BACHELOR OF SCIENCE IN BIOLOGY: CONCENTRATION IN MARINE SCIENCE

Undergraduates may elect a general emphasis in marine invertebrate zoology, marine vertebrate zoology, marine botany, marine microbiology, or limnology. Classes in each of these areas prepare students for careers in the private and public sector and provide the necessary preparation to apply to graduate programs in marine biology, ecology, and conservation biology. It's recommended that students consult with an advisor in the Marine Science program to develop a plan of study that best suits their needs and career goals.

The department does not permit multiple concentrations within the biology degree program. All of the curricula require preliminary work in physics and chemistry because many important biological concepts are based squarely upon principles in the physical sciences. Also, each curriculum includes upper-division work in the biological sciences so that students will receive reasonable breadth and depth in their degree program. Because of the sequential arrangement of courses students are urged to consult the descriptions for the prerequisites of all their courses.

Although course electives are listed for most of the majors, new electives are always being added to various programs. Therefore, we highly recommend that students seek advisement prior to enrolling in elective courses in their major.

General Information and Requirements

- Candidates entering the bachelor's programs in biology should have completed three years of high school mathematics and one year of high school chemistry to allow completion of the curriculum in a timely fashion (see Undergraduate Admission Requirements (http://bulletin.sfsu.edu/undergraduate-admissions/application-procedures/#UAR)).
- To remain enrolled in a biology course, students must be prepared to provide copies of transcripts demonstrating completion of prerequisite courses with a grade of C– or better.
- Early in the first semester, and at regular intervals thereafter, students must consult with a biology advisor to plan a program of study. For the most current advising information, go to biology.sfsu.edu (http://biology.sfsu.edu/).

Program Learning Outcomes

a. UNDERSTANDING THE PROCESS OF SCIENCE: Students can design an experiment with the appropriate control groups to test a hypothesis.
b. QUANTITATIVE REASONING: Students can interpret a graph or dataset to determine if the results of an experiment support or reject a hypothesis.
c. RELATIONSHIP BETWEEN SCIENCE AND SOCIETY: Students can weigh the costs and benefits to society of the use of recent scientific and technological developments.
d. EVOLUTION: Students can explain the role that variation between individuals plays in the processes of natural selection and evolution.
e. RELATIONSHIP BETWEEN STRUCTURE AND FUNCTION: Students can explain how a change in the structural characteristics of a molecule, tissue or organism will affect its function.
f. INFORMATION FLOW AND STORAGE: Students can describe the mechanisms of information flow in classical and molecular genetics and predict the outcomes of crosses.
g. PATHWAYS AND TRANSFORMATION OF MATTER AND ENERGY: Students can explain how a carbon molecule flows through a biological process or system.
h. SYSTEMS (i.e. living systems are interconnected and interacting): Students can predict the consequences of how a change in one aspect of a biological or complex system will affect other aspects of the system.

Biology (B.S.): Concentration in Marine Science — 57 units minimum

- Students must earn a C- or better in a GWAR course to satisfy the GWAR requirement. Marine Science majors may choose between BIOL 475GW, BIOL 478GW, BIOL 570GW, or BIOL 670GW. Contact a departmental advisor for further information.
- All major coursework must be completed with letter grades (CR/NC is not acceptable).
- A minimum grade point average of 2.0 in all coursework is required.
- At least 12 units in biology must be completed at SF State.

General Education Requirements Met in the Major

The requirements below are deemed "met in the major" upon completion of the courses listed (even though the courses and their prerequisites are not approved for GE). This is true whether or not the student completes the major.

- Area B2 (Life Science) is satisfied upon completion of BIOL 240 .
- Upper-Division General Education, Physical, and Life Sciences (UD–B) is satisfied upon completion of BIOL 355.

Lower-Division Requirements (35 units)

Code	Title	Units
BIOL 230	Introductory Biology I	5
BIOL 231	Advising for Success as a Biology Major	1
BIOL 240	Introductory Biology II	5
CHEM 115	General Chemistry I	4
CHEM 130	General Organic Chemistry	3
MATH 226	Calculus I	4
Select One:		4
PHYS 111 & PHYS 112	General Physics I and General Physics I Laboratory	
PHYS 220 & PHYS 222	General Physics with Calculus I and General Physics with Calculus I Laboratory [1]	
Select 8 units from the following:		8
CHEM 215	General Chemistry II	
MATH 227	Calculus II [1]	
Either physics pathway:		
PHYS 121 & PHYS 122	General Physics II and General Physics II Laboratory [2]	
PHYS 230 & PHYS 232	General Physics with Calculus II and General Physics with Calculus II Laboratory [2]	

[1] If taking PHYS 220/PHYS 222, MATH 227 must be taken concurrently.
[2] PHYS 111/PHYS 112 are the prerequisites for PHYS 121/PHYS 122.

