BS IN BIOLOGICAL SCIENCE (CELL AND MOLECULAR BIOLOGY)

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 Cell and Molecular Biology is designed for students interested in advanced studies at the Masters or Ph.D. level, students pursuing career working in biotechnology, or pre-health professions majors pursuing a fundamental understanding of the bimolecular basis of disease. Students completing the degree requirements for the Cell and Molecular Biology concentration also fulfills the requirements for 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 Cell and Molecular Biology (34-36 units)

Code	Title	Units
Required Courses (25-27 Units)		
BIO 121	Molecular Cell Biology	3
BIO 180	Molecular Biology Research Experience	4
BIO 187	Advanced Cell Biology	4
BIO 188	Evolution	3
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 (9 Units)		
Select one of the following:		4
BIO 126	Comparative Vertebrate Morphology	
BIO 127	Developmental Biology	
BIO 128	Plant Anatomy and Physiology	
BIO 131	Systemic Physiology	
Select one of the following Ecology, Evolution, and Biodiversity electives:		3
Part A: Biodiversity Electives		
BIO 103	Plants and Civilization	
BIO 112	Plant Taxonomy	
BIO 140	Medical Microbiology and Emerging Infectious Diseases	
BIO 145	The Diversity of Microorganisms	
BIO 152	Human Parasitology	
BIO 157	General Entomology	
BIO 162	Ichthyology: The Study of Fishes	
BIO 164	Amphibians and Reptiles: An Introduction to Herpetology	
BIO 166	Ornithology	
Part B: Ecology and Evolution Electives		
BIO 113	Evolution and Speciation in Flowering Plants	
BIO 118	Natural Resource Conservation	
BIO 160	General Ecology	
BIO 169	Animal Behavior	
BIO 173	Principles of Fisheries Biology	
BIO 179	Conservation Biology & Wildlife Management	

Select additional upper division electives in consultation with an advisor to total 9 units.	2
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 major requirement.

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

- 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 may be used to count toward the degree.

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

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		
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. [2]		0
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		**36**

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: 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 (Cell and Molecular Biology), 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 1C - Oral Communication [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
Elective of Choice		3
	Units	**14**
Year 2		
First Semester		
BIO 1	Biodiversity, Evolution and Ecology	5
CHEM 1B	General Chemistry II	5
Foreign Language Semester 1 [2]		4
	Units	**14**
Second Semester		
BIO 2	Cells, Molecules and Genes	5
CHEM 31	Quantitative Analysis	4
ENGL 20	College Composition II	3
Foreign Language Semester 2 [2]		4
	Units	**16**
Year 3		
First Semester		
BIO 100	Introduction to Scientific Analysis	3
BIO 184	General Genetics	4
CHEM 20	Organic Chemistry Lecture–Brief Course	3
CHEM 20L	Introductory Organic Chemistry Laboratory	1
Ecology, Evolution, and Biodiversity Elective [3]		3
GE Area 3A - Arts [2]		3
	Units	**17**
Second Semester		
BIO 121	Molecular Cell Biology	3
CHEM 161	General Biochemistry	3
Cell and Molecular Biology Elective [3]		3
GE Area 3B - Humanities [2]		3
GR American Institutions (GOVT) [2]		3
	Units	**15**
Year 4		
First Semester		
BIO 180	Molecular Biology Research Experience	4
BIO 188	Evolution	3
CHEM 162	General Biochemistry Laboratory	3
PHYS 5A	General Physics: Mechanics, Heat, Sound	4
	Units	**14**
Second Semester		
BIO 187	Advanced Cell Biology	4
PHYS 5B	General Physics: Light, Electricity and Magnetism, Modern Physics	4
BIO 126 or BIO 127 or BIO 128 or BIO 131	Comparative Vertebrate Morphology [3] or Developmental Biology or Plant Anatomy and Physiology or Systemic Physiology	3 - 4
Upper Division GE Area 3 - Arts or Humanities [2]		3
Upper Division GE Area 4 - Social & Behavioral Sciences + Writing Intensive [2]		3
	Units	**17-18**
	Total Units	**122-124**

Biological Science (Cell and Molecular Biology), BS: 2-Year Roadmap

Course	Title	Units
Year 1		
First Semester		
BIO 100	Introduction to Scientific Analysis	3
BIO 184	General Genetics	4
Ecology, Evolution, and Biodiversity Elective [3]		3
Foreign Language Semester 1 [2]		4
	Units	**14**
Second Semester		
BIO 121	Molecular Cell Biology	3
CHEM 161	General Biochemistry	3
Cell and Molecular Biology Elective [3]		3
Foreign Language Semester 2 [2]		4
Elective of Choice		3
	Units	**16**
Year 2		
First Semester		
BIO 180	Molecular Biology Research Experience	4
BIO 188	Evolution	3
CHEM 162	General Biochemistry Laboratory	3
Upper Division GE Area 4 - Social & Behavioral Sciences + Writing Intensive [2]		3
GR American Institutions (GOVT) [2]		3
	Units	**16**
Second Semester		
BIO 187	Advanced Cell Biology	4
BIO 126 or BIO 127 or BIO 128 or BIO 131	Comparative Vertebrate Morphology [3] or Developmental Biology or Plant Anatomy and Physiology or Systemic Physiology	3 - 4
Upper Division GE Area 3 - Arts or Humanities [2]		3
GR American Institutions (US History) [2]		3
Elective of Choice		3
	Units	**16-17**
	Total Units	**62-63**

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.