# BIOLOGY

## Programs Offered

- Bachelor of Science in Biology
  - Emphasis in Biotechnology
  - Emphasis in Cell and Molecular Biology
  - Emphasis in Clinical Laboratory Science
  - Emphasis in Ecology, Evolution and Organismal Biology
  - Emphasis in Medical Imaging
- Bachelor of Arts in Biology
  - Emphasis in Ecology, Evolution and Organismal Biology
  - Emphasis in General Biology
  - Emphasis in Pre-Professional Studies
  - Emphasis in Subject Matter Preparation in Teaching Biology *(Pending CCTC approval)*
- Master of Science in Biotechnology and Bioinformatics
  - Emphasis in Biotechnology
  - Emphasis in Bioinformatics
  - Emphasis in Stem Cell Technology and Laboratory Management
- Master of Science in Biotechnology and Master of Business Administration (Dual Degree)
- 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.

Bachelor of Science in Biology with an Emphasis in Clinical Laboratory Science prepares students for further clinical training and California License Exam in Clinical Laboratory Science or for training and certification in Public Health Microbiology.

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 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

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## Contact Information

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## Bachelor of Science Degree in Biology - (120 units)

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

*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 |

## 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 |
| BIO | 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 a minimum of 14 units of biology courses from 300 and 400 levels, one of which must be a lab course. Biology courses numbered from 326 to 345 are counted toward GE credits only and they are not counted towards the 14 units of electives.*

No more than 2 units taken from the following can be counted towards the 14 units of electives:

| | | | |
|---|---|---|---|
| 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, 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*

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

2. *Physics - 8 units*
*Select one of the following combinations:*

| | | | |
|---|---|---|---|
| PHYS | 100 | Introduction to Physics I, GE-B1 | .4 |
| PHYS | 101 | Introduction to Physics II, GE-B1 | .4 |
| **or** | | | |
| PHYS | 200 | General Physics I, GE-B1 | .4 |
| 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 |
| (For A3, recommend MATH 230 Mathematical Reasoning) | |
| Category C | .12 units |
| Category D | .12 units |
| Category E | 3 units |

5. *American Institutions Requirement - 6 units*

## Emphasis in Biotechnology

## Upper Division Requirements in the Major - 49 units

1. *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 |

2. *Electives in Biology and Physics - 12 units*
*Select from the following list of courses:*

| | | | |
|---|---|---|---|
| BIOL | 315 | Introduction to Biophysics (PHYS) | 4 |
| 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 | 426 | Hematology | .4 |
| 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

1. *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*

2. *Statistics, Mathematics and Computer Applications - 7 units*

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

3. *Other Required GE Courses in Categories A-E - 36 units*

| | |
|---|---|
| Category A | 9 units |
| (For A3, recommend MATH 230 Mathematical Reasoning) | |
| Category C | .12 units |
| Category D | .12 units |
| Category E | 3 units |

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

4. *American Institutions Requirement - 6 units*

## 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 PHYS | .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 | 426 | Hematology | .4 |
| 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 can be counted towards the 9 units of electives:*

| | | | |
|---|---|---|---|
| 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 |
| **and** | | | |
| 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 one of the following combinations:*

| | | | |
|---|---|---|---|
| PHYS | 100 | Introduction to Physics I, GE-B1 | .4 |
| PHYS | 101 | Introduction to Physics II, GE-B1 | .4 |
| **or** | | | |
| PHYS | 200 | General Physics I, GE-B1 | .4 |
| 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 |
| (For A3, recommend MATH 230 Mathematical Reasoning) | |
| Category C | .12 units |
| Category D | .12 units |
| Category E | 3 units |

5. *American Institutions Requirement - 6 units*

## Emphasis in Clinical Laboratory Science

### Additional Requirements in the Major 41 - 43 units

1. *Required Biology Courses - 37 units*

| | | | |
|---|---|---|---|
| BIOL | 217 | Medical Microbiology | .4 |
| BIOL | 300 | Cell Biology | .4 |
| BIOL | 302 | Genetics | .4 |
| BIOL | 303 | Evolutionary Biology | .3 |
| BIOL | 317 | Parasitology | .4 |
| BIOL | 318 | Medical Mycology | .4 |
| BIOL | 420 | Cellular and Molecular Immunology | .4 |
| BIOL | 421 | Virology | .3 |
| BIOL | 426 | Hematology | .4 |
| BIOL | 432* | Principles of Epidemiology and Environmental Health, GE-B2, D, UDID. | .3 |

