
BIOLOGY

PROGRAMS OFFERED

- Bachelor of Science in Biology
- Bachelor of Science in Biology with an Emphasis in Biotechnology
- Bachelor of Science in Biology with an Emphasis in Cell and Molecular Biology
- Bachelor of Science in Biology with an Emphasis in Ecology, Evolution and Organismal Biology
- Bachelor of Science in Biology with an Emphasis in Medical Imaging
- Bachelor of Arts in Biology with an Emphasis in Ecology, Evolution and Organismal Biology
- Bachelor of Arts in Biology with an Emphasis in General Biology
- Bachelor of Arts in Biology with an Emphasis in Pre-Professional Studies
- Bachelor of Arts in Biology with an Emphasis in Subject Matter Preparation in Teaching Biology
- Master of Science in Biotechnology and Bioinformatics
- Master of Science in Biotechnology and Master of Business Administration
- Minor in Biology
- Certificate in Biotechnology
- Honors in Biology

PROGRAM DESCRIPTION

Biology is the study of life, its origins, diversity and intricacies. It emphasizes the relationship between structure and function in living systems and the processes, by which organisms grow, reproduce and interact with each other and their environment. The discipline is dynamic and rapidly advancing, particularly in the areas of biotechnology and information technology. The Biology Program provides its undergraduate and graduate students with a strong theoretical foundation in biology, combined with extensive hands-on laboratory experiences using state-of-the-art technology. Students take a series of core courses augmented by electives selected from areas of special interest.

CAREERS

The Bachelor of Science in Biology is designed for students who wish to enter medical, dental or other health professional or graduate schools, or to seek careers in business, industry or government.

The Bachelor of Science in Biology with an Emphasis in Biotechnology enables students to make a smooth transition from academia to biotechnology industry by understanding the concepts of basic and applied biotechnology. This program allows students to have numerous career avenues and the groundwork for graduate study.

The Bachelor of Science in Biology with an Emphasis in Cell and Molecular Biology offers students an

opportunity to study the exciting developments in genetics, molecular biology, cloning, biotechnology and bioinformatics. This program leads to careers in medical sciences, biotechnology, pharmaceuticals, research and development, intellectual property and patent law.

The Bachelor of Science in Biology with an Emphasis in Ecology, Evolution and Organismal Biology allows students to explore biodiversity at multiple levels of organization, from molecules to the biosphere. Students will gain an understanding of the complex interactions among organisms and between organisms and their physical environments. The emphasis prepares students for environmental studies, conservation, research, or education. It also provides preparation for graduate study in biology.

The Bachelor of Science in Biology with an Emphasis in Medical Imaging prepares students for graduate or professional study in the medical sciences (medical imaging, medical physics, health physics, dosimetry, nuclear medicine, radiotherapy, oncology, biomedical engineering), or for entry into professional positions in the clinical environment and in medical imaging research and development.

The Bachelor of Arts degree is designed to obtain a general background in both the concepts and the technical skills of modern biology. Students completing the Bachelor of Arts major will find that their strong general background will allow them flexibility in both completing minor fields of study and career choices. The degree prepares graduates for careers in medical and other health professions (Emphasis in Pre-Professional Studies), science education (Emphasis in Subject Matter Preparation in Teaching Biology), industry or government (Emphasis in General Biology).

Biology as a discipline has been rapidly advancing in the last decade. With the information derived from the sequencing of the genomes of many organisms, it will have far-reaching impacts on the environment, public health, and on local, regional, and global economies. The Biology Minor allows students in majors other than biology to gain an understanding of these exciting developments. It will provide a solid background in biology and the opportunity to explore selected area(s) at a greater depth. Equipped with a minor in biology, students with a major in other disciplines will have a greater understanding and knowledge of the latest advances in many areas of biology and will therefore be more versatile in their career paths. The requirement for a Minor in Biology is 21 units.

The Certificate in Biotechnology will provide students with advanced knowledge and skills in modern biotechnology that will lead to careers in biotechnology as well as pharmaceutical industries.

PROGRAM LEARNING OUTCOMES

Students graduating from the Biology program will be able to:

- explain the basic structures and fundamental processes of life at molecular, cellular and organismal levels;
- identify the evolutionary processes that lead to adaptation and biological diversity;
- describe the relationship between life forms and their environment and ecosystems;
- collect, organize, analyze, interpret and present quantitative and qualitative data and incorporate them into the broader context of biological knowledge;
- effectively apply current technology and scientific methodologies for problem solving;
- find, select and evaluate various types of scientific information including primary research articles, mass media sources and world-wide web information; and
- communicate effectively in written and oral forms.

