Department of Biology

Biology

Biology

Bachelor of Arts

Biology

Bachelor of Science

Bioinformatics

Biology

• Ecology and Evolution Option

• Doctor of Osteopathic Medicine Articulation

Minor

Biology

Certificate Program

Biotechnology

Master of Science

Biology

The major in biology emphasizes the relationship between structure and function in living systems and the concept that biological processes can be studied at different levels of organization. The program provides a balanced blend of traditional and modern biology, incorporating the important generalizations of traditional biology and the more recent advances essential to the successful biologist or medical practitioner of the future.

The excellent facilities and equipment of the department are readily available to all students enrolled in biology courses. Qualified seniors are encouraged to engage in research projects through the independent study program. Field trips are a normal and required part of a number of courses.

Many career opportunities are available to the student majoring in biology. The undergraduate program provides an excellent background for further work in medicine, dentistry, veterinary medicine and graduate programs. It can also serve for entry into a career in education, industry and governmental organizations.

Preprofessional students of medicine, dentistry or other science-based fields seeking a major in biology should consult with a departmental advisor.

Teaching Credential Program

Teaching Credential Preparation Subject Matter Preparation Program in Science: Biology

Bioinformatics

Department of Biology

Biology students wishing to pursue a single subject teaching credential in science with a concentration in biology will need to take the CSET series examination. In order to learn the range of content covered in the CSET, it is recommended that the biology student should, in addition to the requirements for the Bachelor of Arts or Bachelor of Science in Biology, take the following courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ASTR 103</td>
<td>Descriptive Astronomy</td>
<td>5</td>
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<tr>
<td>GEOL 101</td>
<td>Introductory Geology</td>
<td>5</td>
</tr>
<tr>
<td>GEOL 250</td>
<td>Historical Geology</td>
<td>5</td>
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In addition, certain prerequisites and professional education courses are required. For information about admission to the teacher education program, education courses required, or the specific requirements of the single subject teaching credential in science program, contact the Department of Teacher Education and Foundations in the College of Education.

Honors in Biology

Candidacy for departmental honors in biology is voluntary. To be eligible a student must fulfill the following requirements:

1. Achieve a minimum grade point average of 3.5 for all courses satisfying the requirements for the major (as defined above);
2. Take at least five courses in the major at this university;
3. Satisfactorily complete BIOL 596. Independent Research;
4. Satisfactorily complete the departmental comprehensive examination.

Application for candidacy must be made at the beginning of the senior year. Approval of candidacy and of the project and project advisor rests with the department. The project advisor will have sole responsibility for acceptance of the completed project.

The department may grant honors to exceptional students who fail to meet the above requirements, but who have in the judgment of the department brought distinction upon themselves and the department in some other appropriate manner.

Bioinformatics

Department of Biology

Bioinformatics is essentially the interdisciplinary study of biology and biochemical systems using mathematics and computer science. Bioinformatics is a growing area, with many definitions and descriptions. Bioinformatics is the use of computers and statistics to make sense out of the huge mounds of data that are accumulating from high-throughput biological and chemical experiments, such as sequencing of whole
gnomes, DNA microarray chips, two-hybrid experiments, and tandem mass spectrometry.

There are three different approaches to bioinformatics:

1. Tool building. Creating new programs and methods for analyzing and organizing data.
2. Tool using. Using existing programs and data to answer biologically interesting questions.
3. Tool maintenance. Setting up databases, translating biologists’ questions into ones that programs can answer, keeping the tools working and the databases up to date.

The main goal of the degree is to prepare the students for graduate studies in bioinformatics. A secondary goal is to provide the students with very relevant bioinformatics skills that will be useful for Research and Development in the growing biotechnology industries.

The degree is jointly administered by the Department of Biology, the Department of Chemistry and Biochemistry, and the School of Computer Science and Engineering. The program is housed in the School of Computer Science and Engineering.

Current Faculty
Nicole Bournias-Vardiabasis, Professor
B.S. 1975, University of California, Irvine
Ph.D. 1978, University of Essex, United Kingdom

Michael Y. Chao, Professor, Chair
B.S. 1993, National Taiwan University
Ph.D. 2001, University of Texas Southwestern Medical Center

Jeremy Dodsworth, Assistant Professor
B.S. 2000, University of Wisconsin, Madison
Ph.D. 2006, University of Washington

James A. Ferrari, Professor
B.A. 1975, Queens College, City University of New York
M.S. 1979, Ph.D. 1985, University of California, Riverside

Angela Horner, Associate Professor
B.S. 2000, Centre College
M.S. 2005, University of Cincinnati
Ph.D., 2010, Ohio University - Main Campus

Anthony E. Metcalf, Professor
B.A. 1977, Simon Fraser University
B.S. 1988, Ph.D. 1998, University of California, Riverside

Laura Newcomb, Professor
B.S. 1995, University of Wisconsin, Milwaukee
Ph.D. 2001, University of Wisconsin, Madison

Daniel Nickerson, Assistant Professor
B.S. 2000, Kenyon College
Ph.D. 2008, University Of Colorado at Boulder

Paul M. Orwin, Professor
B.S. 1991 Harvey Mudd College
Ph.D. 2001, University of Minnesota

Tomasz Owerekowicz, Associate Professor

David Polcyn, Professor, Associate Chair

B.A. 1981, California State University, Fullerton
M.A. 1983, Ph.D. 1988, University of California, Riverside

Breanna Putman, Assistant Professor
B.S. 2010, California Polytechnic State University San Luis Obispo
Ph.D. 2016, San Diego State

David Rhoads, Associate Professor
B.S. 1994, Pennsylvania State University
Ph.D., 1992, Michigan State University

John Skillman, Professor
B.S. 1988, Oregon State University
Ph.D. 1994, Duke University

David Smith, Assistant Professor
B.S. 2001, Texas State University
Ph.D. 2012, Northern Arizona University

Stuart S. Sumida, Professor

Kimberlyn Williams, Professor
B.A. 1979, University of California, Davis
Ph.D. 1987, Stanford University

Emeriti
Klaus Brasch, Professor
Sarojam Mankau, Professor
Jeffrey M. Thompson, Professor
Ruth Wilson, Professor

Undergraduate Degrees
Bachelor of Arts
• Biology (http://bulletin.csusb.edu/colleges-schools-departments/natural-sciences/biology/biology-ba/)

Bachelor of Science
• Bioinformatics (http://bulletin.csusb.edu/colleges-schools-departments/natural-sciences/biology/bioinformatics-bs/)
• Biology (http://bulletin.csusb.edu/colleges-schools-departments/natural-sciences/biology/biology-bs/) with options in:
  • Ecology and Evolution (http://bulletin.csusb.edu/colleges-schools-departments/natural-sciences/biology/biology-ecology-evolution-option-bs/)
  • Doctor of Osteopathic Medicine Articulation Program (http://bulletin.csusb.edu/colleges-schools-departments/natural-sciences/biology/biology-doctor-osteopathic-medicine-articulation-bs/)

Graduate Degree
Master of Science
• Biology (http://bulletin.csusb.edu/colleges-schools-departments/natural-sciences/biology/biology-ms/)
Minors

- Biology (http://bulletin.csusb.edu/colleges-schools-departments/natural-sciences/biology/biology-minor/)

Certificate Program

- Biotechnology (http://bulletin.csusb.edu/colleges-schools-departments/natural-sciences/biology/biotechnology-certificate/)

Courses

BIOL 100. Topics in Biology. 5 Units.

(GE=B2)
Provides a broad understanding of biology, our molecular-organismic-ecological heritage and humankind’s place within the biosphere. Four hours lecture and three hours laboratory. Materials fee required.

