BIOCHEMISTRY

Degree: B.S., Chemistry
Department of Chemistry and Physics (https://cas.umw.edu/chemistry/)

Chemistry, the study of the structure, properties, and reactivity of matter, has been called the "central science" because it is central to a fundamental understanding of biology, pharmacy, medicine, agriculture, geology, engineering, and physics. The Bachelor of Science in Chemistry degree program offers a modern curriculum for the study of chemistry within the general framework of a liberal arts and sciences education. It prepares a student for graduate, medical, or dental school; for employment in the chemical industry; or for secondary school teaching. In addition, several courses provide an important foundation in chemical theory and practice for the study of biology, geology, environmental science, and the health sciences. The program has been approved by the American Chemical Society (ACS) to offer certified degrees in Chemistry. In general, chemistry is a solid major program around which one can build a career-focused set of courses from other disciplines, e.g., with mathematics and computer science for chemical engineering or industrial chemistry; with economics and business administration for industrial chemistry; with biology for the health sciences; and with geology for energy or environmental research. The Biochemistry track provides students interested in this interdisciplinary subject a path to explore the chemical and molecular fundamentals that control the structures and metabolic functions of living systems.

The department has well-equipped laboratories to support and reinforce classroom instruction and to provide opportunities for research. Instrumentation for spectroscopy includes ultraviolet-visible and infrared spectrophotometers; two nuclear magnetic resonance spectrometers; and atomic absorption and emission spectrometers with both flame and inductively coupled plasma sources. Other major equipment items include a scanning probe microscope, a gas chromatograph/mass spectrometer system; several other gas and liquid chromatographs; electrochemical analyzers; and a differential scanning calorimeter.

Majors are encouraged to fulfill the general education experiential learning requirement by completing URES 197 Undergraduate Research, CHEM 491 Individual Study, CHEM 493 Chemical Outreach, or CHEM 499 Internship. Alternatively, majors may meet this requirement by participating in an approved summer research program, either the UMW Summer Research Program (or a similar program at another college or university) or a program in an industrial laboratory. **To complete the experiential learning requirement through a summer research experience, contact the department chair for more details.**

During the senior year qualified students may pursue Honors in Chemistry by completing an independent research project and writing and defending a thesis. Students interested in post-graduate study or industrial careers in chemistry should pursue an ACS-certified degree. Students completing the Biochemistry track will be prepared for careers in medical, pharmaceutical, or biotechnological fields.

Student Learning Outcomes

1. Students will comprehend the basic topics/content of fundamental chemistry.

2. Students will retain major fundamental chemical concepts and phenomena.

3. Students will comprehend basic laboratory techniques in chemistry.

4. Students will be proficient in the four major areas of the discipline.

5. Students will research and present on primary chemistry literature.

6. Students will prepare for advanced study in graduate/professional school or employment in a chemistry-related field.

7. Students will interpret and solve chemical problems (critical thinking skills).

Biochemistry Track Requirements

Code	Title	Credits
Select one of the following:		8
BIOL 121 & BIOL 132	Biological Concepts and Organism Function and Diversity	
BIOL 125 & BIOL 126	Phage Hunters I and Phage Hunters II	
BIOL 340	Cellular Biology	4
BIOL 341	General Genetics	4
CHEM 111	General Chemistry I	4
CHEM 112	General Chemistry II	4
CHEM 211	Organic Chemistry I	4
CHEM 212	Organic Chemistry II	4
CHEM 317	Biochemistry I	3
CHEM 318	Biochemistry II	3
CHEM 319	Biochemistry Laboratory I	1
CHEM 320	Biochemistry Laboratory II	1
CHEM 383A	Physical Chemistry I	3
CHEM 453	Seminar	2
Select one of the following:		3
BIOL 415	Nutrition and Metabolism	
BIOL 440	Biology of Cancer	
BIOL 443	The Biology and Biochemistry of Proteins	
BIOL 444	Bioinformatics	
BIOL 471	Topics in Biology [2]	
Total Credits		**48**

[1] MATH 122 Calculus II and PHYS 105 University Physics, w/Lab and PHYS 106 University Physics w/Lab are prerequisites to CHEM 383A Physical Chemistry I and should be completed before the junior year.
[2] Approval required

Students interested in graduate studies in biochemistry are encouraged to complete additional BIOL coursework such as BIOL 430 Molecular Biology of the Gene. Students wishing to earn an ACS-certified Biochemistry Track must complete CHEM 253 Chemical Analysis I, CHEM 254 Chemical Analysis II, CHEM 343 Inorganic Chemistry, and CHEM 345 Inorganic Chemistry Laboratory.

