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 course work). 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 course work.

<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>
<tr>
<td>Mathematics Courses</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Introductory Physics Courses</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Science Electives and Research Courses</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td><strong>Total Hours</strong></td>
<td>69</td>
<td></td>
</tr>
</tbody>
</table>

## 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:</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>
<tr>
<td>One of these sequences:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM:2120 &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>
<tr>
<td>One of these:</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:</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>
</tr>
</thead>
<tbody>
<tr>
<td>One of these sequences:</td>
<td></td>
<td></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:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>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

A total of 6 s.h. from these:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>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>

## ACS Certification elective courses

## Teacher Licensure

Majors interested in earning licensure to teach in elementary and/or secondary schools must complete the College of Education’s Teacher Education Program (TEP) in addition to the requirements for the major and all requirements for graduation. The TEP requires several College of Education courses and student teaching. Contact the Office of Student Services for details.

Students must satisfy all degree requirements and complete TEP licensure before degree conferral.

Majors who plan to use their work toward a minor in chemistry as academic background for earning teacher licensure should contact the Office of Student Services about requirements.

Students with a strong interest in science teaching may complete a science education major. Students choose one of five emphases—biology, chemistry, earth science, physics, and all-science—and earn a Bachelor of Science degree. They may apply for admission to the TEP. See the B.S. in science education in the Teaching and Learning section of the Catalog.

## Honors

### 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. In addition, they 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.

**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 Principles of Chemistry II, or equivalent course work

**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 course work 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><strong>First Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM:1110</td>
<td>Principles of Chemistry I a,b</td>
<td>4</td>
</tr>
<tr>
<td>MATH:1850</td>
<td>Calculus I a,b</td>
<td>4</td>
</tr>
<tr>
<td>RHET:1030</td>
<td>or ENGL:1200 Rhetoric or The Interpretation of Literature</td>
<td>3 - 4</td>
</tr>
<tr>
<td>GE CLAS Core:</td>
<td>Social Sciences d</td>
<td>3</td>
</tr>
<tr>
<td>CSI:1600</td>
<td>Success at Iowa</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Hours</td>
<td>16-17</td>
</tr>
<tr>
<td>Spring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM:1120</td>
<td>Principles of Chemistry II a</td>
<td>4</td>
</tr>
<tr>
<td>RHET:1030</td>
<td>or ENGL:1200 Rhetoric or The Interpretation of Literature</td>
<td>3 - 4</td>
</tr>
<tr>
<td></td>
<td>Hours</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Total Hours</td>
<td>125-133</td>
</tr>
</tbody>
</table>

- MATH:1860 Calculus II
- GE CLAS Core: World Languages First Level Proficiency or elective course e
- **Second Year**
  - Fall
    - CHEM:2230 Organic Chemistry I for Majors f 3
    - CHEM:2021 Fundamentals of Chemical Measurements g 3
    - PHYS:1611 Introductory Physics I a 4
    - GE CLAS Core: World Languages Second Level Proficiency or elective course e
    - Hours 15-17
  - Spring
    - CHEM:2240 Organic Chemistry II for Majors h 3
    - CHEM:2420 Organic Chemistry Laboratory for Majors h 3
    - CHEM:3250 Inorganic Chemistry h 3
    - PHYS:1612 Introductory Physics II a 3 - 4
    - GE CLAS Core: World Languages Second Level Proficiency or elective course e
    - Hours 16-18
- **Third Year**
  - Fall
    - CHEM:3110 Analytical Chemistry I f 3
    - CHEM:4432 Physical Chemistry II 3
    - CHEM:3530 Inorganic Chemistry Laboratory f 3
    - GE CLAS Core: World Languages Fourth Level Proficiency or elective course e
    - GE CLAS Core: International and Global Issues d 3
    - Hours 16-17
  - Spring
    - CHEM:3120 Analytical Chemistry II h 3
    - CHEM:4431 Physical Chemistry I 3
    - Elective course i 3
    - GE CLAS Core: Historical Perspectives d 3
    - GE CLAS Core: Literary, Visual, and Performing Arts 3
    - Hours 15
- **Fourth Year**
  - Fall
    - CHEM:3440 Physical Measurements f 3
    - CHEM:4270 Advanced Inorganic Chemistry f 3
    - BIOC:3110 Biochemistry i, k 3
    - CHEM:3994 Undergraduate Research k 2
    - GE CLAS Core: Diversity and Inclusion d 3
    - Elective course l 2 - 3
    - Hours 16-17
  - Spring
    - CHEM:3994 Undergraduate Research k 2
    - CHEM:3430 Analytical Measurements h 3
    - GE CLAS Core: Values and Culture d 3
    - GE CLAS Core: International and Global Issues d 3
    - Elective course l 3
    - Elective course l 3
    - Elective course l 3
    - Hours 17
    - Total Hours 125-133
a Fulfills a major requirement and may fulfill a GE requirement.
b Enrollment in chemistry courses requires completion of a placement exam.
c Enrollment in math courses requires completion of a placement exam.
d 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.
e 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.
f Typically this course is offered in fall semesters only. Check MyUI for course availability since offerings are subject to change.
g Students should take CHEM:2021 during the first semester of the second year.
h Typically this course is offered in spring semesters only. Check MyUI for course availability since offerings are subject to change.
i 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.
j Students who want an ACS certified degree must complete one of these optional courses: BIOC:3110 or BIOC:3120.
k Students are required to complete 6 s.h. in science electives and research toward the 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 & Padys 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.

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.