

College of *Science and Mathematics*

Faculty Offices East (25), Room 229
(805) 756-2226

Philip S. Bailey, Dean
Roxy L. Peck, Associate Dean

ACADEMIC PROGRAMS

Biochemistry	<i>BS</i>
Biological Sciences	<i>BS, MS</i>
Biology	<i>Minor</i>
Biotechnology	<i>Minor</i>
Chemistry	<i>BS</i>
Environmental Studies	<i>Minor</i>
Geology	<i>Minor</i>
Kinesiology	<i>BS, MS</i>
Mathematics	<i>BS, MS, Minor</i>
Microbiology	<i>BS, Minor</i>
Physics.....	<i>BA, BS, Minor</i>
Polymers and Coatings Science	<i>MS</i>
Statistics	<i>BS, Minor</i>

The mission of the College of Science and Mathematics is to facilitate learning, understanding, and appreciation of science and mathematics as a basis for creative endeavors, intellectual pursuits, careers, and critical consideration of issues confronting society. The College has two equally important roles: (1) to provide specialized coursework for students enrolled in the College's undergraduate, graduate and minor programs, and (2) to provide support and breadth courses in science and mathematics for all students of the university. In cooperation with the College of Education, the College also offers programs leading to teaching credentials in mathematics, physical education, and three subjects in science – biology, chemistry and physics.

The College of Science and Mathematics has a tradition and reputation for excellence in teaching and is dedicated to undergraduate instruction. The College provides a student-centered learning environment consistent with the University's "learn by doing" philosophy. In laboratories, students have access to modern instrumentation and computer technology. Classroom instruction is done in relatively small classes so that a personal approach by instructors is possible. Because of the College's large role in offering support courses to the rest of the university community, the number of faculty in each department is relatively large and favors student-faculty interaction, both inside and outside of the classroom.

STUDENT SERVICES

The College Office acts on various student-initiated petitions (change of major, curriculum substitutions, withdrawal from the university). In addition, the office has the dual function of counseling those on academic probation and notifying those undergraduate students who are eligible each quarter for the Dean's Honor List.

FACULTY ADVISING

Faculty members take an active role in academic and career advising. Students are encouraged to obtain academic advising prior to registration each quarter. The advisor-student relationship becomes important especially when the student needs a letter of reference for a potential employer or needs career advice.

ADVISING CENTER

Anya Bergman, Advisor
Kristi Weddige, Advisor
Rebecca Westmoreland, Administrative Coordinator
Science North (Bldg. 53), Room 219
(805) 756-2615
www.calpoly.edu/~cosamac

The College of Science and Mathematics Advising Center provides academic advising services to all students within the college. These services include help with scheduling classes and developing long-range academic plans, career advising; information on university policies and procedures, special programming to facilitate student success, and referral of students to other campus offices.

The Advising Center also has a library of materials for student use. This includes information on the health professions, graduate schools, job opportunities, internships, study abroad, and catalogs from junior colleges and other four-year institutions. Most student-related forms – curriculum substitutions, concentration forms, graduation evaluation forms – are also available.

HEALTH PROFESSIONS ADVISING CENTER

Kristi Weddige, Advisor
 Science North (Bldg. 53), Room 219
 (805) 756-2840
www.calpoly.edu/~cosamac/health

The Health Professions Advising Center provides advising to all students at Cal Poly interested in entering a health professions career. Support includes health careers advising; assistance in applying to internships, summer programs and research opportunities; and development of the application to professional school. Pre-health professions students are also advised to contact the Health Professions Peer Advisors and the members of the Health Professions Resource Committee.

APPLYING TO GRADUATE SCHOOL

College of Science and Mathematics faculty have earned advanced degrees from a wide variety of universities and are excellent sources for information and advice about graduate programs, prerequisites and application procedures. Applications to graduate programs should be made in the fall for admission to the following fall term. The Graduate Record Exam (GRE) should be taken early in the application cycle. Generally, two or more letters of reference from faculty are required. Most Ph.D. granting institutions offer financial support in the form of teaching assistantships and research fellowships.

BIOTECHNOLOGY MINOR

The Biotechnology Minor consists of a core of required courses and restricted elective courses. Advising for students in the Biotechnology Minor takes place in the student's major department, including selection of restricted electives and preparation of an agreement form listing specific courses to satisfy the requirements for the minor. The Biotechnology Minor Form is available from the Dean's Office or the Advising Center in the College of Science and Mathematics. Final approval of the minor is by the Program Coordinator in the College of Science and Mathematics.

The minor is open to any major except Biochemistry, Microbiology, and Biological Sciences with the Molecular and Cellular Biology concentration.

Biological Sciences students preparing for the minor should take CHEM 316, 317, and 371 to fulfill the organic chemistry and biochemistry requirements in their major.

Core courses (15-21)	<i>Units</i>
BIO 161, MCRO 221, MCRO 224, or BOT 121	4-5
BIO 303, BIO 351, or CHEM 373	3-5
CHEM 313 or CHEM 371	5
Laboratory elective: ASCI 403, BIO/CHEM 375, BOT 450 or CHEM 474	2-5
SCM 201 Orientation to Biotechnology	1
Restricted electives	7-13
(See below for choices)	

Animal Biotechnology:

- ASCI 403 Applied Biotech in Animal Science (5)
- ASCI 406 Applied Animal Embryology (5)
- ASCI 503 Advanced Molecular Techniques in
Animal Science (4)
- DSCI 330 Artificial Insemination and Embryo
Biotech (4)
- VS 340 Immunology and Diseases (4)

Bioinformatics:

- BIO/CHEM 441 Bioinformatics Applications (4)
- CSC/CPE 448 Bioinformatics Algorithms (4)

Cell and Molecular Biology/Microbial Biotechnology:

- BIO 452 Cell Biology (4)
- BIO/CHEM 375 Molecular Biology Laboratory (2)
- BIO 426 Immunology (4)
- BIO 476 Gene Expression Laboratory (2)
- CHEM 472 Plant Biochemistry (3)
- CHEM 473 Immunochemistry (3)
- CHEM 474 Protein Techniques Laboratory (2)
- CHEM 528 Nutritional Biochemistry (3)
- MCRO 225 General Microbiology II (5)
- MCRO 320 Emerging Infectious Diseases (3)
- MCRO 402 General Virology (5)
- MCRO 433 Microbial Biotechnology (3)

Engineering-related Biotechnology:

- BRAE 448 Bioconversion (4)
- ENVE 443 Bioenvironmental Engineering (4)
- ENGR 581, 582, 583 Biochemical Engineering I,
II, III (4, 4, 4)

Ethics:

- PHIL 339 Biomedical Ethics (4)
- SCM 451 Ethics in the Sciences (3)

Pharmaceutical Biotechnology:

- CHEM 377 Chemistry of Drugs and Poisons (3)
- CHEM 477 Biochemical Pharmacology (3)

Plant Biotechnology:

- BOT 323 Plant Pathology (4)
- BOT 324 Ornamental and Forest Pathology (4)
- BOT 450 Plant Biotechnology Laboratory (2)
- CHEM 472 Plant Biochemistry (3)

ENVIRONMENTAL STUDIES MINOR

Students who complete a minor in Environmental Studies will be able to:

- Analyze, explain, and evaluate environmental issues from both scientific/technical and social/political/economic perspectives.
- Integrate and synthesize knowledge from multiple disciplines.
- Explain and apply the methodologies and approaches that different disciplines bring to bear on complex problems.
- Work productively and effectively with students from other disciplines and with other points of view.
- Confront and grapple with real issues of contemporary significance.
- Gain employment or pursue further study that emphasizes interdisciplinary knowledge and skills.

More information about the Environmental Studies Minor, including Subject Area Electives appropriate for students in each of the colleges, can be obtained from the College of Science and Mathematics Dean's Office in Building 25, Room 229C. Subject Area Electives **must be approved in advance** by an advisor for the minor.

*Satisfies General Education requirement. Units

Subject Area Electives

Select one course from each subject area. Electives must be approved in advance by an advisor for the minor.

<i>Biology and ecology: select one</i>	4
BIO 112 (B5)*, 227 (B2)*, 301, 325; FNR 306, 319 (B5)*	
<i>Earth science: select one</i>	3-4
ERSC 144; GEOG 250; GEOL 102 (B3)*; PHYS 313; PSC 201 (B5)*; ERSC 202	
<i>Energy and pollution: select one</i>	3-4
BRAE 348 (F)*; ENVE 324 (F)*, 330, 331; ME 321 (F)*; PHYS 310; PSC 320 (F)*	
<i>Social, political, and ethical issues: select one</i>	3-4
CRP 404; ECON 431; HUM 303 (C4)*; PHIL 340 (C4)*; POLS 325 (D5)*, 333 (F)*; REC 302; SOC 431; UNIV 333 (F)*	
<i>Environmental planning, management, and sustainability: select one</i>	3-4
AG/HUM/UNIV 330 (F)*; AG 360 (F)*; CRP 336; EDES 406; FNR 202; GEOG 301 (D5)*, 333; LA 321	
Elective	4
Choose one additional 300-400 level course from the above lists.	
Capstone Course	4
AG/BUS/EDES/ENGR/HUM/SCM/UNIV 350 The Global Environment (F)*	

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Biological Sciences

Department Office
Fisher Science Hall (33), Room 273
(805) 756-2788
Email address: bio@calpoly.edu
www.calpoly.edu/~bio

Department Chair, Michael A. Yoshimura

Nikki L. Adams	Anthony E. Knable
Frederick P. Andoli	Charles A. Knight
Michael W. Black	Mark Kubinski
Robert J. Brown	Kingston L. Leong
Raul J. Cano	Mark A. Moline
Jaime S. Colomé	Royden Nakamura
Alvin A. De Jong	Elizabeth K. Perryman
Susan L. Elrod	David S. Pilliod
Pat M. Fidopiastis	Matthew K. Ritter
Dennis F. Frey	Scott J. Steinmaus
David V. Grady	Emily N. Taylor
Michael T. Hanson	Lars Tomanek
Kenneth J. Hillers	Francis X. Villablanca
Edward T. Himelblau	Larisa K. Vredevoe
V. L. Holland	Dirk R. Walters
Peter T. Jankay	Archie M. Waterbury
Elena L. Keeling	Dean E. Wendt
David J. Keil	Candace R. Winstead
Christopher L. Kitts	Po Sai Marie Yeung

ACADEMIC PROGRAMS

BS, MS Biological Sciences
BS Microbiology
Biology Minor
Microbiology Minor

The department offers complete undergraduate programs leading to Bachelor of Science degrees in Biological Sciences and Microbiology, and minors in Biology and Microbiology. For qualified students, a graduate program is available leading to the Master of Science degree. In addition, courses are offered to satisfy biology requirements in other academic majors.

The Biological Sciences department teaches courses with the following prefixes: BIO (Biology), BOT (Botany), MCRO (Microbiology), and ZOO (Zoology).

The department is housed in modern facilities equipped with up-to-date instrumentation. Cal Poly's geographical setting offers unusual opportunities for studying representative plants and animals of both Northern and Southern California. Graduates of the various programs enter fields in teaching; medical laboratory technology; public health; biotechnology research and manufacturing; wildlife management; agriculture; industry; and private, state, and national park and forest services. A significant number enter graduate or professional schools for advanced study of botany, entomology, micro-biology, plant pathology, zoology, marine sciences, veterinary science, cell and molecular biology, medicine, and dentistry. The department

offers courses required for preprofessional training in medicine and paramedical fields. In the teaching area, all state requirements may be met with an academic major in biological sciences leading to a credential in secondary teaching.

