BACHELOR OF ARTS IN GENERAL BIOLOGY

The curriculum in general biology provides students with exposure to a broad spectrum of biological sciences including genetics, cell biology, physiology, ecology, and organismal and evolutionary biology. Since basic principles of physical science are central to many biological concepts, coursework in physics and chemistry is included in the lower-division requirements. The B.A. program is suited for students preparing for professional schools, including teacher credentialing programs, or careers that require students to be versed in diverse areas of biology.

Students preparing to become teachers should note that additional science preparation beyond the major is required (geosciences breadth: meteorology, astronomy, geology, and oceanography). It is important to consult early and often with a credential advisor in the Biology department to plan the major and keep abreast of any state-mandated changes in requirements.

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 coursework 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

Core Competencies

a. Understanding the Process of Science: Students will demonstrate how a theory is supported or can be rejected based on data from experiments.
b. Quantitative Reasoning: Students will be able to create graphs and perform simple statistical tests to determine whether or not differences between groups are significant.
c. Relationship Between Science and Society: Students will be able to explain a biological process or phenomenon as it relates to a societal issue.

Core Concepts

a. Evolution: Students will be able to understand the fundamental concepts of evolution, role of selective pressures, and how genes change.
b. Relationship Between Structures and Function: Students will be able to describe how variation in the structure of an organ in a plant or animal contributes to variation in its function.
c. Information Flow and Storage: Students will be able to explain the transmission of heritable traits.

General Biology (B.A.) — 58 units

- Students must take at least one GWAR course and earn a C- or better in a GWAR course to satisfy the GWAR requirement. GWAR courses are listed in upper-division categories and electives in the program. 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 (22 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
Select One:		3
CHEM 130	General Organic Chemistry	
CHEM 233	Organic Chemistry I	
PHYS 111	General Physics I	3
PHYS 112	General Physics I Laboratory	1

Quantitative Reasoning (4-6 units)

Select One:

Code	Title	Units
MATH 197 & MATH 198	Prelude to Calculus I and Prelude to Calculus II	6
MATH 199	Pre-Calculus	4
MATH 226	Calculus I	4

Upper-Division Requirements (16-23 units)

Upper-Division Core (6 units):

Code	Title	Units
BIOL 337	Evolution	3
BIOL 355	Genetics	3

One Physiology or Cell Biology Course (3-4 units):

Code	Title	Units
BIOL 328	Human Anatomy	4
BIOL 350	Cell Biology	3
BIOL 357	Molecular Genetics	3
BIOL 382	Developmental Biology	3
BIOL 401	General Microbiology	3
BIOL 435	Immunology	3
BIOL 442	Microbial Physiology	3
BIOL 446	Microbial Genomics	4
BIOL 453	General Parasitology	3
BIOL 525	Plant Physiology	3
BIOL 612	Human Physiology	3
BIOL 630	Animal Physiology	3
CHEM 349	General Biochemistry	3

One Physiology or Cell Biology Laboratory Course (1-4 units):

Take a GWAR course if not already taken to meet requirements in another area.

Code	Title	Units
BIOL 351GW	Experiments in Cell and Molecular Biology - GWAR	4
BIOL 402GW	General Microbiology Laboratory - GWAR	3
BIOL 436	Immunology Laboratory	2
BIOL 443	Microbial Physiology Laboratory	2
BIOL 454	Parasitology Laboratory	1
BIOL 526	Plant Molecular Physiology Laboratory	2
BIOL 613GW	Human Physiology Laboratory - GWAR	3
BIOL 631GW	Animal Physiology Laboratory - GWAR	4
BIOL 638	Bioinformatics and Sequence Analysis	4

Two Ecology, Evolution, or Organismal Biology Courses (6-9 units)

Take a GWAR course if not already taken to meet requirements in another area.