BIOL 200. Biology of the Cell. 5 Units.

Provides basic understanding of the process of life and the universality of life processes at the molecular and cellular level. Four hours lecture and three hours laboratory. A strong background equivalent to one year each of high school biology and chemistry is highly recommended. Materials fee required.

BIOL 201. Biology of Organisms. 5 Units.

Prerequisites: BIOL 200 with a grade of C or better
Provides basic understanding of the functional attributes of organisms and their diversity. Includes examination of their comparative and evolutionary relationships. Four hours lecture and three hours laboratory. Materials fee required.

BIOL 202. Biology of Populations. 5 Units.

Prerequisites: BIOL 201 with a grade of C or better
(GE=B2)
Provides a basic understanding of the principles of genetics, evolution and ecology of organisms, populations, and communities. Four hours lecture and three hours laboratory. Materials fee required.

BIOL 216. Genetics and Society. 2 Units.

(GE=B4)
Technological advances in human genetics and their impact on society. Biological and ethical perspectives of the application of genetic research. Two hours lecture.

BIOL 217. Biology of Sexually Transmitted Diseases. 2 Units.

(GE=B4)
The pathogenesis, biology of the agent, treatment and diagnosis of the prominent sexually transmitted diseases. Impact of current biotechnology in relation to vaccine development, experimental treatments, and improved diagnostics and screening. Two hours lecture.

BIOL 220. Principles of Microbiology. 5 Units.

Prerequisites: one lower-division biology course
Morphology, physiology and classification of bacteria, fungi and viruses. Microbiology of air, soil and dairy products; rudiments of infection and immunity. Laboratory training in culture preparation, sterilization, inoculation and identification. Four hours lecture and three hours laboratory Materials fee required. Students enrolling in this course for a third time may do so only with the consent of instructor. (BIOL 100 strongly recommended).

BIOL 223. Human Physiology and Anatomy I. 5 Units.

Prerequisites: BIOL 100 and currently a major in B.S. in Nursing or B.S. in Health Science or B.S. in Nutrition and Food Science or B.S. in Kinesiology or Minor in Kinesiology or consent of instructor
Comprehensive study of human form and function including living chemistry, cells, tissues, skeletal, muscular and nervous systems. Four hours lecture and three hours laboratory. Materials fee required. Students enrolling in this course for a third time may do so only with the consent of instructor.

BIOL 224. Human Physiology and Anatomy II. 5 Units.

Prerequisites: BIOL 223 and currently a major in B.S. in Nursing or B.S. in Health Science or B.S. in Nutrition and Food Science or B.S. in Kinesiology or Minor in Kinesiology or consent of instructor
Continuation of BIOL 223 with coverage of special senses, digestive, respiratory, cardiovascular, urinary, endocrine and reproductive systems. Four hours lecture and three hours laboratory. Materials fee required. Students enrolling in this course for a third time may do so only with the consent of instructor.

BIOL 251. Readings in Ecosystem Biology. 1 Unit.

Prerequisite/Corequisite: BIOL 349. Must be completed within two quarters of having completed BIOL 349
Selected assigned readings in ecosystem biology. For students formally enrolled in the University Honors Program and in BIOL 349. One hour of discussion.

BIOL 295A. Special Studies in Biology. 1 Unit.

Prerequisites: consent of instructor
Investigation, research, or study of a selected topic, the topic title to be specified in advance. May repeat for credit as topics change.

BIOL 295B. Special Studies in Biology. 2 Units.

Prerequisites: consent of instructor
Investigation, research, or study of a selected topic, the topic title to be specified in advance. May repeat for credit as topics change.

BIOL 300. Cell Physiology. 5 Units.

Prerequisites: BIOL 200, BIOL 201 and BIOL 202 with grades of C or better; CHEM 215 and CHEM 216
Study of cell properties, organization and activities; consideration of structure-function relationships of cellular membranes, the cell surface and cytoskeletal elements; metabolism of cell growth, maturation, specialized function and reproduction. Four hours lecture and three hours laboratory. Materials fee required.

BIOL 301. Biology in the Classroom. 4 Units.

A comprehensive survey of the design and function of living organisms, from the cellular through the ecosystem levels as these relate to instruction in the elementary and middle school classroom. Unifying concepts such as evolution, energetics and the chemical nature of life will be stressed throughout. Three hours lecture and three hours laboratory. Materials fee required. This course does not satisfy any requirements for the B.A. or B.S. major in Biology.
BIOL 304. Biology of Cancer. 4 Units.
Prerequisites: BIOL 100
A comprehensive survey of the biological principles underlying the causes and treatment of cancer. Topics include the genetics of cancer, factors affecting tumor growth, host defense against cancer cells, and modern therapeutic protocols. Four hours lecture. This course does not satisfy requirements for the B.A. and B.S. majors in biology.

BIOL 305. Biology of the Dinosauria. 4 Units.
Prerequisites: one lower-division biology course
A survey of major groups of dinosaurs, their interrelationships, and biology. Examples from dinosaurs and their close relatives are used to highlight and explain important issues and topics in biology such as anatomy, evolution, biogeography, climate change, ecology, the use of the scientific literature, and popular interpretations of science. This course does not satisfy any requirements for the B.A. or B.S. in Biology. Four hours lecture.

BIOL 306. Human Heredity and Development. 4 Units.
Prerequisites: one lower-division biology course
Introductory course in human development. Emphasis on the principles of heredity as they apply to normal human developmental sequences from fertilization to adolescence. Birth defects relating to heredity, and drug or other environmental factors will illustrate how developmental sequences can be modified before birth. This course does not satisfy any requirements for the B.A. or B.S. in Biology.

BIOL 314. Biology of Human Sexuality. 4 Units.
Prerequisites: one lower-division biology course
Biological aspects of human anatomy, physiology and behavior as related to sexual reproduction including discussion of fertility, pregnancy, childbirth and birth control; consideration also given to homosexuality, sexually transmitted diseases, sexual intercourse and response. Four hours lecture. This course does not satisfy any requirements for the B.A. or B.S. in Biology.

BIOL 319. Local Flora. 5 Units.
Prerequisites: BIOL 300 with a grade of C or better or consent of instructor
Identification of the flora and ecological communities of southern California with a consideration of taxonomic principles. Field collections, four hours lecture and three hours laboratory. Materials fee required.

BIOL 320. Microorganisms. 6 Units.
Prerequisites: BIOL 300 with a grade of C or better
Study of microbial organisms: their cell structure and function, metabolism, genetics and ecology with an introduction to bacterial, viral, fungal, and protozoan pathogens. Four hours lecture and six hours laboratory. Materials fee required.

BIOL 321. Evolution. 4 Units.
Prerequisites: BIOL 300 with a grade of C or better
Darwin, views of evolution and their implications in various disciplines. Four hours lecture.

BIOL 323. Human Anatomy for Biology Majors. 6 Units.
Prerequisites: BIOL 300 with a grade of C or better
Comprehensive study of the human form in the broader context of vertebrate animals. Topics include the anatomy of early development and the following systems: integumentary, skeletal, muscular, nervous, digestive, respiratory, cardiovascular, excretory, reproductive, and endocrine and special senses. Four hours lecture and three hours laboratory. Materials fee required.

BIOL 324. Human Physiology for Biology Majors. 5 Units.
Prerequisites: BIOL 300 with a grade of C or better
Comprehensive study of the human form in the broader context of vertebrate animals. Topics include the physiology of the following systems: integumentary, skeletal, muscular, nervous, digestive, respiratory, cardiovascular, excretory, reproductive, and endocrine and special senses. Four hours lecture and six hours laboratory. Materials fee required.

