California State University Channel Islands

Program Modification

Program modifications must be submitted by October 15, 2012, and finalized by the end of that fall semester for catalog production.
Enter data in YELLOWED areas.

Date (Change date if modified and update the file name with the new date): 2012 2013 Catalog Copy 5.9.12; rev 11.2.12; rev 12.11.12
Program Area: BIOLOGY
Semester /Year First affected: FALL 2013

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.

SUMMARY OF CHANGES

1. Remove CLS Certificate due to lack of funding (Ching 5.7.12)
2. Removal of options/emphases from undergraduate major
3. Several new courses added, or course names modified
4. Several inactive courses removed
5. Undergraduate "Careers" section modified to reflect new curriculum
6. Biology minor moved to follow undergraduate major descriptions, instead of following graduate curriculum
7. Biology minor required courses amended
8. Personnel information updates

JUSTIFICATION

1. Lack of funding for CLS Certificate (Ching 5.7.12), program will not be offered in the near future.
2. The primary recommendation from Biology's external program reviewers (program review site visit November 2009) was that we significantly modify and streamline the major, removing the complicated emphasis structure and establishing 3-4 "core" courses, with elective courses recommended, but not mandated. Biology program faculty agree with this recommendation and have modified our program accordingly for the following reasons:

a. Previous emphasis structure has become too confusing for students and university advisers, curriculum is intimidating and off-putting to students due to its complexity and restrictive nature. Many students feel that they have to choose an emphasis, which then locks them into a prescribed set of courses and does not allow them to explore biological subdisciplines.
b. Making required courses available to meet graduation requirements of majors in all emphases under current budgetary restrictions is extremely difficult and limits severely the electives we can offer. Yearly elective choices are always the same, many important and valuable courses cannot be offered so that resources can be directed to required courses for low-enrollment emphases. This curtails faculty creativity and innovation, restricts us from exploring the most recent scientific developments in our curriculum, limits the diversity of elective courses available to students, and slows down progress to degree. Moving to a core/elective model allows our curriculum to be more flexible, accommodating rapid advances in biology, and accommodating diverse student interests and interdisciplinarity (students may choose certain electives from outside of biology).
c. This revised curriculum requires only 4 upper-division biology courses (considered foundational courses for all biology subdisciplines) and then gives students freedom to choose any electives. The program will provide detailed graduation roadmaps with recommendations for electives that align with a variety of student interests and career goals (e.g., there are road maps to prepare students for medical/dental/veterinary/pharmacy schools, graduate programs/careers in molecular and cellular biology, graduate programs/careers in organismal biology, ecology and conservation, preparation for biology teaching, preparation for clinical laboratory scientist internships and certification, etc.). Within the modified curriculum students will be able to complete requirements necessary for admission to professional schools, teaching credential programs, clinical lab science internships, but will have more freedom in elective choice.

3. New and modified courses currently under consideration have been added to the electives list where appropriate.
4. Courses on the inactive list have been removed from the electives list where appropriate.
5. Introduction to major amended to reflect the curriculum modification (e.g., references to emphases removed).
6. Biology minor description was moved from current position at the end of the Biology section to immediately following BS and BA descriptions, keeping all of the undergraduate information together instead of splitting it before and after the graduate section.
7. Biology minor courses amended slightly to align with core curriculum in major.
8. Personnel updates as required.

CURRENTLY APPROVED PROGRAM	PROPOSED PROGRAM
Biology **Programs Offered** • Bachelor of Science in Biology	**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 Pre-Professional Studies~~ ~~Emphasis in Subject Matter Preparation in Teaching Biology~~ • 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~~ • Stem Cell Technology Certificate Program	• Bachelor of Arts in Biology • Minor in Biology • 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) • Stem Cell Technology Certificate Program
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.	**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 health professional (e.g., medical, dental, veterinary, pharmacy) or graduate schools, or 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.~~	**Careers** The Bachelor of Science in Biology provides breadth and depth in biology and supporting sciences and is designed for students who wish to enter health professional (e.g., medical, dental, veterinary, pharmacy) programs, graduate schools in all aspects of biology, or seek careers in business, industry or government. By following course roadmaps that align with their interests and career goals, students can choose electives that prepare them for careers in biotechnology, natural resources, conservation, education or for entry into certification programs in health-related fields (including medical imaging, clinical laboratory science, and public health microbiology).