Code	Title	Units
BIOL 380	Evolutionary Developmental Biology	3
BIOL 425	Emerging Diseases	3
BIOL 460	General Entomology	4
BIOL 470	Natural History of Vertebrates	4
BIOL 475GW	Herpetology - GWAR	3
BIOL 478GW	Ornithology - GWAR	4
BIOL 482	Ecology	4
BIOL 490	Ecology of Infectious Diseases	4
BIOL 500	Evolution and Diversity of Plants	4
BIOL 502	Biology of the Algae	3
BIOL 504	Biology of the Fungi	4
BIOL 505	Plant Structure and Function	4
BIOL 514	Plant Biodiversity and California Field Botany	5
BIOL 529GW	Plant Ecology - GWAR	4
BIOL 532	Restoration Ecology	3
BIOL 534	Wetland Ecology	4
BIOL 555	Marine Invertebrate Zoology	4
BIOL 570GW	Biology of Fishes - GWAR	4
BIOL 580	Limnology	3
BIOL 582	Biological Oceanography & Limnology	4
BIOL 585	Marine Ecology	3
BIOL 586GW	Marine Ecology Laboratory - GWAR	4
BIOL 600	Animal Behavior	3

Upper-Division Electives (7-16 units)

Students should take as many units as needed to reach a total of 58 units in the program. Elective courses can be additional courses listed above not used to satisfy requirements in those categories. Take a GWAR course if not already taken. Only one of the following courses can be used as an elective: BIOL 317, BIOL 327, BIOL 330, or BIOL 349. Up to 3 units of BIOL 699 can also be used towards the total units. Other biology courses that have BIOL 230 and/or BIOL 240 as prerequisites can also be used as electives. Advisor approval is needed IN ADVANCE for any substitutions to elective courses.

Code	Title	Units
AA S 587	Asian Americans and Environmental Justice [1]	3
AA S 591	Asian American Community Health Issues [1]	3
AFRS 370	Health, Medicine, and Nutrition in the Black Community [1]	3
AIS 450	American Indian Science [1]	3
AIS 520	Before the Wilderness: American Indian Ecology [1]	3
ANTH 630	Medical Anthropology [1]	3
BIOL 315	Field Methods in Ecology and Evolution	1
Select a Maximum of One:		3
BIOL 317	Ecology of California	
BIOL 327	AIDS: Biology of the Modern Epidemic	
BIOL 330	Human Sexuality	
BIOL 349	Bioethics	
BIOL 318	Our Endangered Planet	3
BIOL 328	Human Anatomy	4
BIOL/RRS 331	Research with Communities	3
BIOL 332	Health Disparities in Cancer	3
BIOL 350	Cell Biology	3
BIOL 351GW	Experiments in Cell and Molecular Biology - GWAR	4
BIOL 357	Molecular Genetics	3
BIOL 358	Forensic Genetics: Math Matters	4
BIOL 360	Cancer Biology	3
BIOL 380	Evolutionary Developmental Biology	3
BIOL 382	Developmental Biology	3
BIOL 401	General Microbiology	3
BIOL 402GW	General Microbiology Laboratory - GWAR	3
BIOL 425	Emerging Diseases	3
BIOL 435	Immunology	3
BIOL 436	Immunology Laboratory	2
BIOL 442	Microbial Physiology	3
BIOL 443	Microbial Physiology Laboratory	2

