California State University Channel Islands

## **Program Update** For Minor Program Updates Only

Program updates must be submitted by October 15, 2010 for priority catalog review

Date (Change if modified and update the file name with the new date): 2011 2012 Catalog Copy; rev 10.25.10<u>: rev 11.10.10</u> Program Area: Biology Semester/Year first affected: Fall 2011

**Instructions:** Please use this <u>Program Update</u> form for minor changes to existing programs. Highlight all changes in YELLOW. Appropriate updates for this form include faculty or address changes, additions of approved electives, minor editing for clarity, and other minor updates. Any change to program requirements, units, outcomes, emphases or options, or other programmatic concerns require the standard two column <u>Program Modification</u> form, available at the Curriculum website.

### CURRENTLY APPROVED PROGRAM WITH CHANGES TRACKED

Paste the latest approved version of your entire program in the below the line and before the Summary of Changes before you begin (If you are unsure about which version is the most recent, contact Kathy Musashi). If the form does not preset to the tracked changes mode, turn on tracked changes using Word Tools before making the necessary edits. Please set the view to ORIGINAL SHOWING MARKUP.



**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 farreaching 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 <u>21</u> 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: <u>amv.denton@csuci.edu</u>

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: <u>aeoffrev.doughertv@csuci.edu</u>

Nancy Mozingo, PhD, Associate Professor of Biology Phone: 805 437-8989 Email: <u>nancv.mozingo@csuci.edu</u>

Nitika Parmar, PhD, Assistant Professor of Biology

Phone: 805 437-8873 Email: <u>nitika.parmar@cusci.edu</u>

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: <u>ching-hua.wang@csuci.edu</u>

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 - <u>14</u> units

Select a minimum of <u>14</u> 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 <u>14</u> units of electives.

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

BIOL	492	Internship2-	-3
BIOL	494	Independent Research1-	-3
BIOL	497	Directed Study1-	-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 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 on	e of the	following combinations:
PHYS	100*	Introduction to Physics I, GE-B14
PHYS	101*	Introduction to Physics II, GE-B14
or		
PHYS	200*	General Physics I, GE-B14
PHYS	201*	General Physics II, GE-B14

#### 3. Statistics and Mathematics - 7 units

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

Category D	12 units
Category E	3 units

5. American Institutions Requirement - 6 units

### Emphasis in Cell and Molecular Biology

# Upper Division Requirements in the Major - 40 units 1. *Required Biology Courses* - <u>31</u> *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 - <u>9</u> units Select from the following list of courses:

BIOL	402	Toxicology3
BIOL	403	Foundations of Structural Biology4
BIOL	404	Plant and Animal Tissue Culture3
BIOL	405	Biochemical Engineering4
BIOL	408	Nanobiotechnology3
BIOL	416	Radiobiology and Radionuclides (PHYS) 3
BIOL	420	Cellular & Molecular Immunology4
BIOL	421	Virology3
BIOL	422	Molecular Plant Physiology4
BIOL	423	Cellular & Molecular Neurobiology3
BIOL	424	Human Physiology3
BIOL	425	Human Genetics3
BIOL	426	Hematology4
BIOL	427	Developmental Biology4
BIOL	428	Biology of Cancer3
BIOL	432*	Principles of Epidemiology and
		Environmental Health, GE-B2, D, UDIGE3

No more than  $\underline{2}$  units taken from the following can be counted towards the  $\underline{9}$  units of electives:

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

### Required Supporting and Other GE Courses

### 72 units

1. Chemistry minimum - <u>15</u> 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
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### 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 - <u>8</u> units

Select <u>one</u> of the following combinations:

PHYS	100*	Introduction to Physics I, GE-B14
PHYS	101*	Introduction to Physics II, GE-B14
or		
PHYS	200*	General Physics I, GE-B14
PHYS	201*	General Physics II, GE-B14

### 3. Statistics and Mathematics - 7 units

BIOL	203*	Quantitative Methods for Biology,	
		GE-B3, B4	5
MATH	150*	Calculus I, GE-B34	ŀ

4.	Other Required GE Courses in Categories	s A-E - <u>36</u> 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 - <u>37</u> units

BIOL	217	Medical Microbiology	2
BIOL	300	Cell Biology	2
BIOL	302	Genetics	2
BIOL	303	Evolutionary Biology	3
BIOL	317	Parasitology	2
BIOL	318	Medical Mycology	2
BIOL	420	Cellular and Molecular Immunology	2
BIOL	421	Virology	3
BIOL	426	Hematology	2
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

