BIOLOGY

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**Faculty Early Retirement Program*

Programs Offered

Bachelor of Arts in Biology
Bachelor of Science in Biology
Master of Science in Biology
Minor in Biology

The Department of Biology offers two broadly based bachelor's degree programs, within which are opportunities for selecting a special concentration. The department also has a graduate program that offers a Master of Science degree in biology (see below). A congenial atmosphere allows students to develop a close relationship with peers, graduate students, and faculty. An emphasis is placed on laboratory and field courses, to give students practical experience, and on participation in research.

Laboratory courses are designed to focus on structure, development, physiology, microbiology, genetics, and DNA recombination. Laboratory instruction provides students with hands-on opportunities with physiological equipment, ultracentrifugation, PCR, electrophoresis, image analysis using epifluorescence, confocal, atomic force, and scanning electron microscopy and microbiological techniques. A radioisotope laboratory is also available.

Field courses draw upon an unparalleled diversity of habitats, streams, lakes, estuaries, bays, open coasts, marshes, grasslands, vernal pools, oak woodlands, redwood groves, thermal springs, and geothermal steam fields, all in close proximity to the campus. In addition, the department maintains extensive museum collections of local plants (North Coast Herbarium of California), algae, fungi, invertebrates (including insects), and vertebrates.

Careers in Biology

Biology graduates are prepared to enter the job market in a variety of careers, including government agencies, park service, biological research, teaching, biotechnology, and medical technology. Students seeking a teaching credential may elect biology as their major within the teaching credential preparation program in science. Graduates from the department have an outstanding record of acceptance in advanced degree programs at technical, dental, veterinary, medical, and graduate schools, as well as in fifth-year hospital traineeships in medical technology.

The biology curriculum, supported by physical sciences and mathematics, is designed to provide students with a strong background in the principles of biology and rigorous upper-division instruction. This combination of breadth and in-depth instruction allows students to develop the intellectual foundations and the skills necessary to deal with the specific biological concerns of today and the flexibility to meet the needs of the profession.

Biology Degree Concentrations

Many students are well served by the basic B.A. plan, without a concentration. Some, however, select one of four concentrations for a B.A. Both the B.A. and B.S. share a common lower-division core, hence beginning students need not select a plan immediately. The B.A. program leaves more flexibility for electives and a minor. The B.S. requires more physical science, mathematics, a specific concentration, and total units. Upon completion of specified course work, a concentration will be designated on the transcript and diploma. Students should contact the department for specific requirements.

Bachelor of Arts	***Bachelor of Science***
Botany	Aquatic Biology
Marine Biology	Molecular and Cell Biology
Microbiology	Ecology and Evolutionary Biology
Zoology	Physiology

Preparation for Applying to Health Professions

Students majoring in biology intending to pursue careers in the allied health fields may follow the guidelines for a B.S. degree, or a B.A. degree with the addition of MATH 161, CHEM 335B, and PHYS 210AB and 209AB. They are encouraged to enroll in SCI 150, Introduction to Careers in the Health Professions, during their first fall semester.

For admission to most health profession schools, it is typically recommended or required that specific biology courses be incorporated into the B.A. or B.S. degree. These include:

Premedical

BIOL 342 Molecular Genetics	4
BIOL 344 Cell Biology	4
BIOL 328 Vertebrate Evolutionary Morphology	4
BIOL 472 Developmental Biology	4

Preveterinary

BIOL 342 Molecular Genetics	4
BIOL 344 Animal Physiology	4
BIOL 472 Developmental Biology	4

Predentistry

BIOL 342 Molecular Genetics	4
BIOL 344 Cell Biology	4
BIOL 340 General Bacteriology	4
BIOL 328 Vertebrate Evolutionary Morphology	4
BIOL 472 Developmental Biology	4
BIOL 307 Human Nutrition	3
BIOL 480 Immunology	4

Secondary Education Teaching Credential Preparation in Life Science

Contact the department chair for information on completing a biological sciences concentration for a Single Subject Credential Preparation Program.

Degree Requirements

	B. A.	B. S.
General Education (51 units, 12 units covered by major requirements in math and science)	39	39
Lower-Division Biology (BIOL 121, 122, 123)	12	12
Upper-Division Biology Core (1 course from each of 4 areas)	16	16
Upper-Division Biology Electives (as specified by concentration)	15	18
Senior Research (BIOL 496)	--	2
Physical Sciences and Mathematics:		
CHEM 115AB	10	10
CHEM 335A or 232	5	
CHEM 335AB	--	8
MATH 165	4	4
MATH 161	--	4
B. A.		
PHYS 210A/209A or GEOL 102	4 or 3	--
B. S.		
PHYS 210A/210B and either PHYS 209 A or B; or PHYS 114/116/214	--	7 or 9
AND		
Concentration specific physical science	--	3
General Electives	***15-16***	***3-1***
Total Units for Graduation	120	126

Upper-Division Biology Core

Complete one course from each of the following groups (additional courses from each group may be used as electives or may be required for particular concentrations):

Organismal Biology (4 units)

BIOL 329 Plant Biology (4)
BIOL 340 General Bacteriology (4)
BIOL 322 Invertebrate Biology (4)
BIOL 327 Vertebrate Biology (4)
BIOL 382 Parasitology (4)

Physiology (4 units)

BIOL 349 Animal Physiology (4)
BIOL 347 Environmental Physiology (4)
BIOL 348 Plant Physiology (4)
BIOL 328 Vertebrate Evolutionary Morphology (4)