BIOL 453	General Parasitology	3
BIOL 454	Parasitology Laboratory	1
BIOL 458	Biometry	4
BIOL 460	General Entomology	4
BIOL 470	Natural History of Vertebrates	4
BIOL 475GW	Herpetology - GWAR	3
BIOL 478GW	Ornithology - GWAR	4
BIOL 482	Ecology	4
BIOL 490	Ecology of Infectious Diseases	4
BIOL 500	Evolution and Diversity of Plants	4
BIOL 502	Biology of the Algae	3
BIOL 504	Biology of the Fungi	4
BIOL 505	Plant Structure and Function	4
BIOL 514	Plant Biodiversity and California Field Botany	5
BIOL 525	Plant Physiology	3
BIOL 526	Plant Molecular Physiology Laboratory	2
BIOL 529GW	Plant Ecology - GWAR	4
BIOL 530	Conservation Biology	3
BIOL 532	Restoration Ecology	3
BIOL 534	Wetland Ecology	4
BIOL 555	Marine Invertebrate Zoology	4
BIOL 570GW	Biology of Fishes - GWAR	4
BIOL/ERTH 577	Climate and Ecological Interactions	4
BIOL 580	Limnology	3
BIOL 582	Biological Oceanography & Limnology	4
BIOL 585	Marine Ecology	3
BIOL 586GW	Marine Ecology Laboratory - GWAR	4
BIOL 600	Animal Behavior	3
BIOL 612	Human Physiology	3
BIOL 613GW	Human Physiology Laboratory - GWAR	3
BIOL 617	Environmental Physiology	3
BIOL 630	Animal Physiology	3
BIOL 631GW	Animal Physiology Laboratory - GWAR	4
BIOL 638	Bioinformatics and Sequence Analysis	4
BIOL 644	LEADerS Service Learning Course: Learners Engaged in Advocating for Diversity in Science	4
BIOL/CHEM 667	Optical Engineering for the Biological Sciences	3
BIOL 670GW	Ecology and Evolution of Marine Systems I - GWAR	6
BIOL 671	Ecology and Evolution of Marine Systems II	6
BIOL 694	Cooperative Internship in Biology	2-4
BIOL 699	Independent Study in Biology	1-3
CHEM 343	Biochemistry I Laboratory	3
CHEM 349	General Biochemistry	3
CSC 306	An Interdisciplinary Approach to Computer Programming	3
CSC 408	Machine Learning and Data Science for Personalized Medicine	3
CSC 411	Introduction to Machine Learning for Interdisciplinary Data Scientists [1]	3
CSC 509	Data Science and Machine Learning for Medical Image Analysis [1]	3
I R/ENVS 331	Global Environmental Crisis [1]	4
LTNS 500	Latina/o Community Mental Health [1]	3
RRS 303	Health and Wellness among Pacific Islanders [1]	3
RRS 304	Decolonize Your Diet: Food Justice and Gendered Labor in Communities of Color [1]	3
ENVS 460	Energy, Justice, and Sustainability [1]	3
ENVS 480	Climate Change Adaptation and Justice [1]	3
ERTH 330	California Water [1]	3
ERTH 335	Global Warming [1]	3
ETHS 500	Introduction to Race, Ethnicity, and Health [1]	3
FIN/ECON/ENVS 651	Student Managed Fund in Environmental, Social and Governance (ESG) Investments [1]	3
GEOG/USP 433	Urban Transportation [1]	4
GEOG 435	Geography of Global Transportation [1]	4
PH 414	Women's Health [1]	3
PHIL 383	Ethics in Medicine [1]	3
USP 514	Sustainable Development in Cities [1]	4
WGS 593	Gender, Health, and the Environment [1]	3

[1] Classes can only account for 6 units of upper-division elective courses.

Note: A minimum of 30 upper-division units must be completed for the degree (including upper-division units required for the major, General Education, electives, etc.). A student can complete this major yet not attain the necessary number of upper-division units required for graduation. In this case, additional upper-division courses will be needed to reach the required total.

Complementary Studies

Students in the B.A. Biology program will satisfy the Complementary Studies requirement with the completion of courses in chemistry, physics, mathematics or computer science that are required for the major.

General Education Requirements

Requirement	Course Level	Units	Area Designation
Oral Communication	LD	3	A1
Written English Communication	LD	3	A2
Critical Thinking	LD	3	A3
Physical Science	LD	3	B1
Life Science	LD	3	B2
Lab Science	LD	1	B3
Mathematics/ Quantitative Reasoning	LD	3	B4
Arts	LD	3	C1
Humanities	LD	3	C2
Arts or Humanities	LD	3	C1 or C2
Social Sciences	LD	3	D1
Social Sciences: US History	LD	3	D2
Lifelong Learning and Self-Development (LLD)	LD	3	E
Ethnic Studies	LD	3	F

Physical and/or Life Science	UD	3	UD-B
Arts and/or Humanities	UD	3	UD-C
Social Sciences	UD	3	UD-D
SF State Studies			
Courses certified as meeting the SF State Studies requirements may be upper or lower division in General Education (GE), a major or minor, or an elective.			
American Ethnic and Racial Minorities	LD or UD	3	AERM
Environmental Sustainability	LD or UD	3	ES
Global Perspectives	LD or UD	3	GP
Social Justice	LD or UD	3	SJ

Note: LD = Lower-Division; UD = Upper-Division.

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/ba-general-biology/roadmap-i-ii-eng/)

Transfer Student Roadmap (2 Year)

For students with an AS-T in **Biology**.
BIOL ADT Roadmap (http://bulletin.sfsu.edu/colleges/science-engineering/biology/ba-general-biology/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.