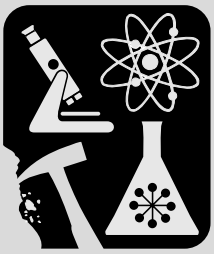
science subject matter program



biological sciences • chemistry • geosciences • physics

Program Description

The Science Subject Matter Program, with concentrations in either Biological Sciences, Chemistry, Geosciences or Physics, leads to a BA degree in the area of concentration and meets the latest subject matter requirements of the California Commission on Teacher Credentialing (CCTC) for subject-matter preparation of teachers of Natural Science at the general science level and in the student's area of concentration at the advanced high school level. In order to obtain a California Teaching Credential a program of professional Education preparation is required in addition to the Subject Matter Program. A typical credential might read, for example, SCIENCE: Concentration Chemistry.

Career Possibilities

Middle School Science Teacher • High School Teacher of General Science and Biology, Chemistry, Geoscience, or Physics depending on choice of major

Faculty

Biology: Nicholas Ewing, *Department Chair*; Sequoia Hall 202; (916) 278-6535; *nnewing@csus.edu* • Melanie Loo, *Advisor*; Sequoia Hall 414; (916) 278-6573; *mwloo@csus.edu*

Chemistry: Susan Crawford, *Department Chair*; Sequoia Hall 506; (916) 278-6684; *scrawford@csus.edu* • Londa Borer, *Advisor*; Sequoia Hall 514; (916) 278-6712; *borerl@csus.edu* • Jeffrey Paradis, *Advisor*; Sequoia Hall 444C; (916) 278-6987; *jparadis@csus.edu*

Geology: David Evans, *Department Chair*; Placer Hall 2003; (916) 278-6337; *david_evans@csus.edu* • Judi Kusnick, *Advisor;* Placer Hall 1019; (916) 278-4692; *kusnickje@csus.edu*

Physics: Michael Shea, *Advisor*; Sequoia Hall 230; (916) 278-6540; *sheamj@csus.edu* • Lynn Tashiro, *Advisor*; Sequoia Hall 436; (916) 278-7687; *tashirol@csus.edu*

College of Education: Teacher Preparation and Credentials office; Eureka Hall 216; (916) 278-6403

Contact Information

Center for Mathematics and Science Education: Sequoia Hall 330 • (916) 278-5487 • *kzoller@csus.edu*

A grade of at least a "C-" and an overall GPA of 2.7 in all courses in the Science Subject Matter Program are required for admission to the Teacher Education Program. It is recommended that all course work for the Subject Matter Program be completed before starting the Teacher Education Program. At least 15 units of the course work or equivalent work experience must be current, i.e. completed within the past six years.

It is also possible to obtain admission to the Professional Education Program by passing a series of subject-matter examinations specified by the CTC in lieu of this Science Subject Matter Program. For information about this option contact the Teacher Preparation Program office (Eureka Hall 216, (916) 278-6403).

Note: Due to policy changes from the California Commission on Teacher Credentialing and the federal No Child Left Behind mandate, the Science Subject Matter program was under review at the time of this 2006-2008 catalog printing and is subject to revision. As a result it is important to consult a credential advisor for current details.

Concentrations

BA: Biological Sciences / Chemistry / Geosciences / Physics

Special Features

- At Sacramento State all four science departments have strong BA and BS programs supported by an active faculty and with modern laboratory facilities. The departments are committed to the education and development of new science teachers and have a solid record of providing professional activities and support for local experienced teachers through the work of the Center for Mathematics and Science Education.
- This subject matter program is based on the concept that, if well educated science majors pursue teaching careers in K-12 education, science instruction will improve. To this end the Sacramento State Science Subject Matter Program embodies the following features. The program:
  - emphasizes breadth in all four of the sciences. All credential candidates will complete a full year or more of laboratory-based science in each of the natural sciences.
  - requires depth of study in one of the natural sciences. All credential candidates must complete the BA requirements in one of the natural sciences. Through deeper study of science, credential candidates become learners in the discipline and develop the ability to be creative teachers and models for their students.

- emphasizes laboratory and field work so that credential candidates learn to use the many tools of science including computers. This will enable them to develop laboratory programs and structure field experiences for students in their schools.
- emphasizes science for all students. The departments recognize the need to have programs which address the needs of underrepresented groups in science; women, African-Americans, Native Americans, and Hispanics. The SEE (Science Education Equity) Office and the Center for Mathematics and Science Education encourage and enable these student groups to be successful in science and to consider careers in education.

