CHEMISTRY, B.A.

The mission of the Department of Chemistry is to conduct world-class, groundbreaking research in the chemical sciences while offering the highest quality of education to undergraduate students, graduate students, and postdoctoral associates. The department's leadership in research includes the traditional areas of physical, analytical, inorganic, and organic chemistry, and has rapidly evolved to encompass environmental chemistry, chemical biology, biophysical chemistry, soft and hard materials chemistry, and nanotechnology. The Department of Chemistry prides itself on its highly interactive, diverse, and collegial scientific environment. Our emphasis on collaboration connects us to colleagues across campus, around the country, and throughout the world.

The undergraduate chemistry major leads to a bachelor of science or a bachelor of arts degree awarded by the College of Letters & Science. The curriculum provides excellent preparation in chemistry, along with a wide breadth of liberal arts coursework. At the same time, the program provides significant opportunities for students to participate in scientific inquiry, within both laboratory courses and research laboratories. Students from other colleges within the university may pursue the chemistry major as an additional major. When pursuing a chemistry major, the undergraduate student must meet university general education requirements and breadth requirements of their own college, along with the specific requirements for the chemistry major.

The chemistry major prepares graduates for a wide variety of careers in the chemical and related industries (e.g., consumer and agricultural products, materials, energy, petroleum, paper, and food), as well as environmental, pharmaceutical, and other health-related sciences. Combined with a master's program in secondary education, the major qualifies the student to teach chemistry in secondary schools. The major prepares students for graduate-level work in chemistry, chemical physics, biochemistry, biophysics, materials chemistry, and other related fields. Students who excel in undergraduate chemistry coursework are able to obtain funding for graduate studies in chemistry and related sciences through teaching or research assistantships and fellowships. Some chemistry major graduates go on to professional schools to study medicine, pharmacy, dentistry, veterinary medicine, business, or law.

HOW TO GET IN

Students who are interested in the chemistry major are encouraged to declare the major no later than the end of their sophomore year. There are many advantages to declaring the chemistry major early, including access to chemistry advising, access to scholarships only available to chemistry majors, and access to announcements for chemistry majors. Students who have declared the major become a part of our chemistry community, enabling them to better connect with faculty, staff and other chemistry majors.

Students who meet the recommendations (https://www.chem.wisc.edu/content/declaring-major) for declaring the major are invited to schedule an appointment (https://www.chem.wisc.edu/content/undergraduate-advising) with the undergraduate chemistry advisor to develop a four-year plan and to declare.

REQUIREMENTS

UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatetestudytext) section of the Guide.

Requirements Detail

General Education

- Breadth—Humans/Literary/Arts: 6 credits
- Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits
- Breadth—Social Studies: 3 credits
- Communication Part A & Part B *
- Ethnic Studies *
- Quantitative Reasoning Part A & Part B *

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

COLLEGE OF LETTERS & SCIENCE BREADTH AND DEGREE REQUIREMENTS: BACHELOR OF ARTS (B.A.)

Students pursuing a bachelor of arts degree in the College of Letters & Science must complete all of the requirements below. The College of Letters & Science allows this major to be paired with either a bachelor of arts or a bachelor of science curriculum. View a comparison of the degree requirements here. (https://pubs.wisc.edu/home/archives/ug15/images/babs2009.pdf)

BACHELOR OF ARTS DEGREE REQUIREMENTS

Requirements Detail

Mathematics

- Fulfilled with completion of University General Education requirements Quantitative Reasoning a (QR A) and Quantitative Reasoning b (QR B) coursework. Please note that some majors may require students to complete additional math coursework beyond the B.A. mathematics requirement.