General Education Requirements

The general education requirements for Bachelor of Arts/Bachelor of Science degrees (https://catalog.umw.edu/undergraduate/general-education/requirements-bachelor-arts-bachelor-science-degrees/) apply to all students who are seeking to earn an undergraduate B.A., B.S. or B.S.Ed. degree.

Students seeking a Bachelor of Liberal Studies degree have a separate set of BLS general education requirements (https://catalog.umw.edu/undergraduate/general-education/requirements-bachelor-liberal-studies-degrees/).

Electives

Elective courses are those that are not needed to fulfill a general education requirement or major program requirement but are chosen by the student to complete the 120 credits required for graduation with a B.A./B.S./B.S.Ed. degree or the BLS degree. These courses may be taken graded or pass/fail (or S/U in the case of physical education and 100-level dance). No student in a regular B.A./B.S./B.S.Ed. program may count more than 60 credits in a single discipline toward the 120 credits required for graduation.

Total Credits Required for the Degree: 120 credits

Plans of Study

These suggested plans of study should serve as guides to assist students when planning their course selections. They are not a substitute for a student's Degree Evaluation or the Program Requirements listed for this major in the catalog. Academic planning is the student's responsibility, and course selections should be finalized only after speaking with an advisor. Students should familiarize themselves with the catalog in effect at the time they matriculated at the University of Mary Washington. Students should also familiarize themselves with general education requirements (https://catalog.umw.edu/undergraduate/general-education/) which can be fulfilled through general electives as well as major/minor course requirements. Course requirements and sequencing may vary with AP, IB, CLEP, Cambridge or previous coursework, transfer courses, or other conditions. To be considered full-time, an undergraduate student must be enrolled in 12 or more credits for the semester.

Biochemistry Major

Course	Title	Credits
Freshman		
Fall		
BIOL 121 or BIOL 125	Biological Concepts or Phage Hunters I	4
CHEM 111	General Chemistry I [1]	4
FSEM 100	First-Year Seminar	3
MATH 121	Calculus I	4
	Credits	**15**
Spring		
BIOL 132 or BIOL 126	Organism Function and Diversity or Phage Hunters II	4
CHEM 112	General Chemistry II [2]	4
MATH 122	Calculus II	4
General Education Course		3
	Credits	**15**
Sophomore		
Fall		
BIOL 340	Cellular Biology	4
CHEM 211	Organic Chemistry I [3]	4
PHYS 101 or PHYS 105	General Physics w/Lab [4] or University Physics, w/Lab	4
General Education Course		3
	Credits	**15**
Spring		
BIOL 341	General Genetics	4
CHEM 212	Organic Chemistry II [3]	4
PHYS 102 or PHYS 106	General Physics w/Lab [4] or University Physics w/Lab	4
General Education Courses		5
	Credits	**17**
Junior		
Fall		
CHEM 317	Biochemistry I	3
CHEM 319	Biochemistry Laboratory I [5]	1
General Education Courses or Electives		12
	Credits	**16**
Spring		
CHEM 318	Biochemistry II	3
CHEM 320	Biochemistry Laboratory II [5]	1
General Education Courses or Electives		9
	Credits	**13**
Senior		
Fall		
CHEM 383A	Physical Chemistry I	3
Biology Elective [6]		3-4
General Electives		9
	Credits	**15-16**
Spring		
CHEM 453	Seminar	2
General Electives		12
	Credits	**14**
	Total Credits	**120-121**

Note: There are many ways to sequence the courses in Biochemistry Major. See Chemistry faculty for details.

