

Biochemistry (BA/BS)

The Department of Chemistry and Biochemistry offers majors in chemistry and biochemistry. Biochemistry majors complete an integrated, rigorous program that includes foundational course work in chemistry and biochemistry and additional course work in related fields. Undergraduate majors benefit from taking graduate courses in synthetic modeling, physical chemistry, materials, computational chemistry, biochemistry, molecular biology, and modern instrumental techniques.

The American Chemistry Society-certified degree emphasizes laboratory experience and the development of professional skills. A unique strength of the department is the opportunity for undergraduates to participate in the activities of a dynamic research group that considers problems extending well beyond textbook instruction.

Program Learning Outcomes

Upon successful completion of this program, students will be able to:

- **Coursework:** Students will demonstrate an understanding of the fundamental concepts in the basic areas of the discipline (organic, inorganic, analytical, physical, and biochemical). Students will demonstrate a firm foundation in the conceptual, quantitative, and computational thinking that underlies the theories and models that form the basis for reasoning about molecular systems. Students will be able to connect this theoretical understanding to the experimental methods used to test those theories and models. Students will also have opportunities to obtain in-depth knowledge in multiple areas of the discipline. The foundational and in-depth coursework will be aligned with the most recent American Chemical Society Guidelines for Chemistry Programs (<https://www.acs.org/education/policies/acs-approval-program.html>).
- **Instructional Laboratory:** Students will demonstrate proficiency in laboratory techniques and the use of modern instrumentation. Students will be able to carry out experiments in the laboratory, accurately record data and observations, and be able to analyze the results of experiments. Students will be able to handle, synthesize, purify, and characterize new and existing substances. This includes knowing the proper procedures and regulations for the safe handling, use and disposal of chemicals.
- **Research:** Students will employ critical thinking and the scientific method to design, carry out, record, analyze and communicate the results of chemical/biochemical experiments. This includes the ability to identify, or create an appropriate model, formulate a hypothesis, choose an appropriate set of tools and techniques, and design an experiment that tests the hypothesis and analyze the results from that experiment drawing sound scientific conclusions from the results obtained. Students must be able to locate, identify and critically evaluate the chemical/biochemical literature.
- **Communication:** Students will demonstrate effective scientific communication skills, both orally and in writing, to a range of audience levels and for a variety of purposes. Students will understand how scientific information is shared between peers in modern science, including responsible conduct for acknowledging prior and current contributions.
- **Professional Skills:** Students will develop the interpersonal skills to function cooperatively in a team setting. Students will successfully pursue their career objectives in advanced education in professional and/or graduate schools, in a scientific career in government or

industry, in a teaching career in the school systems, or in a related career following graduation

- **Ethics:** Students will be able to understand and apply ethics and values to all professional activities. Students will demonstrate an awareness of the benefits and impacts of chemistry related to the environment, society, and other disciplines outside the scientific community. Students will be prepared to contribute solutions to society's challenges at the intersection of science and society.

Courses taken to satisfy major requirements must be passed with grades of C– or better. Variations in courses and order may be worked out in consultation with an advisor.

Students who plan to attend graduate school should include research in their advanced work. If chemical research is included as part of the advanced work, at least 6 credits of CH 401 Research: [Topic] must be completed. Students who plan to apply to medical schools should investigate the need for a physics laboratory course that is not included in this curriculum.

Biochemistry Major Requirements

Code	Title	Credits
Required Chemistry Courses		
CH 221	General Chemistry I	4
or CH 224H	Advanced General Chemistry I	
CH 222	General Chemistry II	4
or CH 225H	Advanced General Chemistry II	
CH 223	General Chemistry III	4
or CH 226H	Advanced General Chemistry III	
CH 227	General Chemistry Laboratory	2
or CH 237		
CH 228	General Chemistry Laboratory	2
or CH 238		
CH 229	General Chemistry Laboratory	2
or CH 239		
CH 337	Organic Chemistry Laboratory	3
CH 341–343	Majors Track Organic Chemistry I-III	12
CH 348	Organic Chemistry Laboratory for Majors	4
CH 411–412	Physical Chemistry	8
CH 461–463	Biochemistry	12
CH 467	Biochemistry Laboratory	4
Related Science Requirements		
MATH 251–253	Calculus I-III	12
PHYS 201–203	General Physics	12
or PHYS 251–253	Foundations of Physics I	
BI 281H	Accelerated Biology I: Cells, Biochemistry and Physiology	6
BI 282H	Accelerated Biology II: Genetics and Molecular Biology	6
BI 320	Molecular Genetics	4
Physical Laboratory Requirement		
Select one of the following:		3-8
PHYS 204–206	Introductory Physics Laboratory	

