

CHEMISTRY

DEPARTMENT OFFICE

Darwin Hall 300
(707) 664-2119
www.sonoma.edu/chemistry

DEPARTMENT CHAIR

Carmen Works
Darwin 312
(707) 664-3084
Works@sonoma.edu

Faculty

Bogdan Negru
Steven Farmer
Jon M. Fukuto
Monica Lares
Jennifer Whiles
Mark J. Perri
Meng-Chih Su
Carmen F. Works

Programs Offered

Bachelor of Science in Chemistry
(Certified by the American Chemical Society)

Bachelor of Arts in Chemistry

Bachelor of Science in Biochemistry
(Certified by the American Chemical Society)

Minor in Chemistry

Teaching Credential Preparation

Chemistry is the study of matter, its properties, and how it changes. An understanding of chemical principles is required to fully understand most scientific disciplines such as biology, medicine, physics, environmental science, geology, materials science, pharmaceuticals, agriculture, forensic science, most branches of engineering, and even studio art. Chemists not only study molecules that nature provides but also synthesize new molecules to be used in many of these fields.

The department offers both bachelor of arts and bachelor of science degrees. Both degrees provide students with a solid chemical foundation to prepare them for graduate school, professional school, or the workforce. The B.S. degree requires more science coursework, while the B.A. allows more flexibility for other academic interests. The B.S. in biochemistry is designed for students with an interest in the biological aspects of chemistry and the pre-health professions.

Careers in Chemistry

Sonoma State University is fortunate to be situated within the greater Bay Area, which is rapidly becoming a leading area for research in disciplines such as biotechnology, pharmaceuticals, materials science, and proteomics. Sonoma State graduates have a high success rate for acceptance into advanced degree programs in chemistry and biochemistry; medical, dental, and veterinary schools; cell and molecular biology; and materials science. They have also entered the job market in a variety of careers, including government agencies (FBI, forensics), technical writing, chemical and biochemical research, cosmetics and perfumes, space chemistry, teaching at all levels, medical technology, pharmaceuticals, patent law, materials research, consulting, and applications of chemistry in business.

Students seeking teaching credentials may elect chemistry as their major within the teaching credential program in science.

The Chemistry Department

The small size and educational philosophy of the department encourage's students to develop close relationships with other students, faculty, and staff. Coursework and individual research projects place an emphasis on laboratory experiences in which students are expected to become familiar with a variety of techniques and instruments. In their freshman year, students participate in a learning community with other chemistry and biochemistry majors and in their senior year participate in a capstone experience to further prepare themselves for entry into industry or graduate education. Novel undergraduate research experiences are an integral part of our program. In 2006, the department returned to the newly remodeled Darwin Hall, equipped with new lower-division teaching laboratories and facilities for advanced laboratory courses and undergraduate research. Our laboratories are equipped with many modern, computerized instruments that include ultraviolet, visible, infrared, atomic absorption, and fluorescence spectrophotometers; a high field resonance spectrometer; high-pressure liquid, gas, and ion exchange chromatographs; and gas chromatographs with mass spectrometer detectors, and an LCMS with time of flight detector.

Repeat Policy

Any student wishing to repeat a chemistry course must first fill out a course repeat form and have it approved by the chemistry department chair before they will be allowed a seat in the class. Students repeating a class will be given last priority at registration. Students that register for the class without following this policy will be administratively dropped from the course. Course repeat forms are available in the department office.

Chemistry and Biochemistry majors may only repeat a total of three chemistry courses, any combination, in order to graduate

with a chemistry or biochemistry degree. Students can petition the department for reinstatement on a case-by-case basis.

Bachelor of Science in Chemistry (Certified by the American Chemical Society)

(See page 91 for a sample four-year program.)

The B.S. degree provides thorough preparation for students who wish to pursue advanced degrees in the chemical sciences, go to professional school, or work as chemists in industry. All courses in the major core, major electives, and supporting courses must be taken in the traditional grading mode (A-F). Transcripts will be noted as approved by the American Chemical Society.

