

# BIOCHEMISTRY, BS

## Introduction

Please click here (<http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/chemistry/>) to see Chemistry department information.

Biochemistry is the chemistry of life - the molecules, reactions, and energy transformations that underlie structure and function in all living organisms. The study of biochemistry combines knowledge from chemistry, biology, physics, and mathematics (and sometimes other disciplines) to understand how life works at the molecular level. This integrated scientific knowledge will be essential for understanding the future of human health, sustainable energy, and the environment.

The BS Biochemistry program at CU Denver strongly emphasizes connections between basic science and human health. Required coursework covers much of the foundational knowledge and skills for graduate and health professions entrance exams. Several courses explore connections between cutting-edge biochemical research and different diseases. Students are encouraged to take advantage of undergraduate research opportunities in biochemistry and related fields either at CU-Denver or on the nearby Anschutz Medical campus. Graduates learn skills in critical thinking, problem solving, and scientific communication for careers in the health and natural sciences.

A BS in Biochemistry stands out as a premiere accomplishment in applications for professional degree programs, including pharmacy, medicine, nursing, dentistry, medical technology, and many others.

These degree requirements are subject to periodic revision by the academic department, and the College of Liberal Arts and Sciences reserves the right to make exceptions and substitutions as judged necessary in individual cases. Therefore, the College strongly urges students to consult regularly with their major advisor and CLAS advisor to confirm the best plans of study before finalizing them.

Qualified majors are strongly urged to participate in directed research and departmental honors programs. We also strongly encourage Biochemistry majors to participate in the Chemistry department by serving as learning assistants or teaching assistants.

Students interested in the Biochemistry major or a double Chemistry and Biochemistry major should consult regularly with a Biochemistry Major Advisor: Dr. Kyoung Nan Kim [kyoung.kim@ucdenver.edu](mailto:kyoung.kim@ucdenver.edu) or Dr. Marta K. Maroń [marta.maron@ucdenver.edu](mailto:marta.maron@ucdenver.edu).

## Program Delivery

- This is an on-campus program.

## Declaring This Major

- Click here (<http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/#policiestext>) to go to information about declaring a major.

## General Requirements

To earn a degree, students must satisfy all requirements in each of the three areas below, in addition to their individual major requirements.

- CU Denver General Graduation Requirements (<http://catalog.ucdenver.edu/cu-denver/undergraduate/graduation/>)
- CU Denver Core Curriculum (<http://catalog.ucdenver.edu/cu-denver/undergraduate/graduation-undergraduate-core-requirements/>)
- College of Liberal Arts & Sciences Graduation Requirements (<http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-liberal-arts-sciences/#graduationrequirementstext>)
- Click here (<http://catalog.ucdenver.edu/cu-denver/undergraduate/academic-policies-procedures/>) for information about Academic Policies

## Program Requirements

1. Students must complete a minimum of 74 credit hours, including a minimum of 33 CHEM credit hours.
2. Students must complete a minimum of 16 upper-division (3000-level and above) CHEM credit hours.
3. Students must earn a minimum grade of C- (1.7) in all courses that apply to the major and must achieve a minimum cumulative major GPA of 2.0. Courses taken using P+/P/F or S/U grading cannot apply to major requirements.
4. Students must complete a minimum of 14 credits hours with CU Denver faculty including CHEM 4518 Physical Chemistry Laboratory: Reaction Analysis or CHEM 4538 Physical Chemistry Laboratory: Molecular Structure or CHEM 4548 Physical Biochemistry Laboratory.

