

CHEMISTRY

Overview

The department of Chemistry offers Bachelor of Science and Bachelor of Arts degrees in Chemistry in the College of Liberal Arts and Sciences.

Graduates holding the B.S. degree in Chemistry qualify in many fields as: teachers of Chemistry, supervisors in industry, technical sales personnel, and research chemists in federal, state, municipal, academic, or industrial laboratories. Students with high scholastic standing often continue with graduate work, where they may explore more thoroughly the specialized areas of chemistry in which they are interested.

The B.A. degree is useful for students who intend to pursue studies in parallel areas, such as secondary school teaching, to obtain additional majors, minors, or for pursuing professional school (such as medical, dental, or pharmacy school) outside of Chemistry. The B.S. degree is recommended for students who wish to pursue graduate studies or a research career in Chemistry.

Student Learning Outcomes

Upon graduation students should:

- have firm foundations in the fundamentals and application of current chemical theories.
- be able to design, carry-out, record, and analyze the results of chemical experiments.
- use modern instrumentation and classical techniques to identify and solve chemical problems as well as explore new areas of research.
- communicate the results of their work to chemists, as well as non-chemists.
- understand the ethical and environmental dimensions of problems and issues facing chemists.
- follow the proper procedures and regulations for safe storage, labeling, use of chemicals, and disposal of chemicals.
- be able to use chemical literature (perform searches for, read, evaluate, and appropriately cite publications)
- be skilled in problem solving, critical thinking, and analytical reasoning.

These skills may be applied to careers in education and industry; in professions such as law, medicine, environmental sciences, and forensic sciences. The curricula in Chemistry are approved by the American Chemical Society (ACS). Students who complete the program obtain an ACS certified baccalaureate degree provided they also take one Biochemistry course, typically BBMB 301 Survey of Biochemistry, BBMB 316 Principles of Biochemistry or BBMB 404 Biochemistry I and (<http://catalog.iastate.edu/>

previouscatalogs/2023-2024/azcourses/bbmb/)BBMB 405 Biochemistry II.

Liberal arts majors who wish to transfer into Chemistry at the end of their second year may still complete all degree requirements and graduate within five years.

Degree Requirements

As majors in the College of Liberal Arts and Sciences, Chemistry students must meet College of Liberal Arts and Sciences (<http://catalog.iastate.edu/previouscatalogs/2023-2024/collegeofliberalartsandsciences/#lascollegerequirementstext>) and University-wide requirements (<http://catalog.iastate.edu/previouscatalogs/2023-2024/collegescurricula/>) for graduation in addition to those stated below for the major.

LAS majors require a minimum of 120 credits, including a minimum of 45 credits at the 300/400 level. You must also complete the LAS world language requirement and career proficiency requirement.

Communication Proficiency requirement: According to the university-wide Communication Proficiency Grade Requirement, students must demonstrate their communication proficiency by earning a grade of C or better in ENGL 250. The Department requires a grade of C– or better in ENGL 314.

Students in all ISU majors must complete a three-credit course in U.S. diversity and a three-credit course in international perspectives. Check (<http://www.registrar.iastate.edu/courses/div-ip-guide.html>) for a list of approved courses. Discuss with your advisor how the two courses that you select can be applied to your graduation plan.

Chemistry, B.S.

Undergraduate students seeking the Bachelor of Science (B.S.) degree in Chemistry have the following courses in their degree programs as minimum requirements.

CHEM 177 & CHEM 178 or CHEM 201 or CHEM 167	General Chemistry I and General Chemistry II Advanced General Chemistry General Chemistry for Engineering Students	4-7
CHEM 177L or CHEM 177N or CHEM 201L or CHEM 167L	Laboratory in General Chemistry I Laboratory in General Chemistry I Laboratory in Advanced General Chemistry Laboratory in General Chemistry for Engineering	1
CHEM 211	Quantitative and Environmental Analysis	2
CHEM 211L	Quantitative and Environmental Analysis Laboratory	2
CHEM 301	Inorganic Chemistry	2

