Chemistry, B.S.

Learning Outcomes

The Department of Chemistry is committed to maintaining excellence in teaching and mentoring, and to providing the maximum educational benefit to each chemistry graduate. The desired outcomes will prepare students for success in graduate or professional school, industry or government employment, and a wide variety of career choices. The graduate with a bachelor's degree in chemistry will be able to use the knowledge and skills obtained in the program to demonstrate the following.

• Knowledge and Understanding of Chemistry
  Graduates will be able to demonstrate:
  - mastery of major concepts, theoretical principles, and experimental findings in chemistry;
  - an understanding of the relationship between molecular structure and physical/chemical properties;
  - an understanding of the relationship between the microscopic, macroscopic, and symbolic descriptions of matter and the changes it undergoes; and
  - an understanding of the conditions that affect stability and factors that control rates of change.

• Laboratory Skills
  Graduates will be able to:
  - assess chemical and procedural hazards involved in laboratory work;
  - use strategies to minimize the risks associated with laboratory work;
  - maintain a clearly organized laboratory notebook;
  - use a variety of synthetic techniques;
  - use instrumentation and laboratory techniques to separate, purify, identify, quantify, and characterize chemical species; and
  - use computers as tools for data acquisition, management, and analysis.

• Scientific Thinking
  Graduates will be able to:
  - pose scientific questions with a clear hypothesis;
  - plan and carry out scientific investigations;
  - analyze data in order to make inferences about chemical and physical behavior and properties, and construct scientific arguments to support conclusions;
  - use scientific theory and/or interpretations of experimental results to explain chemical phenomena;
  - use mathematics and computational thinking to understand and predict chemical behavior;
  - identify and quantify uncertainties in measurements and limitations in methods; and
  - use graphs, diagrams, and other models to communicate chemical information.

• Chemical Information Skills
  Graduates will be able to:
  - use modern library search tools to locate and retrieve chemical information;
  - read, analyze, and critically evaluate journal articles; and
  - reference and cite chemical literature appropriately using designated citation styles.

• Professional Skills
  Graduates will be able to:
  - report scientific findings in oral presentations in a clear and organized fashion using appropriate visual tools;
  - report on experimental work and scientific findings in written reports;
  - communicate results of scientific work to nontechnical audiences;
  - work collaboratively with peers to plan and conduct experiments, interpret chemical information, and solve problems; and
  - engage in responsible and ethical scientific conduct.

Requirements

The Bachelor of Science with a major in chemistry requires a minimum of 120 s.h., including 69 s.h. of work for the major (20 s.h. in foundation chemistry courses, 27 s.h. in advanced chemistry, and 22 s.h. in supporting coursework). Students must earn at least 20 s.h. in advanced chemistry courses at the University of Iowa. They must maintain a g.p.a. of at least 2.00 in all courses for the major and in all UI courses for the major. Students also must complete the College of Liberal Arts and Sciences GE CLAS Core.

The B.S. degree with a major in chemistry is certified by the American Chemical Society (ACS) when a biochemistry course is included. An ACS-approved program offers a broad-based and rigorous chemistry education that provides students with the intellectual, experimental, and communication skills to become effective scientific professionals in chemical and other related fields. The program also provides all the prerequisites for graduate work in chemistry or biochemistry and in other biomedical areas with a molecular focus.

Courses in the chemistry major have prerequisites, so they must be taken in the correct order. Advanced chemistry courses are built on the chemistry foundation courses. Most advanced courses are taught only once a year. Students should consult their academic advisors and plan their course schedules carefully. They should take CHEM:2021 Fundamentals of Chemical Measurements during the first semester of the second year.

Students may not use a course to fulfill more than one requirement.

