Chemistry (BA/BS)

The Department of Chemistry and Biochemistry offers majors in chemistry and biochemistry. Biochemistry majors complete an integrated, rigorous program that includes foundational course work in chemistry and biochemistry and additional course work in related fields. Undergraduate majors benefit from taking graduate courses in synthetic modeling, physical chemistry, materials, computational chemistry, biochemistry, molecular biology, and modern instrumental techniques.

The American Chemistry Society-certified degree emphasizes laboratory experience and the development of professional skills. A unique strength of the department is the opportunity for undergraduates to participate in the activities of a dynamic research group that considers problems extending well beyond textbook instruction.

Program Learning Outcomes

Upon successful completion of this program, students will be able to:

• Coursework: Students will demonstrate an understanding of the fundamental concepts in the basic areas of the discipline (organic, inorganic, analytical, physical, and biochemical). Students will demonstrate a firm foundation in the conceptual, quantitative, and computational thinking that underlies the theories and models that form the basis for reasoning about molecular systems. Students will be able to connect this theoretical understanding to the experimental methods used to test those theories and models. Students will also have opportunities to obtain in-depth knowledge in multiple areas of the discipline. The foundational and in-depth coursework will be aligned with the most recent American Chemical Society Guidelines for Chemistry Programs (https://www.acs.org/education/policies/acs-approval-program.html).

• Instructional Laboratory: Students will demonstrate proficiency in laboratory techniques and the use of modern instrumentation. Students will be able to carry out experiments in the laboratory, accurately record data and observations, and be able to analyze the results of experiments. Students will be able to handle, synthesize, purify, and characterize new and existing substances. This includes knowing the proper procedures and regulations for the safe handling, use and disposal of chemicals.

• Research: Students will employ critical thinking and the scientific method to design, carry out, record, analyze and communicate the results of chemical/biochemical experiments. This includes the ability to identify, or create an appropriate model, formulate a hypothesis, choose an appropriate set of tools and techniques, and design an experiment that tests the hypothesis and analyze the results from that experiment drawing sound scientific conclusions from the results obtained. Students must be able to locate, identify and critically evaluate the chemical/biochemical literature.

• Communication: Students will demonstrate effective scientific communication skills, both orally and in writing, to a range of audience levels and for a variety of purposes. Students will understand how scientific information is shared between peers in modern science, including responsible conduct for acknowledging prior and current contributions.

• Professional Skills: Students will develop the interpersonal skills to function cooperatively in a team setting. Students will successfully pursue their career objectives in advanced education in professional and/or graduate schools, in a scientific career in government or industry, in a teaching career in the school systems, or in a related career following graduation.

• Ethics: Students will be able to understand and apply ethics and values to all professional activities. Students will demonstrate an awareness of the benefits and impacts of chemistry related to the environment, society, and other disciplines outside the scientific community. Students will be prepared to contribute solutions to society's challenges at the intersection of science and society.

The program described below is the recommended curriculum for chemistry majors. It includes courses in chemistry and related fields. Courses taken to satisfy major requirements must be passed with grades of C– or better. Variations in courses and order may be worked out in consultation with an advisor. Advisors can also provide lists of substitute courses and courses that are recommended but not required.

Students are encouraged to participate in CH 401 Research: [Topic].

