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.

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]).

• 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 to receive a degree in these programs.

• 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.

• At least 12 units in biology must be completed at SF State.

• 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

1. UNDERSTANDING THE PROCESS OF SCIENCE: Students can design an experiment with the appropriate control groups to test an hypothesis.

2. QUANTITATIVE REASONING: Students can interpret a graph or dataset to determine if the results of an experiment support or reject an hypothesis.

3. RELATIONSHIP BETWEEN SCIENCE AND SOCIETY: Students can weigh the costs and benefits to society of the use of recent scientific and technological developments.

4. EVOLUTION: Students can explain role that variation between individuals plays in the processes of natural selection and evolution.

5. 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.

6. INFORMATION FLOW AND STORAGE: Students can describe the mechanisms of information flow in classical and molecular genetics and predict the outcomes of crosses.

7. PATHWAYS AND TRANSFORMATION OF MATTER AND ENERGY: Students can explain how a carbon molecule flows through a biological process or system.

8. 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.

Graduation Writing Assessment Requirement (GWAR)

Students must earn a C- or better in a GWAR course to satisfy the 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.

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.

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

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>
</tr>
</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></td>
</tr>
<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>
</tr>
<tr>
<td>MATH 226</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>Select One:</td>
<td></td>
<td></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>
<td></td>
</tr>
<tr>
<td>PHYS 220</td>
<td>General Physics with Calculus I</td>
<td></td>
</tr>
<tr>
<td>&amp; PHYS 222</td>
<td>and General Physics with Calculus I Laboratory</td>
<td></td>
</tr>
<tr>
<td>Select 8-9 units from the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 215</td>
<td>General Chemistry II: Quantitative Applications of Chemistry Concepts</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 216</td>
<td>and General Chemistry II Laboratory. Quantitative Applications of Chemistry Concepts</td>
<td></td>
</tr>
<tr>
<td>MATH 227</td>
<td>Calculus II</td>
<td></td>
</tr>
</tbody>
</table>

1. Courses that require CHEM 115 and BIOL 110.
Either physics pathway:

- PHYS 121 & PHYS 122: General Physics II and General Physics II Laboratory
- PHYS 230 & PHYS 232: General Physics with Calculus II and General Physics with Calculus II Laboratory

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.

**Upper-Division Requirements (22-25 units)**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</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>
</tbody>
</table>

Select 3-4 units from the following:

- 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:

- 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
- GEOG 629: Coastal and Marine Applications of GIS
- MSCI 306: Marine Science Diving and Boating

<table>
<thead>
<tr>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 585: Marine Ecology</td>
<td></td>
</tr>
<tr>
<td>BIOL 586GW: Marine Ecology Laboratory - GWAR</td>
<td></td>
</tr>
<tr>
<td>BIOL 600: Animal Behavior</td>
<td></td>
</tr>
<tr>
<td>BIOL 607: Conservation and Management of Marine Mammals</td>
<td></td>
</tr>
<tr>
<td>BIOL 617: Environmental Physiology</td>
<td></td>
</tr>
<tr>
<td>BIOL 630: Animal Physiology</td>
<td></td>
</tr>
<tr>
<td>BIOL 631GW: Animal Physiology Laboratory - GWAR</td>
<td></td>
</tr>
<tr>
<td>BIOL 644: LEADerS Service Learning Course: Learners Engaged in Advocating for Diversity in Science or BIOL 654: Peer Assistants for Learning Science (PALS)</td>
<td></td>
</tr>
<tr>
<td>BIOL 670GW: Ecology and Evolution of Marine Systems I - GWAR</td>
<td></td>
</tr>
<tr>
<td>BIOL 671: Ecology and Evolution of Marine Systems II</td>
<td></td>
</tr>
<tr>
<td>BIOL 699: Independent Study in Biology</td>
<td></td>
</tr>
<tr>
<td>GEOG 629: Coastal and Marine Applications of GIS</td>
<td></td>
</tr>
<tr>
<td>MSCI 306: Marine Science Diving and Boating</td>
<td></td>
</tr>
</tbody>
</table>

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

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

2. Select the row that matches your English course choice for A2.*

3. Select the column that matches your QR/Math course choice for B4.

4. Click the Roadmap that lines up with your row and column.

For example, if you select ENG 104/ENG 105 and a multi-semester QR/ math sequence for your first year, then choose Roadmap D.

**Course Choice** | **One-Semester Course** | **Two-Semester Sequence or Support Course**
|-------------------|------------------------|-----------------------------|

* Composition for Multilingual Students: If taking ENG 209 as your first English course, choose the ENG 114 row. If taking ENG 201 or ENG 212 for your first English course, choose the ENG 104/ENG 105 row.

**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.

This roadmap opens in a new tab. (http://bulletin.sfsu.edu/colleges/science-engineering/biology/bs-biology-concentration-marine-science/scholars-roadmap/)

Transfer Student Roadmap (2 year)

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
1. Before transfer, complete as many lower-division requirements or electives for this major as possible.

2. 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;

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.

**All Students Must Meet the Transfer Eligibility Requirements Outlined Below for Admission.**

For more information, visit the Undergraduate Admissions section (http://bulletin.sfsu.edu/undergraduate-admissions/).

- Complete 60 or more transferable semester units or 90 or more quarter units.
- Earn a college grade point average of 2.0 or better in all transferable courses. Non-local area residents may be held to a higher GPA standard.
- Be in good standing at the last college or university attended.
- Complete 30-semester units (45-quarter units) of General Education, including four basic skills courses:
  a. One course in oral communication (same as CSU GE Area A1)
  b. One course in written composition (same as CSU GE Area A2)
  c. One course in critical thinking (same as CSU GE Area A3)
  d. One course in mathematics or quantitative reasoning (same as CSU GE Area B4)
- The four basic skills courses and a minimum of 60 transferable semester units (90-quarter units) must be completed by the spring semester prior to fall admission, or by the fall semester prior to spring admission. Earn a C- or better grade in each basic skills course.