

## Interested in This Major?

Contact the Department of Chemistry:

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## What is Chemistry and Biochemistry?

Our world is made up of an enormous variety of both naturally-occurring and man-made elements and compounds. From our galaxy to the earth's inner crust to the ecosystem of the rain forest to our own bodies, everything is made from elementary parts. There are new substances evolving from old substances with and without our help each day. Chemistry is a science that attempts to organize and explain, in a systematic and logical manner, knowledge about the existence, purpose and interaction of these substances. Chemists are involved in the development of synthetic fibers, paints, adhesives, electronic components, lubricants and thousands of other products. Chemists also devise ways to save energy and reduce pollution.

Biochemistry poses the same questions but with a focus on the substances that make up living systems. It is a basic tool of biology and medicine and the foundation for the manufacture and design of drugs, improvements in food processing and food safety, and best practices in agriculture.

## Why Study Chemistry or Biochemistry?

Understanding the principles and concepts of chemistry helps us function rationally and effectively within our physical surroundings. Chemistry has been called the central science because of its relationship to all other sciences.

As the study of elementary substances, a chemistry or biochemistry major forms the foundation of many different careers. Only some of these jobs are traditional "chemist" jobs located in a lab with solutions, glassware and instruments. Chemistry and biochemistry majors also find job opportunities

in medical labs, crime labs, sales, teaching, manufacturing and government. The chemical industry continues to be strong. A chemistry or biochemistry major is also excellent preparation for further studies in medicine, law, molecular biology, toxicology, pharmacology, many areas of engineering, environmental science and more.

## UWM's Programs

UWM students can choose from four different tracks to tailor a program to their career goals. The **standard chemistry major** is all-purpose and provides appropriate preparation for a job or graduate school. The **chemistry major with a biochemical option** substitutes some chemistry classes with biochemistry and biology classes. Students planning further study in biochemistry, molecular biology or medicine may prefer this option. The **course in chemistry** follows a curriculum approved by the American Chemical Society; it requires more chemistry and fewer social sciences and humanities and carries added professional recognition in certain industries. The **biochemistry major** requires fewer credits in quantitative analysis and physical chemistry, eliminates inorganic chemistry and calculus, and requires more credits in biology. This option prepares students for work in the biochemical industry; however, students who intend to pursue graduate work in biochemistry should opt for the standard chemistry major with biochemical option.



Undergraduates can participate in hands-on research that often is reserved only for grad students at other schools.

## Preparatory Courses

Ideally, high school students should take four years of math and science, including chemistry and physics. Once at UWM, students complete Chem 102 and 104 (General Chemistry and Qualitative Analysis) with a 2.5 GPA and enroll in Chem

343 (Organic Chemistry) before declaring the major. It is important to work with an advisor early in order to keep on track towards degree completion. We advise students to declare a major right after completing these courses.

### Chemistry Major Requirements

In addition to the preparatory classes, required courses for the standard chemistry major are:

8 credits in organic chemistry
7 credits in analytical chemistry
8 credits in physical chemistry
Introduction to Inorganic Chemistry
Instrument Analysis
Advanced Chemistry Lab I or II
Intro to Biochemistry OR Advanced Inorganic Chemistry
10 to 16 credits in calculus
1 to 2 credits in a research experience
10 credits in calculus-based physics

The *standard chemistry major with a biochemical option* omits Advanced Chemistry Lab as well as the choice between Intro to Biochemistry and Intermediate Inorganic Chemistry. Students must take Intro to Biochemistry plus another 9 credits in biochemistry and 7 credits in biology.

The *course in chemistry* has the same core courses as the standard chemistry major except students must take both Intro to Biochemistry and Advanced Inorganic Chemistry; both Advanced Chemistry Laboratory I and II; Linear Algebra and Differential Equations; and only 18 humanities, social sciences and arts courses instead of 27.

### Biochemistry Major Requirements

In addition to the preparatory classes, other required courses for the biochemistry major are:

4 credits in analytical chemistry
8 credits in organic chemistry
3 credits in physical chemistry
11 credits in biochemistry
2 credits in a research experience
10 credits in physics
14 credits in biology
10 credits in math, including a survey course in calculus

### Chemistry Minor

A chemistry minor complements other natural science majors. The minor consists of 20 credits in chemistry with at least 9 credits at the 300-level or above. These credits must include general chemistry,

at least one laboratory course besides general chemistry, and at least one course from three of the following areas: analytical chemistry, biochemistry, inorganic chemistry, organic chemistry or physical chemistry.