The department supports the concept of international education and encourages students to investigate opportunities for overseas study. For further information, see Study Abroad Programs.

Students majoring in Biological Sciences or Microbiology may take advantage of opportunities to participate in research projects. Special opportunities are available through the Environmental Biotechnology Institute (EBI) that is developing biological tools to address environmental concerns through collaborative interdisciplinary research and education; the Center for Coastal Marine Science (CCMS) that promotes and facilitates basic and applied studies of coastal marine systems for the purposes of addressing environmental concerns and fostering hands-on learning through discovery and outreach; the Undergraduate Biotechnology Laboratory (UBL), which is co-funded by Cal Poly and the National Science Foundation to provide undergraduates with hands-on experience with biotechnology; and Estero Conservation Alliance (ECA), which provides students with opportunities to work with local environmental organizations to enhance the Morro Bay National Estuary and its watershed. In addition, there are many opportunities to work with individual faculty members in areas such as conservation, genetics and biology, behavioral ecology, endangered species, infectious disease mechanisms, developmental biology, and plant pathology, genetics and physiology.

Biological Sciences Major

With the curricular concentrations described below, this degree offers students a broad education in biology from molecules to ecosystems. It is suitable for preprofessional preparation in the biomedical fields, teaching, technical competency in the concentrations offered, certification as an Associate Ecologist, Fisheries Biologist, or Associate Wildlife Biologist, or as a base for work toward post-baccalaureate studies. Students are encouraged to take BIO 100 Orientation to Biological Sciences (1 unit) their first quarter to help them learn about their chosen degree program, concentration choices, career options, study skills, and departmental opportunities.

Curricular Concentrations

Anatomy-Physiology. Designed for students who are interested in the biological sciences with an emphasis in the structure and function of animals and especially for preprofessional students interested in the health sciences.

Ecology. The study of ecology spans a wide breadth of habitats, from terrestrial to marine, and multiple scales of organization, from microbial interactions to global processes. As such, the ecology concentration allows flexibility for students to design a program to fit their interests and career goals within this broad discipline. The concentration emphasizes collection and analysis of data to better understand the factors that affect the distribution and abundance of organisms. In many contexts, these results are used to identify and solve environmental problems.

Graduates may pursue careers in education, ecological consulting, planning or coordination, habitat restoration, or environmental law. A graduate may be academically qualified for professional certification as an Associate Ecologist by the Ecological Society of America.

Field and Wildlife Biology. Field and Wildlife biologists understand the factors that affect the distribution and abundance of terrestrial plants and animals. Emphasis is on identification of organisms in the field with the intent of developing a conceptual understanding of community structure and wildlife habitats. By appropriate selection of electives, students in the Wildlife Biology emphasis are academically prepared to apply for professional certification as an Associate Wildlife Biologist by the Wildlife Society. The emphasis also includes management of both game and non-game wildlife species. The Field Biology emphasis educates students to have an intimate understanding of biological diversity, and provides students with a broader training of plants and animals and their ecological interrelationships in the field. The Field and Wildlife Biology concentration prepares students for graduate training or for professional employment in public or private agencies dealing with field inventories of biological diversity. Graduates may pursue careers as field biologists, outdoor educators, park naturalists, biological resource scientists, biology teachers, environmental consultants, or wildlife conservation biologists.

General Biology. Gives the student a broad training in biology and provides a background for various careers in biology, graduate study, or a single-subject teaching credential in biological sciences.

Marine Biology and Fisheries. Prepares students for advanced training or professional employment in public or private agencies concerned with marine sciences, freshwater ecology, fisheries biology, fisheries management, or related fields. By judicious selection of electives, the student is academically prepared to apply for professional certification as a Fisheries Biologist by the American Fisheries Society.

Molecular and Cellular Biology. Designed for students who are interested in how genes and their products work to create cellular structures, activities and interactions in organisms ranging from microbes to plants and animals.

This concentration augments the diverse biological sciences curriculum with laboratory courses in nucleic acid and protein techniques, along with additional courses in bioinformatics, industrial microbiology, immunology, virology, and plant biotechnology. An understanding of molecular and cellular biology is a cornerstone for various biotechnology, medical, and pharmaceutical industries as well as for graduate or professional study in biology, microbiology, biochemistry, the health professions, or other related fields. Students electing this concentration are not eligible for the Biotechnology Minor.

Systematics and Biodiversity. Prepares students for advanced training or professional employment in public or private agencies that deal with the identification, relationships, and classification of organisms. Students develop an understanding of biological diversity, its origins, its significance, and how it is described and organized. Graduates may pursue careers in education, biotic inventories and assessment, museums, herbaria, zoos, and botanic gardens.

Microbiology Major

Cal Poly is one of the few California State University or University of California universities offering a laboratory-intensive Bachelor of Science degree in Microbiology. The Microbiology major consists of a core of freshman courses that provide students with a basic foundation in key biological principles and includes an introduction to organismal, cellular, and molecular biology, as well as evolution, ecology and biodiversity. In the sophomore year, majors are provided with a solid training in the manipulation of microorganisms, as well as an understanding of microbial cell structure and function, metabolism, genetics, and ecology.

In the junior and senior years, majors take specialized courses in medical microbiology, immunology, microbial physiology, genetics, virology, and cell biology. During this time students also choose elective courses related to individual student interests and career goals in close consultation with their faculty advisor. Such goals may include graduate school, professional studies or post-baccalaureate employment in applied areas such as industrial microbiology, food and dairy microbiology, and biotechnology, as well as in public health microbiology, epidemiology, or medical laboratory technology.

Biotechnology Minor

For information regarding the Biotechnology Minor, please see College of Science and Mathematics Section.

BIOLOGY MINOR

The purpose of the minor is to help students from other disciplines acquire increased factual and conceptual knowledge in biology, an increased understanding of scientific methods and techniques used to study biology, and an increased ability to analyze biological topics in the news or in various jobs. Biological issues are important throughout modern life and particularly relevant in many careers, including those in health-related businesses, agriculture, several engineering disciplines, city planning, teaching K-12 students, journalism, political science, psychology, and statistics. Students in more closely related majors such as biochemistry or kinesiology may also be interested in strengthening their biology background. In addition, an enhanced biology background helps students become better educated citizens regarding a variety of controversial issues (e.g., genetically-modified organisms in agriculture, human cloning, genetic discrimination, the pressures of population growth). Students may choose courses in environmental biology or in human biology and biotechnology, or may choose to take courses in several areas.

Required Courses.*Units*

Choose 1 of the following combinations of courses 12-13

BIO 160 Diversity and the History of Life (4)

BIO 161 Introduction to Cell and Molecular Biology (4) (B2&B4)

BIO 162 Intro to Organismal Form and Function (5) *or* BIO 263 Intro Ecology and Evolution (4)*OR*

BIO 113 Animal Diversity and Ecology (4) (B2&B4)

BIO 114 Plant Diversity and Ecology (4) (B2&B4) *or* BOT 121 General Botany (4) (B2&B4)BIO 115 Animal/Human Structure and Function (4) *or* BIO 111 General Biology (4) (B2&B4) *or* MCRO 221 Microbiology (4) (B2&B4)

The first combination (BIO 160, BIO 161, BIO 162 *or* BIO 263) is recommended and provides the prerequisites for many courses offered in the department. Other introductory courses may be substituted with approval by the Biology Minor Coordinator.

Advisor Approved Electives..... 15-16

Students must obtain prior approval from the Biology Minor Coordinator.

Choose a minimum of 15-16 units from 300-400 level courses in BIO, BOT, MCRO or ZOO to create a cohesive set of courses that reflect a particular focus in biology, for a total of at least 28 units. Suggested combinations of courses in particular areas of biology are available in the department.

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MICROBIOLOGY MINOR

This minor is designed to give students from majors in which microbiology may be an important component increased exposure to factual information, concepts, and skills in order to provide those students a more complete understanding of the roles of microorganisms as they pertain to studies in their chosen major. The emphasis areas of the minor allow students in the allied health and related fields to expand their breadth of knowledge in microbial diseases, transmission and prevention, and immunologic responses. Students in applied fields of study such as Food and Dairy Sciences and various aspects of agriculture can gain additional information in pertinent topics such as microbial involvement in water and wastewater treatment; the role of microorganisms in recycling of nutrients and soil fertility; microbial roles in food processing, spoilage, production; and disease transmission.

Required Courses.*Units*MCRO 221 Microbiology (B2&B4) *or*

MCRO 224 General Microbiology (B2&B4) 4/5

MCRO 225 General Microbiology II 5

MCRO 423 Medical Microbiology (for

Medical/Health Science emphasis area) *or*

MCRO 424 Microbial Physiology (for Applied and Environmental emphasis area) 5

Emphasis area courses..... 11-12

Select courses from one of the following emphasis areas:

Medical/Health Sciences

MCRO 320, 342, 402, 424,

BIO 426, ZOO 425, 428

Applied and Environmental Sciences

MCRO 342, 421, 423, 433, 436, SS 422

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BS BIOLOGICAL SCIENCES

- ☐ 60 units upper division ☐ GWR
☐ 2.0 GPA ☐ USCP

* = Satisfies General Education requirement

Course sequencing: See flowcharts at www.calpoly.edu/~cosamac

MAJOR COURSES

BIO 160 Diversity & the History of Life	4
BIO 161 Intro to Cell & Molecular Bio (B2&B4)*	4
BIO 162 Intro to Organismal Form & Function.....	5
BIO 263 Introductory Ecology and Evolution	4
BIO 351 Principles of Genetics.....	5
BIO 414 Evolution	4
BIO 461 Senior Project – Research Proposal <i>or</i>	
BIO 462 Senior Project – Research.....	2
¹ <i>Biological Diversity:</i>	4
BIO 328, BIO 415, BOT 313, BOT 323, BOT	
334, BOT 433, BOT 437, MCRO 224, MCRO	
402, ZOO 321, ZOO 322, ZOO 323, ZOO 329,	
ZOO 335, ZOO 336, ZOO 341, ZOO 425	
² <i>Ecology:</i> BIO 318, BIO 325, BOT 326, MCRO 436	4
³ <i>Physiology:</i> BIO 361, BIO 434, BIO 435	4
Concentration	39
	79

SUPPORT COURSES

CHEM 127 General Chemistry (B3&B4)*	4
CHEM 128, 129 General Chemistry	4, 4
⁴ CHEM 312 Survey of Organic Chemistry <i>or</i>	
CHEM 316 Organic Chemistry I	5
MATH 161, 162 Calculus/Life Sciences I, II (B1)*	4, 4
PHYS 121, 122, 123 College Physics I, II, III....	4, 4, 4
STAT 218 Appl Statistics-Life Sciences (B1)*	4
	41

GENERAL EDUCATION (GE)

72 units required; 16 units are in Major/Support.

→See page 56 for complete GE course listing.

→Minimum of 12 units required at the 300-400 level.