Please see the current approved curriculum on the SSU official catalog web page.

| Degree Requirements | Units |
|--|------------|
| General education (50, 13 in major) | 50 |
| Major requirements | 48 |
| Supporting courses | 19 |
| Electives | 3 |
| Total units needed for graduation | 120 |

Major Core Requirements

| | |
|---|-----------|
| CHEM 125AB General Quantitative Chemistry 10 units, 4 in the major core, 6 in GE (B1 and B3) | 4 |
| CHEM 255 Quantitative Analysis | 4* |
| CHEM 275 Instrumental Analysis | 2 |
| CHEM 310AB Physical Chemistry | 6 |
| CHEM 315 and 316 Introduction to Research Methods | 3 |
| CHEM 325 Inorganic Chemistry | 3 |
| CHEM 335AB Organic Chemistry Lecture | 6 |
| CHEM 336AB Organic Chemistry Laboratory | 4 |
| CHEM 401 Senior Integrated Lab | 3 |
| CHEM 402 Advanced Synthesis and Analysis | 3 |
| CHEM 445, 446, or 340 Biochemistry | 3 |
| CHEM 496 UD CHEM Elective | 6 |
| CHEM 497 Research Seminar | 1 |
| Total units in the major core | 48 |

* Quantitative Analysis (CHEM 255) is not required for students who have completed CHEM 125 A & B., but is required for majors who took CHEM 115AB. Students should replace these four units by completing the challenge by exam form upon completion of the series.

Supporting Courses

| | |
|---|-----------|
| MATH 161 Calculus I (3 units, counted as GE B4) | 1 |
| MATH 211 Calculus II | 4 |
| MATH 261 Calculus IV | 4 |
| PHYS 114 Introduction to Physics I | 4 |
| PHYS 116 Introduction to Physics Laboratory I | 1 |
| PHYS 214 Introduction to Physics II | 4 |
| PHYS 216 Introduction to Physics Laboratory II | 1 |
| Total units in supporting courses | 19 |

GE Courses

| | |
|----------------------------------|------------|
| CHEM 120AB | 4 |
| CHEM 115AB | 6 |
| MATH 161 | 3 |
| Others | 37 |
| Total units in GE courses | 50 |
| Electives | 3 |
| Total units to graduate | 120 |

Bachelor of Science in Biochemistry (Certified by the American Chemical Society)

(See page 92 for a sample four-year program.)

The B.S. degree in biochemistry is appropriate for students interested in the medical fields, graduate study in chemistry or biochemistry, or employment in the biochemical, pharmaceutical or biotechnology industries. All courses in the major core, major electives and supporting courses must be taken in the traditional grading mode (A-F). Undergraduate research is required for the B.S. degree in biochemistry. Transcripts will be noted as approved by the American Chemical Society.

Please see the current approved curriculum on the SSU official catalog web page.

| Degree Requirements | Units |
|--|------------|
| General education (50, 16 in major) | 50 |
| Major requirements | 43 |
| Biology / Chemistry courses | 10 |
| Supporting courses | 13-15 |
| Electives | 2-4 |
| Total units needed for graduation | 120 |

Major Core Requirements

| | |
|---|-----------|
| CHEM 125 AB General Chemistry 10 units, 4 in the major core, 6 in GE (B1 and B3) | 4 |
| CHEM 255 Quantitative Analysis | 4* |
| CHEM 275 Instrumental Analysis | 2 |
| CHEM 310 AB Physical Chemistry | 6 |
| CHEM 315 and 316 Introduction to Research Methods | 3 |
| CHEM 325 Inorganic Chemistry | 3 |
| CHEM 335 AB Organic Chemistry | 6 |
| CHEM 336 A Organic Chemistry Lab | 2 |
| CHEM 401 Senior Integrated Lab | 3 |
| CHEM 441 Biochemical Methods | 3 |
| CHEM 445 Structural Biochemistry | 3 |
| CHEM 446 Metabolic Biochemistry | 3 |
| CHEM 497 Research Seminar | 1 |
| Total units in the major core | 43 |

* Quantitative Analysis (CHEM 255) is not required for students who have completed CHEM 125 A & B, but is required for majors that took 115AB. Students should replace these four units by completing the challenge by exam form upon completion of the series.