2. *Other Required Courses in Biology - 4-6 units*
*If one chooses to complete CHEM 318 and BIOL 203, one needs to complete a minimum of 6 units from the following courses. Otherwise, one needs to complete minimum of 4 units from the following courses:*

| | | | |
|---|---|---|---|
| BIOL | 400 | Molecular Biology | .4 |
| BIOL | 424 | Human Physiology | .3 |
| BIOL | 425 | Human Genetics | .3 |

### Required Supporting and Other GE Courses 69 - 71 units

1. *Chemistry - 19- 20 units*

| | | | |
|---|---|---|---|
| CHEM | 121* | General Chemistry I, GE-B1 | .4 |
| CHEM | 122 | General Chemistry II GE-B1 | .4 |
| CHEM | 250 | Quantitative Analysis | .2 |

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

CHEM 251 Quantitative Analysis Laboratory . . . . .2
CHEM 311 Organic Chemistry I . . . . . .3
CHEM 312 Organic Chemistry I Laboratory . . . . .1
**and**
CHEM 318 Biological Chemistry . . . . . .3
**or**
CHEM 460 Biochemistry I . . . . . .4

*An Organic Chemistry course with laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM 311 and 312.*

2. *Physics - 8 units*
PHYS 100 Introduction to Physics I, GE-B1 . . . . .4
PHYS 101 Introduction to Physics II, GE-B1 . . . . .4

3. *Statistics and Mathematics - 3-4 units*
*Select one of the following combinations:*
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 - 33 units*
Category A . . . . . 9 units
(For A3, recommend MATH 230 Logic and Mathematical Reasoning)
Category C . . . . . .12 units
Category D . . . . . 9 units
Category E . . . . . 3 units

5. *American Institutions Requirement - 6 units*

## 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
BIOL 433* Ecology and the Environment, GE- B2, UDID . . . . . .4
BIOL 499 Senior Capstone in Biology . . . . . .3

*Select one of the following courses:*
BIOL 310 Vertebrate Biology . . . . . .4
BIOL 316 Invertebrate Zoology . . . . . .4

2. *Ecology/Evolution - 6-7 units*
*Select two courses from the following list:*
BIOL 313 Conservation Biology (ESRM) . . . . .4
ESRM 352 Theory and Practice of Ecological Restoration . . . . . .3
BIOL 406 Evolutionary Biogeography . . . . . .3
BIOL 407 Behavioral Ecology. . . . . .3

3. *Organismal Biology - 4 units*
*Select one course from the following list:*
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 - 3-4 units*
*Select one course from the following list:*
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 - 3-4 units*
*Select one course from the following list:*
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
(For A3, recommend MATH 230 Logic and Mathematical Reasoning)
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

*One must choose enough elective units to reach the required 120 units for the degree.*

## 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 (PHYS) | .3 |
| BIOL | 434* | Introduction to Biomedical Imaging, (HLTH/PHYS) GE-B1, E, UDID | .4 |
| BIOL | 464 | Medical Instrumentation (PHYS) | .4 |
| BIOL | 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 (PHYS) | .4 |
| BIOL | 401 | Biotechnology and Recombinant DNA Techniques | .5 |
| BIOL | 420 | Cellular & 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 Environmental Health, GE-B2, D, UDID | .3 |
| BIOL | 433* | Ecology and the Environment, GE-B2, UDID | .4 |
| PHYS | 445* | Image Analysis and Pattern Recognition, COMP/MATH GE-B1, B4, UDID | .3 |

*No more than 2 units taken from the following can be counted towards the 8 units of electives:*

| | | | |
|---|---|---|---|
| PHYS | 492 | Physics Internship *(Recommended for students pursuing a career in medical imaging).* | .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 311and 312.*

2. *Mathematics - 4 units*

| | | | |
|---|---|---|---|
| MATH | 150* | Calculus I, GE-B3 | .4 |

3. *Physics - 8 units*
*Select one of the following combinations:*

| | | | |
|---|---|---|---|
| PHYS | 100 | Introduction to Physics I, GE-B1 | .4 |
| PHYS | 101 | Introduction to Physics II, GE-B1 | .4 |
| ***or*** | | | |
| PHYS | 200 | General Physics I, GE-B1 | .4 |
| PHYS | 201 | General Physics II, GE-B1 | .4 |

4. *Other Required GE Courses in Categories A-D - 33 units*
Category A . . . . . 9 units
(For A3, recommend MATH 230 Logic and Mathematical Reasoning)
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*