<u>4</u> units from the following courses:

BIOL	400	Molecular Biology4
BIOL	424	Human Physiology3
BIOL	425	Human Genetics

Required Supporting and Other GE Courses 69 - 71 units

### 1. Chemistry - <u>19- 20</u> 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
(Note	: Chem	314 is prerea for Chem 460)	

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-B14
PHYS	101*	Introduction to Physics II, GE-B14

### 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)

and Mathematical (Casoning)	
Category C	
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 - <u>26</u> 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 <u>one</u> of the following courses:

BIOL	310	Vertebrate Biology	4
BIOL	316	Invertebrate Zoology	4

### 2. Ecology/Evolution - 6-7 units

### Select <u>two</u> 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 - <u>4</u> units Select <u>one</u> 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 - <u>3-4</u> units Select <u>one</u> 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 <u>one</u> 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 -	<u>36</u> 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 - <u>6</u> units

Electives in Any Discipline - 4 - 7 units One must choose enough elective units to reach the required <u>120</u> units for the degree.

### **Emphasis in Medical Imaging**

Additional Lower Division Requirements

in the Major - 8 units

BIOL210Human Anatomy and Physiology I ......4BIOL211Human Anatomy and Physiology II ......4

Upper Division Requirements in the Major - 38 units

1. Require	ed Biolo	ogy and Physics Courses - <u>30</u> units	
BIOL	300	Cell Biology	1

BIOL	301	Microbiology4
BIOL	302	Genetics4
BIOL	400	Molecular Biology4
BIOL	416	Radiobiology and Radionuclides (PHYS)3
BIOL	434*	Introduction to Biomedical Imaging,
		(HLTH/PHYS) GE-B1, E, UDIGE4
BIOL	464	Medical Instrumentation (PHYS)4
BIOL	499	Senior Capstone in Biology3

# 2. Electives in Biology and Physics - <u>8</u> units Select from the following list of courses:

BIOL	315	Introduction to Biophysics (PHYS)4
BIOL	401	Biotechnology and Recombinant
		DNA Techniques5
BIOL	420	Cellular & Molecular Immunology4
BIOL	421	Virology3
BIOL	423	Cellular and Molecular Neurobiology3
BIOL	424	Human Physiology3
BIOL	425	Human Genetics3
BIOL	427	Developmental Biology4
BIOL	428	Biology of Cancer3
BIOL	431*	Bioinformatics, GE-B2, B4, UDIGE4
BIOL	432*	Principles of Epidemiology and
		Environmental Health, GE-B2, D, UDIGE
BIOL	433*	Ecology and the Environment,
		GE-B2, UDIGE4
PHYS	445*	Image Analysis and Pattern Recognition,
		COMP/MATH GE-B1, B4, UDIGE3

3

No more than  $\underline{2}$  units taken from the following can be counted towards the  $\underline{8}$  units of electives:

PHYS	492	Physics Internship3
		(Recommended for students pursuing a
		career in medical imaging).
BIOL	494	Independent Research 1-3
or		

PHYS 497 Directed Study......1-3

Required Supporting and Other GE Courses

### 66 units

1. Chemistry - <u>15</u> 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 311 and 312.

### Mathematics - <u>4</u> units MATH 150\* Calculus I, GE-B3.......4 Physics - <u>8</u> units Select <u>one</u> 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 I, GE-B1......4 Other Required GE Courses in Categories A-D - <u>33</u> units

5. American Institutions Requirement - <u>6</u> 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 Populatio	n
		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 <u>one</u> of the following courses:

BIOL	310	Vertebrate Biology	4
BIOL	316	Invertebrate Zoology	4

### 2. Ecology/Evolution - <u>3 - 4</u> units

Select <u>one</u> course from the following list:

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

### 3. Organismal Biology - <u>4</u> units

Select <u>one</u> course from the following list:

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

316	Invertebrate Zoology	4
	(if not taken as part of core)	
317	Parasitology	4
450	Ichthyology: The Biology of Fishes	4
451	Ornithology	4
	316 317 450 451	<ul> <li>316 Invertebrate Zoology</li></ul>

## 4. Physiology/Developmental/Molecular Biology - <u>3-4</u> units Select <u>one</u> course from the following list:

		0	
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	1
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

### 

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 - <u>12</u> units

Select a minimum of <u>12</u> 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 <u>12</u> units of electives).

