Program
BS in Chemistry
Options in:
  Biochemistry
  Professional Chemistry
American Chemical Society
Certificate in Chemistry
Minor in Chemistry
Pre-professional Programs:
  Dentistry
  Medicine
  Optometry
  Pharmacy
  Pre-physical Therapy
Single Subject Teaching
  Credential in Science

Behind the scenes in almost any area — medicine, transportation, agriculture, the environment, computing, entertainment, law, psychology, and the arts — is an army of chemists and chemical technicians who help prepare materials, analyze evidence, create new substances, and answer the “What is it?” questions that are presented each day. They help clean the environment, cure the ill, convict the guilty, and keep us fed, clothed, sheltered, and healthy. And we will continue to need more of these kinds of services to help clean our environment, defeat the next epidemic, and improve our energy efficiency.

The B.S. in Chemistry includes a broad selection of courses in the sciences and in mathematics that provides an excellent background for careers in a wide range of fields or preparation for professional schools, especially medicine (including dentistry and pharmacy).

Upon completion of the series of courses prescribed by American Chemical Society guidelines, students may be certified as professional chemists and awarded the American Chemical Society Certificate in Chemistry.

Faculty and Facilities
The Committee on Professional Training of the American Chemical Society has approved the chemistry faculty, facilities, and curriculum. This is a clear statement of the quality of our program and our graduates to anyone in the field.

There are eleven permanent faculty with Ph.D.’s in chemistry, representing the major areas of the science. The small size of most major courses assures students of friendly, close contact with the faculty allowing for hands-on learning of techniques and instrumentation. Short-term research projects with faculty are accessible to all chemistry students. The Department of Chemistry is housed in the Physical Science Building and includes nine laboratories and a number of specialized instrument and project rooms.

Career Outlook
A bachelor’s degree in chemistry is the minimum requirement for starting a career as a chemist. Graduate training is necessary for most research and college teaching positions. Nearly two-fifths of all chemists are involved in research and development — extending scientific knowledge and creating new products. Nearly one-fifth work in production and inspection activities. Others work as analysts in forensics or environmental laboratories, professors in colleges and universities, as consultants in industry and government agencies, and marketing or sales representatives.

Growth in demand for industrial products (plastics, man-made fibers, pharmaceuticals, and fertilizers), the recognition of the need for pollution control, and improved health care programs will increase opportunities for chemists. In addition, new and more efficient fuels or fuel cells must be developed to stem energy shortages. Larger enrollments in chemistry education in the future will increase the need for chemists to teach at universities, community colleges, and high schools.
**Chemistry**

**THE BACHELOR OF SCIENCE IN CHEMISTRY**

**Total Course Requirements**
for the Bachelor's Degree: 128 units

See “Requirements for the Bachelor’s Degree” in The University Catalog for complete details on general degree requirements. A minimum of 40 units, including those required for the major, must be upper division.

A suggested Major Academic Plan (MAP) has been prepared to help students meet all graduation requirements within four years. Please request a plan from your major adviser or view it and other current advising information on the CSU, Chico Web.

**General Education Requirements:** 48 units

See “General Education Requirements” in The University Catalog and The Class Schedule for the most current information on General Education Requirements and course offerings. The course requirements marked below with an asterisk (*) may also be applied toward General Education.

BIOL 151 may be used to fulfill General Education Breadth Area B2 for the Option in Biochemistry or the Option in Professional Chemistry.

**Cultural Diversity Course Requirements:** 6 units

See “Cultural Diversity” in The University Catalog. Most courses taken to satisfy these requirements may also apply to General Education.

**American Institutions Requirement:** 6 units

See the “American Institutions Requirement” under “Bachelor’s Degree Requirements.” This requirement is normally fulfilled by completing HIST 130 and POLS 135. Courses used to satisfy this requirement do not apply to General Education.

**Literacy Requirement:**

See “Mathematics and Writing Requirements” in The University Catalog. Writing proficiency in the major is a graduation requirement and may be demonstrated through satisfactory completion of a course in your major which has been designated as the Writing Proficiency (WP) course for the semester in which you take the course. Students who earn below a C- are required to repeat the course and earn a C- or better to receive WP credit. See The Class Schedule for the designated WP courses for each semester. You must pass ENGL 130 (or its equivalent) with a grade of C- or better before you may register for a WP course.

**Course Requirements for the Major:** 70-78 units

The following courses, or their approved transfer equivalents, are required of all candidates for this degree. Additional required courses, depending upon the selected option or advising pattern, are outlined following the degree core program requirements.

**The Option in Professional Chemistry:** 70-72 units

The Option in Biochemistry: 76-78 units

**Lower-Division Core:** 36 units

Mathematics Requirement: 12 units

3 courses required:
MATH 120 Analytic Geometry and Calculus 4.0 FS
Prerequisites: Completion of ELM requirement; both MATH 118 and MATH 119 (or high school equivalent); a score that meets department guidelines on a department administered calculus readiness exam.
MATH 121 Analytic Geometry and Calculus 4.0 FS
Prerequisites: Completion of ELM requirement; MATH 120 with a grade of C- or higher.
MATH 220 Analytic Geometry and Calculus 4.0 FS
Prerequisites: Completion of ELM requirement; MATH 121 with a grade of C- or higher.

Physics Requirement: 12 units

3 courses required:
PHYS 204A Mechanics 4.0 FS
Prerequisites: High school physics or faculty permission. Concurrent enrollment in or prior completion of MATH 121 (second semester of calculus) or equivalent.
PHYS 204B Electricity and Magnetism 4.0 FS
Prerequisites: MATH 121, PHYS 204A with a grade of C- or higher.
PHYS 204C Heat/Wave Motion/Sound/Light 4.0 FS
Prerequisites: MATH 121, PHYS 204A with a grade of C- or higher.