Chemistry Major Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Chemistry Courses</strong></td>
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<tr>
<td>CH 224H–226H</td>
<td>Honors General Chemistry</td>
<td>12</td>
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<tr>
<td>or CH 221–</td>
<td>General Chemistry</td>
<td></td>
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<tr>
<td>223</td>
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<td></td>
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<tr>
<td>CH 227–229</td>
<td>General Chemistry Laboratory</td>
<td>6</td>
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<tr>
<td>or CH 237–</td>
<td>Advanced General Chemistry Laboratory</td>
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<tr>
<td>239</td>
<td></td>
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<tr>
<td>CH 341–343</td>
<td>Majors Track Organic Chemistry I-III</td>
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<tr>
<td>CH 337</td>
<td>Organic Chemistry Laboratory</td>
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</tr>
<tr>
<td>CH 348–349</td>
<td>Organic Chemistry Lab for Majors</td>
<td>8</td>
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<tr>
<td>CH 411–413</td>
<td>Physical Chemistry</td>
<td>12</td>
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<td>CH 417–419</td>
<td>Physical Chemistry Laboratory</td>
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<tr>
<td>Advanced Electives (see Advanced Electives table below)</td>
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<tr>
<td>CH 429</td>
<td>Instrumental Analysis</td>
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<td><strong>Related Science Requirements</strong></td>
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<tr>
<td>MATH 251–253</td>
<td>Calculus I-III</td>
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</tr>
<tr>
<td>MATH 256</td>
<td>Introduction to Differential Equations</td>
<td>4</td>
</tr>
<tr>
<td>MATH 281</td>
<td>Several-Variable Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 251–253</td>
<td>Foundations of Physics I</td>
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</tr>
<tr>
<td>or PHYS 201–</td>
<td>General Physics</td>
<td></td>
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<tr>
<td>203</td>
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<tr>
<td>PHYS 290</td>
<td>Foundations of Physics Laboratory (three terms)</td>
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<tr>
<td>or PHYS 204–</td>
<td>Introductory Physics Laboratory</td>
<td></td>
</tr>
<tr>
<td>206</td>
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<td></td>
<td><strong>Total Credits</strong></td>
<td>114-120</td>
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</table>

Advanced Electives

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced electives (e.g., three courses or 9 credits of research or one course and 6 credits of research) chosen from the following:</td>
<td>9-12</td>
<td></td>
</tr>
<tr>
<td>CH 401</td>
<td>Research: [Topic]</td>
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<tr>
<td>CH 420</td>
<td>Physical Organic Chemistry I</td>
<td></td>
</tr>
<tr>
<td>CH 421</td>
<td>Physical Organic Chemistry II</td>
<td></td>
</tr>
<tr>
<td>CH 431</td>
<td>Inorganic Chemistry</td>
<td></td>
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</tbody>
</table>
Bachelor of Arts in Chemistry

Course | Title | Credits | Milestones
--- | --- | --- | ---
**First Year**
**Fall**
MATH 112Z or MATH 251 | Precalculus II: Trigonometry or Calculus I | 4 | 
WR 121Z | Composition I | 4 | 
CH 221 or CH 224H | General Chemistry I or Advanced General Chemistry I | 4 | 
CH 227 | General Chemistry Laboratory | 2 | 
**Winter**
WR 123 or WR 122Z | College Composition III or Composition II | 4 | 
CH 222 or CH 225H | General Chemistry II or Advanced General Chemistry II | 4 | 
CH 228 | General Chemistry Laboratory | 2 | 
MATH 251 or MATH 252 | Calculus I or Calculus II | 4 | 
**Spring**
CH 223 or CH 226H | General Chemistry III or Advanced General Chemistry III | 4 | 
CH 229 | General Chemistry Laboratory | 2 | 
MATH 252 or MATH 253 | Calculus II or Calculus III | 4 | 
**Total Credits** | **42** | 

Honors Program

The criteria used for the selection of students who graduate with departmental honors in chemistry or biochemistry are as follows:

1. Grade point average (GPA) of at least 3.50 in all graded courses
2. Suitable accomplishment in undergraduate chemical or related research. Specifically, the student must pursue a research problem for one academic year or longer and be recommended as worthy of honors by the faculty supervisor. Positive accomplishment and publishable results are expected but not required
3. Endorsement for a major with honors by a member of the university faculty
4. Completion of all course requirements for the BS degree in chemistry (waivers or substitutions allowed with approval)