Foreign Language

- Complete the fourth unit of a foreign language; OR
- Complete the third unit of a foreign language and the second unit of an additional foreign language

Note: A unit is one year of high school work or one semester/term of college work.
L&S Breadth

- Humanities, 12 credits: 6 of the 12 credits must be in literature
- Social Sciences, 12 credits
- Natural Sciences, 12 credits: must include one 3+ credit course in the biological sciences; must include one 3+ credit course in the physical sciences

Liberal Arts and Science Coursework

108 credits

- Depth of Intermediate/Advanced work: 60 intermediate or advanced credits

Major

Declare and complete at least one (1) major

Total Credits

120 credits

UW-Madison Experience

- 30 credits in residence, overall
- 30 credits in residence after the 90th credit

Minimum GPAs

- 2.000 in all coursework at UW–Madison
- 2.000 in intermediate/advanced coursework at UW–Madison

NON–L&S STUDENTS PURSUING AN L&S MAJOR

Non–L&S students who have permission from their school/college to pursue an additional major within L&S only need to fulfill the major requirements and do not need to complete the L&S breadth and degree requirements above.

REQUIREMENTS FOR THE MAJOR

MATH & PHYSICS

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mathematics (1 course)</td>
<td>5</td>
</tr>
<tr>
<td>MATH 222</td>
<td>Calculus and Analytic Geometry 2</td>
<td></td>
</tr>
<tr>
<td>MATH 276</td>
<td>Topics in Calculus II</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Physics</td>
<td>10</td>
</tr>
<tr>
<td>PHYSICS 207</td>
<td>General Physics</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 201</td>
<td>General Physics</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 247</td>
<td>A Modern Introduction to Physics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>First Introductory Course (1 course)</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 208</td>
<td>General Physics</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 202</td>
<td>General Physics</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 248</td>
<td>A Modern Introduction to Physics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Second Introductory Course (1 course)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Credits</td>
<td>15</td>
</tr>
</tbody>
</table>

CHEMISTRY

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>General Chemistry (1 course)</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 104</td>
<td>General Chemistry II</td>
<td></td>
</tr>
<tr>
<td>CHEM 109</td>
<td>Advanced General Chemistry</td>
<td></td>
</tr>
<tr>
<td>CHEM 115</td>
<td>Chemical Principles I</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Analytical Chemistry (1 course)</td>
<td>4-5</td>
</tr>
<tr>
<td>CHEM 327</td>
<td>Fundamentals of Analytical Science</td>
<td></td>
</tr>
<tr>
<td>CHEM 329</td>
<td>Fundamentals of Analytical Science</td>
<td></td>
</tr>
<tr>
<td>CHEM 116</td>
<td>Chemical Principles II</td>
<td></td>
</tr>
</tbody>
</table>

Inorganic Chemistry (1 course) 4

CHEM 311 Chemistry Across the Periodic Table 4

Organic Chemistry (3 courses) 2

- CHEM 343 Introductory Organic Chemistry
- CHEM 344 Introductory Organic Chemistry Laboratory
- CHEM 345 Intermediate Organic Chemistry 3-4

Physical Chemistry

Part 1 (1 course)

- CHEM 561 Physical Chemistry
- CHEM 565 Biophysical Chemistry
- CBE 310 Chemical Process Thermodynamics

Part 2 (1 course) 4

- CHEM 562 Physical Chemistry

Part 3 (2 courses)

- CHEM 564 Physical Chemistry Laboratory
- CHEM 563 Physical Chemistry Laboratory

Advanced Non-laboratory Coursework 5

- non-lab CHEM 500–680
- non-lab BIOCHEM 500-680

Additional Laboratory Work 3

- CHEM 346 Intermediate Organic Chemistry Laboratory
- CHEM 524 Chemical Instrumentation
- CHEM 691 Senior Thesis & CHEM 692 Senior Thesis
- CHEM 699 Directed Study
- BMOLCHEM 504 Human Biochemistry Laboratory 7

Total Credits 36-38

RESIDENCE AND QUALITY OF WORK IN THE MAJOR

2.000 GPA in all CHEM and major courses

2.000 GPA on at least 15 credits of upper-level work in the major 8

15 credits in CHEM, taken at UW–Madison

NOTES

1. MATH 234 Calculus–Functions of Several Variables and MATH 320 Linear Algebra and Differential Equations is highly recommended

2. Enrollment in CHEM 115 and CHEM 116 is by invitation only. Entering first-year students are screened on the basis of high school record and placement scores, and additional information is sent to those who might be eligible.

