

BIOLOGY

DEPARTMENT OFFICE

Darwin Hall 200
(707) 664-2189
www.sonoma.edu/biology/

DEPARTMENT CHAIR

Richard Whitkus

ADMINISTRATIVE COORDINATOR

Kathleen Hardy, Lakin Khan

Faculty

Thomas N. Buckley
James L. Christmann
Michael F. Cohen
Daniel E. Crocker
J. Hall Cushman
Nicholas R. Geist
Derek J. Girman
Karina J. Nielsen
Murali C. Pillai
Nathan E. Rank
Eileen F. Thatcher
Richard Whitkus

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 undergraduates two broadly based bachelor's degree programs and a Master of Science degree. Within each undergraduate degree program, there are opportunities for selecting a concentration. 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 and on participation in research.

The Biology Master's program is comprised of an active cohort of graduate students engaged in original research with faculty members in all areas of research specialization covered in the department. Graduate research is often supported by external funding and graduate student support includes teaching associateships that involve close mentoring relationships with instructional faculty. Many graduates of the masters program go on to pursue doctoral degrees, and others continue in research, biotechnology, resource management, and education.

Laboratory instruction provides students with hands-on opportunities with physiological equipment, ultracentrifugation, PCR,

electrophoresis, light microscopy, immunofluorescence microscopy, and microbiological techniques. Excellent laboratory and greenhouse facilities, such as the Raymond Burr Greenhouse and orchid collection, exist for maintaining live material for classroom use and research. A radioisotope laboratory is also available.

Field courses draw upon the unparalleled diversity of habitats in the North Bay region. They also capitalize on two spectacular nature preserves: Fairfield Osborn Preserve and Galbreath Wildlands Preserve, administered by Sonoma State University. In addition, the department maintains museum collections of local plants, algae and fungi (North Coast Herbarium of California), vertebrates (Jack Arnold Vertebrate Collection), and insects and other invertebrates.

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 future 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 two 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 a specific concentration, including more physical science, mathematics, 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

Botany
Zoology

Bachelor of Science

Physiology
Molecular and Cell Biology
Ecology and Evolution and Conservation
Marine Biology
Microbiology

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, regardless of major, it is typically recommended or required that specific biology courses be incorporated into the B.A. or B.S. degree. These include:

	<i>Premedical</i>	<i>Preveterinary</i>	<i>Predental</i>
BIOL 342 Molecular Genetics (4)	x	x	x
BIOL 472 Developmental Biology (4)	x	x	x
BIOL 349 Animal Physiology (4)		x	
BIOL 328 Vertebrate Evolutionary Morphology (4)	x		x
BIOL 344 Cell Biology (4)	x		x
BIOL 340 General Bacteriology			x
BIOL 307 Human Nutrition			x
BIOL 480 Immunology			x

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	17-20
Concentration specific physical science	--	3-0
Senior Research (BIOL 495 and 496)	--	3
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 (PHYS 114/116/214 may substitute)	--	7
General Electives	15-16	3
Total units needed 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 Evolution (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 and alternative courses in a concentration.
2. Any Biology course numbered greater than 320. 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, 496, 498, and 499 (see **Restrictions**, below, for unit limits 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, unless the course is listed as part of a**

concentration. (Obtain forms in department office.) The following is the current list of acceptable courses: ANTH 301, 302, 318, 345, 414; BIOL 220, 224, 243, 307; CHEM 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 Courses(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 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. The B.A. does not require a concentration. However, students may wish to focus their upper division course work in a particular area. Botany and Zoology are approved concentrations in the B.A., which may be designated on the diploma. Courses from all 4 core areas are included in each concentration. The upper division major requirements for each are:

B.A. Botany Concentration (31 units)

BIOL 329 Plant Biology	4
BIOL 348 Plant Physiology	4
BIOL 330 Plant Taxonomy	4
BIOL 331 Aquatic Botany	4
BIOL 333 Ecology	4
BIOL 341 Evolution	4
One of the following 2 courses:	4
BIOL 342 Molecular Genetics, or	
BIOL 344 Cell Biology	
Additional upper division major electives	3

B. A. Zoology Concentration (31-32 units)

BIOL 322 Invertebrate Biology	4
BIOL 327 Vertebrate Biology	4
BIOL 328 Vertebrate Evolutionary Morphology	4
BIOL 323 Entomology	4
One of the following 2 courses:	4
BIOL 347 Environmental Physiology or	
BIOL 349 Animal Physiology	
One of the following 3 courses:	3-4
BIOL 463 Herpetology, or	
BIOL 468 Mammalogy or	
BIOL 472 Developmental Biology	
One course from the Molecular and Cell Biology Core Area	4
One course from the Ecology and Evolution Core Area	4

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. Students normally complete the additional physical science and mathematics for the B.S. after the first two years.