Area A Communication (12 units)

A1 Expository Writing	4
A2 Oral Communication	4
A3 Reasoning, Argumentation, and Writing.....	4

Area B Science and Mathematics (no add'l units req'd)

B1 Mathematics/Statistics * 8 units in Support....	0
B2 Life Science * 4 units in Major.....	0
B3 Physical Science * 4 units in Support	0
B4 One lab taken with either a B2 or B3 course	

Area C Arts and Humanities (20 units)

C1 Literature	4
C2 Philosophy	4
C3 Fine/Performing Arts	4
C4 Upper-division elective	4
Area C elective (Choose one course from C1-C4)	4

Area D/E Society and the Individual (20 units)

D1 The American Experience (40404)	4
D2 Political Economy	4
D3 Comparative Social Institutions	4

D4 Self Development (CSU Area E)	4
D5 Upper-division elective	4
Area F Technology Elective (upper division)(4 units)	4
	56
ELECTIVES	4
	180

Concentrations (select one)

Anatomy and Physiology Concentration	
BIO 432 Vertebrate/Human Anatomy & Phys I	5
BIO 433 Vertebrate/Human Anatomy & Phys II	5
BIO 452 Cell Biology.....	4
CHEM 371 Biochemical Principles <i>or</i> CHEM 313	
Survey of Biochemistry and Biotechnology	5
⁵ Advisor approved electives.....	20
	39

Ecology Concentration

<i>Ecology (Choose 4 courses)</i>	15-17
BIO 318, BIO 328, BIO 415, BIO 434, BIO 444,	
BOT 326, MCRO 436, ZOO 423, ZOO 437	
<i>Methodology (Choose 3 courses)</i>	10-12
BIO/CHEM 375, BIO 419, FNR/GEOG/LA 318,	
FNR 416, STAT 313, STAT 419	
Advisor approved electives	10-14
	39

Field and Wildlife Biology Concentration

BOT 313 Taxonomy of Vascular Plants.....	4
BOT 433 Field Botany	4
ZOO 321 Mammalogy.....	4
ZOO 323 Ornithology	4
Emphasis Area (choose one)	23
<i>Field Biology Emphasis</i>	
ZOO 335 General Entomology (4)	
ZOO 341 Herpetology (4)	
ZOO 437 Animal Behavior (4)	
BIO 318/ZOO 322/ZOO 423 (4)	
Advisor approved electives (7)	
<i>Wildlife Biology Emphasis</i>	
BIO 327 Wildlife Biology Methods (5)	
BIO 427 Wildlife Management (4)	
BIO 444 Population Ecology (3)	
FNR 416 Environmental Impact Analysis/Mgmt (4)	
FNR 203 Resource Law Enforcement (3)	
STAT 313 Applied Experimental Design &	
Regression Models (4)	
	39

¹ Students in the Molecular and Cellular Biology concentration should take MCRO 224 to fulfill this requirement.

² Students in the Ecology concentration should take BIO 325 to fulfill this Ecology requirement.

³ Students in the Ecology concentration should take BIO 435 to fulfill this Physiology requirement.

⁴ Students in the Molecular and Cellular Biology concentration should take CHEM 316 to fulfill this requirement.

⁵ Guidelines are available for advisor approved electives in most concentrations. See your faculty advisor for assistance.

General Biology Concentration

BIO 452 Cell Biology	4
CHEM 313 Survey of Biochem and Biotech	5
Anatomy/Physiology	4
BIO 432 ¹ , BIO 433, BIO 434, BIO 435, BOT 335, MCRO 424, ZOO 422	
Botany	4
BOT 313, BOT 323, BOT 334, BOT 335, BOT 433, BOT 437	
Microbiology	3-5
BIO 426, MCRO 224, MCRO 225, MCRO 320 ¹ , MCRO 342, MCRO 402, MCRO 421, MCRO 433, MCRO 436, ZOO 428	
Zoology	4
BIO 318, BIO 328, ZOO 321, ZOO 322, ZOO 323, ZOO 329, ZOO 335, ZOO 336, ZOO 341, ZOO 425	
Advisor approved electives	13-15
	39

Marine Biology and Fisheries Concentration

BIO 328 Marine Biology	5
BIO/CHEM 375 Molecular Biology Laboratory	2
BOT 437 Phycology	4
STAT 313 Applied Experimental Design and Regression Models	4
ZOO 322 Ichthyology	4
ZOO 336 Invertebrate Zoology	4
² Advisor approved electives	16
	39

Molecular and Cellular Biology Concentration

BIO/CHEM 375 Molecular Biology Laboratory	2
BIO 452 Cell Biology	4
CHEM 317 Organic Chemistry II	5
CHEM 371 Biochemistry	5
CHEM 372 Metabolism	3
CHEM 474 Protein Techniques Laboratory <i>or</i> BIO/CHEM 476 Gene Expression Laboratory	2
Choose 8 units from the following	8
BIO 405, BIO/CHEM 441, BOT 450, CHEM 473 <i>or</i> BIO 426, MCRO 402, MCRO 433, SCM 201	
² Advisor approved electives	10
	39

Systematics and Biodiversity Concentration

BIO 343 Principles of Systematic Biology	4
BIO/CHEM 375 Molecular Biology Laboratory	2
BIO 415 Biogeography	4
BIO/CHEM 441 Bioinformatics Applications	4
STAT 313 Applied Experimental Design and Regression Models	4
STAT 419 Applied Multivariate Statistics	4
² Advisor approved electives	17
	39

BS MICROBIOLOGY

☐ 60 units upper division ☐ GWR
☐ 2.0 GPA ☐ USCP

* = Satisfies General Education requirement

Course sequencing: See flowcharts at

www.calpoly.edu/~cosamac

MAJOR COURSES

BIO 160 Diversity & the History of Life	4
BIO 161 Introduction to Cell & Molecular Biology (B2&B4)*	4
BIO 263 Introductory Ecology and Evolution	4
BIO 351 Principles of Genetics	5
BIO 426 Immunology	4
BIO 452 Cell Biology	4
MCRO 224 General Microbiology I	5
MCRO 225 General Microbiology II	5
MCRO 402 General Virology	4
MCRO 423 Medical Microbiology	5
MCRO 424 Microbial Physiology	5
MCRO 461 Senior Project – Research Proposal <i>or</i> BIO 462 Senior Project - Research	2
Advisor approved electives	18
	69

³ SUPPORT COURSES

CHEM 127 General Chemistry (B3&B4)*	4
CHEM 128, 129 General Chemistry I, II	4, 4
CHEM 316 Organic Chemistry I	5
CHEM 317 Organic Chemistry II	5
⁴ CHEM 371 Biochemical Principles	5
MATH 161 Calculus for the Life Sciences I (B1)*	4
PHYS 121, 122, 123 College Physics I, II, III	4, 4, 4
STAT 218 Applied Statistics-Life Sciences (B1)*	4
	47

GENERAL EDUCATION (GE)

72 units required; 16 units are in Major/Support.

→See page 56 for complete GE course listing.

→Minimum of 12 units required at the 300-400 level.

Area A Communication (12 units)

A1 Expository Writing	4
A2 Oral Communication	4
A3 Reasoning, Argumentation, and Writing	4

Area B Science and Mathematics (no add'l units req'd)

B1 Mathematics/Statistics * 8 units in Support	0
B2 Life Science * 4 units in Major	0

¹ Students planning to earn a single subject credential for teaching Biology should take BIO 432 and MCRO 320 and contact the credential advisor to identify other required courses.

² Guidelines are available for advisor approved electives in most concentrations. See your faculty advisor for assistance.

³ Students planning to attend graduate or professional schools are strongly advised to meet with their advisors to ensure that they meet necessary prerequisites for entry into these programs. Additional courses in math and chemistry may be necessary.

⁴ CHEM 313 may be substituted, with advisor approval, for students not planning to pursue graduate school, or a health professions career.

B3 Physical Science * 4 units in Support.....	0
B4 One lab taken with either a B2 or B3 course	
Area C Arts and Humanities (20 units)	
C1 Literature	4
C2 Philosophy	4
C3 Fine/Performing Arts	4
C4 Upper-division elective	4
Area C elective (Choose one course from C1-C4)	4
Area D/E Society and the Individual (20 units)	
D1 The American Experience (40404)	4
D2 Political Economy	4
D3 Comparative Social Institutions	4
D4 Self Development (CSU Area E)	4
D5 Upper-division elective	4
Area F Technology Elective (upper division) (4 units)	<u>4</u>
	56
ELECTIVES	<u>8</u>
	180

MASTER OF SCIENCE DEGREE IN BIOLOGICAL SCIENCES

General Characteristics

This degree offers a broad background in the biological sciences. The program is designed to offer sufficient breadth and depth to strengthen the student's academic understanding and improve competence for: (a) many types of biological work that require advanced training beyond the bachelor's degree; (b) employment in industry and/or civil service; (c) teaching biological sciences at the elementary, secondary, and community college levels; (d) independent research in the field of specialization; or (e) continued graduate work at other institutions.

Prerequisites

Admission as a conditionally classified or classified student in this program requires a minimum grade point average of 3.0 in the last 90 quarter units attempted, satisfactory scores on the Graduate Record Examination, and letters of recommendation from persons knowing your academic potential. Advancement to candidacy requires a satisfactory background in biology, and completion of 12 units of courses specified in an informal study plan with a minimum grade point average of 3.0.

Information pertaining to specific departmental requirements for admission to graduate standing—classified or graduate standing—conditionally classified may be obtained from the Director of the Graduate and Research Committee (Graduate Coordinator) of the Biological Sciences Department.

Program of Study

The formal program of study for the degree must include 45 units of committee-approved graduate work, at least 30 units of which must be at the 500 level. At least 18 units of the formal program of study must be completed after the

student has been advanced to candidacy. A grade point average of 3.0 or better is required in all courses taken as a graduate student. Two approaches to the M.S. degree in Biological Sciences are possible. The requirements for these two approaches are listed below.

CURRICULUM FOR MS BIOLOGICAL SCIENCES

	Thesis Plan	Coursework Plan
BIO 501 Molecular and Cellular Biology	4	4
BIO 502 Biology of Organisms	4	4
BIO 503 Population Biology	4	4
BIO 590 Seminar in Biology	3	3
BIO 599 Thesis, including oral defense of thesis	9	—
BIO 500 Individual Study, including written report	—	4
Comprehensive Exam:		
GRE Advanced Biology	Yes	Yes
Essay	No	Yes
Electives from 500-level courses ...	6	11
Electives from 400- and 500-level courses	15	15
	<u>45</u>	<u>45</u>

All 45 units must be acceptable for graduate credit and in accordance with Graduate Guidelines of the Biological Sciences Department. For further information, students should communicate with the Chair of the Biological Sciences Department or with the Director of the Graduate and Research Committee.

Chemistry and Biochemistry

Department Office
Faculty Offices East Bldg. (25), Room 125B
(805) 756-2693
www.calpoly.edu/~chem

Department Chair, Christina A. Bailey

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Seth Bush	Hima Joshi
Jennifer Carroll	Eric J. Kantorowski
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Robert S. Cichowski	Kevin B. Kingsbury
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Anya Goodman	Margaret (Peggy) S. Rice
Derek E. Gragson	Rod W. Schoonover
John P. Hagen	Michael G. Silvestri
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Ralph A. Jacobson	Nanine A. Van Draanen

ACADEMIC PROGRAMS

BS Biochemistry

BS Chemistry

MS Polymers and Coatings Science

The Chemistry and Biochemistry Department has two roles in the university: to provide professional education for students who are majors in chemistry and biochemistry and who plan careers in the natural sciences and related fields, and to provide instruction in the fundamentals of chemistry to students with majors in fields related to chemistry, especially in the life sciences, agriculture, and engineering.

