

BACHELOR OF SCIENCE IN BIOLOGICAL SCIENCES

	Units
General Education*	51
Preparation for the Major*	41
Core Requirements	17
Concentration Requirements	19

Students must take a sufficient number of elective units to bring the total number of units to a minimum of 120**

*Nine (9) lower-division GE units in Area B (Math and Science) are automatically satisfied by courses taken in Preparation for the Major.

Students who plan on applying to graduate or professional school are strongly recommended to take **MATH 162 as an elective.

Preparation for the Major

Lower-Division Biology Courses (15 units)

BIOL 210	4
BIOL 211	4
BIOL 212	3
BIOL 215	4

Non-Biology Supporting Courses (26 units)

CHEM 150	5
CHEM 160	3
CHEM 201	3
CHEM 201L	2
MATH 160	5

Choose one of the following course sequences:

PHYS 101	4
PHYS 102	4
or	
PHYS 205	4
PHYS 206	4

Core Requirements

Upper-Division (17 units)

BIOL 351	5
BIOL 352	4
BIOL 353	4
BIOL 354	4

Molecular and Cellular Biology Concentration Requirements

Upper-Division (19 units)
Select three of the following courses
(at least one must have a lab):

	10-12
BIOL 356	BIOL 480
BIOL 357	BIOL 503
BIOL 365++	BIOL 504+
BIOL 367	BIOL 520+
BIOL 368/368L	BIOL 531++
BIOL 370/370L	BIOL 532++
BIOL 452	BIOL 537+
BIOL 477/477L	BIOL 540+

← TO BE ADDED HERE
BIOL502 ALSO COUNTS
AS AN MCB ELECTIVE

+ With consent of faculty advisor.

++Only one of these courses may be used to fulfill the Molecular and Cellular Biology Concentration Requirements.

Upper-Division Science Electives 7-9
from any biology courses numbered 355-599. In addition, with consent of advisor may include **PSYC 461** (no BB credit) or one course from the following list which will count for BB and elective credit:

CS 305, 311
CHEM 341, 351, 401, 402, 404
PHYS 440
MATH 362, 374, 441, 448, 464

Other courses may be approved with faculty consent.

Ecology Concentration Requirements

Upper-Division (19 units)
Select three of the following courses
(at least one must have a lab):

	10-12
BIOL 365++	BIOL 400/400L
BIOL 379	BIOL 420
BIOL 380/380L	BIOL 463
BIOL 381/381L	BIOL 502+ ←
BIOL 382	BIOL 505+
BIOL 383	BIOL 513
BIOL 384	BIOL 531++
BIOL 386/386L	BIOL 532++
BIOL 387/387L	BIOL 533+
BIOL 388	BIOL 535+
BIOL 389	BIOL 536+
BIOL 390/390L	BIOL 540

+ With consent of faculty advisor.

++Only one of these courses may be used to fulfill the Ecology Concentration Requirements.

Upper-Division Science Electives 7-9
 from any biology courses numbered 355-599. In addition, with consent of advisor may include **PSYC 461** (no BB credit) or one course from the following list which will count for BB and elective credit:

- CS 305, 311
- CHEM 341, 351, 401, 402, 404
- PHYS 440
- MATH 362, 374, 441, 448, 464

Other courses may be approved with faculty consent.

Physiology Concentration Requirements

Upper-Division (19 units)

Select three of the following courses
 (at least one must have a lab):

Units
10-12

- | | |
|---------------|----------------|
| BIOL 365++ | BIOL 476 |
| BIOL 368/368L | BIOL 505+ |
| BIOL 370/370L | BIOL 512/512L+ |
| BIOL 374 | BIOL 514/514L+ |
| BIOL 375 | BIOL 515+ |
| BIOL 380/380L | BIOL 531++ |
| BIOL 401 | BIOL 532++ |
| BIOL 411/411L | BIOL 576+ |

+ With consent of faculty advisor.

++Only one of these courses can count for upper-division Physiology Concentration Requirements.

Upper-Division Science Electives 7-9
 from any biology courses numbered 355-599. In addition, with consent of advisor may include **PSYC 461** (no BB credit) or one course from the following list which will count for BB and elective credit:

- CS 305, 311
- CHEM 341, 351, 401, 402, 404
- PHYS 440
- MATH 362, 374, 441, 448, 464

Other courses may be approved with faculty consent.