~~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. The emphasis prepares students for graduate study in all aspects of biology as well as careers in environmental science, conservation, government, research or education.~~
~~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 Emphasis in Subject Matter Preparation provides the depth of study necessary for securing a Single Subject Credential in Science for teaching at the high school and middle school levels. Additional courses in geology, astronomy, and chemistry are included to meet the breadth requirements for this credential.~~

~~The Biology Minor allows students in majors other than biology to explore selected area(s) at a greater depth. Equipped with a minor in biology, students with majors in other disciplines will have a greater understanding and knowledge of the latest advances in many areas of biology and will therefore be more versatile in their career paths. The requirement for a Minor in Biology is *21* units.~~

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

Program Learning Outcomes
Students graduating from the Biology program will be able to:

The Bachelor of Arts degree provides a general background in both the concepts and the technical skills of modern biology and is designed for students seeking a more flexible degree program. Within the Bachelor of Arts program, students can choose to follow an elective course roadmap required for entering a single subject credential program in science for teaching at the high school and middle school levels. Additional courses in geology, astronomy, and chemistry are recommended to meet the breadth requirements for credential programs.

The Biology Minor provides non-majors with a background in biology necessary for many graduate and professional programs. Equipped with a minor in biology, students with majors 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.

Program Learning Outcomes
Students graduating from the Biology program will be

- 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 environments 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

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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 environments and ecosystems;
- Collect, organize, analyze, interpret and present quantitative and qualitative data and incorporate them into the broader context of biological knowledge;
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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, GE B2	4

Upper Division Requirements in the Major 39 units

1. *Required Biology Courses - ~~25~~ 14 units*

BIOL	300	Cell Biology	4
BIOL	302	Genetics	4
BIOL	303	Evolutionary Biology	3
~~BIOL~~	~~304~~	~~Comparative Animal Physiology~~	~~3~~
~~BIOL~~	~~400~~	~~Molecular Biology~~	~~4~~
~~BIOL~~	~~433*~~	~~Ecology and the Environment, GE B2, UDIGE~~	~~4~~
BIOL	499	Senior Capstone in Biology	3

~~*2. Electives in Biology - 14 units*~~
~~*Select a minimum of 14 units of biology courses from 300 and 400 levels, one of which must be a lab course. Biology courses numbered from 326 to 345 are counted toward GE credits only and they are not counted towards the 14 units of electives.*~~

Contact Information

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Bachelor of Science Degree in Biology - (120 units)

Lower Division Requirements in the Major 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 - 14 units*

BIOL	300	Cell Biology	4
BIOL	302	Genetics	4
BIOL	303	Evolutionary Biology	3
BIOL	499	Senior Capstone in Biology	3

2. *Electives in Biology - 25 units*
Use the appropriate graduation roadmap for guidance in selecting a minimum of 25 units of biology courses from 300 and 400 levels, two of which must be lab courses.

BIOL	301	Microbial Ecology	4
BIOL	304	Comparative Animal Physiology	3
BIOL	310	Vertebrate Biology	4
BIOL	311	Plant Biology	4
BIOL	312	Marine Biology	4
BIOL	313	Conservation Biology (ESRM) ~~……~~	4
BIOL	315	Introduction to Biophysics	3