MATH 220 Analytic Geometry and Calculus 4.0 FS
Prerequisites: Completion of ELM requirement; MATH 121 with a grade of C- or higher.

**Upper-Division Core:** 17 units

7 courses required:

CHEM 300 The Chemical Literature 1.0 FA WP
Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher, CHEM 270.
CHEM 320 Quantitative Analysis 4.0 FS
Prerequisites: CHEM 312.
CHEM 331 Physical Chemistry 3.0 FA
Prerequisites: CHEM 320, MATH 220, PHYS 204B, PHYS 204C.
CHEM 332 Physical Chemistry 3.0 SP
Prerequisites: CHEM 331.
CHEM 370 Organic Chemistry 3.0 FS
Prerequisites: CHEM 270.
CHEM 370M Organic Chemistry Laboratory 2.0 SP
Prerequisites: Concurrent enrollment in or prior completion of CHEM 370.
CHEM 400 Senior Seminar in Chemistry 1.0 SP

**Major Option Course Requirements:** 17-25 units

The following courses, or their approved transfer equivalents, are required dependent upon the option chosen. Students must select one of the following options for completion of the major course requirements.

**THE OPTION IN PROFESSIONAL CHEMISTRY:** 17-19 units

8 courses required:

CHEM 361 Intermediate Inorganic Chem 2.0 FA
Prerequisites: CHEM 320, MATH 220, PHYS 204B, PHYS 204C.
CHEM 362 Intermediate Inorganic Chem 2.0 SP
Prerequisites: CHEM 361.
CHEM 381 Integrated Chemistry Lab I 2.0 FA
Prerequisites: Concurrent enrollment in or prior completion of CHEM 331 and CHEM 361.
CHEM 382 Integrated Chemistry Lab II 2.0 SP
Prerequisites: CHEM 361, CHEM 361, CHEM 381; concurrent enrollment in or prior completion of CHEM 331.
Corequisites: CHEM 382R.
CHEM 382R Integrated Chem Discussion 1.0 SP
Prerequisites: CHEM 331, CHEM 361, CHEM 381; concurrent enrollment in or prior completion of CHEM 332.
CHEM 420 Instrumental Analysis 2.0 SP
Prerequisites: CHEM 332, CHEM 382.
Corequisites: CHEM 420R.
CHEM 420R Instrumental Analysis Lab 2.0 SP
Prerequisites: CHEM 381, CHEM 382.
Corequisites: CHEM 420.
CHEM 451 Biochemistry 3.0 SP
Prerequisites: CHEM 370.

1-3 units selected from:

CHEM 390 Special Topics 1.0-3.0 FS
CHEM 399 Special Problems 1.0-3.0 FS
Prerequisites: CHEM 312, faculty permission.
CHEM 435 Chemical Thermodynamics 3.0 FS
Prerequisites: CHEM 332.
CHEM 452 Biochemistry 3.0 SP
Prerequisites: CHEM 451.
CHEM 455L Biochemistry Laboratory 2.0 FS
Prerequisites: CHEM 320, CHEM 451; CHEM 370L or CHEM 370M.
CHEM 473 Synthetic Organic Chemistry 1.0-3.0 FA
Prerequisites: CHEM 370, CHEM 370L, or CHEM 370M.
CHEM 474 Physical Organic Chemistry 3.0 SP
Prerequisites: CHEM 332, CHEM 370.
CHEM 475 Advanced Organic Laboratory 2.0 FS
Prerequisites: CHEM 370.
CHEM 477 Seminar Organic Spectroscopy 1.0 FS
Prerequisites: Concurrent enrollment in or prior completion of CHEM 370.
CHEM 490 Research in Chemistry 1.0-2.0 FS
Prerequisites: CHEM 332.
CHEM 491 Research Project 3.0 FA
Prerequisites: Open by invitation to chemistry majors with a GPA of 3.0 or higher; faculty permission.
CHEM 492 Research Project 3.0 SP
Prerequisites: CHEM 491. Not open to students who have completed CHEM 499H; faculty permission.

CHEM 495 Selected Topics in Chemistry 1.0-3.0 FS
Prerequisites: CHEM 332, CHEM 361, CHEM 382, CHEM 420.

CHEM 496 Selected Topics in Chemistry 1.0-3.0 SP
Prerequisites: CHEM 331, CHEM 370, CHEM 451.

CHEM 499H Honors Research Project 3.0 FS WP
Prerequisites: ENGL 130 or its equivalent; with a grade of C or higher. CHEM 320, CHEM 331, CHEM 332, CHEM 370M, MATH 220, PHYS 204A, PHYS 204B, PHYS 204C; faculty permission.

The THE OPTION IN BIOCHEMISTRY: 23-25 units

**6 courses required:**

**BIOL 100** Biological Principles 4.0 FS
Prerequisites: Recommend CHEM 111 or concurrent enrollment.

**BIOL 211** General Microbiology 4.0 FS
Prerequisites: A college course in biology and in general chemistry.

**BIOL 360** Genetics 4.0 FS
Prerequisites: BIOL 152.

**CHEM 451** Biochemistry 3.0 FS
Prerequisites: CHEM 370.

**CHEM 452** Biochemistry 3.0 SP
Prerequisites: CHEM 451.

**CHEM 455L** Biochemistry Laboratory 2.0 FS
Prerequisites: CHEM 320, CHEM 451; CHEM 370L or CHEM 370M.

**1 course selected from:**

**BIOL 400** Fundamentals of Ecology 4.0 FS
Prerequisites: BIOL 152 or faculty permission. Some taxonomic background is recommended.