REQUIREMENTS FOR HONORS IN BIOLOGY

Candidacy for honors in biology is voluntary. To be eligible, a student must fulfill the following requirements:

1. Achieve a minimum grade point average of 3.5 for all courses satisfying the requirements for the major as defined above;
2. Take at least seven courses in the major at this university;
3. Satisfactorily complete a Service Learning course from BIOL 492, 494 or 497;
4. Satisfactorily complete a Senior Capstone course.

Application for candidacy must be made at the beginning of the senior year. Approval of candidacy and of the Service Learning project and project advisor rests with the Biology Program. The project advisor will have the sole responsibility for acceptance of the completed project.

The Biology Program may grant honors to exceptional students who have not met the above requirements, but who have in the judgment of the Program brought distinction upon themselves and the Program in some other significant and appropriate manner.

FACULTY

Ching-Hua Wang, MD, PhD, Professor and
Chair, Biology Program
Director of MS in Biotechnology and
Bioinformatics
Phone: (805) 437-8870
Email: ching-hua.wang@csuci.edu

Amy Denton, PhD, Assistant Professor of Biology
Phone: (805) 437-8458
Email: amy.denton@csuci.edu

Geoff Dougherty, PhD, Professor of Physics
Phone: (805) 437-8990
Email: geoffrey.dougherty@csuci.edu

Nancy Mozingo, PhD, Associate Professor of Biology
Phone: (805) 437-8989
Email: nancy.mozingo@csuci.edu

Nitika Parmar, PhD, Assistant Professor of Biology
Phone: (805) 437-8873
Email: nitika.parmar@csuci.edu

CONTACT INFORMATION

<http://biology.csuci.edu>
biology@csuci.edu

For graduation roadmaps for the B.S. and B.A. programs in Biology, please visit: <http://biology.csuci.edu>.

REQUIREMENTS FOR THE BACHELOR OF SCIENCE DEGREE IN BIOLOGY (120 UNITS)

Common Lower Division Requirements for All Emphases of the Bachelor of Science Degree in Biology (8 Units)

- BIOL 200* Principles of Organismal and Population Biology, GE-B2 (4)
BIOL 201 Principles of Cell & Molecular Biology (4)

FOR BACHELOR OF SCIENCE IN BIOLOGY

Upper Division Requirements in the Major (39 Units)

1. Required Biology Courses (25 units)
 - BIOL 300 Cell Biology (4)
 - BIOL 302 Genetics (4)
 - BIOL 303 Evolutionary Biology (3)
 - BIOL 304 Comparative Animal Physiology (3)
 - BIOL 400 Molecular Biology (4)
 - BIOL 433* Ecology and the Environment, GE- B2, UDID (4)
 - BIOL 499 Senior Capstone in Biology (3)
2. Electives in Biology (14 units)
Select from the following list of courses, one of which must be a lab course.
 - BIOL 301 Microbiology (4)
 - BIOL 310 Vertebrate Biology (4)
 - BIOL 311 Plant Biology and Ecology (4)
 - BIOL 312 Marine Biology (4)
 - BIOL/ ESRM 313 Conservation Biology (4)
 - BIOL 316 Invertebrate Zoology (4)
 - BIOL 317 Parasitology (4)
 - BIOL 401 Biotechnology and Recombinant DNA Techniques (5)
 - BIOL 402 Toxicology (3)
 - BIOL 403 Foundations of Structural Biology (4)
 - BIOL 404 Plant and Animal Tissue Culture (3)
 - BIOL 405 Biochemical Engineering (4)
 - BIOL 406 Evolutionary Biogeography (3)
 - BIOL 407 Behavioral Ecology (3)
 - BIOL 408 Nanobiotechnology (3)

BIOL	420	Cellular & Molecular Immunology (4)
BIOL	421	Virology (3)
BIOL	422	Molecular Plant Physiology (4)
BIOL	423	Cellular & Molecular Neurobiology (3)
BIOL	424	Human Physiology (3)
BIOL	425	Human Genetics (3)
BIOL	427	Developmental Biology (4)
BIOL	428	Biology of Cancer (3)
BIOL	431*	Bioinformatics, GE-B2, B4, UDID (4)
BIOL	432*	Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)
BIOL	450	Ichthyology: The Biology of Fishes (4)
BIOL	451	Ornithology (4)

No more than 2 units taken from the following:

BIOL	492	Internship (2-3)
BIOL	494	Independent Research (1-3)
BIOL	497	Directed Study (1-3)