Molecular and Cell Biology (4 units)

BIOL 342 Molecular Genetics (4)
BIOL 343 Molecular Microbiology (4)
BIOL 344 Cell Biology (4)
BIOL 383 Virology (4)

Ecology and Evolutionary Biology (4 units)

BIOL 333 Ecology (4)
BIOL 341 Evolution (4)
BIOL 335 Marine Ecology (4)
BIOL 337 Behavioral Ecology (4)

Upper-Division Biology Electives

Biology major electives are upper-division courses beyond those used to fulfill the upper-division core and the B.A. or B.S. concentrations. Major electives are used to meet the total upper-division unit requirement for the B.A. (31 units) or B.S. (36 units). Major electives are chosen from among the following:

1. Additional courses from the upper-division core groups.
2. Upper-division biology electives. The current list is: BIO, 307, 323, 330, 331, 339, 485, 346, 323, 472, 426, 460, 463, 465, 468, 480, 481, 484, 491, and 497. This list is subject to revision following this catalog edition. Students should check with their academic advisor for updates. Seniors may also take graduate courses (500 level) with permission of the instructor.
3. Supervisory courses in biology, leading to hands-on experience, extension of knowledge, or research experience. These courses are: BIOL 395, 495, 498, and 499 (see below for unit restrictions for these courses).
4. Biology colloquium, BIOL 390, may be taken twice (2 units) for major credit.
5. A maximum of 4 units from courses related to biology from other departments or from the department's non-majors courses. To apply the units to the major, students are required to obtain written permission from their advisor **before taking these courses**. (Obtain forms in department office.) The following is the current list of acceptable courses: ANTH 301, 302, 314, 318, 345, 414; BIOL 220, 224; CHEM 340, 441, 445, 446; ENSP 315, 321, 322, 323; GEOG 416; GEOL 413; KIN 360; PSY 451.

Restrictions

1. A maximum of 4 units taken in the Cr/NC grading mode may be applied to the major from the following courses: BIOL 390, 395, 498, 499.
2. All other courses in the biology major must be taken in the traditional grading mode (A-F).
3. A maximum of 7 units from the following list of courses may be applied to the major: BIOL 390, 395, 495, 496, 498, and 499.

Sample Four-year Program for Bachelor's Degree in Biology

FRESHMAN YEAR:: 31-33 Units

Fall Semester (16 Units)	*Spring Semester (15-17 Units)*
ENGL 101 (3)* (A2)	PHIL 101 or 102 (3) (A3)
BIOL 121 or 122 (4) (B2)	BIOL 121 or 122 (4) (B3)
MATH 165* (4) (B4)	CHEM 115B (5)
CHEM 115A (5) (B1)	Electives** (3-5)

SOPHOMORE YEAR:: 31-35 Units

Fall Semester (15-17 Units)	*Spring Semester (16-18 Units)*
BIOL 123 (4)	G.E. Group A1 course (3)
CHEM 232 or 335A (5)	Electives*** (9-11)
Electives** (6-8)	BIOL UD core course (4)

Biology majors are expected to complete all of the lower-division core requirements before attaining junior standing (60 units). This maximizes flexibility in upper-division course selection by ensuring that essential prerequisites will have been completed. BIOL 121, 122, and 123 should be completed before taking any upper-division course.

JUNIOR YEAR:: 28-34 Units

Fall Semester (14-17 Units)	*Spring Semester (14-17 Units)*
Complete Written English Proficiency Test after completing a total of 60 units	
Two BIOL UD core courses (8)	1-2 BIOL UD core courses (8)
Electives*** (6-9)	Electives*** (6-9)

SENIOR YEAR:: 30-36 Units

Complete the biology requirements by completing required and elective courses in the major and support courses in physical sciences and math.

Complete general education requirements to a total of 51 units (48 for transfer students), including ethnic studies. All area B GE requirements are met by courses required in the Biology major.

TOTAL UNITS::

for B.A. degree, minimum 120

for B.S. degree, minimum 126

Before or during Fall semester of the fourth year, all students planning to graduate that academic year must formally apply to graduate. With their advisor, students will complete the biology requirements form and list any remaining required courses they must complete to graduate.

**If a student is not eligible to take either of these courses in the first semester, that student must be enrolled in the recommended preparatory course(s) and complete these courses in the next semester. Students must also delay CHEM 115A until satisfying GE math eligibility.* This may extend time to graduation beyond 4 years.

***Electives should include at least one lower-division (100-299) GE course each semester. Electives may include additional physical science and mathematics (consult your biology advisor). Unit total per semester should average approximately 15-16 throughout all eight semesters (8 x 16 = 128) to complete the degree requirements in four years.*

****Electives include upper-division BIOL electives and physical science support as well as upper-division (300-499) GE courses. NOTE: Most upper division BIOL electives require completion of BIOL 123. Beginning in the semester in which 60 units total is reached, each student is required to complete 9 units of upper-division GE.*

Bachelor of Arts in Biology: Concentrations

The B.A. does not require a concentration. However, students may wish to focus their upper division course work in a particular area. The following are approved concentrations in the B.A., which may be designated on the diploma.