**BIOL 410** Cell and Molecular Biology 4.0 FA
Prerequisites: BIOL 152.

**BIOL 412** Bacteriological Physiology 4.0 SP
Prerequisites: BIOL 211; BIOL 360; CHEM 270. CHEM 451 is recommended.

**BIOL 414** Plant Physiology 4.0 FS
Prerequisites: BIOL 108 or BIOL 152; BIOL 209; CHEM 108 or CHEM 270; or faculty permission.

**BIOL 416** Vertebrate Physiology 4.0 FS
Prerequisites: BIOL 152; CHEM 108 or CHEM 270. Strongly recommended: BIOL 210.

**BIOL 417** Cell Physiology 3.0 SP
Prerequisites: BIOL 152; CHEM 108 or CHEM 270.

**BIOL 464** Medical Genetics 3.0 SP
Prerequisites: BIOL 360.

**BIOL 466** Immunology 4.0 SP
Prerequisites: BIOL 152.

**BIOL 470** Medical Bacteriology 5.0 FA
Prerequisites: BIOL 211; BIOL 466; CHEM 270. Immunization against tetanus and diphtheria required.

**BIOL 472** Microbial Genetics 4.0 FA
Prerequisites: BIOL 360; BIOL 211 is recommended.

**BIOL 474** Food and Industrial Microbiology 3.0 SP
Prerequisites: BIOL 211, CHEM 270.

**BIOL 476** General Virology 4.0 F2
Prerequisites: BIOL 152. Recommended: BIOL 211.

**CHEM 347 and CHEM 425** are strongly recommended as additional electives.

**Electives Requirement:**

To complete the total units required for the bachelor's degree, select additional elective courses from the total university offerings. You should consult with an adviser regarding the selection of courses which will provide breadth to your university experience and possibly apply to a supportive second major or minor.

**Grading Requirement:**

All courses taken to fulfill major course requirements must be taken for a letter grade except those courses specified by the department as Credit/No Credit grading only.

**Advising Requirement:**

Advising is mandatory for all majors in this degree program. Consult your department chair or undergraduate adviser for specific information.

**Honors in the Major**

Honors in the Major is a program of independent work in your major. It involves 6 units of honors course work completed over two semesters. Your Honors work will be recognized at your graduation, on your per¬manent transcripts, and on your diploma. It is often accompanied by let¬ters of commendation from your mentor in the department or the depart¬ment chair. Most importantly, however, the Honors in the Major program allows you to work closely with a faculty mentor in your area of interest on an original performance or research project. This year-long collaboration allows you to work in your field at a professional level and culminates in a public presentation of your work. Students sometimes take their projects beyond the university for submission in professional journals, presentation at conferences, or competition in shows; such experience is valuable for graduate school and later professional life. Some common features of Honors in the Major program are:

1. You must take 6 units of Honors in the Major course work. At least 3 of these 6 units are independent study (499H) as specified by your department. You must complete each class with a minimum grade of B.
2. You must have completed 9 units of upper-division course work or 21 overall units in your major before you can be admitted to Honors in the Major. Check the requirements carefully, as there may be specific courses that must be included in these units.
3. Your cumulative GPA should be at least 3.5 or within the top 5 percent of majors in your department.
4. Your GPA in your major should be at least 3.5 or within the top 5 percent of majors in your department.
5. Most students apply for or are invited to participate in Honors in the Major during the second semester of their junior year. Then they complete the 6 units of course work over the two semesters of their senior year.
6. Your honors work culminates with a public presentation of your Honors project.

While Honors in the Major is part of the Honors Program, each department administers its own program. Please contact your major department or major adviser for further information.

**American Chemical Society Certificate in Chemistry**

Course Requirements for the Certificate: 72 units

The following courses, or their approved transfer equivalents, are required of all candidates for this certificate.

Students who complete this program will be awarded a degree in chemistry which will be certified by the American Chemical Society as well as a certificate from CSU, Chico. (Note: ACS requirements change only rarely, but interested students should verify requirements with the Chair of the Department of Chemistry.) Current requirements include the 53-unit core required in the chemistry major and the following additional 20 units. These courses also satisfy the Option in Professional Chemistry.

**8 courses required:**

**CHEM 361** Intermediate Inorganic Chem 2.0 FA
Prerequisites: CHEM 320, MATH 220, PHYS 204B, PHYS 204C.

**CHEM 362** Intermediate Inorganic Chem 2.0 SP
Prerequisites: CHEM 361.

**CHEM 381** Integrated Chemistry Lab I 2.0 SP
Prerequisites: Concurrent enrollment in or prior completion of CHEM 331 and CHEM 361.

**CHEM 382** Integrated Chemistry Lab II 2.0 SP
Prerequisites: CHEM 331, CHEM 361, CHEM 381; concurrent enrollment in or prior completion of CHEM 331.

**CHEM 382R** Integrated Chemistry Discussion 1.0 SP
Prerequisites: CHEM 331, CHEM 361, CHEM 381; concurrent enrollment in or prior completion of CHEM 332.

**CHEM 420** Instrumental Analysis 2.0 FA
Prerequisites: CHEM 332, CHEM 382.

**CHEM 420L** Instrumental Analysis Lab 2.0 FA
Prerequisites: CHEM 381, CHEM 382.

**CHEM 451** Biochemistry 3.0 SP
Prerequisites: CHEM 370.

**3 units selected from:**

**CHEM 473** Synthetic Organic Chemistry 1.0-3.0 FA
Prerequisites: CHEM 370, CHEM 375, or CHEM 370M.

**CHEM 474** Physical Organic Chemistry 3.0 SP
Prerequisites: CHEM 332, CHEM 370.

**CHEM 475** Advanced Organic Laboratory 2.0 FS
Prerequisites: CHEM 370.

**CHEM 452** Biochemistry 3.0 SP
Prerequisites: CHEM 451.

**CHEM 455L** Biochemistry Laboratory 2.0 FS
Prerequisites: CHEM 320, CHEM 451; CHEM 370L or CHEM 370M.

**CHEM 490** Research in Chemistry 1.0-2.0 FS
Prerequisites: CHEM 332.

**CHEM 491** Research Project 3.0 FA
Prerequisites: Open by invitation to chemistry majors with a GPA of 3.0 or higher; faculty permission.