1 Placement test required if taken at UMW. AP test score of 4 counts as credit for CHEM 111.
2 AP test score of 5 counts as credit for CHEM 111 and CHEM 112.
3 For pre-medical/health tracks, CHEM 211 and CHEM 212 are strongly recommended in the sophomore year. Otherwise, it is possible to take CHEM 253 and CHEM 254 in the sophomore year and CHEM 211 and CHEM 212 in the junior year.
4 MATH 121 is a prerequisite or corequisite for PHYS 105; MATH 122 is a prerequisite or corequisite for PHYS 106.
5 CHEM 317 is a corequisite for CHEM 319; CHEM 318 is a corequisite for CHEM 320.
6 Select from BIOL 415, BIOL 440, BIOL 443, BIOL 444, or BIOL 471. BIOL 471 requires approval from the Chemistry Department.

ACS Biochemistry Major

Course	Title	Credits
Freshman		
Fall		
BIOL 121 or BIOL 132	Biological Concepts or Organism Function and Diversity	4
CHEM 111	General Chemistry I [1]	4
FSEM 100	First-Year Seminar	3
MATH 121	Calculus I	4
	Credits	**15**
Spring		
BIOL 132 or BIOL 126	Organism Function and Diversity or Phage Hunters II	4
CHEM 112	General Chemistry II [2]	4
MATH 122	Calculus II	4

General Education Course		3
	Credits	**15**
Sophomore		
Fall		
BIOL 340	Cellular Biology	4
CHEM 211	Organic Chemistry I [3]	4
PHYS 101 or PHYS 105	General Physics w/Lab [4] or University Physics, w/Lab	4
General Education Course		3
	Credits	**15**
Spring		
BIOL 341	General Genetics	4
CHEM 212	Organic Chemistry II [3]	4
PHYS 102 or PHYS 106	General Physics w/Lab [4] or University Physics w/Lab	4
General Education Courses		5
	Credits	**17**
Junior		
Fall		
CHEM 253	Chemical Analysis I	4
CHEM 317	Biochemistry I	3
CHEM 319	Biochemistry Laboratory I [5]	1
General Education Courses or Electives		8
	Credits	**16**
Spring		
CHEM 254	Chemical Analysis II	4
CHEM 318	Biochemistry II	3
CHEM 320	Biochemistry Laboratory II [5]	1
General Education Courses or Electives		5
	Credits	**13**
Senior		
Fall		
CHEM 383A	Physical Chemistry I	3
Biology Elective [6]		3-4
General Electives		9
	Credits	**15-16**
Spring		
CHEM 343	Inorganic Chemistry [7]	3
CHEM 345	Inorganic Chemistry Laboratory [7]	1
CHEM 453	Seminar	2
General Electives		8
	Credits	**14**
	Total Credits	**120-121**

Note: There are many ways to sequence the courses in ACS Biochemistry Major. See Chemistry faculty for details.

1 Placement test required if taken at UMW. AP test score of 4 counts as credit for CHEM 111.

2 AP test score of 5 counts as credit for CHEM 111 and CHEM 112.

3 For pre-medical/health tracks, CHEM 211 and CHEM 212 are strongly recommended in the sophomore year. Otherwise, it is possible to take CHEM 253 and CHEM 254 in the sophomore year and CHEM 211 and CHEM 212 in the junior year.

4 MATH 121 is a prerequisite or corequisite for PHYS 105; MATH 122 is a prerequisite or corequisite for PHYS 106.

5 CHEM 317 is a corequisite for CHEM 319; CHEM 318 is a corequisite for CHEM 320.

6 Select from BIOL 415, BIOL 440, BIOL 443, BIOL 444, or BIOL 471. BIOL 471 requires approval from the Chemistry Department.

7 CHEM 343 and CHEM 345 are offered in alternate years and may need to be taken during the spring semester of the 3rd year.

Chemistry Faculty

K. Nicole Crowder, Chair
Janet A. Asper, Career Advisor

Professors

Janet A. Asper
K. Nicole Crowder
E. Davis Oldham
Kelli M. Slunt

Associate Professors

Leanna C. Giancarlo
Randall D. Reif

Assistant Professors

Sarah E. Smith

Lecturers

Suzanne M. Nguyen