PHYS 290	Foundations of Physics Laboratory (three terms)	
CH 417 & CH 418	Physical Chemistry Laboratory and Physical Chemistry Laboratory ¹	
Advanced Laboratory Requirement		
Select one of the following:		4-6
CH 417	Physical Chemistry Laboratory ¹	
CH 418	Physical Chemistry Laboratory ¹	
CH 419	Physical Chemistry Laboratory	
CH 429	Instrumental Analysis	
CH 401	Research: [Topic] (three terms) ²	
Advanced Biochemistry Electives		
Select two of the following:		8
CH 464	RNA Biochemistry	
CH 465	Physical Biochemistry	
CH 466	Structural Biochemistry	
CH 468	Cellular Biochemistry	
Other Advanced Electives		
See the table below ¹		12
Total Credits		128-135

¹ Courses cannot be used to satisfy requirements in more than one area.
² Minimum of 6 credits of CH 401 and a written report are required for Research.

Other Advanced Electives

Code	Title	Credits
Three approved 400-level courses in chemistry and biology. Students may use one approved 300-level biology course (BI 322, BI 328, or BI 360) as one of the three advanced electives. ¹		
CH 413	Physical Chemistry	
CH 417	Physical Chemistry Laboratory	
CH 418	Physical Chemistry Laboratory	
CH 419	Physical Chemistry Laboratory	
CH 420	Physical Organic Chemistry I	
CH 421	Physical Organic Chemistry II	
CH 429	Instrumental Analysis	
CH 431	Inorganic Chemistry	
CH 432	Inorganic Chemistry	
CH 433	Inorganic Chemistry	
CH 441	Quantum Chemistry	
CH 442	Quantum Chemistry and Spectroscopy	
CH 443	Quantum Chemistry and Spectroscopy	
CH 445	Statistical Mechanics	
CH 446	Chemical Kinetics: [Topic]	
CH 447	Computational Chemistry	
CH 451	Advanced Organic-Inorganic Chemistry	
CH 452	Advanced Organic Chemistry—Stereochemistry and Reactions	
CH 454	Advanced Electrochemistry	
CH 464	RNA Biochemistry	
CH 465	Physical Biochemistry	

CH 466	Structural Biochemistry
CH 468	Cellular Biochemistry
BI 322	Cell Biology
or BI 328	Developmental Biology
or BI 360	Neurobiology
BI 422	Protein Toxins in Cell Biology
BI 423	Human Molecular Genetics
BI 426	Genetics of Cancer
BI 427	Molecular Genetics of Human Disease
BI 428	Developmental Genetics
BI 433	Bacterial-Host Interactions
BI 461	Systems Neuroscience
BI 463	Cellular Neuroscience
BI 466	Developmental Neurobiology
BI 484	Molecular Evolution

¹ See advisor for complete list. Courses used to satisfy the physical and advanced laboratory requirements cannot also be used as an advanced elective.

Honors Program

- The criteria used for the selection of students who graduate with departmental honors in chemistry or biochemistry are as follows:
- 1. Grade point average (GPA) of at least 3.50 in all graded courses
 - 2. Suitable accomplishment in undergraduate chemical or related research. Specifically, the student must pursue a research problem for one academic year or longer and be recommended as worthy of honors by the faculty supervisor. Positive accomplishment and publishable results are expected but not required
 - 3. Endorsement for a major with honors by a member of the university faculty
 - 4. Completion of all course requirements for the BS degree in chemistry (waivers or substitutions allowed with approval)

Four-Year Degree Plan

The degree plan shown is only a sample of how students may complete their degrees in four years. There are alternative ways. Students should consult their advisor to determine the best path for them.