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CHEM 492 Research Project 3.0 SP
Prerequisites: CHEM 491. Not open to students who have completed CHEM 499H; faculty permission.

CHEM 499H Honors Research Project 3.0 FS WP
Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher, CHEM 320, CHEM 331, CHEM 332, CHEM 370M, MATH 220, PHYS 204A, PHYS 204B, PHYS 204C; faculty permission.

With permission of the Chemistry Department, other courses may be substituted.

PRE-PROFESSIONAL PROGRAMS

Pre-Dentistry: 32 units recommended

Entrance into dental school requires from two to four years of pre-dental training. Ordinarily a pre-dental student should plan on pursuing a bachelor's degree program. It is not necessary that this degree be in one of the sciences.

Details about entrance requirements differ considerably from one dental school to another. Further information should be sought from one of the pre-dental advisors and from the booklet entitled, Entrance Requirements of American Dental Schools.

The following list represents the California State University equivalent of the requirements and recommendations common to practically all of the American Dental Schools.

Recommended Courses

BIOL 108 Principles of Biology 3.0 FS *
Prerequisites: High school biology and chemistry.

BIOL 210 General Zoology 3.0 FS
Prerequisites: BIOL 152 or faculty permission.

CHEM 111 General Chemistry 4.0 FS *
Prerequisites: Second-year high school algebra; one year high school chemistry. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)

CHEM 112 General Chemistry 4.0 FS
Prerequisites: CHEM 111.

CHEM 270 Organic Chemistry 4.0 FS
Prerequisites: CHEM 112.

CHEM 370 Organic Chemistry 3.0 FS
Prerequisites: CHEM 270.

ENGL 130 Academic Writing 3.0 FS *
Prerequisites: English Placement Test.

PHYS 202A General Physics 4.0 FS *
Prerequisites: High school physics or faculty permission. High school trigonometry and second-year high school algebra or equivalent (MATH 051 and MATH 118 at CSU, Chico).

PHYS 202B General Physics 4.0 FS
Prerequisites: PHYS 202A.

Pre-Medicine

It is recommended that pre-medical students plan to obtain a degree in a field of science, such as chemistry or biology. While students may apply for admission to medical school any time after their junior year, the majority of those admitted have completed a four-year degree, and a sizable number are admitted only after additional graduate work. The BS in Chemistry, therefore, is also appropriate for those seeking advanced training in graduate schools or employment in fields related to medicine. See also the Pre-Medicine program under Biological Sciences.

Lower-Division Courses

BIOL 151 General Biological Principles 4.0 FS
Prerequisites: Recommend CHEM 111 or concurrent enrollment.

BIOL 152 Biological Principles 4.0 FS
Prerequisites: BIOL 151 or concurrent enrollment.

CHEM 111 General Chemistry 4.0 FS *
Prerequisites: Second-year high school algebra; one year high school chemistry. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)

CHEM 112 General Chemistry 4.0 FS
Prerequisites: CHEM 111.

CHEM 270 Organic Chemistry 4.0 FS
Prerequisites: CHEM 112.

CHEM 370 Organic Chemistry 4.0 FS
Prerequisites: CHEM 270.

ENGL 130 Academic Writing 3.0 FS *
Prerequisites: English Placement Test.

PHYS 202A General Physics 4.0 FS *
Prerequisites: High school physics or faculty permission. High school trigonometry and second-year high school algebra or equivalent (MATH 051 and MATH 118 at CSU, Chico).

PHYS 202B General Physics 4.0 FS
Prerequisites: PHYS 202A.

Upper-Division Courses

CHEM 320 Quantitative Analysis 4.0 FS
Prerequisites: CHEM 112.

CHEM 370 Organic Chemistry 3.0 FS
Prerequisites: CHEM 270.

CHEM 370L Organic Chem Laboratory 1.0 FS
Prerequisites: CHEM 370 may be taken as a prerequisite or concurrently with CHEM 370L.

CHEM 451 Biochemistry 3.0 FS
Prerequisites: CHEM 370.

Recommended Upper-Division Electives

BIOL 360 Genetics 4.0 FS
Prerequisites: BIOL 152.

BIOL 416 Vertebrate Physiology 4.0 FS
Prerequisites: BIOL 152, CHEM 108 or CHEM 270. Strongly recommended: BIOL 210.

BIOL 426 Embryology 4.0 SP
Prerequisites: BIOL 152; BIOL 210 or faculty permission.

BIOL 430 Comparative Anat: Vertebrates 4.0 FA
Prerequisites: BIOL 152, BIOL 210.

Pre-Optometry

The requirements for optometry schools vary widely. The student should see the pre-optometry advisor in the Chemistry Department and the catalog of the school of his/her choice. The prospective student is encouraged to consult the Department Chair for further information.

Pre-Pharmacy

The requirements for pharmacy schools vary widely. The student should see the pre-pharmacy advisor in the Chemistry Department and the catalog of the school of his/her choice. The prospective student is encouraged to consult the Department Chair for further information.

Pre-Physical Therapy

See the listings under Biological Sciences.

Forensic Science and Graduate Programs in Criminalistics

Entry-level employment and graduate programs in criminalistics commonly require a major in one of the physical or biological sciences, including a year of general chemistry and a course in quantitative analysis. Please see the Anthropology section for a program in Forensic Identification.