## Program Restrictions, Allowances and Recommendations

1. A student who has declared a Biochemistry major at CU Denver may not take additional chemistry courses outside of the department for the purpose of applying those credits toward meeting the requirements of the major without prior written approval of the undergraduate Biochemistry advisor. No more than 3 additional hours of such pre-approved transfer credits will be allowed.
2. All courses applied to the Biochemistry major need to be taken within ten years of the graduation date with the exception General Chemistry I and II Lecture and Lab: CHEM 2031 General Chemistry I, CHEM 2081 Honors General Chemistry I, CHEM 2038 General Chemistry Laboratory I, CHEM 2039 Majors General Chemistry I Laboratory, CHEM 2088 Honors General Chemistry I Laboratory, CHEM 2061 General Chemistry II, CHEM 2091 Honors General Chemistry II Lecture, CHEM 2068 General Chemistry Laboratory II, CHEM 2069 Majors General Chemistry II Laboratory and CHEM 2098 Honors General Chemistry II Laboratory. In the event that the student would like to apply for expired credit for CHEM 3481 Majors Organic Chemistry I, the student will need to test at the 50th percentile on the ACS Standardized Exam for Organic Chemistry I.
3. PHYS 2321 Intro Experimental Phys Lab I and PHYS 2341 Intro Experimental Phys Lab II are specifically designed for students in non-Physics majors and can be paired with either PHYS 2010 College Physics I and PHYS 2020 College Physics II or PHYS 2311 General Physics I: Calculus-Based and PHYS 2331 General Physics II: Calculus-Based lectures. Students pursuing a second major in Physics should complete PHYS 2311 General Physics I: Calculus-Based and PHYS 2331 General Physics II: Calculus-Based and PHYS 2351 Applied Physics Lab I and PHYS 2361 Applied Physics Lab II.

4. Students may double major in Biochemistry and Chemistry. Students can apply the requirements for both majors, if the respective courses are a major requirement for both the Chemistry and Biochemistry major. A course cannot fulfill more than two requirement/elective areas in a student's degree.

Code	Title	Hours
Complete the following program requirements		
Complete all of the following required CHEM courses:		33
CHEM 2031	General Chemistry I	3
or CHEM 2030	Majors General Chemistry I	
CHEM 2039	Majors General Chemistry I Laboratory	3
or CHEM 2038	General Chemistry Laboratory I	
CHEM 2061	General Chemistry II	3
or CHEM 2060	Majors General Chemistry II	
CHEM 2069	Majors General Chemistry II Laboratory	3
or CHEM 2068	General Chemistry Laboratory II	
CHEM 3481	Majors Organic Chemistry I	3
CHEM 3488	Majors Organic Chemistry Laboratory I	
CHEM 3491	Majors Organic Chemistry II	3
CHEM 3498	Majors Organic Chemistry Laboratory II	
CHEM 4500	Foundations of Physical Chemistry <sup>1</sup>	3
CHEM 4521	Physical Chemistry: Quantum and Spectroscopy	
or CHEM 4511	Physical Chemistry: Thermodynamics and Kinetics	3
CHEM 4548	Physical Biochemistry Laboratory	
or CHEM 4538	Physical Chemistry Laboratory: Molecular Structure	3
or CHEM 4518	Physical Chemistry Laboratory: Reaction Analysis	
CHEM 4810	General Biochemistry I	3
or CHEM 5810	Graduate Biochemistry I	
CHEM 4828	Biochemistry Lab	3
Complete nine credits from three of the following advanced biochemistry courses:		
BIOL 4125	Molecular Biology Laboratory	3
BIOL 4225	Genomics and Bioinformatics	
CHEM 4411	Bioconjugate Techniques and Theranostic Nanomedicine	3
CHEM 4600	Advanced Topics in Chemistry <sup>3</sup>	
CHEM/BIOL 4815	Structural Biology of Neurodegenerative Diseases	3
CHEM 4820	General Biochemistry II	
CHEM/BIOL 4825	Biochemistry of Metabolic Disease	3
CHEM/BIOL 4835	Biochemistry of Gene Regulation and Cancer	
CHEM 4845	Molecular Modeling and Drug Design	3
CHEM 4860	Bioinorganic Chemistry: Bioinorganic compounds in medicine	
CHEM 4880	Directed Research <sup>2</sup>	3
CHEM 5830	Graduate Biochemistry II	
Complete six credits from the following molecular science elective courses, not already completed:		6
BIOL 3124	Introduction to Molecular Biology	3
BIOL 3226	Human Physiology	
BIOL 3611	General Cell Biology	