The Chemistry and Biochemistry Department provides curricula leading to the Bachelor of Science in Chemistry, the Bachelor of Science in Chemistry with a certified concentration in Polymers and Coatings, the Bachelor of Science in Biochemistry, the Bachelor of Science in Biochemistry with a concentration in Polymers and Coatings, the Bachelor of Science in Biochemistry with a concentration in Molecular Biology, and the Master of Science in Polymers and Coatings Science. The BS in Chemistry and the concentration in Polymers and Coatings are certified by the American Chemical Society. An option in Chemical Education designed for aspiring teachers in secondary schools is also available.

The baccalaureate curricula in biochemistry and chemistry include required courses in general chemistry, analytical chemistry, inorganic chemistry, organic chemistry, biochemistry and physical chemistry. Advanced undergraduates choose electives from courses that cover a broad range of specialized topics, such as environmental

chemistry, geochemistry, glass chemistry, immunochemistry, nutritional biochemistry, advanced organic and physical chemistry, pharmacology, and polymer chemistry. The curricula emphasize laboratory work, especially current techniques and the use of instrumentation in all fields of chemistry. The programs provide opportunities for independent research under faculty guidance, including a requirement for a senior project. A senior project may consist of pure or applied research in chemistry or biochemistry, or it may involve interdisciplinary work with another field such as art, biology, civil or environmental engineering, psychology, or soil science. Under the department's cooperative education program, bachelor's degree candidates may work full-time in industry or government for one or two quarters, for pay and academic credit.

Career opportunities for chemists are increasing. There are openings in traditional areas such as clinical chemistry, environmental analysis, the health professions, industrial research and production, pharmacology, toxicology, product quality control, and teaching at the secondary or university level. Newer opportunities lie in related areas such as library science, market research, patent law, and safety engineering.

There is a rapidly increasing number of career opportunities in the expanding fields of biotechnology and polymers and coatings. Students completing a concentration in either molecular biology or in polymers and coatings are prepared for direct entry into these careers, as well as for postgraduate education in a professional specialty.

Students interested in teaching at the secondary level can follow an accelerated path that leads to a bachelor's degree in either chemistry or biochemistry and a teaching credential. Interested students should contact the single subject teaching credential advisor in the Department of Chemistry and Biochemistry for more information.

Curricular Concentrations

Polymers and Coatings. Includes the required courses in the chemistry or biochemistry curriculum and electives in the area of polymers, coatings, surface chemistry and materials engineering. The concentration gives students the background and practical experience to move into a rewarding career in a wide range of fields including textiles, paints and varnishes, rubber, plastics, adhesives and resins.

Molecular Biology. Offers courses which investigate the chemical nature of biological molecules related to genes and their expressed products. It augments the already

strong biochemistry curriculum by emphasizing laboratory techniques in nucleic acid and protein manipulation along with elective courses exploring the fields of bioinformatics, industrial microbiology, pharmacology, and cell biology. Molecular biology is essential for modern applications of biotechnology in the agricultural, pharmaceutical, and medical industries and in pursuing research in all biochemistry related disciplines. It not only prepares students for advanced degrees in biology, microbiology, and biochemistry, but also for the large number of jobs in the biotechnology industry in California.

Biotechnology Minor

For information regarding the Biotechnology minor, see College of Science and Mathematics section.

BS CHEMISTRY

- ☐ 60 units upper division ☐ GWR
☐ 2.0 GPA ☐ USCP

* = Satisfies General Education requirement

Course sequencing: See flowcharts at

www.calpoly.edu/~cosamac

MAJOR COURSES

CHEM 127 General Chemistry (B3 & B4)*	4
CHEM 128 General Chemistry	4
CHEM 129 General Chemistry	4
CHEM 313 Survey of Biochemistry and Biotechnology or CHEM 371 Biochemical Principles	5
CHEM 316 Organic Chemistry I	5
CHEM 317 Organic Chemistry II	5
CHEM 318 Organic Chemistry III	3
CHEM 319 Advanced Organic Chemistry Lab	2
¹ CHEM 331 Quantitative Analysis	5
CHEM 351 Physical Chemistry I.....	3
CHEM 352 Physical Chemistry II.....	3
CHEM 353 Physical Chemistry III	3
CHEM 354 Physical Chemistry Laboratory.....	2
CHEM 357 Physical Chemistry III Laboratory.....	1
CHEM 439 Instrumental Analysis	5
² CHEM 459 Undergraduate Seminar (2) or SCM 491 Student Teacher Seminar (1) (1).....	2
CHEM 461 Senior Project Report.....	1
CHEM 481 Inorganic Chemistry	3
CHEM 484 Inorganic Chemistry Lab	2
³ Advanced advisor approved chemistry electives to complete major, or concentration	15-18

77-80

SUPPORT COURSES

BIO 161 Intro to Cell & Molecular Biology (B2)*	4
MATH 141, 142, 143 Calculus I, II, III (B1)*.....	4,4,4
MATH 241 Calculus IV	4
MATH 244 or 200-400 level STAT or CSC course	4
PHYS 141 General Physics IA.....	4
PHYS 132 General Physics II.....	4
PHYS 133 General Physics III.....	4
Physics elective (200-level and above)	3

39

GENERAL EDUCATION (GE)

72 units required; 16 units are in Major/Support.

→See page 56 for complete GE course listing.

→Minimum of 12 units required at the 300-400 level.

Area A Communication (12 units)

A1 Expository Writing	4
A2 Oral Communication	4
A3 Reasoning, Argumentation, and Writing	4

Area B Science and Mathematics (no additional units are required)

B1 Mathematics/Statistics * 8 units in Support	0
B2 Life Science * 4 units in Support.....	0
B3 Physical Science * 4 units in Major.....	0
B4 One lab taken with either a B2 or B3 course	

Area C Arts and Humanities (20 units)

C1 Literature	4
C2 Philosophy	4
C3 Fine/Performing Arts	4
C4 Upper-division elective	4
Area C elective (Choose one course from C1-C4)	4

Area D/E Society and the Individual (20 units)

D1 The American Experience (40404)	4
D2 Political Economy	4
D3 Comparative Social Institutions	4
D4 Self Development (CSU Area E)	4
D5 Upper-division elective	4

Area F Technology Elective (upper division)

(4 units)	4
	56

ELECTIVES..... 5-8
180

Polymers and Coatings Concentration

CHEM 444 Polymers and Coatings I	3
CHEM 445 Polymers and Coatings II.....	3
CHEM 446 Surface Chemistry of Materials	3
CHEM 447 Polymers and Coatings Lab I.....	2
CHEM 448 Polymers and Coatings Lab II.....	2
CHEM 449 Internship in Polymers and Coatings ...	2
MATE 210 Materials Engineering	3
	18

¹ Students should take CHEM 331 during their second year.

² SCM 491 only for students pursuing Single-Subject Teaching Credential.

³ See department for advanced electives list.

BS BIOCHEMISTRY

☐ 60 units upper division ☐ GWR
☐ 2.0 GPA ☐ USCP

* = Satisfies General Education requirement

Course sequencing: See flowcharts at
www.calpoly.edu/~cosamac

MAJOR COURSES

CHEM 127 General Chemistry (B3 & B4)*	4
CHEM 128 General Chemistry	4
CHEM 129 General Chemistry	4
CHEM 316 Organic Chemistry I	5
CHEM 317 Organic Chemistry II	5
CHEM 318 Organic Chemistry III	3
CHEM 319 Advanced Organic Chemistry Lab	2
¹ CHEM 331 Quantitative Analysis	5
CHEM 351 Physical Chemistry I	3
CHEM 352 Physical Chemistry II	3
CHEM 353 Physical Chemistry III	3
CHEM 354 Physical Chemistry Laboratory.....	2
CHEM 371 Biochemical Principles	5
CHEM 372 Metabolism	3
CHEM 373 Molecular Biology	3
Select one course from:	
² CHEM 375 Molecular Biology Laboratory, or	
CHEM 474 Protein Techniques Laboratory	2
Select one course from:	
CHEM 375, 439 ³ , 474 ² ; BIO 361 ³ , 476.....	2
⁴ CHEM 459 Undergraduate Seminar (2) or SCM	
491 Student Teacher Seminar (1)(1).....	2
CHEM 461 Senior Project Report.....	1
⁵ Advanced advisor approved chemistry electives	
to complete major, or concentration	12-23
	73-84

SUPPORT COURSES

BIO 161 Intro to Cell & Molecular Biology (B2)*	4
MATH 141, 142, 143 Calculus I, II, III (B1)*	4,4,4
PHYS 121, 122, 123 College Physics or	
PHYS 141, 132, 133 General Physics	4,4,4
² MCRO 224 General Microbiology I or BIO 452	
Cell Biology	4-5
	32-33

GENERAL EDUCATION (GE)

72 units required; 16 units are in Major/Support.

→See page 56 for complete GE course listing.

→Minimum of 12 units required at the 300-400 level.

Area A Communication (12 units)

A1 Expository Writing	4
A2 Oral Communication	4
A3 Reasoning, Argumentation, and Writing	4

Area B Science and Mathematics (no add'l units req'd)

B1 Mathematics/Statistics * 8 units in Support	0
B2 Life Science * 4 units in Support	0
B3 Physical Science * 4 units in Major.....	0
B4 One lab taken with either a B2 or B3 course	

Area C Arts and Humanities (20 units)

C1 Literature	4
C2 Philosophy	4

C3 Fine/Performing Arts	4
C4 Upper-division elective	4
Area C elective (Choose one course from C1-C4)	4

Area D/E Society and the Individual (20 units)

D1 The American Experience (40404)	4
D2 Political Economy	4
D3 Comparative Social Institutions	4
D4 Self Development (CSU Area E)	4
D5 Upper-division elective	4

Area F Technology Elective (upper division)

(4 units)	4
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56**ELECTIVES.....****7-19****180****Concentrations (select one)****Molecular Biology Concentration**

CHEM 377 Drugs and Poisons.....	3
BIO/CHEM 441 Bioinformatics Applications	4
BIO 452 Cell Biology.....	4
SCM 201 Orientation to Biotechnology.....	1
Advisor approved electives	11
(select at least 11 units from the following)	
CHEM 472 Plant Biochemistry (3)	
CHEM 473 Immunochemistry (3)	
CHEM 477 Biochemical Pharmacology (3)	
BOT 450 Plant Biotechnology (2)	
MCRO 225 General Microbiology II (5)	
MCRO 320 Emerging Infectious Diseases (3)	
MCRO 402 Virology (4)	
MCRO 424 Microbial Physiology (5)	
MCRO 433 Microbial Technology (3)	
MCRO 436 Environmental Microbiology (4)	
CPE/CSC 448 Bioinformatics Algorithms (4)	
ENGR 581/582/583 Biochemical	
Engineering (4)(4)(4)	
SCM 451 Ethics in the Sciences (3)	
	23

Polymers and Coatings Concentration

CHEM 444 Polymers and Coatings I	3
CHEM 445 Polymers and Coatings II.....	3
CHEM 446 Surface Chemistry of Materials	3
CHEM 447 Polymers and Coatings Lab I.....	2
CHEM 448 Polymers and Coatings Lab II.....	2
CHEM 449 Internship in Polymers and Coatings ...	2
MATE 210 Materials Engineering	3
	18

¹ Students should take CHEM 331 as soon as possible after completing CHEM 129.

² Required for Molecular Biology concentration.

³ Excess units count as approved advanced Biochemistry electives.

⁴ SCM 491 only for students pursuing Single-Subject Teaching Credential.

⁵ See department for advanced electives list for Biochemistry major.