THE MINOR IN CHEMISTRY

Course Requirements for the Minor: 23 units

The following courses, or their approved transfer equivalents, are required of all candidates for this minor.

Lower-Division Courses: 12 units

3 courses required:

CHEM 111 General Chemistry 4.0 FS *
Prerequisites: Second-year high school algebra; one year high school chemistry. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)

CHEM 112 General Chemistry 4.0 FS
Prerequisites: CHEM 111.

CHEM 270 Organic Chemistry 4.0 FS
Prerequisites: CHEM 112.

Upper-Division Courses: 11 units

3 courses required:

CHEM 320 Quantitative Analysis 4.0 FS
Prerequisites: CHEM 112.

CHEM 370 Organic Chemistry 3.0 FS
Prerequisites: CHEM 270.

CHEM 370L Organic Chem Laboratory 1.0 FS
Prerequisites: CHEM 370 may be taken as a prerequisite or concurrently with CHEM 370L.

3 units selected from:

CHEM 300 The Chemical Literature 1.0 FA WP
Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher, CHEM 270.

CHEM 331 Physical Chemistry 3.0 FA
Prerequisites: CHEM 320, MATH 220, PHYS 204B, PHYS 204C.

CHEM 347 Radiation/Radiospecies 1.0-3.0 FS
Prerequisites: Completion of 4 units of physics or physical science and 1 units of chemistry.

CHEM 360 Descriptive Inorganic Chem 3.0 Inq
Prerequisites: CHEM 112.

CHEM 398 Special Topics 1.0-3.0 FS
THE SINGLE SUBJECT TEACHING CREDENTIAL IN SCIENCE WITH A CONCENTRATION IN CHEMISTRY

Course Requirements for the Single Subject Teaching Credential: 83-88 units

In most majors, candidates for this credential will normally fulfill the single subject matter preparation program by completing the appropriate education option in the major. Any exceptions to this procedure are noted at the end of this section. In addition to the single subject matter preparation program, completion of an additional professional education program is required to qualify for a California teaching credential. Professional education (credential) programs are available through the School of Education. For prerequisites and other admission requirements to professional education (credential) programs, see the “Education” chapter of this catalog.

Your departmental credential adviser is responsible for verifying that the subject matter preparation program has been completed. If you are interested in obtaining a teaching credential, confer with your departmental credential adviser early in your university career. Departmental credential advisers can assist you in planning an educational program that meets both major and credential requirements.

Subject matter preparation requirements are governed by federal and state legislative action and approval of the California Commission on Teacher Credentialing. Requirements may change between catalogs. Please consult with your departmental credential adviser for current information.

The BS in Chemistry with either option described above and the additional courses listed below fulfill all requirements for the single subject matter preparation program in science with a concentration in chemistry. 4 courses required:

- **BIOL 151 Biological Principles** 4.0 FS
  Prerequisites: Recommend CHEM 111 or concurrent enrollment.

- **BIOL 152 Biological Principles** 4.0 FS
  Prerequisites: BIOL 151; recommend CHEM 112 or concurrent enrollment.

- **GEOS 102 Physical Geology** 3.0 FS
  Prerequisites: High school chemistry or physics is recommended; students with no previous science courses are advised to enroll in GEOS 101. No college credit for those who have passed GEOS 101.

- **GEOS 300 Earth System Science** 3.0 FA WP
  Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher; CHEM 107 or equivalent; PHYS 202A; PHYS 202B.

The Faculty

Donald B. Alger, 1968, Chair, Professor, PhD, WA State U.
David B. Ball, 1974, Professor, PhD, UCSB.
Marvin C. Burnett, 1959, Professor Emeritus, PhD, U Missouri.
Barbara O. Mejia, 1973, Professor Emerita, PhD, UC Davis.
Alfredo J. Rodriguez, 1998, Assistant Professor, PhD, UCSB.
Christopher J. Nichols, 1999, Assistant Professor, PhD, UCLA.
James M. Postma, 1982, Professor, PhD, UC Davis.
Rodney H. Quacchia, 1969, Professor Emeritus, PhD, U of WA.

Floyd E. Reese, 1956, Professor Emeritus, PhD, Purdue U.
Eugene D. Thomas, 1965, Professor Emeritus, PhD, Ohio St U.
Grover C. Willis, 1957, Professor Emeritus, PhD, U Oregon.

Chemistry Course Offerings

Please see the section on “Course Description Symbols and Terms” in *The University Catalog* for an explanation of course description terminology and symbols, the course numbering system, and course credit units. All courses are lecture and discussion and employ letter grading unless otherwise stated. Some prerequisites may be waived with faculty permission. Many syllabi are available on the Chico Web.

**CHEM 100 Chemistry and Current Issues** 3.0 Fa/Spr

Designed for non-science majors, this course will examine contemporary science issues and use this context to provide an understanding of the basic chemical processes that govern our lives. Students will learn how scientists study chemical processes, decipher them, and develop them to meet our needs. The importance of the relationship between science and technology and the public’s understanding of these issues will also be explored. 2.0 hours lecture, 2.0 hours activity. This is an approved General Education course. Formerly CHEM 004.

**CHEM 105 Nursing Chemistry** 4.0 Fall

Prerequisites: Previous chemistry course recommended.

A brief introduction of the general principles of chemistry specifically related to nursing, followed by a brief survey of organic and biochemistry with an emphasis on practical applications to the nursing profession. A completely online course for experienced nurses completing a BS in Nursing. Formerly CHEM 026.

**CHEM 107 General Chemistry for Applied Sciences** 4.0 Fa/Spr

Prerequisites: Intermediate Algebra.

A survey of the principles of chemistry, primarily for students in agriculture, industry and technology, and pre-nursing. 3.0 hours lecture, 3.0 hours laboratory. This is an approved General Education course. Formerly CHEM 027.

