

BS IN BIOLOGICAL SCIENCE (MICROBIOLOGY)

Units required for Major: 73-85, includes units of study in chosen concentration (see below).

Total units required for BS: 120

Program Description

The concentration in Microbiology is designed to prepare students for entry level technical positions in the industry and graduate programs in Microbiology leading to careers in research and teaching. This curriculum meets the educational requirements for various entry level career positions for biotechnology, environmental, pharmaceutical, wastewater treatment, and agricultural areas of microbiology. Concentration includes a minor in Chemistry.

Program Requirements

Code	Title	Units
Required Lower Division Core Courses (37-41 Units)		
BIO 1	Biodiversity, Evolution and Ecology ¹	5
BIO 2	Cells, Molecules and Genes	5
CHEM 1A	General Chemistry I ¹	5
CHEM 1B	General Chemistry II	5
Select one of the following:		3 - 6
CHEM 20	Organic Chemistry Lecture–Brief Course ²	
CHEM 24 & CHEM 124	Organic Chemistry Lecture I & Organic Chemistry Lecture II	
Select one of the following:		3 - 4
MATH 26A	Calculus I for the Social and Life Sciences	
MATH 30	Calculus I	
PHYS 5A	General Physics: Mechanics, Heat, Sound	4
PHYS 5B	General Physics: Light, Electricity and Magnetism, Modern Physics	4
STAT 1	Introduction to Statistics ¹	3
Required Upper Division Core Courses (7 Units)		
BIO 100	Introduction to Scientific Analysis	3
BIO 184	General Genetics	4
Concentration (29-37 Units)		
Select from the following concentrations:		29 - 37
General Biology		
Biomedical Sciences		
Cell and Molecular Biology		
Clinical Laboratory Sciences		
Ecology, Evolution, and Conservation		
Forensic Biology		
Microbiology		
Total Units		73-85

¹ Course also satisfies General Education (GE)/Graduation Requirement.

² CHEM 24 and CHEM 124 may be taken in lieu of CHEM 20. (CHEM 124 is not counted toward the 36 upper division unit requirement in the major except in the Biomedical Sciences Concentration.)

Notes:

- Pre-Health Professional students should take the Chemistry and Math requirements as stated in the Pre-Health Professional Program section of this catalog.
- With approval, up to six units of upper division coursework from related fields may be applied as electives in the major.

Concentration in Microbiology (34-36 units)

Code	Title	Units
Required Courses (29-31 Units)		
BIO 121	Molecular Cell Biology	3
BIO 139	General Microbiology	4
BIO 143	General Virology	3
BIO 145	The Diversity of Microorganisms	4
BIO 180	Molecular Biology Research Experience	4
CHEM 20L	Introductory Organic Chemistry Laboratory	1 - 3
or CHEM 25	Organic Chemistry Laboratory	
CHEM 31	Quantitative Analysis	4
CHEM 161	General Biochemistry ¹	3
CHEM 162	General Biochemistry Laboratory ²	3
Elective Courses (5 Units)		
Select 5 units from the following Cell and Molecular Biology electives or Clinical Laboratory Science and Infectious Disease electives: ³		5
<i>Cell and Molecular Biology Electives</i>		
BIO 149A	Immunology	
BIO 150	Forensic Biology	
BIO 151	Advanced Laboratory Techniques in Forensic Biology	
BIO 178	Molecular Ecology	
BIO 170	Advanced Nutrition and Metabolism	
BIO 183	Cancer Biology	
BIO 185	Topics in Biology	
BIO 186A	Cell and Molecular Biology Seminar	
BIO 187	Advanced Cell Biology	
<i>Clinical Laboratory Science and Infectious Disease Electives</i>		
BIO 134	Medical Mycology	
BIO 140	Medical Microbiology and Emerging Infectious Diseases ⁴	
BIO 144	Pathogenic Bacteriology ⁴	
BIO 149B	Immunology and Serology Laboratory	
BIO 152	Human Parasitology	
PUBH 148	Epidemiology	
Total Units		34-36

¹ CHEM 160A and CHEM 160B may be taken in lieu of CHEM 161. Only three units of the package may be counted toward the upper division requirement.

