

# CHEMISTRY, BS

The Department of Chemistry and Biochemistry curriculum provides a thorough undergraduate education for students planning careers as research scientists, industrial chemists, and educators in universities or in secondary schools. In addition, department courses provide a foundation in the basic science of chemistry to students majoring in biological or physical sciences, students planning a career in medicine or other health-related fields, students in the College of Engineering and Applied Science, and students in the liberal arts. Especially in its graduate programs, the department stresses interdisciplinary approaches, as exemplified by the Laboratory for Surface Studies and the Great Lakes WATER Institute. It also cooperates with chemists of the Milwaukee area's industrial and scientific community.

## Course of Study: Major Options in Chemistry and Biochemistry

Students may choose from five different curricular options in chemistry and biochemistry:

1. Standard Chemistry Major
2. Course in Chemistry Degree Program
3. Chemistry Major with a Biochemical Option
4. Standard Biochemistry Major
5. Biochemistry Major with an Industrial Fermentation and Biotechnology Option
6. Biochemistry Major with a Clinical Pharmacology Option (BS only)

Undergraduate research is encouraged strongly for students in any of the chemistry options. In some cases, students may start research with a faculty member as early as their freshman year. Information about research opportunities may be obtained from the department office or from SAACS (the American Chemical Society student affiliate group). Pre-medical students who choose to follow one of the chemistry or biochemistry options should see the L&S pre-professional programs section in this catalog and should consult their pre-medical advisor and an advisor in chemistry regularly.

The opportunity to participate in research as an undergraduate is a distinct advantage for UWM undergraduates. At most large, research universities, research opportunities for undergraduates are limited; there are fewer of them and they often are reserved for juniors or seniors. At UWM, you can get involved as early as freshman year. Students work directly with faculty and graduate students on their current research projects, and sometimes find themselves published in a peer-reviewed journal right alongside the faculty member. Participating in undergraduate research is an excellent way to enhance your resume for graduate school or employment.

Chemistry is the study of the elementary parts and substances that make up our world, both the parts that occur in nature as well as man-made objects.

Chemistry is known as the "central science" because of its relationship to all other sciences. Because it is the foundation of other sciences, UWM Chemistry alumni are prepared to go on to countless number of professional roles. While your first impression may be that chemistry majors all end up working in a laboratory surrounded by beakers and test tubes, there is more to the major than that.

Our majors go into medical research, healthcare professions, manufacturing (particularly research and development), scientific writing and marketing, law (particularly areas of law that deal with science such as intellectual property), forensics and toxicology, aspects of engineering and production, teaching, sales, consulting, and government agency work.

## Requirements

### Course of Study – Bachelor of Science Degree

Complete 120 credits including 90 credits in the College of Letters & Science and with 36 of the 90 credits in L&S upper-level (numbered above 300) courses and 30 of those 36 credits in designated upper-level Natural Science. The College requires that students must complete in residence at UWM at least 15 credits in upper-division (numbered 300 or above) courses in their major. Students are also required to complete University-wide General Education Requirements and the specific L&S requirements listed below.

To complete a major, students must satisfy all the requirements of the major as stated in this catalog. Students who declare their majors within five years of entering the UW System as a degree candidate may satisfy the requirements outlined in any catalog issued since the time they entered. Credits used to satisfy the major also may be used to satisfy other degree requirements.

### University General Education Requirements (GER)

Code	Title	Credits
<b>Oral and Written Communication</b>		
<i>Part A</i>		
ENGLISH 102	College Writing and Research (or equivalent)	
<i>Part B</i>		
Course designated as OWC-B; may be completed through a major-specific course requirement		
<b>Quantitative Literacy</b>		
<i>Part A</i>		
Select one of the following:		
MATH 103	Contemporary Applications of Mathematics	
MATH 105	Introduction to College Algebra	
MATH 108	Algebraic Literacy II	
MATH 111	Introduction to Logic - Critical Reasoning <sup>1</sup>	
or PHILOS 111	Introduction to Logic - Critical Reasoning	
Or equivalent course		
<i>Part B</i>		
Course designated as QL-B; may be completed through a major-specific course requirement		
<b>Arts</b>		
Select 3 credits		3
<b>Humanities</b>		
Select 6 credits		6
<b>Social Sciences</b>		
Select 6 credits		6
<b>Natural Sciences</b>		

Select 6 credits (At least two courses including one lab) 6

#### UWM Foreign Language Requirement

Complete Foreign Language Requirement through:

Two years (high school) of a single foreign language

Two semesters (college) of a single foreign language

Or equivalent

#### UWM Cultural Diversity Requirement

One course from the Arts, Humanities, or Social Sciences must also satisfy UWM's Cultural Diversity requirement

<sup>1</sup> Math 111 and Philosophy 111 are jointly offered and count as repeats of one another. Students cannot receive credit for both courses.