	BIOL 316 Invertebrate Zoology ……..4 BIOL 317 Parasitology ……..4 BIOL 318 Medical Mycology ……..4 BIOL 319 Plant Identification and Systematics ……..4 BIOL 335 The Biosphere ……..3 BIOL 345 Science and Public Policy (POLS)……...3 BIOL 389 The Science of Art & the Art of Science (ART)..3 BIOL 400 Molecular Biology ……..4 BIOL 401 Biotechnology and Recombinant DNA Techniques .....5 BIOL 406 Evolutionary Biogeography .....3 BIOL 407 Behavioral Ecology .....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 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 BIOL 434* Introduction to Biomedical Imaging, (HLTH/PHYS) GE B1, E, UDIGE .....4 BIOL 450 Ichthyology: The Biology of Fishes.....4 BIOL 451 Ornithology.....4 BIOL 452 Entomology .....4 BIOL 453 Methods in Population & Community Ecology ……4 BIOL 464 Medical Instrumentation (PHYS) .....4 BIOL BIOL 490 Special Topics .....3 Students may count 3-4 units from the following courses towards the *25* units of electives: CHEM 250 Quantitative Analysis.....3 CHEM 251 Quantitative Analysis Laboratory.....1

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

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

Required Supporting and Other GE Courses
73 units

1. *Chemistry - 16 units*

CHEM	121*	General Chemistry I, GE B1	4
CHEM	122*	General Chemistry II, GE B1	4
CHEM	311	Organic Chemistry I	3
CHEM	312	Organic Chemistry I Laboratory	1
CHEM	314	Organic Chemistry II	3
CHEM	315	Organic Chemistry II Laboratory	1

A year-long organic chemistry sequence with laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM 311, 312, 314, 315

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

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

3. *Statistics and Mathematics - 7 units*

BIOL	203*	Quantitative Methods for Biology, GE B3, B4	3
MATH	150*	Calculus I, GE B3	4
CHEM	318	Biological Chemistry	3
CHEM	301	Environmental Chemistry-Atmosphere and Climate	3
CHEM	302	Environmental Chemistry-Soil and Water	4
CHEM	460	Biochemistry 1	4
GEOL	122	Historical Geology	3
GEOL	321	Environmental Geology, GE B1	4
ESRM	328	Introduction to Geographic Information Systems	3

No more than 2 units taken from the following can be counted towards the 25 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

4. *Other Required GE Courses in Categories A-E - 36 units*
Category A 9
(For A3, recommend MATH 230 Mathematical Reasoning)
Category C 12
Category D 12
Category E 3

5. *American Institutions Requirement - 6 units*

~~Emphasis in Cell and Molecular Biology~~

~~Upper Division Requirements in the Major~~
~~40 units~~

~~1. *Required Biology Courses - 31 units*~~
~~BIOL 300 Cell Biology .....4~~
~~BIOL 301 Microbiology .....4~~
~~BIOL 302 Genetics .....4~~
~~BIOL 303 Evolutionary Biology .....3~~
~~BIOL 400 Molecular Biology .....4~~
~~BIOL 401 Biotechnology and Recombinant DNA Techniques .....5~~
~~BIOL 431* Bioinformatics, GE B2, B4, 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~~

MATH 150* Calculus I, GE B3 4

4. *Other Required GE Courses in Categories A-E - 36 units*
Category A 9
(For A3, recommend MATH 230 Mathematical Reasoning)
Category C 12
Category D 12
Category E 3

5. *American Institutions Requirement - 6 units*

BIOL 432* Principles of Epidemiology and Environmental Health, GE B2, D, UDIGE 3
BIOL 433* Ecology and the Environment, GE B2, UDIGE 4

No more than 2 units taken from the following can be counted towards the 9 units of electives:

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

Required Supporting and Other GE Courses
72 units

1. *Chemistry minimum - 15 units*

CHEM 121* General Chemistry I, GE B1 4
CHEM 122* General Chemistry II, GE B1 4
CHEM 311 Organic Chemistry I 3
CHEM 312 Organic Chemistry I Laboratory 1

Select either:

CHEM 318 Biological Chemistry 3
or
CHEM 314 Organic Chemistry II 3
and
CHEM 315 Organic Chemistry II Laboratory 1

A year-long organic chemistry sequence with laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM 311, 312, 314, 315

2. *Physics - 8 units*

Select one of the following combinations:

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

3. *Statistics and Mathematics - 7 units*

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

4. *Other Required GE Courses in Categories A-E - 36 units*
Category A..... 9
(For A3, recommend MATH 230 Mathematical Reasoning)
Category C..... 12
Category D..... 12
Category E..... 3

5. *American Institutions Requirement - 6 units*

Emphasis in Clinical Laboratory Science

Additional Requirements in the Major - 41-43 units

1. *Required Biology Courses - 37 units*
BIOL 217 Medical Microbiology 4
BIOL 300 Cell Biology 4
BIOL 302 Genetics 4
BIOL 303 Evolutionary Biology 3
BIOL 317 Parasitology 4
BIOL 318 Medical Mycology 4
BIOL 420 Cellular and Molecular Immunology 4
BIOL 421 Virology 3
BIOL 426 Hematology 4
BIOL 432* Principles of Epidemiology and Environmental Health
GE B2, D, UDIGE 3

2. *Other Required Courses in Biology - 4-6 units*
If one chooses to complete CHEM 318 and BIOL 203, one needs to complete a minimum of 6 units from the following courses. Otherwise, one needs to complete minimum of 4 units from the following courses:
BIOL 400 Molecular Biology 4
BIOL 424 Human Physiology 3
BIOL 425 Human Genetics 3

Required Supporting and Other GE Courses 69-71 units

1. *Chemistry - 19-20 units*
CHEM 121* General Chemistry I, GE B1 4
CHEM 122* General Chemistry II, GE B1 4
CHEM 250 Quantitative Analysis 3
CHEM 251 Quantitative Analysis Laboratory 1
CHEM 311 Organic Chemistry I 3

CHEM 312 Organic Chemistry I Laboratory .....1 **and** CHEM 318 Biological Chemistry.....3 **or** CHEM 460 Biochemistry I.....4 Note: CHEM 314 is a prerequisite 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 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 (For A3, recommend MATH 230 Logic and Mathematical Reasoning) Category C..... .....12 Category D..... .....9 Category E..... .....3 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 499 Senior Capstone in Biology .....3 *Select one of the following courses:*	

BIOL 433* Ecology and the Environment, GE B2, UDIGE ..... 4 BIOL 453 Methods in Population and Community Ecology ..... 4 *Courses with * are double-counted toward GE credits.* *Select one of the following courses:* BIOL 310 Vertebrate Biology ..... 4 BIOL 316 Invertebrate Zoology ..... 4 *2. Ecology/Evolution - 6-7 units* *Select two courses from the following list:* BIOL 313 Conservation Biology (ESRM) ..... 4 ESRM 352 Theory and Practice of Ecological Restoration ..... 3 BIOL 406 Evolutionary Biogeography ..... 3 BIOL 407 Behavioral Ecology ..... 3 *3. Organismal Biology - 4 units* *Select one course from the following list:* BIOL 310 Vertebrate Biology ..... 4 *(if not taken as part of core)* BIOL 312 Marine Biology ..... 4 BIOL 316 Invertebrate Zoology ..... 4 *(if not taken as part of core)* BIOL 317 Parasitology ..... 4 BIOL 450 Ichthyology: The Biology of Fishes ..... 4 BIOL 451 Ornithology ..... 4 BIOL 452 Entomology ..... 4 *4. Physiology/Developmental/Molecular Biology - 3-4 units* *Select one course from the following list:* BIOL 300 Cell Biology ..... 4 BIOL 304 Comparative Animal Physiology ..... 3 BIOL 400 Molecular Biology ..... 4 BIOL 422 Molecular Plant Physiology ..... 4 BIOL 427 Developmental Biology ..... 4 *5. Cross-Disciplinary - 3-4 units* *Select one course from the following list:* CHEM 301 Environmental Chemistry-Atmosphere and Climate 3	

GEOL 321 Environmental Geology, GE B1 4
ESRM 328 Introduction to Geographic Information Systems 3

