BIOLOGY

Programs Offered

- Bachelor of Science in Biology
  - 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 Biomedical Engineering
  - Emphasis in Stem Cell Technology and Laboratory Management
- Master of Science in Biotechnology and Master of Business Administration (Dual Degree)
- Minor in Biology
- Clinical Training Certificate Program in Clinical Laboratory Science

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 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 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 Clinical Training Certificate Program in Clinical Laboratory Science will be offered at several local hospitals partnering with CI which will lead to careers in clinical laboratory science.

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.

Faculty

Amy Denton, PhD, Chair and Associate Professor of Biology
Phone: 805 437-8458
Email: amy.denton@csuci.edu

Ruben Alarcon, PhD, Assistant Professor of Biology
Phone: (805) 437-2634
Email: ruben.alarcon@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@cusci.edu

Ching-Hua Wang, MD, PhD, Professor of Biology
Director of MS in Biotechnology and Bioinformatics
Special Assistant to the Provost
Phone: 805 437-8870
Email: ching-hua.wang@csuci.edu

Contact Information

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

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

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, GE-B2	.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
BIOL	304	Comparative Animal Physiology	.3
BIOL	400	Molecular Biology	.4
BIOL	433*	Ecology and the Environment, GE- B2, UDIGE	.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

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

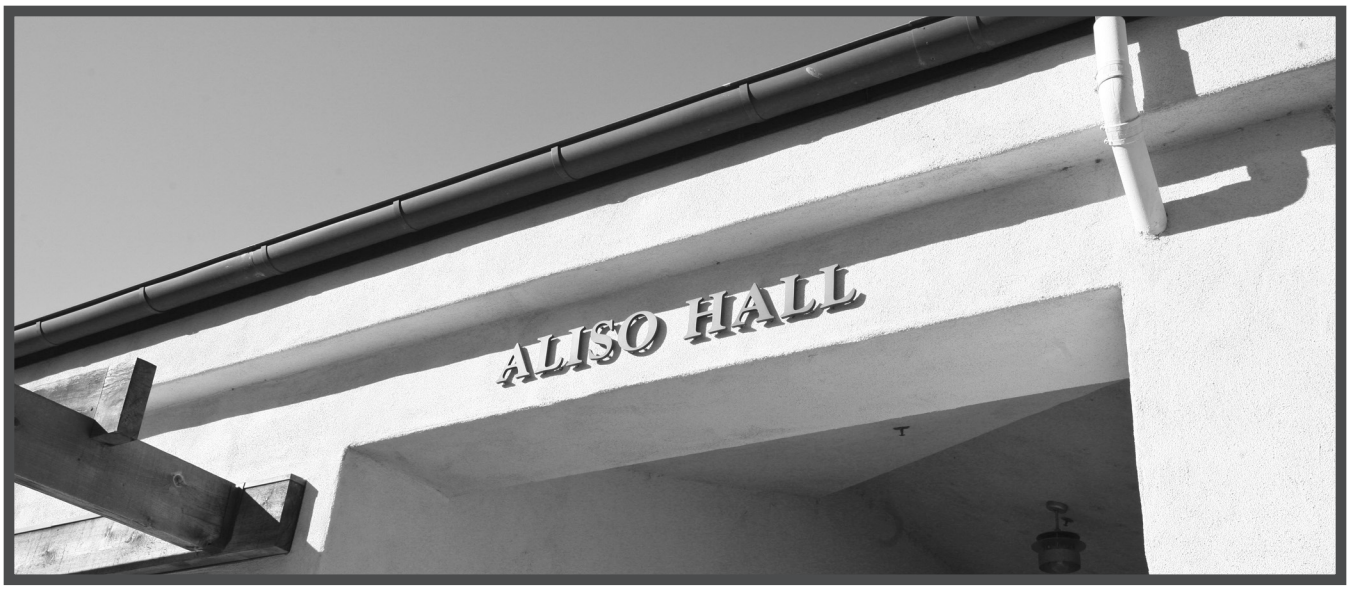
3. *Statistics and Mathematics - 7 units*

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 Cell and Bi Molecularology

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, UDIGE	.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, UDIGE	.3
BIOL	433*	Ecology and the Environment, GE-B2, UDIGE	.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

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

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, UDIGE	.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	.3
CHEM	251	Quantitative Analysis Laboratory	.1
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, UDIGE	.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 *(if not taken as part of core)*	.4
BIOL	312	Marine Biology	.4
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

5. *Cross-Disciplinary - 3-4 units*
Select one course from the following list:

CHEM	301	Environmental Chemistry-Atmosphere and Climate	.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 I 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 (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 - 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, UDIGE	.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, UDIGE	.4
BIOL	432*	Principles of Epidemiology and Environmental Health, GE-B2, D, UDIGE	3
BIOL	433*	Ecology and the Environment, GE-B2, UDIGE	.4
PHYS	445*	Image Analysis and Pattern Recognition, COMP/MATH GE-B1, B4, UDIGE	.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, GE-B1	.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, UDIGE 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 . . . . . .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

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
   (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 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, UDIGE 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, GE-B3 4
   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 Logic and Mathematical Reasoning)
   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, UDIGE 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	335*[1]	The Biosphere, GE-B2, UDIGE	.3
BIOL	433*[1]	Ecology and the Environment, GE-B2, UDIGE	.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*[1]	Introduction to Secondary Schooling, GE-D, UDIGE	.3

2. *Mathematics and Statistics - 7 units*

Select either:

BIOL	203*	Quantitative Methods for Biology, GE-B3, B4	.3
and			
MATH	105*	Pre-Calculus, GE B-3	.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, GE-B1	.4
PHYS	100*	Introduction to Physics I, GE-B1	.4
PHYS	101*	Introduction to Physics II, GE-B1	.4

[1]BIOL 335, BIOL 433, and EDUC 330 meet only 6 of the 9 units of UDIGE; students must complete the remaining 3 units outside of courses with BIOL prefix, and excluding courses cross-listed with BIOL.

4. *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

5. *American Institutions Requirements - 6 units*

The Master of Science Degree in Biotechnology & Bioinformatics (34 - 35 units)

Program Description

The Master of Science in Biotechnology and Bioinformatics is a professional degree program designed to meet the needs of biotechnology industry and related public and private agencies and organizations. The program combines rigorous scientific training in interdisciplinary areas in biotechnology, bioinformatics, biomedical engineering and stem cell technology with course work and experience in business management and regulatory affairs. The program includes a set of core courses with three emphases to choose from: biotechnology, biomedical engineering and stem cell technology and laboratory management, and several elective courses.

Biotechnology is centered in the laboratory and employs sophisticated molecular biology techniques for applications in human and animal health, agriculture, environment, and specialty biochemical manufacturing. In the next century, the major driving force for biotechnology will be the strategic use of the data derived from large-scale genome sequencing projects. Biomedical engineering is an interdisciplinary field, fusing molecular and cellular life sciences with contents in engineering analysis, design, and synthesis approaches, business management, bioethics, law and regulation, and globalization of biotechnology. It introduces the principles and applications of bioinformatics, biomechanics, biorobotics, biomaterials, nanotechnology, genetics, cellular, tissue and organ engineering, biomedical instrumentation and devices, biosensors, and medical imaging in biological systems. Stem cell technology and laboratory management introduces the current knowledge and highly specialized technical skills in the stem cell field and trains technical and managerial personnel in stem cell research and development. Our approach also includes team projects drawn from biotechnology industries to focus on real-world problems and applications of biological sciences, internships and to inculcate interpersonal as well as problem-solving skills using multiple perspectives.

Graduates from this program will develop analytical, managerial and interpersonal skills along with sophisticated expertise in biotechnology, bioinformatics, biomedical engineering or stem cell technology. They will be ready to make immediate contributions to scientific research and development, management in biotechnological, biomedical, biomedical engineering, and pharmaceutical industries, biotechnology law and regulations, governmental or environmental agencies, research institutes, consulting firms, research and clinical laboratories, private and public health organizations, or education.

Admission Requirements

1. Applicants must have a BS/BA degree in Biology, Computer Science, Chemistry, Biochemistry, or Mathematics. Alternatively, applicants with a BA/BS degree in any field and equivalent work experiences in one of the above fields may be granted conditional admission, and they must fulfill all conditional requirements before they can be fully classified.
2. Applicants seeking admission to the professional MS in Biotechnology and Bioinformatics program must be officially accepted into the CI academic program.
3. Applicants must declare themselves as graduate students in the professional MS degree program in Biotechnology and Bioinformatics.
4. Applicants for the Stem Cell Technology and Laboratory Management Emphasis must commit to the stem cell technology internship requirement.
5. Applicants will be evaluated by the Program Admissions Committee which will consider the applicants in the context of the total applicant pool using our general admission standards, including all academic work, GPA, test scores, relevant work experience and other factors that may have a bearing on the individual's potential for success. The following materials are required for our evaluation and admission process:

- Applicants must submit their transcript(s) from their undergraduate institution(s), Graduate Record Examinations (GRE) General Test scores or the Medical College Admission Test (MCAT) scores.
- Applicants who have received their undergraduate degrees from a university where English is not the language of instruction, or have studied fewer than two years at a university where instruction is in English, must submit their Test of English as a Foreign Language (TOEFL) scores for evaluation.
- Applicants must submit a one page "Statement of Purpose" and two letters of recommendations from people able to judge the applicant's academic capacity.

