

BIOLOGY

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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 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 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.

Laboratory instruction provides students with hands-on opportunities with physiological equipment, ultracentrifugation, PCR, electrophoresis, epifluorescence and confocal 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 pharmaceutical research, and health care. 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 health profession and graduate programs.

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

Bachelor of Arts

Botany
Zoology

Bachelor of Science

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

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 degree plan immediately. Students should contact the department and their assigned advisor for specific information on requirements of various concentrations.

Preparation for Applying to Health Professions Programs

Students majoring in biology and intending to pursue careers in the health care profession 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 upper-division biology courses be incorporated into the B.A. or B.S. degree.

These include:

BIOL 328 Vertebrate Evolutionary Morphology

BIOL 340 General Bacteriology

BIOL 344 Cell Biology

BIOL 342 Molecular Genetics

BIOL 349 Animal Physiology

BIOL 472 Developmental Biology

BIOL 480 Immunology

An upper-division biochemistry course (e.g. CHEM 446) is often required/recommended.

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

	<i>B. A.</i>	<i>B. S.</i>
General Education (50 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 core areas)	16	16
Upper-Division Biology Electives (as specified by concentration)	15-16	20
Senior Research (BIOL 494 and 496)	--	3
Physical Sciences and Mathematics:		
CHEM 115AB	10	10
CHEM 335A/336A	5	5
CHEM 335B	--	3
MATH 165	4	4
MATH 161	--	4
B. A.		
PHYS 210A/209A or GEOL 102	4 or 3	--
B. S.		
PHYS 210A/209A and 210B (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 areas (additional courses from each area may be used as electives or may be required for particular concentrations):

Organismal Biology (4 Units)

BIOL 322 Invertebrate Biology (4)

BIOL 323 Entomology (4)

BIOL 327 Vertebrate Biology (4)

BIOL 329 Plant Biology (4)

BIOL 340 General Bacteriology (4)

BIOL 382 Parasitology (4)

Physiology (4 Units)

BIOL 328 Vertebrate Evolutionary Morphology (4)

BIOL 347 Environmental Physiology (4)

BIOL 348 Plant Physiology (4)

BIOL 349 Animal Physiology (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 335 Marine Ecology (4)

BIOL 337 Behavioral Ecology (4)

BIOL 341 Evolution (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. concentration specific requirements. 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 areas 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. These courses are: BIOL 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 unless specified in an approved concentration. 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 from the department office.) 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, 498, 499. All other courses in the biology major must be taken in the traditional grading mode (A-F).
2. A maximum of 7 units from the following list of courses may be applied to the major: BIOL 390, 494, 495, 496, 498, and 499.

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

FRESHMAN YEAR: 33 Units	
<i>Fall Semester (17 Units)</i>	<i>Spring Semester (16 Units)</i>
ENGL 101 (4) (A2)	PHIL 101 or 102 (4) (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)
	GE
SOPHOMORE YEAR: 32-33 Units	
<i>Fall Semester (16 Units)</i>	<i>Spring Semester (16-17 Units)</i>
BIOL 123 (4)	GE Group A1 (3)
CHEM 335A/336A (5)	BIOL UD Core (4)
Electives (7)	Electives (9-10)
GE (3)	GE (6-7)
Support (4)	Support (3)
JUNIOR YEAR: 31-32 Units	
<i>Fall Semester (15-16 Units)</i>	<i>Spring Semester (15-16 Units)</i>
Two BIOL UD core (8)	One BIOL UD core (4)
Electives (7-8)	Electives (11-12)
GE (3-4)	GE (3-4)
Support (4)	BIOL conc. (4)
	Support (4)
SENIOR YEAR: 26-31 Units	
<i>Fall Semester (14-17 Units)</i>	<i>Spring Semester (12-14 Units)</i>
Electives (14-17)	Electives (12-14)
GE (6-8)	GE (3-4)
BIOL conc. (8-9)	BIOL conc. (4)

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
<i>One of the following 2 courses:</i>	4
BIOL 342 Molecular Genetics, or	
BIOL 344 Cell Biology	
<i>Additional upper-division major electives</i>	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
<i>One of the following 2 courses:</i>	4
BIOL 347 Environmental Physiology or	
BIOL 349 Animal Physiology	
<i>One of the following 3 courses:</i>	4
BIOL 463 Herpetology, or	
BIOL 468 Mammalogy, or	
BIOL 472 Developmental Biology	
<i>One course from the Molecular and Cell Biology Core Area</i>	4
<i>One course from the Ecology and Evolution Core Area</i>	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
<i>One course from the Molecular and Cell Biology Core Area</i>	4
<i>Additional upper-division major electives</i>	8
BIOL 494 Independent Research Design	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:

- BIOL 348 Plant Physiology
- BIOL 349 Animal Physiology

Two of the following 4 courses:

- BIOL 343 Molecular Microbiology
- BIOL 383 Virology
- BIOL 472 Developmental Biology
- BIOL 480 Immunology

One of the following 2 courses:

- CHEM 445 Structural Biochemistry
- CHEM 446 Metabolic Chemistry

One of the following 3 courses:

- CHEM 441 Biochemical Methods
- BIOL 544 Advanced Cell Biology
- BIOL 545 Recombinant DNA Laboratory

Additional upper-division major electives

- BIOL 494 Independent Research Design
- BIOL 496 Senior Research

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 course from the Organismal Biology Core Area

One of the following 4 courses:

- BIOL 335 Marine Ecology
- BIOL 337 Behavioral Ecology
- BIOL 338 Environmental Microbiology and Biotechnology
- GEOG 365 Biogeography and Landscape Ecology
- GEOL 413 Paleontology

One course from the Physiology Core Area

Additional upper-division major electives

- BIOL 494 Independent Research Design
- BIOL 496 Senior Research

B. S. Physiology Concentration (39 units)

- BIOL 344 Cell Biology 4
- BIOL 472 Developmental Biology 4
- CHEM 446 Metabolic Chemistry 3

Three of the following 4 courses:

- 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

- 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 494 Independent Research Design 1
- BIOL 496 Senior Research 2

B.S. Microbiology Concentration (39 units)

- 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 338 Environmental Microbiology and Biotechnology

Additional upper-division major electives 7-8

- BIOL 494 Independent Research Design 1
- BIOL 496 Senior Research 2
- + If waived by completion of CHEM 125A/B these 4 units must be completed by taking other advisor approved courses.

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. One GE course in biology or a third lower-division biology major's course can

be applied, 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 program. Students complete 30 units of course work to master the concepts and techniques in their chosen area. They also conduct original research under the direction of a member of the graduate faculty and write up their findings as a Master's Thesis.

Graduate students in the Department of Biology are supported through a variety of sources. The Department has a limited number of paid teaching associateships available each semester. The University offers a limited number of tuition fee waivers for qualified teaching associates. In addition, students may receive research associateships through their faculty mentor's research grants. Students can also obtain academic scholarships as well as financial aid (usually in the form of low-interest loans).

The Department of Biology graduate faculty are actively involved in research 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 pursue careers in teaching, research, environmental consulting, resource management, industry, and various health care 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 2 and 3 and originals of items 4 and 5 to the Department of Biology Graduate Coordinator. 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. University application obtained from the Admissions and Records Office.
2. Official copies of all undergraduate transcripts.
3. One-to-two page Statement of Purpose essay detailing your 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 the potential for conducting original work.

5. Graduate Record Examination (GRE) scores for the General test. Biology Subject scores are recommended, but not required.

IMPORTANT: The 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 graduate faculty member 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. 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 3.00 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 research in biology.