Chemistry, BA

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.

Graduates will be able to:

Chemical Information Skills
- 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.

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:

Requirements
The Bachelor of Arts with a major in chemistry requires a minimum of 120 s.h., including 53-54 s.h. of work for the major (20 s.h. in foundation chemistry courses, 12 s.h. in advanced chemistry, and 21-22 s.h. in supporting coursework). Students must earn at least 11 s.h. in advanced chemistry courses at the University of Iowa. They must maintain a grade-point average 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 BA degree is a good choice for students interested in medical or other professional schools, or those interested in a teaching career (see "Teacher Licensure" below). The program provides students with the flexibility to earn a degree in chemistry while they also complete related courses required for medical school, such as biology and biochemistry. Compared to the BS degree, the BA has modified mathematics requirements that include a one-semester physical chemistry course, an analytical chemistry course, and a single, integrated capstone laboratory that incorporates analytical, inorganic, and physical chemistry experiments.

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 BA with a major in chemistry requires the following coursework.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry Foundation Courses</td>
<td>20</td>
</tr>
<tr>
<td>Advanced Chemistry Courses</td>
<td>12</td>
</tr>
<tr>
<td>Mathematics Courses</td>
<td>7-8</td>
</tr>
<tr>
<td>Introductory Physics Courses</td>
<td>8</td>
</tr>
<tr>
<td>Science Electives</td>
<td>6</td>
</tr>
</tbody>
</table>
Chemistry Foundation Courses

Students complete the following foundation courses.

<table>
<thead>
<tr>
<th>Course #</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>All of these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>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>
<tr>
<td>One of these sequences:</td>
<td></td>
<td></td>
</tr>
<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>
<tr>
<td>One of these:</td>
<td></td>
<td></td>
</tr>
<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 Courses

<table>
<thead>
<tr>
<th>Course #</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM:3110</td>
<td>Equilibria and Electrochemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:3120</td>
<td>Spectroscopy and Separations (preferred)</td>
<td>3</td>
</tr>
<tr>
<td>All of these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM:3250</td>
<td>Inorganic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:4430</td>
<td>Principles of Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:4450</td>
<td>Synthesis and Measurement</td>
<td>3</td>
</tr>
</tbody>
</table>

Mathematics Courses

<table>
<thead>
<tr>
<th>Course #</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH:1460</td>
<td>Calculus for the Biological Sciences (preferred)</td>
<td>4</td>
</tr>
<tr>
<td>MATH:1550</td>
<td>Engineering Mathematics I: Single Variable Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH:1850</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>One of these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH:1560</td>
<td>Engineering Mathematics II: Multivariable Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH:1860</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>STAT:2010</td>
<td>Statistical Methods and Computing</td>
<td>3</td>
</tr>
<tr>
<td>STAT:3510/IGPI:3510</td>
<td>Biostatistics (preferred)</td>
<td>3</td>
</tr>
</tbody>
</table>

Introductory Physics Courses

<table>
<thead>
<tr>
<th>Course #</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 (preferred)</td>
<td>8</td>
</tr>
<tr>
<td>PHYS:1611- PHYS:1612</td>
<td>Introductory Physics I-II</td>
<td>8</td>
</tr>
</tbody>
</table>

Science Electives

Some of these courses may be used to fulfill other requirements for the major, as listed above: students who have used a course from this list to fulfill another requirement for the major may not use that course as an elective. Students should consult their advisor to gain approval for a course that is not on the list. Undergraduate Research (CHEM:3994) may not be used to satisfy the science electives requirement.

<table>
<thead>
<tr>
<th>Course #</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>A total of 6 s.h. from these:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM:3110</td>
<td>Equilibria and Electrochemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:3120</td>
<td>Spectroscopy and Separations</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:4372</td>
<td>Advanced Organic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:4431</td>
<td>Chemical Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:4432</td>
<td>Quantum Mechanics and Chemical Kinetics</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:4480</td>
<td>Introduction to Molecular Modeling</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:4760</td>
<td>Radiochemistry: Energy, Medicine, and the Environment</td>
<td>3</td>
</tr>
<tr>
<td>CHEM:4873</td>
<td>Atmospheric and Environmental Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>BMB:3110</td>
<td>Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>BMB:3120</td>
<td>Biochemistry and Molecular Biology I</td>
<td>3</td>
</tr>
<tr>
<td>BMB:3130</td>
<td>Biochemistry and Molecular Biology II</td>
<td>3</td>
</tr>
<tr>
<td>CEE:4150/CBE:4420</td>
<td>Environmental Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>EES:4490</td>
<td>Elements of Geochemistry</td>
<td>3</td>
</tr>
<tr>
<td>EES:4520</td>
<td>Isotope Geochemistry</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 Apply 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

BA/MAT (Science Education Subprogram)

Students who are interested in pursuing a graduate degree in teaching may apply to the combined Bachelor of Arts/Master of Arts in Teaching with a science education subprogram offered by the College of Liberal Arts and Sciences and the
College of Education. Designed for undergraduates majoring in biology, chemistry, environmental sciences, or physics, the combined program enables students to earn a BA and MAT in five years by beginning to earn graduate credit during their fourth year of undergraduate study and by counting up to 19 s.h. of qualifying credit toward both degrees. For more information, see “Combined Program” under Science Education in the Master of Arts in Teaching (College of Education) section of the catalog. Interested students should consult an advisor.