3. CHEM 343 must be taken first, followed by CHEM 345. CHEM 344 may be taken concurrently with or after CHEM 345.

4. It is recommended that CHEM 563 be taken concurrently with CHEM 562 and that CHEM 564 be taken after completion of CHEM 562. Especially strong students needing to complete physical chemistry in two semesters may take CHEM 563 concurrently with CHEM 561 (or CHEM 565) and CHEM 564 concurrently with CHEM 562.

5. One credit from each of CHEM 116 and CHEM 565 count toward the 5 credits. Only 2 of the 3 credits from CHEM 524 count. The other credit from CHEM 524 counts toward the additional laboratory work. Some courses from other departments may be chosen as well, including CHEM/M S & E 421, CBE 440, CBE 540, and CBE 547.
HONORS IN THE MAJOR

Students may declare Honors in the Chemistry Major in consultation with the chemistry major advisor (https://www.chem.wisc.edu/content/undergraduate-advising). To be admitted to the Honors Program in Chemistry, students must have declared a major in chemistry and achieved a 3.300 GPA in all CHEM courses taken.

HONORS IN THE CHEMISTRY MAJOR REQUIREMENTS

To earn the B.A. or B.S. with Honors in the Major in Chemistry students must satisfy both the requirements for the major (above) and the following additional requirements:

- Earn a 3.300 overall university GPA
- Earn a 3.300 GPA for all CHEM courses
- Complete at least 3 credits of advanced work beyond those already required for the major. This requirement may be met in one of three ways:
  - With additional 500-level or higher courses in chemistry or biochemistry;
  - With additional research credits, beyond credits for the Senior Honors Thesis and beyond any credits that are being used to satisfy the 3 additional laboratory credits required for the major; or
  - With additional breadth courses in other related disciplines

- Complete a two-semester Senior Honors Thesis in CHEM 681 Senior Honors Thesis and CHEM 682 Senior Honors Thesis, for a total of 6 credits.

Examples of breadth courses include engineering, physics, molecular biology, computer science, water chemistry, and business. Advanced-level courses should be chosen in consultation with the student’s research mentor.

LEARNING OUTCOMES

The chemistry major curriculum provides students with a sound foundation in chemical principles along with significant opportunities to participate in scientific inquiry in a creative environment. Students majoring in chemistry gain knowledge, skills, and experiences that enable them to address real world chemical problems. These skills include the ability to solve problems, think critically, and act ethically. Specific learning goals for the major are detailed below.

1. Students will identify, formulate and solve integrative problems using appropriate information and approaches.
2. Students will demonstrate an understanding of basic chemical transformations, including the ability to predict chemical reactivity and properties.
3. Students will recognize the relationship between structure, bonding and the properties of molecules and materials.
4. Students will model chemical systems and experimental data using relevant quantitative, mathematical and computational methods.
5. Students will be able to design, conduct and analyze experiments safely and successfully.
6. Students will be capable of locating, evaluating and using information in the chemical literature.
7. Students will communicate chemical knowledge effectively through written reports, oral presentations and visual aids.
8. Students will be able to work collaboratively with others, both chemists and those from other disciplines, to solve problems and create new knowledge.
9. Students will recognize how chemistry relates to contemporary issues in our society.
10. Students will have an understanding of professional and ethical responsibility.