The B.S. with a major in chemistry requires the following coursework.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry Foundation Courses</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Advanced Chemistry Courses</td>
<td></td>
<td>27</td>
</tr>
</tbody>
</table>
Mathematics Courses 8
Introductory Physics Courses 8
Science Electives and Research Courses 6
Total Hours 69

Chemistry Foundation Courses
Students complete the following foundation courses.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>All of these: CHEM:1110 &amp; CHEM:1120</td>
<td>Principles of Chemistry I-II</td>
<td>8</td>
</tr>
<tr>
<td>CHEM:2021</td>
<td>Fundamentals of Chemical Measurements</td>
<td>3</td>
</tr>
</tbody>
</table>

One of these sequences:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM:2210 &amp; CHEM:2220</td>
<td>Organic Chemistry I-II</td>
<td>6</td>
</tr>
<tr>
<td>CHEM:2230 &amp; CHEM:2240</td>
<td>Organic Chemistry I for Majors - Organic Chemistry II for Majors (preferred)</td>
<td>6</td>
</tr>
</tbody>
</table>

One of these:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM:2410</td>
<td>Organic Chemistry Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:2420</td>
<td>Organic Chemistry Laboratory for Majors (preferred)</td>
<td>3</td>
</tr>
</tbody>
</table>

Advanced Chemistry

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>All of these: CHEM:3110 &amp; CHEM:3120</td>
<td>Analytical Chemistry I-II</td>
<td>6</td>
</tr>
<tr>
<td>CHEM:3250</td>
<td>Inorganic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:3430</td>
<td>Analytical Measurements</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:3440</td>
<td>Physical Measurements</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:3530</td>
<td>Inorganic Chemistry Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:4270</td>
<td>Advanced Inorganic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:4431- CHEM:4432</td>
<td>Physical Chemistry I-II</td>
<td>6</td>
</tr>
</tbody>
</table>

Mathematics

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>One of these sequences: MATH:1550 &amp; MATH:1560</td>
<td>Engineering Mathematics I: Single Variable Calculus - Engineering Mathematics II: Multivariable Calculus</td>
<td>8</td>
</tr>
<tr>
<td>MATH:1850 &amp; MATH:1860</td>
<td>Calculus I-II (preferred)</td>
<td>8</td>
</tr>
</tbody>
</table>

Introductory Physics

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of these sequences: PHYS:1511- PHYS:1512</td>
<td>College Physics I-II</td>
<td>8</td>
</tr>
<tr>
<td>PHYS:1611- PHYS:1612</td>
<td>Introductory Physics I-II (preferred)</td>
<td>8</td>
</tr>
</tbody>
</table>

Science Electives and Research

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>A total of 6 s.h. from these: CHEM:3994</td>
<td>Undergraduate Research</td>
<td>1-4</td>
</tr>
<tr>
<td>BIOC:3110</td>
<td>Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>BIOC:3120</td>
<td>Biochemistry and Molecular Biology I</td>
<td>3</td>
</tr>
<tr>
<td>BIOC:3130</td>
<td>Biochemistry and Molecular Biology II</td>
<td>3</td>
</tr>
</tbody>
</table>

Advanced science elective courses

ACS Certification Requirement

Students who want an ACS certified degree complete one of these optional courses (also listed above under “Science Electives and Research”).

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOC:3110</td>
<td>Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>BIOC:3120</td>
<td>Biochemistry and Molecular Biology I</td>
<td>3</td>
</tr>
</tbody>
</table>

Teacher Licensure

Students interested in teaching in elementary and/or secondary schools should seek admission to the Teacher Education Program (TEP) in the College of Education.

To qualify for licensure in secondary teaching, students in the TEP complete a degree in education as well as a related College of Liberal Arts and Sciences degree. See Teacher Education Program Application and Admission on the College of Education website for details on requirements and deadlines for applying to the College of Education and about TEP choices of majors leading to licensure.

Combined Programs

B.S./M.S. in Business Analytics (Career Subprogram)

Students majoring in chemistry who are interested in earning a master’s degree in business analytics with a career subprogram may apply to the combined B.S./M.S. program offered by the College of Liberal Arts and Sciences and the Tippie College of Business. The program enables students to begin the study of business analytics before they complete their bachelor’s degree. Students are able to complete both degrees in five years rather than six.

Separate application to each degree program is required. Applicants must be admitted to both programs before they may be admitted to the combined degree program. For information about the business analytics program, see the M.S. in business analytics (career) in the Tippie College of Business section of the Catalog.