Required Supporting and Other GE Courses 63 units

1. *Required Supporting Courses - 21 units*

CHEM 121* General Chemistry I, GE B1 4
CHEM 122* General Chemistry II, GE B1 4
CHEM 311 Organic Chemistry I 3
GEOL 122* Historical Geology, GE B1 3
BIOL 203* Quantitative Methods for Biology, GE B3, B4 3
MATH 150* Calculus I, GE B3 4

An Organic Chemistry I taken at a community college may be accepted for the Biology major in lieu of CHEM 311

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

Category A..... 9
(For A3, recommend MATH 230 Logic and Mathematical Reasoning)
Category C..... 12
Category D..... 12
Category E..... 3

3. *American Institutions Requirement - 6 units*

Electives in Any Discipline - 4-7 units

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

Emphasis in Medical Imaging

Additional Lower Division Requirements in the Major - 8 units

BIOL 210 Human Anatomy and Physiology I..... 4
BIOL 211 Human Anatomy and Physiology II..... 4

Upper Division Requirements in the Major - 38 units

1. *Required Biology and Physics Courses - 30 units*

BIOL 300 Cell Biology 4
BIOL 301 Microbiology..... 4

BIOL 302 Genetics ..... 4 BIOL 400 Molecular Biology ..... 4 BIOL 416 Radiobiology and Radionuclides (PHYS) 3 BIOL 434* Introduction to Biomedical Imaging, (HLTH/PHYS) GE B1, E, UDIGE ..... 4 BIOL 464 Medical Instrumentation (PHYS) ..... 4 BIOL 499 Senior Capstone in Biology ..... 3 2. *Electives in Biology and Physics - 8 units* *Select from the following list of courses:* BIOL 315 Introduction to Biophysics (PHYS) ..... 4 BIOL 401 Biotechnology and Recombinant DNA Techniques ..... 5 BIOL 420 Cellular & Molecular Immunology ..... 4 BIOL 421 Virology ..... 3 BIOL 423 Cellular and Molecular Neurobiology ..... 3 BIOL 424 Human Physiology ..... 3 BIOL 425 Human Genetics ..... 3 BIOL 427 Developmental Biology ..... 4 BIOL 428 Biology of Cancer ..... 3 BIOL 431* Bioinformatics, GE B2, B4, UDIGE ..... 4 BIOL 432* Principles of Epidemiology and Environmental Health, GE B2, D, UDIGE 3 BIOL 433* Ecology and the Environment, GE B2, UDIGE ..... 4 PHYS 445* Image Analysis and Pattern Recognition, COMP/MATH GE B1, B4, UDIGE ..... 3 *No more than 2 units taken from the following can be counted towards the 8 units of electives:* PHYS 492 Physics Internship ..... 3 (*Recommended for students pursuing a career in medical imaging).* 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 311 and 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
(For A3, recommend MATH 230 Logic and Mathematical Reasoning)
Category C 12
Category D 12
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

Bachelor of Arts Degree in Biology - (120 units)

Lower Division Requirements in the Major
8 units

		Biology, GE B2 4
BIOL	201*	Principles of Cell & Molecular Biology, GE B2 4

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~~

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
36 units

1. *Required Biology Courses – 14 units*

BIOL	300	Cell Biology 4
BIOL	302	Genetics 4
BIOL	303	Evolutionary Biology 3
BIOL	499	Senior Capstone in Biology 3

2. *Electives in Biology - 22 units*
Use the appropriate graduation roadmap to select a minimum of 22 units of biology courses from 300 and 400 levels, two of which must be lab courses.

BIOL	301	Microbial Ecology 4
BIOL	304	Comparative Animal Physiology 3
BIOL	310	Vertebrate Biology 4
BIOL	311	Plant Biology 4
BIOL	312	Marine Biology 4
BIOL	313	Conservation Biology (ESRM) 4
BIOL	315	Introduction to Biophysics 3
BIOL	316	Invertebrate Zoology 4
BIOL	317	Parasitology 4
BIOL	318	Medical Mycology 4
BIOL	319	Plant Identification and Systematics 4
BIOL	335	The Biosphere 3
BIOL	345	Science and Public Policy (POLS) 3
BIOL	389	The Science of Art & the Art of Science (ART) .. 3
BIOL	400	Molecular Biology 4
BIOL	401	Biotechnology and Recombinant DNA Techniques 5
BIOL	406	Evolutionary Biogeography 3
BIOL	407	Behavioral Ecology 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