Four-Year Degree Plan

*The degree plan shown is only a sample of how students may complete their degrees in four years. There are alternative ways. Students should consult their advisor to determine the best path for them.*
Winter
PHYS 202 General Physics 4
or Foundations of Physics I
PHYS 252
PHYS 205 Introductory Physics Laboratory 2
or Foundations of Physics Laboratory
PHYS 290
CH 342 Majors Track Organic Chemistry II 4
CH 348 Organic Chemistry Laboratory for Majors 4

Credits 14

Spring
PHYS 203 General Physics 4
or Foundations of Physics I
PHYS 253
PHYS 206 Introductory Physics Laboratory 2
or Foundations of Physics Laboratory
PHYS 290
CH 343 Majors Track Organic Chemistry III 4
CH 349 Organic Chemistry Lab for Majors 4
General-education course in social science 4
Majors take the American Chemical Society Exam at the end of the academic year.
Students interested in undergraduate research should make arrangements to start.

Credits 18

Total Credits 45

Course Title Credits Milestones

Bachelor of Science in Chemistry
Course Title Credits Milestones
First Year
Fall
MATH 112Z or Precalculus II: Trigonometry or Calculus I 4
MATH 251
WR 121Z Composition I 4
CH 221 or General Chemistry I or Advanced General Chemistry I 4
CH 224H
CH 227 General Chemistry Laboratory 2

Credits 17

Spring
CH 412 Physical Chemistry 4
CH 418 Physical Chemistry Laboratory 4
Second term of first-year second-language sequence (BA only) 5
General-education course that also satisfies multicultural requirement 4

Credits 17

Winter
WR 123 College Composition III 4
or Composition II
WR 122Z
### Course Title Credits

#### Second Year

**Fall**
- **PHYS 201** General Physics or Foundations of Physics I 4
- **PHYS 204** Introductory Physics Laboratory or Foundations of Physics Laboratory 2
- **PHYS 205** Introductory Physics Laboratory or Foundations of Physics Laboratory 2
- **CH 337** Organic Chemistry Laboratory 3
- **CH 341** Majors Track Organic Chemistry I 4

**Credits** 13

#### Winter

- **PHYS 202** General Physics or Foundations of Physics I 4
- **PHYS 205** Introductory Physics Laboratory or Foundations of Physics Laboratory 2
- **CH 342** Majors Track Organic Chemistry II 4
- **CH 348** Organic Chemistry Laboratory for Majors 4

**Credits** 14

### Third Year

**Fall**
- **MATH 256** or **MATH 281** Introduction to Differential Equations or Several-Variable Calculus I 4
- **CH 411** Physical Chemistry 4
- **CH 417** Physical Chemistry Laboratory 4
- **MATH 256** or **MATH 281** Introduction to Differential Equations or Several-Variable Calculus I 4

**Credits** 16

**Winter**
- **CH 412** Physical Chemistry 4
- **CH 418** Physical Chemistry Laboratory 4
- **General-education course in social science** 4

**Credits** 16

### Fourth Year

**Fall**
- **CH 401** Research: [Topic] 2
- **400-level course in chemistry, earth sciences, or physics** 4
- **General-education course in arts and letters** 4
- **General-education course that also satisfies multicultural requirement** 4

**Credits** 14

**Winter**
- **CH 401** Research: [Topic] 2
- **400-level course in chemistry, earth sciences, or physics** 4
<table>
<thead>
<tr>
<th>Course Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General-education course that also satisfies multicultural requirement</td>
<td>4</td>
</tr>
<tr>
<td>General-education course in social science</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Credits</strong> 14</td>
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<tr>
<td><strong>Spring</strong></td>
<td></td>
</tr>
<tr>
<td>CH 401 Research: [Topic]</td>
<td>2</td>
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<tr>
<td>400-level course in chemistry, earth sciences, or physics</td>
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<td>General-education course in arts and letters</td>
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<td><strong>Credits</strong> 10</td>
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<td><strong>Total Credits</strong> 38</td>
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