Courses from all 4 core areas are included in each concentration. The following are approved concentrations in the B.S., which will be designated on the diploma. The upper division major requirements for each are:

B. S. Marine Biology Concentration (39 units)

BIOL 322 Invertebrate Biology	4
BIOL 331 Aquatic Botany	4
BIOL 335 Marine Ecology	4
BIOL 341 Evolution	4
BIOL 347 Environmental Physiology	4
BIOL 485 Biometry	4
One course from the Molecular and Cell Biology Core Area	4
Additional upper division major electives	8
BIOL 495 Special Studies prior to Senior Research	1
BIOL 496 Senior Research	2

B. S. Molecular and Cell Biology Concentration (39 units)

BIOL 340 General Bacteriology	4
BIOL 342 Molecular Genetics	4
BIOL 344 Cell Biology	4
BIOL 341 Evolution	4
One of the following 2 courses:	4
BIOL 348 Plant Physiology	
BIOL 349 Animal Physiology	
Two of the following 4 courses:	8
BIOL 343 Molecular Microbiology	
BIOL 383 Virology	
BIOL 472 Developmental Biology	
BIOL 480 Immunology	
One of the following 2 courses:	3
CHEM 445 Structural Biochemistry	
CHEM 446 Metabolic Chemistry	
One of the following 3 courses:	3-4
CHEM 441 Biochemical Methods	
BIOL 544 Advanced Cell Biology	
BIOL 545 Recombinant DNA Laboratory	
Additional upper division major electives	2-1
BIOL 495 Special Studies prior to Senior Research	1
BIOL 496 Senior Research	2

B. S. Ecology, Evolution, and Conservation Concentration (39 units)

BIOL 333 Ecology	4
BIOL 341 Evolution	4
ENSP 322 Conservation Biology	4
BIOL 342 Molecular Genetics	4
BIOL 485 Biometry	4

One of the following 3 courses:	4
BIOL 322 Invertebrate Biology	
BIOL 327 Vertebrate Biology	
BIOL 329 Plant Biology	

One of the following 4 courses:	4
BIOL 335 Marine Ecology	
GEOG 416 Biogeography and Landscape Ecology	
BIOL 337 Behavioral Ecology	
BIOL 243 Environmental Microbiology	

One course from the Physiology Core Area	4
Additional upper division major electives	4
BIOL 495 Special Studies prior to Senior Research	1
BIOL 496 Senior Research	2

B. S. Physiology Concentration (39 units)

BIOL 344 Cell Biology	4
BIOL 372 Developmental Biology	4
CHEM 446 Metabolic Chemistry	3
Three of the following 4 courses:	12
BIOL 328 Vertebrate Evolutionary Morphology	
BIOL 347 Environmental Physiology	
BIOL 348 Plant Physiology	
BIOL 349 Animal Physiology	

One of the following 3 courses:

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

One course from the Ecology and Evolution Core Area	4
Additional upper division major electives	5
BIOL 495 Special Studies prior to Senior Research	1
BIOL 496 Senior Research	2

B.S. Microbiology Concentration (39 units)

**Required or recommended for application to Clinical Laboratory Science Internships*

BIOL 340 General Bacteriology*	4
--------------------------------	---

One of the following 3 courses:	4
BIOL 347 Environmental Physiology	
BIOL 349 Animal Physiology*	
BIOL 348 Plant Physiology	

One of the following 3 courses:	4
BIOL 342 Molecular Genetics*	
BIOL 343 Molecular Microbiology	
BIOL 344 Cell Biology	

One of the following 2 courses:	4
BIOL 333 Ecology*	
BIOL 341 Evolution	

Two of the following 3 courses:	8-9
BIOL 382 Parasitology*	
BIOL 480 Immunology*	
BIOL 481 Medical Microbiology*	

One of the following 2 courses:	4
CHEM 255 Quantitative Analysis*	
BIOL 243 Environmental Microbiology	

Additional upper division major electives	5
BIOL 495 Special Studies prior to Senior Research	1
BIOL 496 Senior Research	2

Minor in Biology

The minor consists of a minimum of 20 units in the Department of Biology with a GPA of 2.00 or higher. The purpose of the minor is to provide the student with a rigorous background in biology that supplements the student's major.