CHEM 316	Instrumental Methods of Chemical Analysis	2	or CHEM 167 General Chemistry for Engineering Students	
CHEM 316L	Instrumental Analysis Laboratory	2	CHEM 177L	Laboratory in General Chemistry I 1
CHEM 322L	Laboratory in Physical Chemistry	3	or CHEM 177N	Laboratory in General Chemistry I
CHEM 324	Introductory Quantum Mechanics	3	or CHEM 201L	Laboratory in Advanced General Chemistry
CHEM 325	Chemical Thermodynamics	3	or CHEM 167L	Laboratory in General Chemistry for Engineering
CHEM 331	Organic Chemistry I	3	CHEM 211	Quantitative and Environmental Analysis 2
CHEM 332	Organic Chemistry II	3	CHEM 211L	Quantitative and Environmental Analysis Laboratory 2
CHEM 331L	Laboratory in Organic Chemistry I	1	CHEM 301	Inorganic Chemistry 2
or CHEM 333L	Laboratory in Organic Chemistry I (for Chemistry and Biochemistry Majors)		CHEM 316	Instrumental Methods of Chemical Analysis 2
CHEM 332L	Laboratory in Organic Chemistry II	1	CHEM 316L	Instrumental Analysis Laboratory 2
or CHEM 334L	Laboratory in Organic Chemistry II (for Chemistry and Biochemistry Majors)		CHEM 324	Introductory Quantum Mechanics 3
CHEM 402	Advanced Inorganic Chemistry	3	CHEM 321L	Laboratory in Physical Chemistry 2-3
CHEM 401L	Inorganic Chemistry Laboratory	1	or CHEM 322L	Laboratory in Physical Chemistry
Two advanced Chemistry courses (min 4 credits)		4-6	CHEM 325	Chemical Thermodynamics 3
CHEM 399 Undergraduate Research or CHEM 499 Senior Research is strongly recommended. Credits earned in 399/499/490 may only be used to meet one of the advanced course requirements.			CHEM 331	Organic Chemistry I 3
The following are required as supporting work:			CHEM 331L	Laboratory in Organic Chemistry I 1
ENGL 150	Critical Thinking and Communication	3	CHEM 332	Organic Chemistry II 3
ENGL 250	Written, Oral, Visual, and Electronic Composition	3	CHEM 332L	Laboratory in Organic Chemistry II 1
or ENGL 250H	Written, Oral, Visual, and Electronic Composition: Honors		The following are required as supporting work:	12
ENGL 314	Technical Communication	3	ENGL 150	Critical Thinking and Communication 3
LIB 160	Introduction to College Level Research	1	ENGL 250	Written, Oral, Visual, and Electronic Composition 3
LAS 203	Professional Career Preparation	1	or ENGL 250H	Written, Oral, Visual, and Electronic Composition: Honors
MATH 165	Calculus I	4	ENGL 314	Technical Communication 3
MATH 166	Calculus II	4	LIB 160	Introduction to College Level Research 1
MATH 265	Calculus III	4	LAS 203	Professional Career Preparation 1
PHYS 231	Introduction to Classical Physics I	4	MATH 165	Calculus I 4
PHYS 231L	Introduction to Classical Physics I Laboratory	1	MATH 166	Calculus II 4
PHYS 232	Introduction to Classical Physics II	4	PHYS 231	Introduction to Classical Physics I 4
PHYS 232L	Introduction to Classical Physics II Laboratory	1	PHYS 231L	Introduction to Classical Physics I Laboratory 1
			PHYS 232	Introduction to Classical Physics II 4
			PHYS 232L	Introduction to Classical Physics II Laboratory 1

Chemistry, B.A.

Undergraduate students seeking the Bachelor of Arts (B.A) degree in Chemistry have the following courses in their degree programs as minimum requirements

One of the following sequences: 6-8

CHEM 177 General Chemistry I
& CHEM 178 and General Chemistry II
or CHEM 201 Advanced General Chemistry

Teacher Preparation Focus

Chemistry majors seeking certification to teach Chemistry in secondary schools can follow the requirements of either the B.S. or the B.A. degree in Chemistry. In addition they must take the complementary coursework listed below and meet all of the requirements of the Secondary Major in Education. (<http://catalog.iastate.edu/previouscatalogs/2023-2024/collegeofhumansciences/educationsecondary/#curriculumtext>)

Complementary Coursework

PSYCH 230 Developmental Psychology 3

EDUC 418	Secondary Science Methods I	3
EDUC 419	Secondary Science Methods II	3
One course in Biology (BIOL 211 & 211L recommended)		
One course in American History or Government		

Note: Teacher license requirements are established by the Iowa Department of Education and the Iowa Board of Educational Examiners and are subject to change. Recent changes may not be reflected in this catalog, but advisers and faculty will be aware.

Chemistry, B.A.