**CHEM 107X General Chemistry Problem Session** 1.0 Fa/Spr

Corequisites: CHEM 107.

Designed to supplement CHEM 107 with additional applications of general chemistry for applied sciences. Provides the student with the opportunity for additional assistance in developing problem-solving abilities. 2.0 hours activity. Credit/no credit grading only. Formerly CHEM 027X.

**CHEM 108 Organic Chemistry for Applied Sciences** 4.0 Fa/Spr

Prerequisites: CHEM 107 or CHEM 111.

A survey of organic chemistry primarily for agriculture, industry and technology, and pre-nursing students. 3.0 hours lecture, 3.0 hours laboratory. Formerly CHEM 028.

**CHEM 111 General Chemistry** 4.0 Fa/Spr

Prerequisites: Second-year high school algebra; one year high school chemistry. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)

The importance of the relationship between science, medical, and related professions. Atomic structure, chemical bonding, stoichiometry, periodic table, gases, solids, liquids, solutions, and equilibrium. 3.0 hours lecture, 3.0 hours laboratory. This is an approved General Education course. Formerly CHEM 037. CAN CHEM 2.

**CHEM 111X General Chemistry Problem Session** 1.0 Fa/Spr

Corequisites: CHEM 111.

Designed to supplement CHEM 111 with additional applications of general chemistry. Provides the student with the opportunity for additional assistance in developing problem-solving abilities. 2.0 hours activity. Credit/no credit grading only. Formerly CHEM 037X.

**CHEM 112 General Chemistry** 4.0 Fa/Spr

Prerequisites: CHEM 111.

A continuation of CHEM 111. Chemical energetics, rates of reaction, acids and bases, solubility, oxidation-reduction, and nuclear chemistry. 3.0 hours lecture, 3.0 hours laboratory. Formerly CHEM 038. CAN CHEM 4.

**CHEM 112X General Chemistry Problem Session** 1.0 Fa/Spr

Corequisites: CHEM 112.

Designed to supplement CHEM 112 with additional applications of general chemistry. Provides the student with the opportunity for additional assistance in developing problem-solving abilities. 2.0 hours activity. Credit/no credit grading only. Formerly CHEM 038X.

**CHEM 180 Scientific Glass Blowing** 1.0 Spring

Prerequisites: CHEM 107 or CHEM 111.

Instruction and practice in scientific glass-blowing. 3.0 hours laboratory. Credit/no credit grading only. Formerly CHEM 060.
CHEM 270 Organic Chemistry 4.0 Fa/Spr
Prerequisites: CHEM 112. An introduction to the theory and mechanism of organic reactions. To be followed by CHEM 370, which completes the two-semester sequence for science majors. 3.0 hours lecture, 3.0 hours laboratory. Formerly CHEM 270.

CHEM 300 The Chemical Literature 1.0 Fall
Prerequisites: CHEM 311 or its equivalent with a grade of C- or higher. CHEM 270. Supervised studies in individual literature searches, including the use of Chemical Abstracts, Chemische Central-Blatt, Patent Indexes, and other reference compilations. 2.0 hours activity. This is a writing proficiency, WP, course; a grade of C- or better certifies writing proficiency for majors. Formerly CHEM 201.

CHEM 320 Quantitative Analysis 4.0 Fa/Spr
Prerequisites: CHEM 112. Precision and accuracy in measurements, interpretation of data by statistical analysis, and development of good quantitative techniques. Analysis by gravimetry, titrimetry, potentiometry, chromatography, and spectrometry. 2.0 hours discussion, 6.0 hours laboratory. Formerly CHEM 105.

CHEM 331 Physical Chemistry 3.0 Fall
Prerequisites: CHEM 120, MATH 220, PHYS 204B, PHYS 204C. Thermodynamics of solids, liquids, gases, and solutions; electrochemistry, kinetics, chemical equilibria, introduction to quantum mechanics, and chemical statistics. Formerly CHEM 210A.

CHEM 332 Physical Chemistry 3.0 Spring
Prerequisites: CHEM 331. A continuation of CHEM 331. Formerly CHEM 210B.

CHEM 345 Toxicology 1.0 Spring
Prerequisites: CHEM 108 or CHEM 270. A brief introduction to the principles of toxicology and presentation of facts about current issues related to toxic substances. Formerly CHEM 203A.

CHEM 347 Radiation and Radioisotopes 1.0-3.0 Fa/Spr
Prerequisites: Completion of 4 units of physics or physical science and 5 units of chemistry. This course is a special topic offered for 1.0-3.0 units. You must register directly with a supervising faculty member. You may take this course more than once for a maximum of 3.0 units. Formerly CHEM 175.

CHEM 350 Introductory Biochemistry 3.0 Fa/Spr
Prerequisites: CHEM 108. A survey of biochemistry, principally for agriculture, child development, and nursing students. Normally not open to chemistry or biological sciences majors. Formerly CHEM 153.

CHEM 350L Introductory Biochemistry Laboratory 1.0 Fa/Spr
Prerequisites: Concurrent enrollment in or prior completion of CHEM 350. Fundamental laboratory studies and examination of the major classes of biological compounds. Principally for agriculture, child development, and nursing students. Normally not open to chemistry or biological sciences majors. 3.0 hours laboratory. Formerly CHEM 154.

CHEM 360 Descriptive Inorganic Chemistry 3.0 Inquire
Prerequisites: CHEM 112. A systematic study of inorganic substances, with emphasis on environmental aspects of the chemical behavior of the elements and their compounds. Formerly CHEM 140.

CHEM 361 Intermediate Inorganic Chemistry 2.0 Fall
Prerequisites: CHEM 120, MATH 220, PHYS 204B, PHYS 204C. Emphasis on description and theory of inorganic substances. Atomic structure, ionic and covalent bonding, acid-base concepts of inorganic substances, structure, bonding, thermodynamics, and reaction mechanisms of transition metal complexes. Formerly CHEM 214A.