ADVISING AND CAREERS

ADVISING

The chemistry advisor (http://www.chem.wisc.edu/content/undergraduate-advising) provides advising for chemistry majors and prospective chemistry majors. Appointments with the advisor can be scheduled via the Scheduling Assistant (https://calendar.wisc.edu/scheduling-assistant/public/profiles/OaaAyBiv.html). Drop-in advising is available during the first two weeks of the fall and spring semesters and during busy enrollment periods, typically in April and November.

Chemistry majors interested in getting involved in research should explore the undergraduate research (http://www.chem.wisc.edu/content/get-started) pages on the chemistry website. Students needing additional information may contact the undergraduate research director by email (chem_ugr_research@chem.wisc.edu).

Students with enrollment and course access questions should first visit our enrollment inquiries (http://www.chem.wisc.edu/content/...
enrollment-inquiries) web page. If further assistance is needed, students may visit the Undergraduate Chemistry Office (room 1328 Chemistry) during normal business hours, email (undergrad@chem.wisc.edu), or call 608-263-2424.

**CAREER SERVICES**

The chemistry major prepares graduates for a wide variety of careers in the chemical and related industries (e.g., consumer and agricultural products, materials, energy, petroleum, paper, and food), as well as environmental, pharmaceutical, and other health-related sciences. Combined with a master’s program in secondary education, the major qualifies the student to teach chemistry in secondary schools. The major prepares students for graduate-level work in chemistry, chemical physics, biochemistry, biophysics, materials chemistry, and other related fields. Students who excel in undergraduate chemistry coursework are able to obtain funding for graduate studies in chemistry and related sciences through teaching or research assistantships and fellowships. Some chemistry major graduates go on to professional schools to study medicine, pharmacy, dentistry, veterinary medicine, business, or law.

Students are encouraged to begin their career planning early and to take advantage of the numerous resources offered by the College of Letters & Science Career Services (http://careers.ls.wisc.edu/students.htm). Information about careers, internships, resumes, cover letters, job search strategies, interviewing, and graduate school preparation are all available through L&S Career Services. Students can also register for BuckyNet (http://careers.ls.wisc.edu/buckynet–students.htm), an online resource for students to make connections with potential employers. Current career, research, and internship opportunities of specific interest to chemistry students can be found on the Career Services (http://www.chem.wisc.edu/content/career-services) pages of the chemistry website.

**PEOPLE**

**PROFESSORS**

Berry, John
Blackwell, Helen
Brunold, Thomas
Burke, Steven
Burstyn, Judith (Chair)
Cavagnero, Silvia
Choi, Kyoung-Shin
Coon, Joshua
Cui, Qiang
Ediger, Mark
Gellman, Samuel
Hamers, Robert
Jin, Song
Kiesling, Laura
Landis, Clark
McMahon, Robert
Moore, John
Nathanson, Gilbert
Raines, Ronald
Record, Thomas
Schwartz, David
Shakhzhiiri, Bassam
Sibert, Edwin
Smith, Lloyd
Stahl, Shannon
Weisshaar, James
Woods, Claude
Wright, John
Yethiraj, Arun
Yoon, Tehshik
Zanni, Martin

**ASSOCIATE PROFESSORS**

Bertram, Timothy
Fredrickson, Daniel
Hermans, Iwe
Schmidt, Jordan
Schomaker, Jennifer

**ASSISTANT PROFESSORS**

Garand, Etienne
Goldsmith, Randall

**AFFILIATED PROFESSORS**

Forest, Katrina (Professor of Bacteriology)
Ge, Ying (Associate Professor of Cell and Regenerative Biology)
Gilbert, Pupa (Professor of Physics)
Golden, Jennifer (Assistant Professor of Pharmacy)
Gopalan, Padma (Professor of Materials Science and Engineering)
Hsing, Richard (Professor of Pharmacy)
Jackson, Catherine (Assistant Professor of History of Science)
Kuech, Thomas (Professor of Chemical and Biological Engineering)
Li, Lingjun (Professor of Pharmacy)
Lynn, David (Professor of Chemical and Biological Engineering)
Meczozzi, Sandro (Associate Professor of Pharmacy)
Middlecamp, Catherine (Professor, Nelson Institute for Environmental Studies)
Pedersen, Joel (Professor of Soil Science)
Tang, Weiping (Associate Professor of Pharmacy)
Weibel, Douglas (Professor of Biochemistry)
Yu, Lian (Professor of Pharmacy)

