**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/#UARR]).
- 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.

**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 344GW, 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 coursework must be completed with letter grades (CR/NC is not acceptable).
- 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 (35-36 units)**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>BIOL 230</td>
<td>Introductory Biology I</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 231</td>
<td>Advising for Success as a Biology Major</td>
<td>1</td>
</tr>
<tr>
<td>BIOL 240</td>
<td>Introductory Biology II</td>
<td>5</td>
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<tr>
<td>CHEM 115</td>
<td>General Chemistry I: Essential Concepts of Chemistry</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 130</td>
<td>General Organic Chemistry</td>
<td>3</td>
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<tr>
<td>MATH 226</td>
<td>Calculus I</td>
<td>4</td>
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<tr>
<td>Select One:</td>
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<td>4</td>
</tr>
<tr>
<td>PHYS 111</td>
<td>General Physics I</td>
<td></td>
</tr>
<tr>
<td>&amp; PHYS 112</td>
<td>and General Physics I Laboratory</td>
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<tr>
<td>PHYS 220</td>
<td>General Physics with Calculus I</td>
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</tr>
<tr>
<td>&amp; PHYS 222</td>
<td>and General Physics with Calculus I Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>Select 8-9 units from the following:</td>
<td>8-9</td>
<td></td>
</tr>
<tr>
<td>CHEM 215</td>
<td>General Chemistry II: Quantitative Applications of</td>
<td></td>
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<tr>
<td>&amp; CHEM 216</td>
<td>Chemistry Concepts</td>
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<tr>
<td>&amp; General Chemistry II Laboratory: Quantitative Applications of Chemistry Concepts</td>
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<tr>
<td>MATH 227</td>
<td>Calculus II</td>
<td>1</td>
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<tr>
<td>Either physics pathway:</td>
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<tr>
<td>PHYS 121</td>
<td>General Physics II</td>
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<tr>
<td>&amp; PHYS 122</td>
<td>and General Physics II Laboratory</td>
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</tbody>
</table>
**Upper-Division Requirements (22-25 units)**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>BIOL 337</td>
<td>Evolution</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 355</td>
<td>Genetics</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 458</td>
<td>Biometry</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 582</td>
<td>Biological Oceanography &amp; Limnology</td>
<td>3-4</td>
</tr>
<tr>
<td>CHEM 680</td>
<td>Chemical Oceanography</td>
<td></td>
</tr>
<tr>
<td>ERTH 400</td>
<td>Earth Systems I</td>
<td></td>
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<tr>
<td>ERTH 434</td>
<td>Coastal Processes</td>
<td></td>
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<tr>
<td>ERTH 470</td>
<td>Physical Oceanography</td>
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</tr>
</tbody>
</table>

Select one class from the following: 3-4

- BIOL 344GW Research Skills - GWAR
- 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 391 Microscopy and Photomicrography
- BIOL 401 General Microbiology
- BIOL 411 Environmental 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 556 Natural History of Marine Invertebrates
- 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 LEADER Service Learning Course: Learners Engaged in Advocating for Diversity in Science
- 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
- GEOG 629 Coastal and Marine Applications of GIS
- MSCI 306 Marine Science Diving and Boating

**First-Time Student Roadmap (4 Year)**

a. 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.

b. In order to choose your English Composition A2 course and your QR/Math B4 course, please complete the online advising activities at https://writingadvising.sfsu.edu and https://mathadvising.sfsu.edu. Questions? Contact Gator Smart Start (https://gatorsmartstart.sfsu.edu).

**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.

**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 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://www.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;

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.