BIOL 331. Biology of Invertebrates. 5 Units.
Prerequisites: BIOL 300 with a grade of C or better
A study of the evolution, anatomy, classification and habits of insects and related arthropods. Field collections, four hours lecture and three hours laboratory. Materials fee required.

BIOL 334. Biology of the Dinosauria. 4 Units.
Prerequisites: one lower-division biology course
A survey of major groups of dinosaurs, their interrelationships, and biology. Examples from dinosaurs and their close relatives are used to highlight and explain important issues and topics in biology such as anatomy, evolution, biogeography, climate change, ecology, the use of the scientific literature, and popular interpretations of science. This course does not satisfy any requirements for the B.A. or B.S. in Biology. Four hours lecture.

BIOL 335. Entomology. 5 Units.
Prerequisites: BIOL 300 with a grade of C or better
The evolution, ecology, physiology and anatomy of invertebrate phyla with emphasis on phylogenetic changes. Four hours lecture and three hours laboratory. Materials fee required.

BIOL 336. Comparative Vertebrate Anatomy. 6 Units.
Prerequisites: BIOL 300 with a grade of C or better
Structural, developmental and ecological changes in the evolution of the chordate groups with an emphasis on comparative vertebrate anatomy. Four hours lecture and six hours laboratory. Materials fee required.

BIOL 337. Human Anatomy. 6 Units.
Prerequisites: BIOL 300 with a grade of C or better
Comprehensive study of the human form in the broader context of vertebrate animals. Topics include the anatomy of early development and the following systems: integumentary, skeletal, muscular, nervous, digestive, respiratory, cardiovascular, excretory, reproductive, and endocrine and special senses. Four hours lecture and three hours laboratory. Materials fee required.

BIOL 338. Human Physiology. 6 Units.
Prerequisites: BIOL 300 with a grade of C or better
Comprehensive study of the human form in the broader context of vertebrate animals. Topics include the physiology of the following systems: integumentary, skeletal, muscular, nervous, digestive, respiratory, cardiovascular, excretory, reproductive, and endocrine and special senses. Four hours lecture and three hours laboratory. Materials fee required.

BIOL 340. Comparative Embryology. 4 Units.
Prerequisites: BIOL 300 with a grade of C or better
BIOL 342 strongly recommended
Descriptive survey of developmental patterns of tissue and organ formation to include studies of insects, echinoderms, and amphibian, avian, reptilian, marsupial plus placental mammalian vertebrate embryology. Three hours lecture and three hours laboratory. Materials fee required.

BIOL 342. Biology of Chordates. 6 Units.
Prerequisites: BIOL 300 with a grade of C or better
Structural, developmental and ecological changes in the evolution of the chordate groups with an emphasis on comparative vertebrate anatomy. Four hours lecture and six hours laboratory. Materials fee required.

BIOL 343. Mammalogy. 6 Units.
Prerequisites: BIOL 300 with grade "C" or better
Introduction to the biology of extant mammals (including humans) and their extinct synapsid ancestors. Discussion of anatomy, physiology, behavior and ecology in and evolutionary context. Laboratory exercises focused on identification, collection and preparation of specimens, coupled with field observations of diverse local fauna and study of museum specimens. Four hours lecture and six hours laboratory. Materials fee required.
BIOL 344. Herpetology. 6 Units.
Prerequisites: BIOL 300 with grade "C" or better
Introduction to the biology of extant amphibians (frogs, salamanders and caecilians) and reptiles (turtles, crocodilians, lizards and snakes). Discussion of anatomy, Physiology, behavior and ecology in the context of tetrapod evolution. Laboratory exercises focused on identification, collection and preparation of specimens, coupled with field observations of diverse local fauna and study of museum specimens. Four hours lecture and six hours laboratory. Materials fee required.

BIOL 345. Ornithology. 6 Units.
Prerequisites: BIOL 300 with grade "C" or better
Introduction to the biology of birds. Course includes study of the functional morphology, ecology and behavior, and the evolutionary relationships among extant taxa. Laboratory exercises will focus on identification, and museum studies, coupled with field observations of avian species diversity and associated habitats with an emphasis on resident and migratory species of southern California. Four hours lecture and six hours laboratory. Materials fee required.

BIOL 349. Biology of Ecosystems. 5 Units.
Prerequisites: one lower division course in biology
Survey of the heredity and environmental factors that influence the survival and reproduction of the organisms that compose the dynamic ecosystems of planet Earth with a consideration of evolution and extinction. Four hours lecture and three hours laboratory. Materials fee required. This course does not satisfy requirements for the B.A. or B.S. in Biology. Formerly BIOL 250.

BIOL 354. Biology of Higher Plants. 6 Units.
Prerequisites: BIOL 300 with a grade of C or better
Comparative morphology of ferns, fern allies and seed plants, with a consideration of their phylogenetic relationships. Four hours lecture and six hours laboratory. Materials fee required.

BIOL 371. Parasitology. 5 Units.
Prerequisites: BIOL 300 with a grade of C or better
Study of the nature and principles of parasitism with a survey of various groups of animal parasites. Four hours lecture and three hours laboratory. Materials fee required.

BIOL 380. Medical and Economic Botany. 4 Units.
Prerequisites: BIOL 300 with a grade of C or better
Survey of medically and economically important plant species and families. Includes plants harmful and beneficial to humans, with emphasis on vascular species. Four hours lecture.

BIOL 390. Biology Seminar. 1 Unit.
Prerequisites: BIOL 300 with a grade of C or better
Topics of current biological interest, presented by students, faculty, and guest speakers. May be taken once for credit toward the major. May be taken three times for credit toward elective units in the Master of Science in Biology. Lecture only. Formerly BIOL 390. Graded credit/no credit.

BIOL 391. Seminar in Biology. 2 Units.
Prerequisites: BIOL 200, 201, 202 and 300
Topics of current biological interest, presented by guest speakers, current faculty, and students are analyzed with associated primary literature and written summaries. May be taken once for credit toward the major. One hour lecture and three hours activity. Materials fee required. Concurrent enrollment in BIOL 390 and 391 is not allowed. Graded credit/no credit.

BIOL 396A. Directed Study. 1 Unit.
Prerequisites: consent of instructor and departmental approval of a written proposal submitted on a standard application form filed in advance of the quarter in which the course is to be taken
Reading and library research in an area of biology conducted under the direction of a faculty member in the Department of Biology. No more than two units may be applied toward a biology elective for graduation. Graded credit/no credit.

BIOL 396B. Directed Study. 2 Units.
Prerequisites: consent of instructor and departmental approval of a written proposal submitted on a standard application form filed in advance of the quarter in which the course is to be taken
Reading and library research in an area of biology conducted under the direction of a faculty member in the Department of Biology. No more than two units may be applied toward a biology elective for graduation. Graded credit/no credit.

BIOL 400. Molecular Biology. 5 Units.
Prerequisites: BIOL 300 with a grade of C or better and CHEM 223 or CHEM 323
A basic course in molecular biology with emphasis on informational macromolecules and how they direct molecular processes in both eukaryotic and prokaryotic cells. Four hours lecture and six hours laboratory. Materials fee required.

BIOL 413. Biology of Stem Cells. 3 Units.
Prerequisites: BIOL 300 with a grade of C or better
Examination of fundamental concepts and themes in stem cell-based regenerative medicine: pluripotency and reprogramming, cell types, organ systems, stem cells and therapeutics an ethics. Experimental approaches and emerging areas in stem cell research addressed in seminars from visiting scholars/scientists and with readings from the primary literature. Three hours lecture.

