CHEMISTRY, B.S.

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 provides students with the critical thinking and problem-solving skills necessary to be successful in a wide variety of careers in the chemical industries (e.g., consumer and agricultural products, materials, energy, petroleum, paper, food, etc.), as well as environmental, pharmaceutical, and other health-related sciences. Students are also well-prepared for graduate-level work in chemistry, chemical physics, biochemistry, biophysics, materials chemistry, and other related fields. Students who excel in undergraduate chemistry coursework are often able to obtain funding for their graduate work through teaching or research assistantships and fellowships. Combined with a master's program in secondary education, the major qualifies the student to teach chemistry in secondary schools. Chemistry majors have also been successful in a variety of professional programs where they have studied medicine, pharmacy, dentistry, veterinary medicine, business, or law.

HOW TO GET IN

Students may declare the chemistry major after they have completed General Chemistry (CHEM 104, CHEM 109, or CHEM 116). Transfer students may declare in their first semester at UW-Madison, if they have transferred credit for one of these courses. Students should schedule an appointment with the undergraduate chemistry advisor to declare and develop a course plan toward graduation. To better inform their decision, undecided students who are exploring chemistry along with other majors are encouraged to take an additional chemistry course or two beyond General Chemistry before declaring. Any student interested in chemistry is welcome to schedule an appointment (https://www.chem.wisc.edu/content/undergraduate-advising) with the advisor to further explore the major.

Students are advised 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.

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.

General Education

- Breadth—Humanities/Literature/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 SCIENCE (B.S.)

Students pursuing a bachelor of science 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 SCIENCE DEGREE REQUIREMENTS

Mathematics Two (2) 3+ credits of intermediate/advanced level MATH, COMP SCI, STAT
Limit one each: COMP SCI, STAT

Foreign Language Complete the third unit of a foreign language

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 6 credits in biological science; and must include 6 credits in physical science

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 PURSUITING 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. Please note that the following special degree programs are not considered majors so are not available to non-L&S-degree-seeking candidates:

- Applied Mathematics, Engineering and Physics (Bachelor of Science–Applied Mathematics, Engineering and Physics)
- Journalism (Bachelor of Arts–Journalism; Bachelor of Science–Journalism)
- Music (Bachelor of Music)
- Social Work (Bachelor of Social Work)

REQUIREMENTS FOR THE MAJOR

MATH & PHYSICS

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

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<td>CHEM 109 Advanced General Chemistry</td>
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<td>Analytical Chemistry (1 course)</td>
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<td>CHEM 116 Chemical Principles II</td>
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<td>Inorganic Chemistry (1 course)</td>
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<td>Organic Chemistry (3 courses)</td>
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<td>Physical Chemistry</td>
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<td>Part 1 (1 course)</td>
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<td>CHEM 565 Biophysical Chemistry</td>
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<td>CBE 310 Chemical Process Thermodynamics</td>
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<td>M S &amp; E 330 Thermodynamics of Materials</td>
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<td>Part 2 (1 course)</td>
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<td>Part 3 (2 courses)</td>
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<td>M S &amp; E/ CBE 440 Polymeric Materials</td>
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<td>CBE 440 Chemical Engineering Materials</td>
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<td>CBE 540 Polymer Science and Technology</td>
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<td>CBE 547 Introduction to Colloid and Interface Science</td>
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<td>CHEM 346 Intermediate Organic Chemistry</td>
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<td>&amp; BIOCHEM 692 Senior Thesis</td>
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<td>BIOCHEM 699 Special Problems</td>
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<td>BMOLCHEM 504 Human Biochemistry Laboratory</td>
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HONORS IN THE CHEMISTRY MAJOR REQUIREMENTS

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To earn 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 and all courses accepted for the major
- 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:
  - Additional 500-level or higher non-laboratory CHEM or BIOCHEM courses;
  - Additional CHEM 699 Directed Study, BIOCHEM 699 Special Problems, or CBE 599 Special Problems credits that are not already being used to satisfy the 3 additional laboratory credits required for the major;
  - Additional breadth courses in other related disciplines ¹
- 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.

¹ 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.

UNIVERSITY DEGREE REQUIREMENTS

To receive a bachelor’s degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.

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LEARNING OUTCOMES

1. Identify, formulate and solve integrative problems using appropriate information and approaches.
2. Demonstrate an understanding of basic chemical transformations, including the ability to predict chemical reactivity and properties.
3. Recognize the relationship between structure, bonding and the properties of molecules and materials.
4. Model chemical systems and experimental data using relevant quantitative, mathematical and computational methods.

5. Design, conduct and analyze experiments safely and successfully.

6. Locate, evaluate and use information in the chemical literature.

7. Communicate chemical knowledge effectively through written reports, oral presentations and visual aids.

8. Work collaboratively with others, both chemists and those from other disciplines, to solve problems and create new knowledge.

9. Recognize how chemistry relates to contemporary issues in our society.

10. Understand 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/0aaAyBiv.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 SuccessWorks at the College of Letters & Science. Information about careers, internships, resumes, cover letters, job search strategies, interviewing, and graduate school preparation are all available through SuccessWorks. Students can also register for BuckyNet (https://careers.ls.wisc.edu/httpswww.uwalumni-comservicesalumni-directorygetting-started), 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.