MASTER OF SCIENCE DEGREE IN POLYMERS AND COATINGS SCIENCE

General Characteristics

A pilot program, the MS in Polymers and Coatings Science offers a unique, focused program closely tied to industry. Students gain academic preparation in polymers and coatings science through lecture and laboratory courses, then undertake a rigorous industrial internship. While on the internship students specialize and develop advanced skills through directed study in areas related to their internship work. The program is designed to prepare students for challenging careers in the polymers and coatings industry. The program also provides excellent background for doctoral studies in areas related to polymer and coatings science. This program is unique in California and relies on the close relationship between the department and the polymers and coatings industry for its success.

Prerequisites

Students entering the program must have a bachelor's degree from an accredited institution with a minimum grade point average of 2.5 in the last 90 quarter units attempted. Applicants with majors in chemistry, biochemistry, materials engineering, chemical engineering or related fields generally meet the prerequisites for courses in the program. Applicants with degrees in other areas may need to take supplemental courses in organic and physical chemistry and can be admitted conditionally. For information concerning additional departmental requirements, the student should contact the Graduate Advisor in the Chemistry and Biochemistry Department.

Advancement to candidacy requires completion of 12 units of an approved study plan with a minimum grade point average of 3.0.

Blended BS + MS Program in Chemistry or Biochemistry (BS) and Polymers and Coatings Science (MS)

The blended program provides motivated students with an accelerated route to the MS in Polymers and Coatings Science, with simultaneous conferring of both bachelor's and master's degrees. Students in the blended program are provided with a seamless process whereby they can progress from undergraduate to graduate status.

Eligibility

Students majoring in chemistry or biochemistry may be eligible to pursue the blended program toward the MS in Polymers and Coatings Science. Participation in the program is based on prior academic performance and other measures of professional promise, with a minimum GPA of 2.5 required (3.0 recommended). Students are generally selected for the blended program by a faculty committee during the junior year. Please see the catalog description on Blended Programs for eligibility criteria.

Students may begin taking the required graduate courses in either their junior or senior year depending on their

preparation. Students may not pursue both the Concentration in Polymers and Coatings and the MS in Polymers and Coatings Science. Students pursuing the concentration take the 400-level polymers and coatings courses while those pursuing the MS degree take the 500-level polymers and coatings courses. Students cannot receive credit for both 400 and 500-level courses in the same topic.

Students in the blended program are eligible to apply for the Graduate Internship upon completion of the required graduate-level chemistry courses.

	<i>Units</i>
Required courses	33
CHEM 544 Polymer Physical Chemistry and Analysis (3)	
CHEM 545 Polymer Synthesis and Mechanisms (3)	
CHEM 547 Polymer Characterization and Analysis Laboratory (2)	
CHEM 548 Polymer Synthesis Laboratory (2)	
CHEM 550 Coatings Formulation Principles (3)	
CHEM 551 Coatings Formulation Laboratory (2)	
CHEM 570 Directed Graduate Study (3 units per quarter for 3 quarters)	
CHEM 598 Graduate Internship (3 units per quarter for 3 quarters)	
Restricted Electives	12
12 units approved electives (400-500 level) chosen from: CHEM, MATE, Bioengineering, STAT 512 <i>or</i> STAT 513.	
Examples of courses satisfying the elective requirement include:	
CHEM 405 Advanced Physical Chemistry (3)	
CHEM 420 Advanced Organic Chemistry (3)	
CHEM 439 Instrumental Analysis (5)	
CHEM 446 Surface Chemistry of Materials (3)	
CHEM 470 Selected Advanced Topics (1-4)	
MATE 530 Biomaterials (4)	
MATE 560 Thin Film Processing (3)	
ENGR 450 Special Topics in Bioengineering (4)	
IME 556 Technological Project Management (4) or other approved management course	
Satisfactorily complete the comprehensive examinations.	

Kinesiology

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Kinesiology Bldg. (43), Room 453
(805) 756-2545
www.calpoly.edu/~pek/

Department Chair, Gerald E. DeMers

Robert Clark	Camille P. O'Bryant
Steven C. Davis	Andrew J. Proctor
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Joanne Hunter	Michael A. Sutliff
Kristine Z. Jankovitz	J. Kevin Taylor
Raymond Nakamura	

ACADEMIC PROGRAMS

BS, MS Kinesiology

The Kinesiology Department offers undergraduate and graduate degree programs in kinesiology. The department also contributes to the general education and elective needs of all students by providing health education, kinesiology, physical education and first aid/CPR courses. Due to its ideal geographical location, the University has become a center for workshops held by many of the state's health and physical education organizations.

Kinesiology is housed in a large complex that was opened in 1993. The Kinesiology building provides state of the art laboratory and office space for the department. The Kinesiology Department also has shared interest in the Recreation Center that provides access to quality activity facilities.

The BS in Kinesiology is a broad based program offering students curricular choices for a wide range of career opportunities. Concentrations include teaching, and exercise science and health promotion. Students also have the option of choosing an individualized course of study.

CURRICULAR CONCENTRATIONS

Exercise Science and Health Promotion. Incorporates the scientific and clinical knowledge of exercise science, health education and nutrition as applied in preventive, clinical and commercial health promotion settings. Graduates work in a wide range of enterprises that include worksite health promotion, clinical exercise physiology, cardiac rehabilitation, commercial fitness, public, private and non-profit health agencies. The concentration provides three tracks that prepares students to take external national certification examinations.

Teaching. Prepares students to meet subject matter competency required for application to the Single Subject Credential program in physical education. In order to meet subject matter competency and to apply for the credential program, students must take specific courses. Please see an advisor for specific requirements.

Individualized Course of Study. Students may choose coursework related to a specific career goal in areas such as occupational therapy, nursing, or physician's assistant. This individualized course of study (ICS) requires 38 advisor-approved units in addition to other required courses. Only 12 units of previous coursework may be included in an ICS program. Those individuals who come to Cal Poly intending to apply to graduate school in one of the other health profession areas may need to take extra courses in addition to their specific major and concentration.

BS KINESIOLOGY

60 units upper division GWR
 2.0 GPA USCP

* = Satisfies General Education requirement

Course sequencing: See flowcharts at
www.calpoly.edu/~cosamac

MAJOR COURSES

¹ KINE 208–KINE 229 Professional Activity	6
KINE 250 Health Education (D4)* <i>or</i> KINE 255 Personal Health: A Multicultural Approach (D4)* (USCP)	4
KINE 270 Orientation to Kinesiology	4
KINE 280 First Aid/CPR.....	1
KINE 301 Functional Muscle Anatomy	1
KINE 302 Biomechanics	4
KINE 303 Physiology of Exercise	4
KINE 307 Adapted Physical Activity	4
KINE 402 Motor Learning and Control	4
KINE 411 Psycho/Social Aspects of Physical Act	4
KINE 451 Nutrition for Fitness and Sport	5
KINE 461 Senior Project (1) <i>or</i> KINE 462 Honors Senior Project (2-4).....	1-4
MATH 118 Pre-Calculus Algebra (B1)* (MATH 116 and MATH 117 are equivalent).....	4
PHYS 121 College Physics I (B3 & B4)*	4

¹ Students following the Exercise Science and Health Promotion Concentration ~~should are to~~ take ~~KINE 211, KINE 212, KINE 219, KINE 220, KINE 227 and KINE 228, and one additional unit from KINE 208-229.~~



STAT 217 Intro to Statistical Concepts and Methods or STAT 218 Applied Statistics-Life Sciences (B1)*	4
ZOO 331, 332 Human Anatomy & Physiol I, II (transfer equivalent ZOO 231, 232)	5,5
Concentration courses (see below) (B2)*	48-59
	112-126

GENERAL EDUCATION (GE)

72 units required; 20 units are in Major/Support.
 →See page 56 for complete GE course listing.
 →Minimum of 12 units required at the 300-400 level.

Area A Communication (12 units)

A1 Expository Writing	4
A2 Oral Communication	4
A3 Reasoning, Argumentation, and Writing	4

Area B Science and Mathematics (no add'l units req'd)

B1 Mathematics/Statistics * 8 in Major	0
B2 Life Science * 4 in Major	0
B3 Physical Science * 4 in Major	0
B4 One lab taken with either a B2 or B3 course	

Area C Arts and Humanities (20 units)

C1 Literature	4
C2 Philosophy	4
C3 Fine/Performing Arts	4
C4 Upper-division elective	4
Area C elective (Choose one course from C1-C4)	4

Area D/E Society and the Individual (16 units)

D1 The American Experience (40404)	4
D2 Political Economy	4
D3 Comparative Social Institutions	4
D4 Self Development (CSU Area E) * 4 in Major	0
D5 Upper-division elective	4

Area F Technology Elective (upper division) (4 units)

4

ELECTIVES

2-16

180**CONCENTRATIONS (select one)****¹ Exercise Science and Health Promotion Concentration****Required courses (27)**

KINE 218 Aquatics.....	2
KINE 219 Progressive Strength Training	1
KINE 304 Pathophysiology and Exercise.....	3
KINE 319 Measurement and Evaluation in Kine	4
KINE 401 Managing Kinesiology Programs	3
KINE 408 Exercise and Health Promotion for Senior Adults	4
KINE 434 Planning Health Promotion Programs: Theory and Practice	4
KINE 463 Clinical and Worksite Health Promotion Field Work	3
BIO 111/BIO 115/BIO 161 (B2/B4)*.....	4

Students select one of the following tracks..... 26-32

² Clinical Exercise Science Track (26-27)

KINE 445, 446, 452; CHEM 111 or 127, 312, 313

Worksite Commercial Health and Fitness Track (28)
 KINE 354, 445, 450, 452; BUS 387; CHEM 110; COMS 301; JOUR 312

Health Education Specialist Track (30-32)

KINE 305, 354, 405, 443, 450; FSN 210, FSN 310 or FSN 315 or PSY 205; MCRO 221; CHEM 110 or 111

54-53 -59

Teaching Concentration

KINE 300 Planning Techniques in PE	3
KINE 306 Assessment in K-12 Physical Education	3
KINE 308 Motor Development	3
KINE 309 Creative and Non-Traditional Games	3
KINE 315 Field Sports	3
KINE 316 Net/Wall Games	3
KINE 384 Water Safety Instructor	4
KINE 396 Outdoor Education.....	3
KINE 419 Physical Education Program Content in Elementary School.....	3
KINE 421 Strategies for Teaching PE.....	3
KINE 422 Teaching Elementary School PE.....	4
KINE 423 Teaching Middle School PE	4
KINE 425 Teaching High School PE	4
KINE 443 Comprehensive School Health Ed	4
BIO 111 General Biology (B2)*	4
CHEM 110 World of Chemistry	4
DANC 381 Methods of Teaching Dance	4
	59

Individualized Course of Study

KINE 218 Aquatics	2
BIO 111 General Biology or BIO 161 Intro to Cell and Molecular Biology (B2)*	4
CHEM 110 or CHEM 111 or CHEM 127	4/5
Advisor approved electives	38
	48-49

¹ Students following the Exercise Science and Health Promotion Concentration ~~should are to~~ take ~~KINE 211, KINE 212, KINE 219, KINE 220, KINE 227 and KINE 228,~~ and one additional unit from ~~KINE 208-229~~.

² Students interested in careers in the health professions should take BIO 161, and CHEM 127 in lieu of CHEM 111.