B.A. Concentrations

A. Marine Biology

All of the following courses (12):

BIOL 335 Marine Ecology	4
BIOL 331 Aquatic Botany	4
BIOL 322 Invertebrate Biology	4
One of the following courses:	*4*
BIOL 349 Animal Physiology (4)	
BIOL 347 Environmental Physiology (4)	
Other upper division core and electives	*15*

B. Botany

All of the following courses (16):

BIOL 330 Plant Taxonomy	4
BIOL 348 Plant Physiology	4
BIOL 329 Plant Biology	4
BIOL 331 Aquatic Botany	4
One of the following courses:	*4*
BIOL 333 Ecology (4)	
BIOL 341 Evolution (4)	
Other upper division core and electives	*11*

C. Zoology

One of the following courses:	*4*
BIOL 333 Ecology (4)	
BIOL 341 Evolution (4)	
One of the following courses:	*4*
BIOL 349 Animal Physiology (4)	
BIOL 347 Environmental Physiology (4)	
One of the following courses:	*4*
BIOL 322 Invertebrate Biology (4)	
BIOL 323 Entomology (4)	
BIOL 382 Parasitology (4)	
One of the following courses:	*4*
BIOL 327 Vertebrate Biology (4)	
BIOL 328 Vertebrate Evolutionary Morphology (4)	
Other upper division core and electives	*15*

D. Microbiology

The following courses (8):

BIOL 343 Molecular Microbiology	4
BIOL 340 General Bacteriology	4

One of the following courses: *4*

BIOL 349 Animal Physiology (4)
BIOL 348 Plant Physiology (4)

Two of the following courses: *8*

BIOL 331 Aquatic Botany (4)
BIOL 339 Mycology (4)
BIOL 383 Virology (4)
BIOL 382 Parasitology (4)
BIOL 480 Immunology (4)

Other upper division core and electives *11*

Bachelor of Science in Biology

Students must specify a particular concentration for the B.S. and meet its requirements. The lower-division core is structured so that switching between the B.A. and B.S. programs in the first two years will not delay completing either degree program.

Concentrations

From among courses used to satisfy U.D. core requirements or electives, concentrations require specific courses as follows:

A. Aquatic Biology

All of the following courses (16):

BIOL 347 Environmental Physiology	4
BIOL 331 Aquatic Botany	4
BIOL 340 General Bacteriology	4
BIOL 322 Invertebrate Biology	4

Two additional courses from U.D. Core *8*

BIOL 496 Senior Research in this area *2*

Upper-division biology electives *10*

Additional physical sciences (one of the following):

CHEM 340 (3), CHEM 445 (3), CHEM 446 (3), or GEOL 323 (3).

B. Molecular and Cell Biology

The following courses (8):

BIOL 342 Molecular Genetics	4
BIOL 344 Cell Biology	4

One of the following courses: *3 or 4*

CHEM 441 Biochemical Methods (3)
BIOL 544 Advanced Cell Biology (4)
BIOL 545 Recombinant DNA Lab (4)

Two of the following courses: *8*

BIOL 340 General Bacteriology (4)
BIOL 343 Molecular Microbiology (4)
BIOL 472 Developmental Biology (4)
BIOL 383 Virology (4)
BIOL 480 Immunology (4)

Two or three additional courses from U.D. Core *8-12*

BIOL 496 Senior Research in this area *2*

Upper-division biology electives *2-8*

Additional physical sciences and math (one of the following):

CHEM 441 (3), CHEM 445 (3), or CHEM 446 (3). One or more of the following is recommended: CS 150 (4), MATH 211S (2), additional physics lab: PHYS 209A (1) or PHYS 209B (1).

C. Ecology and Evolutionary Biology

All of the following courses (12):

BIOL 333 Ecology	4
BIOL 341 Evolution	4
BIOL 485 Biometry	4

One of the following courses: *4*

BIOL 335 Marine Ecology (4)
BIOL 328 Vertebrate Evolutionary Morphology (4)
BIOL 337 Behavioral Ecology (4)

Three additional courses from U.D. Core *12*

BIOL 496 Senior Research in this area *2*

Upper-division biology electives *6*

Additional physical sciences and math (one of the following):

GEOL 102 (3) or GEOG 204 (3). One or more of the following is recommended: MATH 211S (2), additional physics lab: PHYS 209A (1) or PHYS 209B (1), GEOL 413.

D. Physiology

One of the following courses: *4*

BIOL 329 Plant Biology (4)
BIOL 322 Invertebrate Biology (4)
BIOL 327 Vertebrate Biology (4)

One of the following courses: *4*

BIOL 339 Mycology (4)
BIOL 340 General Bacteriology (4)
BIOL 328 Vertebrate Evolutionary Morphology (4)
BIOL 382 Parasitology (4)
BIOL 426 Neurobiology and Neural Networks (4)

Two of the following courses: *8*

BIOL 349 Animal Physiology (4)
BIOL 347 Environmental Physiology (4)
BIOL 348 Plant Physiology (4)

Two additional courses from U.D. Core *8*

BIOL 496 Senior Research in this area	*2*
Upper-division biology electives	*10*

Additional physical sciences (one of the following):

CHEM 340 (3), CHEM 445 (3), or CHEM 446 (3).

One or more of the following is recommended:

PHYS 313/313L (4), ENSP 333 (3-4).

Minor in Biology

The minor consists of a minimum of 20 units in biology with a GPA of 2.00 or higher. The purpose of the minor is to provide the student with an understanding of general biology and to supplement the student's major with pertinent biology courses.

