BACHELOR OF SCIENCE IN BIOCHEMISTRY

High school preparation for the chemistry and biochemistry degree programs should include two years of algebra, one year of geometry, one-half year of trigonometry, one year of chemistry, and one year of physics. Calculus is highly recommended.

Mandatory Advising

All undergraduate chemistry and biochemistry majors are required to meet with a major advisor several times over their academic career. First-time freshmen and new transfer students are required to meet with an advisor or attend a group advising session during the first semester of attendance. Continuing students enrolled in the following courses will be required to meet with an advisor that semester to avoid having a hold placed on their registration for the next semester.

Biochemistry (B.S.) — 72 units

Lower Division Requirements (36 units)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 115</td>
<td>General Chemistry I: Essential Concepts of Chemistry</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 233</td>
<td>Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 321</td>
<td>Quantitative Chemical Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 300</td>
<td>General Physical Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 351</td>
<td>Physical Chemistry I: Thermodynamics and Kinetics</td>
<td>3</td>
</tr>
</tbody>
</table>

- All courses used in the major program must be completed with letter grades (CR/NC not allowed) and a minimum GPA of 2.0 (SFSU Major GPA).
- Grades of C or better are required in chemistry prerequisite courses.
- Grades of C– or better are required in CHEM 341 and CHEM 343.
- Other courses for the major must be completed with grades of C- or better with one exception.

Upper Division Requirements (36 units)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 300</td>
<td>General Physical Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 301</td>
<td>General Physical Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 321</td>
<td>Quantitative Chemical Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 335</td>
<td>Organic Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 340</td>
<td>Biochemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 341</td>
<td>Biochemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 343</td>
<td>Biochemistry I Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 390GW</td>
<td>Contemporary Chemistry and Biochemistry Research - GWAR</td>
<td>3</td>
</tr>
</tbody>
</table>

Students must complete at least 12 units of upper division chemistry and biology electives selected from the lists below. Courses from community colleges can not be substituted for the courses on the list below. Electives must include at least one course with a CHEM prefix and at least three laboratory courses. Note that many biology electives have a BIOL 240 prerequisite. Students wishing to enroll in BIOL 350, BIOL 355, and BIOL 612 without completing the BIOL 240 prerequisite should contact an advisor prior to registration. Students should consult an advisor regarding selection of elective courses and check course co-requisites before enrolling. Graduate level courses in chemistry or appropriate courses in biology, physics, geosciences, and computer science may be substituted upon prior approval of advisor.

Upper Division Electives in Chemistry

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 322</td>
<td>Quantitative Chemical Analysis Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 325</td>
<td>Inorganic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 327</td>
<td>Practical GC and HPLC</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 336</td>
<td>Organic Chemistry II Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 370</td>
<td>Computer Applications in Chemistry and Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 420</td>
<td>Environmental Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 422</td>
<td>Instrumental Analysis</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 426</td>
<td>Advanced Inorganic Chemistry Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 433</td>
<td>Advanced Organic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 443</td>
<td>Biophysical Chemistry Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 451</td>
<td>Experimental Physical Chemistry Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 470</td>
<td>Research</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 640</td>
<td>Advanced Topics in Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 645</td>
<td>Research Trends in Chemistry and Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 680</td>
<td>Chemical Oceanography</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 699</td>
<td>Independent Study</td>
<td>3</td>
</tr>
</tbody>
</table>

Upper Division Electives in Biology

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 350</td>
<td>Cell Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 351GW</td>
<td>Experiments in Cell and Molecular Biology - GWAR</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 355</td>
<td>Genetics</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 357</td>
<td>Molecular Genetics</td>
<td>3</td>
</tr>
</tbody>
</table>
BIOL 401 General Microbiology 3
BIOL 402GW General Microbiology Laboratory - GWAR 3
BIOL 420 General Virology 3
BIOL 435 Immunology 3
BIOL 436 Immunology Laboratory 2
BIOL 612 Human Physiology 3
BIOL 613GW Human Physiology Laboratory - GWAR 3
BIOL 638 Bioinformatics & Genome Annotation 4
BIOL 640 Cellular Neurosciences 3

1 CHEM 351 may be substituted for CHEM 300 and CHEM 353 may be substituted for CHEM 301 if prerequisites for CHEM 351 and CHEM 353 are met.
2 CHEM 338 may be substituted for CHEM 336.
3 By petition only. CHEM 699 and CHEM 470 may not both be used to fulfill the elective requirements.