MASTER OF SCIENCE DEGREE IN KINESIOLOGY

General Characteristics

The degree program is designed to offer advanced study in kinesiology which qualifies students to enter the field at occupational levels requiring a master's degree. The program offers the increased depth and quality needed for teaching physical education at the secondary and community college levels, and positions in corporate, private, and governmental agencies as well as those in clinical preventative and/or rehabilitative health settings.

Areas of Emphasis

Students may select one of the following areas of emphasis which is most compatible with career and personal objectives.

Exercise Science and Health Promotion

This emphasis is an extension of the Exercise Science and Health Promotion Concentration under the BS degree program in Kinesiology. It prepares students to work in the health promotion field in diversified settings, including corporate, club, private, and governmental agencies. It also qualifies graduates to pursue clinically oriented positions in preventative and rehabilitative health programs as well as providing students with an excellent background for further postgraduate study.

Physical Education and Sport Studies

This emphasis is offered for students who wish advanced preparation for elementary, secondary, or college positions in physical education and coaching. It is oriented toward a practical application and offers an opportunity for the in-depth study needed for (a) teaching physical education at all levels; (b) coaching at the secondary and post-secondary levels, as well as with private and municipal agencies; and (c) continued graduate work at other institutions.

Individual Course of Study

Students develop programs of study that meet their projected career goals. Approval must come from the students' advisors and the department graduate coordinator. To be approved, students must present, in writing, proposals describing the interest area they intend to study. Students must have a strong focus outside the two traditional graduate emphases listed above. If students are interested in pursuing a degree beyond the MS, they may develop a course of study which best prepares them academically for further study. The thesis option is highly recommended.

Conditionally Classified Standing

Applicants to the MS degree program in Kinesiology should have an undergraduate degree in Kinesiology or equivalent academic preparation. Those applicants with undergraduate deficiencies must remove these deficiencies through coursework or examination before Advancement to Candidacy and may do this while enrolled as a graduate student at Cal Poly.

Information pertaining to specific requirements for admission may be obtained from the graduate coordinator of the kinesiology program (www.calpoly.edu/~pek, and select "Master of Science").

Classified Standing

For admission to classified standing, an applicant must have an undergraduate major in kinesiology or equivalent academic preparation as determined by the departmental coordinator of graduate studies and a minimum grade point average of 2.75 in the last 90 units of undergraduate work. Students below a 2.75 GPA may appeal to the graduate coordinator to be "conditionally" accepted. This latter procedure involves a review process and a specified contract to be successfully completed before admission to classified standing.

Advancement to Candidacy

For Advancement to Candidacy a student shall have:

- successfully completed all conditionally classified requirements
- successfully completed the Graduation Writing Requirement
- filed a Formal Study Plan
- maintained a minimum 3.0 GPA for all course work completed on the formal study plan

At least 18 units must be completed after advancement to candidacy.

Requirements for the Degree

The formal program of study must include 45 units of approved graduate work; at least 33 of these units must be completed at the 500 level in Kinesiology.

All candidates must meet the current Graduation Writing Requirement.

Each candidate must successfully complete a comprehensive examination before the degree is granted. This examination may take one of two forms: (1) those students presenting a masters thesis or project must successfully defend the thesis or project in an oral examination, or (2) those students not presenting a masters thesis or project must pass an oral examination dealing with general current knowledge of the profession and coursework taken toward the degree requirements. *If the degree requirements are not completed within 7 years, the student may need to complete additional requirements.*

Up to 12 units may be taken in 400-level courses with advisor approval, provided these courses were not required as part of the undergraduate degree program. Graduate students taking 400-level courses are required to complete assignments beyond those normally required of undergraduate students and are graded against more rigorous standards than those applied to undergraduate students in the same course. A maximum of 12 advisor approved units may be taken outside of the Kinesiology Department.

Curriculum For MS Kinesiology

Required courses	24-26
KINE 501 Evaluation of Current Studies (3)	
KINE 510 Health Behavior Change (3)	
KINE 517 Research Methods in Kinesiology (3)	
KINE 522 Advanced Biomechanics (3)	
KINE 525 Adv Motor Learning & Control (3)	
KINE 530 Adv Physiology of Exercise (4)	
KINE 581 Grad Seminar in Kinesiology (1-3)	
STAT 513 Applied Experimental Design and Regression Models (4)	
Area of Emphasis or course of study	10-16
Choose one of the following:	
<i>Exercise Science and Health Promotion (16)</i>	
KINE 503 Current Health Issues (3)	
KINE 504 Advanced Pathophysiology and Exercise (3)	
KINE 511 Management and Administration in Kinesiology Settings (3)	
KINE 534 Planning Health Promotion Programs: Theory and Practice (4)	
KINE 536 Advanced Electrocardiography (4)	
<i>Physical Education and Sport Studies (10)</i>	
KINE 505 Introduction to Issues, Ethics and Policies in Teaching (1)	
KINE 511 Management and Administration in Kinesiology Settings (3)	
KINE 526 Sport and Exercise in Society (3)	
KINE 539 Observation and Analysis of Teaching Physical Education and Coaching Sports (3)	
<i>Individual Course of Study (16)</i>	
Advisor and graduate coordinator approved electives	
Advisor approved electives or thesis	<u>3-11</u>
	45

For more detailed information or advisement, contact the
Coordinator of Graduate Studies for Kinesiology.

Mathematics

Department Office
Faculty Offices East Bldg. (25), Room 208
(805) 756-2206
www.calpoly.edu/~math/

Department Chair, Kent E. Morrison

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Joseph E. Borzellino	Anthony Mendes
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Kelly Delp	Dylan Q. Retsek
Gwen L. Fisher	Benjamin P. Richert
Stuart Goldenberg	Kate J. Riley
Harvey C. Greenwald	Marian E. Robbins
Todd A. Grundmeier	Jonathan E. Shapiro
Caixing Gu	Mark Stankus
Donald G. Hartig	Lawrence Sze
Alan W. Holz	Raymond D. Terry
J. Myron Hood	Todor Todorov
Goro C. Kato	John Van Eps
Anton Kaul	Matthew E. White

ACADEMIC PROGRAMS

BS, MS Mathematics Mathematics Minor

The Mathematics Department offers a complete undergraduate program of courses leading to a Bachelor of Science degree in mathematics. It also offers a program of courses for students who wish to minor in mathematics, as well as graduate courses for programs of study leading to a Master of Science degree. The mix of pure and applied mathematics in these courses increases both the usefulness of and the demand for graduates with a degree in mathematics. In addition, the Mathematics Department offers courses that serve all departments in the university.

The undergraduate program for math majors contains a central core of courses. These courses give a solid basis for advanced work that is tailored to fit the needs and objectives of each individual student. Advanced coursework is chosen in close consultation with faculty advisors.

The rich variety of courses available in the department permits the student not only to obtain a broad exposure to those fields of mathematics which are most useful in the physical sciences and engineering, but also to obtain experience with the mathematics that is used in business, management sciences, and operations research.

Students wishing to prepare for a career teaching mathematics in middle or senior high school should choose the concentration in teaching. The courses in the

concentration, coupled with the other required courses in the major, fulfill the prerequisites for the California Commission on Teacher Credentialing.

All of these programs provide a strong mathematical foundation for the student contemplating the pursuit of an advanced degree in mathematics.

MATHEMATICS MINOR

Students may earn a minor in mathematics by completing a coordinated course of study. The program consists of a core of required courses, followed by two tracks of advanced work, to be chosen in concert with a student's career objectives. Interested students should contact the Mathematics Department for individual advisement.

I. Required courses	8
MATH 206 Linear Algebra I (4) <i>or</i> MATH 244 Linear Analysis I (4)	
MATH 248 Methods of Proof in Mathematics (4)	
II. Complete two tracks	16
A track consists of two courses from one of the groups A- J L. Completion of all four courses in either group K or L is considered two tracks. Some tracks have additional mathematics prerequisites. <i>Corrected effective Summer 2007.</i>	
A. MATH 304 Vector Analysis (4) MATH 404 Intro to Differential Geometry (4)	
B. MATH 306 Linear Algebra II (4) MATH 406 Linear Algebra III (4)	
C. MATH 335 Graph Theory (4) MATH 336 Combinatorial Mathematics (4) MATH 437 Game Theory (4)	
D. MATH 408 Complex Analysis I (4) MATH 409 Complex Analysis II (4)	
E. MATH 412 Introduction to Analysis I (4) MATH 413 Introduction to Analysis II (4)	
F. MATH 416 Differential Equations II (4) MATH 417 Discrete Dynamical Systems (4)	
G. MATH 431 Mathematical Optimization I (4) MATH 432 Mathematical Optimization II (4)	
H. MATH 440 Topology I (4) MATH 441 Topology II (4)	
I. MATH 442 Euclidean Geometry (4) MATH 443 Modern Geometries (4)	
J. MATH 451 Numerical Analysis I (4) MATH 452 Numerical Analysis II (4)	

K. MATH 341 Theory of Numbers (4)	
MATH 419 Intro. to History of Mathematics (4)	
MATH 481 Abstract Algebra I (4)	
MATH 482 Abstract Algebra II (4)	
L. MATH 304 Vector Analysis (4)	
MATH 344 Linear Analysis II (4)	
MATH 416 Differential Equations II (4)	
MATH 418 Partial Differential Equations (4)	
III. Mathematics electives	<u>6</u>
	30

BS MATHEMATICS

☐ 60 units upper division ☐ GWR

☐ 2.0 GPA ☐ USCP

* = Satisfies General Education requirement

Course sequencing: See flowcharts at

www.calpoly.edu/~cosamac

MAJOR COURSES

MATH 141 Calculus I (B1)*	4
MATH 142 Calculus II (B1)*	4
MATH 143 Calculus III	4
MATH 202 Orientation to the Mathematics Major	1
MATH 206 Linear Algebra I.....	4
MATH 241 Calculus IV	4
MATH 242 Differential Equations I	4
MATH 248 Methods of Proof in Mathematics.....	4
MATH 306 Linear Algebra II	4
MATH 336 Combinatorial Mathematics.....	4
MATH 412 Introduction to Analysis I.....	4
MATH 459 Senior Seminar.....	4
MATH 461 Senior Project I	2
MATH 462 Senior Project II.....	2
MATH 481 Abstract Algebra I.....	4
Advanced Work in Major or Concentration	32-34
	85-87

SUPPORT COURSES

Choose one of the following tracks:	8
CSC/CPE 101 and CSC/CPE 102 <i>or</i>	
CSC/CPE 235 and CSC/CPE 236 <i>or</i>	
CSC/CPE 101 and CSC/CPE 236	
PHYS 141 General Physics IA.....	4
PHYS 132 General Physics II (B3 & B4)*	4
PHYS 133 General Physics III.....	4
STAT 301 Statistics I	4
STAT 302/STAT 325/STAT 425.....	4
	28

GENERAL EDUCATION (GE)

72 units required; 12 units are in Major/Support.

→See page 56 for complete GE course listing.

→Minimum of 12 units required at the 300-400 level.

