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 221Z	General Chemistry I	4
or CH 224H	Advanced General Chemistry I	
CH 222Z	General Chemistry II	4
or CH 225H	Advanced General Chemistry II	
CH 223Z	General Chemistry III	4
or CH 226H	Advanced General Chemistry III	
CH 227Z & CH 217	General Chemistry I Laboratory and Chemistry Tools I [1]	2
CH 228Z & CH 218	General Chemistry II Laboratory and Chemistry Tools II [1]	2
CH 229Z & CH 219	General Chemistry III Laboratory and Chemistry Tools III [1]	2
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 251Z–253Z	Calculus: Differential, Integral, and Sequences & Series	12
PHYS 201–203	General Physics [2]	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 [3]	
Advanced Laboratory Requirement		
Select one of the following:		4-6
CH 417	Physical Chemistry Laboratory [3]	
CH 418	Physical Chemistry Laboratory [3]	
CH 419	Physical Chemistry Laboratory	
CH 429	Instrumental Analysis	
CH 401	Research: [Topic] (three terms) [4]	
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 [3]		12
Total Credits		**128-135**

1. Students who transfer CH 227Z/228Z/229Z credits from other schools may have the corresponding CH 217/218/219 course and credit requirements waived.
2. Students may also take PHYS 251, 202, and 203 or PHYS 251, 252, and 203. Students may not go from the 201-203 series to the 251-253 series without approval from the department.
3. Courses cannot be used to satisfy requirements in more than one area.
4. 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		
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 251Z	Precalculus II: Trigonometry or Differential Calculus	4	
WR 121Z	Composition I	4	

CH 221Z or CH 224H	General Chemistry I or Advanced General Chemistry I	4
CH 227Z & CH 217	General Chemistry I Laboratory and Chemistry Tools I	2
	Credits	**14**
Winter		
WR 123 or WR 122Z	College Composition III or Composition II	4
CH 222Z or CH 225H	General Chemistry II or Advanced General Chemistry II	4
CH 228Z & CH 218	General Chemistry II Laboratory and Chemistry Tools II	2
MATH 251Z or MATH 252Z	Differential Calculus or Integral Calculus	4
Meet with an advisor to prepare a four-year plan		
	Credits	**14**
Spring		
CH 223Z or CH 226H	General Chemistry III or Advanced General Chemistry III	4
CH 229Z & CH 219	General Chemistry III Laboratory and Chemistry Tools III	2
MATH 252Z or MATH 253Z	Integral Calculus or Calculus: Sequences and Series	4
Core-education course in social science that also satisfies cultural literacy requirement		4
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**
Second Year		
Fall		
MATH 253Z or MATH 256 or MATH 281	Calculus: Sequences and Series 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		
	Credits	**17**
Winter		
MATH 253Z	Calculus: Sequences and Series	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**
Spring		
BI 320	Molecular Genetics	4
CH 343	Majors Track Organic Chemistry III	4
Core-education course in arts and letters that also satisfies cultural literacy requirement		4
Core-education course in social science		4
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**
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
First term of 1st-year second-language sequence		5
Students should meet with an advisor to review their four-year plan and individual development plan		
	Credits	**19**
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 462	Biochemistry	4
Second term of 1st-year second-language sequence		5
Core-education course in social science		4
	Credits	**19**
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 463	Biochemistry	4
400-level course in chemistry or biology		4
Third term of 1st-year second-language sequence		5
	Credits	**19**
Fourth Year		
Fall		
CH 411	Physical Chemistry	4
CH 417	Physical Chemistry Laboratory	4
400-level course in chemistry or biology		4

First term of 2nd-year second-language sequence		4
Core-education course in arts and letters		4
	Credits	**20**
Winter		
CH 412	Physical Chemistry	4
400-level courses in chemistry or biology		8
Second term of 2nd-year second-language sequence		4
Core-education course in arts and letters		4
	Credits	**20**
Spring		
400-level course in chemistry or biology		4
Third term of 2nd-year second-language sequence		4
Core-education course in social science		4
Core-education course in arts and letters		4
Apply for degree in DuckWeb by end of fourth week of spring term		
	Credits	**16**
	Total Credits	**206**

Bachelor of Science in Biochemistry

Course	Title	Credits	Milestones
First Year			
Fall			
MATH 112Z or MATH 251Z	Precalculus II: Trigonometry or Differential Calculus	4	
WR 121Z	Composition I	4	
CH 221Z or CH 224H	General Chemistry I or Advanced General Chemistry I	4	
CH 227Z & CH 217	General Chemistry I Laboratory and Chemistry Tools I	2	
	Credits	**14**	
Winter			
WR 123 or WR 122Z	College Composition III or Composition II	4	
CH 222Z or CH 225H	General Chemistry II or Advanced General Chemistry II	4	
CH 228Z & CH 218	General Chemistry II Laboratory and Chemistry Tools II	2	
MATH 251Z or MATH 252Z	Differential Calculus or Integral Calculus	4	
Meet with an advisor to prepare a four-year plan			
	Credits	**14**	
Spring			
CH 223Z or CH 226H	General Chemistry III or Advanced General Chemistry III	4	
CH 229Z & CH 219	General Chemistry III Laboratory and Chemistry Tools III	2	
MATH 252Z	Integral Calculus or Calculus: Sequences and Series	4	
or MATH 253Z			
Core-education course in arts and letters		4	
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**	
Second Year			
Fall			
MATH 253Z	Calculus: Sequences and Series	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 shuold meet with an advisor to create an individual development plan			
	Credits	**17**	
Winter			
MATH 253Z	Calculus: Sequences and Series	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**	
Spring			
BI 320	Molecular Genetics	4	
CH 343	Majors Track Organic Chemistry III	4	
Core-education course in arts and letters		4	
Core-education course in social science		4	
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**	
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**	
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
Core-education course in social science		4
	Credits	**16**
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
Core-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**
Fourth Year		
Fall		
CH 401	Research: [Topic]	2
CH 411	Physical Chemistry	4
400-level courses in chemistry or biology		8
Core-education course in arts and letters		4
	Credits	**18**
Winter		
CH 412	Physical Chemistry	4
400-level courses in chemistry or biology		8
Core-education course in social science		4
	Credits	**16**
Spring		
400-level course in chemistry or biology		4
Core-education course in social science		4
Cultural literacy courses		8
Apply for degree in DuckWeb by end of fourth week of spring term		
	Credits	**16**
	Total Credits	**189**