BIOL 420. Medical Microbiology. 6 Units.
Prerequisites: BIOL 300 with a grade of C or better and BIOL 320 or consent of instructor
An overview of topics and lab techniques in medical microbiology, emphasizing the biology of medically relevant bacteria, viruses, fungi and protozoa. The course will focus on the host-pathogen interaction, including the actions of the pathogenic microorganism and the immune response, as well as the overall host microbiome as an ecosystem perturbed by infection. Four hours of lecture and six hours laboratory. Materials fee required.

BIOL 423. Genetics. 5 Units.
Prerequisites: BIOL 300 with a grade of C or better
Principles of classical and modern genetics including an introduction to population genetics. Four hours lecture and three hours laboratory. Materials fee required. Formerly BIOL 421 and BIOL 422.

BIOL 424. Comparative Animal Physiology. 6 Units.
Prerequisites: BIOL 300 with a grade of C or better
A comparative analysis of the physiological mechanisms and processes of animals with emphasis on trends of evolutionary specialization. Four hours lecture and six hours laboratory. Materials fee required.
BIOL 427. Functional Microbial Genomics. 4 Units.
Training in microbiology and molecular biology laboratory skills, biotechnology research, and the broader concepts of genomics and genome database/bioinformatics/cyber infrastructure applications. Mastering the process of science, experimental design, critical thinking, and real-life research problem solving will be stressed. Materials fee required. Prerequisites: BIOL 300 with grade "C" or better and BIOL 400.

BIOL 431. Comparative Plant Physiology. 6 Units.
Prerequisites: BIOL 300 with a grade of C or better, and CHEM 223 or CHEM 323
Analysis of physiological activity at the various levels of cells, tissues, organs and organisms. Four hours lecture and six hours laboratory. Materials fee required.

BIOL 440. Principles of Development. 5 Units.
Prerequisites: BIOL 300 with a grade of C or better, and CHEM 223 or 323
Comparative analysis of patterns and processes of development of organisms, with emphasis on the role of genetic and biochemical mechanisms. Four hours lecture and three hours laboratory. Materials fee required.

BIOL 450. Ecology. 5 Units.
Prerequisites: BIOL 300 with a grade of C or better; and MATH 120, MATH 192 or MATH 211; or consent of instructor
Analysis of the interrelationships of organisms and their physical and biotic environment with a consideration of the role of the environment in natural selection. Four hours lecture and three hours laboratory. Materials fee required.

BIOL 455. Marine Biology and Ecology. 5 Units.
Prerequisites: BIOL 300 with a grade of C or better or consent of instructor
Examination of various marine ecosystems with an analysis of the interactions between organisms and their physical and biotic environments. Laboratory emphasizes southern Californian coastal communities. Four hours lecture and three hours laboratory/field studies. Materials fee required.

BIOL 490A. Special Topics. 1 Unit.
Prerequisites: BIOL 300 with a grade of C or better and consent of instructor
Group study of a selected topic, the title to be specified in advance. May be repeated for credit as topics change.

BIOL 490B. Special Topics. 2 Units.
Prerequisites: BIOL 300 with a grade of C or better and consent of instructor
Group study of a selected topic, the title to be specified in advance. May be repeated for credit as topics change.

BIOL 490C. Special Topics. 3 Units.
Prerequisites: BIOL 300 with a grade of C or better and consent of instructor
Group study of a selected topic, the title to be specified in advance. May be repeated for credit as topics change.

BIOL 490D. Special Topics. 4 Units.
Prerequisites: BIOL 300 with a grade of C or better and consent of instructor
Group study of a selected topic, the title to be specified in advance. May be repeated for credit as topics change.

BIOL 491A. Special Laboratory Topics. 1 Unit.
Prerequisites: BIOL 300 with a grade of C or better and 15 units of upper-division biology course work
Group laboratory study of a selected topic, the title to be specified in advance. May be repeated for credit as topics change. Materials fee required.

BIOL 491B. Special Laboratory Topics. 2 Units.
Prerequisites: BIOL 300 with a grade of C or better and 15 units of upper-division biology course work
Group laboratory study of a selected topic, the title to be specified in advance. May be repeated for credit as topics change. Materials fee required.

BIOL 491C. Special Laboratory Topics. 3 Units.
Prerequisites: BIOL 300 with a grade of C or better and 15 units of upper-division biology course work
Group laboratory study of a selected topic, the title to be specified in advance. May be repeated for credit as topics change. Materials fee required.

BIOL 502. Genetic Engineering. 4 Units.
Prerequisites: BIOL 300 with a grade of C or better, BIOL 400, and CHEM 223 or CHEM 323
Basic course on recombinant DNA technology, concentrating on major DNA manipulation methods, use of vectors, genetic probes, construction of libraries, transgenic animals, plant genetic engineering and ethical and safety considerations. Four hours lecture. Formerly BIOL 402.

BIOL 503. Plant Biology for Teachers. 4 Units.
Prerequisites: one college-level biology course and graduate or postbaccalaureate standing, or consent of instructor
Examination of plant anatomy, morphology, physiology, ecology, and human use, as it applies to the Science Content Standards for California Public Schools. Not acceptable for meeting formal course requirements for the B.A., B.S., or M.S. in biology at CSUSB. Three hours lecture and three hours laboratory. Materials fee required.

BIOL 505. Biostatistics. 5 Units.
Prerequisites: BIOL 300 with a grade of "C" or better, MATH 192 or 211, and consent of instructor
Provides an understanding of the design of biological experiments and analysis of data. Topics will include experimental design and sampling protocols, techniques for displaying and describing data, probability, and hypothesis testing. Surveys statistical approaches to the analysis of proportions and frequencies, comparisons of means among numerical variables, regression, and correlation, as well as non-parametric approaches. (Formerly a topic under BIOL 490). Four hours lecture and three hours laboratory.
BIOL 513. Animal Tissue Culture. 3 Units.
Prerequisites: BIOL 300 with a grade of C or better
Introductory theory and concepts of animal tissue culture including fundamentals of tissue culture techniques, sub-culturing and maintenance of cell lines. Strong emphasis on stem cell technology. Two hours lecture and three hours laboratory. Materials fee required.

BIOL 514. Conservation Biology. 4 Units.
Prerequisites: BIOL 300 with a grade of "C" or better, and BIOL 321 or 450
Examination of factors influencing the loss of biological diversity including habitat loss and fragmentation, loss of genetic variation, and species extinction. The science of biological conservation necessarily overlaps with other disciplines including wildlife and resource management, law, economics, and ethics.

BIOL 515. Global Change Biology. 4 Units.
Prerequisites: BIOL 300 with a grade of "C" or better, and an upper-division lab course in ecology (BIOL 349, BIOL 450, or BIOL 455) or consent of instructor
An examination of changing ecological and biogeochemical system interactions at selected times in the earth's history including, but not limited to, the modern era. Class exploration of causes and consequences of contemporary global change for biological systems including displaced populations, disrupted ecological interactions, and altered epidemiological patterns.

BIOL 516. Introduction to Regulatory Affairs in the Life Sciences. 3 Units.
Prerequisites: BIOL 300 with a grade of "C" or better and consent of the instructor
Introduces the pharmaceutical, biotechnology and biologics industries and the laws and regulations of these products. Discussion of company organization, product development, and commercialization-associated activities. Three hours lecture.