² CHEM 162 can be included in the 36 upper division unit requirement for this concentration.

³ Electives chosen in consultation with an advisor. BIO 124 and BIO 125 cannot be taken to fulfill the elective requirements for the Microbiology Concentration.

⁴ Students may not receive credit for both BIO 140 and BIO 144. Cannot be counted for credit in the Clinical Laboratory Sciences concentration.

⁵ Required for Public Health Microbiology Traineeship.

Code	Title	Units
BIO 195	Biological Internship	1 - 2
BIO 197A	Laboratory Teaching Assistant	1 - 2
BIO 197B	Laboratory Techniques	1 - 2
BIO 197C	Co-curricular Activities in Biology	1 - 2
BIO 199A	Introductory Undergraduate Research	1 - 2
BIO 199B	Directed Readings	1 - 2

- No more than 3 units from the following combined can be applied to the Biological Sciences upper division major requirement. No more than 2 units of BIO 195 and 197 series courses can count toward the major requirement.

General Education Requirements ¹

Code	Title	Units
Area A: Basic Subjects (9 Units)		
A1	Oral Communication	3
A2	Written Communication	3
A3	Critical Thinking	3
Area B: Physical Universe and Its Life Forms (3 Units)		
B1	Physical Science ²	0
B2	Life Forms ²	0
B3	Lab (Note: Lab experience to be taken with one of the following: B1, B2 or B5) ²	0
B4	Math Concepts ²	0
B5	Additional Course (Any B to reach 12 units) - Take upper-division course to complete Area & upper division requirements.	3
Area C: Arts and Humanities (12 Units)		
C1	Arts	3
C2	Humanities	3
C1/C2	Area C Course	3
C1/C2	Area C Course - Take upper-division course to complete Area & upper division requirements.	3
Area D: The Individual and Society (9 Units)		
Area D Course		3
Area D Course		3
Area D Course	- Take upper-division course to complete Area & upper division requirements.	3
Area E: Understanding Personal Development (3 Units)		
Area E Course		3
Area F: Ethnic Studies (3 Units)		

Area F Course	3
Total Units	39

¹ To help you complete your degree in a timely manner and not take more units than absolutely necessary, there are ways to use single courses to meet more than one requirement (overlap). For further information, please visit the General Education page (<https://catalog.csus.edu/colleges/academic-affairs/general-education/>).

Note: There is no way to list all possible overlaps so please consult with a professional advisor. The Academic Advising Center can be visited online (<http://www.csus.edu/acad/>), by phone (916) 278-1000, or email (advising@csus.edu).

² Required in Major; also satisfies GE.

Graduation Requirements ¹

Code	Title	Units
Graduation Requirements (required by CSU) (9 Units)		
American Institutions: U.S. History		3
American Institutions: U.S. Constitution & CA Government		3
Writing Intensive (WI)		3
Graduation Requirements (required by Sacramento State) (12 Units)		
English Composition II		3
Race and Ethnicity in American Society (RE)		3
Foreign Language Proficiency Requirement ²		6

¹ To help you complete your degree in a timely manner and not take more units than absolutely necessary, there are ways to use single courses to meet more than one requirement (overlap). For further information, please visit the General Education page (<https://catalog.csus.edu/colleges/academic-affairs/general-education/>).

Note: There is no way to list all possible overlaps so please consult with a professional advisor. The Academic Advising Center can be visited online (<http://www.csus.edu/acad/>), by phone (916) 278-1000, or email (advising@csus.edu).

² If not satisfied before entering Sacramento State, it may be satisfied in General Education Area C2 (Humanities). "C- or better required." The alternative methods for satisfying the Foreign Language Proficiency Requirement are described here: <https://www.csus.edu/college/arts-letters/world-languages-literatures/foreign-language-requirement.html> (<https://www.csus.edu/college/arts-letters/world-languages-literatures/foreign-language-requirement.html>)

The following roadmaps are sample planning resources. Please consult your academic advisor and Academic Catalog for graduation requirements as you develop your individualized academic plan.