L&S CAREER RESOURCES

SuccessWorks at the College of Letters & Science helps students leverage the academic skills learned in their major, certificates, and liberal arts degree; explore and try out different career paths; participate in internships; prepare for the job search and/or graduate school applications; and network with professionals in the field (alumni and employers).

SuccessWorks can also assist students in career advising, résumé and cover letter writing, networking opportunities, and interview skills, as well as course offerings for undergraduates to begin their career exploration early in their undergraduate career.

- SuccessWorks (https://careers.ls.wisc.edu)
- Set up a career advising appointment (https://careers.ls.wisc.edu/make-an-appointment)
- Learn how we’re transforming career preparation: L&S Career Initiative (http://ls.wisc.edu/lsci)

PROFESSORS

Berry, John
Blackwell, Helen
Brunold, Thomas
Burke, Steven
Burstyn, Judith (chair)
Cavagnero, Silvia
Choi, Kyoung-Shin
Coon, Joshua
Ediger, Mark
Gellman, Samuel
Hamers, Robert
Hernans, Ives
Jin, Song
Landis, Clark
McMahon, Robert
Moore, John
Nathanson, Gilber
Record, Thomas
Schwartz, David
Shakhashiri, Bassam
Silbert, Edwin (associate chair)
Smith, Lloyd
Stahl, Shannon
Weisshaar, James
Woods, Claude
Wright, John
Yethiraj, Arun
Yoon, Tehshik
Zanni, Martin

ASSOCIATE PROFESSORS
Bertram, Timothy
Fredrickson, Daniel
Schmidt, Jordan
Schomaker, Jennifer
Weix, Daniel

ASSISTANT PROFESSORS
Butler, Andrew
Garand, Etienne
Goldsmith, Randall
Wickens, Zachary

AFFILIATED PROFESSORS
Abbott, Nicholas (Professor of Chemical and Biological Engineering)
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)
Gong, Sarah (Professor of Biomedical Engineering)
Gopal, Padma (Professor of Materials Science and Engineering)
Jackson, Catherine (Assistant Professor of History of Science)
Kuech, Thomas (Professor of Chemical and Biological Engineering)
Li, Lijun (Professor of Pharmacy)
Lynn, David (Professor of Chemical and Biological Engineering)
Mecozzi, Sandro (Associate Professor of Pharmacy)
Middlecamp, Catherine (Professor, Nelson Institute for Environmental Studies)
Pedersen, Joel (Professor of Soil Science)
Tang, Weiping (Professor of Pharmacy)
Weibel, Douglas (Professor of Biochemistry)
Yu, Lian (Professor of Pharmacy)

INSTRUCTIONAL STAFF
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)

CHEMISTRY LEARNING CENTER
Dang, Allice (Assistant Faculty Associate)
Jetzer, Kelly (Instructional Specialist)
Jacob, Anthony (Director)

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.

STUDENT ORGANIZATIONS
A number of student organizations are available for students interested in the chemical sciences.

• The American Chemical Society (ACS) Student Chapter (https://win.wisc.edu/organization/acs) facilitates opportunities for students in the chemical sciences to promote the learning and advancement of chemistry. The chapter supports students in their academic development, professional development, and research pursuits.
• Alpha Chi Sigma (AXE) (https://alphachisigmauw.wordpress.com) is a national, co-ed, professional chemistry organization that was founded at UW–Madison in 1902. The UW-Madison chapter has an active membership of about 40 students, both graduate and undergraduate. The organization also has two houses, at 619 and 621 North Lake Street, which house nearly half of the members. The houses are the primary locations for events like tutoring, chapter dinners, meetings, and social events.
• Students Participating in Chemical Education (SPICE) (http://ice.chem.wisc.edu/SPICE.html) trains undergraduates to perform chemistry demonstrations in order to interest elementary and middle
school students in chemistry and science via cool experiments, hands-on activities, and exploration stations at public venues.

- The UW–Madison student chapter of NOBCChE (https://win.wisc.edu/organization/NOBCChE) (National Organization for the Professional Advancement of Black Chemists and Chemical Engineers) seeks to encourage students of color to pursue graduate and professional degrees in chemistry, chemical engineering, and other chemistry-related fields. Members participate in professional development through national conference presentations, networking, and community service activities.

- SACNAS (http://uwmadisonsacnas.weebly.com) (the Society for the Advancement of Hispanics/Chicanos and Native Americans) is a society of scientists dedicated to fostering the success of Hispanic/Chicano and Native American scientists—from college students to professionals—to attain advanced degrees, careers, and positions of leadership in science.

### CERTIFICATION/LICENSEURE

#### ACS 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 for 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/CHEM 682 Senior Honors Thesis, CHEM 691/ CHEM 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 681/CHEM 682, CHEM 691/CHEM 692 and BMOLCHEM 504 all count towards the three additional lab credits required for the 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 (CHEM 103, CHEM 104, and CHEM 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 2017, the department awarded 36 undergraduate scholarships that totaled more than $150,000.

Any student who 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 3.000 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.