

---

## BIOLOGY

---

### PROGRAMS OFFERED

- Bachelor of Science in Biology
- Bachelor of Science in Biology with an Emphasis in Cell and Molecular Biology
- Bachelor of Science in Biology with an Emphasis in Medical Imaging
- 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
- 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 and the Bachelor of Science in Biology with an Emphasis in Cell and Molecular Biology are 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 Cell and Molecular Biology offers students an opportunity to study the exciting developments in genetics, molecular biology, cloning, biotechnology and bioinformatics. Such programs lead to careers in biotechnology, pharmaceuticals, research and development, intellectual property and patent law.

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, science education, industry or government.

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 biotech 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  
Academic Advisor  
Phone: (805) 437-8870  
Email: ching-hua.wang@csuci.edu

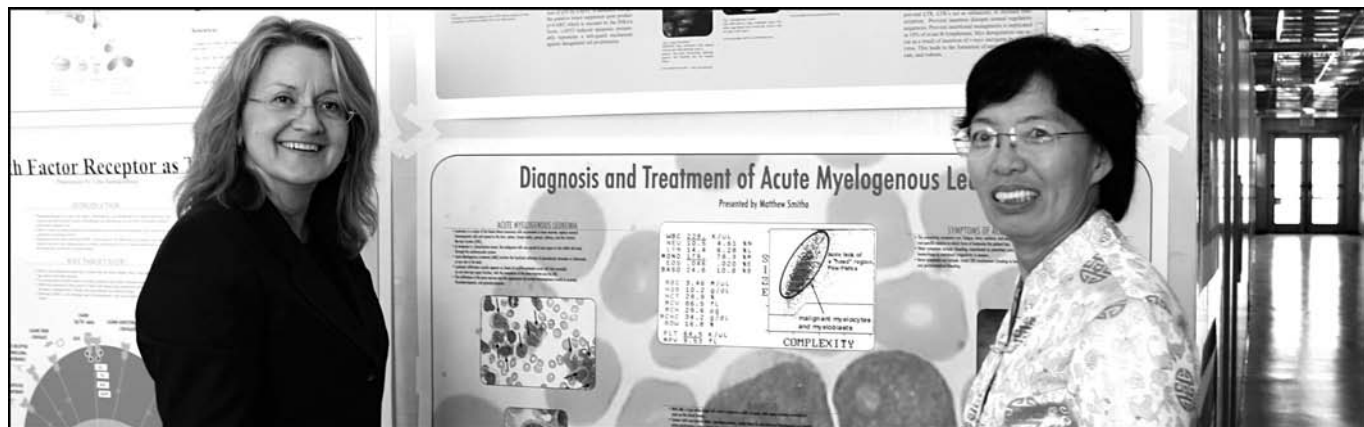
Amy Denton, PhD, Assistant Professor of Biology  
Phone: (805) 437-8458  
Email: amy.denton@csuci.edu

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

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

### CONTACT INFORMATION

<http://biology.csuci.edu>  
[biology@csuci.edu](mailto: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 and 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 (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 Animal Biology and Ecology (4)
  - BIOL 311 Plant Biology and Ecology (4)
  - BIOL 312 Marine Biology (4)
  - BIOL 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 420 Cellular and Molecular Immunology (4)
  - BIOL 421 Virology (3)
  - BIOL 422 Molecular Plant Physiology (4)
  - BIOL 423 Cellular and 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  
*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)

1. Chemistry (16 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 314 Organic Chemistry II (3)
  - CHEM 315 Organic Chemistry II Laboratory (1)
2. Physics (8 units)

Select either

  - PHYS 100 Introduction to Physics I (4)
  - PHYS 101 Introduction to Physics II (4)

*or*

  - PHYS 200 General Physics I (4)
  - PHYS 201 General Physics II (4)
3. Statistics and Mathematics (7 units)
  - BIOL 203\* Quantitative Methods for Biology, GE-B3 (3)
  - MATH 150\* Calculus I, GE-B3 (4)
4. Other Required GE Courses in Categories A-E (36 units)
  - Category A (9)
  - Category C (12)
  - Category D (12)
  - Category E (3)
5. 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 (3)
2. Electives in Biology (9 units)

