

# CHEMISTRY, BS

**Banner Code:** SC-BS-CHEM

## Academic Advising

Phone: 703-993-1071

Email: [sslayden@gmu.edu](mailto:sslayden@gmu.edu)

Website: [cos.gmu.edu/chemistry/undergraduate-programs/](http://cos.gmu.edu/chemistry/undergraduate-programs/)

This program is approved by the American Chemical Society (<https://www.acs.org/content/acs/en.html>). Upon completion, students who choose either the B.S. in Chemistry with no concentration or the Analytical Chemistry concentration are certified to the society. Students that have a keen interest in sustainability should choose the Environmental Chemistry concentration. Students planning professional careers in chemistry should choose this degree.

## Teacher Licensure

Students who wish to become teachers and plan to seek teacher licensure should consider the following options:

- Chemistry, BA or BS/Curriculum and Instruction, Accelerated MED (Secondary Education Chemistry concentration)
- Curriculum and Instruction Undergraduate Certificate

Interested students should attend an information session early in their undergraduate career. For more information, visit the Graduate School of Education's website (<http://gse.gmu.edu>).

## Admissions & Policies

### Admissions

University-wide admissions policies can be found in the Undergraduate Admissions Policies section of this catalog.

To apply for this program, please complete the George Mason University Admissions Application (<https://www2.gmu.edu/admissions-aid/apply-now>).

### Policies

Students must fulfill all Requirements for Bachelor's Degrees, including the Mason Core.

CHEM 336 Physical Chemistry Lab I or CHEM 465 Biochemistry Lab will fulfill the writing intensive requirement for students majoring in chemistry.

### Termination from the Major

To ensure the academic integrity of the Chemistry and Biochemistry undergraduate major program, students are expected to maintain a satisfactory level of academic performance.

No chemistry, math, or science course that is required for the major may be attempted more than three times. Students who do not successfully complete such a course with a grade of C or better by the third attempt may be terminated from the major.

Students who have been terminated from the Chemistry major may not register for a chemistry course without the permission of the Department of Chemistry and Biochemistry.

A student may not declare a major in chemistry if the student has previously met the termination criteria for the major at any time, regardless of what the student's major was at the time the courses were taken.

## Requirements

### Degree Requirements

Total credits: minimum 120

Students should refer to the Admissions & Policies tab for specific policies related to this program.

Students majoring in chemistry must complete the chemistry program requirements with a minimum GPA of 2.30 and present no more than two courses with a grade of 'D' (1.00) in CHEM coursework at graduation.

### BS without Concentration

Students who do not select an optional concentration complete the curriculum requirements listed below.

#### Chemistry Courses

Code	Title	Credits
CHEM 211	General Chemistry I (Mason Core)	3
CHEM 212	General Chemistry II (Mason Core)	3
CHEM 213	General Chemistry Laboratory I (Mason Core)	1
CHEM 214	General Chemistry Laboratory II (Mason Core)	1
CHEM 313	Organic Chemistry I	3
CHEM 314	Organic Chemistry II	3
CHEM 315	Organic Chemistry Lab I	2
CHEM 318	Organic Chemistry Lab II	2
CHEM 321	Quantitative Chemical Analysis	4
CHEM 331	Physical Chemistry I	3
CHEM 332	Physical Chemistry II	3
CHEM 336	Physical Chemistry Lab I <sup>1</sup>	2
CHEM 337	Physical Chemistry Lab II	2
CHEM 422	Instrumental Methods of Chemical Analysis	3
CHEM 423	Instrumental Methods of Chemical Analysis Laboratory	2
CHEM 441	Properties and Bonding of Inorganic Compounds	3
CHEM 445	Inorganic Preparations and Techniques	2
CHEM 463	General Biochemistry I	4
Select 3 credits of chemistry electives <sup>2</sup>		3
<b>Total Credits</b>		<b>49</b>

<sup>1</sup> Fulfills the writing intensive requirement.<sup>2</sup> Any lecture, lab or research course(s)**Mathematics Courses**

Code	Title	Credits
MATH 113	Analytic Geometry and Calculus I (Mason Core)	4
MATH 114	Analytic Geometry and Calculus II	4
MATH 213	Analytic Geometry and Calculus III	3
Total Credits		11