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
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	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
BIOL	434*	Introduction to Biomedical Imaging, (HLTH/PHYS) GE B1, E, UDIGE	4
BIOL	450	Ichthyology: The Biology of Fishes	4
BIOL	451	Ornithology	4
BIOL	452	Entomology	4
BIOL	453	Methods in Population & Community Ecology	4
BIOL	464	Medical Instrumentation (PHYS)	4
BIOL	490	Special Topics	3

Students may count 3-4 units from the following courses towards the 22 units of electives:

CHEM	318	Biological Chemistry	3
GEOL	121*	Physical Geology, GE B1	4
GEOL	122	Historical Geology	3
PHYS	100*	Introduction to Physics 1, GE B1	3

No more than 2 units taken from the following can be counted towards the 22 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:

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
(For A3, recommend MATH 230 Logic and Mathematical Reasoning)
Category C 12
Category D 12
Category E 3

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 Ecology, Evolution and Organismal Biology**~~

~~**Upper Division Requirements in the Major - 36-38 units**~~

~~*1. Required Biology Core Courses - 26 units*~~
~~BIOL 301 Microbiology..... 4~~
~~BIOL 302 Genetics ..... 4~~
~~BIOL 303 Evolutionary Biology..... 3~~
~~BIOL 311 Plant Biology and Ecology ..... 4~~
~~BIOL 433* Ecology and the Environment, GE B2, UDIGE..... 4~~
~~BIOL 499 Senior Capstone in Biology ..... 3~~

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

~~*2. Ecology/Evolution - 3-4 units*~~
~~*Select one course from the following list:*~~
~~BIOL 313 Conservation Biology (ESRM)..... 4~~
~~BIOL 406 Evolutionary Biogeography..... 3~~
~~BIOL 407 Behavioral Ecology ..... 3~~

~~*3. Organismal Biology - 4 units*~~

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
(For A3, recommend MATH 230 Logic and Mathematical Reasoning)
Category C 12
Category D 12
Category E 3

4. *American Institutions Requirements - 6 units*

Electives in Any Discipline - 22-23 units
Select elective units to reach the required *120* units for the degree.

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
BIOL 452 Entomology 4

4. Physiology/Developmental/Molecular Biology - 3-4 units

Select one course from the following list:

BIOL 300 Cell Biology 4
BIOL 304 Comparative Animal Physiology 3
BIOL 400 Molecular Biology 4
BIOL 422 Molecular Plant Physiology 4
BIOL 427 Developmental Biology 4

Required Supporting and Other GE Courses
56 units

1. Required Supporting Courses - 14 units

CHEM 121* General Chemistry I, GE B1 4
CHEM 122* General Chemistry II, GE B1 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
(For A3, recommend MATH 230 Logic and Mathematical Reasoning)
Category C 12
Category D 12
Category E 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 Pre-Professional Studies

Upper Division Requirements in the Major - 32 units

1. Required Biology Courses - 21-22 units

BIOL 300 Cell Biology 4
BIOL 302 Genetics 4
BIOL 304 Comparative Animal Physiology 3
BIOL 400 Molecular Biology 4
BIOL 499 Senior Capstone in Biology 3

Select one of the following:

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

2. Electives in Biology - 10-11 units

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

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

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

Required Supporting and Other GE Courses 69-70 units

1. Chemistry - 16 units

CHEM 121* General Chemistry I, GE B1 4
CHEM 122* General Chemistry II, GE B1 4
CHEM 311 Organic Chemistry I 3
CHEM 312 Organic Chemistry I Laboratory 1
CHEM 314 Organic Chemistry II 3
CHEM 315 Organic Chemistry II Laboratory 1

A year-long organic chemistry sequence with laboratory taken at a community college may be accepted for the Biology major in lieu of CHEM 311, 312, 314, 315

2. Mathematics and Statistics - 3-4 units

Select one of the following:

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

Check with professional schools or pre-professional advisor for specific requirements in this category.