## College of Letters & Science Requirements

### I. English Writing Requirement

Students must satisfy the English Writing Requirement by completing ENGLISH 102 with a grade of C or higher or by placing beyond English 102 on the English Placement Test (EPT).

**Note:** This requirement is the same as the University General Education Requirement for Oral and Written Communication Part A. The College of Letters & Science does not have a specific requirement for a writing course beyond English 102, but students must complete the university-wide requirement for Oral and Written Communication Part B listed above.

### II. Mathematics and Formal Reasoning

To satisfy the Mathematics and Formal Reasoning Requirement, Bachelors of Sciences degree students must satisfy the following two requirements:

1. Complete one of the following courses or an equivalent course:

Code	Title	Credits
MATH 211	Survey in Calculus and Analytic Geometry	4
MATH 213	Calculus with Life Sciences Applications	4
MATH 221	Honors Calculus I	5
MATH 231	Calculus and Analytic Geometry I	4

2. Complete one course (at least 3 credits) at the 200 level or above chosen from courses in Mathematics, PHILOS 212, or Letters and Science statistics courses:

Code	Title	Credits
Complete one of the following:		
3 or more credits in any 200-level or above Math course		
AFRIC 220	Introduction to Statistics in African and African Diaspora Studies	
ANTHRO 568	Introduction to Anthropological Statistics	
ATM SCI 500	Statistical Methods in Atmospheric Sciences	
BIO SCI 465	Biostatistics	
ECON 210	Economic Statistics	
GEOG 247	Quantitative Analysis in Geography	

HIST 595	The Quantitative Analysis of Historical Data
MTHSTAT 215	Elementary Statistical Analysis
PHILOS 211	Elementary Logic
POL SCI 390	Political Data Analysis
POL SCI 392	Survey Research
PSYCH 210	Psychological Statistics
SOCIOL 261	Introduction to Statistical Thinking in Sociology

**Note:** This requirement is NOT the same as the University General Education Requirement for Quantitative Literacy Part B. To complete the BS, students must take one of the L&S approved courses. The courses listed here will satisfy the QL-B requirement.

### III. Foreign Language Requirement

Two courses (minimum of 6 credits) in a language (including American Sign Language) other than English at the 100 level or above are required.

Placement testing may be used to satisfy all or part of this requirement. Language courses (including American Sign Language) other than English taken in high school may be used to satisfy all or part of this requirement. One year of high school language equates to one semester of college work.

Completion of the L&S Language Requirement also satisfies the university-wide Foreign Language GER, but not vice versa.

### IV. International Requirement

See Approved Courses for the L&S International Requirement (<http://catalog.uwm.edu/letters-science/approved-courses-international-requirement>) for course options.

Code	Title	Credits
Completed in one of the following ways:		9
Complete 3 courses (min. 9 cr) in a single foreign language (not including literature-in-translation or American Sign Language) at the 3rd semester level and above		
Complete 3 non-language courses (min. 9 credits) with an international content chosen from at least 2 curricular areas.		
Complete 9 credits in combination of the two options above.		

### V. Breadth Requirement

Along with completing the University General Education Requirements of 3 credits in the Arts (A); 6 credits in the Humanities (HU), Social Sciences (SS), and Natural Sciences (NS/NS+); and a course with the Cultural Diversity (CD/+) designation, L&S students must complete the Breadth requirement.

Code	Title	Credits
<b>Arts</b>		
Select 3 credits		3
<b>Humanities</b>		
Complete 12 credits of L&S courses with Humanities Breadth designation; no more than 6 credits from a single subject area. *		12
<b>Social Sciences</b>		
Complete 12 credits of L&S Courses with Social Science Breadth designation; no more than 6 credits from a single curricular area. *		12

### Natural Sciences

Complete 12 credits of L&S Courses with Natural Sciences Breadth designation, including laboratory or field courses from three different curricular areas.\* 12

#### Cultural Diversity

Complete 3 credits in a course with Cultural Diversity (CD) designation.\*\* 3

\* Students should check their course selections carefully with the list of approved L&S Breadth Courses (<http://catalog.uwm.edu/letters-science/breadth-requirement-course-list>). Students are advised to select at least 6 credits worth of courses in each of the Humanities, Social Science, and Natural Sciences areas that can satisfy both the campus-wide General Education Requirements and the L&S Breadth requirement.

\*\* Students are advised to select a course that satisfies the Cultural Diversity requirement as well as a Humanities or Social Science breadth/GER requirement.