**Physics Courses**

Code	Title	Credits
PHYS 160	University Physics I (Mason Core)	3
PHYS 161	University Physics I Laboratory (Mason Core)	1
PHYS 260	University Physics II (Mason Core)	3
PHYS 261	University Physics II Laboratory (Mason Core)	1
Total Credits		8

**In-Depth Electives**

Code	Title	Credits
Select one from the following:		3
CHEM 413	Synthetic and Mechanistic Organic Chemistry	
CHEM 427	Aquatic Environmental Chemistry	
CHEM 438	Atmospheric Chemistry	
CHEM 458	Chemical Oceanography	
CHEM 464	General Biochemistry II	
CHEM 467	The Chemistry of Enzyme-Catalyzed Reactions	
CHEM 468	Bioorganic Chemistry	
Total Credits		3

**Concentration in Environmental Chemistry (EVCH)**

Students who choose this concentration will have a broad knowledge of chemistry and a firm foundation in the environmental sciences covering atmospheric, aquatic, and soil. The major prepares students to work in the public or private sector as environmental chemists as well as to pursue an advanced degree.

**Chemistry Courses**

Code	Title	Credits
CHEM 211	General Chemistry I (Mason Core)	3
CHEM 213	General Chemistry Laboratory I (Mason Core)	1
CHEM 212	General Chemistry II (Mason Core)	3
CHEM 214	General Chemistry Laboratory II (Mason Core)	1
CHEM 313	Organic Chemistry I	3
CHEM 314	Organic Chemistry II	3
CHEM 315	Organic Chemistry Lab I	2
CHEM 318	Organic Chemistry Lab II	2
CHEM 321	Quantitative Chemical Analysis	4
CHEM 331	Physical Chemistry I	3

CHEM 332	Physical Chemistry II	3
CHEM 336	Physical Chemistry Lab I <sup>1</sup>	2
CHEM 337	Physical Chemistry Lab II	2
CHEM 422	Instrumental Methods of Chemical Analysis	3
CHEM 423	Instrumental Methods of Chemical Analysis Laboratory	2
CHEM 427	Aquatic Environmental Chemistry	3
CHEM 438	Atmospheric Chemistry	3
CHEM 441	Properties and Bonding of Inorganic Compounds	3
or CHEM 446	Bioinorganic Chemistry	
CHEM Elective (lecture or research course)		3
Total Credits		49

<sup>1</sup> Fulfills the writing intensive requirement.**Physics Courses**

Code	Title	Credits
Select one option:		8
<b>Option One:</b>		
PHYS 243	College Physics I (Mason Core)	
PHYS 244	College Physics Lab (Mason Core)	
PHYS 245	College Physics II (Mason Core)	
PHYS 246	College Physics Lab (Mason Core)	
<b>Option Two:</b>		
PHYS 160	University Physics I (Mason Core)	
PHYS 161	University Physics I Laboratory (Mason Core)	
PHYS 260	University Physics II (Mason Core)	
PHYS 261	University Physics II Laboratory (Mason Core)	
Total Credits		8

**Mathematics Courses**

Code	Title	Credits
MATH 113	Analytic Geometry and Calculus I (Mason Core)	4
MATH 114	Analytic Geometry and Calculus II	4
MATH 213	Analytic Geometry and Calculus III	3
or STAT 250	Introductory Statistics I (Mason Core)	
Total Credits		11

**Science Core Courses**

Code	Title	Credits
GEOL 101	Introductory Geology I (Mason Core)	4
GEOL 306	Soil Science	3
EVPP 210	Environmental Biology: Molecules and Cells	4
or BIOL 213	Cell Structure and Function (Mason Core)	
Total Credits		11

**Supporting Science Electives**

Code	Title	Credits
Select two courses from the following: <sup>1</sup>		
CHEM 458	Chemical Oceanography	6-8
or BIOL 309	Introduction to Oceanography	
or EVPP 309	Introduction to Oceanography	
or GEOL 309	Introduction to Oceanography	
EVPP 301	Environmental Science: Biological Diversity and Ecosystems	
EVPP 445	Principles of Environmental Toxicology	
GEOL 305	Environmental Geology	
GEOL 313	Hydrogeology	
BIOL 305 & BIOL 306	Biology of Microorganisms and Biology of Microorganisms Laboratory	
or EVPP 305 & EVPP 306	Environmental Microbiology Essentials and Environmental Microbiology Essentials Laboratory	
GGS 302	Global Environmental Hazards	
Total Credits		6-8

<sup>1</sup> The discipline sequences may be interchanged only with approval by the program coordinator.