Required Supporting and Other GE Courses (73 Units)

- Chemistry (16 units)

CHEM	121*	General Chemistry I, GE-B1 (4)
CHEM	122	General Chemistry II, GE-B1 (4)
CHEM	311	Organic Chemistry I (3)
CHEM	312	Organic Chemistry I Laboratory (1)
CHEM	314	Organic Chemistry II (3)
CHEM	315	Organic Chemistry II Laboratory (1)

(A year-long organic chemistry sequence with laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM 311, 312, 314, 315)
- Physics (8 units)
Select either

PHYS	100	Introduction to Physics I, GE-B1 (4)
------	-----	--------------------------------------

and

PHYS	101	Introduction to Physics II, GE-B1 (4)
------	-----	---------------------------------------

or

PHYS	200	General Physics I, GE-B1 (4)
------	-----	------------------------------

and

PHYS	201	General Physics II, GE-B1 (4)
------	-----	-------------------------------
- Statistics and Mathematics (7 units)

BIOL	203*	Quantitative Methods for Biology, GE-B3, B4 (3)
MATH	150*	Calculus I, GE-B3 (4)
- Other Required GE Courses in Categories A-E (36 units)

Category A	(9 units)
Category C	(12 units)
Category D	(12 units)
Category E	(3 units)
- American Institutions Requirement (6 units)

FOR EMPHASIS IN BIOTECHNOLOGY

Upper Division Requirements in the Major (49 Units)

- Required Biology Courses (37 units)

BIOL	300	Cell Biology (4)
BIOL	301	Microbiology (4)
BIOL	302	Genetics (4)
BIOL	400	Molecular Biology (4)
BIOL	401	Biotechnology and Recombinant DNA Techniques (5)
BIOL	404	Plant and Animal Tissue Culture (3)
BIOL	405	Biochemical Engineering (4)
BIOL	420	Cellular & Molecular Immunology (4)
BIOL	492	Internship (2-3)
BIOL	499	Senior Capstone in Biology (3)
- Electives in Biology and Physics (12 units)
Select from the following list of courses:

BIOL/315	Introduction to Biophysics (4)	
PHYS		
BIOL	403	Foundations of Structural Biology (4)
BIOL	408	Nanobiotechnology (3)
BIOL	421	Virology (3)
BIOL	422	Molecular Plant Physiology (4)
BIOL	423	Cellular & Molecular Neurobiology (3)
BIOL	424	Human Physiology (3)
BIOL	425	Human Genetics (3)
BIOL	428	Biology of Cancer (3)
BIOL	431*	Bioinformatics, GE-B2, B4, UDID (4)
MGT	471	Project Management (3)
BIOL	503	Biotechnology Law and Regulation (3)

Required Supporting and Other GE Courses (63 Units)

- Chemistry (14 units)

CHEM	121*	General Chemistry I, GE-B1 (4)
CHEM	122	General Chemistry II, GE-B1 (4)
CHEM	311	Organic Chemistry I (3)
CHEM	318	Biological Chemistry (3)

(An organic chemistry taken at a community college may be accepted for the Biology major in lieu of CHEM 311)
- Statistics, Mathematics and Computer Applications (7 units)

BIOL	203*	Quantitative Methods for Biology, GE-B3, B4 (3)
MATH	150*	Calculus I, GE-B3 (4)
- Other Required GE Courses in Categories A-E (36 units)

Category A	(9 units)
Category C	(12 units)
Category D	(12 units)
Category E	(3 units)
- American Institutions Requirement (6 units)

FOR EMPHASIS IN CELL AND MOLECULAR BIOLOGY

Upper Division Requirements in the Major (40 Units)

1. Required Biology Courses (31 units)
 - BIOL 300 Cell Biology (4)
 - BIOL 301 Microbiology (4)
 - BIOL 302 Genetics (4)
 - BIOL 303 Evolutionary Biology (3)
 - BIOL 400 Molecular Biology (4)
 - BIOL 401 Biotechnology and Recombinant DNA Techniques (5)
 - BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)
 - BIOL 499 Senior Capstone in Biology (3)
2. Electives in Biology (9 units)

Select from the following list of courses:

 - BIOL 402 Toxicology (3)
 - BIOL 403 Foundations of Structural Biology (4)
 - BIOL 404 Plant and Animal Tissue Culture (3)
 - BIOL 405 Biochemical Engineering (4)
 - BIOL 408 Nanobiotechnology (3)
 - BIOL / 416 Radiobiology and Radionuclides (3)
 - PHYS
 - BIOL 420 Cellular & Molecular Immunology (4)
 - BIOL 421 Virology (3)
 - BIOL 422 Molecular Plant Physiology (4)
 - BIOL 423 Cellular & Molecular Neurobiology (3)
 - BIOL 424 Human Physiology (3)
 - BIOL 425 Human Genetics (3)
 - BIOL 427 Developmental Biology (4)
 - BIOL 428 Biology of Cancer (3)
 - BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)
 - BIOL 433* Ecology and the Environment, GE-B2, UDID (4)

No more than 2 units taken from the following:

 - BIOL 492 Internship (2-3)
 - BIOL 494 Independent Research (1-3)
 - BIOL 497 Directed Study (1-3)

Required Supporting and Other GE Courses (72 Units)

1. Chemistry (minimum 15 units)
 - CHEM 121* General Chemistry I, GE-B1 (4)
 - CHEM 122 General Chemistry II GE-B1 (4)
 - CHEM 311 Organic Chemistry I (3)
 - CHEM 312 Organic Chemistry I Laboratory (1)

Select either

 - CHEM 318 Biological Chemistry (3)

or

 - CHEM 314 Organic Chemistry II (3)
 - CHEM 315 Organic Chemistry II Laboratory (1)

(A year-long organic chemistry sequence with laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM 311, 312, 314, 315.)

2. Physics (8 units)

Select either

 - PHYS 100 Introduction to Physics I, GE-B1 (4)

and

 - PHYS 101 Introduction to Physics II, GE-B1 (4)

or

 - PHYS 200 General Physics I, GE-B1 (4)

and

 - PHYS 201 General Physics II, GE-B1 (4)
3. Statistics and Mathematics (7 units)
 - BIOL 203* Quantitative Methods for Biology, GE-B3, B4 (3)
 - MATH 150* Calculus I, GE-B3 (4)
4. Other Required GE Courses in Categories A-E (36 units)
 - Category A (9 units)
 - Category C (12 units)
 - Category D (12 units)
 - Category E (3 units)
5. American Institutions Requirement (6 units)

FOR EMPHASIS IN ECOLOGY, EVOLUTION AND ORGANISMAL BIOLOGY

Upper Division Requirements in the Major (42-44 Units)

1. Required Core Courses (26 units)
 - BIOL 301 Microbiology (4)
 - BIOL 302 Genetics (4)
 - BIOL 303 Evolutionary Biology (3)
 - BIOL 311 Plant Biology and Ecology (4)

and

 - BIOL 310 Vertebrate Biology (4)

or

 - BIOL 316 Invertebrate Zoology (4)

and

 - BIOL 433* Ecology and the Environment, GE- B2, UDID (4)
 - BIOL 499 Senior Capstone in Biology (3)
2. Ecology/Evolution

Select two courses from the following list (6-7 units):

 - BIOL/ 313 Conservation Biology (4)
 - ESRM
 - ESRM 352 Theory and Practice of Ecological Restoration (3)
 - BIOL 406 Evolutionary Biogeography (3)
 - BIOL 407 Behavioral Ecology (3)
3. Organismal Biology

Select one course from the following list (4 units):

 - BIOL 310 Vertebrate Biology (4) *(if not taken as part of core)*
 - BIOL 312 Marine Biology (4)
 - BIOL 316 Invertebrate Zoology (4) *(if not taken as part of core)*

- BIOL 317 Parasitology (4)
- BIOL 450 Ichthyology: The Biology of Fishes (4)
- BIOL 451 Ornithology (4)

4. Physiology/Developmental/Molecular Biology
Select one course from the following list (3-4 units):
- BIOL 300 Cell Biology (4)
 - BIOL 304 Comparative Animal Physiology (3)
 - BIOL 400 Molecular Biology (4)
 - BIOL 422 Molecular Plant Physiology (4)
 - BIOL 427 Developmental Biology (4)
5. Cross-Disciplinary
Select one course from the following list (3-4 units):
- CHEM 301 Environmental Chemistry (3)
 - GEOL 321 Environmental Geology, GE-B1 (4)
 - ESRM 328 Introduction to Geographic Information Systems (3)

Required Supporting and Other GE Courses (63 Units)

1. Required Supporting Courses (21 units)
 - CHEM 121* General Chemistry I, GE-B1 (4)
 - CHEM 122 General Chemistry II, GE-B1 (4)
 - CHEM 311 Organic Chemistry I (3)
 - GEOL 122* Historical Geology, GE-B1 (3)
 - BIOL 203* Quantitative Methods for Biology, GE-B3, B4 (3)
 - MATH 150* Calculus I, GE-B3 (4)