BIOL 3650 & BIOL 3651	General Microbiology and General Microbiology Lab	
BIOL 3763	Biostatistics	
BIOL 3804	Developmental Biology	
BIOL 3832	General Genetics	
BIOL 4024	Introduction to Biotechnology	
BIOL 4064	Cell Biology of Disease	
BIOL 4165	Neurobiology	
BIOL 4550	Cell Signaling	
CHEM 4121	Instrumental Analysis	
CHEM 4421/5421	Cannabis Chemistry	
CHEM 4511	Physical Chemistry: Thermodynamics and Kinetics	
CHEM 4521	Physical Chemistry: Quantum and Spectroscopy	
CHEM 4630 & CHEM 4580	Programming for Data Analysis in the Physical Sciences and Molecular Informatics <sup>4</sup>	
CHEM 4640	Artificial Intelligence in Chemistry and Biochemistry	
CHEM 4700	Environmental Chemistry	
CHEM 4880	Directed Research	
PHYS 3452	Biophysics of the Cell NM	
PSYC 3832	Neural Basis of Learning	
Complete ancillary coursework.		26
Biology (p. 2)		
Mathematics (p. 3)		
Physics (p. 3)		
Total Hours		74

<sup>1</sup> Students who choose Physics **Sequence A** can substitute MATH 2421 Calculus III or MATH 3511 Mathematics of Chemistry in place of CHEM 4500 Foundations of Physical Chemistry.

<sup>2</sup> For faculty-mentored research projects related to biochemistry. Major credit for this course requires prior approval from the Biochemistry majors advisor and the research mentor. Major credits do not count toward departmental Honors requirements.

<sup>3</sup> Certain topics, with permission from the Biochemistry Advisor.

<sup>4</sup> These two together fulfill one Molecular Science Elective requirement.

## Biology

Code	Title	Hours
<i>Complete the following:</i>		
BIOL 2010	Organisms to Ecosystems (Gen Bio)	3
or BIOL 2030	Honors Organisms to Ecosystems (Gen Bio)	
BIOL 2011	Organisms to Ecosystems Lab (Gen Bio)	3
or BIOL 2031	Honors Organisms to Ecosystems Lab (Gen Bio)	
BIOL 2020	Molecules to Cells (Gen Bio)	3
or BIOL 2040	Honors Molecules to Cells (Gen Bio)	
BIOL 2021	Molecules to Cells Lab (Gen Bio)	3
or BIOL 2041	Honors Molecules to Cells Lab (Gen Bio)	

## Mathematics

Code	Title	Hours
<i>Complete the following:</i>		<i>8</i>
MATH 1401	Calculus I	
MATH 2411	Calculus II	

## Physics

Code	Title	Hours
<i>Complete one of the following sequences. Refer to note 3 under Program Restrictions, Allowances and Recommendations for alternative Physics lab information:</i>		<i>10</i>
Sequence A <sup>1</sup>		
PHYS 2311	General Physics I: Calculus-Based	
PHYS 2321	Intro Experimental Phys Lab I	
PHYS 2331	General Physics II: Calculus-Based	
PHYS 2341	Intro Experimental Phys Lab II	
Sequence B		
PHYS 2010	College Physics I	
PHYS 2321	Intro Experimental Phys Lab I	
PHYS 2020	College Physics II	
PHYS 2341	Intro Experimental Phys Lab II	

<sup>1</sup> Students who choose Physics **Sequence A** can substitute MATH 2421 Calculus III or MATH 3511 Mathematics of Chemistry in place of CHEM 4500 Foundations of Physical Chemistry.

To learn more about the Student Learning Outcomes for this program, please visit our website (<https://clas.ucdenver.edu/chemistry/undergraduate-students/bs-biochemistry/>).

To review the Degree Map for this program, please visit our website (<https://www.ucdenver.edu/student/advising/undergraduate/degree-maps/clas/>).