### VI. The Major

The College requires that students attain at least a 2.0 GPA in all credits in the major attempted at UWM. In addition, students must attain a 2.0 GPA on all major credits attempted, including any transfer work. Individual departments or programs may require higher GPAs for graduation. Some departmental majors require courses from other departments. Contact your major department for information on whether those credits will count as part of the major GPA. The College requires that students must complete in residence at UWM at least 15 credits in upper-division (numbered 300 or above) courses in their major.

#### Research Requirement

Within their majors, students must complete a research experience approved by the L&S faculty. A list of courses satisfying the research requirement in each major can be found here (<http://catalog.uwm.edu/letters-science/approved-courses-research-requirement>).

### VII. The Minor

The College requires that students attain at least a 2.0 GPA in all credits in the minor attempted at UWM. In addition, students must attain a 2.0 GPA on all minor credits attempted, including any transfer work. Individual departments or programs may require higher GPAs for graduation.

### Prerequisite Preparation for Majors in Chemistry and Biochemistry

General chemistry is a prerequisite to all further courses in chemistry. This requirement is satisfied by CHEM 102 and CHEM 104. Students without high school chemistry or whose background in science is weak may need to take CHEM 100 first.

Mathematics and physics also are required for a major in chemistry. Three semesters of calculus and two semesters of calculus-based physics (or equivalents) are prerequisites to physical chemistry, which, in turn, is required for the advanced chemistry courses that are part of the major.

Students considering a major in chemistry or biochemistry should enroll in general chemistry and mathematics in their first semester, if at all possible, and physics should be started as soon as its prerequisites are met. Because the study of chemistry is cumulative, postponing one's start in math and chemistry courses is likely to delay completion of the degree. It is recommended that chemistry majors follow the suggested

sequence for the Course in Chemistry degree program as closely as possible for the first two years.

Students are urged to contact the Chemistry and Biochemistry Department for academic advice as soon as they believe they have an interest in a major in chemistry.

### Declaration of Major Requirements

To declare a chemistry or biochemistry major, the following are required:

- completion of CHEM 102 and CHEM 104;
- completion or concurrent registration in CHEM 343; and
- a GPA of 2.500 or better in all Chem courses attempted.

Students who are interested in graduate work in biochemistry should follow the standard chemistry major with a biochemical option.

### Chemistry Major Requirements

Students must complete the courses listed below, including at least 15 upper-division (numbered 300 and above) credits in the major in residence at UWM. The College of Letters & Science requires that students attain at least a 2.0 GPA on all credits in the major attempted at UWM. In addition, students must attain a 2.0 GPA on all major credits attempted, including any transfer work.

#### Standard Chemistry Major Option

The standard chemistry major option may be followed in either the Bachelor of Science or Bachelor of Arts degree. It provides a suitable background for students preparing for employment in chemistry and related scientific fields or for subsequent graduate study.

Code	Title	Credits
CHEM 102 & CHEM 104	General Chemistry and General Chemistry and Qualitative Analysis	10
CHEM 221	Elementary Quantitative Analysis	4
CHEM 311	Introduction to Inorganic Chemistry	3
CHEM 343	Organic Chemistry	3
CHEM 344	Organic Chemistry Laboratory	2
CHEM 345	Organic Chemistry	3
CHEM 524	Instrumental Analysis	3
CHEM 561	Physical Chemistry I	3
CHEM 562	Physical Chemistry II	3
CHEM 563	Physical Chemistry Laboratory	1-2
CHEM 582	Advanced Chemistry Laboratory I	2
or CHEM 584	Advanced Chemistry Laboratory II	
CHEM 501	Introduction to Biochemistry	3
or CHEM 511	Inorganic Chemistry	
CHEM 691	Senior Research (satisfies L&S research requirement)	1-4
or CHEM 692	Senior Thesis	
MATH 231	Calculus and Analytic Geometry I	4
MATH 232	Calculus and Analytic Geometry II	4
MATH 233	Calculus and Analytic Geometry III	4
Recommended course:		
MATH 234	Linear Algebra and Differential Equations	10

Select one of the following options:

10

Option 1:	
PHYSICS 209 & PHYSICS 214	Physics I (Calculus Treatment) and Lab Physics I (Calculus Treatment)
PHYSICS 210 & PHYSICS 215	Physics II (Calculus Treatment) and Lab Physics II (Calculus Treatment)
Option 2:	
PHYSICS 219	Physics I: Calculus-Based, Studio Format
PHYSICS 220	Physics II: Calculus-Based, Studio Format
Total Credits	63-67

### Standard Chemistry Major with a Biochemical Option

The standard chemistry major with a biochemical option differs from the standard major option in that some of the chemistry courses required by the standard option are omitted, and courses in biochemistry and biological sciences are added. Some students planning further study in biochemistry, molecular biology, or medicine may prefer this option.