Notes:

- Credential candidates who complete this subject matter program in the sciences will have gained the confidence and ability to do science. They will understand that science is not just a collection of facts to be memorized but a creative and dynamic process which when applied can lead to understanding and appreciation of the natural world. This attitude will be reflected in their classrooms and will make them good models for pre-college students.
- Science majors who intend to pursue a teaching credential should see a faculty advisor or the department chair in the department of their academic major. It is recommended that they do so early as it is critical that their science course work be carefully planned and coordinated with the professional teacher preparation program. In addition, students are encouraged to become involved with education related activities like grading, assisting in labs, tutoring K-12 students, visiting schools, and actually teaching; all experiences that can be arranged through your advisor and the Center for Mathematics and Science Education.

Requirements • Subject Matter Program – Biological Sciences (pre-credential preparation)

Units required for Subject Matter Program: 72
Courses in parentheses are prerequisites.

This subject matter program provides the minimum preparation for biology students interested in the single subject teaching credential in the sciences with a concentration in biology. This program meets the standards for academic preparation set by the California Commission on Teacher Credentialing and qualifies students to teach general science covering all four natural sciences and biology at the high school level.

A. Required Lower Division Core Courses (45 units)

(3)	BIO 010	Basic Biological Concepts
(4)	BIO 011	Animal Biology (BIO 010)
(4)	BIO 012	Plant Biology (BIO 010)
(5)	CHEM 001A	General Chemistry I (High school algebra [two years] and high school chemistry; or equivalent)
(5)	CHEM 001B	General Chemistry II (CHEM 001A)
(3)	CHEM 020	Organic Chemistry Lecture—Brief Course (CHEM 001B)
(4)	PHYS 005A	General Physics: Mechanics, Heat, Sound (Recently completed three years of high school algebra and geometry; and a college course in algebra and trigonometry for those having an inadequate mathematics background)
(4)	PHYS 005B	General Physics: Light, Electricity and Magnetism, Modern Physics (PHYS 005A or instructor permission)
(3)	GEOL 010	Physical Geology
(1)	GEOL 010L	Physical Geology Lab (GEOL 010; may be taken concurrently)
(3)	GEOL 012	Historical Geology (GEOL 010)
(3)	ASTR 004	Introduction to Astronomy (One year of high school geometry or instructor permission)
(3-4)	Select one of the following:	
	MATH 026A	Calculus I for the Social and Life Sciences (MATH 011 or three years of high school mathematics which includes two years of algebra and one year of geometry; completion of ELM requirement and the Intermediate Algebra Diagnostic Test)
	MATH 030	Calculus I (MATH 029 or four years of high school mathematics which includes two years of algebra, one year of geometry, and one year of mathematical analysis; completion of ELM requirement and Pre-Calculus Diagnostic Test)

B. Required Upper Division Core Courses (16 units)

(3)	BIO 121	Cell Physiology (BIO 011, BIO 012, CHEM 161; CHEM 161 may be taken concurrently)
(4)	BIO 139	General Microbiology (BIO 010, BIO 011, BIO 012; CHEM 006B or CHEM 020)
(3)	BIO 160	General Ecology (BIO 011, BIO 012, STAT 001)
(3)	BIO 184	General Genetics (BIO 011, BIO 012, BIO 139)
(3)	CHEM 161	General Biochemistry (CHEM 020 or CHEM 124)

Notes:

- CHEM 161 is not counted toward the 24 upper division unit requirement in the major.
- CHEM 160A and CHEM 160B may be taken in lieu of CHEM 161. Three units may be counted toward the 24 upper division unit requirements for the major.
- BIO 106 and BIO 108 are not acceptable toward a BA in biological sciences.

C. Upper Division Electives (11 units)

Select eleven (11) upper division biology units in consultation with an advisor. Upper division electives in biological sciences must include one course in plant biology and one course in animal biology.

Requirements • Subject Matter Program – Chemistry (pre-credential preparation)

Units required for the Subject Matter Program: 85
A minimum grade "C-" is required in all courses required for the Chemistry major. Grades below "C-" in prerequisite courses do not satisfy prerequisite requirement.
Courses in parentheses are prerequisites.

This subject matter program provides the minimum preparation for chemistry majors interested in pursuing the single subject teaching credential in the sciences with a concentration in chemistry. This program meets the standards for academic preparation set by the California Commission on Teacher Credentialing and qualifies students to teach general science in all the four natural sciences and chemistry at the high school level.