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

4. Other Required GE Courses in Categories A-E - 36 units
Category A 9
(For A3, recommend MATH 230 Logic and Mathematical Reasoning)
Category C 12
Category D 12
Category E 3

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

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[1]
BIOL 433* Ecology and the Environment, GE B2, UDIGE ..... 4[1]
BIOL 499 Senior Capstone in Biology 3

2. *Electives in Biology - 12 units*
Select a minimum of 12 units of biology courses from 300 and 400 levels, one of

which must be a lab course. (Biology courses numbered from 326 to 345, with the exception of BIOL 335 for this emphasis are counted toward GE credits only and they are not counted towards the 12 units of electives).

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

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

Required Supporting and Other GE Courses
76 units

1. *Required Education Course - 3 units*

EDUC 330*[1] Introduction to Secondary Schooling, GE-D, UDIGE 3

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

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

~~Category C..... ..... 12~~
~~Category D..... ..... 12~~
~~Category E .... 3~~

~~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 & 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

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 – 12-13 units

1. *Biology – 7-8 units*
BIOL 300 Cell Biology 4
and
BIOL 302 Genetics 4
or
BIOL 303 Evolutionary Biology.....3
2. *Biology Electives – 5-6 units*

Select a minimum of 5-6 units of 300-400 level biology courses, with no more than one course selected from BIOL 331-345.

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

Program Description

The Master of Science in Biotechnology & 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	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. 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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 who have received their undergraduate degrees from a university where English is not the language of instruction, or have studied fewer than two years at a university where instruction is in English, must submit their Test of English as a Foreign Language (TOEFL) scores for evaluation.
- Applicants must submit a one page "Statement of Purpose" and two letters of recommendations from people able to judge the applicant's academic capacity.

Degree Requirements

Common Core Courses - 12 units

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

Biotechnology Emphasis - 22 units

1. *Required Courses - 15 units*

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

2. *Electives - 7 Units*

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

BINF	511	Computational Genomics	3
~~BIOL~~	~~490~~	~~Special Topics (must be equivalent to a graduate level course)~~	~~1-3~~

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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1. *Required Courses - 15 units*

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

2. *Electives - 7 Units*

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

BINF	511	Computational Genomics	3
BIOL	590	Special Topics in Biotechnology	3

BIOL	500	Introduction to Biopharmaceutical Production Operations	3
BIOL	506	Molecular Evolution	4
BIOL	507	Pharmacogenomics and Pharmacoproteomics	3
BIOL	508	Advanced Immunology	4
BIOL	509	Plant Biotechnology	4
BIOL	516	Clinical Trials and Quality Assurance	3
BIOL	605	Biotechnology Across National Boundaries Field Trip	1
MGT	421	Human Resource Management	3

Biomedical Engineering Emphasis - 23 units

1. *Required Courses - 15 units*

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

Select either BME 502 or PHYS 464 - 3-4 units

BME	502	Biomedical Instrumentation and Devices: 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

2. *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 - 19 units*

BIOL	502	Techniques in Genomics and Proteomics	3

BIOL	500	Introduction to Biopharmaceutical Production Operations	3
BIOL	506	Molecular Evolution	4
BIOL	507	Pharmacogenomics and Pharmacoproteomics	3
BIOL	508	Advanced Immunology	4
BIOL	509	Plant Biotechnology	4
BIOL	516	Clinical Trials and Quality Assurance	3
BIOL	605	Biotechnology Across National Boundaries Field Trip	1
MGT	421	Human Resource Management	3

Biomedical Engineering Emphasis - 23 units

1. *Required Courses - 15 units*

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

Select either BME 502 or PHYS 464 - 3-4 units

BME	502	Biomedical Instrumentation and Devices: 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

2. *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 - 19 units*

BIOL	502	Techniques in Genomics and Proteomics	3

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

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

2. *Electives 3-4 units*
A minimum of one course chosen from the 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 & 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

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

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

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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.