Students will structure programs in consultation with the chair of the Biology Department. General requirements that must be met in any plan are:

Both of the following courses (8):	
BIOL 121 Diversity, Structure, and Function	4
BIOL 122 Genetics, Evolution, and Ecology	4
Twelve additional Biology units	*12*

At least six of these units must be U.D. majors' courses and at least one of those must be a majors' course with laboratory. Colloquium (BIOL 390, 1 unit) may be counted once within the minor.

All courses applied to the biology minor must be taken under the traditional grading mode (A-F), BIOL 390 excepted.

Master of Science in Biology

The M.S. program provides students with an opportunity to conduct original research in collaboration with a biology faculty member. The department has an active group of graduate students who pursue diverse research topics in the four major areas of biology: molecular and cell biology; physiology and functional morphology; ecology and evolutionary biology; and organismal biology. In addition to completing a thesis research project, all students are required to complete 30 units of committee-approved courses. Typically, students take two to three years to complete their graduate degree.

Admission to the Program

The graduate application package consists of the following: 1) a completed University application (obtain from Admissions and Records); 2) official copies of all undergraduate transcripts; 3) a 1-2 page Statement of Purpose essay detailing the student's background in biology, objectives for graduate school, and career goals; 4) two letters of recommendation from individuals familiar with the student's background in biology and able to comment on his/her potential for conducting original work; 5) Graduate Record Examination (GRE) scores for the General test (Biology Subject scores optional).

The originals for items 1-3 must be submitted to SSU's Admissions and Records Office. Copies of items 1-3 and originals of items 4 and 5 must be submitted to the Department of Biology (Graduate Coordinator). Application deadlines in the Department are January 31 for the fall semester and October 31 for the spring semester. A complete application must be received before an applicant will be considered for admission.

Applications are reviewed for evidence that the prospective student is capable of initiating and performing original research. As a general guideline, the Department uses the following criteria to determine this potential: 1) an undergraduate degree or equivalent in biology, including one course in calculus or statistics, one year of general chemistry, one semester of organic chemistry, and at least one other course in physical sciences; 2) a G.P.A. of 3.0 or higher in the last 60 units; 3) a score at or above the 50th percentile on each section of the General Examination of the GRE; 4) evidence in letters of recommendation of potential for conducting independent and original research in biology; 5) acceptance by a Biology faculty member (tenure-track or approved SSU adjunct) to serve as faculty advisor. Students are strongly encouraged to review the information on faculty members contained in the Department's website and contact them prior to completing an application.

Biology Courses (BIOL)

Classes are offered in the semesters indicated. Please see the Schedule of Classes for most current information and faculty teaching assignments. Biology majors are encouraged to complete all the lower-division core requirements as well as two semesters of general chemistry and statistics before attaining junior standing (60 units). This maximizes flexibility in upper-division course selection by ensuring that essential prerequisites will have been completed.

110 Biological Inquiry (4)* Fall, Spring

Lecture, 3 hours; laboratory, 3 hours. A factual and conceptual exploration of the living world through presentation, student inquiry, and laboratory exercises. Topics include the bases of life—organization of living systems, from molecules to ecosystems, and their interactions—genetics, evolution, and ecology. Satisfies GE, category B2 (Biological Sciences), and the GE laboratory requirement. Not applicable to the biology major.

115 An Introduction to Biology (3) Fall, Spring

Lecture, 3 hours. The unifying concepts of biology. Topics include the chemical and physical bases of life; cellular structure and function; molecular and Mendelian genetics; reproduction, development, structure, and function of representative plants and animals; and evolution and ecology. Satisfies GE, category B2 (Biological Sciences). Not applicable to the biology major.

121 Diversity, Structure, and Function (4)* Fall, Spring

Lecture, 3 hours; laboratory, 3 hours. First in three-semester series required for biology and other science majors. Introduces the extraordinary diversity of life and evolutionary relationships between groups of organisms, and compares body plans. For biology majors, satisfies GE, categories B2 or B3, and the GE laboratory requirement.

* Laboratory fee may be charged; see current Schedule of Classes.

122 Genetics, Evolution, and Ecology (4)* Fall, Spring

Lecture, 3 hours; laboratory, 3 hours. Second in three-semester series required for biology majors. Introduces mechanism of inheritance, evolution, and ecology. Recent advances in understanding processes underlying ecological and evolutionary relationships will be emphasized. For biology majors, satisfies GE, categories B2 or B3 and the GE laboratory requirement. May be taken before BIOL 121.

123 Molecular and Cell Biology (4)* Fall, Spring

Lecture, 3 hours; laboratory, 3 hours. Third in three-semester series required for biology majors. Introduction to cell and molecular biology, with emphasis on molecular processes, cellular physiology, and regulatory mechanisms. For biology and other science majors, satisfies GE, categories B2 or B3 and the GE laboratory requirement. Prerequisites: BIOL 121 and 122 or consent of instructor and CHEM 115AB/116AB. Concurrent or prior enrollment in CHEM 335A or 232 recommended.

218 General Microbiology (4)* Fall or Spring

Lecture, 3 hours; laboratory, 3 hours. An introduction to the organization and characteristics of microorganisms, including bacteria, fungi, protists and viruses. Topics include their role in agriculture, industry and disease processes. Not applicable in the Biology major. Prerequisites: BIOL 110 or 115 or 121/122 and CHEM 115AB/116AB or 105.

220 Human Anatomy (4)* Fall, Spring

Lecture, 3 hours; laboratory, 3 hours. Survey of the body systems. Designed for pursuing careers in the allied health professions. Satisfies GE, category B3 and GE laboratory requirement. Prerequisite: BIOL 110 or 115 or 121/122.

