California State University Channel Islands

Program Modification

Program modifications must be submitted by November 2, 2009 for priority catalog review

Date (Change if modified and update the file name with the new date): 5.15.09, catalog copy; REV 12.7.09
Program Area: BIOLOGY
Semester /Year First affected: FALL 2010

Instructions: Please use this Program Modification form for changes to existing program requirements, units, outcomes, emphases or options, or for other programmatic concerns. For minor changes (faculty or address changes, additions of approved electives, minor editing for clarity, and other minor updates) use the Program Update form, available at the Curriculum website.

Paste the latest approved version of your entire program in the left AND right boxes below. Make your deletions in the LEFT column by using the strikeout feature in Word or underlining, and highlight. Insert new language or other changes to the program on the RIGHT and highlight in YELLOW for easy identification. If possible, please align the two columns so that changes appear side-by-side with the original text.

CURRENTLY APPROVED PROGRAM	PROPOSED PROGRAM
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	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)

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

- 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 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 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

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	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 CSUCI 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.

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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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	4

Upper Division Requirements in the Major - 39 units

1. *Required Biology Courses - 25 units*

BIOL	300	Cell Biology	4
BIOL	302	Genetics	4

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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, 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

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

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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 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

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*

BIOL	426	Hematology	4
BIOL	428	Biology of Cancer	3
BIOL	431*	Bioinformatics, GE-B2, B4, UDIGE	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

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

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	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

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	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

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*

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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	2
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

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

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

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	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

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-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 Cchemistry I taken at a community college may be accepted for the Biology major in lieu of CHEM 311

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, 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

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, 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	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	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

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

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 <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 (*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 - <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

Required Supporting and Other GE Courses - 56 units

1. *Required Supporting Courses - <u>14</u> units*

CHEM	121*	General Chemistry I, GE-B1	4
CHEM	122	General Chemistry II, GE-B2	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 (*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 - <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

Required Supporting and Other GE Courses - 56 units

1. *Required Supporting Courses - <u>14</u> 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

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 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 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

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	35*	The Biosphere, GE-B2, UDIGE	3
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, 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

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*	The Biosphere, GE-B2, UDIGE	3
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, 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, 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	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*

The Master of Science Degree in Biotechnology & Bioinformatics (34 - 35 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-B3	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

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*

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

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, stem cell technology and bioinformatics 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 and bioinformatics 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. Bioinformatics turns raw data from genome sequencing and new experimental methodologies such as microarrays and proteomics into useful and accessible information about gene function, protein structure, molecular evolution, drug targets and disease mechanisms using computational analyses, statistics, and pattern recognition. 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 and computational sciences 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 and bioinformatics. They will be ready to make immediate contributions to scientific research and development, management in biotechnological, biomedical 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,

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,

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 CSUCI 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 and Subject (Biology or Biochemistry, Cell and Molecular Biology) Test scores or the Medical College Admission Test (MCAT) scores. The Subject Test scores are used by the Program Admissions Committee to place students into prerequisite courses when there is a deficiency in the subject area.
- 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	502	Techniques in Genomics & Proteomics	3
BIOL	503	Biotechnology Law and Regulation	3
MGT	471	Project Management	3

Biotechnology Emphasis - 22 units

1. *Required Courses - 12 units*

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 CSUCI academic program.
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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:

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- 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

BIOL	504	Molecular Cell Biology	3
BIOL	505	Molecular Structure	4
BIOL	600	Team Project	4
BIOL	601	Seminar Series in Biotechnology and Bioinformatics	1

2. *Electives - 10 Units*

A minimum of ten courses chosen from the following courses and/or from the elective courses under the Bioinformatics Emphasis:

BIOL	500	Introduction to Biopharmaceutical Productions	3
BIOL	506	Molecular Evolution	4
BIOL	507	Pharmacogenomics and Pharmacoproteomics	3
BIOL	508	Advanced Immunology	4
BIOL	509	Plant Biotechnology	4
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
MGT	421	Human Resource Management	3
BIOL	490	Special Topics	1-3

Bioinformatics Emphasis - 23 units

1. *Required Courses - 17 units*

BINF	501	Biological Informatics	3
BINF	510	Database Systems for Bioinformatics	3
BINF	511	Computational Genomics	3
BINF	513	Programming for Bioinformatics	3
BIOL	600	Team Project	4
BIOL	601	Seminar Series in Biotechnology and Bioinformatics	1

2. *Electives - 6 Units*

A minimum of two courses chosen from the following and/or from the elective courses under the Biotechnology Emphasis, with at least one course in the BINF category:

BINF	512	Algorithms for Bioinformatics	3
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*