## Bachelor of Arts Degree in Biology - (120 units)

*Common Lower Division Requirements for All Emphases of the Bachelor of Arts Degree in Biology - 8 units*

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

## 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 | 433* | Ecology and the Environment, GE- B2, UDID | .4 |
| BIOL | 499 | Senior Capstone in Biology | .3 |

*Select one of the following courses:*

| | | | |
|---|---|---|---|
| BIOL | 310 | Vertebrate Biology | .4 |
| BIOL | 316 | Invertebrate Zoology | .4 |

2. *Ecology/Evolution - 3 - 4 units*
*Select one course from the following list:*

| | | | |
|---|---|---|---|
| BIOL | 313 | Conservation Biology (ESRM) | .4 |
| BIOL | 406 | Evolutionary Biogeography | .3 |
| BIOL | 407 | Behavioral Ecology. | .3 |

3. *Organismal Biology - 4 units*
*Select one course from the following list:*

| | | | |
|---|---|---|---|
| BIOL | 310 | Vertebrate Biology *(if not taken as part of core)* | .4 |
| BIOL | 312 | Marine Biology | .4 |

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

| | | | |
|---|---|---|---|
| BIOL | 316 | Invertebrate Zoology (if not taken as part of core) | .4 |
| BIOL | 317 | Parasitology | .4 |
| BIOL | 450 | Ichthyology: The Biology of Fishes | .4 |
| BIOL | 451 | Ornithology | .4 |

4. *Physiology/Developmental/Molecular Biology - 3-4 units*
*Select one course from the following list:*

| | | | |
|---|---|---|---|
| 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 (For A3, recommend MATH 230 Logic and Mathematical Reasoning) | 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

*One must choose enough elective units to reach the required 120 units for the degree.*

## 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 a minimum of 12 units of biology courses from 300 and 400 levels, one of which must be a lab course. (Biology courses numbered from 326 to 345 are counted toward GE credits only and they are not counted towards the 12 units of electives).*

*No more than 2 units taken from the following can be counted towards the 12 units of electives:*

| | | | |
|---|---|---|---|
| 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 (For A3, recommend MATH 230 Logic and Mathematical Reasoning) | 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

*One must choose enough elective units to reach the required 120 units for the degree.*

## 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 |
| BIOL | 499 | Senior Capstone in Biology | .3 |

*Select one of the following:*

| | | | |
|---|---|---|---|
| BIOL | 303 | Evolutionary Biology | .3 |
| BIOL | 433* | Ecology and the Environment, GE-B2, UDID | .4 |

2. *Electives in Biology - 10-11 units*
*Select a minimum of 10-11 units of Biology courses from 300 and 400 levels, one of which must be a lab course. Biology courses numbered from 326 to 345 are counted toward GE credits only and they are not counted towards the 10-11 units of electives*

*No more than 2 units taken from the following can be counted towards the 10-11 units of electives:*

| | | | |
|---|---|---|---|
| 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 |
| (For A3, recommend MATH 230 Logic and Mathematical Reasoning) | |
| 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

*One must choose enough elective units to reach the required 120 units for the degree.*

## Emphasis in Subject Matter Preparation in Teaching Biology (Pending CCTC Approval)

## 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 | 35* | 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 a minimum of 12 units of biology courses from 300 and 400 levels, one of which must be a lab course. (Biology courses numbered from 326 to 345, with the exception of BIOL 335 for this emphasis are counted toward GE credits only and they are not counted towards the 12 units of electives).*

*No more than 2 units taken from the following can be counted towards the 12 units of electives:*

| | | | |
|---|---|---|---|
| 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*
*Select either:*

| | | | |
|---|---|---|---|
| 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*

| | | | |
|---|---|---|---|
| ASTR | 105 | Introduction to the Solar System, (PHYS) GE-B1 | 4 |
| 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 |

4. *Other Required GE Courses in Categories A-E - 36 units*

| | |
|---|---|
| Category A | 9 units |
| (For A3, recommend MATH 230 Logic and Mathematical Reasoning) | |
| 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.*

## 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 five units of 300-400 level biology courses, with no more than one course selected from BIOL 331-345.*

## 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 |

*Select one of the following courses:*

| | | | |
|---|---|---|---|
| CHEM | 318 | Biological Chemistry | .3 |
| CHEM | 460 | Biochemistry I | .4 |

3. *Complete another - 4 units of upper-division biology course in consultation with the program - 4 units;*

4. *Complete BIOL 492 Internship - 2-3 units;*

5. *Complete BIOL 499 Senior Capstone in Biology - 3 units;*

6. *Approval by the Biology program.*