### Chemistry Clubs

The *Student Affiliates of the American Chemical Society (SAACS)* is the undergraduate chemistry club. The group regularly studies together, visits local chemical industries, attends meetings of the Milwaukee section of the ACS, participates in National Chemistry Week, and fundraises for support to attend the national ACS conference.

The student section of the *Society for Applied Spectroscopy (SAS)* is open to undergraduates and graduate students interested in spectroscopy, a widely-used analytical method. The SAS section at UWM hosts colloquium speakers on various spectroscopic methods and engages in community science education projects. The group is also represented nationally at the annual conference of the Federation of Analytical Chemistry and Spectroscopic Societies (FACSS).

### Scholarships

Students are encouraged to explore all options for campus, private or college-level scholarships by contacting the Office of Financial Aid and the College of Letters and Science Office of College Relations. The department offers some of its own scholarships and awards for outstanding majors and also runs some poster competitions with prize money.

### Faculty Research Areas

- metal speciation
- ionic liquids
- anti-viral and anti-cancer drug discovery
- cancer therapy
- pre-steady state kinetics
- toxicity

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One faculty member has partnered with a local business to design an instrument that will reduce the time, money, and environmental impact of treating industrial wastewater.

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- x-ray crystallography
- iron metabolism
- molecular electronics
- inorganic enzymology
- natural products
- molecular recognition
- thin film growth
- corrosion
- laser spectroscopy of proteins
- surface chemistry
- chemistry education



This sample four-year plan shows just one possible pathway to earning a degree with this major in four years. This plan **does not** replace the advice of your advisor, and students are cautioned to meet regularly with their advisor to create a personalized plan that matches their particular circumstances. This plan also follows the degree requirements for students who began their UWM education in Fall of 2013 or later. If you started at UWM prior to Fall of 2013, your degree requirements may be different.

### Degree Requirements for a Bachelor of Science with a Chemistry major (brief summary):

(Chemistry is also available as a Bachelor of Arts degree with a different set of requirements than listed below.)

1. English Proficiency and UWM Oral and Written Communication (OWC) GER - English 102 (OWC-A); and OWC-B course.
2. Math and Formal Reasoning - Math 211, 221, or 231; an additional 200-level course from Math, Philos 212, or Letters and Science statistics course; and QL-B course. (A single course may satisfy both formal reasoning and the QL-B GER.)
3. Foreign Language – 2 semesters of a single Foreign Language
4. L&S Humanities – 12 credits
5. L&S Social Sciences – 12 credits
6. L&S Natural Science – 12 credits including a laboratory course in three distinct natural science areas
7. L&S International – 9 credits usually accomplished in conjunction with Humanities and/or Social Science courses
8. UWM Arts GER – 3 credits
9. UWM Cultural Diversity GER – 3 credits usually accomplished in conjunction with a Humanities or Social Science course
10. 120 credits including 90 credits in L&S and with 36 of the 90 credits in L&S upper-level (numbered 300 and above) courses and 30 of those 36 in courses designated upper-level Natural Science
11. Complete the Chemistry major requirements in either the Standard Chemistry option or the Biochemical option
  - Standard Chemistry option:
    - » 15 credits numbered 300 or above completed at UWM
    - » All of Math 231, 232, 233 or both Math 221 and 222
    - » All of Physics 209, 210, 214, and 215
    - » All of Chem 102, 104, 221, 311, 343, 344, 345, 524, 561, 562, 563
    - » Chem 501 or 511
    - » Chem 582 or 584
    - » One of Chem 691, 692, or 697
  - Biochemical option
    - » 15 credits numbered 300 or above completed at UWM
    - » All of Math 231, 232, 233 or Both Math 221 and 222
    - » All of Physics 209, 210, 214, and 215

- » Both of BioSci 150 and 325
- » All of Chem 102, 104, 221, 311, 343, 344, 345, 501, 524, 561, 562, 563, 603
- » Two of Chem 601, 602, 604, 614
- » One of Chem 691, 692, or 697

### Sample Four Year Plans:

There are hundreds of courses that satisfy various requirements (<http://www4.uwm.edu/lets/requirements/>) and courses in the major can be used. For example, Chemistry 102 counts as a natural science with lab and Chemistry 311 counts as an upper-level natural science course. (This sample assumes no high school Foreign Language was taken and that the student placed into calculus and college-level English.)