Area A Communication (12 units)

A1 Expository Writing	4
A2 Oral Communication	4
A3 Reasoning, Argumentation, and Writing.....	4

Area B Science and Mathematics (4 units)

B1 Mathematics/Stat * 8 units in Major/ Support	0
B2 Life Science	4
B3 Physical Science * 4 units in Support	0
B4 One lab taken with either a B2 or B3 course	

Area C Arts and Humanities (20 units)

C1 Literature	4
C2 Philosophy	4
C3 Fine/Performing Arts	4
C4 Upper-division elective	4
Area C elective (Choose one course from C1-C4)	4

Area D/E Society and the Individual (20 units)

D1 The American Experience (40404)	4
D2 Political Economy	4
D3 Comparative Social Institutions	4
D4 Self Development (CSU Area E)	4
D5 Upper-division elective	4

Area F Technology Elective (upper division)

(4 units)	4
	60
ELECTIVES	<u>7-5</u>
	180

Advanced Work In Major

- 1. Complete either of the following courses** 4
 - CSC/CPE 103 Fundamentals of Computer Science III (4) *or*
 - MATH 350 Mathematical Software (4)
- 2. Complete two tracks from the following four subject areas** 16

A track consists of two paired courses representing depth of study with a particular focus. Each track chosen must belong to a different subject area A-D.

 - A. MATH 341 Theory of Numbers (4) and MATH 482 Abstract Algebra II (4)**
MATH 406 Linear Algebra III (4) *and* MATH 482 Abstract Algebra II (4)
MATH 335 Graph Theory (4) *and* MATH 437 Game Theory (4)
 - B. MATH 413 and MATH 414 Introduction to Analysis II, III (4)(4)**
MATH 408 *and* MATH 409 Complex Analysis I, II (4)(4)
MATH 408 Complex Analysis I (4) *and* MATH 413 Introduction to Analysis II (4)
 - C. MATH 440 and MATH 441 Topology I, II (4)(4)**
MATH 304 Vector Analysis (4) *and* MATH 404 Introduction to Differential Geometry (4)
MATH 416 Differential Equations II (4) *and* MATH 417 Discrete Dynamical Systems (4)
MATH 442 Euclidean Geometry (4) *and* MATH 443 Modern Geometries (4)

- D. MATH 304 Vector Analysis (4) *and* MATH 418 Partial Differential Equations (4)
 - MATH 344 Linear Analysis II (4) *and* MATH 416 Differential Equations II (4)
 - MATH 451 *and* MATH 452 Numerical Analysis I, II (4)(4)
 - MATH 431 *and* MATH 432 Mathematical Optimization I, II (4)(4)
- 3. Complete 12 additional units from the following courses**..... 12
- MATH 304, 335, 341, 344, 404, 406, 408, 409, 413, 414, 416, 417, 418, 419, 431, 432, 437, 440, 441, 442, 443, 451, 452, 470, 482, CSC 349, 361, IME 301, PHYS 301, 302, 323, 405, 408, STAT 302, 325, 425, 426, 427
- 4. Advanced work must include at least two of the following courses:**
- MATH 341, 344, 413, 414, 406, 440, 441, 482

Mathematics Teaching Concentration

SCM 300 Early Field Experience, Science/Math.....	2
MATH 300 Technology in Mathematics Education	4
MATH 341 Theory of Numbers.....	4
MATH 419 Intro to the History of Mathematics.....	4
MATH 423 Advanced Mathematics for Teaching	4
MATH 442 Euclidean Geometry	4
MATH 443 Modern Geometries	4
MATH 482 Abstract Algebra II.....	4
Select 4 units from the following:	4
MATH 304, 335, 344, 406, 408, 413, 416, 417, 431, 437, 440, 451, 470,	
IME 301,	
PHYS 301, 302, 323, 405,	
STAT 425	

34

MASTER OF SCIENCE DEGREE IN MATHEMATICS

General Characteristics

The master of science program in mathematics prepares students to enter careers in government, industry or teaching. A student who completes the degree is qualified and eligible to teach at the community college level. Many of the graduates of the program also pursue further graduate study at Ph.D.-granting institutions.

Prerequisites

Prerequisite to entering the program with a classified or conditionally classified status, the student must have a bachelor's degree from an accredited institution with a minimum grade point average of 2.5 in the last 90 quarter units attempted. Applicants with majors in other areas or applicants with deficiencies in their undergraduate background may be admitted conditionally. For

information concerning additional requirements, the student should contact the Graduate Coordinator in the Mathematics Department.

Advancement to candidacy requires completion of 12 units of an approved study plan with a minimum grade point average of 3.0 and satisfactory completion of the preliminary examinations in analysis and algebra.

BLENDED BS+MS MATHEMATICS

The blended program provides motivated students with an efficient way to complete a BS and MS in mathematics with both degrees being conferred simultaneously. Students are provided with ample advising to ensure a seamless transition from undergraduate to graduate status.

Eligibility

Students majoring in mathematics may apply for the blended program as early as their junior year after completing at least two upper-division mathematics classes and before they have completed 180 units. The Graduate Committee evaluates each applicant individually. Acceptance into the program is based on prior academic performance and the applicant's promise to successfully complete the master's program. See 80 for additional eligibility criteria.

Program of Study

Students must complete the requirements of both the undergraduate and master's program of study for a total of 225 units. However, they are advised to take the undergraduate courses most suitable as preparation for the master's program. They should take the graduate preliminary written examinations at the time they complete the appropriate courses, even possibly before they have graduate status. Finally, the senior project, if sufficiently complex, may be extended into a graduate thesis. This last option is particularly attractive to students participating in one of the many undergraduate summer research programs available at either Cal Poly or other universities, since the research can then be used as a basis for the senior project and master's thesis.

CURRICULUM FOR MS MATHEMATICS *Units*

Required courses	32
MATH 520 & MATH 521 Applied Analysis I, II (4)(4)	
MATH 530 & MATH 531 Discrete Math with Applications I, II (4)(4)	
MATH 540 & MATH 541 Topology I, II (4)(4)	
MATH 550 Real Analysis (4)	
MATH 560 Field Theory (4)	
Electives	13
Select additional units at the 400 or 500 level as approved by the Graduate Committee.	

Satisfactory completion of the comprehensive examinations.

Physics

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(805) 756-2448
www.calpoly.edu/~phys; physics@calpoly.edu

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David H. Chipping	Randall D. Knight
Jodi Christiansen	Jodi I. Lamoureux
Robert Echols	Matthew J. Moelter
Jonathan Fernsler	John Mottmann
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Theodore C. Foster	Karl F. Saunders
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Antonio F. Garcia	John P. Sharpe
Glen D. Gillen	Keith S. Stowe
Katharina Gillen	Nilgun Sungar
Thomas D. Gutierrez	Leonard W. Wall
Chance Hoellwarth	Ronald E. Zammit
Affiliated Faculty:	Lynn E. Moody

ACADEMIC PROGRAMS

BA Physics

BS Physics

Geology Minor

Physics Minor

The Physics Department offers the Bachelor of Arts and the Bachelor of Science degrees in Physics.

The department provides a comprehensive laboratory program. Facilities include specialized laboratories in electrical measurements, optics, solid state physics, nuclear and atomic physics. Student activities include a chapter of the national Society of Physics Students and a chapter of the national physics honor society, Sigma Pi Sigma.

High school students planning to major in physics should include in their high school program as much as possible of the following: eight semesters of college preparatory mathematics, two of physics, and two of chemistry.

BA Physics

The BA in Physics provides the student with a solid foundation in physics. Its primary purpose is to serve students who plan to pursue a career teaching science at the high school level and those who plan a career in science related fields for whom a physics background would be an asset. Students considering a career in teaching should consult with the department advisor early.

The curriculum has fewer required upper division courses than the BS, which allows the student to choose from an extensive list of electives in consultation with an academic advisor. In addition, the BA provides an attractive option

for students in related disciplines who wish to pursue a double major.

BS Physics

The BS in Physics is the appropriate choice for those students planning a career in industry or government laboratories, and those seeking a strong foundation in physics for graduate study.

Students have the choice of selecting one of the specialized concentrations or following the general physics curriculum, which offers a variety of elective coursework. All offer good preparation for graduate study in physics. The electronics concentration is designed for students wishing to acquire a working knowledge of electronics to use in experimental physics. The electro-optics concentration provides a background in optical devices and techniques used in this rapidly expanding field.

GEOLOGY MINOR

The Geology Minor is offered in conjunction with the Earth and Soil Sciences Department. It provides a background useful for careers in environmental consulting or geotechnical fields. Interested students should consult with a geology advisor.

Prerequisites for the minor are SS 121, CHEM 111 or CHEM 128, and PHYS 132.

Required Courses.

	<i>Units</i>
GEOL 201 Physical Geology	3
GEOL 241 Physical Geology Laboratory	1
GEOL 305 Fundamentals of Seismology	4
GEOL 415 Structural Geology	4
GEOL/ERSC 401 Field-Geology Methods	4
GEOL/ERSC 402 Geologic Mapping	4
ERSC 223 Rocks and Minerals	4
ERSC 323 Geomorphology	4
	28

PHYSICS MINOR

The Minor in Physics provides the student with the opportunity to build on the introductory physics core courses with a coordinated set of electives which are based on interests and career objectives selected in consultation with a physics advisor. It consists of 24 units in physics and astronomy (of which 12 units must be upper division).

Required Courses.

	<i>Units</i>
PHYS 133 General Physics	4
(Prerequisite: PHYS 141 or PHYS 131 <i>and</i> MATH 142)	
PHYS 211 Modern Physics I.....	4

Physics/Astronomy electives:	16
Minimum 12 units must be upper division, including at least one of the following courses:	
PHYS 301 Thermal Physics (3)	
PHYS 302 Classical Mechanics I (4)	
PHYS 323 Optics (5)	
PHYS 405 Quantum Mechanics I (4)	
PHYS 408 Electromagnetic Fields and Waves I (4)	
PHYS 412 Solid State Physics (3)	
	24

BA PHYSICS

☐ 60 units upper division ☐ GWR

☐ 2.0 GPA ☐ USCP

* = Satisfies General Education requirement

Course sequencing: See flowcharts at
www.calpoly.edu/~cosamac**MAJOR COURSES**

PHYS 141 General Physics IA.....	4
PHYS 132 General Physics II (B3 & B4)*	4
PHYS 133 General Physics III.....	4
PHYS 206 Instrumentation in Experimental Physics.....	3
PHYS 211 Modern Physics I	4
PHYS 212 Modern Physics II.....	4
PHYS 256 Electrical Measurements Laboratory	1
PHYS 301 Thermal Physics I	3
PHYS 302 Classical Mechanics I	4
PHYS 323 Optics	5
PHYS 405 Quantum Mechanics I or PHYS 412 Solid State Physics	3-4
PHYS 461 Senior Project I or PHYS 463 Senior Project - Lab Research I.....	2
Select one from the following:	3-4
¹ PHIL 321 Philosophy of Science (4) (C4*),	
¹ PHIL 421 Phil. of Space, Time and Matter (4), or SCM 451 Ethics in the Sciences (3)	
CHEM 127 General Chemistry	4
CHEM 128 General Chemistry	4
MATH 141 Calculus I (B1) *	4
MATH 142 Calculus II (B1)*	4
MATH 143 Calculus III.....	4
MATH 241 Calculus IV	4
MATH 244 Linear Analysis I	4
MATH/STAT elective (300-400 level; MATH 344 recommended)	4
PHYS/ASTR/GEOL electives (300-400 level).....	15
	91-93

GENERAL EDUCATION (GE)

72 units required; 16 units are in Major.

→See page 56 for complete GE course listing.

→Minimum of 12 units required at the 300-400 level.