224 Human Physiology (4) Fall, Spring

Lecture, 3 hours; laboratory, 3 hours. An integrated examination of the human body as an efficient system maintained by a complex of interacting, homeostatic mechanisms. Includes fundamental principles of function of major organ systems. Designed for those pursuing careers in the allied health professions. Satisfies GE, category B3 and GE laboratory requirement. Prerequisites: BIOL 110 or 115 or 121/122 and CHEM 115AB/116AB or 105.

307 Human Nutrition (3) Fall or Spring

Lecture, 3 hours. Concepts of modern nutrition, including some discussion of principal nutritional problems and modern food processing methods. Prerequisites: BIOL 110 or 115 or BIOL 121/122 and one course in beginning chemistry.

308 Environmental Toxicology (3) Spring

Lecture, 3 hours. An overview, chemically and physiologically, of toxins in the environment, with an emphasis on the philosophy of chemical use. Includes the nature of the interaction of toxins with living organisms, categories of toxicological activity, toxicological evaluation and environmental monitoring, and governmental regulations and procedures. Satisfies GE, category B3 (specific Emphasis in Natural Sciences). Prerequisites: BIOL 110, BIOL 115 or 121/122.

309 Biology of Cancer (3) Fall or Spring

Lecture, 3 hours. Biological, clinical, environmental, and psychosocial aspects of cancer explored through the perspectives of medical researchers, physicians, patients, and health educators. This lecture series is intended for students of all majors, for those in the health professions and for the general public. It is designed so that everyone (regardless of scientific background) will benefit. Satisfies GE, category B3. Prerequisite: BIOL 110 or 115 or 121/122.

311 Sexually Transmitted Diseases (3) Fall or Spring

Lecture, 3 hours. Biological, environmental, societal, and psychosocial aspects of sexually transmitted diseases. Satisfies GE, category B3. Prerequisite: BIOL 110 or 115 or 121/122.

312 Biological Oceanography (3) Fall or Spring

Lecture, 3 hours. An introduction to the world's oceans with emphasis on the biological diversity and functioning of marine organisms. Includes chemical, geological, and other physical features of the ocean as they relate to life. Satisfies GE, category B3. Prerequisite: BIOL 110 or 115 or 121/122.

314 Field Biology (3)* Fall or Spring

Lecture, 2 hours; laboratory and field, 3 hours. A course emphasizing plant and animal communities of Northern California. Satisfies GE, category B3, and GE laboratory requirement. Prerequisite: BIOL 110 or 115 or 121/122.

318 Biology of Aging (3) Fall or Spring

Lecture, 3 hours. Examines the biological processes occurring in a cumulative fashion in the course of human senescence, including the medical and social consequences. Satisfies GE, category E. Prerequisite: BIOL 110 or 115 or 121/122.

322 Invertebrate Biology (4)* Fall

Lecture, 3 hours; laboratory and field, 3 hours. Exploration of the functional morphology, behavior, ecology, and evolution of invertebrate animals with emphasis on marine invertebrates. Prerequisite: BIOL 121 and 122.

323 Entomology (4)* Fall, even years

Lecture, 3 hours; laboratory and field, 3 hours. A comprehensive foundation in the biology of insects, with emphasis on ecology, behavior, evolution, and systematics. Emphasis on the diagnostic features of insects and their major orders. Prerequisites: BIOL 121 and 122.

327 Vertebrate Biology (4)* Spring

Lecture, 3 hours; laboratory and field, 3 hours. Exploration of the systematics, behavioral ecology, biogeography, evolution, and conservation biology of fish, amphibia, reptiles, birds, and mammals. At least one weekend field trip. Prerequisites: BIOL 121 and 122.

328 Vertebrate Evolutionary Morphology (4)* Spring

Lecture, 3 hours; laboratory, 3 hours. Trends in the evolution of structure and function in the vertebrates. This course focuses on morphological adaptations at the organ system level that have enabled vertebrates to diversify and succeed in a wide range of habitats and environments. Prerequisites: BIOL 121 and 122.

329 Plant Biology (4)* Fall

Lecture, 3 hours; laboratory, 3 hours. An overview of plant biology, with focus on structure, function, reproduction, and evolution. Emphasis is on flowering plants, but a survey of all plant and plant-like organisms, both modern and extinct, is included. Prerequisites: BIOL 121 and 122.

330 Plant Taxonomy (4)* Spring, odd years

Lecture, 3 hours; laboratory and field, 3 hours. An introduction to the principles and practices of plant taxonomy, including approaches to classification, data analysis, and a survey of vascular plant families in the California flora. A minimum of two Saturday field trips is required. Prerequisites: BIOL 121 and 122.

331 Aquatic Botany (4)* Spring

Lecture, 2 hours; laboratory and field, 6 hours. Marine, estuarine, and freshwater plants and algae, with emphasis on their ecology, primary production, growth, and taxonomy. Prerequisites: BIOL 121 and 122.

333 Ecology (4)* Fall

Lecture, 3 hours; laboratory and field, 3 hours. A current overview of this field, with in-depth coverage of ecology at the population, community, and ecosystem level. Emphasis on diverse taxa and habitats, hypothesis testing, and data collection and analysis. Prerequisites: BIOL 121 and 122 and MATH 165.

* Laboratory fee may be charged; see current Schedule of Classes.