B.S./M.S. in Finance

Students majoring in chemistry who are interested in earning a master’s degree in finance may apply to the combined B.S./M.S. program offered by the College of Liberal Arts and Sciences and the Tippie College of Business. The program enables students to begin the study of finance before they complete their bachelor’s degree. Students are able to complete both degrees in five years rather than six.
Separate application to each degree program is required. Applicants must be admitted to both programs before they may be admitted to the combined degree program. For information about the finance program, see the M.S. in finance (Tippie College of Business) section of the Catalog.

Honors in the Major

 Majors are able to graduate with departmental honors. Students must maintain a cumulative University of Iowa g.p.a. of at least 3.33, as required by the College of Liberal Arts and Sciences; additionally, students must maintain a 3.33 cumulative g.p.a. in the major, a g.p.a. set by the Department of Chemistry.

 Students also must complete an undergraduate research project acceptable to their research advisor and must write an honors thesis based on their research. Students should register for CHEM:3994 Undergraduate Research or HONR:3994 Honors Research Practicum to earn credit for their research. They are encouraged but not required to present their research at local and regional meetings and to publish their results in professional journals.

University of Iowa Honors Program

In addition to honors in the major, students have opportunities for honors study and activities through membership in the University of Iowa Honors Program. Visit Honors at Iowa to learn about the University’s honors program.

Membership in the UI Honors Program is not required to earn honors in the chemistry major.

Financial Support

Scholarships and Awards

A number of awards and scholarships are available to chemistry majors, including the American Institute of Chemists Award, the Undergraduate Award in Analytical Chemistry, the Chemistry Alumni Awards (one each for a sophomore, a junior, and a senior), the Merck Index Award, and the Viksnins, Harris & Pady's PLLP Award.

Chemistry majors also may apply for the Donald J. and Margaret Burton Scholarship, Ken Sando Scholarship, Shoemaker-Strickler Scholarship, E. David Cater Scholarship, and Russell K. Simms Scholarship.

For more information, visit Undergraduate Scholarships and Awards on the Department of Chemistry website.

Career Advancement

The undergraduate major in chemistry provides a strong foundation for success in graduate and professional study and for positions in academic or industrial chemistry.

Students with a chemistry degree can pursue careers or graduate study in a wide range of fields. Learn more about career options for chemistry majors on the American Chemical Society website.

The Pomerantz Career Center offers multiple resources to help students find internships and jobs.

Academic Plans

Four-Year Graduation Plan

The following checkpoints list the minimum requirements students must complete by certain semesters in order to stay on the University’s Four-Year Graduation Plan. Courses in the major are those required to complete the major; they may be offered by departments other than the major department.

Courses in the chemistry major have prerequisites, so they must be taken in the correct order. Most advanced courses are taught only once a year. Students should consult their academic advisors and plan their course schedules carefully. They should take CHEM:2021 Fundamentals of Chemical Measurements during the first semester of the second year. Typical chemistry course schedules and a regression list are available at Undergraduate Program in Chemistry on the Department of Chemistry website.

Before the third semester begins: Math through calculus I; CHEM:1110 Principles of Chemistry I and CHEM:1120 Fundamentals of Chemical Measurements; inorganic chemistry; organic chemistry I, II, and lab; calculus II; and physics I and II

Before the fifth semester begins: CHEM:2021 Fundamentals of Chemical Measurements; inorganic chemistry; organic chemistry I, II, and lab; calculus II; and physics I and II

Before the seventh semester begins: six more courses in the major and at least 90 s.h. earned toward the degree

Before the eighth semester begins: three more courses in the major

During the eighth semester: enrollment in all remaining coursework in the major, all remaining GE CLAS Core courses, and a sufficient number of semester hours to graduate

Sample Plan of Study

Sample plans represent one way to complete a program of study. Actual course selection and sequence will vary and should be discussed with an academic advisor. For additional sample plans, see MyUI.