Honors

Honors in the Major
Majors are able to graduate with departmental honors. Students must maintain a cumulative University of Iowa grade-point average (GPA) of at least 3.33, as required by the College of Liberal Arts and Sciences; additionally, students must maintain a 3.33 cumulative GPA in the major, a GPA 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 & Padys PLLP Award.
Chemistry majors also may apply for the Donald J. and Margaret Burton 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 seventh semester begins: two more courses in the major; PHYS:1511 College Physics I–PHYS:1512 College Physics II or PHYS:1611 Introductory Physics I–PHYS:1612 Introductory Physics II; and at least 90 s.h. earned toward the degree.

Before the eighth semester begins: CHEM:4430 Principles of Physical Chemistry and one more course 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, BA

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any Semester</td>
<td>GE CLAS Core: Sustainability</td>
<td>0</td>
</tr>
</tbody>
</table>
First Year

**Fall**

- CHEM:1110 Principles of Chemistry I \(^b\) 4
- ENGL:1200 The Interpretation of Literature or RHET:1030 Rhetoric 3 - 4
- MATH:1440 Mathematics for the Biological Sciences 4
- GE CLAS Core: Diversity and Inclusion \(^d\) 3
- CSI:1600 Success at Iowa 2
- **Hours** 16-17

**Spring**

- CHEM:1120 Principles of Chemistry II 4
- MATH:1460 Calculus for the Biological Sciences 4
- GE CLAS Core: World Languages First Level 4 - 5
- Proficiency or elective course \(e\) 3
- **Hours** 15-16

Second Year

**Fall**

- CHEM:2021 Fundamentals of Chemical Measurements 3
- CHEM:2230 Organic Chemistry I for Majors \(g\) 3
- RHET:1030 Rhetoric or ENGL:1200 The Interpretation of Literature 3 - 4
- GE CLAS Core: World Languages Second Level 4 - 5
- Proficiency or elective course \(e\) 3
- **Hours** 16-18

**Spring**

- CHEM:2240 Organic Chemistry II for Majors \(h\) 3
- CHEM:2420 Organic Chemistry Laboratory for Majors \(h\) 3
- STAT:3510 Biostatistics 3
- GE CLAS Core: World Languages Third Level 4 - 5
- Proficiency or elective course \(e\) 3
- **Hours** 16-17

Third Year

**Fall**

- CHEM:3110 Equilibria and Electrochemistry or Spectroscopy and Separations \(i\) 3
- PHYS:1511 College Physics I 4
- GE CLAS Core: World Languages Culture \(d\) 3
- GE CLAS Core: World Languages Fourth Level 4 - 5
- Proficiency or elective course \(e\) 3
- **Hours** 17-18

**Spring**

- CHEM:3250 Inorganic Chemistry \(h\) 3
- PHYS:1512 College Physics II 4
- Major: science elective course \(f\) 3
- GE CLAS Core: Literary, Visual, and Performing Arts \(d\) 3
- Elective course \(f\) 3
- **Hours** 16

Fourth Year

**Fall**

- CHEM:4430 Principles of Physical Chemistry \(g\) 3
- Major: science elective course \(j\) 3
- GE CLAS Core: International and Global Issues \(q\) 3
- Elective course \(f\) 3
- Elective course \(f\) 3
- **Hours** 15

**Spring**

- CHEM:4450 Synthesis and Measurement \(h\) 3
- GE CLAS Core: Social Sciences \(d\) 3
- Elective course \(f\) 3
- Elective course \(f\) 3
- Elective course \(f\) 3
- **Hours** 15

**Total Hours** 126-132

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a Sustainability must be completed by choosing a course that has been approved for Sustainability AND for one of these General Education areas: Natural Sciences; Quantitative and Formal Reasoning; Social Sciences; Historical Perspectives; International and Global Issues; Literary, Visual, and Performing Arts; or Values and Culture.
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 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.
g Typically this course is offered in fall semesters only. Check MyUI for course availability since offerings are subject to change.
h Typically this course is offered in spring semesters only. Check MyUI for course availability since offerings are subject to change.
i Typically CHEM:3110 is offered in fall semesters only and CHEM:3120 is offered spring semesters only. Check MyUI for course availability since offerings are subject to change.
j Students are required to complete 6 s.h. of science electives chosen from a list of approved courses. Students who have used a course to fulfill another requirement for the major may not use that course as a science elective.
k 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.