General Concentration Requirements

Select one course from each of the three following lists (at least one course must have a lab): 10-12

Molecular and Cellular Biology courses:

- | | |
|---------------|------------|
| BIOT 356 | BIOL 480 |
| BIOT 357 | BIOL 503 |
| BIOL 365++ | BIOL 504+ |
| BIOL 367 | BIOL 520+ |
| BIOL 368/368L | BIOL 531++ |
| BIOL 370/378L | BIOL 532++ |
| BIOL 452 | BIOL 537+ |
| BIOL 477/477L | BIOL 540+ |

TO BE ADDED HERE
 SINCE BIOL 502
 COUNTS AS AN MCB
 ELECTIVE

Ecology courses:

- | | |
|---------------|---------------|
| BIOL 365++ | BIOL 400/400L |
| BIOL 379 | BIOL 420 |
| BIOL 380/380L | BIOL 463 |
| BIOL 381/381L | BIOL 502+ |
| BIOL 382 | BIOL 505+ |
| BIOL 383 | BIOL 513 |
| BIOL 384 | BIOL 531++ |
| BIOL 386/386L | BIOL 532++ |
| BIOL 387/387L | BIOL 533+ |
| BIOL 388 | BIOL 535+ |
| BIOL 389 | BIOL 536+ |
| BIOL 390/390L | BIOL 540 |

Physiology courses:

- | | |
|---------------|----------------|
| BIOL 365++ | BIOL 505+ |
| BIOL 368/368L | BIOL 512/512L+ |
| BIOL 370/370L | BIOL 514/514L+ |
| BIOL 374 | BIOL 515+ |
| BIOL 375 | BIOL 531++ |
| BIOL 380/380L | BIOL 532++ |
| BIOL 401 | BIOL 537 |
| BIOL 411/411L | BIOL 576+ |
| BIOL 476 | BIOL 576+ |

Upper-Division Science Electives 7-9
 from any biology courses numbered 355-599. In addition, with consent of advisor may include **PSYC 461** (no BB credit) or one course from the following list which will count for BB and elective credit:

- CS 305, 311
- CHEM 341, 351, 401, 402, 404
- PHYS 440
- MATH 362, 374, 441, 448, 464

Other courses may be approved with faculty consent.

+ With consent of faculty advisor.

++Only one of these courses can count for upper-division General Concentration Requirements.

MINOR IN QUANTITATIVE BIOLOGY AND BIostatISTICS

Office:

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Telephone:

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Faculty:

Biological Sciences

Denise Garcia, Ph.D.

William Kristan, Ph.D.

George Vourlitis, Ph.D.

Mathematics

Olaf Hansen, Ph.D.

Program Offered:

- Minor in Quantitative Biology and Biostatistics

Biology is becoming far more data-rich and computationally intensive. As a result, effective training of 21st century biologists requires dedicated training of students in quantitative and computational analyses. The purpose of the Minor in Quantitative Biology and Biostatistics is to provide Biological Sciences and related majors formal recognition of their expanded knowledge and skills in scientific computing, modeling, and statistics that will result from completion of a suite of required and elective courses. Students who complete this minor will be well prepared for graduate study, work in the private sector, or positions with government agencies or non-profits. Regardless of their choice of a career, the skills students gain in this minor will serve them well.

The minor requires completion of nine courses (32-33 units), five courses (15-16 units) of which must be at the 300-500 level. The four required lower-division courses (17 units) are also required for majors in the biological sciences and can be double-counted. At least two courses (6 units) at the 300-500 level must be completed at CSUSM. Each course counted toward the minor must be completed with a grade of C (2.0) or better. At least three upper-division courses (9-10 units) must be exclusive to the minor (i.e., not double-counted for the major and minor). The remaining six courses (23-24 units) may also be used to fulfill requirements and electives for any of the concentrations in the B.S. degree in Biological Sciences. Students are advised that some courses have prerequisites, and should plan accordingly.

Required Courses

Lower-Division (17 units)

	Units
BIOL 210*	4
BIOL 211*	4
BIOL 215*	4
MATH 160*	5

Upper-Division (6 units)

<i>Computing</i>	
BIOT 358 or BIOL 365	3

<i>Modeling</i>	
BIOL 535 or MATH 448	3

Upper-Division Electives (9-10 units)***

(Choice of 3)	
BIOL 365**	3
BIOL 420	3
BIOL 502	3
BIOL 531	3
BIOL 532	3
BIOL 533	4
BIOL 535**	3
BIOT 358**	3
MATH 448**	3
PHYS 440	3
Total Units	32-33



* Can be double-counted for lower-division requirements for majors in Biological Sciences and related areas

** If not taken to satisfy one of the UD required courses

*** At least three upper-division courses (9-10 units) must be exclusive to the minor; i.e., not double-counted for the major and minor.