BIOL 517. Laboratory in Human Embryonic Stem Cell Culture. 3 Units.
Prerequisites: BIOL 300 with a grade of "C" or better and consent of instructor
Advanced laboratory training in plating and passaging of human embryonic stem cells and human induced pluripotent stem cells. Mastery of a variety of cell culture techniques including isolation and culturing techniques including isolation and culturing of mouse embryonic fibroblasts, PCR and flow cytometry and immunohistochemistry on human embryonic stem cells and embryoid bodies. One hour of lecture 6 hours of lab. Materials fee required.

BIOL 522. Population Genetics. 4 Units.
Prerequisites: BIOL 423 and MATH 192 or 211
Genetic and ecological mechanisms influencing the development, maintenance and evolution of populations. Four hours lecture.

BIOL 524. Advanced Vertebrate Morphology. 3 Units.
Prerequisites: BIOL 342, BIOL 424 and consent of instructor
Advanced techniques in the study of vertebrates, including dissection and specimen preparation. Construction of animal skeletal materials, and detailed study and dissection of vertebrate organ systems will provide the basis for projects designed on an individual student basis. Two hours lecture and three hours laboratory. Materials fee required.

BIOL 525. Vertebrate Field Biology. 5 Units.
Prerequisites: BIOL 300 with a grade of C or better, BIOL 450, and consent of instructor. Three hours lecture and six hours laboratory
Field study of the ecology and natural history of the vertebrate fauna of southern California.

BIOL 528. Concepts of Molecular Genetics. 4 Units.
Prerequisites: BIOL 300 with a grade of C or better, BIOL 400, 423, and CHEM 223 or 323
Chemical nature of genes, their replication and mode of action at the molecular level. Transfer and expression of genetic information; interaction and hybridization of genes, molecular mutagens and molecular evolution. Four hours lecture. Formerly BIOL 428.

BIOL 530. Microscopy. 5 Units.
Prerequisites: senior standing and consent of instructor
Theory and techniques of modern microscopy. Lectures on theory of optics and imaging for several types of microscopes (Light microscope, fluorescence microscope, confocal microscope, scanning probe microscope, and electron microscope). Laboratory includes hands-on training in the technical aspects of specimen preparation and microscope use. Three hours lecture and six hours laboratory. Materials fee required. (Also offered as BIOL 530. Students may not receive credit for both.).

BIOL 555. Comparative Biomechanics. 5 Units.
Prerequisites: BIOL 300 with grade of C or better, PHYS 121, PHYS 122, or consent of instructor
Examination and quantitative analysis of structure and function of animals and plants using physical principles. Application of fluid and solid mechanics to understanding the design and behavior of biologic materials. Fours hours lecture and three hours laboratory. Materials fee required.

BIOL 565. Physiological Ecology. 6 Units.
Prerequisites: BIOL 354 and 424; or 431 and 331 or 342; and 450
Physiological, biochemical and molecular attributes of organisms and their interactions with the environment. Explanations for distribution, survival and reproduction. Four hours lecture and six hours laboratory. Materials fee required.

BIOL 572. Virology. 4 Units.
Prerequisites: BIOL 400 with a grade of "C" or better
Examination of the structure, genetics and modes of replication of viruses, viroids and other related sub-cellular entities; their implications in medicine and agriculture, and their use in scientific research. Four hours lecture.

BIOL 573. Immunology. 5 Units.
Prerequisites: BIOL 400 with a grade of "C" or better
Foundations of immunology and current advances in the study of the immunological response. Laboratory examination of immunological assays applied in both research and clinical diagnostics. Four hours lecture and three hours laboratory. Materials fee required.

BIOL 575A. Internship in Biology: General. 2 Units.
Prerequisites: department approval in the quarter prior to registration
Supervised work and study in work situations involving biological research and technical skills. May be repeated for a total of six units. Only two units may be applied towards the biology major requirements. Graded credit/no credit.
BIOL 575B. Internship in Biology: Pre-Health. 2 Units.
Prerequisites: department approval in the quarter prior to registration
Supervised work and study in work situations involving biological research
and technical skills. May be repeated for a total of six units. Only two units
may be applied towards the biology major requirements. Graded credit/no
credit.

BIOL 575C. Internship in Biology; Biotechnology. 2 Units.
Prerequisites: department approval in the quarter prior to registration
Supervised work and study in work situations involving biological research
and technical skills. May be repeated for a total of six units. Only two units
may be applied towards the biology major requirements. Graded credit/no
credit.

BIOL 575D. Internship in Biology: Wildlife Biology. 2 Units.
Prerequisites: department approval in the quarter prior to registration
Supervised work and study in work situations involving biological research
and technical skills. May be repeated for a total of six units. Only two units
may be applied towards the biology major requirements. Graded credit/no
credit.

BIOL 575E. Internship in Biology: Botany. 2 Units.
Prerequisites: department approval in the quarter prior to registration
Supervised work and study in work situations involving biological research
and technical skills. May be repeated for a total of six units. Only two units
may be applied towards the biology major requirements. Graded credit/no
credit.

BIOL 575F. Internship in Biology: Science Education. 2 Units.
Prerequisites: department approval in the quarter prior to registration
Supervised work and study in work situations involving biological research
and technical skills. May be repeated for a total of six units. Only two units
may be applied towards the biology major requirements. Graded credit/no
credit.

BIOL 575G. Internship in Biology: Museum Science. 2 Units.
Prerequisites: department approval in the quarter prior to registration
Supervised work and study in work situations involving biological research
and technical skills. May be repeated for a total of six units. Only two units
may be applied towards the biology major requirements. Graded credit/no
credit.

BIOL 576. Endocrinology. 4 Units.
Prerequisites: BIOL 300 with a grade of C or better
Endocrine systems with emphasis on mechanisms for regulating the
biosynthesis, secretion, transport and actions of hormones. Four hours
lecture. Formerly BIOL 486.

BIOL 580. Neurobiology. 4 Units.
Prerequisites: BIOL 300 with a grade of C or better
Study on a cellular level of how neurons function in terms of
structure, physiology and pharmacology. Mechanisms of inter-cellular
communication, perception of sensory information, and development
and aging of the nervous system will be examined. Fours hours lecture.
Formerly BIOL 480.

BIOL 590A. Senior Seminar: Molecular. 2 Units.
Prerequisites: BIOL 300 with a grade of C or better, and a minimum of 15
upper-division units in biology courses supportive of the topic area and
senior standing
Survey of current literature, methods and ethics of scientific inquiry. May
be repeated once as topics change.

BIOL 590B. Senior Seminar: Biosystematics. 2 Units.
Prerequisites: BIOL 300 with a grade of C or better, and a minimum of 15
upper-division units in biology courses supportive of the topic area and
senior standing
Survey of current literature, methods and ethics of scientific inquiry. May
be repeated once as topics change.

BIOL 590C. Senior Seminar: Cellular. 2 Units.
Prerequisites: BIOL 300 with a grade of C or better, and a minimum of 15
upper-division units in biology courses supportive of the topic area and
senior standing
Survey of current literature, methods and ethics of scientific inquiry. May
be repeated once as topics change.

BIOL 590D. Senior Seminar: Physiology. 2 Units.
Prerequisites: BIOL 300 with a grade of C or better, and a minimum of 15
upper-division units in biology courses supportive of the topic area and
senior standing
Survey of current literature, methods and ethics of scientific inquiry. May
be repeated once as topics change.

BIOL 590E. Senior Seminar: Ecology. 2 Units.
Prerequisites: BIOL 300 with a grade of C or better, and a minimum of 15
upper-division units in biology courses supportive of the topic area and
senior standing
Survey of current literature, methods and ethics of scientific inquiry. May
be repeated once as topics change.