The remaining credits are fulfilled by Mason Core requirements or general electives.

**Concentration in Analytical Chemistry (ANAC)**

The Analytical Chemistry concentration is designed to introduce and train students in modern aspects of analytical chemistry. Students who choose this program will be well-prepared to run sophisticated analytical instruments in industry and research laboratories and to pursue an advanced degree specializing in analytical chemistry.

**Chemistry Courses**

Code	Title	Credits
CHEM 211	General Chemistry I (Mason Core)	3
CHEM 213	General Chemistry Laboratory I (Mason Core)	1
CHEM 212	General Chemistry II (Mason Core)	3
CHEM 214	General Chemistry Laboratory II (Mason Core)	1
CHEM 313	Organic Chemistry I	3
CHEM 314	Organic Chemistry II	3
CHEM 315	Organic Chemistry Lab I	2
CHEM 318	Organic Chemistry Lab II	2
CHEM 321	Quantitative Chemical Analysis	4
CHEM 331	Physical Chemistry I	3
CHEM 332	Physical Chemistry II	3
CHEM 336	Physical Chemistry Lab I <sup>1</sup>	2
CHEM 337	Physical Chemistry Lab II	2
CHEM 422	Instrumental Methods of Chemical Analysis	3
CHEM 423	Instrumental Methods of Chemical Analysis Laboratory	2
CHEM 427	Aquatic Environmental Chemistry	3

or CHEM 355	Undergraduate Research	
or CHEM 451	Special Projects in Chemistry	
or CHEM 452	Special Projects in Chemistry	
CHEM 463	General Biochemistry I	4
CHEM 441	Properties and Bonding of Inorganic Compounds	3
CHEM 465	Biochemistry Lab	2
or CHEM 445	Inorganic Preparations and Techniques	
CHEM 424	Principles of Chemical Separation	3
or CHEM 425	Electroanalytical Chemistry	
Total Credits		52

<sup>1</sup> Fulfills the writing intensive requirement.

**Physics Courses**

Code	Title	Credits
PHYS 160	University Physics I (Mason Core)	3
PHYS 161	University Physics I Laboratory (Mason Core)	1
PHYS 260	University Physics II (Mason Core)	3
PHYS 261	University Physics II Laboratory (Mason Core)	1
Total Credits		8

**Mathematics Courses**

Code	Title	Credits
MATH 113	Analytic Geometry and Calculus I (Mason Core)	4
MATH 114	Analytic Geometry and Calculus II	4
MATH 213	Analytic Geometry and Calculus III	3
Total Credits		11

**Science Core Courses**

Code	Title	Credits
GEOL 101	Introductory Geology I (Mason Core)	4
GEOL 306	Soil Science	3
EVPP 210	Environmental Biology: Molecules and Cells	4
or BIOL 213	Cell Structure and Function (Mason Core)	
Total Credits		11

**Supporting Science Electives**

Code	Title	Credits
Select two courses from the following: 6		
BENG 101	Introduction to Bioengineering	
STAT 250	Introductory Statistics I (Mason Core)	
ECE 101	Introduction to Electrical and Computer Engineering	
CHEM 620	Modern Instrumentation	
Total Credits		6

The remaining credits are fulfilled by Mason Core requirements or general electives.

## Concentration in Biochemistry (BC)

Students planning professional careers in biochemistry, the pharmaceutical industry, medicine, biotechnology, or related fields with a chemistry emphasis should choose this program instead of the Chemistry, BS without a concentration. This concentration provides students with a focus on biochemistry while retaining a strong chemistry foundation. Students are allowed to tailor the concentration to their interests with 9 credits of biology or chemistry elective credits.