Area A Communication (12 units)

A1 Expository Writing	4
A2 Oral Communication	4
A3 Reasoning, Argumentation, and Writing.....	4

Area B Science and Mathematics (4 units)

B1 Mathematics/Statistics * 8 in Major	0
B2 Life Science	4
B3 Physical Science * 4 in Major.....	0
B4 One lab taken with either a B2 or B3 course	

Area C Arts and Humanities (20 units)

C1 Literature	4
C2 Philosophy	4
C3 Fine/Performing Arts	4
C4 Upper-division elective.....	4
Area C elective (Choose one course from C1-C4)	4

Area D/E Society and the Individual (20 units)

D1 The American Experience (40404)	4
D2 Political Economy	4
D3 Comparative Social Institutions	4
D4 Self Development (CSU Area E)	4
D5 Upper-division elective	4

Area F Technology Elective (upper division)

(4 units)	4
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60**ELECTIVES..... 27-29[†]****180****BS PHYSICS**

☐ 60 units upper division ☐ GWR

☐ 2.0 GPA ☐ USCP

* = Satisfies General Education requirement

Course sequencing: See flowcharts at
www.calpoly.edu/~cosamac**MAJOR COURSES**

PHYS 141 General Physics IA.....	4
PHYS 132 General Physics II (B3 & B4)*	4
PHYS 133 General Physics III.....	4
PHYS 202 Physics on the Computer.....	4
PHYS 206 Instrumentation in Experimental Phys.	3
PHYS 211 Modern Physics I.....	4
PHYS 212 Modern Physics II	4
PHYS 256 Electrical Measurements Laboratory.....	1
PHYS 301 Thermal Physics I.....	3
PHYS 302 Classical Mechanics I	4
PHYS 323 Optics	5
PHYS 340 Quantum Physics Laboratory I.....	2
PHYS 341 Quantum Physics Laboratory II	1
PHYS 342 Quantum Physics Laboratory III	2
PHYS 405 Quantum Mechanics I	4
PHYS 408 Electromagnetic Fields and Waves I	4
PHYS 461 Senior Project I or PHYS 463 Senior Project - Lab Research I.....	2
PHYS 462 Senior Project II or PHYS 464 Senior Project - Lab Research II.....	2

[†] Care must be taken when selecting electives to ensure compliance with
the "60 unit upper division" requirement.¹ Note (C2) prerequisites for these courses.

CHEM 127 General Chemistry	4
CHEM 128 General Chemistry	4
MATH 141 Calculus I (B1)*	4
MATH 142 Calculus II (B1)*	4
MATH 143 Calculus III	4
MATH 241 Calculus IV	4
MATH 244 Linear Analysis I	4
MATH 304 Vector Analysis	4
MATH 344 Linear Analysis II	4
Advanced Physics electives or Concentration courses (see below)	19
	112

GENERAL EDUCATION (GE)

72 units required; 12 units are in Major.

→See page 56 for complete GE course listing.

→Minimum of 12 units required at the 300-400 level.

Area A Communication (12 units)

A1 Expository Writing	4
A2 Oral Communication	4
A3 Reasoning, Argumentation, and Writing	4

Area B Science and Mathematics (4 units)

B1 Mathematics/Statistics * 8 units in Major	0
B2 Life Science	4
B3 Physical Science * 4 units in Major	0
B4 One lab taken with either a B2 or B3 course	

Area C Arts and Humanities (20 units)

C1 Literature	4
C2 Philosophy	4
C3 Fine/Performing Arts	4
C4 Upper-division elective	4
Area C elective (Choose one course from C1-C4)	4

Area D/E Society and the Individual (20 units)

D1 The American Experience (40404)	4
D2 Political Economy	4
D3 Comparative Social Institutions	4
D4 Self Development (CSU Area E)	4
D5 Upper-division elective	4

Area F Technology Elective (upper division) (4 units)

4

ELECTIVES**8****180****ADVANCED PHYSICS ELECTIVES OR CONCENTRATION**Select *either* the advanced physics electives *or* one of the concentrations.**Advanced Physics Electives**

Select one of the following: PHYS 424 or MATH 418.

In addition, select courses at the 300 or 400 level with the prefixes PHYS, GEOL, MATH, STAT or CSC (but not CSC 302 nor CSC 310). One of the following may also be chosen: CSC 101, 231, 234. At least 9 of these elective units must have the PHYS prefix. All courses must be taken for a letter grade.

For students anticipating an industrial career, PHYS 357, 412, 413, 423, and 452 are suggested electives.

For students anticipating graduate work in physics PHYS 303, 401, 406, 409, 424, and MATH 408 are suggested electives. In addition, PHYS 357 is suggested for students who anticipate becoming experimental physicists.

19**Electronics Concentration**

Students are not be allowed to enroll in EE 228 until they have a) completed PHYS 357 and MATH 344, and b) received the approval of advisors in both Physics and Electrical Engineering. Students are then allowed to enroll in EE courses with physics courses substituting for EE prerequisites.

PHYS 357 Advanced Instrumentation in Experimental Physics	3
EE 228 Continuous-Time Signals and Systems	4
EE 302 Classical Control Systems	3
EE 328 Discrete Time Signals and Systems	3
EE 342 Control Systems Laboratory	1
EE 368 Signals and Systems Laboratory	1
EE 336 Microprocessor System Design <i>or</i> EE 306 <i>and</i> EE 346 Semiconductor Device Electronics and Laboratory	4
	19

Electro-optics Concentration

Students are not allowed to enroll in EE 228 until they have a) completed PHYS 357 and MATH 344, and b) received approval of advisors in both Physics and Electrical Engineering. Students are then allowed to enroll in EE courses with physics courses substituting for EE prerequisites.

PHYS 357 Advanced Instrumentation in Exp Physics	3
PHYS 423 Advanced Optics	4
EE 228 Continuous-Time Signals and Systems	4
EE 403 Fiber Optics Communication	3
EE 418 Photonic Engineering	3
EE 443 Fiber Optics Laboratory	1
EE 458 Photonic Engineering Laboratory	1
	19

Statistics

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Jimmy A. Doi	Jeff C. Sklar
Ulric J. Lund	Kent D. Smith
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ACADEMIC PROGRAMS

BS Statistics
Statistics Minor

The Statistics Department has two primary purposes—to offer introductory statistics courses to students from many different majors at Cal Poly, and to offer a curriculum of diverse statistics courses for those students pursuing a Bachelor of Science degree in Statistics or a minor in the discipline.

In this age of high technology it has become increasingly easy to record and store information resulting from experiments, surveys, and historical studies. It is the responsibility of the professional statistician to determine the best ways to collect, summarize and analyze these data. Because of the increasing number of quantitative studies that are conducted in fields ranging from medicine to agriculture to business, the professional statistician is in great demand.

It has been projected that the job market for those with substantial statistical training remains healthy into the foreseeable future. Recent graduates of the program at Cal Poly are working for companies in fields as varied as insurance, aircraft manufacturing, banking, computer manufacturing, and pharmaceutical development.

The statistics degree program requires students to have a solid foundation in mathematics and computer science. With this basis the students take courses in the following areas—analysis of variance, regression analysis, statistical use of computers, sampling methods, experimental design, analysis of categorical data, multivariate analysis, time series and forecasting, probability, and mathematical statistics. In the various courses the students make use of computing facilities available at Cal Poly.

Throughout the program faculty encourage students to work on practical, realistic problems that require the

understanding of all aspects of the data acquisition and analysis process.

STATISTICS MINOR

The Statistics minor program allows students from across the University to acquire substantial statistical skills that can be applied in their own disciplines.

- Select one of the following introductory sequences** 8–9
- STAT 217 Introduction to Statistical Concepts and Methods (4) *and* STAT 313 Applied Experimental Design and Regression Models (4)
 - STAT 218 Applied Statistics-Life Sciences (4) *and* STAT 313 Applied Experimental Design and Regression Models (4)
 - STAT 221 Intro Probability and Statistics (5) *and* STAT 313 Applied Experimental Design and Regression Models (4)
 - STAT 251 Statistical Inference for Mgmt. I (4) *and* STAT 252 Statistical Inference for Mgmt. II (5)
 - STAT 301 Statistics I (4) *and* STAT 302 Statistics II (4)
 - STAT 312 Statistical Methods for Engineers (4) *and* STAT 323 Design and Analysis of Experiments (4)
 - STAT 321 Probability and Statistics for Engineers and Scientists (4) *and* STAT 322 Statistical Analysis for Engineers and Scientists (4)
- ¹ **Select two from the following** 8
- STAT 323 Design and Analysis of Experiments (4)
 - STAT 324 Applied Regression Analysis (4)
 - STAT 330 Statistical Computing I: SAS (4)
- STAT 400-level electives** 8
(excluding STAT 400, STAT 465, STAT 470, STAT 485, STAT 495)
- Select one course** from outside the Statistics Department, with the approval of the Statistics Department Minor Coordinator, that has substantial statistical applicability 3-4

27-29

¹ Students entering the minor who take STAT 312 as their initial course must stake STAT 324 and STAT 330 in this category.

BS STATISTICS

- ☐ 60 units upper division ☐ GWR
 ☐ 2.0 GPA ☐ USCP

* = Satisfies General Education requirement

Course sequencing: See flowcharts at

www.calpoly.edu/~cosamac

MAJOR COURSES

STAT 150 Introduction to Statistical Investigations	4
MATH 141 Calculus I (B1)*	4
MATH 142 Calculus II (B1)*	4
MATH 143 Calculus III	4
MATH 206 Linear Algebra I	4
MATH 241 Calculus IV	4
STAT 301 Statistics I	4
STAT 302 Statistics II	4
STAT 323 Design and Analysis of Experiments I	4
STAT 324 Applied Regression Analysis	4
STAT 325 Introduction to Probability Models	4
STAT 330 Statistical Computing I: SAS	4
STAT 425 Probability Theory	4
STAT 426 Estimation and Sampling Theory	4
STAT 427 Mathematical Statistics	4
STAT 461 Senior Project I	1
STAT 462 Senior Project I	2
STAT 465 Statistical Communication and Consulting	4
¹ CSC, MATH, STAT electives	11-12
Statistics electives (400 level)	12
	90-91

SUPPORT COURSES

CSC/CPE 235 Fundamentals of Computer Science for Scientists and Engineers <i>or</i> CSC/CPE 101 Fundamentals of Computer Science I	4
MATH 248 Methods of Proof in Mathematics	4
Advisor approved technical electives	8
	16

GENERAL EDUCATION (GE)

72 units required; 8 units are in Major.

→See page 56 for complete GE course listing.

→Minimum of 12 units required at the 300-400 level.

Area A Communication (12 units)

A1 Expository Writing	4
A2 Oral Communication	4
A3 Reasoning, Argumentation, and Writing	4

Area B Science and Mathematics (8 units)

B1 Mathematics/Statistics * 8 units in Major	0
B2 Life Science	4
B3 Physical Science	4
B4 One lab taken with either a B2 or B3 course	

Area C Arts and Humanities (20 units)

C1 Literature	4
C2 Philosophy	4
C3 Fine/Performing Arts	4
C4 Upper-division elective	4
Area C elective (Choose one course from C1-C4)	4

Area D/E Society and the Individual (20 units)

D1 The American Experience (40404)	4
D2 Political Economy	4
D3 Comparative Social Institutions	4
D4 Self Development (CSU Area E)	4
D5 Upper-division elective	4

Area F Technology Elective (upper division)

(4 units)	4
	64

ELECTIVES	9-10
	180

¹ Selected from the following: CSC/CPE 102, 236; CSC 342; MATH 242, 306, 335, 336, 406, 412, 431, 437, 451; STAT 400 level courses.