(An organic chemistry taken at a community college may be accepted for the Biology major in lieu of CHEM 311)
2. Other Required GE Courses in Categories A-E (36 units)
 - Category A (9 units)
 - Category C (12 units)
 - Category D (12 units)
 - Category E (3 units)
3. American Institutions Requirement (6 units)

Electives in Any Discipline (4-7 units)

FOR EMPHASIS IN MEDICAL IMAGING

Additional Lower Division Requirements in the Major (8 Units)

- BIOL 210 Human Anatomy and Physiology I (4)
- BIOL 211 Human Anatomy and Physiology II (4)

Upper Division Requirements in the Major (38 Units)

1. Required Biology and Physics Courses (30 units)
 - BIOL 300 Cell Biology (4)
 - BIOL 301 Microbiology (4)
 - BIOL 302 Genetics (4)
 - BIOL 400 Molecular Biology (4)
 - BIOL/ 416 Radiobiology and Radionuclides (3)
 - PHYS 434* Introduction to Biomedical Imaging, HLTH/ PHYS GE-B1, E, UDID (4)
 - BIOL/ 464 Biomedical Instrumentation (4)
 - PHYS 499 Senior Capstone in Biology (3)
2. Electives in Biology and Physics (8 units)
Select from the following list of courses:
 - BIOL/ 315 Introduction to Biophysics (4)
 - PHYS 401 Biotechnology and Recombinant DNA Techniques (5)
 - BIOL 420 Cellular & Molecular Immunology (4)
 - BIOL 421 Virology (3)
 - BIOL 423 Cellular & Molecular Neurobiology (3)
 - BIOL 424 Human Physiology (3)
 - BIOL 425 Human Genetics (3)
 - BIOL 427 Developmental Biology (4)
 - BIOL 428 Biology of Cancer (3)
 - BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)
 - BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)
 - BIOL 433* Ecology and the Environment, GE-B2, UDID (4)
 - PHYS 445* Image Analysis and Pattern Recognition, GE-B1, B4, UDID (3)

No more than 2 units taken from the following:

 - PHYS 492 Physics Internship (3)
 - BIOL 494 Independent Research (1-3)
 - or*
 - PHYS 494 Independent Research (1-3)
 - BIOL 497 Directed Study (1-3)
 - or*
 - PHYS 497 Directed Study (1-3)

Required Supporting and Other GE Courses (66 Units)

1. Chemistry (15 units)
 - CHEM 121* General Chemistry I, GE-B1 (4)
 - CHEM 122 General Chemistry II (4)
 - CHEM 311 Organic Chemistry I (3)
 - CHEM 312 Organic Chemistry I Laboratory (1)
 - CHEM 318 Biological Chemistry (3)
 - (An organic chemistry I-equivalent course with laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM 311 and 312.)*
 2. Mathematics (4 units)
 - MATH 150* Calculus I, GE-B3 (4)
 3. Physics (8 units)
 - Select either**
 - PHYS 100 Introduction to Physics I, GE-B1 (4)
 - and**
 - PHYS 101 Introduction to Physics II, GE-B1 (4)
 - or**
 - PHYS 200 General Physics I, GE-B1 (4)
 - and**
 - PHYS 201 General Physics II, GE-B1 (4)
 4. Other Required GE Courses in Categories A-D (33 units)
 - Category A (9 units)
 - Category C (12 units)
 - Category D (12 units)
 - Category E- covered by a required GE course for the degree program
 5. American Institutions Requirement (6 units)
- (Courses with * are double-counted toward GE credits.)*

REQUIREMENTS FOR THE BACHELOR OF ARTS DEGREE IN BIOLOGY (120 UNITS)

Common Lower Division Requirements for All Emphases (8 Units)

- BIOL 200* Principles of Organismal and Population Biology, GE-B2 (4)
- BIOL 201 Principles of Cell and Molecular Biology (4)

FOR EMPHASIS IN ECOLOGY, EVOLUTION AND ORGANISMAL BIOLOGY

Upper Division Requirements in the Major (36-38 Units)