335 Marine Ecology (4)* Spring

Lecture, 3 hours; laboratory and field, 3 hours. An overview of current topics in marine ecology and conservation with emphasis on ecology of coastal ecosystems. Extensive focus on field and laboratory research projects. Includes experimental design, data analysis, and presentation. At least three 5-hour field trips outside of scheduled class time. Prerequisites: BIOL 121 and 122 and MATH 165.

337 Behavioral Ecology (4)* Spring

Lecture, 3 hours; laboratory and field, 3 hours. Examines how the behavior of animals functions to optimize their fitness. Explores such topics as foraging, altruism, breeding systems, sexual selection, deceit, communication systems, and aggression with emphasis on techniques for formulating and testing hypotheses. Prerequisites: BIOL 121 and 122.

339 Mycology (4)* Fall, even years

Lecture, 2 hours; laboratory and field, 6 hours. Principles and techniques for studying fungi and allied organisms, including the development of laboratory culture, identification, and field work on terrestrial and aquatic fungi. Prerequisites: BIOL 121 and 122.

340 General Bacteriology (4)* Spring

Lecture, 2 hours; laboratory, 6 hours. Prokaryotes: their taxonomy, physiology, ecology, and genetics. Prerequisites: BIOL 123 and CHEM 335A.

341 Evolution (4) Fall

Lecture, 3 hours; laboratory and field, 3 hours. A broad examination of the patterns and processes involved in the evolution of life on earth. Includes inquiry into the origin of life, microevolutionary processes, systematics, and large-scale evolutionary history. Prerequisite: BIOL 123.

342 Molecular Genetics (4)* Spring

Lecture, 3 hours; laboratory, 3 hours. Gene structure and function at the level of DNA, RNA, and protein interactions. Emphasis on molecular analytical techniques used for genetic analysis in a diversity of prokaryotic and eukaryotic organisms. Prerequisites: BIOL 123 and CHEM 335A.

343 Molecular Microbiology (4)* Fall

Lecture, 3 hours; laboratory, 3 hours. The biochemical and molecular processes of pathogenic organisms within the three major groups of microbes: bacteria, parasites, and viruses. Prerequisites: BIOL 123 and CHEM 335A.

344 Cell Biology (4)* Fall

Lecture, 3 hours; laboratory, 3 hours. An introduction to structural and molecular organization of eukaryotic cells and tissues. Specific topics will represent the central core of cell biology and are concerned mainly with those properties that are common to most eukaryotic cells. Prerequisites: BIOL 123 and CHEM 335A.

346 Introduction to Bioinformatics (4) Fall

Lecture, 2 hours; laboratory, 6 hours. Principles and techniques of accessing biomolecular databases and analyzing retrieved sequences of nucleic acids and proteins. Statistical tools, sequences alignments, pattern mapping, structural modeling, and phylogenetics will be explored. Examples will be selected from plants, animals, fungi, protists, bacteria, and viruses. Laboratory will involve computer exercises, projects, discussions, and student presentations. Prerequisites: BIO 123 or consent of instructor.

347 Environmental Physiology (4)* Fall

Lecture, 3 hours; laboratory, 3 hours. Course examines the adaptations and physiological responses that allow animals to live under widely different environmental conditions. Laboratory and field exercises will utilize modern techniques of physiological measurement to examine adaptive strategies among and between species in different environmental conditions. Prerequisite: BIOL 123.

348 Plant Physiology (4)* Fall

Lecture, 3 hours; laboratory, 3 hours. Concepts and principles of plant function. The following areas are investigated in detail: photosynthesis, water relations, mineral nutrition, and plant growth regulation. Prerequisite: BIOL 123.

349 Animal Physiology (4)* Spring

Lecture, 3 hours; laboratory, 3 hours. Principles and concepts of animal function, with emphasis on cellular and biochemical/molecular bases of physiological activities in tissues and organ systems, environmental adaptations, and comparative homeostatic mechanism. Prerequisite: BIOL 123.

382 Parasitology (4)* Spring

Lecture, 3 hours; laboratory, 3 hours. The biology, epidemiology, ecology, pathogenesis, diagnosis, and prevention of parasitic disease affecting animals and humans. Students will learn about the host-parasite relationship in the context of how social, economic, and ecological factors contribute to the parasitic infections and disease. Labs involve microscopic identification of prepared and live specimens. Prerequisite: BIOL 123.

383 Virology (4) Spring

Lecture, 3 hours; discussion, 1 hour. Viruses: their characteristics, classification, genetics, and host-parasite interactions, including methods of disease prevention, control, and applications in biotechnology. Prerequisites: BIOL 123 and CHEM 335A.

385 Contemporary Issues in Biology (3)

Lecture, 3 hours. Selected topics related to the quality of life and the search for perspectives on the future. May be repeated with different topics. Satisfies GE, category B3. Prerequisite: BIOL 110 or 115 or 121/122.

390 Biology Colloquium (1) Fall, Spring

Lecture, 1 hour. A series of lectures by faculty, master's degree candidates, and invited guests on current research and contemporary issues in biology. All majors and graduate students are encouraged to enroll each semester, although no more than 2 units are applicable to the biology major. Cr/NC only.

395 Community Involvement Program (1-4) Fall, Spring

CIP involves students in basic community problems related to biology—performing such tasks as tutoring, reading to the blind, service to local, county, and state agencies, and service as teacher aides to elementary schools. Students receive 1-4 units depending on the specific task performed. A total of 6 units of CIP credit may be applied toward a degree. Cr/NC only. Prerequisites: approved petition to enroll and completion of biology minor core.