BIOL 590F. Senior Seminar: Bioethics. 2 Units.
Prerequisites: BIOL 300 with a grade of C or better, and a minimum of 15
upper-division units in biology courses supportive of the topic area and
senior standing
Survey of current literature, methods and ethics of scientific inquiry. May
be repeated once as topics change.

BIOL 590G. Senior Seminar: Genetics. 2 Units.
Prerequisites: BIOL 300 with a grade of C or better, and a minimum of 15
upper-division units in biology courses supportive of the topic area and
senior standing
Survey of current literature, methods and ethics of scientific inquiry. May
be repeated once as topics change.

BIOL 590H. Senior Seminar: Evolution. 2 Units.
Prerequisites: BIOL 300 with a grade of C or better, and a minimum of 15
upper-division units in biology courses supportive of the topic area and
senior standing
Survey of current literature, methods and ethics of scientific inquiry. May
be repeated once as topics change.
BIOL 590I. Senior Seminar: Microbiology. 2 Units.
Prerequisites: BIOL 300 with a grade of C or better, and a minimum of 15 upper-division units in biology courses supportive of the topic area and senior standing
Survey of current literature, methods and ethics of scientific inquiry. May be repeated once as topics change.

BIOL 590J. Senior Seminar: Zoology. 2 Units.
Prerequisites: BIOL 300 with a grade of C or better, and a minimum of 15 upper-division units in biology courses supportive of the topic area and senior standing
Survey of current literature, methods and ethics of scientific inquiry. May be repeated once as topics change.

BIOL 590K. Senior Seminar: Botany. 2 Units.
Prerequisites: BIOL 300 with a grade of C or better, and a minimum of 15 upper-division units in biology courses supportive of the topic area and senior standing
Survey of current literature, methods and ethics of scientific inquiry. May be repeated once as topics change.

BIOL 590L. Senior Seminar: Integrative Approach to Biology. 2 Units.
Prerequisites: BIOL 300 with a grade of C or better, and a minimum of 15 upper-division units in biology courses supportive of the topic area and senior standing
Survey of current literature, methods and ethics of scientific inquiry. May be repeated once as topics change.

BIOL 590M. Senior Seminar: Conservation Biology. 2 Units.
Prerequisites: BIOL 300 with a grade of C or better, and a minimum of 15 upper-division units in biology courses supportive of the topic area and senior standing
Survey of current literature, methods and ethics of scientific inquiry. May be repeated once as topics change.

BIOL 591. Biology Seminar. 1 Unit.
Prerequisites: BIOL 300 with a grade of C or better
Topics of current biological interest, presented by students, faculty, and guest speakers. May be taken once for credit toward the major. May be taken three times for credit toward elective units in the Master of Science in Biology. Lecture only. Formerly BIOL 390. Graded credit/no credit.

BIOL 592. Recombinant DNA Techniques. 4 Units.
Prerequisites: BIOL 300 with a grade of C or better and BIOL 400
Techniques utilized in genetic engineering and biotechnology areas (mainly methods for isolating and analyzing genes, including bacterial isolation, DNA isolation and restriction analysis, transformation protocols and purification and manipulation of plasmid and chromosomal DNA techniques). A final research report will be required from the student. Two hours lecture and six hours laboratory. Materials fee required. Formerly BIOL 492.

BIOL 595. All students will be required to present research findings at the Biology Department colloquium each quarter until their projects are complete. All students will be required to attend the Biology Department colloquium each quarter until their projects are complete. All students will be required to attend the Biology Department colloquium each quarter until their projects are complete.

BIOL 596A. Independent Research. 1 Unit.
Prerequisites: a minimum overall grade point average of 3.0, consent of instructor and department approval of a written proposal of a project submitted on a standard application form in advance of the quarter in which the course is to be taken. Consent must be obtained no later than the last day of the quarter preceding the quarter of enrollment. Laboratory and/or field research in selected areas of biology conducted under the direction of a faculty member. A total of six units in BIOL 596 may be applied toward graduation. Graded credit/no credit. Formerly BIOL 595. All students will be required to present research findings at least once per academic year at quarterly Biology Department colloquium until their projects are complete. All students will be required to attend the Biology Department colloquium each quarter until their projects are completed.

BIOL 596B. Independent Research. 2 Units.
Prerequisites: a minimum overall grade point average of 3.0, consent of instructor and department approval of a written proposal of a project submitted on a standard application form in advance of the quarter in which the course is to be taken. Consent must be obtained no later than the last day of the quarter preceding the quarter of enrollment. Laboratory and/or field research in selected areas of biology conducted under the direction of a faculty member. A total of six units in BIOL 596 may be applied toward graduation. Graded credit/no credit. Formerly BIOL 595. All students will be required to present research findings at least once per academic year at quarterly Biology Department colloquium until their projects are complete. All students will be required to attend the Biology Department colloquium each quarter until their projects are completed.

BIOL 596C. Independent Research. 3 Units.
Prerequisites: a minimum overall grade point average of 3.0, consent of instructor and department approval of a written proposal of a project submitted on a standard application form in advance of the quarter in which the course is to be taken. Consent must be obtained no later than the last day of the quarter preceding the quarter of enrollment. Laboratory and/or field research in selected areas of biology conducted under the direction of a faculty member. A total of six units in BIOL 596 may be applied toward graduation. Graded credit/no credit. Formerly BIOL 595. All students will be required to present research findings at least once per academic year at quarterly Biology Department colloquium until their projects are complete. All students will be required to attend the Biology Department colloquium each quarter until their projects are completed.
Biol 596D. Independent Research. 4 Units.
Prerequisites: a minimum overall grade point average of 3.0, consent of instructor and department approval of a written proposal of a project submitted on a standard application filed in advance of the quarter in which the course is to be taken. Consent must be obtained no later than the advisement period preceding the quarter of enrollment. Laboratory and/or field research in selected areas in biology conducted under the direction of a faculty member. A total of six units in BIOL 596 may be applied toward graduation. Graded credit/no credit. Formerly BIOL 595. All students will be required to present research findings at least once per academic year at quarterly Biology Department colloquium until their projects are complete. All students will be required to attend the Biology Department colloquium each quarter until their projects are completed.

Biol 596E. Independent Research. 5 Units.
Prerequisites: a minimum overall grade point average of 3.0, consent of instructor and department approval of a written proposal of a project submitted on a standard application filed in advance of the quarter in which the course is to be taken. Consent must be obtained no later than the advisement period preceding the quarter of enrollment. Laboratory and/or field research in selected areas in biology conducted under the direction of a faculty member. A total of six units in BIOL 596 may be applied toward graduation. Graded credit/no credit. Formerly BIOL 595. All students will be required to present research findings at least once per academic year at quarterly Biology Department colloquium until their projects are complete. All students will be required to attend the Biology Department colloquium each quarter until their projects are completed.

Biol 596F. Independent Research. 6 Units.
Prerequisites: a minimum overall grade point average of 3.0, consent of instructor and department approval of a written proposal of a project submitted on a standard application filed in advance of the quarter in which the course is to be taken. Consent must be obtained no later than the advisement period preceding the quarter of enrollment. Laboratory and/or field research in selected areas in biology conducted under the direction of a faculty member. A total of six units in BIOL 596 may be applied toward graduation. Graded credit/no credit. Formerly BIOL 595. All students will be required to present research findings at least once per academic year at quarterly Biology Department colloquium until their projects are complete. All students will be required to attend the Biology Department colloquium each quarter until their projects are completed.