### Chemistry Courses

Code	Title	Credits
CHEM 211	General Chemistry I (Mason Core)	3
CHEM 213	General Chemistry Laboratory I (Mason Core)	1
CHEM 212	General Chemistry II (Mason Core)	3
CHEM 214	General Chemistry Laboratory II (Mason Core)	1
CHEM 313	Organic Chemistry I	3
CHEM 314	Organic Chemistry II	3
CHEM 315	Organic Chemistry Lab I	2
CHEM 318	Organic Chemistry Lab II	2
CHEM 321	Quantitative Chemical Analysis	4
CHEM 331	Physical Chemistry I	3
CHEM 336	Physical Chemistry Lab I <sup>1</sup>	2
CHEM 446	Bioinorganic Chemistry	3
CHEM 463	General Biochemistry I	4
CHEM 464	General Biochemistry II	3
CHEM 465	Biochemistry Lab <sup>1</sup>	2
Total Credits		39

<sup>1</sup> Fulfills the writing intensive requirement.

### Mathematics Courses

Code	Title	Credits
MATH 113	Analytic Geometry and Calculus I (Mason Core)	4
MATH 114	Analytic Geometry and Calculus II	4
Total Credits		8

### Physics Courses

Code	Title	Credits
Select one option:		8
<b>Option One:</b>		
PHYS 243	College Physics I (Mason Core)	
PHYS 244	College Physics Lab (Mason Core)	
PHYS 245	College Physics II (Mason Core)	
PHYS 246	College Physics Lab (Mason Core)	
<b>Option Two:</b>		
PHYS 160	University Physics I (Mason Core)	
PHYS 161	University Physics I Laboratory (Mason Core)	
PHYS 260	University Physics II (Mason Core)	
PHYS 261	University Physics II Laboratory (Mason Core)	
Total Credits		8

### Biology Courses

Code	Title	Credits
BIOL 213	Cell Structure and Function (Mason Core)	4
BIOL 305	Biology of Microorganisms	3
BIOL 306	Biology of Microorganisms Laboratory	1
Total Credits		8

### Approved Science Electives

Code	Title	Credits
Select 9 credits of approved science electives chosen from CHEM or BIOL courses numbered 302-499 <sup>1</sup>		9
Total Credits		9

<sup>1</sup> Other science or math courses may be approved as electives, subject to prior approval of the undergraduate coordinator.

### Mason Core and Elective Credits

In order to meet a minimum of 120 credits, this degree requires additional credits (specific credit counts by concentration are shown below), which may be applied toward any remaining Mason Core requirements (outlined below), Requirements for Bachelor's Degrees, and electives. Students are strongly encouraged to consult with their advisors to ensure that they fulfill all requirements.

- Without concentration: 49 credits
- Environmental concentration: 32 credits
- Analytical concentration: 33-35 credits
- Biochemistry concentration: 48 credits

### Mason Core

Note: Some Mason Core requirements may already be fulfilled by the major requirements listed above. Students are strongly encouraged to consult their advisors to ensure they fulfill all remaining Mason Core requirements.

Code	Title	Credits
<b>Foundation Requirements</b>		
	Written Communication (ENGH 101)	3
	Oral Communication	3
	Quantitative Reasoning	3
	Information Technology and Computing	3
<b>Exploration Requirements</b>		
	Arts	3
	Global Understanding	3
	Literature	3
	Natural Science	7
	Social and Behavioral Sciences	3
	Western Civilization/World History	3
<b>Integration Requirements</b>		
	Written Communications (ENGH 302)	3
	Writing-Intensive <sup>1</sup>	3
	Synthesis/Capstone <sup>2</sup>	3
Total Credits		40

<sup>1</sup> Most programs include the writing-intensive course designated for the major as part of the major requirements; this course is therefore not counted towards the total required for Mason Core.

<sup>2</sup> Minimum 3 credits required.