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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 Molecular Biology	4
BIOL	300	Cell Biology	4
BIOL	400	Molecular Biology	4

on real-world problems and applications of biological sciences and business. We approach interpersonal skills and problem-solving skills from multiple perspectives.

Admission Requirements

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BIOL	201	Principles of Cell and Molecular Biology	4
BIOL	300	Cell Biology	4
BIOL	400	Molecular Biology	4

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

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

Core Courses

Common Required Courses in the Dual Degree Program - 9 units

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

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

1. *Required Core Courses - 16 units*

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

2. *Elective Courses - 7 units*

A minimum of 7 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

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

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2. *Elective Courses - 6 units*

Double-counted courses:

BINF	500	DNA & Protein Sequence Analysis	3

BIOL 503 Biotechnology Law and Regulation.....3

Graduate Writing Assessment Requirement

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

~~Minor in Biology - (21 units)~~

~~Lower Division Requirements - 8 units~~

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

~~Upper Division Requirements - 13 units~~

~~*1. Biology - 8 units*~~

~~BIOL 300 Cell Biology.....4~~
~~BIOL 302 Genetics.....4~~

~~*2. Biology Electives - 5 units*~~

~~*A minimum of 5 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:~~

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.

~~**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~~

Stem Cell Technology Certificate Program (non-credit)

Program Description:

The Stem Cell Technology Certificate Program focuses on modern aspects of stem cell technology, applications in regenerative medicine, and the techniques of stem cell science, including cell culture and characterization and maintenance of pluripotent human embryonic and adult stem cell lines.

Upon completion of the program, the students are expected to:

- Describe the specific culture requirements and characteristics of various stem cell lines;
- Demonstrate ability to routinely culture and maintain human pluripotent and multipotent stem cell lines
- Apply knowledge and skills in stem cell science in research projects.

Prerequisite: BS in Biology, Chemistry, Biochemistry or related discipline.

Certificate Requirements:

Advanced Topics in Regenerative Medicine - 15 hr

A seminar series involving presentations and discussions of current knowledge of embryonic and adult stem cells and factors that regulate their growth and development. Emphasizes how advancements in cell and molecular biology and tissue engineering can be applied to the use of stem cells in regenerative medicine.

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- Apply knowledge and skills in stem cell science in research projects.

Prerequisite: BS in Biology, Chemistry, Biochemistry or related discipline.

Certificate Requirements:

Advanced Topics in Regenerative Medicine - 15 hr

A seminar series involving presentations and discussions of current knowledge of embryonic and adult stem cells and factors that regulate their growth and development. Emphasizes how advancements in cell and molecular biology and tissue engineering can be applied to the use of stem cells in regenerative medicine.

Discusses social and ethical impacts of stem cell technology. **Advanced Stem Cell Technology - 45 hr** A laboratory intensive course focused on the technical aspects of human embryonic stem cell technology. Develops specific technical skills to successfully culture, characterize and maintain pluripotent human embryonic stem cells. Upon successful completion of the required courses, students will be granted a Certificate of Completion by the Extended University.	Discusses social and ethical impacts of stem cell technology. **Advanced Stem Cell Technology - 45 hr** A laboratory intensive course focused on the technical aspects of human embryonic stem cell technology. Develops specific technical skills to successfully culture, characterize and maintain pluripotent human embryonic stem cells. Upon successful completion of the required courses, students will be granted a Certificate of Completion by the Extended University.

Amy Denton

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Proposer of Program Modification Date

APPROVAL SHEET

Program: BIOLOGY
If your course has a General Education Component or involves Center affiliation, the Center will also sign off during the approval process.

Multiple Chair fields are available for cross-listed courses.

The CI program review process includes a report from the respective department/program on its progress toward accessibility requirement compliance. By signing below, I acknowledge the importance of incorporating accessibility in course design.

Program Chair		
	Signature	Date

Curriculum Chair		
	Signature	Date

AVP		
	Signature	Date