

CHEMISTRY

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).

Chemistry Major Requirements

| Code | Title | Credits |
|----------------------|-----------------------------------|-----------|
| 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 253 | Chemical Analysis I | 4 |
| CHEM 254 | Chemical Analysis II | 4 |
| CHEM 383A | Physical Chemistry I | 3 |
| CHEM 384A | Physical Chemistry II | 3 |
| CHEM 387A | Physical Chemistry Laboratory I | 2 |
| CHEM 388A | Physical Chemistry Laboratory II | 2 |
| CHEM 423 | Experimental Methods in Chemistry | 4 |
| CHEM 453 | Seminar | 2 |
| Total Credits | | 40 |

¹ MATH 122 Calculus II and PHYS 105 University Physics, w/Lab and PHYS 106 University Physics w/Lab or PHYS 101 General Physics w/Lab and PHYS 102 General Physics w/Lab are prerequisites to CHEM 383A Physical Chemistry I and should be completed before the junior year.

ACS-certified Chemistry Degree Requirements

| Code | Title | Credits |
|-----------|-----------------------------------|---------|
| 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 253 | Chemical Analysis I | 4 |
| CHEM 254 | Chemical Analysis II | 4 |
| CHEM 317 | Biochemistry I | 3 |
| CHEM 319 | Biochemistry Laboratory I | 1 |
| CHEM 343 | Inorganic Chemistry | 3 |
| CHEM 345 | Inorganic Chemistry Laboratory | 1 |
| CHEM 383A | Physical Chemistry I | 3 |
| CHEM 384A | Physical Chemistry II | 3 |
| CHEM 387A | Physical Chemistry Laboratory I | 2 |
| CHEM 388A | Physical Chemistry Laboratory II | 2 |
| CHEM 423 | Experimental Methods in Chemistry | 4 |
| CHEM 453 | Seminar | 2 |

Sufficient additional laboratory hours to total 500 contact hours

Total Credits **48**

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.

Chemistry Major

| Course | Title | Credits |
|---------------------------|-----------------------------------|-----------|
| Freshman | | |
| Fall | | |
| CHEM 111 | General Chemistry I ¹ | 4 |
| FSEM 100 | First-Year Seminar | 3 |
| MATH 121 | Calculus I | 4 |
| General Education Courses | | 6 |
| Credits | | 17 |
| Spring | | |
| CHEM 112 | General Chemistry II ² | 4 |
| MATH 122 | Calculus II | 4 |
| General Education Courses | | 6 |
| Credits | | 14 |

Sophomore

| | | |
|--|------------------------------------|------------------------------|
| Fall | | |
| CHEM 211 | Organic Chemistry I ³ | 4 |
| PHYS 101 | General Physics w/Lab ⁴ | 4 |
| | or PHYS 105 | or University Physics, w/Lab |
| General Education Courses | | 7 |
| Credits | | 15 |
| Spring | | |
| CHEM 212 | Organic Chemistry II ³ | 4 |
| PHYS 102 | General Physics w/Lab ⁴ | 4 |
| | or PHYS 106 | or University Physics w/Lab |
| General Education Courses | | 6 |
| Credits | | 14 |
| Junior | | |
| Fall | | |
| CHEM 253 | Chemical Analysis I ³ | 4 |
| CHEM 383A | Physical Chemistry I | 3 |
| General Education Courses or Electives | | 9 |
| Credits | | 16 |
| Spring | | |
| CHEM 254 | Chemical Analysis II ³ | 4 |
| CHEM 384A | Physical Chemistry II | 3 |
| General Electives | | 9 |
| Credits | | 16 |
| Senior | | |
| Fall | | |
| CHEM 387A | Physical Chemistry Laboratory I | 2 |
| CHEM 423 | Experimental Methods in Chemistry | 4 |
| General Electives | | 9 |
| Credits | | 15 |
| Spring | | |
| CHEM 388A | Physical Chemistry Laboratory II | 2 |
| CHEM 453 | Seminar | 2 |
| General Electives | | 9 |
| Credits | | 13 |
| Total Credits | | 120 |

Note: There are many ways to sequence the courses in Chemistry 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.

ACS Certified Chemistry Major

| Course | Title | Credits |
|---------------------------|-----------------------------------|-----------|
| Freshman | | |
| Fall | | |
| CHEM 111 | General Chemistry I ¹ | 4 |
| FSEM 100 | First-Year Seminar | 3 |
| MATH 121 | Calculus I | 4 |
| General Education Courses | | 6 |
| Credits | | 17 |
| Spring | | |
| CHEM 112 | General Chemistry II ² | 4 |

| | | |
|--|---|------------|
| MATH 122 | Calculus II | 4 |
| General Education Courses | | 7 |
| Credits | | 15 |
| Sophomore | | |
| Fall | | |
| CHEM 211 | Organic Chemistry I ³ | 4 |
| PHYS 101 | General Physics w/Lab ⁴ | 4 |
| General Education Courses | | 6 |
| Credits | | 14 |
| Spring | | |
| 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 | | 6 |
| Credits | | 14 |
| Junior | | |
| Fall | | |
| CHEM 253 | Chemical Analysis I ³ | 4 |
| CHEM 317 | Biochemistry I ^{5,6} | 3 |
| CHEM 319 | Biochemistry Laboratory I ^{5,6} | 1 |
| CHEM 383A | Physical Chemistry I | 3 |
| General Education Courses or Electives | | 4 |
| Credits | | 15 |
| Spring | | |
| CHEM 254 | Chemical Analysis II ³ | 4 |
| CHEM 384A | Physical Chemistry II | 3 |
| General Electives | | 9 |
| Credits | | 16 |
| Senior | | |
| Fall | | |
| CHEM 387A | Physical Chemistry Laboratory I | 2 |
| CHEM 423 | Experimental Methods in Chemistry | 4 |
| General Electives | | 9 |
| Credits | | 15 |
| Spring | | |
| CHEM 343 | Inorganic Chemistry ^{5,7} | 3 |
| CHEM 345 | Inorganic Chemistry Laboratory ^{5,7} | 1 |
| CHEM 388A | Physical Chemistry Laboratory II | 2 |
| CHEM 453 | Seminar | 2 |
| General Electives | | 6 |
| Credits | | 14 |
| Total Credits | | 120 |

Note: There are many ways to sequence the courses in the ACS Certified Chemistry 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 to be taken 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 and CHEM 319 and CHEM 343 and CHEM 345 may be taken either 3rd or 4th year depending on scheduling.

⁶ CHEM 317 is a corequisite for CHEM 319.

⁷ CHEM 343 and CHEM 345 are offered in alternating spring semesters.

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