## Honors

### Honors in the Major

Chemistry majors who have completed prerequisites for CHEM 455 Honors Research in Chemistry and CHEM 456 Honors Research in Chemistry and have maintained an overall GPA of at least 3.00 in mathematics and science courses are eligible to enter the departmental honors program. To graduate with honors in chemistry, a student is required to maintain a minimum GPA of 3.00 in mathematics and science courses and successfully complete the two semesters of CHEM 455 Honors Research in Chemistry and CHEM 456 Honors Research in Chemistry with a minimum GPA of 3.50.

In order to apply for Chemistry Honors, please complete the application (<https://cos.gmu.edu/chemistry/wp-content/uploads/sites/7/2015/08/form-honors-program-application-2016.pdf>) and submit it to the undergraduate coordinator.

## Accelerated Master's

### Chemistry, BA or BS/Curriculum and Instruction, Accelerated MEd (Secondary Education Chemistry concentration)

#### Overview

Highly-qualified undergraduates may be admitted to the bachelor's/accelerated master's option and obtain a BA or BS in Chemistry (degree without concentration) and an MEd in Curriculum and Instruction (concentration in secondary education chemistry) in an accelerated time frame after completion of 149 credits. See AP.6.7 Bachelor's/Accelerated Master's Degree for policies related to this program.

This accelerated option is offered jointly by the Department of Chemistry and Biochemistry and the Graduate School of Education.

Students in an accelerated degree program must fulfill all university requirements for the master's degree. For policies governing all graduate degrees, see AP.6 Graduate Policies.

#### Application Requirements

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in Graduate Admissions Policies. For information specific to this accelerated master's program, see Application Requirements and Deadlines (<https://cehd.gmu.edu/bachelors-accelerated-masters-program>).

#### Accelerated Option Requirements

Students complete the following courses in their senior year:

Senior			
Fall Semester	Credits	Spring Semester	Credits
EDCI 573	3	EDCI 673	3
EDUC 672	3	EDRD 619	3
		6	6

Total Credits 12

While undergraduate students, accelerated master's students are able to apply two of the courses listed above to both the bachelor's and master's degrees. These courses are considered advanced standing for the MEd. A minimum grade of B must be earned to be eligible to count as advanced standing. The other two courses are taken as reserve graduate credit and do not apply to the undergraduate degree. Early in their final undergraduate semester, students must submit the Bachelor's/ Accelerated Master's Transition Form to the CEHD Admissions Office and specify which of the four courses are to be designated as advanced standing and reserve graduate credit.

### Chemistry, BS/Chemistry, Accelerated MS Overview

This bachelor's/accelerated master's degree program allows academically strong undergraduates with a commitment to research to obtain both the Chemistry, BS and the Chemistry, MS degrees within an accelerated timeframe. Upon completion of this 144 credit program, students will be exceptionally well prepared for entry into a professional school or a PhD program in chemistry or a related discipline. Students are eligible to enter this program and enroll in graduate courses after successfully completing 90 undergraduate credits, inclusive of prerequisites, toward the Chemistry, BS degree. This flexibility makes it possible for students to complete graduate coursework during their final year.

For more detailed information, see AP.6.7 Bachelor's/Accelerated Master's Degrees. For policies governing all graduate degrees, see AP.6 Graduate Policies.

#### Application Requirements

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in the Graduate Admission Policies section of this catalog. Application information for this accelerated master's program can be found here (<https://www2.gmu.edu/admissions-aid/how-apply/accelerated-masters>).

Successful applicants will have an overall undergraduate GPA of at least 3.00. Additionally, they will have completed 36 credits of CHEM courses with a GPA of at least 3.00.

#### Accelerated Option Requirements

At the beginning of the student's final undergraduate semester, students must submit a bachelor's/accelerated master's transition form (available from the Office of the University Registrar (<http://registrar.gmu.edu>)) to the College of Science's Office of Academic and Student Affairs (<https://cos.gmu.edu/about/contact-us>). Students must begin their master's program in the semester immediately following conferral of the bachelor's degree.

Students must maintain an overall GPA of 3.00 or higher in graduate coursework and should consult with their faculty advisor to coordinate

their academic goals within the chemistry and biochemistry concentrations.

### **Reserve Graduate Credit**

While still in undergraduate status, a maximum of 6 additional graduate credits may be taken as reserve graduate credit and applied to the master's program. Reserve graduate credits do not apply to the undergraduate degree.