BIOL	502	Techniques in Genomics & Proteomics	3
BIOL	505	Molecular Structure	4
BINF	514	Statistical Methods in Computational Biology	3
BIOL	600	Team Project	4
BIOL	601	Seminar Series 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:

BIOL	490	Special Topics	1-3
BIOL	500	Introduction to Biopharmaceutical Productions	3
BIOL	506	Molecular Evolution	4
BIOL	507	Pharmacogenomics and Pharmacoproteomics	3
BIOL	508	Advanced Immunology	4
BIOL	509	Plant Biotechnology	4
BINF	511	Computational Genomics	3
BIOL	516	Clinical Trials and Quality Assurance	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)

BME 502 Biomedical Instrumentation and Devices: Technology and Applications (3)

or PHYS 464 Medical Instrumentation (3)

BIOL 601 Seminar in Biotechnology and Bioinformatics (1)

BINF	514	Statistical Methods in Computational Biology	3
BIOL	504	Molecular Cell Biology	3
BIOL	505	Molecular Structure	4
COMP	445	Image Analysis & Pattern Recognition	3
		(MATH/PHYS) GE-B1, B4, UDIGE	

Stem Cell Technology and Laboratory Management Emphasis
22 - 23 units

1. *Required Courses 19 units*

BIOL	504	Molecular Cell Biology	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	6

2. *Electives 3-4 units*
A minimum of one course chosen from the elective courses in Biotechnology or Bioinformatics Emphasis.

Graduate Writing Assessment Requirement
Writing proficiency prior to the awarding of the degree is demonstrated by successful completion of BIOL 600 Team Project or BIOL 602 Stem Cell Technology Internship with a grade of B or higher.

The Master of Science Degree in Biotechnology & Masters of Business Administration

BIOL	603	Biotechnology Internship (3) or BIOL 600 Team Project (4)	
BIOL	604	Biotechnology across National Boundaries (2)	

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 & 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	6

2. *Electives 3-4 units*
A minimum of one 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 600 Team Project, BIOL 602 Stem Cell Technology Internship, or BIOL 603 Biotechnology Internship with a grade of B or higher.

*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 CSUCI 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 and Subject (Biology or Biochemistry, Cell and Molecular Biology) Test scores. The Subject Test scores are used by the Program Admissions Committee to place students into prerequisite courses when there is a deficiency in the subject area.

The Master of Science Degree in Biotechnology & Masters of Business Administration

*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.

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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

- 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

process:

- Applicants must submit their transcript(s) from their undergraduate institution(s) and Graduate Record Examinations (GRE) General and Subject (Biology or Biochemistry, Cell and Molecular Biology) Test scores. The Subject Test scores are used by the Program Admissions Committee to place students into prerequisite courses when there is a deficiency in the subject area.
- 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

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 610 Capstone Project for MS/MBA Dual Degree with a grade of B or higher.

Minor in Biology - (21 units)

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

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 inconsultation with the* completion of BIOL 610 Capstone Project for MS/MBA Dual Degree 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

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.*	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)

SUMMARY OF CHANGES

The main changes made for the Biology Program are:

1. Deletion of description of Biology Honors
2. Deletion of BS in Biology with an Emphasis in Biotechnology;
3. Inactivation of MS in Biotechnology and Bioinformatics with an Emphasis in Bioinformatics;
4. Deletion of Biotechnology Certificate Program;
5. Addition of MS in Biotechnology and Bioinformatics with an Emphasis in Biomedical Engineering;
6. Addition of Clinical Training Certificate Program in Clinical Laboratory Science;
7. And some minor course and editorial changes.

JUSTIFICATION

1. The section of “Requirements for Honors in Biology” was created in 2001 and the description for Honors in Biology has remained in the University Catalog ever since. As our university policy only calls for 2 program honors each year, this section should be deleted from the program description to not to mislead students.

2. The reason for deleting the BS in Biology with an Emphasis in Biotechnology is its duplicative nature with the BS in Biology with an Emphasis in Cell and Molecular Biology. A few of the required courses for the former are the electives for the latter degree program. With most of the required and elective courses between the two emphases being the same, there is no need to keep the former emphasis. Students who would like to choose biotechnology as a career option would be able to complete the Emphasis in Cell and Molecular Biology and acquire the essential knowledge and skills for their career path. The few students currently in the Biotechnology Emphasis would still be able to complete the degree based on their specific catalog year because all the courses are kept in the BS program for students to take.