Biol 597. Directed Study in Science Education. 1 Unit.
Prerequisites: consent of instructor and departmental approval of a written proposal submitted on a standard application form filed in advance of the quarter in which the course is to be taken. Readings and library research on the pedagogical content knowledge of a specific area of biology. This course should be taken concurrently with or shortly after taking an upper division course in the relevant area of biology. Graded credit/no credit. May be repeated for credit. No more than two units may be applied toward degree requirements for the BA in Biology-Integrated Teaching Track; no more than two units may be applied toward biology elective requirements in other degree options.

Biol 600. Advanced Topics in Molecular Biology. 2 Units.
Prerequisites: consent of instructor. An in-depth consideration of selected research areas in molecular biology. May be repeated for credit as topics change.

Biol 601. Teaching Assistant Training in Biology. 2 Units.
Prerequisites: classified standing in Masters Degree Program. Teaching assistant training in biology trains graduate students in techniques and most current presentation and teaching methods of laboratory-based biology. Course is open to graduate students only. Topics include: teaching and discussion techniques specific to biology laboratories, use of equipment-specific laboratories in the biological sciences, presentation strategies, and safety issues in biology. Successful completion of BIOL 601 is required before a student may act as a teaching assistant in the Department of Biology. Enrollment in BIOL 601 concurrent with first assignment as a teaching assistant is allowed with consent of instructor. Graded Credit/no credit.

Biol 605. Advanced Topics in Cell Biology. 2 Units.
Prerequisites: consent of instructor. An in-depth consideration of selected research areas in cell biology. May be repeated for credit as topics change.

Biol 620. Advanced Topics in Plant Biology. 2 Units.
Prerequisites: consent of instructor. An in-depth consideration of selected areas of current study in plant biology. May be repeated for credit as topics change.

Biol 622. Advanced Topics in Zoology. 2 Units.
Prerequisites: consent of instructor. An in-depth consideration of selected research areas in zoology. May be repeated for credit as topics change.

Biol 624. Advanced Topics in Physiology. 2 Units.
Prerequisites: consent of instructor. An in-depth consideration of selected research areas in physiology. May be repeated for credit as topics change.

Biol 650. Advanced Topics in Genetics. 2 Units.
Prerequisites: consent of instructor. An in-depth consideration of selected research areas in genetics. May be repeated for credit as topics change.

Biol 651. Advanced Topics in Molecular Genetics. 2 Units.
Prerequisites: consent of instructor. An in-depth examination of current research in molecular genetics. May be repeated as topics change.

Biol 660. Advanced Topics in Development. 2 Units.
Prerequisites: consent of instructor. An in-depth consideration of selected research areas in developmental biology. May be repeated for credit as topics change.
BIOL 664. Biosystematics. 2 Units.
Prerequisites: BIOL 423 and one taxonomy-based course; e.g. BIOL 319, 331, 335, 342, 353, or 354. Recommended: MATH 305
Fundamental concepts of classification systems, biometric and experimental taxonomic procedures, nomenclature and systematic literature; both plant and animal materials used.

BIOL 670. Advanced Topics in Ecology. 2 Units.
Prerequisites: BIOL 450 or equivalent
Literature survey of specific topics related to community or ecosystem dynamics. May be repeated for credit as topics change.

BIOL 675. Advanced Topics in Parasitology. 2 Units.
Prerequisites: consent of instructor
An in-depth consideration of selected research areas in parasitology. May be repeated for credit as topics change.

BIOL 677. Advanced Topics in Immunology. 2 Units.
Prerequisites: BIOL 573
An in-depth examination of current research in cellular and molecular immunology. May be repeated for credit as topics change.

BIOL 678. Advanced Topics in Microbiology. 2 Units.
Prerequisites: BIOL 220 or BIOL 320
An in-depth examination of current research in microbiology. May be repeated for credit as topics change.

BIOL 680. Advanced Topics in Evolution. 2 Units.
Prerequisites: consent of instructor
Topics of current research interest in plant or animal evolution. May be repeated for credit as topics change.

BIOL 690. Graduate Seminar in Biology. 2 Units.
Selected topics and reviews of current investigations in the fields of biology. Required of all graduate students in biology. May be repeated for credit as topics change.

BIOL 691. Current Topics in Biology. 1 Unit.
Faculty supervised discussion in journal club format. Students will learn how to interpret, evaluate, present, and critique recently published research articles in various subfields of biology. May be repeated up to three times for credit. Graded credit/no credit.

BIOL 692A. Graduate Research Methods in Biology. 1 Unit.
Prerequisites: classified standing in Masters Degree Program and consent of instructor
Specialized topics in research methods including theory and technique. Topics may vary. Two hours laboratory per unit of credit. May be repeated for credit, but no more than six units may be applied toward the degree. Graded credit/no credit.

BIOL 692B. Graduate Research Methods in Biology. 2 Units.
Prerequisites: classified standing in Masters Degree Program and consent of instructor
Specialized topics in research methods including theory and technique. Topics may vary. Two hours laboratory per unit of credit. May be repeated for credit, but no more than six units may be applied toward the degree. Graded credit/no credit.

BIOL 692C. Graduate Research Methods in Biology. 3 Units.
Prerequisites: classified standing in Masters Degree Program and consent of instructor
Specialized topics in research methods including theory and technique. Topics may vary. Two hours laboratory per unit of credit. May be repeated for credit, but no more than six units may be applied toward the degree. Graded credit/no credit.

BIOL 692D. Directed Graduate Research in Biology. 1 Unit.
Prerequisites: classified standing in Masters Degree Program and consent of instructor
Original individual research in biology; to be conducted under the direct supervision of a faculty member of the students committee, and if desired in collaboration with other members of the students masters committee. Formerly BIOL 695A, 695B and 695C. The course may be taken up to three times for the maximum number of units specified in each degree track. Graded credit/no credit.

BIOL 696A. Directed Graduate Research in Biology. 2 Units.
Prerequisites: classified standing in Masters Degree Program and consent of instructor
Original individual research in biology; to be conducted under the direct supervision of a faculty member of the students committee, and if desired in collaboration with other members of the students masters committee. Formerly BIOL 695A, 695B and 695C. The course may be taken up to three times for the maximum number of units specified in each degree track. Graded credit/no credit.

BIOL 696B. Directed Graduate Research in Biology. 2 Units.
Prerequisites: classified standing in Masters Degree Program and consent of instructor
Original individual research in biology; to be conducted under the direct supervision of a faculty member of the students committee, and if desired in collaboration with other members of the students masters committee. Formerly BIOL 695A, 695B and 695C. The course may be taken up to three times for the maximum number of units specified in each degree track. Graded credit/no credit.

BIOL 696C. Directed Graduate Research in Biology. 3 Units.
Prerequisites: classified standing in Masters Degree Program and consent of instructor
Original individual research in biology; to be conducted under the direct supervision of a faculty member of the students committee, and if desired in collaboration with other members of the students masters committee. Formerly BIOL 695A, 695B and 695C. The course may be taken up to three times for the maximum number of units specified in each degree track. Graded credit/no credit.

BIOL 696D. Directed Graduate Research in Biology. 4 Units.
Prerequisites: classified standing in Masters Degree Program and consent of instructor
Original individual research in biology; to be conducted under the direct supervision of a faculty member of the students committee, and if desired in collaboration with other members of the students masters committee. Formerly BIOL 695A, 695B and 695C. The course may be taken up to three times for the maximum number of units specified in each degree track. Graded credit/no credit.
BIOL 696E. Directed Graduate Research in Biology. 5 Units.
Prerequisites: classified standing in Masters Degree Program and consent of instructor
Original individual research in biology; to be conducted under the direct supervision of a faculty member of the students committee, and if desired in collaboration with other members of the students masters committee.
Formerly BIOL 695A, 695B and 695C. The course may be taken up to three times for the maximum number of units specified in each degree track. Graded credit/no credit.