426 Neurobiology and Neural Networks (3)*

Lecture, 2 hours; laboratory, 3 hours. Theoretical and experimental approach to studying basic concepts of electrophysiology, neuronal electrical activity, and neuronal circuitry in invertebrate and vertebrate animals. Lab exercises include studies of neuronal networks in crayfish, horseshoe crabs, and sea hares. Prerequisite: BIOL 115 or BIOL 121/122 and PHYS 210B or PHYS 214, or consent of instructor.

460 Ichthyology (4)*

Lecture, 2 hours; laboratory, 3 hours. Theoretical and experimental approach to studying basic concepts of electrophysiology, neuronal electrical activity, and neuronal circuitry in invertebrate and vertebrate animals. Lab exercises include studies of neuronal networks in crayfish, horseshoe crabs, and sea hares. Prerequisite: BIOL 115 or BIOL 121/122 and PHYS 210B or PHYS 214, or consent of instructor.

463 Herpetology (4)* Spring

Lecture, 3 hours; laboratory and field, 3 hours. Classification, functional and evolutionary morphology, environmental physiology, and ecology of reptiles and amphibians. Includes at least one weekend field trip. Prerequisite: BIOL 360 or 370.

* Laboratory fee may be charged; see current Schedule of Classes.

465 Ornithology (4)*

Lecture, 3 hours; laboratory and field, 3 hours. Avian classification, anatomy, and life histories, including such topics as molts, distribution, migration, and breeding habits. Prerequisite: BIOL 360 or 370.

468 Mammalogy (4)*

Lecture, 3 hours; laboratory and field, 3 hours. Characteristics, classification, and a functional approach to examine broader conceptual issues including evolution, behavior, ecology, biogeography, and conservation of mammals. Prerequisite: BIOL 360 or 370.

472 Developmental Biology (4)* Spring

Lecture, 3 hours; laboratory, 3 hours. Patterns of animal development. This course is designed to provide students with a comprehensive appreciation of the developmental process, presenting detailed descriptions of developmental mechanism along with a conceptual framework for understanding how development occurs. Prerequisite: BIOL 123.

480 Immunology (4) Fall

Lecture, 3 hours; discussion, 1 hour. The component elements of the immune response; antigens and antibodies; theories of antibody synthesis, cellular reactions, hypersensitivity; and immunogenetics. Prerequisites: one core course from each of the following U.D. Core areas: Physiology, Molecular, and Cell Biology.

481 Medical Microbiology (5)* Fall, odd years

Lecture, 3 hours; laboratory, 6 hours. Mechanisms of infectious diseases caused by bacteria and fungi, host-parasite interactions in the disease process, therapeutic modalities, and infection control. Laboratory techniques for the cultivation, isolation, and identification of pathogenic bacteria and fungi. Emphasis is on methods and procedures currently utilized in diagnostic laboratories. Prerequisite: BIOL 321 or BIOL 340.

484 Hematology (4)* Fall, odd years

Lecture, 3 hours; laboratory, 3 hours. Blood: the normal and abnormal structure and function of red cells, white cells, and hemostatic mechanisms. Prerequisite: BIOL 324 or BIOL 326.

485 Biometry (4) Fall

Lecture, 3 hours; laboratory, 3 hours. Introduces students to quantitative analysis of biological data. The nature of biological data, principles of experimental design, and essential statistical tools used by biologists to analyze their results. Examples used in the course will be drawn from physiology, ecology, evolution, and medicine. Laboratory sections will involve computer exercises, discussions, and student presentations. Prerequisites: BIOL 123 and MATH 165.

491 Library and Information Resources: Natural Sciences (2)

Techniques for finding library and information resources in the life sciences. Course covers use and evaluation of print and electronic information sources, including online and Internet databases, research strategies and techniques, compiling and preparing bibliographies, scientific writing form and style, and organization of personal reference files. Prerequisite: at least one biology course or consent of instructor.

495 Special Studies (1-4)* Fall, Spring

Investigations to meet an advanced specialized study need beyond the department curriculum. The project must be planned and described in written form with consent of the faculty sponsor. Prerequisites: a major or minor in biology with an upper-division standing, consent of instructor and department chair, and approved petition to enroll.

496 Senior Research for the B.S. Degree (2)* Fall, Spring

Experimental or observational research for the B.S. degree conducted under the guidance of one or more of the biology faculty. A written report and an oral presentation of results in a public forum are required. Prerequisites: senior standing in the major.

497 Selected Topics in Biology (1-4)*

Intensive study of biological topics, which will vary from semester to semester. May be repeated for credit and may be applicable to the requirements for a major in biology. Prerequisite: consent of instructor.

498 Biology Practicum (1-4) Fall, Spring

Application of previously studied theory through supervised instructional work experience in biology. Intended for professional growth for undergraduates. Enrollees are required to write an evaluation of their course experience. May be repeated for up to a total of 4 units. Prerequisites: upper-division standing in biology, consent of the instructor in whose course the student will be working, and an approved petition to enroll.

499 Internship in Biology (1-4) Fall, Spring

Work that provides training in the use of biological skills in the community. Requires written agreement by students, faculty sponsor, on-the-job supervisor, and field experience coordinators; please see department office for details. May be repeated for up to 8 units of credit; 3 hours per week for each unit. Cr/NC grading only.

Graduate Courses

500S Graduate Seminar (1-2)

Advanced seminars exploring diverse topics in biological sciences. Topics vary from semester to semester, depending on faculty interest and expertise. This course may be repeated for credit.