Code	Title	Credits
CHEM 102 & CHEM 104	General Chemistry and General Chemistry and Qualitative Analysis	10
CHEM 221	Elementary Quantitative Analysis	4
CHEM 311	Introduction to Inorganic Chemistry	3
CHEM 343	Organic Chemistry	3
CHEM 344	Organic Chemistry Laboratory	2
CHEM 345	Organic Chemistry	3
CHEM 524	Instrumental Analysis	3
CHEM 561	Physical Chemistry I	3
CHEM 562	Physical Chemistry II	3
CHEM 563	Physical Chemistry Laboratory	1-2
CHEM 501	Introduction to Biochemistry	3
Select two of the following:		6
CHEM 601	Biochemistry: Protein Structure and Function	
CHEM 602	Biochemistry: Cellular Processes	
CHEM 604	Biochemistry: Metabolism	
CHEM 603	Introduction to Biochemistry Laboratory	2
CHEM 691	Senior Research (satisfies L&S research requirement)	1-4
or CHEM 692	Senior Thesis	
BIO SCI 150	Foundations of Biological Sciences I	4
BIO SCI 325	Genetics	4
MATH 231	Calculus and Analytic Geometry I	4
MATH 232	Calculus and Analytic Geometry II	4
MATH 233	Calculus and Analytic Geometry III	4
Recommended course:		
MATH 234	Linear Algebra and Differential Equations	
Select one of the following options:		10
Option 1:		
PHYSICS 209 & PHYSICS 214	Physics I (Calculus Treatment) and Lab Physics I (Calculus Treatment)	

PHYSICS 210 & PHYSICS 215	Physics II (Calculus Treatment) and Lab Physics II (Calculus Treatment)
Option 2:	
PHYSICS 219	Physics I: Calculus-Based, Studio Format
PHYSICS 220	Physics II: Calculus-Based, Studio Format
Total Credits	77-81

## Suggested Timetables for Standard Chemistry Major, Courses in Chemistry Degree, and Standard Chemistry Major with a Biochemical Option

### Model Four-Year Program

Year 1		Credits
<b>Semester 1</b>		
CHEM 102	General Chemistry	5
MATH 115	Precalculus	4
Credits		9
<b>Semester 2</b>		
CHEM 104	General Chemistry and Qualitative Analysis	5
MATH 231	Calculus and Analytic Geometry I	4
Credits		9
<b>Year 2</b>		
<b>Semester 1</b>		
CHEM 343	Organic Chemistry	3
CHEM 221	Elementary Quantitative Analysis	4
MATH 232	Calculus and Analytic Geometry II	4
Credits		11
<b>Semester 2</b>		
CHEM 344	Organic Chemistry Laboratory	2
CHEM 345	Organic Chemistry	3
MATH 233	Calculus and Analytic Geometry III	4
PHYSICS 209	Physics I (Calculus Treatment)	4
PHYSICS 214	Lab Physics I (Calculus Treatment)	1
Credits		14
<b>Year 3</b>		
<b>Semester 1</b>		
CHEM 311	Introduction to Inorganic Chemistry	3
CHEM 501	Introduction to Biochemistry (or take in spring) <sup>1</sup>	3
PHYSICS 210	Physics II (Calculus Treatment)	4
PHYSICS 215	Lab Physics II (Calculus Treatment)	1
Credits		11
<b>Semester 2</b>		
CHEM 561	Physical Chemistry I	3
Credits		3
<b>Year 4</b>		
<b>Semester 1</b>		
CHEM 562	Physical Chemistry II	3
CHEM 563	Physical Chemistry Laboratory	1
CHEM 524	Instrumental Analysis	3
CHEM 582	Advanced Chemistry Laboratory I (or take in spring) <sup>1,2</sup>	2
Select one of the following:		1-2
CHEM 691	Senior Research	
CHEM 692	Senior Thesis	
CHEM 697	Senior Seminar	
Credits		10-11

Semester 2		
CHEM 511	Inorganic Chemistry <sup>1</sup>	3
CHEM 584	Advanced Chemistry Laboratory II (or take in fall) <sup>1,2</sup>	2
CHEM 524	Instrumental Analysis	3
CHEM 582	Advanced Chemistry Laboratory I <sup>1,2</sup>	2
CHEM 524	Instrumental Analysis	3
Select one of the following:		1-2
CHEM 691	Senior Research	
CHEM 692	Senior Thesis	
CHEM 697	Senior Seminar	
Credits		14-15
Total Credits		81-83

<sup>1</sup> Courses that may be optional for standard chemistry major; required for the Course in Chemistry degree.