BIOL 696F. Directed Graduate Research in Biology. 6 Units.
Prerequisites: classified standing in Masters Degree Program and consent of instructor
Original individual research in biology; to be conducted under the direct supervision of a faculty member of the students committee, and if desired in collaboration with other members of the students masters committee.
Formerly BIOL 695A, BIOL 695B and BIOL 695C. The course may be taken up to three times for the maximum number of units specified in each degree track. Graded credit/no credit.

BIOL 698A. Continuous Enrollment for Graduate Candidacy Standing. 1 Unit.
Prerequisites: advancement to candidacy and approval of program graduate coordinator or, if an interdisciplinary studies major, consent of the Dean of Graduate Studies
Independent study leading to completion of requirements (other than course work) for the master's degree. To retain classified standing in the master's program, a student must enroll in 698 each quarter until the project or thesis is accepted or the comprehensive examination passed. Students who enroll in 698 through the university have full use of all university facilities. See Culminating Experience: Exam, Thesis, or Project in Graduate Degree and Program Requirements section of the Bulletin of Courses. 698 is a variable unit course, see fee schedule in the Financial Information section of the Bulletin of Courses. Earned units are not degree-applicable nor will they qualify for financial aid.

BIOL 698B. Continuous Enrollment for Graduate Candidacy Standing. 2 Units.
Prerequisites: advancement to candidacy and approval of program graduate coordinator or, if an interdisciplinary studies major, consent of the Dean of Graduate Studies
Independent study leading to completion of requirements (other than course work) for the master's degree. To retain classified standing in the master's program, a student must enroll in 698 each quarter until the project or thesis is accepted or the comprehensive examination passed. Students who enroll in 698 through the university have full use of all university facilities. See Culminating Experience: Exam, Thesis, or Project in Graduate Degree and Program Requirements section of the Bulletin of Courses. 698 is a variable unit course, see fee schedule in the Financial Information section of the Bulletin of Courses. Earned units are not degree-applicable nor will they qualify for financial aid.

BIOL 698C. Continuous Enrollment for Graduate Candidacy Standing. 3 Units.
Prerequisites: advancement to candidacy and approval of program graduate coordinator or, if an interdisciplinary studies major, consent of the Dean of Graduate Studies
Independent study leading to completion of requirements (other than course work) for the master's degree. To retain classified standing in the master's program, a student must enroll in 698 each quarter until the project or thesis is accepted or the comprehensive examination passed. Students who enroll in 698 through the university have full use of all university facilities. See Culminating Experience: Exam, Thesis, or Project in Graduate Degree and Program Requirements section of the Bulletin of Courses. 698 is a variable unit course, see fee schedule in the Financial Information section of the Bulletin of Courses. Earned units are not degree-applicable nor will they qualify for financial aid.

BIOL 698D. Continuous Enrollment for Graduate Candidacy Standing. 4 Units.
Prerequisites: advancement to candidacy and approval of program graduate coordinator or, if an interdisciplinary studies major, consent of the Dean of Graduate Studies
Independent study leading to completion of requirements (other than course work) for the master's degree. To retain classified standing in the master's program, a student must enroll in 698 each quarter until the project or thesis is accepted or the comprehensive examination passed. Students who enroll in 698 through the university have full use of all university facilities. See Culminating Experience: Exam, Thesis, or Project in Graduate Degree and Program Requirements section of the Bulletin of Courses. 698 is a variable unit course, see fee schedule in the Financial Information section of the Bulletin of Courses. Earned units are not degree-applicable nor will they qualify for financial aid.

BIOL 698E. Continuous Enrollment for Graduate Candidacy Standing. 5 Units.
Prerequisites: advancement to candidacy and approval of program graduate coordinator or, if an interdisciplinary studies major, consent of the Dean of Graduate Studies
Independent study leading to completion of requirements (other than course work) for the master's degree. To retain classified standing in the master's program, a student must enroll in 698 each quarter until the project or thesis is accepted or the comprehensive examination passed. Students who enroll in 698 through the university have full use of all university facilities. See Culminating Experience: Exam, Thesis, or Project in Graduate Degree and Program Requirements section of the Bulletin of Courses. 698 is a variable unit course, see fee schedule in the Financial Information section of the Bulletin of Courses. Earned units are not degree-applicable nor will they qualify for financial aid.
BIOL 698F. Continuous Enrollment for Graduate Candidacy Standing. 6 Units.
Prerequisites: advancement to candidacy and approval of program graduate coordinator or, if an interdisciplinary studies major, consent of the Dean of Graduate Studies
Independent study leading to completion of requirements (other than course work) for the master's degree. To retain classified standing in the master's program, a student must enroll in 698 each quarter until the project or thesis is accepted or the comprehensive examination passed. Students who enroll in 698 through the university have full use of all university facilities. See Culminating Experience: Exam, Thesis, or Project in Graduate Degree and Program Requirements section of the Bulletin of Courses. 698 is a variable unit course, see fee schedule in the Financial Information section of the Bulletin of Courses. Earned units are not degree-applicable nor will they qualify for financial aid.

BIOL 698Z. Continuous Enrollment for Graduate Candidacy Standing. 0 Units.
Prerequisites: advancement to candidacy and approval of program graduate coordinator or, if an interdisciplinary studies major, consent of the Dean of Graduate Studies
Independent study leading to completion of requirements (other than course work) for the master's degree. To retain classified standing in the master's program, a student must enroll in 698 each quarter until the project or thesis is accepted or the comprehensive examination passed. Students who enroll in 698 through the university have full use of all university facilities. See Culminating Experience: Exam, Thesis, or Project in Graduate Degree and Program Requirements section of the Bulletin of Courses. 698 is a variable unit course, see fee schedule in the Financial Information section of the Bulletin of Courses. Earned units are not degree-applicable nor will they qualify for financial aid.

BIOL 699A. Thesis Research and Thesis I. 3 Units.
Prerequisites: advancement to candidacy
Independent graduate research conducted under guidance of the major advisor and resulting in a thesis. BIOL 699A, BIOL 699B and BIOL 699C must be completed for a total of nine units. To retain their classified standing in the masters program, students enrolled in this course must attend the Biology Department colloquium called by the department chair each quarter until their projects are completed and their theses accepted.

BIOL 699B. Thesis Research and Thesis II. 3 Units.
Prerequisites: advancement to candidacy
Independent graduate research conducted under guidance of the major advisor and resulting in a thesis. BIOL 699A, BIOL 699B and BIOL 699C must be completed for a total of nine units. To retain their classified standing in the masters program, students enrolled in this course must attend the Biology Department colloquium called by the department chair each quarter until their projects are completed and their theses accepted.

BIOL 699C. Thesis Research and Thesis III. 3 Units.
Prerequisites: advancement to candidacy
Independent graduate research conducted under guidance of the major advisor and resulting in a thesis. BIOL 699A, BIOL 699B and BIOL 699C must be completed for a total of nine units. To retain their classified standing in the masters program, students enrolled in this course must attend the Biology Department colloquium called by the department chair each quarter until their projects are completed and their theses accepted.

BIOL 980. Biology Colloquium. 0 Units.
Required for all students using department research facilities or completing graduate program graduation requirements. Students are required to attend two meetings per quarter, one meeting in the first week of classes and one during the eighth week.

BIOL 999. Comprehensive Examination. 0 Units.
Prerequisites: advancement to candidacy, approval of department, completion of course work in the masters program, and in good academic standing
An assessment of the students ability to integrate the knowledge of the area, show critical and independent thinking and demonstrate mastery of the subject matter.