510 Selected Topics in Biology (2-4)*

Intensive study of biological topics, which will vary from semester to semester. Prerequisites: adequate undergraduate preparation in the topic under consideration and graduate or last-semester-senior standing with consent of instructor.

511 Conservation Genetics (2) Fall, odd years

Lecture, 1 hour; discussion, 1 hour. An examination of the scientific approaches applied to species conservation. Although molecular genetic approaches will be emphasized, a variety of other approaches will also be considered (e.g., captive breeding, population viability analysis, and translocation). Prerequisite: consent of instructor.

512 Conservation Ecology (2) Spring, even years

Lecture, 1 hour; discussion, 1 hour. A seminar format with occasional lectures. An advanced exploration of current topics in the rapidly expanding field of conservation ecology. Specific topics considered will vary from semester to semester, depending on student interests. However, topics will commonly include habitat fragmentation and loss, global climate change, metapopulation dynamics, biological invasions, restoration ecology, and design and management of preserves. Prerequisite: BIOL 300.

513 Speciation (2) Spring, odd years

Lecture, 1 hour; discussion, 1 hour. Examination of the theoretical and empirical approaches to defining species and a detailed survey of speciation modes and mechanisms. Lectures provide a framework for student-led discussion of specific topics and case studies. Prerequisite: consent of instructor.

* Laboratory fee may be charged; see current Schedule of Classes.

515 Macroevolution (2) Fall, even years

Lecture, 1 hour; discussion, 1 hour. A seminar format with occasional lectures. A topical and historical overview of the major macroevolutionary transitions that have occurred during the history of life. Particular attention will be given to broad patterns of change over time at higher levels of structural/organismic organization. Prerequisite: consent of instructor.

516 Bioenergetics (2) Spring, even years

Lecture, 1 hour; discussion, 1 hour. A seminar format with occasional lectures. An in-depth examination of energy flow through living organisms at all levels of biological organization, from molecules to populations. Topics may include cellular metabolism, animal energetics, thermoregulation, fasting physiology, locomotion, foraging energetics, reproductive energetics, life history theory, community energetics, and population energetics. Prerequisite: consent of instructor.

517 Paradigms in Parasitology (2) Fall, odd years

Lecture, 1 hour; discussion, 1 hour. A seminar format with occasional lectures. Parasitology is a subject area that crosses many biological disciplines, and concepts in parasitology can be applied to any field of science. Students may choose topics that most closely relate to their research interests. Topics may include: ecology of emerging infectious diseases, how parasites affect their host's behavior, co-evolution of host-parasite associations, RNA editing, and how parasites evade the immune system. Prerequisite: consent of instructor; parasitology background not required.

518 Biotechnology (2) Spring, odd years

Lecture, 1 hour; discussion, 1 hour. A seminar format with occasional lectures. The field of biotechnology is moving at a rapid pace, and many of the molecular and biochemical techniques are being applied to a wide variety of biological disciplines. Topics include: structure-based approach to drug design, expressing recombinant proteins, DNA vaccines, and toxicity screening. Prerequisite: consent of instructor.

524 Neurobiology (3)

Lecture, 3 hours. Vertebrate and invertebrate nerve cells, nerve networks and behavior, nervous development and differentiation, and functional anatomy of neural systems. Prerequisite: BIOL 324 or 326.

544 Advanced Cell Biology (4)* Spring, odd years

Lecture, 2 hours; laboratory, 6 hours. Development and applications of major concepts in modern cell biology. Specific topics will include: membrane structure and properties, metabolic pathways and physiology of energy conversion, cell signaling and principles of intercellular communication, cell-cycle dynamics, and macromolecular regulation of cell division. Prerequisites: BIOL 325, and BIOL 324 or 334.

545 Recombinant DNA Laboratory (4)* Fall

Laboratory, 9 hours; discussion, 1 hour. Techniques for the manipulation of DNA through gene cloning applicable in the study of all biological processes. Prerequisites: BIOL 320 or BIOL 321 and CHEM 340 or BIOL 340.

578 Project Continuation (1-3) Fall, Spring

Designed for students working on their thesis or master's project but who have otherwise completed all graduate coursework toward their degree. This course cannot be applied toward the minimum number of units needed for completion of the master's degree. Prerequisite: permission of the graduate coordinator. Cr/NC only.

590 Biology Colloquium (1) Fall, Spring

Lecture, 1 hour. A series of lectures by faculty, master's degree candidates, and invited guests on current research and contemporary issues in biology. All graduate students are encouraged to enroll each semester, although no more than 2 units are applicable to the M.S. degree. Cr/NC only.

595 Special Studies in Biology (1-3)* Fall, Spring

Investigations to meet highly specialized needs and to explore possible thesis topics. Project must be planned and described in writing with consent of faculty sponsor. Prerequisite: approved petition to enroll.

598 Graduate Practicum (1-4) Fall, Spring

Application of previously studied theory to development and delivery of new instructional materials. Intended to provide professional growth for graduate students. Enrollees are required to write an evaluation of their course experience. Prerequisites: graduate standing in biology, consent of the instructor in whose course the student will be working, and an approved petition to enroll.

599 M.S. Thesis (1-3)* Fall, Spring

Original investigation based on laboratory or field research that meets the department and University standards. Prerequisite: admission to classified standing and advancement to candidacy.

* Laboratory fee may be charged; see current Schedule of Classes.