No more than <u>2</u> units taken from the following can be

counted towards the <u>12</u> units of electives:

annoa	to mar ao		
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 - <u>8</u> units

CHEM 121*	General Chemistry I, GE-B14
CHEM 122*	General Chemistry II, GE-B14

### 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

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 <u>120</u> units for the degree.

### Emphasis in Pre-Professional Studies

### Upper Division Requirements in the Major - 32 units

1. Required Biology Courses - <u>21-22</u> units

0 Cell Biolog	y4
02 Genetics	
4 Comparati	ve Animal Physiology3
0 Molecular	Biology4
9 Senior Cap	ostone in Biology3
	<ul> <li>Cell Biolog</li> <li>Genetics</li> <li>Comparati</li> <li>Molecular</li> <li>Senior Cap</li> </ul>

Select one of the following:

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

2. Electives in Biology - <u>10-11</u> units

Select a minimum of <u>10-11</u> 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 <u>10-11</u> 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 - <u>16</u> units

CHEM	121*	General Chemistry I, GE-B14
CHEM	122*	General Chemistry II GE-B14

CHEM 311Organic Chemistry I......3CHEM 312Organic Chemistry I Laboratory.....1CHEM 314Organic Chemistry II.....3CHEM 315Organic 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. Mathen	natics a	nd Statistics - <u>3-4</u> units	
Select one	e 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-B14
PHYS	101*	Introduction to Physics II, GE-B14

4.	Other Required GE Courses in Categories A-E	- <u>36</u> 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 <u>120</u> 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* <sup>1</sup>	The Biosphere, GE-B2, UDIGE	3
BIOL	433* <sup>1</sup>	Ecology and the Environment,	
		GE-B2, UDIGE	4
BIOL	499	Senior Capstone in Biology	3

### 2. Electives in Biology - <u>12</u> units

Select a minimum of <u>12</u> 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 <u>12</u> units of electives).

No more than <u>2</u> units taken from the following can be counted towards the <u>12</u> units of electives:

	BIOL	492	Internship2-3
	BIOL	494	Independent Research1-3
	BIOL	497	Directed Study1-3
	-	-	<b>,</b>
D,	a uirad S	Sunnorti	ng and Other CE Courses
		Supporti	ng and Other GE Courses
76	units		
1.	Require	ed Educ	ation Course - <u>3</u> units
	EDUC	330* <sup>1</sup>	Introduction to Secondary Schooling,
			GE-D, UDIGE3
2.	Mathen	natics ai	nd Statistics - 7 units
S	elect eith	ner <sup>.</sup>	
0	BIOI	203*	Quantitative Methods for Biology
	DIOL	200	CE-R3 R4
	e u el		GL-D3, D4
		405*	
	MATH	105^	Pre-Calculus, GE B-34
	or		
	MATH	150*	Calculus I, GE-B34
3.	Physica	al Scienc	ces - <u>24</u> units
	ASTR	105*	Introduction to the Solar System,
			(PHYS) GE-B1 4
	CHEM	121*	General Chemistry   GE-B1 4
		121	Conoral Chomistry II, CE-B1
		122	Developed Coology, CE D1
	GEOL	121	Physical Geology, GE-B14

PHYS 100\* Introduction to Physics I, GE-B1......4 PHYS 101\* Introduction to Physics II, GE-B1......4

<sup>1</sup>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.

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 this 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

- BINF500DNA & Protein Sequence Analysis ......3BIOL503Biotechnology Law and Regulation ......3BIOL504Molecular Cell Biology ......3

