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/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/collegeofliberalartsandsciences/#lascollegerequirementstext) and University-wide requirements (http://catalog.iastate.edu/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.

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 177 &amp; CHEM 178</td>
<td>General Chemistry I and General Chemistry II 4-7</td>
</tr>
<tr>
<td>or CHEM 201</td>
<td>Advanced General Chemistry</td>
</tr>
<tr>
<td>or CHEM 167</td>
<td>General Chemistry for Engineering Students</td>
</tr>
<tr>
<td>CHEM 177L</td>
<td>Laboratory in General Chemistry I 1</td>
</tr>
<tr>
<td>or CHEM 177N</td>
<td>Laboratory in General Chemistry I</td>
</tr>
<tr>
<td>or CHEM 201L</td>
<td>Laboratory in Advanced General Chemistry</td>
</tr>
<tr>
<td>or CHEM 167L</td>
<td>Laboratory in General Chemistry for Engineering</td>
</tr>
<tr>
<td>CHEM 211</td>
<td>Quantitative and Environmental Analysis 2</td>
</tr>
<tr>
<td>CHEM 211L</td>
<td>Quantitative and Environmental Analysis Laboratory</td>
</tr>
<tr>
<td>CHEM 301</td>
<td>Inorganic Chemistry 2</td>
</tr>
<tr>
<td>CHEM 316</td>
<td>Instrumental Methods of Chemical Analysis 2</td>
</tr>
</tbody>
</table>
CHEM 316L  Instrumental Analysis Laboratory  2
CHEM 322L  Laboratory in Physical Chemistry  3
CHEM 324  Introductory Quantum Mechanics  3
CHEM 325  Chemical Thermodynamics  3
CHEM 331  Organic Chemistry I  3
CHEM 332  Organic Chemistry II  3
CHEM 331L  Laboratory in Organic Chemistry I  1
  or CHEM 333L  Laboratory in Organic Chemistry I (for Chemistry and Biochemistry Majors)
CHEM 332L  Laboratory in Organic Chemistry II  1
  or CHEM 334L  Laboratory in Organic Chemistry II (for Chemistry and Biochemistry Majors)
CHEM 402  Advanced Inorganic Chemistry  3
CHEM 401L  Inorganic Chemistry Laboratory  1
Two advanced Chemistry courses (min 4 credits)  4-6
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.

The following are required as supporting work:
ENGL 150  Critical Thinking and Communication  3
ENGL 250  Written, Oral, Visual, and Electronic Composition  3
  or ENGL 250H  Written, Oral, Visual, and Electronic Composition: Honors
ENGL 314  Technical Communication  3
LIB 160  Introduction to College Level Research  1
LAS 203  Professional Career Preparation  1
MATH 165  Calculus I  4
MATH 166  Calculus II  4
MATH 265  Calculus III  4
PHYS 231  Introduction to Classical Physics I  4
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
  or CHEM 201 Advanced General Chemistry
  or CHEM 16L General Chemistry for Engineering Students
CHEM 177L  Laboratory in General Chemistry I  1
  or CHEM 177N  Laboratory in General Chemistry I
  or CHEM 201L  Laboratory in Advanced General Chemistry
  or CHEM 167L  Laboratory in General Chemistry for Engineering
CHEM 211  Quantitative and Environmental Analysis  2
CHEM 211L  Quantitative and Environmental Analysis Laboratory
CHEM 301  Inorganic Chemistry  2
CHEM 316  Instrumental Methods of Chemical Analysis  2
CHEM 316L  Instrumental Analysis Laboratory  2
CHEM 324  Introductory Quantum Mechanics  3
CHEM 321L  Laboratory in Physical Chemistry  2-3
  or CHEM 322L  Laboratory in Physical Chemistry
CHEM 325  Chemical Thermodynamics  3
CHEM 331  Organic Chemistry I  3
CHEM 331L  Laboratory in Organic Chemistry I  1
CHEM 332  Organic Chemistry II  3
CHEM 332L  Laboratory in Organic Chemistry II  1

The following are required as supporting work:
ENGL 150  Critical Thinking and Communication  3
ENGL 250  Written, Oral, Visual, and Electronic Composition  3
  or ENGL 250H  Written, Oral, Visual, and Electronic Composition: Honors
ENGL 314  Technical Communication  3
LIB 160  Introduction to College Level Research  1
LAS 203  Professional Career Preparation  1
MATH 165  Calculus I  4
MATH 166  Calculus II  4
PHYS 231  Introduction to Classical Physics I  4
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

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/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