Degree Requirements

Common Core Courses - 12 units

BINF	500	DNA & Protein Sequence Analysis	.3
BIOL	503	Biotechnology Law and Regulation	.3
BIOL	504	Molecular Cell Biology	.3
MGT	471	Project Management	.3

Biotechnology Emphasis - 22 units

1. *Required Courses - 15 units*

BINF	514	Statistical Methods in Computational Biology	.3
BIOL	502	Techniques in Genomics & Proteomics	.3
BIOL	505	Molecular Structure	.4
BIOL	600	Team Project	.4
BIOL	601	Seminar in Biotechnology and Bioinformatics	.1

2. *Electives - 7 Units*

A minimum of two courses chosen from the following elective courses and/or from the required courses for the other emphases of the program:

BINF	511	Computational Genomics	.3
BIOL	490	Special Topics	.1-3
BIOL	500	Introduction to Biopharmaceutical Production Operations	.3
BIOL	506	Molecular Evolution	.4
BIOL	507	Pharmacogenomics and Pharmacoproteomics	.3
BIOL	508	Advanced Immunology	.4
BIOL	509	Plant Biotechnology	.4
BIOL	516	Clinical Trials and Quality Assurance	.3
MGT	421	Human Resource Management	.3
MGT	421	Human Resource Management	.3

Biomedical Engineering Emphasis - 23 units

1. *Required Courses - 15-16 units*

BME	500	Biological Systems and Biomechanics: Principles and Applications	.3
BME	501	Fundamentals of Tissue Engineering and Biomaterials	.3
BIOL	601	Seminar in Biotechnology and Bioinformatics	.1
BIOL	604	Biotechnology across National Boundaries	.2

Select either BME 502 or PHYS 464 (3 units)

BME	502	Biomedical Instrumentation and Devices: Technology and Applications	.3
or			
PHYS	464	Medical Instrumentation	.3

Select either BIOL 600 or 603 (3-4 units)

BIOL	600	Team Project	.4
or			
BIOL	603	Biotechnology Internship	.3

2. *Electives - 7-8 Units*
A minimum of two courses chosen from the elective courses for the Biotechnology Emphasis and/or from the required courses for the other emphases of the program.

Stem Cell Technology and Laboratory Management Emphasis 22 - 23 units

1. *Required Courses 19 units*

BIOL	502	Techniques in Genomics and Proteomics	.3
BIOL	510	Tissue Culture Techniques and Stem Cell Technology	.3
BIOL	511	Advanced Stem Cell Technology	.3
BIOL	512	Advanced Topics in Regenerative Medicine	.1
BIOL	513	Cell Culture Facility Management	.3
BIOL	602	Stem Cell Technology Internship (1.5 units X 4)	.6

**BIOL 602 course is offered quarterly at 1.5 units, which is repeatable for a total of 6 units for a year long project.*

2. *Electives 3-4 units*
A minimum of one course chosen from the eelective courses for the Biotechnology Emphasis and/or from the required courses for the other emphases of the program.

Graduate Writing Assessment Requirement

Writing proficiency prior to the awarding of the degree is demonstrated by successful completion of BIOL 504 with a grade of B or higher.

The Master of Science Degree in Biotechnology & Masters of Business Administration (72 units)* (Dual Degree)

*Assumes that at least one set of the Foundation Courses listed below has been completed in a business or science undergraduate degree program.

Program Description

The Master of Science in Biotechnology and Master of Business Administration is a dual professional degree program designed to meet the needs of biotechnology industry and related public and private agencies and organizations. The program combines rigorous scientific training in biotechnology with graduate course work and experience in business management and regulatory affairs. The program includes the foundation courses for the dual degree program, a set of graduate level core courses in both biotechnology and business, and several elective courses.

Our approach includes team projects drawn from biotechnology industries to focus on real-world problems and applications of biological sciences and business. We approach interpersonal skills and problem-solving skills from multiple perspectives.