3. The MS in Biotechnology and Bioinformatics Emphasis in Bioinformatics was developed for students with academic preparation or interest in computer science or computational biology. To date, only five students have completed this emphasis and none are currently matriculated. Although we get several inquiries each year regarding admission to the Bioinformatics Emphasis, enrollment numbers remain low and it is not possible to offer all of the required courses often enough to provide students a reasonable time-to-degree. We propose to inactivate the Bioinformatics Emphasis while we work with the Computer Science faculty to remodel the emphasis and design appropriate prerequisite courses to better accommodate and attract students entering the MS Biotechnology and Bioinformatics program and seeking an advanced degree in this field. Inactivation of the Bioinformatics Emphasis and temporary deletion of its description from the University catalog will eliminate confusion in prospective applicants who may be seeking admittance to a bioinformatics program. BINF courses will continue to be offered as required courses (BINF 500, BINF 514) or electives for the Biotechnology, Stem Cell Technology and Laboratory Management, and Biomedical Engineering emphases, and the MS Biotechnology/MBA dual degree.

4. The Biotechnology Certificate Program was established before we launched the MS Biotechnology and Bioinformatics Program. With the latter degree program and the existence of the BS in Biology with an Emphasis in Cell and Molecular Biology, there is no need to keep the Biotechnology Certificate Program.

5. A new Emphasis in Biomedical Engineering (BME) is added to the MS in Biotechnology and Bioinformatics Program. The main reason for this addition is workforce development need in the region and the nation. Biomedical engineering comprises the two largest sectors for employment in biopharmaceuticals and medical devices, instruments, and diagnostics. Together, they represent 190,000 positions, or 70%, of the biotechnology industry’s jobs in California. Over the years, the local community has requested CSUCI repeatedly to develop engineering programs. During spring 2009, Academic Program’s Office organized meetings with science faculty members and identified BME as one of two engineering programs for CSUCI. The proposed BME program will contribute to the growing regional and national need for biomedical engineers. By drawing students from our ethnically diverse student populations including underrepresented minorities in the fields of science and engineering, working adults and military

personnel, the BME program will graduate highly educated and trained engineers with integrative knowledge and skills in science, engineering, business, ethics as well as international perspectives to meet the workforce development needs of the nation.

6. California is currently experiencing critical workforce shortages in many health professions. During the past 10 years, shortages in the nursing profession have been widely known, leading to efforts resulting in a significant reduction of these shortages. A gap in the nursing workforce remains, However. The less publicized shortages in other allied health fields also threaten access to quality healthcare. Allied health includes over 200 health professions, one of which is clinical laboratory science.

   The shortage of clinical laboratory scientists is one of the most pressing workforce issues currently facing hospitals. Hospitals indicate that they currently can take as much as a year to fill some CLS job openings. The American Society for Clinical Pathology, which certifies lab professionals, indicates average job vacancy rates currently top 50% in some states. The Campaign for College Opportunity recently conducted a study funded by Kaiser Permanente and the California Wellness Foundation. The study analyzed 15 allied health positions and found that the annual projected shortfall for clinical laboratory scientist positions in California is at an alarming rate of 85%.

   To help ameliorate the impact of the CLS workforce shortage, California passed legislation in 2002 to introduce licensure for medical laboratory technicians (MLTs). These workers generally possess an associate degree from community colleges and can perform phlebotomy and less to moderately complex laboratory testing, and supervise lower level laboratory workers. However, even with the addition of the MLT classification, the CLS workforce shortage continues to be severe as MLTs cannot perform more complex testing and California has only one formal, accredited MLT training program.

   The Certificate Program will be offered through Extended University. The partner hospitals offer a tuition loan forgiveness program of $12,000 per student enrolled in the program to cover the cost of tuition and educational expenses.

7. Minor changes are made as follows:
   a. Made personnel changes of two faculty members due to change of responsibilities;
   b. BIOL 502 and 504 are switched between common core courses and required courses for the Biotechnology and Stem Cell Technology Emphases. This is due to the need of the BME program to have BIOL 504 but not 502 as one of the core courses.
   c. BINF 514 is added as a required course to strengthen the bioinformatics content for the Biotechnology Emphasis of the MS in Biotechnology and Bioinformatics Program.
   d. To clarify the “Electives” for the three emphases of the MS in Biotechnology and Bioinformatics Program, the description is rephrased to include elective courses listed under the “Electives” as well as required courses of other emphases. Added BINF 511 and BIOL 516 to the list of elective courses. The former is a key bioinformatics course for the program and the latter represents a major aspect of biotechnology that was missing from our previous curriculum.
   e. Added BIOL 603 as a course for the GWAR for the Stem Cell Technology and Lab Management Emphasis.
   f. Other minor editorial changes are made with no substantive modification to the program.

_____Ching-Hua Wang_____10-15-09_____
Proposer of Program Modification Date

Program:

Program Chair		
	Signature	Date

Curriculum Chair		
	Signature	Date

Dean of Faculty		
	Signature	Date