Chemistry (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.

The program described below is the recommended curriculum for chemistry majors. It includes courses in chemistry and related fields. 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. Advisors can also provide lists of substitute courses and courses that are recommended but not required.

Students are encouraged to participate in CH 401 Research: [Topic].

Chemistry Major Requirements

Code	Title	Credits
Chemistry Courses		
CH 224H–226H	Honors General Chemistry	12
or CH 221–223	General Chemistry	
CH 227–229	General Chemistry Laboratory	6
or CH 237–239	Advanced General Chemistry Laboratory	
CH 341–343	Majors Track Organic Chemistry I-III	12
CH 337	Organic Chemistry Laboratory	3
CH 348–349	Organic Chemistry Lab for Majors	8
CH 411–413	Physical Chemistry	12
CH 417–419	Physical Chemistry Laboratory	12
Advanced Electives (see Advanced Electives table below)		9-12
CH 429	Instrumental Analysis	5
Related Science Requirements		
MATH 251–253	Calculus I-III	12
MATH 256	Introduction to Differential Equations	4
MATH 281	Several-Variable Calculus I	4
PHYS 251–253	Foundations of Physics I	12
or PHYS 201–203	General Physics	
PHYS 290	Foundations of Physics Laboratory (three terms)	3-6
or PHYS 204–206	Introductory Physics Laboratory	
Total Credits		**114-120**

Advanced Electives

Code	Title	Credits
Advanced electives (e.g., three courses or 9 credits of research or one course and 6 credits of research) chosen from the following: [1]		9-12
CH 401	Research: [Topic]	
CH 420	Physical Organic Chemistry I	
CH 421	Physical Organic Chemistry II	
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 461	Biochemistry
CH 462	Biochemistry
CH 463	Biochemistry
CH 464	RNA Biochemistry
CH 465	Physical Biochemistry
CH 466	Structural Biochemistry
CH 467	Biochemistry Laboratory
ERTH 471	Thermodynamic Geochemistry
ERTH 472	Aqueous-Mineral-Gas Equilibria
ERTH 473	Isotope Geochemistry
PHYS 411–413	Mechanics, Electricity, and Magnetism
PHYS 414–415	Quantum Physics
Total Credits	**9-12**

[1] Other courses may be included with advisor approval.

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 Chemistry

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 or CH 237	General Chemistry Laboratory or Advanced 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 or CH 226H	General Chemistry Laboratory or Advanced General Chemistry III	2	
MATH 251 or MATH 252	Calculus I or Calculus II	4	
	Credits	**14**	
Spring			
CH 223 or CH 226H	General Chemistry III or Advanced General Chemistry III	4	
CH 229 or CH 239	General Chemistry Laboratory or Advanced General Chemistry Laboratory	2	
MATH 252 or MATH 253	Calculus II or Calculus III	4	
General-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**	
	Total Credits	**42**	

Course	Title	Credits	Milestones
Second 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 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	**13**
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 342	Majors Track Organic Chemistry II	4
CH 348	Organic Chemistry Laboratory for Majors	4
	Credits	**14**
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 343	Majors Track Organic Chemistry III	4
CH 349	Organic Chemistry Lab for Majors	4
General-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	**18**
	Total Credits	**45**

Course	Title	Credits	Milestones
Third Year			
Fall			
CH 411	Physical Chemistry	4	
CH 417	Physical Chemistry Laboratory	4	
MATH 256 or MATH 281	Introduction to Differential Equations or Several-Variable Calculus I	4	
First term of first-year second-language sequence (BA only)		5	
Students should meet with an advisor to review their four-year plan and individual development plan			
	Credits	**17**	
Winter			
CH 412	Physical Chemistry	4	
CH 418	Physical Chemistry Laboratory	4	
Second term of first-year second-language sequence (BA only)		5	
General-education course that also satisfies multicultural requirement		4	
	Credits	**17**	
Spring			
CH 413	Physical Chemistry	4	
CH 419	Physical Chemistry Laboratory	4	
Third term of first-year second-language sequence (BA only)		5	
General-education course in social science		4	
	Credits	**17**	
	Total Credits	**51**	

Course	Title	Credits	Milestones
Fourth Year			
Fall			
CH 401	Research: [Topic]	2	
400-level course in chemistry, earth sciences, or physics		4	
First term of second-year second-language sequence (BA only)		5	
General-education course in arts and letters		4	
General-education course in social science that also satisfies multicultural requirement		4	
	Credits	**19**	
Winter			
CH 401	Research: [Topic]	2	
400-level course in chemistry, earth sciences, or physics		4	
Second term of second-year second-language sequence (BA only)		5	
General-education course in arts and letters		4	
General-education course in social science that also satisfies multicultural requirement		4	
	Credits	**19**	
Spring			
CH 401	Research: [Topic]	2	
CH 429	Instrumental Analysis	5	
400-level course in chemistry, earth sciences, or physics		4	
Third term of second-year second-language sequence (BA only)		5	
General-education course in arts and letters		4	
	Credits	**20**	
	Total Credits	**58**	

Bachelor of Science in Chemistry

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 or CH 237	General Chemistry Laboratory or Advanced 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 or CH 226H	General Chemistry Laboratory or Advanced General Chemistry III	2
MATH 251 or MATH 252	Calculus I or Calculus II	4
Meet with an advisor to prepare a four-year plan		
	Credits	**14**
Spring		
CH 223 or CH 226H	General Chemistry III or Advanced General Chemistry III	4
CH 229 or CH 239	General Chemistry Laboratory or Advanced General Chemistry Laboratory	2
MATH 252 or MATH 253	Calculus II or Calculus III	4
General-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**
	Total Credits	**42**

Course	Title	Credits	Milestones
Second 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 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	**13**	
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 342	Majors Track Organic Chemistry II	4	
CH 348	Organic Chemistry Laboratory for Majors	4	
	Credits	**14**	
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 343	Majors Track Organic Chemistry III	4	
CH 349	Organic Chemistry Lab for Majors	4	
General-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	**18**	
	Total Credits	**45**	

Course	Title	Credits	Milestones
Third Year			
Fall			
CH 411	Physical Chemistry	4	
CH 417	Physical Chemistry Laboratory	4	
MATH 256 or MATH 281	Introduction to Differential Equations or Several-Variable Calculus I	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**	
Winter			
MATH 281	Several-Variable Calculus I	4	
CH 412	Physical Chemistry	4	
CH 418	Physical Chemistry Laboratory	4	
General-education course in social science		4	
	Credits	**16**	
Spring			
CH 413	Physical Chemistry	4	
CH 419	Physical Chemistry Laboratory	4	
CH 429	Instrumental Analysis	5	
General-education course in social science		4	
	Credits	**17**	
	Total Credits	**49**	

Course	Title	Credits	Milestones
Fourth Year			
Fall			
CH 401	Research: [Topic]	2	

400-level course in chemistry, earth sciences, or physics		4
General-education course in arts and letters		4
General-education course that also satisfies multicultural requirement		4
	Credits	**14**
Winter		
CH 401	Research: [Topic]	2
400-level course in chemistry, earth sciences, or physics		4
General-education course that also satisfies multicultural requirement		4
General-education course in social science		4
	Credits	**14**
Spring		
CH 401	Research: [Topic]	2
400-level course in chemistry, earth sciences, or physics		4
General-education course in arts and letters		4
	Credits	**10**
	Total Credits	**38**