PHYS 220/PHYS 222 are the prerequisites for PHYS 230/PHYS 232.

Upper-Division Requirements (22-25 units)

Code	Title	Units
BIOL 337	Evolution	3
BIOL 355	Genetics	3
BIOL 458	Biometry	4
Select 3-4 units from the following:		3-4
BIOL 582	Biological Oceanography & Limnology	
CHEM 680	Chemical Oceanography	
ERTH 400	Earth Systems I	
ERTH 434	Coastal Processes	
ERTH 470	Physical Oceanography	
Select one class from the following:		3-4
BIOL 475GW	Herpetology - GWAR	
BIOL 478GW	Ornithology - GWAR	
BIOL 570GW	Biology of Fishes - GWAR	
BIOL 586GW	Marine Ecology Laboratory - GWAR	
BIOL 670GW	Ecology and Evolution of Marine Systems I - GWAR	
Select 6-7 units from the following:		6-7
BIOL 315	Field Methods in Ecology and Evolution	
BIOL 349	Bioethics	
BIOL 350	Cell Biology	
BIOL 356	Honors Genetics	
BIOL 357	Molecular Genetics	
BIOL 380	Evolutionary Developmental Biology	
BIOL 382	Developmental Biology	
BIOL 401	General Microbiology	
BIOL 460	General Entomology	
BIOL 470	Natural History of Vertebrates	
BIOL 482	Ecology	
BIOL 502	Biology of the Algae	
BIOL 525	Plant Physiology	
BIOL 526	Plant Molecular Physiology Laboratory	
BIOL 530	Conservation Biology	
BIOL 532	Restoration Ecology	
BIOL 534	Wetland Ecology	
BIOL 555	Marine Invertebrate Zoology	
BIOL 572	Colloquium in Ecology, Evolution, and Conservation	
BIOL 580	Limnology	
BIOL 582	Biological Oceanography & Limnology	
BIOL 585	Marine Ecology	
BIOL 586GW	Marine Ecology Laboratory - GWAR	
BIOL 600	Animal Behavior	
BIOL 607	Conservation and Management of Marine Mammals	
BIOL 617	Environmental Physiology	
BIOL 630	Animal Physiology	
BIOL 631GW	Animal Physiology Laboratory - GWAR	
BIOL 644	LEADerS Service Learning Course: Learners Engaged in Advocating for Diversity in Science	
or BIOL 654	Peer Assistants for Learning Science (PALS)	
BIOL 670GW	Ecology and Evolution of Marine Systems I - GWAR	
BIOL 671	Ecology and Evolution of Marine Systems II	
BIOL 699	Independent Study in Biology	
MSCI 306	Marine Science Diving and Boating	

First-Time Student Roadmap (4 Year)

The roadmaps presented in this Bulletin are intended as suggested plans of study and do not replace meeting with an advisor. For a more personalized roadmap, please use the Degree Planner (https://registrar.sfsu.edu/degreeplanner/) tool found in your Student Center.

First-Time Student Roadmap (http://bulletin.sfsu.edu/colleges/science-engineering/biology/bs-biology-concentration-marine-science/roadmap-i-ii-eng/)

SF State Scholars

The San Francisco State Scholars program provides undergraduate students with an accelerated pathway to a graduate degree. Students in this program pursue a bachelor's and master's degree simultaneously. This program allows students to earn graduate credit while in their junior and/or senior year, reducing the number of semesters required for completion of a master's degree.

SF State Scholars Roadmap (http://bulletin.sfsu.edu/colleges/science-engineering/biology/bs-biology-concentration-marine-science/scholars-roadmap/)

Transfer Student Roadmap (2 year)

For students with an AS-T in **Biology**.
BIOL ADT Roadmap (http://bulletin.sfsu.edu/colleges/science-engineering/biology/bs-biology-concentration-marine-science/adt-roadmap/)

This degree program is an approved pathway ("similar" major) for students earning the ADT in Biology

California legislation SB 1440 (2009) mandated the creation of the Associate Degree for Transfer (ADT) to be awarded by the California Community Colleges. Two types of ADTs are awarded: Associate in Arts for Transfer (AA-T) and Associate in Science for Transfer (AS-T).