*Select from the following list of courses:*

  - BIOL 402 Toxicology (3)
  - BIOL 416 Radiobiology and Radionuclides (3)
  - BIOL 420 Cellular and Molecular Immunology (4)
  - BIOL 421 Virology (3)
  - BIOL 422 Molecular Plant Physiology (4)
  - BIOL 423 Cellular and 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 (4)  
CHEM 311 Organic Chemistry I (3)  
CHEM 312 Organic Chemistry I Laboratory (1)  
*and 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 (4)  
PHYS 101 Introduction to Physics II (4)  
*or*  
PHYS 200 General Physics I (4)  
PHYS 201 General Physics II (4)
3. Statistics and Mathematics (7 units)  
BIOL 203\* Quantitative Methods for Biology,  
GE-B3 (3)  
MATH 150\* Calculus I, GE-B3 (4)
4. Other Required GE Courses in Categories A-E (36 units)  
Category A (9)  
Category C (12)  
Category D (12)  
Category E (3)
5. American Institutions Requirement (6 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  
BIOL/ 434\* Introduction to Biomedical  
PHYS Imaging, GE-B1, E, UDID (4)  
BIOL/ 464 Biomedical Instrumentation (4)  
PHYS  
BIOL 499 Senior Capstone (3)
2. Electives in Biology and Physics (8 units):  
*Select from the following list of courses:*  
BIOL/ 315 Introduction to Biophysics (4)  
PHYS  
BIOL 401 Biotechnology and Recombinant  
DNA Techniques (5)  
BIOL 420 Cellular and Molecular Immunology (4)  
BIOL 421 Virology (3)  
BIOL 423 Cellular and 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 Environ-  
mental 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  
BIOL 497 Directed Study (1-3)  
*or* PHYS

#### 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 (4)  
PHYS 101 Introduction to Physics II (4)  
*or*  
PHYS 200 General Physics I (4)  
PHYS 201 General Physics II (4)
4. Other Required GE Courses in Categories A-D (33 units)  
Category A (9)  
Category C (12)  
Category D (12)  
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 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 (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 Animal Biology and Ecology (4)  
BIOL 311 Plant Biology and Ecology (4)  
BIOL 312 Marine Biology (4)  
BIOL 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 420 Cellular and 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)  
*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 (4)
2. Mathematics and Statistics (3-4 units)  
*Select one of the following:*  
BIOL 203\* Quantitative Methods for Biology, GE-B3 (3)  
MATH 105 Pre-Calculus (4)  
MATH 150\* Calculus I, GE-B3 (4)
3. Other Required GE Courses in Categories A-E (36)  
Category A (9)  
Category C (12)  
Category D (12)  
Category E (3)
4. American Institutions Requirements (6)

### 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)  
*AND 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 (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 Animal Biology and Ecology (4)  
BIOL 311 Plant Biology and Ecology (4)

- BIOL 312 Marine Biology (4)
  - BIOL 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 420 Cellular and 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)
- 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 (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)
2. Mathematics and Statistics (3-4 units)
 

*Select one of the following:*

  - BIOL 203\* Quantitative Methods for Biology, GE-B3 (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 (4)
  - PHYS 101 Introduction to Physics II (4)
4. Other Required GE Courses in Categories A-E (36)
  - Category A (9)
  - Category C (12)
  - Category D (12)
  - Category E (3)
5. American Institutions Requirements (6)

### 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 (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 Animal Biology and Ecology (4)
  - BIOL 311 Plant Biology and Ecology (4)
  - BIOL 312 Marine Biology (4)
  - BIOL 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 420 Cellular and Molecular Immunology (4)
  - BIOL 421 Virology (3)
  - BIOL 422 Molecular Plant Physiology (4)
  - BIOL 423 Cellular and 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)

*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 (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 (4)  
GEOL 121 Physical Geology (4)  
PHYS 100 Introduction to Physics I (4)  
PHYS 101 Introduction to Physics II (4)  
PHYS 105 Introduction to the Solar System (4)
  
4. Other Required GE Courses in Categories A-E (36)  
Category A (9)  
Category C (12)  
Category D (12)  
Category E (3)
  
5. American Institutions Requirements (6)

(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 (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 331-342.



## REQUIREMENTS FOR THE CERTIFICATE IN BIOTECHNOLOGY (23-24 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:
  - CHEM 318 or 460 Biological Chemistry or Biochemistry I (3-4)
  - BIOL 401 Biotechnology and Recombinant DNA Techniques (5)
  - BIOL 420 Cellular and Molecular Immunology (4)
  - BIOL 431 Bioinformatics (4)
3. Complete another 4 units of upper-division biology course in consultation with the program;
4. Complete an internship course;
5. Complete the capstone course;
6. Approval by the Biology program.