A. Required Lower Division Core Courses (61 units)

(3)	ASTR 004	Introduction to Astronomy (One year of high school geometry or instructor permission)
(3)	BIO 010	Basic Biological Concepts
(4)	BIO 011	Animal Biology (BIO 010)
(4)	BIO 012	Plant Biology (BIO 010)
(5)	CHEM 001A	General Chemistry I (High school algebra [two years] and high school chemistry; or equivalent)
(5)	CHEM 001B	General Chemistry II (CHEM 001A)
(3)	CHEM 024	Organic Chemistry Lecture I (CHEM 001B)
(3)	CHEM 025	Organic Chemistry Laboratory I (CHEM 124; may be taken concurrently)
(4)	CHEM 031	Quantitative Analysis (CHEM 001B)
(3)	GEOL 010	Physical Geology
(1)	GEOL 010L	Physical Geology Lab (GEOL 010; may be taken concurrently)
(3)	GEOL 012	Historical Geology (GEOL 010)
(4)	MATH 030	Calculus I (MATH 029 or four years of high school mathematics which includes two years of algebra, one year of geometry, and one year of mathematical analysis; completion of ELM requirement and Pre-Calculus Diagnostic Test)
(4)	MATH 031	Calculus II (MATH 030 or appropriate high school based AP credit)
(4)	MATH 032	Calculus III (MATH 031)
(4)	PHYS 005A	General Physics: Mechanics, Heat, Sound (Recently completed three years of high school algebra and geometry; and a college course in algebra and trigonometry for those having an inadequate mathematics background)
(4)	PHYS 005B	General Physics: Light, Electricity and Magnetism, Modern Physics (PHYS 005A or instructor permission)

B. Required Upper Division Courses (24 units)

(3)	CHEM 124	Organic Chemistry Lecture II (CHEM 024, or instructor permission; concurrent enrollment in CHEM 025 recommended)
(3)	CHEM 140A	Physical Chemistry Lecture I (CHEM 001B, CHEM 024, CHEM 031, MATH 032; PHYS 005A, PHYS 005B or PHYS 011A, PHYS 011B, PHYS 011C; PHYS 011C may be taken concurrently)
(3)	CHEM 140B	Physical Chemistry Lecture II (CHEM 140A)
(3)	CHEM 141	Physical Chemistry Laboratory (ENGL 020 or an equivalent second semester composition course; CHEM 140A, CHEM 140B or CHEM 142, instructor permission; CHEM 140B either may be taken concurrently)
(12)		Additional courses to a minimum of 24 upper division units in Chemistry including two lecture courses and two laboratory courses. Elective courses should be selected in consultation with an advisor.

Requirements • Subject Matter Program – Geosciences (pre-credential preparation)

Units required for the Subject Matter Program: 79-82

The subject matter program provides the minimum preparation for geology majors interested in pursuing the single subject teaching credential in the sciences with a concentration in the geosciences. This program meets the standards for academic preparation set by the California Commission on Teacher Credentialing and qualifies students to teach all four of the natural sciences and the geosciences at the high school level.

A. Required Lower Division Core Courses (43-46 units)

(3)	ASTR 004	Introduction to Astronomy (One year of high school geometry or instructor permission)
(3)	BIO 010	Basic Biological Concepts
(4)	BIO 011	Animal Biology (BIO 010)
(4)	BIO 012	Plant Biology (BIO 010)
(5)	CHEM 001A	General Chemistry I (High school algebra [two years] and high school chemistry; or equivalent)
(5)	CHEM 001B	General Chemistry II (CHEM 001A)
(3)	GEOL 010	Physical Geology
(1)	GEOL 010L	Physical Geology Lab (GEOL 010; may be taken concurrently)
(3)	GEOL 012	Historical Geology (GEOL 010)
(4)	MATH 030	Calculus I (MATH 029 or four years of high school mathematics which includes two years of algebra, one year of geometry, and one year of mathematical analysis; completion of ELM requirement and Pre-Calculus Diagnostic Test) **OR**
	MATH 029	Pre-Calculus Mathematics (MATH 011 or three years of high school mathematics which includes two years of algebra and one year of geometry; completion of ELM requirement and Intermediate Algebra Diagnostic Test) **AND**
	MATH 026A	Calculus I for the Social and Life Sciences (MATH 011 or three years of high school mathematics which includes two years of algebra and one year of geometry; completion of ELM requirement and the Intermediate Algebra Diagnostic Test)
(4)	PHYS 005A	General Physics: Mechanics, Heat, Sound (Recently completed three years of high school algebra and geometry; and a college course in algebra and trigonometry for those having an inadequate mathematics background)
(4)	PHYS 005B	General Physics: Light, Electricity and Magnetism, Modern Physics (PHYS 005A or instructor permission)