1. Required Biology Core Courses (26 units)
 - BIOL 301 Microbiology (4)
 - BIOL 302 Genetics (4)
 - BIOL 303 Evolutionary Biology (3)
 - BIOL 311 Plant Biology and Ecology (4)
 - BIOL 310 Vertebrate Biology (4) *or*
 - BIOL 316 Invertebrate Zoology (4)
 - BIOL 433* Ecology and the Environment, GE- B2, UDID (4)
 - BIOL 499 Senior Capstone (3)
2. Ecology/Evolution
 - Select one course from the following list (3-4 units):*
 - BIOL/ ESRM 313 Conservation Biology (4)
 - BIOL 406 Evolutionary Biogeography (3)
 - BIOL 407 Behavioral Ecology (3)
3. Organismal Biology
 - Select one course from the following list (4 units):*
 - BIOL 310 Vertebrate Biology (4) *(if not taken as part of core)*
 - BIOL 312 Marine Biology (4)
 - BIOL 316 Invertebrate Zoology (4) *(if not taken as part of core)*
 - BIOL 317 Parasitology (4)
 - BIOL 450 Ichthyology: The Biology of Fishes (4)
 - BIOL 451 Ornithology (4)
4. Physiology/Developmental/Molecular Biology
 - Select one course from the following list (3-4 units)*
 - BIOL 300 Cell Biology (4)
 - BIOL 304 Comparative Animal Physiology (3)
 - BIOL 400 Molecular Biology (4)
 - BIOL 422 Molecular Plant Physiology (4)
 - BIOL 427 Developmental Biology (4)

Required Supporting and Other GE Courses (56 Units)

1. Required Supporting Courses (14 units)
CHEM 121* General Chemistry I, GE-B1 (4)
CHEM 122 General Chemistry II, GE-B2 (4)
GEOL 122* Historical Geology, GE-B1 (3)
BIOL 203* Quantitative Methods for Biology,
GE-B3, B4 (3)
2. Other Required GE Courses in Categories A-E
(36 units)
Category A (9 units)
Category C (12 units)
Category D (12 units)
Category E (3 units)
3. American Institutions Requirement (6 units)

Electives in Any Discipline (18-20 units)

FOR EMPHASIS IN GENERAL BIOLOGY

Upper Division Requirements in the Major (37 Units)

1. Required Biology Courses (25 units)
BIOL 300 Cell Biology (4)
BIOL 302 Genetics (4)
BIOL 303 Evolutionary Biology (3)
BIOL 304 Comparative Animal Physiology (3)
BIOL 400 Molecular Biology (4)
BIOL 433* Ecology and the Environment, GE-B2,
UDID (4)
BIOL 499 Senior Capstone in Biology (3)
2. Electives in Biology (12 units)
*Select at least three courses from the following list, one
of which must be a lab course.*
BIOL 301 Microbiology (4)
BIOL 310 Vertebrate Biology (4)
BIOL 311 Plant Biology and Ecology (4)
BIOL 312 Marine Biology (4)
BIOL/ESRM 313 Conservation Biology (4)
BIOL 316 Invertebrate Zoology (4)
BIOL 317 Parasitology (4)
BIOL 401 Biotechnology and Recombinant DNA
Techniques (5)
BIOL 402 Toxicology (3)
BIOL 403 Foundations of Structural Biology (4)
BIOL 404 Plant and Animal Tissue Culture (3)
BIOL 405 Biochemical Engineering (4)
BIOL 406 Evolutionary Biogeography (3)
BIOL 407 Behavioral Ecology (3)
BIOL 408 Nanobiotechnology (3)
BIOL 420 Cellular & Molecular Immunology (4)
BIOL 421 Virology (3)
BIOL 422 Molecular Plant Physiology (4)
BIOL 423 Cellular & Molecular Neurobiology (3)

- BIOL 424 Human Physiology (3)
BIOL 425 Human Genetics (3)
BIOL 427 Developmental Biology (4)
BIOL 428 Biology of Cancer (3)
BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)
BIOL 432* Principles of Epidemiology and
Environmental Health, GE-B2, D,
UDID (3)
BIOL 450 Ichthyology: The Biology of Fishes (4)
BIOL 451 Ornithology (4)
No more than 2 units taken from the following:
BIOL 492 Internship (2-3)
BIOL 494 Independent Research (1-3)
BIOL 497 Directed Study (1-3)

Required Supporting and Other GE Courses (53-54 Units)

1. Chemistry (8 units)
CHEM 121* General Chemistry I, GE-B1 (4)
CHEM 122 General Chemistry II, GE-B1 (4)
2. Mathematics and Statistics (3-4 units)
Select one of the following:
BIOL 203* Quantitative Methods for Biology, GE-
B3, B4 (3)
MATH 105 Pre-Calculus (4)
MATH 150* Calculus I, GE-B3 (4)
3. Other Required GE Courses in Categories A-E (36
units)
Category A (9 units)
Category C (12 units)
Category D (12 units)
Category E (3 units)
4. American Institutions Requirements (6 units)