CHEM 362 Intermediate Inorganic Chemistry 2.0 Spring
Prerequisites: CHEM 361. A continuation of CHEM 361. Formerly CHEM 214B.

CHEM 370 Organic Chemistry 3.0 Fa/Spr
Prerequisites: CHEM 270. Lecture continuation of the theory and mechanisms of organic reaction. Formerly CHEM 170.

CHEM 370L Organic Chemistry Laboratory 1.0 Fa/Spr
Prerequisites: CHEM 370 may be taken as a prerequisite or concurrently with CHEM 370. Laboratory continuation of the theory and mechanisms of organic reactions. Completes the two-semester sequence for science majors. 3.0 hours laboratory. Formerly CHEM 170L.

CHEM 370M Organic Chemistry Laboratory 2.0 Spring
Prerequisites: Concurrent enrollment in or prior completion of CHEM 370. Laboratory continuation of the theory and mechanisms of organic reactions. Completes the two-semester sequence for chemistry majors. 6.0 hours laboratory. Formerly CHEM 170M.

CHEM 381 Integrated Chemistry Laboratory I 2.0 Fall
Prerequisites: Concurrent enrollment in or prior completion of CHEM 331 and CHEM 361. Integrated application of concepts and techniques in analytical, inorganic, and physical chemistry. 6.0 hours laboratory. Formerly CHEM 215A.

CHEM 382 Integrated Chemistry Laboratory II 2.0 Spring
Prerequisites: CHEM 331, CHEM 361, CHEM 381; concurrent enrollment in or prior completion of CHEM 331. A continuation of CHEM 381. 6.0 hours laboratory. Formerly CHEM 215B.

CHEM 382R Integrated Chemistry Discussion 1.0 Spring
Prerequisites: CHEM 331, CHEM 361, CHEM 381; concurrent enrollment in or prior completion of CHEM 331. Integrated applications of concepts and techniques in analytical, inorganic, and physical chemistry. Formerly CHEM 215R.

CHEM 390 Special Problems in Science Education 1.0-3.0 Fa/Spr
Prerequisites: CHEM 111, faculty permission. This course is a supervised study in science outreach to K-14 schools and is offered for 1.0-3.0 units. You must register with a supervising faculty member. You may take this course more than once for a maximum of 3.0 units. Credit/no credit grading only. Formerly CHEM 190.

CHEM 398 Special Topics 1.0-3.0 Fa/Spr
This course is for special topics offered for 1.0-3.0 units. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See The Class Schedule for the specific topic being offered. Formerly CHEM 198.

CHEM 399 Special Problems 1.0-3.0 Fa/Spr
Prerequisites: CHEM 112, faculty permission. This course is an independent study of special problems and is offered for 1.0-3.0 units. You must register directly with a supervising faculty member. You may take this course more than once for a maximum of 6.0 units. Credit/no credit grading only. Formerly CHEM 199.

CHEM 400 Senior Seminar in Chemistry 1.0 Spring
Presentation and discussion of topics from chemical literature. 2.0 hours activity. Formerly CHEM 202.

CHEM 420 Instrumental Analysis 2.0 Fall
Prerequisites: CHEM 332, CHEM 382. Corequisites: CHEM 420L. Theory and procedures used in separations and instrumental analysis. Formerly CHEM 218.

CHEM 420L Instrumental Analysis Laboratory 2.0 Fall
Corequisites: CHEM 420, CHEM 421. Laboratory experience to accompany CHEM 420. 6.0 hours laboratory. Formerly CHEM 215C.

CHEM 425 Basic Instrumental Analysis 3.0 Spring
Prerequisites: CHEM 111, CHEM 112. Basic theory and practices of analytical instruments. Care and use of instruments; interpretation of results. 2.0 hours discussion, 2.0 hours activity. Formerly CHEM 255.

CHEM 435 Chemical Thermodynamics 3.0 Fa/Spr
Prerequisites: CHEM 332. Principles of thermodynamics, application to methods in chemical problems, introduction to the use of statistical thermodynamics, and calculations of thermodynamic functions from spectroscopic data. Formerly CHEM 290.

CHEM 440 Environmental Chemistry 3.0 Spring
Prerequisites: CHEM 112. A general study of the chemistry of the geosphere, hydrosphere, and atmosphere; special focus on the sources and fates of inorganic environmental pollutants. Formerly CHEM 204.

CHEM 445 Environmental Toxicology 2.0 Spring
Prerequisites: CHEM 108 or CHEM 270. A brief introduction to the principles of toxicology and presentation of facts about current issues related to toxic substances, with special expanded emphasis on environmental aspects of topics presented in CHEM 345. Formerly CHEM 203B.

CHEM 451 Biochemistry 3.0 Fa/Spr
Prerequisites: CHEM 451. A general study of the chemistry of biomolecules. Conformation and function of enzymes and other proteins; metabolism, energy generation, and storage; brief discussion of chemistry of DNA replication, transcription, and translation, and of important physiological processes. Formerly CHEM 250A.

CHEM 452 Biochemistry 3.0 Spring
Prerequisites: CHEM 451. Advanced topics in biochemistry. Biosynthesis of lipids, steroids, amino acids, and nucleotides. Comprehensive study of the chemical role of DNA and RNA in replication, transcription, protein synthesis, and viral activity. Formerly CHEM 250B.
CHEM 455L Biochemistry Laboratory 2.0 Fa/Spr
Prerequisites: CHEM 120, CHEM 451, CHEM 370L or CHEM 370M. Separation, identification, and/or analysis of biological materials by modern procedures, such as spectrophotometry, chromatography (gas, paper, TLC, column, ion exchange), electrophoresis, enzymology, fluorimetry, and high-speed centrifugation. 6.0 hours laboratory. Formerly CHEM 251.