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>CHEM 177 or 201$^{1,2,F}$</td>
<td>1-2</td>
<td>CHEM 178 or 211 and 211L</td>
<td>2</td>
<td>3-4</td>
</tr>
<tr>
<td>CHEM 177N or 201L$^{2,F}$</td>
<td>1</td>
<td>CHEM 101</td>
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<td>1</td>
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<tr>
<td>CHEM 101$^3$</td>
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<td>MATH 166</td>
<td>4</td>
<td>4</td>
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<tr>
<td>MATH 165</td>
<td>4</td>
<td>Electives</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>ENGL 150</td>
<td>3</td>
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<tr>
<td>Electives</td>
<td>14-15</td>
<td>Electives</td>
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### Sophomore

<table>
<thead>
<tr>
<th>Fall</th>
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<th>Spring</th>
<th>Credits</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 331</td>
<td>3</td>
<td>CHEM 332</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 333L$^{F,2}$</td>
<td>2</td>
<td>CHEM 334L$^{2,S}$</td>
<td>4</td>
<td>2</td>
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<tr>
<td>CHEM 110</td>
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<td>ENGL 250</td>
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<td>CHEM 211, CHEM 211L (or Electives)</td>
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<tr>
<td>Electives</td>
<td>LAS 203</td>
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### Junior

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<thead>
<tr>
<th>Fall</th>
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<th>Spring</th>
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<tbody>
<tr>
<td>CHEM 324</td>
<td>3</td>
<td>CHEM 325</td>
<td>3</td>
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<tr>
<td>World Language - first semester of any world language accepted$^4$</td>
<td>4</td>
<td>CHEM 321L$^S$</td>
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<tr>
<td>Electives</td>
<td>8</td>
<td>CHEM 301$^S$</td>
<td>2</td>
</tr>
<tr>
<td>Electives</td>
<td>8</td>
<td>World Language - second semester$^4$</td>
<td>4</td>
</tr>
<tr>
<td>Electives</td>
<td>CHEM 550 (strongly recommended)$^S$</td>
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</tr>
<tr>
<td>Electives</td>
<td>MATH 165</td>
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<tr>
<td>Electives</td>
<td>ENGL 150</td>
<td>3</td>
<td>3</td>
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### Senior

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 316$^F$</td>
<td>2 BBMB 301 (strongly recommended)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 316L$^F$</td>
<td>2 CHEM 399 (strongly recommended)</td>
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<td>0</td>
</tr>
<tr>
<td>ENGL 314</td>
<td>3 Electives</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Electives</td>
<td>9</td>
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</table>

**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.
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

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
<th>Credits</th>
</tr>
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<tr>
<td>CHEM 177 or 201$^{1,2,F}$</td>
<td>1-2</td>
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<tr>
<td>CHEM 177N or 201L$^{2,F}$</td>
<td>1</td>
<td>CHEM 101</td>
<td>1</td>
<td>1</td>
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<tr>
<td>CHEM 101$^3$</td>
<td>1</td>
<td>MATH 166</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>MATH 165</td>
<td>4</td>
<td>Electives</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>ENGL 150</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIB 160</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>15</td>
<td>Electives</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

**Required of Chemistry Learning Community Members.**

**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

LIB 160 1 Electives 3
Electives

14-15 15

Sophomore

Fall Credits Spring Credits
CHEM 331 3 CHEM 332 3
CHEM 333L₂,F 2 CHEM 334L₂,S 2
CHEM 110F 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 316F 2 CHEM 322L₅ 3
CHEM 316L₅ 2 CHEM 301₅ 2
World Language - first World Language - second semester of any world semester³ language accepted³ Electives 4 CHEM 550 (strongly recommended)₅ 1
Electives 3

15 16

Senior

Fall Credits Spring Credits
CHEM 402F 3 CHEM 401L₅ 1
ENGL 314 3 Advanced Chemistry⁵ 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:
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.

Chemistry Minor

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

<table>
<thead>
<tr>
<th>CHEM 177</th>
<th>General Chemistry I</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 177L</td>
<td>Laboratory in General Chemistry I</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 167 &amp; 167L</td>
<td>General Chemistry for Engineering Students and Laboratory in General Chemistry for Engineering</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 178</td>
<td>General Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 211</td>
<td>Quantitative and Environmental Analysis</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 211L</td>
<td>Quantitative and Environmental Analysis Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 324</td>
<td>Introductory Quantum Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 331 &amp; CHEM 332</td>
<td>Organic Chemistry I and Organic Chemistry II</td>
<td>3-6</td>
</tr>
<tr>
<td>or CHEM 231</td>
<td>Elementary Organic Chemistry</td>
<td></td>
</tr>
<tr>
<td>CHEM 331L &amp; CHEM 332L</td>
<td>Laboratory in Organic Chemistry I and Laboratory in Organic Chemistry II</td>
<td>1-2</td>
</tr>
<tr>
<td>or CHEM 231L</td>
<td>Laboratory in Elementary Organic Chemistry</td>
<td></td>
</tr>
</tbody>
</table>

And one of the following: 2-5

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