### **Biotechnology Emphasis - 22 units**

### 2. Electives - <u>7</u> 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:

BIOL       500       Introduction to Biopharmaceutical Production Operations         BIOL       605       Biotechnology Across National Boundaries Field Trip	BINF BIOL	511 490	Computational Genomics	3 . 1-3
BIOL       605       Biotechnology Across National Boundaries Field Trip	BIOL	500	Introduction to Biopharmaceutical Production Operations	3
Boundaries Field Trip1           BIOL         506         Molecular Evolution           BIOL         507         Pharmacogenomics and Pharmacoproteomics           BIOL         508         Advanced Immunology           BIOL         509         Plant Biotechnology           BIOL         516         Clinical Trials and Quality Assurance           BIOL         605         Biotechnology Across National Boundaries Field Trip	BIOL	605	Biotechnology Across National	
BIOL       506       Molecular Evolution         BIOL       507       Pharmacogenomics and Pharmacoproteomics         BIOL       508       Advanced Immunology         BIOL       509       Plant Biotechnology         BIOL       516       Clinical Trials and Quality Assurance         BIOL       605       Biotechnology Across National Boundaries Field Trip.			Boundaries Field Trip	1
BIOL       507       Pharmacogenomics and Pharmacoproteomics         BIOL       508       Advanced Immunology         BIOL       509       Plant Biotechnology         BIOL       516       Clinical Trials and Quality Assurance         BIOL       605       Biotechnology Across National Boundaries Field Trip	BIOL	506	Molecular Evolution	4
Pharmacoproteomics         BIOL       508         Advanced Immunology         BIOL       509         Plant Biotechnology         BIOL       516         Clinical Trials and Quality Assurance         BIOL       605         Biotechnology Across National         Boundaries Field Trip	BIOL	507	Pharmacogenomics and	
BIOL       508       Advanced Immunology         BIOL       509       Plant Biotechnology         BIOL       516       Clinical Trials and Quality Assurance         BIOL       605       Biotechnology Across National         Boundaries Field Trip.       1			Pharmacoproteomics	3
BIOL       509       Plant Biotechnology         BIOL       516       Clinical Trials and Quality Assurance         BIOL       605       Biotechnology Across National         Boundaries Field Trip1	BIOL	508	Advanced Immunology	4
BIOL 516 Clinical Trials and Quality Assurance BIOL 605 Biotechnology Across National Boundaries Field Trip1	BIOL	509	Plant Biotechnology	4
BIOL 605 Biotechnology Across National Boundaries Field Trip1	BIOL	516	Clinical Trials and Quality Assurance	ə3
BIOL 605 Biotechnology Across National Boundaries Field Trip1				
Boundaries Field Trip1	BIOL	605	Biotechnology Across National	
			Boundaries Field Trip	1

MGT 421 Human Resource Management ......3

# Biomedical Engineering Emphasis - 23 units

1.	Require	d Cours	ses - <u>15-17</u> units
	BME	500	Biological Systems and Biomechanics:
			Principles and Applications3
	BME	501	Fundamentals of Tissue Engineering and
			Biomaterials3
	BIOL	601	Seminar in Biotechnology
			and Bioinformatics1
	BIOL	604	Biotechnology across National
			Boundaries2

### Select either BME 502 or PHYS 464 (3-4 units)

BME	502	Biomedical Instrumentation and De	evices:
		Technology and Applications	3
or			

PHYS 464 Medical Instrumentation......4

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

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

Electives - 6-8 units
 The number of elective units will be dependent on required courses taken to total 23 units in the emphasis.

Stem Cell Technology and Laboratory Management Emphasis

22 - 23 units

1. Required Courses <u>19</u> units

Techniques in Genomics and Proteomics 3 BIOL 502 BIOL 510 **Tissue Culture Techniques and** Advanced Stem Cell Technology ......3 BIOL 511 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 <u>one</u> course chosen from the elective 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 -

<u>16</u> 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 <u>16</u> units

- BUS 502 Quantitative Methods for

Decision-Making......3

BUS	504	Introduction to Accounting and Finan	ce 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 Management3	
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
	<b>F00</b>	Distant and and some and Description	0

- BIOL503Biotechnology Law and RegulationBIOL504Molecular Cell Biology3

- Bioinformatics......1

2. Elective Courses - 7 units

A minimum of <u>seven</u> 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 - <u>18</u> 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 - <u>6</u> 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 - <u>8</u> units

BIOL	300	Cell Biology4	ł
BIOL	302	Genetics4	1

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.

### SUMMARY OF CHANGES (Mark applicable change box below)

- Adding elective courses
- \_\_\_\_ Updating faculty or addresses

x Minor editing for clarity

x Other, Please briefly explain Split BIOL 604 course into two courses: BIOL 604 and 605 as suggested by the Curriculum Committee.

Ching-Hua Wang	10-26-2010	
Proposer of Program Modification	Date	

Proposer of Program Modification

## **APPROVAL SHEET**

### Program:

Program Chair		
	Signature	Date
	Olghature	Date
Curriculum Chair		
	Ciana atuma	Data
	Signature	Date
Deep of Eaculty		
Dean of Faculty		
	Signature	Date