Biological Science (Microbiology), BS: 4-Year Roadmap

Course	Title	Units
Year 1		
First Semester		
MATH 26A or MATH 30	Calculus I for the Social and Life Sciences ³ or Calculus I	3 - 4
GE Area 1A	English Composition ²	3
GE Area 3A	Arts ²	3
GE Area 6	Ethnic Studies ²	3
GR American Institutions	(US History) ²	3
Units		15-16

Second Semester

CHEM 1A	General Chemistry I	5
STAT 1	Introduction to Statistics	3
GE Area 1B - Critical Thinking ²		3
GE Area 1C - Oral Communication ²		3
Units		14

Year 2**First Semester**

BIO 1	Biodiversity, Evolution and Ecology	5
CHEM 1B	General Chemistry II	5
ENGL 20	College Composition II	3
GR American Institutions (GOVT) ²		3
Units		16

Second Semester

BIO 2	Cells, Molecules and Genes	5
CHEM 31	Quantitative Analysis	4
GE Area 3B - Humanities ²		3
GE Area 4 - Social & Behavioral Sciences ²		3
Units		15

Year 3**First Semester**

BIO 100	Introduction to Scientific Analysis	3
BIO 184	General Genetics	4
CHEM 20 or CHEM 24 or CHEM 124	Organic Chemistry Lecture-- Brief Course ³ or Organic Chemistry Lecture I or Organic Chemistry Lecture II	3
CHEM 20L or CHEM 25	Introductory Organic Chemistry Laboratory ³ or Organic Chemistry Laboratory	1 - 3
Foreign Language Semester 1 ²		4
Units		15-17

Second Semester

BIO 121	Molecular Cell Biology	3
BIO 139	General Microbiology	4
CHEM 161	General Biochemistry	3
Foreign Language Semester 2 ²		4
Units		14

Year 4**First Semester**

BIO 180	Molecular Biology Research Experience	4
CHEM 162	General Biochemistry Laboratory	3
PHYS 5A	General Physics: Mechanics, Heat, Sound	4
Cell and Molecular Biology or Clinical Laboratory Science and Infectious Disease Elective ³		3
Upper Division GE Area 3 - Arts or Humanities ²		3
Units		17

Second Semester

BIO 143	General Virology	3
BIO 145	The Diversity of Microorganisms	4
PHYS 5B	General Physics: Light, Electricity and Magnetism, Modern Physics	4
Cell and Molecular Biology or Clinical Laboratory Science and Infectious Disease Elective ³		3

Upper Division GE Area 4 - Social & Behavioral Sciences + Writing Intensive² 3

Units	17
Total Units	123-126

Biological Science (Microbiology), BS: 2-Year Roadmap

Course	Title	Units
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Year 1**First Semester**

BIO 100	Introduction to Scientific Analysis	3
BIO 184	General Genetics	4
GR American Institutions (GOVT) ²		3
Foreign Language Semester 1 ²		4
Units		14

Second Semester

BIO 121	Molecular Cell Biology	3
BIO 139	General Microbiology	4
CHEM 161	General Biochemistry	3
Foreign Language Semester 2 ²		4
Units		14

Year 2**First Semester**

BIO 180	Molecular Biology Research Experience	4
CHEM 162	General Biochemistry Laboratory	3
Cell and Molecular Biology or Clinical Laboratory Science and Infectious Disease Elective ³		3
Upper Division GE Area 3 - Arts or Humanities ²		3
GR American Institutions (US History) ²		3
Units		16

Second Semester

BIO 143	General Virology	3
BIO 145	The Diversity of Microorganisms	4
Cell and Molecular Biology or Clinical Laboratory Science and Infectious Disease Elective ³		3
Upper Division GE Area 4 - Social & Behavioral Sciences + Writing Intensive ²		3
Elective of Choice		3
Units		16
Total Units		60

¹. Any course not completed in the first semester should be taken in the second or a later semester.

². Please see General Education/Graduation Requirement **course options** (https://www.csus.edu/academic-affairs/curriculum-%20workflow/_internal/_documents/program-road-maps/als_2yr/art_transfer-%20roadmap-2024-25.pdf).

³. Please see an academic advisor for elective options.