Biology/Chemistry Courses

| | |
|--|-----------|
| BIOL 130, Introduction to Cell Biology and Genetics (4 units, 1 in the major core, 3 in general education B2) | |
| BIOL 321, Molecular Biology, Cell Biology and Physiology | 4 |
| BIOL 325, Molecular and Cellular Lab Techniques | |
| <i>Choose 1 from the following:</i> | |
| CHEM 496, UD CHEM Elective | 4 |
| BIOL 338 Environmental Microbiology and Biotechnology | 4 |
| BIOL 340 General Bacteriology | 4 |
| BIOL 342 Molecular Genetics | 4 |
| BIOL 344 Cell Biology | 4 |
| BIOL 348 Plant Physiology | 4 |
| BIOL 349 Animal Physiology | 4 |
| BIOL 383 Virology | 4 |
| BIOL 481 Medical Microbiology | 5 |
| BIOL 544 Advanced Cell Biology | 4 |
| <i>(or other courses approved by the Chemistry Department)</i> | |
| Total units in Biology/Chemistry Courses | 10 |

GE Courses

| | |
|---|------------|
| CHEM 120AB, Thinking Like a Scientist (GE A3) | 4 |
| MATH 161 (GE B4) | 3 |
| BIOL 130 (GE B2) | 3 |
| Others | 34 |
| Total units in GE courses | 50 |
| Electives | 2-4 |
| Total units to graduate | 120 |

Supporting Courses

| | |
|--|--------------|
| MATH 161 Calculus I (4 units, 1 in major core, 3 in GE B4) | 1 |
| MATH 211 Calculus II | 4 |
| CHEM 115AB (GE B1 & B3) or CHEM 125 AB (GE B1 & B3) | 6 |
| PHYS 114 or 210A Physics I | 3-4 |
| PHYS 116 or 209A Physics Laboratory I | 1 |
| PHYS 214 or 210B Physics II | 3-4 |
| PHYS 216 or 209B Physics Laboratory II | 1 |
| Total units in Supporting Courses | 13-15 |
| Electives | 2-4 |
| Total units to graduate | 120 |

Bachelor of Arts in Chemistry

(See page 92 for a sample four-year program.)

The B.A. degree provides a solid foundation in chemistry so students have the same career options as those with the B.S. degree, while allowing students the flexibility to pursue other academic interests. All courses in the major core, major electives, and supporting courses must be taken in the traditional grading mode (A-F). It is highly recommended that students perform undergraduate research with a faculty member.

Please see the current approved curriculum on the SSU official catalog web page.

| Degree Requirements | Units |
|--|------------|
| General education (50, 13 in major) | 37 |
| Major requirements | 34 |
| Supporting courses | 13-15 |
| Electives | 34-36 |
| Total units needed for graduation | 120 |

Major Core Requirements

| | |
|--|-----------|
| CHEM 125AB General Chemistry 10 units, 4 in the major core, 6 in GE (B1 and B3) | 4 |
| CHEM 255 Quantitative Analysis | 4* |
| CHEM 275 Instrumental Analysis | 2 |
| CHEM 310AB Physical Chemistry | 6 |
| CHEM 325 Inorganic Chemistry | 3 |
| CHEM 335AB Organic Chemistry | 6 |
| CHEM 336A Organic Chemistry Lab | 2 |
| CHEM 401 Senior Integrated Lab | 3 |
| CHEM (315, 316, 336B, 402, 441, 445, 446, or 496) | 3 |
| CHEM 497 Research Seminar | 1 |
| Total units in the major core | 34 |