Freshman

Fall	Credits Spring	Credits
CHEM 177 or 201 ^{1,2,F}	4-5 CHEM 178 or 211 <i>and</i> 211L ²	3-4
CHEM 177N or 201L ^{2,F}	1 CHEM 101	1
CHEM 101 ³	1 MATH 166	4
MATH 165	4 Electives	6
ENGL 150	3	
LIB 160	1	
Electives		
14-15		14-15

Sophomore

Fall	Credits Spring	Credits
CHEM 331	3 CHEM 332	3
CHEM 333L ^{F,2}	2 CHEM 334L ^{2,5}	2
CHEM 110	1 ENGL 250	3
PHYS 231	4 PHYS 232 ²	4
PHYS 231L	1 PHYS 232L ²	1
Electives	3 CHEM 211, CHEM 211L (or Electives) LAS 203	3-4 1
14		17-18

Junior

Fall	Credits Spring	Credits
CHEM 324	3 CHEM 325	3
World Language - first semester of any world language accepted ⁴	4 CHEM 321L ^S	2
Electives	8 CHEM 301 ^S World Language - second semester ⁴ CHEM 550 (strongly recommended) ^S	2 4 1

Electives		3
15		15
Senior		
Fall	Credits Spring	Credits
CHEM 316 ^F	2 BBMB 301 (strongly recommended)	3
CHEM 316L ^F	2 CHEM 399 (strongly recommended)	0
ENGL 314	3 Electives	12
Electives	9	
16		15

Total Credits: 120-123

¹ Advanced high school chemistry and strong algebra skills are necessary for success in CHEM 201. Math ACT of 24 or greater is strongly recommended.

² Students may substitute the following courses, if necessary:

- CHEM 201 for 177 and 178;
- CHEM 177L for 177N or 201L.
- CHEM 331L and 332L for 333L and 334L; however, this substitution may result in a program which is deficient in the laboratory experience recommended by the American Chemistry Society.
- CHEM 321L for 322L; however this substitution may result in a program which is deficient in the laboratory experience recommended by the American Chemistry Society.
- PHYS 131/131L and 132/132L for PHYS 231/231L and 232/232L, however PHYS 231/231L and 232/232L are highly recommended.

³ Required of Chemistry Learning Community Members.

⁴ Completion of three years of foreign language in high school fulfills this requirement.

F Class offered Fall Semester only.

S Class offered Spring Semester only.

Individuals earning a B.A. degree in Chemistry who have taken 331L, 334L and 322L can obtain American Chemical Society certification by taking an additional advanced chemistry lecture course of BBMB 301 or 404. CHEM 550 may not be used to satisfy the Advanced Chemistry requirement.

Chemistry, B.S.

Freshman

Fall	Credits Spring	Credits
CHEM 177 or 201 ^{1,2,F}	4-5 CHEM 178 ^{1,2}	3
CHEM 177N or 201L ^{2,F}	1 CHEM 211	2
CHEM 101 (required for LC members)	1 CHEM 211L	2

MATH 165	4 CHEM 101	1
ENGL 150	3 MATH 166	4
LIB 160	1 Electives	3
Electives		

14-15 **15**

Sophomore

Fall	Credits Spring	Credits
CHEM 331	3 CHEM 332	3
CHEM 333L ^{2,F}	2 CHEM 334L ^{2,S}	2
CHEM 110 ^F	1 ENGL 250	3
MATH 265	4 PHYS 232	4
Electives	PHYS 232L	1
PHYS 231	4 CHEM 211 & CHEM 211L (or Electives)	3-4
PHYS 231L	1 LAS 203	1

15 **17-18**

Junior

Fall	Credits Spring	Credits
CHEM 324	3 CHEM 325	3
CHEM 316 ^F	2 CHEM 322L ^S	3
CHEM 316L ^F	2 CHEM 301 ^S	2
World Language - first semester of any world language accepted ³	4 World Language - second semester ³	4
Electives	4 CHEM 550 (strongly recommended) ^S	1
	Electives	3

15 **16**

Senior

Fall	Credits Spring	Credits
CHEM 402 ^F	3 CHEM 401L ^S	1
ENGL 314	3 Advanced Chemistry ⁵	4-5
Electives	8 BBMB 301 (strongly recommended)	3
	CHEM 399 (strongly recommended, credits variable)	0
	Electives	6

14 **14-15**

Total Credits: 120-123

¹ Advanced high school chemistry and strong algebra skills are necessary for success in CHEM 201. Math ACT of 24 or greater is strongly recommended.