Chemistry, B.S.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>CHEM:1110 Principles of Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>MATH:1850 Calculus I</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>ENGL:1200 or RHET:1030 The Interpretation of Literature</td>
<td>3 - 4</td>
</tr>
<tr>
<td></td>
<td>GE CLAS Core: Social Sciences</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CSI:1600 Success at Iowa</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Hours</td>
<td>16-17</td>
</tr>
<tr>
<td>Spring</td>
<td>CHEM:1120 Principles of Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>RHET:1030 or ENGL:1200 Rhetoric or The Interpretation of Literature</td>
<td>3 - 4</td>
</tr>
<tr>
<td></td>
<td>MATH:1860 Calculus II</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>GE CLAS Core: World Languages First Level Proficiency or elective course</td>
<td>4 - 5</td>
</tr>
<tr>
<td></td>
<td>Hours</td>
<td>15-17</td>
</tr>
</tbody>
</table>
### Second Year

**Fall**
- **CHEM:2021** Fundamentals of Chemical Measurements  
  3
- **CHEM:2230** Organic Chemistry I for Majors  
  3
- **PHYS:1611** Introductory Physics I  
  4
- **GE CLAS Core: World Languages Second Level** Proficiency or elective course  
  4 - 5

| Hours | 14-15 |

**Spring**
- **CHEM:2240** Organic Chemistry II for Majors  
  3
- **CHEM:2420** Organic Chemistry Laboratory for Majors  
  3
- **CHEM:3250** Inorganic Chemistry  
  3
- **GE CLAS Core: Historical Perspectives**  
  3
- **GE CLAS Core: World Languages Second Level** Proficiency or elective course  
  4 - 5

| Hours | 16-17 |

### Third Year

**Fall**
- **CHEM:3530** Inorganic Chemistry Laboratory  
  3
- **CHEM:4270** Advanced Inorganic Chemistry  
  3
- **CHEM:4431** Physical Chemistry I  
  3
- **GE CLAS Core: International and Global Issues**  
  3
- **GE CLAS Core: World Languages Fourth Level** Proficiency or elective course  
  4 - 5

| Hours | 16-17 |

**Spring**
- **CHEM:4432** Physical Chemistry II  
  3
- **PHYS:1612** Introductory Physics II  
  3 - 4
- **Science elective course**  
  3
- **Elective course**  
  3
- **GE CLAS Core: Literary, Visual, and Performing Arts**  
  3

| Hours | 15-16 |

### Fourth Year

**Fall**
- **BIOC:3110** Biochemistry  
  3
- **CHEM:3110** Analytical Chemistry I  
  3
- **CHEM:3440** Physical Measurements  
  3
- **GE CLAS Core: Diversity and Inclusion**  
  3
- **Elective course**  
  2 - 3

| Hours | 14-15 |

**Spring**
- **CHEM:3120** Analytical Chemistry II  
  3
- **CHEM:3430** Analytical Measurements  
  3
- **GE CLAS Core: Values and Culture**  
  3
- **Elective course**  
  3
- **Elective course**  
  3

**Degree Application: apply on MyUI before deadline (typically in February for spring, September for fall)**

| Hours | 15 |

| Total Hours | 121-129 |

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**Notes:**
- Enrollment in chemistry courses requires completion of a placement exam.
- Fulfill a major requirement and may fulfill a GE requirement.
- Enrollment in math courses requires completion of a placement exam.
- GE CLAS Core courses may be completed in any order unless used as a prerequisite for another course. Students should consult with an advisor about the best sequencing of courses.
- Students who have completed four years of a single language in high school have satisfied the GE CLAS Core World Languages requirement. Enrollment in world languages courses requires a placement exam, unless enrolling in a first-semester-level course.
- Students should take CHEM:2021 during the first semester of the second year.
- Typically this course is offered in fall semesters only. Check MyUI for course availability since offerings are subject to change.
- Typically this course is offered in spring semesters only. Check MyUI for course availability since offerings are subject to change.
- Students may use elective courses to earn credit towards the total s.h. required for graduation or to complete a double major, minors, or certificates.
- Students who want an ACS certified degree must complete one of these optional courses: BIOC:3110 or BIOC:3120.
- Please see Academic Calendar, Office of the Registrar website for current degree application deadlines. Students should apply for a degree for the session in which all requirements will be met. For any questions on appropriate timing, contact your academic advisor or Graduation Services.

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**References:**
- a Enrollment in chemistry courses requires completion of a placement exam.
- b Fulfill a major requirement and may fulfill a GE requirement.
- c Enrollment in math courses requires completion of a placement exam.