BIOL 498 (2)**Senior Library Thesis**

In-depth reading and researching of the literature on current issues in biology. The student must consult with a biology faculty member to decide on the topic and then produce a (approximately) 30-page paper with supporting citations that summarizes the current state of knowledge on the topic. *May be repeated, but no more than two (2) units may be applied to the major. Enrollment restricted to students who have obtained consent of instructor.*

BIOL 499 (2)**Senior Laboratory Thesis**

Research project in the laboratory or field, generated in collaboration with a biology faculty member. *May be repeated, but no more than two (2) units may be applied to the major. Enrollment restricted to students who have obtained consent of instructor.*

BIOL 502 (3)**Population Genetics**

Patterns of the distribution of genes in populations with emphasis on quantitative genetics, gene frequency, selection and the effects of mutation on populations. Genetic mechanisms in evolution are considered. *Prerequisite: BIOL 352, or enrollment in the Biological Sciences graduate program.*

BIOL 503 (3)**Modern Molecular Biology and Genomics**

An introduction to modern application of molecular biology, including genomics. Specific topics covered will include genome sequencing, transcript profiling, genome-wide association studies, and large scale mutagenesis. Using the primary literature as a guide, the class explores both the technologies that underlie modern molecular biology and the impacts that current studies are having on our understanding of all biology, from agriculture to human disease. Accompanying laboratory provides students with hands-on experience in the analysis of genomic data sets. *May not be taken for credit by students who have received credit for BIOL 596G. Prerequisite: BIOL 351 or BIOL 355, or enrollment in the Biological Sciences graduate program.*

BIOL 504 (4)**Virology**

A comparative survey of bacterial, animal and plant virus variations, including retroviruses and prions. Emphasis is placed upon the variations in structure, nucleic acid composition, and replication patterns. The relationship of viruses to disease is given serious consideration. *Prerequisite: BIOL 351 or BIOL 355, or enrollment in the Biological Sciences graduate program.*

BIOL 505 (3)**Physiological Ecology**

Advanced exploration of the interactions between animals and their environment. Focuses on major life processes such as respiration, endothermy versus ectothermy, torpor, hibernation, and the physiological trade-offs between growth, storage, reproduction and survival. Physiological features of animals that permit them to live in extreme environments including the deep sea, deserts, boreal/polar regions, and caves will be discussed. *Field trip(s) during or outside of class (including weekends) may be required. Prerequisite: BIOL 353, or enrollment in the Biological Sciences graduate program.*

BIOL 512 (3)**Physiology of Aging**

Examines changes in animal physiology that occurs during aging. Subjects include evolutionary and proximate causes of aging, physiological mechanisms proposed to explain aging, and methods to study and to manipulate rate of aging (e.g. caloric restriction). Both theoretical concepts and empirical examples will be addressed. *Prerequisite: BIOL 353, or enrollment in the Biological Sciences graduate program.*

BIOL 512L (1)**Physiology of Aging Laboratory**

Provides hands-on experience in techniques currently used to study physiological changes during aging. Students will design and perform experiments that demonstrate central topics of the biology of aging. Exact labs will change as the field of biogerontology develops, but may include experiments to test effects of caloric restriction, trade-offs between reproduction and longevity, declines in physiological systems with age, and cellular resistance to oxidative stress. Model organisms will typically include small rodents, insects, and nematode worms. *Three hours laboratory. Co/Prerequisite: BIOL 512.*

BIOL 513 (3)**Ecology of Parasitism**

Parasites have regulatory effects on host populations, impart significant economic impact, and are sensitive indicators of pollution as well as other natural and anthropogenic effects. Examines the interaction of parasites with their hosts. The host-parasite interaction creates a unique physiological and genetic system as both host and parasite adjust and adapt to the pressures imposed by the other. Modes of parasitism, life cycles, mechanisms of infection, alteration of host behavior, and novel physiological pathways will be examined as a biological arms race is waged between genetically distinct organisms. *Prerequisite: BIOL 354, or enrollment in the Biological Sciences graduate program.*

BIOL 514 (3)**Physiology of Parasitism**

Examines the physiology of hosts and parasites including how host physiology affects its susceptibility to parasites and subsequent host response to infection. Explores how parasite physiology influences their ability to infect hosts. Subjects will range from whole animal metabolism and immune response to specific biochemical pathways that change during parasitism. Both theoretical concepts and empirical examples will be addressed. *Prerequisite: BIOL 353, or enrollment in the Biological Sciences graduate program.*

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