Supporting Courses

| | |
|--|--------------|
| MATH 161 Calculus I (4 units, 1 in major core, 3 in GE B4) | 1 |
| MATH 211 Calculus II | 4 |
| PHYS 114 or 210A Physics I | 3-4 |
| PHYS 116 or 209A Physics Laboratory I | 1 |
| PHYS 214 or 210B Physics II | 3-4 |
| PHYS 216 or 209B Physics Laboratory II | 1 |
| Total units in supporting courses | 13-15 |

GE Courses

| | |
|-----------------------------|----|
| CHEM 120AB | 4 |
| CHEM 125AB or CHEM 115AB | 6 |
| MATH 161 | 3 |
| Others | 37 |

* Quantitative Analysis (CHEM 255) is not required for students who have completed CHEM 125 A & B, but is required for students who took CHEM 115AB. Students should replace these four units by completing the challenge by exam form upon completion of the series.

| | |
|----------------------------------|--------------|
| Total units in GE courses | 50 |
| Electives | 21-23 |
| Total units to graduate | 120 |

Minor in Chemistry

Completion of the following SSU courses (or their equivalent): General Chemistry 115A and B (10 units), Quantitative Analysis 255 (4 units), Organic Chemistry 335A (3 units), and 336A (2 units), plus at least two additional upper-division classes for a total of 6 units. These additional upper-division classes must be taken in residence at SSU. Up to six units in chemistry 115A/B may count toward the General Education requirements in area B including the laboratory requirement. CHEM 125A/B may be substitute for the combined requirement of 115A/B and 255.

Secondary Education Teaching Credential Preparation

Chemistry students must demonstrate competence in the natural sciences by passing the subject matter examination required by the California Commission on Teacher Credentialing. One part of the examination will test breadth of knowledge in biology, chemistry, physics, astronomy, and geology. Another part of the examination will test depth of knowledge in a particular area, such as chemistry. The B.A. or B.S. degree in chemistry is recommended to prepare for the part of the examination that tests depth of knowledge in chemistry. For more information, please contact the Chemistry Department office, Darwin Hall 300, (707)664-2119.

Sample Four-Year Program for Bachelor of Science in Chemistry

FRESHMAN YEAR: 31 Units

Fall Semester (15 Units)

CHEM 125A (5)
MATH 161 (4)
CHEM 120A (A3) (2)
GE (4)

Spring Semester (16 Units)

CHEM 125B (5)
MATH 211 (4)
PHYS 114 (4)
PHYS 116 (1)
CHEM 120B (A3) (2)

SOPHOMORE YEAR: 30 Units

Fall Semester (14 Units)

CHEM 335A/336A (5)
MATH 261 (4)
PHYS 214 (4)
PHYS 216 (1)

Spring Semester (16 Units)

CHEM 335B (3)
CHEM 336B (2)
CHEM 255 (4)*
GE (7)

JUNIOR YEAR: 29 Units

Fall Semester (15 Units)

CHEM 445 (3)
CHEM 310A (3)
CHEM 315 (1)
GE (8)

Spring Semester (14 Units)

CHEM 310B (3)
CHEM 316 (2)
CHEM Elective (3)
GE (6)

SENIOR YEAR: 30 Units

Fall Semester (14 Units)

CHEM 275 (2)
CHEM 401 (3)
CHEM Elective (3)
GE (6)

Spring Semester (16 Units)

CHEM 325 (3)
CHEM 402 (3)
CHEM 497 (1)
GE (6)
Elective (3)

TOTAL SEMESTER UNITS: 120

* Quantitative Analysis (CHEM 255) is not required for students who have completed CHEM 125 A & B. Students should replace these four units by completing the challenge by exam form upon completion of the series.