General Education Requirements Met in the Biochemistry Major or Undeclared with Interest in Biochemistry

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 B1 (Physical Science) is satisfied upon completion of CHEM 233.
- Area B2 (Life Science) is satisfied upon completion of either BIOL 240 or CHEM 341.
- Area B3 (Laboratory Science) is satisfied upon completion of CHEM 234.

General Education Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Course Level</th>
<th>Units</th>
<th>Area Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral Communication</td>
<td>LD</td>
<td>3</td>
<td>A1</td>
</tr>
<tr>
<td>Written English Communication I</td>
<td>LD</td>
<td>3</td>
<td>A2</td>
</tr>
<tr>
<td>Critical Thinking</td>
<td>LD</td>
<td>3</td>
<td>A3</td>
</tr>
<tr>
<td>Written English Communication II</td>
<td>LD</td>
<td>3</td>
<td>A4</td>
</tr>
<tr>
<td>Physical Science</td>
<td>LD</td>
<td>3</td>
<td>B1</td>
</tr>
<tr>
<td>Life Science</td>
<td>LD</td>
<td>3</td>
<td>B2</td>
</tr>
<tr>
<td>Lab Science</td>
<td>LD</td>
<td>1</td>
<td>B3</td>
</tr>
<tr>
<td>Mathematics/Quantitative Reasoning</td>
<td>LD</td>
<td>3</td>
<td>B4</td>
</tr>
<tr>
<td>Arts</td>
<td>LD</td>
<td>3</td>
<td>C1</td>
</tr>
<tr>
<td>Arts or Humanities</td>
<td>LD</td>
<td>3</td>
<td>C1 or C2</td>
</tr>
<tr>
<td>Humanities: Literature</td>
<td>LD</td>
<td>3</td>
<td>C3</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>LD</td>
<td>3</td>
<td>D1</td>
</tr>
<tr>
<td>Social Sciences: US History</td>
<td>LD</td>
<td>3</td>
<td>D2</td>
</tr>
</tbody>
</table>

Social Sciences: US & CA Government
Lifelong Learning and Self-Development (LLD)
Physical and/or Life Science
Arts and/or Humanities
Social Sciences

SF State Studies

Courses certified as meeting the SF State Studies requirements may be upper or lower division in General Education (GE), in a major or minor, or an elective.

- American Ethnic and Racial Minorities (AERM)
- Environmental Sustainability (ES)
- Global Perspectives (GP)
- Social Justice (SJ)

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

First Time Student Roadmap (4 year)

This link opens the current roadmap in a new tab. (http://bulletin.sfsu.edu/past-bulletin-archive/2017-2018/colleges/science-engineering/chemistry-biochemistry/bs-biochemistry/roadmap.html)

Transfer Student Roadmap (2 year)


This degree program is an approved pathway (“similar” major) for students earning the ADT in Chemistry

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 includes completion of all lower-division General Education requirements and at least 18 units in a specific major. 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
and displays:

- How many lower-division units required for the major have been
  completed upon entry based on award of a specific ADT;
- Which lower-division requirements are considered complete upon
  entry based on 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
   - a 2nd-semester course in written English composition

For information about satisfying the requirements described in (1) and
(2) above at a California Community College (CCC), please visit 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, including 2nd-semester composition;
- Which courses at a CCC satisfy CSU GE, US History, and US & CA
  Government.

Remedial courses are not transferable and do not apply to the minimum
60 units/90 quarters 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
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 in order 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
(GE 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 http://bulletin.sfsu.edu/
undergraduate-education/general-education/lower-division/#AAEL.

Identify and complete a 2nd-semester written English composition
course before transfer. This is usually the next course after the typical
“freshman comp” course, with a focus on writing, reading and critical
analytical skills for academic purposes, and developing skills in
composing, revising, and the use of rhetorical strategies.

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.

- Complete 60 or more transferable semester units or 90 or more
  quarter units
- Earn a college grade point average of 2.00 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, with
     intermediate algebra as a prerequisite (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.