² Students may substitute the following courses, if necessary:

- CHEM 201 for 177 and 178;
- CHEM 177I for 177N or 201L
- CHEM 331I and 332L for 333L and 334L; however, this substitution may result in a program which is deficient in the laboratory experience recommended by the American Chemistry Society.

³ Completion of three years of foreign language in high school fulfills this requirement.

⁴ The completion of two courses (minimum of 2 credits each) are required to meet this requirement. (In addition to advanced Chemistry courses, certain courses in Biochemistry-Biophysics, Chemical Engineering, Computer Science, Mathematics and Materials Science and Engineering are acceptable.) Up to four credits in undergraduate research (CHEM 339 and/or 499) can be counted as one of the two advanced chemistry courses. CHEM 550 may not be used to satisfy the Advanced Chemistry requirement.

⁵ The program as listed above meets the standard for a certified degree of the American Chemical Society's Committee on Professional Training if BBMB 301 or 404 is one of the Advanced Chemistry Courses.

F Class offered Fall Semester only.

S Class offered Spring Semester only.

Chemistry Minor

The Department offers a minor in chemistry which may be earned by credit in:

CHEM 177	General Chemistry I	4
CHEM 177L	Laboratory in General Chemistry I	1

or

CHEM 167 & 167L	General Chemistry for Engineering Students and Laboratory in General Chemistry for Engineering	5
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CHEM 178	General Chemistry II	3
CHEM 211	Quantitative and Environmental Analysis	2
CHEM 211L	Quantitative and Environmental Analysis Laboratory	2

CHEM 324	Introductory Quantum Mechanics	3
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CHEM 331 & CHEM 332	Organic Chemistry I and Organic Chemistry II	3-6
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or CHEM 231	Elementary Organic Chemistry	
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CHEM 331L & CHEM 332L	Laboratory in Organic Chemistry I and Laboratory in Organic Chemistry II	1-2
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or CHEM 231L	Laboratory in Elementary Organic Chemistry	
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And one of the following: 2-5

CHEM 301	Inorganic Chemistry	
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CHEM 316 Instrumental Methods of Chemical Analysis
& 316L and Instrumental Analysis Laboratory

CHEM 325 Chemical Thermodynamics
& CHEM 321L and Laboratory in Physical Chemistry
or CHEM 322 Laboratory in Physical Chemistry

CHEM 332 Organic Chemistry II
& 332L and Laboratory in Organic Chemistry II

The total minimum credits in Chemistry thus will be 20 to 23 depending on which advanced courses are selected. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement.

The concurrent Chemistry/MBA program is designed to be completed in five academic years, with three years of undergraduate coursework followed by two years of MBA studies alongside the remaining undergraduate courses.

Concurrent students are part of the full-time MBA program. Admission to the concurrent MBA program is competitive. You should apply during your junior year. Successful candidates demonstrate superior academic ability, strong leadership attributes, and clear career focus. Previous business coursework is not a requirement for application.

Internships, co-op experiences, extracurricular, and leadership activities are highly valued in the MBA candidate selection process. However, you aren't required to have additional coursework in business in preparing for the MBA.

Admitted students typically have a cumulative GPA of 3.00 or above and have scored 600 or higher on the GMAT exam or GRE equivalent. If you're interested in the concurrent MBA program, you should apply by **March 15** of your junior year to be considered for scholarships and assistantships. The final application deadline is June 1.

Graduate Programs

The Department offers work for the degrees Master of Science and Doctor of Philosophy with majors in Chemistry, Analytical, Inorganic, Organic, and Physical chemistry. Co-majors may be taken between areas within Chemistry or between one of the areas in Chemistry and another department. Courses in other areas of Chemistry as well as courses in other departments may be used to satisfy the requirement for coursework outside the major field. A Ph.D. student in Chemistry may choose an additional specialty in one of six areas: Materials Chemistry, Industrial Chemistry, Biomolecular Sciences, Chemistry Education, Chemical Instrumentation, and Forensic Chemistry. A minimum of ten credits is required for each additional specialty. A course which counts towards an additional specialty may also count toward the outside course requirement. A minor in Chemistry is available to students in other

departments. The Department participates in the interdepartmental major in Toxicology.

The Department of Chemistry requires all graduate students majoring in Chemistry to teach as part of their training for an advanced degree. Prerequisite to major graduate work is the completion of undergraduate work in Chemistry, Mathematics, and Physics substantially equivalent to that required of undergraduate Chemistry majors at this institution.