Electives in Any Discipline (21-22 units)

FOR EMPHASIS IN PRE-PROFESSIONAL STUDIES

Upper Division Requirements in the Major (32 Units)

1. Required Biology Courses (21-22 units)
BIOL 300 Cell Biology (4)
BIOL 302 Genetics (4)
BIOL 304 Comparative Animal Physiology (3)
BIOL 400 Molecular Biology (4)
Select one of the following:
BIOL 303 Evolutionary Biology (3)
BIOL 433* Ecology and the Environment, GE-B2,
UDID (4)
and
BIOL 499 Senior Capstone in Biology (3)
2. Electives in Biology (10-11 units)
*Select at least three courses from the following list, one
of which must be a lab course.*
BIOL 301 Microbiology (4)
BIOL 310 Vertebrate Biology (4)

- BIOL 311 Plant Biology and Ecology (4)
 - BIOL 312 Marine Biology (4)
 - BIOL/ESRM 313 Conservation Biology (4)
 - BIOL 316 Invertebrate Zoology (4)
 - BIOL 317 Parasitology (4)
 - BIOL 401 Biotechnology and Recombinant DNA Techniques (5)
 - BIOL 402 Toxicology (3)
 - BIOL 403 Foundations of Structural Biology (4)
 - BIOL 404 Plant and Animal Tissue Culture (3)
 - BIOL 405 Biochemical Engineering (4)
 - BIOL 406 Evolutionary Biogeography (3)
 - BIOL 407 Behavioral Ecology (3)
 - BIOL 408 Nanobiotechnology (3)
 - BIOL 420 Cellular & Molecular Immunology (4)
 - BIOL 421 Virology (3)
 - BIOL 422 Molecular Plant Physiology (4)
 - BIOL 423 Cellular & Molecular Neurobiology (3)
 - BIOL 424 Human Physiology (3)
 - BIOL 425 Human Genetics (3)
 - BIOL 427 Developmental Biology (4)
 - BIOL 428 Biology of Cancer (3)
 - BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)
 - BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)
 - BIOL 450 Ichthyology: The Biology of Fishes (4)
 - BIOL 451 Ornithology (4)
- No more than 2 units taken from the following:*
- BIOL 492 Internship (2-3)
 - BIOL 494 Independent Research (1-3)
 - BIOL 497 Directed Study (1-3)

Required Supporting and Other GE Courses (69-70 Units)

1. Chemistry (16 units)
 - CHEM 121* General Chemistry I, GE-B1 (4)
 - CHEM 122 General Chemistry II GE-B1 (4)
 - CHEM 311 Organic Chemistry I (3)
 - CHEM 312 Organic Chemistry I Laboratory (1)
 - CHEM 314 Organic Chemistry II (3)
 - CHEM 315 Organic Chemistry II Laboratory (1)

(A year-long organic chemistry sequence with laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM 311, 312, 314, 315)
2. Mathematics and Statistics (3-4 units)

Select one of the following:

 - BIOL 203* Quantitative Methods for Biology, GE-B3, B4 (3)
 - MATH 150* Calculus I, GE-B3 (4)

(Check with professional schools or pre-professional advisor for specific requirements in this category.)
3. Physics (8 units)
 - PHYS 100 Introduction to Physics I, GE-B1 (4)
 - PHYS 101 Introduction to Physics II, GE-B1 (4)

4. Other Required GE Courses in Categories A-E (36 units)
 - Category A (9 units)
 - Category C (12 units)
 - Category D (12 units)
 - Category E (3 units)

5. American Institutions Requirements (6 units)

Electives in Any Discipline (10-11 Units)

FOR EMPHASIS IN SUBJECT MATTER PREPARATION IN TEACHING BIOLOGY

Upper Division Requirements in the Major (36 Units)

1. Required Biology Courses (24 units)
 - BIOL 300 Cell Biology (4)
 - BIOL 302 Genetics (4)
 - BIOL 303 Evolutionary Biology (3)
 - BIOL 304 Comparative Animal Physiology (3)
 - BIOL 335* The Biosphere, GE-B2, UDID (3)
 - BIOL 433* Ecology and the Environment, GE-B2, UDID (4)
 - BIOL 499 Senior Capstone in Biology(3)
2. Electives in Biology (12 units)

Select at least three courses from the following list, one of which must be a lab course.