Bachelor of Arts in Biochemistry

Course	Title	Credits	Milestones
First Year			
Fall			
MATH 112Z or MATH 251	Precalculus II: Trigonometry or Calculus I	4	
WR 121Z	Composition I	4	
CH 221 or CH 224H	General Chemistry I or Advanced General Chemistry I	4	
CH 227	General Chemistry Laboratory	2	
Credits			14

Winter

WR 123 or WR 122Z	College Composition III or Composition II	4
CH 222 or CH 225H	General Chemistry II or Advanced General Chemistry II	4
CH 228	General Chemistry Laboratory	2
MATH 251 or MATH 252	Calculus I or Calculus II	4

Meet with an advisor to prepare a four-year plan

Credits	14
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Spring

CH 223 or CH 226H	General Chemistry III or Advanced General Chemistry III	4
CH 229	General Chemistry Laboratory	2
MATH 252 or MATH 253	Calculus II or Calculus III	4

General-education course in social science that also satisfies multicultural requirement	4
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Meet with an advisor if interested in undergraduate research.

All majors take the American Chemical Society Exam at the end of the academic year.

Credits	14
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Total Credits	42
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Course	Title	Credits	Milestones
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Second Year
Fall

MATH 253 or MATH 256 or MATH 281	Calculus III or Introduction to Differential Equations or Several-Variable Calculus I	4
BI 281H	Accelerated Biology I: Cells, Biochemistry and Physiology	6
CH 337	Organic Chemistry Laboratory	3
CH 341	Majors Track Organic Chemistry I	4

Students should meet with an advisor to create an individual development plan	
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Credits	17
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Winter

MATH 253	Calculus III	4
BI 282H	Accelerated Biology II: Genetics and Molecular Biology	6
CH 342	Majors Track Organic Chemistry II	4
CH 348	Organic Chemistry Laboratory for Majors	4

Credits	18
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Spring

BI 320	Molecular Genetics	4
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CH 343	Majors Track Organic Chemistry III	4
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General-education course in arts and letters that also satisfies multicultural requirement	4
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General-education course in social science	4
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Majors take the American Chemical Society Exam at the end of the academic year.

Students interested in undergraduate research should make arrangements to start.

Credits	16
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Total Credits	51
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Course	Title	Credits	Milestones
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Third Year
Fall

PHYS 201 or PHYS 251	General Physics or Foundations of Physics I	4
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PHYS 204 or PHYS 290	Introductory Physics Laboratory or Foundations of Physics Laboratory	2
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CH 461	Biochemistry	4
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CH 467	Biochemistry Laboratory	4
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First term of first-year second-language requirement (BA only)	5
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Students should meet with an advisor to review their four-year plan and individual development plan

Credits	19
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Winter

PHYS 202 or PHYS 252	General Physics or Foundations of Physics I	4
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PHYS 205 or PHYS 290	Introductory Physics Laboratory or Foundations of Physics Laboratory	2
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CH 462	Biochemistry	4
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Second term of first-year second-language requirement (BA only)	5
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General-education course in social science	4
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Credits	19
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Spring

PHYS 203 or PHYS 253	General Physics or Foundations of Physics I	4
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PHYS 206 or PHYS 290	Introductory Physics Laboratory or Foundations of Physics Laboratory	2
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CH 463	Biochemistry	4
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400-level course in chemistry or biology	4
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Third term of first-year second-language requirement (BA only)	5
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Credits	19
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Total Credits	57
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Course		Title	Credits	Milestones	Spring	
Fourth Year						
Fall						
CH 411	Physical Chemistry	4		CH 223 or CH 226H	General Chemistry III or Advanced General Chemistry III	4
CH 417	Physical Chemistry Laboratory	4		CH 229	General Chemistry Laboratory	2
400-level course in chemistry or biology		4		MATH 252 or MATH 253	Calculus II or Calculus III	4
First term of second-year second-language requirement (BA only)		4			General-education course in arts and letters	4
General-education course in arts and letters		4			Meet with an advisor if interested in undergraduate research.	
Credits		20				
Winter						
CH 412	Physical Chemistry	4		All majors take the American Chemical Society Exam at the end of the academic year.		
400-level courses in chemistry or biology		8				
Second term of second-year second-language requirement (BA only)		4				
General-education course in arts and letters		4				
Credits		20				
Spring						
400-level course in chemistry or biology		4				
Third term of second-year second-language requirement (BA only)		4				
General education course in social science		4				
General education course in arts and letters		4				
Apply for degree in DuckWeb by end of fourth week of spring term						
Credits		16				
Total Credits		56				