Sample Four-Year Program for Bachelor of Science in Biochemistry

FRESHMAN YEAR: 30 Units

| <i>Fall Semester (15 Units)</i> | <i>Spring Semester (15 Units)</i> |
|---------------------------------|-----------------------------------|
| CHEM 125A (5) | CHEM 125B (5) |
| CHEM 120A (2) | CHEM 120B (2) |
| MATH 161 (4) | PHYS 210A (3) |
| GE (4) | PHYS 209A (1) |
| | MATH 211 (4) |

SOPHOMORE YEAR: 29Units

| <i>Fall Semester (13 Units)</i> | <i>Spring Semester (16 Units)</i> |
|---------------------------------|-----------------------------------|
| CHEM 335A (3) | CHEM 335B (3) |
| CHEM 336A (2) | CHEM 255 (4)* |
| PHYS 210B (3) | BIOL 321 (4) |
| PHYS 209B (1) | BIOL 325 (1) |
| BIOL 130 (4) | GE (4) |

JUNIOR YEAR: 30 Units

| <i>Fall Semester (14 Units)</i> | <i>Spring Semester (14-16 Units)</i> |
|---------------------------------|--------------------------------------|
| CHEM 310A (3) | CHEM 310B (3) |
| CHEM 315 (1) | CHEM 316 (2) |
| CHEM 445 (3) | CHEM 446 (3) |
| GE (3) | GE (4) |
| GE (4) | Elective (2-4) |

SENIOR YEAR: 31 Units

| <i>Fall Semester (16 Units)</i> | <i>Spring Semester (15 Units)</i> |
|---------------------------------|-----------------------------------|
| CHEM 275 (2) | CHEM 497 (1) |
| CHEM 401 (3) | CHEM 325 (3) |
| GE (3) | CHEM 441 (3) |
| GE (4) | BIOL or CHEM UD Elective (4) |
| GE (4) | GE (4) |

TOTAL SEMESTER UNITS: 120

* Quantitative Analysis (CHEM 255) is not required for students who have completed CHEM 125 A & B. Students should replace these four units by completing the challenge by exam form upon completion of the series.

Sample Four-Year Program for Bachelor of Arts in Chemistry

FRESHMAN YEAR: 30 Units

| <i>Fall Semester (15 Units)</i> | <i>Spring Semester (15 or 16 Units)</i> |
|---------------------------------|---|
| CHEM 125A (5) | CHEM 125B (5) |
| MATH 161 (4) | MATH 211 (4) |
| GE (4) | PHYS 210 A (3) |
| CHEM 120A (A3) (2) | PHYS 209A (1) |
| | CHEM 120B (A3) (2) |

SOPHOMORE YEAR: 28 Units

| <i>Fall Semester (13-17 Units)</i> | <i>Spring Semester (13 Units)</i> |
|------------------------------------|-----------------------------------|
| CHEM 335A/336A (5) | CHEM 335B (3) |
| PHYS 210B (3) | CHEM 336B (2) |
| PHYS 209B (1) | CHEM 255 (4)* |
| GE (3) | GE (4) |
| Elective (1-4) | |

JUNIOR YEAR: 31 Units

| <i>Fall Semester (16 Units)</i> | <i>Spring Semester (15 Units)</i> |
|---------------------------------|-----------------------------------|
| CHEM 310A (3) | CHEM 310B (3) |
| GE (10) | GE (12) |
| Elective (3) | |

SENIOR YEAR: 31 Units

| <i>Fall Semester (15 Units)</i> | <i>Spring Semester (16 Units)</i> |
|---------------------------------|-----------------------------------|
| CHEM 275 (2) | CHEM 497 (1) |
| CHEM 401 (3) | CHEM 325 (3) |
| Chemistry Elective (3) | Elective (12) |
| GE (4) | |
| Elective (3) | |

TOTAL SEMESTER UNITS: 120

* Quantitative Analysis (CHEM 255) is not required for students who have completed CHEM 125 A & B. Students should replace these four units by completing the challenge by exam form upon completion of the series.

Chemistry Electives: CHEM 315, 316, 336B, 402, 441, 445, 446, or 496