**INSTRUCTIONAL STAFF**

Abruña-Rodríguez, Angel (Senior Faculty Assistant)
Bain, Rachel (Instructional Technology Specialist)
Block, Stephen (Lecturer and General Chemistry Assistant Laboratory Director)
Bowman, Matthew (Lecturer)
Doolittle, Pamela (Analytical Chemistry Laboratory Director)
Esselman, Brian (Lecturer and Organic Chemistry Assistant Laboratory Director)
Hill, Nicholas (Organic Chemistry Laboratory Director)
Hooker, Paul (Senior Lecturer)
Lamont, Liana (Faculty Assistant)
Maynard, James (Lecture Demonstrator)
McClain, Robert (Analytical Chemistry Laboratory Director)
Stoll, Lindy (Faculty Assistant)
Tatarsky, Amy (Faculty Assistant)
Wendt, Mark (Physical Chemistry Laboratory Director)
Wilkinson, Chad (General Chemistry Laboratory Director)
Zelewski, Linda (Lecturer)
Zhou, Jia (Associate Lecturer)
CHEMISTRY LEARNING CENTER
Dang, Allice (Assistant Faculty Associate)
Jetzer, Kelly (Instructional Specialist)
Jacob, Anthony (Director)
Laboy, José (Associate Faculty Associate)
Lee, Agnes (Faculty Associate)
Ramey, Shea (Faculty Associate)
Reitz, Tracey (Assistant Faculty Associate)
Toland, David (Assistant Faculty Associate)
Zayas Gonzáles, Yashira (Assistant Faculty Associate)

STUDENT SERVICES AND ADVISING
Barta, Cheri (Undergraduate Research Director)
Hammers, Jeanne (Undergraduate Chemistry Director and Chemistry Advisor)

CHEMISTRY LEARNING CENTER

STUDENT ORGANIZATIONS

RESEARCH

There are many research opportunities for undergraduates in the Department of Chemistry. When conducting research, students will have the opportunity to work alongside world-class faculty, staff, and graduate students to gain hands-on research experiences that will supplement their liberal arts education and prepare students for future careers. We have researchers involved in all the core areas of chemistry: analytical, chemical biology, chemical education, inorganic, materials, organic, physical, and theoretical. Many of our researchers conduct research across disciplines, including medicine, pharmacy, biology, engineering, energy, environmental sciences, and physics. Although preference is given to chemistry majors in good academic standing, any student interested in conducting chemistry research can seek out opportunities in our department. Students have the option of volunteering in a research lab or conducting research for course credit by enrolling in CHEM 299 Directed Study, CHEM 699 Directed Study, CHEM 681/682 Senior Honors Thesis, or CHEM 691/692 Senior Thesis. Students can also gain research experiences through the elective courses CHEM 260 Entering Research I, CHEM 261 Entering Research II, and CHEM 346 Intermediate Organic Chemistry Laboratory, as well as the required course CHEM 329 Fundamentals of Analytical Science. In some cases, experienced undergraduates may be paid to conduct research. For additional information about undergraduate research, including how to get involved, please visit the department’s Undergraduate Research (https://www.chem.wisc.edu/content/research-overview) page.

WISCONSIN EXPERIENCE

CERTIFICATION/LICENSURE

ACCS CERTIFIED DEGREE

The UW–Madison Department of Chemistry is approved by the American Chemical Society (ACS) to certify the degrees of graduating students who have completed the curriculum and professional training recommended by ACS for chemistry bachelor’s degree graduates. Certification indicates that the student has completed rigorous course work that provides them with the skills needed for a successful career in science.