Admission Requirements

1. Applicants must have a BA/BS. degree in Biology, Chemistry, Biochemistry, or Business/ Economics related discipline. Alternatively, applicants with a BA/BS degree in any field and equivalent work experiences in one of the above fields may be admitted and must fulfill the foundation course requirements before taking the core courses and electives in the degree program.
2. Applicants seeking admission to the dual degree program must be officially accepted into CI as graduate students.
3. Applicants must declare themselves as graduate students in the dual degree program.
4. Applicants will be evaluated by the Program Admissions Committee which will consider the applicants in the context of the total applicant pool using our general admission standards, including all academic work, GPA, test scores, relevant work experience and other factors that may have a bearing on the individual's potential for success. The following materials are required for our evaluation and admission process:
   - Applicants must submit their transcript(s) from their undergraduate institution(s) and Graduate Record Examinations (GRE) General Test scores.
   - Applicants who have received their undergraduate degrees from a university where English is not the language of instruction, or have studied fewer than two years at a university where instruction is in English, must submit their Test of English as a Foreign Language (TOEFL) scores.
   - Applicants must submit a one page "Statement of Purpose" and two letters of recommendations from people able to judge the applicant's capacity for both academic and professional success.

Degree Requirements

Required Foundation Courses - 16 units

1. *Required Foundation Courses in Biology and Chemistry for Students without a B.S. in Biology or Chemistry - 16 units*

CHEM	110	Chemistry of Life	.4
BIOL	201	Principles of Cell and Biology	.4
BIOL	300	Cell Biology	.4
BIOL	400	Molecular Biology 4	

2. *Required Foundation Courses in Business/Economics for Students without a B.A./B.S. in Business or Economics or a Related Discipline 16 units*

BUS	500	Economics for Managers	.3
BUS	502	Quantitative Methods for Decision-Making	.3
BUS	504	Introduction to Accounting and Finance	.4
BUS	506	Principles of Management and Marketing	.3
BUS	508	Business Ethics and Law	.3

Core Courses

Common Required Courses in the Dual Degree Program - 9 units

MGT	471	Project Management	.3
BIOL	610	Capstone Project for MS/MBA Dual Degree (BUS)	.6

Required Courses in the Master of Science in Biotechnology - 23 units

1. *Required Core Courses - 16 units*

BINF	500	DNA & Protein Sequence Analysis	.3
BIOL	502	Techniques in Genomics/Proteomics	.3
BIOL	503	Biotechnology Law and Regulation	.3
BIOL	504	Molecular Cell Biology	.3
BIOL	510	Tissue Culture Techniques and Stem Cell Technology	.3
BIOL	601	Seminar in Biotechnology and Bioinformatics	.1

2. *Elective Courses - 7 units*
A minimum of seven units from the elective courses in MS Biotechnology and Bioinformatics program.

Required Courses in the Master of Business Administration - 24 units

1. *Required Core Courses - 18 units*

BUS	510	High Performance Management	.3
BUS	520	Strategy and Leadership	.3
BUS	530	Managing Business Operations	.3
BUS	540	Financial Reporting and Analysis	.3
BUS	550	The Contemporary Firm	.3
BUS	560	The Entrepreneurial Manager	.3

2. *Elective Courses - 6 units*
Double-counted courses:

BINF	500	DNA & Protein Sequence Analysis	.3
BIOL	503	Biotechnology Law and Regulation	.3

Graduate Writing Assessment Requirement

Writing proficiency prior to awarding of the degree is demonstrated by successful completion of BIOL 504 or BUS 520 with a grade of B or higher.

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.

Clinical Training Certificate Program in Clinical Laboratory Science (16 units)

Program Description:

The Clinical Training Certificate Program in Clinical Laboratory Science consists of twelve-months learning of the specialties of each individual department in a clinical laboratory at a partner hospital, including blood bank, chemistry, urinalysis, flow cytometry, immunohistochemistry, hematology, microbiology and parasitology. Emphasis will be placed on the importance of safety, quality control and quality assurance.
Prerequisites: BS in Biology with an Emphasis in Clinical Laboratory Science or equivalent educational credential.

Certificate Requirements (16 units):

CLS 500 Clinical Training Certificate Program Part I (8 units)
Orientation (1 week)
General Laboratory Techniques (3 weeks)
Blood Bank (5-week rotation)
Chemistry (15-week rotation)
Flow Cytometry and Immunohistochemistry (2 weeks)

CLS 501 Clinical Training Certificate Program Part II (8 units)
Urinalysis (3 weeks)
Hematology/Coagulation (8-week rotation)
Microbiology (9-week rotation)
Parasitology (3 weeks)
Enhancement Sites (1 week)
Central Processing and Phlebotomy (ongoing)
Review (2-week rotation)

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