Course	Title	Credits	Milestones
Second Year			
Fall			
MATH 253	Calculus III	4	
BI 281H	Accelerated Biology I: Cells, Biochemistry and Physiology	6	
CH 337	Organic Chemistry Laboratory	3	
CH 341	Majors Track Organic Chemistry I	4	
Students should meet with an advisor to create an individual development plan			
Credits		17	
Winter			

Bachelor of Science in Biochemistry

Course	Title	Credits	Milestones
First Year			
Fall			
MATH 112Z or MATH 251	Precalculus II: Trigonometry or Calculus I	4	CH 342 Majors Track Organic Chemistry II 4
WR 121Z	Composition I	4	CH 348 Organic Chemistry Laboratory for Majors 4
CH 221 or CH 224H	General Chemistry I or Advanced General Chemistry I	4	Credits 18
CH 227	General Chemistry Laboratory	2	Spring
Credits		14	BI 320 Molecular Genetics 4
Winter			
WR 123 or WR 122Z	College Composition III or Composition II	4	CH 343 Majors Track Organic Chemistry III 4
CH 222 or CH 225H	General Chemistry II or Advanced General Chemistry II	4	General-education course in arts and letters 4
CH 228	General Chemistry Laboratory	2	General-education course in social science 4
MATH 251 or MATH 252	Calculus I or Calculus II	4	Majors take the American Chemical Society Exam at the end of the academic year.
Meet with an advisor to prepare a four-year plan			Students interested in undergraduate research should make arrangements to start.
Credits		14	Credits 16
			Total Credits 51
Second Year			
Fall			
Course Title Credits Milestones			
Third Year			
Fall			
PHYS 201 or PHYS 251	General Physics or Foundations of Physics I	4	

PHYS 204 or PHYS 290	Introductory Physics Laboratory or Foundations of Physics Laboratory	2
CH 461	Biochemistry	4
CH 467	Biochemistry Laboratory	4
Students should meet with an advisor to review their four-year plan and individual development plan		

Credits	14
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Winter

PHYS 202 or PHYS 252	General Physics or Foundations of Physics I	4
PHYS 205 or PHYS 290	Introductory Physics Laboratory or Foundations of Physics Laboratory	2
CH 401	Research: [Topic]	2
CH 462	Biochemistry	4
General-education course in social science		4

Credits	16
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Spring

PHYS 203 or PHYS 253	General Physics or Foundations of Physics I	4
PHYS 206 or PHYS 290	Introductory Physics Laboratory or Foundations of Physics Laboratory	2
CH 401	Research: [Topic]	2
CH 463	Biochemistry	4
General-education course in arts and letters		4
Students should meet with an advisor to review their four-year plan and individual development plan		

Credits	16
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Total Credits	46
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Course	Title	Credits	Milestones
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Fourth Year

Fall

CH 401	Research: [Topic]	1-21
CH 411	Physical Chemistry	4
400-level courses in chemistry or biology		8
General-education course in arts and letters		4

Credits	17-37
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Winter

CH 412	Physical Chemistry	4
400-level courses in chemistry or biology		8
General-education course in social science		4

Credits	16
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Spring

400-level course in chemistry or biology		4
General education course in social science		4
Multicultural courses		8

Apply for degree in DuckWeb by end of fourth week of
spring term

Credits	16
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Total Credits	49-69
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