Students graduating with the chemistry major from UW–Madison already meet most of the requirements of ACS certification. They can obtain the certification by electing to take specific courses that satisfy both the requirements of the major and the ACS guidelines. Additional requirements for certification are:

- A course in biochemistry, satisfied by BIOCHEM 501 Introduction to Biochemistry or BIOCHEM 507 General Biochemistry I (3 credits)
- At least 400 total laboratory hours, which can be satisfied by the combination of all the required core laboratory courses (in organic, inorganic, analytical and physical chemistry) plus two to three laboratory credits from any combination of CHEM 346 Intermediate Organic Chemistry Laboratory, CHEM 524 Chemical Instrumentation (3 credit course, but only one credit is a lab credit), CHEM 681/682 Senior Honors Thesis, CHEM 691/692 Senior Thesis or BMOLCHEM 504 Human Biochemistry Laboratory. The exact number of lab credits required from these courses depends on how the student has satisfied the core lab requirements. Please consult the Chemistry Major Advisor (https://www.chem.wisc.edu/content/undergraduate-advising) for more details.

The biochemistry course satisfies three of the five credits of advanced work required for the chemistry major, while two credits from CHEM 524 also count towards the advanced work. CHEM 346, 1 credit of CHEM 524, CHEM 691/692 and BMOLCHEM 504 all count towards the three additional lab credits required for the major, while CHEM 681/CHEM 682...
does not. CHEM 681/682 is required for students earning honors in the chemistry major.

Note that neither CHEM 299 Directed Study nor CHEM 699 Directed Study can be used to satisfy the lab hours needed for ACS certification. However, CHEM 699 can be used to satisfy additional lab credits needed for the chemistry major.

RESOURCES AND SCHOLARSHIPS

ACADEMIC RESOURCES

A number of resources are available to students seeking assistance with their chemistry courses. Students are strongly encouraged to attend the office hours of the instructors for the course.

The Chemistry Learning Center (CLC) (http://www.chem.wisc.edu/areas/clc/mission.htm) supports students in introductory chemistry courses (103, 104, and 108) and in some sections of organic chemistry. The center welcomes as many students as possible but unfortunately does not have sufficient resources to support all students seeking help. The center is funded to work with specific groups of students, such as first-generation low-income students, underrepresented students, students on academic probation, students with disabilities, students who have trouble understanding English, new transfer students, recently returning veterans, and students at-risk of failing the course. These are general guidelines and the center considers each student seeking assistance on a case-by-case basis, taking into account available program space. Program eligibility is usually determined by an interview with a staff member.

Further assistance may be sought from various tutoring services on campus, including the Greater University Tutoring Services (GUTS) (http://www.guts.wisc.edu), University Housing Tutoring (http://www.housing.wisc.edu/residencehalls-academics-tutoring.htm), and the College of Engineering Undergraduate Learning Center (ULC) (https://www.engr.wisc.edu/academics/student-services/ulc). Alpha Chi Sigma (AXE) (https://win.wisc.edu/organization/axsigma) is a co-ed professional chemistry fraternity that also offers tutoring. For students seeking more individualized tutoring, the Department of Chemistry maintains a list of private tutors (https://www.chem.wisc.edu/content/tutors) available for hire.

SCHOLARSHIPS

Through the generosity of alumni and other friends of the department, the Department of Chemistry is able to offer scholarships and summer research support. In 2016, the department awarded almost 30 undergraduate scholarships that totaled more than $150,000.

Any student who will be enrolled as an undergraduate at UW-Madison during the next academic year and is a chemistry major or is conducting research with a chemistry faculty member is eligible to apply for the scholarships. An overall GPA of at least 3.0 is required for application; awards are based on both merit and financial need. Students may apply for academic year scholarships and/or summer research support. Learn more about chemistry scholarships (https://www.chem.wisc.edu/content/chemistry-scholarships) and how to apply.