### Chemistry Major with Biochemical option

	Semester 1	Semester 2
Year 1	Math 231	Math 232
	Chemistry 102	Chemistry 104
	English 101	English 102 (OWC-A)
	1st semester Foreign Language	2nd semester Foreign Language
Year 2	Math 233	Arts GER
	Bio Sci 150	Physics 209 and 214
	Chem 221	Chem 344
	Chem 343	Chem 345
		L&S Social Science/ International
Year 3	Chem 311	Chem 561
	Chem 501	Chem 602 or 604
	Physics 210 and 215	Bio Sci 325
	L&S Humanities/Cultural Diversity	L&S Humanities
	OWC-B course	L&S Social Science/ International
Year 4	Chem 524	Chem 603
	Chem 562 and 563	L&S Upper-level elective
	Chem 601	Chem 691 or 692
	L&S Social Science	L&S Social Science
	L&S Humanities/International	L&S Humanities

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**Chemistry Major with Standard option**

	Semester 1	Semester 2
Year 1	Math 231	Math 232
	Chemistry 102	Chemistry 104
	English 101	English 102 (OWC-A)
	1st semester Foreign Language	2nd semester Foreign Language
Year 2	Math 233	Arts GER
	Physics 209 and 215	Physics 210 and 215
	Chem 221	Chem 344
	Chem 343	Chem 345
		L&S Social Science/ International
Year 3	Chem 311	Chem 561
	Chem 501 or 511	OWC-B course
	Natural Science with lab	L&S Social Science/ International
	L&S Humanities/Cultural Diversity	L&S Humanities
	L&S Social Science	L&S Upper-level elective
Year 4	Chem 524	L&S Upper-level elective 582
	Chem 562	Chem 691 or 692
	Chem 563	L&S Social Science
	Chem 582	L&S Upper-level elective
	L&S Humanities/International	Elective

**Chemistry Course List as shown in samples:**

(for full list, see UWM Course Catalog)

Chemistry 102: General Chemistry  
 Chemistry 104: General Chemistry and Qualitative Analysis  
 Chemistry 221: Elementary Quantitative Analysis  
 Chemistry 311: Introduction to Inorganic Chemistry  
 Chemistry 343: Introductory Organic Chemistry Laboratory  
 Chemistry 344: Organic Chemistry  
 Chemistry 345: Organic Chemistry Laboratory  
 Chemistry 501: Introduction to Biochemistry.  
 Chemistry 511: Inorganic Chemistry  
 Chemistry 524: Instrumental Analysis  
 Chemistry 560: Biophysical Chemistry  
 Chemistry 561: Physical Chemistry I  
 Chemistry 562: Physical Chemistry II  
 Chemistry 563: Physical Chemistry Laboratory  
 Chemistry 582: Advanced Chemistry Lab I  
 Chemistry 584: Advanced Chemistry Lab II  
 Chemistry 601: Biochemistry: Protein Structure and Function  
 Chemistry 602: Biochemistry: Cellular Processes  
 Chemistry 603: Introduction to Biochemistry Laboratory  
 Chemistry 604: Biochemistry: Metabolism  
 Chemistry 614: Bio-Inorganic Chemistry  
 Chemistry 691: Senior Research  
 Chemistry 692: Senior Thesis  
 Chemistry 697: Senior Seminar



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### Degree Requirements for a Bachelor of Science with a Biochemistry major (brief summary):

(Biochemistry is also available as a Bachelor of Arts degree with a different set of requirements than listed below.)

- English Proficiency and UWM Oral and Written Communication (OWC) GER - English 102 (OWC-A); and OWC-B course.
- Math and Formal Reasoning - Math 211, 221, or 231; an additional 200-level course from Math, Philos 212, or Letters and Science statistics course; and QL-B course. (A single course may satisfy both formal reasoning and the QL-B GER.)
- Foreign Language – 2 semesters of a single Foreign Language
- L&S Humanities – 12 credits
- L&S Social Sciences – 12 credits
- L&S Natural Science – 12 credits including a laboratory course in three distinct natural science areas
- L&S International – 9 credits usually accomplished in conjunction with Humanities and/or Social Science courses
- UWM Arts GER – 3 credits
- UWM Cultural Diversity GER – 3 credits usually accomplished in conjunction with a Humanities or Social Science course
- 120 credits including 90 credits in L&S and with 36 of the 90 credits in L&S upper-level (numbered 300 and above) courses and 30 of those 36 in courses designated upper-level Natural Science
- Complete the Biochemistry major requirements:
  - 15 Chem credits numbered 300 or above must be completed at UWM
  - Math 211
  - Math Stat 215
  - One of Math 205 or 405
  - All of Physics 120, 121, 122, and 123
  - All of Chem 102, 104, 221, 343, 344, 345, 501, 560, 603
  - Two of Chem 601, 602, 604
  - One of Chem 691 or 692
  - Both of BioSci 150 and 325
  - 7 credits from BioSci 315, 316, 356, 383, 401, 402, 405, 470, 490, 529, 536, 539, 540, 572, 573, 580, 595, 607, 625, 630, 667