<sup>2</sup> Courses that are omitted for the standard chemistry major with the biochemical option. In addition, students must take CHEM 501, CHEM 603, and two courses selected from CHEM 601, CHEM 602, CHEM 604, and CHEM 614. BIO SCI 150 and BIO SCI 325 also are required for the biochemistry option.

## Letters & Science Advising

The College of Letters and Science provides general academic advising for all students with a major in the College, particularly as it relates to campus' general education requirements and the College's degree requirements. We also provide specialized advising for pre-professional students (pre-med, pre-dental, pre-pharmacy, etc.) regardless if their major is in Letters and Science or not. Prospective students, including high school students and students seeking to transfer to a program in Letters and Science may also receive advising from our admissions counselors.

Upon admission, students are assigned an advisor in the College advising office. Academic advising is available Monday through Friday from 8:30 a.m. to 4:30 p.m. by appointment. Appointments outside of these times may be available and phone appointments are available for online students. The advising office (<https://uwm.edu/letters-science/advising/contact-advising>) is located on the first floor of Holton Hall. Current students should call (414) 229-4654 to schedule an appointment or use the Student Success Collaborative website (<https://uwmilwaukee.campus.eab.com>) to make an appointment with your assigned advisor; online scheduling is only available if you already have a Letters & Science advisor assigned to you. Prospective students should call (414) 229-7711 or email [let-sci@uwm.edu](mailto:let-sci@uwm.edu).

When students declare a major, they will receive an additional faculty advisor located within the major department who will assist with requirements for that major. Students should read the "Declaration of Major" information on the website of the major that they are interested in. In some cases, the student will need to choose a faculty advisor as part of the declaration process.

All students are cautioned to consult their Letters & Science academic advisor AND their major advisor prior to each registration period to ensure they understand all requirements. Do not rely on pre-printed sample plans, as they are intended to be samples only and may not be right for your particular situation.

## Honors in the Major

Students in any of the chemistry or biochemistry options who meet all of the following criteria are awarded honors in the major upon graduation:

- 3.500 cumulative GPA in all UWM graded credits;
- 3.750 GPA in all UWM chemistry credits;
- 3.500 GPA in all advanced credits in chemistry (numbered above 300); and
- Six credits of senior thesis with an average grade of B or better.

Students who believe they may qualify for honors in chemistry should apply to the department during their last semester of study.

A departmental "Undergraduate Awards Program and Research Symposium" is held each spring to highlight undergraduate research accomplishments and honor students who have distinguished themselves in various areas. Among the awards are the Durward Layde Memorial Fellowship, the Chemistry Emeritus Award for the Outstanding Junior, the McFarland Awards for the best undergraduate research poster presentations, as well as awards for Outstanding Performance in Introductory Chemistry, Analytical Chemistry, Biochemistry, Inorganic Chemistry, Organic Chemistry (Kovacic Award), and Physical Chemistry (Vanselow Award).

## Honors in the College of Letters and Science

### Dean's Honor List

GPA of 3.750 or above, earned on a full-time student's GPA on 12 or more graded credits in a given semester.

### Honors Degree and Honors Degree with Thesis

Granted to graduating seniors who complete Honors College requirements, as listed in the Honors College (<http://catalog.uwm.edu/opportunities-resources/honors-college>) section of this site.

### Commencement Honors

Students with a cumulative GPA of 3.500 or above, based on a minimum of 40 graded UWM credits earned prior to the final semester, will receive all-university commencement honors and be awarded the traditional gold cord at the December or May Honors Convocation. In schools and colleges in which fewer than 15% of the traditional students have a 3.500 GPA, all-university honors will be awarded to approximately the top 15% of graduating students. A criterion GPA (not lower than 3.200) for this 15% will be calculated based on statistics from the previous comparable semester. Please note that for honors calculation, the GPA is **not** rounded and is truncated at the third decimal (e.g., 3.499).

### Final Honors

Earned on a minimum of 60 graded UWM credits: Cum Laude - 3.500 or above; Magna Cum Laude - 3.650 or above; Summa Cum Laude - 3.800 or above.

### Contact Information

Current Students contact Senior Lecturer Gloria Freschl, [freschl@uwm.edu](mailto:freschl@uwm.edu)

Prospective Students contact a Letters & Science Admissions Counselor at (414) 229-7711 or [let-sci@uwm.edu](mailto:let-sci@uwm.edu)

<https://uwm.edu/chemistry/undergraduate/>