CHEM 473 Synthetic Organic Chemistry 1.0-3.0 Fall
Prerequisites: CHEM 370, CHEM 370L or CHEM 370M. This course is offered for 1.0-3.0 units. Modern synthetic reactions and processes, with emphasis on rearrangement reactions, stereospecific methods, and synthetic design. You may take this course more than once for a maximum of 3.0 units. Formerly CHEM 228.

CHEM 474 Physical Organic Chemistry 3.0 Spring
Prerequisites: CHEM 332, CHEM 170. Resonance and orbital theory; mechanisms, kinetics, and thermodynamics of organic reactions. Formerly CHEM 227.

CHEM 475 Advanced Organic Laboratory 2.0 Fa/Spr
Prerequisites: CHEM 370. Application of modern techniques and spectroscopy in organic synthesis, product identification, reaction mechanisms, and natural product chemistry. 6.0 hours laboratory. Formerly CHEM 172.

CHEM 477 Seminar in Organic Spectroscopy 1.0 Fa/Spr
Prerequisites: Concurrent enrollment in or prior completion of CHEM 370. Solving problems in organic chemistry using NMR, IR, UV, and mass spectral analysis. Formerly CHEM 271.

CHEM 490 Research in Chemistry 1.0-2.0 Fa/Spr
Prerequisites: CHEM 332. This course is an independent study offered for 1.0-2.0 units. You must register directly with a supervising faculty member. Original laboratory or library investigation under individual faculty supervision. You may take this course more than once for a maximum of 4.0 units. Formerly CHEM 200.

CHEM 491 Research Project 3.0 Fall
Prerequisites: Open by invitation to chemistry majors with a GPA of 3.0 or higher; CHEM 332, CHEM 370, CHEM 451. A research project within chemistry or an interdisciplinary project which involves chemistry. Students will be involved with design, library, laboratory, and data analysis aspects of a research problem. Formerly CHEM 285A.

CHEM 492 Research Project 3.0 Spring
Prerequisites: CHEM 491. Not open to students who have completed CHEM 499H; faculty permission. A continuation of CHEM 491. Formerly CHEM 285B.

CHEM 495 Selected Topics in Physical, Analytical, and Inorganic Chemistry 1.0-3.0 Fa/Spr
Prerequisites: CHEM 332, CHEM 361, CHEM 382, CHEM 420. This course is a special topic offered for 1.0-3.0 units. You must register directly with a supervising faculty member. Presentation of topics of current interest, such as in Physical: theories of x-ray diffraction, spectroscopy, NMR, etc.; Inorganic: reaction mechanisms, non-aqueous solvents; Analytical: ion exchange, selective ion electrodes. Three-hour laboratory optional. You may take this course more than once for a maximum of 3.0 units. Formerly CHEM 280.

CHEM 496 Selected Topics in Organic and Biochemistry 1.0-3.0 Spring
Prerequisites: CHEM 331, CHEM 370, CHEM 451. This course is a special topic offered for 1.0-3.0 units. You must register directly with a supervising faculty member. Presentation of topics of current interest, such as in Organic: heterocyclic, polymer, organometallic, and natural product chemistry; Biochemistry: biosynthesis and metabolism, enzymes, biophysical chemistry, and bioenergetics. You may take this course more than once for a maximum of 2.0 units. Formerly CHEM 281.

CHEM 499H Honors Research Project 3.0 Fa/Spr
Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher, CHEM 320, CHEM 331, CHEM 332, CHEM 370M, MATH 220, PHYS 204A, PHYS 204B, PHYS 204C. Faculty permission. Open by invitation to chemistry majors who have a GPA of 3.5 or higher. Not open to students who have credit for CHEM 491 or CHEM 492. This is an "Honors in the Major" course. You may take this course more than once for a maximum of 6.0 units. This is a writing proficiency, WP, course; a grade of C- or better certifies writing proficiency for majors. ABC/no credit grading only. Formerly CHEM 299H.

CHEM 500 Selected Topics in Chemistry 1.0-3.0 Fa/Spr
Prerequisites: CHEM 331, CHEM 332, CHEM 370M, MATH 220, PHYS 204A, PHYS 204B, PHYS 204C. Faculty permission. This course is a special topic offered for 1.0-3.0 units. Students must register directly with a supervising faculty member. Presentation of selected topics of current interest, with emphasis on recent developments. You may take this course more than once for a maximum of 3.0 units. Formerly CHEM 300.

CHEM 610 Chemistry Seminar 1.0 Fa/Spr
Prerequisites: CHEM 331, CHEM 332, CHEM 370, MATH 220, PHYS 204A, PHYS 204B, PHYS 204C. Faculty permission. Presentation and discussion of reports on current literature and special studies in chemistry. Formerly CHEM 390.

CHEM 697 Independent Study 1.0-4.0 Fa/Spr
Prerequisites: Faculty permission. This course is a graduate-level independent study offered for 1.0-4.0 units. You must register directly with a supervising faculty member. Investigation involving scientific literature and laboratory or field experimentation. Maximum of 8 units of credit may be used for a master's degree. You may take this course more than once for a maximum of 6.0 units. Formerly CHEM 398.

CHEM 699T Master's Thesis 1.0-6.0 Fa/Spr
Prerequisites: CHEM 331, CHEM 332, CHEM 370, MATH 220, PHYS 204A, PHYS 204B, PHYS 204C. Faculty permission. This course is offered for 1.0-6.0 units. You must register directly with a supervising faculty member. You may take this course more than once for a maximum of 6.0 units. Formerly CHEM 399.