Students must develop a program in consultation with a faculty advisor in the Biology Department. Requirements of the Biology Minor are:

Take two of the 3 lower-division major's courses listed below	8
BIOL 121 Diversity, Structure, and Function	
BIOL 122 Genetics, Evolution, and Ecology	
BIOL 123 Molecular and Cell Biology	

Twelve additional units in Biology	12
------------------------------------	----

At least eight of these units must be upper-division courses for majors and at least one of those must have a laboratory. Only one GE course in biology or a third lower-division biology major's course can be applied to the minor, as well as one unit of Biology Colloquium (BIOL 390). All courses applied to the minor must be taken for a letter grade, except BIOL 390.

Master of Science in Biology

The Master of Science degree in the Department of Biology is a thesis research program. Students complete 30 units of course work that allows them to master the concepts and techniques of their chosen discipline. They also conduct original research under the direction of a member of the faculty and write up their findings as a Master's Thesis. Typically, students take two to three years to complete their graduate degree requirements.

Graduate students in the Department of Biology are supported through a variety of sources. The Department has approximately 12 teaching associateships (two laboratory sections) available each semester, and these positions are filled one semester in advance (contact the Graduate Coordinator for details). In addition, students may receive research associateships through individual faculty members and their research grants. The University offers a limited number of tuition fee waivers for qualified teaching associates. Students can also obtain academic scholarships as well as financial aid (usually in the form of low-interest loans).

The Department of Biology permanent faculty are actively involved in a wide range of disciplines, including ecology and evolutionary biology, molecular and cell biology, physiology, functional morphology, and organismal biology. Additional faculty from other departments on campus have expertise in biology and are adjunct members of the graduate program.

Graduates of this program find themselves with an enhanced understanding of biology and first-hand experience in the practice of science. Many of our students go on to doctoral programs; others use their degree to pursue careers in teaching, research, environmental consulting, resource management, industry, and various health professions.

Admission to the Program

To apply, you must submit: A) items 1-3 to SSU's Admissions and Records Office, and B) copies of items 1-3 and originals of items 4 and 5 to the Department of Biology Graduate Coordinator, Dan Crocker. The application deadline in the department is January 31 for the Fall semester and October 31 for the Spring semester. The SSU Admissions and Records Office will notify students about the status of their applications.

1. Complete a University application obtained from the Admissions and Records Office. NOTE: If you submit online, be sure to print a hardcopy to send to the Department of Biology.
2. Provide official copies of all undergraduate transcripts.
3. Provide a one-to-two page Statement of Purpose essay detailing your background in biology, objectives for graduate school, and career goals.
4. Request two letters of recommendation from individuals familiar with the student's background in biology and able to comment on the potential for conducting original work.
5. Provide Graduate Record Examination (GRE) scores for the General test. Biology Subject scores are strongly recommended, but not required.

IMPORTANT: The above complete application package must be received in the Admissions and Records Office and by the Biology Graduate Coordinator before an applicant will be considered for admission.

Admission to the program requires:

- I. Meeting California State University admissions requirements.
- II. Acceptance by a Biology faculty member (tenure-track or approved SSU adjunct) to serve as a faculty advisor. Students are strongly encouraged to review the information on faculty members and contact them prior to completing an application.

III. Approval of the Graduate Committee. Applications will be reviewed for evidence that the prospective student is capable of initiating and performing original research. Students will be admitted into Classified Standing. Applicants deficient in undergraduate course preparation will be expected to demonstrate competency before being advanced to candidacy. As a general guideline, the Department uses the following criteria to determine this potential:

An undergraduate degree in biology or equivalent, including:

- A. One course in calculus or statistics;
- B. One year of general chemistry and one semester of organic chemistry;
- C. At least one other course in physical sciences;
- D. Upper division coursework demonstrating competence in three of four core areas (organismal biology; physiology; molecular or cellular biology; ecology or evolutionary biology);
- E. GPA of 3.0 or higher in the last 60 units;
- F. A score at or above the 50th percentile on each section of the General Examination of the GRE; and
- G. Evidence in letters of recommendation of potential for conducting independent and original research in biology.