### Sample Four Year Plan:

There are hundreds of courses that satisfy various requirements (<http://www4.uwm.edu/lets/requirements/>) and courses in the major can be used. For example, Chemistry 102 counts as a natural science with lab and Chemistry 311 counts as an upper-level natural science course. (This sample assumes no high school Foreign Language was taken and that the student placed into calculus and college-level English.)

	Semester 1	Semester 2
Year 1	Math 105 (QL-A)	Math 211 (NS)
	Bio Sci 150	Chem 102 (NS with lab)
	1st semester Foreign Language	2nd semester Foreign Language
	English 101	English 102 (OWC-A)
	L&S Humanities/International	Physics 120 and 121
Year 2	Math 205	MathStat 215 (QL-B)
	Physics 122 and 123	Chem 221
	Chem 104	Chem 343
	L&S Humanities/Cultural Diversity	L&S Social Science/International
	L&S Social Science/International	OWC-B course
Year 3	Chem 344	Chem 501
	Chem 345	L&S Humanities
	Bio Sci 325	Bio Sci Upper-level elective
	Chem 560	L&S Social Science
	L&S Social Science	L&S Humanities
Year 4	Chem 603	Chem 602
	Chem 601	Chem 691 or 692
	Bio Sci Upper-level elective	L&S Upper-level elective
	Arts GER	Elective
	Elective	Elective

(NS) Natural Science GER

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### Degree Requirements for a Bachelor of Science with a Course in Chemistry major (brief summary):

1. English Proficiency and UWM Oral and Written Communication (OWC) GER - English 102 (OWC-A); and OWC-B course
2. Math and Formal Reasoning - Math 211, 221, or 231; an additional 200-level course from Math, Philos 212, or Letters and Science statistics course; and a QL-B course. (A single course may satisfy both formal reasoning and the QL-B GER.)
3. Foreign Language – 2 semesters of a single foreign language
4. L&S Humanities – 6 credits
5. L&S Social Sciences – 6 credits
6. UWM Arts GER – 3 credits
7. UWM Cultural Diversity GER – 3 credits usually accomplished in conjunction with a Humanities or Social Science course
8. All of Math 231, 232, 233 or both Math 221 and 222
9. Math 234
10. All of Physics 209, 210, 214, and 215
11. All of Chem 102, 104, 221, 311, 343, 344, 345, 501, 511, 524, 561, 562, 563
12. Chem 582 or 584
13. One of Chem 691, 692, or 697

### Sample Four Year Plan:

There are hundreds of courses that satisfy various requirements (<http://www4.uwm.edu/letscli/requirements/>), and courses in the major can be used. For example, Chemistry 102 counts as a natural science with lab and Chemistry 311 counts as an upper-level natural science course. (This sample assumes no high school Foreign Language was taken and that the student placed into calculus and college-level English.)

	Semester 1	Semester 2
Year 1	Math 231 (QL-B)	Math 232
	1st semester Foreign-Language	2nd semester Foreign Language
	English 101	English 102 (OWC-A)
	Chem 102 (NS with lab)	Chem 104
	L&S Humanities	L&S Social Science
Year 2	Math 233	Math 234
	Physics 209 and 214	Physics 210 and 215
	Chem 221	Chem 344
	Chem 343	Chem 345
Year 3	Chem 311	OWC-B course
	Chem 501	L&S Humanities
	L&S Social Science	Chem 561
	Arts GER	Cultural Diversity
	Elective	Elective
Year 4	Chem 562	Chem 511
	Chem 563	Chem 584
	Chem 524	Chem 691 or 692 or 697
	Elective	Elective
	Chem 582	Elective