B. Upper Division Courses (35 units)

(5)	GEOL 100	Mineralogy (CHEM 001A, GEOL 010, GEOL 010L)
(4)	GEOL 102A	Igneous/Metamorphic Petrology (GEOL 100, GEOL 103A, GEOL 110A)
(4)	GEOL 103A	Sedimentology/Stratigraphy (GEOL 010, GEOL 010L, GEOL 012, GEOL 100; ENGL 001A or demonstrated writing ability. Corequisite: GEOL 103B required as co-requisite for BS students)

(4) GEOL 105 Paleontology (GEOL 010, GEOL 010L, GEOL 012 and GEOL 012L)
(4) GEOL 110A Structural Geology and Tectonics (GEOL 010, GEOL 010L, GEOL 012, GEOL 012L, GEOL 100, GEOL 103A, GEOL 111A and GEOL 111B; PHYS 005A or PHYS 011A; MATH 030 or MATH 026A)
(2) GEOL 111A Field Geology (GEOL 010, GEOL 010L, GEOL 012, GEOL 012L, GEOL 100. Corequisite: GEOL 103A, GEOL 103B, GEOL 111B)
(2) GEOL 111B Field Techniques (GEOL 010, GEOL 010L, GEOL 012, GEOL 012L, GEOL 100. Corequisite: GEOL 103A, GEOL 103B, GEOL 111A)
(4) GEOL 112 Geophysics for Geologists (GEOL 103A, GEOL 111A, GEOL 111B and PHYS 005A and PHYS 005B or PHYS 011A and PHYS 011B, MATH 026A or MATH 030)
(6) Electives. (Three credits must be an applied geology elective and three credits may be chosen from GEOL 114, GEOL 121, GEOL 130, GEOL 140, and GEOL 170.)

Note: Attendance at 16 colloquia, verified by faculty signature, is required.

Requirements • Subject Matter Program – Physics (pre-credential preparation)

Units required for the Subject Matter Program: 88

The subject matter program provides the minimum preparation for physics majors interested in pursuing the single subject teaching credential in the sciences with a concentration in physics. This program meets the standards for academic preparation set by the California Commission on Teacher Credentialing and qualifies students to teach all four of the natural sciences and physics at the high school level.

A. Required Lower Division Courses (59 units)

(3) ASTR 004 Introduction to Astronomy (One year of high school geometry or instructor permission)
(1) ASTR 006 Astronomical Observation Lab (ASTR 004, may be taken concurrently)
(3) BIO 010 Basic Biological Concepts
(4) BIO 011 Animal Biology (BIO 010)
(4) BIO 012 Plant Biology (BIO 010)
(5) CHEM 001A General Chemistry I (High school algebra [two years] and high school chemistry; or equivalent)
(5) CHEM 001B General Chemistry II (CHEM 001A)
(3) GEOL 010 Physical Geology
(1) GEOL 010L Physical Geology Lab (GEOL 010; may be taken concurrently)
(3) GEOL 012 Historical Geology (GEOL 010)
(4) MATH 030 Calculus I (MATH 029 or four years of high school mathematics which includes two years of algebra, one year of geometry, and one year of mathematical analysis; completion of ELM requirement and Pre-Calculus Diagnostic Test)
(4) MATH 031 Calculus II (MATH 030 or appropriate high school based AP credit)
(4) MATH 032 Calculus III (MATH 031)
(3) MATH 045 Differential Equations for Science and Engineering (MATH 031)
(4) PHYS 011A General Physics: Mechanics (MATH 030, MATH 031; or equivalent certificated high school courses. MATH 031 may be taken concurrently)
(4) PHYS 011B General Physics: Heat, Light, Sound (MATH 031, PHYS 011A)
(4) PHYS 011C General Physics: Electricity and Magnetism, Modern Physics (MATH 031, PHYS 011A)

B. Upper Division Courses (29 units)

(3) PHYS 105 Mathematical Methods in Physics (MATH 032; PHYS 011A, PHYS 011B, PHYS 011C or PHYS 005A, PHYS 005B)
(3) PHYS 106 Introduction to Modern Physics (MATH 031; PHYS 011A, PHYS 011B, PHYS 011C or PHYS 005A, PHYS 005B)
(3) PHYS 110 Classical Mechanics (MATH 045, PHYS 011C, PHYS 105)
(4) PHYS 115 Electronics and Instrumentation (PHYS 011C or PHYS 005B with instructor permission.)
(3) PHYS 124 Thermodynamics and Statistical Mechanics (MATH 045, PHYS 011A, PHYS 011B, PHYS 011C)
(3) PHYS 135 Electricity and Magnetism (MATH 045, PHYS 011C, PHYS 105)
(2) PHYS 175 Advanced Physics Laboratory (6 units of upper division physics)
(2) PHYS 191 Senior Project
(6) Electives

Note: Elective courses must be selected in consultation with the credential advisor.