Note: no specific degree is required for admission as an upper-division student. However, the ADT includes specific guarantees related to admission and graduation and is designed to clarify the transfer process and strengthen lower-division preparation for the major.

An ADT totals 60 units and in most cases includes completion of all lower-division General Education requirements and at least 18 units in a specific major. (The Biology, Chemistry, and Environmental Science AS-T degrees defer 3 units in lower-division GE area C and 3 units in lower-division GE area D until after transfer.) Students pursuing an ADT are guaranteed admission to the CSU if minimum eligibility requirements are met, though not necessarily to the CSU campus of primary choice.

Upon verification that the ADT has been awarded prior to matriculation at SF State, students are guaranteed B.A. or B.S. completion in 60 units if pursuing a "similar" major after transfer. Determinations about "similar" majors at SF State are made by faculty in the discipline.

Degree completion in 60 units cannot be guaranteed when a student simultaneously pursues an additional major, a minor, certificate, or credential.

A sample advising roadmap for students who have earned an ADT and continue in a "similar" major at SF State is available on the Roadmaps tab on the degree requirements page for the major. The roadmap displays:

- How many lower-division units required for the major have been completed upon entry based on the award of a specific ADT;
- Which lower-division requirements are considered complete upon entry based on the award of a specific ADT;
- How to complete the remaining 60 units for the degree in four semesters.

Students who have earned an ADT should seek advising in the major department during the first semester of attendance.

General Advising Information for Transfer Students

a. Before transfer, complete as many lower-division requirements or electives for this major as possible.
b. The following courses are not required for admission but are required for graduation. Students are strongly encouraged to complete these units before transfer; doing so will provide more flexibility in course selection after transfer.
    - a course in U.S. History
    - a course in U.S. & California Government

For information about satisfying the requirements described in (1) and (2) above at a California Community College (CCC), please visit http://www.assist.org (http://assist.org). Check any geographically accessible CCCs; sometimes options include more than one college. Use ASSIST to determine:

- Which courses at a CCC satisfy any lower-division major requirements for this major;
- Which courses at a CCC satisfy CSU GE, US History, and US & CA Government requirements.

Remedial courses are not transferable and do not apply to the minimum 60 semester units/90 quarter units required for admission.

Additional units for courses that are repeated do not apply to the minimum 60 units required for upper-division transfer (for example, if a course was not passed on the first attempt or was taken to earn a better grade).

Before leaving the last California Community College of attendance, obtain a summary of completion of lower-division General Education units (IGETC or CSU GE Breadth). This is often referred to as a GE certification worksheet. SF State does not require delivery of this certification to Admissions, but students should retain this document for verifying degree progress after transfer.

Credit for Advanced Placement, International Baccalaureate, or College-Level Examination Program courses: AP/IB/CLEP credit is not automatically transferred from the previous institution. Units are transferred only when an official score report is delivered to SF State. Credit is based on the academic year during which exams were taken.

Refer to the University Bulletin in effect during the year of AP/IB/CLEP examination(s) for details regarding the award of credit for AP/IB/CLEP.

Students pursuing majors in science, technology, engineering, and mathematics (STEM) disciplines often defer 6-9 units of lower-division General Education in Areas C and D until after transfer to focus on preparation courses for the major. This advice does not apply to students pursuing associate degree completion before transfer.

Transferring From Institutions Other Than CCCs or CSUs

Review SF State's lower-division General Education requirements. Note that, as described below, the four basic skills courses required for admission meet A1, A2, A3, and B4 in the SF State GE pattern. Courses that fulfill the remaining areas of SF State's lower-division GE pattern are available at most two-year and four-year colleges and universities.

Of the four required basic skills courses, a course in critical thinking (A3) may not be widely offered outside the CCC and CSU systems. Students should attempt to identify and take an appropriate course no later than the term of application to the CSU. To review more information about the A3 requirement, please visit bulletin.sfsu.edu/undergraduate-education/general-education/lower-division/#AAEL.

Waiting until after transfer to take a single course at SF State that meets both US and CA/local government requirements may be an appropriate option, particularly if transferring from outside of California.