec, calorimetry, evanescent waves, plasmon resonance, Xray diffraction, absorbance and fluorescence spectroscopy, magnetic resonance, electron and optical microscopy and single molecule methods. Discusses ways to maximize rigor and reproducibility in biophysical studies. Department enforced prerequisites: undergraduate chemistry (general, organic physical); physics; calculus.
Equivalent - Duplicate Degree Credit Not Granted: BCHM 5491
Requisites: Requires prerequisite courses of PHYS 1110 or PHYS 2010 and MATH 2300 or APPM 1360 and BCHM 2700 or BCHM 4700 or BCHM 4611 (all minimum grade C).
Recommended: Prerequisite or corequisite BCHM 4400 or CHEM 4531.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

BCHM 4611 (3) Principles of Biochemistry
One-semester overview of the main themes of modern biochemistry: biomolecular structure/function, metabolism, biosynthesis, DNA from genome to proteome and cellular signaling. For biology and engineering majors and others wanting an overview of biochemistry. Formerly CHEM 4611.
Equivalent - Duplicate Degree Credit Not Granted: BCHM 5611
Requisites: Requires prerequisite course of CHEM 3311 or CHEM 3451 (minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

BCHM 4621 (3) Genome Databases: Mining and Management
Develops essential skills for performing genomic analyses, with focus on developing practical research tools. Introduces human genome and microbiome projects, Python/Sql scripting, accessing and understanding genomic data, sequence alignment and search, evolutionary models, expression data, biological networks, and macromolecular structure.
Equivalent - Duplicate Degree Credit Not Granted: MCDB 4621, MCDB 5621 and BCHM 5621
Requisites: Requires prerequisite course of BCHM 2700 or BCHM 4700 or CSCI 3104 or MCDB 3500 (minimum grade C-).
Recommended: Prerequisite MCDB 3135 or CSCI 3104 or BCHM 2700 and recommended corequisite of CSCI 2270.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

BCHM 4631 (3) Statistical and Computational Analysis of the Human Genome
This lab course covers fundamental statistical and computational approaches to large scale data. Students will learn the unix command line to: access public human genome data, learn what statistics apply to which types of data and apply them to study specific regions of the human genome involved in development and disease. This lab course will cover fundamental aspects of Virtual computing, Container analysis pipelines (e.g. NextFlow, GItHub) in an intuitive and practical learning framework.
Equivalent - Duplicate Degree Credit Not Granted: BCHM 5631
Requisites: Requires prerequisite course of BCHM 4740 or MCDB 3135 (minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

BCHM 4720 (4) Metabolic Pathways and Human Disease
Covers energy metabolism and anabolic/catabolic pathways; metabolism of carbohydrates, lipids, amino acids, and nucleic acids; photosynthesis; special topics on human diseases with pathologies and metabolic pathways. Formerly CHEM 4720.
Equivalent - Duplicate Degree Credit Not Granted: BCHM 5720
Requisites: Requires prerequisite courses of BCHM 2700 and CHEM 3331 or CHEM 3471 or BCHM 3491 (all minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

BCHM 4740 (4) Biochemistry of Gene Transmission, Expression and Regulation
Covers biosynthesis and function of macromolecules including DNA, RNA and proteins; molecular basis of replication, transcription and translation; biochemistry of subcellular systems; signaling and regulation of gene expression in eukaryotes; and special topics. Formerly CHEM 4740.
Equivalent - Duplicate Degree Credit Not Granted: BCHM 5740
Requisites: Requires a prerequisite course of BCHM 2700 or CHEM 4700 (minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

BCHM 4751 (3) Current Topics in Biochemical Research
Lec. Covers current topics in modern biochemical research through lectures, reading recent research articles, critical thinking and class discussion. Topics include protein and nucleic acid structure and function, biomolecular interactions, enzyme function and cellular signaling and regulation. Formerly CHEM 4751.
Equivalent - Duplicate Degree Credit Not Granted: BCHM 5751
Requisites: Requires prerequisite courses of MCDB 3135 or BCHM 4700 or BCHM 2700 and BCHM 4740 (all minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

BCHM 4761 (3) Biochemistry Laboratory
Two 4-hour periods per week. Introduction to modern biochemical techniques. Topics include enzymology, spectrophotometry, electrophoresis, multi-step protein purification, recombinant DNA techniques and molecular cloning. Formerly CHEM 4761.
Requisites: Requires prerequisite courses of BCHM 2700 or CHEM 4700 and CHEM 3341 or 3381 (all minimum grade C-). Restricted to Chemistry (CHEM) or Biochemistry (BCHM) majors only.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sci Lab Arts Sci Gen Ed: Distribution-Natural Sciences

BCHM 4850 (3) Chemistry and Biology of Nucleic Acids
A comprehensive course in advanced topics in nucleic acid chemistry and biology. Topics will include the chemical properties of nucleic acids, chemical and biological synthesis, structure, biology of ribozymes and ribonuclear complexes, protein recognition, nucleic acids as targets and therapeutics and diagnostic and other applications of nucleic acids.
Equivalent - Duplicate Degree Credit Not Granted: BCHM 5850
Requisites: Requires prerequisite course of BCHM 2700 or BCHM 4611 (minimum grade C-).
Grading Basis: Letter Grade

BCHM 4901 (1-6) Independent Study in Biochemistry
For undergraduate study. Department consent required.
Repeatable: Repeatable for up to 8.00 total credit hours.