 - BIOL 301 Microbiology (4)
 - BIOL 310 Vertebrate Biology (4)
 - BIOL 311 Plant Biology and Ecology (4)
 - BIOL 312 Marine Biology (4)
 - BIOL/ESRM 313 Conservation Biology (4)
 - BIOL 316 Invertebrate Zoology (4)
 - BIOL 317 Parasitology (4)
 - BIOL 400 Molecular Biology (4)
 - BIOL 401 Biotechnology and Recombinant DNA Techniques (5)
 - BIOL 402 Toxicology (3)
 - BIOL 403 Foundations of Structural Biology (4)
 - BIOL 404 Plant and Animal Tissue Culture (3)
 - BIOL 405 Biochemical Engineering (4)
 - BIOL 406 Evolutionary Biogeography (3)
 - BIOL 407 Behavioral Ecology (3)
 - BIOL 408 Nanobiotechnology (3)
 - BIOL 420 Cellular & Molecular Immunology (4)
 - BIOL 421 Virology (3)
 - BIOL 422 Molecular Plant Physiology (4)
 - BIOL 423 Cellular & Molecular Neurobiology (3)
 - BIOL 424 Human Physiology (3)
 - BIOL 425 Human Genetics (3)
 - BIOL 427 Developmental Biology (4)
 - BIOL 428 Biology of Cancer (3)
 - BIOL 431* Bioinformatics, GE-B2, B4, UDID (4)
 - BIOL 432* Principles of Epidemiology and Environmental Health, GE-B2, D, UDID (3)

- BIOL 450 Ichthyology: The Biology of Fishes (4)
- BIOL 451 Ornithology (4)
- No more than 2 units taken from the following:*
- BIOL 492 Internship (2-3)
- BIOL 494 Independent Research (1-3)
- BIOL 497 Directed Study (1-3)

Required Supporting and Other GE Courses (76 units)

1. Required Education Course (3 units)
 - EDUC 330* Introduction to Secondary Schooling,
GE-D, UDID (3)

2. Mathematics and Statistics (7 units)
 - BIOL 203* Quantitative Methods for Biology, GE-
B3, B4 (3)
 - and*
 - MATH 105 Pre-Calculus (4)
 - or*
 - MATH 150* Calculus I, GE-B3 (4)

3. Physical Sciences (24 units)
 - CHEM 121* General Chemistry I, GE-B1 (4)
 - CHEM 122 General Chemistry II, GE-B1 (4)
 - GEOL 121 Physical Geology (4)
 - PHYS 100 Introduction to Physics I, GE-B1 (4)
 - PHYS 101 Introduction to Physics II, GE-B1 (4)
 - PHYS/
ASTR 105 Introduction to the Solar System, GE-
B1 (4)

4. Other Required GE Courses in Categories A-E (36 units)
 - Category A (9 units)
 - Category C (12 units)
 - Category D (12 units)
 - Category E (3 units)

5. American Institutions Requirements (6 units)

*(Courses with * are double-counted toward GE credits.)*

REQUIREMENTS FOR THE MINOR IN BIOLOGY (21 UNITS)

LOWER DIVISION REQUIREMENTS (8 UNITS)

- BIOL 200* Principles of Organismal and
Population Biology, GE-B2 (4)
- BIOL 201 Principles of Cell and Molecular
Biology, GE-B2 (4)

UPPER DIVISION REQUIREMENTS (13 UNITS)

1. Biology (8 units)
 - BIOL 300 Cell Biology (4)
 - BIOL 302 Genetics (4)
2. Biology Electives (5 units)

A minimum of 5 units of 300-400 level biology courses, with no more than one course selected from BIOL 331-345.

REQUIREMENTS FOR THE CERTIFICATE IN BIOTECHNOLOGY (25-27 UNITS)

(For students with a B.S. degree in biology pursuing a certificate in biotechnology)

1. B.S. degree in biology (may be concurrent);
2. Completion of the following courses with C or better grades (16-17 units):
 - BIOL 401 Biotechnology and Recombinant DNA Techniques (5)
 - BIOL 420 Cellular & Molecular Immunology (4)
 - BIOL 431 Bioinformatics (4)
 - CHEM 318 Biological Chemistry (3)
 - or*
 - CHEM 460 Biochemistry I (4)
3. Complete another 4 units of upper-division biology course in consultation with the program (4);
4. Complete BIOL 492 Internship (2-3 units);
5. Complete BIOL 499 Senior Capstone in Biology (3 units);
6. Approval by the Biology program.

